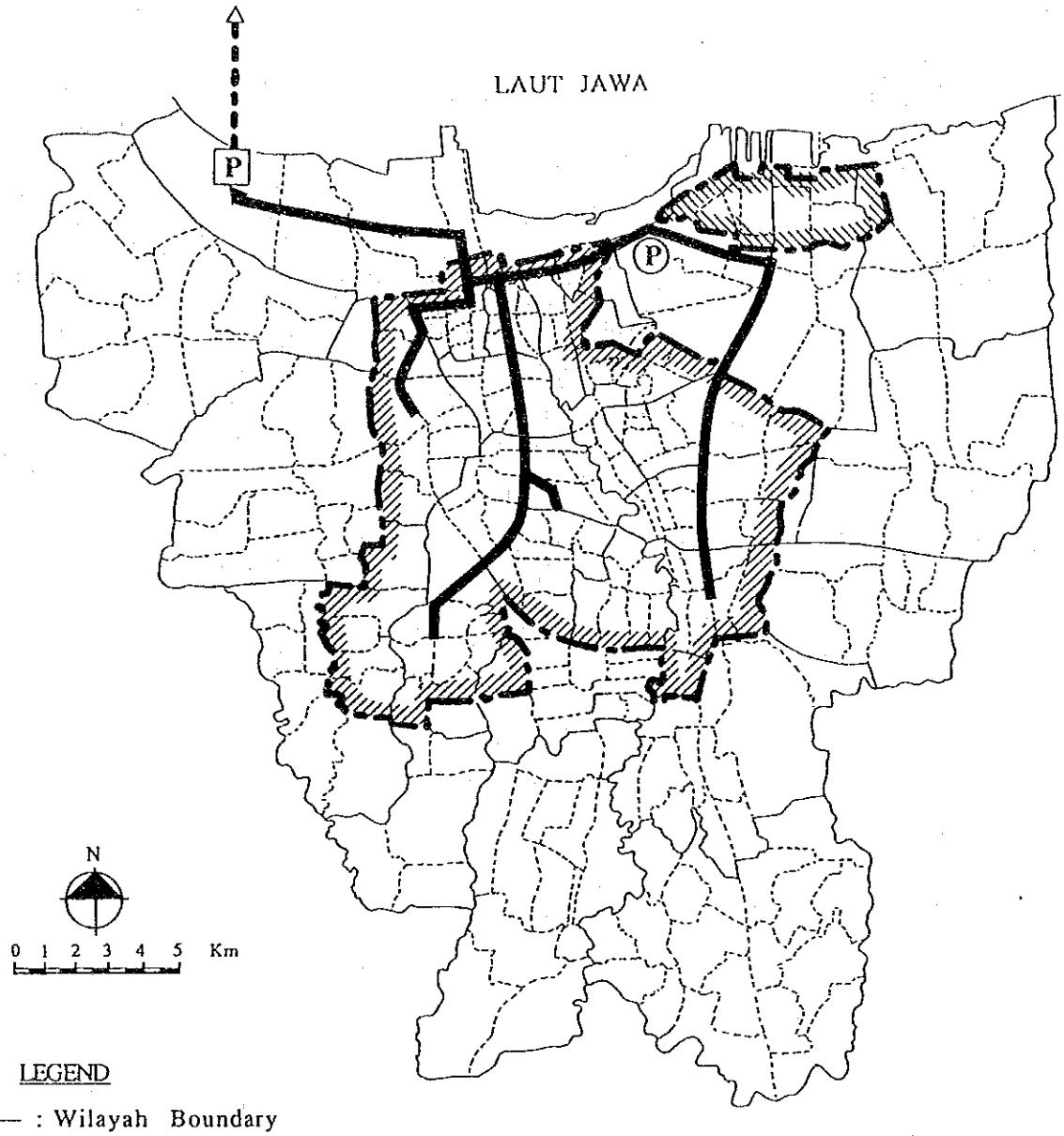


LEGEND

——— : Wilayah Boundary
—·—·— : Kecamatan Boundary
- - - - - - : Kelurahan Boundary
— — — : Boundary of Sewerage Development Zone
▬▬▶ : Conveyance Sewer Line

