- Considering 'Demand and Supply' relationship as mentioned in the previous section, with the expected completion year for both 'ongoing UATP' and 'proposed CWSP' being the same, CWSP should limit its activities to the distribution component, and not to execute 'treatment plant'.
- RPWSIP (for Phase I) will be allowed to execute all phases. The reasons are as follows:

  i) It will serve as a useful 'practical study/research on treatment of highly polluted water'.

  ii) Since the scale of the proposed treatment plant is comparatively small, it would allow MWSS to recover its construction investment completely by the time the supply source will be changed over from Laguna Lake water to Kaliwa river water upon completion of MWSP III.

  iii) By the time of change over, the planned service area of RPWSIP, which is just along the proposed route of distribution main from the treatment plant (Pantay) to proposed southeastern area of MSA, could be served without any difficulty.

2.3.3 Water Treatment Facilities

(1) Existing Capacity of Water Treatment Facilities

The Angat-Novaliches Water Supply System is the sole existing water supply system, composed of the tunnels from Ipo to Bicti Basins, aqueducts from Bicti to Novaliches Reservoir and La Mesa Plant, and the Balara and La Mesa Water Treatment Plants. The capacities of these facilities are shown in Table 2..

Balance in the system shows that raw water conveyance capacity is 4,650 mld and 4,840 mld by tunnels and aqueducts, respectively, while treatment capacity of 4,000 mld is the lowest among the system and indicates the actual potential capacity as much as the potential raw water sources are available. This can cover the water demand up to year 1998.

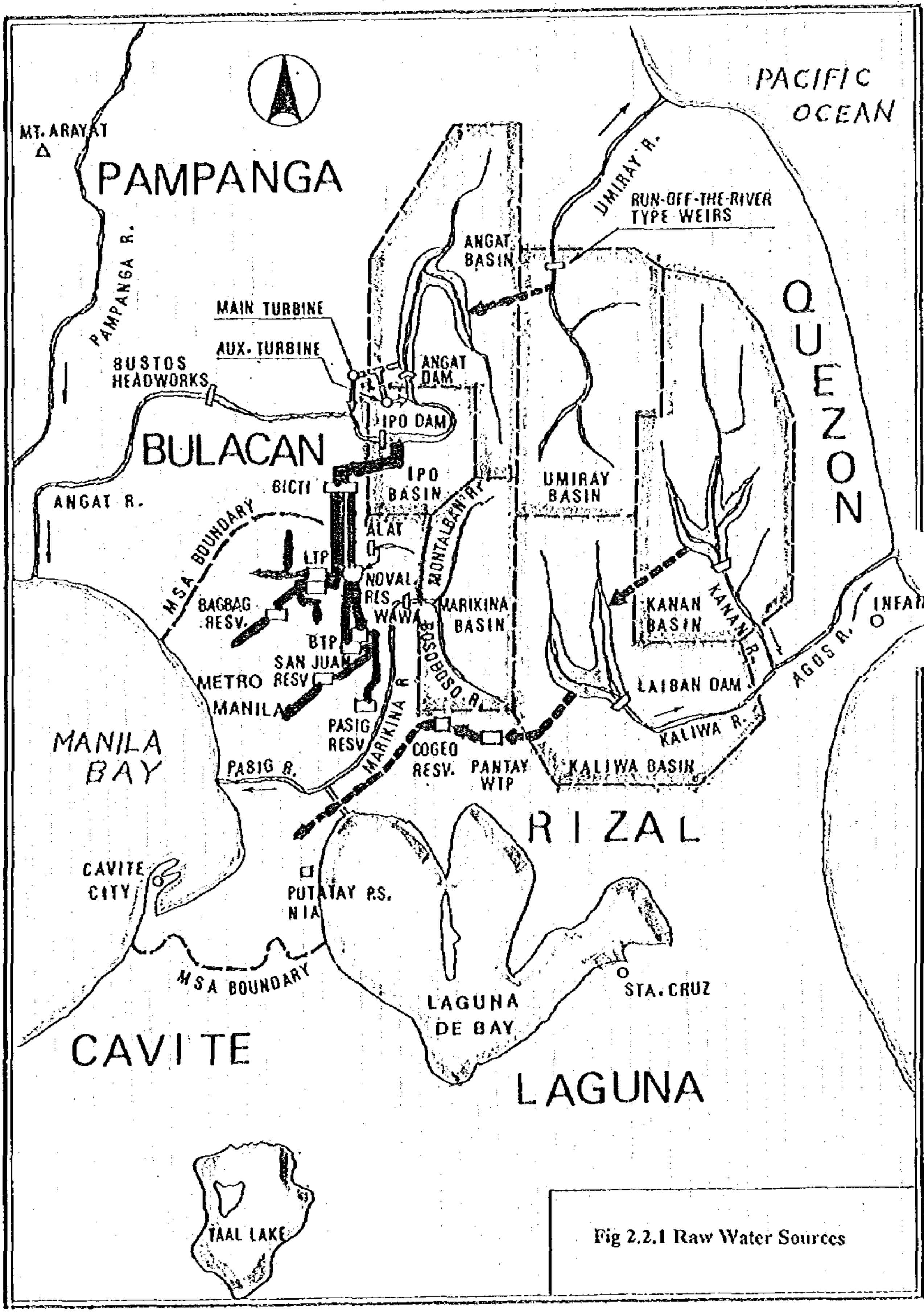


Fig 2.2.1 Raw Water Sources

Table 2.2.35 Present Production Capacity

Description	Design Capacity in mld
Tunnels from Ipo Dam to Bicti Basins	
Tunnel No. 1	760
Tunnel No. 2	1,890
Tunnel No. 3	2,000
Total	4,650
Aqueducts from Bicti to Novaliches Reservoir and La Mesa Plant	
Aqueduct No. 1	380
Aqueduct No. 2	380
Aqueduct No. 3	830
Aqueduct No. 4	1,250
Aqueduct No. 5	2,000
Total	4,840
Water Treatment Plants	
Balara TP1	470
Balara TP2	1,130
La Mesa TP1	1,500
La Mesa TP2	900
Total	4,000

(2) Treatment Capacity to be Expanded

Table 2. presents production capacity to be expanded in each phase from 1995 to 2015 on a daily maximum demand basis. During each phase, the water supply deficit is expected to be 560, 686, 847, 1,391, and 1,918 mld, respectively, under the conditions that the ongoing projects will be commissioned as follows:

Table 2.2.36 Treatment Capacity to be Expanded (mld)

Description	1995	2000	2005	2010	2015
Daily Ave. Water Demand	2,765	3,360	3,889	4,324	4,746
Daily Max. Water Demand (a)	3,456	4,200	4,861	5,405	5,932
Prospective Production* Cap. (b)	2,896	3,514	4,014	4,014	4,014
Deficit = (a) - (b)	560	686	847	1,391	1,918

Note : * Prospective production capacity shows the designed production capacity of water conveyance and treatment facilities.

- RPWSIP will increase a capacity of 48 mld in 1997,
- AWSOP will increase a additional capacity of 170 mld in 1999,
- UATP will increase a total capacity of 900 mld, 400 mld in 1999 and 500 mld in 2000, respectively.

Meanwhile, update of the existing water treatment facilities, which should be considered to augment the production capacity, may not be acceptable due to the following:

- Their current high filtration velocity 288, 348, 348, and 280 m/d in Balara TP1, Balara TP2, La Mesa TP1, and La Mesa TP2, respectively. Even the higher filtration velocity may be achievable, the production allowance should be reserved as a safe ratio.

Therefore, augmentation of the water supply capacity will be necessarily conducted by the expansion of water treatment facilities. Table 2.2.36 concludes that new water supply system, covering the additional demand of 686, 847, 1,391 and 1,918 mld by year 2000, 2005, 2010, and 2015 respectively, shall be constructed concurrently with development of a new water sources after the ongoing projects will be commissioned.

(3) Evaluation of Planned Water Supply Projects

Table 2.3 presents the major MWSS planned water supply augmentation projects. AWSOP, UATP, and MSWDP, and MNEWSP withdraws the Angat Dam water as a water source, while CWSP and RPWSIP takes from the Laguna Lake and MWSP III is from the Laiban Dam. MSWDP and MNEWSP are only tapping their demand from the capacity to be augmented by AWSOP and UATP. MNEWSP utilizes groundwater source and is also a tapping project from the production capacity of the existing Balara TP with a capacity of 1,600 mld after the rehabilitation. Therefore, actual augmentation of water supply is only planned under CWSP, MWSP III, and RPWSIP; however, with the latter aimed only as the emergency supply of 48 mld to the areas specified in the Province of Rizal.

Table 2.3 Planned Water Supply Augmentation Projects

Projects	Imp. Schedule	Augmentation Cap.	Water Source
AWSOP	1989-1996	1,300	Angat Dam
UATP	1993-1999	780	Angat Dam
MSWDP	1993-1997	300	Angat Dam
MNEWSP	1996-2002	300	Angat Dam*
CWSP	1996-2000	600	Laguna Lake
MWSP III	1998-2003	1,950	Laiban Dam
RPWSIP	1988-1998	48	Laguna Lake

Notes : Groundwater development projects are excluded. *MNEWSP plans to utilize both surface water from the Angat dam and ground water source.

Meanwhile, available water sources are so limited around Metropolitan Manila as discussed in the previous section, namely: Kaliwa Reservoir to be constructed by MWSP III. Kaliwa Reservoir has several advantages, one of which being its high level location 200 masl as shown below:

- To be able to utilize the relatively high gravity head to minimize the future dependence on an energy intensive pumping system.
- To be able to develop hydraulically independent zones from the existing CDS which will enable increases in supply pressure when necessary.
- To be able to supply sufficient water to meet the projected water demand by the year of 2015.

Therefore, the MWSP III project should be highly prioritized and fully implemented as soon as possible, starting with a review of the past F/S.

2.3.4 Distribution Facilities

The present distribution system receives its supply from the La Mesa and Balara treatment plants located at the northern part of the service area. This system is composed of reservoirs, pipe networks and pumping facilities which have some noticeable defects in their location, capacity and use. The reservoirs are spread out in the service area; but no reservoirs exist immediately downstream of the treatment plants. If there had been reservoirs at the treatment plant sites, and if the pipe networks and reservoirs have adequate capacity, most of the water coming from the relatively high treatment plants could be distributed by gravity, not pumping. The result would be lower pump maintenance and power cost and a more reliable supply and stable pressure of water.

(1) Distribution System Issues and Planning Guidelines

The basic issues on the existing water supply system and the policies to be followed in planning for an adequately equipped distribution system in the future are as follows:

a) Issues on Existing Water Supply

♦ Hydraulic Issues

* The distribution main head loss is relatively large that uniform pressure in the supply area is difficult to maintain

* The main pipes are not interconnected adequately to effectively work as a network.

* The water received by the customers has inadequate pressure not only due to the generally low system pressure but also because of the head loss at the small tertiary mains and service pipes.

* With the source and most of the distribution facilities situated at the northern part of the service area, supplying water to the southern areas is difficult.

* Supply by gravity and by pumping are mixed in some areas.

* Energy is being needlessly lost in the distribution system by filling the reservoir then pumping from the reservoir instead of pumping directly from the mains.

* The reservoirs have inadequate capacity and are not ideally located.

♦ O & M Issues

* There are many old pipes which require the throttling of valves to reduce pressures and minimize leakage caused by high water pressures.

* There are many old pipes with significantly reduced carrying capacities.

* Most pumps are old and have already lost their initial capacities. Their maintenance is not good due to difficulties in securing spare parts and incidentals.

* Pump stations require considerable manpower for operation and maintenance.

b) Planning Guidelines for Future Water Supply System

In coming up with solutions to the issues listed under the existing distribution facilities, planning guidelines for the future water supply system have been formulated, as follows:

* The pump supplied areas shall be as small in size as practicable and shall be totally isolated from the gravity served areas to minimize maintenance and power costs.

* The main pipes shall be looped and reinforced to attain a stable water supply, uniform system pressures and flexibility during emergencies.

* The pipe networks that will served new areas should be isolated from those presently served to minimize leakage in the old pipe networks.

* Additional reservoirs shall be constructed should have adequate storage capacities for regulation and for emergency purposes.

* New pipes shall be installed to replace old pipes and to fill the network in order to achieve stable water supply and uniform system pressures.

* The service area shall be subdivided into big size blocks to simplify operation and maintenance.

(2) Existing Balara and La Mesa Lineage

The primary plan for the distribution facilities is to have an all-gravity system. Except for some high areas which would be isolated from the system, distribution pumps will be used only in the meantime until the construction of the planned reservoirs and pipe networks.

In the construction of the new pipes, replacement of old ones is also necessary. This replacement process is planned to be a continuous program and must be conducted in areas which must be isolated to minimize the negative effects of increased pressures on old pipe networks.

(3) Proposed Pantay Lineage

The Pantay TP lineage will be subjected to pressures which will be higher than those in other lineages, hence, its coverage will be limited to areas which will have new pipe networks. These areas include the portion east of Marikina River, the southern part of NCR and the provinces of Cavite and Rizal, which are mostly served from groundwater sources. At present, these areas have a low pipe density that will make replacement of old pipes relatively easy.

Provisions will be made for changing the Pantay TP supply coverage in the future. Depending on the rehabilitation works at the Balara/La Mesa lineage, areas which used to have old pipes may become eligible for higher system pressures. During emergency cases, the Pantay TP may have to serve areas outside its normal limits, at the southern and northern sides. Also, if excess water becomes available with the construction of the other treatment plant, bulk water supply may be made available at the MWSS southern boundary for the municipalities of Cavite and Laguna provinces located outside the present MWSS service area.

(4) Proposed Distribution Blocks

The service area was subdivided into distribution blocks to facilitate the planning of the future water supply coverage. Considering geography, existing facilities and development projects, seven blocks were established and classified into distribution lineages as presented in Table 2.2.38. These distribution blocks are shown in Figure 2.2.2.

(5) Expansion to Unsupplied Areas

The water supply system will be expanded to serve the presently unsupplied areas and zones with relatively low water supply coverage located in Block Nos. 1 and 7.

Pumps, reservoirs and pipelines will be constructed under AWSOP to supply Block No. 1 areas from La Mesa TP 2. Detailed design of these facilities have been completed and pre-construction activities are on-going.

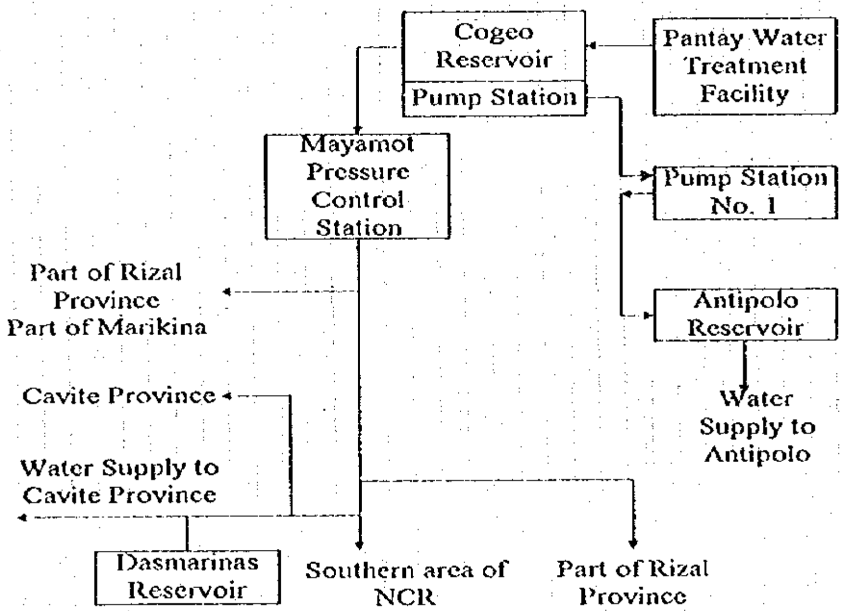


Figure 2.2.3 Block 7 Distribution Lineage

Table 2.2.38 Distribution Blocks

Block No.	Distribution Lineage	Coverage	Remarks
1	La Mesa Reservoir	part of Quezon, part of Caloocan, Valenzuela	North of La Mesa TP is mostly not served. Valenzuela, supplied now from Bagbag reservoir, is in Block No.1 due to geographical reason and, as planned in AWSOP, will be supplied from La Mesa TP2.
2	Bagbag Reservoir	part of Quezon, Malabon, Navotas, part of Caloocan	This block is adjacent to but different from Block No. 5 because supply comes from Bagbag reservoir (La Mesa TP No.1) only. Caloocan R/P (not in operation) is in this block.
3	Balara, Cubao, San Juan, Pasig Pump Stations	part of Quezon, part of San Juan, part of Pasig, part of Mandaluyong	This block is at higher portion coverage area and is supplied by pumping. This area is planned to be supplied from La Mesa TP2&3 and Balara TP. Balara R/P, Cubao P, San Juan R/P and Pasig R/P are in this block.
4	Fort Bonifacio, Makati PS	part of Makati, part of Taguig	Block No.4 is downstream of Block No. 6 and is supplied by pumping from Balara TP. Makati R/P (not in operation) and F.Bonifacio R/P are in this block.
5	Bagbag Reservoir and Balara Treatment Plant	part of Quezon, Manila, part of San Juan, part of Mandaluyong, part of Makati, part of Pasay, part of Paranaque, part of Las Pinas	This is the largest block in the existing supplied area and is being served from Balara and La Mesa TP by mixed gravity and pumping. D.Tuazon R/P (not in operation), Algeciras R/P, Tondo R/P (not in operation), Ermita R/P. Espiritu R/P (not in operation) and Pasay R/P are in this block. The two plans considered on how to distribute water in this block are the following: Case 1 Distribute water using existing reservoirs and pumps. Case 2 Distribute water entirely by gravity. Case 2 is ideal but will take long time to construct new pipes and replace old pipes, so Case 1 is still needed at the transition period to Case 2.
6	Balara Treatment Plant	part of Marikina, part of Pasig	Block No. 6 is upstream of Block No. 4 and supplied by gravity from Balara TP. The size will be reduced and limited only to western side of Marikina River.
7	Pantay Treatment Plant	part of Marikina, part of Pasig, Pateros, part of Taguig, part of Pasay, part of Paranaque, part of Las Pinas, Muntinlupa, all of Rizal and Cavite.	Present supply coverage is low. To increase supply, planned future source for this area is Laiban Dam at Kaliwa River. Construction of facilities, however, will take a long time.

