8. Cost Estimates

8.1 Project Cost Estimates

The proejct cost estimates for the Immediate Project are presented on Table 7 brokendown into foreign exchange and local currency components. The costs are estimated on the basis of the unit costs as of August 1983 which are prepared taking into account current tender prices of plant equipment, pipes and appurtenances and civil works. Total costs including land acquisition cost and contingencies amoun to :

Foreign Exchange Component	Rp. 17,000 million	(US$ 17.0 million)
Local Currency Component	Rp. 15,300 "	(US$ 15.45 ")
T o t a l	Rp. 32,130 "	(US$ 33.45 ")

The foreign exchange component includes costs of imported equipment and materials (CIF Jakarta) and expatriate services for installation of equipment to be paid in foreign currency. The local currency component includes costs of labor and materials to be paid in the local currency, namely, it comprises the costs for local labour and materials locally manufactures or produced, including local handling and transportation charges for imported materials, for expatriate's local expenditure, and for imported materials which are locally available.

8.2 Operation and Maintenance Cost Estimates

1) Composition of staff in the new treatment plant :

Chief of the plant	1
Chief of electrical facilities	1
Chief of mechanical facilities	1
Administration	3
Laboratory	3
Four shifts of staff for control room, Handling chemicals, inspecting machinery and patrol	4 x 8
Miscellaneous worker	5
Total staff	46

2) Operation and Maintenance Costs :

Personnel cost
46 @ Rp. 109,000/month x 12 months = Rp. 60.2 x 10^6

Power Cost
12,901,000 kWH/year x (1+0.01) x Rp.26.5/KWH = Rp. 345.3 x 10^6

Chemical Cost ;

Chlorine gas	520.1 t/year	@ Rp.1,115,000	= Rp.	579.9 x 10^6
Alum	2,081 t/year	@ Rp. 162,000	= Rp.	579 x 10^6
Polymer	2.1 t/year	@ Rp. 162,000	= Rp.	337.1 x 10^6
Lime	1,248.3 t/year	@ Rp. 41,000	= Rp.	51.2 x 10^6
			Rp.	970 x 10^6

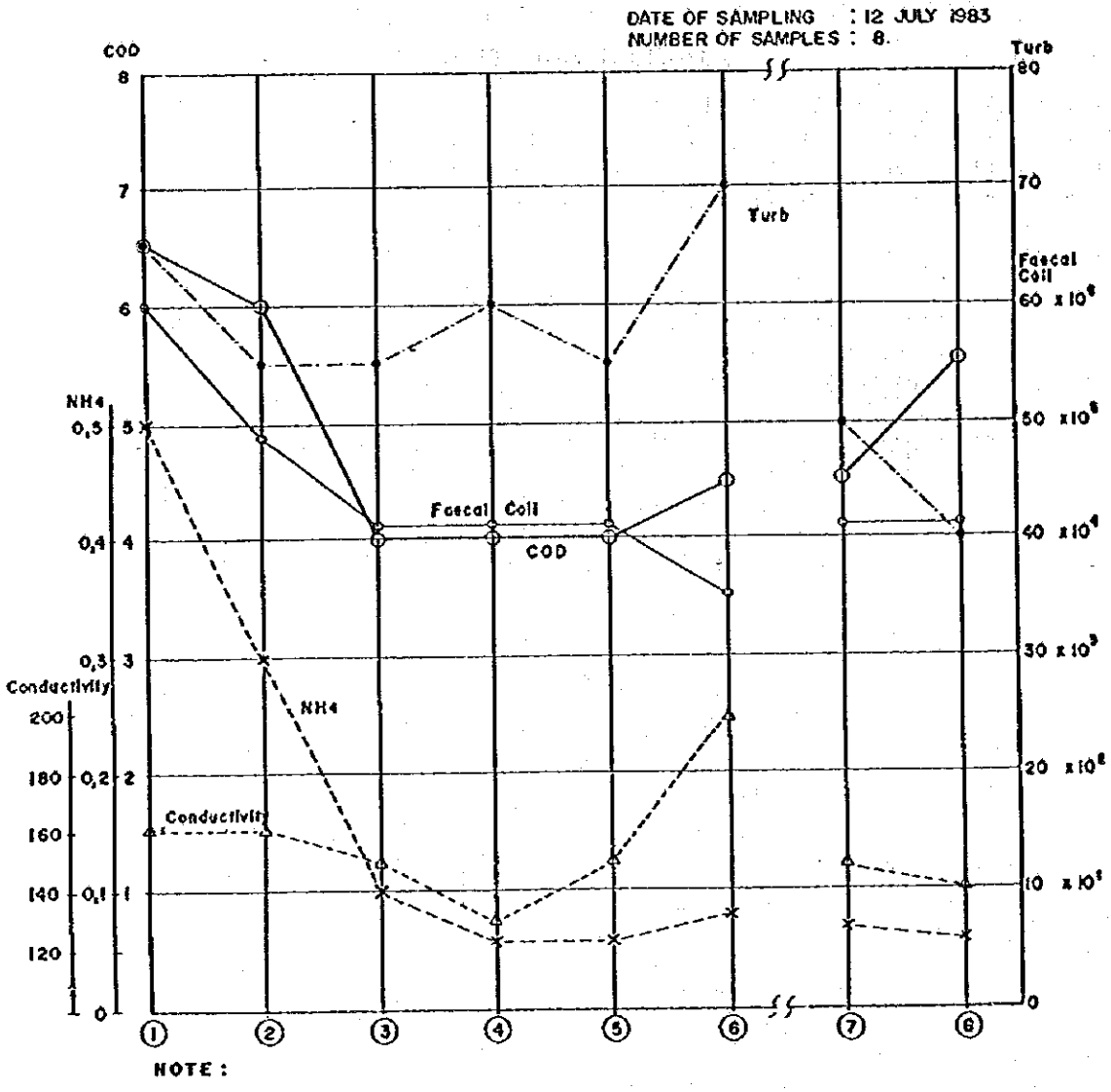
Maintenance cost (amounting 3 % of machinery costs)

US$ 1,759,000 x 3 % @ Rp. 980 = Rp. 51.7 x 10^6

Total O/M costs Rp.1,427.2 x 10^6

FIGURES AND TABLES

Fig. 1 WATER QUALITY ALONG THE WEST TARUM CANAL

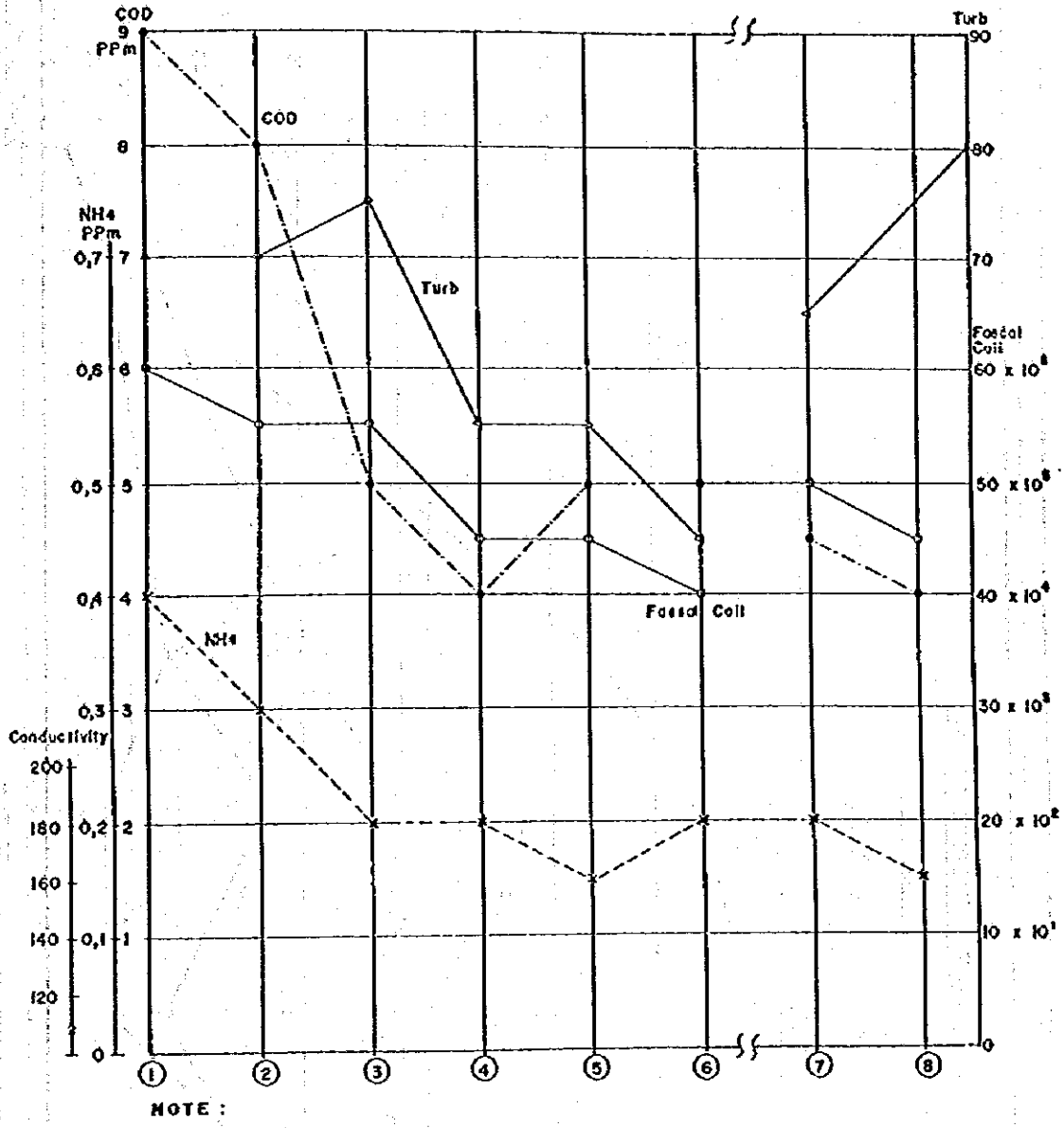


NOTE :

① CROSSING POINT WITH THE CIPINANG RIVER
② JUST BEFURE CROSSING POINT WITH THE SUNTER RIVER
③ CROSSING POINT WITH THE BUARAN RIVER
④ CROSSING POINT WITH THE CARUNG RIVER
⑤ JUST AFTER CROSSING POINT WITH THE BEKASI RIVER
⑥ JUST BEFORE CROSSING POINT WITH THE BEKASI RIVER
⑦ BEKASI RIVER JUST BEFORE JOINT POINT
⑧ BEKASI RIVER 4Km UPSTREAM FROM JOINT POINT

SOURCE : SURVEY BY JICA TEAM

Fig.2 WATER QUALITY ALONG THE WEST TARUM CANAL



NOTE :

① CROSSING POINT WITH THE CIPINANG RIVER
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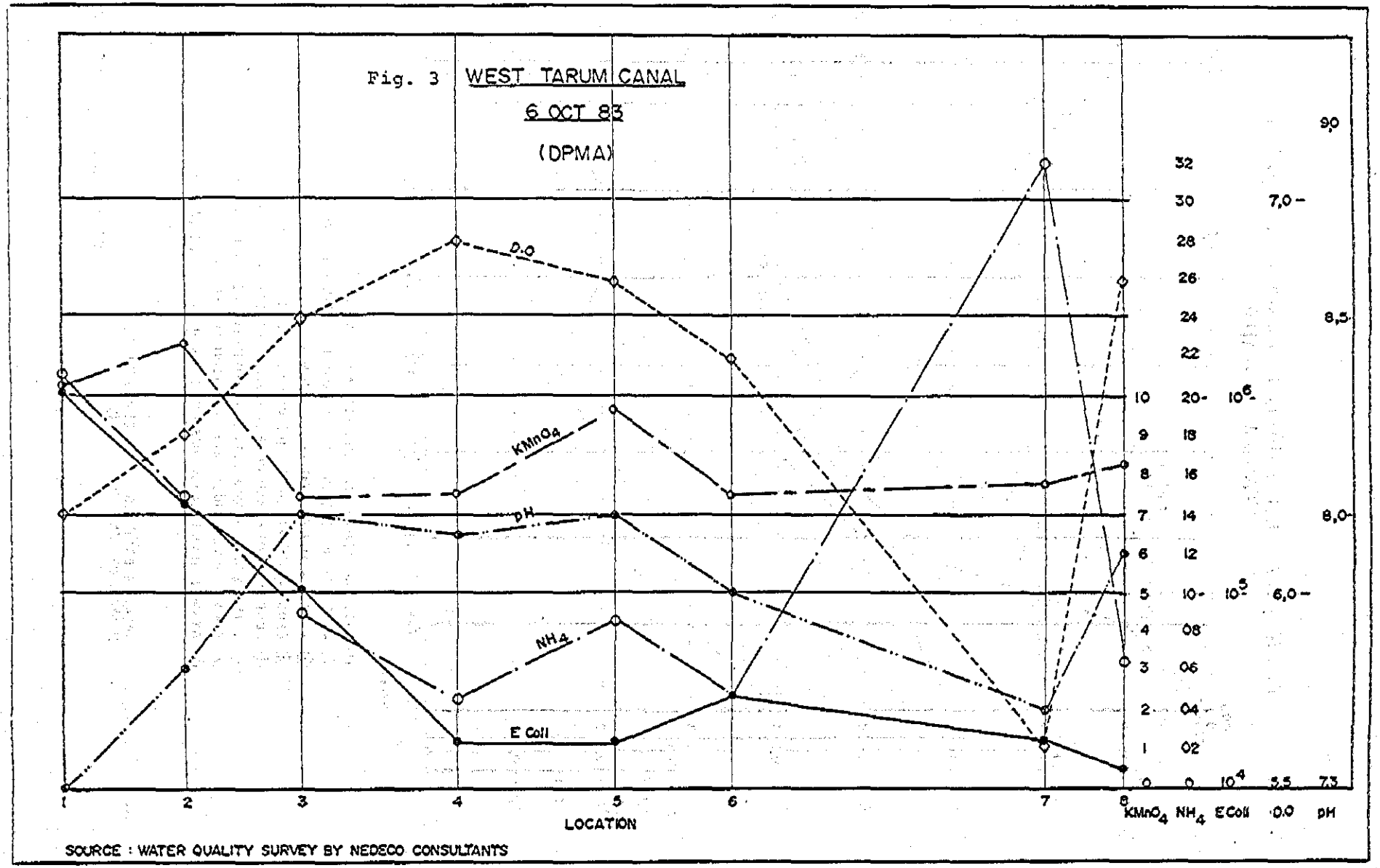
⑥ JUST BEFORE CROSSING POINT WITH THE BEKASI RIVER
⑦ BEKASI RIVER JUST BEFORE JOINT POINT
⑧ BEKASI RIVER 4Km UPSTREAM FROM JOINT POINT

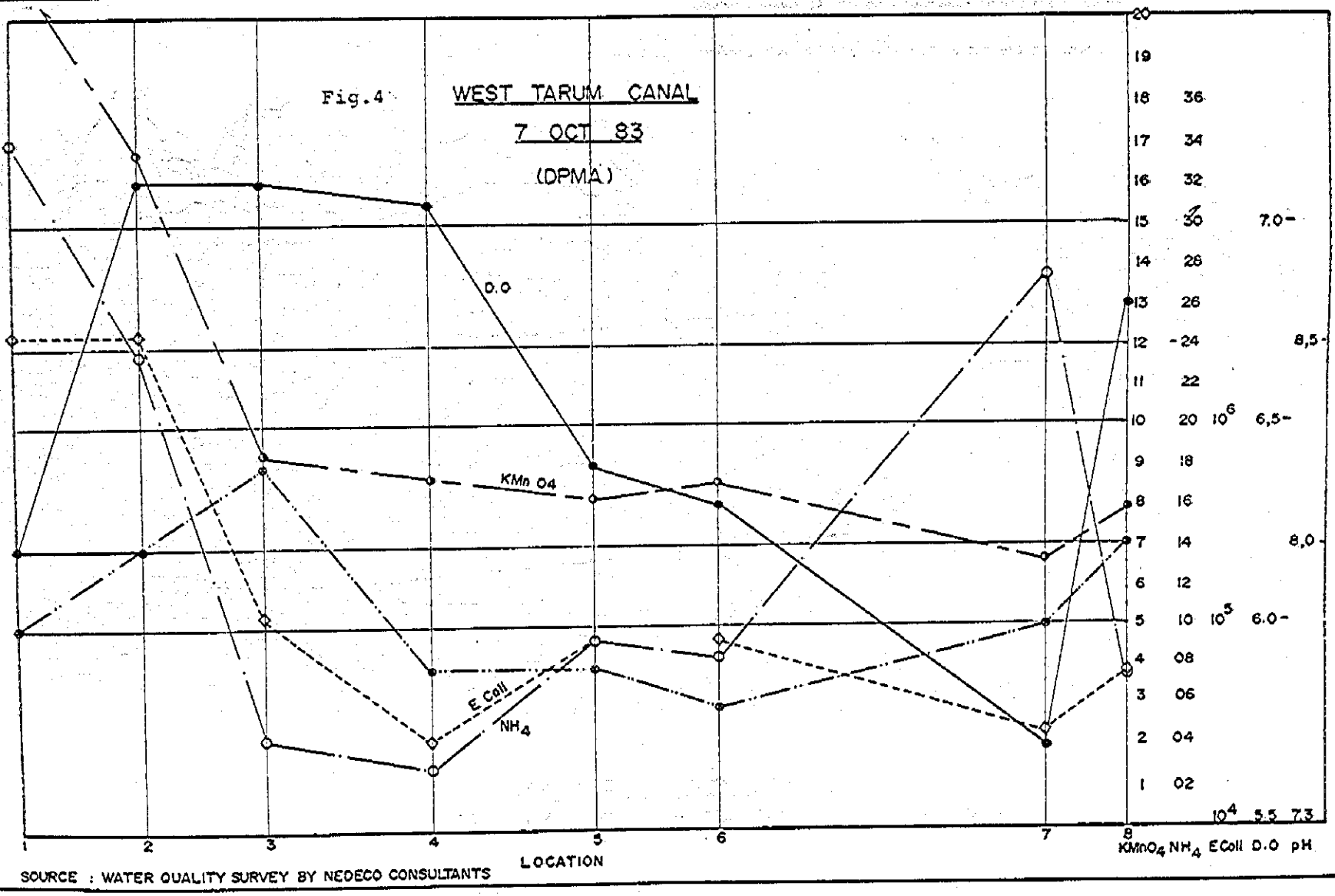
DATE OF SAMPLING 25 AUGUST 1983
NUMBER OF SAMPLES 8.

SOURCE : SURVEY BY JICA TEAM



SOURCE : WATER QUALITY SURVEY BY NEDECO CONSULTANTS

Fig.4 WEST TARUM CANAL
7 OCT 83
(DPMA)