Ⓟ : Booster Pump Station

[P] : Outfall Pump Station

- - - -▷ : Outfall Pipe

FIG. H.17 OCEAN OUTFALL SYSTEM

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

FIG. H.18 IMPLEMENTATION SCHEDULE OF MULTIPLE SMALL SCALE ON-LAND TREATMENT SYSTEM

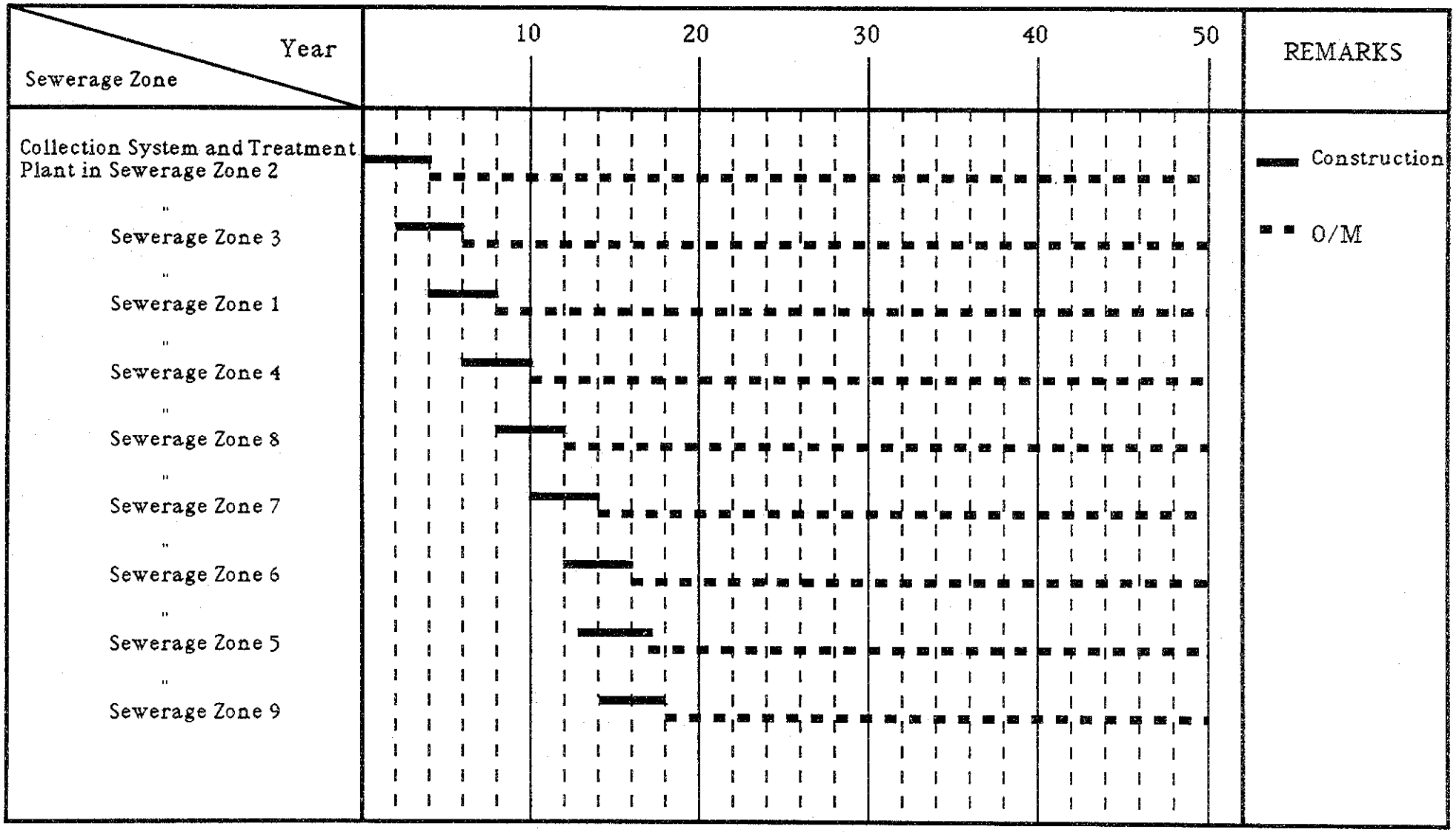


FIG. H.19 IMPLEMENTATION SCHEDULE OF MULTIPLE MEDIUM SCALE ON-LAND TREATMENT SYSTEM

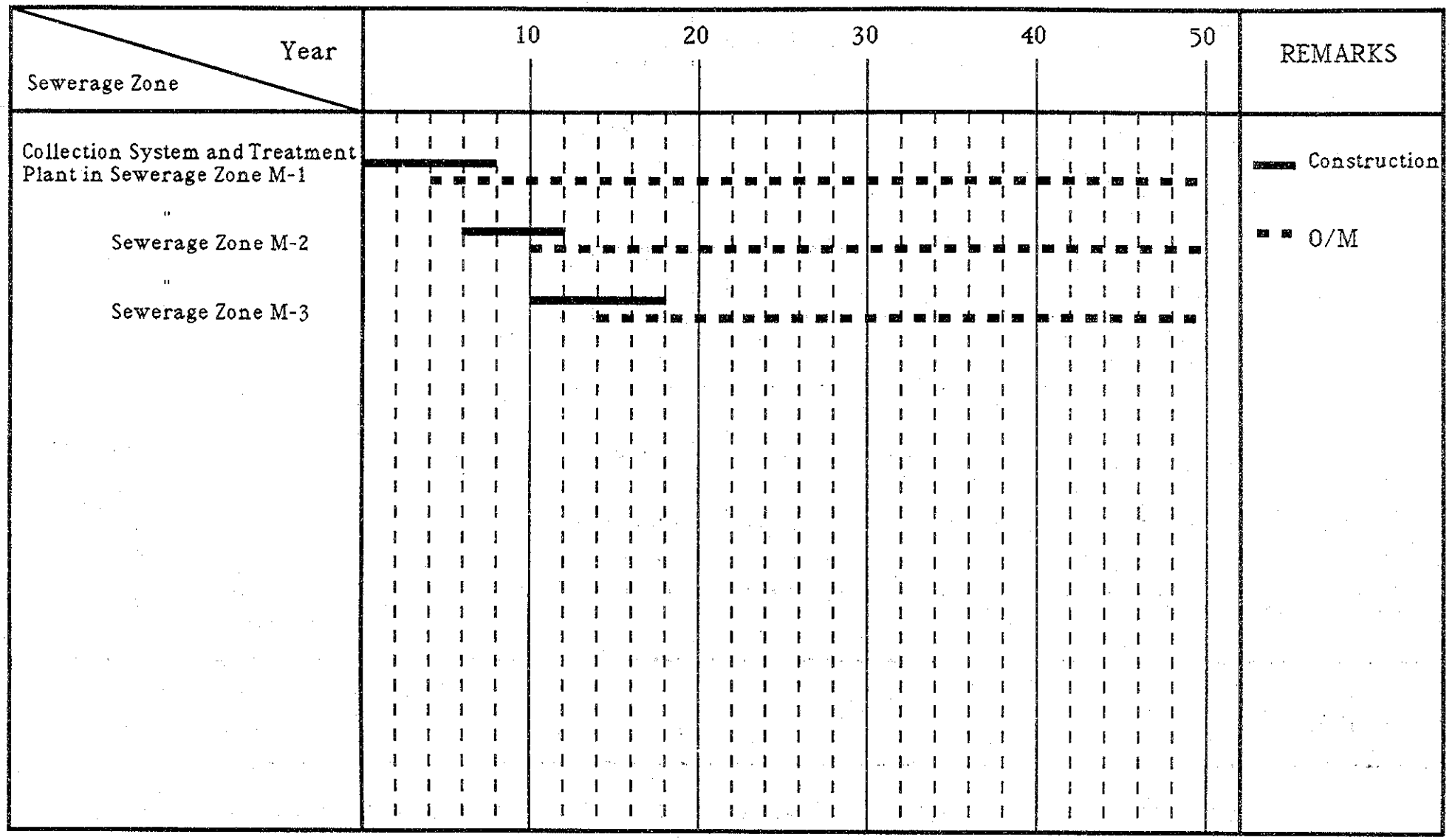


FIG. H.20 IMPLEMENTATION SCHEDULE OF SINGLE LARGE SCALE ON-LAND TREATMENT SYSTEM

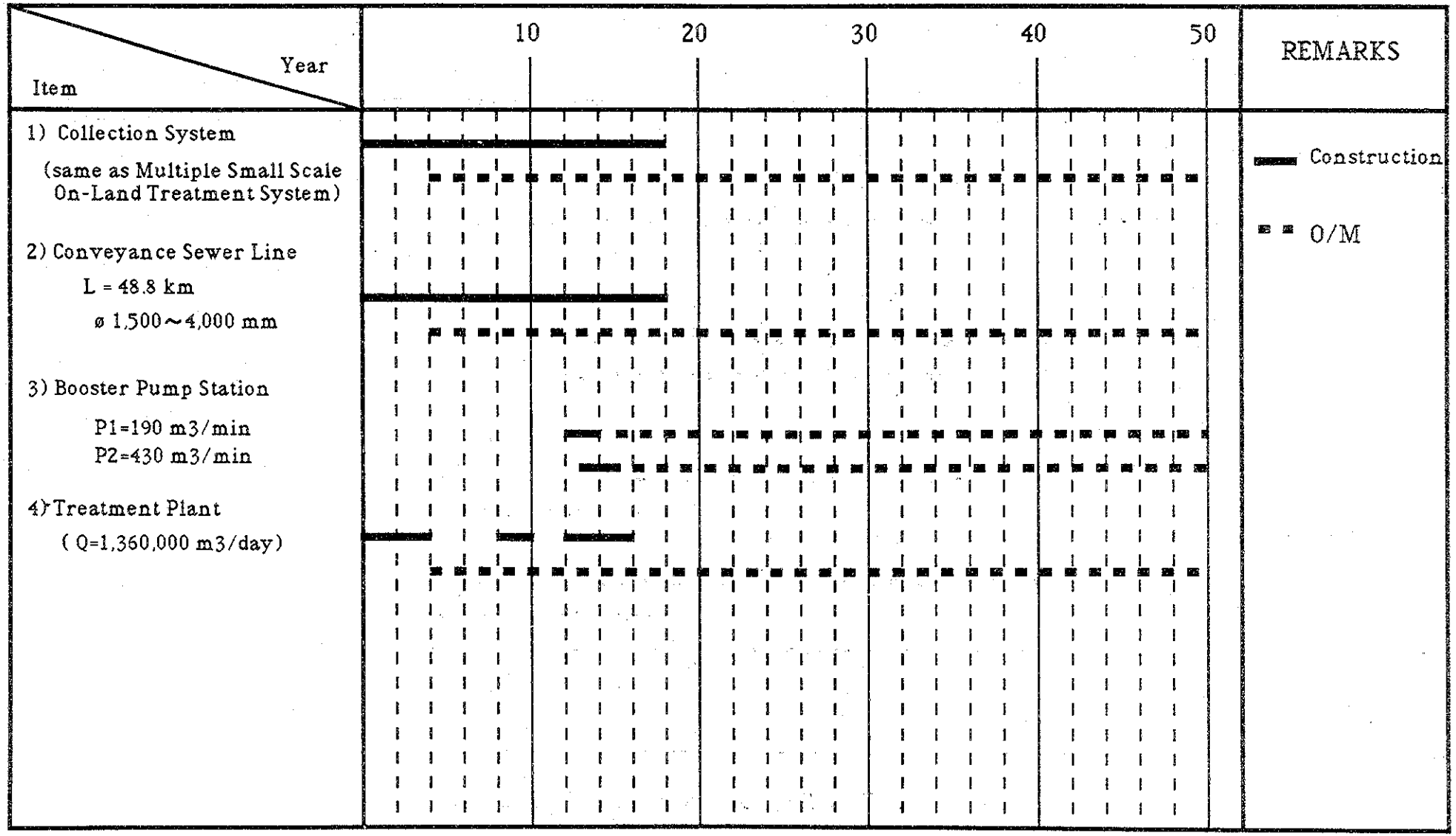
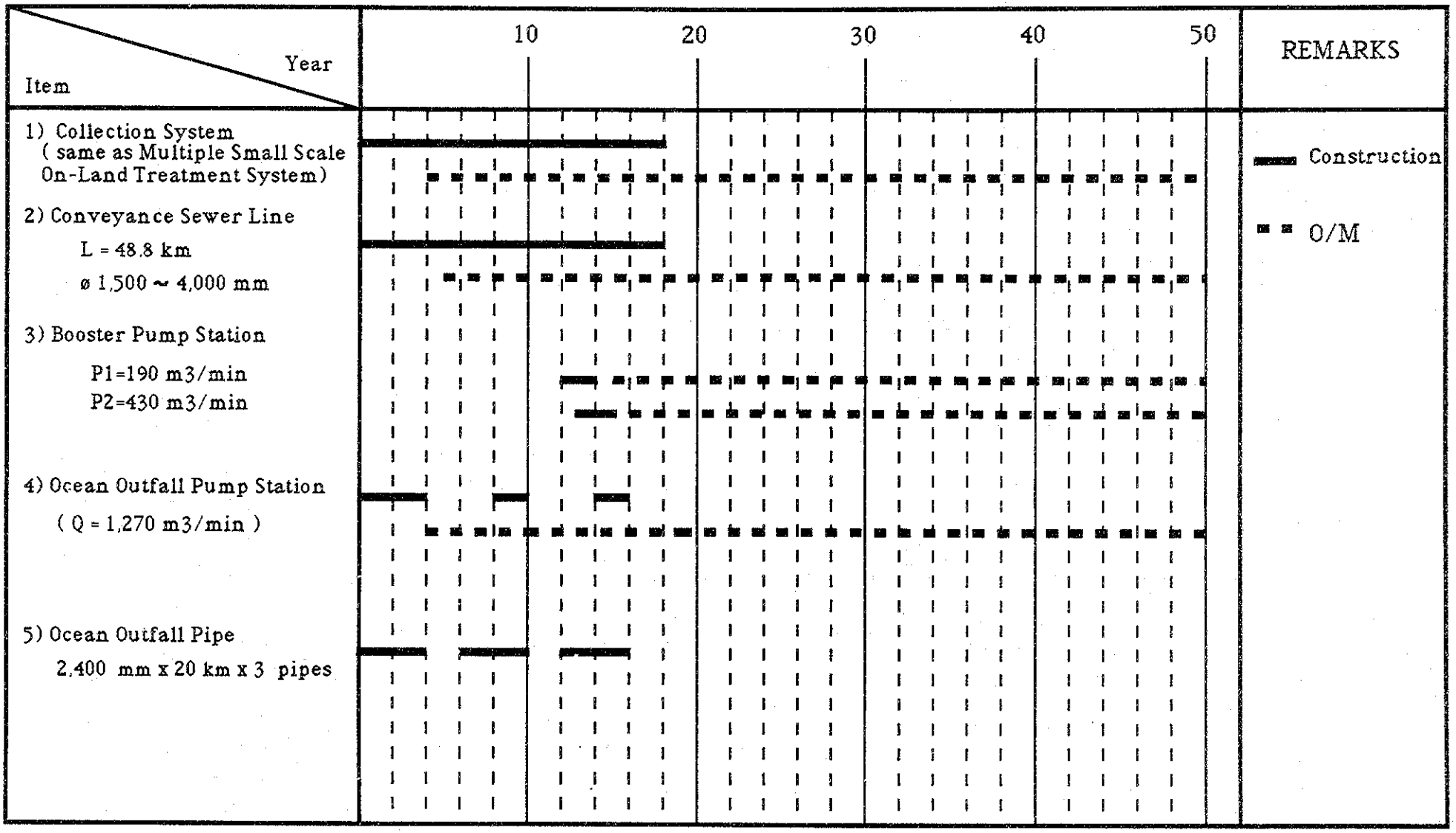
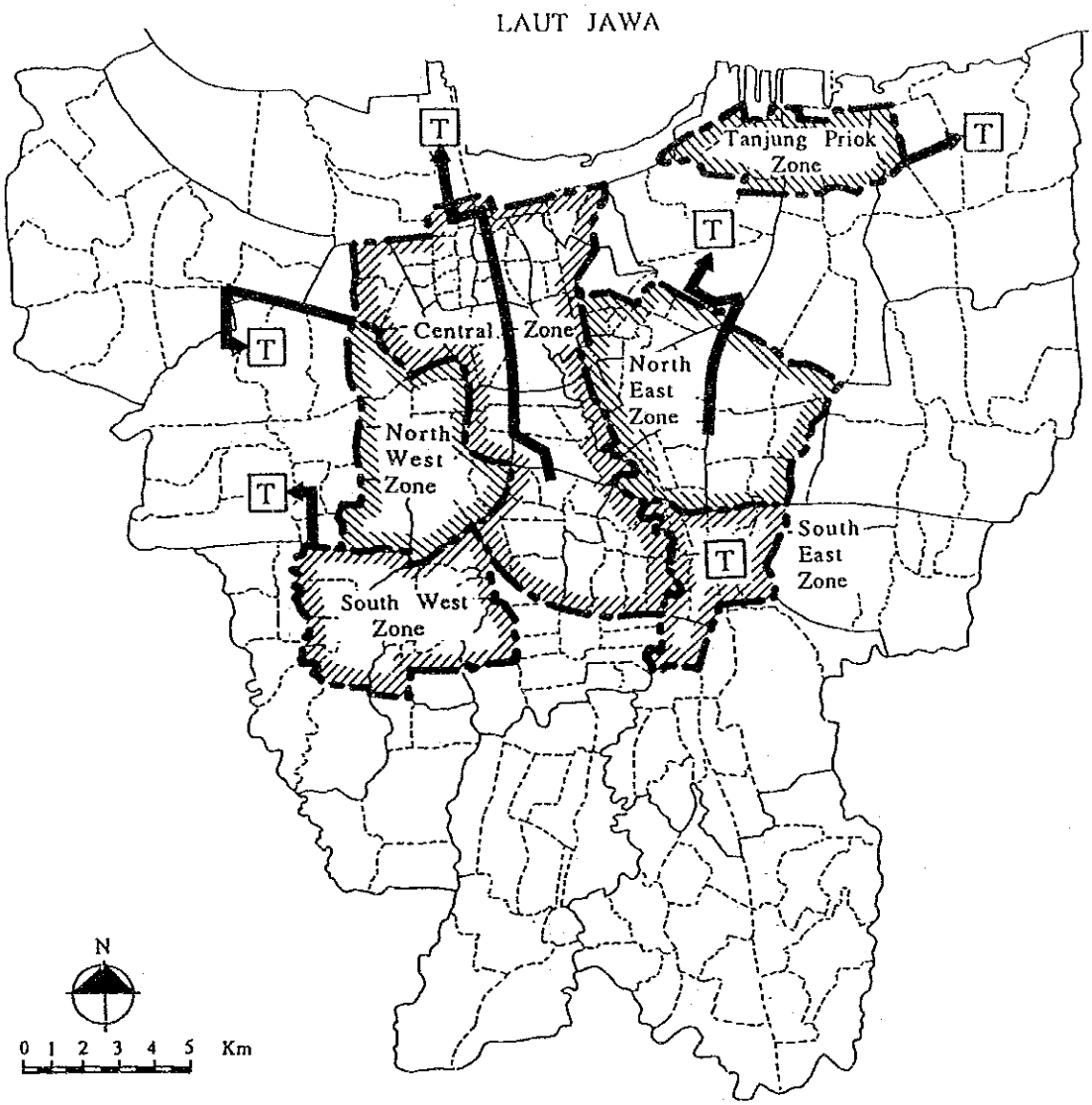


Fig. H.21 IMPLEMENTATION SCHEDULE OF OCEAN OUTFALL SYSTEM





LEGEND

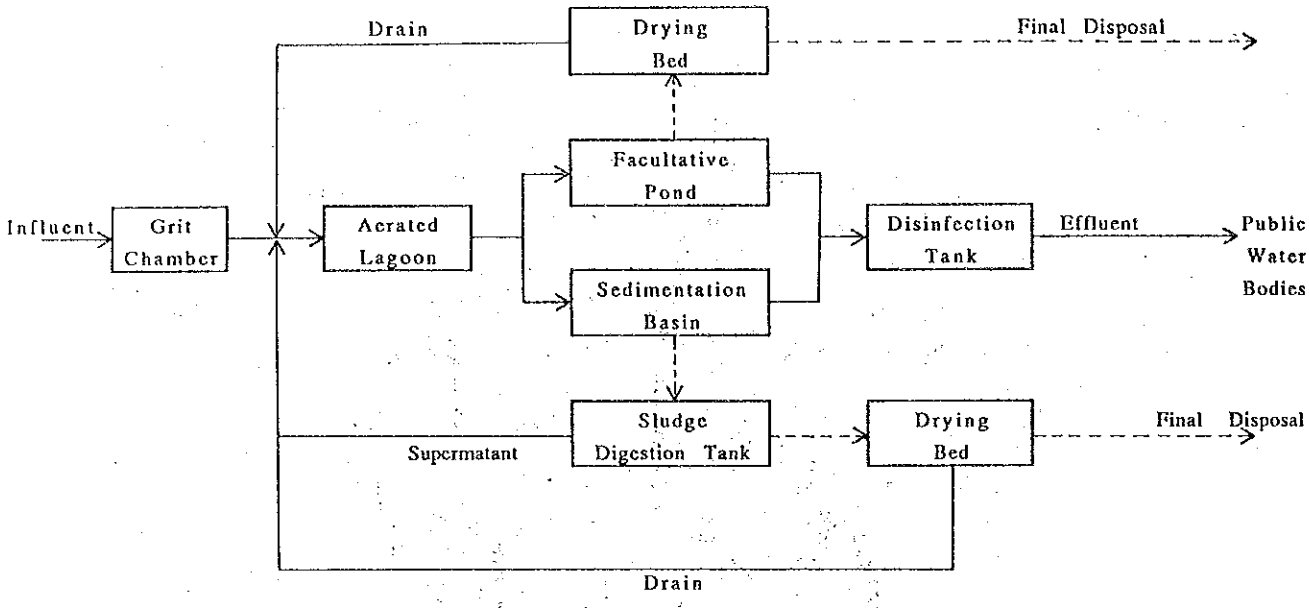
——— : Wilayah Boundary
— — — : Kecamatan Boundary
- - - - - - : Kelurahan Boundary
▬ ▬ ▬ : Boundary of Sewerage Development Zone
▬▬▶ : Conveyance Sewer Line
[T] : Sewerage Treatment Plant

