3.5 Water Supply Condition

Production capacity of the system is considerably below water demand at present partly due to the delay of the implementation of the expansion project, the First Stage Project. Table 3.20 shows the past trend of production increase for ten years from 1973, and the table indicates the ratio between average day and maximum day productions has been decreasing to 1.05 from about 1.2 in 1977 suggesting lack of production capacity. Figs. 3.11 and 3.12 show the water pressure conditions of service area in 1982 and 1983 respectively according to the pressure records measured by PDAM. As the matter of course, water pressure shows high in the area near the treatment plants, but sudden drop of water pressure is observed which will indicate that such phenomenon is caused by not only the lack of production capacity but also inadequate sizes of distribution trunk mains and/or deteriorated old mains and insufficiency of the secondary and tertiary mains in the service area. Areas except locations near the treatment plant are presumed with problems on water supply. The area remote from the treatment plant is suffering from the shortage of supply and deterioration of water quality due to low water pressure and existence of suction pumps connected directly with the distribution pipelines. Fig. 3.10 in the previous subsection shows the deterioration of distributed water quality in low water pressure zones and areas along old distribution pipelines.

Considering the big deviation between present supply capacity and water demand, improvement within a short time of the existing system including both production capacity and distribution pipelines will be difficult. As described in the preceeding subsection, production capacity will be increased at 3,000 l/sec and corresponding distribution trunk mains are also planned to be installed. However further increment of production will be required in the near future to reach to the tolerable supply level. Great effort is also necessary to install the secondary and tertiary mains to distribute water newly produced together with installation of service connections.

From the above, the areas requiring urgent improvement are identified in the present service area mainly for the purpose of water supply to domestic users in deteriorated groundwater conditions and densely populated areas. These areas are as follows:

1) Whole the North District where lack of distribution pipelines is remarkable and deterioration of groundwater quality is observed.

2) Sawah Besar and Kemayoran in the Central District where old and complex secondary and tertiary mains are installed. Those pipelines are to be rehabilitated or replaced.

3) Taman Sari and Tambora in the West District where is presently a commercial center with high population density and also old and complex secondary and tertiary mains supply water in the area.

4) Northern part of Grogol Petamburan in the West District where high population growth is observed and deterioration of groundwater quality is expected.

5) Tebet and Setia Budi in the South District where a lack of distribution pipelines is remarkable and draw down of groundwater table is recently reported which causes difficulties of use of the shallow well during dry season.

6) Kebayoran Baru in the South District which is the residential area of higher income group with high consumption.

PDAM Jaya has categorized the consumers to 26 classifications in respect of water tariff as shown in Table 3.21. The table also shows number of service connections, average consumption per month and daily consumption per one connection in each categorized use. Categories of consumers are briefly explained as follows:

- Office : Government offices and diplomatic offices
- Boarding Houses : Government domitory, guest houses, lodges
- Religious Places : Mosque, church and other relogious institution
- Industrial Enterprise : Factories, industries
- Small Industries : Home industries, small size workshop with residence
- Hydrant, Water Vendor : Public hydrant where people buy or use piped water at low water rate, Water vendor who buy water and sell it to the people living
- Depok National : Housing area located in Depok out side of DKI Jakarta. PDAM Jaya supplies water from Ciburial, Bogor.
- Wind Mills : Groundwater lifted up by the wind mills is supplied to neigbouring people.
- Armed Forces (ABRI) : Military camps, headquqters, housing for family.

For the reference of demand projection, the consumers classified into two major categories, i.e. Domestic Use and Non-Domestic Use, and Non-Domestic Use consumer is further classified into smaller categories. Table 3.22 indicates the number of connection categorized based on the above classification in the year 1980 through year 1982 and in May 1983.

Table 3.20 Production Record

PLANT/SPRING/ WELL	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983 1/
YEARLY PRODUCTION (million m3)											
PEJOMPONGAN I	45.5	57.9	61.6	67.1	67.6	64.9	64.7	66.7	67.7	66.9	21.5
PEJOMPONGAN II	54.6	55.0	64.8	64.3	75.6	91.9	93.0	93.5	93.6	93.4	30.4
PULOGADUNG 3/	-	-	-	-	-	-	-	-	-	12.7	9.4
MINI-PLANT 3/	-	-	-	-	2.9 2/	3.1 2/	3.7 2/	4.4 2/	5.0	5.8	3.0
SUB-TOTAL	100.1	112.9	126.4	131.4	146.1	159.9	161.4	164.6	166.3	178.8	64.3
BOGOR SPRING	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
DEEP WELL	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
TOTAL	113.5	126.3	139.8	144.8	159.5	173.3	174.8	178.0	179.7	192.2	64.3
AVERAGE DAY PRODUCTION (1,000 m3/day) (A)											
PEJOMPONGAN I	124.4	158.5	168.7	183.3	185.1	177.7	177.1	182.3	1854	183.4	178.9
PEJOMPONGAN II	149.6	150.7	177.6	175.5	207.2	251.8	255.4	255.4	256.4	255.8	253.6
PULOGADUNG	-	-	-	-	-	-	-	-	-	69.2	78.1
MINI-PLANT	-	-	-	-	8.0 2/	8.6 2/	10.0 2/	12.0 2/	13.7	19.2	25.2
SUB-TOTAL (m3/day)	274.2	309.2	346.3	358.8	400.3	438.1	442.5	449.7	455.5	527.6	535.8
BOGOR SPRING 4/	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
DEEP WELL	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
TOTAL (m3/day)	310.9	345.9	383.0	385.5	437.0	474.8	479.2	486.4	492.2	564.3	572.5
(l/sec)	3,600	4,000	4,430	4,580	5,060	5,500	5,550	5,630	5,700	6,530	6,630
MAXIMUM PRODUCTION (1,000 m3/day) (B)											
PEJOMPONGAN I	184.3	187.5	212.1	106.5	211.9	207.3	209.1	208.1	211.9	202.0	193.6
PEJOMPONGAN II	194.4	-	197.1	202.2	259.2	268.0	259.2	259.2	259.2	259.2	259.2
PULOGADUNG	-	-	-	-	-	-	-	-	-	86.3	83.1
MINI-PLANT 6/	-	-	-	-	-	-	-	-	14.8	25.0	27.0
SUB-TOTAL (m3/day)	378.7	-	409.2	408.7	471.1	475.3	468.3	467.3	485.9	572.5	562.9
BOGOR SPRING	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
DEEP WELL	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
TOTAL (m3/day)	415.4	-	445.7	445.4	507.8	512.0	505.0	504.0	522.6	609.2	599.6
(l/sec)	4,810	-	5,160	5,160	5,890	5,930	5,840	5,830	6,050	7,050	6,940
(B/A) (%)	1.34	-	1.16	1.15	1.16	1.09	1.05	1.04	1.06	1.08	1.05

Note :

1/ up to April 1983

2/ production of mini-plant, Cilandak, is assumed to have been increasing from about 8,000 m3/day (100 l/sec) to 13,600 m3/day in the year 1981

3/ operation start of Pulogadung and mini-plants are as follows;

Pulogadung	July 1982	Cakung	July 1982
Cilandak	1977	Sunter	October 1982
Pesing	1980	Cengkareng	October 1982
Muara Karang	July 1982	Pejaten	December 1982

4/ capacity of Bogor Spring is estimated as 300 l/sec

5/ deep well production is estimated as 300 l/sec (250 m3/day. well x 43 wells)

6/ no data available on max. production of Mini-plants from 1977 to 1980

7/ Data Source: Monthly Report, Instalasi" 1973 through 1983 by PDAM.

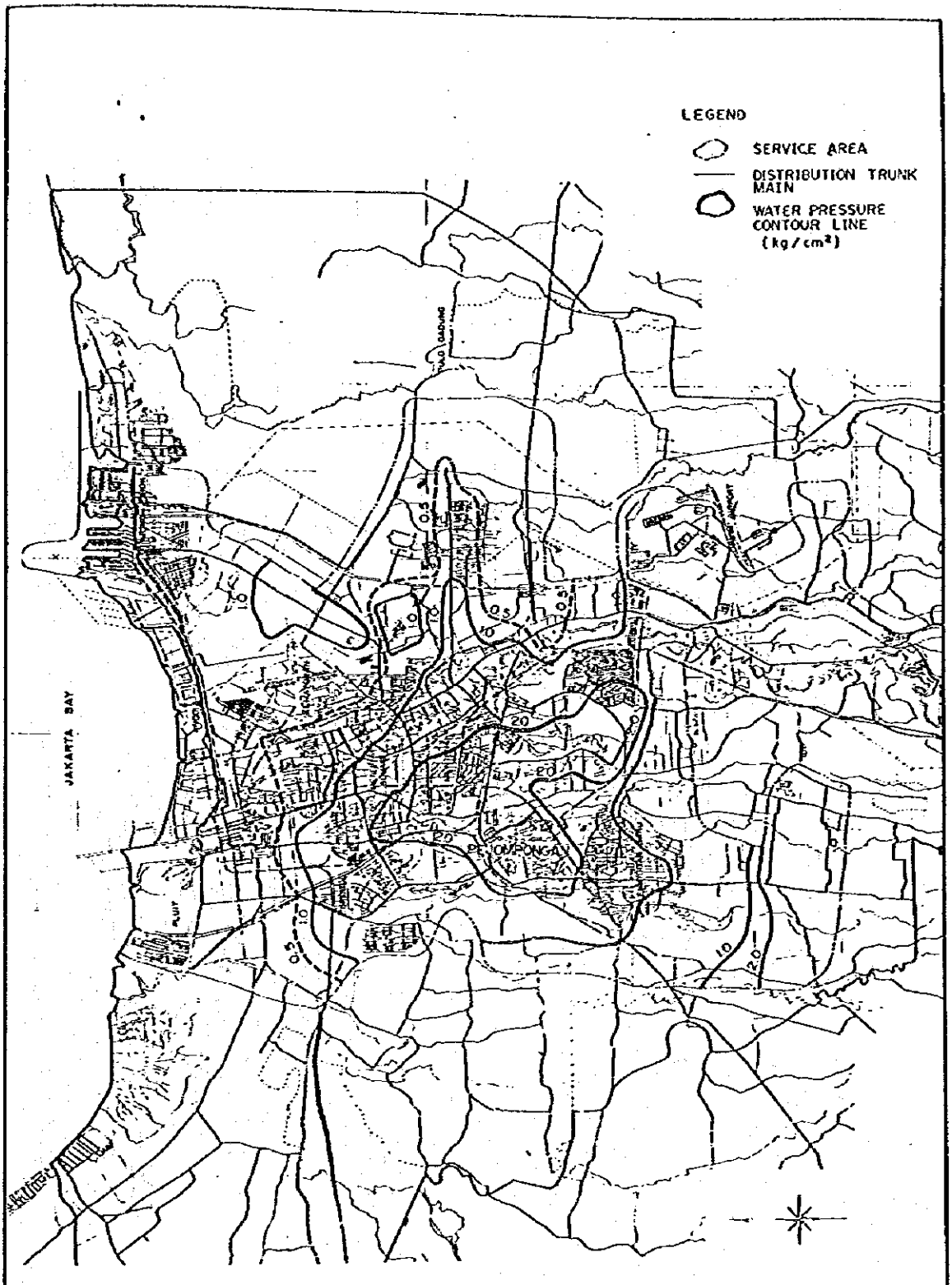

FIG 3.11 WATER SUPPLY CONDITION IN 1982 (Before Operation of Pulogadung Plant)

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

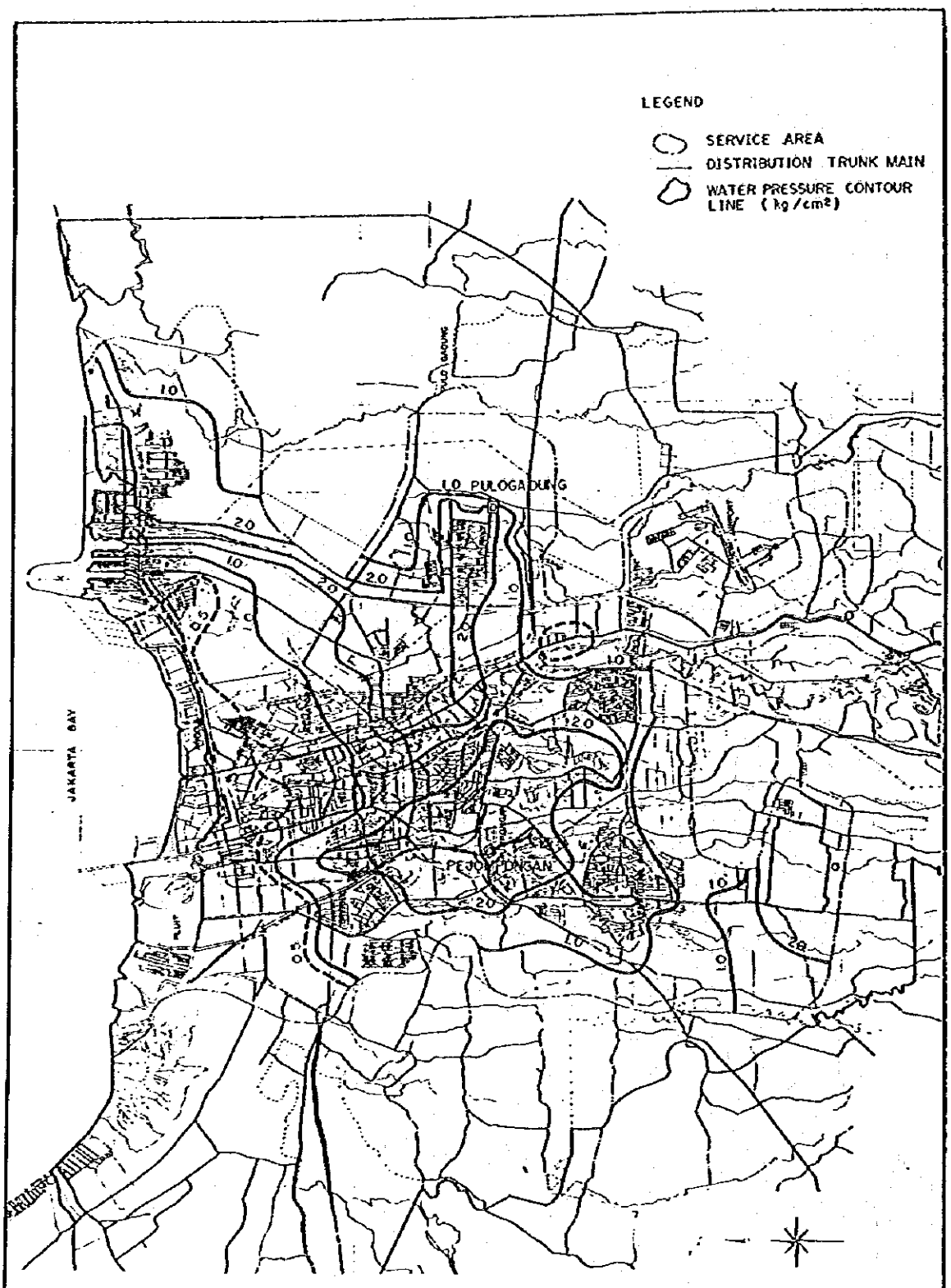

FIG 3.12 WATER SUPPLY CONDITION IN 1983 (After Operation of Pulogadung Plant)

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

Table 3.21 Number of Service Connections and Water Consumption in 1982 and 1983

	1982					1983				
	Number of Connections		Aver. Water Consumption		Aver. Daily Consumption per connection	Number of Conenection		Aver. Water Consumption		Aver. Dauly Consumption per connection
	1/	2/	'000 m3/month	%	m3/day/conn	1/	2/	'000 m3/month	%	m3/day/conn
1. Residential Use	105,119	(96,897)	3,178.4	(41.0)	1.0	111,451	(103,698)	3,324.7	(24.6)	1.0
2. Office	1,849	(1,613)	1,742.3	(22.5)	35.6	1,201	(1,105)	784.5	(10.0)	22.9
3. School & Institution	284	(275)	41.0	(0.5)	4.9	303	(296)	43.3	(0.5)	4.7
4. Boarding House	153	(147)	165.5	(2.1)	36.9	155	(151)	141.9	(1.8)	30.3
5. Religious Place	357	(348)	30.6	(0.3)	2.9	390	(384)	37.0	(0.4)	3.1
6. Government Hospital	57	(55)	128.2	(1.6)	76.1	59	(55)	118.0	(1.5)	69.2
7. Industrial Enterprise	337	(321)	165.7	(2.1)	17.0	261	(257)	87.6	(1.1)	10.9
8. Store House	292	(282)	22.3	(0.2)	2.6	293	(292)	20.1	(0.2)	2.2
9. Trade Enterprise	9,118	(8,724)	467.2	(6.0)	1.7	9,650	(9,366)	600.5	(7.7)	2.0
10. Market	4	(4)	0.5	(0.0)	2.6	5	(5)	0.5	(0.0)	3.6
11. Small Industry	6,086	(5,732)	159.5	(2.0)	0.9	6,519	(6,243)	166.7	(2.1)	0.8
12. Hotel	113	(105)	281.6	(3.6)	88.4	114	(114)	293.2	(3.7)	82.9
13. Steambath	204	(201)	9.2	(0.1)	1.5	218	(215)	8.1	(0.1)	1.2
14. Night Club	49	(35)	3.5	(0.0)	3.2	48	(37)	4.2	(0.0)	3.6
15. Barbar Shop	40	(40)	3.2	(0.0)	2.6	44	(43)	57.3	(0.7)	42.9
16. Tailor	156	(153)	10.3	(0.1)	2.2	158	(153)	5.7	(0.0)	1.2
17. G.P Doctor	557	(572)	68.1	(0.8)	3.9	577	(573)	26.6	(0.3)	1.4
18. Judge/Lawyer	71	(71)	6.6	(0.0)	3.0	71	(71)	13.4	(0.1)	6.1
19. Bank	140	(136)	80.1	(1.0)	19.4	147	(144)	90.4	(1.1)	20.2
20. Service Station	135	(132)	16.0	(0.2)	3.9	136	(136)	13.7	(0.1)	3.2
21. Private Hospital	93	(90)	15.5	(0.2)	5.6	81	(80)	47.0	(0.6)	18.9
22. Public Hydrant	1,197	(953)	335.1	(4.3)	11.5	1,417	(1,070)	310.7	(3.9)	9.3
23. Depok	1	(1)	181.2	(2.3)	5,987.6	1	(1)	174.5	(2.2)	5,631.3
24. Windmill/etc.	43	(20)	3.0	(0.0)	4.9	42	(19)	4.3	(0.0)	7.3
25. Port Tanjung Priok	6	(6)	279.3	(3.6)	1,398.3	9	(9)	492.4	(6.3)	1,764.9
26. Army	3	(3)	347.0	(4.4)	3,792.5	624	(509)	942.2	(11.8)	58.5
	126,484	(116,916)	7,742.2	(100.0)	2.04	133,974	(125,026)	7,791.8	(100.0)	1.94

Note : 1/ Average number of registered connection
2/ Number of connections issued bills

Table 3.22 Number of Service Connections in the year 1980, 1981, 1982 and in May 1983

Categories	1980	1981	1982	1983 (May)
A. Residential Use	92,177	99,797	105,119	111,451
B. Non-Domestic Use				
B-1 Public Use				
a. Government Offices	1,784	1,824	1,849	1,201
b. Scholls	239	267	284	303
c. Religious Places	305	333	357	390
d. Hospitals				
i. General Hospitals	50	56	57	59
ii. Maternity Hospitals (Private)	89	85	93	81
e. Boarding Houses	139	146	153	155
B-2 Industries Use				
a. i. Industries	324	327	337	261
ii. Store house	300	294	292	293
b. Small Industries	5,291	5,656	6,086	6,519
B-3 Trade and Services				
a. Hotels	109	107	113	114
b. Trade and Services	9,666	9,928	10,490	11,049
B-4 Port Tanjung Priok	7	8	6	9
B-5 Armed Forces	0	0	3	624
B-6 Depok National Housing	2	1	1	1
B-7 Others (Market, Wing Mill)	55	47	47	47
Total B	18,360	19,079	20,168	21,106
Total A and B	110,537	118,876	125,287	132,557
C. Public Hydrant	1,149	1,231	1,197	1,417
Total A, B and C	111,686	120,107	126,484	133,974

3.6 Unaccounted-for water

3.6.1 General

A large amount of wasted or lost portion of the distributed water, about 53 % of the total production in 1983, is regarded as unaccounted-for water. It was almost 59 % in 1977 and reduced by means of improved reduction of losses effectively undertaken by PDAM.

A slight increase, however, was recorded during the year 1983, which may be caused by the system pressure increase effected by commissioning of the newly constructed Pulogadung Plant.

Detailed analysis of the unaccounted-for water in the PDAM's water supply system has been made and presented in Appendix MII-3.

3.6.2 Components of Unaccounted-for Water

The analysis on the present unaccounted-for water shows that the losses consist of mainly in two groups, namely (1) illegal use, billing errors, etc., and (2) system leakage.

Preliminary estimate of components of the unaccounted-for water is made and summarized as shown below:

Components	Unaccountes-for Water (percentage of production)
1. Illegal Use	5
2. Under-registration	5
3. Under-estimation by Estimated Billing	1
4. Public Use	1
5. System Leakage	41
Total	53 %

It is observed in many countries that number of leaks in service connection ranges at 85 - 90 % of the total system leakage. PDAM has recorded rather low rate (43 %) for the service connections, and so the actual leakage cases may be estimated more than the reported amount.

The present system leakage has been verified as a trial case, based on the PDAM's record and the experience obtained in the large size cities in Japan, and summarized as follows:

	Cases of Leaks	Unit Rate of Leaks (m3/hr/case)	Amount of Leakage (m3/hr)
Distribution main	3,000	1.0 - 2.0	3,000 - 6,000
Service connections	5,000 - 10,000	0.25 - 0.5	1,250 - 5,000
Total			4,250 - 11,000 (17%) (44%)

3.6.3 Present Leakage Abatement Work

At present in 1984, PDAM's water supply system has approximately 133,000 customers or service connections in various categories of users. Out of the present service connections, about 42 % is installed with old meters over 10 years without replacement. According to the report of PDAM[1], the present system leakage can be divided into two categories by pipe size: service mains and connections, and distribution mains. And a large portion of leaks, about 88 % of the total was found in the old pipelines.

Note : (1) Data-Data Penaggulangan Lebocoram Pipa, 1982/83 PDAM

PDAM has been implementing leakage detection and repair works by branch office basis. In fiscal year 1982/83, total 4,578 cases of leaks were found and repaired. According to the PDAM's report, leakage cases increase during the dry season, while it is less in the rainy season, which will be explained that the leakage detection work is difficult in the wet season. Many cases of leaks are also found and reported by the customers. PDAM is generally detecting visible leakage only, therefore, leaks in the underground are not included in the record of leaks found and repaired by PDAM. In the case of leakage in the service connections, leaks may not come out on the ground surface due to low system pressure and small amount of leaks.

Recently, in 1984, PDAM organized a new team especially for leakage abatement works by assigning a total of 78 personnel and staff who are transferred from branch offices and the Distribution Division.

According to the PDAM, the new organization will serve on the all newly defined five sub-service zones which are corresponding to the present five districts. And, PDAM is planning to apply its task force concentrating on the repair works of visible leaks for the time being.

3.6.4 Field Survey

The field surveys were conducted twice during the study period at the same area in Pulo Mas, east district of Jakarta. The reason for selection of the area is explained in Appendix MIII-3. The survey area is occupied entirely by residential houses, about 110 resident, so that minimum night flow is considered more or less equivalent to leaks.

Major findings of the survey are as follows:

1. The existing drawing of pipelines does not show actual conditions of pipelines, and some valves indicated on drawing are missing.

2. No stop cock on service connection was found while the standard drawing shows it.

3. About 34 percent of installed meters are not working or cannot be read.

4. Leakage of the system in the survey area is considered as 40 - 50 %.

For the leakage abatement, the complete as-built drawing of pipelines and service connections are inevitable. Rehabilitation of valves and arrangement of stop cocks on every service connection are vital for the works.

3.6.5 Recommended Target of Leakage Reduction

The said study on the Unaccounted-for Water, included in Appendix MIII-3, recommends to set the target of leakage reduction and decrease the unaccounted-for water below:

Target Reduction of Unaccounted-for Water

Category	Present (1982)	Immediate (by 1990)	Final (by 2005)
Illegal	5%	3%	1%
Under-registration	5%	3%	2%
Under-estimation	1%	-	-
Public Uses	1%	1%	1%
Leakage	41%	33%	21%
Total	53%	40%	25%

Recommended measures to decrease the present rate of the unaccounted for water are summarized as follows:

1. Metering program including replacement of old and defective meters and establishment of meter testing and repair procedure.

2. Replacement of old pipelines together with old service connection tapped from them.

3. Intensive survey and study on leakage abatement.

4. Training for leak detection and repair

5. Establishment of organization which has the overall responsibility for water loss reduction program.

6. Installation of stop cock on service connection as shown on standard drawing of PDAM.

7. Preparation of precise drawings showing size and materials of pipelines, location of accessories such as valves, air valves, hydrants, blow offs, pipe bridges road crossings and other important appurtenances. Also detailed drawings of service mains and connections showing alignment, size and materials, and locations of stop cocks and water meters etc.

The period for implementation of the above program will be about five years as the reasonable term to establish the frame work for the future activities of water loss reduction.

The cost for the above works is estimated as Rp. 22,600 million or US$ 22.5 million equipment.

The details of the above are presented in Appendix MIII-3.

The proposed rehabilitation program is reflected in the recommended measures presented in Section 4.5 Immediate Program in the report.