SOURCE : WATER QUALITY SURVEY BY NEDECO CONSULTANTS

Fig.5 SAMPLING POINT FOR WATER QUALITY ANALYSIS OF WEST TARUM CANAL

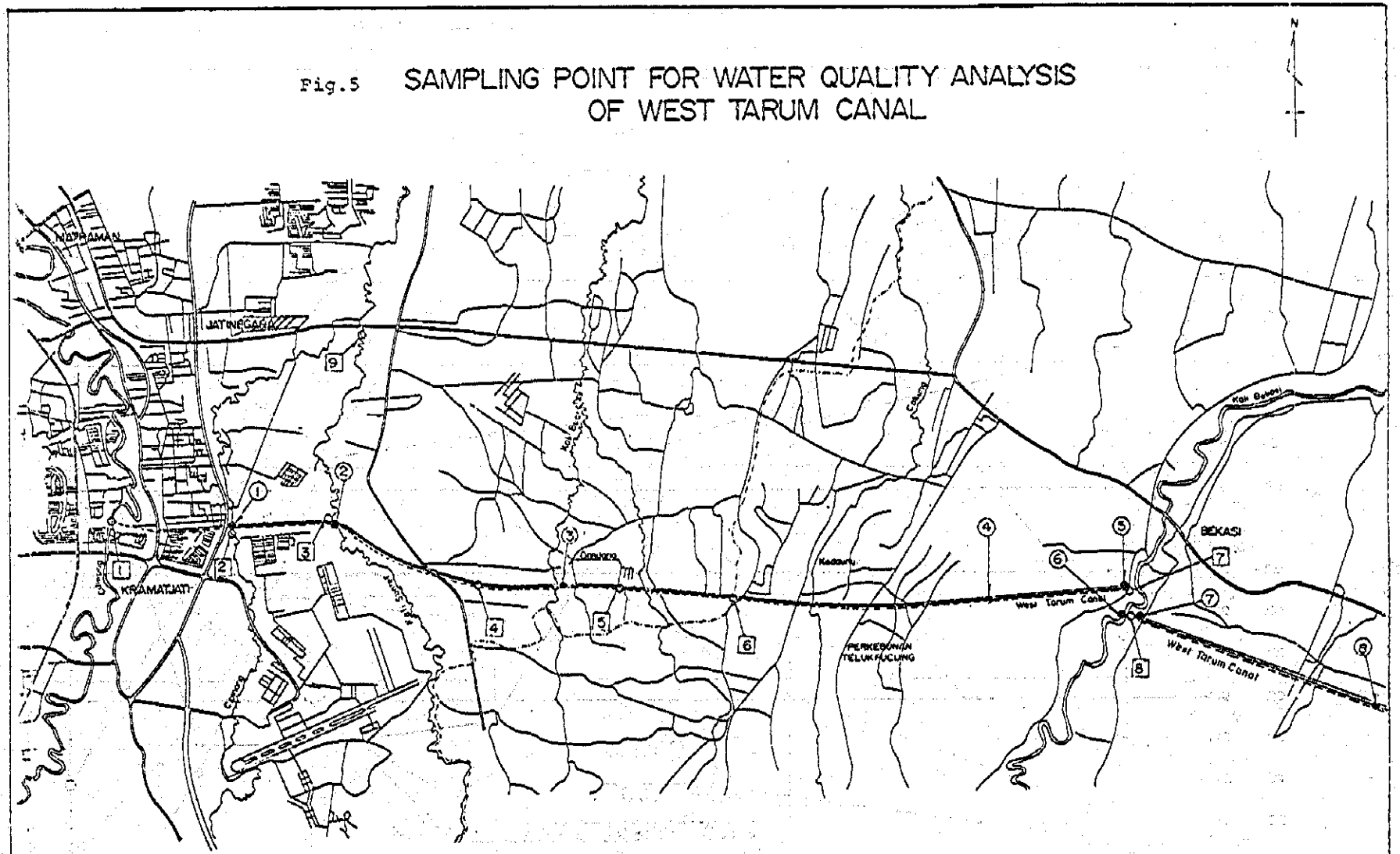


Fig.7 ALTERNATIVE I FOR IMMEDIATE PROJECT

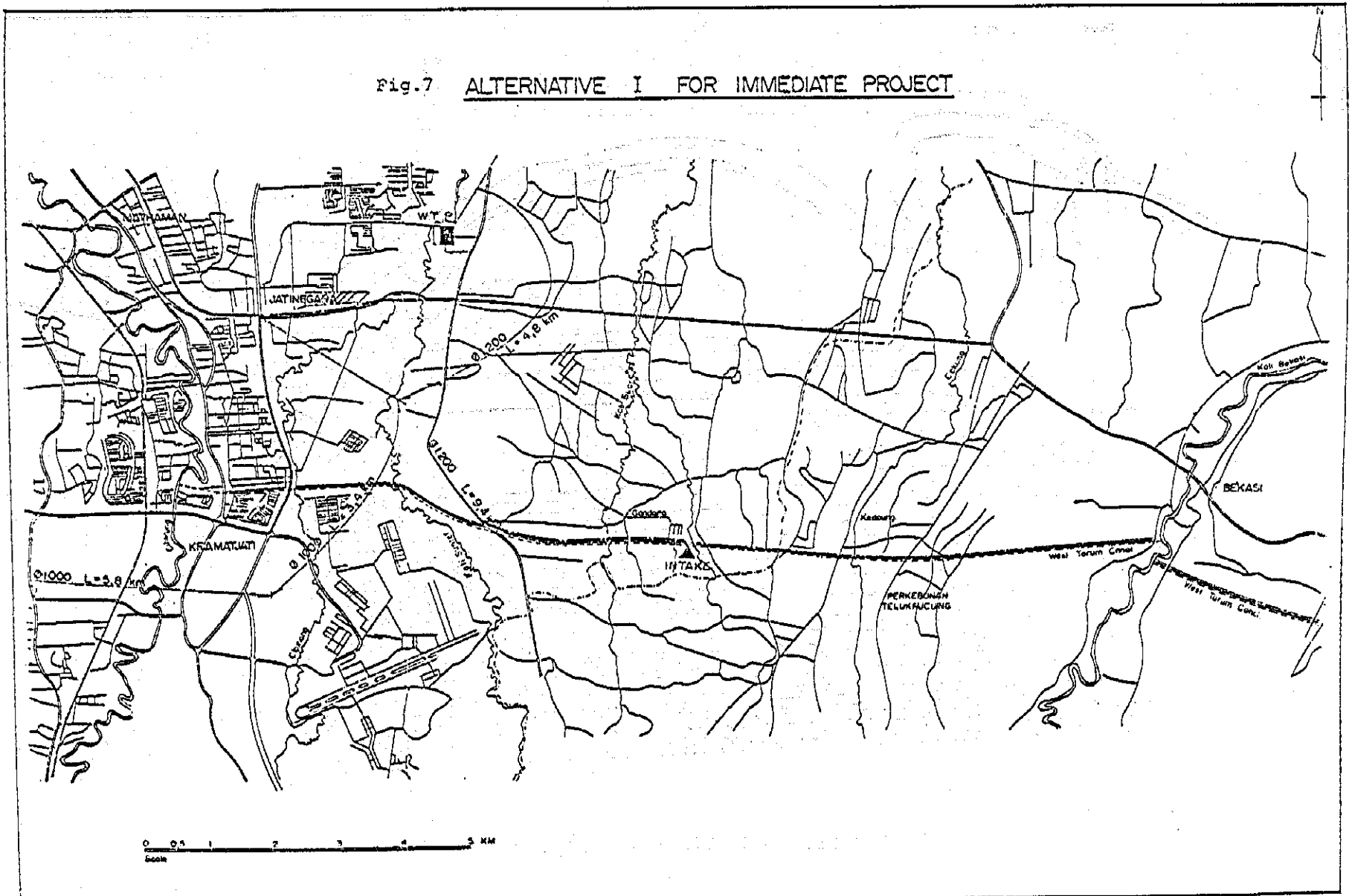


Fig 8 PLAN OF TREATMENT PLANT FOR ALTERNATIVE I

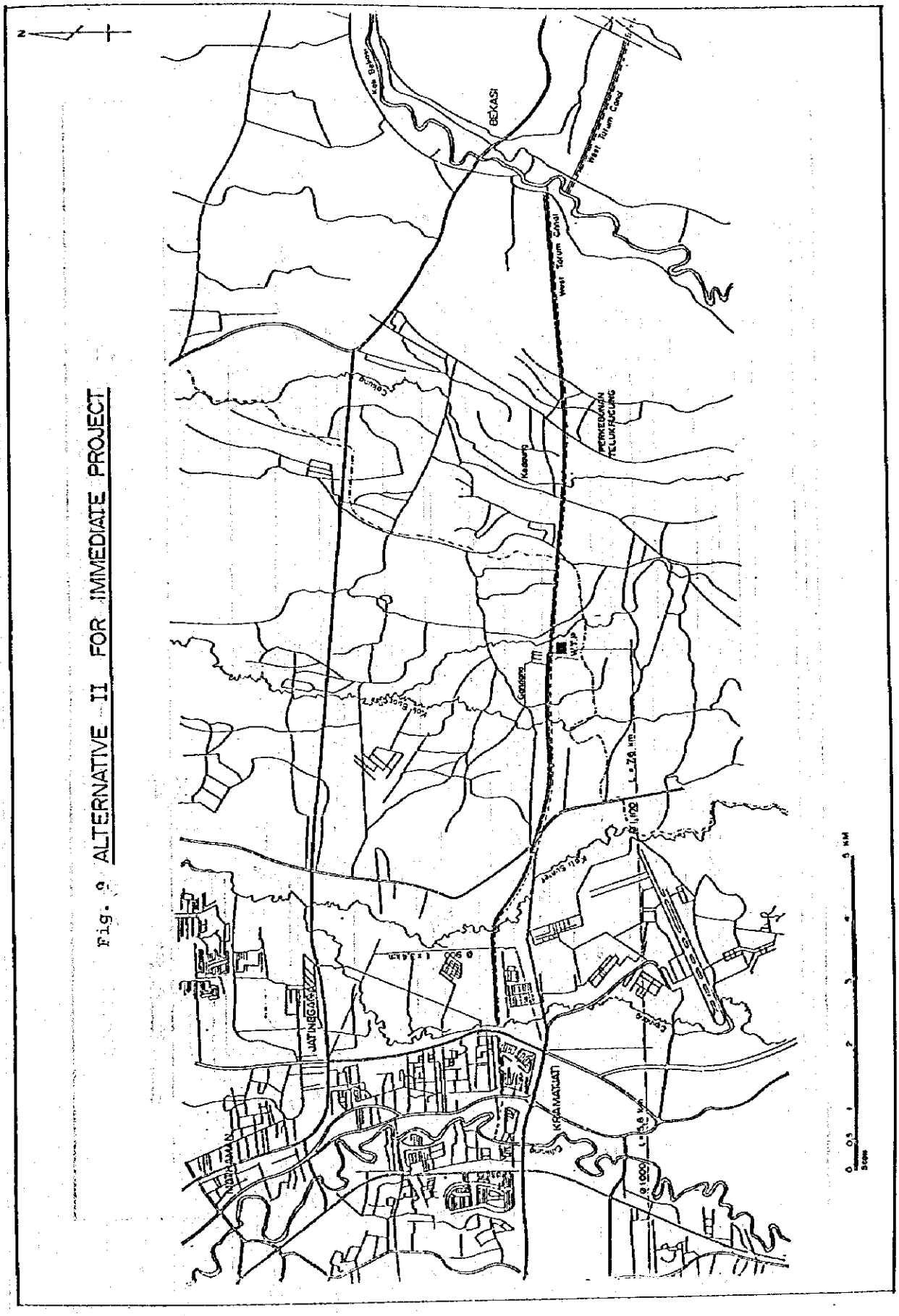


Fig. 9 ALTERNATIVE II FOR IMMEDIATE PROJECT

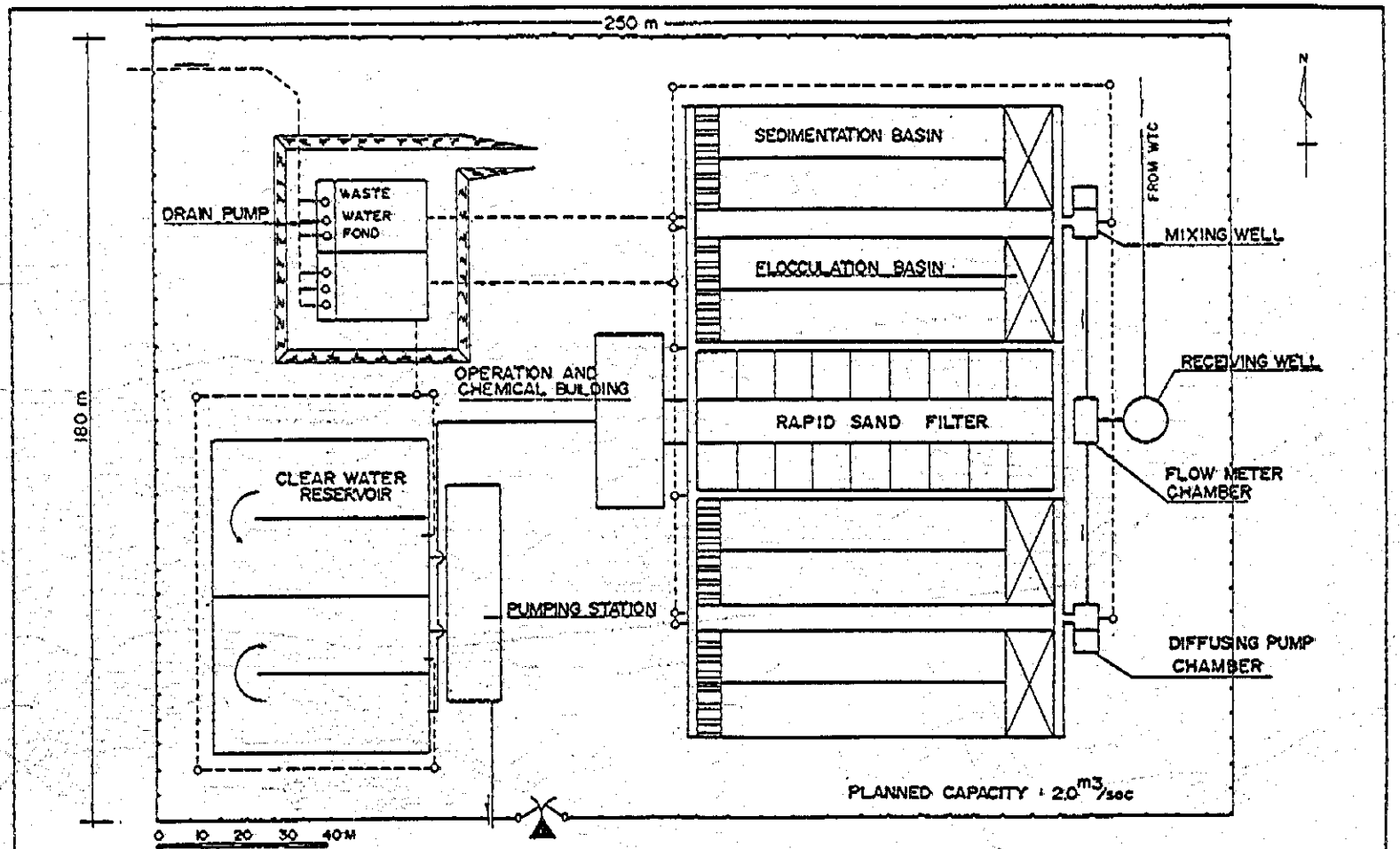


Fig.10 PLAN OF TREATMENT PLANT FOR ALTERNATIV II

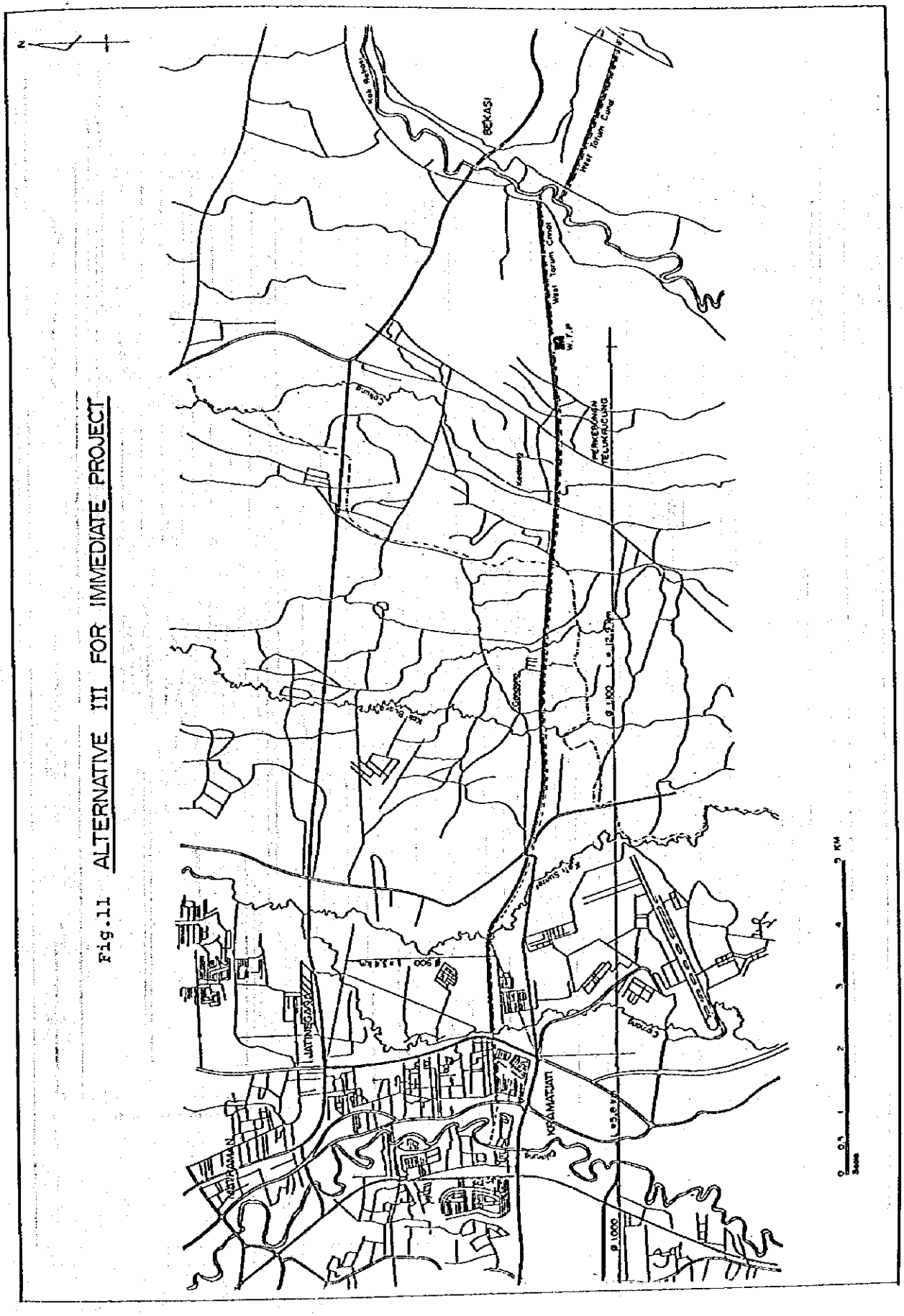


Fig.11 ALTERNATIVE III FOR IMMEDIATE PROJECT

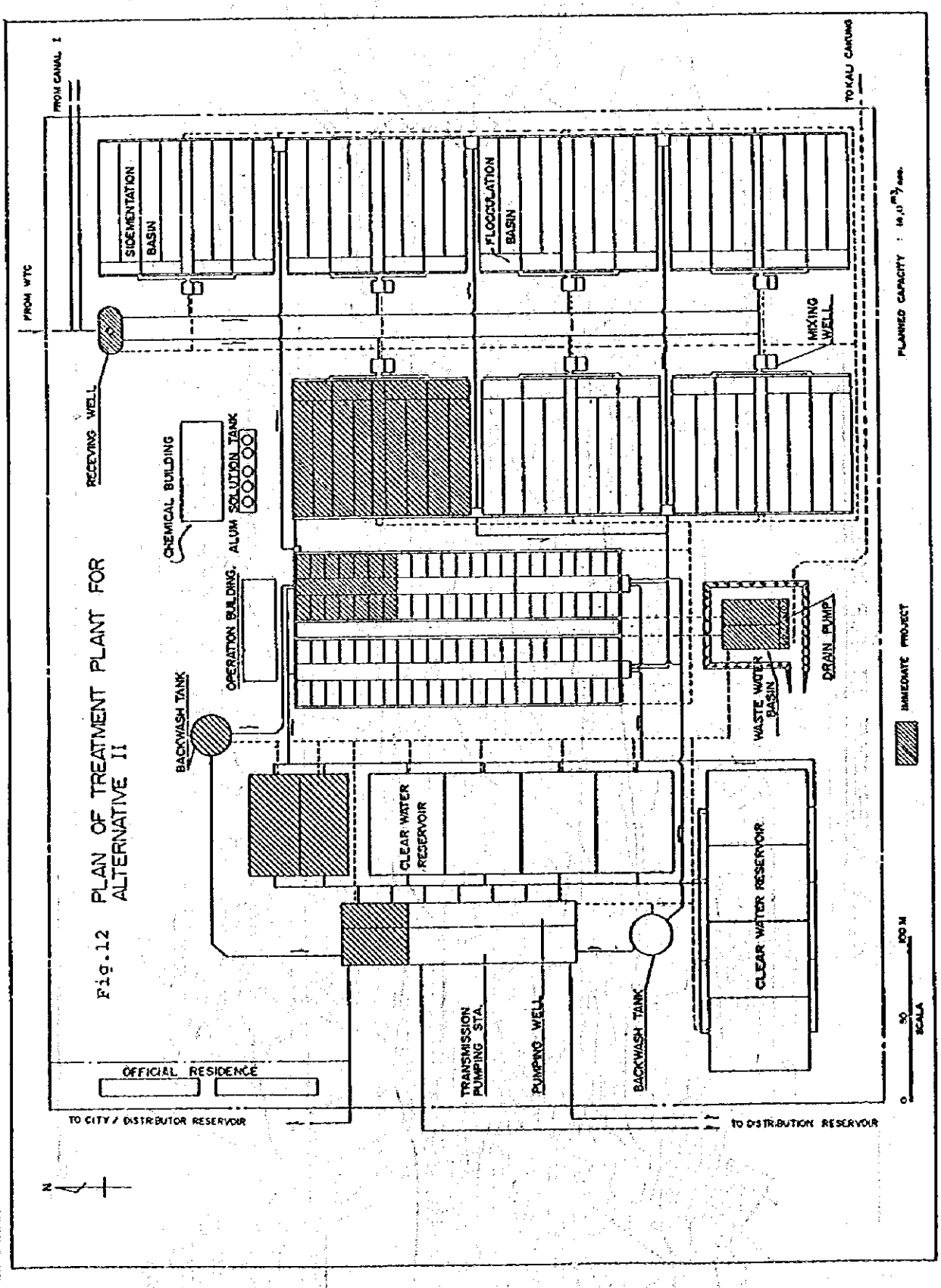


Fig.12 PLAN OF TREATMENT PLANT FOR ALTERNATIVE II

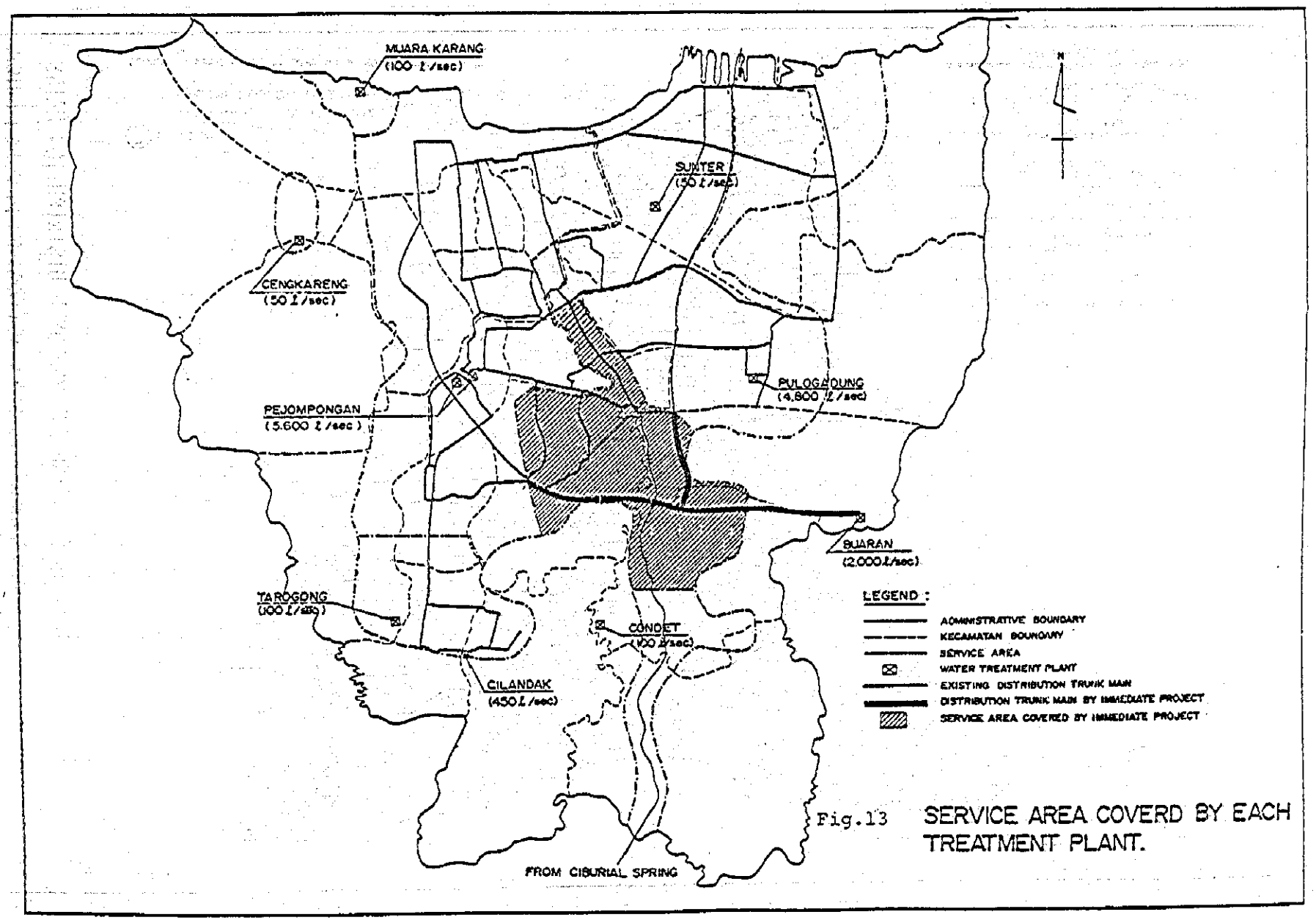


Fig.13 SERVICE AREA COVERD BY EACH TREATMENT PLANT.

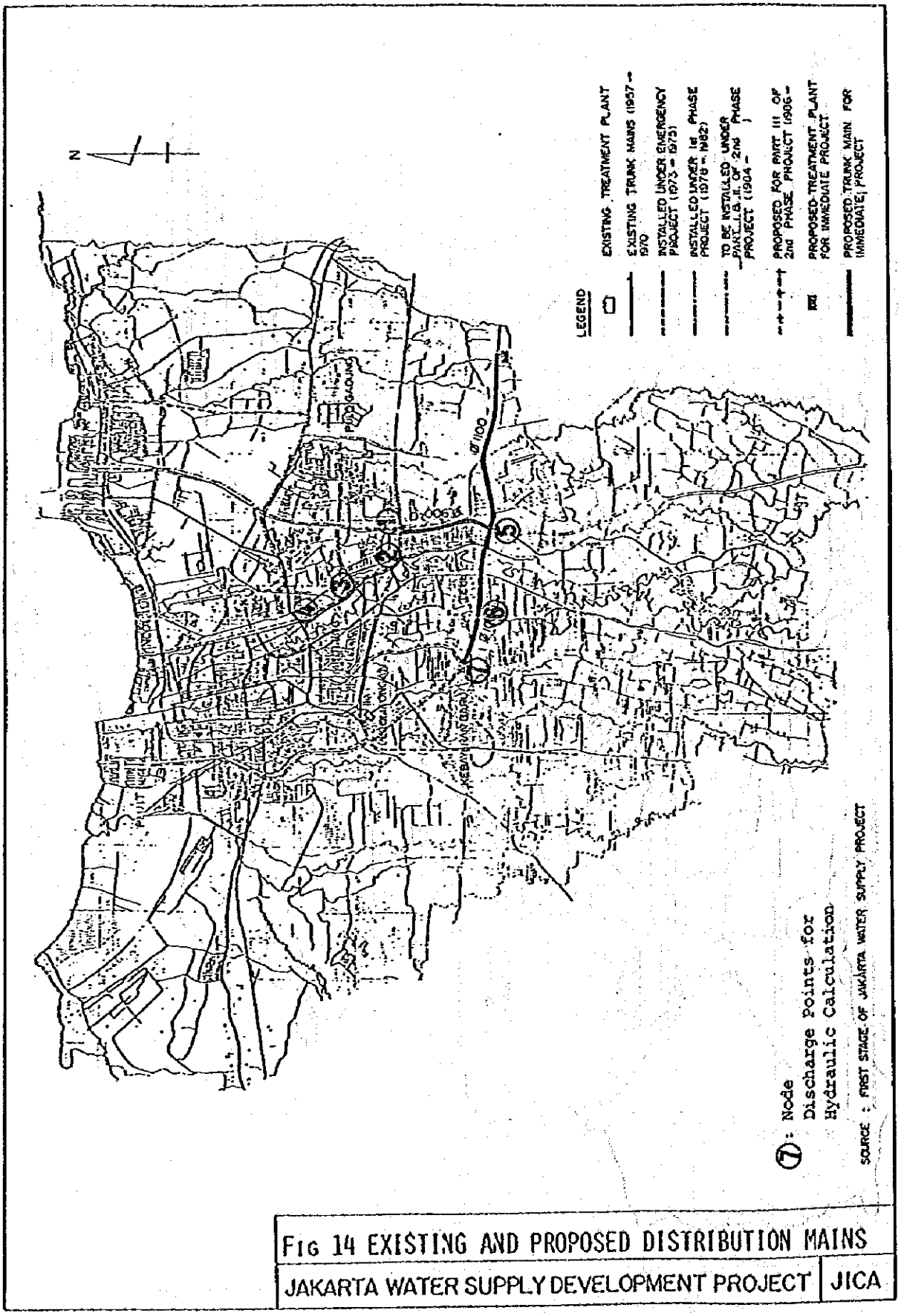


Fig 14 EXISTING AND PROPOSED DISTRIBUTION MAINS

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

FIG 4.13 GENERAL MAP OF PROPOSED TREATMENT PLANT

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

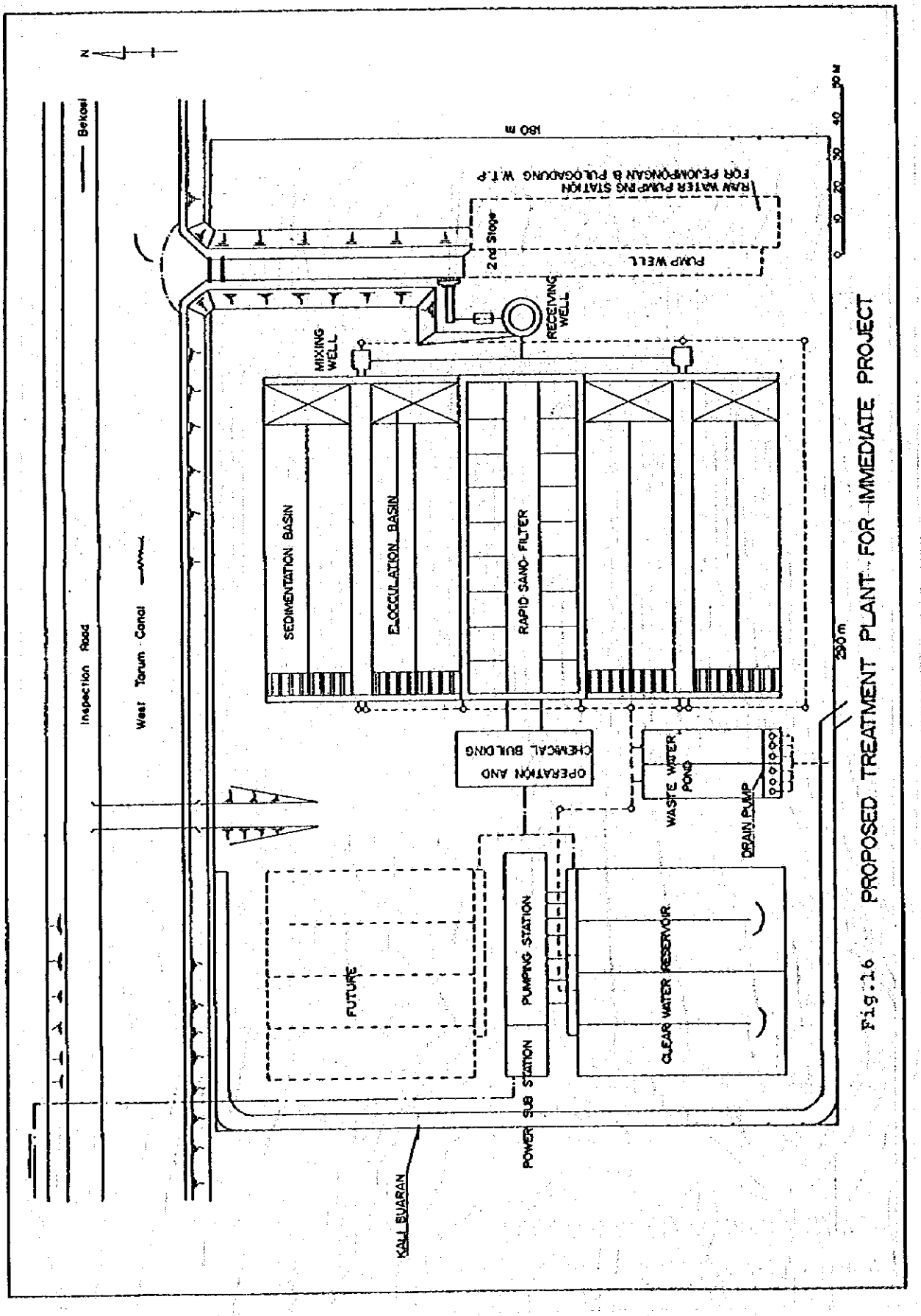


Fig.2.6 PROPOSED TREATMENT PLANT FOR IMMEDIATE PROJECT

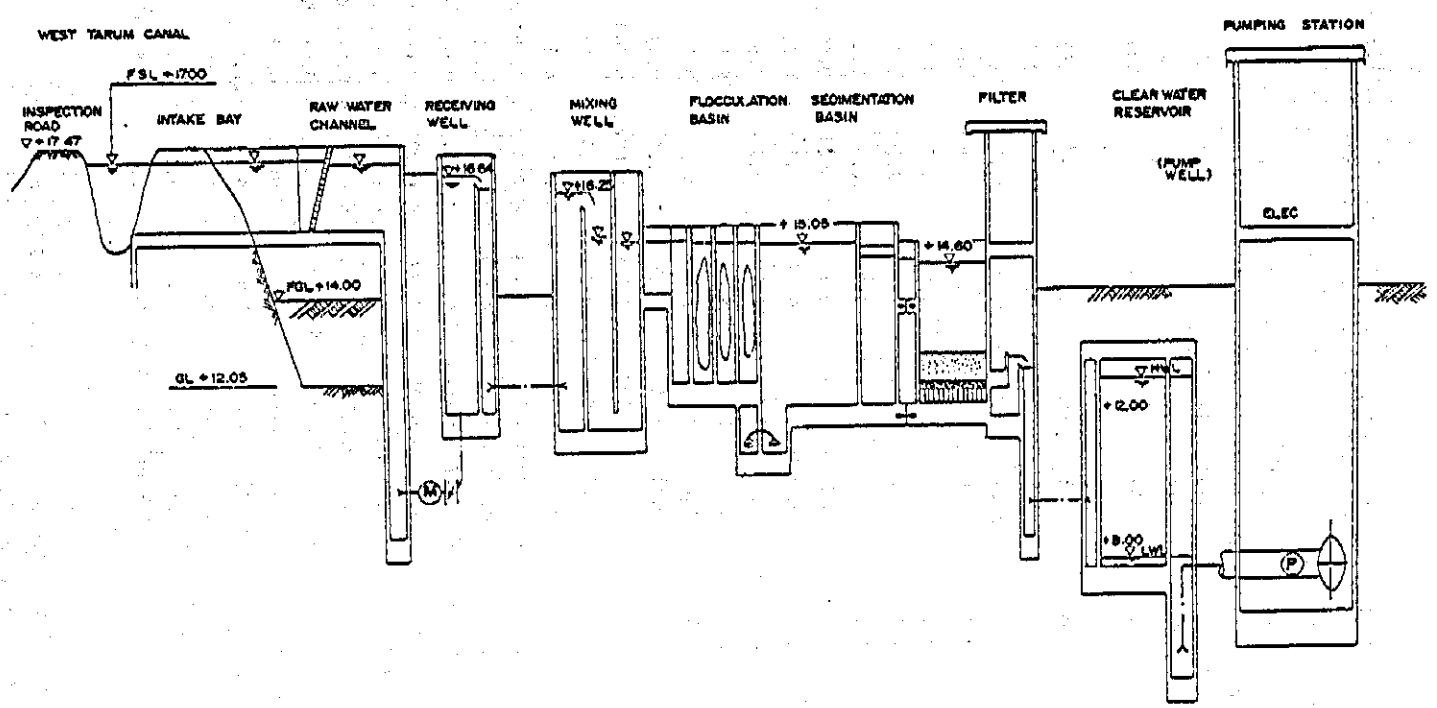


Fig.17 HYDRAULIC PROFILE OF TREATMENT PLANT

Table 2 Quality of Water in West Tarum Canal and in Sources

Water	Unit	Curug - Cibeet	Cibeet Cikarang	Cikarang Bekasi	Bekasi Jakarta	Jatiluhur Reservoir	Cibeet	Cikarang	Kali Bekasi
Temperatur	°C	30	30	30	30	30	29	29	29
Colour	Uinb PtCo	17	24	28	19	12	23	20	17
Turbidity	mg/l SiO_2	78	176	142	103	14	86	126	65
Dissolved Solids	mg/l	105	119	112	104	107	128	116	112
Suspended Solids	mg/l	118	459	326	160	26	285	188	94
Total Solids	mg/l	196	635	468	264	123	371	414	159
Conductivity	umho/cm	155	168	152	153	145	187	169	156
pH	mg/l	7.8	7.6	7.6	7.6	8.3	7.6	7.7	7.6
Calcium Ca	mg/l	16.0	19.7	20.3	19.9	16.1	21.6	21.1	19.4
Magnesium Mg	mg/l	5.5	5.5	4.6	3.6	4.6	5.6	5.3	4.6
Sodium Ng	mg/l	6.8	7.1	5.4	7.6	6.8	7.2	5.5	4.5
Potassium K	mg/l	2.4	2.4	1.9	4.4	2.3	2.3	1.7	1.8
Iron Fe	mg/l	1.1	2.5	1.7	1.3	0.3	1.4	1.5	0.9
Manganese Mn	mg/l	0.07	0.20	0.13	0.11	0.03	0.19	0.14	0.06
Amonium NH	mg/l	0.20	0.16	0.15	0.29	0.32	0.26	0.23	0.27
Bicarbonate HCo3	mg/l	72.2	79.7	77.8	72.9	73.6	87.9	85.1	71.3
Chloride Cl	mg/l	7.5	7.3	7.1	5.4	6.2	6.1	6.0	7.5
Sulphate SO_4	mg/l	8.3	11.8	8.1	8.7	5.3	10.8	8.0	9.5
Nitrate NO_3	mg/l	0.033	0.17	0.25	0.18	0.26	0.19	0.28	0.21
Nitrite NO_2	mg/l	0.004	0.004	0.002	0.008	0.002	0.003	0.004	0.006
Fluoride F	mg/l	0.06	0.04	0.01	0.012	0.04	0.02	0.016	0.07
Carbondioxide CO_2	mg/l	3.6	3.9	4.5	3.4	2.5	4.8	4.3	3.5
Arsenic As	mg/l	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Cadmium Cd	mg/l	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Chrom (VI) Cr	mg/l	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017	< 0.017
Copper Co	mg/l	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Mercury Hg	mg/l	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006	< 0.0006
Nickel Ni	mg/l	< 0.024	< 0.024	< 0.024	< 0.024	< 0.024	< 0.024	< 0.024	< 0.024
Lead Pb	mg/l	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Tine Zn	mg/l	0.13	0.12	0.10	0.14	0.08	0.09	0.09	0.05
Organic Matter	mg/l $KMnO_4$	8.2	12.8	11.9	11.5	4.7	11.4	9.4	8.3
BOD ($20^{\circ}C$-5d)	mg/l	1.1	1.2	1.6	1.6	0.8	1.6	1.4	1.2
Dissolved Oxygen	mg/l	6.4	6.5	6.9	6.1	7.5	6.7	6.9	6.9
Faecal Coli ($44.5^{\circ}C$)	MPN/100 ml	1.7×10^4	1.1×10^5	6.7×10^4	1.6×10^6	135	1.5×10^4	5.8×10^4	6.0×10^4

Source : " Study of Cibeet Irrigation Flood Control and Water Supply, Vol. 6 March 1983" by NEDECO

Table 3 Water Quality Analysis of West Tarum Canal Water

Analysed by Institute of Hydraulic Engineering (DPMA)

No.	PARAMETER	Unit	Result of Analysis 1		2		3		4		5		6		7		8		9	
			6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct 83	6 Oct 83	7 Oct
1.	Temperatur	°C	31	31	31	32	31	32	31.5	30	31	30	31.5	29	30	29	31	29	21	32
2.	Dissolved Oxygen	mg/l	6.2	6.2	6.4	7.2	6.7	7.2	6.9	7.1	6.8	6.4	6.6	6.3	5.9	5.7	6.8	6.8	6.0	6.0
3.	pH	-	7.5	7.8	7.6	8.0	8.0	8.2	7.95	7.7	8.0	7.7	7.8	7.6	7.5	7.8	7.8	8.0	8.1	7.9
4.	Conductivity	Umho/cm	190	199	190	305	186	195	188	200	189	197	190	198	191	198	185	199	173	182
5.	Turbidity	mg/l SiO2	24	24	26	24	23	21	21	24	21	21	23	20	23	23	20	20	21	21
6.	Colour	PtCo	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
7.	Organic matter KMnO4	mg/l KMnO4	10.2	21	11.4	16.7	7.4	9.3	7.6	8.7	9.7	8.2	7.5	8.6	7.8	6.6	8.3	7.8	8.3	9.1
8.	T.O.C	mg/l	4.2	5.8	4.6	5.3	3.3	4.1	4.6	4.2	4.1	5.1	4.2	4.5	5.8	5.7	4.2	6.3	4.7	4.1
9.	Amonia - N	mg/l	0.21	0.34	0.15	0.28	0.090	0.45	0.045	0.030	0.066	0.095	0.057	0.085	0.320	0.275	0.064	0.076	0.065	0.0
10.	Nitrate - N	mg/l	0.30	0.61	0.27	0.51	0.32	0.44	0.39	0.43	0.41	0.48	0.42	0.46	0.37	0.36	0.16	0.18	0.18	0.4
11.	Nitrite - N	mg/l	0.031	0.020	0.029	0.013	0.029	0.021	0.031	0.022	0.028	0.019	0.040	0.024	0.073	0.042	0.012	0.007	0.030	0.0
12.	E. Coli	MPN/100ml	$1.1x10^6$	$4.6x10^6$	$4.6x10^5$	$4.6x10^6$	$1.1x10^5$	$1.5x10^5$	$2.4x10^4$	$4.3x10^4$	$2.4x10^4$	$9.3x10^4$	$4.6x10^4$	$9.3x10^4$	$2.4x10^4$	$4.6x10^4$	$1.5x10^4$	$7.5x10^4$	$2.4x10^4$	9.3
13.	Total Coli	MPN/100ml	$1.1x10^6$	$4.6x10^5$	$4.6x10^6$	$4.6x10^6$	$1.1x10^5$	$1.5x10^5$	$2.4x10^4$	$4.3x10^4$	$2.4x10^4$	$9.3x10^4$	$4.6^{2}10^4$	$9.3x10^4$	$2.4x10^4$	$4.6x10^4$	$1.5x10^4$	$7.5x10^4$	$2.4x10^4$	9.3

Number location of sampling.

1. West Tarum Canal outlet to Citarum
2. West Tarum Canal inlet to Cipinang (BTB 53)
3. West Tarum Canal near Sunter river (BTB 51 a)
4. West Tarum Canal (BTB 49), middle of the Sunter and Buaran Rivers.
5. West Tarum Canal (BTB 48) , near the Buaran river
6. West Tarum Canal (BTB 47) , near DKI boundary
7. West Tarum Canal at silt trap
8. West Tarum Canal (BTB 45), out let to the Bekasi River
9. Sunter river at down stream

Source: Water Quality Survey by NEDECO Consultants

Table 6 Water Supply Facilities for Immediate Project

Items	Description
Max Daily Demand	2.0 m3/sec (Average daily demand)
Intake/ Treatment Flow Rate	2.14 m3/sec
A. Land Acquisition	
1. Intake/ Treatment Plant Site	290 m x 180 m = 52,200 m2 (including land for raw water pumping station on 2nd stage)
2. Distribution Mains Site	
B. Intake	
1. Intake bay	B_1 20.0 m x B_2 6.0 m x L 7.0 m x 1 Bay (for common use of the First Phase of Stage II)
2. Raw water channel	B 6.0 m x H 2.5 m x L 70 m x 1 channel (for common use with the First Phase of Stage II)
C. Treatment Plant	
1. Receiving well	ϕ 7.0 m x D 5.2 m V = 200 m3 1 well RT = 1.5 min with overflow weir
2. Mixing well	B 5.0 m x L 5.0 m x D 5.3 m V = 133 m3 2 well RT = 2.0 min with overflow weir
3. Flocculation Basin	L 24.1 x W 3.0 x D 3.0 m x 3 stage V = 660 m3 4 units RT = 20 min with mechanical flocculator
4. Sedimentation Basin	Horizontal flow type W = 24.5 m x L 70 m x D 3.5 V = 6,000 m3 4 units RT = 3 hrs mean velocity = 0.38 m/min with sludge scraper
5. Rapid Sand Filter	Conventional type Area of bed 91.2 m2 18 units (including 1 standby), flow rate = 5.0 m3/m2/hr surface wash pump 18.5 m3/min x 20 m x 90 kW x 2 sets
6. Clear water reservoirs	L 50 m x W 36 m x D 4.0 m V = 720 m3 2 units RT = 2 hrs
7. Clear water pump well	W 3.0 m x D 4.5 m with influent channel
8. Operation and Chemical Building	Office space for monitoring of treatment process, chemical feeders and chemical storage space and laboratory area = 1,280 m2. Back wash tank, reinforced concrete with a capacity of 757 m3. Backwash pump 18.9 m3/min x 17 m x 70 kW x 2 sets.
9. Waste water desposal facility	W 10.0 m x L 35.0 m x D 3.0 m V = 1,050 m3 2 units with drain pump 37 kW x 6 sets
10. Chemical feeding system	Alum, lime and chlorine
11. Power Substation	12 m x 15 m = 180 m2, 4500 kVA
D. Distribution	
1. Pumping Station	BF : Pump house I F = Electric equipment A = 1,200 m2
2. Distribution pump	60 m3/min x 54 m x 720 kw x 3 sets including 1 standby
3. Distribution main	DIP ϕ 1,100 L = 7,600 m DIP ϕ 1,000 L = 5,800 m DIP ϕ 900 L = 3,400 m

Table 7 Cost Estimate for Immediate Project

ITEMS	DESCRIPTION	F/C	L/C
A. Land Acquisition			
1) Treatment plant	4.5 ha for Immediate Project	-	270.0
B. Civil Works			
B-1 Intake Facilities			
1) Intake Bay 1/	W 20m x 6m x L7m	-	10.0
2) Intake channel 1/	B 6m x H 2,5m x L 70m	-	61.1
Sub-total			71.1
B-2 Treatment facilities			
1) Receiging well	ø 7m x 5.2m = 200m3	-	56.8
2) Mixing, flocculation and Sedimentation basins	Mixing well 133m3 x 2, Flocculation basin 660 m3 x 4, sedimentation basin 6,000 m3 x 4	-	1,815.6
3) Rapid sanf filter	93.2 m2 x 18 units	-	1,593.9
4) Clear water reservoir	50m x 36m x 4m x 2 units (14,400 m3)	-	892.8
5) Operation/chemical blidges	40m x 16m x 2 stories, backwash tank 757 m3	-	769.4
6) Wastewater pond	10m x 35m x 3.0 m x 2 units	-	188.5
7) Yard piping	ø1,200 x 160m, ø1,100 x 80m, ø1,000 x 20m, ø600 x 110m	-	71.9
Sub-total			5,388.9
B-3 Distribution facilities			
1) Distribution pump house	pump house 1,200 m3, power receiving house 180 m2	-	936.0
2) Distribution mains	ø1,100 x 7.6 km, ø1,000 x 5.8km, ø900 x 3.4km	-	2,119.4
Sub-total			3,055.4

Immediate Project

ITEMS	DESCRIPTION	F/C	L/C
C. Installation of Equipment			
1) Chemical feeders		-	24.0
2) Electric facilities		-	324.0
3) Transmission pumps		-	20.7
4) Backwash, surface wash pumps		-	3.8
Sub-total		-	372.5
D. Administration Cost			
1) Administration cost	10 % for total costs of (B+C)	-	889.1
E. Equipment and Materials			
1) Intake bay and channel	gates, coarse and fine screens	143	-
2) Receiving well	gates	17	-
3) Flocculation/sedimentation basins	flocculators, sludge scrapers, valves/pipes	801	-
4) Rapid sand filter	valves/pipes, surface water pump	1,618	-
5) Chemical-feeders	alum, polymer, lime and chlorine	458	-
6) clear water reservoir	valves and pipes	125	-
7) Yard pipes	pipes, gate for wastewater pond	271	-
8) Pumps,	Distribution pump, backwash pump, header pipe and drain pumps	546	-
9) Electrical equipment	power receiving, instrumentation etc.	1,682	-
10) Distribution Mains	ø1,100 x 7.6km, ø1,000 x 5.8km, ø 900 x 3.4 km	6,529	-
Sub-total		12,190	-
F. Engineering Cost			
1) Consultancy services	for detiled design and supervision service	1,341	622
Total (A to F)		13,531	10,669

Immediate Project

ITEMS	DESCRIPTION	F/C	L/C
G. Contingency			
1) Physical contingency	10 % for F/C and 12% for L/C for total costs of (B to F)	1,353	1,280
2) Price Contingency	7 % to 6 % for F/C and 11 % to 7 % for L/C of total costs of (A to G-1)	2,116	3,351
Sub-total		3,469	4,631
Total costs		17,000	15,300

Total Project Costs Equivalent to Rupiah Rp. 32,130 million

Conversion rate : US$ 1.0 = Rp. 990 = Y 230 (as of November, 1983)

Note : F/C, Foreign exchange to be paid in foreign currency for imported materials and equipment (CIF), and foreign currency portion for expatriate service fees

L/C, Local currency to be paid in local currency for land acquisition, local labors and materials for civil works and materials locally manufactured

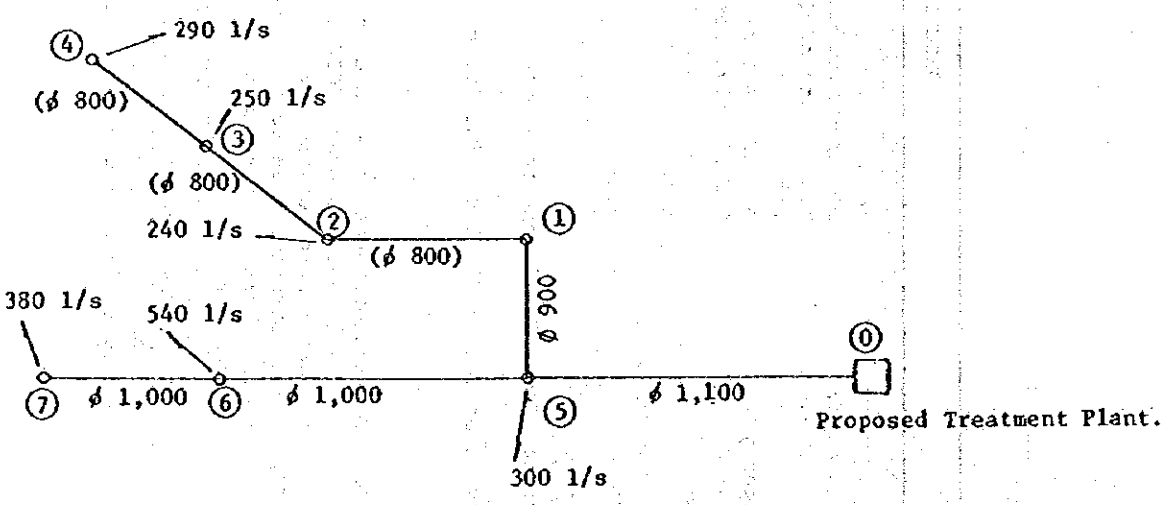
1/ Facilities are constructed as conjoint structure with the raw water intake facilities for the existing Pejompongan Plant, and cost is amounted as allocation cost by ratio of raw water flow rate.

