Attachment

CONSIDERATION ON RAW WATER SOURCES

FOR

JAKARTA WATER SUPPLY SYSTEM IN 1995

1. General

Water demand of Jakarta has been increasing rapidly, especially to the west and east of Jakarta. Raw water for water supply system at present derives from the main rivers in Jakarta such as the Ciliwung, Cipinang and Sunter rivers and the West Tarum Canal from the Jatiluful Reservoir. Due to the recent rapid population increase and economic activities, water quality of the rivers in Jakarta has been deteriorated and it becomes critical for water supply. Only the West Tarum Canal is the raw water source for near future.

Water demand of Jakarta will reach to about 24 m3/sec by 1995, while the present production capacity is about 7 m3/sec and additional capacity will be about 5 m3/sec up to 1987. Therefore about 12 m3/sec is to be added by 1995.

Two water sources are considered for future water supply of Jakarta, they are derived from the Citarum and Cisadane basins located at the east and the west of Jakarta respectively. Presently, only the feasibility study on water resources of the Citarum basin was completed and the Canal 1 is confirmed as the reliable raw water source for Jakarta from the Jatiluful Reservoir. On the other hand, that of the Cisadane is planned to be started from the next year and to be completed in two years.

In this short paper, the possible water supply system considering direction of raw water to Jakarta; from the east and west, is examined by the cost comparison against water requirement in 1995. Only water supply facilities within Jakarta is examined in this paper and costs for water resources development and raw water conveyance system are excluded.

2. Alternatives

As shown in Fig. 1, service area in 1995 will be divided into six supply zones where three zones are located in the west part of Jakarta or the west of the Ciliwung river. The total water demand of the west part of Jakarta is estimated at about 13 m3/sec out of which about 6 m3/sec will be supplied from the existing Pejompongan Plant. The raw water of the Plant comes from the West Tarum Canal. The water demand of the east is about 11 m3/sec and about 6 m3/sec is supplied from the existing Pulogadung Plant and the Buaran Plant planned by the Immediate Project which raw water source comes from the West Tarum Canal.

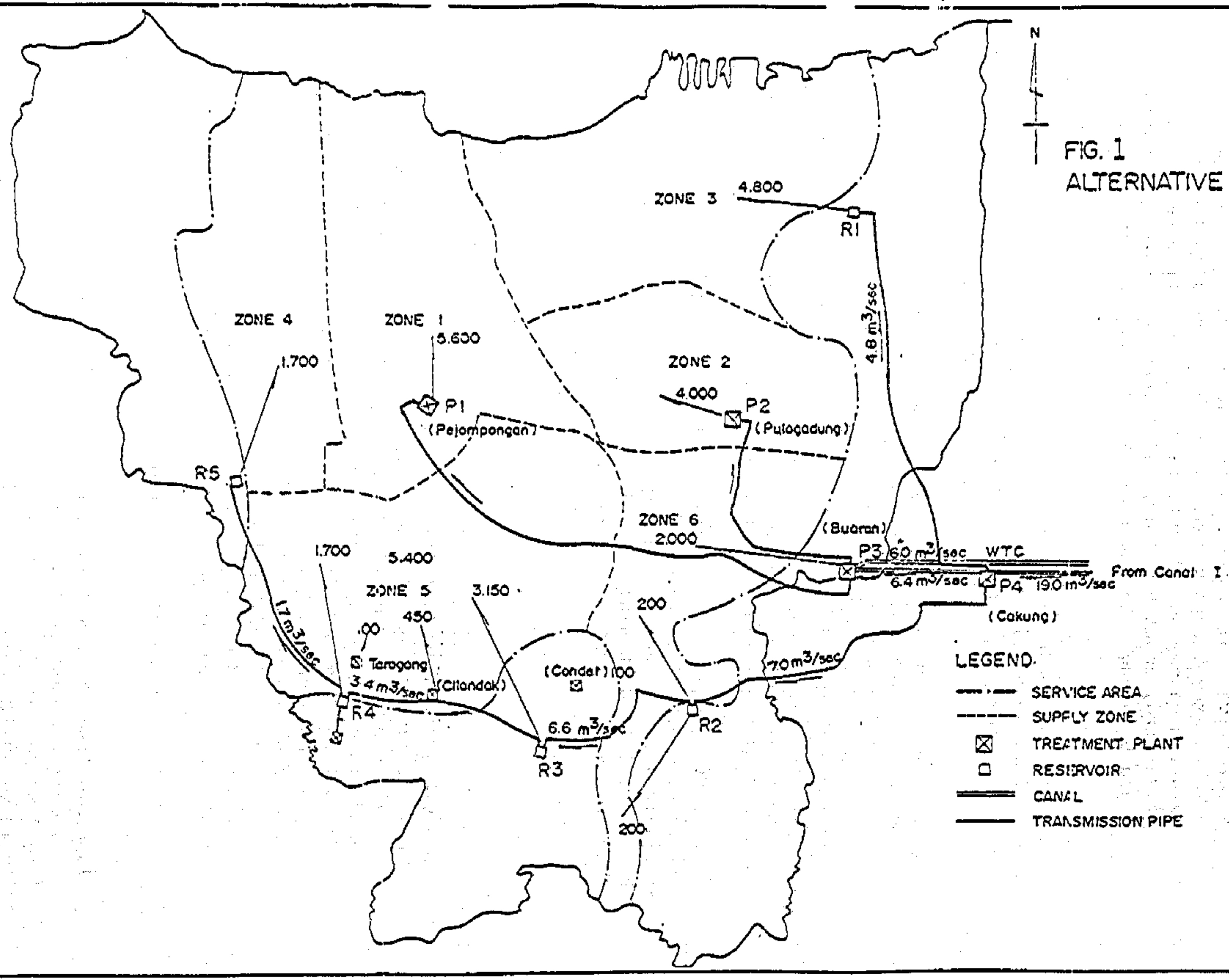
Three alternatives are considered fro the comparison described as below.

<u>Alternative - 1</u>: Whole raw water for additional production, 12 m3/sec, is derived from the east of Jakarta, from the West Tarum Canal and the Canal 1. Water for the west part of Jakarta, supply zones 4 and 5, is transmitted by pipeline through reservoirs after treated as shown in Fig. 1.

Alternative - 2: Water requirement of the west part of Jakrta is partly transmitted from the west of Jakarta, 1.7 m3/sec, and distributed to supply zone 4 from the reservoir 5 as shown in Fig 2.

Alternative - 3: Water requirement of the west part of Jakarta except supply zone 1, which is supplied from the existing Pejompongan Plant, is transmitted from the west of Jakarta, about 5 m3/sec, and distributed to supply zones 4 and 5 through the reservoir 4 and 5 as shown in Fig. 3.

