REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS (DPU)
DIRECTORATE GENERAL OF HOUSING, BUILDING,
PLANNING AND URBAN DEVELOPMENT (CIPTA KARYA)

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

VOLUME III

FEASIBILITY STUDY REPORT

MARCH 1985

JAPAN INTERNATIONAL COOPERATION AGENCY

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TABLE OF CONTENTS

ABBREVIATION

millimeter	mm	kilogram per square centimeter	kg/cm^2
centimeter	cm		
meter	m		
kilometer	km	centimeters per second	cm/sec
		meter per second	m/sec
square centimeter	cm^2		
square meter	m^2	cubic meters per second	m^3/sec
square kilometer	km^2	cubic meters per minute	m^3/min
hectare	ha	cubic meters per day	m^3/d
		liter per capita per day	lpcd
cubic millimeter	mm^3		
cubic centimeter	cm^3	volt	V
cubic meter	m^3	kilovolt	kV
		kilowatt	kW
milliliter	ml	revolutions per mintue	rpm
liter	l		
		ampere	A
milligram	mg	kilovolt-ampere	kVA
gram	g	direct current	DC
kilogram	kg	altering current	AC
metric ton	t		

ORGANIZATION

DPU	Ministry of Public Works
PLN	Ministry of Electric Power
Cipta Karya (DGCK)	Directorate General of Housing, Building, Planning and Urban Development
DWS	Directorate of Water Supply
DGWRD	Directorate General of Water Resources Development
POJ	Jatiluhur Authority
DPMA	Institute of Hydraulic Engineering
DEG	Directorate of Environmental Geology
DKI Jakarta	Jakarta Municipality
PDAM Jaya	Jakarta Water Supply Enterprise
JATS	Jabotabek Advisory Team Services
JICA	Japan International Cooperation Agency
OECF	Overseas Economic Cooperation Fund, Japan

OTHERS

JMDP	Jabotabek Metropolitan Development Project
CJC Master Plan	Cisadane-Jakarta-Cibeet Water Resources Development Study
WTC	West Tarum Canal
TJC	Tarum Jaya Canal

CURRENCY EQUIVALENT

U.S.$1.0 = Rp 1,004 = Yen 224

(As of March, 1984)

1. INTRODUCTION

1. INTORDUCTION

1.1 Background of the Study

The Government of Indonesia requested the Government of Japan, in 1982, for technical assistance to prepare a master plan and feasibility study of the Jakarta water supply system (the Work) considering the chronic water shortage prevailing in the Metropolitan area. In response to this request, the Government of Japan decided to undertake the work through Japan International Cooperation Agency (JICA) within the frame of the international cooperation of Japan. JICA contracted the work with Nihon Suido Consultants Co., Ltd. on June 7, 1983.

The engineering service were conducted from June, 1983 up to March, 1985 in accordance with the terms and conditions of the contract.

1.2 Objective, Scope and Study Area

1) Objective

The objective of the work is to prepare a Master Plan for phased improvement of the water supply system up to the year 2005 and a Feasibility Study for an urgent project identified in the Master Plan.

2) Scope of Work

The scope of work, as contracted, includes the following:

i) Master Plan
   a. Data collection and analysis,
   b. Definition of service areas for planning,
   c. Estimation of population,
   d. Estimation of water demand,
   e. Study of present status of water works, including losses and intake problem,
   f. Study of water sources,
   g. Planning of water supply system,
   h. Rough estimation of cost for construction, operation and maintenance,
   i. Preparation of implementation schedule,
   j. Socioeconomic study and
   k. Study of organization, operation and management plan

ii) Feasibility Study
   a. Definition of proejct area
   b. Estimation of population to be served
   c. Estimation of water demand
   d. Study of improvement of existing facilities and proposed program of immediate action
   e. Study of water source
   f. Study of required facilities and layout of facilities
   g. Study of design criteris,
   h. Preliminary design,

i. Preparation of construction shcedule,
j. Study of construction materials and labour force and study of construction ability of local contractors,
k. Preparation of construction method and procurement method of materials and equipment,
l. Estimation of costs for construction, operation and maintenance,
m. Estimation of benefits,
n. Financial analysis
o. Study of alternatives of organization operation and management plana and
p. Preparation of implementation program

3) Study Area

The Study Area covers the administrative area of Jakarta City (DKI). The study will touch on those facilities in the immediate environs of the City which are related to the water supply project of Jakarta.

1.3 Composition of the Report

The report of the study will be compiled in the following volumes:

I. Executive Summary
II. Master Plan Report
III. Feasibility Study Report
IV. Appendices for Master Plan Report
V. Appendices for Feasibility Study Report

This volume consists of the above Item III Feasibility Study Report.

1.4 Outline of the Second Stage Project

Master Plan has proposed that the whole construction during its design period up to the year 2005 be implemented in two stages, namely, the Second Stage Project succeeding to the First Stage Project now in progress and Third Stage Project. The Second Stage Project was planned to meet the water demand of the City of Jakarta in the year 1995. The project consists of :

- Immediate Program
  Immediate Project
  Short Term Improvement Project
  Rehabilitation Works for Distribution Pipelines
  Improvement of the Pejompongan Treatment Plant I
  Improvement of the Distribution Pipelines (Secondary and Tertiary mains)

- First Phase Project
- Second Phase Project

Raw water for the Second Stage Project is planned to be supplied from the West Tarum Canal, the Cisadane River and the Tarum Jaya Canal*. For these water sources, three water treatment plants were proposed by the Master Plan, namely, a plant at Buaran for the West Tarum Canal, a plant at Lebakbulus for the Cisadane and a plant at Cakung for the Tarum. The raw water supply from the West Tarum Canal will be replaced by the Tarum Jaya Canal upon its completion in the future.

The served area will be reorganized along with the progress of the Project for improvement of supply condition and convenience of operation of the whole water supply system. In reorganizing the served area, six supply zones will be established, each having a water treatment plant or a distribution center.

Features of the Project are outlined in the Table 1.1

1.5 Scope of Feasibility Study

The Feasibility Study covers the First Phase of the Second Stage Project as recommended by the Master Plan. The reasons for this recommendation were :

1) The total supply capacity of the water supply system, completed under the First Phase Prject, is capable of nearly meeting the potential water demand without unrealistically large investment.

2) Water sources required until the end of the First Phase are available, as ensured by the authorities, from the Cisadane River and the West Tarum Canal presently under enlargement.

3) Financing, both internal and international, of the required funds for the proposed project is considered to fall within the affordable range of the agencies concerned.

4) Incidentally, it is meaningful and appropriate that the water supply project should be completed in the same target year as that of the Five-Year Plan for Social Economic Development (PELITA IV), contributing to the development of Metropolis and the welfare of the public.

Meanwhile, the Immediate Program will be taken into the program of implementation and the financial analysis of the Feasibility Study.

Note: * Canal 1 was renamed Tarum Jaya Canal by the Authority on 10 August, 1984

Table 1.1 Outline of the Second Stage Project

Description		Present		1st Phase	2nd Phase
Target Year		1988 (Completion of 1st Stage Project)		1990	1995
Service Area (km2)		283		338	383
Total Population (x 1,000)	(A)	8,375	*	8,872	9,949
Total Population in Service Area (x 1,000)	(B)	6,072	*	6,538	8,002
Population Served (x 1,000)	(C)	3,707	*	5,357	6,523
Service Ratio (%)	(C/B)	61.0		81.9	81.5
	(C/A)	44.3		60.4	65.5
Water Requirement					
Average Consumption (l/s)	(D)	5,200	*	9,600	13,600
Unaccounted-for Water (l/s)	(E)	4,200 (45 %)	*	6,300 (40 %)	6,700 (33 %)
Average Demand (l/s)	(F)	9,400	*	15,900	20,300
Gross Per Capita Demand (lpcd)	(F/C)	254		257	268
Maximum Daily Demand (Average Demand x 1.15)		10,800	**	18,300	23,300
Expanded Capacity)l/s)		-		6,000	5,000
Raw Water Requirement (l/s) (expanded Capacity x 1.07)		-		6,400	5,300

Note : * Projected figures
** Total water production

2. WATER REQUIREMENT

2. WATER REQUIREMENT

2.1 General

The water demands for Jakarta was developed in the Master Plan from actual data on consumption of all categories of consumers and considering city planning and land use plan in Jakarta Master Plan (1985 - 2005) as well as population density present and in future.

Service areas exnteded by the year 1990 are presented in the following subsection.

Based on the projected total population, population in service area and population served, estimated on 5-year basis, of the Master Plan, annual population figures are estimated as shown on Table 2.1.

2.2 Service Area

The service area of the First Phase of the Seocnd Stage Project defined in the Master Plan, is extended from present 283 km2 to 338 km2 by the end of 1990, which is approximately 52 percent of DKI Jakarta administrative area.

The areas proposed to be extended in the immediate near future in the 1st Phase program are shown on Fig. 2.1 and briefly illustrated below :

1) Parts of Kec. Penjaringan and Cengkareng, North and West Jakarta Districts :

   This area has been developing in accordance with a housing plan which is to be completed within couple of years. At present, huge area on land development and housing construction is actively under way.

2) Kec. Kebon Jeruk, east side part of Pasanggrahan River, West Jakarta District and Part of Kebayoran Lama, South Jakarta District :

   Highway construction work, crossing Jl. Let. Jen. S. Paraman and extending Jl. Kyai Caringin to Tangerang is now under way. The area to be served will be expanded along the highway and road running from north to south crossing this highway. Future extension of the city activity such as housing and commercial area establishment is expected due to accessibility of better transportation.

3) Part of Kel. Kepala Gading, Kec. Koja, North Jakarta District:

   This area, at present, being developed and housing construction in progress, will be developed as industrial area. By establishment of the industrial estate, water supply system will be expanded to the estate in near future.

4) Part of Kec. Jatinegara (Kel. Cipinang Muara, Cipinang Besar, Pondok Bambu and Klender), East Jakarta District :

The area of east side along Jl. Jen. D.I. Panjaitan is now served by the system. Further, the inside area of east part is congested with houses up to Jl. Pahlawan Revolusi, and some housing complexes are located beyond this street.

5) Part of Kec. Mampang Prapatan (Kel. Pengadengan, Rawajati, Pancoran, Cikoko and parts of Kel. Pejaten, Kalibata, and Duren Tiga), South Jakarta District :

Southward area from Jl. Let. Jen. M.T. Haryono, along jl. Raya Besar Pasar Minggu and Jl. Dewi Sartika, is congested with many houses at present. As east of Jl. Raya Besar Pasar Minggu still has huge open space, this area will be developed as housing area at an earlier stage.

2.3 Population Served

The annual population served and population in the service area are interpolated based on the developed population figures in DKI boundary in the Master Plan and presented in Table 2.1.

Table 2.1 Population Served, Population in Service Area vs. Population in DKI Boundaries

Year	Population Served 1/	Population in Service Area	Population in DKI boundaries
	('000)	('000)	('000)
1980	4,024 (62 %)	4,949 (76 %)	6,468
1981	4,103 (61 %)	5,034 (75 %)	6,700
1982	4,182 (60 %)	5,118 (74 %)	6,933
1983	4,261 (59 %)	5,203 (73 %)	7,165
1984	4,340 (59 %)	5,287 (71 %)	7,397
1985	4,419 (58 %)	5,372 (70 %)	7,630
1986	4,608 (58 %)	5,605 (71 %)	7,878
1987	4,793 (59 %)	5,838 (72 %)	8,126
1988	4,983 (59 %)	6,072 (73 %)	8,375
1989	5,168 (69 %)	6,305 (73 %)	8,623
1990	5,357 (60 %)	6,538 (74 %)	8,872
1991	5,590 (61 %)	6,830 (75 %)	9,087
1992	5,823 (62 %)	7,123 (76 %)	9,302
1993	6,056 (64 %)	7,416 (78 %)	9,518
1994	6,289 (65 %)	7,709 (79 %)	9,733
1995	6,523 (66 %)	8,002 (80 %)	9,949
2000	7,497 (68 %)	9,092 (83 %)	11,004
2005	8,784 (73 %)	10,496 (87 %)	11,998

Note : 1/ Population served shown in the above table is the figures of potential population and is assumed to be served by system if the supply capacity is not limited. For water requirement projection, the population served shown in the above table was applied.

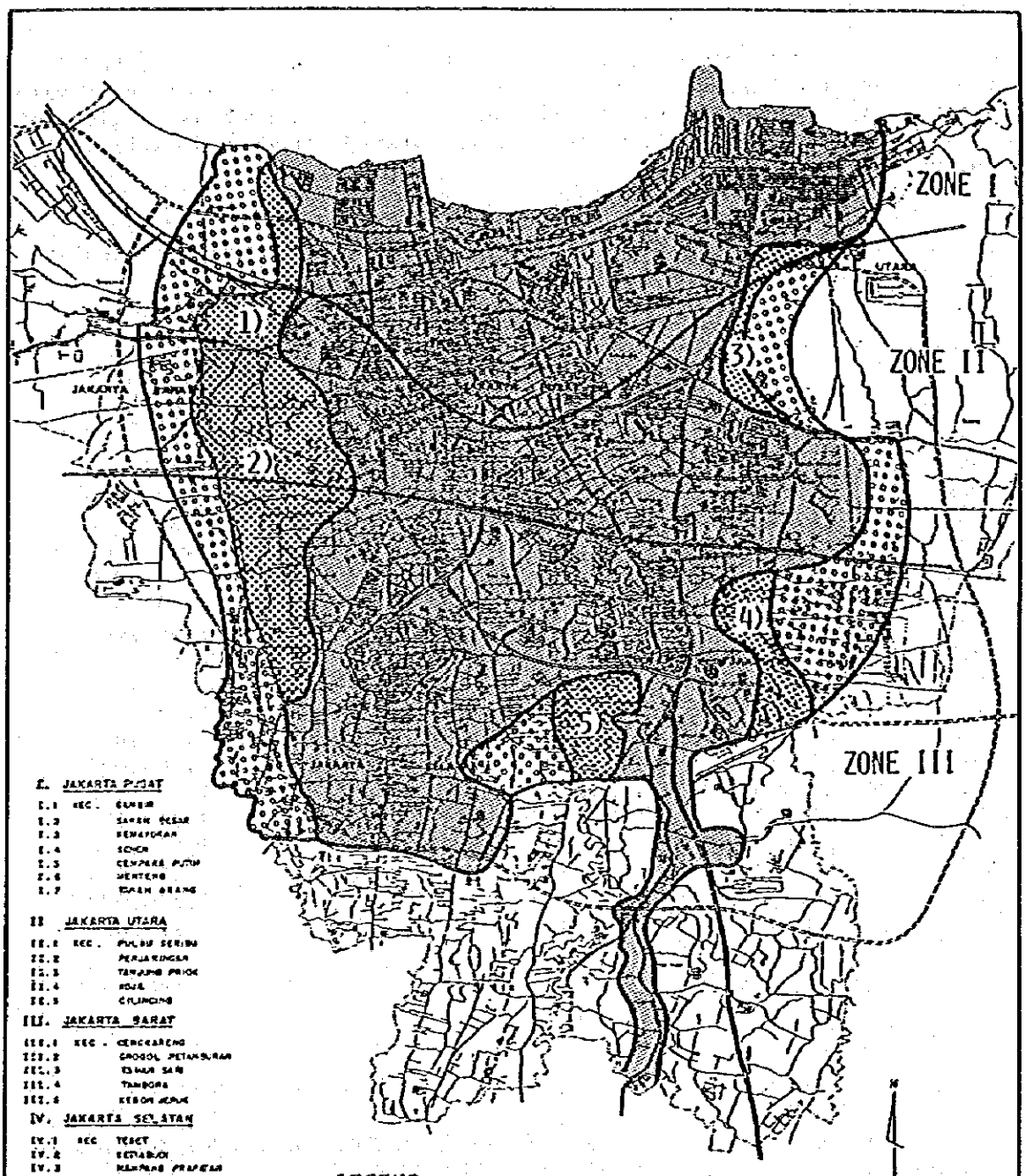


FIG 2.1 SERVICE AREA IN YEAR 1990/1995

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

2.4 Water Requirement

The average day demand and maximum day demand were estimated in the Master Plan based on the population served and the average unit water demand, including domestic use and non-domestic use, such as public use, industrial use, trade and service, ports, aremed forces and estimated unaccounted-for water.

The annual average day demand and maximum day demand were calculated from the demand projcted in the Master Plan and are tabulated in Table 2.2

Table 2.2 Projected Water Demand for Each Year

	Average Day Demand 1/		Maximum Day Demand 2/	
	1/ sec	m3/day	1/sec	m3/day
1980	11,400	985,000	13,100	1,132,000
1981	11,800	1,020,000	13,560	1,172,000
1982	12,200	1,054,000	14,020	1,211,000
1983	12,600	1,089,000	14,480	1,251,000
1983	13,000	1,123,000	14,940	1,291,000
1985	13,400	1,158,000	15,400	1,331,000
1986	13,900	1,201,000	15,980	1,381,000
1987	14,400	1,244,000	16,560	1,431,000
1988	14,900	1,244,000	17,140	1,481,000
1989	15,400	1,311,000	18,340	1,531,000
1990	15,900	1,374,000	18,300	1,581,000
1991	16,780	1,450,000	19,300	1,668,000
1992	17,660	1,526,000	20,300	1,754,000
1993	18,540	1,602,000	21,300	1,840,000
1994	19,420	1,678,000	22,300	1,927,000
1995	20,300	1,754,000	23,300	2,013,000
2000	25,300	2,186,000	29,100	2,514,000
2005	31,500	2,722,000	36,200	2,128,000

Note: 2/ is obtained by multipling 1/ by 1.15 which is described in 4.2 Design Criteria

2.5 Treatment Plant Production

The projected water demand and proposed production capacities in the Second Stage Project are shown on Fig. 2.2.

The production capacities of the existing treatment plants including mini-plants and new treatment plants proposed are summarized in Table 2.4.

As shown on Fig. 2.2, the treatment plant production will gradually expanded step-wise to satisfy average water demand after year 1990 fully. Available production capacity in each year and percentage against average water demand is presented in Table 2.3.

The summary of water demand discussed in the Master Plan is shown in Table 2.6 together with figures showing water demands (Average Day Demand and Maximum Day Demand) and proposed water production.

Table 2.3 Water Demand (Average) and Total Production

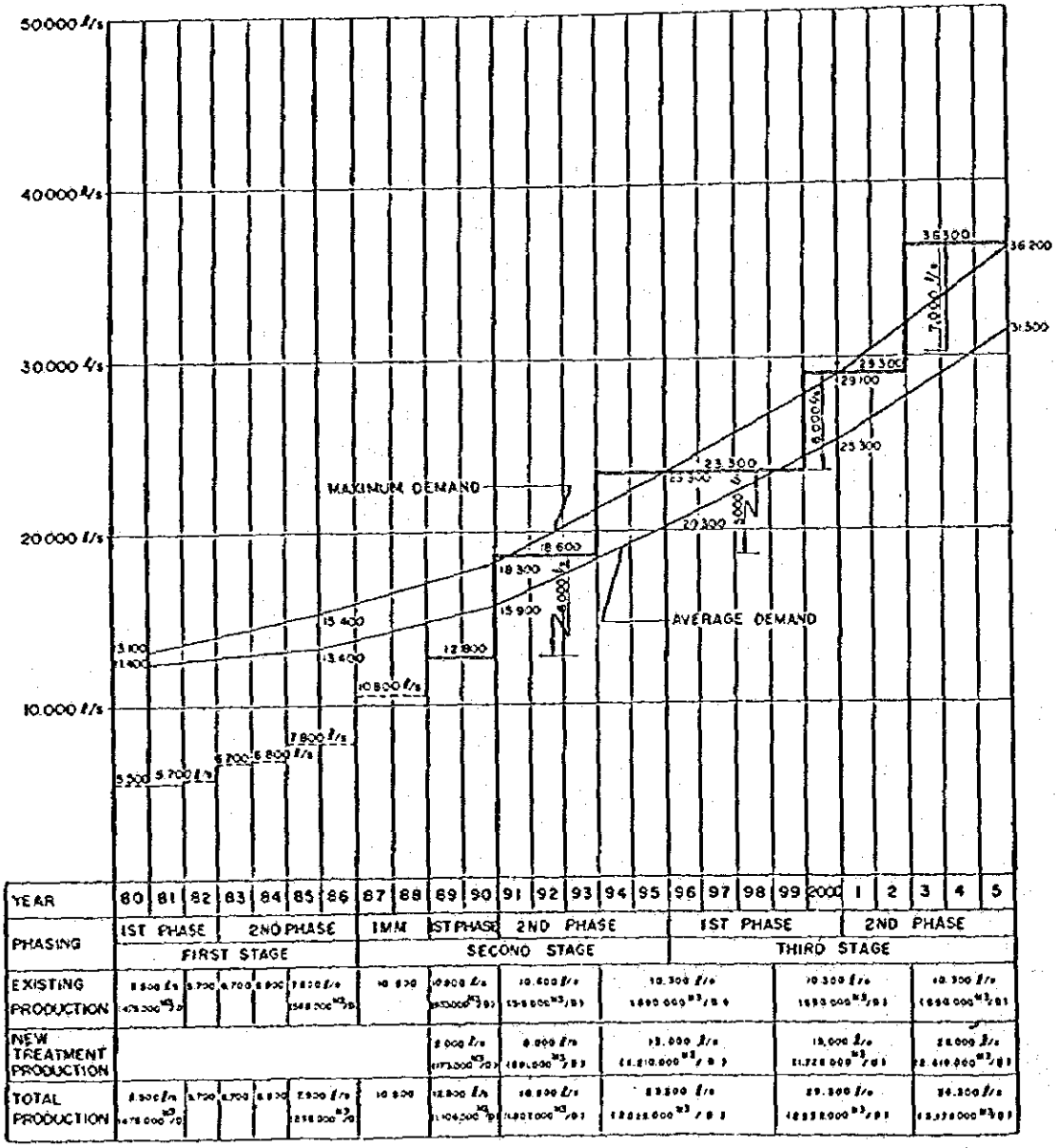
	Projected Water Demand in Average (l/sec) (1)	Total Production 1/ at Treatment Plant (l/sec) (2)	(%) (2)/(1)
1980	11,000	5,500	48
1981	11,800	5,500	47
1982	12,200	5,700	47
1983	12,600	6,700	53
1984	13,000	6,800	52
1985	13,400	7,800	58
1986	13,900	7,800	56
1987	14,400	10,800	75
1988	14,900	10,800	72
1989	15,400	12,800	83
1990	15,900	12,800	81
1991	16,780	18,600	110
1992	17,660	18,600	105
1993	18,540	18,600	100
1994	19,420	23,300	120
1995	20,300	23,300	115
2000	25,300	29,300	116
2005	31,500	36,300	115

Note : 1/ a. Treatment plant facilities at Pulogadung 3 m3/sec under the First Stage Project is scheduled to be completed at the end of year 1986 and placed in operation in the year 1987.

b. Treatment plant facilities of the Immediate Project, with rated capacity of 2 m3/sec and the plant facilities of 6 m3/sec under the First Phase of the Second Stage Project are scheduled to be completed at the end of year 1988 and 1990, respectively, and to be in operation in the following year of 1989 and 1991, respectively.

2.6 Water demand Distribution

The area-wise day maximum demand by each Kecamatan in the year 1990 and 1995 are presented in Table 2.5.