Table 8

Hydraulic Calculation of Distribution Main

i - j	Q	D	IL	I	hf	hf--	Hw	GH	Heff	Remarks
	1/sec	mm	km	o/oo	m	m	+ m	+ m	m	
0							+ 59.2			Treatmen plant
0 - 5	2,000	ϕ 1,100	7.6	2.97	22.6	22.6	+ 36.6			C = 130
5 - 6	920	ϕ 1,000	3.9	1.30	5.1	27.7	+ 31.5	+ 15.5	16.0	
6 - 7	380	ϕ 1,000	1.9	0.25	0.5	28.2	+ 31.0			
5 - 1	780	ϕ 900	3.4	1.60	5.4	28.0	+ 31.2			
1 - 2	780	(ϕ 800)	1.5	2.84	4.3	32.3	+ 26.9			Existing pipe
2 - 3	540	(ϕ 800)	3.8	1.44	5.5	37.8	+ 21.4			do
3 - 4	290	(ϕ 800)	3.6	0.46	1.5	39.3	+ 19.9	+ 3.0	16.9	do

Hazen-Williams Formula Velocity Coefficient C = 1



Note: ( ) shows the existing main.
Refer to Fig.14 on the location of discharge points.

Table 9 shows distribution quantities in sevice area to be supplied by each treatment plant.

Table 9 Water Demand Distribution and Supplied Quantity in 1988

Supply Zone	Kecamatan		Water Demand Day Ave. l/s	Water Demand Day Max. l/s	Supplied * Quantity l/s	Remarks
Pejompongan						
	I - 1		630	730	600	consists of Pejompongan Plant I and II, Muarakarang, Cenkareng, Cilandak and Tarogong.
	2	(80%)	460	530	450	
	6		440	500	420	
	7		690	790	660	
	II - 2		650	750	620	total capacity:
	III - 1		60	70	50	Pejompongan 5,600 l/s
	2		890	1,020	850	Muarakarang 100
	3		450	520	430	Cenkareng 50
	4		480	550	460	Cilandak 450
	5		20	20	20	Tarogong 100
	IV - 2	(30%)	120	140	110	6,300 l/s
	3	(60%)	200	230	190	
	4		100	110	100	
	5		630	720	600	
	6		500	580	480	
	7		240	280	230	
	Total		6,560	7,540	6,270	
Pulogadung						
	I - 2	(20%)	120	130	100	consists of Pulogadung, and Sunter
	3		550	620	520	
	4	(35%)	180	210	170	total capacity:
	5		540	620	520	Pulogadung 4,800 l/s
	II - 3		1,080	1,240	1,040	Sunter 50
	4		500	570	480	4,850 l/s
	5		300	350	290	(Pulogadung Plant will be operated at 20 % increased rate)
	V - 1	(70%)	320	370	300	
	2		860	990	830	
	3	(40%)	250	280	240	
	6		340	390	330	
	Total		5,040	5,770	4,830	
Buarang						
	I - 4	(65%)	330	380	320	consists of Buarang, Condet and Ciburial Spring.
	IV - 1		560	640	540	
	2	(70%)	280	320	270	
	3	(40%)	130	150	130	total capacity:
	V - 1	(30%)	130	150	130	Buarang 2,000 l/s
	3	(60%)	360	420	350	Condet 100
	4		480	550	460	Spring 200
	5		150	170	140	2,300 l/s
	Total		2,270	2,610	2,340	

Note: * Proposed capacity to be supplied by each treatment plant

ATTACHMENTS

Attachment 1. Cost Estimates for Alternatives I to III

Table 5-a Cost Estimate of Each Alternative For Immediate Project
(Alternative - I)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
Intake Facilities			
1) Intake Bay	Q = 2,200 l/sec	83 1/	10.0
2) Intake Pipe	ø1,200 x 2 lines x 50 m	43	11.0
3) Raw Water Pump	ø 700 x 300 KW x 3 sets	306	9.0 4/
4) Pump Well/House	Well 24m x 8m x 3m = 576 m3 House 24m x 12m = 288 m2	15 1/	276.5
5) Electric Fac Facilities	Total 900 KW	403	449.0
Sub-total		850	755.5
Raw Water Transmission Mains			
6) Raw water main	ø 1,200 x 9.4 km DIP	4,794	1,252.0
sub-total		4,794	1,252.0
Treatment Facilities			
7) Receiving Well	V = 130 m3	17 1/	36.9
8) Mixing Well/ Flocculation & Sedimentation Basins	V = 24,100 m3	723 2/	1,638.8
9) Rapid Sand Filters	A = 1,440 m2 Backwash pump 185 KW x 3	1,485 3/	1,370.7
10) Chemical Feeders	Q = 2,200 l/sec	202	10.7 4/
11) Electric Facilities	Q = 2,200 l/sec	556	238.4 5/

(Alternative - I)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
12) Clear Water Reservoir	V = 14,400 m3	125 1/	892.8
13) Yard Piping Plant	ø 1,200 x 750m	319	99.9
14) Chemical Building	30m x 15m x 2stories = 900 m2	-	315.0
Sub-total		3,427	4,603.2
Distribution Facilities			
15) Distribution Pumps	ø700 x 710kW x3sets	426	63.9 4/
16) Operation Building	60m x18m x2stories = 2,160 m2 including header-pipe	58	1,684.8
17) Distribution Mains	ø1,200x4.8km, ø1,100x3.4km ø1,000x5.8km including pipe bridges & road crossings	6,081	1,872.0
Sub-total		6,565	3.621.1
Administration Cost			
18) Administratio Cost	10 % for 1) to 17)	-	1,023.2
Sub-total		-	1,023.2
Land Acquisition Cost			
19) Land Cost	4 ha @ Rp 40,000/m2	-	1,600.0
Sub-total		-	1,600.0
Total of Construction Cost		15,636	12,855.0
Engineering Cost			
20) Engineering Cost for Design Engineering & Supervision Services	8% for F/C 5 % for L/c	1,251	643.0
Sub-total		1,251	643.0

(Alternative - I)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
Contingency			
21) Physical Contingency	10 % for total costs from 1) to 20)	1,689	1,350.0
22) Price Contingency	5 % per annum for F/C 10 % per annum for L/C	2,424	4,452,0
Sub-total		4,113	5,802.0
Total Project Costs		21,000	19,300.0

Note: 1/ includes gates/valves
2/ includes flocculator, sludge scrapers, drain valves and pipes
3/ includes pipes and valves in gallery and backwash pumps
4/ includes installation of equipment
5/ includes installation of equipments and power receiving cost to be paid to PLN

Table 5-b Cost Estimate of Each Alternative For Immediate Project
(Alternative - II)

Items	Description	F/C	L/C	
		US$ 1,000	Rp. million	
Intake Facilities				
1) Intake Bay	Q = 2,200 l/sec	83 1/	10.0	
2) Intake Channel	2.0m x 90m x 1.7m	60 6/	61.3	
3) Raw Water Pump	-	-	-	
4) Pump Well/House	-	-	-	
5) Electric Facilities	-	-	-	
Sub-total		143		71.3
Raw Water Transmission Mains				
6) Raw Water Main		-	-	
Sub-total		-	-	
Treatment Facilities				
7) Receiving Well	V - 200 m3	17 1/	56.8	
8) Mixing Well/ Flocculation & Sedimentation Basin	V = 26,400	801 2/	1,815.6	
9) Rapid Sand Filters	A = 1,680 m2 surface wash pump /400 x 90kW x 2sets	1,618 3/	1,595.7	
10) Chemical Feeders	Q = 2,200 l/sec	458	24.0 4/	
11) Electric Facilities	Q = 2,200 l/sec	1,682	324.0 5/	

(Alternative - II)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
12) clear Water Reservoir	V = 14,400 m3	125 1/	892.8
13) Backwash Tank	V = 760 m3	86	
	Pumps ø400 x 65 KW x 3 sets	154	141.4
14) Yard Piping in Plant	ø1,200x160m, ø1,100x80m	137	
	ø1,000x20m, ø600x110m	137	71.9
15) Wastewater Basin	V = 2,070m3, Drain pumps and pipes/gates	137	188.5
16) Operation Building	A=40m x 15m x 3stories = 1,800 m2	-	630.0
Sub-total		5,058	5,740.7
Distribution Facilities			
17) Distribution Pumps	ø700 x 690 KW x 3sets	414	20.7 4/
18) Pump house	40m x 15m x 2stroesi = 1,200m2, including header pipe	46	936.0
19) Distribution Mains	ø1,100x7.6km, ø1,000x5.8km ø900x3.4km including pipe bridges & road crossings	6,529	2,119.4
Sub-total		6,989	3,076.1
Administration Cost			
20) Administration Cost	10% of 1) to 19)	-	889.1
Sub-total		-	889.1
Land Acquisition Cost			
21) Land Cost	4.5 ha @Rp.6,000/m2	-	270.0
Sub-total		-	270.0
Total of Construction Cost		12,190	10,047.0

(Alternative - II)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
Engineering Cost			
22) Engineering Cost for Design Engineering & Supervision Services	11 % for F/C 7 % for L/C	1,341	622.0
Sub-total		1,341	622.0
Contingency			
23) Physical Contingency	10 % for total costs from 1) to 22)	1,353	1,067.0
24) Price Contingency	5 % per annum for F/C 10 % per annum for L/C	2,116	3,564.0
Sub-total		3,469	4,641.0
Total Project Costs		17,000	15,300

Note:
1/ includes gates/va;ves
2/ includes flocculators, sludge scrapers, and drain valves/pipes
3/ includes pipes and valves in gallery and surface wash pumps
4/ includes installation of equipment
5/ includes installation of equipment and power receiving cost to be paid to PLN
6/ includes fine screen and gates

Table 5-c Cost Estimate of Each Alternative for Immediate Project
(Alternative - III)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
Intake Facilities			
1) Intake Bay	Q = 2,200 l/sec	83 1/	10.0
2) Intake Pipe	ø1,200 x 2 lines x 50m	43	11.0
3) Raw Water Pump	ø800 x 75kW x 3sets	94	2.3 4/
4) Pump Well	15m x 11m x 4m = 660 m2	15 1/	59.4
5) Electric Facilities		-	-
Sub-total		43	11.1
Raw Water Transmission Mains			
6) Raw Water Main	ø 1,200 x 10 m	43	11.1
Sub-total		43	11.1
Treatment Facilities			
7) Receiving Well	V = 1,400 m3	150 1/	397,6
8) Mixing Well/ Flocculation & Sedimentation Basins	V = 26,400 m3	801 2/	1,815,6
9) Rapid Sand Filters	A = 1,717 m2 surface wash pump ø 400 x 125 kW x 2 sets	1,733 3/	1,632.2
10) Chemical Feeders	Q = 2,200 l/sec	458	24.0 4/
11) Electric Facilities	Q = 2,000 l/sec	1,682	324.0 5/

(Alternative - III)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
12) Clear Water Reservoir	V = 14,400 m3	125 1/	892.8
13) Backwash Tank	V = 1,320 m3	109	240.6
	pumps ø600x150kWx2sets	404	123.6
14) Yard Piping in Plant	ø2,000x160m, ø1,500x140m, ø1,200x100m, ø1,000x170m ø800x200m		
15) Operation Building	100mx20m = 2,000m2	-	350.0
16) Wastewater Basin	V = 3,600 m3, Drain pumps and pipes gates	165	348.1
Sub-total		5,627	6,149.5
Distribution Facilities			
17) Distribution Pumps	ø700 x 920 kW x 3 sets	938	27.6 4/
18) Pump House	40m x 15 m x 2 stories = 1,200 m2, including header-pipe	39	1,056.0
19) Distribution Mains	ø1,100 x 12.9km, ø1,000 x 5.8km ø900 x 3.4km, including Pipe bridges & road crossings	8,531	2,827.7
Sub-total		9,508	3,911.3
Administration Cost			
20) Administration Cost	10% of 1) to 19)	-	1,015.4
Sub-total		-	1,015.4
Local Acquisition Cost			
Land Cost	10ha @ Rp3,000	-	300.0
Sub-total		-	300.0
Total of Construction Cost		15,143	11,470.0

(Alternative - III)

Items	Description	F/C	L/C
		US$ 1,000	Rp. million
Engineering Cost			
20) Engineering Cost for Design Engineering & Supervision Services	9 % of for F/C 6 % for L/C	1,387	688.0
Sub-total		1,387	688.0
Contingency			
21) Physical Contingency	10% for total costs from 1) to 20)	1,680	1,216.0
22) Price Contingency	5 % per annum for F/C 10 % per annum for L/C	2,520	4,026.0
Sub-total		4,200	5,242.0
Total Project Costs		21,000	17,400

Note :
1/ includes gates/valves
2/ includes flocculators, sludge scrapers, drain valves and pipes
3/ includes pipes and valves in gallery and surface wash pump
4/ includes installation of equipment
5/ includes installation of equipment and power receiving cost to be paid to PLN

Attachment 2.

Operation Cost Estimates for each Alternative

1. Personnel Cost

a. Alternative I

Composition of the staff in the plant is as follows :

Four shifts of staff for control room, handling chemicals, inspection of machinary and patrol	4 x 8
Miscellaneous worker	2
Total	34

Annual personnel cost : 34 @ Rp. 109,000/month x 12 months
= Rp. 44,472,000

b. Alternative II and III

Composition of staff in the new treatment plant is as follows:

Chief of the Plant	1
Chief of electrical facilities	1
Chief of mechanical facilities	1
Administration	3
Laboratory	3
Four shifts of staff for control room, handling chemicals, inspection of machinary and patrol	4 x 8
Miscellaneous worker	5
Total	46

Annual personnel cost : 46 @ Rp. 109,000/month x 12 months
= Rp. 60,168,000

2. Power and Fuel Costs

a. Alternative I

raw water pump	300 kW x 2 x 24h x 365 =	5,256,000 kWH
Flocculator	22 kW x 2 x 24h x 365 =	385,440 kWH
Distribution pump	710 kW x 2 x 24h x 365 =	12,439,200 kWH
Backwash pump	185 kWHx2x10/60x10x365 =	225,083 KWH
Other miscellaneous powers (2 % of total powers)	=	366,114 kWH
		18,671,837 kWH

Fuel : Power costs x 1 %
Power costs : 18,672,000 kWH x Rp. 26.5/kWH x (1 + 0.01)
= Rp. 499,756,000

b. Alternative II

Flocculator	42 kW x 24h x 365	=	367,920 kWH
Surface wash pump	90 kW x 10/60 x 9 x 365	=	49,275 kWH
Bachwash pump	65 kW x 40/60 x 9 x 365	=	142,350 kWH
Distribution pump	690 kW x 2 x 24h x 365	=	12,088,800 kWH
Other miscellaneous power (2% of total powers)		=	252,967 kWH
Total		=	12,901,312 kWH

Power cost : 12,901,000 kWH x Rp. 26.5 kWH x (1 + 0.01)
= Rp. 345,295,000

c. Alternative II

Raw water pump	75 kW x 2 x 24h x 365	=	1,314,000
Flocculator	42 kWH x 24h x 365	=	367,920
Surface wash pump	125 kW x 10/60 x 7 x 365	=	53,229
Backwash pump	150 kW x 40/60 x 7 x 365	=	225,500
Distribution pump	920 kW x 2 x 24h x 365	=	16,118,400
Other miscellaneous power (2% of total powers)		=	365,181
Total			18,471,230

Power costs : 18,471,000 kWH x Rp. 26.5/kWH (1 + 0.01)
= Rp. 494,276,000

3. Chemical Costs for Alternative I to III

Prechlorine, intermediate chlorine and postchlorine :
average 7.5 ppm x 0.19 t/ppm x 365 x @ Rp. 1,115,000 = 579,939,000

Alum : aver. 30 ppm x 0.19 x 365 x @ Rp. 162,000 = 337,041,000

Polymer: aver. 0.03 ppm x 0.19 x 365 x @ Rp. 882,000 = 1,835,000

Postlime : aver. 18 ppm x 0.19 x 365 x @ Rp. 4,100 = 51,180,000

Total Chemical costs Rp.969,995,000

4. Maintenance Cost

a. Alternative I
US$ 1,795 x 10,000 x 3 % @ Rp. 980 Rp. 52,800,000

b. Alternative II
US$ 1,759 x 10,000 x 3 % @ Rp. 980 Rp. 51,700,000

c. Alternative III
US$ 2,400 x 10,000 x 3 % @ Rp. 980 Rp. 70,600,000

5. Summary of Operation Costs

Unit : Rp. 1,000

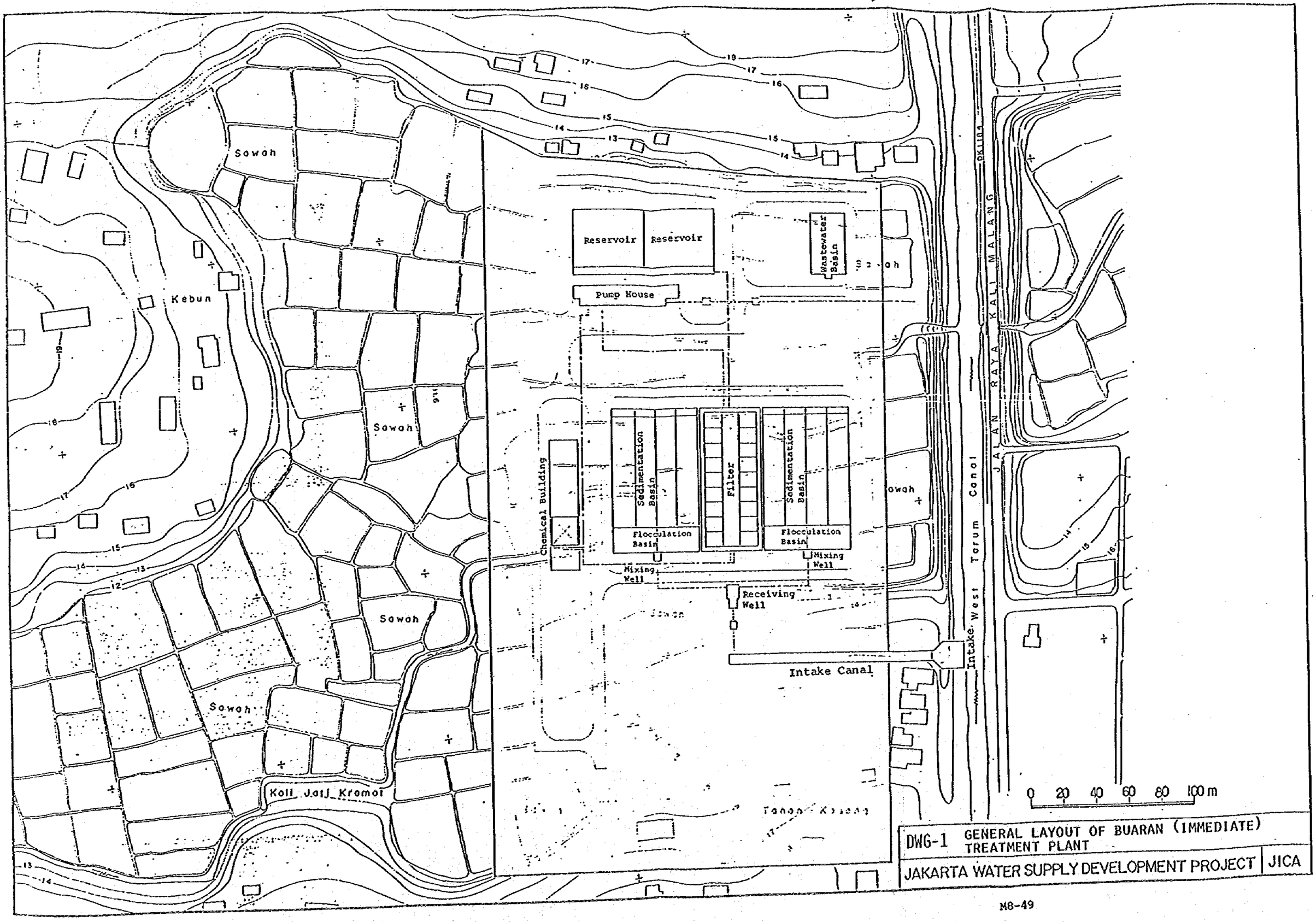
	Alternative I	Alternative II	Alternative III
1. Personnel costs	44,472	60,168	60,168 *
2. Power cost	499,756	345,295	494,376
3. Chemical cost	969,995	969,995	969,995
4. Maintenance cost	52,800	51,700	70,600
Total	1,567,023	1,427,158	1,595,139

Note : * Personnel will be joined with the new treatment plant for Second Stage Extension.

ATTACHMENT

(DRAWINGS)

DWG- 1	General Layout of Buaran (Immediate) Treatment Plant
DWG- 2	Intake Weir & Bay
DWG- 3	Floccuration & Sedimentation Basin
DWG- 4	Filter
DWG- 5	Clear Water Reservoir
DWG- 6	Pump House
DWG- 7	Alum Tank & Feed Pump
DWG- 8	Chemical Building
DWG- 9	Polymer Feeding System
DWG-10	Alum Feeding System
DWG-11	Lime Feeding System
DWG-12	Chlorination System
DWG-13	Neutralization Diagram
DWG-14	Single Line Diagram-1
DWG-15	Single Line Diagram-2
DWG-16	Single Line Diagram-3
DWG-17	Single Line Diagram-4
DWG-18	Instrumentation Diagram-1
DWG-19	Instrumentation Diagram-2



DWG-1 GENERAL LAYOUT OF BUARAN (IMMEDIATE) TREATMENT PLANT

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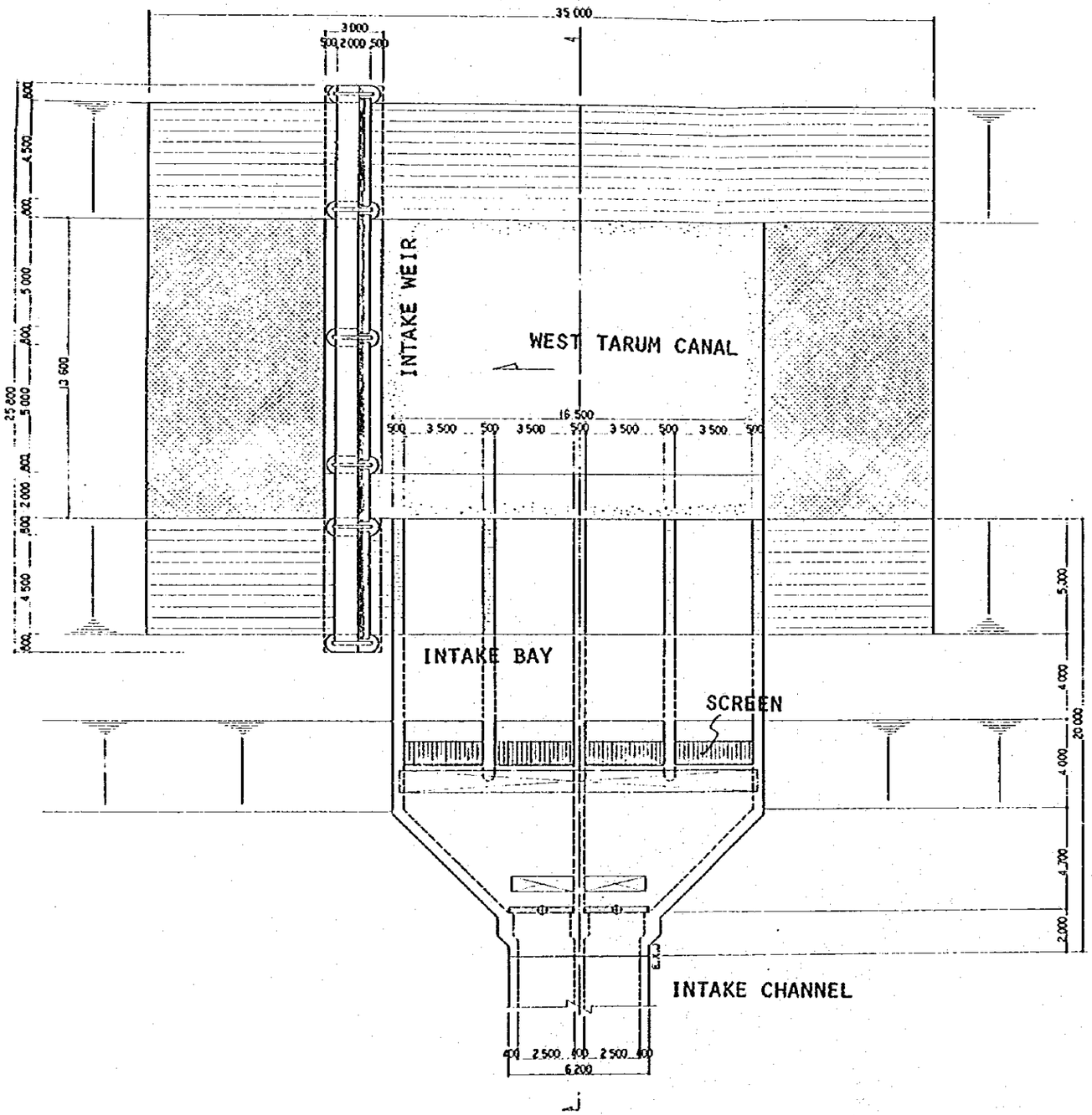
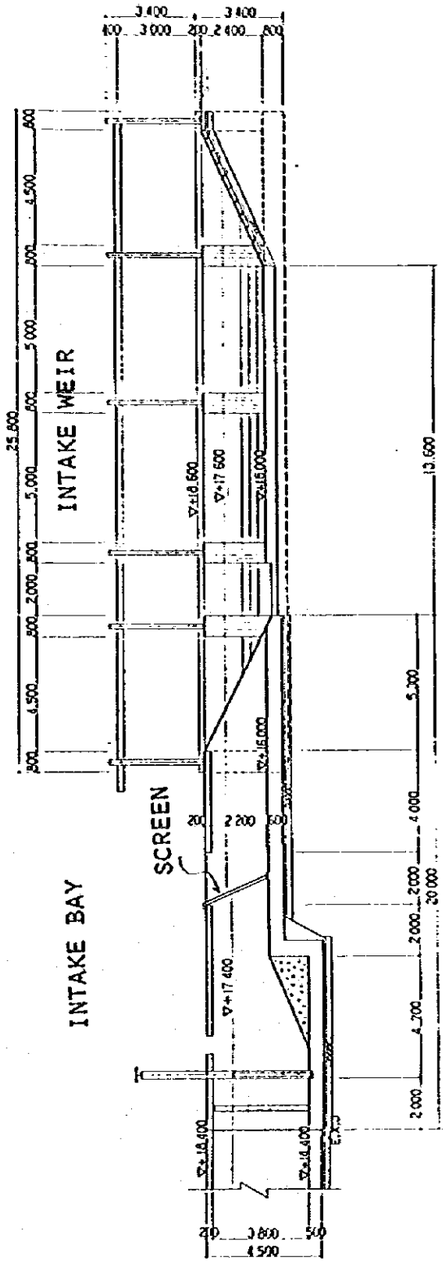


PLAN



SECTION

DWG-2 INTAKE WEIR AND BAY

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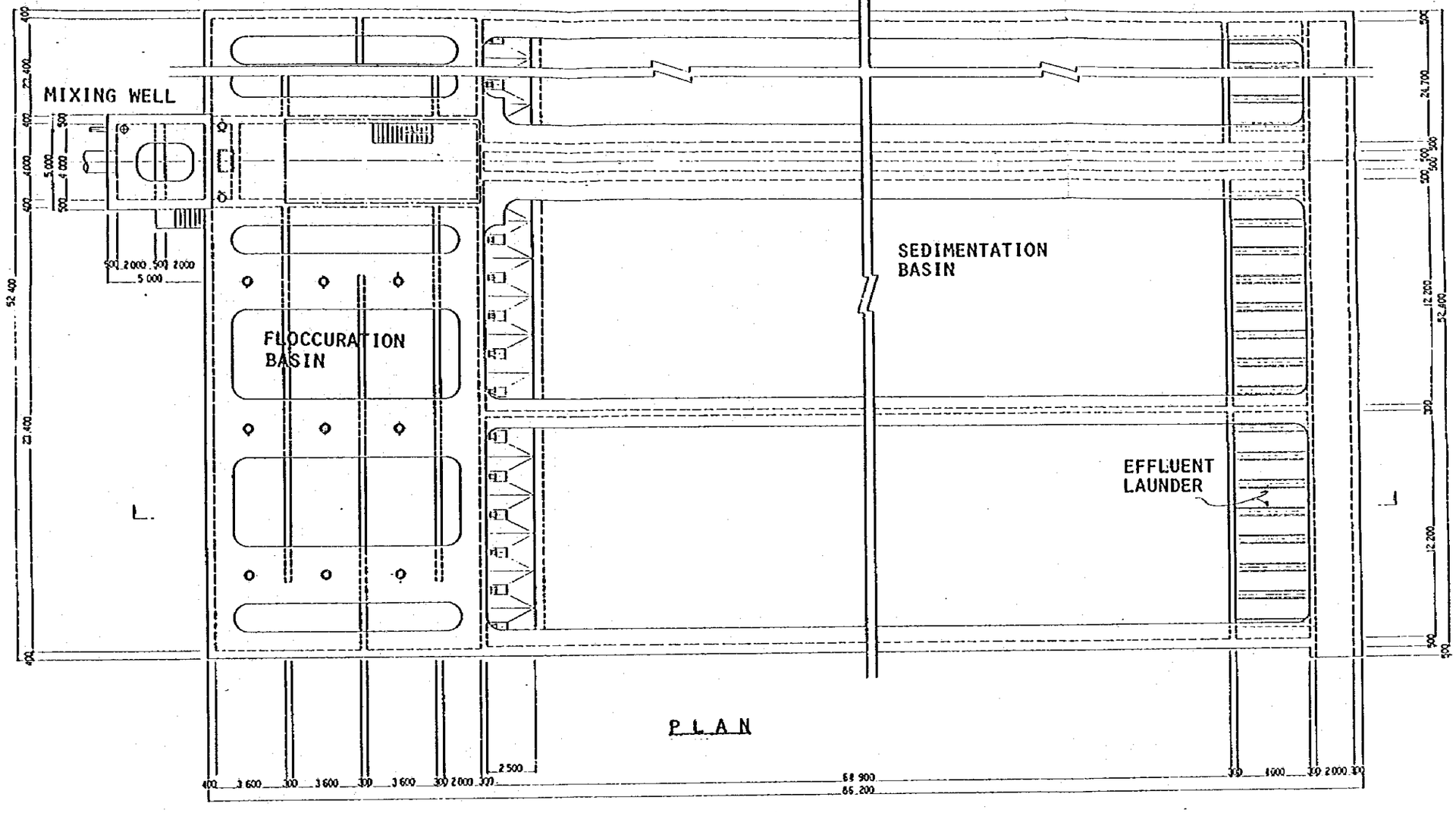

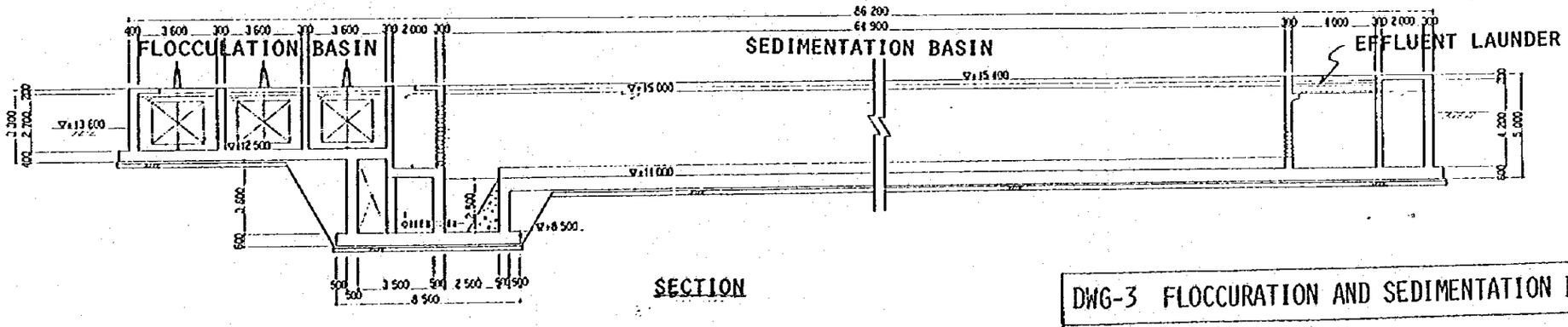

DWG-3 FLOCCURATION AND SEDIMENTATION BASIN

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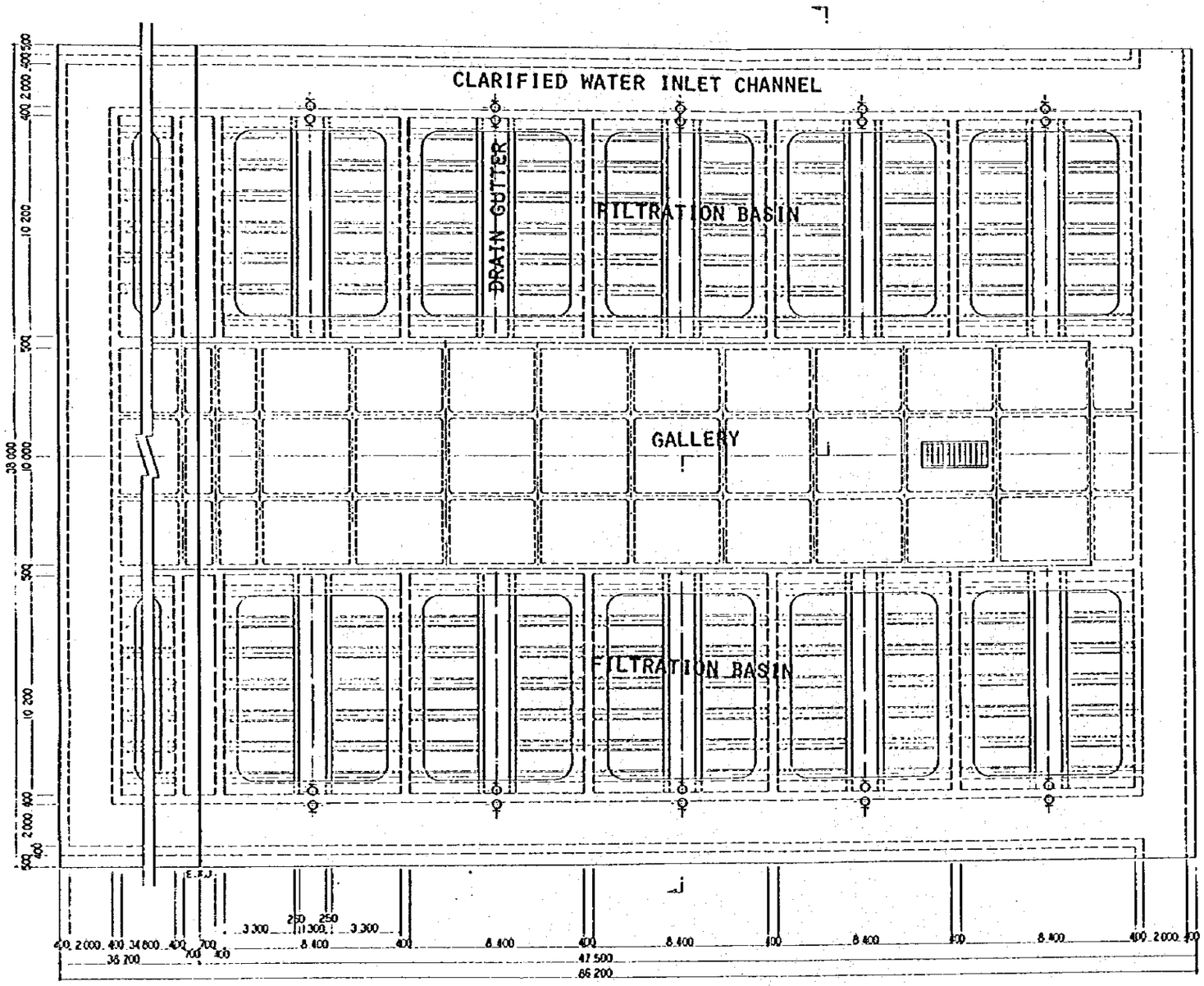