FIG. 1
ALTERNATIVE – I



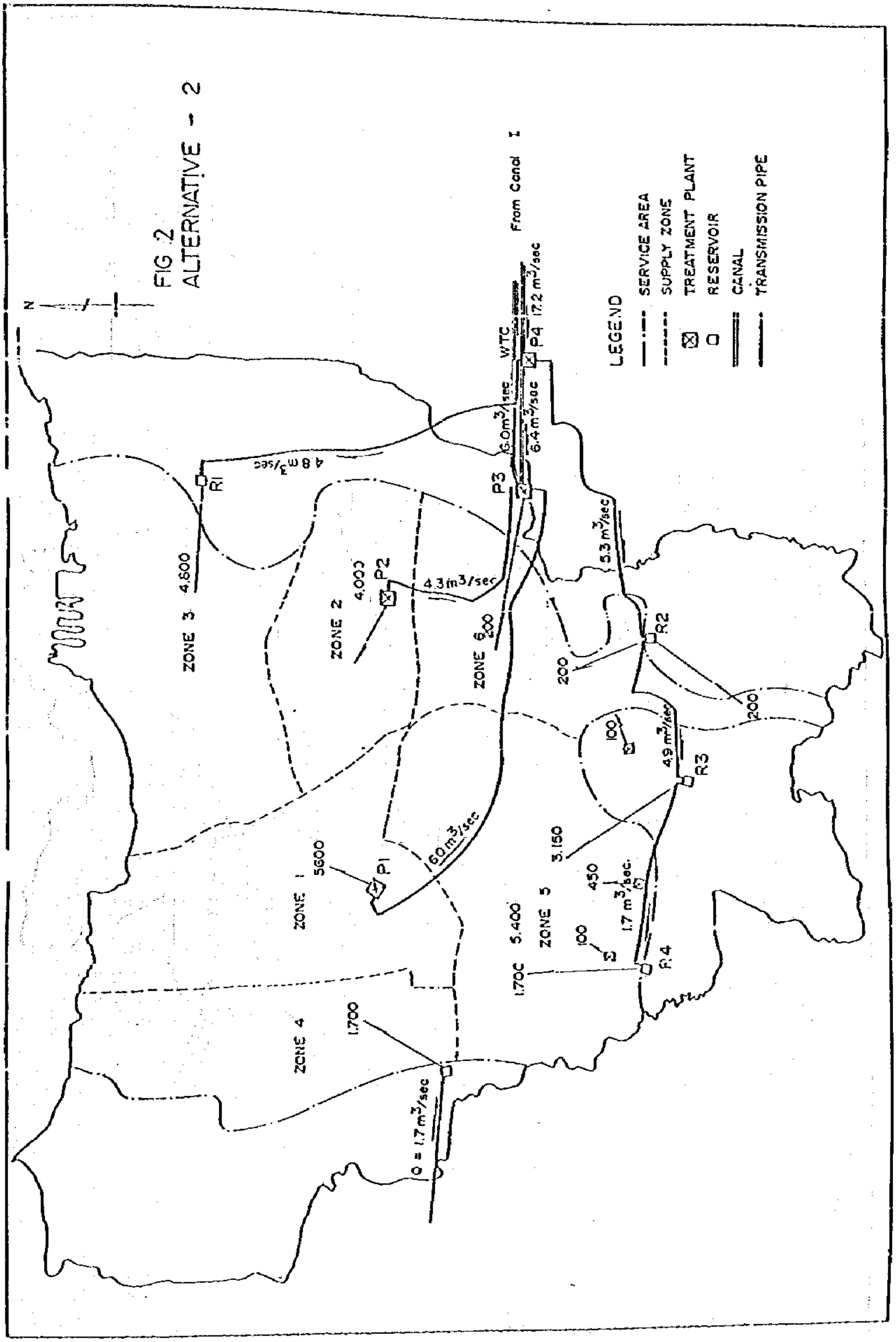


FIG 2
ALTERNATIVE - 2
N
From Canal I
WTC
P4
17.2 m^3/sec
6.0 m^3/sec
6.4 m^3/sec
P3
R1
4.8 m^3/sec
ZONE 3
4,600
P2
4,000
4.3 m^3/sec
ZONE 2
ZONE 6
200
5.3 m^3/sec
R2
200
200
100
4.9 m^3/sec
R3
3,150
450
1.7 m^3/sec.
ZONE 5
5,400
100
R4
1,700
ZONE 1
5600
P1
60 m^3/sec
ZONE 4
1,700
Q = 1.7 m^3/sec
LEGEND
SERVICE AREA
SUPPLY ZONE
TREATMENT PLANT
RESERVOIR
CANAL
TRANSMISSION PIPE

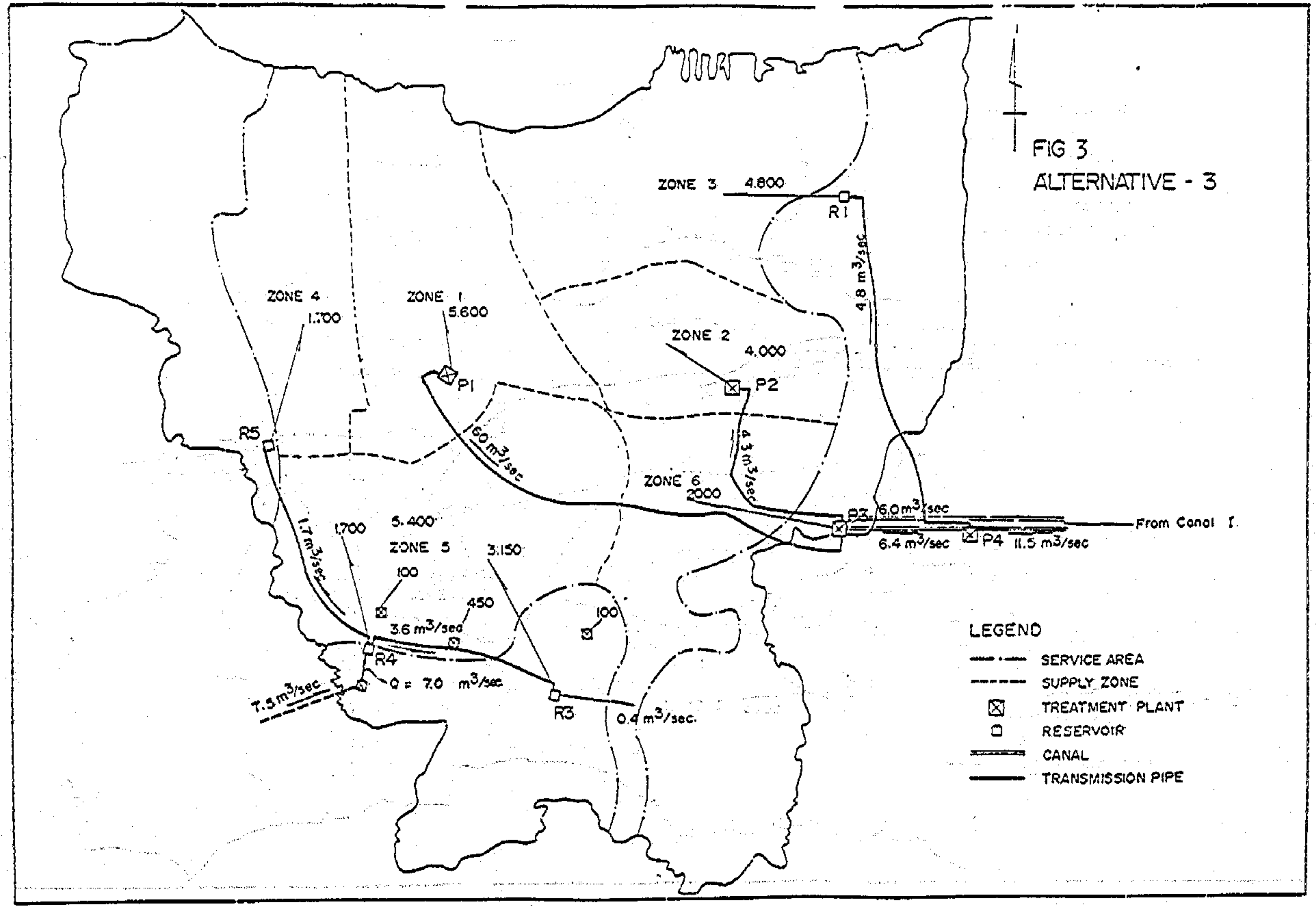


FIG 3
ALTERNATIVE - 3

3. Cost Comparison

Cost for each alternative is estimated according to the facilities presented in Table 1 which includes construction cost for transmission pipelines, transmission pumps and electric facilities, pump well and pump house and operation and maintenance costs for personnel, electricity, and maintenance of equipment. The result of the cost estimate for each alternative is summarized in the below.

Table 1 Cost Estimate of Alternatives

(unit: million Rp.)

	Alternative-1	Alternative-2	Alternative-3
Construction Cost	69,600	53,400	31,900
Operation and Maintenance Cost	2,100	1,800	840

- costs for treatment plant and clear water reservoir are not included in the above cost which are almost same among alternatives.

4. Conclusion

The alternative-3 shows the most economical system if only water supply facilities within Jakarta is compared, and also it is desirable to have two raw water sources for safe water supply. However, it seems to be difficult to provide big ammount of water from the Cisadane basin in the short term, by 1990. Thus it will be reasonable to plan the water supply facilities for the Second Stage Project based on raw water source from the east of Jakarta, i.e., from the Canal 1 considering implementation schedule of the Project. It is recommendable to start feasibility study on the Cisadane Basin as soon as possible considering economical water supply system and safe water supply having two main water sources, from the east and the west of Jakarta.

Table 2 Summary of Facilities

Transmission Route	Facilities	Alternative - 1	Alternative - 2	Alternative - 3
Cakung Plant - Reservoir 1	Transmission Pipe:	Ø 1,650mm x L 14.8km	Ø 1,650mm x L 14.8km	Ø 1,650mm x L 14.8km
	Transmission Pump:	Ø700 x Ø500mm x Q72m3/min x H35m x 550kW x 6 units	Ø700 x Ø500mm x Q72m3/min x H35m x 550kW x 6 units	Ø700 x Ø500mm x Q72m3/min H35m x 550kW x 6 units
	Power Receiving:	3,100 kVA	3,100 kVA	3,100 kVA
	Pump Well:	2,900 m3	2,900 m3	2,900 m3
	Pump House:	1,100 m2	1,100 m2	1,100 m2
Cakung Plant - Reservoir 2	Transmission Pipe:	Ø 2,000mm x L 13.5km	Ø 1,800mm x L 13.5km	-
	Transmission Pump:	Ø800 x Ø600mm x Q98m3/min x H47m x 1,60kW x 6 units	Ø800 x Ø600mm x Q80m3/min x H50m x 860kW x 6 units	-
	Power Receiving:	6,000 kVA	5,000 kVA	-
	Pump Well:	4,150 m3	3,200 m3	-
	Pump House:	1,300 m2	1,200 m2	-
Reservoir 2 - Reservoir 3	Transmission Pipe:	Ø 2,000mm x L 6.8km	Ø 1,650mm x L 6.8km	-
	Transmission Pump:	Ø800 x Ø600mm x Q98m3/min x H35m x 740kW x 6 units	Ø700 x Ø500mm x Q74m3/min x H38m x 600kW x 6 units	-
	Power Receiving:	4,200 kVA	3,400 kVA	-
	Pump Well:	3,900 m3	2,900 m3	-
	Pump House:	1,300 m2	1,000 m2	-
Reservoir 3 - Reservoir 4	Transmission Pipe:	Ø 1,650mm x L 7.5km	Ø 1,200mm x L 7.5km	Ø 1,500mm x L 7.5km
	Transmission Pump:	- (by gravity)	- (by gravity)	Ø500 x Ø400mm x Q48m3/min H38m x 400kW x 6 units
	Power Receiving:	negligible (by gravity)	negligible (by gravity)	2,200 kVA
	Pump Well:	- (by gravity)	- (by gravity)	1,900 m3
	Pump House:	- (by gravity)	- (by gravity)	800 m2
Reservoir 4 - Reservoir 5	Transmission Pipe:	Ø 1,200mm x L 8.4km	-	Ø 1,200mm x L 8.4km
	Transmission Pump:	- (by gravity)	-	- (by gravity)
	Power Receiving:	negligible (by gravity)	-	negligible (by gravity)
	Pump Well:	- (by gravity)	-	- (by gravity)
	Pump House:	- (by gravity)	-	- (by gravity)