Note: Pantay system (lineage) has higher water pressure than others, hence, water supply coverage is limited only in areas east of Marikina River, southern part of the NCR, Cavite and Rizal where pipes are or will be relatively new. In the future, after replacement of old pipe lines in the other parts of the system and when all the pipes can already bear high water pressures, reblocking the service area may be considered.

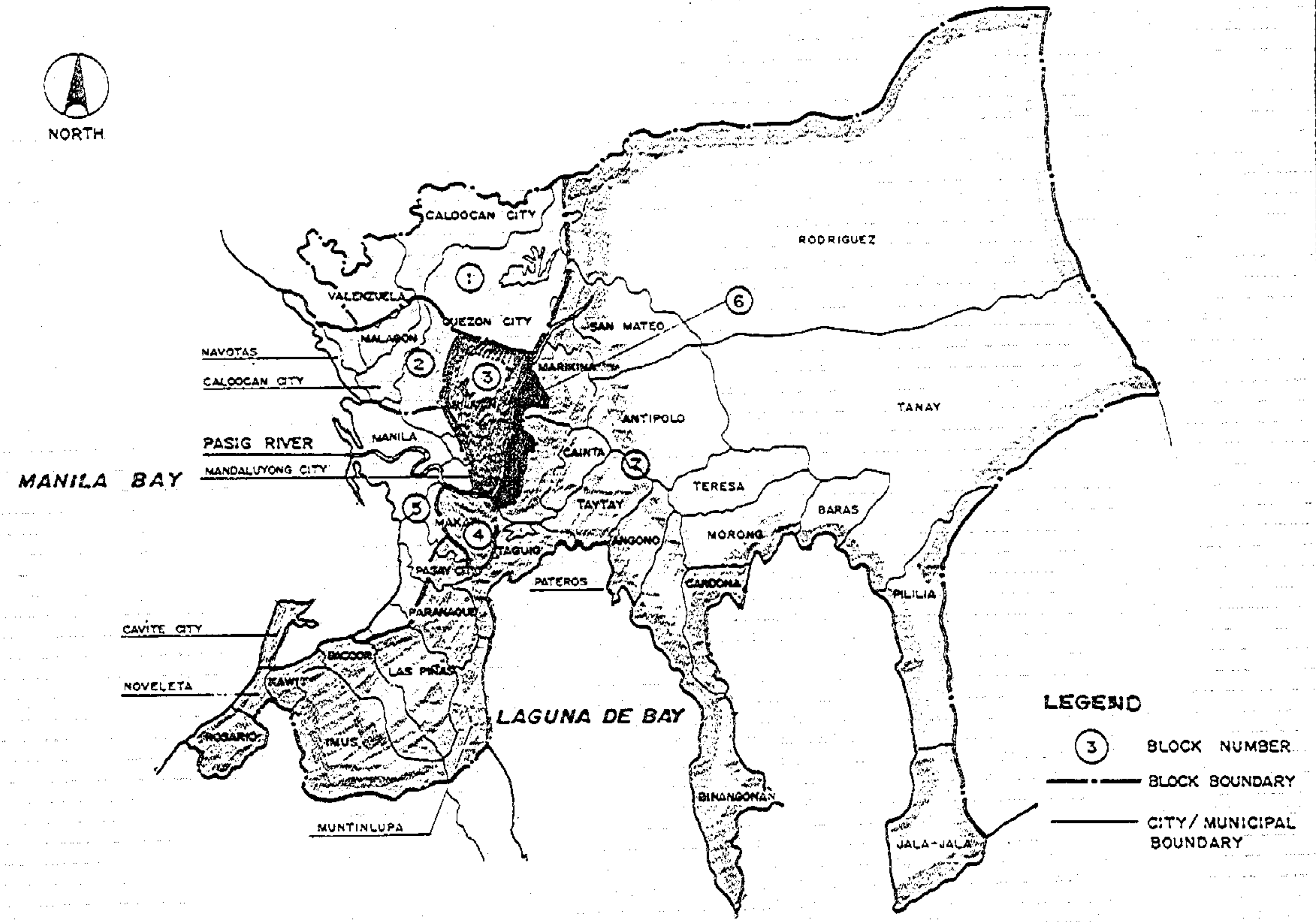


Figure 2.2.2 Proposed MWSS Service Area Distribution Blocks

The Block 7 Distribution Lineage presented in Figure 2.2.3 shows the water supply system planned to serve unsupplied areas in Block 7. In the interim, until the completion of the Block No. 7 system, these areas will continue to be supplied from the central distribution system, from MWSS groundwater sources, or from private wells. Not included in these areas is the mountainous portion of Tanay which will be better served by a separate system supplied from groundwater sources.

(6) Distribution System to be Expanded

Presented below are the treatment and distribution facilities planned for the future water supply system.

a) La Mesa TP 3

Already planned under the UATP is the 500 mld La Mesa TP 3 which will be constructed near the existing La Mesa TP 1 and 2.

b) Block No.1

The distribution facilities for Block No.1 were already planned under AWSOP in 1997 as the target year. Due to higher projected demand for the new target year, 2015, sizes of some pipes need to be revised. Also, AWSOP proposed pumps and pipes have to be reinforced.

c) Block Nos. 2 and 5

As planned in AWSOP, a 2800 mm pipe line is now being laid from La Mesa to Balara. A large portion of water delivered through this pipeline will be supplied to Block No. 5 through the Balara TP distribution pipes.

For a more uniform and reliable water distribution in the metropolitan area and for easier maintenance of facilities, upstream reservoirs are needed. At the La Mesa side, the existing Bagbag reservoir satisfies this requirement. At the Balara side, however, no upstream reservoir exists, hence, a new treated water reservoir, La Mesa Reservoir No. 2, is being recommended for construction inside the Novaliches raw water reservoir.

The water distribution method for Block Nos. 2 and 5 is planned to be either by combined gravity and pumping (Case 1) or by gravity only (Case 2). The requirements for the two cases are as follows:

Case 1 Requirements

- Rehabilitate the required existing pumps and reservoirs.
- Construct La Mesa Reservoir No. 2
- Construct additional reservoir in Bagbag
- Reinforce existing pipe network

Case 2 Requirements

- Abandon existing pumps and the attached reservoirs
- Construct La Mesa Reservoir No. 2 (with bigger capacity than for Case 1)
- Construct additional reservoir in Bagbag (with bigger capacity than for Case 1)
- Reinforce existing pipe network (significantly larger in scale than in Case 1)

d) Block No. 3

The existing distribution facilities are planned to be used for Block No. 3. What would be needed, however, is the rehabilitation of pump facilities and reinforcement of pipe networks.

e) Block No. 4

For Block No. 4, the plan is to rehabilitate the pumping facilities and the reinforcement of pipe network. Also, valves will be closed to isolate this pump supplied zone.

f) Block No. 6

The coverage area is planned to be limited to the western side of Marikina River only with Balara and La Mesa TP as supply sources. This is not only due to the limited quantity but also of the relatively high pressure of water from Pantay TP which may cause bursting of pipes and excessive leakage in the old pipe networks at the Block No. 6 areas. Reinforcement of the pipe network is include in the plan.

g) Block No. 7

The planned distribution of water for Block No. 7 will require the construction of source facilities in Kaliwa River and the installation of treatment and distribution facilities planned in the MWSP III. The treatment plant capacity, however, will be lower than the 2400 mld as proposed in the MWSP III. To match the capacity of the source, a 1950 mld treatment is recommended for Block No. 7.

The water to be distributed in Block No 7 is planned to be supplied either from the combined production of the CWSP TP and the Pantay TP (Case 1) or from the Pantay TP only (Case 2).

Case 1 facilities are planned to be implemented in two phases: Phase 1 - the construction of CWSP treatment and distribution facilities, and Phase 2 - the construction of Pantay TP and the construction of distributions facilities and their interconnection with the Phase 1 reservoir (Dasmarinas Reservoir).

With Case 1, the Cavite area will receive sufficient water after a shorter timeframe than the time needed for the completion of the water supply facilities if Case 2 is adopted. With Case 1, however, there will be notable problems related to quality and energy. As to water quality, Laguna de Bay is suffering from eutrophication due to fish farms, discharge of domestic and industrial wastes and salt water intrusion. Regarding energy, substantial amount will be incurred for the continuous operation of pumps at the intake and transmission facilities.

With Case 2, the water supply facilities will be constructed in a single phase, and will be similar to Case 1 facilities minus the CWSP treatment plant and its potential quality and energy problems. Table 2.2.39 summarizes the planned water supply facilities for each distribution block.

Detailed capacity and hydraulic calculations are described in "Capacity and Hydraulic Calculations", Supporting Report.

(7) **Small Pipes for In-Filling**

The quantity of small diameter pipes (250 mm and smaller pipes) planned for in-filling pipe networks was estimated with consideration given to the existing pipe density and the increasing served population. The basic present pipe density figures are as follows:

NCR : 0.66 m/person

Cavite : 1.19 m/person

Rizal : 1.09 m/person

Considering the above figures, the required pipes for the increasing served population were estimated as follows:

NCR : 0.7 m/person, but for cities/municipalities with more than 50% supply coverage at present, a lower ratio of 0.35m/person is used

Cavite and Rizal : 1.1 m/person, but for cities/municipalities with existing minor water systems, a lower ratio of 0.7 m/person is used.

The estimated quantities of small pipes planned for each city/municipality, based on the above figures, are presented in Table 2. 2. 40.

Table 2.2.39 Water Supply Facilities to be Expanded

Block No.	Facilities		Remarks
3 , 5	*Treatment Plant : 1 place* Pipeline from La Mesa to Balara : 8,800 m		La Mesa TP No. 3 **AWSOP**
1	Reservoir : 3 places Pump Station : 2 places Pipeline : 72,716 m		**AWSOP**
2 , 5	**Case 1**	**Case 2**	
	Reservoir : 2 places Pump Station Rehab. : 2 places Recommission Pump Stations : 5 places Pipeline : 20,540 m	Reservoir : 2 places Pipeline : 44,519 m	
3 (common)	Pump Station Rehabilitation : 3 places		
3	**Case 1**	**Case 2**	
	Pipeline : 12,402 m	Pipeline : 16,033 m	For supply to Block No. 5
4	Pump Station Rehabilitation : 2 places Recommission Pump Station : 1 place Pipeline : 6,442 m		
7	[Kaliwa River connected facilities] Dam, Intake, Conveyance, Hydro Power, Transmission facilities : a complete set Treatment Plant : 1 place Reservoir : 1 place Pressure Control Facilities : 1 place		
	[Antipolo area facilities] Transmission PS : 2 places Reservoir : 1 place *Pump Station (booster) : 2 places* Pipeline : 18,950 m		
	[Facilities for mountainous portion of Tanay and other areas] Intake, treatment, transmission and distribution facilities : a complete set.		
7	**Case 1**	**Case 2**	
	[CWSP related], **Phase 1** Intake facilities : 1 place Conveyance facilities : 1 place Treatment plant : 1 place Reservoir : 1 place Pipe : 70,900 m **Phase 2** Pipe : 171,045 m	Reservoir : 1 place Pipe : 208,335 m	
All Blocks	Small diameter pipes (250 mm & smaller): 4,913 km Distribution pipe replacement : 2,054 km		

Table 2.2.40 Small Pipes for In-Filling

	Year 1994 Served Population (persons)	Year 2015 Served Population (persons)	((2) - (1)) x (0.7m/per. or 0.35 m/per.)
	(1)	(2)	
NCR			
Sub-Total	5,506,990	11,339,680	2,849,487
Manila	1,434,007	1,633,535	69,835
Pasay	242,402	465,978	78,252
Quezon	1,451,802	2,473,439	357,573
Caloocan	448,311	2,473,439	223,626
Mandaluyong	202,571	269,942	23,580
Las Pinas	85,879	693,735	425,499
Makati	381,472	532,141	52,734
Malabon	173,061	335,826	56,968
Marikina	282,765	490,213	72,607
Muntinlupa	59,283	539,007	335,807
Navotas	136,897	268,680	46,124
Paranaque	138,587	542,127	282,478
Pasig	326,198	622,218	103,607
Pateros	23,116	59,630	25,560
San Juan	121,831	146,095	8,492
Taguig	42,898	581,971	377,351
Valenzuela	155,910	597,902	309,394
			((2) - (1)) x
CAVITE	(1)	(2)	(1.1m/per. or 0.7m/per.)
Sub-Total	165,702	771,998	424,408
Cavite City	73,961	106,295	22,634
Bacoor	40,483	325,390	199,435
Imus	9,267	161,438	106,520
Kawit	30,455	74,764	31,016
Noveleta	5,046	31,796	18,725
Rosario	6,490	72,315	46,078
			((2) - (1)) x
RIZAL	(1)	(2)	(1.1m/per. or 0.7m/per.)
Sub-Total	181,309	2,087,762	1,638,689
Angono	0	102,470	112,717
Antipolo	49,325	518,384	328,341
Baras	0	35,231	38,754
Binangonan	0	265,084	291,592
Cainta	33,162	306,106	191,061
Cardona	0	61,213	67,334
Jala-Jala	0	30,302	33,332
Morong	0	58,361	64,197
Pililla	0	60,858	66,944
Rodriguez	19,849	124,681	73,382
San Mateo	39,032	156,924	82,524
Tanay	0	108,576	119,434
Taytay	39,941	221,233	126,904
Teresa	0	38,339	42,173
Total	6,054,000	14,199,440	4,912,584

Note: Sizes of small pipes planned for in-filling of pipe networks will be 250 mm and smaller.

(8) Pipe Replacement

Pipe replacement is closely related to leak prevention. A high priority must be given to the replacement of leak-prone and weak pipes that have had a high rate of repairs. The pipes that require replacement are those old pipes mostly found in Quezon City, Manila and Makati where the early water supply systems were installed. Also planned for replacement are relatively weak pipes, mainly ACP pipes, constructed under roads subjected to heavy vehicular loads.

The existing distribution pipes have a total length of about 4,300 km, 910 km of which are ACP pipes. But the actual quantity for ACP is possibly very much higher considering the significant length, totaling about 1,317 km of pipes of unverified materials.

Taking into consideration the pipe network arrangement, the condition of pipes and the plans for the future, the total length of pipes to be replaced is estimated in this report as follows:

All ACP pipes		= 908 km
50% of all pipes of unverified materials	= 1,317 x 50%	= 659 km
50% of pipes in Manila, Quezon City & Makati (excluding ACP and pipes of unverified materials)	= (297+545+131) / 2	= 487 km
	Total	= 2,054 km

(9) Others

Records must be kept to preserve vital information from all divisions of MWSS and must be made readily available as reference for planning of facilities and replacement works in the future. The stored data must include the layout of water supply components, its history (year constructed, materials used, condition, repairs made, etc.), its operation and maintenance schedule, the personnel in charge, and improvement plans for the future.