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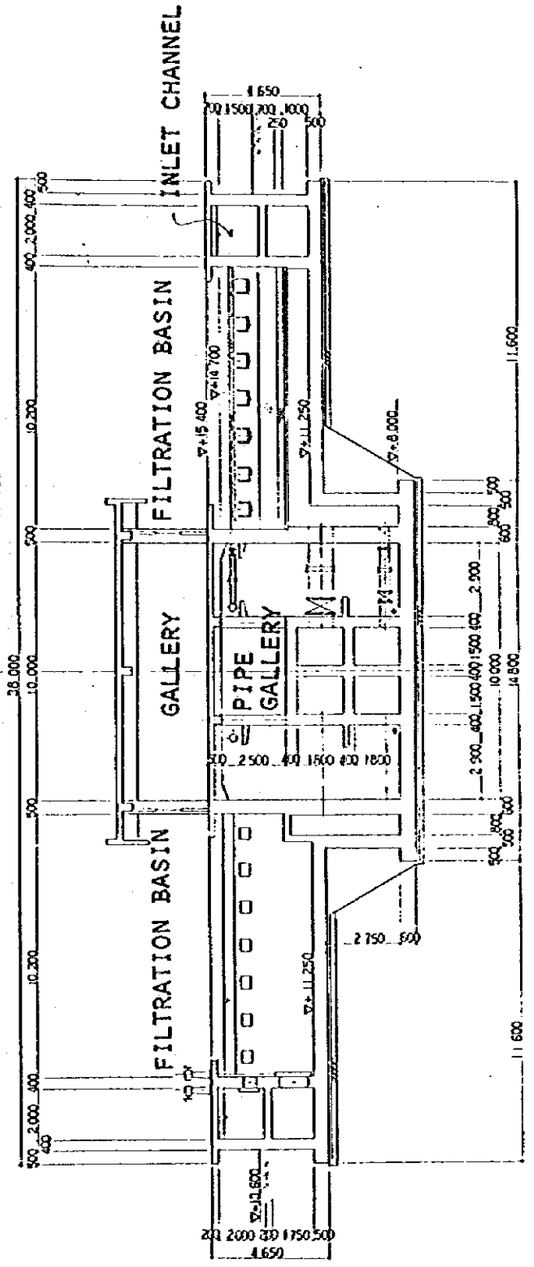
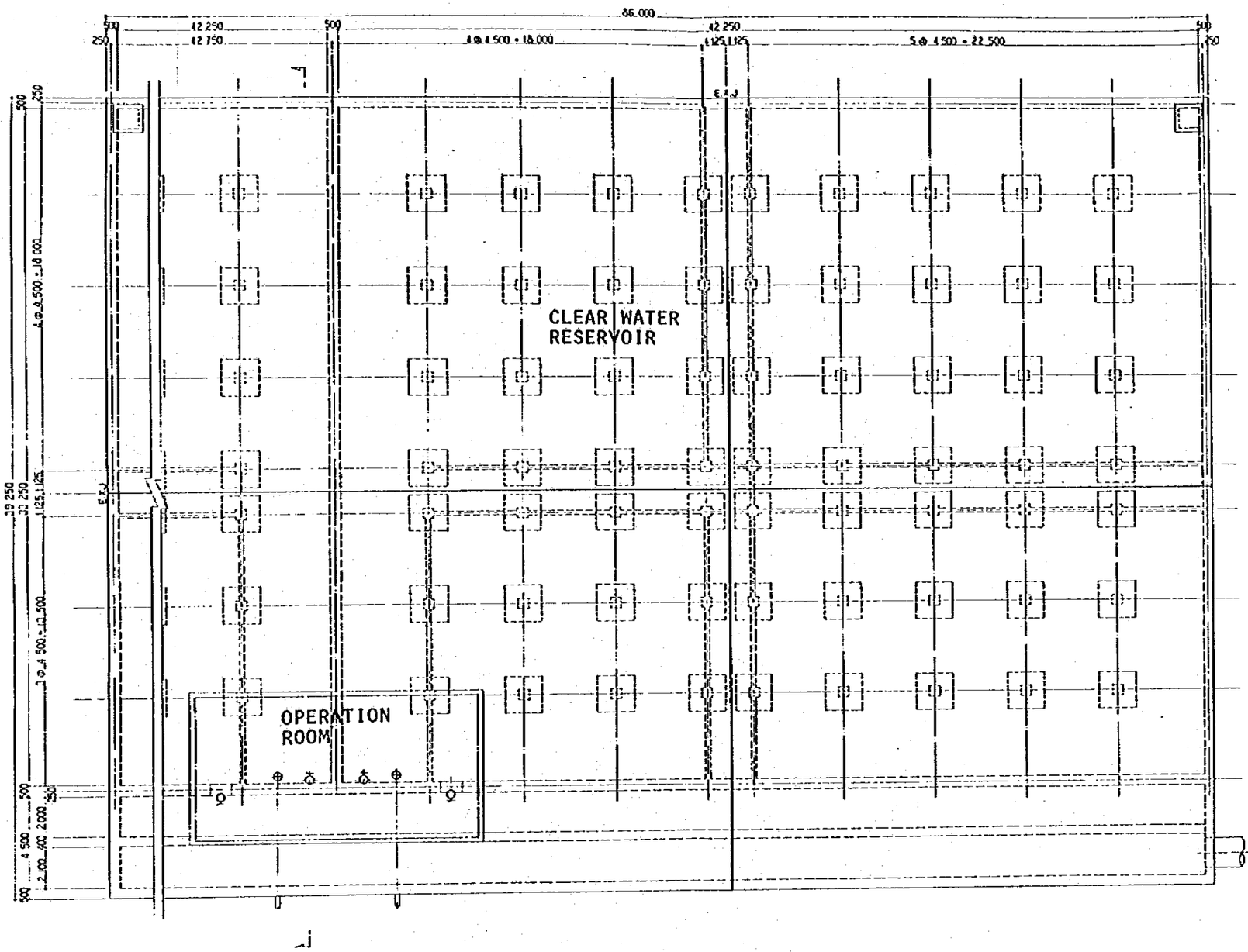


SECTION

DWG-4 FILTER

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA



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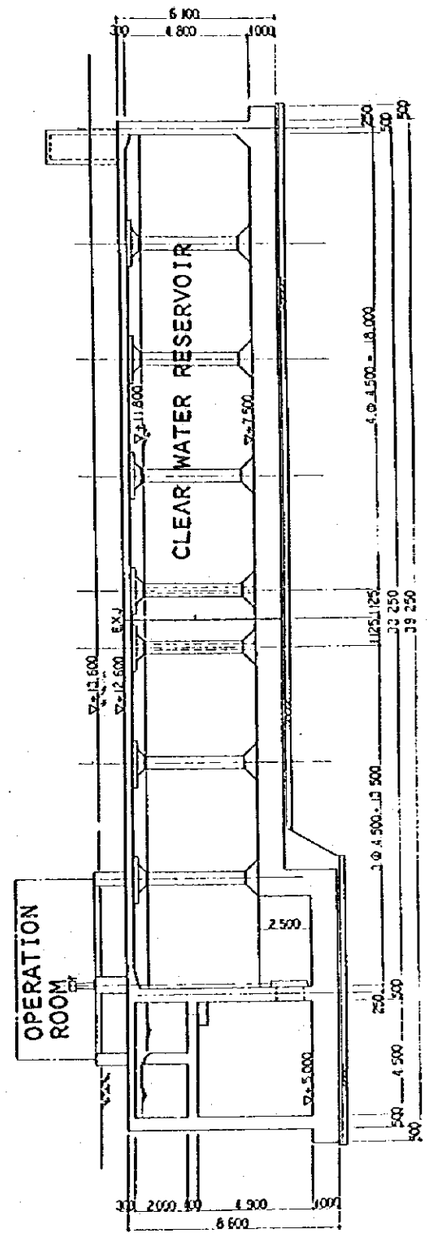
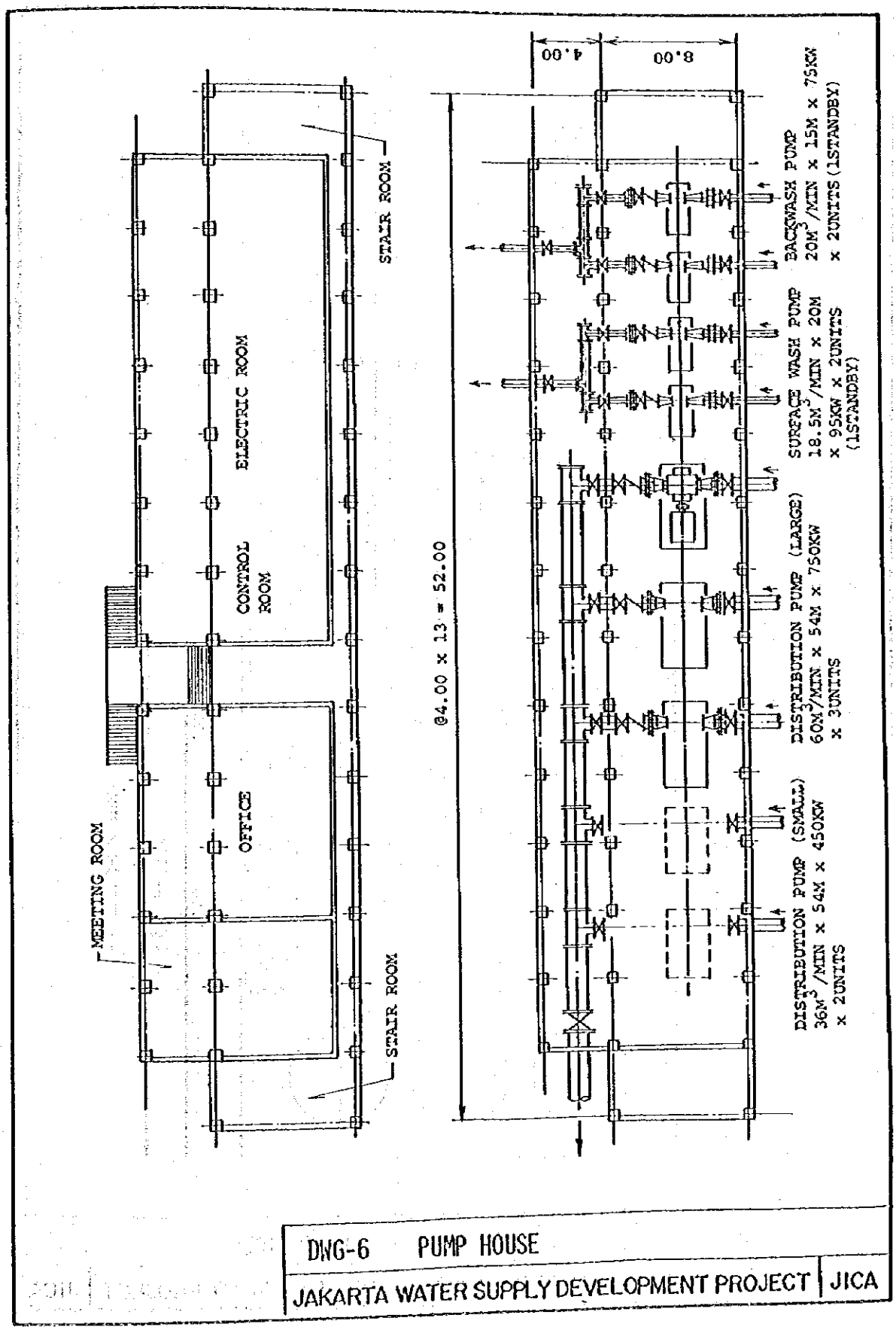


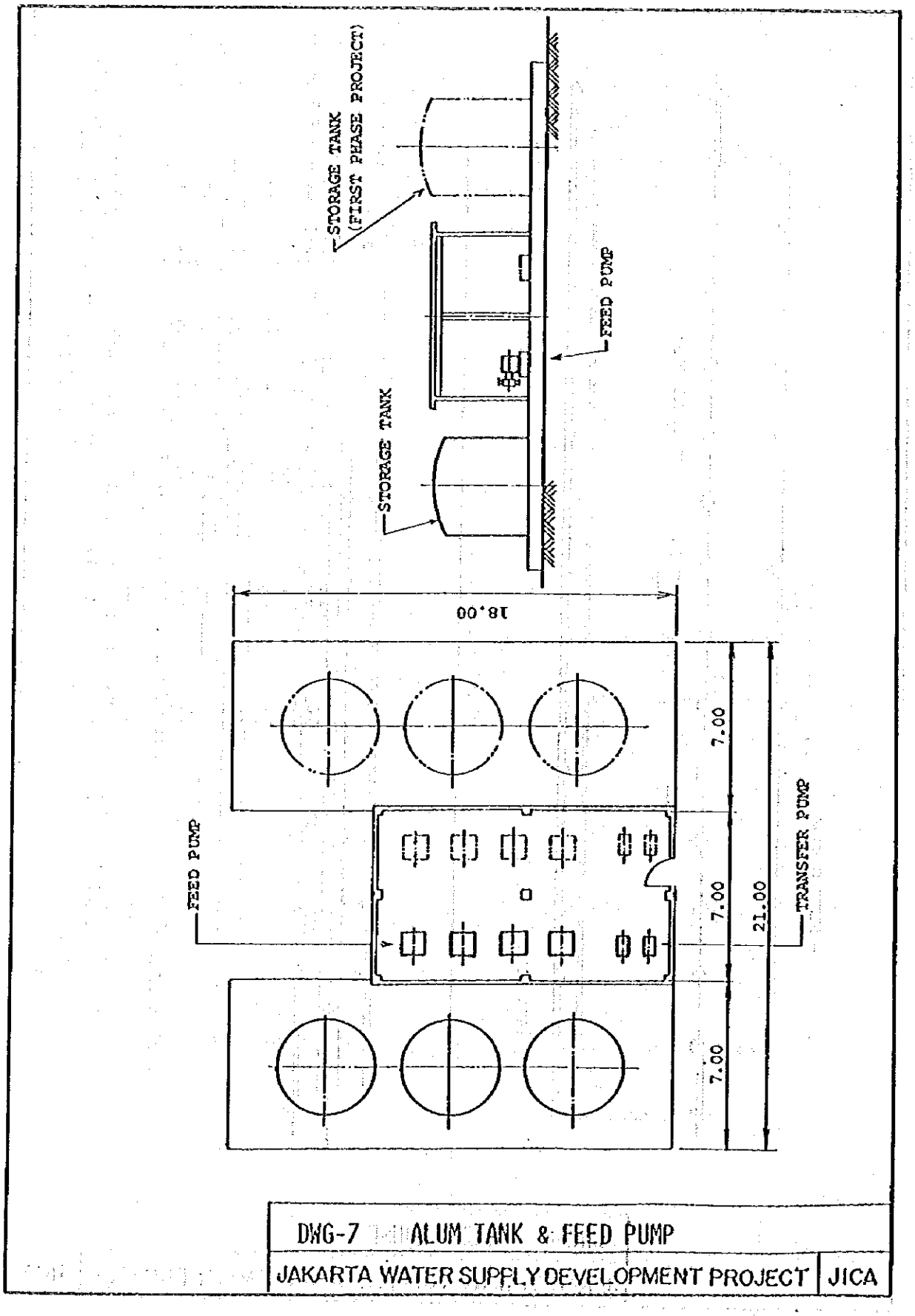
SECTION

DWG-5 CLEAR WATER RESERVOIR	
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT	JICA



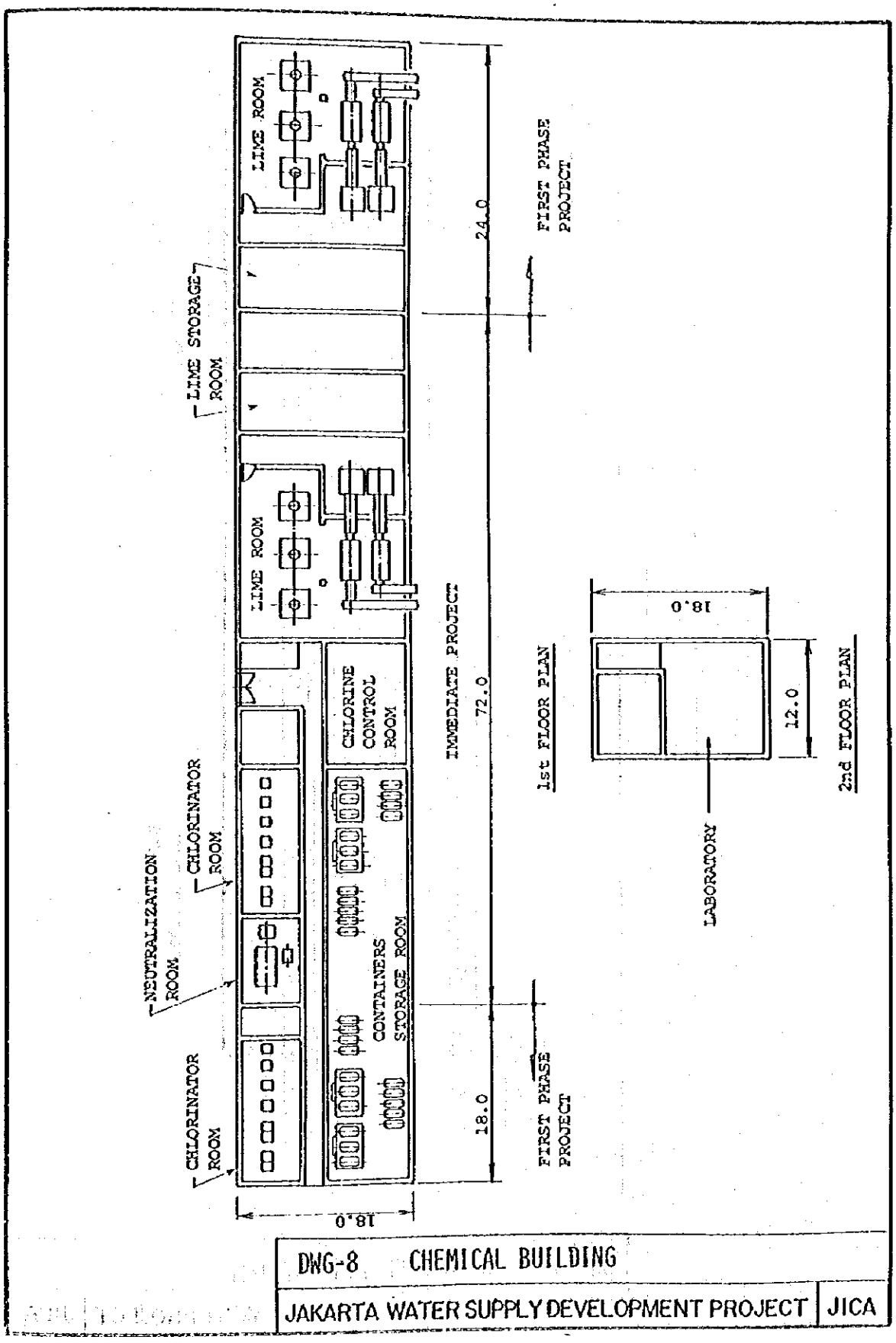
DWG-6 PUMP HOUSE

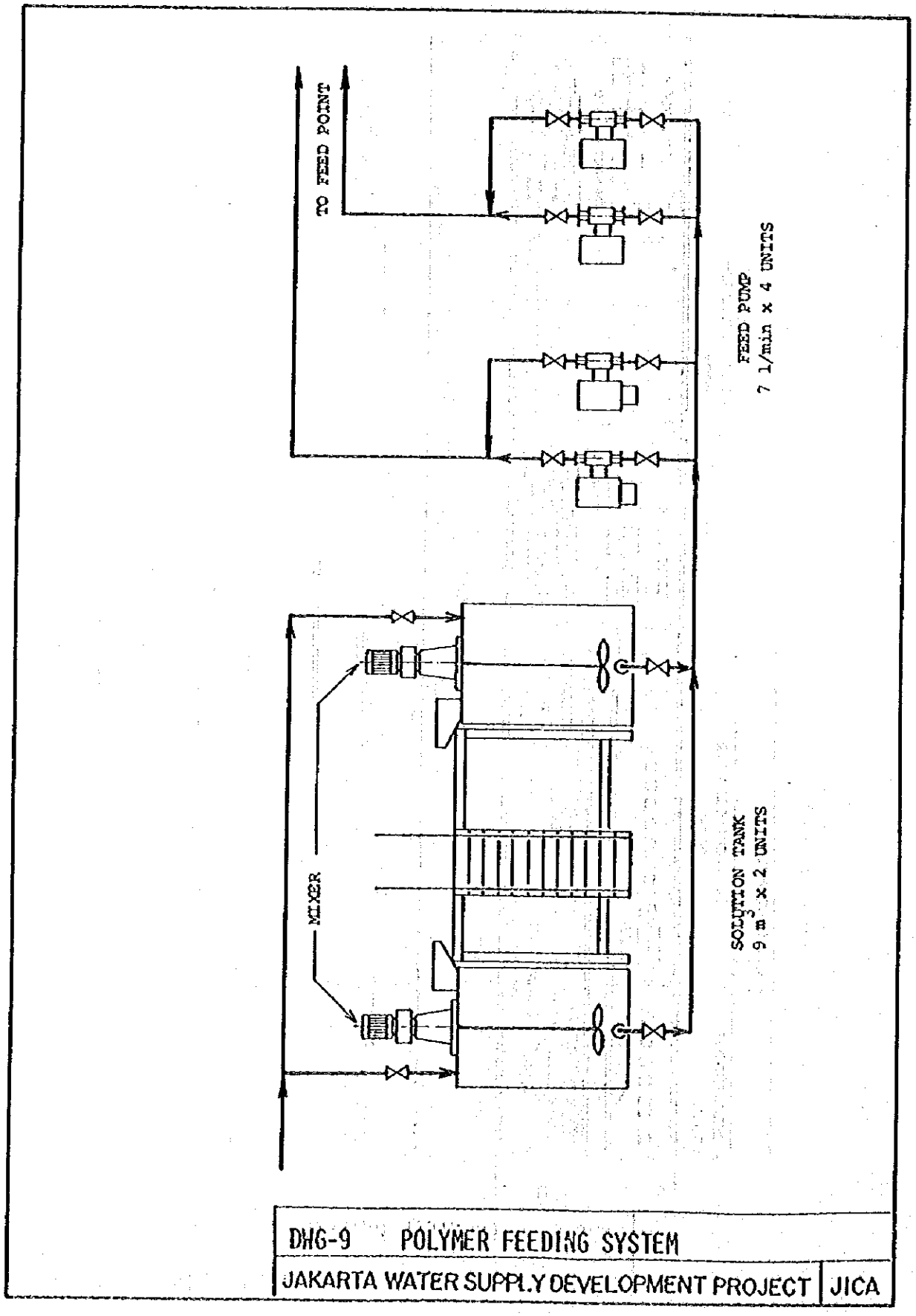
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA



DWG-7 ALUM TANK & FEED PUMP

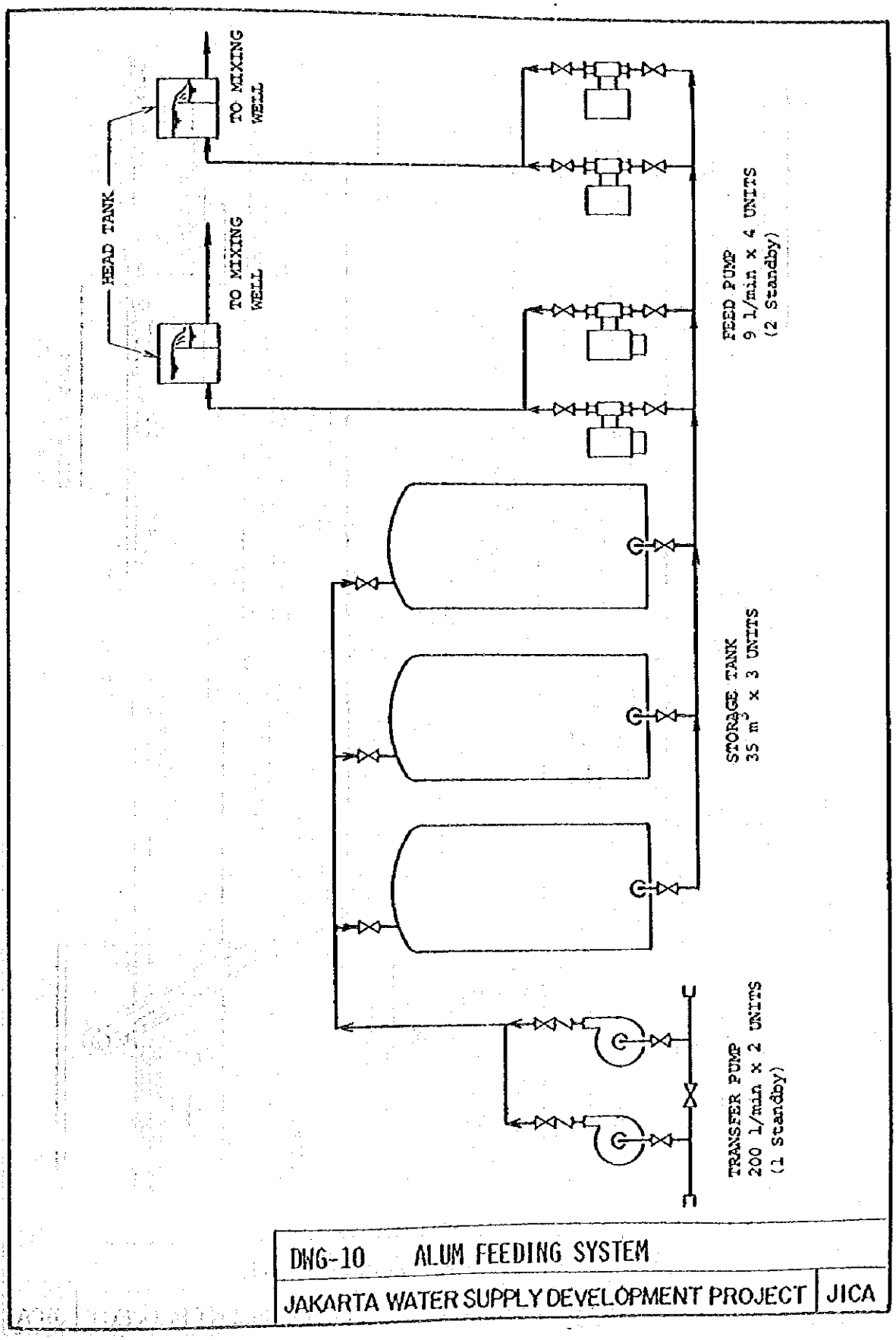
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA


LIME ROOM
LIME STORAGE ROOM
LIME ROOM
CHLORINE CONTROL ROOM
CHLORINATOR ROOM
NEUTRALIZATION ROOM
CONTAINERS STORAGE ROOM
CHLORINATOR ROOM
18.0
24.0
72.0
18.0
IMMEDIATE PROJECT
FIRST PHASE PROJECT
FIRST PHASE PROJECT
1st FLOOR PLAN
18.0
12.0
LABORATORY
2nd FLOOR PLAN
DWG-8 CHEMICAL BUILDING
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA



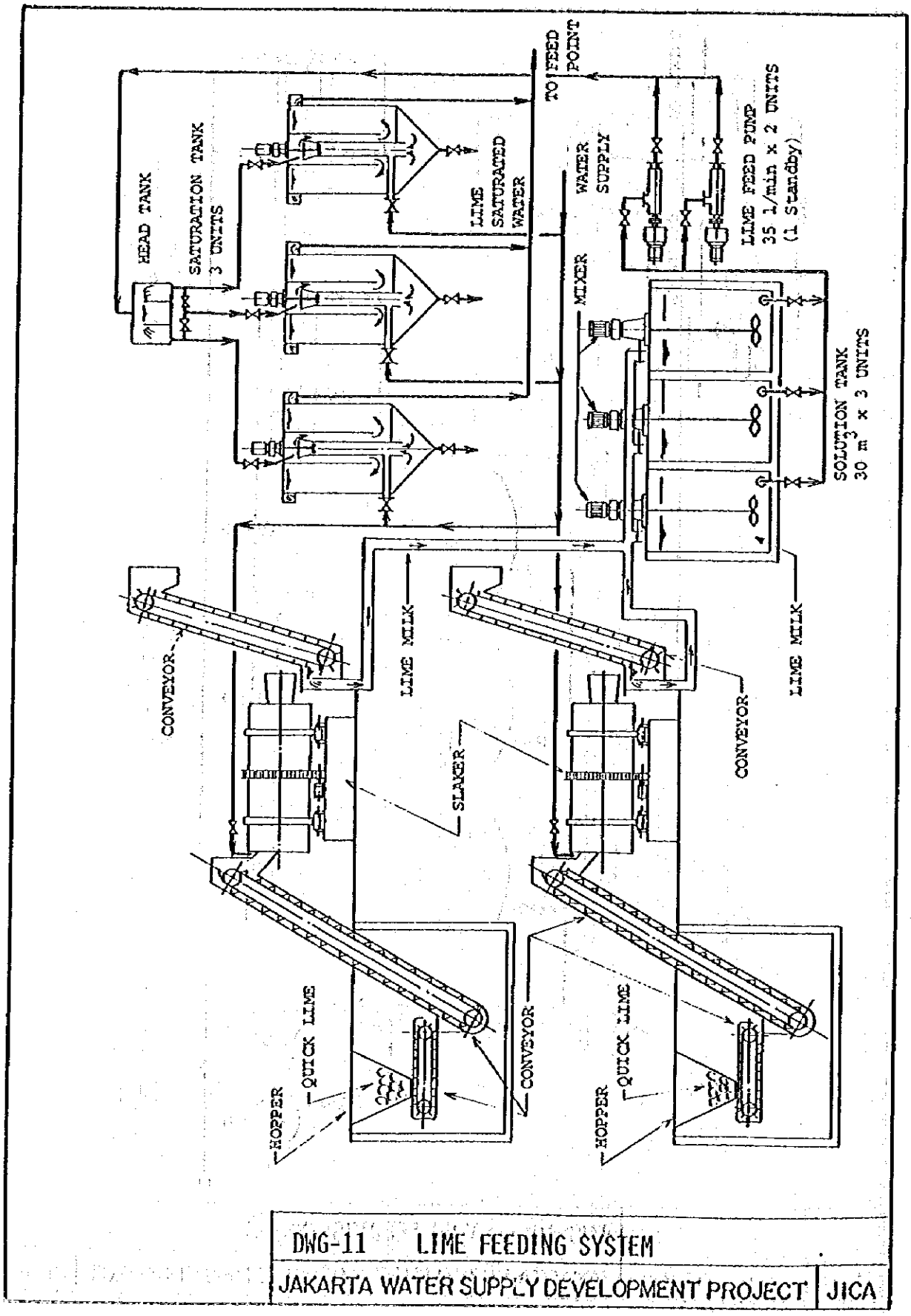
DH6-9 POLYMER FEEDING SYSTEM

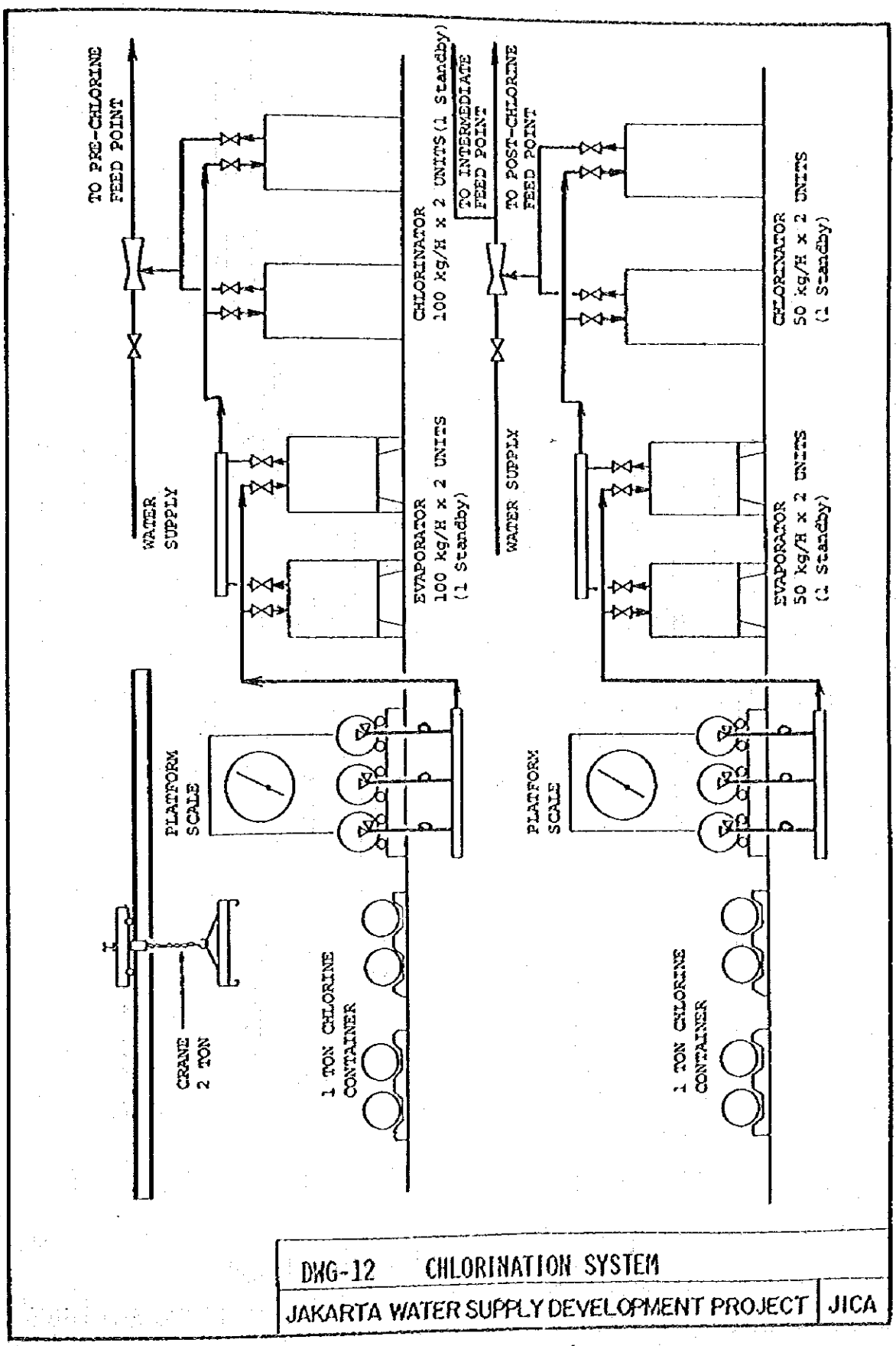
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