Attachment

FACILITIES AND CONSTRUCTION COST
IN CASE OF
THE THIRD STAGE RAW WATER SUPPLY
ONLY FROM WATER RESOURCES IN THE EAST

Facilities Only Raw Water from the East

Facilities	Second Stage Project	Third Stage Project
1. Raw Water Intake	Intake Capacity Q = 3.2 m3/sec	
2. Raw Water Transmission		
1) Serpong - Lebakbulus a. Transmission Pipe b. Transmission Pump	ø 1,500 mm x L 16.5 km Q48m3/min x H50m x 550 kW x 6 units	
2) Bekasi (Canal 1) - Cakung	B6.0m x H3.0m x L6.7km	
3) Cakung - Buaran	B3.8m x H1.9m x L4.9km	
3. Water Treatment Plant		
1) Buran Plant	Production Capacity Q = 3.0 m3/sec	
2) Lebakbulus Plant	Production Capacity Q = 3.0 m3/sec	
3) Cakung Plant	Production Capacity Q = 5.0 m3/sec	Production Capacity Q = 13.0 m3 sec
4. Treated Water Transmission		
1) Buaran - R1 a. Transmission Pipe b. Junction Well c. Transmission Pump	ø1,500mm x L3.4km, ø1,650mm x L12.9km D 13 m x H 6.0 m (RC made) Q45m3/min x H24m x 250kW x 6 units	
2) Cakung - R 1 a. Transmission Pipe b. Transmission Pump	ø 1,000 mm x L 1.8 km (up to J.Well) Q23m3/min x H19m x 100kW x 6 units	ø 1,100 mm x L 14.7 km Q24m3/min x H18m x 100kW x 6 units (Pumps are installed from the Second Phase)
3) Cakung - R 2 a. Transmission Pipe b. Transmission Pump	ø 1,500 mm x L 13.5 km Q52m3/min x H42m x 480kW x 6 units	ø 2,400 mm x L 13.5 km Q147m3/min x H34m x 1,100kW x 6 units
4) R 2 - R 3 a. Transmission Pipe b. Transmission Pump	ø 1,500 mm x L 6.8 km Q47m3/min x H30m x 310kW x 6 units	ø 2,200 mm x L 6.8 km Q117m3/min x H28m x 720kW x 6 units
5) R 3 - Lebakbulus a. Transmission Pipe b. Transmission Pump	ø 1,000 mm x L 7.5 km (by gravity)	ø 2,000 mm x L 7.5 km (by gravity)
6) Lebakubulus - R 4 a. Transmission Pipe b. Transmission Pump	ø 1,200 mm x L 9.1 km (by gravirty)	ø 1,500 mm x L 9.1 km Q71m3/min x H 8m x 120kW x 6 units (pumps are installed from the Second Phase)
7) R 4 - R 5 a. Transmission Pipe b. Transmission Pump		ø 1,350 mm x L 13.6 km Q36m3./min x H15m x 120kW x 6 units
5. Distribution Facilities		
1) Pejomongan System (zone 1) a. Distribution Trunk Main	ø 300 - ø 900mm, L = 53 km	ø 300mm, L = 5 km
2) Pulogadung system (zone 2) a. Distribution Trunk Main	ø 300 - ø 600mm, L = 37 km	ø 300mm, L = 9 km
3) Buaran/Cakung System (Zone 6) a. Operational Reservoir b. Distribution Pump	11,000 m3 (at Buarang Plant) Q36m3 min x H54m 450kW x 2 units (at Buarang Plant)	17,000 m3 (at Cakung Plant) Q47m3min x H54m x 570kW x 3 units Q24m3/min x H54m x 290kW x 2 units (at Cakung Plant)

Facilities	Second Stage Project	Third Stage Project
c. Distribution Trunk Main	ø 300 - ø 1,000mm, 1 L = 25km	ø 300 - ø 1,200mm, L = 48km
4) R - 1 System (zone 3)		
a. Operational Reservoir	49,000 m3	18,000 m3
b. Distribution Pump	Q78m3/min x H59m x 1,100kW x 6 units Q39m3/min x H59m x 550kW x 2 units	Q50m3/min x H59m x 670kW x 3 units Q25m3/min x H59m x 340kW x 2 units
c. Distribution Trunk Main	ø 300 - ø 1,800mm, L = 46 km	ø 300 - ø 1,200mm, L = 34 km
5) R - 2 System (zone 9)		
a. Operational Reservoir	4,000 m3	22,000 m3
b. Distribution Pump	Q9.4m3/min x H65m x 150 kW x 3 units Q4.7m3/min x H65m x 75 kW x 2 units	Q35m3/min x H25m x 210kW x 6 units Q18m3/min x H25m x 110kW x 2 units
c. Distribution Trunk Main		ø 400 - ø 1,200mm, L = 23 km
6) R - 3 System (zone 8)		
a. Operational REservoir	26,000 m3	17,000 m3
b. Distribution Pump	Q42m3/min x H22m x 210kW x 6 units Q21m3/min x H22m x 110kW x 2 units	Q47m3/min x H22m x 240kW x 3 units Q24m3/min x H22m x 130kW x 2 units
ø 300 - ø 1,500mm, L = 23 km	ø 300 - ø 1,000mm, L = 23 km	
c. Distribution Trunk Main		
7) Lebakbulus System (zone 7)		
a. Operational Reservoir	20,000 m3	18,000 m3
b. Distribution Pump	Q32m3/min x H48m x 370kW x 6 units Q16m3/min x H48m x 190kW x 2 units	Q50m3/min x H48m x 550 kW x 3 units Q25m3/min x H48m x 280kW x 2 units
c. Distribution Trunk Main	ø 300 - ø 1,500mm, L = 51 km	ø 300 - ø 900mm, L = 25 km
8) R - 4 System (zone 5)		
a. Operational Reservoir	21,000 m3	25,000 m3
b. Distribution Pump	Q33m3/min x H52m x 400kW x 6 units Q17m3/min x H52m x 200kW x 2 units	Q72m3/min x H52m x 850kW x 3 units Q36m3/min x H52m x 430kW x 2units
c. Distribution Trunk Main	ø 300 - ø 1,500mm, L = 54 km	ø 300 - ø 1,200mm, L = 37 km
9) R - 5 System (zone 4)		
a. Operational Reservoir		26,000 m3
b. Distribution Pump		Q42m3/min x H50m x 460kW x 6 units Q21m3/min x H50m x 240kW x 2 units
c. Distribution Trunk Main		ø 300 - ø 1,200mm, L = 21 km
10) Secondary Main	ø 200 - ø 250 mm, L = 200 km	ø 200 - ø 250 mm, L = 200 km
11) Tertiary Main	ø 50 - ø 150 mm, L = 3,400 km	ø 50 - ø 150 mm, L = 3,600 km

Table Cost Estimate of The Project (only raw water from the east)

UNIT : F/C '000 US$
L/C million Rp.

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
1. Raw Water Intake								
1) Serpong	2,970	1,780	-	-	2,970	1,780	-	-
2. Raw Water Transmission								
1) Serpong - Lebackbulus	10,201	3,721	-	-	10,201	3,721	-	-
2) Canal 1 end - Cakung	-	-	-	6,988	-	6,988	-	-
3) Cakung - Buaran	-	-	-	3,822	-	3,822	-	-
Sub-total	10,201	3,721	-	10,810	10,201	14,531	-	-
3. Treatment Plant								
1) Buaran	7,020	7,970	-	-	7,020	7,970	-	-
2) Lebakbulus	7,411	6,651	-	-	7,411	6,651	-	-
3) Cakung	-	-	12,000	12,400	12,000	12,400	31,200	31,720
Sub-total	14,431	14,621	12,000	12,400	26,431	27,021	31,200	31,720
4. Treated Water Transmission								
1) Buarang - DC, R1	13,907	4,504	-	-	13,907	4,504	-	-
2) Cakang - DC, R1	-	-	948	810	948	810	5,842	2,680
3) Cakung - DC, R3	-	-	10,352	3,467	10,352	3,467	26,642	7,886
4) DC, R2 - DC, R3	-	-	5,474	2,029	5,474	2,029	12,347	4,392
5) DC, R3 - Lebakbulus	-	-	2,310	1,038	2,310	1,038	8,733	2,322
6) Lebakbulus - DC, R4	3,606	1,325	-	-	3,606	1,325	6,207	2,391
7) DC, R4 - DC, R5	-	-	-	-	-	-	7,499	3,049
Sub-total	17,513	5,829	19,084	7,344	36,597	13,173	67,270	22,720

(Continued)