FIG. H.22 OPTIMUM SEWERAGE DEVELOPMENT SYSTEM

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

Aerated Lagoon System



Conventional Activated Sludge System

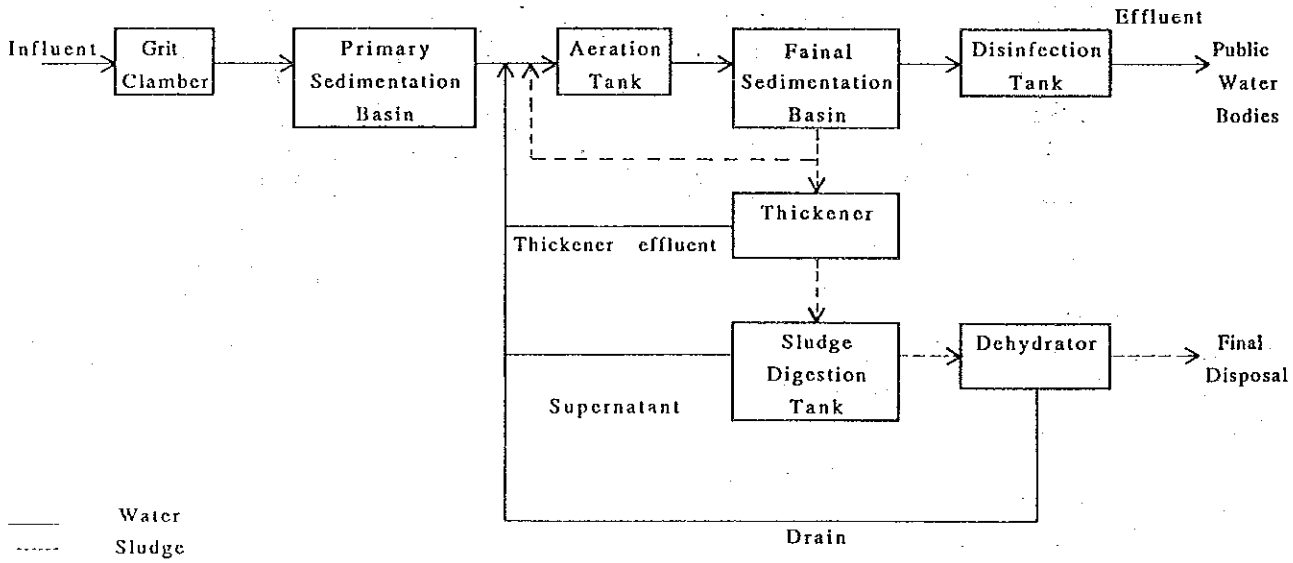


FIG. H.23 FLOW CHART OF TREATMENT SYSTEM

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

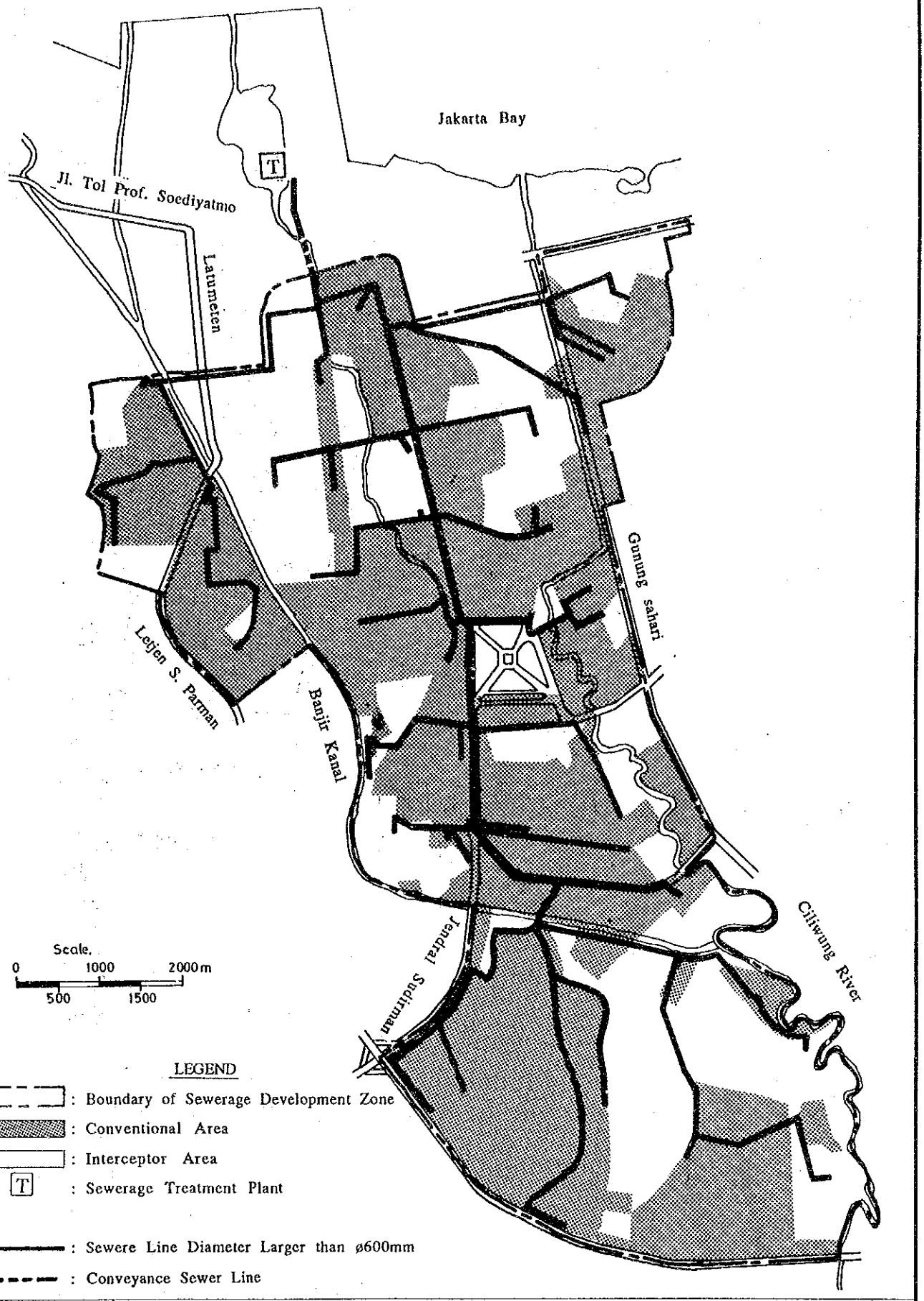


FIG. H.24 SEWERAGE DEVELOPMENT PLAN IN CENTRAL ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

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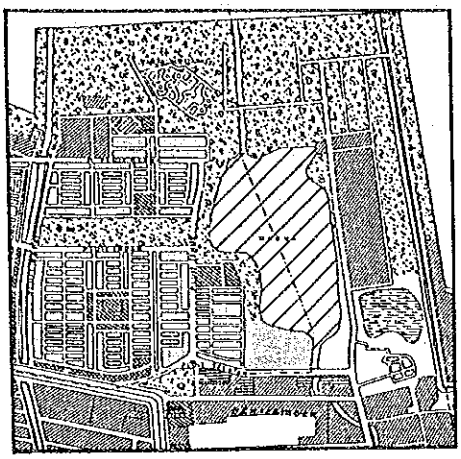
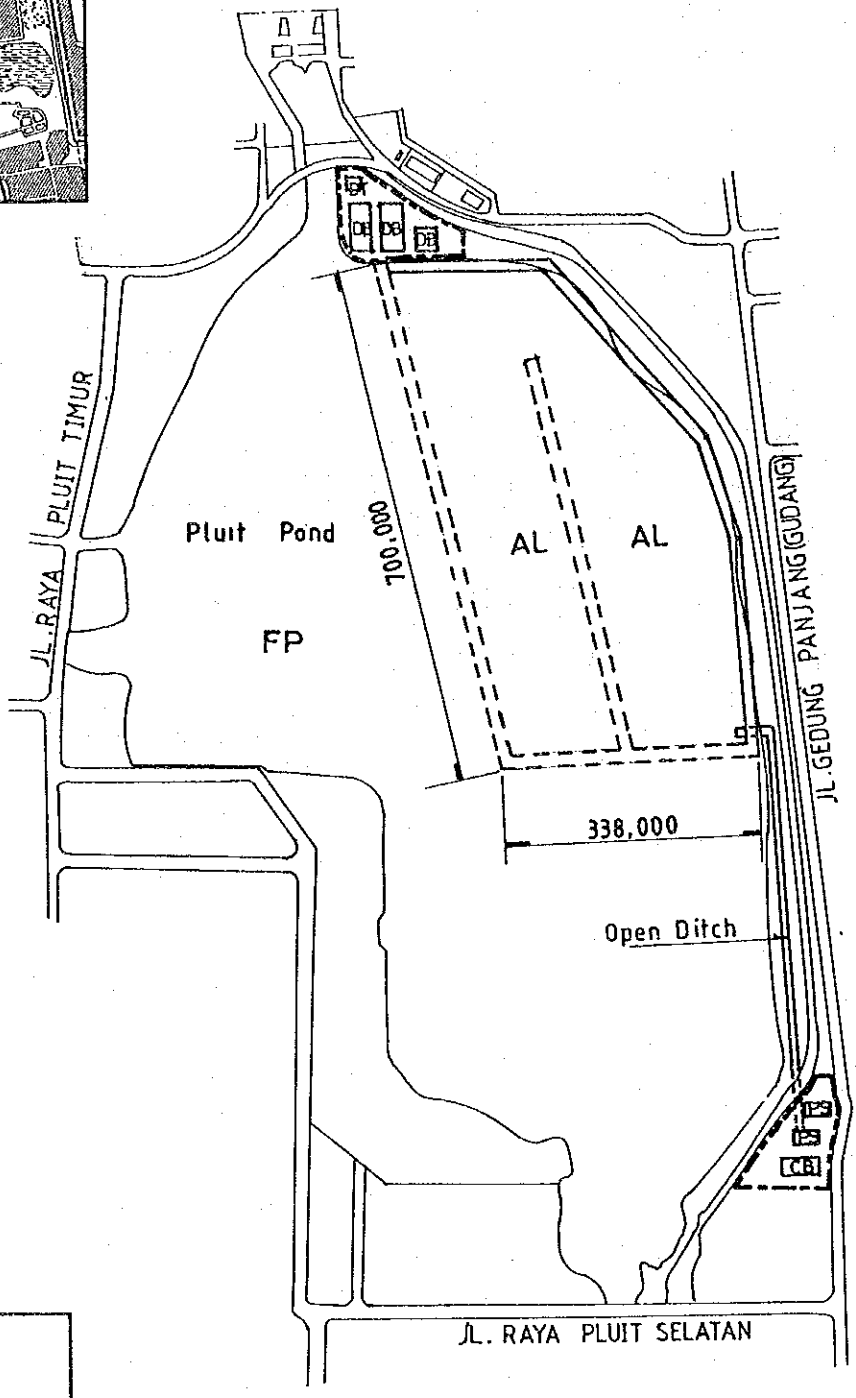




LEGEND

GC	:	Grit Chamber
PS	:	Pump Station
AL	:	Aerated Lagoon
FP	:	Facultative Pond
DT	:	Disinfiction Tank
DB	:	Drying Bed
CB	:	Control Building

FIG. H.25 LAYOUT OF TREATMENT PLANT OF CENTRAL ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

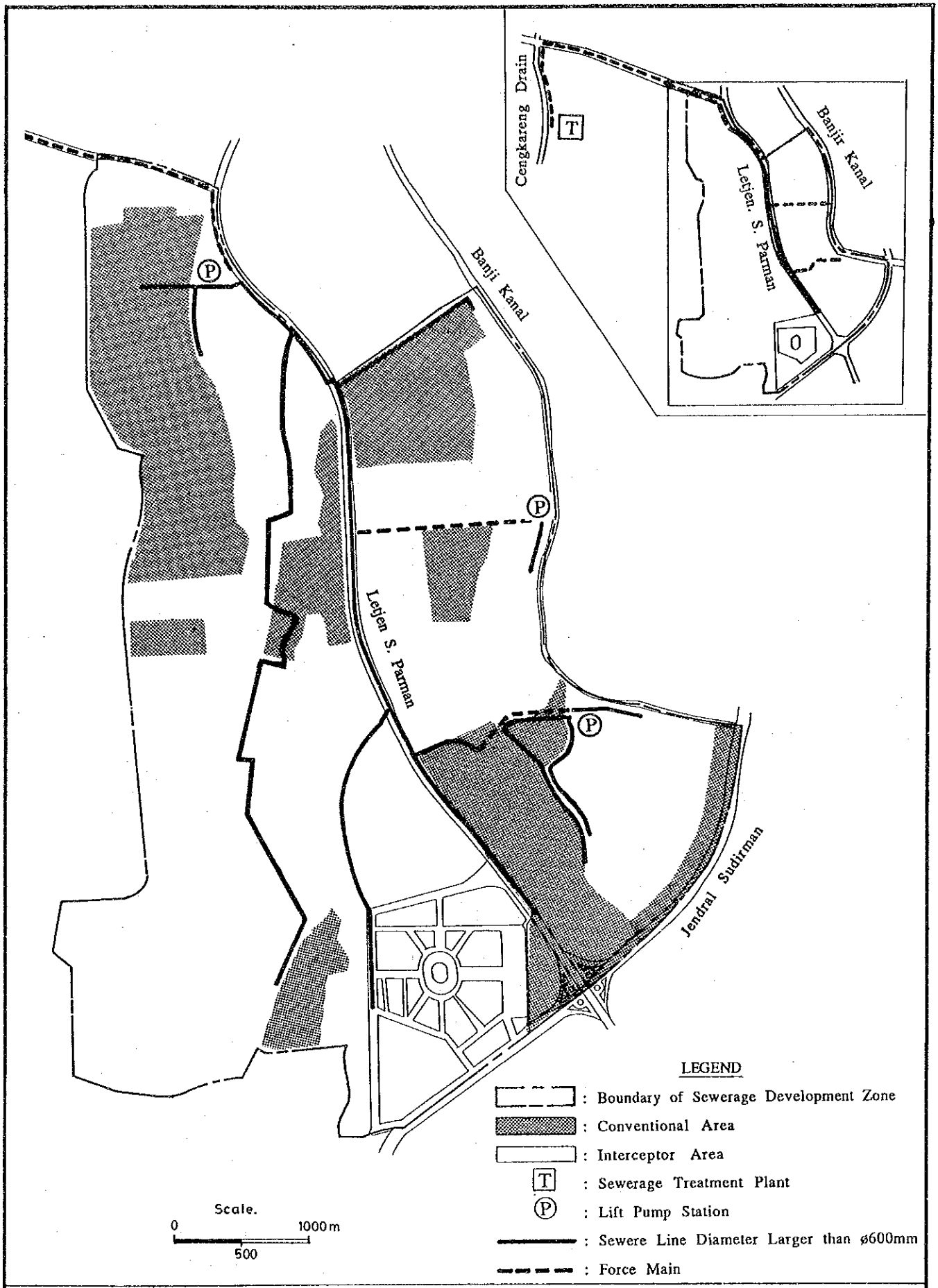
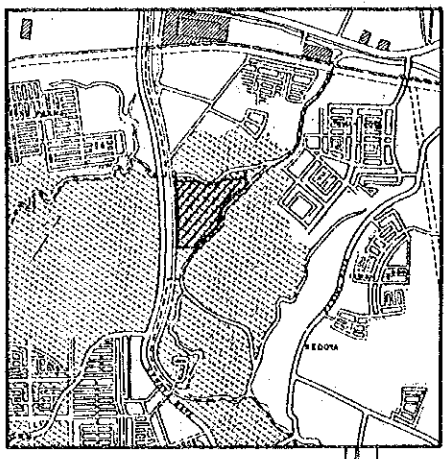
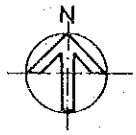
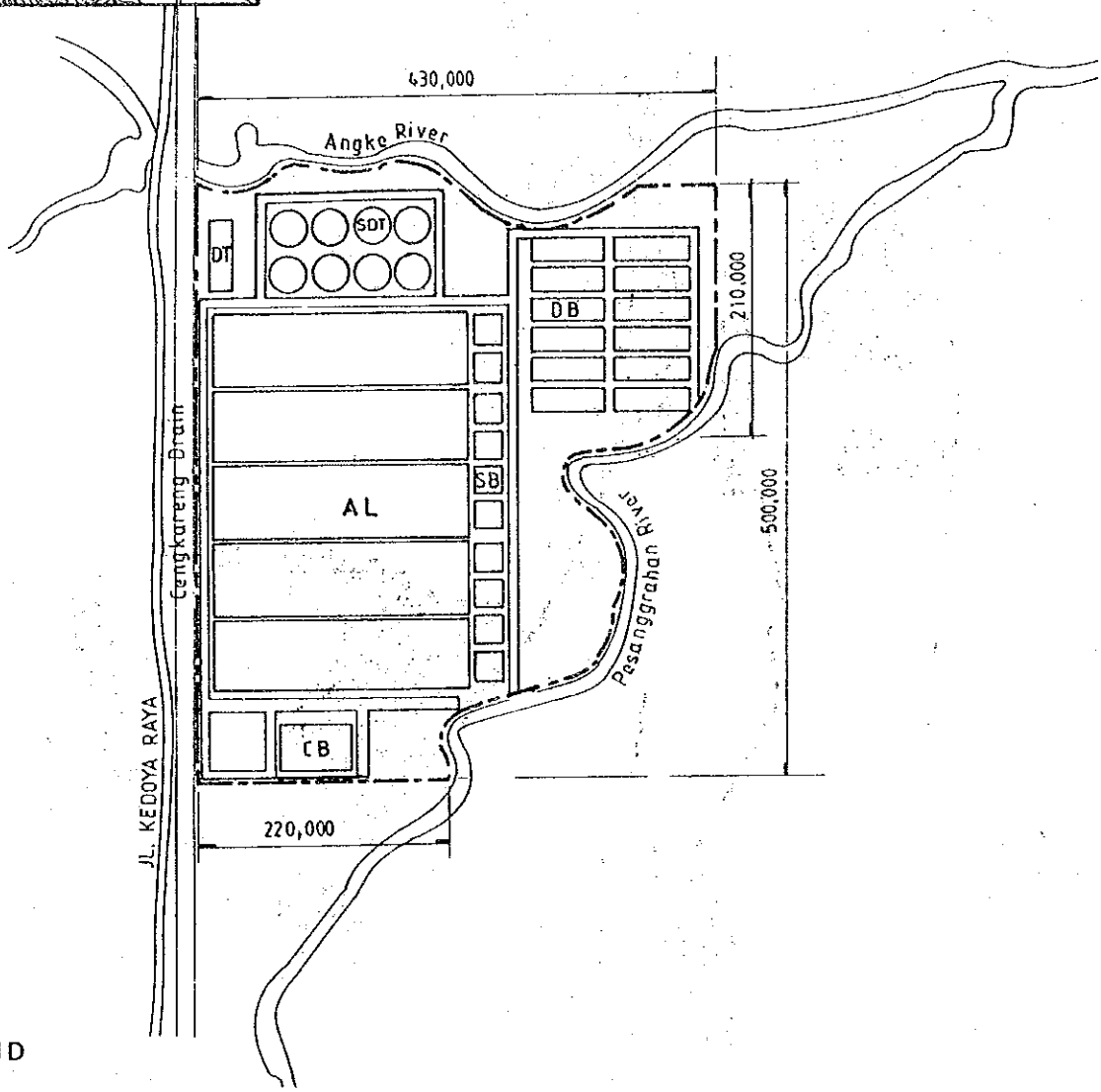