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			2NO PHASE				IMM		1ST PHASE		2ND PHASE					1ST PHASE					2ND PHASE				
	FIRST STAGE							SECOND STAGE									THIRD STAGE									
EXISTING PRODUCTION	5300 l/s	5700	6700	6800	7800 l/s			10 800		10800 l/s		10.400 l/s			10.300 l/s				10.300 l/s			10.300 l/s				
NEW TREATMENT PRODUCTION										2 000 l/s		8 000 l/s			13.000 l/s				15,000 l/s			26.000 l/s				
TOTAL PRODUCTION	5300 l/s	5700	6700	6800	7800 l/s			10 800		12800 l/s		18 400 l/s			23300 l/s				29 300 l/s			36 300 l/s				

FIG 2.2 WATER DEMAND AND PROPOSED WATER PRODUCTION

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

Table 2.4 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) (Krweut River)	200	1977
PESING (Angke River)	5	1980
MUARA KARANG (Banjir Canal)	100	1982
CENGKARENG (Angke River)	50	1982
SUNTER (Sunter River)	50	1982
CAKUNG (Irrigation Canal)	25	1982
PEJATEN (Ciliwung River)	5	1976
(CONDET) (Ciliwung 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		
PULOGADUNG		1000				1000					1000					1000					1000		
					EXPANSION		3000				3000					3000					3000		
(CILANDAK) (Krweut River)		200				200					200					200					200		
				EXPANSION		250					250					250					250		
PESING (Angke River)		5				5					5				Stand –	5	By or	Emergency	Use		5		
MUARA KARANG (Banjir Canal)		100				100					100				Stand –	100	By or	Emergency	Use	Only	100		
						100					Operation												
CENGKARENG (Angke River)		50				50					50					50					50		
SUNTER (Sunter River)		50				50					50				Stand –		By or	Emergency	Use	Only			
CAKUNG (Irrigation Canal)		25				25					25					25					25		
PEJATEN (Ciliwung River)		5				5					5					5					5		
(CONDET) (Ciliwung River)		100			NEW	MINI	PLANT				100					100					100		
(TAROGONG) (Grogol River)			100		NEW	MINI	PLANT				100					100					100		
BOGOR CIBURIAL SPRING		300				300					300					300					300		
IMMEDIATE PROGRAM OF STAGE II							2000				2000					2000					2000		
FIRST PHASE OF STAGE II											6000					6000					6000		
SECOND PHASE OF STAGE II PROGRAM												3000				9000					9000		
FIRST PHASE OF STAGE III PROGRAM																	6000				6000		
SECOND PHASE OF STAGE III PROGRAM																					7000		
TOTAL PRODUCTION	6.735 l/s	6.835	7.765	7.765					18.630 l/s		23.330 l/s			23.330 l/s			29.330 l/s		29.330 l/s		36.330 l/s		
		6.700	6.800	7.800	10.800	12.800 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 2.5 Area-wise Day Maximum Demand

Walikota	Kecamatan	1990 Service Area (ha)	1990 Day Max. Demand (l/sec)	1995 Service Area (ha)	1995 Day Max. Demand (l/sec)
I. PUSAT	1. Gambir	757.6	640	757.6	710
	2. Sawah Besar	583.2	590	583.2	640
	3. Kemayoran	704.0	620	704.0	670
	4. Senen	461.0	540	461.0	580
	5. Cempaka Putih	717.6	640	717.6	680
	6. Menteng	613.6	480	613.6	520
	7. Tanah Abang	1,016.8	720	1,016.8	790
	Sub-Total	4,853.8	4,240	4,853.8	4,600
II. UTARA	1. Pulau Seribu	-	-	-	-
	2. Penjaringan	3,315.7	980	3,315.7	1,310
	3. Tanjung Priok 1)	2,423.0	1,210	2,423.0	1,410
	4. Koja	2,004.4	750	2,004.4	930
	5. Cilincing	1,190.5	390	1,190.5	530
	Sub-Total	8,933.6	3,310	8,933.6	4,190
III. BARAT	1. Cengkareng	1,160.6	180	1,573.4	320
	2. Grogol Petamburan	1,763.1	1,310	1,763.1	1,540
	3. Taman Sari	430.0	540	430.0	600
	4. Tambora	570.2	590	570.2	640
	5. Kebon Jeruk	1,686.3	490	2,533.7	990
	Sub-Total	5,610.2	3,120	6,870.4	4,090
IV. SELATAN	1. Tebet	958.0	670	958.0	770
	2. Setiabudi	792.4	460	792.4	520
	3. Mampang Prapatan	1,292.8	560	1,860.4	990
	4. Pasar Minggu	530.8	150	795.9	310
	5. Kebayoran Baru	1,258.4	710	1,258.4	830
	6. Kebayoran Lama	1,886.4	780	2,931.1	1,460
	7. Cilandak	766.9	310	766.9	430
	Sub-Total	7,485.7	3,660	9,363.1	5,290
V. TIMUR	1. Matraman	480.0	590	480.0	640
	2. Pulogadung	1,476.2	1,100	1,476.2	1,230
	3. Jatinegara	1,599.4	900	2,323.5	1,410
	4. Kramat Jati	2,042.2	630	2,117.4	780
	5. Pasar Rebo	479.7	170	479.7	200
	6. Cakung	878.2	480	1,399.7	750
	Sub-Total	6,955.7	3,860	8,276.5	5,000
	Total	33,839.0	18,200	38,297.4	23,170

NOTE: 1) Included water demand of Harbour at Tanjung Priok as 333 l/sec and 336 l/sec in year 1990 and 1995, respectively.
2) Water demand of Depok (out of JAKARTA) as 115 l/sec and 104 l/sec for year 1990 and 1995 is not included in this Table.

Table 2.6 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)	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

3. IMMEDIATE PROGRAM

3. IMMEDIATE PROGRAM

Prior to the implementation of the First Phase of Seocnd Stage Project succeeding to the First Stage, now under way, execution of projects concerning the abatement of the existing leakage, full utilization of present water production of Pulogadung Plant and increase of production capacity was immediately needed and recommended as the immediate program in the Master Plan. The costs estimated for these prejcts are to be reflected in the financial analysis hereafter. The cost necessary for each project is described as follows:

1) Rehabilitation works and leakage abatement

Rehabilitation works to abate the existing water losses were planned for replacement of water meters, old distribution pipelines and old service connections and leakage abatement Estimated cost for immediate execution up to the year 1990 is described below:

Replacement of water meters	= Rp. 3,235 million
Replacement of old distribution pipelines	= Rp.13,377 million
Replacement of old service connections	= Rp. 842 million
Leakage abatement	= Rp. 5,189 million
Total	Rp. 22,643 million

2) Rehabilitation works for Prjompongan Plant I

This project was planned to be normalized, with four phases implementation, the present function for mechanical and electrical equipment deteriorated due to long term work. The project started in 1983 and is scheduled to be completed in 1986. Cost estiamted in each phase is described below:

Phase 1 : Replacement of equipment in intak pump station,
Completed in 1983,
Total costs : Rp. 470 million
Phase 2 : Replacement of equipment in treatment plant,
Completion in 1984,
Total costs : Rp. 1,750 million
Phase 3 : Replacement of chemical feeding equipment
Completion in 1985
Total costs : Rp. 620 million
Phase 4 : Replacement of and overhaul of electrical equipment
Completion in 1986
Total costs : Rp. 1,500 million

3) Short term improvement project for the existing treatment process

To treat adequately present raw water polluted year by year until completion of the raw water transmission sysgtem of direct intake from the WTC, strengthening of chlorination was recommended as the short term improvement in the Master Plan. The project consists of installation of chirinator and neutralization equipment for the

existing system and newly installation of pre-chlorination equipment for raw water transmitted directly from the WTC. The total costs for each plant are estimated as follows:

Pejompongan Plants	:	Rp. 489 million
Pejompongan Plant I	:	Rp. 300 million
Pejompongan Plant II	:	Rp. 153 million
Pulogadung Plant	:	Rp. 228 million

The pre-chlorination equipment at Pejompongan Plant will be installed around the year 1989 in accordance with the construction schedule of the raw water transmission pipeline from the WTC.

4) Immediate Project

As proposed in the Master plan, the Immediate proejct was conceived to fill the present gap between the supply capacity and the potential water demand as early as possible using raw water available from the WTC after completion of enlargements. The project consists of the construction of new treatment plant with a capacity of 2.0 m3/sec at Buaran and new distribution mains to be connected to the existing mains. Fund of foreign portion required for the Project implementation has been decided to be financed by OECF and the Loan Agreement was concluded between OECF and the Government of Indonesia. Total proejct costs appraised by OECF are as follows:

Foreign exchange portion :		Y 4,500 million
	=	Rp. 18,996 million
Local currency portion:		Rp. 18,153 million
Total Equivalent in		Rp. 37,148 million
(Coversion rate : US$ 1.0	=	Rp. 992 = Y235)

Disbursement will be done from the year 1985 to 1988.

5) Improvement of distribution pipeline

For full utilization of available water production, strengthening the distribution networks by small size pipeline in the existing service area was planned. The project will start in 1985 and be completed in 1989. Total project costs are as follows:

Foreign exchange portion	:	US$ 9,967 thousand
Local currency portion	:	Rp. 16,852 million
Total	Equivalent in	Rp. 26,859 million

4. FIRST PHASE OF SECOND STAGE PROJECT

4. FIRST PHASE OF SECOND STAGE PROJECT

4.1 General

The preliminary design of the First Phase of the Second Stage Project, following the concept of the Master Plan, is made on the basic conditions mentioned below:

- Raw Water sources are the West Tarum Canal and the Cisadane river and the intake points are at Buaran from the former and at Serpong from the latter.
- Whole service area is divided into six supply zones to keep as uniform supply as possible and to minimize the cost.
- Each supply zone basically has either a treatment plant or a distribution center from where water is distributed by pumps.
- Basically, the sizes and scales of the major facilities are determined taking into consideration the requirement of the Second Stage.

The First Phase Project is composed of two systems according to the location of water sources and area-wise water demand. They are the West Tarum Canal System (WTC system) and the Cisadane River System (Cisadane system). General layout of the system for the First Phase Project is shown on Fig. 4.1. WTC system covers one supply zone located in the eastern area of the City bounded by the Ciliwung river and Cisadane system covers two supply zones in the western area. The rest three supply zones located in the central area of the city, as are presently covered, are supplied from the existing treatment plants, and the Buaran plant to be constructed by the Immediate Project.

WTC system consists of raw water intake and water treatment plant with a production capacity of 3.0 m3/sec at Buaran, and treated water transmission to the distribution center of the Supply Zone 3.

Cisadane system consists of raw water intake from the Cisadane river, raw water transmission facilities with a production capacity of 3.0 m3/sec, water treatment plant with the same capacity located at Lebakbulus and treated water transmission facilities to the distribution center of the Supply Zone 4. In addition, the treatment plant at Lebakbulus distributes water directly to the Supply Zone 5.

Each distribution center consists of operational reservoir and distribution pump facilities.

4.2 Design Criteria

The summary of design criteria for preliminary design for feasibility study is presented below. The design criteria for preliminary design is attached in Appendix FIV-1.

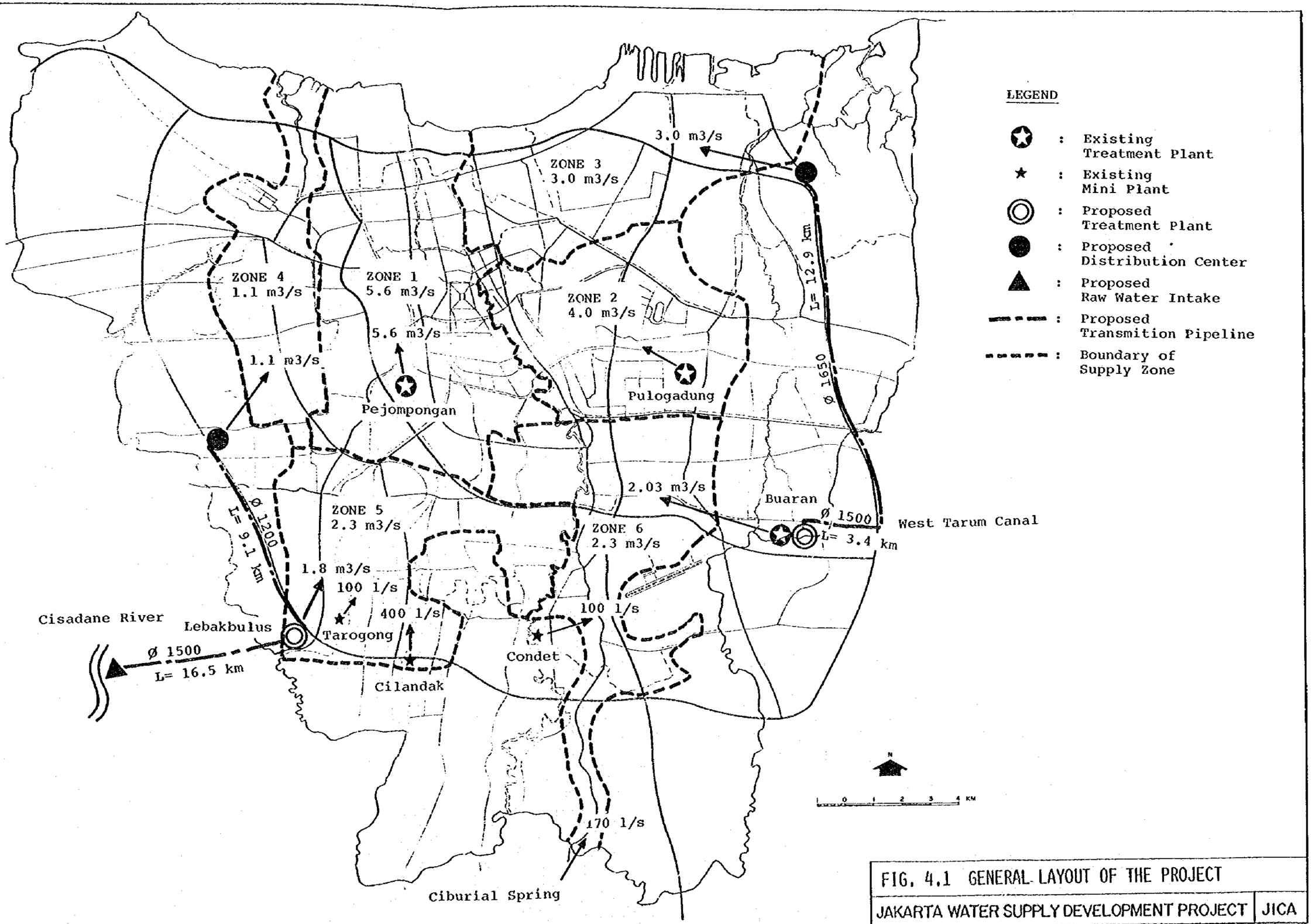


FIG. 4.1 GENERAL LAYOUT OF THE PROJECT

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1) Intake and Treatment Facilities

Intake pump station, raw water transmission mains, treatment plant and clear water transmission mains are sized to supply maximum day demands.

2) Fluctuation in Water Demand

Day Maximum Water Demand : 115 % of Day Average Water Demand

Hourly Maximum Water Demand : 130 % of Day Maximum Water Demand

3) Distribution Facilities

a. The distribution system is designed to deliver hourly maximum flow.

b. Operational storage is sized to meet the fluctuation in demand in excess of the average flow.

c. The distribution trunk mains are sized to provide a minimum pressure of 1.7 kg/cm2 at the end of the main. The secondary main and the tertiary pipes are sized to provide a minimum pressure of 0.75 kg/cm2 at service connection which supply water up to the second floor with flow rate of 0.15 l/sec.

d. The maximum system pressure is 7.5 kg/cm2.

4) Coefficient for Hydraulic Calculation

Hazen-Williams "C" values of 130 and 120 are used for sizing new transmission mains and distribution pipelines, respectively and 100 and 110 are applied to old pipelines considering the age and condition of the pipelines.

4.3 WTC System

4.3.1 General

The WTC system, as planned in the Master Plan, will take raw water from the West Tarum Canal through the intake channel which is to be constructed by the Immediate Project, and the water treatment plant will be constructed in the premises of the same project.

The said intake channel is capacitated to accommodate the following requirements.

6.0 m3/sec for the raw water improvement project (Pejompongan Plant)

2.1 m3/sec for the Immediate Project

3.2 m3/sec for the First Phase of the Second Stage

The treatment plant, taking advantage of the water level of the Canal, about 5 m above the ground level of the plant site, is planned to employ gravity flow all through the treatment processes from the intake channel down to the clear water reservoir.

4.3.2 Raw Water Intake

The cross section of the Canal at the intake is as shown below, after the enlargement of the Canal which is currently under designing.

- Width of the canal bottom : 13.6 m
- Slope of the bank : 1 : 2
- Designed water depth at full capacity : 1.87 m
- Free board of the canal : 0.80 m
- Designed water level at full capacity : 17.05 (Walahar level)

As the depth of the Canal is rather small, the variation of the water level is confined within a small range, and besides, there is a "cross regulator" installed downstream of the intake to maintain the water level at a necessary elevation for diversion of irrigation water.

However, to make secure the withdrawal of raw water by gravity even under unexpected changes of the flow in the Canal, the water level has to be regulated within a predetermined range of variation. For this purpose, a regulator will be constructed under this project, close to and downstream of the intake channel. Detailed analysis to decide the range of water level fluctuation should be made during the detailed design stage considering operation and control of inflow to the Canal together with the control device of water level.

Further, an overflow device should be considered in the detailed design, as a measure for emergency, such as sudden stoppage of water intake or sudden increase of canal flow.

There are two datum levels based on mean sea level at Walahar (WP) and that of Jakarta Bay (PP). Relationship of the level is as follows:

WP : PP + 0.61 m

4.3.3 Treatment Plant

1) Treatment Process and Chemical Application

The preliminary design of the water treatment plant is described briefly in the following paras. The design is intended to show an overall picture of the plant to be constructed in the First Phase Project, and to estimate the cost thereof to be used for the financial planning in the feasibility study.

The plant type is selected from among various possible types which are applicable to the raw water. The construction cost of the plant type described here is, in general, conservative and safe side. The type, and chemical application as well, are to be further reviewed at the detailed design stage when more up-to-date data of water quality may become available.

(1) Raw Water Quality and Drinking Water Standard

Major raw water quality items are summarized as shown below from data provided by DPMA. The figures may not necessarily cover the whole range of possible variations but are considered sufficient to plan the chemical applications. The characteristics of water quality do not indicate requirement for any special treatment to produce water conforming to the drinking water standard, shown on Table 4.1. An ordinary conventional treatment, therefore, will be employed in the preliminary design.

Parameters	Range of Variation	Average
pH	6.9 - 8.0	7.5
Alkalinity (mg/l)	37 - 72	51
Turbidity (mg/l)	36 - 160	90
Color (Unit)	10 - 25	19
Iron (dissolve) (mg/l)	0.3 - 2.3	0.75
Organic Matter (mg/l)	5 - 24	12
Ammonium (mg/l)	0.1 - 0.75	0.27
E. Coli (MPN/100 ml)	1.5×10^4 - 4.6×10^5	1.1×10^5

Data sources : DPMA
- 16 samples during November 1983 to May 1984
- Sampling point : BTB 49

(2) Chemical Applications

a. Alum and Polymer

For coagulation alum will be used. As it was found by jar test that polymer is useful for the raw water in the dry season, polymer will be employed together with alum. The dosages of alum and polymer estimated are as follows:

	Average	Maximum
Alum	30 mg/l	7.0 mg/l
Polymer	0.03 mg/l	0.1 mg/l

Usages of PAC instead of Alum and Polymer are to be further reviewed during detailed design stage considering their advantages and disadvantages.

b. Pre-chlorine

Pre-chlorination will be applied to remove Ammonium and E. Coli, reduce Organic Matter and oxidize Iron and Color. The dosage recommendable is for Ammonium 10 to 15 times its concentration. Therefore, pre-chlorine dosage taken for the design is 4 to 5 mg/l in average and 10 m/l in maximum.

c. Intermediate-chlorine

Intermediate-chlorine to clarified water before filtration is employed for the purpose of protecting filter bed free from E. Coli and Organic Matter. The dosage is planned at 1 to 2 mg/l in average and 3 mg/l in maximum, that is, to the extent of keeping free residual chlorine in the filtrate.

d. Post-chlorine

Post-chlorination, for disinfection, is advisable to be made to the extent of keeping more than 1 mg/l residual chlorine in the distribution water. The dosage planned is 1 to 2 mg/l in average and 3 mg/l in maximum.

e. Post-lime

Post-lime will be used to adjust pH value of the finished water to the non-corrosive level of 7.4, calculated by Langelier Index. Considering the present dosages in the three plants which are 11 mg/l to 15 mg/l for adjusting pH value of finished water to 7.0 and 7.1 from pH 6.1 and 6.3 of Clarified water, the dosage is planned at 15 to 20 mg/l in average and 24 mg/l in maximum.

(3) Treatment Processes

What has been described so far is summarized schematically in Fig. 4.2.

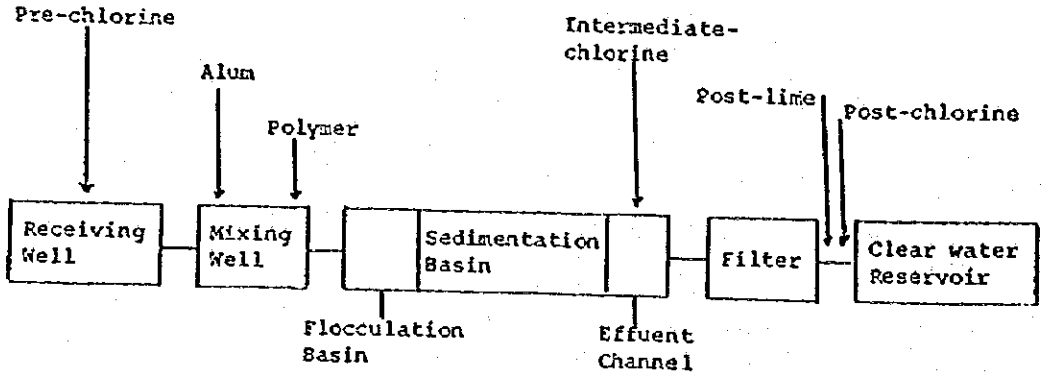

Fig. 4.2 Treatment Process of the WTC System

Table 4.1 Requirement of Drinking Water in Indonesia

Items		Permissible Value	Non-permissible Value
1. Physical Requirement			
pH		7.0 - 8.5	6.5 - 9.5
Solid matters		500 mg/l	1,500 mg/l
Turbidity (Silicia unit)		1 "	5 "
Color (Platina Cobalt unit)		5 "	50 "
Taste		non-objectionable	-
Odor		"	-
2. Chemical Requirement			
Lead	Pb	0.5 mg/l	
Selenium	Se	0.05 "	
Arsenic	As	0.2 "	
Chromium (hexavalent)	Cr VI	0.5 "	
Cyanida	C.N	0.01 "	
Fluor	F	1.0 "	
Nitrite	NO2	0.001"	
Nitrate	NO3	100 "	
Iron	Fe	0.3 "	1.0 mg/l
Manganese	Mn	0.1 "	0.5 "
Copper	Cu	1.0 "	1.5 "
Zinc	Zn	5.0 "	15.0 "
Calcium	Ca	75.0 "	200.0 "
Magnesium	Mg	50.0 "	150.0 "
Sulphate	SO4	200.0 "	400.0 "
Chlorine	Cl	200.0 "	600.0 "
Sulphate magnesium + Sulphate natrium		500.0 "	1,000.0 "
Phenol		0.001"	0.002"
Carbon dioxide aggressive	CO2	0	10
3. Bacteriological Requirement			

Drinking water must be free from infectious micro-organism and coliform bacteria. In order to ensure the requirements which are already described, tap water shall be disinfected and periodical and regular bacteriologic test must be made.

2) Water Treatment Plant

(1) Plant Site

Plant site, presently paddy fields, is rather flat with ground elevation of about +11.6 m in average. On the other hand, the elevation of the bank of the Canal is about +17 m. Thus, partial embankment fill is necessary for better access, drainage from the plant and protection from flood. The Jati Kramat river, a small river meandering in the plant site, is to be relocated for the new plant construction.

(2) Condition of the Preliminary Design

The following are the design conditions for the preliminary design based on the study on "treatment processes and chemical application" and preliminary design of the Immediate Project on intake facilities.

a. Capacity of the Plant

- treatment capacity	:	3.2 m3/sec (276,000 m3/day)
- production capacity	:	3.0 m3/sec (259,000 m3/day)

b. Water Source and Intake

- water source	:	West Tarum Canal
- raw water quality	:	see sub-section 4.3.3 - 1)
- intake point	:	intake channel constructed by the Immediate Project
- intake water level	:	+17.60 m (minimum intake level)

c. Treatment Processes

- mixing of chemicals
- flocculation
- sedimentation
- rapid sand filtration

d. Chemical Application

- Alum and Polymer	:	dosing point; at mixing well max. dosing rate; - alum 70 mg/l - polymer 0.1 "
e. lime	:	dosing point; entrance of clear water reservoir max. dosing rate; 25 mg/l

f. chlorine

- pre-chlorine	:	dosing point; at receiving well max. dosing rate; 10 mg/l
- intermediate-chlorine	:	dosing point; at effluent of sedimentation basin max. dosing point; 3 mg/l
- post-chlorine	:	dosing point; entrance of clear water reservoir max. dosing rate; 3 mg/l

(3) Profile of the Treatment Plant

Profile of the treatment plant is presented on Fig. 4.4 showing schematically all structures and dosing points, and the general plan thereof on Fig. 4.3.

As seen on the Figure, the difference of elevation between the Canal and the plant site makes possible gravity flow through the treatment processes, covering the required water head of 5.00 m, from the receiving well to the high water level of clear water reservoir.

Water level of the clear water reservoir is +11.8 m at high water level and +7.8 m at low water level.