Description	SECOND STAGE First Phase F/C	First Phase L/C	Second Phase F/C	Second Phase L/C	Total F/C	Total L/C	THIRD STAGE F/C	THIRD STAGE L/C
5. Distribution Facilities								
1) Pejompongan System	4,825	4,015	785	751	5,610	4,766	274	260
2) Pulogadun System	1,786	1,633	1,118	1,050	2,904	2,683	510	482
3) Buaran/Cakung System	2,960	3,413	736	710	3,696	4,123	11,577	9,577
4) Dc, R 1 System	14,885	11,031	3,540	3,718	18,395	14,749	8,813	7,329
5) DC, R 2 System			439	483	439	483	7,269	7,418
6) DC, R 3 System			9,097	7,711	9,097	7,711	2,936	3,680
7) Lebakbulus System	9,527	7,747	965	971	10,492	8,718	4,970	5,209
8) DC, R 4 System	9,812	7,734	2,371	2,304	12,183	10,038	7,139	7,157
9) DC, R 5 System	-	-	-	-	-	-	7,986	7,321
Sub-total	43,765	35,573	19,051	17,698	62,816	53,271	51,474	48,433
10) Secondary Main	3,177	2,911	4,411	3,406	7,588	6,317	6,786	5,853
11) Tertiary Main	13,393	14,860	16,967	18,823	30,360	33,683	32,148	35,665
Sub-total	16,570	17,771	21,378	22,229	37,948	40,000	38,934	41,518
Construction Cost	105,450	79,295	71,513	70,481	176,963	149,776	188,878	144,391
6. Land Aquisition								
1) Serpong Intake Station	-	56	-	-	-	56	-	-
2) Raw Water Transmission	-	460	-	-	-	460	-	-
3) Raw Water Canal								
Canal 1 end - Cakung	-	-	-	400	-	370	-	-
Cakung - Buaran	-	-	-	245	-	245	-	-
4) Treatment Plant								
Buaran	-	1,280	-	-	-	1,280	-	-
Lebakbulus	-	1,719	-	-	-	1,719	-	388
Cakung	-	-	-	2,000	-	2,000	-	3,400

(Continued)

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
5) Distribution Center								
DC, R1	-	386	-	-	-	386	-	231
DC, R2	-	-	-	55	-	55	-	105
DC, R3	-	-	-	115	-	115	-	90
DC, R4	-	245	-	-	-	245	-	115
DC, R5	-	-	-	-	-	-	-	253
Sub-total	-	4,146	-	2,815	-	6,961	-	4,532
7 Power Receiving								
1) Serpong Intake Station	-	600	-	-	-	600	-	-
2) Treatment Plant								
Buaran	-	-	-	-	-	-	-	-
Lebakbulus	-	620	-	-	-	620	-	560
Cakung	-	-	-	680	-	680	-	1,200
3) Distribution Center								
DC, R1	-	620	-	-	-	620	-	420
DC, R2	-	-	-	500	-	500	-	640
DC, R3	-	-	-	460	-	460	-	440
DC, R4	-	400	-	-	-	400	-	440
DC, R5	-	-	-	-	-	-	-	520
Sub-total	-	2,240	-	1,640	-	3,880	-	4,220
8. Administration Cost (2%)	-	1,714	-	1,499	-	3,213	-	3,063
9. Engineering Cost	7,382	2,379	5,006	2,114	12,388	4,493	13,221	4,332
TOTAL (1 - 9)	112,832	89,774	76,519	78,549	189,351	168,323	202,099	160,538

(Continued)

Description	SECOND STAGE						THIRD STAGE	
	First Phase		Second Phase		Total			
	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
10. Contingencies								
1) Physical Contingency	11,283	8,978	7,652	7,855	18,935	16,833	20,210	16,054
2) Price Contingency	62,885	79,248	75,829	112,596	138,714	191,844	417,691	476,408
Sub-total	74,168	88,226	83,481	120,451	157,649	208,677	437,901	492,462
Total Project Cost	187,000	178,000	160,000	199,000	347,000	377,000	640,000	653,000
Equivalent (billion Rupiah)						725		1,296

MASTER PLAN FOR
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M11. APPENDIX MIV-5

ALTERNATIVE STUDY ON TREATMENT PLANT SITE OF WTC SYSTEM FOR THE FIRST PHASE OF SECOND STAGE PROJECT

ALTERNATIVE STUDY ON TREATMENT PLANT SITE OF WTC SYSTEM

1. General

The Master Plan proposed productions and locations of the treatment plants to be constructed until the end of the Second Stage as tabulated below:

Project	Water Source	Plant Site	Production
Immediate Project	WTC	Buaran	2,000 l/sec
1st Phase	Cisadane	Lebakbulus	3,000
1st Phase*	WTC	Buaran	3,000
2nd Phase	WTC	Cakung	6,000

However, it is deemed appropriate to ascertain the advantage of Buaran as the plant site for 3 m3/sec (marked with * in the table) from the WTC. In this connection, it should be taken into consideration that the Buaran Plant may have been constructed prior to the 3 m3/sec plant. Therefore, to select a most feasible location for the plant, several possible alternative plans will be compared in the following, assuming the intake at Cakung and/or at Buaran.

2. Alternatives

Four alternatives were selected as shown on Table 1 taking into account the locations of proposed plant site, routes of transmission pipelines and optimum size of pipeline. Fig. 1 through 4 show the general layout of alternatives.

Table 1. Alternatives for Location of Plant and Transmission Main to Zone 3

Description	Alternative I	Alternative II	Alternative III	Alternative IV
- Plant site	Cakung	Cakung	Buaran	Buaran
- Capacities of transmission main	1st Phase 3.0 m3/s 2nd Phase 1.5 m3/s	1st Phase 3.0 m3/s 2nd Phase 1.5 m3/s	1st Phase 3.0 m3/sec 2nd Phase 1.5 m3/sec	1st Phase 3.0 m3/sec 2nd Phase 1.5 m3/sec
- Diameter of the mains to be installed in the 1st Phase	Single line ø1650 mm	Double lines ø1500 mm for 1st Phase	Single line ø1350 mm from Buaran to junction well and ø1650 mm from junction well to distribution center	Double lines ø1500 mm for 1st Phase from Buaran to distribution center
- Diameter of the mains to be installed in the 2nd Phase	-	ø1000 mm for 2nd Phase	ø1000 mm from Cakung to junction well	ø1100 mm for 2nd Phase from Cakung to distribution center
- Other facilities to be constructed			Junction well D8.0m x H7.0m (1350 m3)	

3. Cost Comparison

Facilities for the cost comparison is for the intake, raw water transmission and clear water transmission facilities to simplify the calculation. Table 2 indicates the summary of facilities for each alternative. Cost estimate includes the construction costs and operation and maintenance costs for the above facilities. Table 3 shows the summary of cost estimate of each alternative. The result of the present worth analysis is presented in the table below.

Present Worth of Each Alternative

(Unit: million Rupiah)

Discount Rate	Alternative 1	Alternative 2	Alternative 3	Alternative 4
8%	22,046	23,772	22,563	23,340
10%	20,485	21,841	20,682	21,313
12%	18,760	19,871	18,786	19,326

where:

base year for P.W. calculation	:	1988
timing of investment	:	1st Phase in 1989 2nd Phase in 1993 (investment of whole construction cost is assumed to be made in the above year)
start operation	:	1st Phase from 1991 2nd Phase from 1994
operation terms	:	30 years from 1991

4. Selection of the Plant Site for the First Phase Project

Since cost comparison between Alternatives 1 and 3 indicates a minor difference, the selection cannot be made only from the viewpoint of economy in the construction cost. Apart from the economy, merits and demerits of the two Alternatives will be considered with the following aspects.

1) Operation

If the two plants, one for 2 m3/sec and another for 3 m3/sec, are constructed as one plant, it will have a bigger advantage than the case where the two plants are separately constructed, on operation/maintenance of the facilities and staffing therefore, not to mention the construction cost.

2) Certainty of Future Programming

Regarding the raw water supply of 6 m3/sec after the First Phase, the timing, quantity, etc. are not necessarily firmly fixed. Therefore, it may not be appropriate to plan the 3 m3/sec plant together with the still-uncertain 6 m3/sec plant.

Table 2 Summary of the Facilities

Facilities	Alternative - 1	Alternative - 2	Alternative - 3	Alternative - 4
Intake Facilities				
1.Intake Facilities				
1st Phase:				
capacity	Cakung 9.6 m3/sec		Buaran 3.2 m3/sec	
volume	Cakung 990 m3		Buaran 390 m3	
2nd Phase				
capacity	-		Cakung 6.4 m3/sec	
volume	-		Cakung 720 m3	
2.Raw Water Pump				
1st Phase	Q96 x H8 x 185kW x 3nos		-	
2nd Phase	Q96 x H8 x 185kW x 6nos	Same as the left	Q96 x H8 x 185kW x 6nos	Same as the left
3.Electric Facilities				
1st Phase				
power receiving	1,600 kVA		-	
electric panels	3 sets		-	
instrumentation	1 lot		-	
2nd Phase				
power receiving	-		1,100 kVA	
electric panels	6 sets		6 sets	
instrumentation	-		1 lot	
4.Raw Water Pump Well				
1st Phase	5,800 m3		-	
2nd Phase	-		3,800 m3	
5.Raw Water Pump House				
1st Phase	2,300 m2		-	
2nd Phase	-		1,600 m3	
Transmission Facilities				
1.Transmission Pipe				
1st Phase	Ø1,650mm x L13.7km	Ø1,500mm x L13.7km	Ø1,650mm x L11.7km Ø1,350mm x L 3.0km Ø1,000mm x L 1.0km	Ø1,500mm x L14.9km
2nd Phase	-	Ø1,100mm x L13.7km		Ø1,100mm x L13.7km
2.Transmission Pump				
1st Phase	Q68 x H19 x 280kW x 4nos	Q68 x H16 x 250kW x 4nos	Q45 x H29 x 300kW x 6nos	Q45 x H20 x 210kW x 6nos
2nd Phase	Q68 x H19 x 280kW x 2nos	Q69 x H16 x 250kW x 2nos	Q23 x H26 x 150kW x 6nos	Q23 x H22 x 125kW x 6nos
3.Electric Facilities				
1st Phase				
power receiving	1,600 kVA	1,400 kVA	1,700 kVA	1,200 kVA
electric panels	4 sets	4 sets	6 sets	6 sets
instrumentation	1 lot	1 lot	1 lot	1 lot
2nd Phase				
power receiving	-	-	900 kVA	700 kVA
electric panels	2 sets	2 sets	6 sets	6 sets
instrumentation	-	-	1 lot	1 lot
4.Transmission Pump Well				
1st Phase	2,700 m3	2,700 m3	1,800 m3	1,800 m3
2nd Phase	-	-	900 m3	900 m3
5.Transmission Pump House				
1st Phase	1,300 m2	1,300 m2	860 m2	860 m2
2nd Phase	-	-	600 m2	600 m2
6.Junction Well				
1st Phase	-	-	-	
2nd Phase	-	-	1,350 m3	-

3) Future Development of Water Demand

The increase of the supply capacity planned up to the end of the First Phase is quite sizable, namely, 3 m3/sec by Pulogadung Plant, 2 m3/sec by the Immediate Project and (3+3) m3/sec by the First Phase Project, altogether 11 m3/sec. To avoid an over- or under-investment in the Second Phase, the timing, capacity and location of the treatment plant for the Second Phase should be reviewed at the time of its feasibility study. From this standpoint, it is considered preferable to plan the Second Phase plant based the actual development of water demand.