FIG. H.26 SEWERAGE DEVELOPMENT PLAN IN NORTH WEST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA







LEGEND

GC	:	Grit Chamber
AL	:	Aerated Lagoon
SB	:	Sedimentation Basin
DT	:	Disinfiction Tank
SDT	:	Sludge Digestion Tank
DB	:	Drying Bed
CB	:	Control Building

FIG. H.27 LAYOUT OF TREATMENT PLANT OF NORTH WEST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

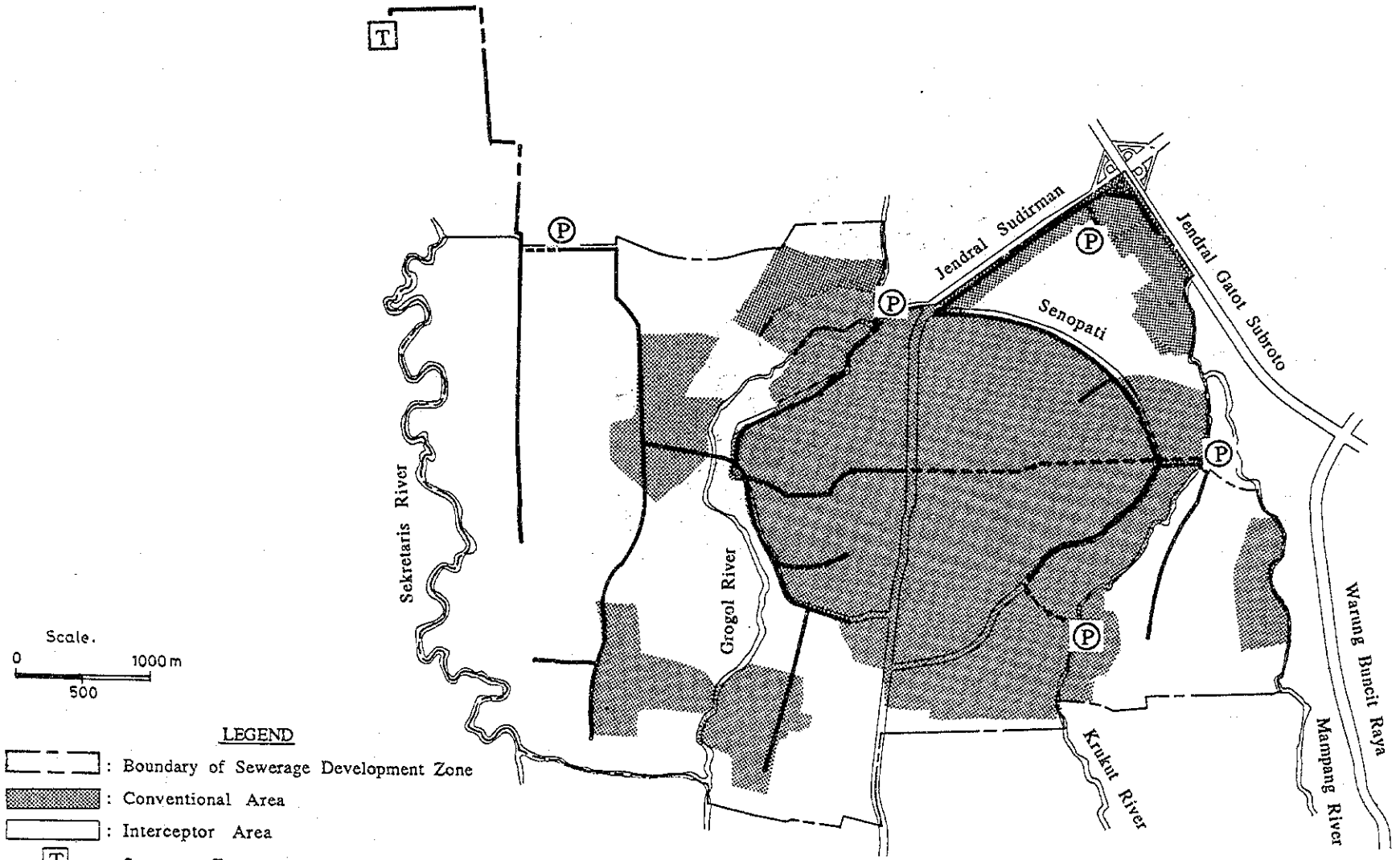


FIG. H.28 SEWERAGE DEVELOPMENT PLAN IN SOUTH WEST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

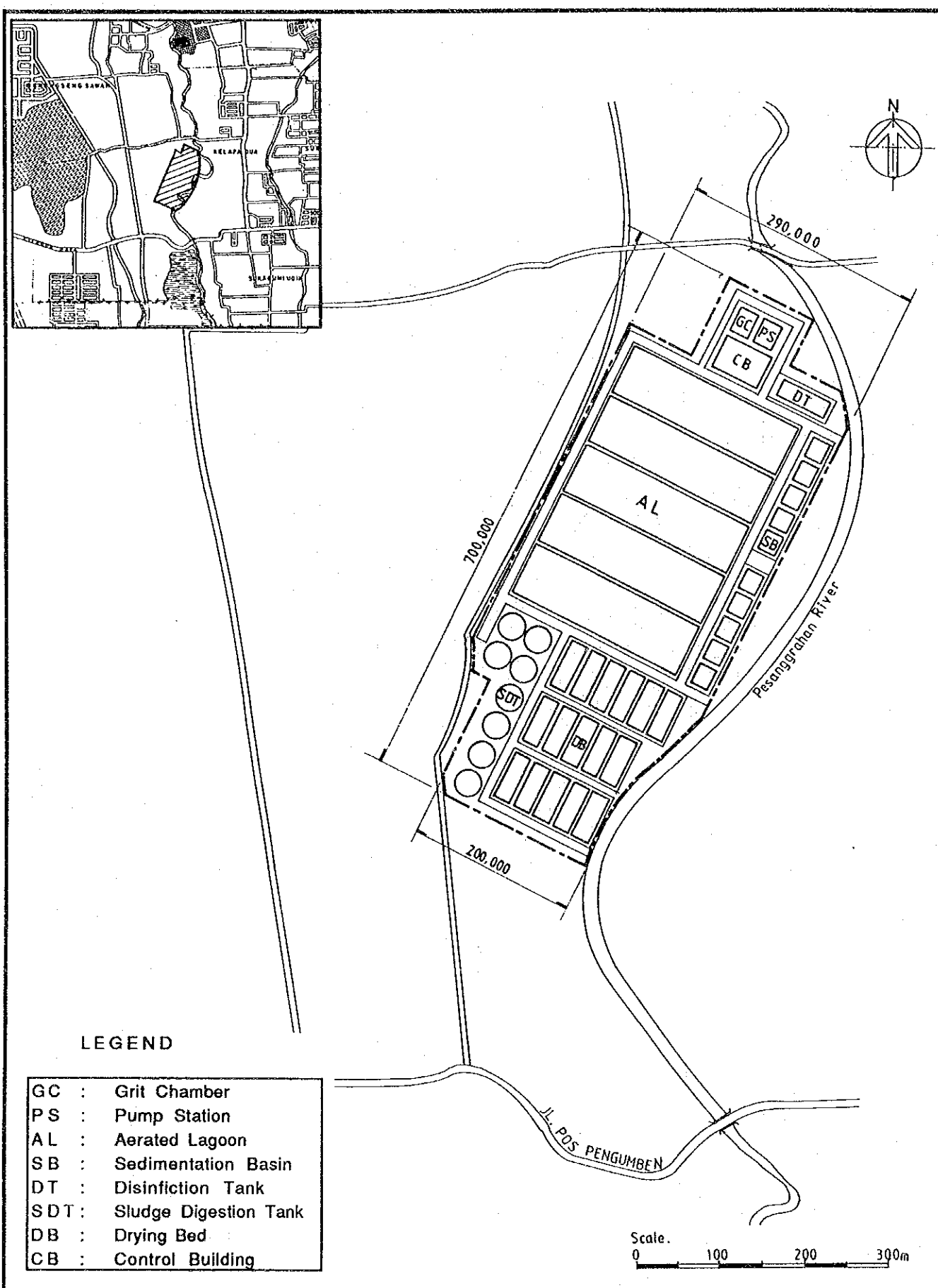
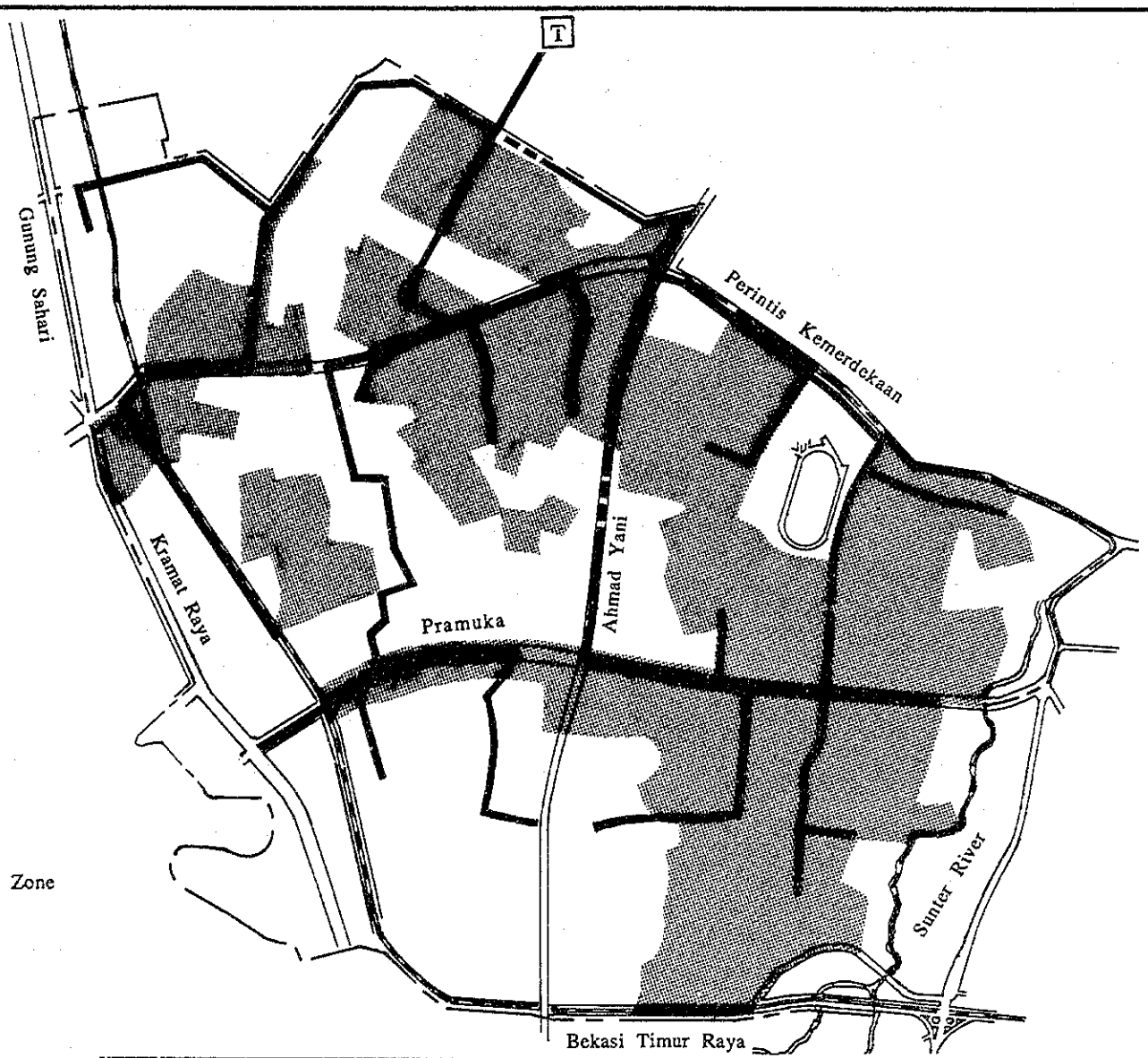


FIG. H.29 LAYOUT OF TREATMENT PLANT OF SOUTH WEST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



Scale.
0 1000 2000m
500 1500

LEGEND

: Boundary of Sewerage Development Zone

: Conventional Area

: Interceptor Area

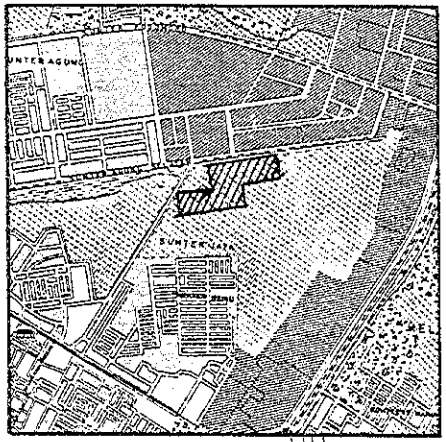
T : Sewerage Treatment Plant

: Sewere Line Diameter Larger than ø600mm

: Conveyance Sewer Line

FIG. H.30 SEWERAGE DEVELOPMENT PLAN IN NORTH EAST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



LEGEND

GC	:	Grit Chamber
PS	:	Pump Station
PSB	:	Primary Sedimentation Basin
AT	:	Aeration Tank
FSB	:	Final Sedimentation Basin
DT	:	Disinfiction Tank
TT	:	Thickener
SDT	:	Sludge Digestion Tank
DW	:	Dehydrator
BB	:	Blower Building
CB	:	Control Building