(4) Facilities of the Treatment Plant

The intake facilities of intake bay and channel will be constructed by the Immediate Project as combined structure. The facilities in the Plant are planned covering all facilities from raw water main, to clear water reservoir. The capacity, volume and dimension for the facilities, planned on the basis of design criteria, are described below:

a. Raw water main

Raw water main	:	ø 1,500 mm x L 50 m x single line
Water meter	:	Ultra sonic type, ø 1,500 mm, one unit
Flow controller	:	motorlized butterfly valve, one unit

b. Receiving well

Dimension	:	B 9.0 m x L 5.0 m x H 65 m = v 292 m3 x one well
Retention time	:	1.5 minutes

c. Mixing Well

Dimension	:	B 6.0 x L 2.0 m x H 4.0 m = 48 m3 x two wells
Mixing method	:	by water fall
Retention time	:	30 sec

d. Flocculation basin

Dimension	:	B 32.9 m x L 11.1 m (divided by 3 compartments) x H 2.5 m x 4 basins
Type	:	stirring by flocculator
Flocculator	:	Vertical type flocculator 12 units/basin
Retention time	:	20 minutes

e. Sedimentation basin

Dimension	:	B 33.6 m x 72 m x H 3.6 m x 4 basins
Overflow rate	:	1.2 m3/m2/hr
Retention time	:	3 hrs
Mean velocity	:	40 cm/min
Type	:	rectangular horizontal flow
Effluent	:	effluent launder at basin end (weir load; 360 m3/m/day)
Desludge	:	bridge type traveling girder with suspended sweeps for sludge scraping

f. Filter

Dimension	:	B 3.20 m x L 14.4 m x 2 beds x 20 filters (including one standby)
Type	:	conventional type with single media
Filtration rate	:	150 m3/m2/day
Total filter head	:	2.3 m
Surface area	:	1,843 m2
Water depth above sand	:	1.5 m
Filter media	:	Single media of filter sand
		Effective size : 0.65mm
		Uniformity coefficient : 1.3 - 1.5
		Thickness : 70 cm
Supporting Gravel	:	Grading 4 - 40 mm
		Thickness 25 cm
Under drain	:	nozzel type
washing	:	Backwashing + surface washing
		Backwash rate : 0.7 m3/min/m2
		Surfacewash rate : 0.2 m3/min/m2

g. Clear water reservoir

Dimension	:	B 85.0 m x L 33.25 m x H 4.0 m x 1 nos = 11,300 m3
Retention time	:	1.5 hour

h. Backwash tank

Dimension	:	B 10.4 m x L 17.6 m x H 2.5 m = 450 m3 x 2 units (0.7 m3/m2 x 92.2 m2 x 6.0 min x 1.1 = 450 m3)

i. Backwash pump : For backwash tank

Number	:	2 (including one standby) units
Discharge	:	450 m3/30 min = 15 m3/min
Total head	:	15 m
Power	:	0.163 x 15 x 15 x 1.15/0.8 = 55 kW

j. Surfacewash pump

Number	:	2 (including one standby)
Discharge	:	0.2 m3/m2 x 92.2 m2 = 19 m3/min
Total head	:	20 m
Power	:	0.163 x 19 x 20 x 1.15/0.8 = 95 kW

k. Wastewater pond

Dimension	:	B 12.5 m x L 32.0 m x H 2.5 m = 1,000 m3 x 2 basins

l. Drain pump

Number	:	3 (including one standby) units
Discharge	:	1,000 x 1/40 min x 1/2 = 13 m3/min
Total head	:	7 m
Power	:	0.163 x 13 x 7 x 1.15/0.75 = 30 kW

m. Operation building : Two-story building

Basement floor	:	Pump room	784 m2
First fllor	:	Electric room, control room, office	784 m2

n. Chemical building : Extension of Immediate Project building

Basement floor	:	324 m2 lime solution tank
First floor	:	434 m2 storage and feeding equipment for chlorine, storage of lime

o. Chemical feeding facilities

Chemical	Alum	Lime	Chlorine	Polymer
State of chemical	Solution concentration 8%	Quick lime	Liquid	Zuklur
Storage (for average consumption)	7 days	15 days	15 days	30 days
Storage	Outdoor Steel made 300 m3 x 3 units	in chemical building parted by wall	in chemical building 1 ton container x 38 numbers	in chemical building bag 250 kg
Feeding system Total numbers (standby)	by metering pump 4 (2)	slaker 2 (1) solution tank 3 (1) feed pump 2 (1) saturation tank 2 (1) by gravity	platform scale 2 (1) evaporator pre 2 (1) post 2(1) chlorinator pre- 2 (1) intermediate- post- 2 (1)	solution tank 3 (1) by metering pump 4 (2)
Others			Neutraliza-tion equipment	

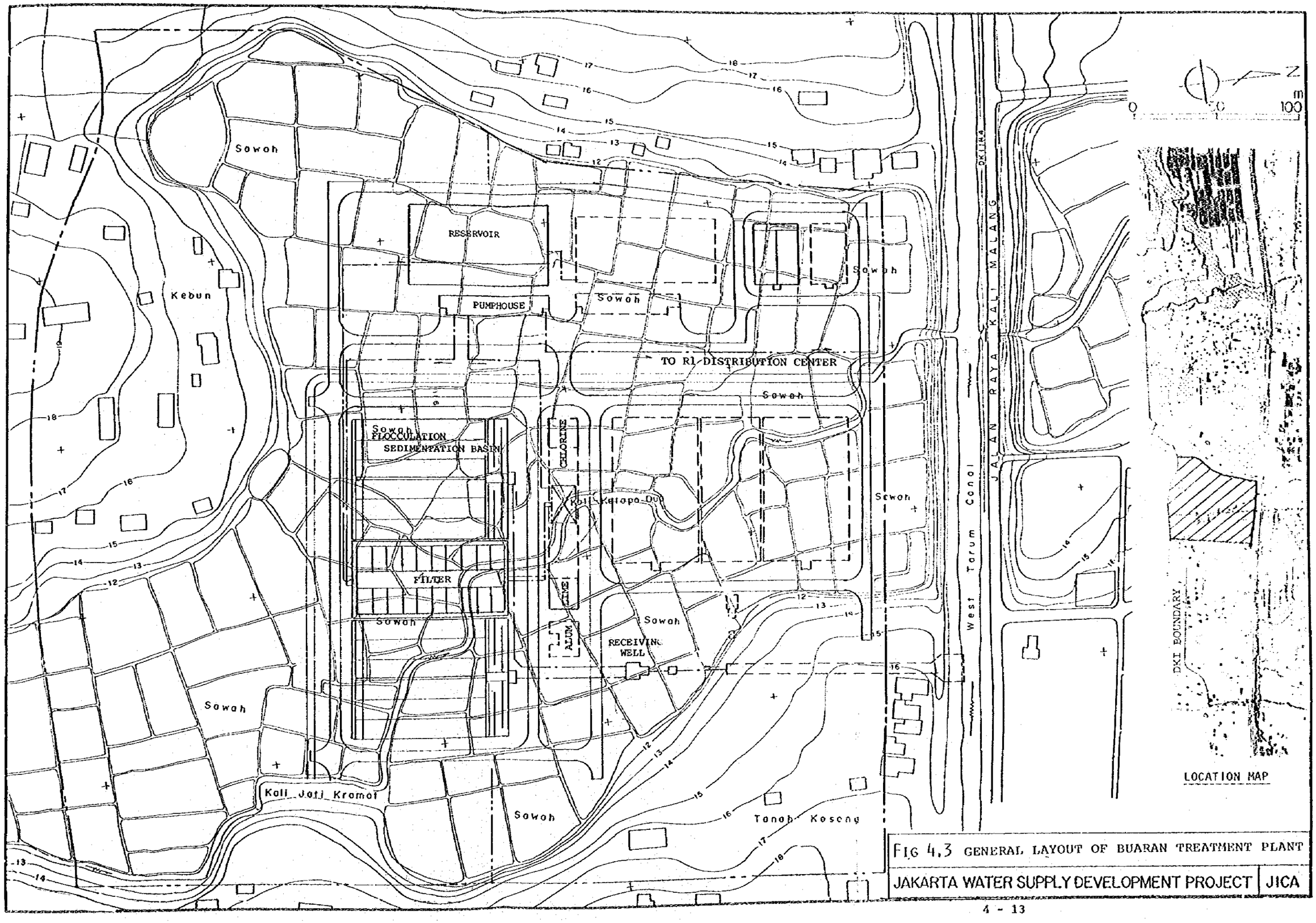

FIG 4.3 GENERAL LAYOUT OF BUARAN TREATMENT PLANT

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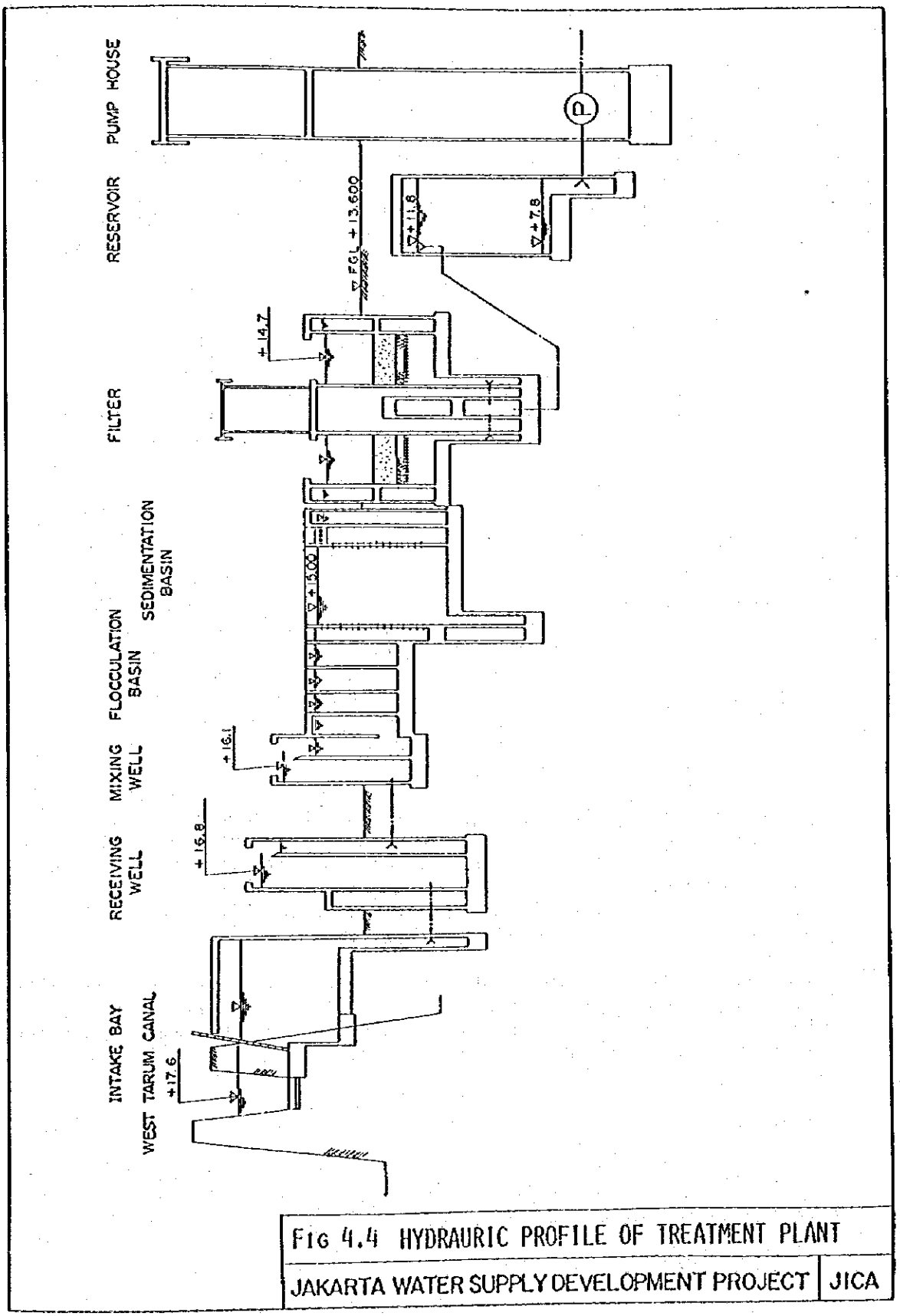

Fig 4.4 HYDRAURIC PROFILE OF TREATMENT PLANT

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4.3.4 Treated Water Transmission

Transmission of treated water will be made by pump through ø 1,500 mm and ø 1,650 mm of pipelines to the Distribution Center in the Supply Zone 3. The capacity of the transmission facilities is 3.0 m3/sec. The transmission pipe will be laid along the north bank of the West Tarum Canal from the treatment plant to the intersection with the planned Outer Link Road and along the said road to the Distribution Center. The size of pipeline up to the intersection is ø 1,350 mm in diameter and afterward it becomes ø 1,650 mm pipeline with the junction well at the intersection. The following are the summary of transmission facilities of WTC system.

- Transmission Pump : ø 600 mm x ø 450 mm x Q 45 m3/mim x H 24 m x 250 kW x 6 units (2 standbys)
- Transmission pump House : described as operation building in treatment facilities
- Transmission Pipes : ø 1,500 mm x 3.4 km from the treatment plant to the intersection with the Outer Link Road

  ø 1,650 mm x 12.9 km from the above intersection to the Distribution Center

4.4 Cisadane System

4.4.1 General

As regards the raw water 3.2 m3/sec from the Cisadane River proposed by the Master Plan, there are two possible locations for the treatment plant, near by the river or within the City at Lebakbulus. The results of comparison of these two locations indicate that the location at Lebakbulus is recommendable for the reasons that this is more economical and more convenient for operation, since this is within the City boundary. Therefore, the latter location is selected.

Cisadane system is composed of the raw water intake, the raw water transmission pumps and pipelines, the water treatment plant including distribution facilities to supply for Zone 5 and clear water transmission facilities to the Distribution Center of Zone 4.

4.4.2 Raw Water Intake

1) Intake Site

The intake site of the system is selected at Serpong considering the following conditions, after comparing two possible sites, that is, Serpong and and Cilangkap.

- Raw water quality and turbidity are not affected by the collection of gravel and sand; there are several locations for such purpose between Cilangkap and Serpong.
- Position of the main stream in the river cross section.
- Better access to the intake site.
- Availability of land and conditions during flood.
- Most shortcut to the treatment plant

2) Raw Water Intake Facilities

Proposed site of the raw water pump station is on paddy field at present and situated at about 5 m above the river water level. According to the inhabitant that present paddy field has not been flooded so far. Accordingly, the crest of intake and grit chamber is planned to be put at 20 cm above the ground in this study assuming 5 m fluctuation of water level between low and high levels. It is recommendable that in the detailed design stage, the Cisadane river development study regarding the water resource will progress and the planned flood level will be decided, so that the economical design should be made after review of the report and collection of further data concerned. In the feasibility study, the following facilities are planned. (Fig. 4.5)

a. Intake bay

Dimension : B 5.5 m x B 3.7 m x L 14.0 x 1 Bay
Carse screen,
Fine screen,

b. Intake channel

Dimension : B 1.5 x H 2.0 m x L 117m box culvert

c. Grit chamber

Dimension : B 9.0 m x L 35.0 m x H 2.5 x 2 Basin = 1,575 m3
Retention time: 8 minutes
Mean velocity : 7 cm/sec
Type : Rectagular horizontal flow
De-sanding : Bridge type travelling girder with suspended pump for suction

d. Raw water transmission pump

Number	:	6 Nos (including two standby)
Discharge	:	3.2 x 60/4 = 48 m3/min
Total head	:	50 m
Specification	:	ø 600 x 48 m3/min x 50 m x 550 kW

e. Pump house: two story building

Basement floor	:	504 m2
	:	pump room
First floor	:	336 m2
	:	electric room, controll room, office

4.4.3 Raw Water Transmission Pipeline

The topographic feature between the intake and treatment plant site is variable, rise and fall, and pipeline crosses several small rivers and streams. There is no main road with enough width for the installation of large size pipe between both sites. The selection of pipeline route is made based on the topographical map with scale of 1 to 50,000. The route is selected rather conservatively so that the pipeline passes below the hydrodynamic head at any places. (Fig. 4.6)

For the installation and maintenance of pipeline, the road is necessary with enough width. The road is planned with gravel walk along the pipeline. The width of the road will be necessary as 10 meter width at least for the construction.

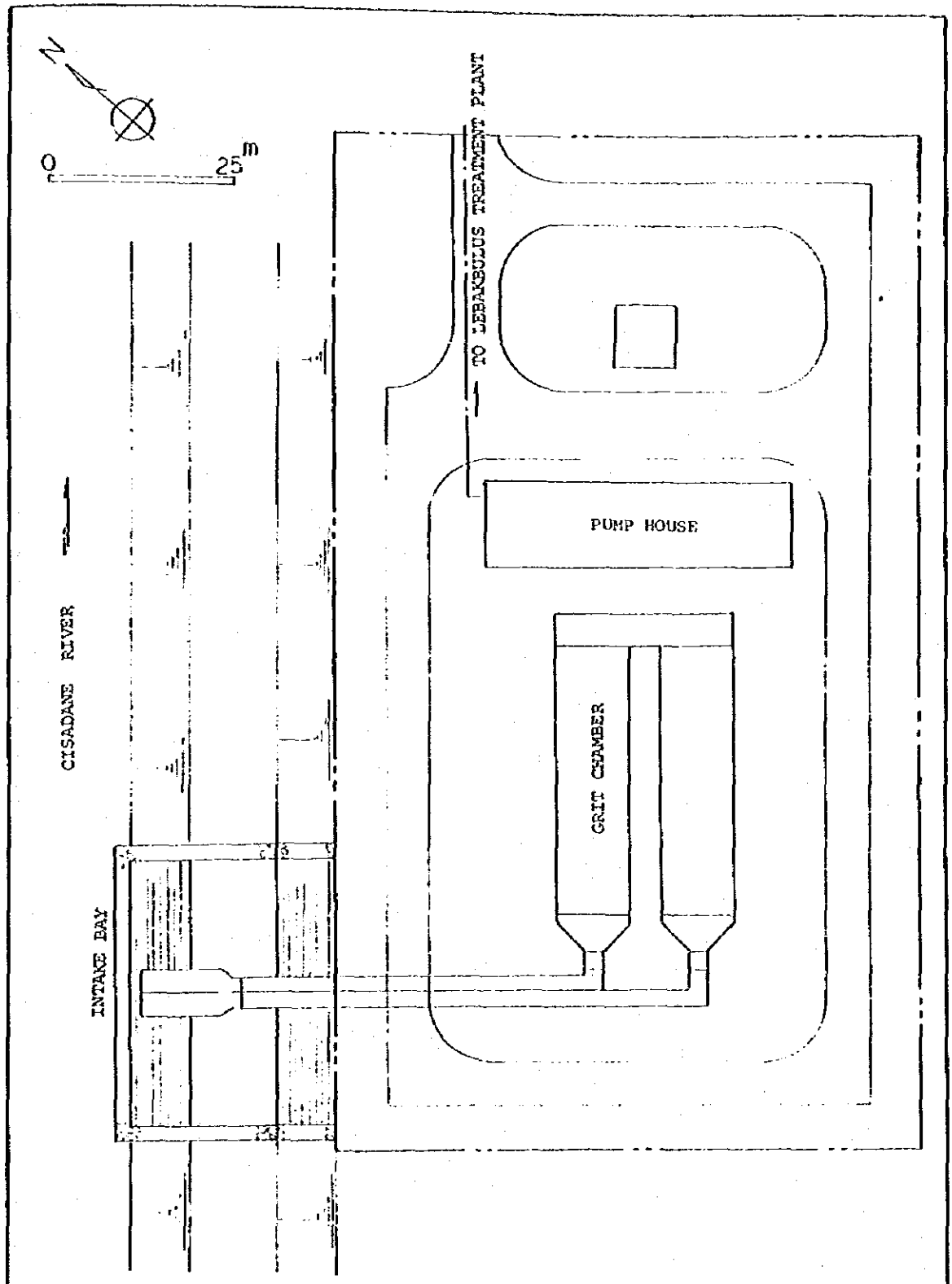

FIG 4.5	GENERAL LAYOUT OF SERPONG INTAKE STATION
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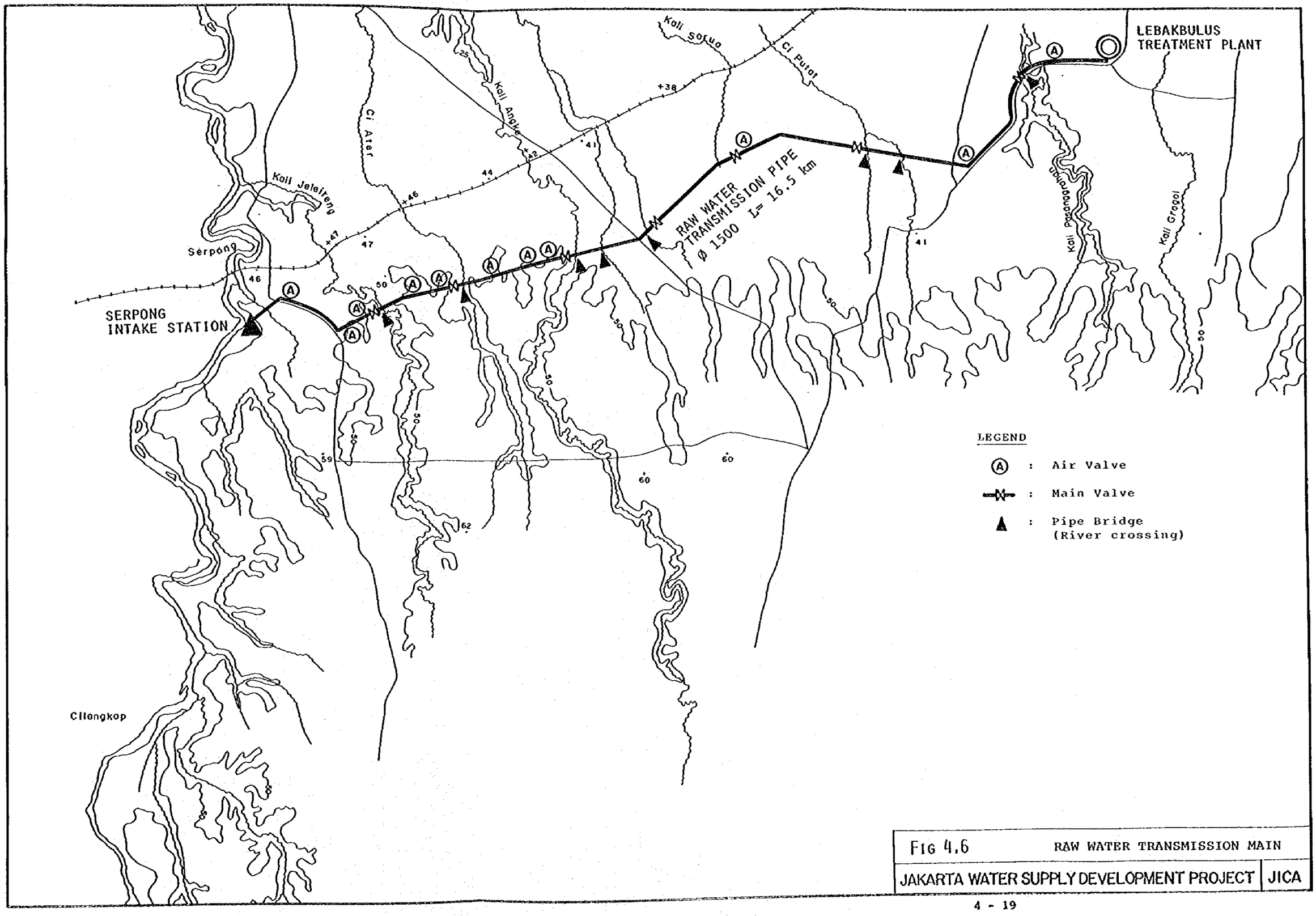

FIG 4.6 RAW WATER TRANSMISSION MAIN

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4.4.4 Treatment Plant

1) Treatment Processes and Chemical Applications

As described below, water samples employed for the present study are those obtained in a rather short period of the wet season. In the detailed design stage, samples covering a longer period should be analyzed, and accordingly the chemical application and treatment processes proposed here are subject to change.

(1) Raw Water Quality

The following are concentrations of raw water quality parameters based on the data surveyed by NEDECO and JICA.