Conclusively, it is recommendable to site the treatment plant of the First Phase at Buaran.

Table 3 Summary of Cost Estimate unit: Million Rupiah

Facilities	Alternative - 1	Alternative - 2	Alternative - 3	Alternative - 4
(Initial Cost)				
Intake Facilities				
1.Intake Bay and Channel				
1st Phase				
screen	382		127	
civil structure	190		75	
total	572		202	
2nd Phase				
screen	-		255	
civil structure	-		138	
total	-		393	
2.Raw Water Pump				
1st Phase	162		-	
2nd Phase	324	The same as the left	324	The same as the left
3.Electric Facilities				
1st Phase	221		-	
2nd Phase	206		295	
4.Raw Water Pump Well				
1st Phase	473		-	
2nd Phase	-		310	
5.Raw Water Pump House				
1st Phase	1,642		-	
2nd Phase	-		1,142	
Sub-total				
1st Phase	3,070		202	
2nd Phase	530		[illegible],464	
total	3,600		2,666	
Transmission Facilities				
1.Transmission Pipes				
1st Phase	14,645	11,682	14,948	12,706
2nd Phase	-	7,322	837	7,322
2.Transmission Pump				
1st Phase	295	263	475	330
2nd Phase	148	131	198	174
3.Electric Facilities				
1st Phase	325	295	459	330
2nd Phase	104	93	205	183
4.Transmission Pump Well				
1st Phase	220	220	147	147
2nd Phase	-	-	73	73
5.Transmission Pump House				
1st Phase	928	928	614	614
2nd Phase	-	-	428	428
6.Junction Well				
1st Phase	-	-	-	-
2nd Phase	-	-	386	-
Sub-total				
1st Phase	16,413	13,388	16,643	14,127
2nd Phase	305	7,546	2,127	8,176
total	16,718	20,934	18,770	22,303
Total				
1st Phase	19,483	16,458	16,845	14,329
2nd Phase	835	8,076	4,591	10,640
total	20,318	24,534	21,436	24,969
(O & M Cost)				
Intake Facilities				
1. Power Cost				
1st Phase	78		-	
2nd Phase	235		157	
2. Personnel Cost				
1st Phase	14		14	
2nd Phase	14		28	
3. Maintenance Cost				
1st Phase	15		3	
2nd Phase	26		20	
Transmission Facilities				
1. Power Cost				
1st Phase	178	159	254	178
2nd Phase	237	212	360	271
2. Personnel Cost				
1st Phase	14	14	14	14
2nd Phase	14	14	28	28
3. Maintenance Cost				
1st Phase	12	11	19	13
2nd Phase	17	16	27	20

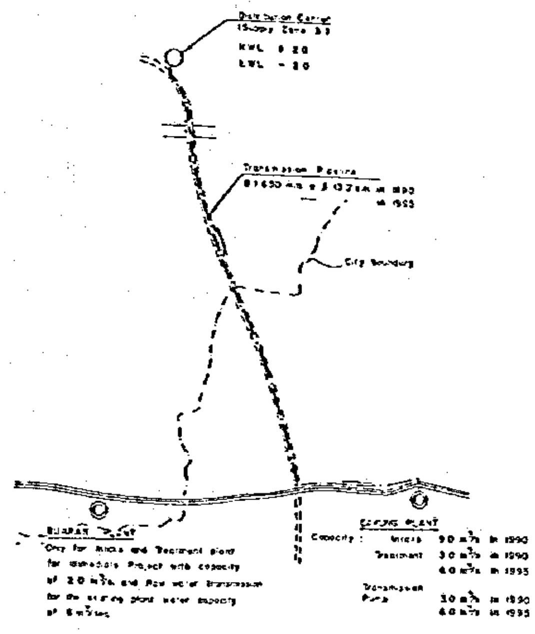


Fig. 1 General layout, Alternative – 1

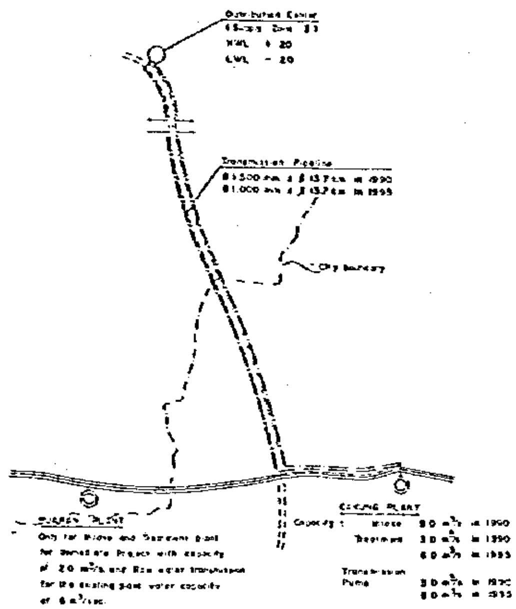


Fig. 2 General layout, Alternative – 2

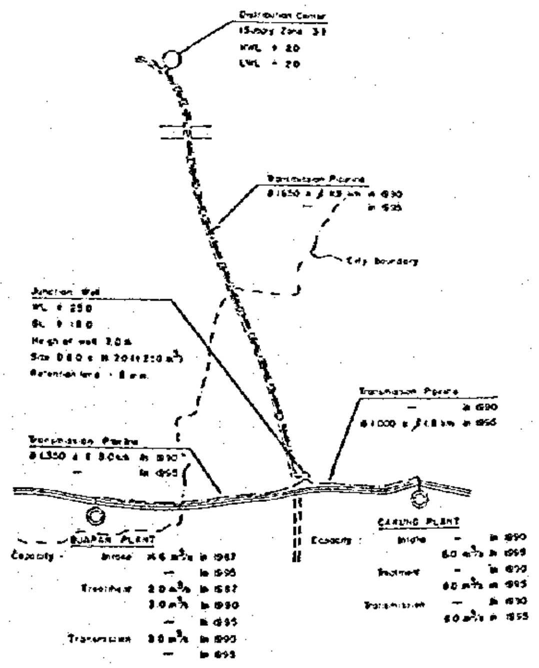


Fig. 3 General layout, Alternative – 3

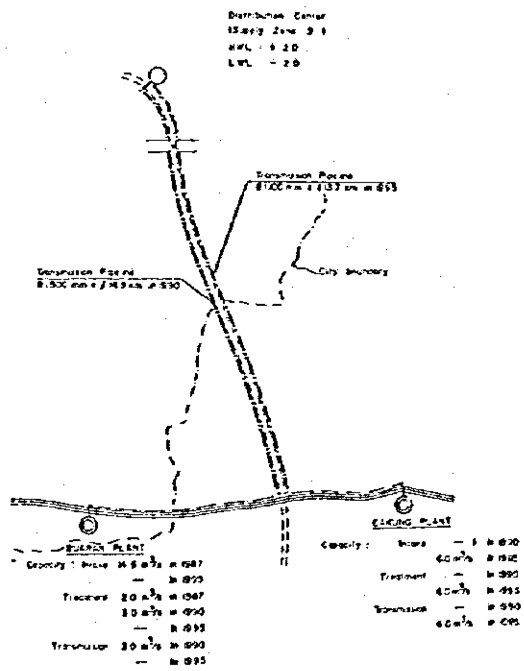


Fig. 4 General layout, Alternative – 4

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT	JICA

MASTER PLAN FOR
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M12. APPENDIX MIV-6

ALTERNATIVE STUDY ON TREATMENT PLANT SITE OF CISADANE SYSTEM FOR THE FIRST PHASE OF SECOND STAGE PROJECT

ALTERNATIVE STUDY ON TREATMENT PLANT SITE OF CISADANE SYSTEM

1. General

As for the Cisadane System, the intake and treatment plant are planned to be located at Cilangkap along the Cisadane river for the First Phase of the Second Stage Project. However, the treatment plant site is considered preferable for the operation by PDAM if it is located within the City boundary.

A cost comparison is made to select a most adequate treatment plant location.

2. Alternatives

Four alternatives considering location of the treatment plant site are selected for the cost comparison as shown on Table 1 and Fig. 1 taking into account the topographical feature along the Cisadane river where hilly places are located near the river.

The comparison, however, is made based on the assumption below, as the exact intake site is not fixed yet. Cilangkap is the place for the planned intake dam for the future water supplies for the cities including Jakarta and irrigation. Serpong is the nearest place from the proposed treatment plant/distribution center. Then, the intake site is proposed at Serpong for the study.