Scale.
0 100 200 300m

FIG. H.31 LAYOUT OF TREATMENT PLANT OF NORTH EAST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

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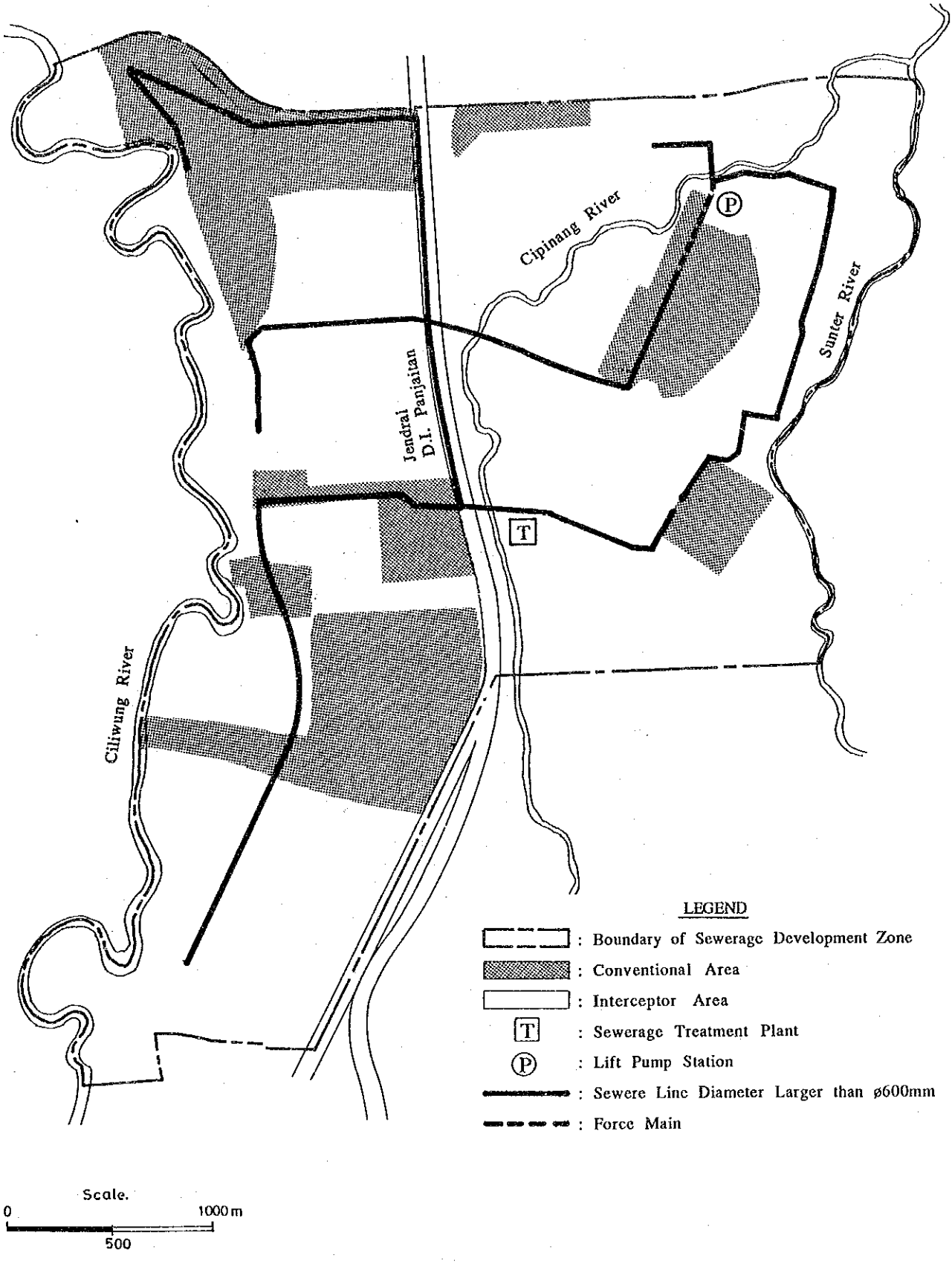
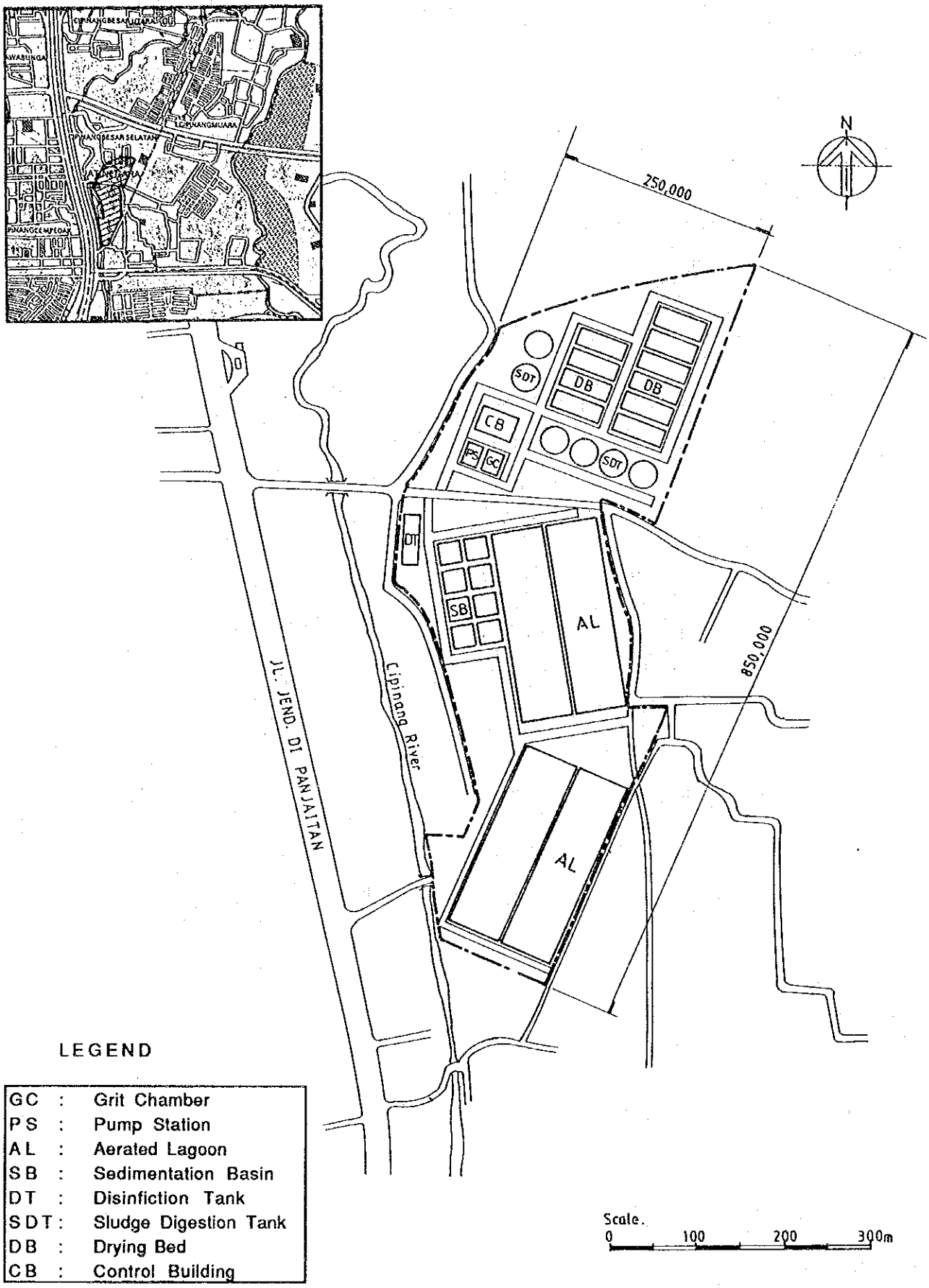


FIG. H.32 SEWERAGE DEVELOPMENT PLAN IN SOUTH EAST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



LEGEND

GC	:	Grit Chamber
PS	:	Pump Station
AL	:	Aerated Lagoon
SB	:	Sedimentation Basin
DT	:	Disinfiction Tank
SDT	:	Sludge Digestion Tank
DB	:	Drying Bed
CB	:	Control Building

FIG. H.33 LAYOUT OF TREATMENT PLANT OF SOUTH EAST ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

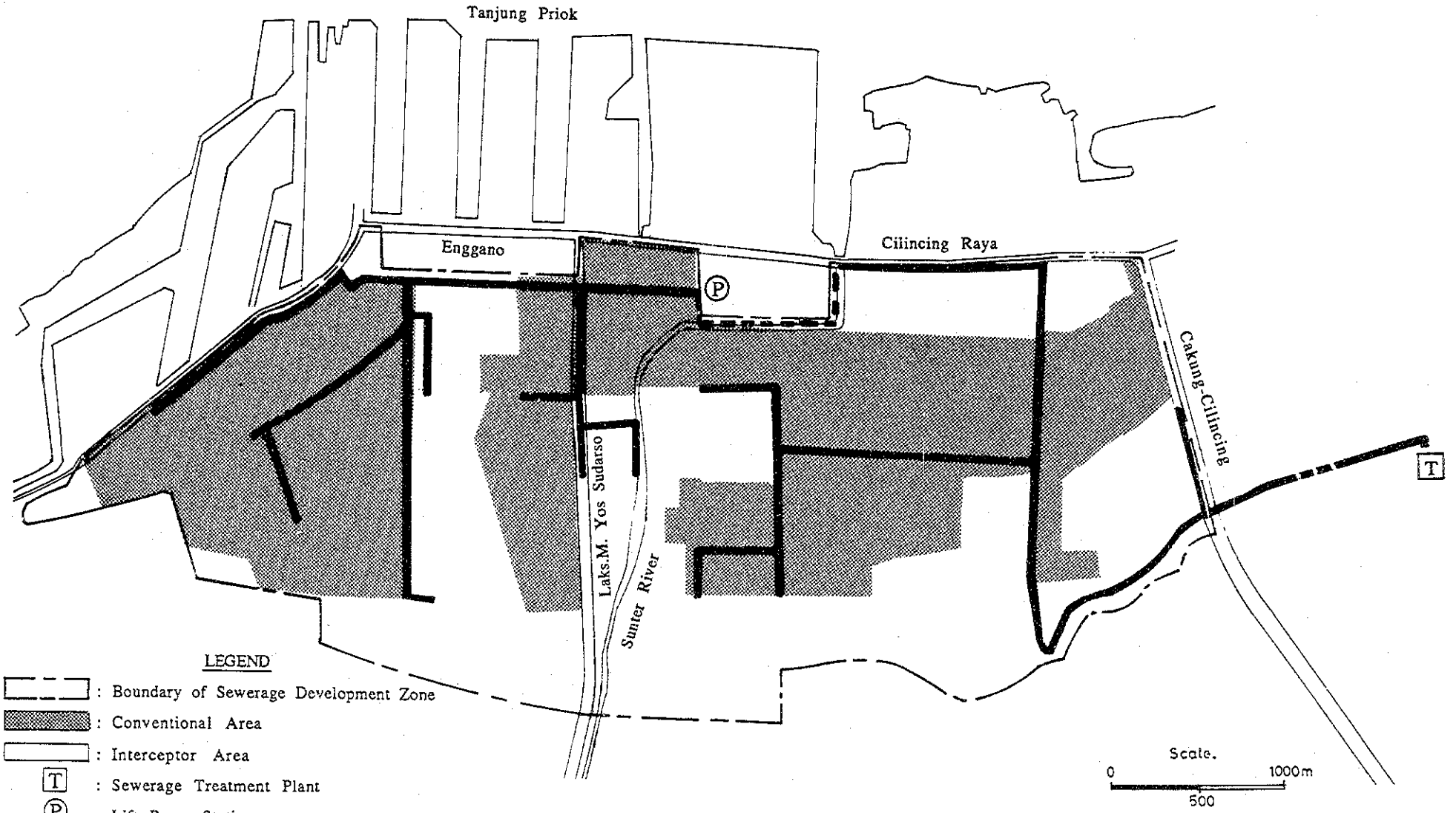
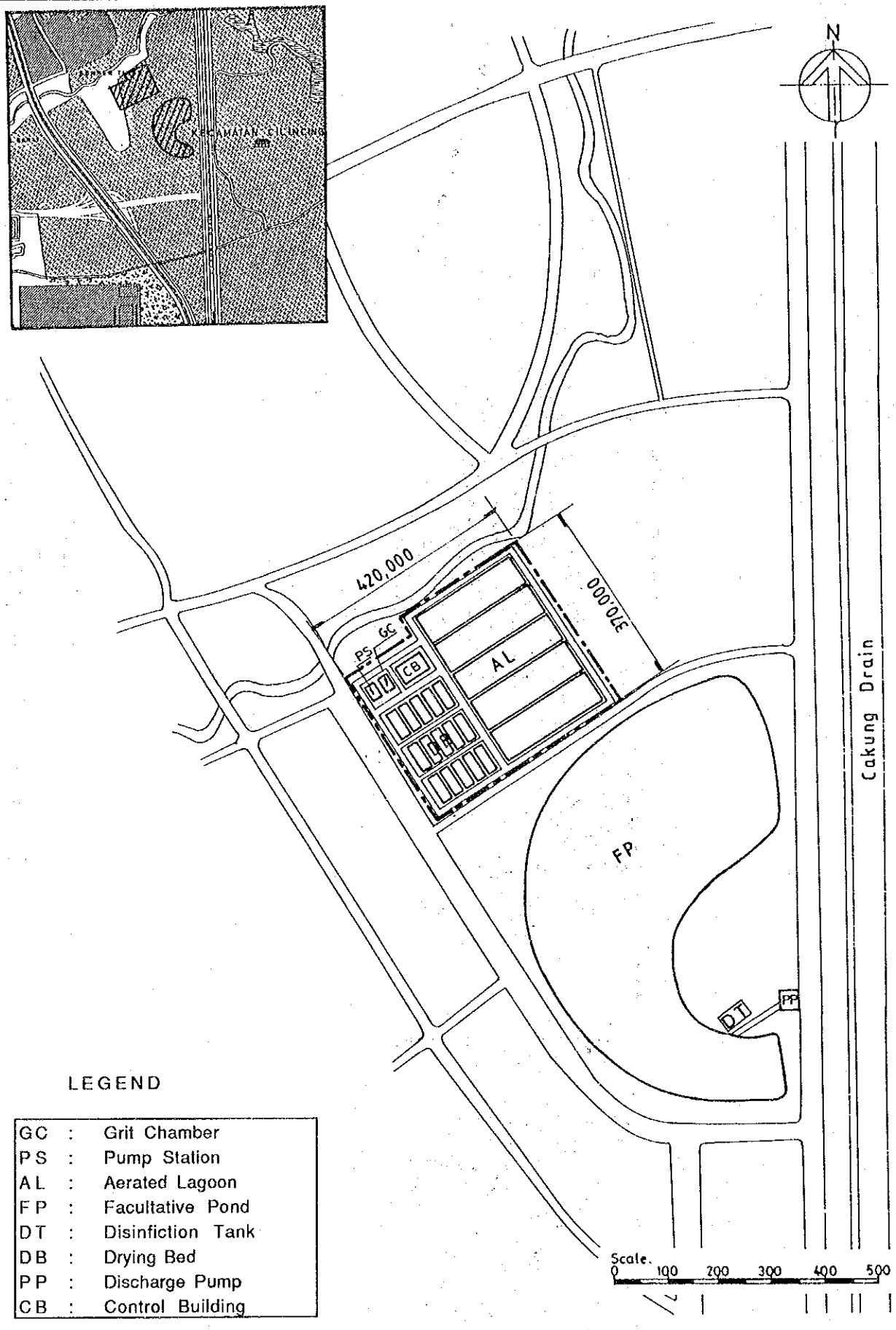