The present collection and management of data will have to be improved to minimize recurrence of present problems, such as getting different figures from different sources regarding the water supply system. The improved management data base must be commonly accessible to all MWSS staff and must be the only recognized data source. The data must be properly updated regularly, or when the need arises.

2.3.5 Staged Development Plan

Table 2.2.41 presents the development plan of the water supply scheme by five years, toward the target year of 2015. It is characterized as follows:

Table 2.2.41 Staged Development Plan

Phase	Implementation Plan
I (1996-2000)	• Full accomplishment of the ongoing projects (AWSOP , UATP, etc.) • F/S and D/D on development of new potential water sources and construction of impound reservoir and related water supply facilities • Implementation of the planned NRW reducing projects • F/S and D/D on prioritized projects in the study (rehabilitation of facilities/equipment, improvement of distribution network, etc.)
II (2001-2005)	• Continuation of development of water sources and staged water supply augmentation project (Stage I) • Continuation of the planned NRW reducing projects • Implementation of rehabilitation of the existing water treatment facilities/equipment • Implementation of improvement of distribution network
III (2006-2010)	• Continuation of staged water supply augmentation project (Stage II and III), including treatment facilities and distribution piping • Continuation of the planned NRW reducing projects • Continuation of improvement of distribution network
IV (2011-2015)	• Operation and maintenance of new water supply systems • Continuation of the planned NRW reducing projects • Continuation of improvement of distribution network • Review of achievement level of target and establish new master plan for next decades

(1) Phase I (1996-2000; full accomplishment of the ongoing projects and preparation for new water supply system)

In this phase, the supply capacity is inadequate at fulfilling the water demand by about 560 mld on a daily maximum demand basis. The inadequacy is felt by those residing in the study area, particularly in the central part of NCR, now suffering from intermittent water supply and lack of water pressure. As for the people in the depressed areas, they resort to buying their daily minimum water needs from vendors who sell water of questionable quality. And or those living around the periphery Manila Bay, the problem posed by groundwater salinity is still something they have to live with at present.

To cope with and improve the prevailing situation, all ongoing projects, such as the AWSOP, UATP, etc., should be completed without any more delays. Based on the full optimization of the "Angat-Novaliches Water Supply System", every possible water supply augmentation project should be totally reviewed, including CWSP, MNEWSP, MWSP III, etc. All efforts with regard to the detailed design of the expansion projects, site decision, land acquisition, etc. should be effected and/or implemented so that construction work can commence during this phase.

At the same time, another major issue, that of non-revenue water, should be decisively addressed. The NRW reducing project should not aim only at leak prevention but also at optimizing the existing distribution network, including the replacement/renewal of the pipelines. NRW reduction and improvement of the pipe network need to be continuously and systematically implemented until and beyond the project target year 2015.

(2) Phase II (2001-2005; accomplishment of new water supply system)

In phase II, water demand is projected to exceed the combined capacities of the existing system plus that of AWSOP and UATP. The new water supply system, whose construction would have been started during Phase I, should be commissioned to supplement the deficit of about 690 mld and to meet increased demand. During this phase, the expansion of services will extend to unsupplied areas to Cavite and Rizal Provinces; while the current water supply conditions in the existing areas of NCR would be remarkably improved.

NRW should be reduced preferably as scheduled in Phase 1 by the replacement/renewal of deteriorated pipes.

(3) Phase III (2006-2010; stable implementation of expansion project)

In Phase III, the planned expansion projects should be satisfactorily conducted as scheduled so that the solid gains achieved in Phases I and II would not go to waste. The additional water supply system with a capacity of 1,350 (2 x 650 mld), which enable supply capacity to catch up with the demand, shall be constricted during this phase.

(4) Phase IV (2011-2015; achievement of the master plan goals)

In Phase IV, the targets set in Phase 1 should be reviewed in the light of the Master Plan.

2.4 Operation and Maintenance

2.4.1 Non Revenue Water Reduction

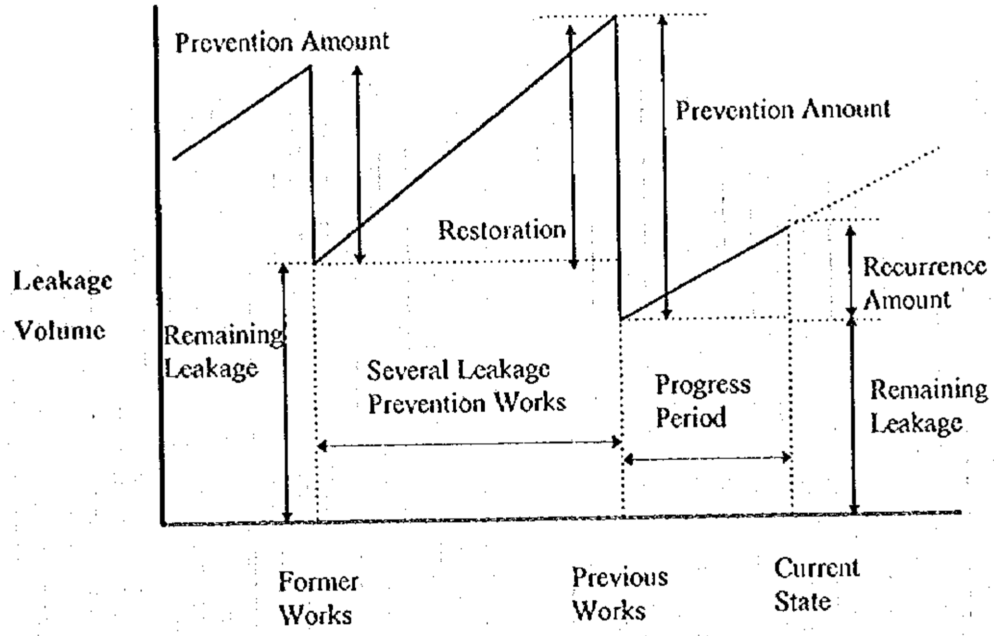
(1) Objectives

Non-revenue water has been and still is a nagging problem of MWSS. Corrective measures, through a number of projects and programs, have been instituted, particularly in the last 10 years, but no significant permanent reduction was made nor were the other problems attendant to NRW resolved. As an indication of administrative and technical efficiency, NRW is a high 57 % at the end of 1994. The issues and problems concerning NRW, where all efforts have been exerted to reduce it, are shown below. The NRW is composed of leakage (35 %), pilferage (8 %), meter-related errors (12 %), and of effective non revenue water (2 %), i.e. operational use. This is even higher than the NRW values obtained before these projects started ten years ago.

Table 2.2.42 Objectives of NRW Reduction

1. Maximum utilization of the limited water sources	It is difficult and costly to develop water sources as well as treatment and distribution systems. All efforts, including cost and time, will be wasted if the NRW remains to be a significant portion of water production.
2. Improvement of financial source	NRW is the loss of the production water which includes the manpower, chemical, and power costs. The increase of NRW will then aggravate the economy of operations of the waterworks system.
3. Improvement of supplied water pressure and quality as well as prevention of supplied water contamination	Leakage will cause low and inadequate water supply. Low pressure will further contribute to the deterioration of distributed water quality due to the inflow of contaminated water from outside. This is a breach of the important aims of the public water supply body.
4. Prevention of traffic accident due to road depressions caused by pipe damage	Leaked water floods the residential areas. Pipe damage will cause a depression of road as well as traffic congestion.

Leakage prevention and control demand continuous and consistent effort, not to mention budgetary support. Leak repair in the service areas is, more often than not, a temporary measure to put a stop to the water losses; but a more permanent solution must be instituted. See Figure 2.2.4 for reason behind leak recurrence. This is where a comprehensive NRW program comes in.



Recurrence of Leakage

Figure 2.2.4 Characteristics of Leakage

Through the past experiences and with several projects consistently confirming the fact, the major causes of NRW are leaks, unauthorized use and metering errors. To be able to reduce the NRW to 30 % by the target year 2015 level, as shown in the previous chapter, the following measures should be undertaken systematically:

- Controlling unauthorized use of water
- Improving metering efficiency
- Reducing leakage
- Institutional Improvement

(2) Controlling Unauthorized Use of Water

The control of illegal or unauthorized use of water should not begin and end by being preventive in nature. Punitive measures/actions must be available to MWSS to give teeth to the total NRW program. To pinpoint the areas where illegal and unauthorized use is rampant, it is important to conduct extensive surveys. Although it is suspected that violations are rampant in depressed areas, many cases of violations were also noted in commercial establishments and in residential places. Thus, suitable programs, will have to be formulated for each category of violations; not to mention social water projects for the depressed. Controlled use through public faucets, where water can be accounted for, and where payment, even at subsidized prices, is made, is still better than illegal use because it minimizes wasteful use.

Other measures that would promote or encourage users to legalize their illegal connections should be looked into, such as, but not limited to:

- the replacement and monitoring of fire deteriorated hydrants,
- the creation of an illegal connection task force,
- installation and monitoring of public faucets, and
- the investigation and evaluation of by-passes as well as the unauthorized selling of water and unregistered service connections.

(3) Improving Metering Efficiency

The amount of water a consumer receives is measured by a device called a water meter. The measurement, or the reading made from the water meter is the basis for payment of the water fee. Much of the water, translated into revenues by MWSS, is lost through measurement errors or deficiencies. These are due mainly to unmetered services, defective or tampered meters, obstructed or inaccessible meters and under registration of working meters.
Various issues related to billing practices, and the lack of water meters have prevented past efforts at correcting the situation.

MWSS must meter all unmetered water connections. The installation of new meters and the replacement of old and defective meters will solve part of the NRW problem. More important, however, is the provision of reliable equipment and tools, as well as the improvement of the methods and techniques in meter testing and repair. A new division, which will focus on the preventive maintenance of water meters with 40 mm sizes and replacing these meters which have been in continuous service for at least 10 years; and several years for meters with sizes 100 mm diameter and larger, should be created.

MWSS is presently building the TELEMETRY system program to improve operational control of the system initially by means of real-time monitoring and at a later date by including remote command-and-control functions for some key facilities. A separate program will be adopted to account for the volume of water distributed per zone through district meters. An important part of the metering program is the immediate and periodic inspection of all installed water meters to determine those that are malfunctioning due to age, improper installation or improper sizing.

A standard for water meters should also be established and all new installations should comply with this standard. Quality control should focus on warranting that only the acceptable types are installed. In the long run , this could provide real savings as compared to the individual meter testing currently being done, which is time consuming and people dependent.

MWSS should adopt a policy of MWSS ownership of all water meters. The current practice of making the customer provide (or purchase) his own meter is not only wasteful of the time and cost of testing, but also makes the assurance of meter quality very difficult.

(4) **Reducing Leakage**

At 35 %, leakage is the most substantial contributor to NRW; while leakage control constitutes the most tedious and difficult activity being handled by MWSS. There used to be a "leak repair program" involving thousands of personnel and large amounts of resources that repaired close to 50,000 leaks over 10 years now. But there has been no considerable decrease or reduction in water losses due to leaks. On the contrary, losses attributed to leaks have increased.

The occurrence of leaks only means that leak repair has become an essential and vital maintenance activity. But for the purpose of reducing the NRW losses, leak repair cannot be expected to produce significant results. A leak, by itself, already means that water has been lost even before it can be stopped.

The solution is not a reactive program; but rather a proactive one where permanent and solid gains can be achieved. The saying that "An ounce of prevention is worth more than a pound of cure" is the answer. Thus, leakage prevention is the way to go. This implies pipeline renewal before the end of its useful life. The main directions for leakage reduction must therefore be as follows:

- Pipe replacement/renovation to renew old and defective distribution components
- Adoption of stricter quality control and quality assurance on construction activities

- Research and development of new pipe materials, workmanship and technologies which will lengthen the useful life of the distribution facilities.

To prevent the further increase in leakage losses, the leak repair program should have to be accelerated to be able to reduce the reaction time from the receipt of the leak report to the final completion of the leak repair. Likewise, to maximize the effects of replacement of deteriorated pipings, replacement works should be done from the upstream to the downstream of the distribution network. As more and more facilities are renovated in the future, the incidence of leakage is expected to gradually decrease, thus allowing for a corresponding decrease in the number of maintenance teams.

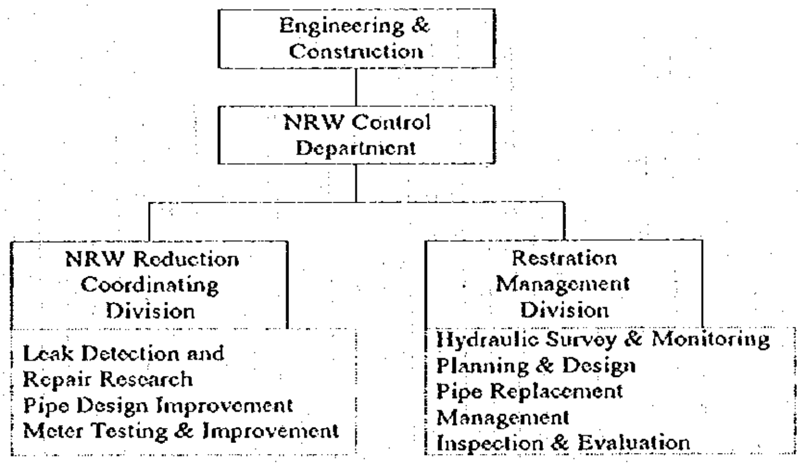


Figure 2.2.5 Proposed NRW Control Organization

(5) Institutional Improvement

The various programs envisioned need institutional support and improvement measures in the areas of organizational streamlining, logistic build-up, communications and information processing and human resources development. Some of these measures are as follows:

Creation of a permanent unit within MWSS which will assume responsibility of NRW activities on a sustained and continuous basis. This unit should at least be at the level of a division. A proposed organization is shown in Figure 2.2.5.

2.4.2 Maintenance and Logistics

(1) General

The major issues of the operations and maintenance areas are centered in and around the maintenance of facilities and equipment, and logistics of maintenance resources such as materials, spare parts, tools and equipment. This is due to a lack of planning and coordination among operations, maintenance, material control and procurement activities. In spite of the fact that those activities are closely related, they are performed by different offices and departments and each operating unit is functioning independently from the others, thus resulting in inefficient repair and maintenance work.

Another critical issue for operations and maintenance is budget constraints. Due to the fact that the budget for O&M is limited, necessary maintenance resources are always in short supply and repair and maintenance work are not performed on time and at the optimum level of work quality.