3.7 Operation and Maintenance

Present conditions of operation and maintenance of the existing water supply facilities are investigated by site visit in the following fields:

1) Treatment plants
2) Distribution method
3) Public Hydrants
4) Master repair shop and storage
5) Storage facilities of Chemicals and parts of materials
6) Storage and stock yard
7) Motor vehicles
8) Fire hydrant

Present condition are described in the following sections.

3.7.1 Treatment Plants

Present status of operation of Pejompongan plants I and II and Pulogadung plant is shown in Table 3.23 covering coagulation and sedimentation, filtration, and chemical application. Up flow type clarifier and Aquazur filter with air scouring and backwash system are employed in Pejompongan plants and conventional types of flocculation and horizontal flow sedimentation basins and filter with surface and backwash systems in Pulogadung plant. The plant facilities are operated in accordance with the operation mannuals in each plant. In dry season, particularly, the treatment of polluted raw water is not satisfactorily performed. The outstanding issues in operation and maintenance are as follows:

(1) coagulation and sedimentation
- Due to accumulation of sludge in center drain, cleaning of bottom of clarifier is forced to be done every two months in Plant I.
- Suspension of sludge blanket zone is problematic in case of high turbid raw water and twice cleaning in a year for each clarifier seems necessary in Plant II.
- Scum is producted and thicknened on surface of flocculation basin and it gives unsatifactory for coagulation in Pulogadung Plant. Appropriate countermeasure for scum removal is necessary.

(2) Filtration
- Mud balls grow in filter sand bed. It seems to be caused by backwash in flow and duration Pejompongan Plants.
- Air scouring of filter bed is ununiform due to crack in sand layer of filter bed, in Pejompongan Plants.

(3) Chemical Application
- Dosages of chemicals are not adequate, so that removal of pollutants is not sufficient and finished water frequently does not meet the water quality standard in Pejompongan Plants.

Table 3.23A PRESENT STATUS OF OPERATION AND MAINTENANCE OF TREATMENT PLANT - (1)

Items	Pejompongan I	Pejompongan II	Pulogadung
1. Coagulation and Sedimentation			
1) Design point of chemicals			
a. Alum	raw water channel	mixing for high turbidity/ inlet well	mixing well
b. Polymer	- do -	-	receiving well
c. Pre-lime	- do -	mixing well	- do -
d. Pre-chlorine	- do -	- do -	open channel
e. Intermediate-chlorine	-	-	Filtered water conduit
f. Post-chlorine	filtered water conduit	filtered water conduit	- do -
h. Activated Carbon	raw water channel	-	receiving well
2) Sampling/analysis of concentration of sludge zone	no sampling	one basin, sampling at bottom of sludge blanket zone. 4 hrs interval sampling No data available on concentration of sludge	no sampling
3) Desludge			
a. Frequency/time	every 15 min/25 sec	dry season : every 10 min/30 sec wet season : every 6 min/30sec	dry season : 3 times/day wet season : 6 times/day 5 min desludge
b. Basis of determing frequency and time	by condition of sludge volume	by routine work	by turbidity of raw water and condition of sludge volume
4) Problems	cleaning of the bottom of accerator is reuqired every two months due to accumulation of sludge	no comments available	raw water quality - inflow of plastics - detergent at effluent channel - scum at flocculation basin - high turbidity lime - no crusher for limestone
2. Filtration			
1) Filter media			
a. Effective size of filter sand	0.7 - 1.4 mm	0.9 mm (0.6 to 1.5 mm)	0.7 mm
b. uniformity coefficient of filter sand	-	1.5	1.6
c. Thickness of filter sand layer	85 cm	100 cm	70 cm

Table 3.23B PRESENT STATUS OF OPERATION AND MAINTENANCE OF TREATMENT PLANT - (2)

Items	Pejompongan I	Pejompongan II	Pulogadung
d. Size of gravel	7 - 14 mm	10 - 15 mm	5 - 10 mm
e. Thickness of gravel layer	15 cm	10 cm	25 cm
2) Filter run			
a. Filtration rate	5 to 7 m3/hr/m2	5 m3/hr/m2	max. 0.25 m3/hr/m2
b. Head loss	-	1.8 to 1.9 m	-
c. Filter run	48 hrs	48 hrs	dry season : 72 hrs, wet season : 48 hrs
3) Sampling/analysis of filter media	no sampling	no sampling	no sampling
4) Washing of filter sand			
a. Filtration rate	5 to 7 m3/hr/m2	5 m3/hr/m2	max. 0.25 m3/hr/m2
b. Rate/time for washing	air scouring : 0 min backwashing : 8 min 35 cm/min	air scouring : 0 min backwashing : 0 min 34 cm/min	dry season : every 2 or 3 days wet season : every 1 or 2 days backwashing : 5 min 70 cm/min surface washing : 10 min 13 cm/min
c. Source of washing water	from clear water reservoir	from clear water reservoir	from clear water reservoir
5) Problems	- Algal growth on the sand bed in dry season	- non-uniformity of air scouring due to crack in the sand layer of filter bed	- Outflow of sand from filter underdrain
3. Chemical Application			
1) Storage area			
a. Alum	19 m x 17.4 m 330 m2	included in Pejompongan I	13.5 m x 24 m 324 m2
b. Lime/Soda ash	5.0m x (33m +14.1m) 273 m2	- do -	18.0 m x 3.5 m 63 m2
c. Chlorine gas	9.95 m x 17.4 173 m2	8.5 m x 21.1 m 179 m2	30.0 m x 9.0 m 270 m2
d. Hypochlorite	5.8 m x 18.8 m 109 m2	-	-
2) Storage			
a. Alum (from Pulogadung)	1,000 tons	-	200 - 250 tons
b. Lime (from Bogor)	500 tons	-	20 tons
c. chlorine (from Surabaya)	1 ton x 16 containers	1 ton x 4 containers	1 ton x 6 containers
d. Activated carbon (from Bandung)	-	-	20 kg x 200 packs

Table 3.23C PRESENT STATUS OPERATION AND MAINTENANCE OF TREATMENT PLANT - (3)

Items	Pejompongan I	Pejompongan II	Pulogadung
3) Laboratory			
a. Staffing	chief 1, for analysis 5	chief 1, for analysis 5,	chief1, for analysis 8,
b. Space	chemical analysis 6 x 8 = 48 m2	5 m x 10 m 50 m2	chemical analysis 9 x (5+6) = 135 m2
	biological analysis 4 x 6 = 24 m2		biological analysis 6 x 9 54 m2
4) Water quality analysis			
a. Frequency	3 times/day	3 times.day	3 times/day
b. Sampling point	raw water, clarified water, filtered water, and finished water.	raw water, clarified water, filtered water, and finished water.	raw water, clarified water, filtered water, and finished water.
c. Items of analysis	color, Turbidity, pH, KMnO4 M-Alkali, Fe, Mn, Ca, Mg, Cl, SO4, NH4-N, NO2, SiO2	Color, Turb., pH, KmnO4, CO2, CO3, H2CO3, CaCO3, Ca, Mg, Fe, Cl, NH4, NO2	Color, Turb., pH KMnO4, CO2, M-Alkali, Fe, Mn, Ca, Mg, Cl, NH4, NO2
5) Method of Analysis			
a. Color	Hellige	Hellige	Pt. Co Standard
b. Turbidity	Hach	Hach	Hach
c. pH	pH meter	pH meter	standard
d. Hardness	EDTA (PDTA)	EDTA (PDTA)	EDTA
e. Iron	Hellige	Hellige	Hellige
f. Manganese	- do -	- do -	- do -
g. Ammonium	Hellife	Hellige	Hellige
h. Coliform	Eckman method	-	-
6) Jar Test			
a. Frequency	3 times/day	6 times/day, 7:00-14:00 2 times 14:00-22:00 2 " 22:00- 7:00 2 "	3 times/day
b. Analysis of water quality	raw water, pH, Turb. clarified water, pH Turb.	raw water, pH, Turb. clarified water, pH Turb.	raw water, pH, Turb clarified water, pH Turb
c. Observation of floc/ settling velocity	-	-	-

3.7.2 Distribution Method

Distribution method of water from the treatment plants to the service area depends on direct pump system. The service area is divided into two areas, eastern and western parts separated by the Ciliwung River. Eastern area is covered by Pulogadung plant and western area by Pejompongan plant. These service areas spread between 5 m to 10 m in elevation, gradually high toward south, and are directly served by the distribution pumps with 50 m head. Hilly area, 18 m to 27 m in elevation, is served directly by pumps with 75 m head equipped in Pejompongan plant I.

Mini-plants cover independently each limited area, which is isolated from the existing service area covered by the said plants, and newly developed area. These areas are also directly served by pumps.

The area along the Ciburial spring system, 12 m to 30 m in elevation, are served from clear water storage reservoir located in Pasar Rabo by gravity.

At present, as shown on Fig. 3.6, five booster pump stations are operated in the distribution system to improve supply conditions in low pressure and each station receives water in storage reservoir from the distribution main. Two are for shipping supply at Tanjung Priok and supply to remote area from distribution trunk mains at Klender, and another three for independently developed housing areas. In Sumur Batu booster pump station, currently, all of three old pumps with a capacity of 100 l/sec were replaced by big pumps with a capacity of 260 l/sec to meet the water demand for Sunter housing area newly developed. Each station supplies water to the area with direct booster pump system.

3.7.3 Public Hydrants

DKI Jakarta has 1,509 public hydrants as of August 1984 including 83 hydrants for public bathing, washing and excreta disposal uses for which service charge is not collected, and 1,426 public hydrants for general public uses by several categories as shown on Table 3.24.

Present condition of the existing public hydrants, problems and consideration for future extension of the system is described below.

Approximately 25 % of the existing hydrants were, in the year 1980, out of service because of many reasons, i.e., not sufficient water or pressure is available in service pipes, age of the hydrant system is old, leaks and damages on service pipe and water chamber are existent. Those defective hydrants need to be rehabilitated as soon as possible. For this purpose PDAM conducted field investigations on the existing hydrants.

Table 3.24 Public Hydrant DKI Jakarta
(As of August 1984)

Categories of Hydrant	Location (Kechamaton) PUSAT (Central)	TIMUR (East)	BARAT (West)	SELATAN (South)	UTARA (North)	TOTAL
1. Hydrant Proyek BAPPEN MHT	283	35	303	14	170	805
2. Hydrant M.C.K. Proyek BAPPEM MHT.	27	1	41	1	13	83
3. Hydrant Murni (Hydrant Biasa/Perorangan)	77	6	94	3	231	411
4. Hydrant Penertiban	22	2	25	-	2	51
5. Hydrant Jampang Kencana (H.J.K)	56	37	17	39	-	149
6. Hydrant Mini Plant Pesing/Muara Angke	-	-	1	-	2	3
7. Hydrant Volstation (Hydrant Tangki)	1	5	-	-	1	7
	466	86	481	57	419	1,509

Note:
1. Under Mohamad Husuni Tamrin (MHT) project, (KIP Project), installed for lower ingome group
2. Under MHT project, installed for bathing, washing and excreta disposal and service charge is not collected
3. Normal hydrant used for public use, establishment (Company) sells water to water vendor by the contract between company and vendor.
4. Customer who owns hydrant sell water through his hydrant
5. Hydrant installed in community, Kencana
6. Hydrant which receives water from Mini-plant, one (1) from pesing plant and two (2) from Muara Karang Plant
7. Water is delivered by tank car to filling station (or directly served by tank car)

Under the Mohamad Husuni Tamrin (MHT) project, and in the community Kencana, considerable numbers of hydrant were installed, (70 % of total hydrants as of August 1984) and these systems were operated by community or part of district where the public hydrant located and PDAM did not directly participated in its operation and maintenance of the system. Therefore when the system was not properly operated and maintained, great volume of water might be leaked and wasted. As these problems has been recognized among the people concerned at DKI and PDAM, recently it was agreed that installation and operation of the hydrant system are placed under the control of DKI Jakarta.

It is proposed that the above hydrant systems and other hydrants are gradually transfered to PDAM or operated under the control of PDAM as soon as possible.

Apart from the above public hydrants, PDAM is considering a plan of supplying water in areas where drinking water is hardly available. This plan is not included in the work of the present Master Plan, but for reference an outline of the plan is described here. The supply method is 1) to construct water tanks with a capacity of 20 m3, equipped with taps, 2) to store water therein transporting from the water works by tank lorry, and 3) for nearby residents to take water through the tap.

3.7.4 Meter Repair Shop and Meter Storage

There are four (4) different smaller size of meters, 1/2", 3/4", 1" and 1-1/2", and eight (8) numbers of larger size meters, 2", 3", 4", 6", 8", 10", 12" and 16" in use. The type of smaller size meters is an influential type, and main manufactures are from BASCO (Single-jet, wet type, made in Italy), METRONEX (Single-jet, dry type, Poland), CENTURY (Multi-jet, dry type, Venezuela), KENT (Single-jet, dry type, England), KINMON (Multi-jet dry type, Japan), and AICHI (Multi-jet, dry type, Japan). The type of larger size meters is a Waltman type and mainly from PONT A MUSON and BASCO.

As of July 1983, total number of servic connections is 135,300. Out of this, 126,095 (93.2%) number of connections are with smaller size meters, 688 (0.5%) number of connections are with larger size meters and the rest of 8.517 (6.3%) are with no meters.

Past record of meter purchasing and present status of meter installation are presented in Appendix MIV-9.

Adjacent to the PDAM central office and next to the Pejompongan Treatment plant there is a building which has a meter repair shop and a meter storage beside a warehouse for pipings and fittings.

Present condition on operation and maintenance of the meter repair shop and the meter storage are as follows.

1) Meter Test Bench and Machine

PDAM Meter Division maintains the following meter test benches and machines in operation.

Meter Test Bench

Meter size to be tested	Capacity Number of meter per test	Number of unit	Purchase year	Remarks
1/2" - 1"	24	2	1973	Good condition for operation
1/2" - 1"	24	1	1981	Good condition for operation
Combined Test Bench for				
1/2" - 1-1/2"	4	1	1973	Good condition for operation
2" - 6"	1			

Note : 1. No meter test facility for above 6" meter at present

Machines

Name of Machine	Manufactures	Purchase Year	Remarks
a. Lathe (small size)	EMBO (BULGARIA)	1980	For making part
b. Lathe (large size, 1.5 m length C to C)	VOEST (BULGARIA)	1973	For making part
c. Drilling machines		1980	1 mm to 25 mm
d. Milling Machines	ADCOCK-SHIPLEY LEICESTER (ENGLAND)	1980	

As of August 1984, electricity is out of order and the cables to above machines are disconnected. The machines, however, seem to be in good condition in appearance.

2) Meter Repairing

Meters removed for repair or replacement are brought to the meter repair shop from each branch office (Cabang). After shop staff have checked the meters and available parts such as gear mechanism, which are imported, those meters are repaired and overhauled. The parts such as dial, screw pin are available in Indonesia. The meters which cannot be repaired are stored until the imported parts purchased or some of them are abandoned and sold off with salvage value.

Average number of meters repaired per month by each meter size at present are as follows:

Size of Meter	Number of Meter repaired per month (in Average)
1/2" - 1-1/2"	300 - 500
2" or larger	30 - 50

Space of the Repair Shop

Space for test bench and testing seems large enough at present and also in near future until the year 1990 or around. However, the work place for repairing should be enlarged and the existing machines be placed with sufficient space for safety and efficient.

Layout of present repair shop is shown in Fig. 3.13.

3) Staffing

Present organization of PDAM Meter Division is as follows:

(1)	Repair and Maintenance	17 staff
(2)	Administration	18 staff
(3)	Water Meter Control	20 staff
		55 staff

Note: 1. Division chief is included in Administration

"Repair and Maintenance" section staff (17 persons) are able to cover present repair requirement stated above. Present practice of meter repair is 15 - 25 numbers per day and maximum capacity of the meter repair at present will be approximately 30 - 50, and of meter testing will be 280 - 300 per day for 1/2" - 1" meter. (24 numbers x 3 benches x 4 time test per day assumed). Therefore, only one of three meter test benches of 1/2" - 1" is in operation in a day and the remaining two units are left as standby units.

In future, when increase of number of meters to be overhauled, repaired and require more work efficient in the terms of technique and time related to the work, the "Repair and Maintenance" section should be further divided into three (3) sub-section such as 1) Repair and Overhaul, 2) Meter Test, 3) Record and Registration.

4) Meter Storage

Adjacent to the meter repair shop, there is a meter storage with steel shelf furnished for smaller size of meters. Larger size meters are placed on the concrete floor. At present, the space for handling of meters is limited especially for larger size meters.

The layout of existing meter storage is shown of Fig. 3.13.

In order to improve present meter repairing work, it is recommendable to provided some machines such as sand bluster, universal type milling machine, gasket cutting machine, and to install additional meter test benches for smaller size meters as well as a new meter test facility for larger meters as repair and maintenance needs increase in future. Further the space for reparing should be enlarged to place the machines with sufficient space provided to ensure safety in work, and space for meter storage, prepared separately for smaller size and larger size meters, and sufficient space to access to each storage area should be provided. Meter repair shop and storage should be sufficiently staffed in accordance with the expansion of the shop and storage.

3.7.5 Storage Facilities of Chemicals and Parts of Materials

Chemicals are procured from both local and foreign sources. The local producers of alum, lime, activated carbon, chlorine gas are located as shown below:

Alum	:	Pulogadung, Jakarta
Lime	:	Bogor, West Java
Activated carbon	:	Bandung, West Java
Chlorine gas	:	Surabaya, East Java

Enough spaces are provided for chemicals in both plants of Pejompongan and Pulogadung. At the time of investigation in August 1984, alum and lime were stored for about two months supply. Chlorine gas is supplied by regular transportation from Surabaya every day due to limited chlorine gas container, and always stored with one ton cylinder for fifteen days supply. Besides, the imported products of soda ash, polyelectrolyte and hypochlorite are procured and stored in the lump for necessary volume for a year's supply. Carrying in and out chemicals are done by mannual handling using cart in Pejompongan Plant and by forklift truck in Pulogadung plant for alum and lime, and for chlorine gas cylinder, handling is done by trolley with a chain block.

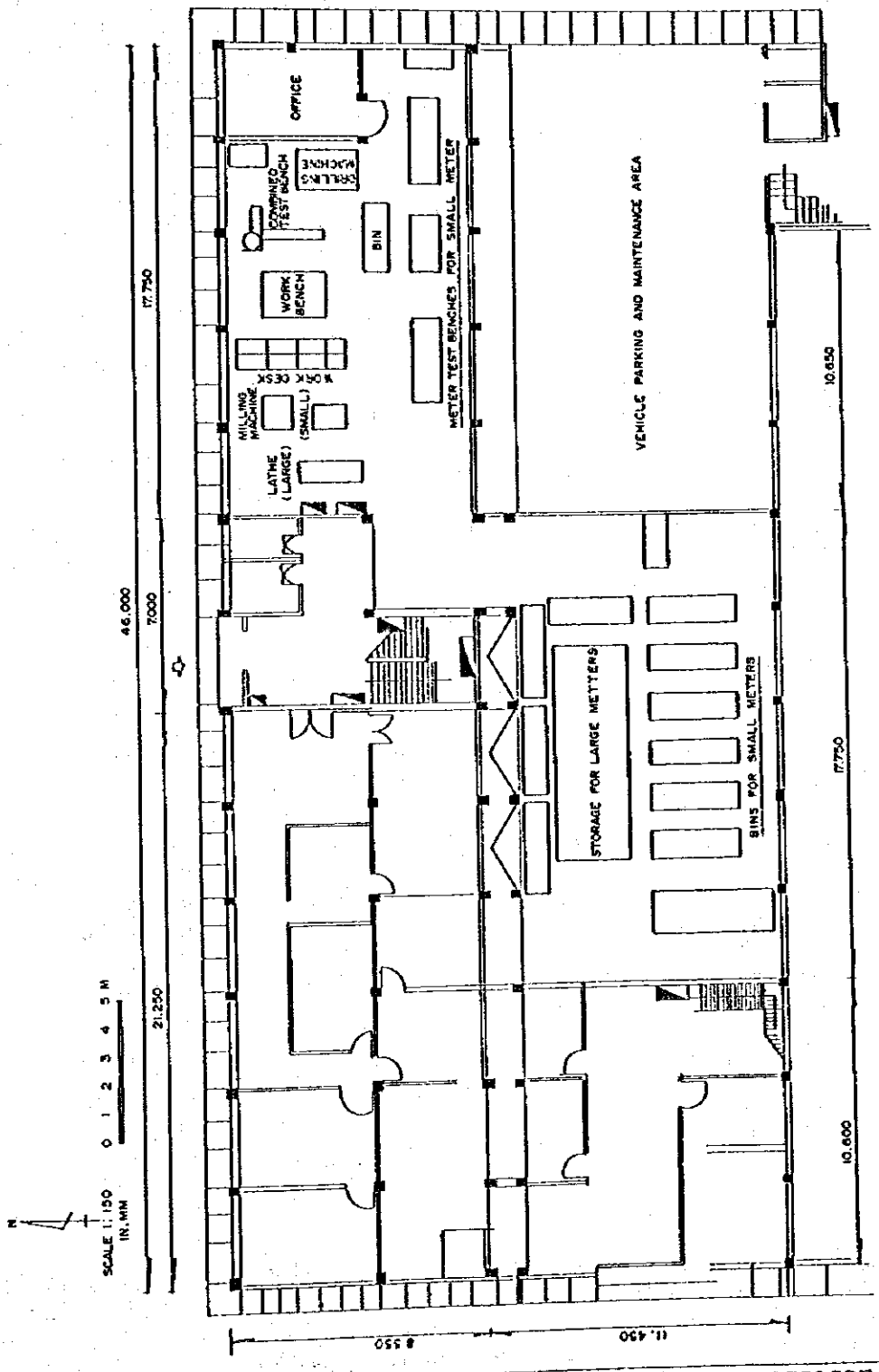

FIG 3.13 GENERAL LAYOUT OF METER PEPAIRE SHOP AND STORAGE (EXISTING)

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3.7.6 Storage and Stock Yard

Each cabang has a closed storage for piping materials for service connection and tertiary pipes including service saddles, fitting valves, accessories, small size DCIP, SP, PVC pipes, limited numbers of flow meters of 50 - 100, valve covers, etc which are authorized to use under the responsibility of cabang for installation of new service connection and replacement of defective part of the service lines. The space is approximately 120 - 300 square meters. Most of these materials are put on the floor because of the limited number of shelves or bins and piping materials are put in jumble. It is recommended to provide appropriate numbers of bins, and dispose the materials in order with enough space for access to the materials.

Part of the office yard are used as stock yard of pipe materials, relatively larger diameter pipes than those stored in closed storage. North branch office has their storage yard about 3 km apart from the branch office. According to the account of branch office staff until now present space is enough for their open storage yard since they receive the materials from central office stock yards every time when need arises. The problems are handling, off and on loading, and transportation from central office and to project sites, because of the lack of mobil equipment and machine for that purpose. They request and borrow the mobil equipment and machine from central office every time needed, and some time it takes time until they can use them.

For safe keeping stored materials, one to two staff keep watch in two or three shifts of 12 to 8 hours.

Storage and stock yard maintained under control of PDAM central office are as tabulated below.

No.	Location	Type	Space	Material Stored
1.	Pejompongan	closed	± 700 m2	Accessories
2.	Pejompongan	closed	± 500 m2	Chemicals
3.	Pejompongan	open	± 2,000 m2	Pipes
4.	Kebayoran	closed	± 300 m2	Accessories
5.	Kebayoran	open	± 300 m2	Pipes
6.	Kamp. Rambutan	closed	± 300 m2	Pipes
7.	Kamp. Rambutan	open	± 300 m2	Pipes
8.	Cibinong	semi closed	± 200 m2	Accessories
9.	Gunung Batu	open	± 200 m2	Pipes & Accessories
			± 4,800 m2	

It is recommended that storage yeards be provided especially for piping materials for immediate rehabilitation work and secondary and tertiary pipe works which are scheduled to be implemented in near future. It is also required to purchase vehicles for pipe laying as well as operation and maintenance.

3.7.7 Motor Vehicles

PDAM at present owns motor vehicles of pick-ups, trucks, mini-buses and tank Lorrys, 128 numbers in total and 398 numbers of motor bikes. Approximately 45 percent of the motor behicles were purchased 10 years or more ago. The remaining are purchased mostly in past 5 years according to the inventory record. Approximately 40 % the motor bikes are purchased since year 1969 till year 1976 and have been used for more than 9 years till present time.

Some of the vehicles are considerably worn out due to heavy work, age and limited maintenance work available.

445 numbers of motor bikes were purchased since year 1969 till year 1983 and 398 numbers of motor bikes are registered.

The breakdown of motor vehicles and condition of the vehicles are described below.

Type of Vehicle	Numbers of Vehicles
Pick-up	84
Trucks	17
Mini-Buses	18
Tank Cars (Lorry)	9
Motor Bikes	398
Total	526

a. Age of approximately 40 % of pick-up is over 10 years old and need replacement with new one.

b. About 50 % of pick-up has been purchased since the year 1981, and among these, 24 numbers of pick-up were purchased in the year 1983, according to the inventory record, which is operated in good condition at present.

c. 1 number of truck was purchased in the year 1970 and 1971. 15 numbers of truck were purchased in two years from 1981 to 1982 and are running in good condition. However because of heavy work, mainly used for transportation of pipe materials and under relatively bad road condition of access road to the work sites, abrasion and damages on body of the truck are rather high compared with usual use. Life of truck might be 5 years or around.

d. Mini busses are used for mainly tranportation of staff of PDAM and workers to sites. According to the inventory record oldest purchase year is year 1974 and number of mini-buses purchased in this year is 4.

e. According to the inventory record, since year 1969 approximately 440 numbers of motor bikes were purchased and among them, 398 numbers of motor bikes are at present in operation and are registered at PDAM.