Parameters		Limits	Average
pH		6.9 - 8.1	7.5
Alkalinity	(mg/l)	23 - 41	31
Turbidity	(mg/l)	21 - 589	224
Color	(unit)	5 - 70	29
Iron (Total)	(mg/l)	0.65 - 3.86	1.5
Organic Matter	(mg/l)	3.5 - 10.7	6.8
Ammonium	(mg/l)	0.0 - 0.32	0.16
E. Coli (MPN/100 ml)		-	1,100

Sampling point: Serpong
- 4 samples November 1976 to January 1977 by Coyne & Bellier and Sogreah "CJC Water Resources Development Plan, 1979"
- 1 sample March 1984 by JICA Team

The raw water, as seen on the Table, has rather high turbidity, color and iron, and low concentrations of Ammonium, Organic Matter and E. Coli. For treatment of raw water of this quality, the ordinary treatment method will be effectively applied.

(2) Chemical Application

The following are necessary chemical applications proposed for the system, from the above water quality.

a. Alum

Estimated dosage rate is 20 to 30 mg/l in average and 80 mg/l in maximum on the basis of Jar test results performed by PDAM in March 1984.

b. Pre-lime

Purpose of pre-lime dosage is to supplement Alkalinity which is consumed by Alum, i.e., 1 mg/l of Alum consumes 0.45 mg/l of Alkalinity. As minimum Alkalinity of the raw water is 23 mg/l, it becomes zero by more than 50 mg/l of Alum dosage. The dosage rate planned is 13 mg/l in maximum in the case of 80 mg/l of Alum dosage and 23 mg/l of Alkalinity in the raw water. Pre-lime will be operated when more than 50 mg/l of Alum is dosed.

c. Pre-chlorine

The pre-chlorine will be dosed for removing pollutants and Dissolved Iron. The dosage rate planned is 2 mg/l in average and 5 mg/l in maximum considering concentrations of Ammonium and Organic Matter of the raw water.

d. Post-chlorine

The dosage rate planned is 1 to 2 mg/l in average and 3 mg/l in maximum.

e. Post-lime

The dosage rate will be 15 to 19 mg/l in average and 22 mg/l in maximum, judging from the results of Jar test.

(3) Treatment Processes

Based on the descriptions of raw water quality and chemical applications, water treatment processes planned of the Cisadane system are shown on Fig. 4.7 below.

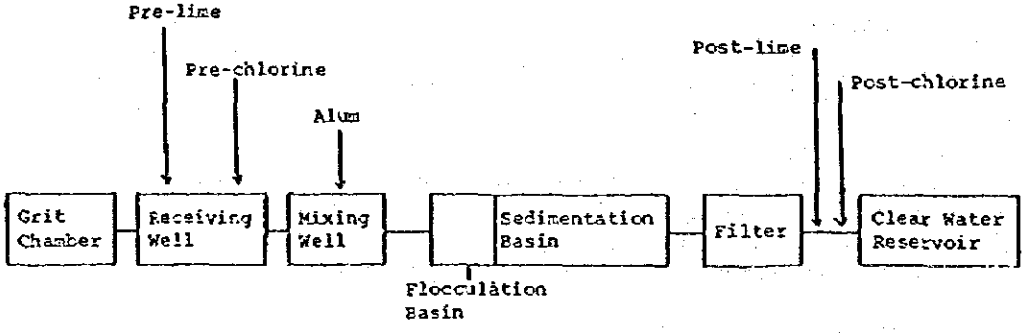

Fig. 4.7 Treatment Processes of the Cisadane System

2) Water Treatment Plant

(1) Plant Site

The water treatment plant is selected at Lebakbulus in Kecamatan Kebayoran Lama (inter-section of Jalan Metro Pondok Indah and Jalan Lebakbulus). The ground elevation varies from +31.5 to +36 at plant site. According to the topographical map, the plant site is almost vacant except for a few houses. The area required for construction is about 7.0 ha.

(2) Condition for the Preliminary Design

The following are the fundamental conditions for the preliminary design based on the study on treatment process and chemical application.

a. Capacity of the Plant

- treatment capacity : 3.2 m3/sec (276,000 m3/day)
- production capacity : 3.0 m3/sec (259,000 m3/day)

b. Water Source and Intake

- water source : Cisadane river
- raw water quality : See sub-section 4.4.4 - 1)

c. Treatment Processes

- mixing of chemicals
- Flocculation and sedimentation
- rapid sand filtration

d. Chemical Application

- Alum : dosing point: mixing well
  maximum dosing rate; 80 mg/l

- Lime : dosing point: receiving well pre-lime; entrance of clear water reservoir for post-lime

  maximum dosing rate:
  15 mg/l for pre-lime
  15 mg/l for post-lime

- Chlorine : dosing point:
  receiving well for pre-chlorine entrance of clear water reservoir for post-chlorine

  maximum dosing rate:
  5 mg/l for pre-chlorine
  3 mg/l for post-chlorine

(3) Profile of the Treatment Plant

Profile of the treatment plant is shown on Fig. 4.9 and the general layout of the plant on Fig. 4.8. Total head loss in the treatment processes is 5.1 m from the receiving well to high water level of clear water reservoir.

(4) Plant Facilities

a. Raw water main

Raw water main	:	ø 1,500 mm x L 188 m x single line
Water meter	:	Ultra sonic type, ø 1,500 mm, one unit
Flow controller	:	motorlized butterfly valve, one unit

b. Receiving well

Dimension	:	B 9.0 m x L 5.0 m x H 6.5 m = V 292 m3 x one well
Retention time	:	1.5 minutes

c. Mixing Well

Dimension	:	B 6.0 x L 2.0 m x H 4.0 m = 48 m3 x two wells
Mixing method	:	by water fall
Retention time	:	30 sec

d. Flocculation basin

Dimension	:	B 32.9 m x L 11.1 m (divided to 3 compartments) x H 2.5 m x 4 basins
Type	:	stirring by flocculator
Flocculator	:	Vertical type flocculator 12 units/basin
Retention time	:	20 minutes

e. Sedimentation basin

Dimension	:	B 33.6 m x 72 m x H 3.6 m x 4 basins
Overflow rate	:	1.2 m3/m2/hr
Retention time	:	3 hrs
Mean velocity	:	40 cm/min
Type	:	rectangular horizontal flow
Effluent	:	effluent launder at basin end (weir load; 360 m3/m/day)
Desludge	:	bridge type traveling girder with suspended sweeps for sludge scraping

f. Filter

Dimension	:	B 3.50 m x L 13.2 m x 2 beds x 20 filters (including one standby)
Type	:	conventional type with single media
Filtration rate	:	150 m3/m2/day
Total filter head	:	2.3 m
Surface area	:	1,848 m2
Water depth above sand	:	1.5 m
Filter media	:	Single media of filter sand
		Effective size : 0.65mm
		Uniformity coefficient : 1.3 - 1.5
		Thickness : 70 cm

Supporting Gravel	:	Grading	4 - 40 mm
		Thickness	25 cm
Under drain	:	nozzel type	
washing	:	Backwashing + surface washing	
		Backwash rate	: 0.7 m3/min/m2
		Surfacewash rate	: 0.2 m3/min/m2

g. Clear water reservoir

Dimension	:	B 42.75 m x L 60.5 m x H 4.0 m x 2 nos. = 20,600 m3
Retention time	:	3 hour of 1.9 m3/sec (Distribution discharge)

h. Backwash tank

Dimension	:	B 10.4 m x L 17.6 m x H 2.5 m = 450 m3 x 2 units (0.7 m3/m2 x 92.4 m2 x 6.0 min x 1.1 = 450 m3)

i. Backwash pump : For backwash tank

Number	:	2 (including one standby) units
Discharge	:	450 m3/30 min = 15 m3/min
Total head	:	15 m
Power	:	0.163 x 15 x 15 x 1.15/0.8 = 55 kW

j. Surfacewash pump

Number	:	2 (including one standby)
Discharge	:	0.2 m3/m2 x 92.4 m2 = 19 m3/min
Total head	:	20 m
Power	:	0.163 x 19 x 20 x 1.15/0.8 = 95 kW

k. Wastewater pond

Dimension	:	B 13.55 m x L 30.0 m x H 2.5 m = 1,000 m3 x 2 basins

l. Drain pump

Number	:	3 (including one standby) units
Discharge	:	1,000 x 1/40 min x 1/2 = 13 m3/min
Total head	:	7 m
Power	:	0.163 x 13 x 7 x 1.15/0.75 = 30 kW

m. Operation building : Two-story building

Basement floor	:	Pump room	816 m2
First fllor	:	Electric room, control room, office	816 m2

n. Chemical Building

(A) Chlorine Building : two story building
First floor : 657 m2
: storage and feeding equipment for chlorination

Second Floor: 216 m2
: electric room, chemical examination room

(B) Lime Building : two story building
Basement floor : 324 m2
: saturation tank

First floor : 216 m2
: lime storage, slaker

o. Chemical feeding facilities

Chemical	Alum	Lime	Chlorine
State of chemical	Solution concentration 8%	Quick lime	Liquid
Storage (for average consumption)	7 days	15 days	15 days
Storage	Outdoor Steel made 300 m3 x 3 units	in chemical building parted by wall	in chemical building 1 ton container x 38 numbers
Feeding system Total numbers (standby)	by metering pump 4 (2)	slaker 2 (1) solution tank 3 (1) feed pump pre 2 (1) post 2(1) saturation tank 2 (1) by gravity	platform scale 2 (1) evaporator pre 2 (1) post 2(1) chlorinator pre- 2 (1) intermediate- post- 2 (1)
Others			Neutralization equipment

4.4.5 Treated Water Transmission Facilities

Transmission of treated water is planned to be by gravity from the treatment plant to the Distribution Center of Zone 4. The diameter of transmission main is calculated at ø 1,200 mm based on the capacity of the Second Stage, 1.9 m3/sec and effective water head between the Plant and the Center as high as 15 m. Total length is estimated at 9 km.

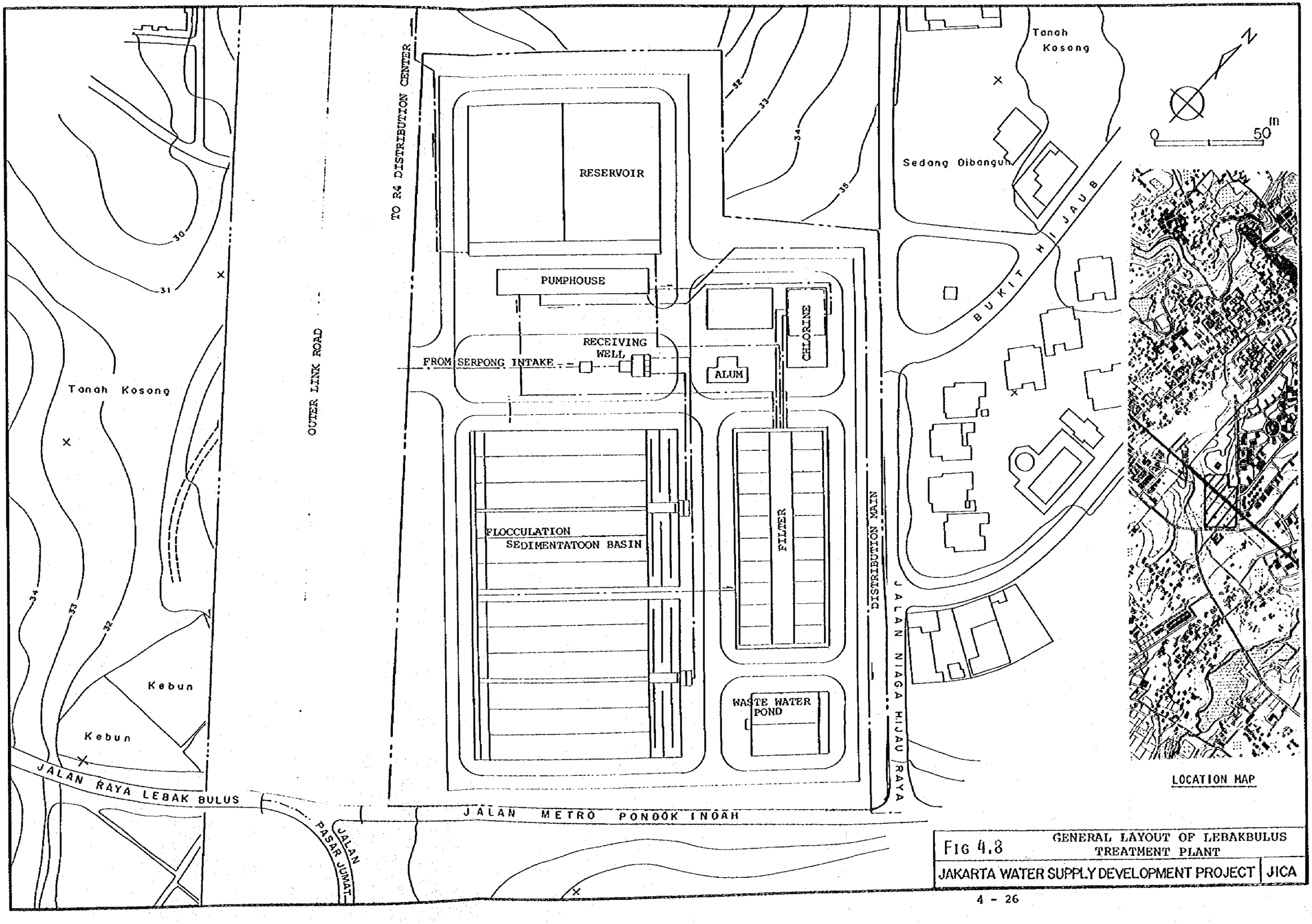

FIG 4.8 GENERAL LAYOUT OF LEBAKBULUS TREATMENT PLANT

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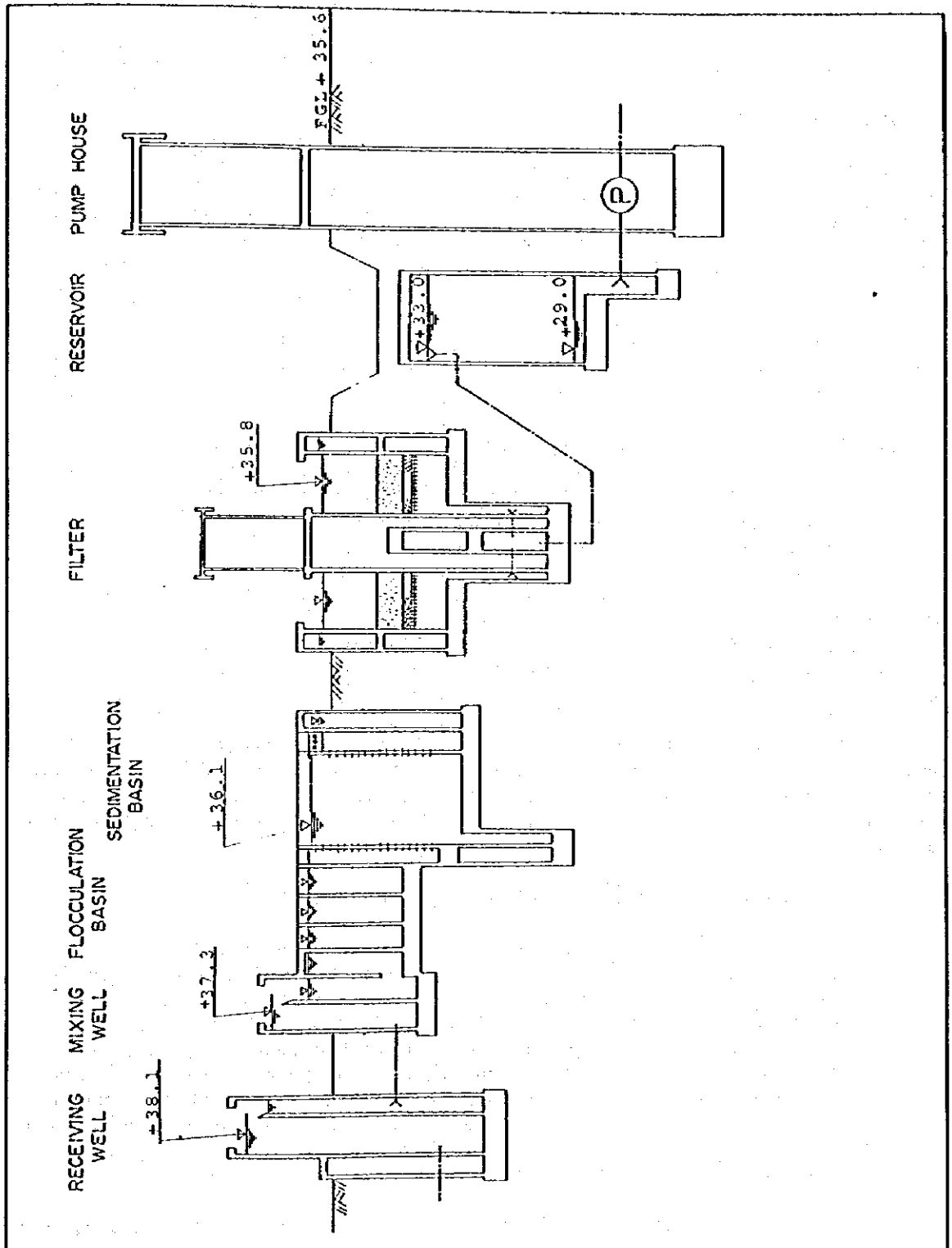

FIG 4.9 HYDRAURIC PROFILE OF TREATMENT PLANT

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4.5 Distribution System

Whole service area is divided by Six (6) supply zones. Each supply zone has basically a treatment plant or a distribution center from where water is distributed by pumps.

The boundary of supply zones for the First Phase Project were adjusted from the Second Stage according to the areawise water demand in 1990 so as to minimize the capacity of the First Phase Project by utilizing the capacity of the existing treatment plant fully. The boundary of each supply zone was delineated taking into account the routes and capacities of the existing trunk mains.

Supply zones are to be interconnected to supplement water to each other in case of emergency. In normal condition, however, operation of each supply zone is made independently from others.

4.5.1 Distribution Center

Two distribution centers are placed at the eastern and western edges of the service area to distribute water to supply zones 3 and 4 which are both remote from the treatment plants.

The distribution center is composed of operational reservoir, distribution pump facilities and chlorination facilities. The chlorination facilities are planned, considering long transmission pipeline from the treatment plant, to supplement the disinfection in the plant.

Water transmitted from treatment plant is disinfected before the entrance of reservoirs into pipe according to the necessity based on the measurement of residual chlorine in the distribution water. Dosage rate of chlorine was planned at 1 mg/l as the maximum rate and 0.5 mg/l as the average rate.

1) Distribution Center of Supply Zone 3 (R-1)

The distribution center is placed at Kelurahan Sukapura along the planned outer link road in Kecamatan Cilincing. The site is low land and flat with ground elevation varying from +0.5 to +1.5. The capacity of the distribution center was planned at 5.9 m^3/sec based on hourly maximum water demand in the Second Stage. Therefore, pump house and trunk main from the distribution center are designed to meet the requirement of the Second Stage. Number of pumps and capacity of reservoir, however, were designed to meet water demand in the First Phase as 3.9 m^3/sec (hourly Maximum). Water level of reservoir is planned at +2.4.

The summary of the facilities are presented in Table 4.2, and general layout is shown in Fig. 4. 10.

2) Distribution Center of Supply Zone 4 (R-4)

The distribution center is placed at Kelurahan Joglo in Kecamatan Kebon Jeruk along the planned outer link road. The site

is vacant but partly used for rice field. The ground elevation varies from +8 to +12. The capacity of the distribution center was planned at 2.5 m^3/sec, but number of pumps and capacity of reservoir are prepared to meet water demand of the First Phase as 1.4 m^3/sec. Water level of reservoir is planned at +11.9 (HWL).

The summary of the facilities are presented in Table 4.3 and general layout of the distribution center is shown in Fig. 4.11.

4.5.2 Distribution Trunk Main

Routes of trunk mains were determined on the existing and planned roads using 1/50,000 and 1/5,000 maps. Proposed diameter of trunk mains were determined based on the water demand of the Second Stage. Those diameters were checked according to the flows required in the First Phase and they were modified where it is considered to be necessary. Calculation of discharge rates of every node of the network was made using unit demand of each kecamatan (l/sec/ha). Distribution network analysis was made using computer, and the routes and diameters of proposed distribution trunk mains were determined based on the above analysis. The result of the network analysis is shown in Appendix FIV-2. The general layout of the distribution trunk mains is shown in Fig. 4.12. The locations and sizes of interconnecting pipes are shown in Fig. 4.13

The total length of the trunk mains for the First Phase Project is 200 km including interconnecting pipes between supply zones and supplemental mains laid within the larger grids. The summary of trunk main length is presented in Table 4.4 broken down into length required in each supply zone.

Table 4.2 Distribution Center R-1 (Zone 3)

A. Distribution flow rate (= Daily maximum x 1.3)

	Daily maximum	Hourly maximum
1st Phase	3.0 m^3/sec	3.9 m^3/sec = 234 m^3/min
2nd Phase	4.5 "	5.85 " = 351 m^3/min

B. Water level

HWL: +2.40 m
LWL: -1.6 m

C. Reservoir

1st Phase Project: 32,800 m^3
(47.5 m x 86.5 m x H 4.0 m x 2 units)

2nd Phase Project: 16,400 m^3
(47.5 m x 86.5 m x H 4.0 m x 1 unit)

2nd Stage Project total: 49,200 m^3

D. Distribution Pump

	Total number (including standby)		
	1st Phase	2nd Phase	Total
ø800 x 78 m^3/min x 59 m x 1,100 kW	4 (1)	2 (1)	6 (2)
ø450 x 39 m^3/min x 59 m x 550 kW	2 (1)	0	2 (1)

E. Pump House

Basement floor: Pump room B 13 m x L 68 m = 884 m^2
1st Floor : Electric, Operation room B 9 m x L 68 m = 612 m^2

F. Chlorination

a. Dosage rate
Average : 0.5 mg/l
Maximum : 1.0 mg/l

b. Dosing point : Transmission pipe

c. Chlorinator
1st Phase : 20 kg/hr x 2 units (including 1 standby)
2nd Phase : 0
2nd Stage Total: 20 kg/hr x 2 units (including 1 standby)

d. Storage (15 days of average daily consumption)
1 ton container: 3

f. Evaporation
1st Phase : 50 kg/hr x 2 units (including 1 standby)
2nd Phase : 0
2nd Stage Total: 50 kg/hr x 2 units (including 1 standby)

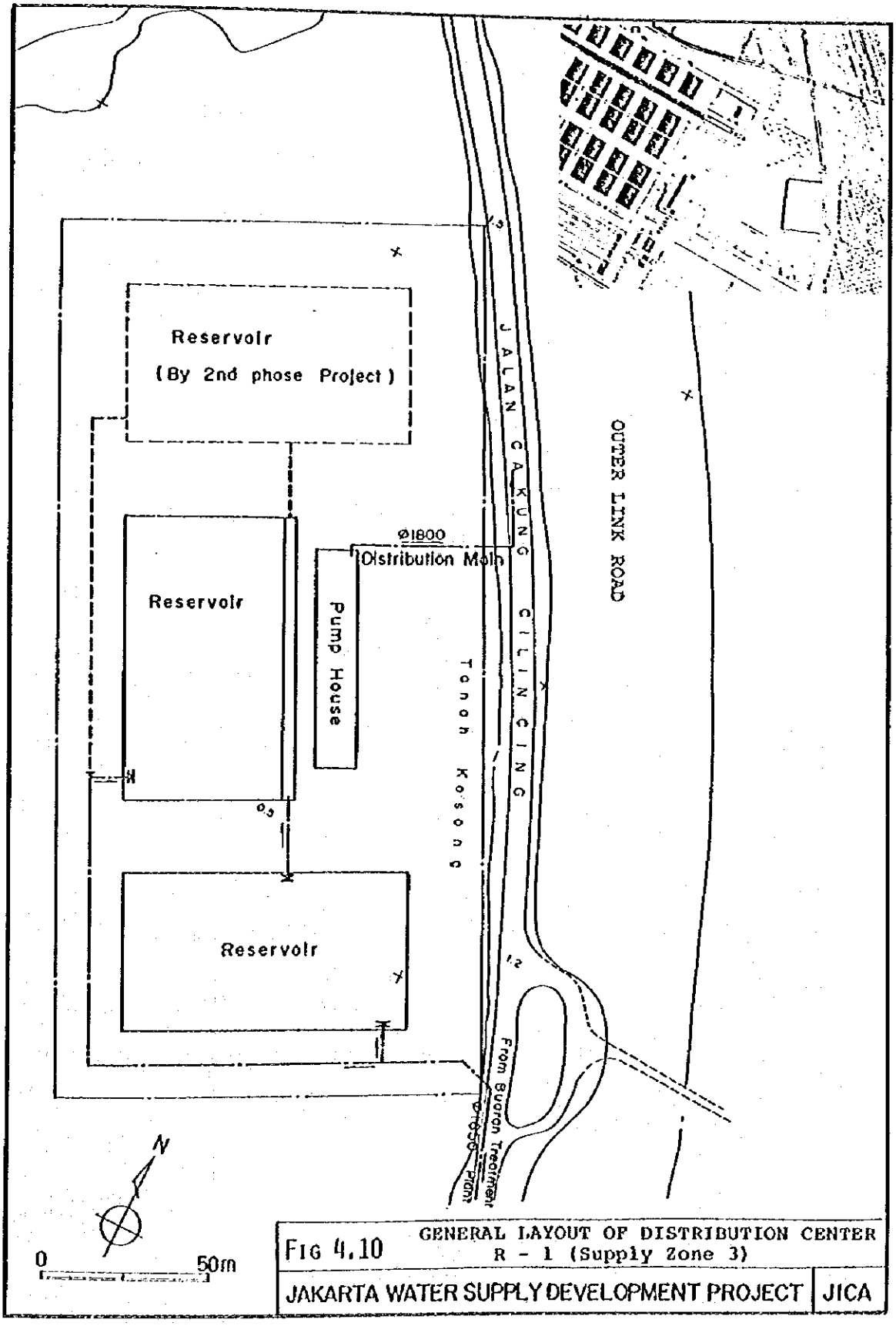

FIG 4.10 GENERAL LAYOUT OF DISTRIBUTION CENTER R - 1 (Supply Zone 3)