In order to improve the operations in the maintenance and logistics functions, the Study Team identified the following three options:

- Option 1 - Re-engineering
- Option 2 - Management Contract
- Option 3 - Joint Venture

(2) Option 1 - Re-engineering

a) Objective

In order to streamline the existing maintenance and logistics operations in the Operation Area, MWSS should apply the re-engineering approach and integrate the maintenance and logistics operations. The business processes to be re-engineered will be as follows:

<u>Maintenance Operations</u>

- Maintenance planning (Planning process)
- Job order monitoring (Core process)
- Resource allocation and scheduling (Core process)

- Maintenance and repair (Core process)
- Job costing and performance measurement (Supporting process)
- Equipment management and maintenance recording (Supporting process)

Logistics Operations

- Procurement planning (Planning process)
- Procurement management (Core process)
- Receiving and issuing (Core process)
- Inventory control and monitoring (Supporting process)
- Inventory valuation (Supporting process)

The following depicts a proposed process flow of maintenance and logistics:

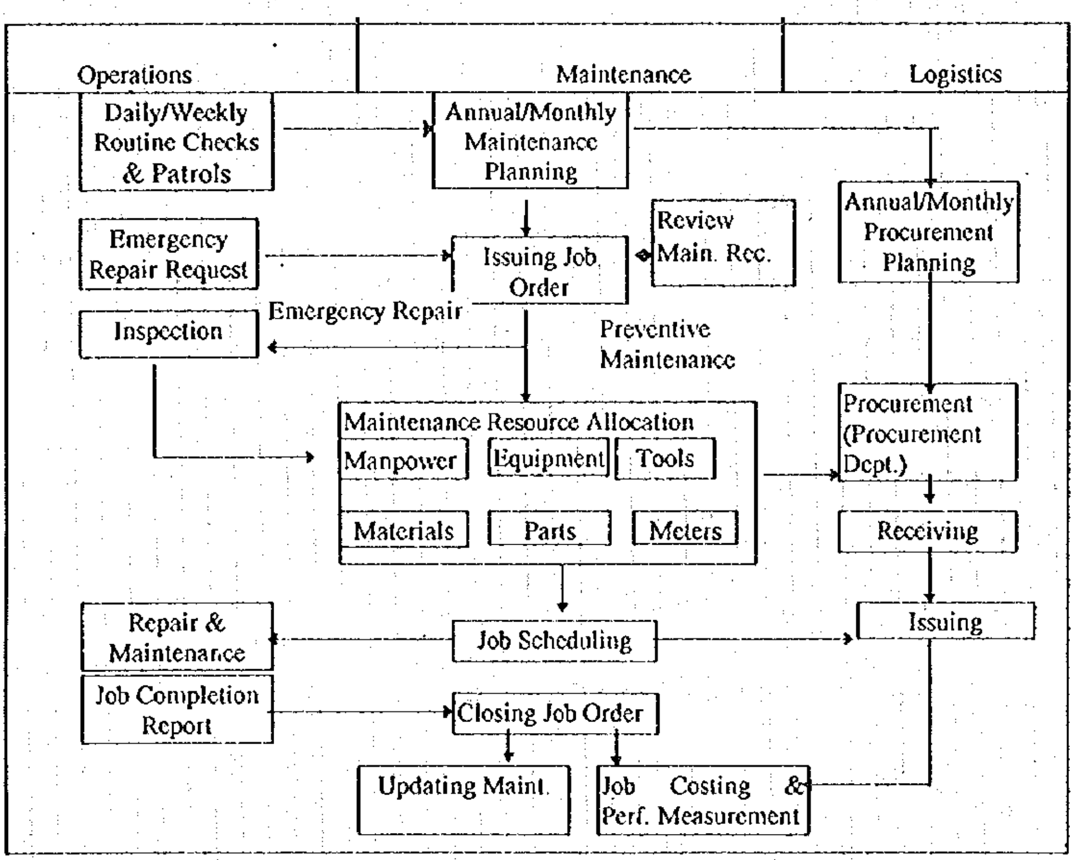


Figure 2.2.6 Proposed Process Flow of Maintenance and Logistics

b) Approach

In order to perform the re-engineering project efficiently, a re-engineering project team should be formed, headed by one senior officer as the Project Manager who will report directly to the Administrator. The Project Manager will be supported by the project coordinator and an outside consultant who has extensive knowledge and experience in re-engineering or change management process. The project team will consist of four working groups including maintenance process, logistics process, organization and human resource, and information system as shown below:

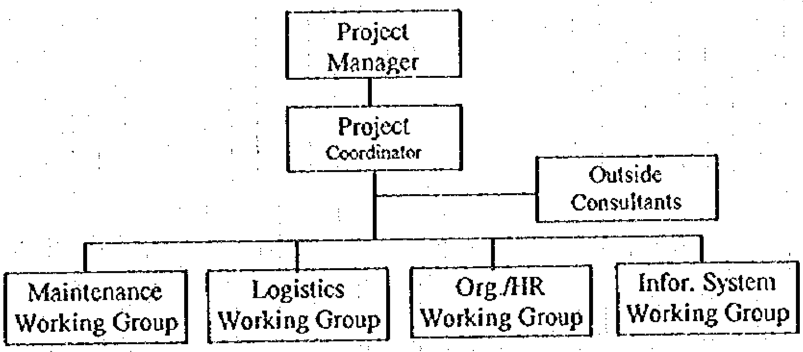


Figure 2.2.7 Proposed Project Organization Chart

Members of the working groups will be selected from departments in the Operations Area, the Treasury Dept., Procurement Dept., Personnel Dept., HRDD, and SSD and assigned to the project on a full time or part time basis.

c) Assessment

One advantage of this option is to avoid disruptions resulting from the current major restructuring and maintenance efforts to improve overall MWSS operations based on a full implementation of ISP (Information System Plan) and the proposed CMP (Change Management Program). Another advantage is that it will also be less radical to change organizational and operational set-up and easy to train MWSS personnel who are familiar with the existing operations. The third advantage is that MWSS would be able to utilize its own manpower resources with minimal assistance from outside consultants.

A major disadvantage is that it will be difficult to completely remove existing functional red tape if each functional unit would try to protect their existing power and authority in their respective turfs so that dramatic improvements may not be attained. Another disadvantage is that the resulting new organization and operations would still be under the control of DBM and COA.

(3) Option 2 - Management Contract

a) Objective

Under this type of contract, the foreign firm contracts to manage, on compensatory basis, specific operations in which it has no ownership interests. As such, the management contract permits the acquisition of much needed technical and managerial skills such as maintenance planning and scheduling, service parts inventory control, logistics of maintenance resources, etc. In addition, know-how such as quality and price data on supply materials and parts, supplier global network, purchase negotiation, etc. would also be transferred by the foreign enterprise.

b) Approach

The functional responsibilities to be assigned under the management contract will be as follows:

- Maintenance function of water source, treatment and transmission facilities
- Logistics of supply materials, parts, tools and equipment required for repair and maintenance of wholesale area

Basically, the Manager's duties are the same as the administrative and technical functions that this foreign company would perform for its own subsidiary. The following outline the services that might be provided by the Manager:

<u>Maintenance management</u>

- Maintenance policy and standards
- Maintenance resource management
- Maintenance planning and scheduling
- Job order monitoring
- Maintenance history recording and updating

<u>Logistics management</u>

- Material/parts management policy and standards
- Material and purchase planning

- Procurement management
- Receiving and issuing
- Parts inventory control and monitoring

Additional Duties

- Provision of relevant technical data, books and manuals
- Provision of worldwide procurement channel data
- Provision of quality and cost data for materials and parts
- Development of standard operating procedure (SOP) manuals for maintenance and logistics
- Development of training program for maintenance and logistics

c) Assessment

A major advantage of this option is that MWSS would be able to acquire advanced technology, data on material and parts quality and costs, procurement and inventory management methodology and training of MWSS personnel. Another advantage is that MWSS would be able to have access to domestic and international material and parts supply networks which have already been developed by the management company and to improve purchase negotiation.

A major disadvantage is that this arrangement will be expensive for MWSS due to the requirement of expatriates from foreign countries because most management companies are foreign. Another disadvantage is that it is difficult to establish and measure performance of the contractor to monitor progress of improvement, as basis of paying an incentive to the contractor. The third disadvantage is that technology transfer and training of MWSS personnel may take a long time even beyond the contact period.

A large risk with a management contract is that differences in contractual relationship may arise between MWSS and the management company when the Manager's interest in the operations conflicts with MWSS'. Conflicts of this nature usually occur when the Manager has a profit link to the enterprise or has some other absolute interest in its economic success. In such instances, the management contractor is likely to concentrate its efforts in making the operations run efficiently and profitably even if in doing so it sacrifices the long-term and larger interests of

MWSS, such as when equipment are operated continuously without allowing time for regular preventive maintenance.

(4) Option 3 - Joint Venture

a) Objective

In order to lessen government controls, a joint venture (JV) with a JV partner that specializes in the provision of maintenance and logistics service to MWSS may be created between MWSS and a private company. Being an entity separate from MWSS, it would have full autonomy and could pinpoint internal customers with ease. A management contract between the joint venture and the private company will also be concluded in addition to the service contract and the joint venture agreement.

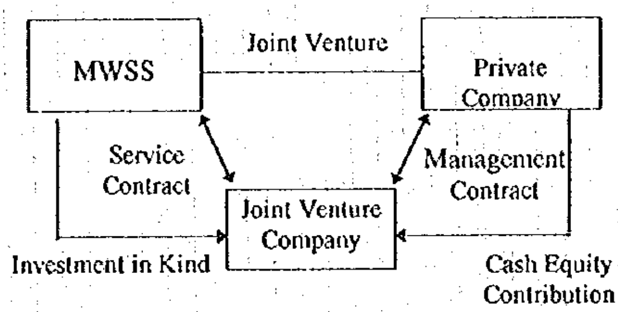


Figure 2.2.8 Structure of Joint Venture Scheme

b) Approach

The joint venture will be established between MWSS and a private concern. The private company-JV investor will be selected through public bidding. Cash equity raised will be spent to improve maintenance facility and equipment. MWSS will transfer existing maintenance facility, equipment, tools, and materials and spare parts inventory to the joint venture as its investment in kind.

The following functions will be handled by the joint venture:

- Engineering and maintenance service
- Procurement and material control
- Administration and accounting

c) Assessment

This option has same advantages as Option 2 mentioned above. In addition, a full autonomy of maintenance and logistics operations can be established and government regulations and controls such as the flag law and COA rules will be minimized. The joint venture will be subject to post audit by COA but not the COA pre audit procedures.

A major disadvantage of this option is that it requires an amendment of the MWSS Charter, since the current Charter does not permit MWSS to invest in subsidiaries. Another disadvantage will be the difficulty in establishing equitable transfer prices between MWSS and the joint venture for maintenance facility, equipment and parts.

(5) Budget for Maintenance and Repair

MWSS does not have sufficient budget for satisfactory repair and maintenance work. Repair and maintenance budget has been at an extremely low level for the past several years despite the increasing amount of repair and maintenance work required as infrastructure become old and new facilities are added. Since there is no guideline on budget allocation for repair and maintenance, a substantial portion of the proposed budget requested by operating units is usually cut. In other words, MWSS is operating with profits by sacrificing costs for repair and maintenance, accelerating deterioration of the facilities and eventually requiring more costly rehabilitation of infrastructure.

In order to raise necessary funds for maintaining infrastructure at satisfactory level of work quality, the cash inflows of MWSS must be improved and the water tariff should be reviewed, modified and set at a level that will adequately cover necessary repair and maintenance and rehabilitation costs. One major problem in determining repair and maintenance costs is that there is no universal methodology in the water utility industry.

As a short-term solution for determining repair and maintenance costs for budgeting purposes, an allocation guideline should be established based on a logical assumption, such as percentage of the total operating expense. Once the total budget for repair and maintenance is determined, the budgeted amount will be allocated to departments, divisions and sections based on a pre-determined formula.

As a long-term strategy, the budget for repair and maintenance work should be increased gradually at an amount that adequately covers costs to maintain infrastructure at required level.

In order to estimate repair and maintenance costs properly, MWSS must develop policies and guidelines for repair and maintenance work and material and parts procurement and inventory management. In addition, job costing system to monitor labor, material and overhead costs should be developed and implemented.

2.4.3 Operation and Maintenance of Facilities/Equipment

(1) Objectives

The water supply facilities/equipment should always be kept in such good condition through proper operation and maintenance to maximize the functions of the equipment, extend its useful life and save on costly repairs in the future. Another objective of a regular operation and maintenance program is that it provides the people in the service area with an uninterrupted, equitably distributed, and adequate amount of safe water supply.

Any omission or negligence of such proper operation and maintenance may lead to the unexpected damage to not only to the consumers; but also to the water supply facilities where repairs take more time and money.

(2) Facility Maintenance

The maintenance of each facility and equipment is composed mainly of patrol/inspection and maintenance. Patrol/inspection should be done periodically, to check the normal function, working condition, etc., of each facility and equipment. Any feedback should be relayed so that maintenance work can be made to restore the normal function of each facility and equipment through cleaning, overhaul, and other preventive measures. Patrol has a shorter interval than inspection. The relation of the operation and maintenance is shown in Figure 2.2.9. Preventive maintenance is further stressed in the following section.

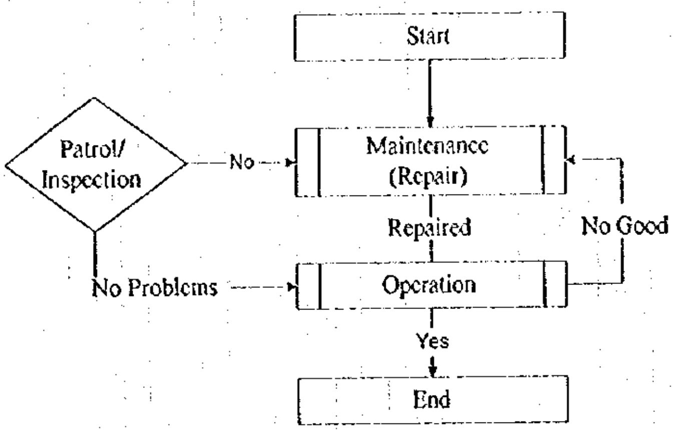


Figure 2.2.9 Operation and Maintenance

To get the full result out of maintenance works, procedures and methods for regular maintenance works should be standardized and systematized as shown in Table 2.2.43, for effectivity and efficiency in the production of the required quality and quantity of water. The standardization process should take into account the following items:

- Production Control

  Based on the fluctuations in water demand, each facility must be optimized. To do so, data concerning production amount, distribution pressure, and water level at each distribution tank, together with the operation of mechanical facilities/equipment including the distribution valves and pumps, should be monitored and complied, which could be useful for future production control.

- Water Quality Control (Refer to the following section, water quality control.)

2.4.4 Preventive Maintenance

(1) Objectives

The objective of preventive maintenance is to manage all the facilities of MWSS properly, safely, and assure that these facilities are in the best condition at the minimum cost possible.

The objective of preventive maintenance is embodied in the following items. These items are inter-related and contribute to the increase in the effective revenue through a reduction in the expenditure for maintenance.

a) Reduction of Maintenance Cost

The reduction of maintenance cost can be achieved by implementing the maintenance program at the proper time by the proper method. For example, if a bearing fails due to oil deterioration or shortage, it will result in costlier repair. Similarly, neglect in painting will lead to rusting.

b) Reduction of Production Loss

Production loss is caused by failure of facilities. Leakage from transmission pipe or distribution pipe at the water works is a typical example. Proper maintenance can minimize such wastage and contribute to an increase the revenue of the system.

(2) Method of Preventive Maintenance

In order to attain the desired results, preventive maintenance should be carried out in accordance with a well-prepared and sound program.

There is no defined preventive maintenance program in the MWSS at present. The following steps will be helpful in the preparation of a preventive maintenance program. Detailed implementation of preventive maintenance is referred to Supporting Report.

a) Preparation of Preventive Maintenance Program

(i) Investigation of Existing Facilities and Equipment

The actual condition of existing facilities and equipment should be carefully investigated and a complete inventory should be made prior to the preparation of the program.

(ii) Identification of Important Facilities

The important facilities shall be as follows:

- Raw water intake facilities
- Water treatment facilities
- Water distribution facilities

For each facility, further identification of the important equipment should be conducted.