To clarify the difference on the numbers of motor bikes between 440 and 398, number purchased and registered, investigation by PDAM is scheduled to be made in near future.

Under the condition above, and considering need, at present and near future, at central office, cabang, installation, and unit motor vehicles including mobil equipment and motor bikes are required to be purchased in order to implement operation and maintenance works on all systems efficiently.

Next to the existing meter shop, there is a small vehicle parking and maintenance area, with the space of 200 m2 where only minor repair is available. Major repair is made at private garages.

3.7.8 Fire Hydrant

Two kinds of hydrant having two outlets for each hydrant, the one hydrant has outlet size of 1-1/2" and the other has 2-1/2", are installed on pipelines of ø 100 - ø 250 and ø 150 - ø 250 respectively.

The total numbers of hydrants are very little comparing with the length of existing secondary mains of ø 200 - ø 250, approximately 300 km.

The numbers of the hydrant as of year 1984 is only 239 and these are distributed in each district as shown below.

DISTRICT	NUMBER
CENTRAL	67
NORTH	30
WEST	47
SOUTH	47
EAST	48
TOTAL	239

According to the information from Fire Department, DKI Jakarta, about 20 numbers of hydrant only are planned to be installed every year, although their target of distance between each hydrant is 100 m in populated residential area. These hydrants are installed considering the priority of the area, i.e., 1) Densely populated residential area, 2) Industry area and, 3) Office and Commercial area. The Building which has more than 5 stories is required, under the present regulation, to install a fire hydrant per 800 m2 floor space. The maintenance of the hydrant is responsible by the owner of the building. Cost for the materials and installation of fire hydrant is born by the Fire Department.

Because of the limited number of hydrant and water quantity from the system, water sources for fire fighting are not only from hydrant also from other available sources such as river, canal, pond, spring etc.

The number of the hydrant should be increase as the production increased and pipeline system be improved and expanded.

3.8 Rehabilitation and Improvement Works

From the findings in the review of the existing water supply system, rehabilitation and improvement works presently in progress and the works which are urgently to be executed are summarized in the following. Such works consist mainly of water intake, treatment plant and distribution pipelines.

3.8.1 Work in Progress

1) Pejompongan Plant I

The structures of plant facilities in Pejompongan Plant I are still in good condition, whereas mechanical and electrical equipment are in a condition to be rehabilitated, especially raw water pumps, drain valves and reduction gear for accelerator, pumps and air blowers for filter wash, chemical feeders for alum, lime and chlorine and electrical equipment. Under these circumstances, in DKI Jakarta, the Technical Team was organized for the study on rehabilitation of the Plant I in August 1981 and inspected all facilities in accordance with the scope of the rehabilitation works proposed by Degremont, France, as designer. Based on the report prepared by the Team, PDAM budgeted for the stagewise rehabilitation works, and commenced the work in 1983. The condition of the facilities and equipments and the rehabilitation works of the Plant I are as follows :

(1) Intake facilities

It is necessary to normalize deteriorated function of raw water pumps due to wear and tear and sticking of plastic films on the impellers of pumps to maintain the normal raw water quantity. Major works are to replace all of raw water pumps by new ones, to install coarse and fine screens for removing of floating rubbish and plastic films, and to replace travelling desludge girder.

(2) Treatment plant equipment

No replacement of rotating equipment of accelerators and backwash pumps and air blowers of filters were done after operation of the plant, so that the function of equipment has been deteriorating year by year. Major works are to replace the said equipment by new ones and damaged divices of operation and indicators in filter operation desk and filter sand, gravel and under drain system. Furthermore, replacement of part of distribution pumps, and supply of spareparts will be necessary.

(3) Chemical feeding equipment

Whereas chemical feeding equipment of alum, lime and chlorine have been in operation for a long period with damaged equipment repaired, replacements of most equipment are required as early as possible. Major works are to replace the equipment and pipes with new ones and install standby units.

(4) Electrical equipment

Major works are to replace some parts of electrical equipment in power substation and to overhaul low voltage equipment, and to install remote control equipment.

2) Pejompongan Plant II

Rehabilitation works for the mechanical and electrical equipment in the Plant II are to be planned by PDAM after completion of the works for the Plant I. The improvement works, now under way, for the production increase from 3,000 l/sec to 3,600 l/sec by operating of four raw water pumps are to be completed in 1984 and major works are described below:

(1) Replacement of coarse screens by fine screens and transformers by ones of bigger capacities, and installation of desludge girder in pump well

(2) Replacement of damaged diffuser and collecting pipes in Palsators.

(3) Repalcement of alum feeding and transferring pumps by ones of bigger capacities and their pipes.

3) Distribution Pipeline System

No systematic rehabilitation works of distribution pipelines have been performed by PDAM for leakage abatement so far. PDAM, however, is aware of the need to reduce unaccounted-for water and, as the substancial improvement, intends to start the rehabilitation/replacement of the distribution pipelines, whereas details of work are still under consideration.

Besides, PDAM carried out the Sensus Program, which includes survey on the status of meter indication, irregal connection, number of persons for one connection and leakage and wastage in service connection and so on, for all customers registered to PDAM, from 1977 through 1983 to find out the irregal connections and misclassification of customer's registration for increment of the income (for details refer to Appendix MIII-3).

The leakage repair is done by the Branch Office and Units for service connections and distribution secondary and tertiary pipelines and by the Distribution Division in the headquarter for the emergency and trunk mains.

3.8.2 Rehabilitation and Improvement Works Required

Under this category of works, rehabilitation of the existing distribution pipelines and leakage abatement, and improvement of raw water to the existing treatment plans, short term improvement for the existing treatment, and improvement of distribution pipeline system are included.

1) Rehabilitation Works and Leakage Abatement

Presently, unaccounted-for water ratio was estimated at 53 % for total water production in fiscal year 1982/83. This unaccounted-for water consists of items to be solved by management such as illegal connections, billing errors and failures and water uses unchargeable, and items to be dealt with technically; leakage and under-estimation of meter. In this paragraph, physical water losses reduction is discussed.

Through the course of the present study, the unaccounted-for water study was carried out (for details refer to Appendix MIII-3). To reduce the existing water losses, as immediate works, improvement of metering and leakage abatement, including rehabilitation of distribution pipeline, leakage abatement study and leakage detection and repair, were recommended. The rehabilitation works and leakage abatement required hereafter are briefed below:

(1) Rehabilitation works
- Replacement of old meters and defective meters and new installation of unmetered connections
- Replacement of old service connection
- Replacement of old distribution secondary and tertiary mains
- Removel of old trunk mains

(2) Leakage abatement
- Leakage abatement study including intensive survey for system leakage and preparation of detailed maps.
- Training for leakage survey and leak repair
- Leakage detection and repair including assessment of the effect

2) Relocation of the Intakes

As described earlier in Section 3.4.2, the raw water pollution has advanced to the extent of the treatment capability of the plants of Pejompongan and Pulogadung. In principal, the present raw water sources are to be avoided for water supply if alternative raw water sources are available. In this connection, alternative methods for raw water improvement, namely, pretreatments and relocation of intake, were examined as described in detail in Appendix MIII-4. Conclusively, the latter was recommended as breifed below.

(1) Water Sources

West Tarum Canal, from which raw water intake is made indirectly for the existing plants, will be directly tapped for the raw improvement works. Rivers which flow in or near the city are not suitable for the works because of pollution or available quantity.

(2) Suitable Location for Intake

Considering the following water quality characateristics (refer also to Table 3.25), the section of West Tarum Canal between BTB 47 and BTB 49 is recommendable for intake.

a. Average concentrations of pH, Conductivity, Turbidity, Color, Suspended Solids, Alkalinity, Iron, Manganese and MBAS were varied widely along the WTC section.

Table 3.25a Water Quality on WTC near Bekasi (BTB 45)

	1 Nov	17 Nov	1 Dec	15 Dec	29 Dec	12 Jan	26 Jan	2 Feb	23 Feb	8 Mar	22 Mar	5 Apr	19 Apr	3 May	17 May	31 May	Ave
Do* (mg/l)	6.6	6.3	6.1	7.0	6.4	6.4	6.0	7.1	6.9	6.7	6.2	6.3	6.4	6.4	6.9	6.7	6.5
pH	6.9	7.8	7.2	7.8	7.3	7.6	7.7	7.1	7.8	6.9	7.2	7.4	7.1	7.1	7.1	7.9	
Conductivity (umho/cm)	146	139	129	189	134	142	145	127	148	141	144	142	132	132	155	145	
Turbidity (mg/l SiO2)		30	26	55	70	49	33	255	41	56	41	75	60	265	59	21	76
Color (Unit Pt Co)	20	20	25	20	30	25	20	15	15	15	15	15	15	15	25	15	19
SS* (mg/l)	280	19	81	158	73	22	72	202	61	80	46	47	88	357	94	52	
BOD_5 (mg/l)	2.6	2.4	2.5	2.2	2.4	1.6	2.0	2.0	2.4	2.0	1.3	1.2	2.5	2.0	2.0	1.2	2.0
COD (mg/l)	11	11.6	4.5	6.1	5.4	4.8	3.6	5.3	6.7	6.7	4.4	11.5	5.0	5.6	8.8	6.9	
TOC (mg/l)		3.4	3.6	3.0	2.6	2.1	4.7	2.1	2.3	2.2		2.4		3.3	2.0	3.8	
O. Matter * (mg/l KMnO4)	14	14.4	10.5	9.1	9.8	7.4	8.3	10.1	10	4.1	5.9	6.2	8.0	17.7	9.5	5.1	9.4
Alkalinity (mg/l)	62	60	60	66	47	56	50.9	45	53	64	61	59	50	55	46	51	55
Iron (diss/ total (mg/l)	0.81/ 19	1.3/ 2.9	0.1/ 1.05	1.3/ 11.3	0.59/ 6.6	0.98/ 4.45	0.5/ 2.0	1.3/ 9.5	0.59/ 3.0	0.39/ 3.1	0.57/ 3.8	0.9/ 4.1	0.49/ 3.4	2.8/ 3.0	0.43/ 4.8	0.28/ 1.7	
Mn* (diss/ total (mg/l)	0.06/ 0.29	ud/ 0.02	ud/ ud	0.01/ 0.04	0.04/ 0.1	0.08/ 0.1	0.05/ 0.05	0.04/ 0.17	0.06/ 0.08	0.07/ 0.11	0.04/ 0.08	0.1/ 0.12	ud/ 0.07	0.23/ 0.43	0.03/ 0.12	ud	
Ammonia - N (mg/l)	ud	0.04	0.13	0.33	0.1	0.28	0.44	0.3	0.42	0.29	0.05	0.29	0.37	0.10	ud	0.13	0.22
Nitrite - N (mg/l)	0.015	0.018	0.005	0.01	0.005	0.002	0.016	0.017	0.009	0.015	ud	ud	0.031	0.002	0.003	0.007	
Nitrate - N (mg/l)	0.6	0.8	0.63	0.70	0.1	0.47	0.50	0.8	0.50	0.8	0.25	0.25	0.22	0.2	0.32	0.16	
MBAS (mg/l)	0.04	0.12	0.07	0.02	0.07	0.05	0.03	0.02					0.17	0.15	0.03		
F. Coli (MPN/100 ml)	$4.3x10^4$	$2.1x10^4$	$2.3x10^4$	$2.1x10^5$	$9.3x10^4$	$4.3x10^4$	$9.3x10^3$	$4.6x10^3$	$2.4x10^4$	$4.3x10^4$	$4.3x10^4$	$2.4x10^5$		$4.0x10^3$	$4.6x10^5$	$4.6x10^5$	$1.5x10^5$

(Source: DPMA)

* : DO: Dissolved Oxygen, SS: Suspended Solid, O. Matter: Organic Matter, Mn: Manganese

Table 3.25b Water Quality on WTC at BTB 49

	1 Nov	17 Nov	1 Dec	15 Dec	29 Dec	12 Jan	26 Jan	2 Feb	23 Feb	8 Mar	22 Mar	5 Apr	19 Apr	3 May	17 May	31 May	Ave
Do* (mg/l)	5.8	6.0	5.7	6.2	6.8	6.8	6.5	6.6	7.1	6.1	4.7	6.1	6.1	6.2	6.5	6.9	6.3
pH	7.4	7.3	7.7	7.7	7.5	7.3	7.7	7.7	8.0	6.9	7.5	7.7	7.1	7.6	7.2	7.8	
Conductivity (umho/cm)	155	170	153	162	140	137	149	123	156	131	137	138	133	86	129	172	
Turbidity (mg/l SiO2)		36	160	71	160	86	63		39	58	144	60	99	94	159	45	91
Color (Unit Pt Co)	25	20	25	20	25	20	15	15	10	15	15	15	15	15	25	25	18.7
SS* (mg/l	1.051	86	228	252	184	32	58		59	74	120	122	83	92	202	67	
BOD_5 (mg/l)	3.3	2.9	3.8	4.5	2.2	2.6	2.4	2.0	1.6	2.0	2.7	1.6	2.7	2.1	2.6	1.6	2.5
COD (mg/l)	18.2	7.9	9.3	10.2	10.9	5.6	3.2	8.0	3.6	4.8	9.5	7.7	5.2	5.0	12.3	5.8	7.9
TOC (mg/l)		3.2	5.2	6.4	3.4	3.4	2.4	2.9	3.0	3.0			1.5		4.1	3.8	
O. Matter * (mg/l KMnO4)	24	17.8	18	16.3	9.5	8.1	8.6	12.4	7.0	14	10.4	9.9	9.6	10.9	13.5	5.1	12.2
Alkalinity (mg/l)	64	59	64	72	44.7	56.3	44.5	37	38	45	50	62	45	42	42	51	51
Iron (diss/ total (mg/l)	0.93/ 32.4	0.36/ 0.41	0.3/ 5.28	2.3/ 12.7	1.4/ 13	0.83/ 5.7	0.59/ 3.8	0.77/ 4.1	0.28/ 3.0	0.39/ 4.6	0.49/ 7.1	1.7/ 7.1	0.45/ 5.6	0.37/ 8.1	0.64/ 12.9	0.54/ 4.0	0.77
Mn* (diss/ total (mg/l)	0.08/ 0.61	ud/ ud	ud/ 0.17	0.09/ 0.09	0.07/ 0.23	ud/ 0.12	0.07/ 0.08	0.1/ 0.18	0.03/ 0.07	0.02/ 0.11	0.04 0.14	0.12 0.15	ud/ 0.15	0.04/ 0.18	0.04/ 0.38	0.04/ 0.11	0.04
Ammonia - N (mg/l)	0.001	0.10	0.18	0.11	0.09	0.32	0.47	0.35	0.47	0.27	0.05	0.23	0.75	0.08	ud	0.46	0.27
Nitrite - N (mg/l)	0.019	0.014	0.002	0.015	0.013	0.002	0.009	0.012	0.009	0.006	0.005	0.002	0.019	ud	0.003	0.008	
Nitrate - N (mg/l)	1.8	1.3	1.42	0.60	2.0	0.40	0.75	0.9	0.6	0.6	0.22	0.38	0.5	0.6	0.12	0.38	
MBAS (mg/l)	0.06	0.02	0.10	0.06	0.05	0.09	0.03	0.03					0.02	ud	0.007	0.2	0.05
F. Coli (MPN/100 ml)	$2.4x10^5$	$4.3x10^4$	$4.3x10^4$	$1.5x10^4$	$9.3x10^4$	$7.5x10^4$	$2.3x10^4$	$1.4x10^4$	$3.9x10^4$	$2.4x10^5$	$7.5x10^4$	$2.3x10^4$	$1.5x10^5$	$2.0x10^4$	$4.3x10^4$	$4.6x10^5$	$1.5x10^5$

(Source: DPMA)

* : DO: Dissolved Oxygen, SS: Suspended Solid, O. Matter: Organic Matter, Mn: Manganese

Table 3.25c Water Quality on WTC at canal end

	1 Nov	17 Nov	1 Dec	15 Dec	29 Dec	12 Jan	26 Jan	2 Feb	23 Feb	8 Mar	22 Mar	5 Apr	19 Apr	3 May	17 May	31 May	Ave
Do* (mg/l)	4.8	5.7	6.9	6.2	5.8	6.7	6.4	6.5	6.7	6.0	4.3	6.1	5.7	6.0	5.9	6.2	6.0
pH	7.6	6.5	7.3	7.4	7.7	7.3	7.7	7.6	7.6	6.9	7.8	7.6	7.0	7.7	7.1	7.4	
Conductivity (umho/cm)	178	175	174	164	146	141	162	125	168	138	131	136	133	124	132	168	
Turbidity (mg/l SiO2)		92	37	41	144	61	60	159	39	45	135	75	99	79	129	42	83
Color (Unit Pt Co)	25	15	25	20	25	25	15	10	10	25	20	15	15	15	20	20	18.4
SS* (mg/l)	1,496	187	144	119	211	118	86	153	82	64	172	133	109	79	186	60	
BOD_5 (mg/l)	6.1	4.8	2.5	2.5	2.8	2.6	2.8	2.3	2.2	2.4	3.7	4.4	3.1	4.5	3.5	2.0	
COD (mg/l)	32.5	9.0	7.1	9.7	9.1	5.2	4.2	5.3	4.3	6.2		10.2	10.2	10	13.7	6.1	
TOC (mg/l)		5.6	3.6	3.6	3.8	2.3	3.0	2.5	4.7	3.3		10			4.6	7.1	
O. Matter * (mg/l KMnO4)	50	20	14	11.6	10.8	8.7	9.2	13	7.0	6.6	17.4	9.4	10	15.3	13.8	6.1	13.3
Alkalinity (mg/l)	75	66	85	71	40.2	54.5	53	39	39	40	47	50	45	45	42	51	52
Iron (diss/ total (mg/l)	1.7/ 66	0.36/ 6.3	0.87/ 1.23	2.0/ 11	1.3/ 13	0.43/ 83	0.38/ 5.0	0.48/ 9.3	0.33/ 3.7	0.39/ 2.9	0.43/ 8.5	1.7/ 7.7	0.34/ 5.0	0.46/ 6.2	1.1/ 9.4	0.41/ 4.8	
Mn* (diss/ total (mg/l)	0.09/ 1.27	ud/ 0.07	ud/ ud	0.06/	0.08/	0.01/ 0.18	0.03/ 0.12	0.03/ 0.1	0.02/	0.03 0.09	0.02/ 0.18	0.16 0.18	ud/ 0.1	0.04/ 0.1	0.1/ 0.24	0.06 0.13	
Ammonia - N (mg/l)	0.002	0.13	0.15	0.10	0.12	0.34	0.24	0.15	0.21	0.12	0.83	0.10	0.62	0.05	ud	0.01	0.20
Nitrite - N (mg/l)	0.002	0.025	0.005	0.00	0.00	0.002	0.007	0.01	0.06	0.01	ud	0.004	0.02	ud	0.004	0.41	
Nitrate - N (mg/l)	1.3	1.5	0.40	0.60	0.1	0.47	0.38	0.8	0.5	0.7	0.45	0.31	0.24	0.16	0.06	0.05	
MBAS (mg/l)	0.01	ud	0.04	0.02	0.0	0.16	0.03	0.03					0.05	0.07	0.04	ud	
F. Coli (MPN/100 ml)	$9.3x10^4$	$9.3x10^4$	$9.3x10^4$	$9.0x10^4$	$9.3x10^4$	$9.3x10^4$	$9.3x10^5$	$2.8x10^4$	$4.3x10^5$		$4.3x10^5$	$2.3x10^5$			$2.4x10^5$		$1.9x10^5$

(Source: DPMA)

* : DO: Dissolved Oxygen, SS: Suspended Solid, O. Matter: Organic Matter, Mn: Manganese

b. Dissolved Oxygen at points of the Bekasi, BTB49 and the canal end was 6.5, 6.3 and 6.0 mg/l in averages respectively, gradually decreasing from upstream to downstream.

c. Number of Faecal Coli was 2.8×10^4 to 4.3×10^5 MPN/100ml in the section and increased from BTB 51a to the canal end.

d. Canal water at silt trap near the Bekasi sometimes had high Ammonium, about 0.3 mg/l, although concentrations of Organic Matter and Faecal Coli were similar along donwstream from the point.

e. Canal water in the section between BTB 47* and BTB 49* near the Jakarta DKI boundary had lowest concentration of pollutants.

f. Canal water in the section between BTB 51a and the canal end had higher and more fluctuating concentration of pollutants than the water upstream from the BTB 49*.

g. Canal water of the end had highest and most fluctuating concentrations of pollutants, above the Raw Water Standard in Ammonium, BOD, Iron, Manganese and Faecal Coli. In addition to the above, environmental conditions along the canal influences to the water quality of the canal water as follows:

- Canal section between the Bekasi and the BTB 49 has higher desirable condition. Water level is higher than the ground level around the canal so that wastewater does not flow into the canal.

- Canal downstream from the BTB 51a* has undesirable condition having lower water level than the ground level around the canal.

- Population density along the canal in the DKI boundary will gradually grow, having apaproximately 200 persons/ha of population density in 1995.

Note : * Milage mark from starting point of the WTC.
BTB 47: 60.3 km near DKI boundary
BTB 48: 62.3 km crossin point with the Jati Kramat River (proposed intake site of Buaran Plant)
BTB 49: 63.6 km crossing point of the Buaran River
BTB 51a: 67.1 km crossing point of the Sunter River

3) Raw Water Conveyance System for the Existing Plants

Based on the relocation of the intake recommended for the countermeasure against the deterioration of the present raw water to the existing plants, DGWRD has executed the feasibility study of the raw water transmission system. It is hoped that the project is implemented as soon as possible. As raw water quality of WTC is better than present, considerable cost saving of chemicals, especially chlorine, is expected. According to the tentative analysis, about 40 % of cost saving is obtained as shown in Appendix MIII-2.

4) Short Term Improvement for the Existing Treatment Process

To treat the present polluted raw water, necessary improvement of the existing treatment processes was recommended as follows (for details refer to Appendix - MIII-2 and MIII-4):

(1) Strengthening of chlorination
   a. Pre-chlorination
   b. Employment of intermediate-chlorination to Pejompongan Plants I and II
   c. Post-chlorination

(2) Improvement of operation of the Plants
   a. Appropriate pre-chlorine and alum dosage based on the results of water quality analysis and coagulation test.
   b. Increase of backwash flow rate and time by checking water head loss of filters and filtered water quality.
   c. Increase of dosing rate of activated carbon powder in dry season for removal of odor.
   d. Training of laboratry staff and operators

5) Distribution Pipeline System

3,000 l/sec from Pulogadung Plant after completion of the construction will be supplied to the existing service area in 1987. Furthermore, water from Buaran Plant to be constructed under the Immediate Project will be also supplied for the existing area until re-organizing of the service area. The area to be supplied with the above water is not sufficient in distribution network of secondary and tertiary mains though about 60 km of secondary mains are to be installed under the present First Stage Extension Project. Therefore, augmentation of distribution network on secondary and tertiary mains is proposed for the existing service area scheduling completion up to the year 1989.

3.9 Institution and Finance

Jakarta water supply operation is fully rested with Perusahaan Air Minmum Dki Jakarta (PDAM Jaya), an independent autonomous entity of Jakarta Municipality, DKI. Since PDAM Jaya was established as the sole water supply agency separated from the Public Works Department (Dinas Pekerjaan Umum) of DKI by the decision of the Governor DKI, it has been reorganized several times to seek more autonomy. PDAM Jaya, however, is further required to improve its administration, management, and financial capability along the program of system expansion envisaged in the long range plan to meet the increasing demand of the city.

This section deals with organizational, management and financial areas of PDAM Jaya, DKI Jakarta. The existing organization, its structure and management, and financial operation of PDAM water enterprise, is presented based on the review.

3.9.1 Review of Institution and PDAM Organization

1) Water Supply Institutions

Institution directly involved in water supply are the Directorate General Cipta Karya (Cipta Karya) of the Ministry of Public Works (DPU Department Rekerjaan Umum) and PDAM of the local government. The Directorate of Water Supply (DWS) in the Directorate General Cipta Karya prepars policy of water supply program planning and identifies projects and implements them, as an executing agency of the central govenment. Water supply programs and their implementation for the capital city is also under this administrative arrangement, and it is practiced that major capital works of water supply system are constructed by and at the expense of DWS, Cipta Karya. Water supply facilities once constructed by the central government were turned over to PDAM Jaya for operation and maintenance under a certain condition of repayment of such capital expense to the central government. PDAM Jaya, therefore, is not entitled to borrow from foreign loan agencies for major construction works. Finance for project is provided by the central government and terms are arranged according to a nation-wide standard of equity. Current practice indicates that, in addition to operation and maintenance costs, PDAM is required to share the project costs also based on the level of supply by per capita per day. It seems difficult that PDAM alone implements the capital investment projects in undertaking construction of the systems together with operation and maintenance thereof by its own resources of finance and manpower. Therefore the present arrangement and practice of water supply undertakings are considered appropriate and will continue for sometime due to incapacity of the present PDAM engineering force and capital investment finance. PDAM's involvement in the phase of project preparation and implementation is, however, advisable considering future management on operation and maintenance.

2) Water Supply in the Capital

The administrative boundary of the special territory of DKI Jakarta has been expanded, and according to the Statistical Year Book of Jakarta (1982), the present city now covers a total administrative area of 655.70 km2, and has a population of 6.7 million in 1983. As described earlier, the water supply system in Jakarta is operated and maintained by PDAM, a public water enterprise under Municipal Government of DKI, Jaya, which was established on 10 December 1968 by the Governor Decree No. 16/3/3/22/1968. The organization of water supply was separated from the Public Works Depratment of DKI to form a sole water agency in the capital, accordingly with self-sustained basis of independent budget separated from the municipal general budget. Since then, it has been reorganized several times to seek more autonomy, although it is still under strict control and supervision of DKI.