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Table 4.3 Distribution Center 4 (Zone 4)

A. Distribution flow rate (Daily maximum x 1.3)

	Daily maximum	Hourly maximum
1st Phase	1.1 m^3/sec	1.4 m^3/sec = 84 m^3/min
2nd Phase	1.9 "	2.5 " = 150 m^3/min

B. Water level

HWL: +11.90 m
LWL: +7.9 m

C. Reservoir

1st Phase Project: 11,900 m^3
(34.5 m x 43.5 m x H 4.0 m x 2 units)

2nd Phase Project: 79,000 m^3
(31.0 m x 73.0 m x H 4.0 m x 1 unit)

2nd Stage Project total: 20,900 m^3

D. Distribution Pump

	Total number (including standby)		
	1st Phase	2nd Phase	Total
ø450 x ø250 x 33 m^3/min x 52 m x 400 kW	3 (1)	3 (1)	6 (2)
ø400 x ø250 x 18 m^3/min x 52 m x 200 kW	2 (1)	0	2 (1)

E. Pump House: By 1st Phase Project

a. Dosage rate
Average : 0.5 mg/l
Maximum : 1.0 mg/l

b. Dosing point : Influent pipe (Transmission pipe)

c. Chlorinator
1st Phase : 10.0 kg/hr x 2 units (including 1 standby)
2nd Phase : 0
2nd Stage Total: 10.0 kg/hr x 2 units (including 1 standby)

d. Storage (15 days of average daily consumption)
1 ton container: 2

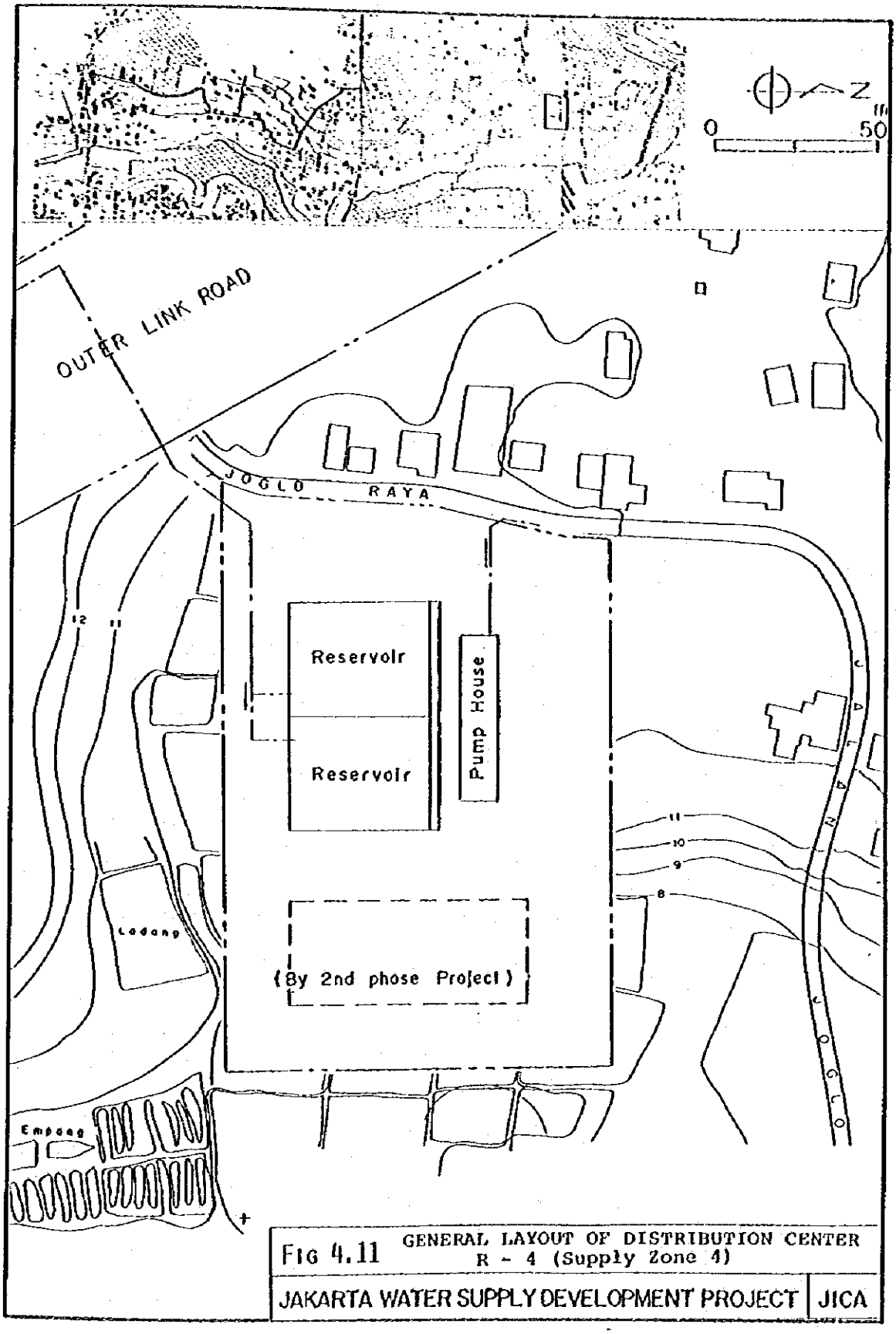

FIG 4.11 GENERAL LAYOUT OF DISTRIBUTION CENTER R - 4 (Supply Zone 4)

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Table 4.4 Summary of Distribution Trunk Main

Supply Zone	Diameter (mm)	Length (km)	
		1900	1995
Zone 1	ø 900	3.0	-
	ø 800	5.7	-
	ø 600	2.6	1.6
	ø 500	4.0	0.3
	ø 400	7.0	-
	ø 300	19.9	8.9
Zone 2	ø 600	3.5	-
	ø 500	-	3.9
	ø 400	3.9	4.6
	ø 300	16.2	4.7
Zone 3	ø 1,800	3.0	-
	ø 1,650	2.7	-
	ø 1,350	1.2	-
	ø 1,100	6.0	-
	ø 900	2.5	2.9
	ø 800	-	5.0
	ø 600	5.8	-
	ø 500	-	1.9
	ø 400	-	1.9
	ø 300	11.3	2.0
Zone 4	ø 1,500	1.8	-
	ø 1,200	2.6	-
	ø 900	1.6	-
	ø 800	8.1	2.0
	ø 600	6.2	1.8
	ø 500	6.3	2.9
	ø 400	7.8	4.2
	ø 300	7.2	1.9
Zone 5	ø 1,800	-	-
	ø 1,500	0.9	5.0
	ø 1,350	2.5	-
	ø 1,100	-	3.0
	ø 1,000	-	6.6
	ø 900	4.9	-
	ø 800	3.9	-
	ø 600	10.8	3.2
	ø 500	-	2.9
	ø 400	2.1	-
	ø 300	18.2	10.0
Zone 6	ø 1,000	2.4	-
	ø 800	2.7	-
	ø 600	-	3.2
	ø 400	6.5	2.6
	ø 300	5.2	2.4

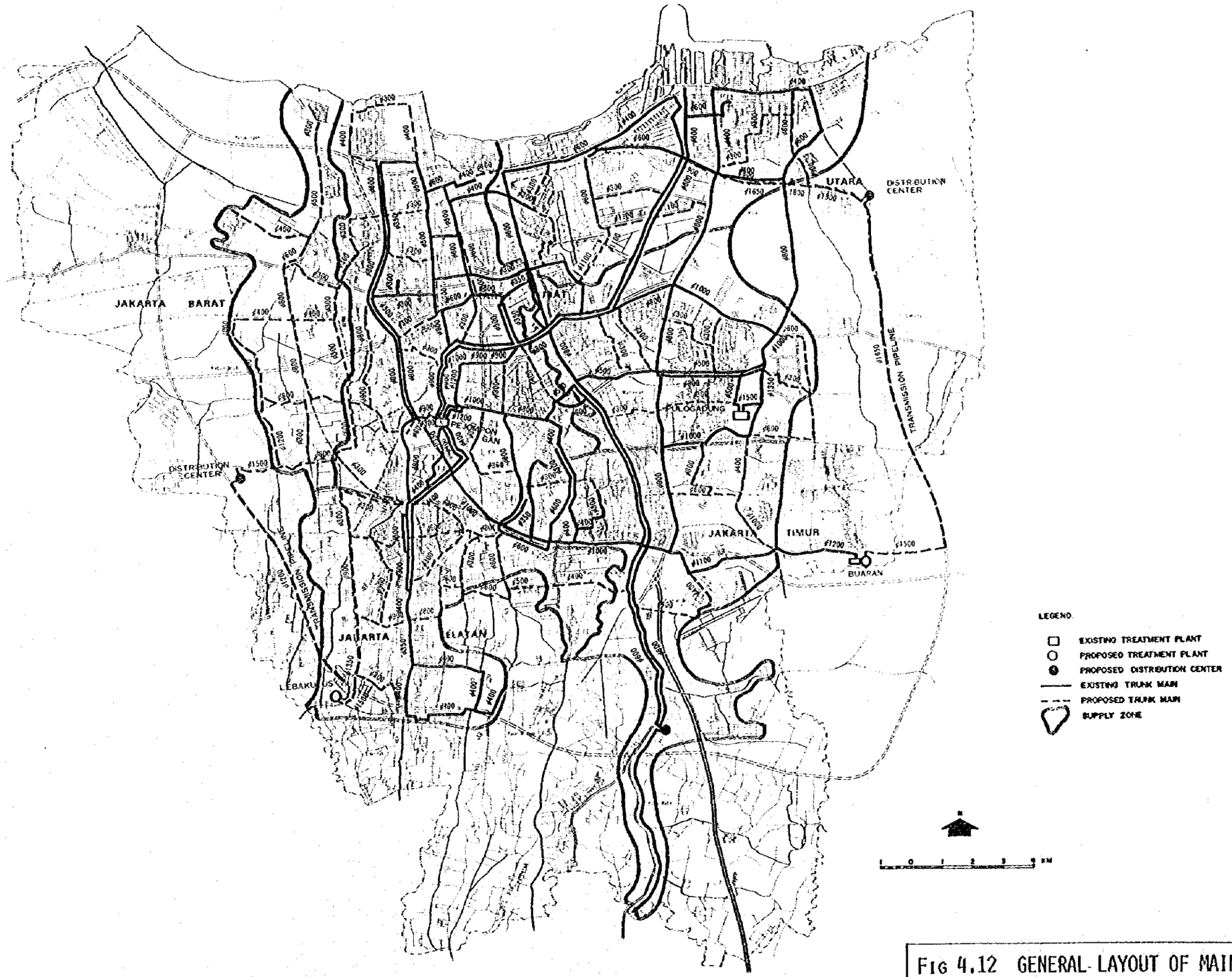

Fig 4.12 GENERAL LAYOUT OF MAIN GRID

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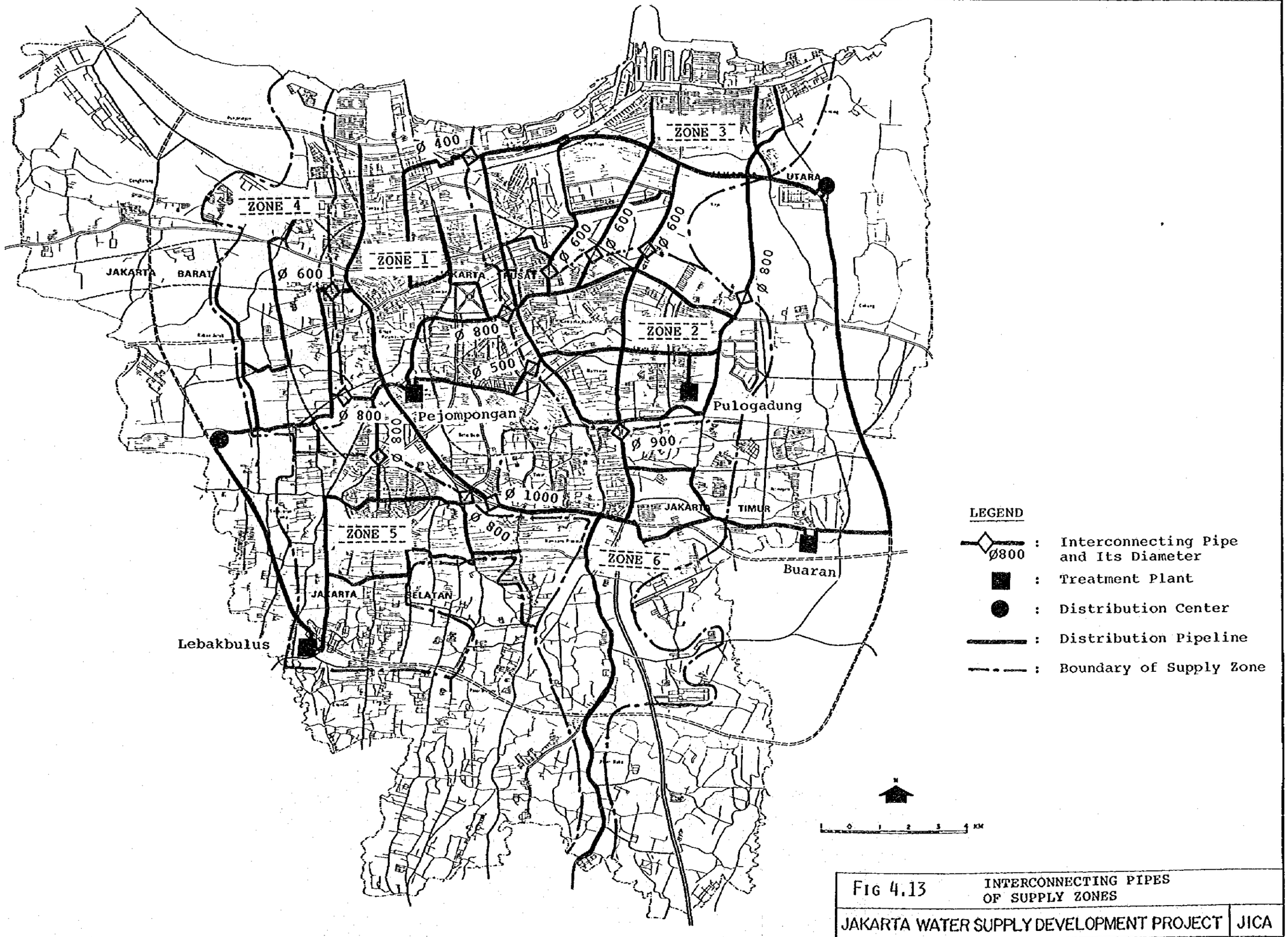

FIG 4.13 INTERCONNECTING PIPES OF SUPPLY ZONES

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4.5.3 Secondary and Tertiary Mains

The present length of the secondary and tertiary mains are about 310 km and 2,860 km, respectively. The length of the secondary mains is according to the PDAM's estimate, while the length of the tertiary mains includes the estimation of the length of ø50 mm in diameter as presented in Appendix MIII-3 of the Master Plan.

To estimate the necessary lengths of the secondary and tertiary mains for the First Phase Project, the following approach was employed.

1) Classify the whole service area into three categories according to the density of water demand in 1990. Domestic water demand is applied for classification by the consideration that the length of pipelines will be affected more by the domestic consumption and its density.

2) Select sample areas (Kecamatan) which represent the average density of water demand of each classification in 1990.

3) Pipe arrangement was made in such sample area using 1/5,000 topographic map.

4) Obtained length of pipeline, secondary and tertiary mains, of each sample area is converted to unit length. The total length of the secondary and tertiary mains required for the First Phase Project were calculated multiplying such unit length by service area.

From the above approach, the total length required for the First Phase Project were estimated as 440 km for the secondary main and 5,360 km for the tertiary main including the existing pipeline length.

Some of the existing secondary mains are used as if they are the trunk main, and such pipelines are laid along the same routes of the existing and planned trunk mains. Such pipelines will not be counted as the effective length for future secondary mains. The length of such secondary mains are estimated at about 60 km which is obtained from the existing distribution pipeline map. Therefore, the necessary length of the secondary mains for the First Phase Project is about 500 km in total.

As described in Chapter 3.8.2. and 4.5.2. of the Master Plan, installation of the secondary and tertiary mains is required before the First Phase Project to distribute water fully from the existing treatment plants and planned new plants, extension of the Pulogadung plant and the Buaran plant under the Immediate Project. The necessary lengths of the secondary and tertiary mains were estimated at about 120 km and 1,000 km, respectively.

The length to be installed in the First Phase Project, therefore, is 70 km of the secondary main and 1,500 km of tertiary main.

Table 4.5 Estimate for the Length of Secondary and Tertiary Mains

ITEM	III-3	A-BLOCK	V-2	B-BLOCK	IV-3	C-BLOCK	TOTAL
AREA (ha)	430.0	11,323.7	1,476.2	12,917.6	836.1	9,597.7	33,839.0
TERTIARY (km)	96.1	2,530.6	227.6	1,991.6	73.3	841.4	5,363.6
SECONDARY (km)	7.1	186.9	18.8	164.5	7.3	83.8	435.2

KECAMATAN	AREA '90 (ha)	DOM ('000 m^3/d)	DOM (%)	1980 DENSITY (m^3/d/ha)	TOTAL ('000 m^3/d)	DOM (%)	1990 DENSITY (m^3/d/ha)
						0	0
V-1	480.0	7.6	74	27	26.6	73	40
III-4	570.2	21.9	91	27	26.5	85	39
III-3	430.0	12.1	70	26	24.4	66	37
I-3	704.0	21.6	78	21	27.8	78	31
I-5	717.6	20.2	73	21	29.0	77	31
I-4	461.0	12.7	54	22	24.5	59	31
I-2	583.2	14.8	61	19	26.5	65	30
IV-1	958.0	10.3	85	14	30.4	85	27
III-2	1,763.1	28.6	76	16	58.9	79	26
V-2	1,476.2	10.8	74	15	49.5	77	26
I-6	613.6	10.8	62	15	21.6	68	24
I-1	757.6	13.5	54	15	29.3	58	22
IV-2	792.4	9.2	69	11	20.9	76	20
I-7	1,016.8	22.4	58	13	32.5	64	20
A-BLOCK	11,323.7	216.5			428.4	73	28
IV-5	1,258.4	8.1	64	9	32.2	74	19
V-3	1,599.4	9.7	60	10	40.5	68	17
IV-3	1,292.8	5.7	62	7	25.5	77	15
IV-6	1,886.4	7.6	71	6	35.1	74	14
II-4	2,004.4	9.4	85	9	33.7	75	13
IV-7	766.9	2.7	62	5	14.1	71	13
III-5	1,686.3	0.5	50	3	22.5	81	11
II-3	2,423.0	8.6	80	6	37.0	69	11
B-BLOCK	12,917.6	52.3			240.6	73	14
II-2	3,315.7	10.8	82	7	44.0	69	9
V-4	2,042.2	7.3	51	4	28.7	63	9
II-5	1,190.5	3.8	81	5	17.6	60	9
IV-4	530.8	1.1	48	3	6.7	64	8
V-6	878.2	2.2	34	3	21.4	31	8
III-1	1,160.6	2.2	76	2	8.2	60	4
V-5	479.7	1.1	18	2	7.6	26	4
C-BLOCK	9,597.7	28.5			134.2	57	8
TOTAL	33,839.0	297.3	69	10	803.2	70	17

4.5.4 Implementation of Distribution Pipelines

Implementation of distribution pipelines will be different from each zones according to the conditions of them. The following implementation is proposed based on the conditions of each supply zone.

SUPPLY ZONE - 1

The supply zone 1 is composed of mainly old service area and supplied from the existing Pejompongan plants. The capacity of the system for the First Phase is 5.6 m^3/sec. The existing distribution network is able to distribute water to the whole service area with supplemental trunk mains due to decreasing service area to be covered. Therefore, it will be possible to put off the implementation of the trunk mains slightly than other zones where urgent implementation is required. The secondary and tertiary mains, however, are able to commence their implementation together with replacement and rehabilitation of old pipelines. Such works are planned to commence before the First Phase by the Improvement Program as described in the Master Plan.

SUPPLY ZONE - 2

The supply zone 2 is supplied from the existing Pulogadung plant with a capacity of 4.0 m^3/sec. According to the hydraulic analysis, no additional trunk mains is required except those in Pulogadung industrial area and supplemental mains to be laid within the main grids. It will be possible to put off the implementation of trunk mains considering the volume of the works.

SUPPLY ZONE - 3

Supply condition of this zone is very poor at present in term of both water pressure and supply quantity due to the remote location from supply sources. For a meantime, up to the completion of the First Phase Project, water is to be supplied from the Pulogadung plant. Therefore, the implementation of trunk mains is proposed to commence at earlier stage considering big volume of the works.

SUPPLY ZONE - 4

The supply zone 4 is newly developed area and supplied from the proposed distribution center R-4. No distribution network exists in the zone at present, but partly supplied from the existing mini-plants. Water demand increase, however, is the most rapid among other zones. Implementation of the trunk mains is proposed to commence at the earlier stage. Then the secondary and tertiary mains can start their implementation.

SUPPLY ZONE - 5

Water demand of the supply zone is also increasing rapidly. Currently, Kebayoran Baru is supplied from the Pejompongan plant and the Cilandak plant supplies water for the surrounding area partly. No trunk mains are installed in the areas. Water pressure is not enough to supply water from the Pejompongan plant to those areas because of high ground elevation of the areas for the transit period up to the completion of the First Phase Project. Therefore, earlier stage of the implementation of trunk mains is proposed.

SUPPLY ZONE - 6

By the Immediate Project, the trunk mains are planned to be installed and connected with the existing trunk mains as described in the Master Plan to supplement shortage water supply of the existing system. No trunk mains exist, however, in the new service area extended by the First Phase Project. Earlier stage of implementation of the trunk mains is proposed.

4.5.5 Consideration on Demand Deviation

During the course of implementation of all the projects proposed by the Master Plan, the actual water demand may possibly deviate from the estimation. Such deviations may occur with 1) the total demand, and 2) the demand in supply zones. For example, the total demand may be larger or smaller than estimated, and the individual demands in supply zones may show similar deviations. Against these unforeseen demand deviations, the following have been considered and taken into planning.

(1) Total Demand Deviation

Should the actual total water demand be significantly smaller than estimated, the execution of certain phase projects can be postponed, as deemed appropriate. Contrary, if the actual demand should be larger than estimated, either one alternative measure of the following two should be taken, i.e., 1) advance of the execution of the succeeding project, or 2) execution of the measures of the following paragraph.

(2) Demand Deviation in Supply Zones

Deviation to be specially considered is water demand in supply zones far larger than estimated. In this case, countermeasures to be taken are as follows:

1) Overload operation of the treatment plants and pumping stations concerned utilizing standby equipment. The Pejompongan Plants, however, may not be possible, and the measure 2) is to be practiced.

2) Provisional change of boundary of supply zones to accommodate the unforeseen demand increase, until the succeeding project.

3) Extension of tertiary, sometimes secondary, mains in the supply zone in question. High elevation places, such as Pasar Minggu and Kramat Jati, might require installation of booster pumps according to the mignitude of demand increase.