Table 2.2.43 Operation and Maintenance Program (1/2)

Facilities	Daily Patrol		Regular Inspection		Maintenance Work	
	Frequency	Contents to be Checked	Frequency	Contents to be Checked	Frequency	Contents to be Checked
1 Angat Dam	once	a raw water quality (Tu, pH, algae growth, etc.)	3 months	a leakage and moving condition of gates	1 year	a cleaning of intake mouth
	ditto	b water level	1 year	b concrete cracking, aging, and leakage	everyday	b removal of screenings
	ditto	c condition of intake tower including equipment			3 years	c painting of gates, screens, steel parts
2 Ipo Dam	once	a raw water quality (Tu, pH, algae growth, etc.)	4 months	a working condition of gates	everyday	a removal of screenings
	ditto	b water level	4 months	b working condition of screens	3 years	b painting of gates, screens, steel parts
	ditto	c condition of gates	1 year	d concrete cracking, aging, and leakage	as required	c lubrication of gates and screens
	ditto	d condition of screens				
3 Bicti Headworks	once	a water level	4 months	a moving condition of gates	everyday	a removal of screenings
	ditto	b condition of gates	1 year	b concrete cracking, aging, and leakage	3 years	b painting of gates and steel parts
					as required	c lubrication of gates
4 Treatment Plant						
4-1 Receiving Well	3 times	a flow of raw water (flow meter)	1 year	a concrete crack, aging, and leakage	3-6 months	a cleaning of wells
	ditto	b water level (flow rate, level meter)	ditto	b moving condition of valves	3 years	b painting of steel parts
	ditto	c raw water quality (Tu, pH, Alkalinity, etc.)	ditto	c concrete cracking, aging, and leakage		
4-2 Mixing Tank	3 times	a flow of raw water	3 months	a working condition of valves	3-6 months	a cleaning of mixing tanks
	ditto	b water level	ditto	b working condition of mixers	3 years	b painting of steel parts
	ditto	c raw water quality (Tu, pH, Alkalinity, etc.)	1 year	c concrete crack, aging, and leakage	as required	c lubrication of mixers
	ditto	d chemical piping and dosage (jar test)	1 month	d consume of lubricant		
	ditto	e mixing condition of chemicals				
	ditto	f condition of mixers (rotation speed, current, oil volume and leakage, vibration and noise)				
4-2 Flocculation Tank	3 times	a water level	3 months	a working condition of valves	3-6 months	a cleaning of flocculation tanks
	ditto	b growth condition of floc	ditto	b working condition of flocculators	3 years	b painting of steel parts
	ditto	c quality of effluent (Tu, pH, Alkalinity, etc.)	1 year	c concrete crack, aging, and leakage	as required	c lubrication of flocculators
	ditto	d chemical piping and dosage (jar test)	1 month	d consume of lubricant		
	ditto	d condition of flocculators (rotation speed, current, oil volume and leakage, vibration and noise)				
4-3 Sedimentation Tank	3 times	a water level (detention time)	3 months	a working condition of valves	everyday	a removal of algae, scum, floating materials, etc
	ditto	b flowing condition and state of floc settling	1 year	b concrete crack, aging, and leakage	6 months	b grease up of spindle of sludge withdrawal valves
	ditto	c quality of effluent (Tu, pH, Alkalinity, etc.)	2 months	c state of adhesive (algae, scum, etc.)		
	ditto	d condition of valves	ditto	d state of launders (orifice)	3-6 months	c cleaning of sedimentation tanks
			3 months	e amount of accumulated sludge	3 years	d painting of steel parts
			1 month	f working condition of sludge withdrawal valves		

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Table 2.2.43 Operation and Maintenance Program (2/2)

Facilities	Daily Patrol		Regular Inspection		Maintenance Work	
	Frequency	Contents to be Checked	Frequency	Contents to be Checked	Frequency	Contents to be Checked
4 Treatment Plant						
4-4 Filter Tank	3 times	a water level	2 months	a state of adhesive (algae, scum, etc.) on concrete walls and washing troughs	6 months	a cleaning up of filter tanks
	ditto	b filtration volume, filtration velocity, filtration head loss and filter run	1 year	b concrete cracks, aging, and leakage	as required	b replenishment of filter media (at the time when the thickness of media layer is reduced by 10%)
	ditto	c filtered water quality (Tu, pH, Alkalinity, Residual Chlorine, etc.)	ditto	c filter media (pollution of filter media, occurrence of mud balls, effective particle size, filter media thickness, etc.)	10-15 years	c replacement of whole of filter media
	ditto	d surface washwater volume and washing time	ditto	d movement of gravel layer	1 year	d repair of control equipment and pipe insulation
	ditto	e backwash volume and washing time			3 years	e painting of mechanical equipment
	ditto	f washing condition (expansion rate, carryover of filter media, trouble of washing apparatus, surface of filter media after washing	ditto	f working condition of filtration head loss meter	5-10 years	f overhaul of motor driven valves
	monthly	g turbidity of washed water	ditto	g condition of underdrain		
	3 times	h condition of valves (current, oil volume and leakage, vibration, valve operation system and noise)	ditto	h damage of surface wash apparatus		
4-5 Filter Washing Facilities	3 times	a current, pressure and discharge of pumps	1 year	a condition of grand packing	1 year	a adjustment/replacement of gland packing
		b abnormal noise, vibration and oil leakage	ditto	b condition of lubrication	1-5 years	b overhaul of bearing
		c temperature of bearing	ditto	c condition of pressure gauge	ditto	c overhaul of coupling
		d leakage from gland packing	ditto	d working condition of valves	5-10 years	d overhaul of pumps
					ditto	e overhaul of motor-driven valves
					as required	f fill up lubricant
					3 years	g painting of piping and steel parts
4-6 Wash Water Tank	as required	a water level	monthly	a working condition of water level meter	1 year	a cleaning of wash water tanks
	ditto	b pollution control from outside (ventilation, manhole)			3 years	b painting of steel parts
5 Chemical Building (Coagulants, polymer, chlorine)	3 times	a storage amount of chemicals	as required	a quality of chemicals(conc., temp.)	2-5 years	a overhaul of pumps
	ditto	b leakage of chemicals	ditto	b working condition of valves	3 years	b painting of mechanical equipment
	ditto	c opening of valves	ditto	c leakage of chemicals from piping and tanks	5-10 years	c replacement of piping and valves
	ditto	d storage of solution		d operation conditions (temperature controller, alarm, leak test)	6 months	d calibration of weighing scale
	ditto	e condition of chemical feed pumps (current, pressure, abnormal noise, vibration, oil volume and oil leakage)		e operation condition of hoist	as required	e lubrication of hoist
					6 months	f filter exchange of evaporator
	ditto	g dosage and dosing rate			2 years	g clean up of water bath of evaporator
(Chlorine evaporator)	ditto	h operation conditions (pressure, temperature, heater)	6 months		3 years	h painting of evaporator
	ditto	i gas cylinder(leakage, pressure)	1 year			
6 Pumping Station (Reservoir)	3 times	a water level of reservoirs	1 year	a condition of gland packing	1 year	a adjustment of gland packing
	ditto	b condition of pumps (current, pressure, abnormal noise, vibration, oil volume and leakage)	ditto	b condition of lubrication	1-5 years	b overhaul of bearing
	ditto	c opening of valves	ditto	c condition of pressure gauge	ditto	c overhaul of coupling
	ditto	d temperature of bearing	ditto	d condition of level meter	5-10 years	d overhaul of pumps
	ditto	e leakage from grand packing			3 years	e painting of steel parts
	ditto	f distributed water quality (Tu, pH, Alkalinity, etc.)				
	ditto	g pollution control from outside (ventilation, manhole)				

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(iii) Examination and Determination of Limits of Economical Repair

Repair of deteriorated facilities to restore to functional condition is part of the preventive maintenance. However, ways and means shall be determined if it is economically feasible.

(iv) Consensus of Persons Concerned

It is important in the performance of the preventive maintenance, to obtain the consensus of the persons concerned through discussion.

(v) Formulation of Organization

In order to attain an efficient preventive maintenance program, it is essential to formulate a suitable organization with the necessary authority and the appropriate number of personnel.

(vi) Formulation of System and Procedures

For an efficient preventive maintenance, it is necessary to establish the most suitable system and procedures;

(3) Application of Preventive Maintenance

(i) Ascertaining of Repair Limits

The time when each facility reaches the repair limit should be ascertained through proper performance of daily and periodical checking of the facilities.

(ii) Method of repair should meet the requirements of each facility in the most economical way

(iii) Practice of Appropriate Improvement of Facilities

In order to stop the deterioration and reduce preventive maintenance cost of facilities, appropriate improvement of facilities is necessary.

(iv) Timely Renovation of Facilities

Any facility which has deteriorated, and whose efficient performance cannot restored by regular maintenance work, requires timely renovation after due consideration of its economical effectiveness.

(v) Confirmation of the Effects of Preventive Maintenance

It is necessary to confirm whether the preventive maintenance has brought the anticipated effects or not. If any unsatisfactory results or defects were found after thorough investigation, these should be corrected.

(3) Cost of Maintenance

Execution of maintenance guarantees the usability of equipment and facilities within or sometimes even beyond the expected life. After expiration, however, the efficiency of equipment and facilities may decline even if they are properly maintained, some gradually while some abruptly. A large scale rehabilitation or renovation entails considerable expense. In order to cope with such exigency, therefore, a budgetary system to ensure the availability of funds for major rehabilitation or renovation should be established.

Hereunder are the common procedures for estimating the budget for preventive maintenance.

a) Estimation of Budget for Preventive Maintenance

The estimation of budget for preventive maintenance is usually performed by either the following procedures:

(i) Based on the previous records of preventive maintenance cost.

This procedure may not be very applicable since there is scarcely any preventive maintenance.

(ii) Based on the total invested amount

This procedure is to multiply an appropriate factor to the total invested amount. The percentage factor for similar facilities and equipment in many other projects shows 1.0 to 3.0 percent per year.

Table 2.2.44 shows the benefits of preventive maintenance in IRR, assuming the following items:

- With preventive maintenance, full rehabilitation works for mechanical and electrical facilities/equipment shall be done every 15 years.
- With preventive maintenance, full rehabilitation works for piping shall be done every 30 years.
- Without preventive maintenance, full rehabilitation works for mechanical and electrical facilities/equipment shall be done every 10 years.
- Without preventive maintenance, full rehabilitation works for piping shall be done every 20 years.

Table 2.2.44 Benefits of Preventive Maintenance

Maintenance Budget*	IRR for Mech. & Elec.	IRR for Piping
1%	43.9%	14.8%
2%	26.8%	8.8%
3%	15.2%	5.1%

Note : Maintenance budget is a ratio of preventive maintenance cost with the initial mechanical or electrical cost.

For mechanical and electrical facilities/equipment, 3 % of maintenance cost benefits 15.2 %, while for piping, 1 % of maintenance cost realizes 14.8 % of benefits. These figures reveal not only the technical importance of the preventive maintenance but also the economical benefits derived from it.

b) Budget Item for Preventive Maintenance

The budget for preventive maintenance consists of these four items:

- Inspection cost
- Ordinary repair cost
- Emergency repair cost
- Improvement cost

(i) Inspection Cost

Inspection cost is mostly labor cost. When an engineer is recruited for conducting the preventive maintenance, the respective budget will be necessary.

(ii) Ordinary Repair Cost

The ordinary repair cost is further divided into the preventive repair cost and the after repair cost. The preventive maintenance cost shall be charged to the preventive maintenance repair cost and the rest of the budget shall be for the after repair cost.

(iii) Emergency Repair Cost

Although the preventive maintenance is carried out, it is difficult to avoid sudden accidents or unforeseen increase of expenses. In addition to this, the occurrence of natural calamity shall also be taken into account.

The unforeseen repair work shall be accounted neither for ordinary repair cost, nor for any budgetary item. It shall be handled as the supplementary budget on the contingency budget.

As to contingency budget, it is important to establish a system to prevent recurrence of the same trouble by preparing the detailed survey report on the same cause after the completion of the relevant repair work.

(iv) Improvement Cost

Improvement works is accompanied by a large amount of expenditures. Therefore, the procedure for budgeting shall primarily be established by trial basis, generally taking a considerable period. Thus, the cost for trials shall be budgeted as a part of the improvement cost.

(4) Practice of Preventive Maintenance Budget

After compilation and approval of the budget, it will be applied in accordance with the approved preventive maintenance program. Since the budget is going to be disbursed as programmed, its effective execution should be simplified by making the officer-in-charge directly responsible for it. In the case of ordinary repair and improvement work, however, the officer in charge of operations can oversee said work/expenses as detailed in the weekly or monthly repair work plan which can be established through a meeting of all concerned.

(i) Plan for Monthly Repair Work

The person in charge of preventive maintenance shall call a meeting with the sections concerned to set-up a detailed plan for monthly repair work and to decide the schedule, the priority and sequence, the confirmation of necessary equipment and materials, and the selection of contractor/s.

(ii) Plan for Weekly Repair Work

Small scale maintenance/repair works which are requested by concerned sections may be planned by the division in charge of preventive maintenance and carried out according to the detailed weekly plan.

(5) Rehabilitation and Improvement Work Management System

After long years of equipment, facilities and integrated systems operation, sometimes there is a need for large-scale rehabilitation/improvement works to restore these to their original condition, or to upgrade their efficiency, even if these have been carefully operated and well maintained.

The major contents of the management system for rehabilitation/improvement work are:

- Progress of work management
- Work management
- Materials management
- Tools management

(i) Progress of Work Management

Progress of work management may be done in the following ways:

- Rehabilitation/Improvement works should be conducted according to pre-scheduled, well-planned programs and should never be done in a haphazard manner.
- During the work period, all personnel (inspector, operators and contractors) should hold meetings periodically and/or as needed for better coordination.

- The actual cost of rehabilitation/improvement works should be kept and recorded for proper administration of funds.

(ii) Work Management

Generally, rehabilitation and/or improvement is a time consuming job; so that the efficiency of the said work should be maintained as high as possible.

(iii) Materials Management

Materials for a repair work should be carefully managed considering the following points:

- Materials and spare parts which are frequently used for repair works should be ready in stock for use at any time.
- Materials and parts which are not frequently used should be purchased whenever necessary.

(iv) Tools Management

It is recommended that a Tool Room be established, and a property custodian who will be responsible for issuance, records keeping, and management of tools, should be designated in order to avoid misuse or loss of tools.

2.4.5 Water Quality Control

Quality control in the water systems aims basically to assure users of a constant supply of hygienic, safe and clean water at their service taps, free from trouble regarding the quality of water or other inconveniences.

To maintain a high level of service, the following quality measures must be implemented:

- to keep the source water as clean as possible, to effect optimal water treatment, and
- to prevent contamination of treated water as it flows through the distribution system

To achieve optimal water treatment, it is vital to analyze the quality of raw water, effluent from the coagulation/flocculation/sedimentation processes, filtered water, and final effluent. It is also important to evaluate fully through jar tests the proper doses of coagulant or coagulant aid, as well as to assess periodically possible methods of improving the process of water treatment.

To maintain water quality throughout the distribution system, it is essential to use care, to follow the highest work standards, and to be aware of the need for cleanliness. Water distribution performance must be monitored carefully by means of the collection of samples for bacteriological and chlorine residual analyses. Finally, to maintain quality service, adequate countermeasures to accidents and troubles must be taken as quickly as possible.

(1) Scope of Water Quality Control

At present, MWSS depends on the "Angat-Novaliches Water Supply System" as its only source of water. Quality control of water can be considered in terms of source water quality control, quality control in the processes of water treatment, and quality control in the distribution of water.

a) Source Water Quality Control

Plankton and algae growing in the still water of reservoirs like the Angat Dam, the Ipo Dam, and Novaliches Reservoir (La Mesa Dam) may impart taste and odor-causing substances to the water. Manganese, dissolving in oxygen-poor bottom waters during periods of thermal stratification, sometimes interferes with normal water treatment.

In general, however, reservoir water is less subject to qualitative fluctuation than river water and is less turbid. Furthermore, the number of bacteria in reservoir water is also usually lower due to the self-purifying function of the reservoir.

As mentioned above, reservoir water is affected by the growth of plankton and algae. Some species of plankton and algae impart substances which have been variously described (aromatic odors, fishy and earthy odors, odors of decay, etc.). The higher the levels of plankton and algae, the higher the frequency of clogging. Algae consume dissolved carbon dioxide during daylight hours, thus causing the pH to rise remarkably as a result.

The discharge of nutrients such as nitrogen and phosphorous to a reservoir causes the enrichment of the water. If uncontrolled, such discharges may promote the growth of algae, plankton, and other biological forms and cause a significant degradation of water quality. Effective control of waste discharges to water supply reservoirs must be instituted.

b) Quality Control in Water Treatment

Rapid sand filtration at the existing plants, Balara and La Mesa Water Treatment Plants, starts with coagulation, which is chemical addition process to the raw water, and is immediately followed by flocculation and sedimentation. This process entails the conditioning of the raw water such that particles contributing to turbidity can be coalesced and removed in a quiescent sedimentation basin. The success of rapid sand filtration is mostly due to the process of physical filtration. This mode of water treatment provides excellent performance in removing suspended substances.

Coagulation, flocculation and sedimentation are greatly affected by the dosing rate of coagulant, no matter how large or small may be the dosing rate. Optimal dosing rates must be set according to the results of jar tests. The optimal dosing rate varies with the quality of raw water. Dosing rates must be adjusted when the quality of raw water changes.

After a heavy rainfall, even reservoir water, the turbidity of raw water sometimes rises quickly over a short time span, thus making it difficult to set the optimal dosing rate. To cope with such cases, a "turbidity-dosing rate relation diagram" should be made in advance. This is done using jar tests wherein highly turbid sample waters are prepared by mixing raw water with different quantities of clay. The diagram above allows an operator to adjust the dosing rate quickly in accordance with the present turbidity of raw water.

Aluminum sulfate, the coagulant, chemically reacts with alkaline components dissolved in water, producing metal hydrides, and flocculation takes place with the alkaline components. When the raw water has insufficient alkalinity, alkaline agent must be added to the raw water for normal flocculation to occur.

With rapid sand filtration, the turbidity of filtered water increases as the process of filtration continues. At some point - either an increase of effluent turbidity or excessive headloss through the filter - filtration must be stopped and filter must be backwashed. With this in mind, it is essential to carefully monitor the process of rapid sand filtration to ensure proper filter performance.

c) Quality Control in Water Distribution

Sometimes, turbid water may emerge from service taps in a certain district, despite the fact that clear water is distributed from the water treatment plant. In this case, it is vital to determine the cause as soon as possible and a survey should be made to define the area affected and to pinpoint the cause of the turbidity. This might often be related to the leakage or breakage of the distribution system.

For quality and sanitary water service, the entire water system including the water treatment facilities must be so managed that water samples taken throughout the system meet the National Drinking Water Standards and contain sufficient residual chlorine as regulated to maintain not less than 0.1 mg/l at the farthest point of the distribution system.