- Length of raw water transmission pipeline : 1 km
- Length of clear water transmission pipeline : 20 km
- Diameter of transmission pipeline : ø1,500 mm
- Intake water level : +23 m
- Head loss of the treatment plant (from the receiving well to low water level of the clear water reservoir) : 9 m

Table 1. Alternatives for Location of Plant Site

Description	Alternative I	Alternative II	Alternative III	Alternative IV
- Plant site	Nearby intake site	Nearby intake site	Lebakbulus	Lebakbulus
- Transmission method	By gravity flow to distribution center	By pumping up to distribution center	By pumping up from intake site to the plant	By gravity flow from junction well at a high elevation nearby the intake site
- Transmission main	For raw water ø1500 x 1.0 km For clear water ø1500 x 20 km	For raw water ø1500 x 0.1 km For clear water ø1500 x 20 km	For raw water ø1500 x 20 km	For raw water, from intake to junction well, ø1500 x 1.0 km, from junction well to the plant, ø1500 x 20 km
- Other facilities				Junction well

3. Selection of the Treatment Plant Site

Cost comparison is made only for transmission facilities to simplify the calculation, the results of which are shown on the Table below. The facilities for comparison and summary of cost estimates are presented on Tables 2 and 3.

Present Worth of Each Alternative

(Unit: million Rupiah)

Discount Rate	Alternative 1	Alternative 2	Alternative 3	Alternative 4
8%	22,341	22,157	21,055	22,355
10%	20,540	20,363	19,387	20,589
12%	19,143	18,971	18,387	19,211

It is found by the above comparison that the Alternative 3 is the least cost solution. However, the difference of cost among the Alternatives is not necessarily decisive to select a most feasible one. Therefore, further examination of suitability of the site to be selected is considered essential from other viewpoints. The results thereof are as follows.

1) Operation

This treatment plant is meant to cover two supply zones in the west of Metropolis. The location of the plant is desirable to be as close to the supply zones as possible, to facilitate quick and adequate actions for changing demand conditions and unforeseeable emergency. From this standpoint, Lebakbulus is preferable.

2) Land Cost

At this stage, no detailed information about land price is obtained, but generally speaking the land price in the Metropolitan area is higher than that in the suburban areas. From this viewpoint, Cilangkap is preferable.

3) Policy of DKI

DKI intends to place water treatment plants outside the Metropolitan area as far as possible. But this policy will be reverse from the standpoint of the municipality which is supposed to accommodate such plant.

4) Future Expansion

In the future when the Cisadane River water resources are developed, raw water for water supply will be conducted from the upper reaches of the River to another place within the city boundary, because of multi purposes of water conductance. At this moment, therefore, it is premature to discuss the suitability of the plant site from this standpoint.

5) Power Supply

Both Cilangkap and Lebakbulus have not much difference in the convenience of power supply.

The results of comparison as made above show that there are no decisive factors to determine the site for the plant. Besides, the costs of construction for the Alternatives have no significant difference. For the present study, therefore, Lebakbulus will be taken provisionally, considering operational convenience. Final decision of the plant site is recommended to be made at the time of detailed design, investigating advantages and disadvantages of each site.

Table 2 Summary of Facilities

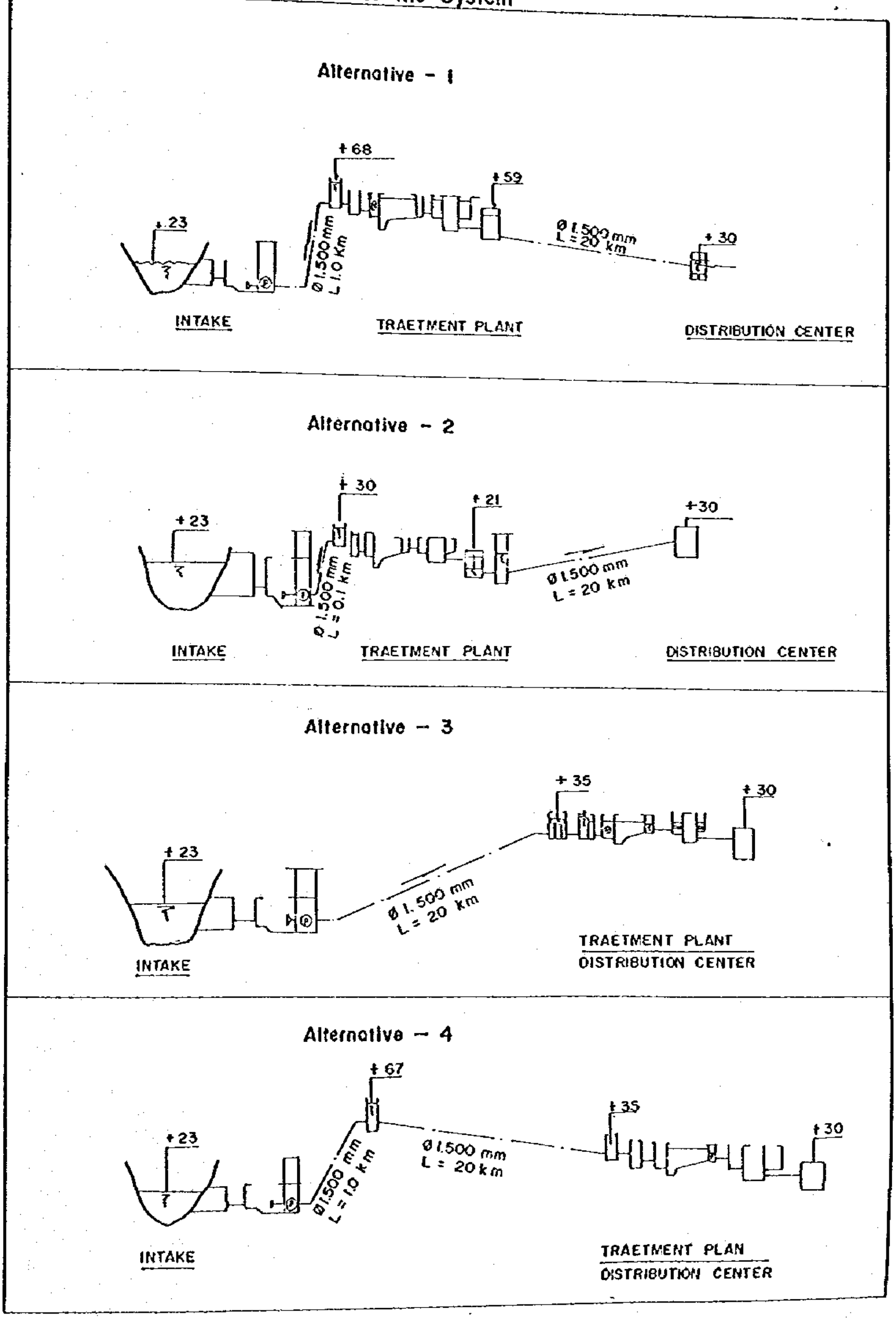
Facilities	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1. Transmission Pipe	Ø 1500 x 1.0 Km Ø 1500 x 20 Km	Ø 1500 x 0.1 Km Ø 1500 x 20 Km	- Ø 1500 x 20 Km	Ø 1500 x 0.1 Km Ø 1500 x 20 Km
2. Transmission Pump	Q 48 m^3/min x H 51 m x 570 kW x 6 units	Q 48 m^3/min x H 11 m x 125 kW x 6 units	Q 48 m^3/min x H 47 m x 520 kW x 6 units	Q 48 m^3/min x H 50 m x 550 kW x 6 units
	-	Q 45 m^3/min x H 41 m x 430 kW x 6 units	-	-
3. Electric Facilities				
1) Power Receiving	3,200 KVA	3,200 KVA	3,000 KVA	3,100 KVA
2) Electric Panels	6 sets	6 sets (at intake station)	6 sets	6 sets
	-	6 sets (at treatment plant)	-	-
3) Instrumentation				
a. water level	1 set	2 sets	1 set	1 set
b. pressure	1 set	2 sets	1 set	1 set
b. flow	1 set	2 sets	1 set	1 set
4. Pump House & Electric Room	930 m2 -	800 m2 930 m2	930 m2 -	930 m2 -
5. Junction Well	-	-	-	960 m3

Table 3 **Summary of Cost Estimates**

(Unit: million Rupiah)

Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Initial Cost				
1. Transmission Pipe	17,907	17,140	17,054	17,907
2. Transmission Pump	901	678	820	869
	-	198	-	-
3. Electric Facilities	845	645	773	817
	-	204	-	-
4. Pump House and	664	571	664	664
Electric Room	-	664	-	-
5. Junction Well	-	-	-	274
T O T A L	20,317	20,100	19,311	20,531
O & M Cost				
1. Personnel	14	28	14	14
2. Power	476	463	434	459
3. Maintenance	35	35	32	34
T O T A L	525	526	480	507

Fig. 1 Profile of the System



MASTER PLAN FOR

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M13. APPENDIX MIV-7

CONSIDERATION FOR SELECTION OF TREATMENT METHODS

CONSIDERATION FOR SELECTION OF TREATMENT METHODS

Treatment methods generally employed at the water treatment plants consist of a number of unit processes, and besides chemicals are used in different kinds for same purposes. Therefore, combinations of such processes and chemicals reach to a sizable number, that is, there are many possible alternatives. However, if most appropriate processes and chemicals suited for the given raw water are adopted, the number of alternatives may not be so many. In this respect, basic consideration for selection of appropriate processes and chemicals, from technical stand-point, are presented in broad terms, as described below.