4) Tolerance of water pressure drop in limited area, which may be requested of the customers therein.

It is recommendable to monitor continuously the trend of demand increase so as to take prompt actions to minimize adverse effects of water demand deviation. Meanwhile, as regards the above countermeasures, some capacity surplus and budgetary provisions are allowed for in the planning.

4.6 Service Connections and Water Meters

The potential requirement of service connections for house connection, non-domestic connection and public hydrant are projected in Master Plan. However, as the treatment production will gradually reach to the required water demand until the year 1990, the service connection and meter installation will not be attained to the projected requirement of connections. Considering the available production against the water demand shown in Section 2, Table 2.3 Water Demand and Total Production, and linearly increased the percentage of connection and meter installations, proposed number of connections is developed. Further the figures, projected in the above concept, are modified and smooth out the number of connections projected especially early couple of years considering present PDAM capability of 10,000 connection per year.

The First Phase program install the service connections and water meters scheduled until the year 1990, shown on Tables 4.6 and 4.7.

Table 4.6 Schedule of Service Connection

DOMESTIC SERVICE CONNECTION			NON-DOMESTIC SERVICE CONNECTION	TOTAL NO. OF CONNECTION	INCREMENT
YEAR	RESIDENTIAL	PUBLIC HYDRANT			
1980	92,177 1)	1,149 1)	18,360 1)	111,686	0
1981	99,797 1)	1,231 1)	19,079 1)	120,107	8,421
1982	105,119 1)	1,197 1)	20,168 1)	126,474	6,367
1983	111,451 2)	1,417 2)	21,106 2)	133,974	7,500
1984	120,460	1,560	21,980	144,000	10,026
1985	131,720	1,780	23,500	157,000	13,000
1986	150,280	2,060	24,660	177,000	20,000
1987	175,810	2,360	28,830	207,000	30,000
1988	205,830	2,690	32,480	241,000	34,000
1989	237,500	3,030	37,470	278,000	37,000
1990	272,800	3,300	41,870	318,000	40,000
1991	309,810	3,760	47,430	361,000	43,000
1992	347,470	4,190	54,340	406,000	45,000
1993	387,540	4,620	60,840	453,000	47,000
1994	428,310	5,050	67,640	501,000	48,000
1995	470,830	5,480	74,690	551,000	50,000
2000	691,320	7,950	117,730	817,000	266,000
2005	954,010	15,090	175,900	1,145,000	328,000

Note: 1) Existing Number of Connection as of May '83
2) " "

Table 4.7 Schedule of Meter Installation
(For New Connection)

YEAR	METER SIZE 1/2" - 1 1/2" NUMBER OF METER	METER SIZE 1/2" - 1 1/2" ADDITIONAL REQUIRED	METER SIZE 2" - 16" NUMBER OF METER	METER SIZE 2" - 16" ADDITION REQUIRED METER	TOTAL NUMBER OF METER	TOTAL ADDITIONAL REQUIRED METER
1983	126,095	0	688	0	126,783[1)]	0
1984	134,800	8,705	700	12	135,500	8,717
1985	147,760	12,960	740	40	148,500	13,000
1986	167,660	19,900	840	100	168,500	20,000
1987	197,510	29,850	990	150	198,500	30,000
1988	231,340	33,830	1,160	170	232,500	34,000
1989	268,150	36,810	1,350	190	269,500	37,000
1990	307,950	39,800	1,550	200	309,500	40,000
1991	350,740	42,790	1,760	210	352,500	43,000
1992	395,510	44,770	1,990	230	397,500	45,000
1993	442,280	46,770	2,220	230	444,500	47,000
1994	490,000	47,760	2,460	240	492,500	48,000
1995	539,790	49,750	2,710	250	542,500	50,000
2000	804,460	264,670	4,040	1,330	808,500	266,000
2005	1,130,820	326,360	5,680	1,640	1,136,500	328,000

Note: 1. 8,517 number of connection out of total 135,300 in July 1983 are unmetered and are excluded from the total numbers of meter. However, almost all these connection are for house connection and small commercial connection and is assumed to be smaller size, 1" or below.

2. Total number of meters are including the existing number of meters and additionally installed new meters of new connections.

3. The schedule for installation of total 8,517 meters, unmetered connection (rounded 8,500) is discussed in the rehabilitation program in the master plan.

4.7 Public Hydrant

Public hydrants are increased as scheduled in Table 4.6.

In addition to the increase of public hydrant, the existing hydrant, from which water vendors are exclusively taking water and selling water, is gradually abolished as proposed in master plan. Schedule of hydrants for this purpose are presented in Table 4.8.

Table 4.8 Improvement Schedule of Hydrants Murni (Hydrant used for Public use through water vendor)

AREA KOTAMADYA	EXISTING NUMBER (AUG. 1984)	Improvement Schedule					
		1985	1986	1987	1988	1989	1990
PUSAT (Central)	77	7	10	15	15	15	15
TIMUR (East)	6	-	-	-	2	2	2
BARAT (West)	94	9	15	15	15	20	20
SELATAN (South)	3	-	-	-	-	-	3
UTARA (North)	231	11	40	45	45	45	45
Total	411	27	65	75	77	82	85

4.8 Work Shop, Meter Test Facility, Storage, Equipment and Tools, and Motor Vehicles

4.8.1 Work Shop and Storage Room

For overhauling and repairing equipment, and carrying out routine maintenance work, the work shop is proposed to be constructed at Buaran Plant and storage room for storing material and spare parts is also proposed. Machine tools, portable equipment, tools and work benches are proposed to be provided and crane facilities are also proposed. Machine tools proposed are tabulated below.

- Lathe (lathe bed length, about 2.0 m)	x 1 set
- Lathe (lathe bed length, about 1.0 m)	x 1 set
- Drilling machine (drill diameter, Ø 40 mm)	x 1 set
- Drilling machine (drill diameter, Ø 20 mm)	x 1 set
- Surface milling machine	x 1 set
- Welder	x 1 set

Fund amount for the purchase of the above machines for work shop are included in the routine operation and maintenance cost.

A work shop with storage room is proposed to be constructed in the property at Buarang treatment plant site. Necessary procedure for purchase of the land property is commenced in year 1984 by Cipta Karya and DKI Jakarta.

A general layout of the work shop and storage room is shown in Fig. 4.14.

4.8.2 Meter Test Facilities

As proposed in Master Plan, a meter test facility for larger meters is installed during the First Phase program. The meter test is installed next to the present meter repair shop as shown in general layout in Master Plan. A schematic drawing of the Facility is shown in Fig. 4.15.

4.8.3 Storage and Stock Yard

Existing storage and stock yard maintained by PDAM are presented in Section 3.7.6 in Master Plan.

It is proposed to provide stock yard required to store pipe materials needed for one year replacement work of old distribution pipelines installed in 1920's as proposed in rehabilitation works of immediate program 40 km (200 km per 5 years). For extention of secondary and tertiary pipe lines installed in the First Phase Project, it is proposed to prepare stock yard needed for also one year installation work which is approximately 700 km (2,700 km per 4 years construction period) of ø50 through ø250 pipelines.

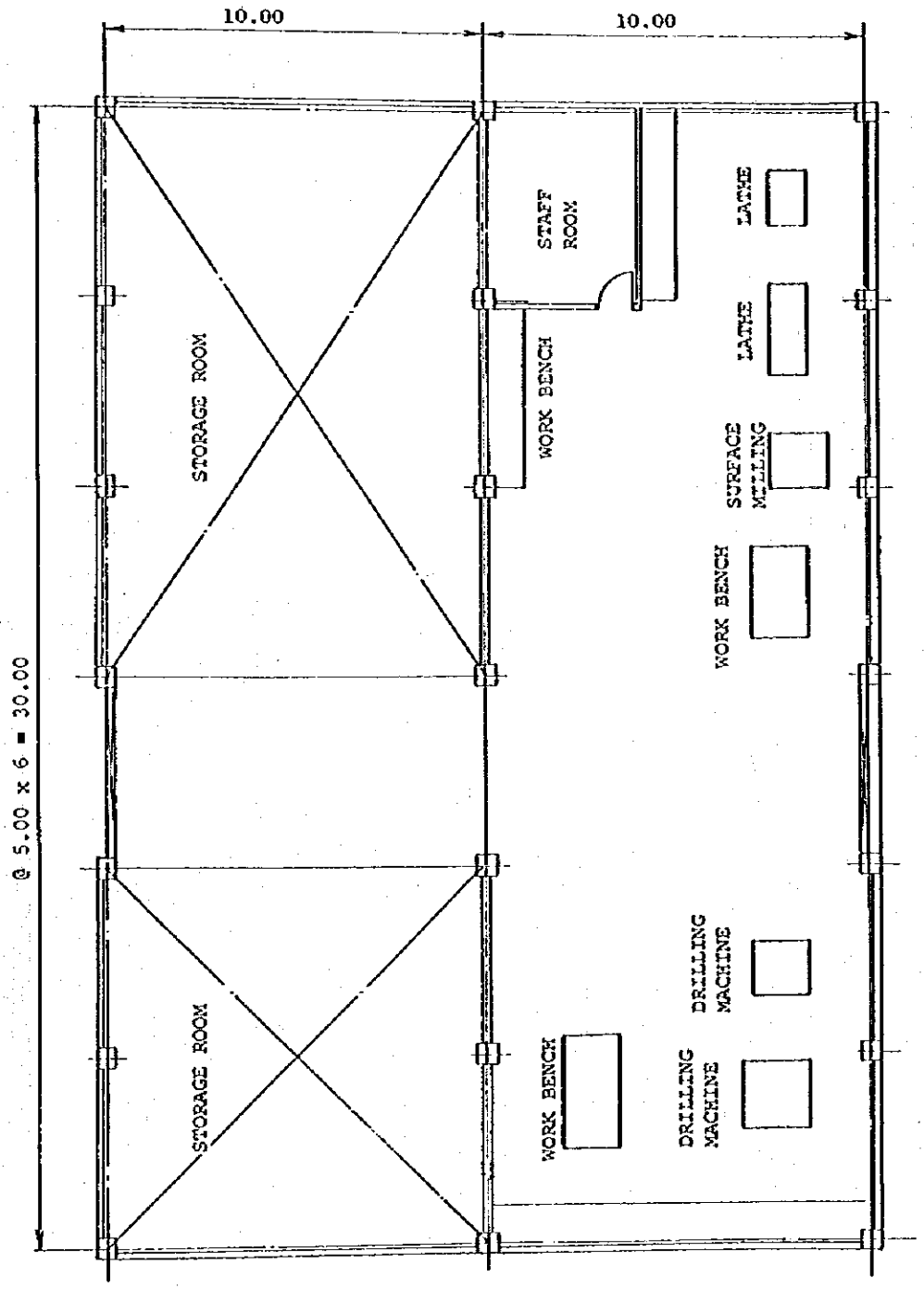


FIG. 4.14 GENERAL LAYOUT OF WORK SHOP

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

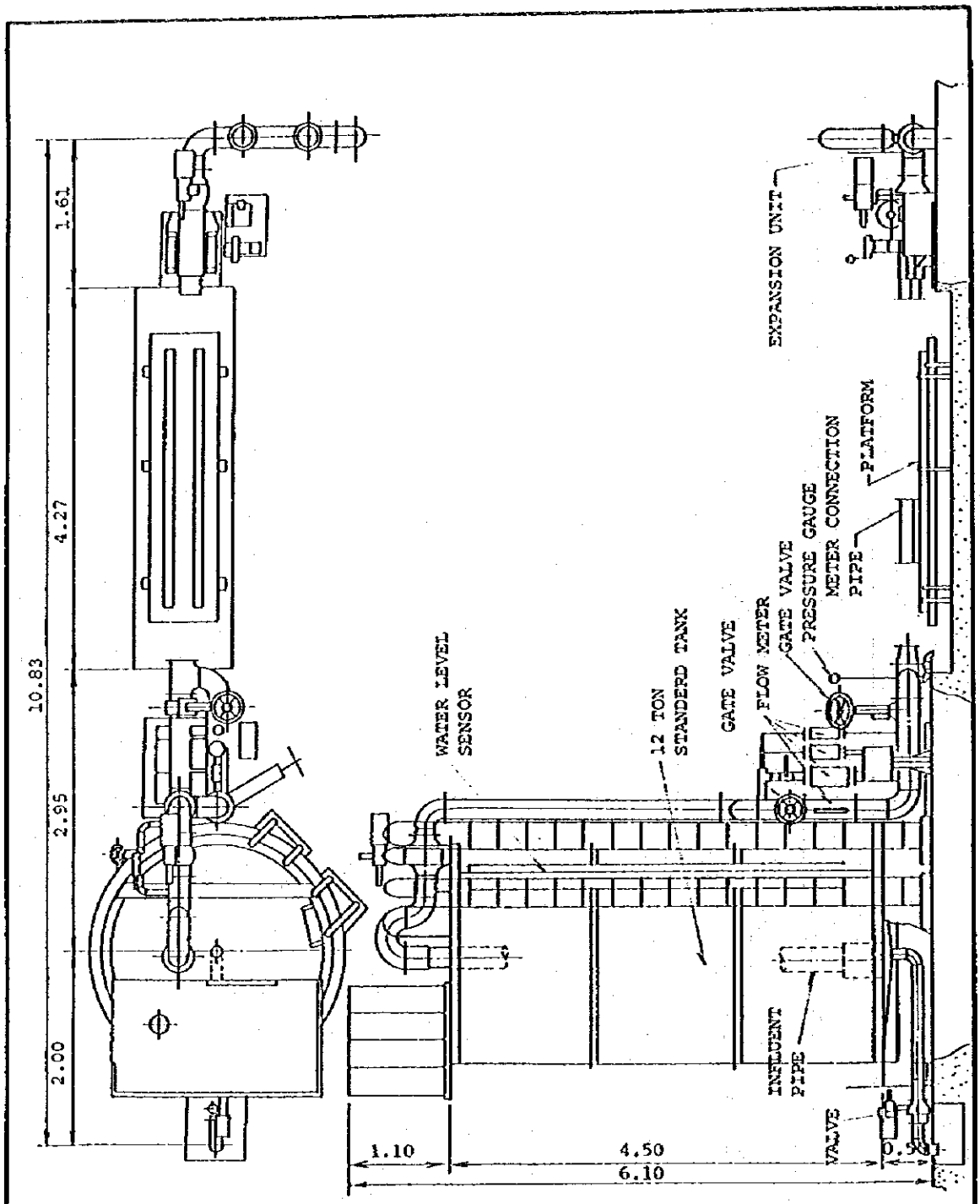


FIG. 4.15 METER TEST FACILITIES

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

The proposed storage yards are estimated based on the manufactures recommendation on piling in multiple layer for each pipe diameter, and are as follows.

For Rehabilitation	:	2,000 m2 (0.2 ha)
For Extension of pipeline	:	23,000 m2 (2.3 ha)
		25,000 m2 (2,5 ha)

Closed storage, for the valves, accessories etc., with the area of 600 m2 is required for the rehabilitation and expansion works stated above.

The land for the above storages is available in the Buaran treatment plant property provided under the immediate project and is ready to use in the year 1986 after making necessary banking at the site.

4.8.4 Equipments and Tools for Pipe Laying Work

Main pipe laying works, transmission and distribution, pipeline system, are conducted by contractors selected by the local tendering procedure under the responsibility of central government, and those pipeline systems are transferred to PDAM after completion of the system. PDAM is responsible, after receipt of the systems, for operation and maintenance of the systems.

PDAM conducts the secondary and tertialy pipeline installation works which are carried out by local contractor under the responsibility of PDAM. Under the supervision by central office of PDAM, branch office (Cabang) executes the secondary and tertialy pipelines installation works as well as necessary maintenance of the pipelines.

Service connection and meter installation, and maintenance work are also responsible by PDAM and these works are carried out by Cabang under the control of central office.

In the year 1984, PDAM established special leakage repair team at the central office under the direct control of president director of PDAM in order to be able to make quick action for repairing upon receipt notice on leakage on the system from consumers or citizen.

According to the information obtained from some Cabangs, because of lack of mobil equipments, pipe laying equipments, transportation and laying works faces difficulties in its implementation as scheduled, and also it results in below standard installation works of both pipe laying and service connection works as well as repairing.

Among others, it is strongly recommended to furnish pipe cutter for largr pipes, say above 4" pipe in nominal, as well as for smaller pipes in addition to those presently obtained. For service connection, chisel is used instead of using tapping or drilling machines under pressure, which caused making unproper tapping and damages on the pipes to be connected to service connection.

In order to improve pipe laying work and service connection work, following tools and equipment are purchased. Fund amount for the tools and equipments are included in routine operation and maintenance cost.

Tools and Equipment for Pipe Laying Work

Item	Number
A. Pipe Cutters	
1. Rotary Cutters for DCIP, CIP, SP For 5" - 30" pipe	45 NOS
2. Hinged Cutters for DCIP, CIP, SP For 1" - 12" pipe	25 NOS
3. PVCP Cutter For 1-7/8" - 6"	30 NOS
B. Pipe Beveler and Field Lathes	
1. PVCP Beveler with Chain Vises	10 NOS
C. Tapping Machine and Drilling Machine	
1. Tapping Machine for DCIP/CIP	20 NOS
2. Drilling Machine for PVCP	20 NOS
D. Equipment for Pipe Laying Work	
1. Diaphram pump, with suction hose	10 NOS
2. Road Cutter	10 NOS
3. Tamper, Compactor	5 NOS
4. Hand Roller	1 NO.
E. Equipment for Testing	
1. Water Pressure Gauge Self Recording Type	10 NOS
2. Water Pressure Gauge Faucet Type	10 NOS
F. Tools	
Pipe Threader, Torque Wrench, Chain Wrench	1 L.S.

4.8.5 Motor Vehicles

Considering need, at present and near future, at cabang (branch) offices, units, installations, mini-plants, special units and central office, it is proposed that following numbers of motor vehicles be purchased in near future.

Proposed number of motor vehicles

Type of Motor Vehicle	Number	Remarks	
Pick-up	124	3 cars x 6 cabangs	= 18
		3 cars x 6 units	= 18
		3 cars x 4 installations (Pej I, Pej II, Pulogadung Cilandak)	= 12
		2 cars x 8 mini-plants	= 16
		3 cars x 3 special units	= 9
		3 cars x Klender	= 3
		4 cars x 12 bidangs (Central office)	= 48
			124
Pick-up with hoist	30	2 cars x (6 cabangs + 6 units)	= 24
		1 car x 4 installations	= 4
		1 car x (1 special unit + Klender)	= 2
			30
Truck	18	1 car x (6 cabangs + 6 units + 4 installation)	= 16
		1 car x (Distribution/Meter Section)	= 2
			18
Truck Crane	2	1 car x (Logistic/Technical Equipment)	= 2
Mini-Bus	12	1 car x (6 cabang + 6 units)	
Tank Rolly	5		
Motor bikes	120	20 bikes x 6 cabangs	

Fund amount for the purchase of the above vehicles are included in the routine operation and maintenance cost.

5. COST ESTIMATE

5. COST ESTIMATE

5.1 Cost Estimate of the Project

The cost estimate of the project are presented in Table 5.1, broken down into foreign and local components. The total project cost including land cost, power receiving cost, administration cost, engineering services fee and contingencies amounts to Rp.366,286 million or US$365 million equivalent. Out of which, foreign component amounts US$187 million and local component amounts Rp.178,470 million. The costs are estimated based on the rate as of March 1984.

Cost Estimate for all civil works is based on prevailing market prices of materials and labours in Jakarta, while for supplies of materials and plant equipment are based on the manufacturer's quotations which are adjusted according to the past bidding prices in Jakarta.

In estimation of the project costs, unit price of materials imported is broken down into CIF price and local handling and transportation charges.

The local currency component includes costs of labour and materials paid actually in the local currency. Namely, it comprises the costs for local labours and materials locally manufactured or produced, including handling and local transportation charges for imported materials and equipment, tax and overhead cost for civil works and expatriate's local expenditures.

The foreign currency component represents the costs to be paid in foreign currency such as those of imported materials and equipment (CIF price), small sizes of pipe materials locally produced and foreign currency portion of expatriate services fee.

Physical contingency will be allowed both for the basic cost of materials and works as the rate of 10 per cent against the basic cost of each item of works.

Price contingency will be allowed for both basic cost and physical contingency for overall period of the project implementation at the rates for foreign and local currency components as follows:

Price Escalation Rate (per annum)

Currency	1984	1985	1986 and thereafter
Foreign Component	7.5	7.0	6.0
Local Component	15.0	11.0	7.0

Unit costs have been developed for major items of the works based on the unit prices of locally produced materials and labours, and pipe materials imported. Detailed cost estimate of each work is presented in Appendix FV-1 together with unit prices.

Table 5.1 Summary of Cost Estimate

Unit: F/C million US$
L//C million Rupiah

No.	Item	Total Cost F/C	Total Cost L/C
1.	LAND AQUISITION	0	4,146
2.	SUPPLY & CONSTRUCT.		
	1) Surpong Intake	2,970	1,780
	2) Raw Water Trans. Main	10,210	3,721
	3) Buaran t.P ($3\ m^3/s$)	8,749	10,337
	4) Lebakbulus T.p ($3\ m^3/s$)	9,451	8,889
	5) T.W. Trans. (LE-DC4)	3,606	1,325
	6) T.W. Trans. (BU-DC3)	12,799	3,859
	7) Distri. Center-Zone 4	2,084	2,128
	8) Distri. Center-Zone 3	3,377	5,102
	9) Dist. Trunk Main	35,643	24,383
	(Zone 4 and 5)	(15,215)	(11,114)
	(Zone 1, 2, 3 and 6)	(20,428)	(13,269)
	10) Dist. Secondary Main	2,375	2,049
	(Zone 4 and 5)	(1,591)	(1,373)
	(Zone 1, 2, 3 and 6)	(784)	(676)
	11) Dist. Tertiary Main	13,393	14,860
	(Zone 4 and 5)	(6,295)	(6,985)
	(Zone 1, 2, 3 and 6)	(7,098)	(7,875)
	12) Zonal Meter	802	862
	(Zone 4 and 5)	(193)	(207)
	(Zone 1, 2, 3 and 6)	(609)	(655)
	(TOTAL ITEM 2)	105,450	79,295
3.	POWER RECEIVING		
	1) Surpong Intake	0	600
	2) Lebakbulus T.P	0	620
	3) Distri. Center-Zone 4	0	400
	4) Distri. Center-Zone 3	0	620
	(TOTAL ITEM 3)	0	2,240
4.	ADMINISTRATION COST	0	1,714
5.	ENGINEERING COST		
	1) Detailed Design	2,953	952
	2) Const. Supervision	4,429	1,427
	(TOTAL ITEM 5)	7,382	2,379
6.	TOTAL ITEM (1 - 5)	112,832	89,774
7.	CONTINGENCIES		
	1) Physical, 10% of 6.	11,284	8,978
	2) Price Contingency	62,952	79,718
	(TOTAL ITEM 7)	74,236	88,696
8.	PROJECT COST	187,068	178,470

5.2 Operation and Maintenance Cost

The cost estimate for major items of operation and maintenance cost such as personnel, chemical and power costs are presented in Table 5.2, 5.3 and 5.4, respectively. As for other operating expenses, such as raw water charge, house connection expense, maintenance and administration expenses, they are described in Appendix F VII-1. The above costs and expenses are escalated every year at the rate of domestic inflation.

The personnel cost is estimated in each year multiplying unit price, which are used in PDAM's 1984/85 budget, by the number of staff estimated in Chapter 8 of this report.

The chemical cost is estimated in each year multiplying unit cost per production by average annual production. The unit cost of each major plant is estimated based on the current unit prices of chemicals used by PDAM and those proposed average dosage rates. As for the mini-plants and Ciburial Spring, the current unit costs per production are applied.

The power cost is estimated in each year also multiplying unit cost per production by average annual production or distribution. The unit cost for each treatment plant and the distribution center is obtained based on the unit power cost charged by PLN and power consumption of each facility. As for the existing treatment plants, mini-plants and booster pumping station, the current unit costs for per production or distribution for the above are applied.

As for the production of each facility, it is projected based on the potential demand of each zone and year which is adjusted by the ratio of planned number of service connections and those of potential number to meet the potential demand.

Table 5.2 Personnel Cost

Year	Unit Cost (M Rp/year)	Personnel	Escalation Factor	Personnel Cost (M Rp/year)
1984	2,158	2,025	1.00	4,370
1985		2,134	1.11	5,111
1986		2,298	1.19	5,890
1987		2,587	1.27	7,091
1988		2,796	1.36	8,203
1989		3,081	1.45	9,674
1990		3,356	1.56	11,276
1991		3,682	1.67	13,237
1992		3,901	1.78	15,003
1993		4,120	1.91	16,958
1994		4,462	2.04	19,651
1995		4,720	2.18	22,241

Note: Unit cost of personnel is estimated applying total personnel cost dividing by total number of personnel which are used in 1984/85 PDAM's budget.