The effort of PDAM, as the sole water agency for the metropolitan region, has been fulfilled for operation and maintenance of the water supply facilities. Since it is practiced that the construction of major capital works has been carried out by the central government, PDAM is carrying out the minor construction works of mini treatment plant, installation of distribution mains and tertiary pipes, and rehabilitation of facilities by its generated funds.

According to the Governor's Regional Regulation No.3, year 1977, the principal duty of PDAM Jaya is to produce clean water which is sufficient, in terms of quantity and quality, to meet requirements of all kinds of water use at any time, for drinking, fire fighting and other uses. PDAM's principal tasks, described in the same Regional Regulations, are among others;

- to develop the supply of potable water according to the development program of the Regional Government;
- to construct, manage and maintain water supply installations and also water sources and reservoir;
- to install and maintain distribution mains and other related facilities;
- to serve the request of connections for municipal water from domestic, social, commercial and other users;
- to collect water charge and other incomes.

3) PDAM Organization

(1) Past Review

In 1972, Jakarta Water Supply Master Plan was prepareed encompassing required development of future water supply program with target year of 2000. Future extension program was

envisaged in the Master Plan to meet the increasing water demand in the capital. Within the future extension program, the First Stage Project, construction of a new water treatment plant at Pulogadung with total capacity of 4,000 l/sec to meet the demand in 1980, was put into implementation in 1975. To make the expansion program feasible, study on management and administration areas of PDAM was conducted in the part of the Master Plan. In 1975, further review and study of the organization and management were carried out with an objective of assessing sound organization structure together with improvement of management procedures. Through these studies, recommendations to improve PDAM's operation were made including;

- strengthening of organizational and managerial areas of PDAM,
- improvement and modification of the organization and management system, and further,
- assurance of financial capability for implementation of the First Stage Project.

The existing organization has been expanded in terms of capacity of administration as well as personnel number, and has now grew as an institution having a total staff of 2,025 as of October 1983. In the past 15 years since its separation from DKI Municipality and establishment of self-sustained organization, changes of structure of organization has followed three times in 1971 (March), 1973 (August) and 1980 (June), while expansion of major facilities has been implemented comissioning of Pejompongan II (portion of 1,000 l/sec, 1974 and the remaining portion of 2,000 l/sec, 1975); completion of Pulogadug (first portion of 1,000 l/sec, 1982 and the remaining portion of 3,000 l/sec expected in 1987), and construction of mini plants.

The present financial achievement ensures that PDAM management and system opertion has been greatly improved. Considering the continuous programs of expansion of water supply system to meet the increasing demand, however, the existing organization is further to be improved and strengthened in order to facilitate more sound management, operation and maintenance of the expanded capacity of the facilities and to provide better service of water supply.

(2) Present Structure of Organization

The present structure of organization was set up in 1980 by the Governor Decree No. 664. Review of the Decree is given in section 3.10. The management operation of PDAM is largely divided into the operation of the central office, and that of branch offices and special units. The central office is the center of management and administration, establishing task planning and programming, and supervising implementation of all operation and activities, while, branch offices and special units are, under control and supervision of the central office,

in charge of field administration and operation on PDAM's regional activities in customer meter reading and collection of bills charged, and maintenance of distribution system. The treatment plants (Instalasi) is also in the field operation in charge of water production under the supervision of the central office. The present organization chart is shown in Fig. 3.14.

The function of PDAM is divided into three Directorates, namely, (1) Technical and Production, (2) Business, and (3) Administration and Finance. Each field is under the control of the respective vice directors, responsible for engineering, business, and administration and finance activities respectively.

Technical and Production Directorate is responsible for technical planning and operation and maintenance of treatment plants and distribution. The function of Business Directorate covers customer service, water meter and logistic which was formerly under technical and production division. The Diretorate of Administration and Finance took over the activities including administration, personnel and household & supply once handled in the former managing bureau secretariat which was abolished.

At the division level, separated line from three Directorates, under the President Director, the division of Research and Development was provided in the organization to be in charge of research work and studies related to the improvement of the existing water system, staff development, water operations, administration, water demand and supply etc. The division of Inspection was strengthened by number of staff, to be in charge of supervisory activities on mostly technical and also budgetry, monetary and procurement in part. Internal audit is also conducted for the financial operation by examining compliance with rules and regulations.

(3) Management Capacity

PDAM is managed by four senior management staff: (1) President Director, and other three Deputy Directors of (2) Technical and Production, (3) Business, and (4) Administration and Finance.

President Director has the overall responsibility of technical, business, administration and financial operation of PDAM. Three Deputy Directors each reporting for Technical/Production, Business, and Administration and Finance, are supporting President Director, who is again responsible to report progress of activities and performance to the Governor, Head of the Region, and also Chairman of DKI Water Board which is the policy making organ of PDAM.

In the present organization, there remains difficulties to direct clear objectives and target of performance properly to divisions and sections in the organization. Consequently,

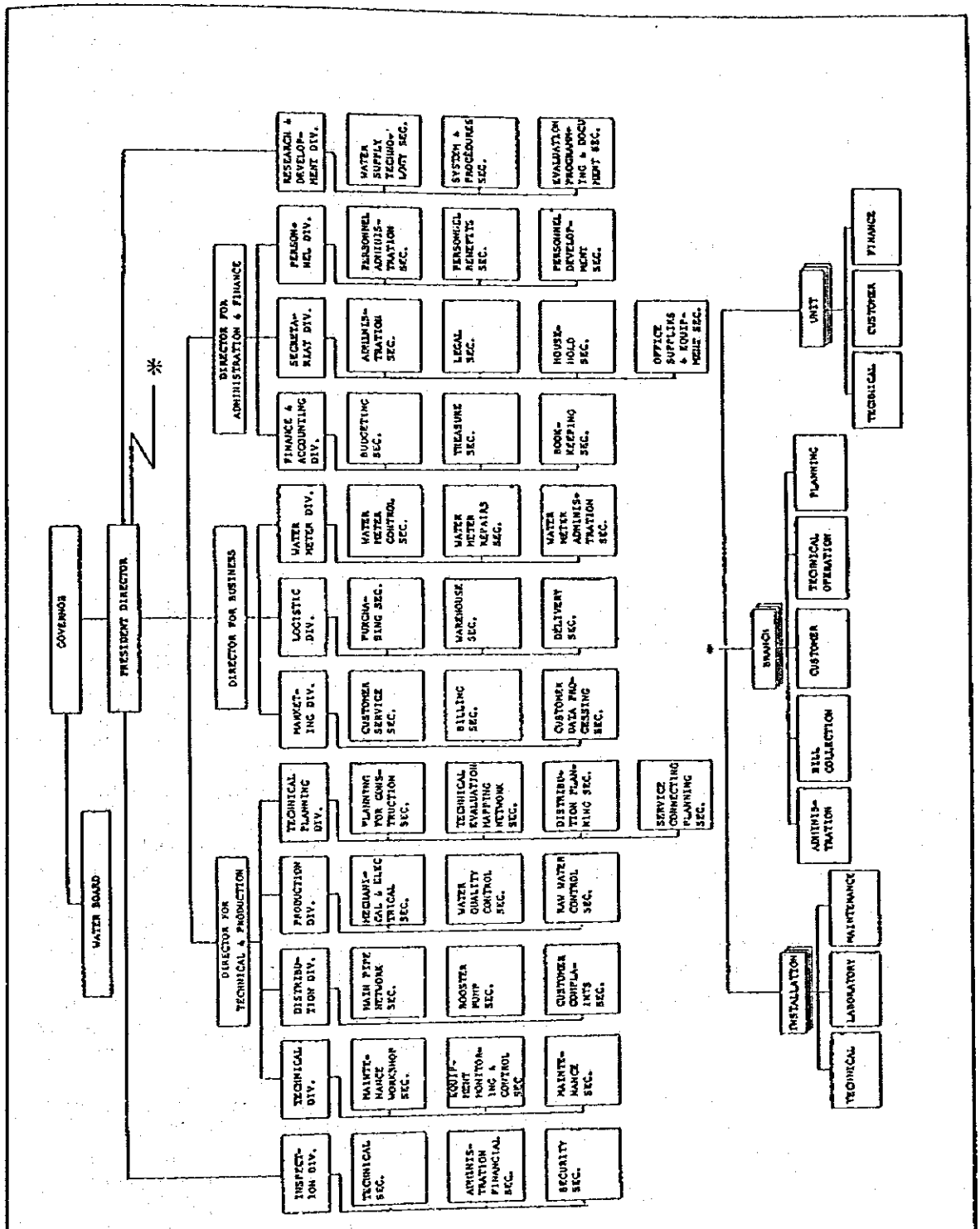

FIG 3.14 PRESENT ORGANIZATION CHART

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

concerted effort of the respective divisions has not been well effectuated to the performance of the set target. Many reports have been furnished from sections in central and branch offices addressed to senior management staff, however, reports format is not uniform and information contained in such reports is not in confirmity to requirements for needed decision and actions to be taken. It is hard to know any of the significance of the respective reports from the point of appraising the actual performance against the planned target.

Besides, lack of coordination among divisions has been observed to attain target of the enterprise in providing water supply services. Problems exist even in the same divisions. Some of the essential information and records that are useful or sometime important have not been referred to the related sections for further plans or actions to be formulated or taken.

(4) Divisional Capability

PDAM's structure consists of three main operational Directorates; Technical/Production, Business, and Administration and Finance. Technical/Production is engineering which is responsible to physical planning of treatment facilities and production and distribution of drinking water to consumer. Business Directorate is in charge of customer service to sell drinking water produced in the plant and collect charges from customers. Primary importance for the Directorate to receive customers reliance is to conduct meter reading in an accurate manner periodically and also conduct billing and collection in sound systematic procedures.

PDAM's activities in the field of engineering include planning of physical construction and operation and maintenance of constructed facilities for production and distribution of water. It is, however, to be pointed out that engineering capacity is not enough to cover whole function of activities in the present organization. Function of Technical/Production Directorate is largely divided into technical engineering for water supply facilities and production for treatment process in the plant. Job assignment and task order prepared by PDAM indicate that Technical is in charge of planning of civil works, evaluation of network, and planning of distribution and service connection. In this Division, there are section of Technical Planning, Distribution, and Equipment. Technical Planning handles planning of civil structure, distribution pipes and service connection, and prepare plans and specifications. Distribution handles installation of main water pipelines, booster pumps and customer complaints. Also it is in charge of main pipe laying projects, construction supervision, rehabilitation, maintenance, and booster pumps, pipe repairing and other operations and maintenance. Equipment handles maintenance of workshop, monitoring and control of equipment and analysis of equipment requirement. Review disclosed that Sections are not arranged as intended and are

not operated properly. Line of organization, direction and job assignments is not properly coincide with such objectives. Task is duplicated in several Sections. Customer Complaints Section (Seksi Pelayanan Gangguan) in Distribution Division should be provided in each of Branch Offices in its nature, and in the Central Office, Customer Service Section in Marketing Division should have the power and the responsibility of handling customers request and complaints. The coordination of activities was not well maintained or sometime lacked among Sections in the same Divisions. Each Section is doing its work without maintaining coordination and exchanging information, and this has been the causes of problems in overall work performance of organization and adverse effect to the work efficiency in the operation. As expansion of the system is planned in the near future, improvement of the existing organization, considering the efficient operation and achievement of required work, is the matter of importance.

In the present organization, related divisions with water production are, Production Divison of Central Office and Installation of Plants (Instalasi) in field office. It seems that the Production Division gives guidance and direction for Instalasi whose tasks are production and delivery of potable water. However, in reality, there is a lack of close coordination between Production Division and Instalasi. Production Division has three Sections of (1) Mechanical and Electrical, (2) Water Quality Testing, and (3) Raw Water Materials Control, and most of the Sections' tasks are, operation of pumping and equipment, and monitoring water flow and quality. There seems no involvement in production processes. Actual production processes are rested with plants, and the present operation practice done by the plants is not always appropriate showing difficulties to cope with raw water treatment. Maintenance of treatment process is not satisfactory without adjustments of an appropriate dosage of chemicals, neglecting repairs and maintenance of the plants. In order to attain proper operation of the plants for ensuring continuous production and delivery of potable water, an improvement together with upgrading capability of operators in the areas of production in the existing organization is to be achieved. At the same time, proper supervision of the respective management with technical competence is required, including providing necessary actions according to the reports prepared by the respective Sections.

(5) Personal Policy

Another areas to be looked into carefully in PDAM organization is the personnel matter. Since achievement and performance of the required tasks are depending heavily on its personnel.

The total staff of PDAM numbers 2,025 as of October 1983. Although there might be some ranges, however, it is reported that out of the total personnel approximately 500 are engaged

in technical and the remaining are assigned for administration. The figure indicates that 25 % of the total staff is in technical and other 75 % in administration. Considering that the primary tasks of PDAM are engineering oriented to provide water service backed by production and distribution of drinking water, it is said that PDAM faces shortage of technical personnel. And this is quite true when the present personnel is evaluated from the point of distribution in different qualifications. Record in the Personnel Division shows that engineers with full grade and bachelor of engineer both university grade numbers 53 or 3 % of the total staff. In case of full grade of engineers, it is only 21 staff or 1 % of the total. If number is looked in the Central Office and Branch Office, and Special Unit, Instalasi and Mini Plants, most of engineers of 17 are in Central Office, and there are only four engineers in the field offices.

If looked in Instalasi, Special Units and Mini Plants, there is limited number of engineers, and Instalasi are staffed by seven technicians of bachelor of engineers. In case of Mini Plants, none of engineers nor technicians are staffed.

4) Responsibility for Raw Water Supply and Protection

The development of future water resources for water supply and the prevention of raw water sources from industrial and domestic wastes pollution are two important and acute problems for the Jakarta water supply. As the result of increase of municipal water demand in the past years, the city of Jakarta is facing shortage of surface water, and the need for exploring additional resources for urban water supply has been increasing year by year. Considering the present and future demand of water supply, irrigation and other uses, an integrated water management program must be formulated to plan and implement coordinated water resources management in the capital region.

With respect to institutional responsibility for water resources development and raw water supply and protection, neither the Directorate of Water Supply (DWS), Cipta Karya, an excuting agency of water supply implementation in the central government, nor PDAM Jaya has direct responsibility in the management of water resources in spite of their responsibility for development and provision of urban water supply program. Institutions involved in the raw water development and utilization in the capital region are, (i) the Directorate General of Water Resources Development, (ii) the Jatiluhur Authority, (iii) BAPPEDA of DKI, Jakarta, and (iv) the West Java Provincial Government. DGWRD is responsible for water resources planning and development, and the Jatiluhur Authority is responsible for operation of the Jatiluhur reservoir and power station. BAPPEDA of DKI is a local planning board and deals with long term planning for the city, deeply involved in the investment for development projects for the city and plays an important role in the development of Jabatabek Metropolitan area. The provincial government of West Java exercises main control on water resources in Jabotabek.

Water resources planning and management activities in the past have been developed independently without any coordination among institutions. When urban water is needed to develop for Jakarta Metropolitan area, such water resources development has been considered exclusively for Jakarta, without giving any attention to adjacent cities and towns in the West Java Province, although water resources are originated in the Province. To establish intergrated and coordinated plan of water resources development, water management committee is to be formed in connection with the formulation of Jabotabek Master Plan. It may be advisable that the present KANWIL organization and funciton can be expanded with an objective of being responsible for future management of water resources and development. From point of urban water supply, following should be taken into consideration,

- develop water resources for urban water supply requirement, and provide adequate supplies for domestic, commercial and industrial uses,

- provide raw water sources and improve and maintain water resources utilized for urban raw water source by establishment of a monitoring system.

The Jakarta municipal environ is experiencing the rapid urbanization under the government schemes of housing and industrial estates. Due to the new settlements and industrialization expanding to tributary areas of water resource, most of the river water has been affected and deterioration of water quality is evidenced clearly, as described in Section 3.4.2 of the Report. It is an urgent matter to establish an comprehensive water quality management program to protect water resources, and an appropriate institution is to be set up for the realization of environmental protection. PDAM is required to keep close coordination and cooperation for efficient and economical utilization of water resources at the same time monitoring and evaluation of the environmental pollution.

Such institution will be staffed with the representatives from the respective agencies and also with scientists and technical experts provided with the appropriate facilities for the measurement, continuous observation, and analysis of the environmental situation. PDAM Jaya should take initiative to control pollution of water sources, giving an appropriate advices and recommendations from the view point of water supply.

5) Present Staffing

The total number of PDAM staff is 2,025 as of October 1983, out of which approximately 500 are for technical and the remaining are for administration. According to the past records, PDAM recruited about 100 staff per year. As the present customers are about 137,078, a staff of PDAM serves a total of about 68 customers which seems to be in average. The present PDAM staff distribution in each of division in Kantor Pusat or Central Office, and Branch Offices and Special Unit is shown in Table 3.26. Staff number in Kantor Pusat amounts to 643, or 32 % of the

Table 3.26 PDAM Staff Distribution

Assignment Costomer	No. of Costomers	No. of Employees	Customers per Employee
Operating Units :			
Branch Offices/Special Units/Rayon:			
Central	35,697	205	174
North	11,490	88	130
West	35,880	170	211
South	13,340	111	120
East	8,905	109	82
Bogor	1,798	42	43
Unit VII/Pluit Ancol	4,776	17	281
Unit VII/Kunigan	8,931	58	154
Unit IX/Cempaka Putih	5,050	41	123
Unit X/Commercial Meter	1,323	44	30
Unit XI/Hydrant	1,504	32	47
Unit XII/Sumbur Dalan	282	62	5
Rayon Klender	8,102	39	207
Installation		364	
Supporting Units:			
Management		4	
Inspection		83	
Research and Development		114	
Planning and Desinging		46	
Production		26	
Distribution		41	
Equipment and Maintenance		44	
Customer		43	
Logistic		34	
Water Meter		55	
Finance and Accounting		51	
Secretariat		79	
Personnel		23	
Total	137,078	2,025	68

total staff. Staff assigned in the Branch office is 725 or 36 %. Staff engaged in Instalasi or Production Facilities is 364 or 18 %. There are 236 staff or 12 % in Special Unit which is the small sub-branch offices. It can be said that PDAM's strategy of customer service is shifted from Kantor Pusat to Cabang from the fact that much more staff are distributed to the branches than Pusat. This coinsides with the policy of PDAM that Cabang/Units/Rayons are functioning as operational units, while, Pusat is working as supporting units.

The status of PDAM personnel indicated that 1,183 staff of more than half of the employees, or 58 % are pegawai negri sipil while 842 staff or about 42 % are PDAM Jaya-recruited staff. Table 3.27 shows status of PDAM personnel.

Table 3.27 Status of PDAM Personnel

	Number	% of Total
Government Civil Servant, Central	1	-
Government Civil Servant, Local	1,182	58
PDAM Employment	842	42
	2,025	100

If analized from position level, only 55 or 5% of the 1,183 employees are classified as pegawais of Level III. A large percentage, about 44 %, are at Level II. Position levels are shown in Table 3.28.

In terms of education, about 35 or 3 % of the employees possess educational background of sarijana muda. The majority, about 1,082 or 91 % possess high school backgrounds.

Table 3.28 Position Levels of Employee

Level	A	B	C	D	Total	% of Total
I	9	50	219	323	601	50.8
II	101	119	235	71	526	44.5
III	29	18	7	1	55	4.7
	139	187	461	395	1,182	100.0

The current salary structure of PDAM follows the national standard of civil servant applicable to all government agencies (Daftar Gaji Pokok Pegawai Negri Sipil, Nomor 7, 1977). According to the salary structure, progression within the grade is not related to performance. The award of increments is automatic each year for all staff. A new entrant will start at the minimum

salary for the grade allocated to his job. Promotion for higher grade of salary is in proportion to length of service and seniority and normally it will take every 4 years to move one grade to another at the fastest. Increment to higher Golongan depends on education background and job experience. If an employee is evaluated to be excellent for his past performance, he can receive an extra increment. Salary structure is shown in Table 3.29.

Based on analysis of payment record, actual salary of PDAM paid for staff is higher than the salary structure, probably due to other incentives. The reason is not known yet. PDAM salary and allowance reviewed is given in Table 3.30. Under the present practice of payment of salary, grades have been related to the seniority and qualification of an individual and not the level of skill and knowledge associated with a particular job. It is required for PDAM to introduce system of payment that can encourage to pay based on level of skills and performance of the employee. For evaluation of level of performance, the following should be considered:

(a) skills
(b) knowledge
(c) aptitude
(d) personality
(e) interest
(f) physical traits

In addition to the need to increase total remuneration, it is important to provide adequate bonuses and incentives. These payments of salary will encourage new entrants to PDAM at the time of recruitment and keep again qualified staff retained in the organization.

Table 3.30 PDAM Salary and Allowance (in Thousand Rupiah)

	Item	Amount
1.	Salary for Official, PDAM DKI	Rp. 75,213
2.	Salary for Workers, PDAM DKI	" 25,479
3.	Salary for applicant workers, PDAM DKI	" 1,007
4.	Salary for honor, PDAM DKI	" 301
5.	Bonus	" 2,959
6.	Transportation Allowance	" 37,210
7.	Incentive Official, PDAM DKI Rp.5,800 Workers, PDAM DKI Rp.4,227	" 10,027
8.	Allowance for office manager	" 7,035
9.	Medical Treatment	" 7,678
	Total	Rp. 166,910

LAMPIRAN II PERATURAN PEMERINTAH REPUBLIK INDONESIA
NOMOR : 7 TAHUN 1977
TANGGAL : 1 MARET 1977

Table 3.29 Salary Structure of PDAM

DAFTAR GAJI POKOK PEGAWAI NEGERI SIPIL
BERDASARKAN PERATURAN PEMERINTAH NOMOR 7 TAHUN 1977

	GOLONGAN I					GOLONGAN II					GOLONGAN III					GOLONGAN IV				
MASA KERJA GOL	RUANG DAN KENAIKAN GAJI POKOK				MASA KERJA GOL	RUANG DAN KENAIKAN GAJI POKOK				MASA KERJA GOL	RUANG DAN KENAIKAN GAJI POKOK				MASA KERJA GOL	RUANG DAN KENAIKAN GAJI POKOK				
	a	b	c	d		a	b	c	d		a	b	c	d		a	b	c	d	e
	600	700	800	900		1100	1200	1300	1400		1700	1800	1900	2000		2400	2500	2600	2700	2800
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
0	12.000																			
1	"																			
2	13.200																			
3	"	15.700	16.500	17.400																
4	14.400	"	"	"																
5	"	17.100	18.100	19.200																
6	15.600	"	"	"	0	21.200														
7	"	18.500	19.700	21.000	1	"														
8	16.800	"	"	"	2	23.400														
9	"	19.900	21.300	22.800	3	"	26.900	28.200	29.600											
10	18.000	"	"	"	4	25.600	"	"	"											
11	"	21.300	22.900	24.600	5	"	29.300	30.800	32.400	0	34.100	35.900	37.800	39.800	0	42.200	44.700	47.300	50.000	52.800
12	19.200	"	"	"	6	27.800	"	"	"	1	"	"	"	"	1	"	"	"	"	"
13	"	22.700	24.500	26.400	7	"	31.700	33.400	35.200	2	37.500	39.500	41.600	43.800	2	47.000	49.700	52.500	55.400	58.400
14	20.400	"	"	"	8	30.000	"	"	"	3	"	"	"	"	3	"	"	"	"	"
15	"	24.100	26.100	28.200	9	"	34.100	36.000	38.000	4	40.900	43.100	45.400	47.800	4	51.800	54.700	57.700	60.800	64.000
16	21.600	"	"	"	10	32.200	"	"	"	5	"	"	"	"	5	"	"	"	"	"
17	"	25.500	27.700	30.000	11	"	36.500	38.600	40.800	6	44.300	46.700	49.200	51.800	6	56.600	59.700	62.900	66.200	69.600
18	22.800	"	"	"	12	34.400	"	"	"	7	"	"	"	"	7	"	"	"	"	"
19	"	26.900	29.300	31.800	13	"	38.900	41.200	43.600	8	47.700	50.300	53.000	55.800	8	61.400	64.700	68.100	71.600	75.200
20	"	"	"	"	14	36.800	"	"	"	9	"	"	"	"	9	"	"	"	"	"
21	24.600	28.300	30.900	33.600	15	"	41.300	43.800	46.400	10	51.100	53.900	56.800	59.800	10	66.200	69.700	73.300	77.000	80.800
22		"	"	"	16	38.800	"	"	"	11	"	"	"	"	11	"	"	"	"	"
23		"	"	"	17	"	43.700	46.400	49.200	12	54.500	57.500	60.600	63.800	12	71.000	74.700	78.500	82.400	86.400
24		30.400	33.300	36.300	18	41.000	"	"	"	13	"	"	"	"	13	"	"	"	"	"
					19	"	46.100	49.000	52.000	14	57.900	61.100	64.400	67.800	14	75.800	79.700	83.700	87.800	92.000
					20	"	"	"	"	15	"	"	"	"	15	"	"	"	"	"
					21	44.300	48.500	51.800	54.800	16	61.300	64.700	68.200	71.800	16	80.600	84.700	88.900	93.200	97.600
					22	"	"	"	"	17	"	"	"	"	17	"	"	"	"	"
					23	"	"	"	"	18	64.700	68.300	72.000	75.800	18	85.400	89.700	94.100	98.600	103.200
					24	47.600	52.100	55.500	59.000	19	"	"	"	"	19	"	"	"	"	"
					25	"	"	"	"	20	"	"	"	"	20	"	"	"	"	"
					26		"	"	"	21	69.800	73.700	77.700	81.800	21	92.600	97.200	101.900	106.700	111.600
					27		59.700	62.400	65.200	22	"	"	"	"	22	"	"	"	"	"
										23	"	"	"	"	23	"	"	"	"	"
										24	74.000	78.100	82.400	87.000	24	98.000	104.700	109.700	114.800	120.200

6) Administration and Management

(1) Management Information System

Every badang or division in Central Office and every Branch Office/Unit/Rayon is obliged to produce its activities and performances during the month in a written report to the respective Directors, Litbang, and the President Director. This is called Laporan Bulanan or monthly report. In general, these monthly reports prepared by the respective badangs include, (1) result of performance activities in the respective months, (2) assemble of records of such result, and (3) statistical data. The objectives of the monthly report is to present division head and management group actual business activities of PDAM. Management group, in turn, will make necessary countermeasures and decision based on the contents of the report. Table 3.31 shows operating information reports prepared by the respective divisions, and table 3.32 shows management reports and their addresses.