Treatment method to be available for employing in treatment plants is shown in Fig. 1.

(1) Pre-treatment before intake

In case that some plant has polluted raw water and wide space, natural soil filtration on Lagoon has been employed for pre-purifying the polluted water to plants in Europe. Generally employment of this method may not be conducted because of its expensive cost and lack of wide space. On the other hand, dam water is clarified by natural sedimentation of suspended solids including pollutants.

(2) Pre-treatment before coagulation

Most pre-treatments are applied for removing or decreasing pollutants, as water treatment after pre-treatment is carried out easier operation and produces safe drinking water constantly below the Drinking Water Standard.

a. Aeration

Aeration is used for partly removing odors caused by the gases due to organic decomposition, removing carbon dioxide, iron and pH control, but odors and tastes from solution of decomposed organic matter or industrial wastes are but little affected.

Pre-chlorination

Pre-chlorination is commonly applied in many countries to raw water having pollutants. It may improve coagulation and will reduce tastes and odors. By reducing algae and other organisms it may keep the filter sand cleaner and increase the length of filter runs. Its range of effective action will, of course, depend upon the maintenance of a residual chlorine through the units of the plant. For greater oxidation of organisms, iron and Manganese, free residual chlorination should be used by adding sufficient chlorine to destroy the ammonia.

c. Ozonization

Ozonization of the raw water will reduce organic matter present through the action of the nascent oxygen and has been mainly employed in Germany and France. Oxidation of Manganese ion by ozone may produce colored water so that ozone is unable to apply to the raw water having it. Ozone cannot compete in cost with chlorine.

d. Activated Carbon Powder Treatment

This is used for odor and color removals caused by the pollution or algae growth if they are not removed by pre-chlorine or ozone. However this method has disadvantages of troublesome operation of its dosage, increase of sludge and no reduction of ammonium concentration.

e. Fixed Biological Film Contact Oxidation Method (FBF method)

As described in Appendix MIII-2, the method may be employed for treatment of seriously polluted water when the water is not treated sufficiently by ordinary treatment of the plants.

(3) Coagulation

By coagulation colloidal clay and suspended solids including organisms or algae may be removed by increasing their settling velocities at sedimentation basin. It is done by adding to the water certain chemicals known as coagulants, the commonest being Aluminum Sulfate (Alum).

Alum has been used for the present water treatment of waterworks in Jakarta getting effective results of turbidity removal and can obtain by local produce.

Recently Poly Aluminum Chloride (PAC) is employed in waterworks as coagulant instead of Alum in Japan and USA. Coagulation using PAC is more effective for water treatment having low water temperature and turbidity. But more PAC dosage than Alum which consumes alkalinity of 4 times and rapidly reduces pH value comparing with PAC, will be necessary for coagulation of a water being high pH, above 7.5, to come down to optimum pH range 6.3 and 7.0 after dosing coagulant. Cost of PAC is more expensive than that of Alum.

Polymer has been used for coagulant or coagulant aid together with Alum in Pejompongan I for effectice coagulation and economical operation. Jar tests conducted for reservoir or dam water, in fact, showed effective coagulation for light suspended solid water. Usage of the chemical, therefore, proposed for Buaran plant. Polymer, however, has disadvantage of toxicity if it is applied too much in quantity. In practice the use of Polymer is not allowed for drinking water supply in Japan due to expected effect for health. Careful study is advisable in the use of the chemical for coagulation.

Alkaline materials, Lime, Soda ash and Caustic soda are dosed with coagulant to keep optimum pH range of coagulated water.

(4) Sedimentation basin

Horizontal flow type and up flow type have been commonly employed for sedimentation basin at the plant.

Both have many advantages and disadvantages as follows:

a. Up flow type may have less expensive construction cost.

b. Horizontal flow type needs more space than up flow type.

c. In case that origin of water source is dam or lake, horizontal flow type has easier removement of floc.

d. Horizontal flow type has easier operation of desludging and less amount of desludging volume.

e. In case that turbidity of the raw water may change widely and frequently, horizontal flow type gets more stabilized treated water.

For the proposed plants, horizontal flow type sedimentation basin was proposed taken into account (i) easiness of operation, (ii) land availability, and (iii) more stableness against sudden flactuation of turbidity.

(5) Intermediate-chlorination

Intermediate-chlorination to clarified water before filtration has been employed for the purposes of protecting filter bed free from Bacteria and Organic Matter, oxidizing manganese ion remained in the clarified water and reducing produce of Trihalomethane in Japan. The method may be effectively used in tropical countries because residual chlorine may hardly remain in the clarified water by high water temperature of the water.

(6) Rapid sand filtration

Conventional type with single media has been commonly used for filtration. Employment of double media filter has recently been increased expecting longer filter run and higher filtration rate. Single media type with filtration rate of 120 m/d has been used in Jakarta. Higher filtration rate, 150 m/d, with single media was proposed considering the present practice. For washing of sand layer, two methods are commonly used: combination of backwashing and surfacewashing and usage of air scoring with water. The former method was employed considering liable washing and single media.

(7) Odor, toxic matter removal

If the filtered water remains odor caused by algae or organisms, ozone feeding or activated carbon filtration may be employed after filtration. And in case that toxic matters such as phenol and heavy metals are present in the raw water, activated carbon filtration will be used. As the methods are expensive and of additional process, raw water having no odor or toxic matters should be studied and selected before employing them.

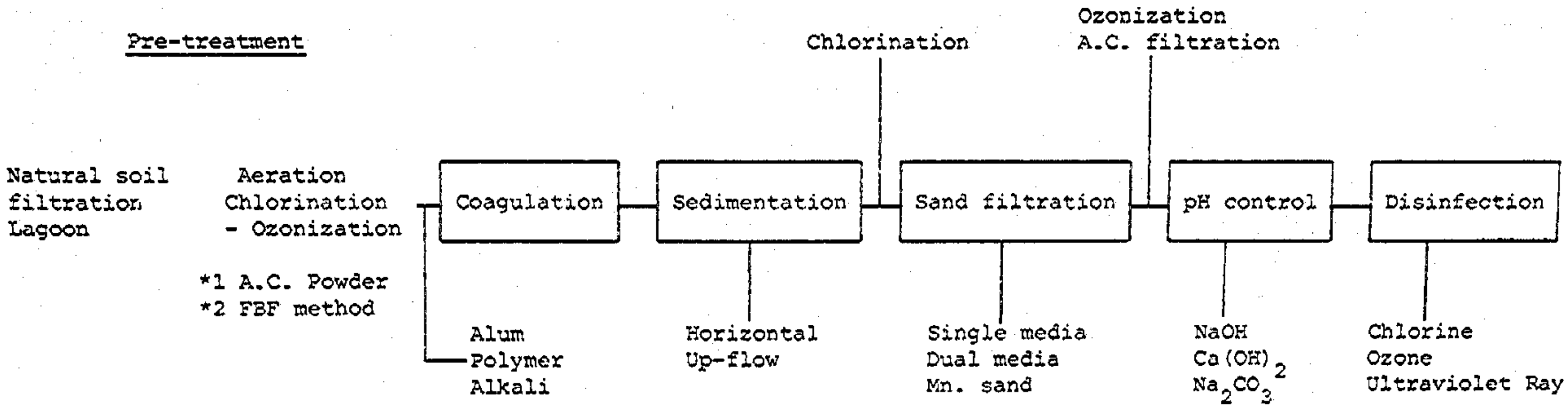
(8) pH value of the filtered water may be less than 7 in order to conduct optimum coagulation. From the viewpoint of protection of corrosion of pipes and of colored water, pH value of the finished water has to keep to more than 7 using alkaline chemicals, Lime, Soda ash or Caustic soda. Lime and Soda ash are obtained as a powder or solids though Caustic soda is solution, Soda ash and Caustic soda are more expensive than lime, but are more convenient to handle. In Indonesia lime can be obtained from local, but others have to be imported.

(9) Disinfection

Disinfection of the finished water is the killing of disease bacteria that it may contain. Chlorine, in its various forms, is almost universally used in disinfecting water. It is cheap, reliable, and presents no great difficulty in handling.

Ultraviolet ray is also disinfectant having advantages of causing no tastes or odors in the water and presenting no danger of overdosage, but disadvantage of greater cost than disinfection with chlorine. The process is used more in small private water supplies, battling works, and swimming pools than in large water works.

Ozone is a disinfectant much used for water treatment in Germany and France, but only a few installation have been made in the United States. It cannot compete in cost with chlorine.



*1: Activated carbon
*2: Fixed Bilogical Film Contact Oxidation Method

Fig. 1 Treatment Methods in each step

MASTER PLAN FOR
JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M14. APPENDIX MIV-8

SERVICE CONNECTION

1. Service Connections

According to the billing records, there were approximately 112,000 service connections including non-domestic service connections in the year 1980, 120,000 number of the service connection in the year 1981, 126,000 number in the year 1982, and 134,000 number in May 1983. Breakdown of each category of consumers is shown in Table 1.

The service connection which are required at 5 year intervals for the Master Plan are developed and are presented in Table 2.