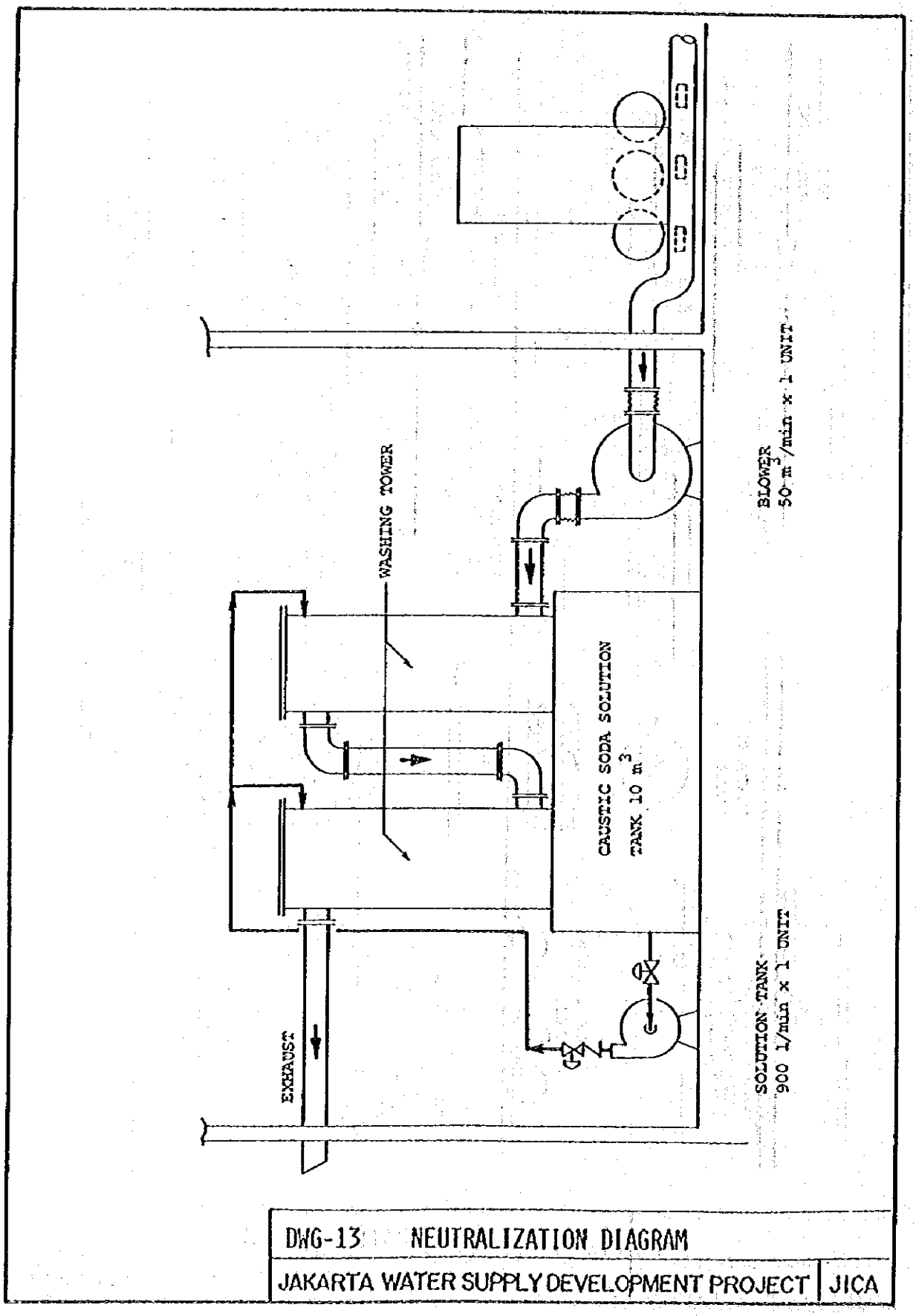


DWG-10 ALUM FEEDING SYSTEM

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

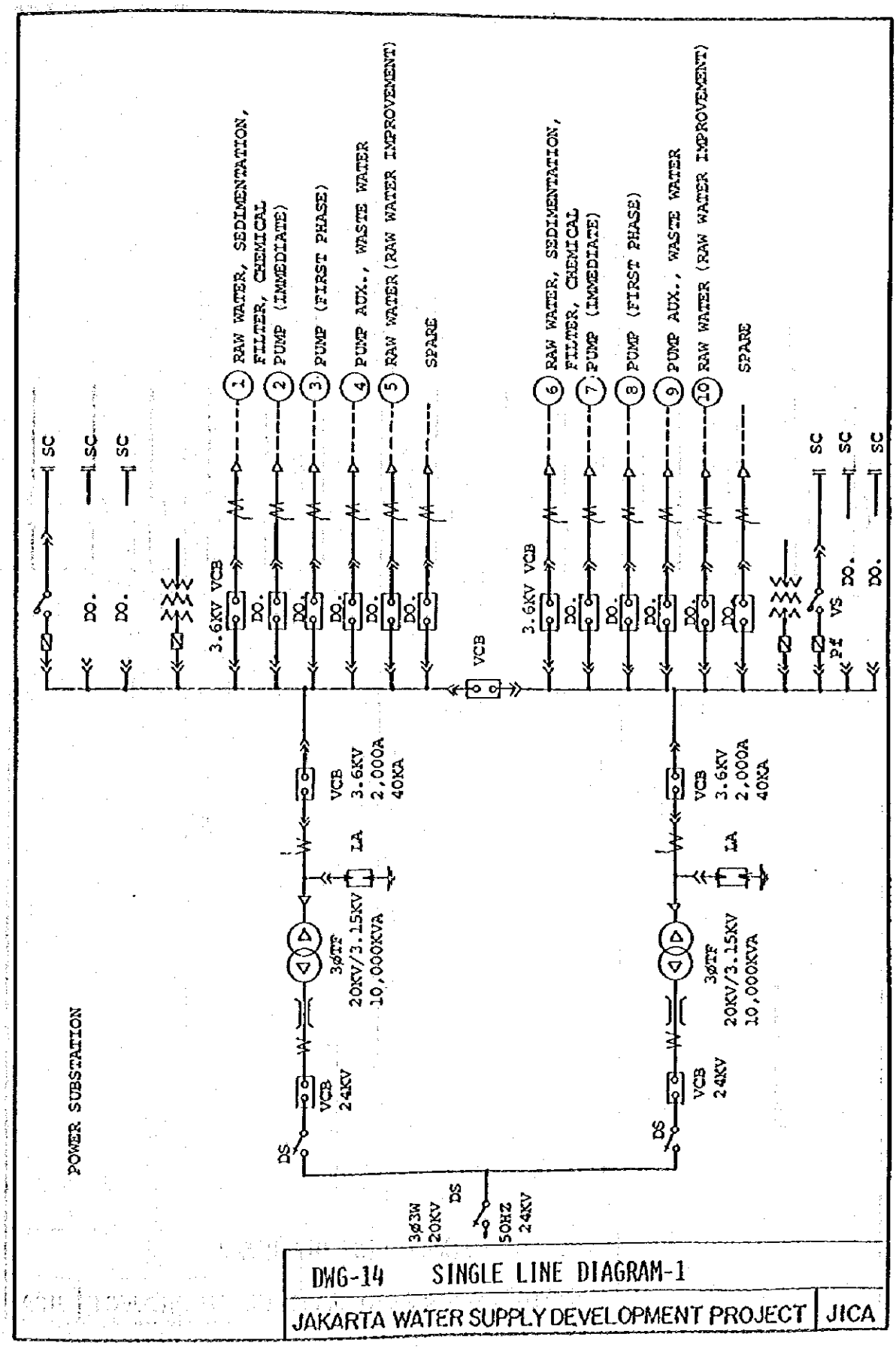

TO FEED POINT
LIME FEED PUMP
35 l/min x 2 UNITS
(1 Standby)
WATER SUPPLY
LIME SATURATED WATER
HEAD TANK
SATURATION TANK
3 UNITS
MIXER
SOLUTION TANK
30 m³ x 3 UNITS
LIME MILK
LIME MILK
CONVEYOR
CONVEYOR
SLAKER
CONVEYOR
QUICK LIME
QUICK LIME
HOPPER
HOPPER
DWG-11 LIME FEEDING SYSTEM
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA

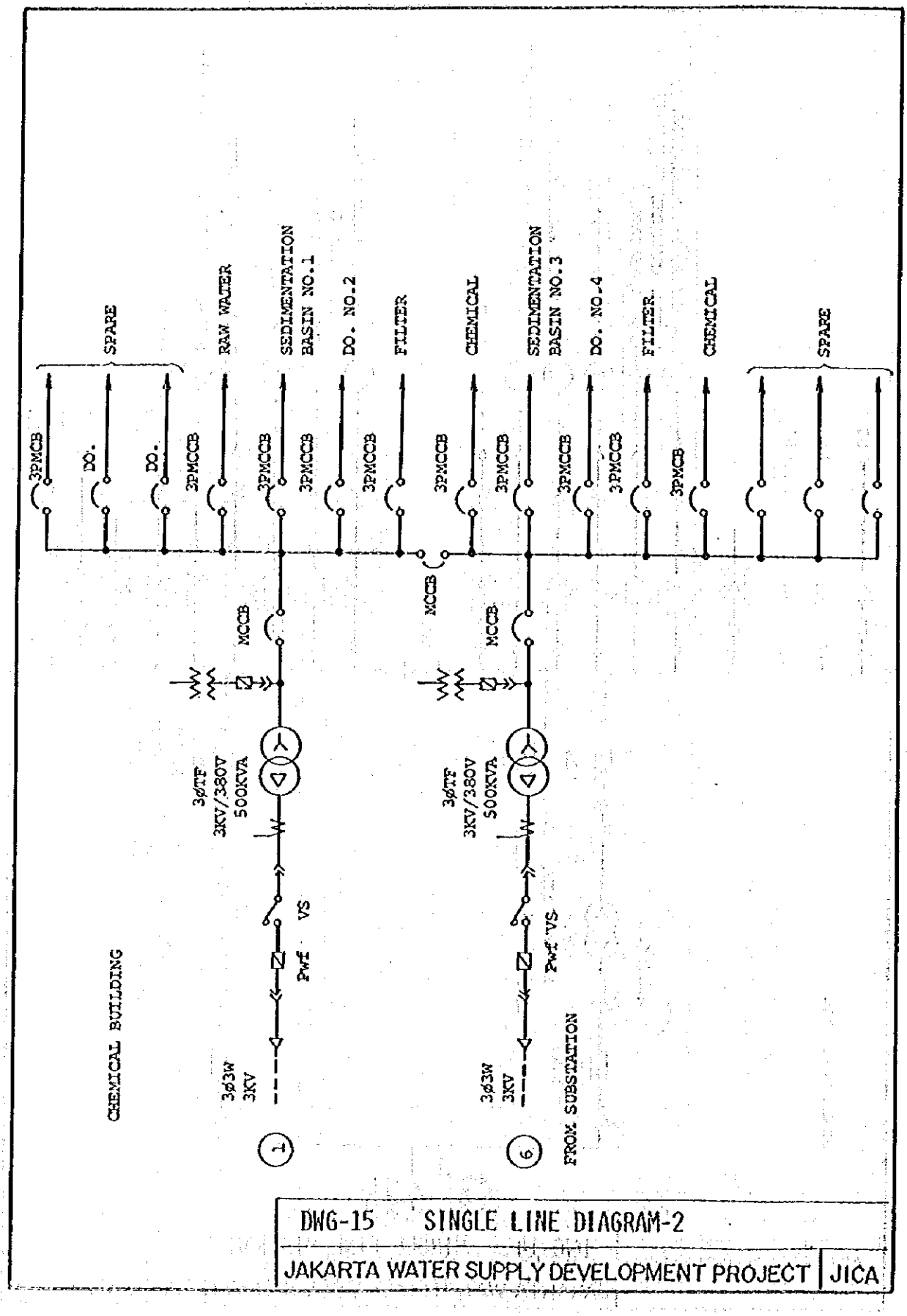

TO PRE-CHLORINE FEED POINT
WATER SUPPLY
CHLORINATOR 100 kg/H x 2 UNITS (1 Standby)
TO INTERMEDIATE FEED POINT
TO POST-CHLORINE FEED POINT
EVAPORATOR 100 kg/H x 2 UNITS (1 Standby)
CHLORINATOR 50 kg/H x 2 UNITS (1 Standby)
EVAPORATOR 50 kg/H x 2 UNITS (1 Standby)
PLATFORM SCALE
CRANE 2 TON
1 TON CHLORINE CONTAINER
DWG-12 CHLORINATION SYSTEM
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA



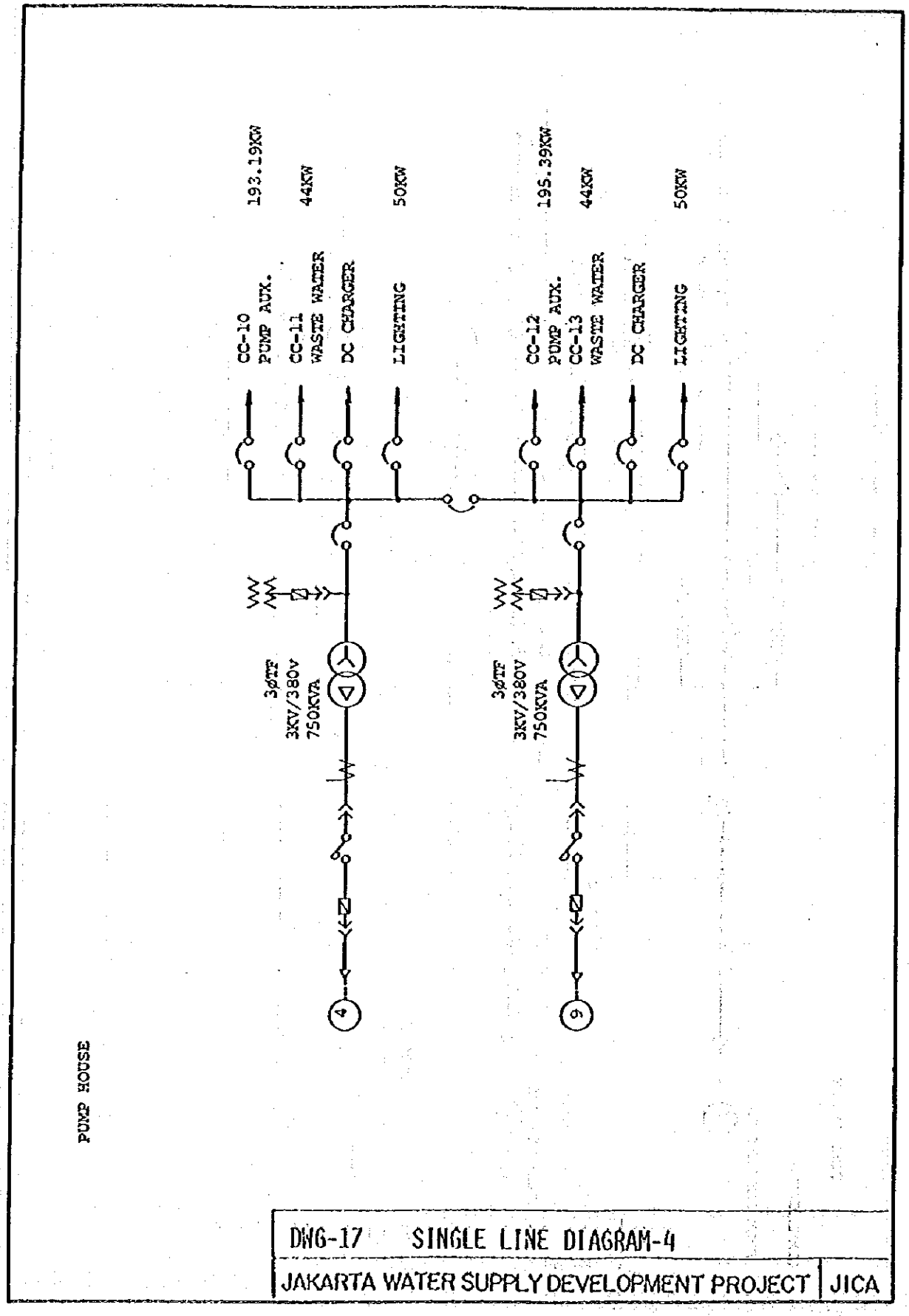
DWG-13 NEUTRALIZATION DIAGRAM

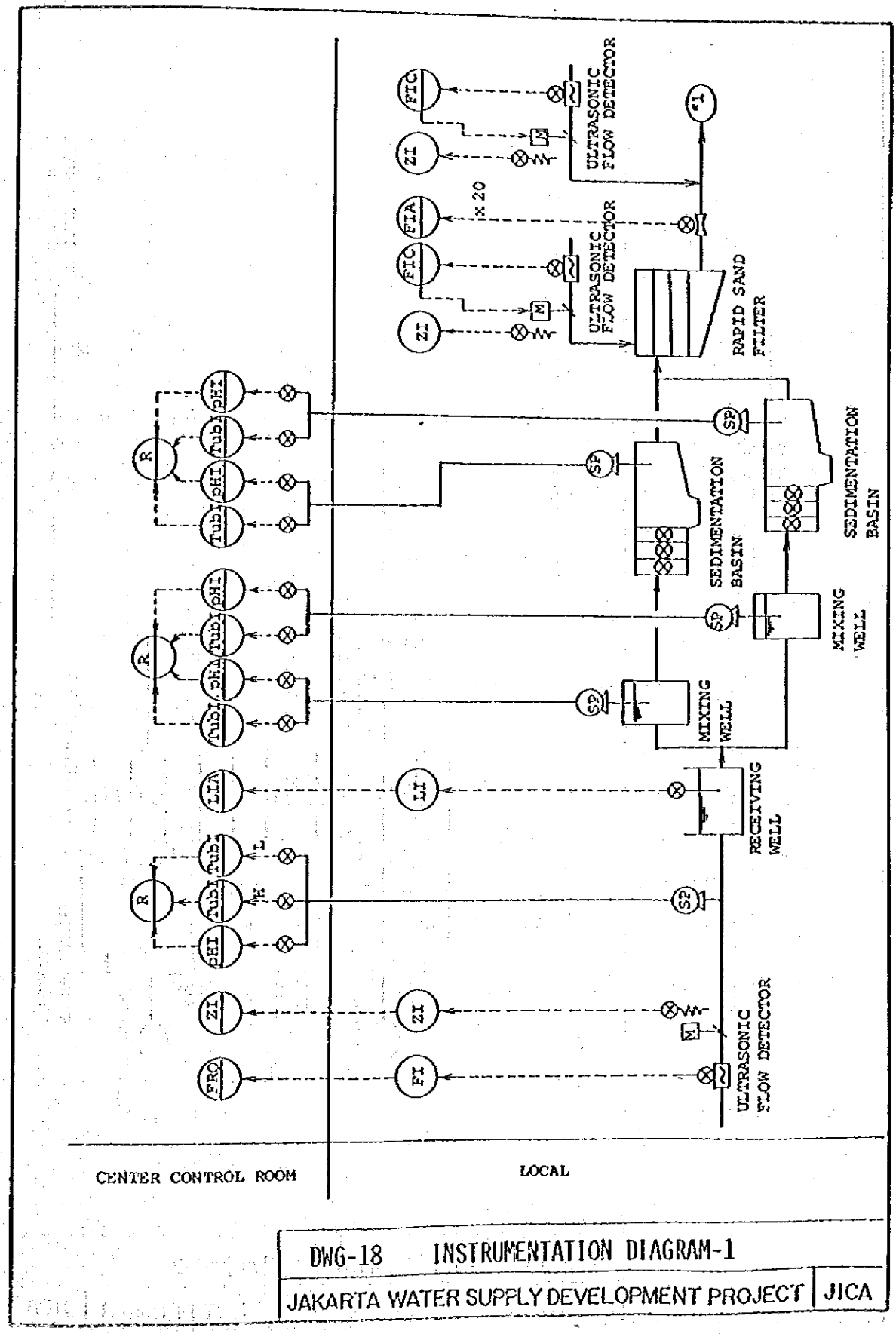
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA


POWER SUBSTATION
3φ3W 20KV 50HZ
DS
24KV
DS
VCB 24KV
3φTF 20KV/3.15KV 10,000KVA
LA
VCB 3.6KV 2,000A 40KA
3.6KV VCB
1 RAW WATER, SEDIMENTATION, FILTER, CHEMICAL
2 PUMP (IMMEDIATE)
3 PUMP (FIRST PHASE)
4 PUMP AUX., WASTE WATER
5 RAW WATER (RAW WATER IMPROVEMENT)
SPARE
VCB
6 RAW WATER, SEDIMENTATION, FILTER, CHEMICAL
7 PUMP (IMMEDIATE)
8 PUMP (FIRST PHASE)
9 PUMP AUX., WASTE WATER
10 RAW WATER (RAW WATER IMPROVEMENT)
SPARE
SC
PT
VS
DWG-14 SINGLE LINE DIAGRAM-1
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA


SPARE
DO.
DO.
3PMCCB
RAW WATER
SEDIMENTATION BASIN NO.1
DO. NO.2
FILTER
CHEMICAL
SEDIMENTATION BASIN NO.3
DO. NO.4
FILTER
CHEMICAL
SPARE
MCCB
3ØTF 3KV/380V 500KVA
Pwr VS
3Ø3W 3KV
CHEMICAL BUILDING
FROM SUBSTATION
1
6
DWG-15 SINGLE LINE DIAGRAM-2
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA

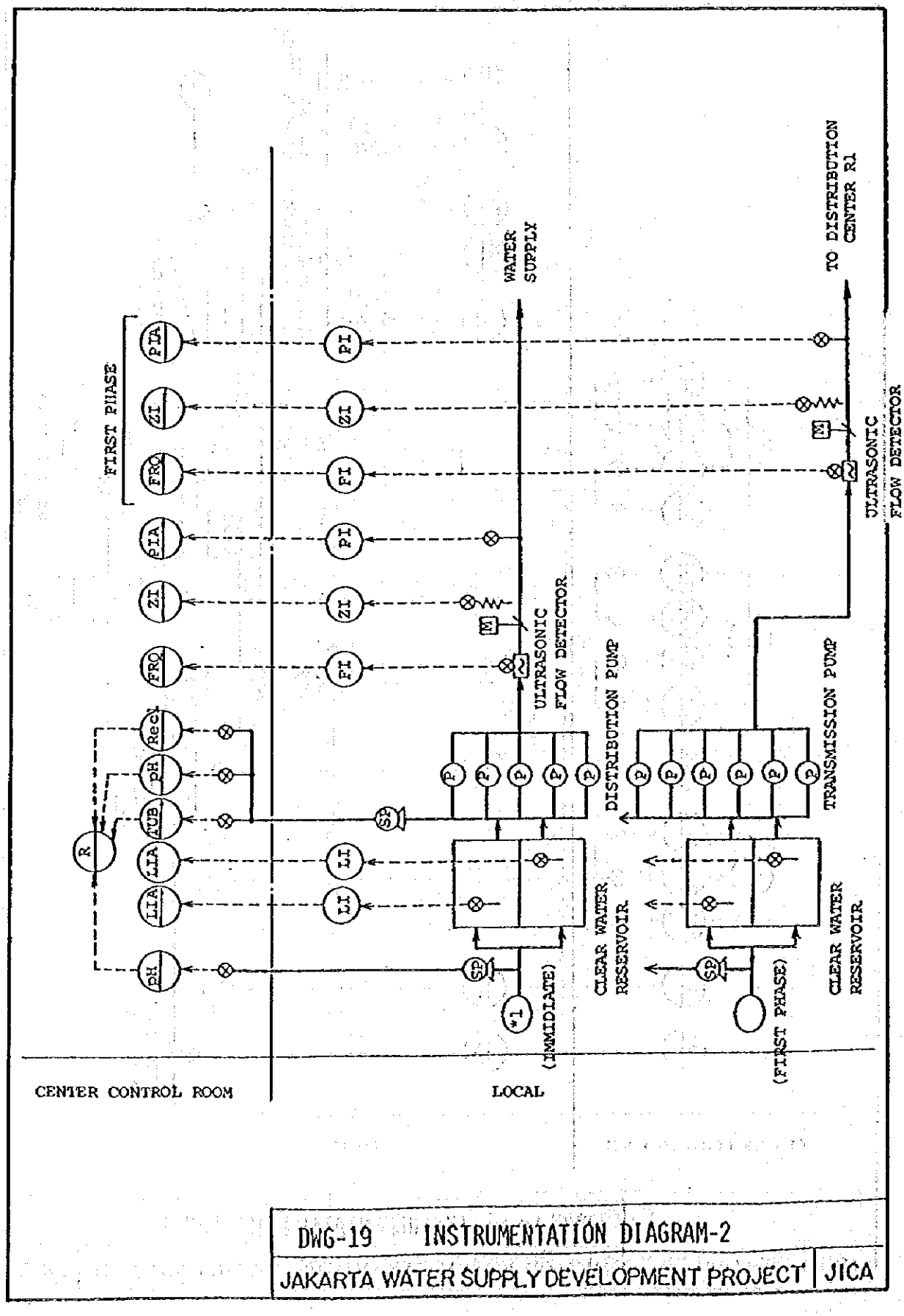
PUMP HOUSE
(IMMEDIATE)
FROM SUBSTATION
DISTRIBUTION PUMP
750KW
750KW
750KW
DISTRIBUTION PUMP
450KW
450KW
TRANSMISSION PUMP
315KW
315KW
315KW
315KW
315KW
315KW
IM
DITTO
VS
PWF
DS
FROM SUBSTATION
(FUTURE)
(FIRST PHASE)
2
7
3
8
DWG-16 SINGLE LINE DIAGRAM-3
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA


PUMP HOUSE
CC-10
PUMP AUX.
193.19KW
CC-11
WASTE WATER
44KW
DC CHARGER
LIGHTING
50KW
CC-12
PUMP AUX.
195.39KW
CC-13
WASTE WATER
44KW
DC CHARGER
LIGHTING
50KW
3øTF
3KV/380V
750KVA
3øTF
3KV/380V
750KVA
4
9
DWG-17 SINGLE LINE DIAGRAM-4
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT
JICA



DWG-18 INSTRUMENTATION DIAGRAM-1

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA



DWG-19 INSTRUMENTATION DIAGRAM-2

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

MASTER PLAN FOR

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M9. APPENDIX MIV-3

DIVISION OF THE SERVICE AREA (SUPPLY ZONES)

DIVISION OF THE SERVICE AREA
(SUPPLY ZONES)

Contents

Introduction

The existing water supply system of Jakarta is large in service area and complicated in network of pipelines with many supply sources. As a result of this magnitude and complication, the operation of the water supply system is not necessarily easy, and it is difficult in an emergency case to deliver water to places where water is wanted. Considering the above condition of the water supply system, a basic improvement of the system is considered to be of primary importance in the planning of the water supply system to be constructed in the future.

A new concept of the water supply system is, therefore, introduced here, which is to divide the whloe supply area into plural number of supply areas. This area is termed in the present report as "supply zone". Each zone will be operated as if it is an independent service area, each having a supply source of its own, such as a treatment plant or a distribution center.

The major advantages of the above system will be as follows:

1. Rational operation and maintenence will be possible grasping areawise tendencies of water demand increase and charactaristic of water consumption pattern.

2. It will be easier to make more presice planning for future extention and arrangement of the distribution system in accordance with the above.

3. More uniform water pressure of the service area as a whole can be maintained; as the result it becomes possible to reduce leakage by reducing excessive water pressure of the distribution pipelines.

4. It becomes possible to prevent the wide area's suspension of water supply in case of unforeseable emergency in the major facilities such as intake, treatment plant, transmission mains and distribution trunk mains.

Considering the above merits, the smaller size of zone will have more advantage only from the technical point of view, while size of zone is to be decided from the view points of physical conditions of the service area and economical advantage.

To find out such supply zones, the following approach will be employed, namely, 1) to identify a most feasible size of supply zone by using module, and 2) to divide the service area applying the result of the above module study.

1. Distribution of Water Demand to Kecamatan

To fulfil the purpose of dividing the served area, the magnitude of a supply zone must be appropriate in terms of both its area and supply capacity. For convenience of analysis, water demand that is the basis to determine the supply capacity will be firstly distributed to Kecamatan in the processes as described below.

(1) Domestic Demand

Firstly, population in the service area of each Kecamatan is estimated based on population distribution of each transport zone prepared in the Master Plan of Jakarta City in this report and service area map prepared in section 4.1.

Secondly, population served of each Kecamatan which is classified into three categories by income level, income groups I & II, income groups III & IV and income group V, is estimated based on the service ratio of each income group in the physical zone defined by the Master Plan of Jakarta City.

Finally, domestic demand of each Kecamatan is estimated as the product of unit demand (per capita consumption) defined in Section 4.2 and population served estimated in the above.

(2) Public Use

Public use is further classified into five categories such as governmental use, educational use, religious institutional use, hospital use and armed forces use.

Governmental Use

Firstly, present government employees are distributed to each Kecamatan based on the land use map in 1980.

Secondly, government employees of each SDP zone in the Master Plan of Jakarta City are redistributed to each Kecamatan applying the present proportion of employees to each Kecamatan involved in SDP zone concerned.

Finally, water demand of Governmental use of every five years is distributed to each Kecamatan according to the proportion of employees obtained in the above.

Educational and Religious Institutional Use

Water demand of educational and religious institutional uses are distributed applying the proportion of population in the service area.

Hospital Use

Water demand of hospital is divided into two categories, general hospital (large scale hospital) and small hospital (such as maternity hospital).

Present water demand of the general hospitals is distributed to each Walikota based on the number of connections of each Walikota and unit demand which is further distributed to each Kecamatan. Water demand of each Kecamatan in 2005 is distributed applying the proportion of population in the service area. Demand distribution of every five years is made using proportions of water demand of each Kecamatan in 1980 and 2005 estimated in the above. Water demand distribution of small hospital is made according to the proportion of population in the service area.

Armed Forces Use

Water demand for Armed Forces of each Walikota is distributed according to the ratio of the present consumption and it is further distributed to each Kecamatan equally.

(3) Industrial Demand

Water demand of Industrial Use is further classified into two categories, Large & Medium and Small industries.

Large & Medium Industries

Water demand for Large & Medium Industries is distributed based on proportion of the industrial area in each Kecamatan as shown on Land use map at present and Land use plan in 2005 prepared in the Master Plan of Jakarta City.

Small Industries

Water demand for Small Industries is distributed by the proportion of population in the service area considering Small Industries scattered in the whole area of Jakarta which is defined as home industry.

(4) Water Demand of Trade and Services

Water demand of Trade and Services is further classified into two categories which are demands for hotels and trade & services.

Water Demand of Hotel

Present water demand of Hotels is distributed based on the number of rooms in each Kecamatan and unit consumption per room. Future water demand is distributed based on such consideration that water demand of hotel will increase in proportion to the water demand increase of trade & services then water demand in 2005 is distributed in proportion to the water demand of trade & services. From the above two figures, water demand distribution of every five years is estimated.

Water Demand of Trade & Services

Water demand of trade & services is distributed based on the proportion of area in present land use map and distribution of employees of trade & service sector of each SDP zone estimated in the Master Plan of Jakarta City which is further distributed to each Kecamatan.

Distribution of water demand of each kecamatan in every five years is estimated according to the above approach and the result is summarized in Table 1 and shown on Fig. 1 for the year of 1990, 1995 and 2005.

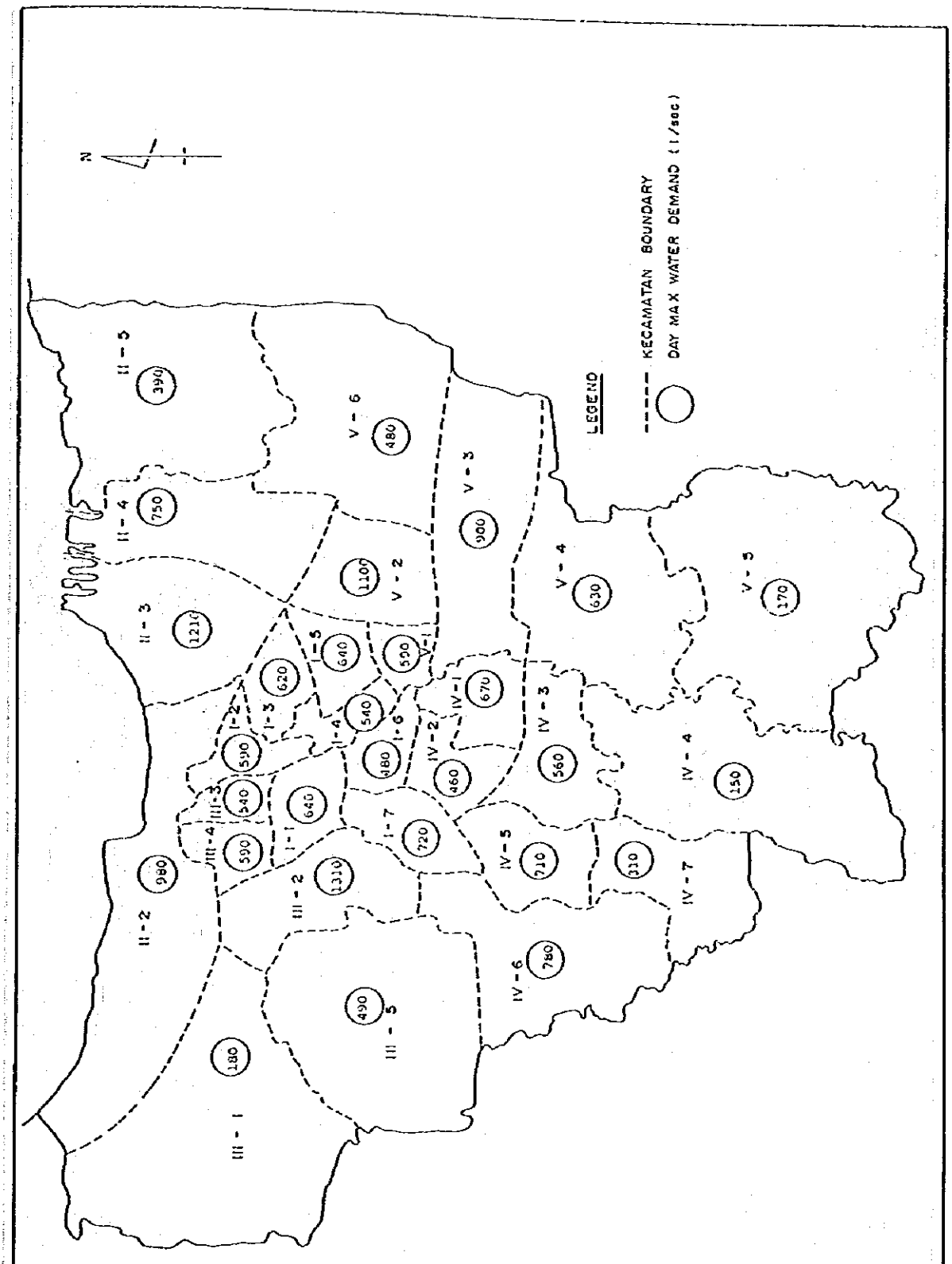


FIG 1A WATER DEMAND DISTRIBUTION (IN 1990)

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

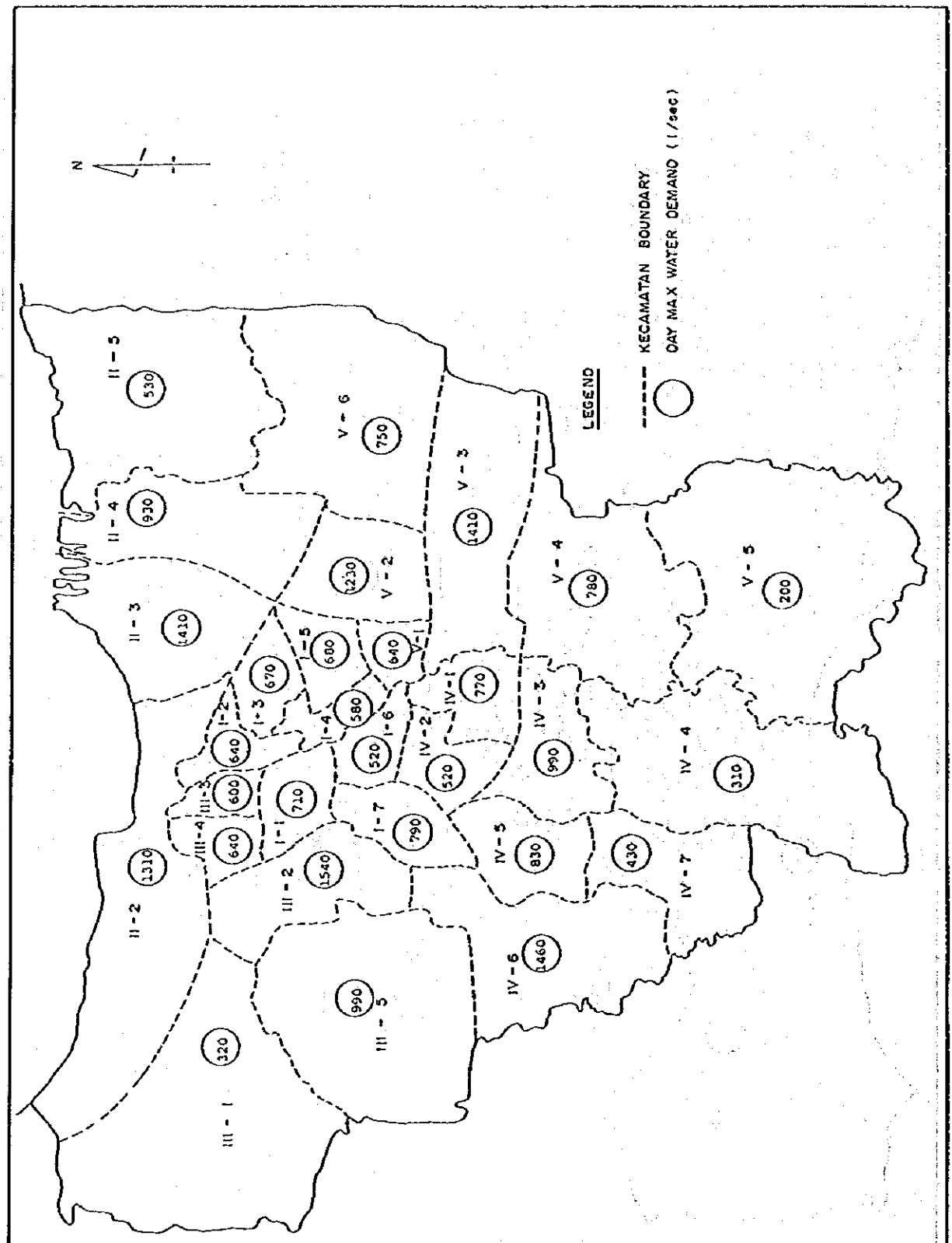


FIG 1B WATER DEMAND DISTRIBUTION (IN 1995)