FIG. H.34 SEWERAGE DEVELOPMENT PLAN IN TANJUNG PRIOK ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA



LEGEND

GC	:	Grit Chamber
PS	:	Pump Station
AL	:	Aerated Lagoon
FP	:	Facultative Pond
DT	:	Disinfiction Tank
DB	:	Drying Bed
PP	:	Discharge Pump
CB	:	Control Building

FIG. H.35 LAYOUT OF TREATMENT PLANT OF TANJUNG PRIOK ZONE

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

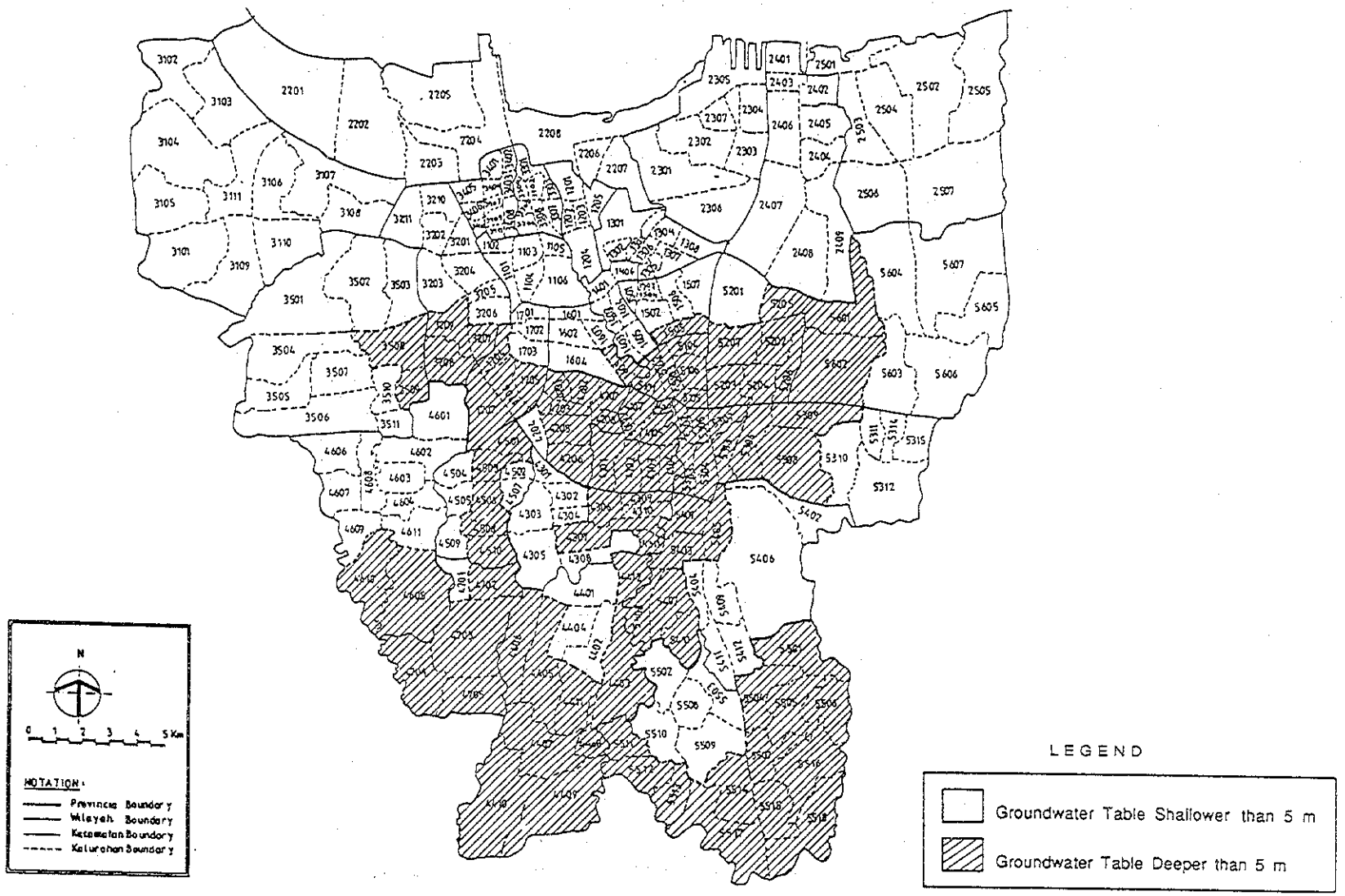
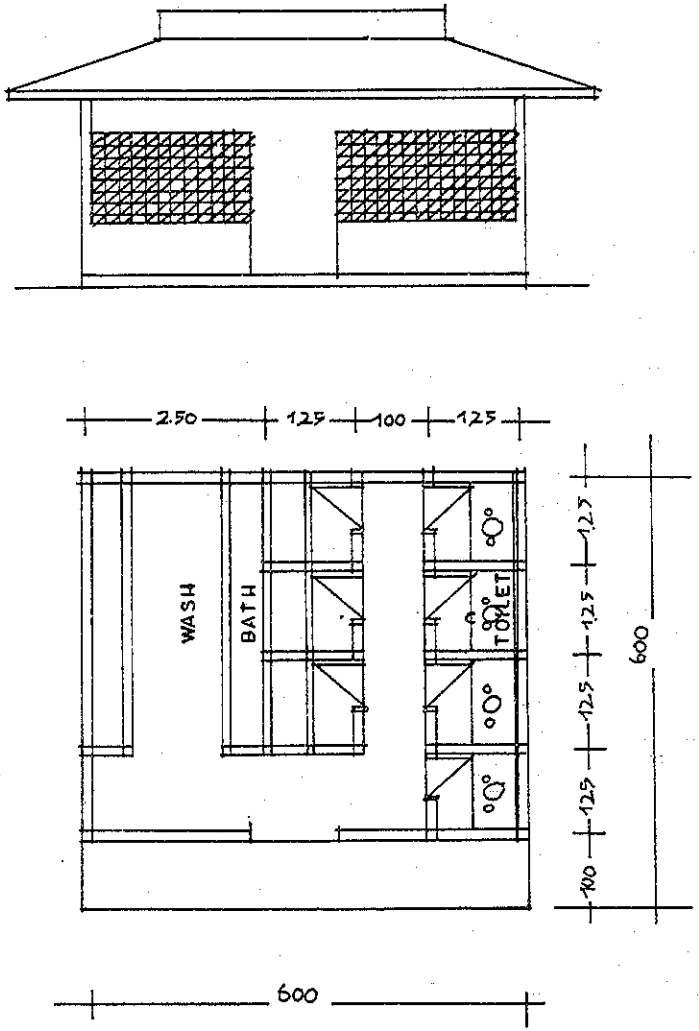


FIG. H.36 KELURAHAN OF DEEP AND SHALLOW GROUNDWATER

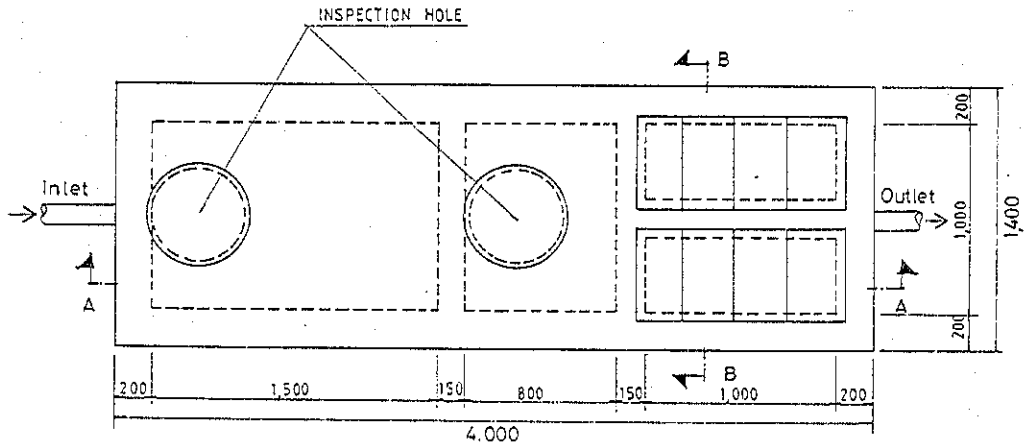
THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