PDAM operational reports can be largely devided into technical operation and financial operation. Technical operation reports aime to give information of records on production, distribution and consumption, while financial operation reports contain financial performance including water sales revenue collection etc, and water service rendered. These reports should contain right performance resources reflect actual status of PDAM business operation for the purpose of presenting management group to judge right shape of the enterprise and to help them make required decision. The reports should also contain analysis of the figures and performance.

The present information reports should be modified into the same format for readable and quick decision making.

(2) Budgetary System

Budget is prepared once a year. Finance and Accounting Division is responsible for compiling the required budget of the respective divisions. In the months of September and October, Director of Administration and Finance distributes circulars to other Directorate heads requesting them to submit their budget proposal for the forthcoming year. On receipt of this, a proper draft budget is prepared, and is tabled for the approval of Badan Pengawas. The Badan Pengawas may reduce or increase any of the items. The budget is referred to the Governor of DKI for final approval. Implementation for approval is shown in Table 3.33 Procedures of Budget Compilation. To monitor and control the execution of the budget, management group incluidng Director of three Directorates and Divisions Head is to review implementation every three month, and status of budget execution is presented in PDAM quarterly statement.

Table. 3.31 Divisions and Their Information Reports Prepared in PDAM, DKI

Division \ Reports	a. Annual Report	b. Quarterly Report	c. Monthly Report	d. Technical Report	e. Periodicals	Addressed to/ or with an aim of
HEAD OFFICE	0					a. Governor, DKI
Inspection Div			0			c. Director, PDAM
Technics & Production						
Equipment Div.			0			c. Director, PDAM, and other management group
Distributin Div.		0				c. - do -
Production Div.		0				c. - do -
Technical Planning Div.			0			c. - do -
Marketing						
Water Meter Div.		0				c. Director, PDAM, and other management group
Logistic Div.			0			c. - do -
Marketing Div.			0			c. - do -
Finance & Administration						
Personnel Div.			0			c. Director, PDAM, and other management group
Secretariat Div.					0	c. Members of PERPAMSI
Finance & Accounting Div.	0					c. Director, PDAM and other management group
Research & Development Div.			0	0	0	c. Director, PDAM d. - do - c. Public Relation
BRANCH OFFICE			0			c. Director, PDAM and other management group
UNIT/RAYON			0			d. Director, PDAM, and other management group

Table 3.32 Management Reports and Their Addresses

Title of Report	Prepared by	Governor DKI	President Director	Director Technical/ Production	Director Marketing	Director Finance/ Administration	Inspection	Research & Development	Division Head
Daily									
Cashier's Daily Report	Treasury Sec, Finance & Accounting. Div.					X			
Monthly									
Monthly Report on Production	Production Div.		X	X	X	X	X	X	X
Monthly Report on Distribution	Distribution Div.		X	X	X	X	X	X	X
Monthly Report on Planning	Technical Planning Div.		X	X	X	X	X	X	X
Monthly Report on Logistic	Logistic Div.		X	X	X	X	X	X	X
Monthly Report on Customer	Marketing Div.		X	X	X	X	X	X	X
Montyly Report on Meter	Water Meter Div.		X	X	X	X		X	
Monthly Report on Branch	Branch Office		X	X	X	X		X	
Quarterly									
Quarterly Report on Marketing & Production	President Director	X		X	X	X	X	X	
Annual									
Annual Report of PDAM	President Director	X							

Table 3.33 Procedures of Budget Compilation

Process	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Preparation of budget proposal in each Division	---------- (About 1 - 2 month)						
After screening work, A&F prepares draft budget and subit to President Director			----- (1 month)				
Draft Budget for Approval by Bidan Pengwas				----- (1 month)			
Approval by DKI					---------- (About 1 - 2 month)		
Implementation							-----

After 6 months of implementation of budget and if any of the budget is not sufficient, supplementary budget is prepared and approved.

(3) Accounting and Finance

The Division of Fianance and Accounting is in charge of procedures of budgeting, treasurer, accounting and bookkeeping. Currently full accrual accounting system has not yet been introduced in PDAM, but modified cash basis of accounting is employed. It is practiced that an income statement and a balance sheet are prepared on an accrual commercial basis, while, a cash flow statement is prepared on a cash basis which is linked with budget. This means that revenues are recognized and recorded at the time service is rendered regardless of the time of collection, and costs and expenses are recorded only upon payment. PDAM has a plan to introduce full accrual accounting system after studied by a management consultant in a few years.

(4) Procurement and Inventory

The works of procurement and inventory are handled by the Logistic Division under the Business Directorate. Logistic Division is staffed with 34 personnel, which consists of the following Sections:

a) Purchase and Supply,
b) Warehousing, and
c) Delivery.

The tasks of the Division can be largely summarized to,

- manage the procurement of mateials and technical equipment,

- perform the funcitons of planning of procurement, and to carry out the storage and the distribution of materials and technical equipment.

The procedures of procurement is described below:

- Purchase request is prepared by Branch Office/Units and will be submitted to the President Director.

- After approval of the President Director, request will be sent to the Logistic.

- Request will be evaluated at the Budget Committee consisting of Head of Divisions of PDAM and after evaluation, will be sent to the President Director for approval.

- Validation will be made in DKI.

- Purchasing is made under control of Auction Committee by means of either public auction or limited auction.

When procurement of required mateirals and equipment is made, items will be brought to PDAM warehouse. Any acceptance of purchased materials and equipment in the warehouse is carried out on the basis of the approval of the authorized personnels. Before the materials are declared to be good and acceptable, a checking and/inspection has to be made by the Materials Examination Committee consisting of,

- the Company Inspector
- Technical Equipment Section
- Water Meter Section
- Production Section
- Secretariat Seciton

The inspection to be conducted includes; the matters of quantity, quality, and standard required. When acceptance

order is issued, following procedures are taken place in the Logistic,

- to book the materials in the stock,
- to prepare the storage thereof,
- to prepare the plan of use of thereof,
- to check the period of storing for purchase of accurate preservation, security and safety.

The delivery of materials is made after,

- examination of the authorization slips and the letter of request,
- clearing the materials for warehosue,
- dispatch of the materials to each fields.

PDAM's inventory belongs to the responsibility of the President Director and Head of Bureau IV/IPM, as the property of PDAM and DKI, Jaya.

PDAM material inventory is arranged in,

- group of the kinds of materials,
- nature of materials,
- planning of the use of materials,
- facilities and equipment of the warehouse.

PDAM has been taken measures to improve procedures of purchasing and inventory by setting up the Procurement Committee together with an improved system and its administration to ensure an optimum operation. There are, however, still room for improvement of the existing procedures. It is required that,

- comprehensive system of materials warehouse and inventory has to be made,
- sufficient equipment and tools facilities and warehouse for storing are to be provided,
- improvement of reporting system as to the responsibility for materials are to be made.

(5) Procedrues of Connection and Meter Installation

a) Service Connection

PDAM total service connection showed 135,300 as of July 1983. Past increase of connections indicated about 6,000 to 7,000 in average in a year. Connection increase

in years 1983/84 showed over 10,000 to the previous year. The installation of service connection and water meters is handled in each of Branch Office. When new customer wishes to get a connection for PDAM water supply, he makes a request submitting an application after filling necessary items in that form. Once application examined and approved by the Seksi Rencana Sambunngan Air Minum, Perencanaan Teknik in the Central Office and payment made, Branch office receives notice from the Division to make installation. Installation works are all done by PDAM in-house field technicians. Disconnection and reconnection works are also done by Branch Offices. Case of disconnection due to delinquency of water bills is, according to the Customer Division, almost none.

b) Meter Installation and Reading

The administration and control of water meter are handled by the Water Meter Division under the Technical and Production in PDAM Central Office. Table 3.34 shows metered connections and non-metered connections from records of the Meter Division as of April 1982.

Out of total connections, 8,139 or 6.5% are unmetered. The West and Central Branches shows existence of high percentage of unmetered connection. The reasons of non-metered connections claimed by PDAM are that (i) connection without meter for easy water flow in the areas where suffering from low pressure of water mains and (ii) connection without meter due to shortage of meter.

According to the records kept by the Meter Division, about 22,000 to 25,000 meters are procured in a year. PDAM has a program to meter all service connections, and 2,400 meters in average are installed in a year, or 100 to 200 meters per month. Installation of meters is carried out by each Branch Office under the direction of the Meter Division.

PDAM's replacement program indicates that all meters once installed will be replaced after five years service, and there are about 10 to 15% meters replaced per year. However, the present system of periodical replacement of old meters has not been practiced and there are quite a number of defective meters still in use. Replacement works of defective meters are carried out by Branch Office. Defective meters replaced will be brought in the Repair Section and will be repaired and refurnished in a month and will be kept stored for ready to serve. Meter repair and storage is described in Section 3.7.4. In case there is need of replacement, request slip from Branch Offices to Water Meter Division will be issued, indicating required number, type and size of meter, and after approval meters will be provided to Branch Office. Meters, once installed will be registered according to the

procedures of installation. Installation report will be issued at Branch Offices and sent to Meter Division to record in Water Meter Card and will be registered in slip of computer data.

Meter reading is done once every month in PDAM Branch Offices, Units and Rayons. Table 3.35 shows number of metered connection and meter readers in each Branch Office.

Table 3.34 Metered and Non-Metered Connections

(As of April 1982)

Branch Office	Metered Connection	Non-Metered Connection	Total Connection
Central	31,937	2,546	34,483
West	27,224	4,964	32,188
South	11,917	145	12,062
East	8,225	97	8,322
North	8,670	11	8,681
Bogor	1,637	-	1,637
Cempaka Putih	4,591	33	4,624
Pluit/Ancol	3,228	265	3,493
Bundungam Hiler	8,389	33	8,422
Special Unit	1,355	-	1,355
Hydrant	1,344	-	1,344
Deep Well	269	12	281
Klender	8,016	33	8,049
Total	116,802	8,139	124,941

Table 3.35 Metered Connections and Meter Reader in Branch Office

Branch Office [1/]	Metered Connections	Meter Reader	Average No. of Meter Read [2/]
Central	34,798	40	35
North	11,721	14	33
South	13,377	18	30
East	8,883	13	27
West	33,259	30	44
Bogor	1,798	5	14
Total	103,836	120	865

Note: 1/ Special Unit and Khusus are excluded.
2/ Average number of meter to be read by one reader per day in 25 working days in a month.

As can be seen, there are 15 to 40 meter readers are staffed depending on the numbers of meter installed in the areas covered by the respective Branch Offices. Based on rough assumption, average numbers of meter to be read by a meter reader in 25 working days in a month show about 30 to 45.

Present meter reading does not seem to be efficient, because reading is not properly arranged according to the location of customers. Besides, meter readers are not rotated. Reading of meters is recorded on a card in which register number, reading of previous month, types and size of meter, customer's name and address are indicated. This card filled up by meter readers in each Branch Office, is to be sent to the Customer Division of Central Office to be processed for customer bill. If the meter is out of order, billing is made in the assumption of water quantity used by a customer in the last three months.

(6) Bill Rendering and Collection

Marketing Division in Central Office is in charge of processing and developing water bills on the basis of the records of meter reading and by means of computer and data processing. Bills prepared are delivered to the respective Branch Offices for collection. PDAM records show total of 135,000 connections in July 1983 which represent an increment of 9,000 connections to the previous year. Number of connection in the last four years is shown below:

Year*	No. of Connections	Increase
1980	104,000	
1981	117,000	13,000
1982	125,000	8,000
1983	135,000	10,000

* End of fiscal year except 1983 which shows connections in July.

Table 3.36 shows the number of connections according to categories of users in the years 1982 and 1983. As can be seen, out of total connections, domestic shares 112,700 or 83%. Following to domestic are trade and small industries with connections of 9,700 or 7.2%, and 6,400 or 5.1% respectively. This represents that domestic customers are predominant among other categories of users.

PDAM issues bills to customers monthly based on the meter reading and also collected charges for the bills rendered. Meter reading and collection of bills are done in each of Branch Office. Collection is done by two ways: (i) office collection and (ii) field collection. Field collection by collectors staffed at each Branch Office is major system now employed in PDAM. Number of bill collectors in each of Branch is shown below:

Table 3.36 Breakdown of Connections

No.	Categories	1983 (May)	Percentage	1982 (March)	Increase/ Decrease
1.	Domestic	112,713	83.0	104,066	8,647
2.	Offices	1,179	1.0	1,843	664
3.	School/Institution	309	0.2	284	25
4.	Boarding Houses	160	0.1	151	9
5.	Religious Places	388	0.4	352	36
6.	Government Hospitals	59	-	57	2
7.	Industrial Interprise	246	0.2	337	91
8.	Store Houses	288	0.2	291	3
9.	Trades Industreis	9,720	7.2	8,946	774
10.	Inpres Market	6	-	4	2
11.	Small Industries	6,436	5.1	5,982	458
12.	Hotel	116	0.1	112	4
13.	Steam Bath Place	215	0.2	206	9
14.	Night Club/Bar etc.	47	-	49	2
15.	Berbar Shop	38	-	40	2
16.	Tailors	156	0.1	158	2
17.	G.P. Doctors	551	0.4	575	24
18.	Judge/Lawger	74	-	71	3
19.	Bank	150	0.1	139	11
20.	Service Stations	136	0.1	136	-
21.	Privte Hospital	77	-	92	15
22.	Hydrant/Water Tanks	1,438	1.1	1,311	127
23.	Depok	1	-	1	-
24.	Wind Mils	42	-	43	1
25.	Port of Tanjung Priok	3	-	9	-
26.	Armed Forces (ABRI)	660	0.5	-	660
27.	Others	86	-	-	86
	Total	135,300	100	125,255	10,045

Branch	No. of Bill Collector
Central	31
East	8
West	31
South	24
North	20
	90

There are about 20 bill collectors staffed in each of Branch Office. Collection is done in or following month on basis of meter reading of a previous month. Areas are divided into zones for collection. Collectors report to Cashier total money collected every assignment, and total collected money will be transmitted to Central Office every day.

The present practice shows that the collection of a particular month bill requires two to three months, and collection efficiency, although varies according to Branch Offices, is shown below:

First Collection	65 - 75%
Second Collection	10 - 12%
Third Collection	5%

The present collection efficiency is low. The system of billing and collection in each of Branch Office is not uniform and discrepancies of number of billing also exist between Branch Office and Central Office.

(7) Auditing

Internal audit is conducted by Administration/Finance Section of Inspection Division. At present, their responsibilities are centered around examining compliance with rules and regulations and taking necessary measures to correct deviation, if any. The system appears to be rather backward-looking rather than forward-looking in a sense that it is not necessarily directed to evaluate the existing systems and procedures and to make necessary alternations or to design/introduce new systems.

External audit has been conducted by the following three authorities/institutions:

- Public Accountant Office: once a year
- Provincial Inspector - DKI Jakarta: regular audit at the end of a year and other several ad hoc audits a year
- Board of Financial Control: usually four times a year and results are reported to the House of Representatives

In addition to the above, audits by Board of Finance and Devleopment to be reported to the President and by the Ministry of Home Affairs are scheduled for 1984/85.

7) Findings on Organization and Management

PDAM has been taking policy of decentralization to carry out water service in each branch office scattered in the city because of complexity of operation of work due to the increase of population served. As a result, in addition to its Central Office, it has provided 13 Cabangs/Units/Rayons in the city in charge of customer service. In order to manage operation of water service efficiently by decentralization, however, policy of water supply undertaking and also management plan should be clearly directed through the Central Office. Assignment of required number of staff should also be made accordingly. Necessary control and supervision by the Central Office has not been achieved successfully to the operations done by the branch offices. It is strongly desired that clear objective of PDAM water supply policy should be established and improvement of the existing management organization should be made to enable such policy and target be realized.

Considering above finding, following improvement should be made:

a) PDAM's clear objective should be set up and management strategies should be formulated, and be fully recognized by employee.

b) Present organization structure should be improved so as to achieve such objectives.

c) Function of divisions and sections should be established according to the improved structure, and divisional coordination should be attained.

d) To rectify the present imbalanced personnel distribution in areas of technical and administration, recruitment of a number of engineers and technicians should be made to strengthen also manpower capacity in the areas of engineering.

e) Overall personnel policy and administration should be set up to select, train, and utilize capable staff.

f) An appropriate compensation should be assured to attract new applicants as well as encourage employee in PDAM for better achievement of tasks.

g) All employee should be informed of his duties, responsibilities, areas of authority, benefits, and condition of employment at the time of employment.

h) It is required to set up standards of staff performance based on a job evaluation.

i) To let management and administration staff familialize with activities and operation in both central office and

field office, periodical shifts of personnel based on a personnel policy should be arranged.

j) The present information system should be modified up to the level of providing top management with analized technical and managerial information for their quick decision making.

k) Administration and Finance Directorate should well prepare procedures of capital loan repayment administration to the central government that will start in 1984.

PDAM is now undertaking review and detailed study of organization and management through retention of management consultants. The result of review on organization and operation has been drafted, and recommendations suggested which call for PDAM to strengthen further its organization and management procedures. After obtaining approval of the DKI Water Board (Badan Pengawas) and the Governor, effort and actions are required to undertake early implementation of the improvement plan recommended.

8) Future Organization Requirements

It is essential for PDAM to improve its organization and administration system for better operation and maintenance of facilities to be expanded in the Second Stage. It is also required to establish sound management system including financial arrangement and fund for future physical extension program. Future organization of PDAM is considered based on the review and findings of, assessing changes required to enable PDAM to manage the development and operation of water supply systems.

(1) Objectives for PDAM's Future Organization

For the purpose of improvement of PDAM's organization to meet the future requirement, following objectives are to be taken into account.

a) Production and Supply of Safe Drinking Water

It is as ever important for PDAM to produce and supply hygenically safe drinking water to customers continuously supported by a reliable organization, management and legislation.

b) Provision of Maximum Level of Service

Water supply operation should be significant as public service through maximum level of service by PDAM. Effort, therefore, should be made in PDAM to maintain and/or upgrade such level of service.

c) Maximum Utilization

Maximum utilization of the existing water supply facilities in PDAM should be attained through efficient and effective control of every possible resources.

d) Minimum Costs

It is also important for PDAM to provide its customers with required services at the lowest possible costs.

e) Financial Independence

System of financial self-supporting that has the ability to maintain PDAM should further be improved so that the revenue generated by business operation can be used entirely for water supply program.

(2) Short Term Improvement

Along with improvement plan recommended by PDAM's own management Consultant, the following are suggested to be implemented immediately, without extensive reorganization or development of detailed systems and procedures:

a) Technical

(i) Attainment of normal operation of the existing systems and facilities by the operator behavior of action forewarded for better operation and maintenance.

(ii) Development and implementation of operating procedures for optimum use and control of facilities.

(iii) Assignments of delegation to operator in charge to make decision and to take necessary actions without waiting higher level approval.

(iv) Development of records system of major technical operations and performances for future improvement of operation.

b) Administrative

(i) By way of utilizing the result of census program (sensus langganan), implementation of reduction of illegal connections and avoiding meter reading by assumption.

(ii) Improvement of meter reading system and increases of accuracy of meter reading.

(iii) Reduction of account receivable by improving collection system.

(iv) Reduction of administrative leakage by strengthening effort to identify consumption of water by customer in blockwise service area.

(3) Long Term Improvement

In order to facilitate PDAM to operate the expanded facilities in the proposed Second Stage Project, changes and improvements are required raising operation procedures to an adequate level of performance and reliability. One of the most significant changes is the revision of the existing organization structure. As indicated in the organization review, some of the functions have not been well managed, without recognition of functional tasks and target fulfilment. The proper work order based on the principal policy was not formulated at the management level and there was no clear cut tasks of future oriented and ordinary routine. As a result, there are no system of evaluation of works conducted to know the achievement for the set target in the organization. The required change of organization should be the one that can facilitate management of the divisional target and requirement under proper system and procedures in the areas of both technical and administration. These changes refer to the centralization of maintenance activities into larger units with greater capabilities.

Extensive procedures for controlling work will also be required to supplement the organizational changes. These procedures include planning and scheduling for operations in the form of written operating procedures. For that purpose, routine work and nonroutine work are to be clearly distinguished. Planning and programming for system improvement and expansion together with scheduling and estimation are included in nonroutine, and day to day operation and maintenance are included in routine work. Planning and scheduleing systems are only part of the overall program presented for comprehensive of operating and maintenance activities. Management information system is to be improved to make the evaluation of performance and for the development of work standards. The proposed organization for PDAM is presented in Chapter 4 of the Report.

3.9.2 Finance

1) Investment Finance

Construction of water supply facilities for the city of Jakarta has been administered by both the Ministry of Public Works and PDAM. The works and finance for construction of treatment plants, installation of trunk mains, and a part of installation of secondary and tertiary pipes have been managed by the former, and construction of mini-plants, installation of most of secondary and tertiary pipes, and rehabilitation of treatment plants and pipes have been covered by the latter utilizing PDAM's own generated funds and DKI Jakarta's equity financing.

The Central Government, both the Ministries of Public Works and Home Affairs, finances water development schemes of municipalities and local water enterprises from its own development budget and/or external sources, applying either one or a combination of the following guidelines:

- To meet the requirement of water supply up to an average of 60 liters per capita per day, necessary funds will be financed as grant.

- Funding above 60 liters and up to 125 liters per capita per day will be provided by blend of equity and loan.

- Above the average of 125 liters per capita per day will have to be financed fully by loan.

Grant finance requires no repayments of beneficiary municipalities. Typical terms and conditions of loan finance are 20-year repayment period including 6-year grace period at 6-9 percent interest rate, although they vary depending upon negotiations between the central and local government. In case of equity finance, it must be repaid but incurs no interests as long as repayment period is not more than 20 years. If more than 20 years, it bears 6 percent interest.

Financing sources available for the central government are the following four funds:

- Approved Project List Fund (DIP) : normally for grant finance
- State Capital Participation Fund (PMP) : normally for equity finance
- Investment Plan Fund (RDI) : normally for loan finance
- Foreign Aid Fund (BLN)

The facilities constructed under the project management of the Ministry of Public Works are handed over to PDAM against financial obligations of DKI Jakarta/PDAM unless financing condition is grant. The financing conditions for the past and ongoing projects are as follows:

(1) First Phase of First Stage Project

- 60 percent of investment: loan with 9 percent interest per annum and 30-year repayment period including 6-year grace.

- 40 percent: equity with no interest, 6-year grace and 20-year repayment period.

(2) Second Phase of First Stage Project

- Loan for foreign exchange portion with 9 percent interest per annum and 30-year repayment period including 6-year grace.

- Equity for local currency portion with no interest, 6-year grace and 20-year repayment period.

Note: PDAM is not obliged to pay interests during construction.

Future projects are expected to be financed fully by loan since Jakarta's average consumption per capita per day will exceed 125 liters. The likely terms of a loan are 30-year repayment period including 6-year grace at 11 percent interest rate.

2) Tariff

Revision of water tariff has been made every two to four years, and the latest one was made in May 1983. For tariff revision PDAM is required to obtain approval of the Governor and the Local Assembly. The procedures are: i) submission of a tariff proposal from PDAM to DKI Board; ii) from DKI Board to the Governor; iii) from the Governor to the Local Assembly. When approved by the Assembly, the new tariff is enacted as the Governor's Decree. The Ministry of Home Affairs has been preparing general guidelines on a level and structure of water tariff (See Appendix MIII-5); however, they are not mandatory and Jakarta's tariff does not strictly conform with them.

For charging purposes, costomers are divided into four groups: i) non-commercial; ii) commercial; iii) service; iv) others, and these four are further sub-divided into totaling about thirty categories. Residential users are subject to progressive block tariff, which is designed to penalize excessive water use, especially the use of more than 30 m3 per connection per month. More generous progressive tariff is applied to small industry/commerce and offices. Others are charged at a flat rate. Heavy cross-subsidy from the commercial and service users to the residential is observed. As a result, while the residential consume about 43 percent of the total water sold, their contribution to PDAM's water sales revenues is only about 10 percent. (For tariff level and structure, see Appendix MIII-5.)

Although the tariff increase in May 1983 brought up the average rate from Rp. 100/m3 to Rp. 250/m3 which cannot be considered as low comparing to levels of other developing countries, a decrease in total water consumption from the previous year's level was very small. This result, together with the fact that people living in the water-scarece part of the city are paying at an extreamly high rate to water vendors, may suggest that people's willingness to pay for water is very strong and that demand is not significantly sensitive to a price level. Interpreting this with an affordability viewpoint, it might be said that there is still room to raise tariff for financing future investment for expansion and improvement. At present, middle income families with monthly revenues of Rp. 75,000 to 150,000 are estimated to be paying about 1.4 percent of their income. This percentage is still below the generally accepted rules of thumb of the 4 percent ceiling.

However, it is difficult to obtain assurance regarding whether the present level of connection charges, which is estimated to amount to about 2 month worth of middle income familiers' income, is affordable for the majority of potential customers. It may be necessary, when production and distribution facilities are sufficiently expanded to meet the demand, to counter the charges' demand suppressing effect by taking such measures as reducing the charging level or introducing an installment plan for new connections.