(2) Quality Tests

a) Purpose of Quality Tests

Quality tests are a means to control the water quality and are implemented in accordance with the aims specified below:

- To assess the quality of raw water precisely
- To achieve optimal control of water treatment processes/facilities
- To make sure that water from service taps is safe and fit to drink.

b) Water Sampling for Quality Tests

Water specimens for quality tests must be collected at appropriate locations which are selected in advance according to the purpose of the particular quality test. Care must be used in selecting the methods of sampling, conveyance of sampled water and preservation thereof so that the quality does not change before the analysis is made, as prescribed in "The Manual of Standard Methods for the Analysis of Air and Water".

c) Test Items and Intervals of Testing

It is recommended that MWSS keep its own quality test standards and quality check system, each covering the entire spectrum of tests prescribed in the National Drinking Water Standard. It is also necessary that specialists with appropriate technical background be in charge of the test and check. These specialists should receive on-going training to maintain their qualifications and upgrade their expertise.

The costs of the testing program described above may be substantial. In case MWSS does not have the facilities or personnel required for conducting all tests, the conduct of some tests can be contracted to other government or private laboratories. Tests which should be done by MWSS are those related to water quality control at the source, water treatment operations, and water distribution, and the remainder can be entrusted to an outside party specializing in such testing.

The test items will vary to some extent, depending on the mode of quality control at the source of water and the process of water treatment. Some of the test parameters given in Table 2.2.45 should be selected. The interval of testing should be as shown in Table 2.2.45 or may be adjusted as necessary. Typical qualitative abnormality and their countermeasures are shown in "Water Quality Control in Qualitative Abnormalities and Countermeasures", Supporting Report.

It is recommended that MWSS perform testing for those parameters requiring a daily analysis and that test parameters which necessitate special knowledge and skill be entrusted to an outside organization. When testing is entrusted to outsiders along with the sample, a data sheet should accompany the sample. The data sheet should be completed as described earlier in regard to sampling procedures.

Extra Quality Test

In addition to the above, an extra quality test must be implemented in each of the following cases:

- Whenever the quality of water has deteriorated significantly
- Whenever the source of water shows some abnormality
- Whenever an epidemic disease has broken out among residents living near the water source or in the water distribution service area.
- Whenever some abnormality is observed in the process of water treatment

- Whenever piping or other water supply facilities are considered to have incurred pollution.

Quality Test Prior to the Distribution of Water

Water from service taps downstream of a water supply facility which has been newly installed, extended or altered, must be subjected to quality tests before service is started. Sampling sites must be carefully selected, taking into account the configuration of the water system involved and the topographical conditions so that the samples will be truly representative. The source of water and water treatment plant should also be tested when deemed necessary.

d) Recording of Test Data

Quality test results for raw water and treated water should be recorded on sheets. These test results are significant not only for maintaining present operation but for reference in the future.

(3) Emergency Stop of Water Supply

MWSS is responsible to stop water supply immediately whenever the supply water is found to have been polluted or is harmful to public health. Further, MWSS is also responsible to inform users without delay not to use the water. Subsequently, appropriate measures must be taken as soon as practicable to improve the situation. MWSS is allowed to restart the service only when absolute safety is certain. Generally, it is required to suspend the service of water supply when the following occur:

a) When water is contaminated with pollutants

- When raw water is polluted or suspected to have been contaminated with disease-causing microbes or toxic substances, and the removal of which is impractical or unfeasible by means of conventional water treatment.
- When waters at the respective stages of filtration, transmission, and distribution are found polluted or suspected to have been contaminated with disease-causing microbes or toxic substances.

b) When source water, intake water and raw water in the transmission pipeline are contaminated and there is one of the following abnormalities, intake must be stopped immediately, followed by quality checks, and water supply may have to be suspended:

- When water undergoes a conspicuous change in color and turbidity due to uncertain causes.
- When water shows remarkable change in taste and odor.
- When many fishes are found dead
- When a corpse, carcass, trash, filth and other unsanitary substances are found afloat at the source of water

c) When there is a failure of chlorination, either due to equipment malfunction or a shortage of chlorine, water supply must be basically suspended.

Table 2.2.45 Parameters and Frequency of Water Quality

No.	Parameter \ Sample	Raw Water	Rapid Sand Filtration: After Sedimentation	Rapid Sand Filtration: Filtered Water	Rapid Sand Filtration: Chlorinated Water
1	Atmosphere Temperature	A	-	-	-
2	Water Temperature	A	A	A	A
3	Turbidity	A	A	A	A
4	pH	A	A	A	A
5	Electrical Conductivity	A	A	A	A
6	Color	A	A	A	-
7	Taste	A	-	-	A
8	Odor	A	-	-	A
9	Alkalinity	A	A	-	-
10	Residual Chlorine	-	-	-	A
11	Chlorine Demand	B	-	A	-
12	Organic Substances	B	B	B	B
13	Suspended Solids	B	-	-	-
14	Dissolved Solids	B	-	-	-
15	Ammonia Nitrogen	B	B	B	B
16	Nitrate Nitrogen	B	B	B	B
17	Chloride Ion	B	-	-	B
18	Coliform Group	B	-	-	B
19	Plankton	B	-	-	-
20	Hardness	C	-	-	C
21	Iron	C	-	-	C
22	Manganese	C	-	-	C
23	Copper	C	-	-	C
24	Zinc	C	-	-	C
25	Lead	C	-	-	C
26	Cyanide	C	-	-	C
27	Cadmium	C	-	-	C
28	Chromium	C	-	-	C
29	Selenium	C	-	-	C
30	Arsenic	C	-	-	C
31	Fluoride	C	-	-	C
32	Sulfate Ion	C	-	-	C
33	Calcium	C	-	-	C
34	Magnesium	C	-	-	C
35	Total Solids	C	-	-	C
36	Phenol	C	-	-	C
37	Surface-active Agents (Anionic)	C	-	-	C

Note:
- A: To be tested daily
- B: To be tested monthly
- C: To be tested yearly
- -: Optional, whenever required

Chapter 3.

Proposed Project

Chapter 3. Proposed Project

3.1 Expansion/Augmentation Project

3.1.1 Selection of Plan

To identify the appropriate water supply system for the target year 2015, possible alternatives were developed on a per block basis; that is, in relation to the proposed water treatment lineages and distribution system in the Master Plan. These alternatives are summarized as follows:

Table 2.3.1 Proposed Alternative Plan for Augmentation Project

	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Block 1	Common	Common	Common	Common
Block 2 Block 3	Case 1 (pump and gravity)	Case 1 (pump and gravity)	Case 2 (gravity)	Case 2 (gravity)
Block 4	Common	Common	Common	Common
Block 5	Same as Block 2&3	Same as Block 2&3	Same as Block 2&3	Same as Block 2&3
Block 6	Common	Common	Common	Common
Block 7	W/ CWSP & MWSP III	W/O CWSP, W/ MWSP III	W/ CWSP & MWSP III	W/O CWSP, W/ MWSP III

Alternative 1 involves such projects as the CWSP and the MWSP III to augment production capacity, as well as an extension of the existing distribution system. Alternative 2 comprises the same system as Alternative 1, except for CWSP. Alternative 3 will employ the gravity system for Blocks 2, 3 and 5; while production is planned to be augmented by MWSP III and CWSP, or the same as Alternative 1. Finally, Alternative 4 will utilize the gravity system in the extension of the distribution system; while production capacity will be augmented only by MWSP III.

Considering all the qualitative and quantitative aspects, the implementation of MWSP III should be undertaken to augment the required water demand of 1,918 mld by the target year 2015. This realization of a dual water supply system, together with the Angat-Novaliches Water Supply System run by gravity system, will greatly contribute to the reliability of needed water service in a megalopolis like Metro Manila.

The implementation of CWSP, however, has major disadvantages such as:

- Utilizing the Laguna Lake water as raw water source, whose quality has seriously deteriorated due to the delay of necessary development of the sewage treatment system;

- Getting the risk of additional investment because of said degradation of the water source should the plans for the water treatment plant be abandoned;

- Going through with the construction of the CWSP treatment plant would still necessitate the construction of the MWSP III treatment plant to be able to keep pace with the water demand. Up to the target year of 2015, MWSP III can cover the demand without CWSP. Thus, the CWSP can still be constructed after 2015, which is not really "late" considering that the water from Laguna Lake would have been improved by possible sewage discharge control by then.

In the development of the distribution system, the gravity system is obviously more preferable to the pumping system in terms of operation and maintenance. The operational cost for the gravity system is much lower, however, its construction cost is much higher due to the construction of primary mains.

Technically, therefore, without looking at other concerns, Alternative 4 is the most superior alternative. Alternative 2, on the other hand, is the best when consideration the estimated economic burden. Thus, MWSP III is highly recommended for implementation as the "Water Supply Augmentation Project for Metro Manila", incorporated with the distribution system improvement/expansion and service network expansion projects.

3.2 Rehabilitation Project

3.2.1 Water Treatment Facilities

It is recommended that full rehabilitation works for the mechanical and electrical facilities/equipment of the water treatment plant should be done periodically to ensure these facilities' full performance as well as to generate the economic benefits.

The Balara Water Treatment, originally constructed in 1935 and upgraded last in 1981, has since been rehabilitated under a grant aid scheme of the Government of Japan. Rehabilitation works were undertaken to restore, once again, the plant's rated production capacity and improve the quality of the treated water.

It is now necessary that the rehabilitation of La Mesa No. 1, which commenced in 1985, be totally rehabilitated during 2010 to 2015. La Mesa No. 2, rehabilitation of which commenced in mid-1995, will again need rehabilitation if preventive maintenance works are not properly carried out, as detailed in the previous section.

3.3 NRW Reduction Project

Water demand projection is sensitive to the NRW reduction, where NRW should be reduced to the allowable level of 30 % from the current level of 57 %. The Master Plan addresses the replacement of the existing pipe network as a critical activity that should be given high priority should a true reduction of NRW be realized.

To ensure the Augmentation project, the following pipe replacement as "a long term target" should be implemented urgently and effectively through the target year 2015.

1) Old Pipe Renovation Project

- All ACP pipes : 908 km
- 50 % of all pipes of unverified materials : 659 km
- 50 % of pipes in Manila, Quezon City & Makati (excluding ACP and pipes of unverified materials) : 487 km
- reducing leakage

Together with the above long-term plan as stated above, is the implementation of "short but quick" term measures. By simply maximizing/utilizing the lawful power in newly-enacted National Water Crisis Act of 1995. NRW could be effectively curbed by 12 % without budgetary allocation. All that needs to be done is controlling the implementation of the law with forceful management, or political will.

2) Controlling Unauthorized Water Use Project

- controlling unauthorized use of water by illegal connection and illegal drawing (8 %, NRW),
- controlling malfunctioning of tampered meters (4 %, NRW),

3.4 Priority of the Proposed Projects

All the proposed projects are discussed based on the scheduled completion of ongoing projects and on the minimum requirements to meet projected water demand by 2015.

The first priority should be given, therefore, to the completion of the ongoing projects as the AWSOP, UATP, and RPWSIP.

Considering a low cost but high benefit project, second priority is placed on the implementation of NRW reduction through the control of pilferage or unauthorized water use.

Another NRW reduction project, the replacement of old and defective pipelines is give third priority.

Forth priority is placed on the MWSP III (including the relevant expansion/augmentation of the distribution system), the only project that can meet the increased water demand projected by 2015, which even reduction in NRW can not accomplish.

The rehabilitation of La Mesa Plant No. 2 should be ranked as the fourth priority to ensure existing production capacity of 1,500 mld, or almost half of the existing facilities.

The following shows the summary of the priority projects.

Table 2.3.1 Priority of the Proposed Projects

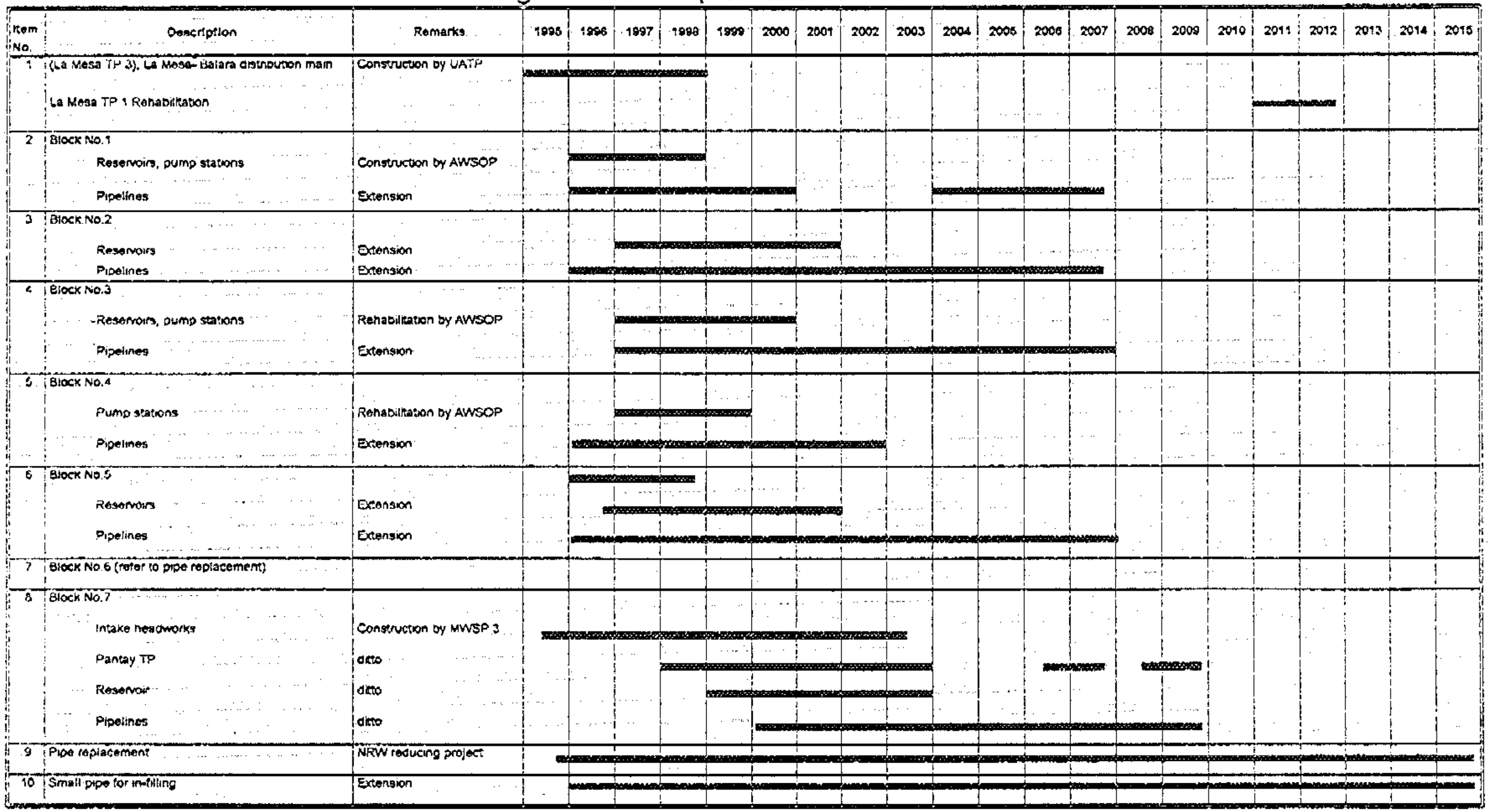
Priority	Projects
1	Accomplishment of the ongoing projects (AWSOP, UATP, and RPWSIP)
2	Controlling unauthorized water use project
3	Old pipe renovation project
4	MWSP III, including Distribution system improvement/expansion project Service system expansion project
5	Rehabilitation project for La Mesa No. 1 Plant

3.5 Implementation Plan

The five selected projects are recommended to be implemented on a per block basis for the entire system will be more effective. This manner of implementation of projects will also mean absence of unnecessary delays due to lack or mis-coordination.

Figure 2.3.1 shows a total implementation schedule in each block. Details are referred to "Implementation Schedule", Supporting Report.

Figure 2.3.1 Implementation Schedule



3.6 Project Cost

3.6.1 General

The cost for each alternative mentioned above was roughly estimated in the conduct of a financial evaluation, as discussed in the following section. The price level was set in August, 1995, at the time of the site investigation for the project cost estimation. The project cost includes the following items:

- Direct construction cost

  The direct construction cost was estimated as manner as shown in section 3.6.2.

- Land acquisition cost

  The land acquisition cost was estimated by " REM Weekly".

- Engineering services expenses

  The engineering services expenses were estimated in proportion to the direct construction cost to cover for the detailed design, the tender design and construction supervision on respective phases. A 7 % of the direct construction cost was applied.