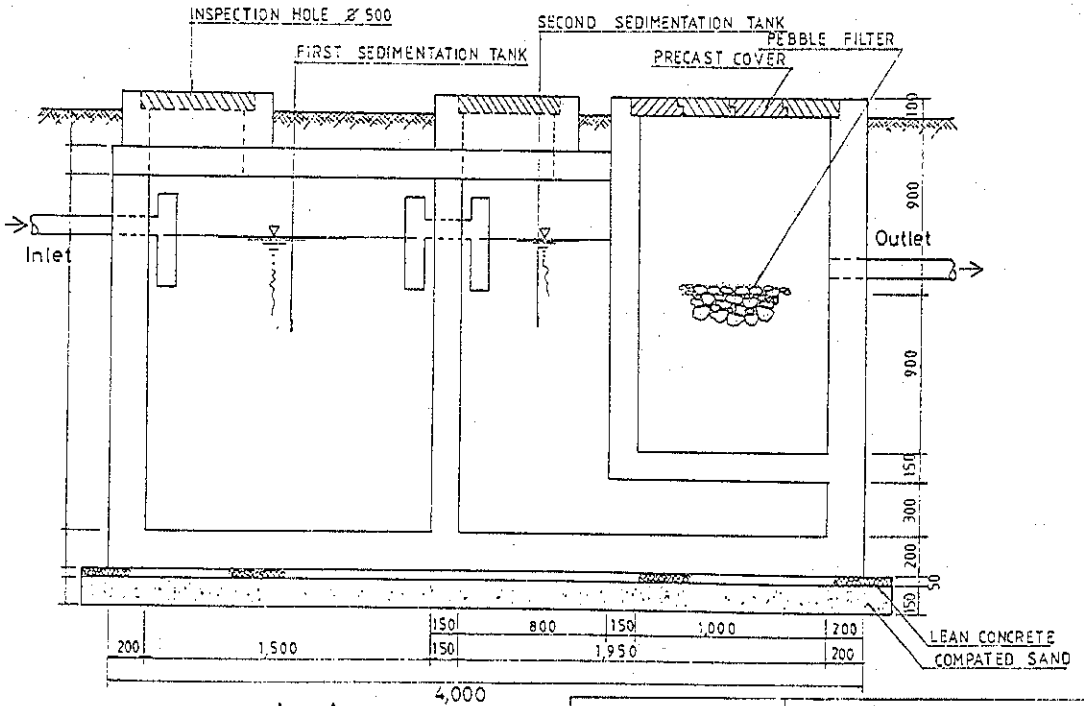


Dimension : cm

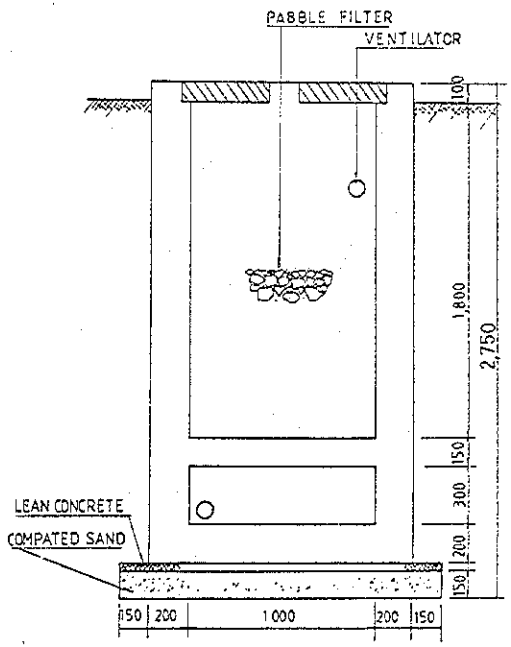
FIG. H.37 TYPICAL LAYOUT OF PUBLIC TOILET AREA B

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA





SECTION. A – A



SECTION. B – B

FIG. H.38 SEPTIC TANK WITH UPFLOW FILTER

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

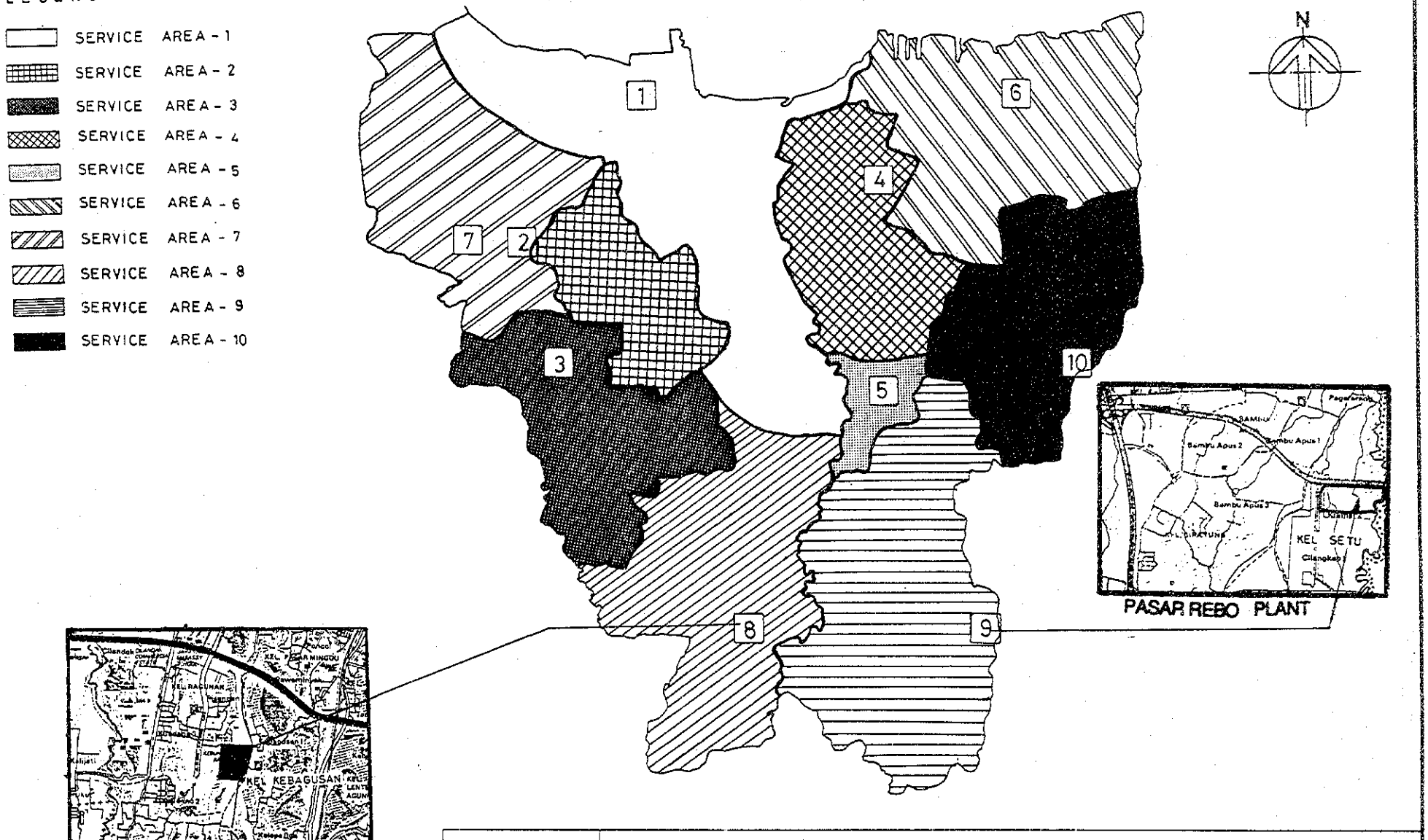
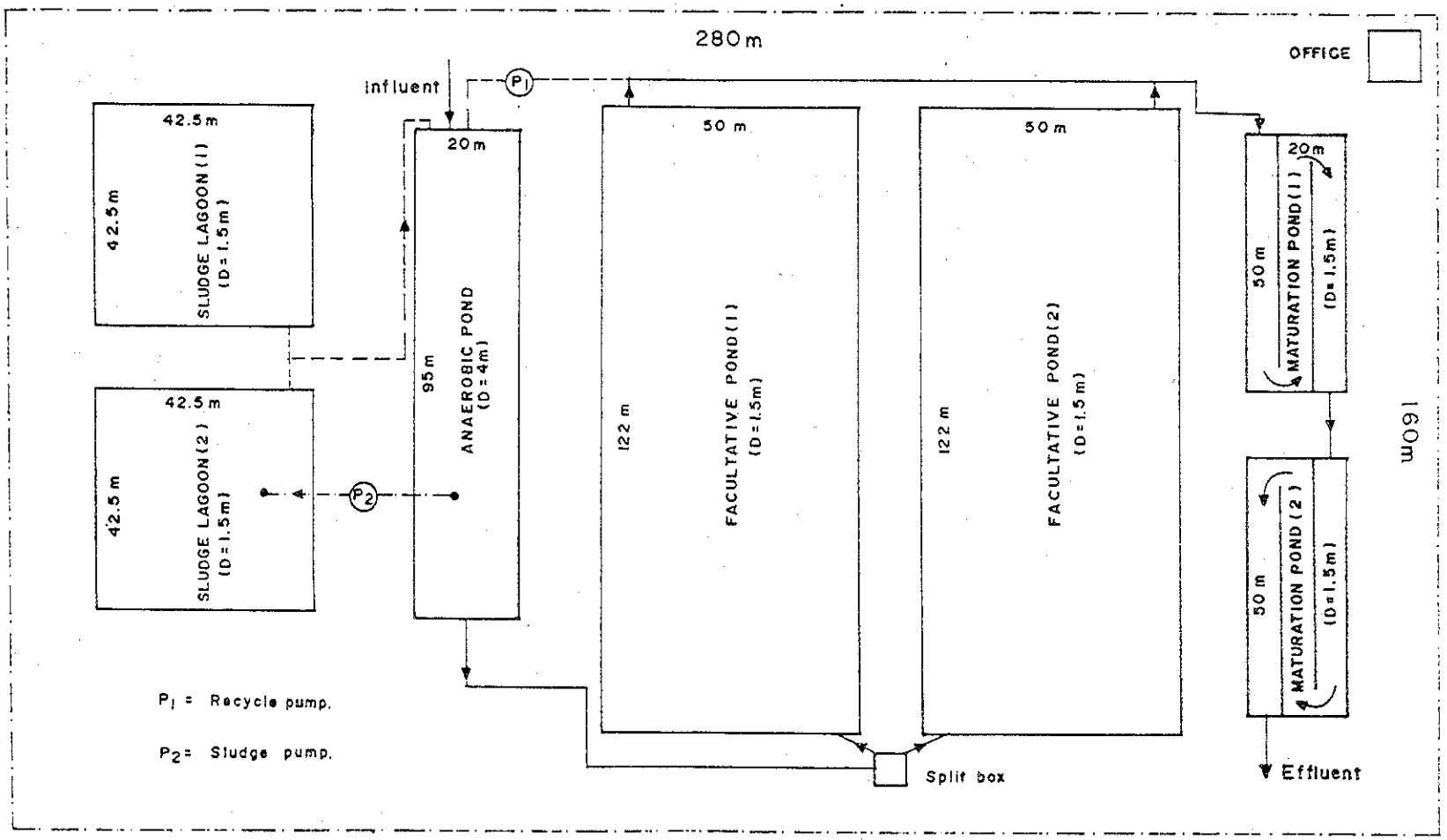


FIG. H.39 SERVICE AREA OF DESLUDGING AND TREATMENT

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991

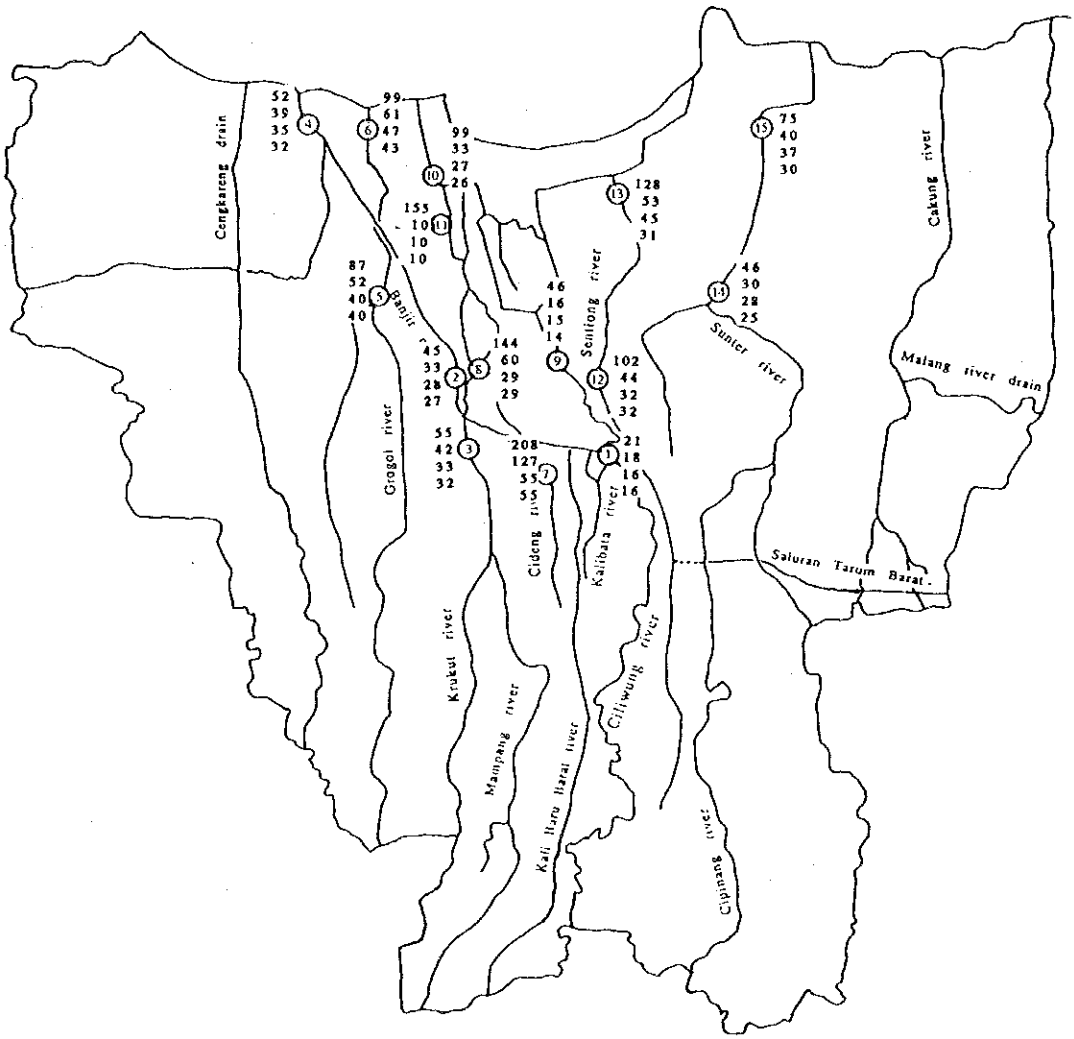


Note : All dimensions at mid effective depth
Ponds are of slope 1:3, vertical to horizontal
All free board 0.5 m

FIG. H.40 LAYOUT OF SLUDGE TREATMENT SYSTEM

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

JICA A.D 1991



LEGEND

River

O Station

Figures mean river water quality of BOD in mg/l

21 TOP : Water quality without Project
17 SECOND :Water quality with Sewerage Development
16 THIRD :Water quality with Sewerage & On-site treatment
16 BOTTOM :Water quality with Sewerage & On-site treatment & Industorial wastewater Control

FIG. H.41 RIVER WATER QUALITY IMPROVEMENT BY EACH COUNTER MEASURES

THE STUDY ON URBAN DRAINAGE AND WASTE WATER DISPOSAL PROJECT IN THE CITY OF JAKARTA

APPENDIX I

IMPLEMENTATION PROGRAMME

APPENDIX I IMPLEMENTATION PROGRAMME

1. Implementation Programme of Urban Drainage Development

1.1 Prioritization

The Study Area is divided into six (6) drainage zones as identified in Appendix G. In this chapter, priority study for these drainage zones are carried out to establish the implementation programme of the proposed projects in coordination with the on-going projects.

Priority of each zone is determined based on the aspects of needs/benefits, regional equality, environmental quality improvement and poverty alleviation. The above four (4) aspects are evaluated by the following major factors.

- Needs/benefits : extent of flood damage and drainage requirements to meet future land development
- Regional Equality : progress rate of urban drainage development
- Environmental Quality Improvement : population density
- Poverty Alleviation : people's income level

The above five (5) major factors are estimated and compared for the six (6) drainage zones as follows.

(1) Extent of Flood Damage

Average annual flood damage is estimated for the respective flood prone areas of the Study Area (Refer to Appendix B). Based on the above estimates, average annual flood damage per capita in the potential flood areas of each drainage zone is determined as shown below.

Zone No.	Annual Flood Damage (Mil. Rp.)	Population in Flood Area (person)	Flood Damage per Capita (Mil.Rp./person)	Ratio to Max. Zone (%)
1	2,143	56,560	37,889	95
2	8,613	384,653	22,392	56
3	7,178	183,652	39,985	100
4	11,571	665,493	17,387	43
5	471	25,715	18,324	46
6	17,085	818,334	20,889	52

Higher priority will be assigned to the drainage zone with higher per capita annual flood damage. Priority index of 1 to 4 is assigned based on the extent of per capita that damage in a zone given in the above table as: point 1 for 0 - 25%, point 2 for 25 - 50%, point 3 for 50 - 75% and point 4 for 75 - 100%.

Zone No.	Point of Priority
1	4
2	3
3	4
4	2
5	2
6	3

(2) Drainage Requirements to Meet Future Land Development

The Study Area is composed of four (4) types of land use,which are by residential, commercial and institutional, industrial and other areas. Area occupied by each type of land use in 1988 (at present) and in 2010 (target year) are estimated based on the DKI Jakarta Structure Plan 2005. The former three (3) areas represents urbanized area and the last one green area.

Rapid increase of this urbanized area is expected in some areas between in 1988 and in 2010. Such areas should be provided with drainage improvement works prior or in parallel with the urban development.

Rate of increase in urbanized area between 1988 year and 2010 year by each drainage zone is estimated as shown below.

Zone No.	Urban Area in 1988 (ha)	Urban Area in 2010 (ha)	Increased Urban Area (ha)	Increasing Rate (%)
1	6,093	8,115	2,021	33
2	9,905	10,185	280	3
3	6,886	7,411	525	8
4	4,765	4,882	118	3
5	7,841	8,322	482	6
6	14,319	16,941	2,622	18

Higher priority will be given to the drainage zone with higher increasing rate of urban area. Priority index ranging from 1 to 4 is assigned to each drainage zone based on the above table as: point 1 to 0 - 10%, point 2 to 10 - 20%, point 3 to 20 - 30% and point 4 to 30 - 40%. So priority ranking for each zone is as shown below.

Zone No.	Point of Priority
1	4
2	1
3	1
4	1
5	1
6	2

(3) Progress Rate of Urban Drainage Development

The on-going projects are progressed beyond detailed design work, and most of them are to be completed within several years. All the remaining projects required to attain a full development of major urban drainage of the Study Area are recommended as the proposed project in Appendix G.

The ratio of the on-going project cost to the total project cost, which is the sum of the on-going and proposed project costs, represents progress rate of the urban drainage development plan.

Then, progress rate of each drainage zone is estimated below.