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

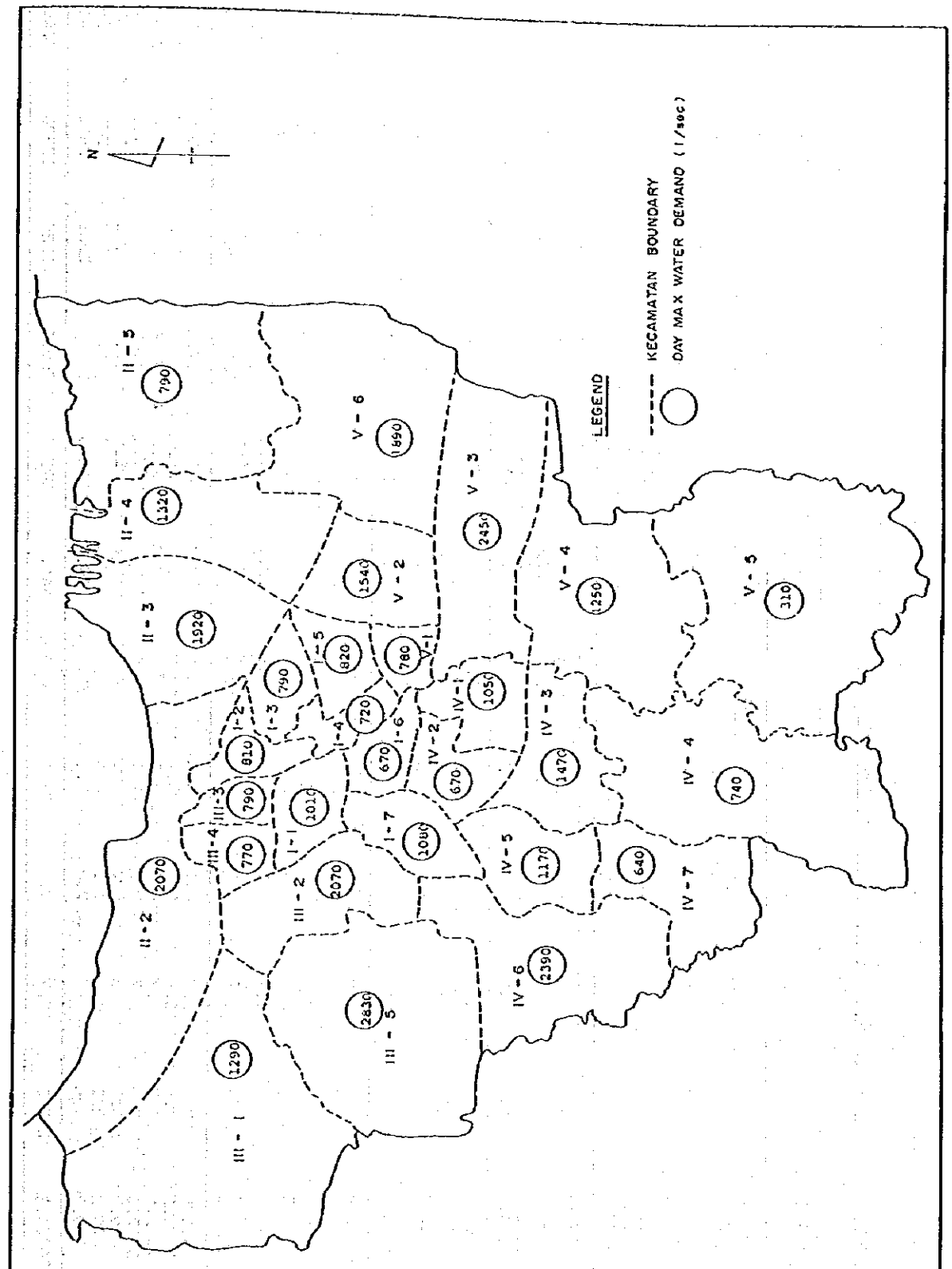


FIG 1C WATER DEMAND DISTRIBUTION (IN 2005)

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT | JICA

Table 1A Water Demand Distribution by Each Kecamatan, 1980

KECAMATAN	AREA	DOMESTIC	NON-DOMESTIC				CONSUMP-TION	UNACCOUNT	DEMAND(DAY AVG)		DAY MAX	DENSITY
			Public	Industry	T & c	Total			(m3/d)	(l/s)		
	(ha)	('000m3/d)				('000m3/d)	('000m3/d)	(54%)			(l/s)	
I-1	757.6	11.4	7.0	0.1	2.7	9.8	21.2	24.9	46.1	530	610	0.81
I-2	583.2	11.2	5.4	0.3	1.7	7.4	18.6	21.8	40.4	470	540	0.93
I-3	704.0	14.6	3.2	0.2	0.7	4.1	18.7	22.0	40.7	470	540	0.77
I-4	461.0	9.9	6.0	0.1	2.3	8.4	18.3	21.5	39.8	460	530	1.15
I-5	717.6	15.0	4.8	0.2	0.6	5.6	20.6	24.2	44.8	520	600	0.84
I-6	613.6	9.3	4.0	0.1	1.5	5.6	14.9	17.5	32.4	380	440	0.72
I-7	1016.8	12.9	6.9	0.4	2.1	9.4	22.3	26.2	48.5	560	640	0.63
I-TOTAL	4853.8	84.3	37.3	1.4	11.6	50.3	134.6	158.0	292.6	3390	3900	0.80
II-2	2509.5	17.0	2.4	1.0	0.6	4.0	21.0	24.7	45.7	530	610	0.24
II-3	2423.0	13.9	15.8	1.1	0.1	17.0	30.9	36.3	67.2	780	900	0.37
II-4	1571.7	14.7	1.5	0.7	0.3	2.5	17.2	20.2	37.4	430	490	0.31
II-5	1190.5	5.9	0.8	0.4	0	1.2	7.1	8.3	15.4	180	210	0.18
II-TOTAL	7694.7	51.5	20.5	3.2	1.0	24.7	76.2	89.5	165.7	1920	2210	0.29
III-1	607.5	1.4	0.2	0	0.2	0.4	1.8	2.1	3.9	50	60	0.10
III-2	1518.0	23.8	5.0	0.5	2.3	7.8	31.6	37.1	68.7	800	920	0.61
III-3	430.0	11.1	1.5	0.1	3.1	4.7	15.8	18.5	34.3	400	460	1.07
III-4	570.2	15.5	0.6	0.4	0.6	1.6	17.1	20.1	37.2	430	490	0.86
III-5	94.2	0.3	0.2	0	0.1	0.3	0.6	0.7	1.3	20	20	0.21
III-TOTAL	3219.9	52.1	7.5	1.0	6.3	14.8	66.9	78.5	145.4	1680	1930	0.60
IV-1	958.0	13.7	1.8	0.3	0.5	2.6	16.3	19.1	35.4	410	470	0.49
IV-2	792.4	8.6	3.3	0.2	0.3	3.8	12.4	14.6	27.0	310	360	0.45
IV-3	836.1	6.0	2.7	0.2	0.8	3.7	9.7	11.4	21.1	240	280	0.33
IV-4	439.4	1.2	1.0	0	0.2	1.2	2.4	2.8	5.2	60	70	0.16
IV-5	1258.4	11.8	5.1	0.2	1.3	6.6	18.4	21.6	40.0	460	530	0.42
IV-6	1475.4	8.7	1.7	0.3	1.6	3.6	12.3	14.4	26.7	310	360	0.24
IV-7	766.9	3.8	1.5	0.1	0.7	2.3	6.1	7.2	13.3	150	170	0.22
IV-TOTAL	6526.6	53.8	17.1	1.3	5.4	23.8	77.6	91.1	168.7	1950	2240	0.34
V-1	480.0	12.8	3.7	0.2	0.6	4.5	17.3	20.3	37.6	440	510	1.06
V-2	1476.2	21.6	6.4	0.6	0.7	7.7	29.3	34.4	63.7	740	850	0.58
V-3	1002.5	10.3	4.7	0.2	2.1	7.0	17.3	20.3	37.6	440	510	0.51
V-4	1722.6	7.5	5.7	0.2	1.1	7.0	14.5	17.0	31.5	360	410	0.24
V-5	479.7	0.9	3.8	0.3	0	4.1	5.0	5.9	10.9	130	150	0.31
V-6	878.2	2.5	3.0	1.3	0.6	4.9	7.4	8.7	16.1	190	220	0.25
V-TOTAL	6039.2	55.6	27.3	2.8	5.1	35.2	90.8	106.6	197.4	2280	2620	0.43
TOTAL	28334.2	297.3	109.7	9.7	29.4	148.8	446.1	523.7	969.8	11220	12900	0.46

Table 1B Water Demand Distribution by Each Kecamatan, 1985

KECAMATAN	AREA	DOMESTIC	NON-DOMESTIC				CONSUMP-TION	UNACCOUNT	DEMAND(DAY AVG)		DAY MAX	DENSITY
			Public	Industry	T & c	Total			(m3/d)	(l/s)		
	(ha)	('000m3/d)				('000m3/d)	('000m3/s)	(49%)			(l/s)	
I-1	757.6	14.2	7.1	0.2	3.6	10.9	25.1	24.1	49.2	570	660	0.87
I-2	583.2	14.2	5.7	0.3	2.3	8.3	22.5	21.6	44.1	510	590	1.01
I-3	704.0	18.0	3.5	0.4	0.9	4.8	22.8	21.9	44.7	520	600	0.85
I-4	461.0	12.1	6.2	0.2	3.1	9.5	21.6	20.8	42.4	490	560	1.21
I-5	717.6	18.4	5.1	0.4	0.8	6.3	24.7	23.7	48.4	560	640	0.89
I-6	613.6	11.9	4.3	0.1	1.8	6.2	18.1	17.4	35.5	410	470	0.77
I-7	1016.8	16.7	7.1	0.5	2.8	10.4	27.1	26.0	53.1	610	700	0.69
I-TOTAL	4853.8	105.5	39.0	2.1	15.3	56.4	161.9	155.6	317.5	3670	4220	0.87
II-2	2509.5	22.6	3.1	3.1	0.8	7.0	29.6	28.4	58.0	670	770	0.31
II-3	2423.0	18.8	18.1	3.3	0.1	21.5	40.3	38.7	79.0	910	1050	0.43
II-4	1571.7	18.9	1.9	1.7	0.4	4.0	22.9	22.0	44.9	520	600	0.38
II-5	1190.5	7.9	1.4	1.9	0.1	3.4	11.3	10.9	22.2	260	300	0.25
II-TOTAL	7694.7	68.2	24.5	10.0	1.4	35.9	104.1	100.0	204.1	2360	2710	0.35
III-1	607.5	1.9	0.2	0	0.3	0.5	2.4	2.3	4.7	50	60	0.10
III-2	1518.0	31.8	5.1	0.8	3.4	9.3	41.1	39.5	80.6	930	1070	0.70
III-3	430.0	13.5	1.8	0.3	4.2	6.3	19.8	19.0	38.8	450	520	1.21
III-4	570.2	19.0	1.3	0.6	0.9	2.8	21.8	20.9	42.7	490	560	0.98
III-5	94.2	0.5	0.3	0	0.2	0.5	1.0	1.0	2.0	20	20	0.21
III-TOTAL	3219.9	66.7	8.7	1.7	9.0	19.4	86.1	82.7	168.8	1950	2240	0.70
IV-1	958.0	19.1	2.1	0.4	0.8	3.3	22.4	21.5	43.9	510	590	0.62
IV-2	792.4	12.0	3.5	0.3	0.5	4.3	16.3	15.7	32.0	370	430	0.54
IV-3	836.1	9.4	2.8	0.3	1.1	4.2	13.6	13.1	26.7	310	360	0.43
IV-4	439.4	2.0	1.3	0	0.3	1.6	3.6	3.5	7.1	80	90	0.20
IV-5	1258.4	17.3	5.2	0.3	1.9	7.4	24.7	23.7	48.4	560	640	0.51
IV-6	1475.4	13.7	2.4	0.5	2.6	5.5	19.2	18.4	37.6	440	510	0.35
IV-7	766.9	6.4	1.8	0.1	1.1	3.0	9.4	9.0	18.4	210	240	0.31
IV-TOTAL	6526.6	79.9	19.1	1.9	8.3	29.3	109.2	104.9	214.1	2480	2850	0.44
V-1	480.0	16.0	4.5	0.2	1.0	5.7	21.7	20.8	42.5	490	560	1.17
V-2	1476.2	29.2	7.1	1.1	1.0	9.2	38.4	36.9	75.3	870	1000	0.68
V-3	1002.5	14.6	5.6	0.3	3.2	9.1	23.7	22.8	46.5	540	620	0.62
V-4	1722.6	11.1	6.5	0.4	1.8	8.7	19.8	19.0	38.8	450	520	0.30
V-5	479.7	1.4	4.2	0.5	0	4.7	6.1	5.9	12.0	140	160	0.33
V-6	878.2	4.2	3.7	2.9	1.2	7.8	12.0	11.5	23.5	270	310	0.35
V-TOTAL	6039.2	76.5	31.6	5.4	8.2	45.2	121.7	116.9	238.6	2760	3170	0.52
TOTAL	28334.2	396.8	112.9	21.1	42.2	176.2	573.0	550.5	1123.5	13000	14950	0.53

Table 1C Water Demand Distribution by Each Kecamatan, 1990

KECAMATAN	AREA	DOMESTIC	NON-DOMESTIC				CONSUMP-TION	UNACCOUNT	DEMAND (DAY AVG)		DAY MAX	DENSITY
			Public	Industry	T & c	Total			(m3/d)	(l/s)		
	(ha)	('000m3/d)				('000m3/d)	('000m3/s)	(40%)			(l/s)	
I-1	757.6	17.0	6.0	0.4	5.9	12.3	29.3	19.5	48.8	560	640	0.84
I-2	583.2	17.3	5.2	0.6	3.3	9.1	26.4	17.6	44.0	510	590	1.01
I-3	704.0	21.6	4.1	0.7	1.4	6.2	27.8	18.5	46.3	540	620	0.88
I-4	461.0	14.4	5.5	0.2	4.4	10.1	24.5	16.3	40.8	470	540	1.17
I-5	717.6	22.2	5.1	0.7	1.0	6.8	29.0	19.3	48.3	560	640	0.89
I-6	613.6	14.7	4.1	0.2	2.6	6.9	21.6	14.4	36.0	420	480	0.78
I-7	1016.8	20.8	6.6	0.8	4.5	11.9	32.7	21.8	54.5	630	720	0.71
I-TOTAL	4853.8	128.0	36.6	3.6	23.1	63.3	191.3	127.5	318.8	3690	4240	0.87
II-2	3315.7	30.3	3.7	8.6	1.4	13.7	44.0	29.3	73.3	850	980	0.30
II-3	2423.0	25.7	20.8	7.6	0.2	28.6	54.3	36.2	90.5	1050	1210	0.50
II-4	2004.4	25.4	2.8	4.7	0.8	8.3	33.7	22.5	56.2	650	750	0.37
II-5	1190.5	10.6	1.6	5.2	0.1	6.9	17.5	11.7	29.2	340	390	0.33
II-TOTAL	8933.6	92.0	28.9	26.1	2.5	57.5	149.5	99.7	249.2	2880	3310	0.37
III-1	1160.6	4.9	0.7	1.8	0.8	3.3	8.2	5.5	13.7	160	180	0.16
III-2	1763.1	46.4	5.5	1.6	5.5	12.6	59.0	39.3	98.3	1140	1310	0.74
III-3	430.0	16.1	1.7	0.5	6.2	8.4	24.5	16.3	40.8	470	540	1.26
III-4	570.2	22.4	1.7	1.0	1.2	3.9	26.3	17.5	43.8	510	590	1.03
III-5	1686.3	18.2	2.0	0.5	1.8	4.3	22.5	15.0	37.5	430	490	0.29
III-TOTAL	5610.2	108.0	11.6	5.4	15.5	32.5	140.5	93.7	234.2	2710	3120	0.56
IV-1	958.0	25.7	2.8	0.5	1.3	4.6	30.3	20.2	50.5	580	670	0.70
IV-2	792.4	15.9	3.7	0.4	0.8	4.9	20.8	13.9	34.7	400	460	0.58
IV-3	1292.8	19.7	3.3	0.6	1.9	5.8	25.5	17.0	42.5	490	560	0.43
IV-4	530.8	4.3	1.8	0.1	0.6	2.5	6.8	4.5	11.3	130	150	0.28
IV-5	1258.4	23.9	4.7	0.4	3.2	8.3	32.2	21.5	53.7	620	710	0.56
IV-6	1886.4	25.9	3.8	1.0	4.4	9.2	35.1	23.4	58.5	680	780	0.41
IV-7	766.9	10.0	2.0	0.2	2.0	4.2	14.2	9.5	23.7	270	310	0.40
IV-TOTAL	7485.7	125.4	22.1	3.2	14.2	39.5	164.9	109.9	274.8	3180	3660	0.49
V-1	480.0	19.4	5.2	0.3	1.6	7.1	26.5	17.7	44.2	510	590	1.23
V-2	1476.2	38.2	7.7	2.1	1.6	11.4	49.6	33.1	82.7	960	1100	0.75
V-3	1599.4	27.5	6.9	0.7	5.2	12.8	40.3	26.9	67.2	780	900	0.56
V-4	2042.2	18.1	7.0	0.6	2.9	10.5	28.6	19.1	47.7	550	630	0.31
V-5	479.7	2.0	4.8	0.8	0.1	5.7	7.7	5.1	12.8	150	170	0.35
V-6	878.2	6.7	5.3	7.0	2.6	14.9	21.6	14.4	36.0	420	480	0.55
V-TOTAL	6955.7	111.9	36.9	11.5	14.0	62.4	174.3	116.2	290.5	3360	3860	0.55
TOTAL	33839.0	565.3	136.1	49.8	69.3	255.2	820.5	547.0	1367.5	15830	18200	0.54

Table 1D Water Demand Distribution by Each Kecamatan, 1995

KECAMATAN	AREA	DOMESTIC	NON-DOMESTIC				CONSUMP-TION	UNACCOUNT	DEMAND (DAY AVG)		DAY MAX	DENSITY
			Public	Industry	T & C	Total			(m3/d)	(l/s)		
	(ha)	('000m3/d)				('000m3/d)	('000m3/d)	(33%)			(l/s)	
I-1	757.6	19.9	6.1	0.5	9.3	15.9	35.8	17.6	53.4	620	710	0.94
I-2	583.2	20.8	5.9	0.9	4.8	11.6	32.4	16.0	48.4	560	640	1.10
I-3	704.0	25.4	5.1	1.1	2.0	8.2	33.6	16.5	50.1	580	670	0.95
I-4	461.0	16.6	5.8	0.3	6.3	12.4	29.0	14.3	43.3	500	580	1.26
I-5	717.6	26.2	5.7	0.9	1.5	8.1	34.3	16.9	51.2	590	680	0.95
I-6	613.6	17.5	4.5	0.2	4.0	8.7	26.2	12.9	39.1	450	520	0.85
I-7	1016.8	25.1	7.0	1.0	7.0	15.0	40.1	19.8	59.9	690	790	0.78
I-TOTAL	4853.8	151.5	40.1	4.9	34.9	79.9	231.4	114.0	345.4	4000	4600	0.95
II-2	3315.7	39.0	5.6	19.0	2.6	27.2	66.2	32.6	98.8	1140	1310	0.40
II-3	2423.0	32.2	24.4	14.2	0.5	39.1	71.3	35.1	106.4	1230	1410	0.58
II-4	2004.4	31.7	4.1	9.4	1.4	14.9	46.6	23.0	69.6	810	930	0.46
II-5	1190.5	14.1	2.4	9.9	0.3	12.6	26.7	13.2	39.9	460	530	0.45
II-TOTAL	8933.6	117.0	36.5	52.5	4.8	93.8	210.8	103.8	314.6	3640	4190	0.47
III-1	1573.4	9.0	1.3	4.6	1.3	7.2	16.2	8.0	24.2	280	320	0.20
III-2	1763.1	59.2	7.1	2.5	8.5	18.1	77.3	38.1	115.4	1340	1540	0.87
III-3	430.0	18.8	2.2	0.6	8.6	11.4	30.2	14.9	45.1	520	600	1.40
III-4	570.2	26.0	2.9	1.7	1.9	6.5	32.5	16.0	48.5	560	640	1.12
III-5	2533.7	40.0	4.7	1.2	4.1	10.0	50.0	24.6	74.6	860	990	0.39
III-TOTAL	6870.4	153.0	18.2	10.6	24.4	53.2	206.2	101.6	307.8	3560	4090	0.60
IV-1	958.0	32.0	3.9	0.7	2.3	6.9	38.9	19.2	58.1	670	770	0.80
IV-2	792.4	19.7	4.5	0.5	1.4	6.4	26.1	12.9	39.0	450	520	0.66
IV-3	1860.4	39.7	5.7	0.9	3.2	9.8	49.5	24.4	73.9	860	990	0.53
IV-4	795.9	11.0	2.7	0.3	1.4	4.4	15.4	7.6	23.0	270	310	0.39
IV-5	1258.4	30.4	5.3	0.5	5.4	11.2	41.6	20.5	62.1	720	830	0.66
IV-6	2931.1	56.3	8.1	1.9	7.0	17.0	73.3	36.1	109.4	1270	1460	0.50
IV-7	766.9	15.2	2.6	0.3	3.4	6.3	21.5	10.6	32.1	370	430	0.56
IV-TOTAL	9363.1	204.3	32.8	5.1	24.1	62.0	266.3	131.2	397.5	4600	5290	0.56
V-1	480.0	22.9	6.3	0.4	2.6	9.3	32.2	15.9	48.1	560	640	1.33
V-2	1476.2	47.5	9.2	2.8	2.5	14.5	62.0	30.5	92.5	1070	1230	0.83
V-3	2323.5	51.0	10.7	1.4	8.2	20.3	71.3	35.1	106.4	1230	1410	0.61
V-4	2117.4	25.4	8.6	0.8	4.6	14.0	39.4	19.4	58.8	680	780	0.37
V-5	479.7	2.8	5.3	1.5	0.1	6.9	9.7	4.8	14.5	170	200	0.42
V-6	1399.7	15.4	6.6	10.3	5.1	22.0	37.4	18.4	55.8	650	750	0.54
V-TOTAL	8276.5	165.0	46.7	17.2	23.1	87.0	252.0	124.1	376.1	4350	5000	0.60
TOTAL	38297.4	790.8	174.3	90.3	111.3	375.9	1166.7	574.6	1741.3	20150	23170	0.61

Table 1E Water Demand Distribution by Each Kecamatan, 2000

KECAMATAN	AREA	DOMESTIC	NON-DOMESTIC				CONSUMP-TION	UNACCOUNT	DEMAND (DAY AVG)		DAY MAX	DENSITY
			Public	Industry	T & C	Total			(m3/d)	(l/s)		
	(ha)	('000m3/d)				('000m3/d)	('000m3/s)	(29%)			(l/s)	
I-1	757.6	23.0	6.5	0.7	15.2	22.4	45.4	18.5	63.9	740	850	1.12
I-2	583.2	24.0	6.4	1.3	6.8	14.5	38.5	15.7	54.2	630	720	1.23
I-3	704.0	28.9	5.6	1.5	2.9	10.0	38.9	15.9	54.8	630	720	1.02
I-4	461.0	19.1	6.4	0.3	9.1	15.8	34.9	14.3	49.2	570	660	1.43
I-5	717.6	30.2	6.3	1.3	2.2	9.8	40.0	16.3	56.3	650	750	1.05
I-6	613.6	20.8	4.8	0.3	5.6	10.7	31.5	12.9	44.4	510	590	0.96
I-7	1016.8	29.7	7.5	1.3	10.9	19.7	49.4	20.2	69.6	810	930	0.91
I-TOTAL	4853.8	175.7	43.5	6.7	52.7	102.9	278.6	113.8	392.4	4540	5220	1.08
II-2	3315.7	47.7	6.3	31.3	4.5	42.1	89.8	36.7	126.5	1460	1680	0.51
II-3	2423.0	38.4	28.4	21.2	1.1	50.7	89.1	36.4	125.5	1450	1670	0.69
II-4	2004.4	37.3	4.8	14.4	2.7	21.9	59.2	24.2	83.4	970	1120	0.56
II-5	1190.5	17.1	3.0	14.8	0.5	18.3	35.4	14.5	49.9	580	670	0.56
II-TOTAL	8933.6	140.5	42.5	81.7	8.8	133.0	273.5	111.7	385.2	4460	5130	0.57
III-1	2240.7	17.2	2.5	9.9	3.6	16.0	33.2	13.6	46.8	540	620	0.28
III-2	1763.1	70.5	7.8	3.5	13.2	24.5	95.0	38.8	133.8	1550	1780	1.01
III-3	430.0	21.3	2.3	1.0	12.5	15.8	37.1	15.2	52.3	610	700	1.63
III-4	570.2	29.4	3.0	2.7	2.6	8.3	37.7	15.4	53.1	610	700	1.23
III-5	3442.7	69.8	7.3	2.1	10.1	19.5	89.3	36.5	125.8	1460	1680	0.49
III-TOTAL	8446.7	208.2	22.9	19.2	42.0	84.1	292.3	119.4	411.7	4770	5490	0.65
IV-1	958.0	39.4	4.4	0.9	4.0	9.3	48.7	19.9	68.6	790	910	0.95
IV-2	792.4	23.6	4.8	0.6	2.5	7.9	31.5	12.9	44.4	510	590	0.74
IV-3	1860.4	53.0	6.6	1.4	5.2	13.2	66.2	27.0	93.2	1080	1240	0.67
IV-4	1133.3	19.4	3.9	0.5	3.3	7.7	27.1	11.1	38.2	440	510	0.45
IV-5	1258.4	37.9	5.9	0.7	8.8	15.4	53.3	21.8	75.1	870	1000	0.79
IV-6	3169.1	82.3	10.7	2.9	11.3	24.9	107.2	43.8	151.0	1750	2010	0.63
IV-7	766.9	19.0	3.0	0.3	5.9	9.2	28.2	11.5	39.7	460	530	0.69
IV-TOTAL	9938.5	274.6	39.3	7.3	41.0	87.6	362.2	147.9	510.1	5900	6790	0.68
V-1	480.0	26.0	7.0	0.5	4.1	11.6	37.6	15.4	53.0	610	700	1.46
V-2	1476.2	56.1	10.4	3.7	3.9	18.0	74.1	30.3	104.4	1210	1390	0.94
V-3	2669.5	70.9	12.5	2.1	13.2	27.8	98.7	40.3	139.0	1610	1850	0.69
V-4	2423.1	34.8	9.8	1.4	7.3	18.5	53.3	21.8	75.1	870	1000	0.41
V-5	479.7	3.6	5.9	2.2	0.2	8.3	11.9	4.9	16.8	190	220	0.46
V-6	1693.8	24.4	8.2	19.8	11.0	39.0	63.4	25.9	89.3	1030	1180	0.70
V-TOTAL	9222.3	215.8	53.8	29.7	39.7	123.2	339.0	138.5	477.5	5530	6360	0.69
TOTAL	41394.9	1014.8	202.0	144.6	184.2	530.8	1545.6	631.3	2176.9	25200	28980	0.70

Table 1F Water Demand Distribution by Each Kecamatan, 2005

KECAMATAN	AREA	DOMESTIC	NON-DOMESTIC				CONSUMP-TION	UNACCOUNT	DEMAND(DAY AVG)		DAY MAX	DENSITY
			Public	Industry	T & C	Total			(m3/d)	(l/s)		
	(ha)	('000m3/d)				('000m3/d)	('000m3/s)	(25%)			(l/s)	
I-1	757.6	26.1	7.3	0.9	22.9	31.1	57.2	19.1	76.3	880	1010	1.33
I-2	583.2	27.3	7.2	1.8	9.1	18.1	45.4	15.1	60.5	700	810	1.39
I-3	704.0	32.6	6.1	2.0	3.8	11.9	44.5	14.8	59.3	690	790	1.12
I-4	461.0	21.3	6.8	0.4	12.1	19.3	40.6	13.5	54.1	630	720	1.56
I-5	717.6	34.2	6.9	1.7	3.0	11.6	45.8	15.3	61.1	710	820	1.14
I-6	613.6	24.1	5.3	0.4	8.0	13.7	37.8	12.6	50.4	580	670	1.09
I-7	1016.8	34.0	8.3	1.7	16.7	26.7	60.7	20.2	80.9	940	1080	1.06
I-TOTAL	4853.8	199.6	47.9	8.9	75.6	132.4	332.0	110.7	442.7	5120	5890	1.21
II-2	3315.7	57.4	7.6	45.7	5.9	59.2	116.6	38.9	155.5	1800	2070	0.62
II-3	2423.0	45.2	33.1	28.2	1.9	63.2	108.4	36.1	144.5	1670	1920	0.79
II-4	2004.4	43.7	5.6	19.7	5.5	30.8	74.5	24.8	99.3	1150	1320	0.66
II-5	1190.5	20.6	3.4	19.7	0.9	24.0	44.6	14.9	59.5	690	790	0.66
II-TOTAL	8933.6	166.9	49.7	113.3	14.2	177.2	344.1	114.7	458.8	5310	6110	0.68
III-1	3233.1	32.8	4.2	26.5	9.0	39.7	72.5	24.2	96.7	1120	1290	0.40
III-2	1763.1	83.8	9.0	4.9	19.1	33.0	116.8	38.9	155.7	1800	2070	1.17
III-3	430.0	24.2	2.7	1.3	16.6	20.6	44.8	14.9	59.7	690	790	1.84
III-4	570.2	33.1	3.2	3.7	3.6	10.5	43.6	14.5	58.1	670	770	1.35
III-5	4375.6	123.1	12.4	4.1	19.6	36.1	159.2	53.1	212.3	2460	2830	0.65
III-TOTAL	10372.0	297.0	31.5	40.5	67.9	139.9	436.9	145.6	582.5	6740	7750	0.75
IV-1	938.0	46.5	5.0	1.1	6.4	12.5	59.0	19.7	78.7	910	1050	1.10
IV-2	792.4	27.5	5.3	0.9	3.8	10.0	37.5	12.5	50.0	580	670	0.85
IV-3	1860.4	65.2	7.6	1.8	8.1	17.5	82.7	27.6	110.3	1280	1470	0.79
IV-4	1467.3	29.2	5.0	0.8	6.6	12.4	41.6	13.9	55.5	640	740	0.50
IV-5	1258.4	44.9	6.6	0.9	13.8	21.3	66.2	22.1	88.3	1020	1170	0.93
IV-6	3169.1	101.4	13.0	4.2	16.5	33.7	135.1	45.0	180.1	2080	2390	0.75
IV-7	786.9	23.3	3.4	0.5	9.3	13.2	36.5	12.2	48.7	560	640	0.83
IV-TOTAL	10272.5	338.0	45.9	10.2	64.5	120.6	458.6	152.9	611.5	7080	8140	0.79
V-1	480.0	29.4	7.8	0.6	6.2	14.6	44.0	14.7	58.7	680	780	1.63
V-2	1676.2	64.7	11.6	4.8	5.7	22.1	86.8	28.9	115.7	1340	1540	1.04
V-3	3188.0	100.2	15.5	3.3	19.2	38.0	138.2	46.1	184.3	2130	2450	0.77
V-4	2728.7	46.2	11.4	2.1	10.9	24.4	70.6	23.5	94.1	1090	1250	0.46
V-5	663.4	7.0	6.6	3.3	0.3	10.2	17.2	5.7	22.9	270	310	0.47
V-6	2479.1	46.3	11.1	27.1	21.7	59.9	106.2	35.4	141.6	1640	1890	0.76
V-TOTAL	11015.4	293.8	64.0	41.2	64.0	169.2	463.0	154.3	617.3	7140	8210	0.75
TOTAL	45447.3	1295.3	239.0	214.1	286.2	739.3	2034.6	678.2	2712.8	31400	36110	0.79

2. Study by Module to Select Optimal Supply Zones

To select optimal supply zones, various-sized supply blocks and their combination will be compared in respect to costs, considering at the same time convenience of operation. For this comparative study, some assumptions will first be made, and then based on them, costs be estimated, as briefed in the following.

1) Assumptions

(1) Topographical Condition

a. Flat: To be applied to the northern part of the served area as shown on Fig. 2.

b. Sloping, with gradient of 3% :

To be applied to the southern part of the served area as shown on Fig. 2.
This gradient will be considered in calculating pipe size.

(2) Unit Water Demand per Hectare

The following three cases, which are taken from Table 1 as representative unit water demands, will be applied for calculation of necessary pipes.

a. 1.0 l/sec
b. 0.75 l/sec
c. 0.50 l/sec

(3) Size of Supply Zone

To obtain roughly an appropriate magnitude of supply zone, the following assumptions will be employed for module study, although a square-shaped zone cannot be applied to the served area.

a. 5 x 5 km = 25 km2
b. 7.5 x 7.5 km = 56 km2
c. 10 x 10 km = 100 km2

(4) Modules for Comparison

Based on the above assumptions, 18 modules are made as shown on Fig. 3.

FIG 2 : TOPOGRAPHICAL FEATURE OF SERVICE AREA

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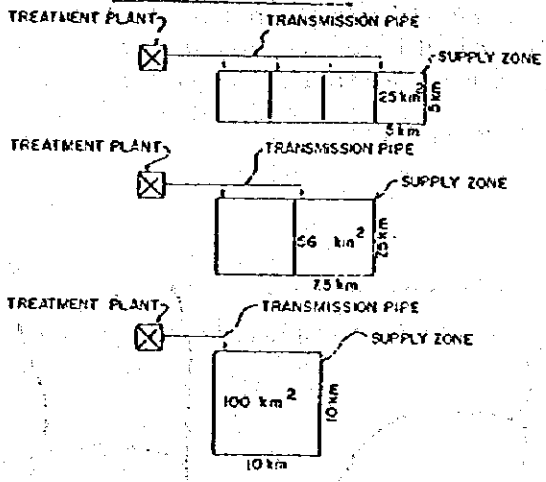
Scale of Supply Zone

① 4 × 25 km² = 100 km²

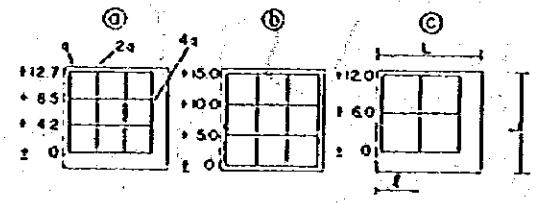
② 2 × 56 km² = 112 km²

③ 1 × 100 km² = 100 km²

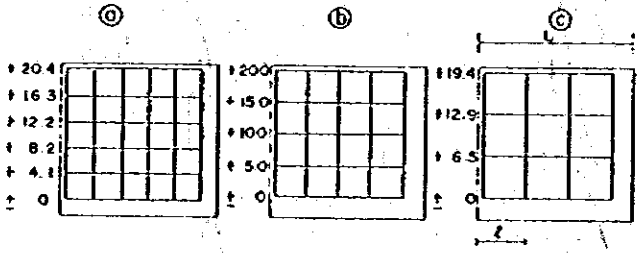
Schem of Supply Sistem



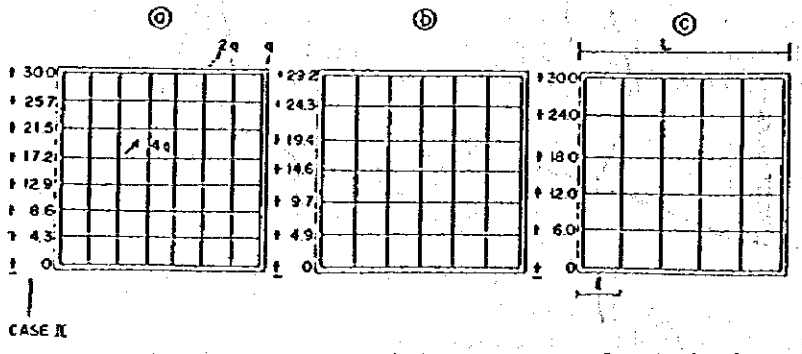
LAYOUT OF TRUNK MAIN OF EACH CASE



	a	b	c
ℓ(km)	141	167	200
L(km)	5	5	5
q(l/s)	60	68	65



	a	b	c
ℓ(km)	136	167	215
L(km)	75	75	75
q(l/s)	60	68	95



	a	b	c
ℓ(km)	143	162	200
L(km)	10	10	10
q(l/s)	66	64	65

CASE II

a : unit water demand 1.0 l/s/ha (day maximum)
b : unit water demand 0.75 l/s/ha (day maximum)
c : unit water demand 0.50 l/s/ha (day maximum)

l : unit length of main grid
q : discharge rate of node (hourly maximum)

CASE I : flat area CASE II : area with gradient, 3%

FIG 3 MODULE FOR COST COMPARISON

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2) Cost Comparison

Applying the assumptions in the foregoing para, construction and O & M costs, and present worth of the costs will be calculated on the following conditions.

i. Total construction period is assumed as 6 years, where construction of transmission facilities in two years, and distribution facilities in six years.

ii. Operation period is assumed as 20 years after completion of construction.

iii. Mechanical and electrical equipment are considered to be replaced at every 15 years after starting operation.