- Physical contingency

  The physical contingency was provided to cover minor differences in actual and estimated quantities, omission of minor items of work incidental to pay items, difficulties unforeseenable at the site, possible changes in plans, and other uncertainties. A 10 % of the total cost including direct construction cost, land acquisition cost, and engineering services charge was applied.

3.6.2 Cost Estimation

The direct construction cost were estimated based on data provided by MWSS. The following shows a detailed cost estimate approach.

(1) Aqueducts

The cost for aqueduct from La Mesa Plant to Balara Plant was estimated based on the MWSS 1992 cost estimation devaluated by 10 % each year up to the year 1995.

(2) Water Treatment Plant

The cost for Water Treatment Plant was estimated based on the La Mesa No. 2. (900 mld) bid proposal in 1992. 10 % of devaluation was applied from the year 1993 to 1995. To convert the La Mesa No. 2 cost to the other plant with a deferent capacity, it is assumed that the cost is given in proportion to the capacity rate in 0.7 power.

(3) Distribution Tank

From the construction cost for the Sacred Heart, Binuksuk, and La Mesa reservoirs in the 1992 AWSOP, devaluated by 10 % from 1993 to 1995, the unit construction cost was assumed as shown below:

Capacity of reservoir	Unit cost per m^3 in pesos
0 to 20 ml	2,143
20 to 100	1,770
more than 100	1,600

(4) Pump Station

The cost for constructing the pump station was assumed in the same manner as the reservoir cost estimation as shown below:

Building type	Unit building construction cost for pump station in pesos
High class specification	38,700/m^2
Ordinal class specification	8,200/m^2

The rehabilitation cost for the existing pump station was estimated based on the 1992 AWSOP cost estimation devaluated by 10 % from 1993 to 1995.

The cost for facilities including pumps, electrical control panels, etc. of the proposed pump station was estimated based on the market price collected by the Study Team.

(5) Distribution Pipe

a) Extension

The cost for pipe extension works was estimated based on the MWSS standard cost provided by the Bidding Documentation and Evaluation Division and the local market price collected by the Study Team.

The cost for small pipes for in-filling was estimated by weighted average cost of the pipes from 50 to 250 mm. Same unit cost as pipe extension works for each pipe size was applied.

b) Replacement

The cost for pipe replacement was estimated as same manner as the pipes for in-filling by weighted average cost of each pipe size.

(6) MWSP III

The whole cost for the MWSP III related facilities, including land acquisition, Laiban Dam, raw water outlet works, headrace and hydropower works, treated waterways, power lines, Pantay Water Treatment Plant, and Mayamot Pressure Reduction Facilities was based on the 1994 data updated by the MWSP III project office. 10 % of devaluation was applied to the 1995 cost estimation. The scale down of the Pantay Water Treatment Plant from 2,400 to 1,950 mld was done by the rate of (1,950/2,400^0.7) as same manner as the cost estimation of water treatment plant.

(7) Land Acquisition

Necessary land acquisition cost was estimated by the Study Team based on " REM Weekly". Due to the distribution pipe work should be done under public roads, this was not applied to the land acquisition for the piping works.

3.6.3 Project Cost

The project cost is summarized in Table 2.3.2 and Table 2.3.3. Detailed cost estimate are shown by block in the "Cost Estimate", Supporting Report.

Among the alternatives, Alternative 2 is the lowest at 56,272 million pesos, next is Alternative 4 at 57,462 million pesos. Alternatives 1 and 3, which include CWSP, cost higher than Alternatives 2 and 4.

Table 2.3.2 Cost for Alt. 1 and Alt. 2

Alt. 1

Item No.	Description	Case	Foreign Portion (x 1,000 pesos)	Local Portion (x 1,000 pesos)	Cost (x 1,000 pesos)
1	Rehab. of La Mesa TP1		528,000	792,000	1,320,000
2	Distribution Pipes (La Mesa to Balara)		99,440	894,960	994,400
3	Block No. 1		1,116,615	808,584	1,925,199
4	Block No. 2 and No. 5	Case 1	342,385	582,980	925,365
5	Block No. 3	Common	416,209	178,375	594,584
6	ditto	Case 1	95,002	63,335	158,337
7	Block No. 4		145,147	74,773	219,920
8	Block No. 7	Common	5,068,085	14,424,549	19,492,633
9	ditto case 1	Phase 1	2,286,486	1,724,893	4,011,380
10	ditto case 1	Phase 2	4,098,861	2,732,574	6,831,435
11	Common to all Blocks		1,427,603	12,848,424	14,276,027
	Sub-total (including land acquisition cost) (a) = (b) + (c)		15,623,833	35,125,447	50,749,280
12	Sum of Total Land Acquisition Cost (b)		0	3,040,820	3,040,820
13	Sum of Total Construction Cost except Land Acquisition (c)		14,687,677	33,020,783	47,708,460
14	Engineering Cost (7%) (d) = (c) x 0.07		1,028,137	2,311,455	3,339,592
	Total (e)=(a)+(d)		15,715,814	38,373,058	54,088,872
15	Physical Contingency (10%) (f) = (e) x 0.1		1,571,581	3,837,306	5,408,887
	Grand Total		17,287,396	42,210,364	**59,497,759**

Alt. 2

Item No.	Description	Case	Foreign Portion (x 1,000 pesos)	Local Portion (x 1,000 pesos)	Cost (x 1,000 pesos)
1	Rehab. of La Mesa TP1		528,000	792,000	1,320,000
2	Distribution Pipes (La Mesa to Balara)		99,440	894,960	994,400
3	Block No. 1		1,116,615	808,584	1,925,199
4	Block No. 2 and No. 5	Case 1	342,385	582,980	925,365
5	Block No. 3	Common	416,209	178,375	594,584
6	ditto	Case 1	95,002	63,335	158,337
7	Block No. 4		145,147	74,773	219,920
8	Block No. 7	Common	5,068,085	14,424,549	19,492,633
9	ditto	Case 2	4,684,800	3,392,441	8,077,242
10	Common to all Blocks		1,427,603	12,848,424	14,276,027
	Sub-total (including land acquisition cost) (a) = (b) + (c)		13,923,286	34,060,421	47,983,707
11	Sum of Total Land Acquisition Cost (b)		0	2,666,780	2,666,780
12	Sum of Total Construction Cost except Land Acquisition (c)		13,149,475	32,167,452	45,316,927
13	Engineering Charge (7%) (d) = (c) x 0.07		920,463	2,251,722	3,172,185
	Total (e)= (a) + (d)		14,069,938	37,085,954	51,155,891
14	Physical Contingency (10%) (f) = (e) x 0.1		1,406,994	3,708,595	5,115,589
	Grand Total		15,476,932	40,794,549	**56,271,481**

Table 2.3.3 Cost for Alt. 3 and Alt. 4

Alt. 3

Item No.	Description	Case	Foreign Portion (x 1,000 pesos)	Local Portion (x 1,000 pesos)	Cost (x 1,000 pesos)
1	Rehab. of La Mesa TP1		528,000	792,000	1,320,000
2	Distribution Pipes (La Mesa to Balara)		99,440	894,960	994,400
3	Block No. 1		1,116,615	808,584	1,925,199
4	Block No. 2 and No. 5	Case 2	645,115	1,198,071	1,843,186
5	Block No. 3	Common	416,209	178,375	594,584
6	ditto	Case 2	151,103	100,736	251,839
7	Block No. 4		145,147	74,773	219,920
8	Block No. 7	Common	5,068,085	14,424,549	19,492,633
9	ditto case 1	Phase 1	2,286,486	1,724,893	4,011,380
10	ditto case 1	Phase 2	4,098,861	2,732,574	6,831,435
11	Common to all Blocks		1,427,603	12,848,424	14,276,027
	Sub-total (including land acquisition cost) (a) = (b) + (c)		15,982,665	35,777,938	**51,760,603**
12	Sum of Total Land Acquisition Cost (b)		0	3,040,820	3,040,820
13	Sum of Total Construction Cost except Land Acquisition (c)		15,043,719	33,676,064	48,719,783
14	Engineering Cost (7%) (d) = (c) x 0.07		1,053,060	2,357,324	3,410,385
	Total (e) = (a) + (d)		16,096,779	39,074,209	55,170,988
15	Physical Contingency (10%) (f) = (e) x 0.1		1,609,678	3,907,421	5,517,099
	Grand Total		17,706,457	42,981,630	**60,688,087**

Alt. 4

Item No.	Description	Case	Foreign Portion (x 1,000 pesos)	Local Portion (x 1,000 pesos)	Cost (x 1,000 pesos)
1	Rehab. of La Mesa TP1		528,000	792,000	1,320,000
2	Distribution Pipes (La Mesa to Balara)		99,440	894,960	994,400
3	Block No. 1		1,116,615	808,584	1,925,199
4	Block No. 2 and No. 5	Case 2	645,115	1,198,071	1,843,186
5	Block No. 3	Common	416,209	178,376	594,584
6	ditto	Case 2	151,103	100,736	251,839
7	Block No. 4		145,147	74,773	219,920
8	Block No. 7	Common	5,068,085	14,424,549	19,492,633
9	ditto	Case 2	4,684,800	3,392,441	8,077,242
10	Common to all Blocks		1,427,603	12,848,424	14,276,027
	Sub-total (including land acquisition cost) (a) = (b) + (c)		14,282,117	34,712,912	**48,995,030**
11	Sum of Total Land Acquisition Cost (b)		0	2,666,780	2,666,780
12	Sum of Total Construction Cost except Land Acquisition (c)		13,504,747	32,823,502	46,328,250
13	Engineering Cost (7%) (d) = (c) x 0.07		945,332	2,297,645	3,242,977
	Total (e) = (a) + (d)		14,450,080	37,787,928	52,238,007
14	Physical Contingency (10%) (f) = (e) x 0.1		1,445,008	3,778,793	5,223,801
	Grand Total		15,895,088	41,566,720	**57,461,808**

Chapter 4.

Evaluation

Chapter 4. Evaluation

4.1 Technical Evaluation

4.1.1 Balance in Demand and Supply

Table 2.4.1 and Figure 2.4.1 presents the balance between the projected water demand and supply based on the following conditions:

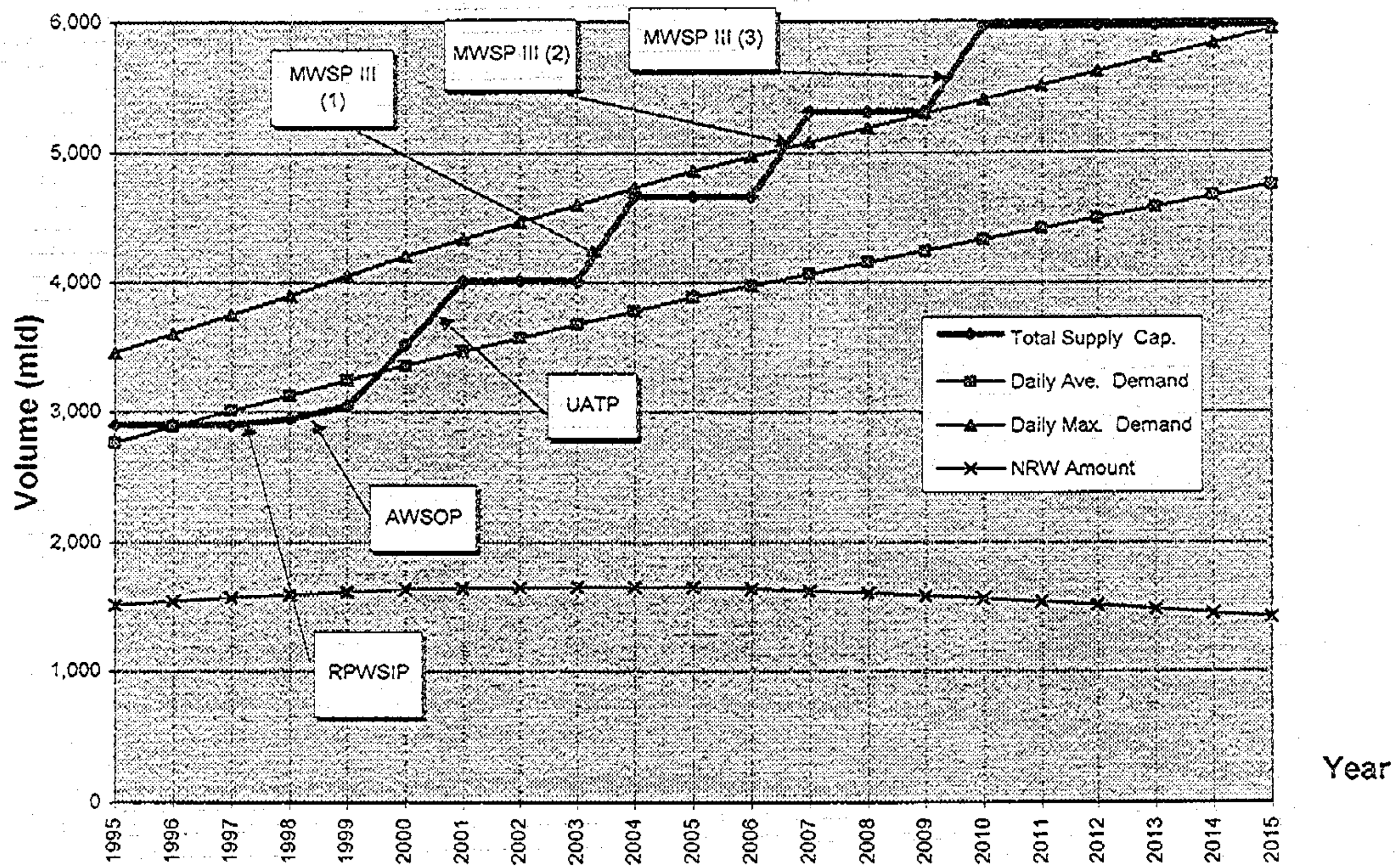
Table 2.4.1 Water Demand and Supply (in mld)

Year	Total Supply Cap.	Daily Ave. Demand	Daily Max. Demand	NRW Amount	NRW (%)	Current Prod. Cap.	Proposed Projects to be Implemented			
							RPWSIP	AWSOP	UATP	MWSP III
							48	170	900	1,950
1995	2,896	2,764	3,455	1,518	54.9	2,896				
1996	2,896	2,883	3,604	1,547	48.7					
1997	2,896	3,002	3,753	1,574	48.7		48			
1998	2,944	3,121	3,902	1,598	48.7			100		
1999	3,044	3,240	4,050	1,618	48.7			70	400	
2000	3,514	3,359	4,199	1,636	48.7				500	
2001	4,014	3,465	4,332	1,645	42.5					
2002	4,014	3,571	4,464	1,651	42.5					
2003	4,014	3,677	4,596	1,654	42.5					650
2004	4,664	3,783	4,729	1,655	42.5					
2005	4,664	3,869	4,861	1,653	42.5					
2006	4,664	3,976	4,970	1,640	36.2					650
2007	5,314	4,063	5,078	1,624	36.2					
2008	5,314	4,150	5,187	1,607	36.2					
2009	5,314	4,237	5,296	1,587	36.2					650
2010	5,964	4,324	5,405	1,565	36.2					
2011	5,964	4,408	5,510	1,541	30.0					
2012	5,964	4,492	5,616	1,515	30.0					
2013	5,964	4,577	5,721	1,487	30.0					
2014	5,964	4,661	5,826	1,456	30.0					
2015	5,964	4,745	5,932	1,424	30.0					

(Note) Total supply capacity shows the total system capacity including raw water sources, water treatment facilities, and distribution facilities, excluding for the groundwater capacity.

- The current production capacity is recognized to be 2,896 mld based on the 1994 data;
- RPWSIP, with a capacity of 48 mld will commence in 1997;
- AWSOP will provide a capacity of 100 mld in 1998 and a capacity of 70 mld in 1999;
- UATP will provide a capacity of 400 mld in 1999 and a capacity of 500 mld in 2000, and;

Figure 2.4.1 Projected Water Demand and Supply



- The first phase of MWSP III will commence in 2003, the second phase in 2006, and the third phase in 2009, each with a capacity of 650 mld, or a total of 1,950 mld.
- Daily Max. and Ave. water demand are computed on a linear method based on the selected year's water demand projection.
- The capacity of MWSS and private owned groundwater supply is excluded for the total supply capacity.

Each phase in the Staged Development Plan is characterized as follows:

(1) Phase I (1996-2000; full accomplishment of the ongoing projects and preparation for new water supply system)

Depressed water supply conditions will last during the first phase. The water supply capacity will be less than the daily average demand even the ongoing projects be accomplished. The private wells will serve as a dependable water source until turning to the second phase.