Rp.4,595 million/2129 personnel

Table 5.3 Chemical Cost

Facilities	Production Unit Price	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
PEJOMPONGAN SYSTEM (Supply Zone 1)	Production (M m3/year)		167.8	158.9	158.9	167.8	167.8	167.8	174.7	144.4	152.0	167.8	178.8
	Unit Cost (Rp/m3)		23.7	23.7	23.7	23.7	23.7	15.0	15.0	15.0	15.0	15.0	15.0
	Cost (M Rp/year)		3,550	3,977	3,766	3,977	3,977	2,517	2,621	2,166	2,280	2,517	2,517
PULOGADUNG SYSTEM (Supply Zone 2)	Production (M m3/year)		30.0	30.0	113.5	119.8	119.8	119.8	124.9	102.8	113.5	119.8	119.8
	Unit Cost (Rp/m3)		24.2	24.2	24.2	26.4	26.4	15.3	15.3	15.3	15.3	15.3	15.3
	Cost (M Rp/year)		726	726	2,747	3,163	3,163	1,833	1,911	1,573	1,737	1,833	1,833
DISTRIBUTION CENTER R - 1 (Supply Zone 3)	Production (M m3/year)		-	-	-	-	-	-	-	78.5	83.6	89.9	89.9
	Unit Cost (Rp/m3)									14.5	14.5	14.5	14.5
	Cost (M Rp/year)		-	-	-	-	-	-	-	1,138	1,212	1,304	1,304
DISTRIBUTION CENTER R - 4 (Supply Zone 4)	Production (M m3/year)		-	-	-	-	-	-	28.1	32.2	33.1	33.1	33.1
	Unit Cost (Rp/m3)								9.8	9.8	9.8	9.8	9.8
	Cost (M m3/year)		-	-	-	-	-	-	275	316	324	324	324
LEBAKBULUS SYSTEM (Supply Zone 5)	Production (M m3/year)		-	-	-	-	-	-	46.7	52.0	57.1	57.1	57.1
	Unit Cost (Rp/m3)								9.2	9.2	9.2	9.2	9.2
	Cost (M Rp/year)		-	-	-	-	-	-	430	478	525	525	525
BUARAN SYSTEM (Supply Zone 6)	Production (M m3/year)		-	-	-	-	59.9	59.9	50.5	54.9	59.9	59.9	59.9
	Unit Cost (Rp/m3)						15.1	15.1	15.1	15.1	15.1	15.1	15.1
	Cost (M Rp/year)		-	-	-	-	904	904	763	829	904	904	904
MINI-PLANTS	Production (M m3/year)		26.5	26.5	25.2	26.5	26.5	26.5	15.8	18.0	19.2	19.2	19.2
	Unit Cost (Rp/m3)		16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6	16.6
	Cost (M Rp/year)		440	440	418	440	440	440	262	299	319	319	319
CIBURIAL SPRING	Production (M m3/year)		9.2	9.2	9.2	9.2	9.2	9.2	4.7	5.1	5.4	5.4	5.4
	Unit Cost (Rp/m3)		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
	Cost (M Rp/year)		32	32	32	32	32	32	16	18	19	19	19
TOTAL Basic Cost			4,748	5,175	6,963	7,612	8,516	5,726	6,278	6,817	7,320	7,745	7,745
Price Escalation Factor			1.28	1.37	1.46	1.56	1.67	1.79	1.92	2.05	2.19	2.35	2.51
Total Chemical Cost		2,378	6,077	7,090	10,166	11,875	14,222	10,250	12,054	13,775	16,031	18,201	19,440

note: chemical cost for the year of 1984 is estimated based on the actual expenditure in 1983/84.

Table 5.4 Powe Cost

Facilities	Production Unit Price	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
PEJOMPONGAN SYSTEM (Supply Zone 1)	Production (M m3/year)		167.8	158.9	158.9	167.8	167.8	167.8	174.7	144.4	152.0	167.8	178.8
	Unit Cost (Rp/m3)		18.1	18.1	18.1	18.1	18.1	13.7	13.7	13.7	13.7	13.7	13.7
	Cost (M Rp/year)		2,711	3,037	2,876	3,037	3,037	2,299	2,393	1,978	2,082	2,299	2,299
PULOGADUNG SYSTEM (Supply Zone 2)	Production (M m3/year)		30.0	30.0	113.5	119.8	119.8	119.8	124.9	102.8	113.5	119.8	119.8
	Unit Cost (Rp/m3)		14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
	Cost (M Rp/year)		447	447	1,691	1,785	1,785	1,785	1,861	1,532	1,691	1,785	1,785
DISTRIBUTION CENTER R - 1 (Supply Zone 3)	Production (M m3/year)		-	-	-	-	-	-	-	78.5	83.6	89.9	89.9
	Unit Cost (Rp/m3)									28.3	28.3	28.3	28.3
	Cost (M Rp/year)		-	-	-	-	-	-	-	2,222	2,366	2,544	2,544
DISTRIBUTION CENTER R - 4 (Supply Zone 4)	Production (M m3/year)		-	-	-	-	-	-	28.1	32.2	33.1	33.1	33.1
	Unit Cost (Rp/m3)								36.1	36.1	36.1	36.1	36.1
	Cost (M Rp/year)		-	-	-	-	-	-	1,014	1,162	1,195	1,195	1,195
LEBAKBULUS SYSTEM (Supply Zone 5)	Production (M m3/year)		-	-	-	-	-	-	46.7	52.0	57.1	57.1	57.1
	Unit Cost (Rp/m3)								33.1	33.1	33.1	33.1	33.1
	Cost (M Rp/year)		-	-	-	-	-	-	1,546	1,721	1,890	1,890	1,890
BUARAN SYSTEM (Supply Zone 6)	Production (M m3/year)		-	-	-	-	59.9	59.9	50.5	54.9	59.9	59.9	59.9
	Unit Cost (Rp/m3)						20.1	20.1	20.1	20.7	20.7	20.7	20.7
	Cost (M Rp/year)		-	-	-	-	1,204	1,204	1,015	1,136	1,240	1,240	1,240
MINI-PLANTS	Production (M m3/year)		26.5	26.5	25.2	26.5	26.5	26.5	15.8	18.0	19.2	19.2	19.2
	Unit Cost (Rp/m3)		9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
	Cost (M Rp/year)		241	241	229	241	241	241	144	164	175	175	175
BOOSTER PUMPING STATION	Cost (M Rp/year)		123	123	123	123	123	123	-	-	-	-	-
Total Basic Cost			3,522	3,848	4,919	5,186	6,390	5,652	7,973	9,915	10,639	11,128	11,128
Price Escalation Factor			1.28	1.37	1.46	1.56	1.67	1.79	1.92	2.05	2.19	2.35	2.51
Total Power Cost		2,933	4,508	5,272	7,182	8,090	10,671	10,117	15,308	20,326	23,299	26,151	27,931

note: power cost for the year of 1984 is estimated based on the actual expenditure in 1983/84

6. IMPLEMENTATION OF PROJECT

6. IMPLEMENTATION OF PROJECT

The First Phase of Second Stage Project is planned for meeting the water demand in the year 1990 by the two treatment plants to be established at west and east sides of the City. At least therefore Lebakbulus Plant, west side, should be completed and cover the newly developed service area in 1990.

Considering the said status, the construction schedule of the Project should be prepared. In this Chapter, the implementation of the Project is described covering circumstances of construction materials locally available and local contractors for civil works, construction and procurement methods, land acquisition program, construction schedule and implementation schedule for whole projects inclusive of the immediate program.

6.1 Construction Materials and Labor Force

In view of current rush of high building construction in Jakarta, most of materials needed for construction of treatment plants and distribution centers will be available locally. Major local materials are shown on Table 6.1.

Table 6.1 Local Materials and Products

Items	Description
Construction Materials	1) Cement : portland cement, ready mixed concrete 2) Aggregate : sand and gravel for concrete 3) Form work : teak woods, plywood 4) scaffolding : pipe frame 5) Steel : rounded bar (ø6 - ø32), deformed bar (D10 - D36), equilateral angle steel, I-steel, channel steel, steel pipe pile etc. 6) Paint : water paint, oil paint, epoxy paint 7) Cable and lighting apparatuses,
Pipe materials	1) Steel pipe : ø100 - ø2,000 (spiral type) - coating : coal tar enamel coating, epoxy and asphalt felt wrapping, polyvinyl tape system, and epoxy coating - lining : coal tar enamel lining, cement mortar lining and bitumen lining 2) Asbestos cement pipe : ø80 - ø600 - Fittings : cast iron, bitumen coating and cement mortar lining (Australian Standard) 3) PVC pipe (bell end and rubber gasket joint) : ø75 - ø300 - Fittings : bend, tees, reducer, flange socket, double socket etc. 4) Galvanized iron pipe (GIP) : ø1/2" - ø6" - Fittings : elbow, tee, plug, socket, nipple etc.

Besides, enough manpower for construction works is also available. At present sort of laborer covers navvy, stonemason, carpenter, reinforcement worker, painting worker, pipelaying worker, asphalt worker, electricity worker and foreman. However, only a few skilled laborers are available, so that supervising by inspector or superintendent will be necessary for the execution of constructions works and installation of the equipment.

6.2 Construction Ability of Local Contractor

In principle, general contractors and suppliers who intend to undertake the construction works and supply of construction materials and equipment relative to the public works, are to register their qualification to the Government Agencies concerned. The registration of general contractors is classfied into eleven (11) construction fields such as building, pipelaying and water supply facilities, roads, bridges, field-preparation for the settlement of transmigrations, reservoirs, irrigation, rivers, swamps, flood-gates, and well drillings. The qualification is also classfied into five (5) classes in accordance with the ability of contractors taking into account holding numbers of equipment for construction such as dewatering pump, concrete mixer, rammer, vibrator, truck and other heavy machinary, and qualified engineers, and past experience. The registration is to be renewed every year.

Present status of the registration of contractors and suppliers connected with the water supply project is shown below:

Table 6.2 Registration of Contractors and Suppliers

Contractors 1/	More than Rp.500	More than Rp. 500	Rp.100 tp Rp. 500	R.100 to Rp. 500	Less than Rp. 100
Classification	(A1)	(A2)	(B1)	(B2)	(C)
- Building/ Structure	1	-	2	6	31
- Pipelaying works	-	1	2	3	18
- Bridges	2	-	1	5	28
- Reservoirs	1	-	2	2	9

Table 6-2 (Cont'd)

Suppliers 2/	Over Rp. 100	Rp. 100 to Rp.200	Rp. 10 to Rp 100	Rp. 3 to Rp. 10	Less than Rp. 3
Classifications	(A)	(B)	(C1)	(C2)	(C3)
- Construction materials (pipes, steels, cables etc)	23	17	60	22	17
- Construction equipment (Heavy equipment, compressor, generator etc)	34	18	48	34	11

(Unit : Rp. million for contract amount)

Note : A1 with big volume and high technical requirements
A2 with big colume and moderate technical requirements
A1 with moderate volume and high technical requirements
B2 with moderate volume and moderate technical requirement

1/ total registered contractors of 46
2/ total registered supplier of 319

Only a few contractors registered have heavy construction machinery. Most of contractors have no construction machinery so that they lease machinery by hourly basis for the construction period. Currently, lease companies have been established and handle heavy construction machinery such as bulldozer, excavator, dump-truck, diesel pile hammer, shovel loader, road-roller, asphalt sprayer, asphalt finisher, grader etc.

There are not so many contractors experienced in water-tight structures of waterworks, although most local contractors are sufficiently experienced in the usual structures. Considering such capability of the local contractors, it is desirable that construction of the plant facilities should be undertaken under joint venture of local contractors and foreign experienced contractors, to secure the desired workmanship of structure and speedy execution.

6.3 Construction and Procurement Methods

As regards water supply of Jakarta, division of functions and responsibilities for construction so far practiced is that Cipta Karya undertakes all construction works including procurement of equipment and materials, and PDAM, DKI operates and maintains the completed facilities being handed over from Cipta Karya. As has been proved from the experience, this arrangement is considered appropriate from the viewpoint of financing and engineering.

Further, regarding methods of construction of projects, the widely accepted practice, namely, procurement of equipment and materials through international competitive bidding and civil works by local competitive tendering, has been followed. The above arrangement of functions and responsibilities and methods of implementation will be basically applicable to the present project.

Following the above basic consideration, the procedures for the construction of the First Phase Project including the Immediate Project are worked out and described below together with some recommendations deemed necessary for smooth execution of the projects.

The equipment and materials necessary for treatment plant and transmission and distribution systems are procured by the open international competitive bidding procedure in accordance with the guideline on procurement procedure of bilateral/multilateral lending agencies under the responsibility of Logistic Division of DWS.

The civil works of plant facilities and pipe-laying works are conducted by the local contractors selected by the local tendering procedures under the responsibility of Construction Division of DWS. The Installation of plant equipment is conducted by the local contractors under the contract of the suppliers. Both construction and installation works are superintended by the responsibility of Project Manager of Jakarta Water Supply Projec Office, under the direction of the Construction Division of DWS.

The procedure for construction methods for the Improvement Project, Immediate Project and First Phase of Second Stage Project will be considered as follows:

1) International Tendering

The procurement of plant equipment and pipe materials is to be made by the open international competitive bidding procedures in accordance with the guideline of the lending agency. Grouping of the plant euqipment and pipe materials for said tendering wil be made as follows:

a. Plant equipment

- screen for the water inteke
- pumps, motors and appurtenances
- sludge removal equipment for sedimentation basins, filter equipment
- chemical feeding equipment, and
- electrical facilities including power substation, and instrumentation

b. Pipes, fittings, valves, gates, jointing materials and flow meters for the plant facilities and transmission pipeline.

c. Pipes, fittings, valves and jointing materials for distribution pipelines, flow meters at distribution centers.

The procedure of tendering is described in Chapter 8 - Implementation Schedule.

2) Local Tendering

The contractors are required to register at the Government and obtain the license for business. After registration, the contractors are ranked by the Government according to their qualification on the basis of the evaluation of the capital of the firm, number of qualified engineer, annual contract amounts undertaken and past experience.

Grouping of the civil works for tendering of the system for the registered contractor is to be as follows :

a. Civil works of intake and treatment plant facilities for Buaran system.

b. Civil works of intake and treatment facilities for the Cisadane system.

c. Pipe-laying works of transmission pipeline for the Buaran system.

d. Pipe-laying works of transmission pipelines of raw water and clear water for the Cisadane system.

e. Civil works of distribution centers including clear water storage reservoir and pump house.

f. Pipe-laying works of distribution pipelines.

g. Pipe bridge works including abutment and pipes

h. Pipe driving works of road crossing.

The tendering for the above mentioned works will be in accordance with the local tendering procedures of the executing agency.

6.4 Construction Schedule of the First Phase of Second Stage Project

The construction schedule of each construction work on the First Phase of Second Stage Project is presented on Table 6.3 Construction Schedule. The schedule is prepared by splitting into several groups the whole construction works of intake pump station, treatment plant, distribution center and transmission and distribution pipelines, and also considering the capability of contractors. Each construction work is briefed as follows:

1) Land Acquisition

As shown in later section, Land Acquisition Program, the land for the proposed treatment plant and distribution center sites is scheduled to be purchased in 1986 and for the raw water transmission pipeline route in 1987.

2) Detailed Design Engineering

After conclusion of the loan negotiation, the detailed design engineering is conducted by the selected consultants in 1986 with fifteen (15) months period.

3) Cisadane System

The Cisadane system is scheduled to be completed in 1990. Accordingly, the tendering on civil works of intake, treatment plant and distribution center, and procurement of equipment and pipe materials are to start after completion of the detailed design engineering upon approval of the agencies concerned. The pipelaying works for raw water transmission are to be commenced after delivery of pipe materials.

4) WTC System

The WTC system is scheduled to start in 1988 and be completed in middle of 1991 depending on the schedule of procurement and installation of the clear water transmission main. Considering this schedule, the procurement of transmission pipe materials is to start on same period as the Cisadane System in 1987.

5) Distribution Trunk Main

Installation of distribution mains precedes for Zones 4 and 5, western and south-western areas, for Cisadane system. Procurement of pipe materials is to be commenced with tender calling in 1987, and they are to be installed grouped in some packages and the last installation is scheduled to be completed mostly in 1991.

At present, Zone 3, northern area, is covered with the existing distribution mains. The distribution mains in this Zone are longer length and bigger diameter than other Zones. Considering to require long period for manufacturing and delivering of pipe materials, procurement of pipe materials is scheduled to be commenced on same period as Zones 4 and 5, and the last installation be completed in 1992.

Zones 1 and 2 are supplied by the existing Plants of Pejompongau and Pulogadung and covered with the existing distribution mains. Then, the new mains augmented are scheduled to be installed in 1991 through 1992.

Zone 6 is supplied by Buaran Plant and covered by the existing distribution mains. Furthermore, secondary and tertiary mains are to be installed for strengthening the distribution network by the secondary and tertiary mains for full utilization of available production capacity.

6) Secondary and Tertiary Mains

Installation of secondary and tertiary mains is done for Zones 4 and 5 in preference to the other zones and the procurement of pipe materials is to start on tender calling in 1988 so as to commence the installation in 1990. The mains are scheduled to be procured every year and installed up to the year 1993.

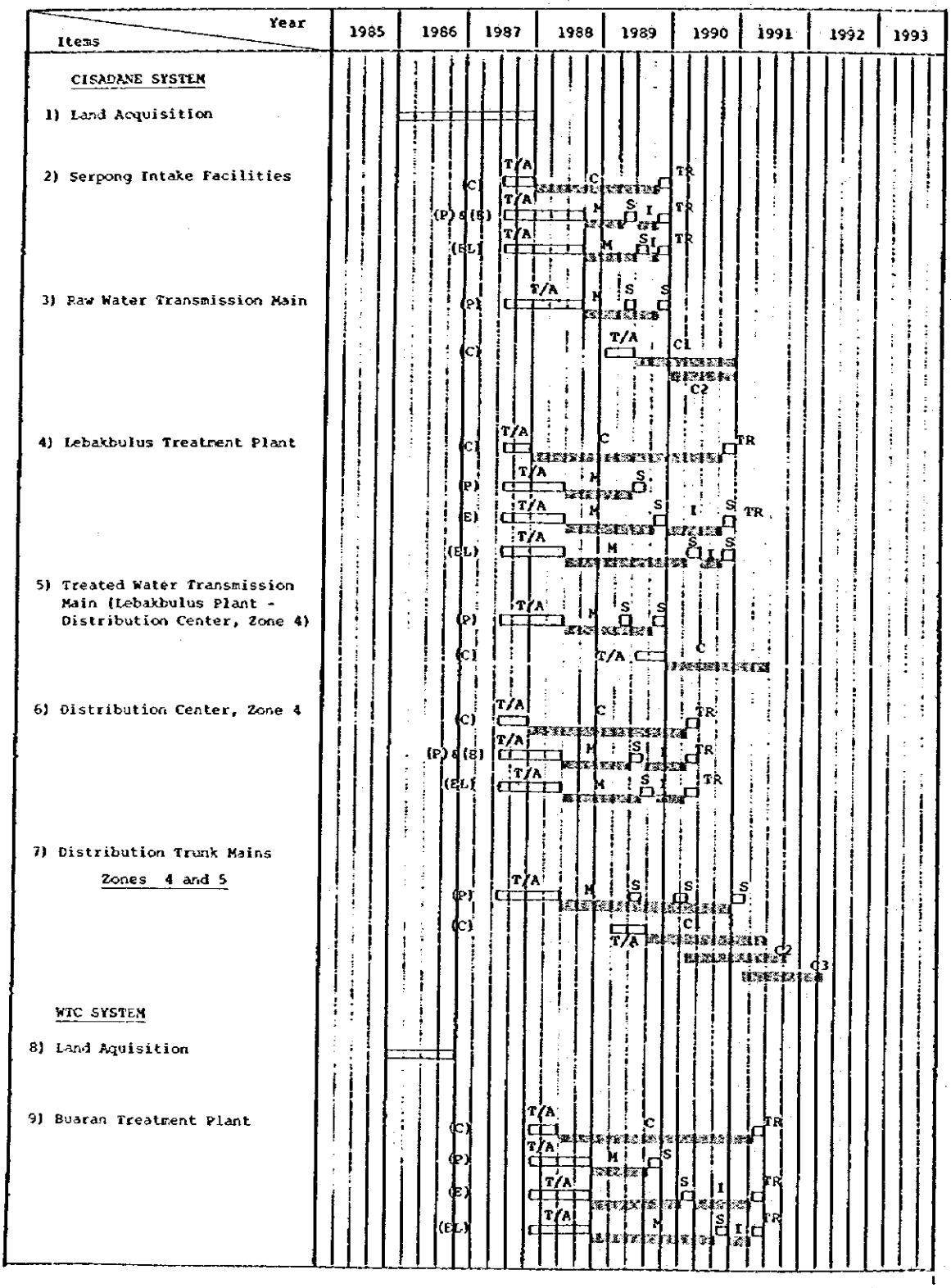
7) Zonal Meter

As the meter is equipped on secondary main grid branched from trunk main, the procurement and installation are done according to the schedule of secondary main.

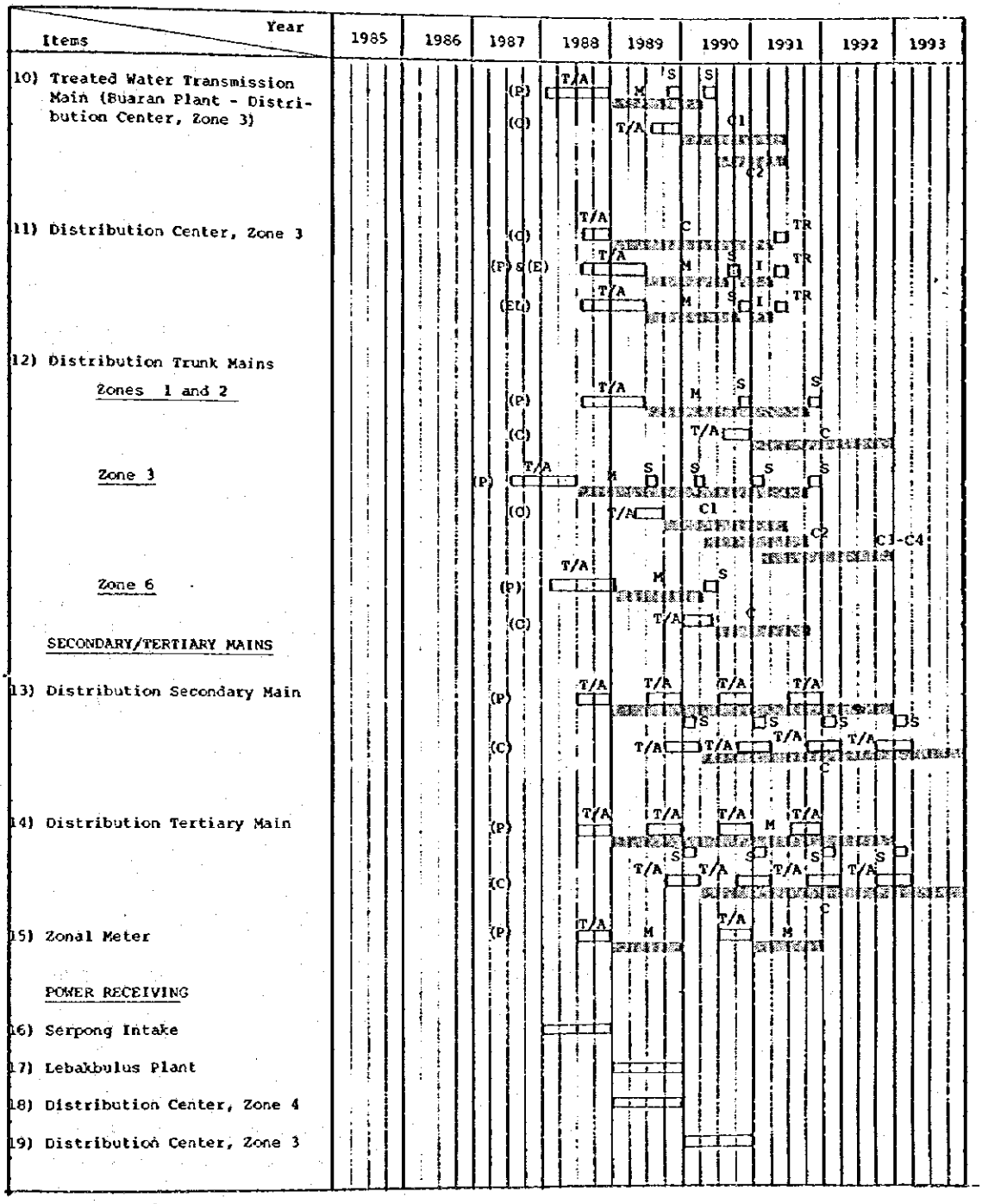
8) Power Receiving

The power receiving work is scheduled to be completed one year before the test operations of the treatment plant and distribution center.