The results of calculation are shown on Table 2. From the Table, the following conclusions will be made, that is:

a. Northern Area with Flat Topography

In all supply capacities, Sub-case 2 with an area of 7.5 km x 7.5 km has least cost.

b. Southern Area with Gradient 3%

Sub-case 3 with 10 km x 10 km area shows least cost, but it is not significantly different from Sub-case 2. Considering that the operation of Sub-case with a smaller area is more convenient and also the supply capacity of this size area is appropriate, Sub-case 2 is considered preferable.

Table 2 Cost Comparison for Scale of Supply Zone

Unit: Million Yen

SUPPLY CAP.	CASE/ SUB-CASE	INITIAL COST		O & M COST		REPLACE-MENT COST	8%		10%		12%	
			UNIT COST		UNIT COST		PRESENT WORTH	UNIT COST	PRESENT WORTH	UNIT COST	PRESENT WORTH	UNIT COST
l/sec	Case I											
2,500	a - 1	4,849	1.94	134.4	0.054	556	5,375	2.15	5,047	2.02	4,722	1.89
5,630	2	10,577	1.88	302.3	0.054	1,283	11,811	2.10	11,008	1.96	10,355	1.84
10,000	3	18,531	1.85	558.6	0.056	2,422	20,955	2.10	19,494	1.95	18,312	1.83
1,880	b - 1	4,230	2.25	102.1	0.054	433	4,561	2.43	4,272	2.27	4,036	2.15
4,240	2	8,217	1.94	246.2	0.058	1,038	9,272	2.19	8,629	2.04	8,108	1.91
7,090	3	14,051	1.98	387.5	0.055	1,691	15,660	2.20	14,534	2.05	13,684	1.93
1,250	c - 1	2,880	2.30	64.4	0.052	297	3,062	2.45	2,874	2.30	2,720	2.18
2,830	2	5,874	2.08	157.3	0.056	673	6,469	2.29	6,041	2.13	5,692	2.01
5,000	3	10,813	2.16	280.2	0.056	1,222	11,834	2.37	11,060	2.21	10,429	2.09
	Case II											
2,500	a - 1	4,713	1.89	114.7	0.046	472	5,087	2.03	4,764	1.91	4,500	1.80
5,630	2	10,147	1.80	208.0	0.037	874	10,062	1.89	9,993	1.77	9,473	1.68
10,000	3	17,502	1.75	324.2	0.032	1,417	18,036	1.80	17,007	1.70	16,154	1.62
1,880	b - 1	4,131	2.20	80.7	0.043	341	4,290	2.28	4,041	2.15	3,835	20.4
4,240	2	7,941	1.87	182.0	0.043	762	8,477	2.00	7,952	1.88	7,521	1.77
7,090	3	13,256	1.87	227.2	0.032	994	13,502	1.90	12,755	1.80	12,132	1.71
1,250	c - 1	2,833	2.27	53.3	0.043	230	2,926	2.34	2,758	2.21	2,619	2.10
2,830	2	5,689	2.01	114.5	0.040	488	5,938	2.10	5,589	1.97	5,300	1.87
5,000	3	10,294	2.06	164.7	0.033	724	10,384	2.08	9,824	1.96	9,355	1.87

Note: In the table, Case I shows the case where topography is flat
Case II shows the case where gradient is 3%
a shows the case where unit demand is 1.0 l/s/h
b " 0.75 "
c " 0.50 "
1 shows the case where the areas is 5 x 5 km2
2 " 7.5 x 7.5 "
3 " 10 x 10 "

3. Conclusion

1) Considerations for Application of Modules

Selected modules will be applied to the dividing of the existing served area, based on the following basic considerations.

(1) Taking advantage of the locations of the existing two major treatment plants, i.e., Pejompongan and Pulogadung, and also the natural topographical boundary of the Ciliwung River, the served area will be divided roughly into two main zones, namely, east and west.

(2) In addition to the above (1), the served area will be roughly divided into two main zones because of the topographical gradient, namely, northern flat zone and southern sloping zone.

(3) Considering the difficulty of expanding the existing water system located in the highly built up area, new additional systems will be located on the periphery of the city to strengthen the water supply in the peripheral areas.

(4) The capacity of a supply zone will be targeted at ± 5 m3/sec, so as to avoid too expensive trunk mains construction works.

2) Proposed Supply Zones

Supply zones selected under the considerations in 1) are proposed as shown on Fig. 4 for 1995 and Fig. 5 for 2005. Water demand of each supply zone is estimated based on area wise (Kecamatan) demand as shown in Tables 3 and 4.

There are some modifications in boundaries of zones for transition from 1995 to 2005, because there are natural growths of water demand. Regarding these modifications, all layout of trunk mains is planned to minimize the construction cost thereof.

3) Supply Zones and Administrative Divisions

The proposed supply zones are determined on technical basis, and do not necessarily correspond with the administrative divisions, the existing Districts. When data sorted by District is required for statistic and other purposes, that is possible by computerized processing.

Table 3 Water Demand Distribution by Supply Zone in 1995 (Day Max in l/s)

Zone	KECAMATAN	1995 TOTAL DEMAND	%	Demand
Z-1	I-1	710	100	710
	I-2	640	-	-
	I-6	520	100	520
	I-7	290	100	790
	II-2	1,310	40	520
	III-2	1,540	85	1,310
	III-3	600	100	600
	III-4	640	100	640
	IV-1	770	-	-
	IV-2	520	40	210
	IV-5	830	10	80
	IV-6	1,450	15	220
	TOTAL			5,600
Z-2	I-3	670	20	130
	I-4	580	65	380
	I-5	680	100	680
	II-4	930	20	190
	V-1	640	100	640
	V-2	1,230	100	1,230
	V-6	750	100	750
	TOTAL			4,000
Z-3	I-2	640	100	640
	I-3	670	80	540
	I-4	580	35	200
	II-2	1,310	30	390
	II-3	1,020	100	1,020
	II-4	930	80	740
	II-5	530	100	530
	Tanjung Priok	390	100	390
	TOTAL			4,450
Z-4	II-2	1,310	30	400
	III-1	320	100	320
	III-2	1,540	15	230
	III-5	980	100	990
	TOTAL			1,940

Zone	KECAMATAN	1995 TOTAL DEMAND	%	Demand
Z-5	IV-1	770	100	770
	IV-2	520	60	310
	IV-3	990	100	990
	IV-4	310	100	310
	IV-5	830	90	750
	IV-6	1,460	85	1,240
	IV-7	430	100	430
	TOTAL			4,800
$\overline{Z}$-6	IV-1	-	-	-
	IV-2	-	-	-
	V-3	1,410	100	1,410
	V-4	780	100	780
	V-5	200	100	200
	TOTAL			2,390
TOTAL				23,200

Table 4 Water Demand Distribution by Supply Zone in 2005 (Day Max in l/s)

Zone	KECAMATAN	2005 TOTAL DEMAND	%	Demand
Z-1	I-1	1,010	100	1,010
	I-6	670	100	670
	I-7	1,080	100	1,080
	III-2	2,070	88	1,820
	III-3	790	65	510
	III-4	770	60	460
	TOTAL			5,550
Z-2	I-4	720	100	720
	I-5	820	100	840
	V-1	780	100	780
	V-2	1,540	100	1,540
	II-4	1,320	10	130
	TOTAL			3,990
Z-3	I-2	810	100	800
	I-3	790	100	790
	II-2	2,070	30	620
	II-3	1,920	100	1,930
	II-4	1,320	90	1,190
	II-5	790	100	790
	TOTAL			6,120
Z-4	II-2	2,070	70	1,450
	III-1	1,290	20	260
	III-2	2,070	5	100
	III-3	790	35	280
	III-4	770	40	310
	TOTAL			2,400
Z-5	III-1	1,290	80	1,030
	III-2	2,070	7	150
	III-5	2,830	100	2,830
	IV-6	2,390	10	240
	TOTAL			4,250
Z-6	V-3	2,450	65	1,590
	V-6	1,890	100	1,890
	TOTAL			3,480
Z-7	IV-5	1,170	100	1,170
	IV-6	2,390	90	2,150
	IV-7	640	100	640
	TOTAL			3,960

Zone	KECAMATAN	2005 TOTAL DEMAND	%	Demand
Z-8	IV-1	1,050	100	1,050
	IV-2	670	100	670
	IV-3	1,470	100	1,470
	IV-4	740	100	740
	TOTAL			3,930
Z -9	V-3	2,450	35	860
	V-4	1,250	100	1,250
	V-5	310	100	310
	TOTAL			2,420
TOTAL				36,100

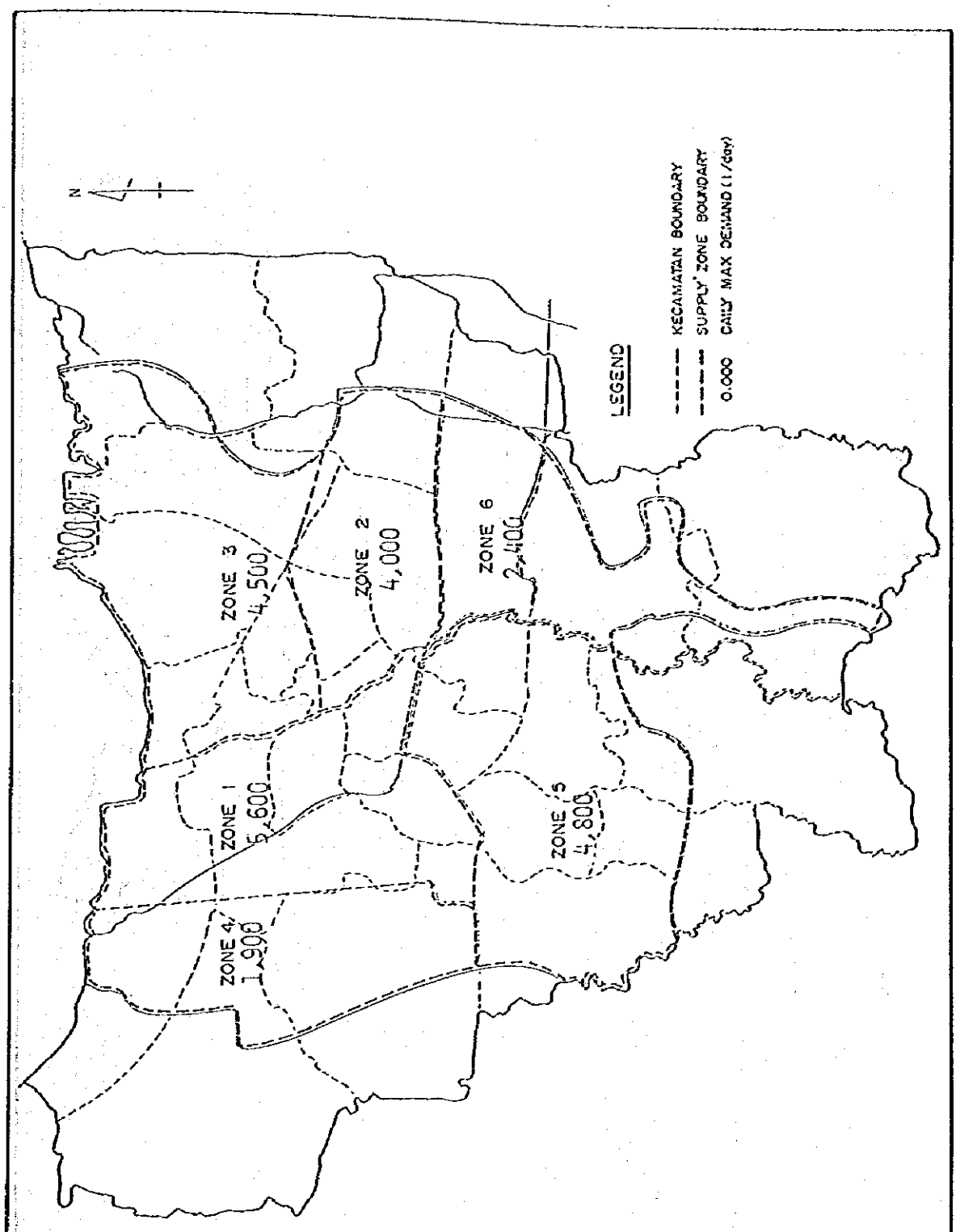

FIG 4 SUPPLY ZONE IN 1995

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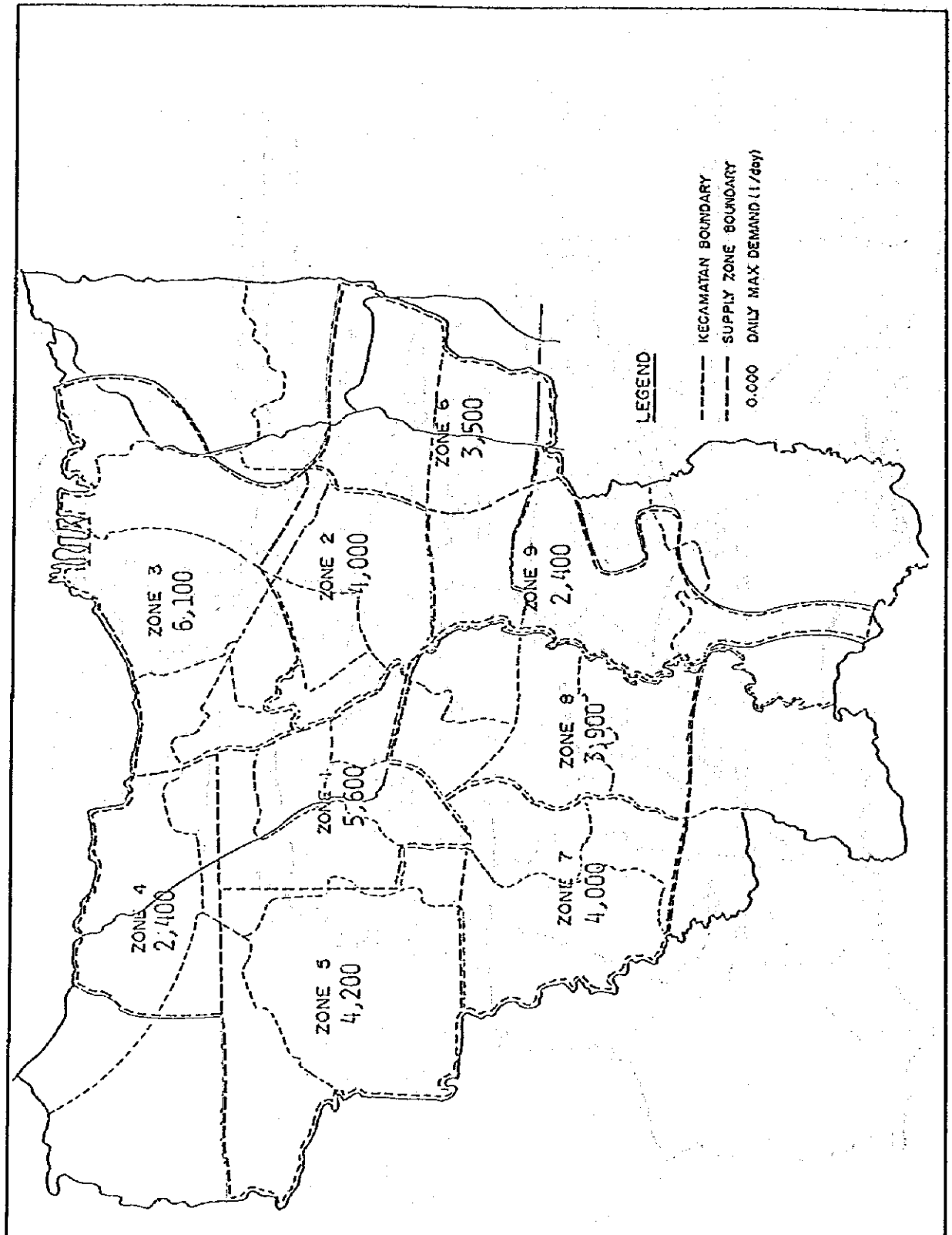

FIG 5 SUPPLY ZONE IN 2005

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MASTER PLAN FOR

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M10. APPENDIX MIV-4

ALTERNATIVE STUDY ON FUTURE WATER SUPPLY SYSTEM

(RAW WATER SOURCE AND TRANSMISSION)

ALTERNATIVE STUDY ON FUTURE WATER SUPPLY SYSTEM

(RAW WATER SOURCE AND TRANSMISSION)

Contents

1. Introduction

Whole service area is planned to be divided into plural supply zones considering the present complicated distribution network and rapid expansion of future water supply system of Jakarta. Details are explained in Appendix MIV-3 "DIVISION OF THE SERVICE AREA ... SUPPLY ZONES".

As to the development of raw water source, two possible source are considered for the future expansion program. They are the Citarum river and the Cisadane river basins located at the east and the west of Jakarta respectively. The feasibility study on the Citarum river basin recommended the Canal 1 as the advantageous raw water conveyance system for water supply to Jakarta. While the feasibility of the development of the Cisadane river basin is in the initial study stage.

It is obvious that balanced raw water supply in quantity from both east and west directions of the City is desirable from the view point of safety water supply. But economical advantage of the system is also vital zoning and availability of raw water, the alternative study was made to find out most advantageous system with required raw water from each source.

During the interim stage of the Master Plan, possible utilization of raw water sources for Jakarta water supply system in the Second Stage was studied comparing feasibleness from the economic point of view (refer to Attachment). According to the study, it was found more advantageous to take raw water from the Cisadane river to meet water demand, about 7 m3/sec, of western part of the City. About 3 m3/sec of raw water from the Cisadane river was confirmed by DGWRD for the near future and the rest is still subject to the study on water resources development of the Cisadane basin.

It should be noted that the cost comparison of the study does not include the costs for water resources development and raw water conveyance systems.

2. Water Demand of Supply Zones

Based on water demand distribution to each Kecamatan, water demand of each supply zone for the Second and the Third Stage Project is estimated and shown in Figs 1-1 and 1-2.

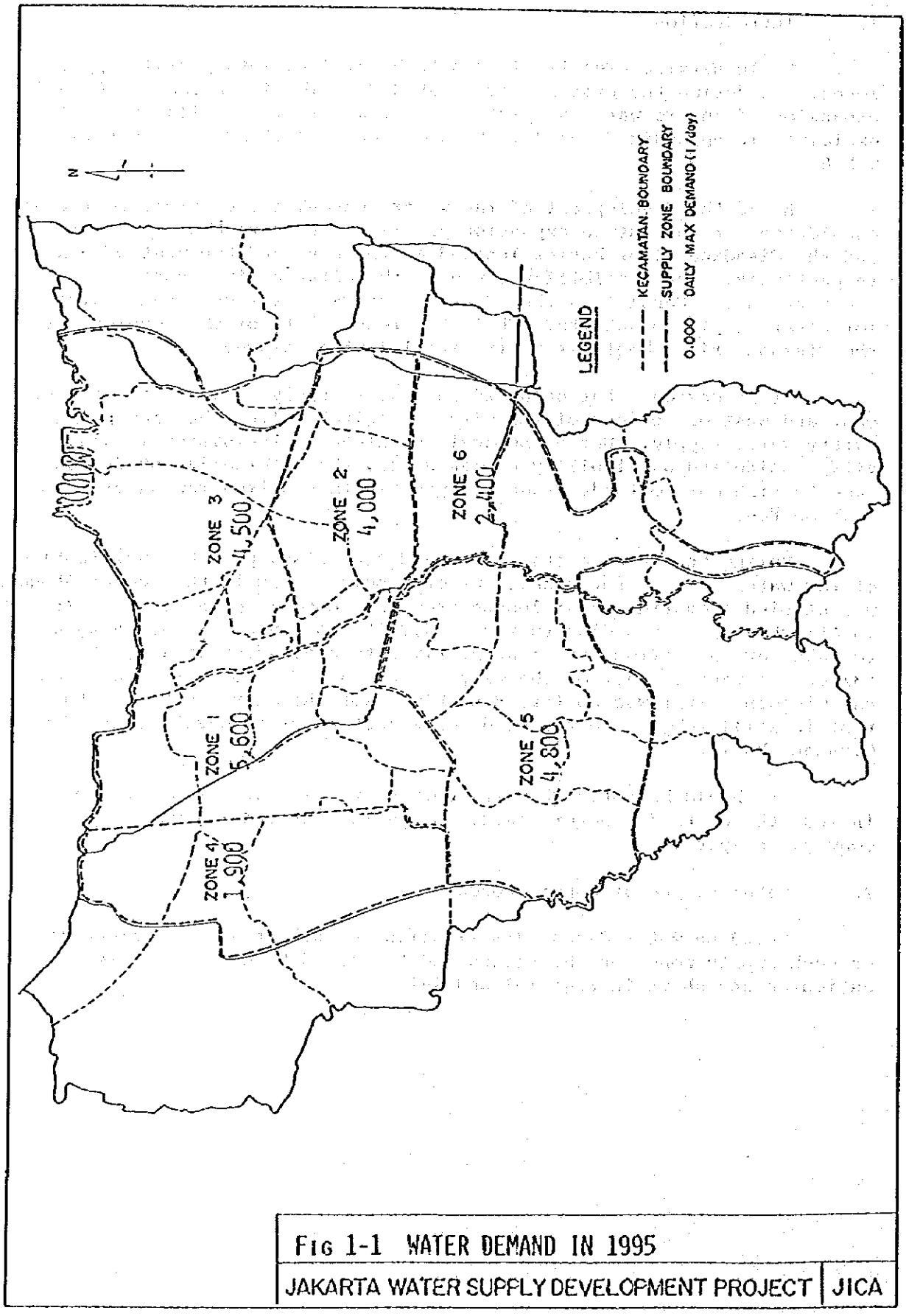

Fig 1-1 WATER DEMAND IN 1995

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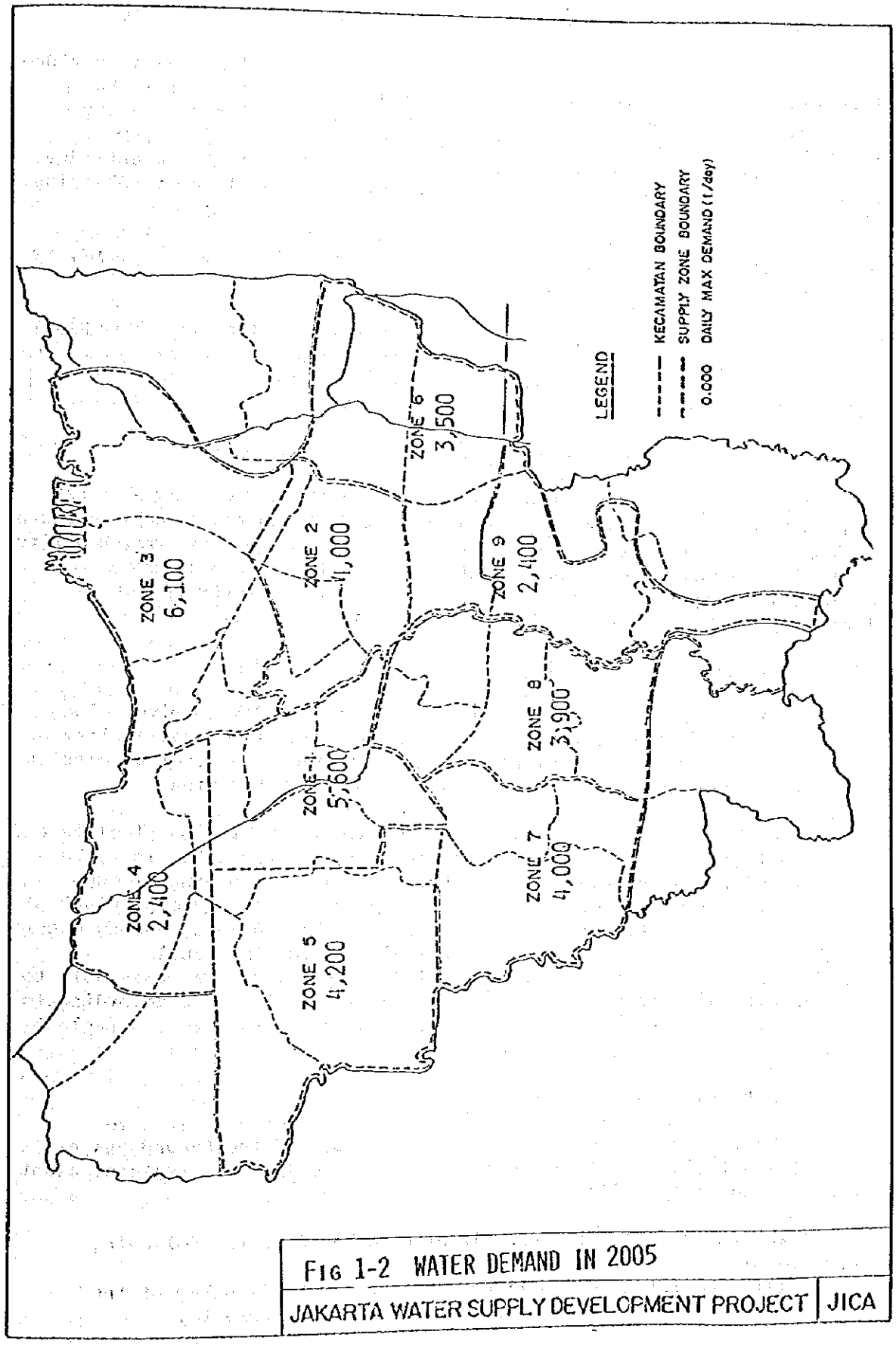

FIG 1-2 WATER DEMAND IN 2005

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3. Location of Treatment Plant and Distribution Center

As described in the preceding section, the service area is divided into plural zones. The congested central area is supplied from the existing treatment plant, Pejompongan and Pulogadung plants, and its surroundings, now developing rapidly, are to be supplied from new sources. It will be rather difficult to expand the existing plants due to land availability and congested surroundings to lay large trunk mains.

On the other hand, two raw water sources stand for the future water supply system of Jakarta, east and west directions of the City, as mentioned in the preceding section.

It will be advantageous to place the future water treatment plant at both eastward and westward of the service area.

3.1 Plant Location

1) Eastward Treatment Plant

The location of the treatment plant for the Immediate and First Phase of the Second Stage Projects is proposed at Buaran, along the south bank of WTC taking into consideration the raw water quality, availability of land and nearer locations from the service area. Details are explained in Appendices MIV-2 and MIV-5. As for the future plant location, there are substantialy two alternatives, i.e.,

(1) At the Canal end, Bekasi

(2) At Cakung, about 2 km downstream of the Bekasi river along WTC. The site was selected considering land availability and convenient location for layout of treated water transmission pipe along the major road now under construction.

In the former case, longer treated water transmission pipeline and pump facilities are required. In the latter case, raw water is to be transmitted from the Canal 1 end either by transmission pipe or open canal. It will be obvious that the case, placing the treatment plant at Cakung and transmitting raw water by canal, has an advantage among others if hydraulically feasible and land is available for the canal construction. According to the hydraulic analysis, raw water is able to be transmitted by gravity. And land is available along WTC according to the site investigation. Therefore, the location of the treatment plant is proposed at Cakung.

2) Westward Treatment Plant

The site of the plant for the First Phase of the Second Stage Project was proposed at Pondok Pinang, namely Lebakbulus treatment plant, as described in Appendix MIV-6.

The future plant location is planned based on the following conditions:

(1) The intake dam will be constructed at Cilangkap of the Cisadane river for raw water supply to Jakarta.

(2) Intake water level of dam is at + 50 m or arround.

(3) The raw water transmission system will be constructed up to the treatment plant site.

To utilize the advantage of high potential of water level at the dam, the plant is to be placed at higher location near to the service area. The location of the future plant is proposed somewhere adjacent to the Lebakbulus plant considering convenient operation and maintenance of the plant and easiness to arrange transmission pipeline to each supply zone along the outer link road.

Ground elevation of the area is + 35 m or arround, therefore the proposed water receiving level at the plant is + 40 m or arround. It will be possible to transmit raw water from the dam to the plant site by gravity considering the difference of elevations as about 10 m and about 20 km distance.

3.2 Location of the Distribution Center

From the advantage of higher location, the distribution centers for supply zones in southern area are placed at south edges along the outer link road. The layout of transmission pipeline will be easier and maintenance of them will be more convenient.

For other distribution centers, located in eastern and western areas, they are also placed at the edges of each supply zone along the outer link road taking into account the tendency of water demand increase to eastern and western directions, availability of land and convenience for layout of transmission pipelines and maintenance of them.

4. The Supply System for the Second Stage Project

It will be advantageous for the First Phase of the Second Stage Project to utilize raw water, 3 m3/sec as described in the above, from the Cisaeane river to supply water for the western zones rather than to transmit water from the east through long transmission pipeline. Earlier completion of the Canal 1 is required if raw water from the Cisadane river is not available.

As for the Second Stage Project, the Canal 1 is the only source for the additional requirement of raw water. Therefore, it is obvious that additional water requirement in the western supply zones is to be transmitted from the east. As the result, the supply system as shown in Fig. 2 is proposed.

Dimension of the transmission facilities are selected as the most advantageous combination of pipe size and pump facilities based on the present worth analysis and taking into consideration of initial cost. The summary of the facilities is presented in Table 1.

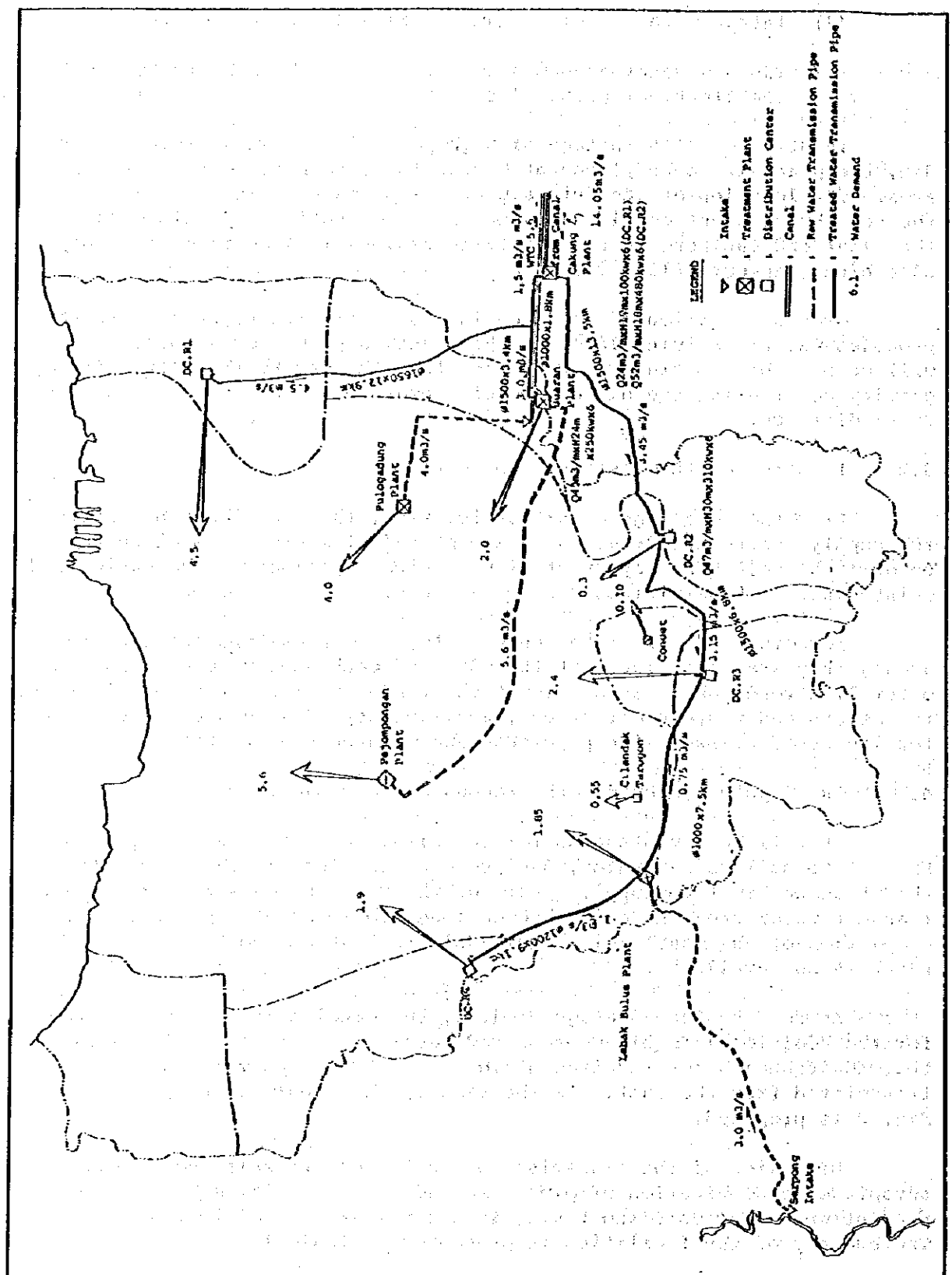

FIG 2 GENERAL LAYOUT OF THE SECOND STAGE PROJECT

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Table 1 Summary of Transmission Facilities for the Second Stage Project

1)	Buaran - R1	
	a. Transmission Pipe	ø1,500mm x L3.4km, ø1,650mm x L12.9km
	b. Junction Well	D 13 m x H 6.0 m (RC made)
	c. Transmission Pump	Q45m3/min x H24m x 250kW x 6 units
2)	Cakung - R 1	
	a. Transmission Pipe	ø 1,000 mm x L 1.8 km (up to J.Well)
	b. Transmission Pump	Q23m3/min x H19m x 100kW x 6 units
3)	Cakung - R 2	
	a. Transmission Pipe	ø 1,500 mm x L 13.5 km
	b. Transmission Pump	Q52m3/min x H42m x 480kW x 6 units
4)	R 2 - R 3	
	a. Transmission Pipe	ø 1,500 mm x L 6.8 km
	b. Transmission Pump	Q47m3/min x H30m x 310kW x 6 units
5)	R 3 - Lebakbulus	
	a. Transmission Pipe	ø 1,000 mm x L 7.5 km
	b. Transmission Pump	(by gravity)
6)	Lebakubulus - R 4	
	a. Transmission Pipe	ø 1,200 mm x L 9.1 km
	b. Transmission Pump	(by gravirty)

5. Alternatives of Transmission System

Four alternatives are proposed as described in the below and they are illustrated in Fig. 3.

Alternative 1

Raw water from the Canal 1 will be increased to meet water demand of the Supply zones 3 and 6: 3.1 m3/s(Zone 3:1.6 m3/s, Zone 6:1.5 m3/s). Raw water from Canal 3 covers water demand of other supply zones except the supply zones 1 and 2 which are supplied from the Pejompogan and Pulogadung plants. As the result, additional transmission systems are required from Lebakbulus plant to DC.R3, DC.R4, and DC.R5 and from the Cakung plant to DC.R1.

Alternative 2

Raw water from the Canal 1 will be increased to meet water demand for all supply zones without increment of any raw water supply from the Cisadane basin. As the result, additional transmission facilities from Cakung plant to every distribution centers are required.

Alternative 3

Raw water from the Canal 1 will be increased to meet water demand of the supply zones 3 and 6: 3.1 m3/s.
Increment of water demand for other supply zones except the supply zones 1 and 2 is transmitted from the Canal 2. As the result, additional transmission facilities from new water treatment plant for DC.R3, Lebakbulus plant, DC. R4, DC.R5 and the Cakung plant to DC.R1 are required. New water treatment plant will be located adjacent to DC.R2.

Alternative 4

No increase of raw water from the Canal 1 is planned while all required increment of raw water for service area comes from the Cisadane river basin through the Canal 3. As the result, additional transmission facilities from the Lebakbulus plant to DC.R3, DC.R4 and DC.R5 and from the Cakung plant to DC.R1 are required.