(2) Phase II (2001-2005; accomplishment of new water supply system)

All the ongoing projects and the first phase of MWSP III will be accomplished. The water supply capacity will reach just over the average demands but less the maximum demand. In conjunction with that, depressed water supply conditions will be gradually improved if the private well be utilized effectively.

(3) Phase III (2006-2010; stable implementation of augmentation/expansion projects)

After the second phase of the MWSP III project, the supply capacity will exceed the daily maximum demand. This remarkable improvement in the service area can urge private well users to minimize groundwater extraction and convert to the MWSS CDS System.

(4) Phase IV (2011-2015; achievement of the master plan goals)

The surplus during the third phase will be further accelerated by the completion of the MWSP III project during the forth phase. The development of a new water source becomes necessary at this point as actual population will continue to increase as with the living standards. Reviewing the groundwater sources in Rizal, where a population boom is projected, will become urgent.

4.1.2 Environmental Protection Consideration

A detailed analysis of the environmental impact associated with the proposed project implementation has been undertaken to the following construction plans as shown in "Environmental Protection Consideration", Supporting Report.

1.	Source Facilities	• Laiban Dam
2.	Conveyance Facilities	• Mayamot
3.	Treatment Plants	• Pantay
4.	Reservoirs and Pump Stations	• La Mesa No. 2 Reservoir, Bagbag Reservoir, Cogeo Reservoir, Antipolo Reservoir

The environmental impact assessment concludes that the construction and eventual operation of the project will cause no significant or lasting harm on the environment. The project could, therefore, be safely be undertaken and practical countermeasures should be taken, when necessary.

4.2 Financial Evaluation

4.2.1 Approach

Financial evaluation is conducted using the financial internal rate of return (FIRR). FIRR is defined as the discount rate that makes the current value of future financial benefits equal to the current value of future financial costs. It is a rate of return at which investment costs will be recovered with the future benefits that will be generated by the investment, and therefore is compared to the financing costs (i.e., interest expense) for such investment in order to assess the financial viability of projects.

Financial benefits of projects will be the incremental revenue amount which will be made possible in the future by those projects. This is calculated as the difference in future revenue between when the projects will be undertaken ("with projects") and when the projects will not be undertaken ("without projects"). Financial benefits will usually come from the increase in service capacity which will be made possible by projects.

Financial costs of projects will be capital costs plus operating expenses that will be necessary to operate new facilities that typically consist of direct operating expenses such as electricity, personnel expenses and repair and maintenance expenses.

FIRR is usually calculated for a period of 20 years after the inception of projects using the cash flow based on constant price (i.e., inflation not considered). In the case of the master plan, it is calculated for the study period of 1995 to 2015.

4.2.2 Financial Benefits

The financial benefits of the proposed projects will be materialized as an increase in revenue water resulting from increased supply capacity to end users. The increase in supply capacity will be made possible by the two components of the proposed projects, namely:

- increased production capacity due to the construction of the Laiban Dam and related facilities
- increased service coverage and improved revenue water rate due to the renovation and replacement of the existing pipe lines and the laying of new pipe lines.

The first component will increase the production capacity at the water treatment plant level, the effect of which will be further enhanced by the improvement in the service coverage and the revenue water rate that will be made possible by the second component. These two components will complement each other, and it is not appropriate to evaluate them separately. As such, they should be financially evaluated together.

Normally, the revenue water volume is the lesser of supply and demand. The demand has been established by the Study Team and included in the previous section of this report. This is fundamentally based on the projections of population and per capita consumption, and the designed service coverage. On the other hand, the supply capacity to end users is calculated as (a) production capacity x (b) operation level x (c) revenue water rate. The production capacity of water treatment facilities for the master plan period is determined by the engineering design of water treatment plants and the timing of their construction. The operation level and the revenue water rate will be determined by the timing of the replacement of the existing pipes and the laying of new ones and engineering design. It is assumed in the financial evaluation that the operation level and the revenue water level resulting from the master plan projects will equalize the water treatment capacity at the facilities to the demand based on the design service coverage since it is almost impossible to relate the pipe replacement to the improvement in service coverage and revenue water rate in a precise sense.

The benefits (in million litters per day) of the proposed projects are summarized as follows:

Table 2.5.1 Benefits in Revenue Water Volume

Year	With	Without	Benefits	Year	With	Without	Benefits
1996	1,342.0	1,306.1	35.9	2006	2,340.5	1,709.5	631.1
1997	1,378.2	1,306.1	72.1	2007	2,445.1	1,709.5	735.6
1998	1,433.0	1,323.4	109.6	2008	2,549.6	1,709.5	840.1
1999	1,509.6	1,359.5	150.1	2009	2,654.1	1,709.5	944.7
2000	1,723.4	1,529.1	194.3	2010	2,758.6	1,709.5	1,049.2
2001	1,825.9	1,709.5	116.4	2011	2,871.3	1,709.5	1,161.8
2002	1,928.4	1,709.5	219.0	2012	2,983.9	1,709.5	1,274.4
2003	2,031.0	1,709.5	321.5	2013	3,096.5	1,709.5	1,387.0
2004	2,133.5	1,709.5	424.0	2014	3,209.1	1,709.5	1,499.6
2005	2,236.0	1,709.5	526.5	2015	3,321.7	1,709.5	1,612.2

Notes: "With" is the lesser of supply capacity when projects are undertaken and projected demand.
"Without" is the lesser of supply capacity when projects are not undertaken and projected demand.
Benefits is the difference between "With" and "Without".

In addition to the incremental increase in revenue water, there will be a byproduct of electricity that will be generated at the new Laiban Dam and that will be sold to Meralco. It is assumed that such a power plant will have the capacity of 30 million watts with an average 70 percent operational level. It is further assumed that electricity will be sold at P2.00 per kilowatt per hour.

The peso value of the financial benefits varies depending on the level of the tariff. The following table shows it in four cases:

Table 2.5.2 Financial Benefits

Case	Tariff increase	% of household income	Incremental water revenue (million pesos)	Revenue from sale of power (million pesos)	Total financial benefits (million pesos)
1	Current level	0.74	42,041	4,415	46,456
2	35%	1.00	53,655	4,415	58,070
3	103%	1.50	76,220	4,415	80,635
4	170%	2.00	98,453	4,415	102,868

Case 1: The present tariff will not be revised at the start of 1996, but will be increased every year for inflation and a half of the growth percentage of GRDP per capita for NCR.

Case 2: The present tariff will be raised by 35 percent at the start of 1996 and then adjusted in the same manner as Case 1. MWSS customers will be spending 1 percent of their income for water and sewer/sanitation services.

Case 3: The present tariff will be raised by 107 percent at the start of 1996 and then adjusted in the same manner as Case 1. MWSS customers will be spending 1.5 percent of their income for water and sewer/sanitation services.

Case 4: The present tariff will be revised by 170 percent at the start of 1996 and then adjusted in the same manner as Case 1. MWSS customers will be spending 2 percent of their income for water and sewer/sanitation services.

4.2.3 Costs

Financial costs of the master plan projects are determined or estimated as follows:

- Capital costs: per the engineering study as shown in this report
- Maintenance of facilities: annually 1% of the cumulative costs of the facilities excluding land
- Direct personnel: additional 110 employees needed
- Electricity: P0.20 per cubic meter of water produced
- Chemicals: P0.10 per cubic meter of water produced
- Collection and other: P0.10 per cubic meter of water billed

The financial costs of the master plan projects are summarized as follows (in million pesos):

Construction and land	57,461
Maintenance of facilities	6,614
Benefits from preventive maintenance	-627
Variable operating expenses	2,553
Total	66,001

4.2.4 Cash Flows and FIRR

Bases upon the net cash flows of the incremental revenue and costs, the financial internal rate of return (FIRR) will be as follows:

Table 2.5.3 FIRR of Proposed Projects

Case	Tariff increase	Financial Benefits (million pesos)	Financial Costs (million pesos)	FIRR
1	Current level	46,456	66,001	-5.4%
2	35%	58,070	66,001	-1.9%
3	103%	80,635	66,001	3.0%
4	170%	102,868	66,001	6.7%

The Study Team is of the opinion that 1 percent should be considered as the upper limit for average households to pay for water and sewer services out of their income. This will allow for a 35 percent tariff increase, resulting in FIRR of negative 1.9 percent for the proposed projects. Since FIRR should be compared to financing costs for undertaking projects, such a rate is far from satisfactory. In order for the proposed projects to be financially viable, the tariff would have to be raised by 170 percent or more at the start of the year 1996 as indicated in the above table, meaning average households would have to spend at least 2 percent of their income on water and sewer services.

Chapter 5.

Conclusion and Recommendation

Chapter 5. Conclusion and Recommendation

5.1 Water Sources

The Kaliwa River, as a water source, will be adequate to meet the projected water demand by the year 2015, covering 90 % of 15.8 million population in the service area of MWSS. This will be the second water source in addition to the existing Angat River. Both sources will not only augment supply but also mutually reinforce or complement each other should unexpected emergencies arise.

Laguna de Bay should be monitored in reviewing the water quality. The treatment plant will serve as a useful 'practical and research on treatment of highly polluted water.

By the year 2015, it is projected that additional water sources will be necessary if population growth will be beyond the projection within the MWSS service area. The first measure to mitigate this is to maximize the utilization of the Angat Reservoir by reallocating the water right among its users--the NPC, NIA, and MWSS. The AWSOP has been estimated to increase water capacity by only 170 mld, based on the actual withdraw record, despite the increase in capacity of 1,300 mld. Second measure is to divert the Kanan River Source to the Laiban Dam Reservoir. Third is the conservation and/or preservation of groundwater sources as a supplemental, economic, and sustainable water source for the MWSS CDS system, for use in the newly growth areas of the Rizal Province.

5.2 Water Treatment Facilities

By MWSP III, Pantay Water Treatment Plant should be constructed in three phases, each with 650 mld capacity and a total capacity of 1,950 mld, utilizing the granted water permit to use (23 cms = 1,987 mld) by NWRB on August 30, 1979 which will assure the water demand in the target year 2015.

To ensure the total water production, the existing water treatment plants -- Balara and La Mesa Plants, which are the major components of the "Angat Novaliches Water Supply System", should be properly maintained by a well planned and organized preventive maintenance system.

5.3 Distribution Facilities

The following should be considered to ensure stable distribution system in the detailed design stage of the expansion project for the distribution network.

- The pump supplied areas will be as small in size as practicable and will be totally isolated from the gravity served areas to minimize maintenance and power costs.
- The main pipe networks will be looped and reinforced to attain a stable water supply, uniform system pressures and flexibility during emergencies.
- The pipe network that will served new areas should be isolated from hose presently served to minimize leakage in the old pipe networks.
- Additional reservoirs will be constructed should have adequate storage capacities for regulation and for emergency purposes.
- New pipes will be installed to replace old pipes and to fill the network in order to achieve stable water supply and uniform system pressure.

5.4 NRW Reduction

To be able to reduce the NRW 30 % level by the target year 2015, the following measures should be undertaken systematically:

- Control of pilferage and unauthorized water use
- Improvement of metering efficiency
- Renovation of the old pipelines
- Improvement of quality control on construction activities of the distribution system
- Adoption of standardized pipe materials, workmanship, and technologies of the distribution facilities
- Creation of division level of a permanent unit for NRW reduction

5.5 Finance

There may be two alternatives to respond for the proposed projects to be financially viable. Since it will be unfair to charge customers more than they can afford, there will be a need to explore possible revenue sources. Possibilities may be subsidies from governments and subscription charges from new customers, both of which appear unpromising at this point.

The other way is to lower the financing costs so that the above FIRR can be justified. It may be grants from foreign governments and equity contribution from the GOP. It should be understood that the BOT scheme will not help since it will usually result in higher financing costs than straight debt financing.

Part III

Sewerage and Sanitation

Chapter 1.

Introduction

Part III Sewerage and Sanitation

Chapter 1 Introduction

As of 1994, less than 10 % of NCR is covered by some sewerage systems. In other areas, night soil and part of sullage (gray water) are disposed of at on-site sanitation facilities like septic tank. However, inefficient maintenance of septic tank causes the overflow of wastewater into the drainage system. Residents are exposed to the danger of hygienic problems aside from the pollution of public water body. The discharge of untreated industry wastewater and dumped garbage are the main other pollutants.

To mitigate such pollution conditions in Metro Manila, many studies including Sewerage/Sanitation Master Plan have been made and the review of them were also conducted by some relevant sector agencies. Consolidation and upgrading of existing plans in the sector are urgent requirements under current urbanization progress and continuous development in proportion to the economic growth.

This Master Plan covering entire MWSS jurisdiction was prepared referring to current data and information and considering the water sector Master Plan and organizational/managerial plans. Planning fundamentals and conditions/assumptions on the sewerage/sanitation systems were established through discussion with concerned parties.

This part comprises six (6) chapters as shown in Figure 3.1.1.

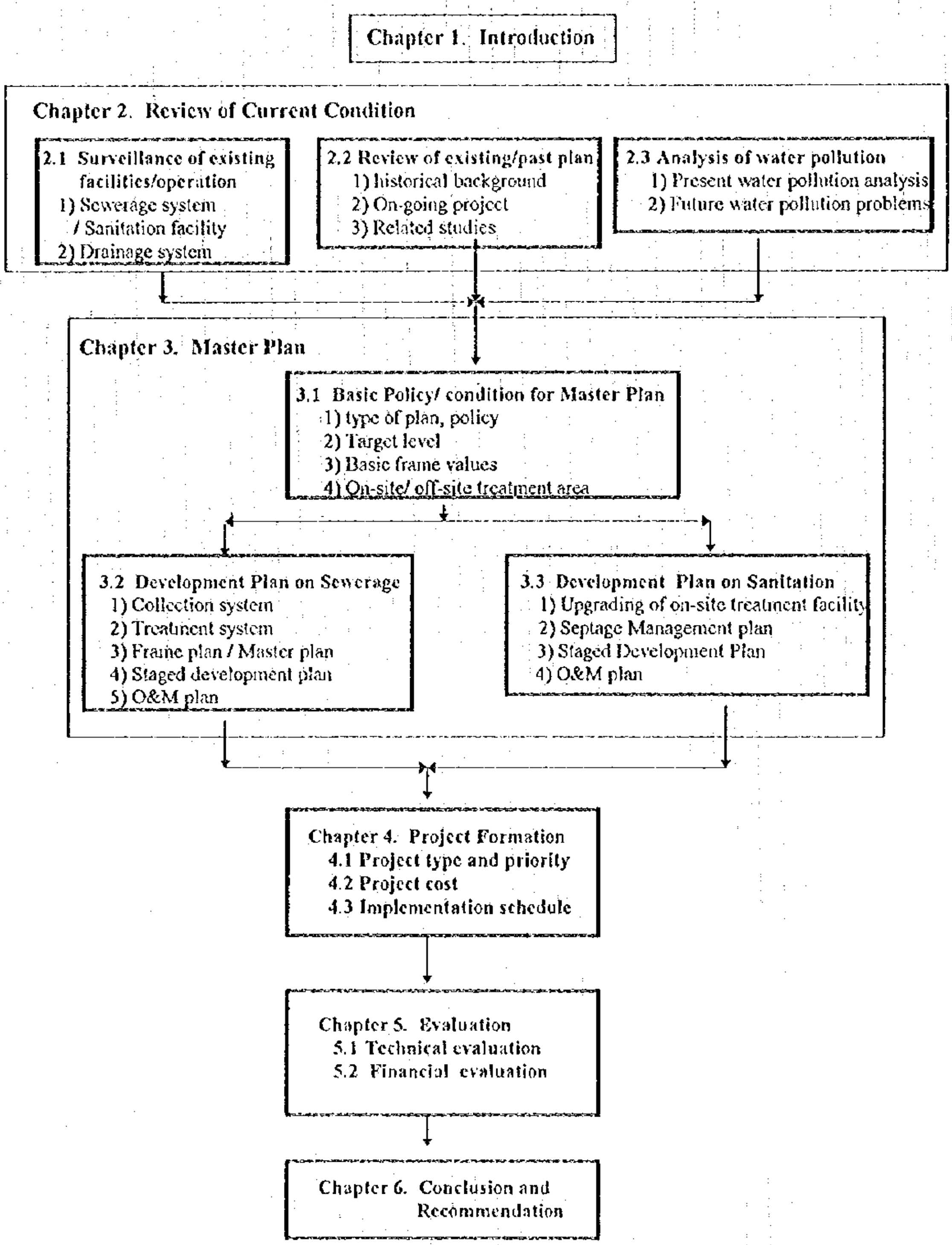


Figure 3.1.1 Study flow in Part III