3) Financial Performance

PDAM's total revenue reported in the income statement of 1983/84 was almost doubled from the previous year's level of Rp. 13.7 billion to Rp. 25.3 billion as the result of the tariff increase in May 1983. Water sales comprised 83 percent of the total revenue and 16 percent came from connection charges. Among the 1 percent balance, some extraordinary items such as interest earnings and revenues from resale of old vehicles were included. However, since their amounts were very small comparing to the total revenues, it can be said that almost all the PDAM's revenues come from ordinary water supply operations.

The largest contributor to PDAM's water sales revenues, as shown below, is Port Tanjung Priok (30.9 % of the total), followed by Trade and Service (29.4 %). These two categories comprise more than 60 percent of water sales while consuming 20 percent of sold water. As mentioned earlier, Residential shares only 10 percent of the water sales revenues.

Categories	% Share in Water Sold	% Share in Water Revenue
Residential	42.7	10.1
Hydrants	4.0	2.0
Public	15.1	13.4
Industry	3.5	4.4
Trade and Service	14.3	29.4
Port Tanjung Priok	6.3	30.9
Armed Forces	11.9	9.3
Depok	2.2	0.5
Total	100.0	100.0

About 8 - 13 percent of billings of Water Sales are not collectable and contributing to build up a fairly large accounts receivable, which amounted to 4.3-month worth of water billings at the end of 1983/84. PDAM has been maintaining a principle to write off these bad debts when they have outstood for more than 5 years; however, this rules has not been strictly enforced. (For details, see Appendix MIII-5.)

In addition to the above revenues stated in the income statement, PDAM collected about Rp. 6 billion ground water charges in 1983/84 on behalf of DKI Jakarta. Then, more than half of them were paid out to DKI and the balance was entered into the balance sheet as Equity of Local Government. It is a basic policy of DKI to use these ground water charges for PDAM's investments for improvement and expansion of water supply systems and, eventually, to reduce dependence on ground water. The amount of each year's equity contribution, i.e., the balance of PDAM's gross collection less payment to DKI, is determined based on the discussion between DKI and PDAM considering PDAM's investment requirements and availability of internally generated funds.

Major components of Rp. 12.3 billion operating expenses were: personnel (21 %), power (21 %), chemicals (17 %), administration (12%), maintenance (10 %). The raw water cost to the Jatiluhur Authority at the rate of Rp. .5/m3 totaling Rp. 47 million comprised less than one percent of the total operating expense in 1983/84; however, this unit rate will be increased to more than Rp. 10.0 within 5 years and some impacts on PDAM's cost structure are expected.

In depreciating fixed assets, PDAM had applied the following rates up to 1982/83:

Items	Service Life	Yearly Depreciation
- Buildings, structures, pipes, and mini-plants, etc.	40.0 years	2.5 %
- Treatment plant :	14.3 years	7.0 %
- Machineries, equipment, deepwells, hydrants, office supplies, etc. :	10.0 years	10.0 %
- Meters, Vechicles, etc. :	5.0 years	20.0 %

PDAM switched the rates for buildings, pipes, and treatment plants to 5.0 percent, 10.0 percent, and 8.0 percent, respectively, from 1983/84. Accordingly, the amount depreciated increased largely comparing to the previous year.

PDAM had been excempted from tax payments since its establishment; however, it has become subject to income tax from 1984/85 according to the following schedule stipulated in the Income Tax Law (1983 No.7, Chapter IV, Article 17):

Net Income	Tax Rate
Rp. 0 - 10 million	15 percent
Rp. 10 - 50 million	25 percent
Rp. more than 50 million	35 percent

By the Governor's Decree, PDAM has to dispose its surplus funds from yearly operations according to the following schedule and is not allowed to retain funds for other than those stipulated below:

- 50 percent: contribution to DKI's budget
- 15 percent: production service (productivity bonus for PDAM's employees)
- 15 percent: social/pension funds
- 20 percent: PDAM's reserve

The Minister of Home Affairs has made a request to the Governor of each region to refrain from taking funds out of PDAMs and to use the funds for investments in water supply improvement/expansion.

Financial performance indicators summarized below tell us that PDAM's financial position, especially after the tariff revision in May 1983, is very healthy, showing low working ratios (defined as operating expenese exclusive of depreciation divided by operating revenues), low operating ratios (operating expenses inclusive of depreciation divided by operating revenues), high rates of return on fixed assets, and low debt/debt & equity ratio. (For detailed financial statements, see Appendix MIII-5.)

These indicators were calculated based on PDAM's reports which, in fact, need some modifications to reflect true positions. For instance, calculation of working and operating ratios including bad debts in the denominator yields better figures. In light of this, revised estimates were prepared. (For estimation procedures, see Appendix MIII-5.) Yet, the working and operating ratios stand at a favorable level of 62 percent and 75 percent, respectively.

The relatively high rates of return on average net plant in operation are partly owing to inadequacy in recording the value of fixed assets. For example, most of pipes installed before 1970 are not recorded in PDAM's balance sheet. Furthermore, general price increases have become a cause of under-stating the value of old assets. An experiment to re-value PDAM's fixed assets ended up with almost 4-5 times increase in assets value. (For revaluation procedures, see Appendix MIII-5.)

Summary of PDAM's Financial Performance

(Unit : Rp. million ; percent)

	1981/82	1982/83	1983/84	1983/84 (revised)
Operating Revenues	10,749	13,722	25,291	22,297
Operating Expenses	7,053	9,659	12,256	12,256
Depreciation	1,461	1,731	2,797	3,766
Net Income	2,235	2,332	4,607 1/	6,275 1/
Contribution to DKI	1,235	1,118	- 1/	- 1/
Working Ratio	66	70	48	62
Operating Ratio	79	83	60	75
Rate of Return	14	13	24	2 2/
Debt 3/ /Debt & Equity Ratio	-	-	-	23

Note : 1/ Figures not yet confirmed
2/ Rate on revalued fixed assets
3/ Long-term debt only

Debt-Service payments have never been entered into PDAM's financial statements, but repayments of loan and equity for the past investments are scheduled to start from 1984 according to the following schedule:

	1984/85	85/86	86/87	87/88	88/89	89/90
Interest	576	1,141	2,160	3,287	5,383	5,176
Amortization	79	170	669	1,241	2,309	5,346
Total	655	1,311	2,829	4,528	7,692	10,522

4) Improvement Required

In order to strengthen PDAM's financial capabilities for generating sufficient funds to meet the financial requirements of further expansion and improvement projects, the review of financial matters described in the preceding sub-sections suggests that efforts should be forcused on the following issues:

In the light of vast financial requirements for meeting the people's needs for drinking water supply and recent stringent financial conditions of the central government, PDAM's capabilities to share the burden of investment costs must be strengthened. In this connection:

a) Tariff should be reviewed every year and revision, if necessary, should be made with greater flexibility. Affordability, in addition to PDAM's financial requirements, should be carefully examined in determining the water rate and connection charges. Furthermore, tariff should be designed not to discourage people currently relying on ground water to use piped water.

b) Administrative loss of revenues, i.e., delinquencies in paying water bills and administrative unaccounted-for water should be reduced to a greater extent.

c) Meter installation, propoer meter maintenance, and correct meter reading should be regarded as a prerequisite for reducing the administrative loss.

The funds generated by PDAM must be used solely for expansion and improvement of water supply facilities and should not be taken out of PDAM to use for other purposes. In this connection:

d) Tax obligations imposed on PDAM should be reconsidered by the authorities concerned.

e) Contribution to DKI budget also should be reconsidered.

f) Surplus funds should be accumulated in the hands of PDAM in order to flexibly meet the varying levels of cash outlay. It would happen, depending upon schedule of investment and repayment, that substantial cash surplus is generated in some years and serious shortages in other years.

In order to effectively invest the generated funds and to determine the degree of dependence on outside financial sources, it is necessary to prepare appropriate financial planning based on data and information which correctly reflect the existing financial operation and performance. In this connection:

g) Medium and long-term financial plan should be prepared. Such plan should continuously be revised taking into consideration changes in later years.

h) Accrual basis accounting should be fully implemented.

i) Assets including inventories should be appropriately recorded paying particular attention to their aquisition date and valuation.

j) External audit by public accountant should be recognized, and be fully utilized, as an effective means to establish appropriate accounting systems and practices.

The two-year program of a detailed management study covering most of the above items is now under way by PDAM consultants and is expected to be completed by the end of 1984. The study is supposed to make recommendations and to prepare an implementation program for improvement. It is expected that PDAM will pay due attention to the study results and take actions in accordance with the recommendations wherever relevant.

3.10 Legal Status of PDAM JAYA

The present legislations and laws that support the operation of PDAM Jaya were reviewed in terms of technical as well as financial capacity. PDAM is now undertaking water supply business operation on the legal base of Law No.3, year 1977, Regional Regulation of the Capital Special Region of Jakarta and Regulation No. 664, year 1980, concerning Structure of Organization and Task Assignment of Municipal Water Enterprise of the Capital Region of Jakarta, and the Letter of Decision from the Director of "PAM JAYA" No.23.PAM/DIR/1980.

1) Regulations Concerning Operation of PDAM JAYA

(1) Law No.3, year 1977, Establishment and Management of Water Supply Enterprise, PAM JAYA

This Regional Regulation was drafted basically matters related with the arrangement and management of regional water supply enterprise the Capital Special Region of Jakarta that replaces the former "PAM JAYA" (old) that has been established since the year 1968 based on the Decision of the Governor/Head of Region No. Ib.3/3/22/1968 on the date 10 of December 1968 that has been modified lastly by the Decision of the Governor/Head of Region No. D.V.-b, 16/1/4/1973 on the date 13 of August 1973. This replacement is to heighten the status and function of "PAM JAYA" to be a Regional Company, according with the letter from the Minister of Home Affairs No. Ekbang 8/3/11 dated 31 of July 1973 by noticing to the status as listed in the Law Number 5, 1962 concerning Regional Company jo. the Law Number 6 year 1969, State Page year (1969 Number 37). The heightening of status to be the Municipal Regional Company of the Capital Special Region of Jakarta is made in the frame of the Regional Government's effort to heighten the function of public-service in the fields of municipal water supply and distribution that comply to the requirements of public health.

(2) Regulation No. 664, year 1980, Structure of Organization and Task Assignment of Water Supply Company of the Capital Special Region of Jakarta

This Regulation was issued as the Governor's Decree to abolish the former Decision from the Governor/Head of the Capital Special Region of Jakarta No. D. Vb 16/1/4/1973 dated 13 August 1973 to establish again the structure of organization and task assignments of "PAM JAYA" considering the Regional Regulation No.3 year 1977 with an eatablished policy of developing the undertaking and improving the public service in the field of municipal water supply. This regulation provided the following:

- Placement of management group consisting of a Director who is assisted by 3 (three) persons of Deputy-Directors.

- Establishment of coordination between Municipal Government DKI and "PAM JAYA": Coordination of District Secretary and Directorate V/Economy with Business, Administration and Finance, Directorate IV/Development with Technology.

- Structuring of "PAM JAYA" organization.

- Formation of a governing and policy making supervisory body in the form of a Badan Pengawas.

- Difinition of the structure of "PAM JAYA" from supervisory body to field level.

(3) Letter of Decision from the Director of PAM JAYA, No.23/PAM/DIR/1980 concerning Job Specification and Work Order

This Letter was issued to establish structure of organization, job specification and work order of PAM JAYA in the more specified and integrated organizational unit component, considering the establishment of the Decision of Governor/Head of the Capital Special Region of Jakarta 23 of June 1980 No.664, year 1980. This Letter of Decision provided the following:

- Establishment of structure of organization, job specification and work order of "PAM JAYA".

- Organizing the tasks to create efficient and effective work-results.

2) Summary of Review

It is clear that PDAM's financial accounting system is separated from the general budget of Municipal Government of DKI, according to the Regulation No.3 year 1977. This means that all assets and capital under the control and management of PDAM Jaya belong to PDAM as separated assets from DKI. The Regulation stipulated that PDAM Jaya can obtain fund from domestic or foreign credit or from obligations by the agreement from the Governor/Head of Region in accordance with the valid regulation. While, Supervisory Body (Badan Pengawas) was formed to formulate the policy of management of "PAM JAYA". The function of Badan Pengawas is the policy making and daily control of management. However, the governing control of the Badan Pengawas is influential in the overall activities of PDAM and any of the procedures should sometime be subject to approvals of Badan Pengawas and Governor, DKI. Since PDAM is free from any control of Pengawas to operate and maintain its facilities, more independence in terms of financial operations and technical activities should be ensured.

There is no stipulations in the Regulation to give power to PDAM to inspect other premises, nor right-of-way for maintenance and new construction. There is neither punitive provisions to discourage illegal connections and collect overdue debts.

The existing Law No.3, year 1977 stipulates establishment and management of the Water Enterprise, and gives legal support for PDAM to undertake operation of the Enterprise, and its management control. Other Regional Regulation No.664, year 1980 stipulates PDAM structure of organization and task assignment. Considering the recent water supply development which is complicated and diversified the present legislation does not necessarily meet such requirement. It is, therefore, important to prepare laws and regulations that will strongly and legislatively support PDAM to give adequate powers to carry out its operation including provision of water tariff and collection of revenue, right of access and right-of-way, and necessary punitive provision to discourage illegal connections and collect overdue debts. PDAM is now drafting (i) Supplement to the Regional Gazette in the form of Ordinance, and (ii) Decree of Decision of the Governor/Head of the Special Region of the Capital Region of Jakarta. The former Ordinance provided the following:

- Orderly and efficient regulation of utilization of water so as to meet the increasing demand of the community.

- Synchronization of utilization of drinking water with any and all activities in order to maintain the preservation of the supply of water.

- Provision of new ordinance on the water supply within the territary of the Special Region of the Capital City of Jakarta in terms of the distribution of water from water works of the Municipality of Jakarta Raya (Gazette of the Municipality Year 1957 Number 15) .

The latter dicision of the Governor provided to form a Drinking Water Control Team to take measures for a complete, directed and integrated control and supervision.

This Ordinance constitues the re-enactment and providing a substitute for the Regulation on the Distribution of water in Jakarta Raya laid down in the Ordinance of the Municipality of Jakarta Raya of the year 1957. The re-enactment of this Ordinance (Municipal Regulation) is intended to regulate the utilization of water, in particular the drinking water, efficiently and effectively so as to realize the equalization of the procurement of drinking water and the maintenance of the preservation of the water sources and the capacity of the Regional Administration to supply drinking water according to the need of the population. The Ordinance is also intended to regulate the system of management and distribution of the drinking water in line with the existing capacity and facilities.

The Ordinace stipulates fixture of water tariff and rental of water meter, and disconnection of water in case of delinquent bill. Stipulation articles of prohibition and penal provisions are also included in the Ordinance. It is felt that this Ordinance covers the most of provisions that are required, however, lacked in the existing regulations, and issuance of the Ordinance will enable PDAM to be rested more legislative power in the management of the Enterprise. It is considered that an early enactment of the Ordinance is therefore, strongly recommended.

4. MASTER PLAN UP TO THE YEAR 2005

4. MASTER PLAN UP TO THE YEAR 2005

This chapter describes the water supply master plan up to the year 2005 conceived based on the results of studies described in the foregoing chapters.

The system improvements are divided into two-staged major improvement named as Second Stage and Third Stage which will follow the presently ongoing First Stage project. An immediate program is initiated in early stage of the Second Stage Project. The immediate program and the staged expansion program are discussed in section 4.5 and 4.6 respectively.

The immediate program includes those items of work which should be implemented immediately, including existing system improvement and rehabilitation, and construction of a new plant using surplus raw water in the enlarged West Tarum canal.

The existing water supply system will recover its design capacity by rehabilitating and improving the plant facilities and distribution pipe systems under the proposed immediate program which is to be implemented concurrently with the construction of new expansion works of water supply system.

The major Second Stage project is divided into two phases and the Third Stage project is also divided into two phases of expansion work, which should be reveiwed at a later stage to update the Third Stage program of the master plan.

The master plan will be presented in the followig manner:

1) to define the service area,
2) to forecast population served and water requirement,
3) to select water sources,
4) To identify immediate program including rehabilitation and improvement of existing system and immediate expansion of the system,
5) to determine treatment processes based on raw water quality of the selected water resources,
6) on these basic factors clarified, to propose the water supply system to be contructed,
7) to estimate construction costs, and then
8) to prepare an overall implementation schedule

Staging of the whole construction will be clarified in the implementation schedule, and also the relationship between the water requirement and the capacity of the water supply system will be made clear in the schedule. Out of the staged projects, a project which is to be implemented in the immediate future will be recommended for feasibility study.

4.1 Service Area and Population Served

4.1.1 Service Area

The Area to be served by future water supply system are determined as described below, taking into account the following information and data, and by the field investigation conducted by the Study Team. (For detailes refer to Appendix MIV-1.)

1) City Plan and Land Use Plan :

DKI Jakarta has been diveloping City Master Plan with a long range target up to the year 2005. The Master Plan has prepared a general land use plan for the year 2005 which covers the city administrative area. While this land use plan is not officially approved yet by City Planning Board, this is considered to provide a basic guideline in identifying direction of development, which would give a general concept in considering future service area.

2) Population Density :

Population density, present and future, is also to be considered as one of the factors in determining boundary of service area for most feasible system extension. The densely populated area will pollute groundwater quality, so that the people using groundwater and living in the densely populated area will gradually rely on piped water.

For the above purpose, and reason, population density of such areas to be considered is proposed basically above 150 persons per hectare for the planning purposes.

3) Highway and Public Road Plan :

Highway and public road construction plans provided in the Master Plan has been referred to and considered in planning the service area, as this would reveal information on future extension of city activities such as housing and commercial establishment development due to better transportation.

Based on the above concept, the future service area up to the year 2005 is proposed as shown on Fig. 4-1, and in Table 4.1.

Table 4.1 Service Area

Year	Service Area (km2)	Percentage (2)
(1) 1980	283	44 %
1985	283	44 %
1990	338	53 %
1995	383	59 %
2000	414	64 %
2005	454	71 %

Note : (1) Present service area as of June 1983, is applied for service area in the year 1980 and also in the year 1985.
(2) Percentage to Total Administration Area of 644 km2.

4.1.2 Population in the Service Area

Based on the population distributed to the area, Kotamadja/Kecamatan in the DKI boundaries as shown on Fig. 4.1, population in the service area up to the year 2005 by five years intervals is projected and is shown in Table 4.2.

Table 4.2 Population in Service Area

Year	Service Area (Km2)	Pop. In Service Area	Pop. In DKI boundaries
1980	283	4,949,000 (76 %)	6,468,500
1985	283	5,372,000 (70 %)	7,630,100
1990	338	6,538,000 (74 %)	8,872,900
1995	383	8,002,000 (80 %)	9,949,600
2000	414	9,092,000 (83 %)	11,004,900
2005	454	10,496,000 (87 %)	11,998,900

In the above estimate, the population in the districts, not fully covered by the projected service area, is estimated on the basis of population density and area to be included in the service area.

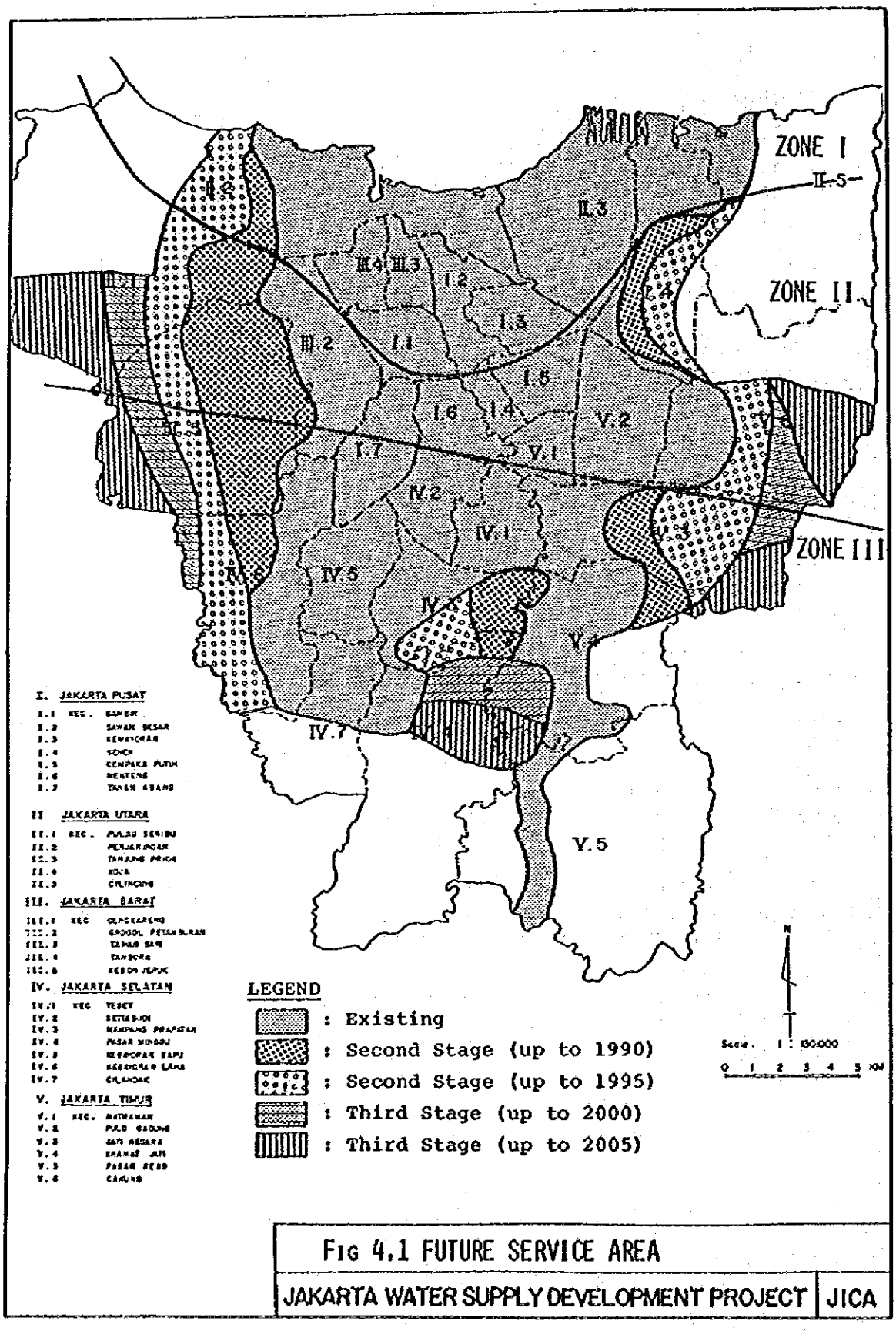

FIG 4.1 FUTURE SERVICE AREA

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4.1.3 Population Served

As of the year 1980, the population served is estimated at approximately 2,100,000 which is 42 percent of population within the service area of the year.

Future population served up to the year 2005 is estimated by taking procedure as described below.

Following the projection of population in the service area, in the preceeding sub-section 4.1.2, population to be served in the future service area which is distributed in accordance with physical zone and income level is developed by applying the following assumption to each group in the physical zone. (For detailes refer to Appendix MIV-1)

Zone I : All people living in this zone of northern coastal area, depend only on piped water for domestic purpose.

Zone II : The higher income group use more piped water, while the lower income group rely more on groundwater.

Zone III : Groundwater is used not only by low income group, but also by high income group, because of the higher availability of groundwater rather than Zone II.

The Study on physical zone and study on income levels and this distribution are described in detail in section 2.2 Socioeconomic Aspects seperately prepared to this portion.

Percentages applied for projection of population served to the population, distributed to physical zone and further income group, in the service area are proposed, considering the availability of groundwater in the physical zone as shown in Table 4.3.

Table 4.3 Percentage Applied For Projection of Population Served

	Income Group I %	Income Group II %	Income Group III %	Income Group IV %	Income Group V %
Zone I	100	100	100	100	100
Zone II	100	100	100	100	100
Zone III	30	40	60	80	90

Population served projected by five-year intervals is summarized in Table 4.4.

Table 4.4 Population Served VS Population in Service Area

Year	Service Area (km2)	Population Served		Population in Service Area		Population in DKI boundaries
1980	283	* 4,024,000	(62 %) (81 %)	4,949,000	(76 %) (100 %)	6,468,500
1985	283	4,419,000	(58 %) (82 %)	5,372,000	(70 %) (100 %)	7,630,100
1990	338	5,357,000	(60 %) (82 %)	6,538,000	(74 %) (100 %)	8,872,900
1995	383	6,523,000	(66 %) (81 %)	8,002,000	(80 %) (100 %)	9,949,600
2000	414	7,497,000	(68 %) (82 %)	9,092,000	(83 %) (100 %)	11,004,900
2005	454	8,784,000	(72 %) (84 %)	10,496,000	(87 %) (100 %)	11,998,900

* Population served in 1980 shows tha figure of potential population served calculated under the assumption as shown in Table 4.3, while the estimated served population is 2,100,000, which was calculated using the number of connections, the number of persons per connection, and per capita consumption. It is considered reasonable to assume that if the supply capacity were not limited, the potential population might be served.

4.2 Water Requirement

4.2.1 Water Demand Projection

Details of water demand projection are presented in Appendix MIV-1, as a separate report. For water demand projection, some assumption were made. In the following paras, such assumptions and the results of projection are described.

1) Major Assumptions

a) Categories of Consumers

The present water demand projection employes the following categories, although PDAM has, at present, 26 categories. As the present domestic consumption is above 40 % of total consumption, the consumers will be first classified into two major categories, i.e., Domestic and Non Domestic, and both further into smaller categories.