The conditions for projection of number of service connection are as discussed in the following.

a. Number of connection is projected based on the population served by income group, and income group I and II rely on Public Hydrant/Vendor, and income group III, IV and V will have direct connection with the water main.

b. For projection of number of house connection, it is estimated that the number of persons per connection is 8 persons in the year 1980 and 6 persons in the year 2005. According to JATS Socio-economic Parameter Base (Survey) and Forecast Data, and household size forecast made by JMDP, average household size are 5.24 and 4.23 in the year 1980 and 2005, respectively. It is assumed No. of persons per connection is approximately 1.5 - 1.4 times of the average household size, i.e.
   5.24 x 1.5 = 7.9, Say 8 (1980), and
   4.23 x 1.4 = 5.9, Say 6 (2005).

c. According to the result of analysis on PDAM "sensus survey" available by January 1984, the average numbers of persons per house connection is more or less 7 (1,689 samples).

d. Number of persons per public hydrant in the year 1980 is assumed as approximately 1000, considering average consumption per month 272,100 m3/month (9.07 m3/day) and estimated per capita demand of 10 lpcd and existing number of connection in operation of 871.

   At present, water vendors deliver water to their customs, 300 meters - 500 meters apart from the hydrant in average, and it seems to cover rather huge area through water vendors per hydrant. In future, the number of the hydrants/stand-pipes installations are increased and location is rather close to dwellings, say 50 - 100 meters, the people will access to the hydrant by themselves.

   The number of consumers per connection is assumed to reduce from 1,000 to 740 in the year 1990 and to 200 in the year 2005 in line with government policy.

e. The service connections of Non-Domestic use which are required at 5 year intervals for potential requirement are projected and are presented in Table 3.

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

Table 1 — Number of Service Connections in the year 1980, 1981, 1982 and in May 1983

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

Table 2 Schedule of Service Connection

Year	Potential Requirement: Domestic Connection: Residential Service Connection	Potential Requirement: Domestic Connection: Public Hydrant	Potential Requirement: Non-Domestic Connection	Potential Requirement: Total	%	Proposed Number of Connection: Domestic Connection: Residential Service Connection	%	Proposed Number of Connection: Domestic Connection: Public Hydrant	%	Proposed Number of Connection: Non-Domestic Connection	%	Proposed Number of Connection: Total
1980	147,630	2,840	18,360	168,830	(62)	92,177*	(40)	1,149*	(100)	18,360*	(66)	111,686
1981	159,380	2,900	19,750	182,030	(61)	99,797*	(42)	1,231*	(97)	19,099*	(66)	120,107
1982	171,000	2,970	21,830	195,800	(61)	105,119*	(40)	1,197*	(92)	20,168*	(65)	126,484
1983	182,750	3,040	23,920	209,710	(61)	111,451*	(47)	1,417*	(88)	21,106*	(64)	133,974
1984	194,380	3,110	26,000	223,490	62	120,460	50	1,560	85	21,980	64	144,000
1985	206,130	3,180	28,080	237,390	64	131,720	56	1,780	84	23,500	66	157,000
1986	228,520	3,320	32,260	264,100	66	150,280	62	2,060	76	24,660	67	177,000
1987	251,290	3,470	36,440	291,200	70	175,810	68	2,360	79	28,830	71	207,000
1988	275,460	3,630	40,610	319,700	75	205,830	74	2,690	80	32,480	75	241,000
1989	291,870	3,790	44,790	340,450	81	237,500	80	3,030	84	37,470	82	278,000
1990	324,300	3,970	48,970	377,240	84	272,800	83	3,300	86	41,870	84	318,000
1991	357,360	4,220	54,900	416,480	87	309,810	89	3,760	86	47,430	87	361,000
1992	391,290	4,480	60,830	456,600	89	347,470	94	4,190	89	54,340	89	406,000
1993	425,530	4,780	66,760	497,070	91	387,540	97	4,620	91	60,840	91	453,000
1994	460,880	5,100	72,690	538,670	93	428,310	99	5,050	93	67,640	93	501,000
1995	497,400	5,480	78,620	581,500	95	470,830	100	5,480	95	74,690	95	551,000
2000	693,950	7,950	118,920	820,820	99	691,320	100	7,950	99	117,730	99	817,000
2005	961,170	15,090	177,680	1,153,940	99	954,010	100	15,090	99	175,900	99	1,145,000

NOTE: *Existing number of connections

Table 3 Projected Number of Service Connection of Non-Domestic Use (Potential Requirement)

Categories	No. of Service Connections 1980	1985	1990	1995	2000	2005
B. Non-Domestic Use						
B-1 Public Use						
a. Government Offices (@ 33.7 m3/ d/conn.)	1,784	1,920	2,630	2,760	3,660	3,770
b. Schools	239	880	2,030	3,850	2,890	4,350
c. Religious Places	305	1,120	3,460	8,380	9,610	10,990
d. Hospitals						
i. General Hospitals (Government)	50	53	62	70	77	84
ii. Maternity Hospitals (Private)	89	110	165	240	275	415
e. Boarding Houses	139	150	170	190	210	230
B-2 Industries Use						
a. i. Industries	324	950	2,570	5,010	8,230	12,180
ii. Store house	300					
b. Small Industries	5,291	6,900	11,200	15,100	21,100	31,400
B-3 Trade and Services						
a. Hotels	109	120	170	260	260	520
b. Trade and Services	9,666	15,280	25,810	41,980	71,740	112,800
B-4 Port Tanjung Priok	7	9	10	11	12	14
B-5 Armed Forces	0	590	690	770	850	930
B-6 Depok National Housing	2	1	1	1	1	1
B-7 Others	55					
	18,360	28,083	48,968	78,622	118,915	177,684

MASTER PLAN FOR

JAKARTA WATER SUPPLY DEVELOPMENT PROJECT

M15. APPENDIX MIV-9

METER INSTALLATION

Meter Installation

1) Past Record of Meter Purchasing

According to information available at the time of field survey in February 1984, number of meters purchased from the year 1967 up to present (latest purchase date is October 1983) are shown in Table below.

	Year	Number of Meter Purchased	Meter Size	Type	Manufacture	Remarks
1)	1967	80,000	1/2" - 12"	Single-jet wet type	BASCO	(Italy)
2)	1975-1980	30,000	1/2" - 2"	Single-jet dry type	METRONEX	(Poland)
3)	1980	40,000	1/2" - 2"	Multi-jet dry type	CENTURY	(Venezuela)
				Multi-jet dry type	KINMON	(Japan)
4)	1980	10,000	1/2"	Multi-jet dry type	AICHI	(Japan)
4)	1980	10,000	1/2" only	Single-jet dry type	KENT	(England)
5)	1983 (Oct.)	5,000	1/2" only	Multi-jet	AICHI	(Japan)

Notes: 1. As of February 1984, no 1/2" meters stored except BASCO (Single-jet wet type meters).

2. Meter Division estimates their need of approximately 30,000 number of meter per year in order to cover present requirement for newly installation and replacement of old and defected meters.

2) Meter Installation

PDAM let each branch office (Cabang) keep 50 numbers of water meter per month in average for immediate use of replacement upon customers request.

Branch office (Cabang) is given right to install the above water meter under their decision, however, they should report to Meter Division in the Central office of PDAM.

PDAM (Meter Division) has intention to replace all small size BASCO meters (1/2" and 3/4", single-jet type wet dial) with newly purchased water meter (multi-jet type with dry dial) since the year 1982, because of following reasons.

a. This single-jet type wet dial meter easily make meter dial dirty and it causes difficulties on reading.

b. This type of meter has point needle reading which causes difficulties on reading.

c. This meter can be easily disturbed the meter running by placing obstacles inside the meter to slow down or stop the meter running.

d. This meter rather easily worn out than multi-jet type meter.

Since 1982, 30,000 number of AICHI meters (small size) has been installed, and after these meters installation 160 pieces of the meters have been repaired as of January 1984.

Larger size meters (above 2") are all Waltman type meter. These meters, including BASCO meters, are repaired at the Meter Shop.

Larger size meters (2" - 4") from PONT A MOUSON (Waltman type) are mostly installed at Deep Well consumers with approximate numbers of 500.

3) Life of Water Meter

New smaller size water meters (1/2" - 1-1/2", multi-jet type with dry dial) have been installed from the year 1982. PDAM expects the life of the meter is about 5 years.

Replacement of larger size meters (2" or larger, Waltman type) is scheduled to be made at 3 years interval, although the life of meter (2" or larger) was about 2 years according to PDAM experience, and it is caused by present deteriorated water quality. It is observed some sticky materials such as mud, pipe scale, limy materials which are contained in the treated water from plants.

4) Type of Water Meter Recommended

It is recommended that PDAM continue to use, for house meters, on multi-jet type with dial of inferential type meter as practiced at present considering following conditions and features of water meter.

In principle, the type of meter is classified into two categories, which are influential type meter and positive displacement type meter. The former is the type of water meter of such mechanism as measures the consumed amount of water in terms of the number of wheel rotation, and the later is the meter of such type as measures water amount with some displacement measure.

Multi-jet type meters are a specific class of the inferential meters, and the disc type meters is one of the type representing the positive displacement type meter.

The advantages among two typical type meters of multi-jet and disc type meters are as follows.

In general, multi-type meters are rather widely used because of cost advantage and accurate enough at the lowest flow rate and at the highest flow rate, should meter size properly selected. The meters are more reliable compare to the displacement type meter to water which contains undesiable partiles against proper meter running. The disc-type meter is, in general, a superior measuring precision and high reliability especially lowest flow rate, but the weak point is that this type is liable to disfunction due to entry of scale and like and block the disc in the measuring chamber or disfacement of disc edge makes leaks and result lowering accuracy. Should such frequent disturbances occur, more maintenance or repair work be required. The cost is higher compare to it of multi-jet type.

In future, when the water quality is much more improved, the possibility of utilization of this displacement type of meter should be reviewed, considering cost of meter, maintenance ability, and benefit by increasing meter accuracy.

At present it is recommendable, considering the above conditions, to use multi-jet of inferential type meters rather than positive displacement type meters.