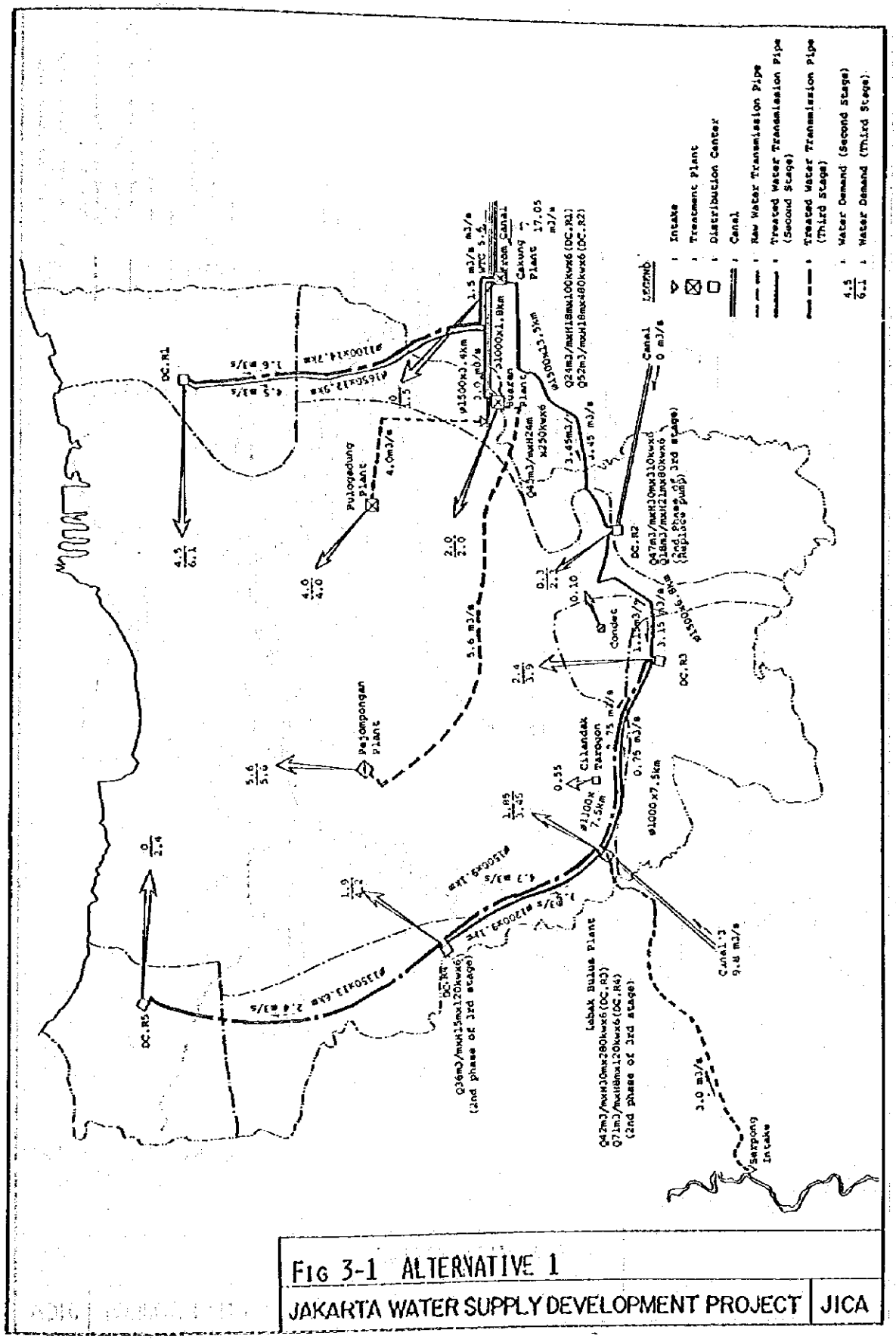

FIG 3-1 ALTERNATIVE 1

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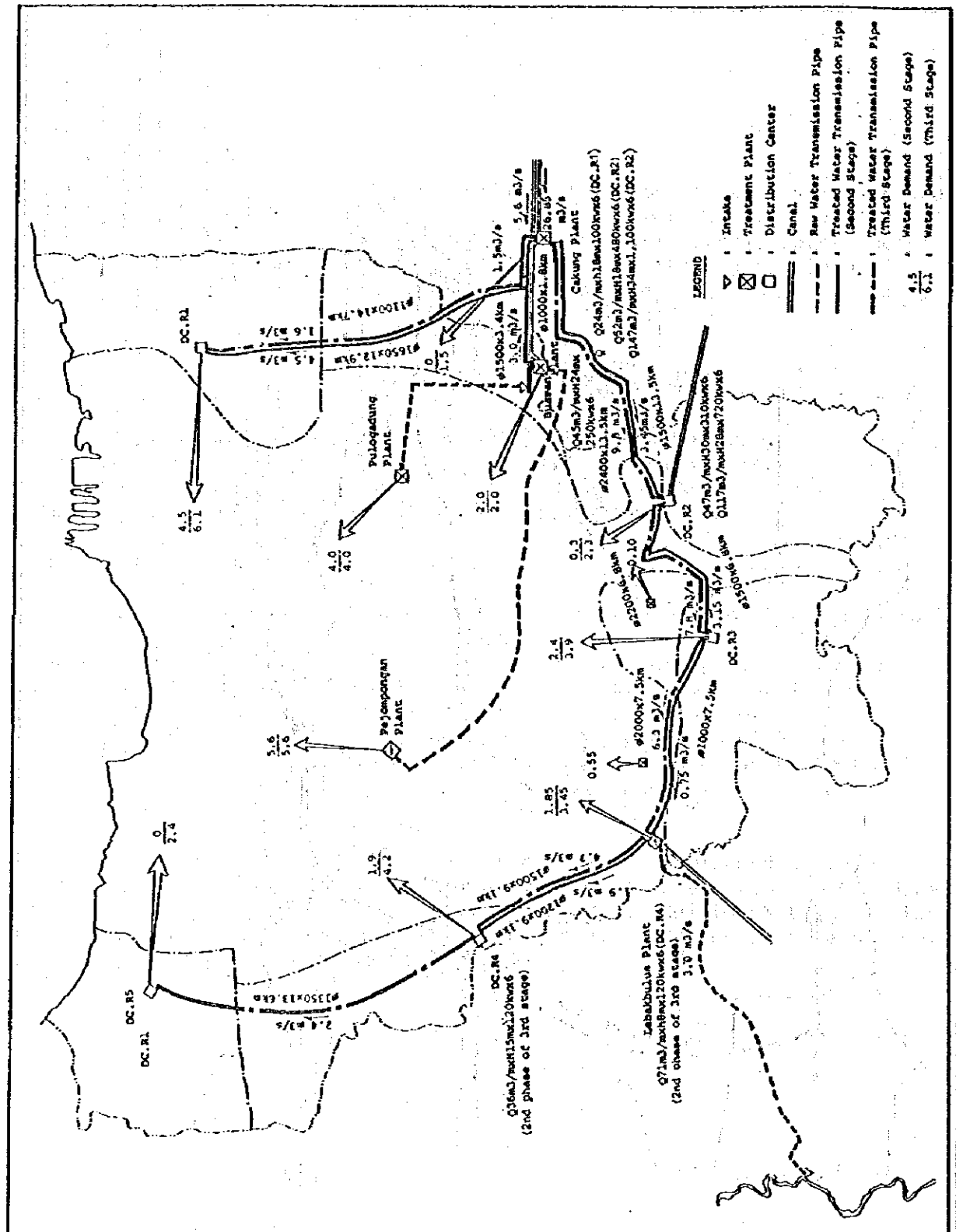

FIG 3-2 ALTERNATIVE 2

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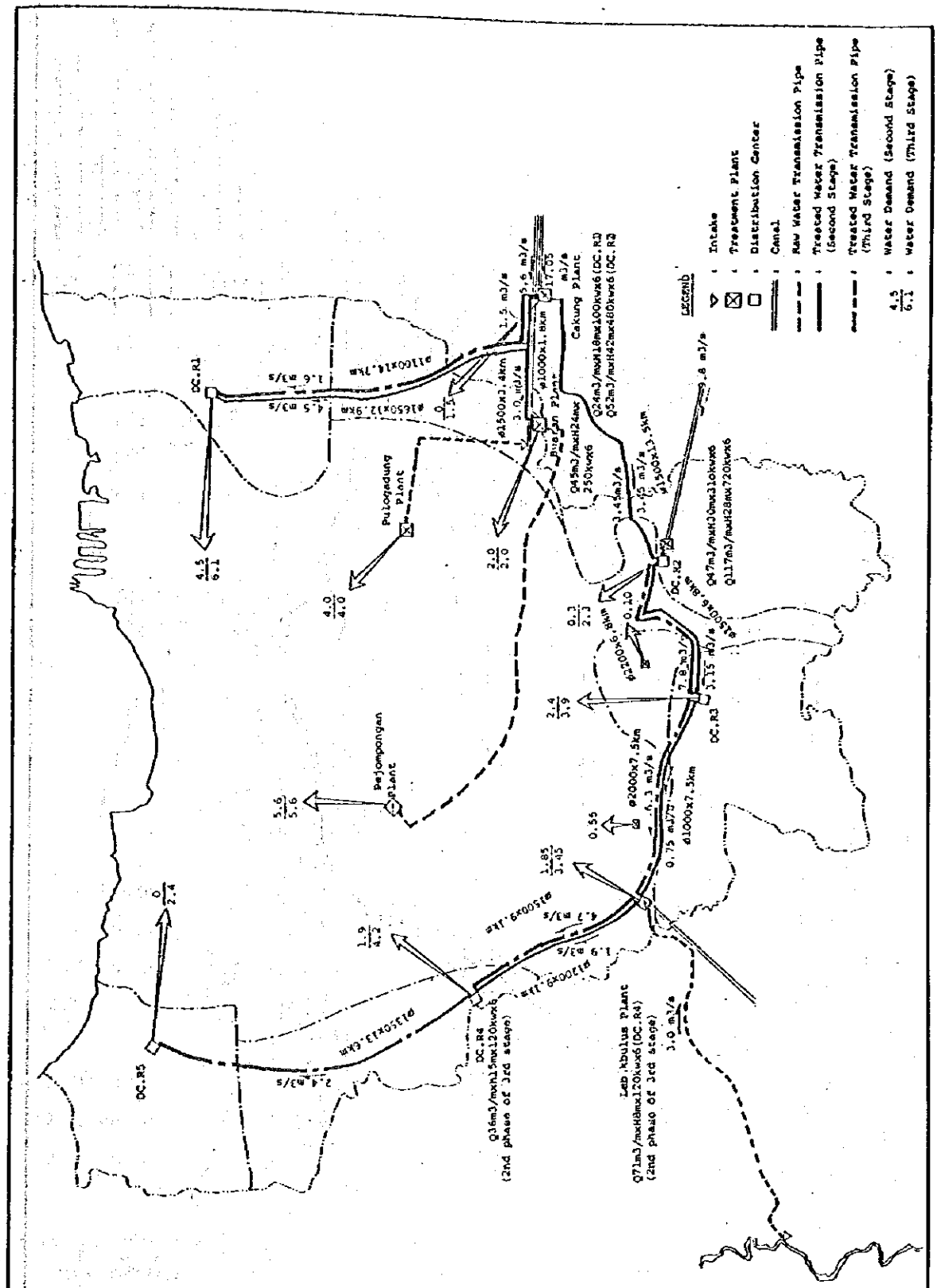

FIG 3-3 ALTERNATIVE 3

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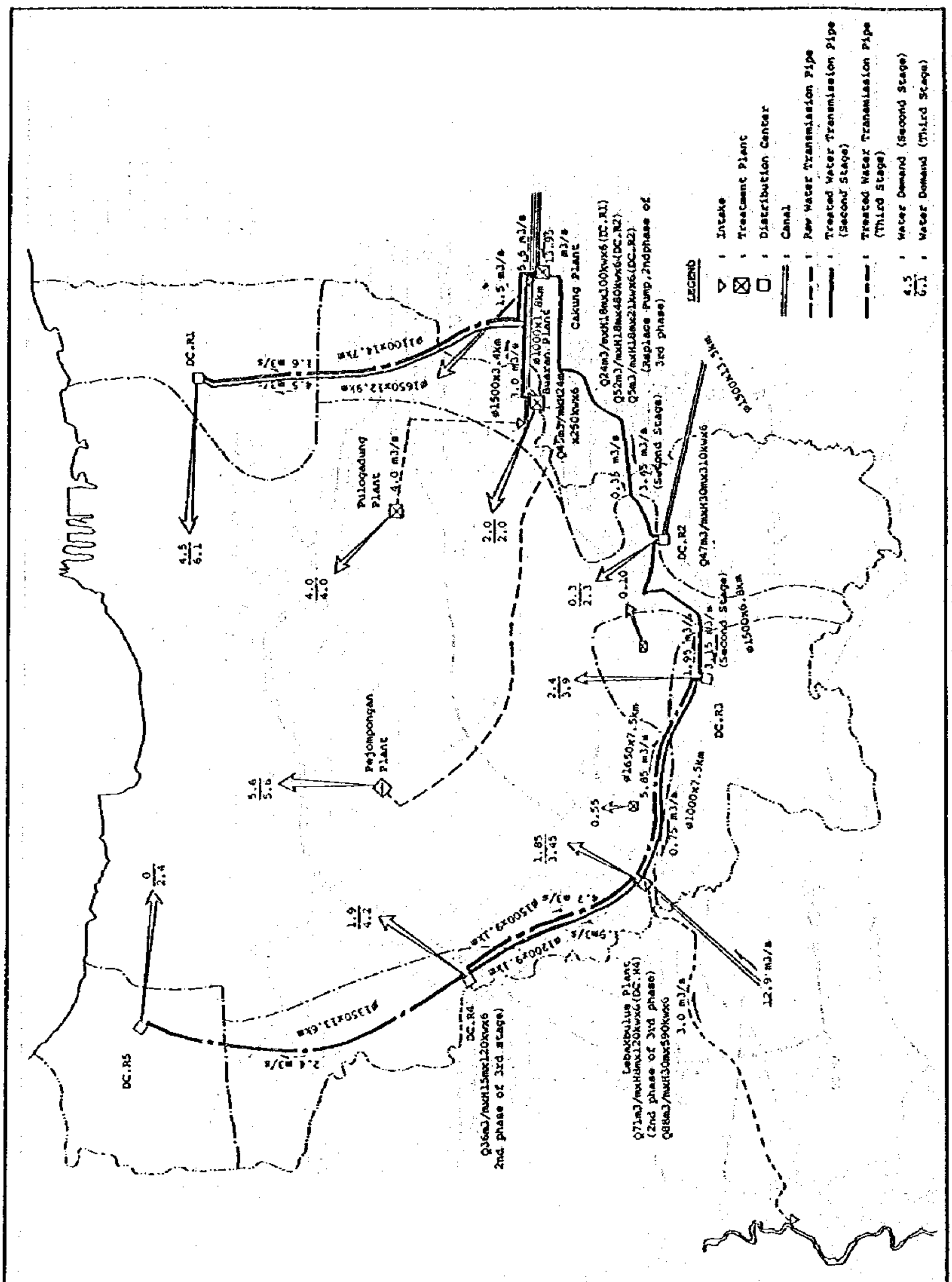

FIG 3-4 ALTERNATIVE 4

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6. Conclusion

The result of the cost comparison shows the system, which receives more water from the Cisadane river basin through the Calal 1, has an advantage as shown in Table 2. Although two alternatives, 1 and 4, indicate the minor difference of present worth, the Alternative 1 is recommended since the cost for the initial investment is about 10 per cent lower than the alternative 4 and the former system will use facilities fully to be constructed in the Second Stage.

Raw water requirement of the proposed system, therefore, is as follows:

(1) West Tarun Canal: 6 m3/sec (5.6 x 1.07) for the Pejompongan Plants

(2) Canal 1: 18 m3/sec (17 x 1.07) for the Pulogadung, Buaran and Cakung Plants

(3) Cisadane River: 3.2 m3/sec (3 x 1.07) for the Lebakbulus Plant (the First Phase of the Second Stage)

(4) Canal 3: 6 m3/sec (5.1 x 1.07) and 11 m3/sec (9.8x 1.07) for the Lebakbulus Plant (the First Phase and the Second Phase of the Third Stage respectively)

Table 2 Summary of Cost Comparison (unit: million Rp.)

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Initial Cost				
1st Phase	30,369	84,335	51,288	3,516
2nd Phase	4,475	6,658	5,177	5,151
Total	34,844	90,993	56,465	40,667
O & M Cost				
1st Phase	2,761	4,709	3,439	2,671
2nd Phase	3,551	7,547	5,057	3,019
Present Worth				
8 % of D.R.	63,584	148,968	96,079	65,571
10 % of D.R.	57,054	135,572	86,986	59,800
12 % of D.R.	52,159	125,590	80,197	55,439

Calculation of the present worth for each alternative is indicated in Table 3 based on the cost estimate as shown in Table 4 and following assumptions:

(1) Period for construction is two years

(2) Procurement of materials and equipment is one year ahead of construction

(3) Total O & M Cost is calculated for 27 years after completion of construction of the First Phase

Breakdown of the cost estimate for each alternative shows in Table 4 and its facilities required is presented in Table 5. Unit costs of materials, equipment and construction works which are used as the basis of the cost estimate are shown in Table 6.

Table 3 Present Worth Analysis

unit : million Rp.

Alternative	Route	Initial Cost	O & M Cost	Present Worth (8%)	(10%)	(12%)
			(Second:1st:2nd)			
Alternative 1	P3/P4-R1	-	797	7551	6130	5073
	P4 - R1	8707	241	9613	9147	8791
	P4 - R2	-	1095	10375	8422	6970
	R2 - R3	186	379:197	2615	2200	1882
	R3 - P5	5987	490:647	11327	10166	9299
	P5 - R4	9158	287	10196	9634	9209
	R4 - R5	10806	287	11907	11355	10935
	TOTAL	34844	-	63584	57054	52159
Alternative 2	P3/P4-R1	-	797	7551	6130	5073
	P4 - R1	8707	241	9613	9147	8791
	P4 - R2	34528	1095:1270:2490	63264	57008	52363
	R2 - R3	16739	714:833:1636	35554	31454	28413
	R3 - P5	11055	-	10883	10844	10806
	P5 - R4	9158	287	10196	9634	9209
	R4 - R5	10806	287	11907	11355	10935
	TOTAL	90993	-	148968	135572	125590
Alternative 3	P3/P4-R1	-	797	7551	6130	5073
	P4 - R1	8707	241	9613	9147	8791
	P4 - R2	-	1095	10375	8422	6970
	R2 - R3	16739	714:833:1636	35554	31454	28413
	R3 - P5	11055	-	10883	10844	10806
	P5 - R4	9158	287	10196	9634	9209
	R4 - R5	10806	287	11907	11355	10935
	TOTAL	56465	-	96079	86986	80197
Alternative 4	P3/P4-R1	-	797	7551	6130	5073
	P4 - R1	8707	241	9613	9147	8791
	P4 - R2	88	113:64	3572	3206	2897
	R2 - R3	-	278: -	952	871	799
	R3 - P5	11908	683:1343	21780	19457	17735
	P5 - R4	9158	287	10196	9634	9209
	R4 - R5	10806	287	11907	11355	10935
	TOTAL	40667	-	65571	59800	55439

Table 4-1 Summary of Cost Estimate (Alternative 1)

Route	Transmission Pipe F/C	Transmission Pipe L/C	Pump Well F/C	Pump Well L/C	Pump House F/C	Pump House L/C	Power Receiving F/C	Power Receiving L/C	Transmission Pump F/C	Transmission Pump L/C	Power Substation F/C	Power Substation L/C	Switch Gear F/C	Switch Gear L/C	Initial Cost F/C	Initial Cost L/C	EL	P	M	O & M Cost
P3/P4-R1																	(735)	(314)	(28)	(797)
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
P4 - R1																				
1st Phase	5463	2125	-	-	-	-	-	-	-	-	-	-	-	-	5463	2125	-	-	-	-
2nd Phase	-	-	-	115	-	513	-	70	169	19	91	10	119	13	379	740	216	17	8	241
P4 - R2																				
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1038	17	40	1095
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1038	17	40	1095
R2 - R3																				
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	336	17	26	379
2nd Phase	-	-	-	-	-	-	-	-	135	15	14	2	18	2	167	19	173	17	7	197
R3 - P5																				
1st Phase	2788	1084	-	198	-	542	-	196	355	40	191	21	250	28	3584	2109	455	17	18	490
2nd Phase	-	-	-	-	-	-	-	-	118	13	64	7	83	9	265	29	606	17	24	647
P5 - R4																				
1st Phase	5752	1817	-	-	-	-	-	-	-	-	-	-	-	-	5752	1817	-	-	-	-
2nd Phase	-	-	-	475	-	523	-	85	203	23	110	12	142	16	455	1134	260	17	10	287
R4 - R5																				
1st Phase	7044	2475	-	-	-	-	-	-	-	-	-	-	-	-	7044	2475	-	-	-	-
2nd Phase	-	-	-	173	-	523	-	85	203	23	110	12	142	16	455	832	260	17	10	287
TOTAL																				
1st Phase	21047	7501	-	198	-	542	-	196	355	40	191	21	250	28	21843	8526	2564	85	112	2761
2nd Phase	-	-	-	763	-	1559	-	240	828	93	389	43	504	56	1721	2754	3288	136	127	3551

Note : ( ) in figure is the cost of Second Stage Project.

Table 4-2 Summary of Cost Estimate (Alternative 2)

Route	Transmission Pipe F/C	Transmission Pipe L/C	Pump Well F/C	Pump Well L/C	Pump House F/C	Pump House L/C	Power Receiving F/C	Power Receiving L/C	Transmission Pump F/C	Transmission Pump L/C	Power Substation F/C	Power Substation L/C	Switch Gear F/C	Switch Gear L/C	Initial Cost F/C	Initial Cost L/C	EL	P	M	O & M Cost
P3/P4-R1																	(735)	(314)	(28)	(797)
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
P4 - R1																				
1st Phase	5463	2125	-	-	-	-	-	-	-	-	-	-	-	-	5463	2125	-	-	-	-
2nd Phase	-	-	-	115	-	513	-	70	169	19	91	10	119	13	379	740	216	17	8	241
P4 - R2																	(1038)	(17)	(40)	(1095)
1st Phase	22476	5272	-	706	-	675	-	770	1265	141	679	75	889	99	25309	7738	1190	17	63	1270
2nd Phase	-	-	-	-	-	-	-	-	596	66	319	36	418	46	1333	148	2380	17	93	2490
R2 - R3																	(671)	(17)	(26)	(714)
1st Phase	9619	2405	-	562	-	617	-	505	744	82	399	45	521	58	11283	4274	779	17	37	833
2nd Phase	-	-	-	-	-	-	-	-	475	53	255	28	334	37	1064	118	1558	17	61	1636
R3 - P5																				
1st Phase	8733	2322	-	-	-	-	-	-	-	-	-	-	-	-	8733	2322	-	-	-	-
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5 - R4																				
1st Phase	5752	1817	-	-	-	-	-	-	-	-	-	-	-	-	5752	1817	-	-	-	-
2nd Phase	-	-	-	475	-	523	-	85	203	23	110	12	142	16	455	1134	260	17	10	287
R4 - R5																				
1st Phase	7044	2475	-	-	-	-	-	-	-	-	-	-	-	-	7044	2475	-	-	-	-
2nd Phase	-	-	-	173	-	523	-	85	203	23	110	12	142	16	455	832	260	17	10	287
TOTAL																				
1st Phase	59087	16416	-	1268	-	1292	-	1275	2009	223	1078	120	1410	157	63584	20751	4413	102	194	4709
2nd Phase	-	-	-	763	-	1559	-	240	1646	184	885	98	1155	128	3686	2972	7118	153	276	7547

Note : ( ) in figure is the cost of Second Stage Project.

Table 4-3 Summary of Cost Estimate (Alternative 3)

Route	Transmission Pipe F/C	Transmission Pipe L/C	Pump Well F/C	Pump Well L/C	Pump House F/C	Pump House L/C	Power Receiving F/C	Power Receiving L/C	Transmission Pump F/C	Transmission Pump L/C	Power Substation F/C	Power Substation L/C	Switch Gear F/C	Switch Gear L/C	Initial Cost F/C	Initial Cost L/C	EL	P	M	O & M Cost
P3/P4-R1																	(735)	(314)	(28)	(797)
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
P4 - R1																				
1st Phase	5463	2125	-	-	-	-	-	-	-	-	-	-	-	-	5463	2125	-	-	-	-
2nd Phase	-	-	-	115	-	513	-	70	169	19	91	10	119	13	379	740	216	17	8	241
P4 - R2																				
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1038	17	40	1095
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1038	17	40	1095
R2 - R3																	(671)	(17)	(26)	(714)
1st Phase	9619	2405	-	562	-	617	-	505	744	82	399	45	521	58	11283	4274	779	17	37	833
2nd Phase	-	-	-	-	-	-	-	-	475	53	255	28	334	37	1064	118	1558	17	61	1636
R3 - P5																				
1st Phase	8733	2322	-	-	-	-	-	-	-	-	-	-	-	-	8733	2322	-	-	-	-
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P5 - R4																				
1st Phase	5752	1817	-	-	-	-	-	-	-	-	-	-	-	-	5752	1817	-	-	-	-
2nd Phase	-	-	-	475	-	523	-	85	203	23	110	12	142	16	455	1134	260	17	10	287
R4 - R5																				
1st Phase	7044	2475	-	-	-	-	-	-	-	-	-	-	-	-	7044	2475	-	-	-	-
2nd Phase	-	-	-	173	-	523	-	85	203	23	110	12	142	16	455	832	260	17	10	287
TOTAL																				
1st Phase	36611	11144	-	562	-	617	-	505	744	82	399	45	521	58	38275	13013	3223	85	131	3439
2nd Phase	-	-	-	763	-	1559	-	240	1050	118	566	62	737	82	2353	2824	4738	136	183	5057

Note : ( ) in figure is the cost of Second Stage Project.

Table 4-4 Summary of Cost Estimate (Alternative 4)

Route	Transmission Pipe F/C	Transmission Pipe L/C	Pump Well F/C	Pump Well L/C	Pump House F/C	Pump House L/C	Power Receiving F/C	Power Receiving L/C	Transmission Pump F/C	Transmission Pump L/C	Power Substation F/C	Power Substation L/C	Switch Gear F/C	Switch Gear L/C	Initial Cost F/C	Initial Cost L/C	EL	P	M	O & M Cost
P3/P4-R1																	(735)	(314)	(28)	(797)
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	735	34	28	797
P4 - R1																				
1st Phase	5463	2125	-	-	-	-	-	-	-	-	-	-	-	-	5463	2125	-	-	-	-
2nd Phase	-	-	-	115	-	513	-	70	169	19	91	10	119	13	379	740	216	17	8	241
P4 - R2																				
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	856	17	40	913
2nd Phase	-	-	-	-	-	-	-	-	35	4	19	2	25	3	79	9	45	17	2	64
R2 - R3																				
1st Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	235	17	26	278
2nd Phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
R3 - P5																				
1st Phase	6240	1760	-	421	-	589	-	414	569	63	306	34	400	44	7515	3325	638	17	28	683
2nd Phase	-	-	-	-	-	-	-	-	429	48	231	25	301	34	961	107	1276	17	50	1343
P5 - R4																				
1st Phase	5752	1817	-	-	-	-	-	-	-	-	-	-	-	-	5752	1817	-	-	-	-
2nd Phase	-	-	-	475	-	523	-	85	203	23	110	12	142	16	455	1134	260	17	10	287
R4 - R5																				
1st Phase	7044	2475	-	-	-	-	-	-	-	-	-	-	-	-	7044	2475	-	-	-	-
2nd Phase	-	-	-	173	-	523	-	85	203	23	110	12	142	16	455	832	260	17	10	287
TOTAL																				
1st Phase	24499	8177	-	421	-	589	-	414	569	63	306	34	400	44	25774	9742	2464	85	122	2671
2nd Phase	-	-	-	763	-	1559	-	240	1039	117	561	61	729	82	2329	2822	2792	119	108	3019

Note : ( ) in figure is the cost of Second Stage Project.

Table 5-1 Summary of Facilities (Alternative 1)

Route	Transmission Pipe	Pump Well	Pump House	Power Receiving	Transmission Pump	Power Substaton	Switch Gear
	(D x km)	(m3)	(m2)	(kVA)	(QxHxkWxNos)	(kVA)	(kW)
P3/P4-R1							
(2nd Stage)	1,500x 3.4	1,800	570	1,400	45x24x250x6	2,100	1,500
	1,000x 1.8	900	530	560	23x19x100x6	840	600
	1,650x12.9	-	-	-	-	-	-
(3rd Stage)	-	-	-	-	-	-	-
P4 - R1							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,100x14.7	-	-	-	-	-	-
2nd Phase	-	960	540	560	24x18x100x6	560	600
P4 - R2							
(2nd Stage)	1,500x13.5	2,070	620	2,690	52x42x480x6	2,690	2,880
(3rd Stage)							
1st Phase	-	-	-	-	-	-	-
2nd Phase	-	-	-	-	-	-	-
R2 - R3							
(2nd Stage)	1,500x 6.8	1,890	580	1,740	47x30x310x6	1,740	1,860
(3rd Stage)							
1st Phase	-	-	-	-	-	-	-
2nd Phase	-	-	-	-	18x21x82x6	-	-
R3 - P5							
(2nd Stage)	1,000x 7.5	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,100x 7.5	1,650	570	1,570	42x30x280x4	1,570	1,120
2nd Phase	-	-	-	-	42x30x280x2	-	560
P5 - R4							
(2nd Stage)	1,200x 9.1	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,500x 9.1	-	-	-	-	-	-
2nd Phase	-	3,960	550	680	71x8x120x6	680	720
R4 - R5							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,350x13.6	-	-	-	-	-	-
2nd Phase	-	1,440	550	680	36x15x120x6	680	720

Table 5-2 Summary of Facilities (Alternative 2)

Route	Transmission Pipe	Pump Well	Pump House	Power Receiving	Transmission Pump	Power Substaton	Switch Gear
	(D x km)	(m3)	(m2)	(kVA)	(QxHxkWxNos)	(kVA)	(kW)
P3/P4-R1							
(2nd Stage)	1,500x 3.4	1,800	570	1,400	45x24x250x6	2,100	1,500
	1,000x 1.8	900	530	560	23x19x100x6	840	600
	1,650x12.9	-	-	-	-	-	-
(3rd Stage)	-	-	-	-	-	-	-
P4 - R1							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,100x14.7	-	-	-	-	-	-
2nd Phase	-	960	540	560	24x18x100x6	560	600
P4 - R2							
(2nd Stage)	1,500x13.5	2,070	620	2,690	52x42x480x6	2,690	2,880
(3rd Stage)							
1st Phase	2,400x13.5	5,880	710	6,160	147x34x1100x3	6,160	3,300
2nd Phase	-	-	-	-	147x34x1100x3	-	3,300
R2 - R3							
(2nd Stage)	1,500x 6.8	1,890	580	1,740	47x30x310x6	1,740	1,860
(3rd Stage)							
1st Phase	2,200x 6.8	4,680	650	4,040	117x28x720x3	4,040	2,160
2nd Phase	-	-	-	-	117x28x720x3	-	2,160
R3 - P5							
(2nd Stage)	1,000x 7.5	-	-	-	-	-	-
(3rd Stage)							
1st Phase	2,000x 7.5	-	-	-	-	-	-
2nd Phase	-	-	-	-	-	-	-
P5 - R4							
(2nd Stage)	1,200x 9.1	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,500x 9.1	-	-	-	-	-	-
2nd Phase	-	3,960	550	680	71x8x120x6	680	720
R4 - R5							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,350x13.6	-	-	-	-	-	-
2nd Phase	-	1,440	550	680	36x15x120x6	680	720

Table 5-3 Summary of Facilities (Alternative 3)

Route	Transmission Pipe	Pump Well	Pump House	Power Receiving	Transmission Pump	Power Substaton	Switch Gear
	(D x km)	(m3)	(m2)	(kVA)	(QxHxkWxNos)	(kVA)	(kW)
P3/P4-R1							
(2nd Stage)	1,500x 3.4	1,800	570	1,400	45x24x250x6	2,100	1,500
	1,000x 1.8	900	530	560	23x19x100x6	840	600
	1,650x12.9	-	-	-	-	-	-
(3rd Stage)	-	-	-	-	-	-	-
P4 - R1							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,100x14.7	-	-	-	-	-	-
2nd Phase	-	960	540	560	24x18x100x6	560	600
P4 - R2							
(2nd Stage)	1,500x13.5	2,070	620	2,690	52x42x480x6	2,690	2,880
(3rd Stage)							
1st Phase	-	-	-	-	-	-	-
2nd Phase	-	-	-	-	-	-	-
R2 - R3							
(2nd Stage)	1,500x 6.8	1,890	580	1,740	47x30x310x6	1,740	1,860
(3rd Stage)							
1st Phase	2,200x 6.8	4,680	650	4,040	117x28x720x3	4,040	2,160
2nd Phase	-	-	-	-	117x28x720x3	-	2,160
R3 - P5							
(2nd Stage)	1,000x 7.5	-	-	-	-	-	-
(3rd Stage)							
1st Phase	2,000x 7.5	-	-	-	-	-	-
2nd Phase	-	-	-	-	-	-	-
P5 - R4							
(2nd Stage)	1,200x 9.1	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,500x 9.1	-	-	-	-	-	-
2nd Phase	-	3,960	550	680	71x8x120x6	680	720
R4 - R5							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,350x13.6	-	-	-	-	-	-
2nd Phase	-	1,440	550	680	36x15x120x6	680	720

Table 5-4 Summary of Facilities (Alternative 4)

Route	Transmission Pipe	Pump Well	Pump House	Power Receiving	Transmission Pump	Power Substaton	Switch Gear
	(D x km)	(m3)	(m2)	(kVA)	(QxHxkWxNos)	(kVA)	(kW)
P3/P4-R1							
(2nd Stage)	1,500x 3.4	1,800	570	1,400	45x24x250x6	2,100	1,500
	1,000x 1.8	900	530	560	23x19x100x6	840	600
	1,650x12.9	-	-	-	-	-	-
(3rd Stage)	-	-	-	-	-	-	-
P4 - R1							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,100x14.7	-	-	-	-	-	-
2nd Phase	-	960	540	560	24x18x100x6	560	600
P4 - R2							
(2nd Stage)	1,500x13.5	2,070	620	2,690	52x42x480x6	2,690	2,880
(3rd Stage)							
1st Phase	-	-	-	-	-	-	-
2nd Phase	-	-	-	120	5.3x18x21x6	120	130
R2 - R3							
(2nd Stage)	1,500x 6.8	1,890	580	1,740	47x30x310x6	1,740	1,860
(3rd Stage)							
1st Phase	-	-	-	-	-	-	-
2nd Phase	-	-	-	-	-	-	-
R3 - P5							
(2nd Stage)	1,000x 7.5	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,650x 7.5	3,720	620	3,310	88x30x590x3	3,310	1,770
2nd Phase	-	-	-	-	88x30x590x3	-	1,770
P5 - R4							
(2nd Stage)	1,200x 9.1	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,500x 9.1	-	-	-	-	-	-
2nd Phase	-	3,960	550	680	71x8x120x6	680	720
R4 - R5							
(2nd Stage)	-	-	-	-	-	-	-
(3rd Stage)							
1st Phase	1,350x13.6	-	-	-	-	-	-
2nd Phase	-	1,440	550	680	36x15x120x6	680	720

Table 6 Unit Cost Used for Cost Estimated

Unit: 1,000 Rupiah

Item	Unit	Unit Cost
Initial Cost		
Transmission Pipe		
ø 700	m	264.4
ø 800	m	314.8
ø 900	m	375.5
ø 1,000	m	446.4
ø 1,100	m	516.2
ø 1,200	m	576.7
ø 1,350	m	699.6
ø 1,500	m	831.8
ø 1,650	m	1,066.7
ø 1,800	m	1,234.1
ø 2,000	m	1,474.0
ø 2,200	m	1,768.3
ø 2,400	m	2,055.4
Pump Well	m3	120.0
Pump House	m2	950.0
Power Receiving	kVA	125.0
Transmission Pump	kW	313.0
Power Substation	kVA	180.0
Switch Gear and Instrumentation	kW	220.0
Operation and Maintenance Cost		
Electricity	kWH	71.0
Personal	L.S	17,000.0
Maintenance 1)	%	2.0

1) For mechanical and electrical equipment