Table 6.3 Construction Schedule for First Phase of Second Stage Project



Construction Schedule (Cont'd)



Legend

(C) : Construction and/or Pipelaying works
(P) : Procurement of pipe materials
(E) : Procurement of mechanical equipment
(EL) : Procurement of electrical equipment
T/A : Advertisement, Tndering, Evaluation and Approval
C : Construction and/or pipelaying works
M : Manufacturing
S : Shipping, Handling, Local transportation
I : Installation of equipment
TR : Test run

6.5 Land Acquisition Program

The land required for treatment plants and distribution centers is scheduled to be purchased in 1986 for topographical survey and soil investigation on foundation of the facilities at the stage of detailed design.

The land, with 10 m wide, for the transmission main route from Serpong raw water pump station to Lebakbulus treatment plant is to be purchased in 1987 as access road for transporting and installing pipes and in future, the road is utilized as conjunction road between the plant and intake station. Selection of the route, therefore, should be carried out in accordance with future road planning of the Central and Local Government. Areas and locations of the land to be purchased and their present circumstances are described below:

Facilities	Area (ha)	Location	Circumstances
Serpong Intake	1.12	Serpon area, right bank of the Cisadane River	Paddy field
Lebakbulus Plant	6.61	Kec. Kebayoran Lama Kel. Pondok Pinang	Uncultivated land, surrounding area is currently being developed as housing area
Buaran Plant	12.80	Southern area of Buaran Plant to be constructed under the Immediate Project	Paddy field and uncultivated land
Distribution Center (Z-4)	2.04	Kec. Kebon Juruk Kel. Joglo	Uncultivated land, surrounding area is uncultivated land and paddy field
Distribution Center (Z-3)	3.51	Kec. Cilincing Kel. Sukapura	Unoccupied ground, bonded warehouses are located western side adjacent to the land.
Raw Water Transmission Pipeline	9.2	Length: 9.2 km Width : 10 m	Uncultivated land and paddy field (utilization as conjunction road between intake station and plant in future)

6.6 Implementation Program

6.6.1 General

Without a well-coordinated implementation of all the projects which are aimed to complete by the year 1990, the objective of immediate and the First Phase Project will hardly be attained. Those projects are complementary to each other. From this consideration, a comprehensive implementation schedule including all the projects are worked out, as shown on Table 6.4.

Meanwhile, although the present First Stage Project has been delayed by a few years for some unexpected reasons, this proposed schedule has not allowed for such delay. It is hoped and naturally assumed that no delay will occur with the proposed project.

6.6.2 Schedule of Each Project

Individual schedules of the projects as shown on the Table are briefed below.

(1) Improvement of Pejompongan Plants

Improvement works of both Plants are in progress at the stage of this feasibility study. The work of Plant II will be completed within 1984, and the work of Plant I by 1987.

(2) Rehabilitation Works and Leakage Abatement

Replacement of deteriorated pipelines and leakage abatement will be carried out as routine work under the general budget of PDAM, and installation of meters to the unmetered connections and defective meters will be carried out similarly. The schedule shows five year plan as the immediate period.

(3) Extension Project of Secondary and Tertiary Mains

The installation of secondary and tertiary mains necessary for the full utilization of water productions for Pulogadung and Buarau Plants will be conducted as the project separated from the First Phase extension project. The project is scheduled to be completed in 1989.

(4) Short Term Improvement

Reinforcement of chlorination facilities will be implemented as scheduled on the Table, and it is desired this work be carried out earlier than scheduled if funding available.

(5) Immediate Project

The Project has been dicided to be financed by OECF. After conclusion of the Loan Agreement, the schedule will proceed as follows:

- Selection of Consultants	5 months
- Detailed design	8 months
- Tendering of procurement of equipment and pipe materials and civil works of treatment plant including approval of tender documents by lending agency	4 months
- Bid evaluation, award of contract and approval of contract	5 months
- Procurement of plant equipment and pipe materials including L/C opening period	13 months
- Construction of treatment plant, installation of plant equipment, pipe-laying works, including local tendering of pipe-laying works, and test run	30 months

(6) First Phase of Second Stage Project

Appraisal of the project and loan negotiation and approval are scheduled in second and third quarters of 1985 for the external resources, and it is expected to conclude the loan agreement around November 1985. The detailed design engineering is scheduled as simultaneous execution of the water supply systems of Cisadane and WTC. Tendering of the procurement and civil works for the WTC system will be done six months behind the Cisadane system. The schedule will proceed as follows:

- Selection of consultants	6 months
- Detailed design	15 months
- Tendering of procurement of plant equipment and pipe materials and civil works of treatment plants including approval of tender documents by lending agency	6 months
- Bids evaluation, award of contract and approval of contract	5 months
- Procurement of plant equipment and pipe materials including L/C opening period	22 to 40 months

- Construction of treatment plants, installation of plant equipment and test run — 36 months

- Pipe-laying works, including local tendering of pipe-laying works — 40 months

6.6.3 Brief Explanation of Major Procedure

Each step of the schedule is described below:

(1) Detail Design Engineering

The detailed design engineering will be carried out by the selected Consultants for the Projects of Immediate and First Phase, respectively. The designs of the structures and pipelines will be made based on the preliminary designs described in the feasibility study report, and specifications and tender documents be prepared in such detail that suppliers and contractors can estimate properly the costs for supplies of materials and equipment, of construction works, and execute the work as aimed in the design.

(2) Tender Procedure

Procurement of materials and equipment will be made, in principle, in accordance with the international competitive bidding basis, and civil works will be carried out by the local competitive bidding basis. The procedure of tendering will be generally (1) prequalification of the prospective bidders for civil works, where required, (2) tender announcement in accordance with the guidelines of the lending agency, (3) bidding, (4) evaluation of the received tenders, (5) negotiations with a lowest evaluated tenderer, and finally (6) awards of contracts. During these series of proceedings, approvals, as required, of the lending agency shall be obtained.

(3) Bid Evaluation

Evaluation of the bids shall be made mainly on three aspects, namely, compliance with administrative requirements, technical standards and bid prices. Regarding the administrative requirements, the tender must meet the requirements set forth in the general conditions in the tender documents and instruction to the tenderers. Materials, equipment and works offered by the tenderers must meet the specified requirements. Finally, with regard to the bid price of tender, all unit prices, calculations and totals will be checked with their appropriateness.

(4) Monitoring of the Project

Monitoring of activities and performances of contractors is essential to ensure satisfactory completion of the project. Major items to be monitored are as follows:

a. Procurement of Materials and Equipment

- Manufacturing and shipping schedules of materials and equipment to be procured.
- Delivery and installation of materials and equipment at sites.
- Test operation.

b. Construction of Civil Work

- Dates of commencement and completion of the whole contractual work, and construction schedules of each facility.
- Schedules for provision of laborers, machinery and equipment and materials to be used.
- Performance of contractors and workmanships of the works.

6.6.4 Recommendation of Project Implementation

Ongoing extension project for the Jakarta Water Supply System has been delayed due to some unexpected reasons and it is expected to be completed by the year 1987. The delay produces an effect on concentrating the improvement project and system expansion project to cope with the water demand increase. Accordingly, no delay should be allowed of the proposed projects.

Prior to the completion of the extension project of First Phase Stage II, it is an essential requirement to accomplish the rehabilitation and improvement works planned as the Immediate Program and the ongoing project of Stage I, since distribution pipelines of the said two projects are basically to distribute the produced water by the First Phase-Stage II project. To meet the above requirement and also to utilize fully the existing productions, the following are recommended:

(1) Completing the First Stage Project, in progress, by 1988 as scheduled because the distribution mains to be installed by the Project must receive water from the Buaran Plant at the beginning of 1989.

(2) Commencing the leakage abatement study in 1986, including site investigation of the existing distribution pipelines to be rehabilitated, engaging the consultants with five years period.

(3) Replacing of old and defective meters and installing new meters on unmetered service connections starting from 1985 providing yearly program for implementation immediately.

(4) Replacing old distribution pipelines laid in 1920's and related service connections starting from 1986. Rehabilitation may be necessary to continue on pipelines installed in 1950's after 1990 as routine works on the basis of the actual results of water loss reduction.

(5) Installing distribution pipelines for secondary and tertiary mains procured under the First Stage Project as scheduled and planning further extension works of the said pipes for full utilization of the available water production before the completion of the above works.

(6) Installing the chlorination equipment in the existing treatment plants as early as possible for strengthening chlorination and executing the construction of pre-chlorination system for Pejompongan plant at the same time of installation for raw water transmission pipeline.

(7) Selecting consultants urgently for detailed design engineering of Immediate Project to complete the Project as scheduled.

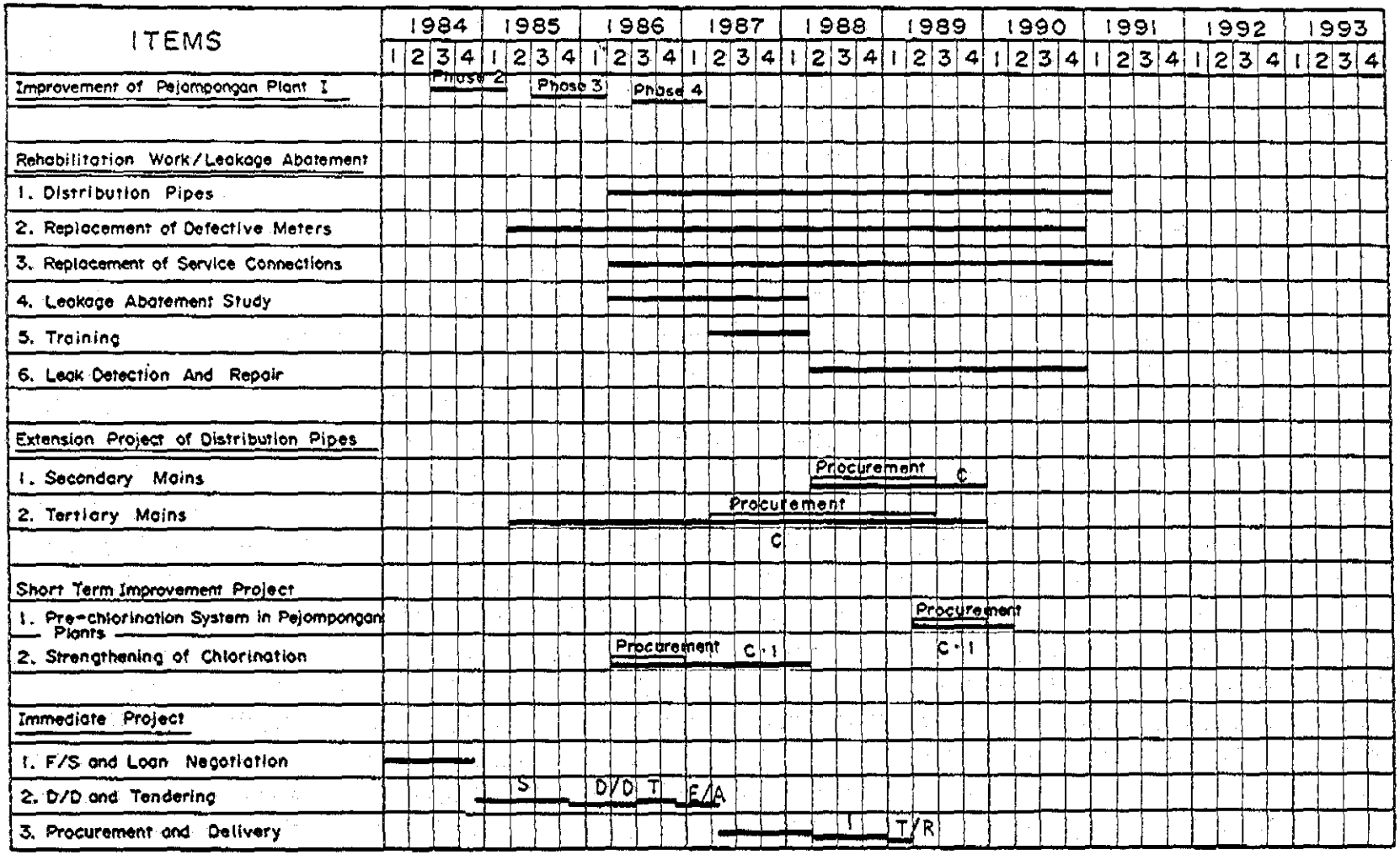
Especially, the future projects concerned the expansion and improvement are to be executed by the agencies interrelated with the Jakarta Water Supply System, such as the system expansion by Cipta Karya, the raw water source development project by DGWRD/POJ and rehabilitation and improvement projects by PDAM. In order to make an attempt for smooth implementation as scheduled, the following are recommended:

(1) Establishing a special group of experts to supervise and control all relevant projects to be implemented by different agencies,

(2) Preparing and giving a guideline difining direction and scope of works, approach etc to the consultants of each project, and

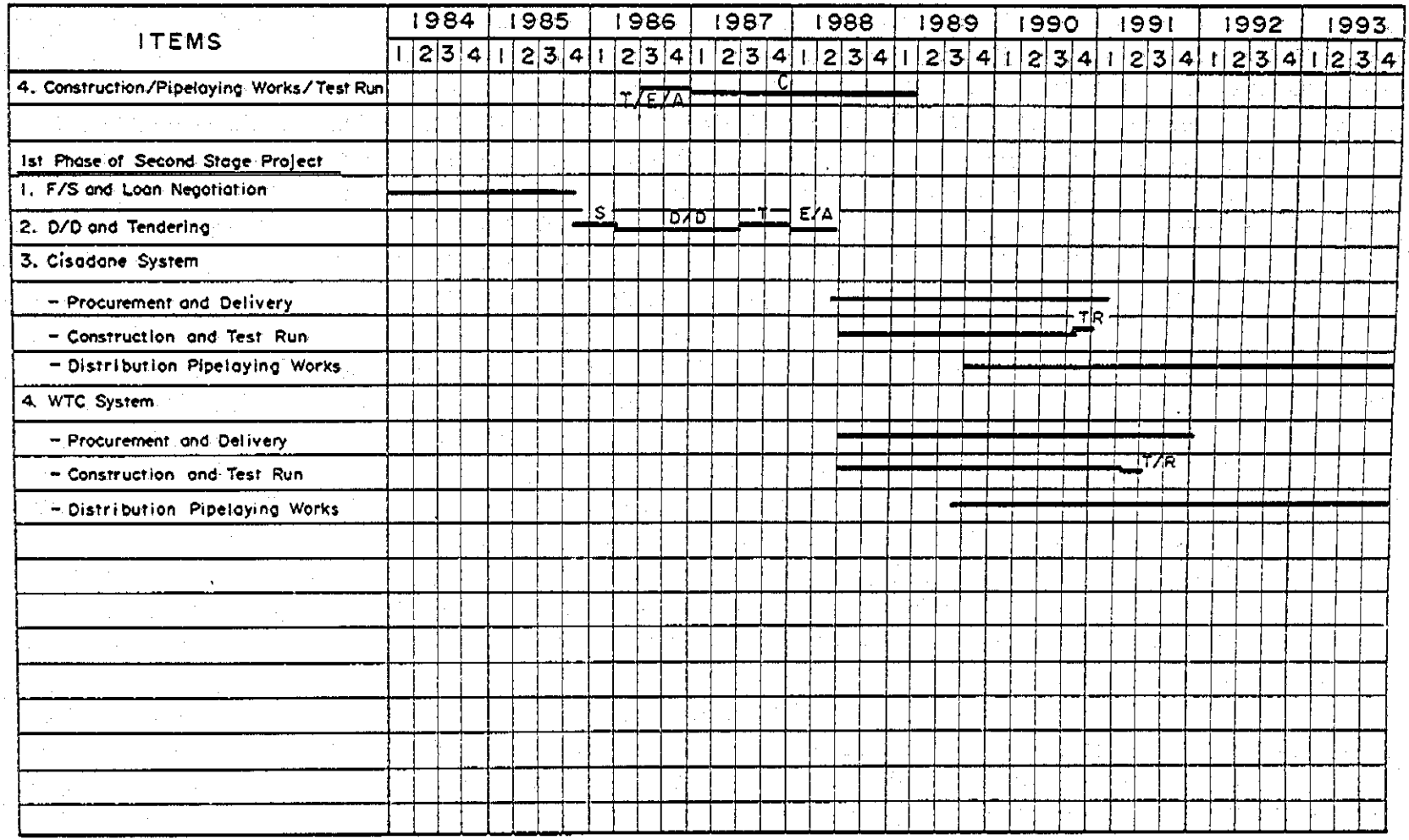
(3) Providing PDAM Jaya with a consultants for coordination and management for expansion of all its business operation and projects.

Table 6.4(A) IMPLEMENTATION SCHEDULE— (I)



Note: F/S; Feasibility study, S; Selection of Consultants, D/D; Detailed design engineering
T ; Tendering, E/A; Bids evaluation and award of contract
I ; Installation of Equipment, T/R ; Test Run, C ; Construction

Table 6.4(8) IMPLEMENTATION SCHEDULE — (2)



7. FINANCIAL AND ECONOMIC ANALYSIS

7. FINANCIAL AND ECONOMIC ANALYSIS

The analyses of this chapter have proved the financial and economic viability of the proposed 6.0 m3/sec expansion project. The sensitivity analysis has showed that cash shortage in the PDAM's funds flow is not foreseen even if risks in realizing the projected revenues were considered to a certain extent. Nevertheless, it is suggested that PDAM be precautions in determining a tariff level and designing a tariff structure.

7.1 Financial Projections

The projection of the future financial positions based on the assumptions indicated below shows that PDAM will be able to meet the debt-service obligations of the proposed 6.0 m3/sec. expansion project.

Major Assumptions (For details, see APPENDIX FVII-1)

1) Average Tariff

(Unit: Rp./m³)

Year		1983	1984	1985	1986	1987	1988	1989
Tariff:	Real	252 1/	219	218	227	235	243	253
	Nominal	252 1/	252	279	310	334	381	423

1990	1991	1992	1993	1994	1995	1993/1983	Average Annual Increase (%) 1983-1993
262	271	281	292	292	292	1.159	1.5
469	520	577	641	685	733	2.544	9.8

Note: 1/ Average tariff after tariff revision in May 1983.

2) Financing Conditions for the Proposed Project

Thirty-year repayment period including 6-year grace period at 11 percent interest rate. Here, following the arrangement of the past loans, interests during construction are not charged. Under this condition, the debt-service for about 47 percent of the total project investment is scheduled to start in 1992, 33 percent in 1993, and 20 percent in 1994.

3) Accounted-for Water

Twenty percent improvement from 47 percent in 1983 to 67 percent in 1995.

4) Raw Water Charge to Jatilhul Authority

Year	Raw Water Charge
1984-1987	Rp. 10/m3
1988-	Rp. 15/m3
	(1984 constant price)

5) Tax

To be paid from 1984 according to the government regulation.

6) Contribution to DKI Budget

To be paid according to the existing regulations.

7) Equity from DKI

Not considered with the reason that the projection should be conservative and that the level of equity receipt should be determined taking account of the result of the projection without equity.

8) Connection Charges

The present rate be gradually reduced so that the charge will be equal to the actual cost of connection in 1995.

Even under the assumptions taken for making the projection conservative, i.e., 5), 7), and 8), the rate of return after tax on the average net plant in operation between 1991 and 1995 is in the reasonable range of 5-10 percent on a historic cost basis and 3-6 percent on a revalued cost basis. During the same period, no drawing-down of cash at hand is observed. The debt/debt & equity ratio reaches a peak of 66 percent in 1991. Yet, the ratio is soon reduced to 51 percent in 1995. With these figures, summarized in Table 7-1, it can be concluded that there will be no serious problems for repayment of loans after 1991 under the assumed tariff schedule. (For detailed financial statements, see Appendix FVII-1).

On the other hand, the projection shows that some additional finance of R. 13.3 billion will be necessary between 1985 and 1988 for not drawing down cash at hand. However, since a magnitude of the cash shortage is not significantly large, it will not be difficult to obtain necessary funds by either one or combination of the followings:

1) Ground water charges (Local Government Equity)

2) Exemption of contribution to DKI budget

3) Exemption of tax

4) Outside borrowing

It should be noticed in Table 7-2 that the sum of tax and DKI contributions between 1984 and 1990 will amount to a fairly large amount of 31 billion. However, even if all the necessary funds are financed by

Table 7-1 Summary of Financial Projections

(Unit: Rp. billion)

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Operating Revenues	10.7	13.7	20.7	25.4	32.7	39.1	60.3	70.2	93.6	105.7	142.7	170.3	206.2	238.5	257.0
Operating Expenses	7.8	10.3	13.1	18.2	25.5	29.9	38.0	45.2	55.7	56.9	75.2	89.9	102.8	116.6	128.0
Depreciation (Revalued)	(1.5) 1/	(1.7) 1/	6.6	8.0	9.0	11.3	12.2	16.8	17.6	19.4	28.4	35.4	40.9	43.8	46.9
Interests	-	-	-	.6	1.1	2.2	3.3	5.4	5.2	9.1	8.7	27.3	39.3	45.7	43.6
Tax	-	-	-	.6	.3	-	3.4	.9	5.1	7.1	8.3	2.6	4.1	8.2	11.3
Net Income	2.2	2.3	1.8	-2.0	-3.3	-4.3	3.4	1.9	10.0	13.2	22.2	15.2	19.0	24.2	27.2
Change in Cash	-1.1	-.5	1.7	.3	- .2	-7.3	-1.6	-4.2	.6	4.6	8.0	6.5	7.4	9.4	11.5
Rate of Return (%) (Historic Cost)	9	9	3	6	4	1	11	5	9	12	10	5	5	7	9
Rate of Return (%) (Revalued Cost)	-	-	1	-2	-2	-3	2	1	4	5	6	3	3	4	4
Working Ratio (%)	73	75	63	72	78	76	63	64	59	54	53	53	50	49	50
Operating Ratio (%) (Historic Cost)	86	88	77	86	90	93	74	82	74	67	71	73	69	65	65
Operating Ratio (%) (Revalued Cost)	-	-	95	103	106	106	83	88	78	72	73	74	70	67	68
Debt/Debt & Equity (%)	0	0	23	26	31	42	47	51	60	65	66	59	60	55	51
Debt Service Coverage (times)	-	-	-	11.0	5.4	3.2	4.9	3.3	3.6	3.1	4.3	1.9	1.8	1.8	2.0

Note : Figure in parenthesis is depreciation on historic cost basis.

outside borrowing, its debt-service will not seriously change the conclusion in the preceding paragraph since, assuming the same financing condition as that of the expansion project, the maximum amount of yearly debt-service will be only Rp.2 billion.

Table 7-2 Financing Plan

(Unit : Rp. million)

	1984 - 90		1991 - 95	
	Amount	Percent	Amount	Percent
Sources				
Internal Cash Generation	157,567	30.6	502,209	81.0
1st Phase/2nd Stage	248,105	48.2	118,181	19.0
Others	109,014	21.2	-	-
Total Borrowings	357,119	69.4	118,181	19.0
Total Source	514,686	100.0	620,390	100.0
Requirements				
1st Stage	71,878	14.0	-	-
Immediate	37,136	7.2	-	-
1st Phase/2nd Stage	248,105	48.2	118,181	19.0
Rehabilitation/Pipe Extension	49,501	9.6	12,188	2.0
Routine Construction	23,083	4.4	18,811	3.0
Total Investment	429,703	83.4	149,180	24.0
1st Phase/2nd Stage	-	-	175,050	28.3
Others	43,504	8.5	74,471	12.0
Total Debt Service	43,504	8.5	249,521	40.3
Working Capital	18,044	3.5	37,857	6.1
Tax	17,547	3.4	34,419	5.5
Contribution to DKI	13,682	2.7	106,681	17.2
Increase in Cash	- 7,794	- 1.5	42,732	6.9
(Finance Required)	(7,794)	(1.5)	(-)	(-)
Total Requirements	514,686	100.0	620,390	100.0

Note: The amount of "Finance Required (Rp.7.8 billion)" is different from that quoted in the text (Rp.13.3 billion) since there is cash surplus of Rp.5.5 billion between 1984-90.