A. Domestic Use

A-1 Residential service connections
A-2 Public hydrants

B. Non-Domestic Use

B-1 Public Use
- a. Government offices
- b. Schools
- c. Religious Places
- d. Hospitals (Government and Private Hospitals)
- e. Boarding Houses

B-2 Industrial Use
- a. Industries (Industrial Enterprises and Store Houses)
- b. Small Industries

B-3 Trade and Services
- a. Hotels
- b. Trade and Services (Trade Enterprise, Bank, Judge/Lawyer, Taylor, Streambath, Night Club, Barbershop, Service Station, Gp Doctor)

B-4 Port Tanjug Priok

B-5 Armed Forces (Military Installation)

B-6 Depok National Housing (Depok)

b) Unit Consumption

For domestic use:

Income groups I and II	30 lpcd
Income groups III and IV	150 lcd
Income group V	250 lcd

For non domestic use:
Based on the past consumptions, unit consumptions are assumed, and in forecasting future consumptions, some adjustments are allowed for.

c) Bulk Supply for Depok

Depok National Housing is presently receiving 65 l/sec, 5,600 m3/d from the Ciburial Spring (300 l/s) System diverted at Depok from the trunk main. It is assumed that this diversion will remain up to the year 1993.

2) Unaccounted-for Water

The overall unaccounted-for water at present is estimated at 54 %. For the development of the water supply system, the following figures, as considered appropriate under the rehabilitation program proposed in master plan, are employed in projecting necessary water production.

1) Unaccounted-for water will be reduced to 25 % in the year 2005.
2) Annual reduction of unaccounted-for water will be targeted at the figures tabulated below.

Year	Decrease of Unaccounted-for water	Unaccounted-for water
1980		54 %
	2 %	
1985		49 %
	4 %	
1990		40 %
	4 %	
1995		33 %
	3 %	
2000		29 %
	3 %	
2005		25 %

* The percentage is the rate of annual descrease against the previous year's percentage.

3) Summary of Projection

The results of projection made using the above assumption, are summarized in Table 4.5.

Table 4.5 Summary of Projection

CLASIFICATIONS	1980	1985	1990	1995	2000	2005
A. Domestic Use						
A-1 Residential Service Connections	101.0 (212.0) *	313.7	477.1	698.5	923.4	1,204.7
B-1 Public Hydrant	9.1 (85.3)	83.1	88.2	92.3	90.8	90.6
Total A (A-1 and A-2)	110.1 (297.3)	396.8	565.3	790.8	1,014.2	1,295.3
B. Non-Domestic Use						
B-1 Public Use						
a. Government Office	54.9	51.9	37.4	29.7	34.8	40.7
b. Schools	1.2	5.9	17.1	39.1	48.3	65.4
c. Religious Places	0.6	3.4	10.4	25.1	28.8	33.0
d. Hospitals	4.3	5.2	6.3	7.5	8.4	9.2
e. Boarding Houses	5.2	5.8	6.5	7.2	8.0	8.9
	66.2	72.2	77.7	108.6	128.3	157.1
B-2 Industries Use						
a. Industries	4.8	14.2	38.6	75.2	123.5	182.7
b. Small Industries	4.9	6.9	11.2	15.1	21.1	31.4
	9.7	21.1	49.8	90.3	144.6	214.1
B-3 Trade and Service						
a. Hotels	7.9	8.6	12.5	18.9	26.4	38.0
b. Trade & Service	21.5	33.6	56.8	92.4	157.8	248.2
	29.4	42.2	69.3	111.3	184.2	286.2
B-4 Port Tanjung Priok	13.5	15.3	17.3	19.5	22.7	26.3
B-5 Armed Forces	(30.0)	35.4	41.1	46.2	51.0	55.6
B-6 Depok	5.6	6.0	6.0	6.0	6.0	6.0
Totals (B1 thru B-6)	124.4 (154.4)	192.2	261.2	381.9	536.8	745.3
Total Average Demand Net Consumption A thu B	234.5 (2700) 451.7 * (5,200)	589.0 (6,800)	826.5 (9,600)	1,172.7 (13,600)	1,551.6 (18,000)	2,040.6 (23,600)
Unaccounted-for Water (% of Production Required) (Case 3)	275.5 (54)	565.9 (49)	551.0 (40)	557.6 (33)	633.8 (29)	680.2 (25)
Production Required (In Average (1,000M3/Day) (l/sec)	510 (982.0) * 5,900 (11,400) *	1,154.9 13,400	1,377.5 15,900	1,750.3 20,300	2,185.4 25,300	2,720.8 31,500
Total Population Served (in 1,000 persons)	2,100 4,024	4,419	5,357	6,523	7,497	8,784
Gross Percapita Demand (lpcd)	243 (244) *	261	257	268	291	309
Day Maximum Demand (l/Sec) (Day Average x 1.15)	6,800 (13,100)*	15,400	18,300	23,300	29,100	36,200
Raw Water Requirement (l/sec) (Day Maximum x 1.07)	7,300 (14,000)	16,400	19,600	24,900	31,100	38,700

* Potential water demand projected for the year 1980

4.2.2 Water Demand and Proposed Production

Based on the projected water demand so far made, a schedule of water supply is prepared as shown on Fig. 4.2. In preparing the schedule, the following matters are taken into consideration.

1) Three mini plants of Muara Karan, Sunter and Pesing will be put out of regular service and maintained for emergency use or standby.

2) Bogor Ciburial Spring water, 300 l/sec, will be wholly supplied to the Depok housing area, including the areas along the tunk main after year 1994. (See Table 4.6)

To cope with the increasing water demand, the schedule of water supply expansion on the other hand is worked out based on the following consideration.

1) For realistic and resonable implementation of the expansion project, the long range project will be staged as Stage II up to year 1995 and Stage III from 1966 to 2005.

2) Considering the acute shortage of water, prevalent now and around the year 1988, an immediate project will be planned, which is incidentally possible as a result of the West Tarum Canal enlargement.

3) For the water demand after the immediate project onward, water source will become available, as the Government is now carrying out various studies of water resources developmnet.

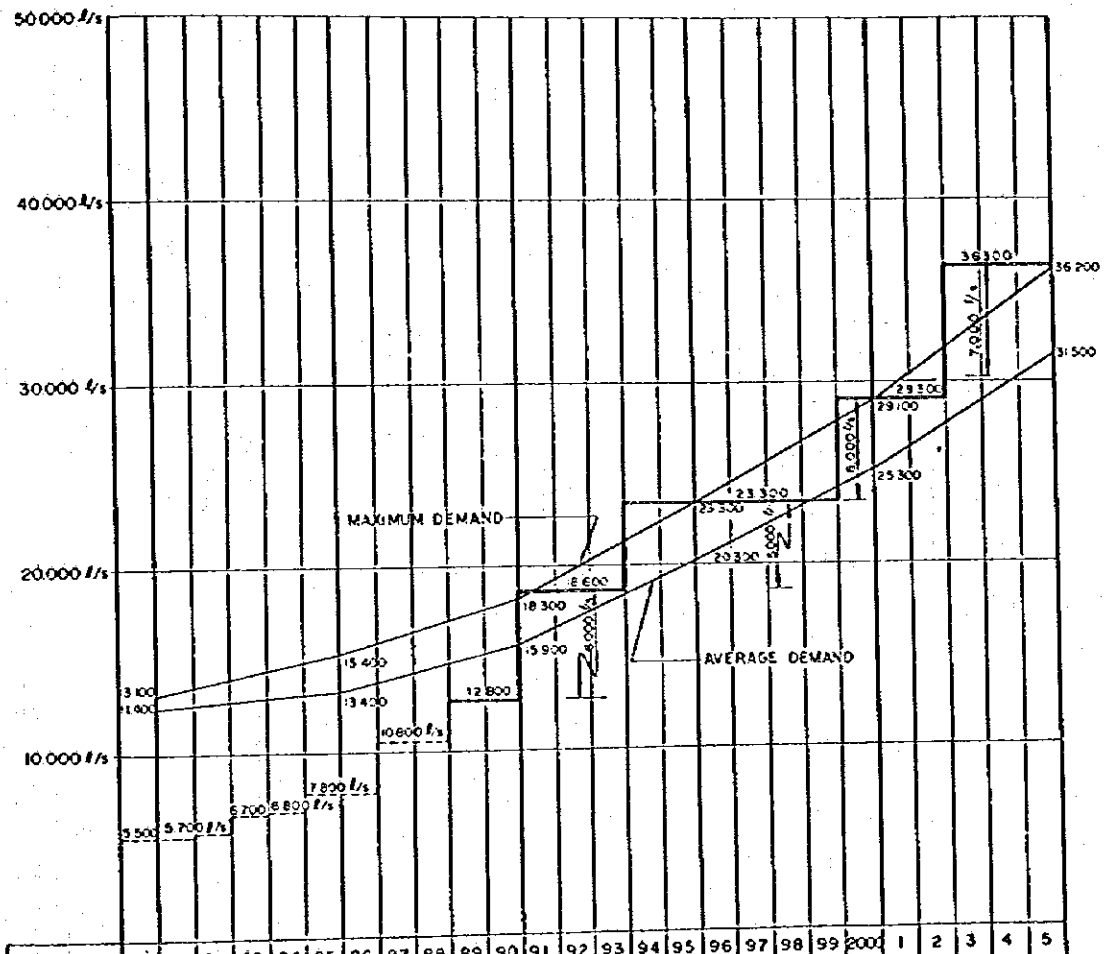
4.2.3 Groundwater Requirement

1) Domestic Use
Groundwater requirement for domestic use is calculated based on the estimated per-capita groundwater demand shown on Table 4.7.

Applying per-capita groundwater demand to population served (Lower income groups I and II) by zone and population not served by piped water in Jakarta administrative area, potential domestic groundwater demand is computed.

2) Non-Domestic Use
Groundwater demand of non-domestic use is calculated applying same unit consumption, adoppted for projection of piped water requirement to each non-domestic use, to the consumers not served by piped water in Jakarta administrative area (Total non-domestic consumer less number of consumers supplied by piped water)

The summary of the projected potential groundwater demand is shown in Table 4.8.



YEAR	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5
PHASING	1ST PHASE			2ND PHASE				IMM	1ST PHASE			2ND PHASE					1ST PHASE					2ND PHASE				
	FIRST STAGE							SECOND STAGE									THIRD STAGE									
EXISTING PRODUCTION	5 500 l/s (475 000 m³/d)	5 700	6 700	6 800	7 800 l/s (588 000 m³/d)			10 600	10 600 l/s (915 300 m³/d)			10 600 l/s (915 000 m³/d)			10 300 l/s (889 000 m³/d)		10 300 l/s (889 000 m³/d)				10 300 l/s (889 000 m³/d)				10 300 l/s (889 000 m³/d)	
NEW TREATMENT PRODUCTION									2 000 l/s (173 000 m³/d)			8 000 l/s (691 000 m³/d)			13 000 l/s (1 123 000 m³/d)		18 000 l/s (1 556 000 m³/d)				28 000 l/s (2 419 000 m³/d)					
TOTAL PRODUCTION	5 500 l/s (475 000 m³/d)	5 700	6 700	6 800	7 800 l/s (588 000 m³/d)		10 800	12 600 l/s (1 088 000 m³/d)				18 600 l/s (1 607 000 m³/d)			23 300 l/s (2 012 000 m³/d)		28 300 l/s (2 445 000 m³/d)				38 300 l/s (3 308 000 m³/d)					

FIG 4.2 WATER DEMAND AND PROPOSED WATER PRODUCTION

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Table 4.6 PRODUCTION CAPACITY BY SYSTEM

SYSTEM	PRESENT RATED CAPACITY (l/sec)	YEARS IN SERVICE
SURFACE WATER SYSTEM		
PEJOMPONGAN I	2000	1957
PEJOMPONGAN II	3000	1973
PULOGADUNG	1,000	1982
(MINI – PLANT)		
(CILANDAK) (Krwcul Rwer)	200	1977
PESING (Angke River)	5	1980
MUARA KARANG (Banjir Canal)	100	1982
CENGKARENG (Angre River)	50	1982
SUNTER (Sunter River)	50	1982
CAKUNG (Irrigation Canal)	25	1982
PEJATEN (Ciliwing River)	5	1976
(CONDET) (Ciliwing River)	–	–
(TAROGONG) (Grogol River)	–	–
SPRING SYSTEM		
BOGOR CIBURIAL SPRING	300	1922
DEEP WELL SYSTEM		
DEEP WELL	0.20)	
PROPOSED NEW TREATMENT PLANT		
IMMEDIATE PROGRAM OF STAGE II		
FIRST PHASE OF STAGE II		
SECOND PHASE OF STAGE II PROGRAM		
FIRST PHASE OF STAGE III PROGRAM		
SECOND PHASE OF STAGE III PROGRAM		
TOTAL PRODUCTION	6.735 l/s	

PROPOSED PRODUCTION CAPACITY BY SYSTEM (l/sec.)

	1983	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5
PEJOMPONGAN I		2000				2000					2000					2000					2000		
PEJOMPONGAN II		3000				3000					3000					3000					3000		
						600					600					600					600		
PULOGADUNG		1000				1000					1000					1000					1000		
					EXPANSION		3000				3000					3000					3000		
(CILANDAK)		200				200					200					200					200		
				EXPANSION		250					250					250					250		
PESING		5				5					5					Stand – By or Emergency Use					5		
MUARA KARANG		100				100					100					100					100		
						100					Canal Extension Program												
CENGKARENG		50				50					50					50					50		
SUNTER		50				50					50					Stand – By or Emergency Use Only							
CAKUNG		25				25					25					25					25		
PEJATEN		5				5					5					5					5		
(CONDET)		100			NEW MINI PLANT						100					100					100		
(TAROGONG)			100		NEW MINI PLANT						100					100					100		
BOGOR CIBURIAL SPRING		300				300					300					300					300		
DEEP WELL																							
IMMEDIATE PROGRAM OF STAGE II							3000				2000					2000					3000		
FIRST PHASE OF STAGE II											6000					6000					6000		
SECOND PHASE OF STAGE II PROGRAM												5000				5000					5000		
FIRST PHASE OF STAGE III PROGRAM																	6000				6000		
SECOND PHASE OF STAGE III PROGRAM																					7000		
TOTAL PRODUCTION	6.735 l/s	6.835	7.785	7.785					18 830 l/s		23.330 l/s			23.330 l/s			29.930 l/s		29.930 l/s			36.330 l/s	
		6.700	6.800	7.800	10.600	12.600 l/s			18 600 l/s		23.300 l/s			23.330 l/s			29.300 l/s		29.300 l/s			36.300 l/s	
YEAR	1983	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5

Table 4.7 Unit Water Consumption by Various Water Source
(For Domestic Use)

Physical Zone	Income Group	Unit Water Consumption (lpcd)							
		Population Served by Piped water				Population Not Served by Pipe water			
		Piped water	Ground water	Others	Total	Piped water	Ground water	Others	Total
I and II	I and II	30	25	5	60	-	55	5	60
	III and IV	150	-	-	150	-	100	-	100
	V	250	-	-	250	-	250	-	250
III	I and II	30	20	10	60	-	50	10	60
	III and IV	150	-	-	150	-	100	-	100
	V	250	-	-	250	-	250	-	250

Table 4.8 Jakarta Groundwater Potential Requirements

(1980 - 2005)

1. Total Area

Description	1980	1985	1990	1995	2000	2005
1. Domestic	231.4	312.1	364.7	372.7	401.1	389.3
2. Public	41.1	49.3	44.2	19.6	20.0	17.4
3. Industries	161.0	179.6	182.4	171.3	144.3	101.1
4. Trade & Service	123.0	140.8	154.5	162.9	152.2	129.9
Total (x 1,000 m3/day)	556.5	681.8	745.8	726.5	717.6	637.7
Total (m3/sec)	6.4	7.9	8.6	8.4	8.3	7.4

2. Zone I

Description	1980	1985	1990	1995	2000	2005
1. Domestic	39.6	40.7	43.5	42.4	41.8	41.4
2. Public	9.9	9.9	8.1	0.8	0.9	1.2
3. Industries	83.9	84.8	76.3	56.5	32.8	0.4
4. Trade & Service	36.5	38.8	39.4	38.0	32.4	24.1
Total (x 1,000 m3/day)	169.9	174.2	167.3	137.7	107.9	67.1
Total (m3/sec)	2.0	2.0	1.9	1.6	1.2	0.8

3. Zone II

Description	1980	1985	1990	1995	2000	2005
1. Domestic	54.4	71.0	72.3	74.7	80.2	66.2
2. Public	10.5	12.5	10.6	5.0	4.8	3.7
3. Industries	63.0	75.4	82.5	88.8	84.8	75.9
4. Trade & Service	36.2	42.0	46.8	51.0	48.7	44.5
Total (x 1,000 m3/day)	163.7	200.9	212.2	219.5	218.5	190.3
Total (m3/sec)	1.9	2.3	2.5	2.5	2.5	2.2

4. Zone III

Description	1980	1985	1990	1995	2000	2005
1. Domestic	137.7	200.4	248.9	255.6	279.6	281.7
2. Public	20.8	26.8	25.4	13.4	14.3	12.5
3. Industries	14.1	19.4	23.6	25.9	26.7	24.9
4. Trade & Service	50.3	60.0	68.4	74.0	71.2	61.3
Total (x 1,000 m3/day)	222.9	306.6	366.3	368.9	391.3	380.4
Total (m3/sec)	2.6	3.5	4.2	4.3	4.5	4.4

NOTE: Groundwater Requirement Projection based on Water Demand, JICA Study Team, 1983 - 1984.

4.3 Raw Water Sources

4.3.1 Future Water Sources for Jakarta Water Supply

The main water source for Jakarta Water Supply is presently surface water, and groundwater is also major water source and acting as supplementary source for domestic, industries and trade & service uses. The future water sources for Jakarta Water Supply System will depend much upon the surface water from the outside of the city due to the limited discharge of rivers within the city and limited grand water potentiality.

Two main rivers available for Jakarta water supply are the Citarum river in the east and the Cisadane river in the west, as briefed below.

1) Water Resources in the Eastern Basin

Table 4.9 summarizes the hydrologic data of the river system in the eastern basin adjacent to Jakarta Metropolis. The Citarum river basin with Jatiluhur reservoir is the main river basin in the region and other local river basins consist of the Cibeet, the Cikarang and the Bekasi. (For details refer to Appendix MIII-1).

The available Citarum water resources at Jatiluhur and Curug are anually 5,708 x 10^6 m3, and 5,834 x 10^6 m3, respectively, based on the data of Jatiluhur Authority (POJ), 1963-1980. The average run-off coefficient is around 50 % of the river basin. On the other hand, the available run-off of the Citarum river was analyzed to be 6,100 x 10^6 m3/year by NEWJEC, 1981, although it was later revised to be 5,400 x 10^6 m3/year by NEDECO, 1983.

The other available water resources of the rivers, the Cibeet, the Cikarang and the Bekasi at each weir are 1,179 x 10^6 m3/year, 501 x 10^6 m3/year, and 1,031 x 10^6 m3/year, respectively, according to the POJ operational records, 1970-1980.

The surface water in the Citarum river basin is in full use for various purposes. Particularly irrigation requirement accounts for nearly 75 % of all the usage of the river water, (NEDECO, 1983). In the year of drought, therefore, water shortage is likely to affect the supply program. In fact there is obviously a 5-year cycle of drought, as indicated by the past record of 1967, 1972, 1977, and recently 1982 when the reservoir water level dropped at the order of 80 m from the average 100 m. (Refer to Fig. 4.1 for water level fluctuation in Jatiluhur reservoir).

According to the assessment by NEDECO, 1983 the water resources in the eastern basin would be enough to sustain the required supply to Jakarta Metropolis in the order of 30 m3/sec additionally.

2) Water Resources in the Western Basin

The Cisadane river runs across the western basin outside DKI Jakarta, and has been considered to be one of the important water sources for Jakarta Water Supply System. Fig. 4.4 and Table 4.10 summarize the hydrologic data of the Cisadane river at Serpong and

Table 4.9 Hydrologic Evaluation of River System in the Eastern Basin

No.	Rive	Location	Catchment Area (Km^2) (A)	Mean Annual Rainfall (mm) (B)	Total Rainfall (C)*** ($10^6 m3$)	Annual Average ($10^6 m3$)	Discharge (D)	Runoff Coefficient (D/C)
1.	Citarum	Saguling St.	2,315	2,262 *	5,236	3,122		0.596
2.	Citarum	Jatiluhur Dam	4,550	2,406 *	10,947	5,708		0.521
3.	Citarum	Curug St.	4,833	2,432 *	11,754	5,834		0.496
4.	Cibeet	Cibeet Weir	507	3,283 *	1,664	1,179		0.709
5.	Cikarang	Cikarang Weir	226	3,467 **	784	501		0.639
6.	Bekasi	Bekasi Weir	412	3,660 **	1,508	1,031		0.684

Note: * Thiessen average by NEDECO, 1983

** Thieseen average by Sogreah/Coyne & Billier, 1979

*** C = A X B

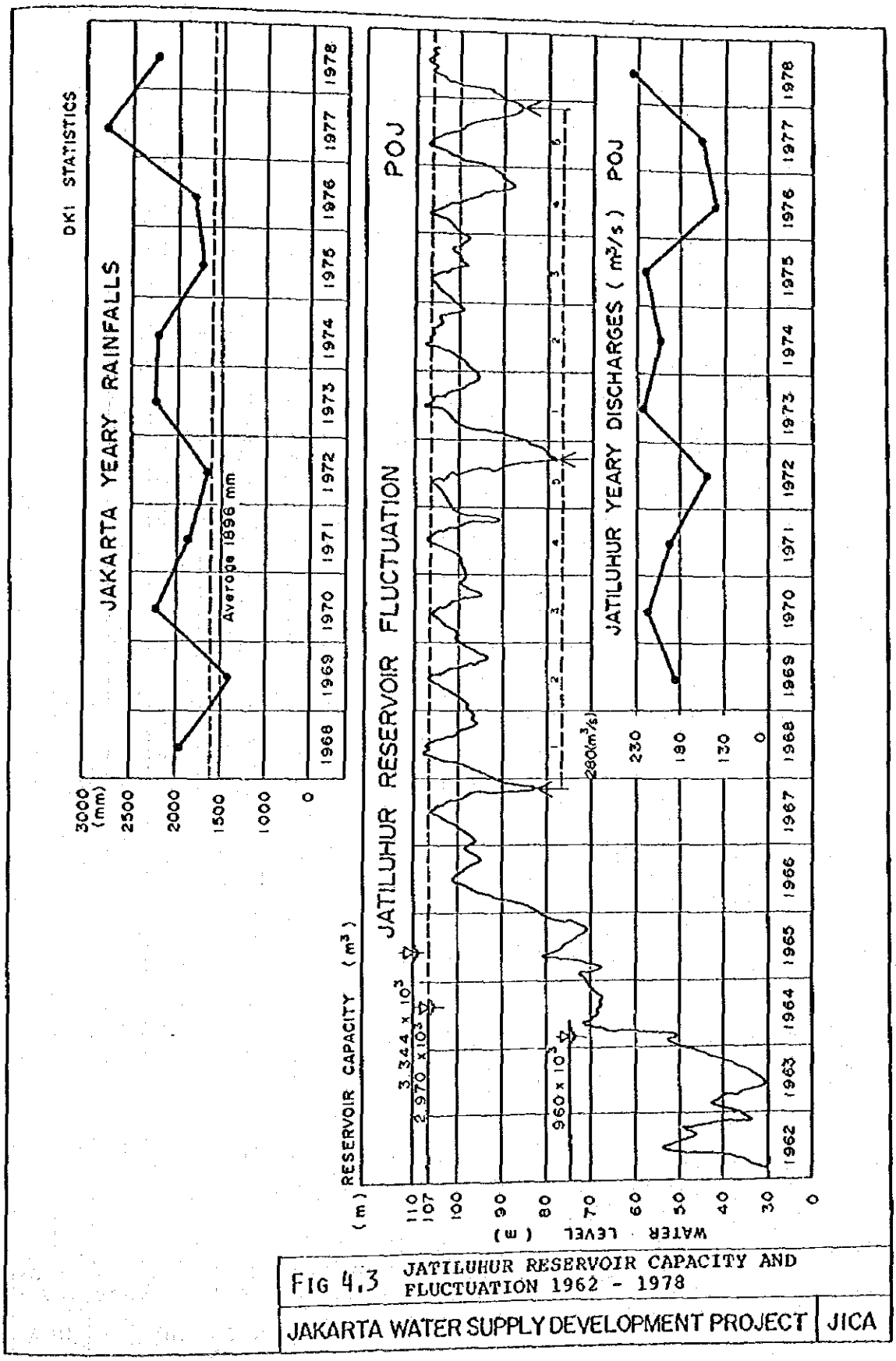

FIG 4.3 JATILUHUR RESERVOIR CAPACITY AND FLUCTUATION 1962 - 1978

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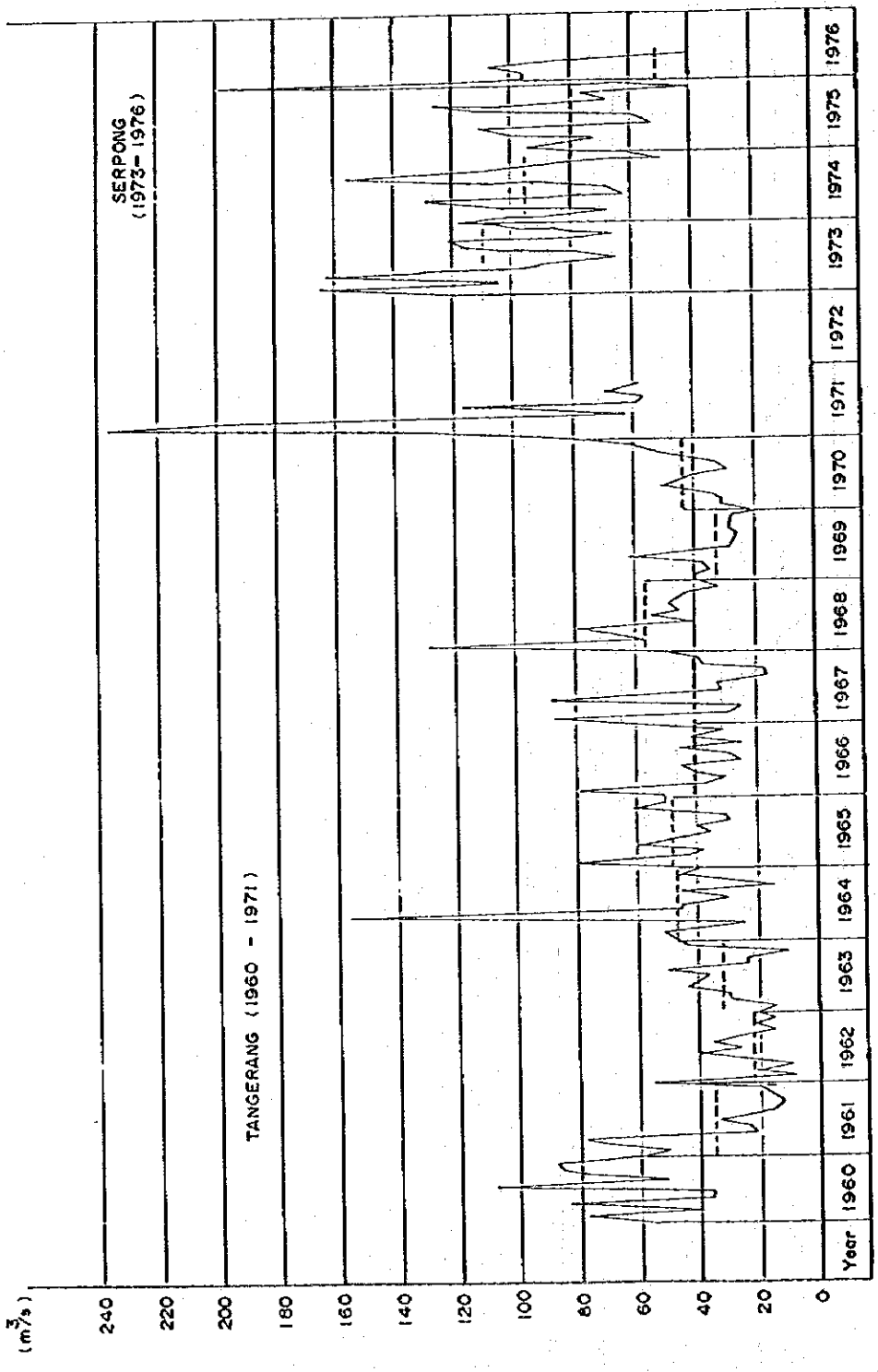

FIG 4.4 DISCHARGE HYDROGRAPH OF CISADANE RIVER AT TANGERANG (1960-1971) AND SERPONG (1973-76)

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Table 4.10 Mean River Discharge of Cisadane River (m3/sec)

Year / Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean Annual Flow
1) Tangerang Observation, Catchment Area 1,349 km													
1960	54.8	77.8	40.1	83.9	34.6	35.3	106.7	51.5	77.3	86.6	88.1	59.1	66.2
1961	50.7	68.8	78.0	20.9	23.9	33.2	21.8	14.8	12.2	15.0	20.0	55.5	34.5
1962	9.5	20.6	9.9	25.8	40.2	25.3	35.5	25.3	15.6	20.1	15.1	20.2	22.0
1963	15.0	29.8	29.5	42.9	40.0	36.2	50.0	22.3	23.7	10.3	43.5	47.4	32.5
1964	50.1	40.3	25.3	155.8	44.9	44.8	30.0	44.9	14.8	34.5	45.0	40.0	47.4
1965	80.0	42.8	38.0	58.7	47.9	35.2	40.0	29.2	30.2	61.1	51.3	50.7	48.1
1966	78.3	37.7	35.3	41.4	45.0	25.1	29.7	44.8	24.8	41.2	31.2	55.1	41.4
1967	87.3	29.7	25.2	86.7	45.4	30.3	33.2	16.1	17.5	36.5	38.9	48.9	41.4
1968	129.2	57.1	66.7	78.1	40.6	54.4	45.9	48.4	46.0	43.0	31.3	38.9	56.8
1969	38.9	35.2	37.6	61.6	40.2	27.8	27.0	25.0	28.1	27.9	26.8	20.7	33.0
1970	30.7	30.3	34.3	51.3	44.3	38.7	29.0	32.1	43.7	52.4	61.2	86.5	44.5
1971	130.5	236.2	205.0	63.3	117.4	58.6	57.4	69.1	58.2				
Mean Monthly Flow	61.8	58.8	52.1	64.3	47.0	37.0	42.2	35.2	32.7	38.9	41.1	47.5	42.5
(Study on a Potential Water Source Cisadane River, JM Montgomery, 1977) Cisadane River													
2) Serpong Observation Station, Catchment Area 1,074 km, DPMA													
1973	121.0	164.5	105.5	163.7	129.9	87.7	64.9	77.8	116.5	121.2	66.7	86.3	108.5
1974	117.9	90.2	68.0	116.4	129.3	62.1	66.9	92.1	156.0	108.1	81.4	50.6	94.9
1975	64.0	94.1	73.6	101.3	111.1	52.7	59.2	88.7	126.4	67.1	76.1	40.3	79.3
1976	198.4	94.9	95.3	107.4	70.5	41.1	-	-	-	-	-	-	-

Tangerang observation stations. During the period of 1973 to 1976, the mean annual discharge at Serpong is ranging from 79.3 m3/sec to 108.5 m3/sec, and during the same period, the maximum and minimum points are recorded at 198.4 m3/sec in Janurary and 40.3 m3/sec in December, respectively.

On the other hand, discharge records collected at Tangerang observation station from 1960 through 1971 indicate the mean annual discharges to be 42.4 m3/sec. The maximum and minimum discharge were recorded at 236.2 m3/sec in February and 9.5 m3/sec in January, respectively. The river discharge of the Cisadane between Serpong and Tangerang decreases its flow due to the irrigational requirements.

Fig. 4.5 illustrates the dependable flow (80%) of the Cisadane river at Serpong analyzed by DPMA, 1977 based on the records from 1955 to 1976. The Maximum dependable flow is about 103 m3/sec in the first half of May and the minimum one is about 23 m3/sec in the first half of September. Therefore, the raw water of 3 m3/sec from the Cisadane river at around Cilangkap which was allocated by DGWRD is potentially available. Also, at Cilangkap, intake dam is planned by DGWRD.

To obtain a stable supply of raw water there is a necessity of constructing a dam/s at suitable location/s. The survey in detail is expected to start in February 1985, but the prospect for the possible allocation for water supply is in the order of 10 m3/sec to 20 m3/sec, according to the CJC Master Plan prepared in 1979.

4.3.2 Water Resources Development Plan

Development of water resources has been repeatedly studied by Government covering the region of CJC (Cisadane-Jakarta-Cibeet) for the past several years. For Jakarta water supply, available water sources and their timing are summarized (Fig.4.6) from the relevant reports of study as described below. (For details refer to Appendix MIII-1).

1) For Short Term Requirement
   Enlargement of West Tarum Canal

West Tarum Canal (WTC) constructed in 1968 is the only existing system with the possibility of feeding additional raw water to the Metropolis from the remote area, and NEDECO proposed in 1981 to enlarge the canal for the purpose of meeting the short term needs of the city, since new canal programs take time for the acquisition of land and the construction of the system. Although Jatiluhur Authority had commiteed to provide Jakarta with water in a volume of 10 m3/sec through this canal, the survey by NEDECO in 1982 has proved that the canal cannot convey more than 6 m3/sec of water due to the size of its final section between the Bekasi and the Cipinang rivers.

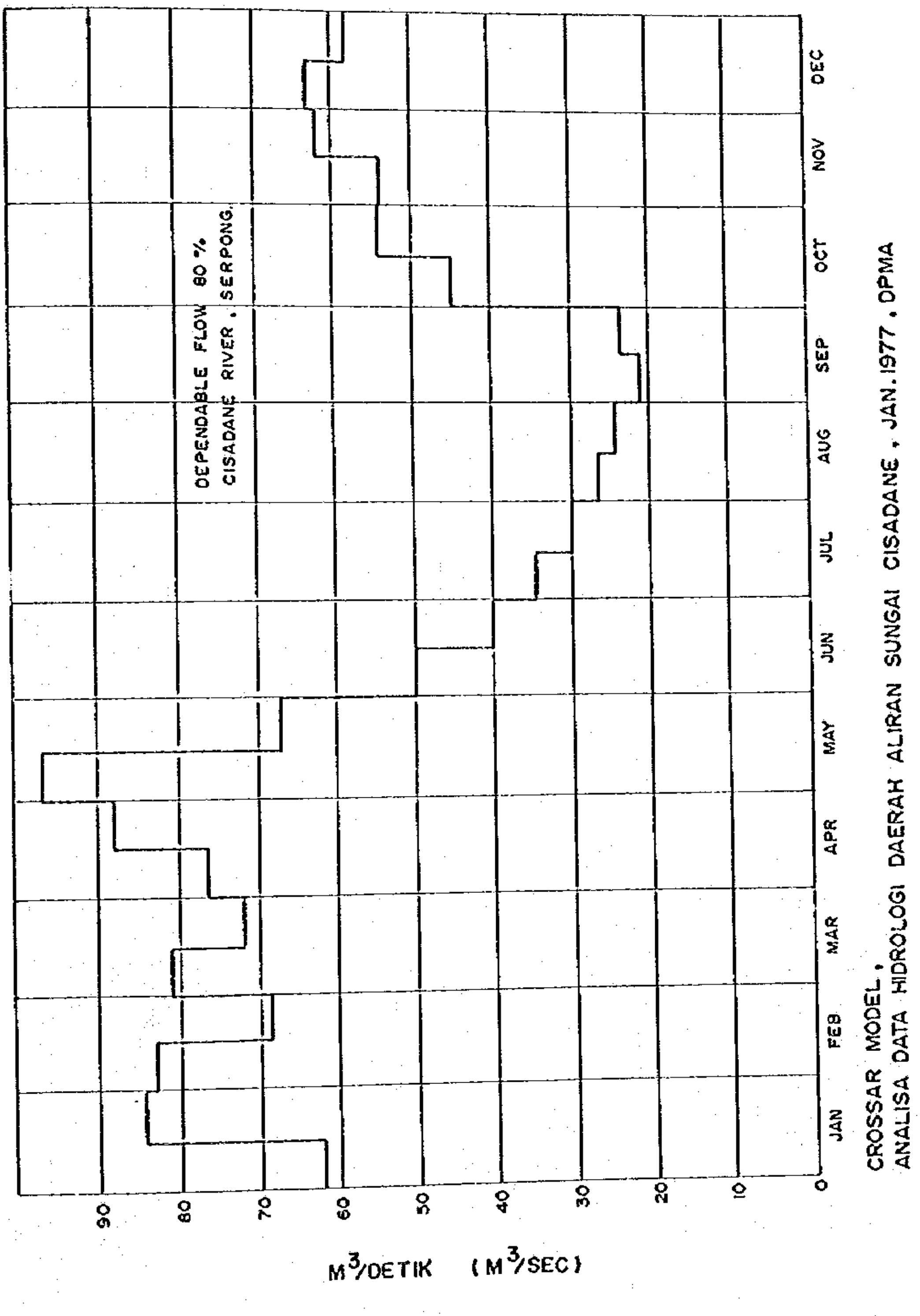

FIG 4.5 DEPENDABLE FLOW(80%), CISADANE RIVER, SERPONG DATA ANALYSIS 1955 - 1976

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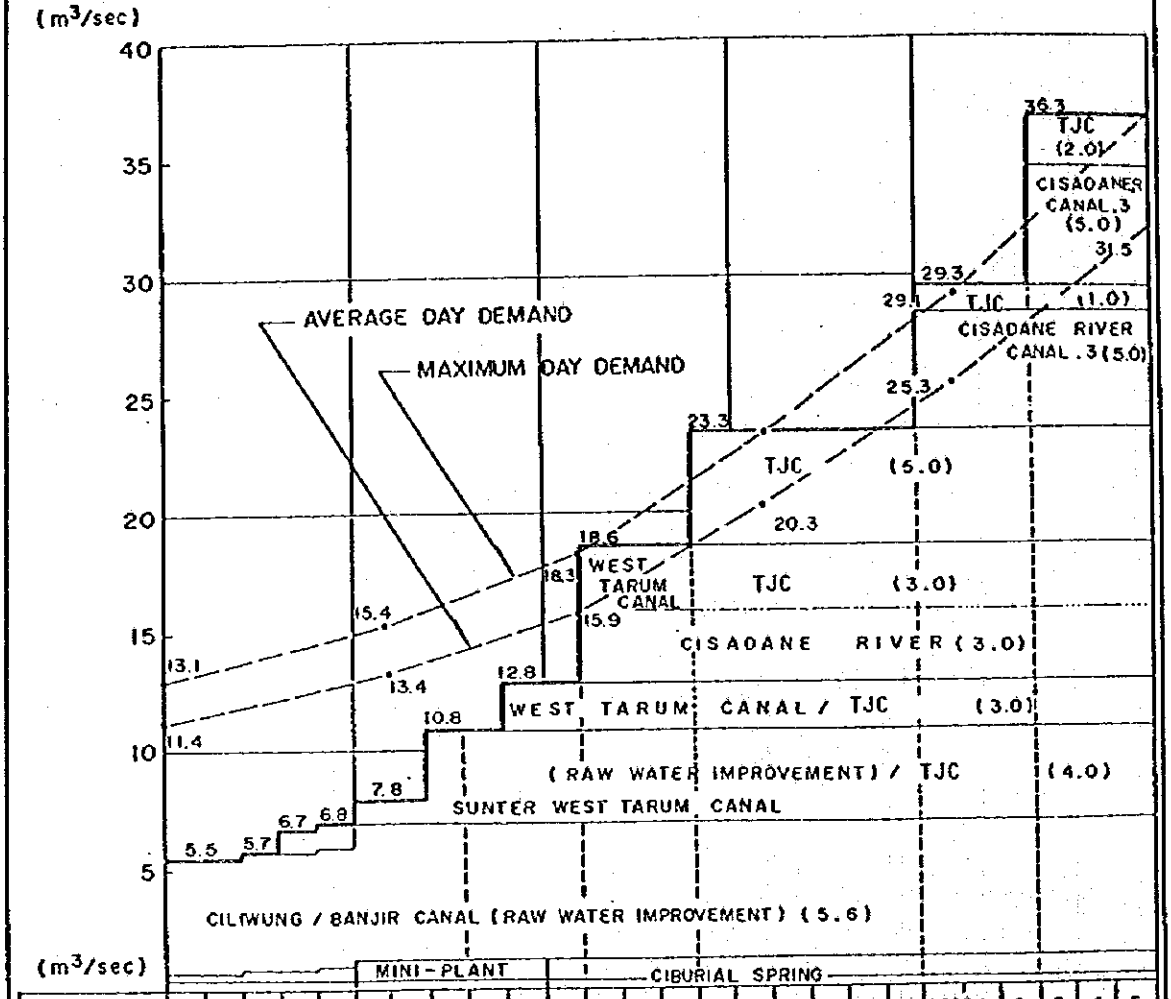

YEAR	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	1	2	3	4	5
PHASING	1 ST PHASE		2 ND PHASE					1 MM		1 ST PHASE		2ND PHASE					1 ST PHASE					2ND PHASE				
	FIRST STAGE							SECOND STAGE									THIRD STAGE									
EXISTING PRODUCTION	5.5		5.7	6.7	6.8	7.8		10.8		10.8		10.6		10.3			10.3					10.3				
NEW PRODUCTION										2.0		8.0		13.0			19.0					26.0				
TOTAL PRODUCTION	5.5		5.7	6.7	6.8	7.8		10.8		12.8		18.6		23.3			29.3					36.3				
RAW WATER DEMAND AT PLANT	(NEW SOURCE)									2.1		8.5		13.8			20.2					27.7				
	(EXISTING SOURCE)									Raw Water Improvement (4.3 + 6.0)																	

FIG 4.6 WATER REQUIREMENT AND NECESSARY OF RAW WATER

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Under such circumstances, the enlargement of the West Tarum Canal was decided by the Government in June of 1982. According to this program, the canal will feed both the Ciliwung and the Sunter rivers eventually to contribute to the operation of existing Pejompongan, Pulogadung plants and a new treatment plant planned in this Master Plan as well as to the flushing requirements of central Jakarta up to 5 m3/sec at the exit of Ciliwung tunnel.

(1)	Pejompongan Plant	:	5.6 x 1.1* = 6.2 m3/sec
(2)	Pulogadung Plant	:	4.0 x 1.1* = 4.4 m3/sec
(3)	Immediate Program	:	2.0 x 1.1* = 2.2 m3/sec
(4)	Flushing Use	:	5.0 m3/sec
(5)	Loss in the Canal	:	1.2 m3/sec
	Total		19.0 m3/sec **

(*; 10 % to allow for conveyance losses)

** Detailed design for the enlargement of WTC is in progress in 1984 by NEDECO employing capacity of 21.1 m3/sec.

The detailed design is now under progress, and the target of the project completion is determined at the end of 1988. Upon completion, the enlarged canal is expected to provide additional raw water to not only the existing water treatment plants with their capacities enhanced but the immediate program to catch up the demand up to the year of 1990 as well. Table 4.11 summarizes the present conditions and the enlargement plan of the Canal.

2) For Mid-Term Requirement
Construction of Tarum Jaya Canal (TJC)

After 1990 following the urgent development plan, an additional supply of water is required to meet the demand for drinking and flushing in Jakarta Metropolis. To cope with the situation, a program for the mid-term water resources development has been under way. Among various plans, the most acceptable one is the development of the Citarum river in the CJC eastern half of the region involving the construction of new dams at Saguling and Cirata. The major source for this development depends upon the capacity of Jatiluhur reservoir located upstream to the south.

According to the feasibility report by NEWJEC, this program includes the construction of Saguling dam in 1985 and Cirata dam in 1987 along the Citarum river and a new canal to transport raw water. Concerning the construction of this canal, TJC/North Bank Route, which closely runs in parallel with the existing West Tarum Canal, was recommended. This proposal, was reportedly accepted during the interdepartment meeting in January, 1983 for the construction by the end of 1990 with an expected capacity of 30 m3/sec to satisfy the demand for 1991 to 1998. However, the schedule of construction and the capacity of TJC be subjected to further review based on the actual water requirement and other available sources such as enlarged capacity of West Tarum Canal and the Cisadane river* in prior to the implementation of its construction.

Table 4.11 ENLARGEMENT OF WEST TARUM CANAL CAPACITIES

No.	Design Section		Length (Km)	Design Capacity (M3/s)	Existing* Capacity 1982 (M3/s)	Enlargement Target Capacity (M3/s)	Note
1	Curug	Ia	7.2	85	56	81	
	To	Ib	10.5	84	55	79	
	Cibeet	IIa	3.9	81	40	73	
		IIb	2.3	77	44	72	
2	Cibeet	III	2.5	80	48	80	
	To	IVa	4.2	66	41	56	
	Cikarang	IVb	2.4	57	41	54	
		IVc	6.2	49	33	49	
3	Cikarang	V	2.1	45	24	39	
	To	VIa	6.8	32	18	35	
	Bekasi	VIb	3.9	29	25	32	
		VIc	2.1	21	19	31	
4	Bekasi to Buaran	VIIa	8.5	14	5.8	19	
	Sunter	VIIb	1.6	14	5.8	19	
			1.9	14	5.8	12	
	Cipinang	VIIc	1.6	14	5.1	12	
	Ciliwung	Tunnel	1.2	10.8	7.2	11.7	

* Existing Capacity of WTC at full supply water level NEDECO, 1982 - 1983.

Further the Cisadane basin study is scheduled to commence in Mid 1985 and completed in 1987. The allocation of raw water from TJC in 1993, 1999 and 2002 should be further reviewed, taking into account the result of the study.

* Directorate General of Water Resources Development (DGWRD) allocated 3.0 m3/sec water from the Cisadane river at Serpong about 20 km upstream of Tangerang in January 1984.

3) For Long Term Requirement
Cisadane River Development, Canal 3

After the enlargement of the West Tarum Canal and construction of TJC, another water source together with a new conveyance system is required for ever-increasing water requirement. Regarding this matter, the CJC Water Resources Development Study in 1979 indicates the possibility of constructing dams at Parungbadak and Sodong on the upper reaches of the Cisadane river for Jakarta water supply. The expected maximum capacities of Parungbadak and Sodong dams are 950 million m3 and 600 million m3, respectively. (Refer to Fig. 4.7)

These basic storage capacities were aimed at supplying urban water to Jakarta through a new conveyance system of Canal 3 in an amount of 10 m3/sec to 20 m3/sec as well as serving the other requirements for irrigation and flushing which are expected to reach 54 m3/sec in the year of 2000, based on the survey of J.M. Motogomery in 1977 as follows:

Cisadene River Estimated Demands for Year 2000

Purpose	Location	Quantity (m3/sec)
Urban Water Supply	Tangerang	3.7
	Serpong	0.3
	Bogor	0.6
	Others	0.6
Flushing	Mookervaat Canal	1.8
Irrigation	Prosida	40.0
	Empang	7.0
Total		54.0

* The above table includes no allowance for urban water supply to Jakarta.

According to the Directorate General Water Resources Development (DGWRD), the feasibility study of the Cisadane basin development was scheduled to start in April, 1984 but postphoned February, 1985. In connection with the foregoing projects, it is deemed necessary to complete the program of this development by the end of 1999 at the latest, since the western part of Jakarta shows signs of progressing water shortage even at present.

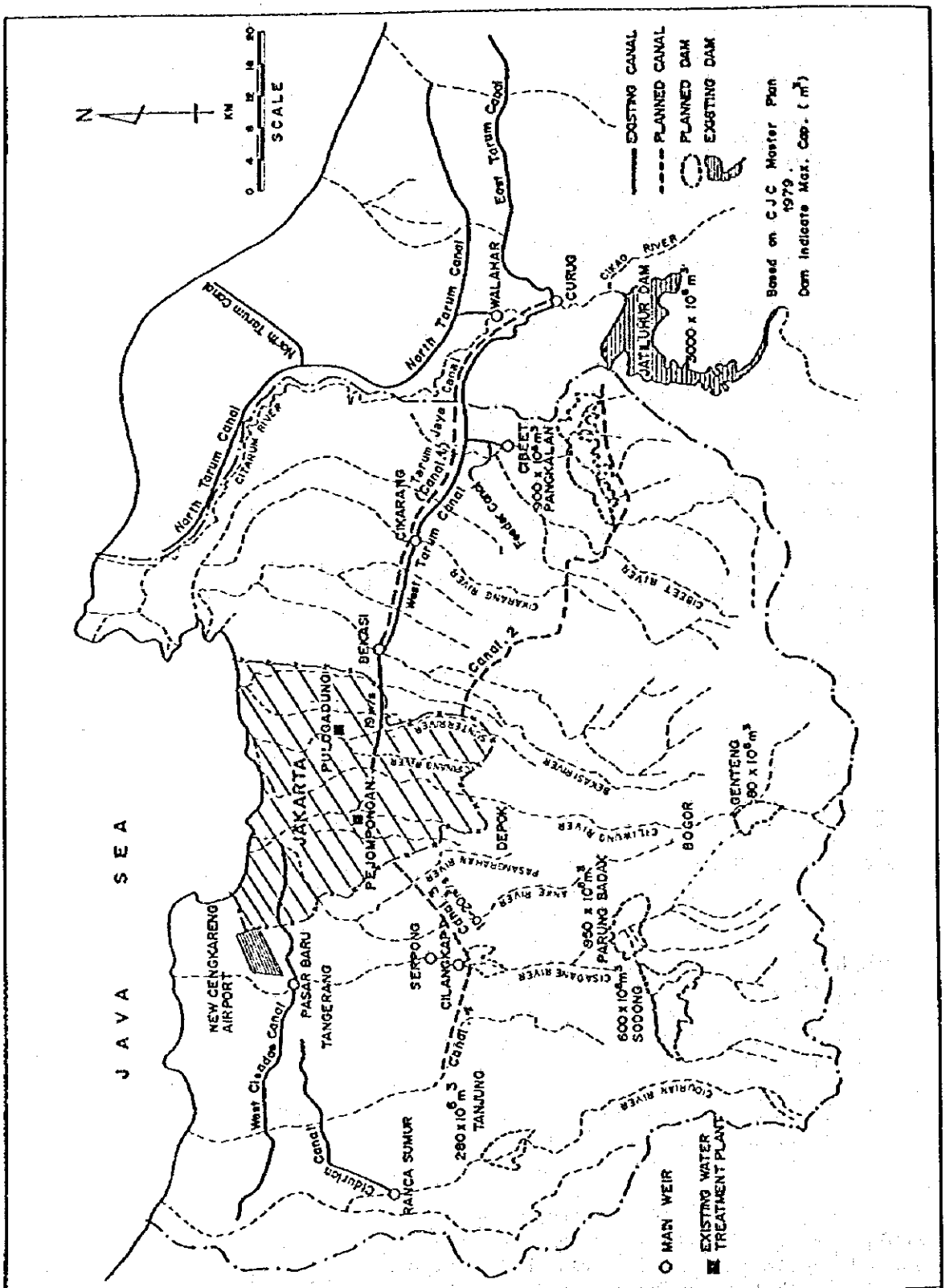

Fig 4.7 WATER RESOURCES DEVELOPMENT PLAN

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