Zone No.	On-going Project Cost (Mil. Rp.)	Proposed Project Cost (Mil. Rp.)	Total Project Cost (Mil. Rp.)	Progress Rate (%)
1	1,842	59,564	61,406	3
2	84,591	9,740	94,331	90
3	5,187	14,565	19,752	26
4	165,891	0	165,891	100
5	0	828	828	0
6	285,526	48,964	334,490	85

Higher priority will be given to the drainage zone with low progress rate of the development plan. The priority index of 1 to 4 are assigned to each drainage zone based on the above table as: point 4 to 0 - 25%, point 3 to 25 - 50%, point 2 to 50 - 75% and point 1 to 75 - 100%.

Zone No.	Point of Priority
1	4
2	1
3	3
4	1
5	4
6	1

(4) Population Density

It is considered that around 2 million people will suffer from floods if the potential flood occurs at present. This corresponds almost a quarter of all the population of the Jakarta City. Such people in the flood areas would be in danger of contracting disease or death.

Such environmental effects are represented in terms of population density in the flood area in this Study. Then, potential flood area, population in the flood area in 1988 and its density are estimated as shown below.

Zone No.	Potential Flood Area (ha)	Population in Flood Area (person)	Population Density (person/ha)
1	894	56,560	63
2	2,122	384,653	181
3	707	183,652	260
4	2,026	665,493	328
5	125	25,715	206
6	5,201	818,334	157

Higher priority will be given to the drainage zone with higher population density at potential flood area. The priority index from 1 to 4 are given to each drainage zone based on the above table as: point 1 to 0 - 100, point 2 to 100 - 200, point 3 to 200 - 300 and point 4 to 300 - 400 person/ha. The estimated priority ranking are shown for each zone.

Zone No.	Point of Priority
1	1
2	2
3	3
4	4
5	3
6	2

(5) People's Income Level

Poverty alleviation is one of the major targets of urban drainage improvement. People's income level in the flood prone area is the typical index for the poverty alleviation. The existing average monthly income per capita in the potential flood area of each drainage zone is estimated based on the study results of Appendix A and Appendix B as shown below.

Zone No.	Average Monthly Income in Flood Area (Rp./person)	Ratio to Study Area (%)
1	40,859	87
2	52,369	111
3	50,391	107
4	47,574	101
5	47,455	101
6	43,485	93
Study Area	46,971	100

Higher priority will be given to the drainage zone with lower average monthly per capita income in flood area. Priority index ranging from 1 to 4 are given to each drainage zone based on the above table as : point 1 to 110-120%, point 2 to 100-110%, point 3 to 90-100% and point 4 to 80-90%.

Zone No.	Point of Priority
1	4
2	1
3	2
4	2
5	2
6	3

The cumulative estimation of priority ranking for each drainage zone are summarized below.

Zone	Factor No.					
No.	(1)	(2)	(3)	(4)	(5)	Total
1	4	4	4	1	4	17
2	3	1	1	2	1	8
3	4	1	3	3	2	13
4	2	1	1	4	2	10
5	2	1	4	3	2	12
6	3	2	1	2	3	11

Herein, No.4 drainage zone has no proposed project except the on-going projects as evident from the factor (3) situation. It is not necessary to give

priority for No.4 drainage zone. Then priority ranking of implementation of the proposed project in each drainage zone are decided as given below.

Zone No.	Point of Priority
1	1
2	5
3	2
4	-
5	3
6	4

1.2 Implementation Programme

The implementation programme for the on-going and proposed projects are studied for each drainage zone. The on-going projects in a drainage zone is at the stage of execution from detailed design up to under construction. So, the construction period including such stages are decided on the basis of conditions as (i) construction period will be at least two (2) years (ii) project cost disbursement is limited to 30,000 million Rp. per year.

While, the construction period for the proposed project is considered as at least three (3) years in consideration to lead time from detailed design stage to construction stage. The project cost disbursement is limited to 30,000 million Rp. per year, the same condition as the on-going project.

Then, the construction period for the on-going and proposed projects in each drainage zone is estimated. They are shown below.

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
On-going	2 year	4 year	2 year	5 year	0 year	9 year
Proposed	3 year	3 year	3 year	0 year	3 year	4 year

The project cost disbursement of each drainage zone is equally allocated to the above determined construction period. Also, operation and maintenance cost is decided as 0.5 % of sum of the direct construction and physical contingency costs.

Then, the implementation programme for the on-going and proposed projects in each drainage zone is established based on the result of the

priority ranking study. The proposed project will commence from just after the completion of the on-going project in the No.1 drainage zone, which is selected as top priority.

The implementation programme of the on-going and proposed projects are shown in Table I.1 to Table I.3 and Fig.I.1.

2. Implementation Programme of Sewerage Development

2.1 Prioritization

Priority sequences for implementation of the sewerage developments are determined based on the aspects of demands/benefits, adverse effects and constraints of the respective development projects.

Demands/benefits consist of population density, public land use rate, water pollution abatement, communities' sanitary improvement effects and reduction of waterborne disease contraction rate. Adverse effects are represented by construction and O&M costs of the project.

Constraints consist of affordability of sewerage development and availability of treatment site.

2.1.1 Demands/Benefits of Sewerage development

(1) Population Density

Population density is the typical index representative to sewerage development requirement.

Average population density of all six (6) sewerage zones is 382 person/ha.

High population density area has higher priority for sewerage development because of high pollution load generation and relatively high unsanitary condition, in principle.

Then a zone of population density over 400 person/ha is defined as high priority zone and one lower than 350 person/ha a low priority zone.

Population density and the assigned priority index of each zone is shown below.

Sewerage Zone	Population Density	Priority Index
Central	404 person/ha	5
North West	318 person/ha	1
South West	311 person/ha	1
North East	388 person/ha	3
South East	421 person/ha	5
Tanjung Priok	441 person/ha	5

The maximum Index of five (5) points is assigned to high priority zone, three (3) points to medium priority zone and one (1) point to low priority zone.

(2) Public Land Use Rate

Ratio of commercial and institutional area to residential area is identified as public land use rate. Higher priority for sewerage development will be given to a zone with high public land use rate.

Since average public land use rate of all six (6) zones is 26%, zones of public land use rate of higher than 30% is considered as high priority zone and lower than 22% as low priority zone.

Public land use rate of each zone is shown below along with the priority index.

Sewerage Zone	Public Land Use Rate (%)	Priority Index
Central	34	5
North West	29	3
South West	24	3
North East	22	3
South East	24	3
Tanjung Priok	19	1

(3) Water Pollution Abatement

Sewerage development contributes to river water quality improvement as mentioned in Chapter 7 of Appendix H.

River water pollution abatement of each sewerage zone development is shown in Table I.4. Water quality improvement ranges from 0% to 93% and each 20% improvement is assigned one (1) point as shown below.

Waterquality Improvement	Point
1 - 20%	1
21 - 40%	2
41 - 60%	3
61 - 80%	4
81- 100%	5

River water quality improvement points of each sewerage zone ranges from 2 points to 20 points with average of 7.5. The zones with improvement points higher than 10 is considered as high priority zone and lower than 5 as low priority zone.

Sewerage Zone	Waterquality Point	Priority Index
Central	20	5
North West	5	3
South West	5	3
North East	7	3
South East	6	3
Tanjung Priok	2	1

(4) Communities' Sanitary Improvement Effects

Since the wastewater is collected by street sewer at the point of origin in the conventional area, conventional sewer system contributes to the improvement of the communities' sanitary condition while the interceptor sewer system will produce no improvement effects on the communities. Sewerage zone with high coverage rate of conventional area is assigned high priority.

Since highest ratio of conventional coverage of 56% is in Central Zone and the lowest of 25% is in South East Zone with an average of 40%, sewerage zones of more than 50% coverage of conventional area is assigned highest priority index while those lower than 30% is assigned lowest priority.

Priority index of each sewerage zone is shown below along with the rate of conventional area.

Sewerage Zone	Conventional Area Rate (%)	Priority Index
Central	56	5
North West	26	1
South West	43	3
North East	45	3
South East	25	1
Tanjung Priok	47	3

(5) Waterborne Disease Contraction Rate

Regional distribution of contraction rate of waterborne diseases is dealt with in Chapter 6 of Appendix C.

Average annual regional waterborne disease contraction rate of all six(6) sewerage zone is 2.0%.

Sewerage zones having waterborne disease contraction rate higher than 2.5% is assigned highest priority index and those lower than 1.5% lowest priority index.

Waterborne disease contraction rate of each sewerage zone is shown below along with the respective priority index.

Sewerage Zone	Disease Contract Ratio (%)	Priority Index
Central	2.1	3
North West	2.2	3
South West	1.3	1
North East	2.5	5
South East	2.0	3
Tanjung Priok	2.1	3

2.1.2 Adverse Effects

(1) Construction Cost

Specific construction cost for BOD load reduction of one (1) kg per day of each sewerage zone ranges from Rp.9.83 million in Central Zone to Rp. 19.32 million in South West with an average of Rp. 12.71 million.

A zone with specific construction cost higher than Rp. 15.0 million is assigned lowest priority index and lower than Rp. 10.0 million highest priority index.

Specific construction cost of each sewerage zone is shown below along with the respective assigned priority index.

Sewerage Zone	Specific Const. Cost	Priority Index
Central	9.83 million Rp.	5
North West	15.02 million Rp.	1
South West	19.32 million Rp.	1
North East	16.05 million Rp.	1
South East	10.99 million Rp.	3
Tanjung Priok	12.49 million Rp.	3

(2) O & M Cost

Specific annual O&M cost for BOD load reduction of one (1) kg per day in each sewerage zone ranges from Rp. 0.10 million in Central Zone to Rp. 0.16 million in South West Zone with an average of Rp. 0.12 million.

Specific annual O&M cost of higher than Rp. 0.13 million is identified as the index for low priority zone and lower than Rp. 0.11 million the high priority zone.

Specific annual O & M cost of each sewerage zone is shown below along with the priority index.

Sewerage Zone	Specific O/M Cost	Priority Index
Central	0.10 million Rp./annum	5
North West	0.13 million Rp./annum	3
South West	0.16 million Rp./annum	1
North East	0.14 million Rp./annum	1
South East	0.12 million Rp./annum	3
Tanjung Priok	0.12 million Rp./annum	3

2.1.3 Constraints

(1) Affordability

Financial viability of the project depends on affordabilitiy of the users. Higher priority will be given to a zone with a higher affordability of the users.

Regional distribution of willingness to pay for sewerage development per hectare by Kelurahan in the year 2010 is shown in Fig.J.13 in Appendix J.

Average willingness to pay of each sewerage zone ranges from Rp. 1.66 million per annum in South West Zone to Rp. 2.24 million per annum in Central Zone with an average of Rp. 1.93 million.

Sewerage zone with average willingness to pay of higher than Rp. 2.20 million is defined as the zone for high priority index and lower than Rp. 1.80 million the zone for low priority index.

Average willingness to pay of each sewerage zone is shown below along with the assigned priority index.

Sewerage Zone	Ave. Willingness to Pay	Priority Index
Central	2.24 million Rp./annum	5
North West	1.75 million Rp./annum	1
South West	1.66 million Rp./annum	1
North East	2.01 million Rp./annum	3
South East	2.22 million Rp./annum	5
Tanjung Priok	1.71 million Rp./annum	1

(2) Treatment Plant Sites Availability

Existing land use condition of proposed treatment site affects the availability of land acquisition. Since the proposed sites of Central Zone is the retention pond for storm water drainage, and Tanjung Priok Zone is the planned storm water retention pond, land acquisition of these sites are comparatively easy.
Proposed sites of North West Zone, South West Zone and North East Zone are paddy field and open land.
The proposed site of South East Zone is cemetry. It is difficult to acquire land in these areas in comparison to the above retention ponds.

Sewerage zones with their treatment plants proposed at the existing and planned retention ponds are identified as high priority zones. South East Zone is of low priority as land acquisition for treatment plant is difficult.

Existing condition of proposed treatment site of each sewerage zone is shown below along with the assigned priority index.

Sewerage Zone	Existing Condition	Priority Index
Central	Retention pond	5
North West	Paddy field & open space	3
South West	Paddy field & open space	3
North East	Paddy field & open space	3
South East	Cemetery	1
Tanjung Priok	Retention pond	5

Integrated priority index, consisting of (1) Demand/Benefit, (2) Construction and O/M costs and (3) Constraints, are compiled in Table I.5.

Central Zone is determined as the first priority implementation zone with priority index of 43, and the second one is South East Zone of 27 points, and the third are North East and Tanjung Priok Zones of 25 points. Lowest priority zone is South West Zone of 17 points.

2.2 Implementation Programme

Since respective six (6) sewerage development zones do not intersect each other, the implementation programme is established according to the discending order of priority sequences of each zone, independently. Implementation is planned to commence in the year 1992 and be completed in the year 2010.

A total construction period of eleven (11) years is assigned for Central Zone, consisting of initial one (1) year for engineering design and land acquisition programme as required and the remaining ten (10) years for construction works. Of this 10 year construction works, the first seven (7) years is assigned for the construction of sewerage in the north central area and the last three (3) years, beginning from 2000, for that of south central area.

The sewerage works of North East Zone will be constructed within eight (8) years since its commencement in the year 1998.

The remaining four (4) sewerage development zones are planed to be constructed in five (5) years, consisting of initial one (1) year design and land

acquisition programme and four (4) years of construction works. The proposed implementation programme of the project is shown in Fig. I.2.

Based on the implementation programme, disbursement schedule is formulated as shown in Table I.6. Total project cost for six (6) sewerage projects is Rp.1,814,500 million at 1990 prices and required annual investment cost ranges from Rp.16,046 million to Rp.161,932 million with an average of Rp.95,500 million.

Table I.1 Disbursement Schedule of the On-going Urban Drainage Projects

Year	Zone 1 Construct.	Zone 1 O&M	Zone 2 Construct.	Zone 2 O&M	Zone3 Construct.	Zone3 O&M	Zone4 Construct.	Zone4 O&M	Zone5 Construct.	Zone5 O&M	Zone6 Construct.	Zone6 O&M	Total Construct.	Total O&M
1990	921	0	21,148	0	2,593	0	33,178	0	0	0	31,725	0	89,565	0
1991	921	3	21,148	75	2,593	12	33,178	119			31,725	124	89,565	333
1992		6	21,148	150		24	33,178	238			31,725	248	86,051	666
1993		6	21,148	225		24	33,178	358			31,725	371	86,051	984
1994		6		300		24	33,178	477			31,725	495	64,903	1,302
1995		6		300		24		596			31,725	619	31,725	1,545
1996		6		300		24		596			31,725	743	31,725	1,669
1997		6		300		24		596			31,725	866	31,725	1,792
1998		6		300		24		596			31,725	990	31,725	1,916
1999		6		300		24		596				1,114		2,040
2000		6		300		24		596				1,114		2,040
2001		6		300		24		596				1,114		2,040
2002		6		300		24		596				1,114		2,040
2003		6		300		24		596				1,114		2,040
2004		6		300		24		596				1,114		2,040
2005		6		300		24		596				1,114		2,040
2006		6		300		24		596				1,114		2,040
2007		6		300		24		596				1,114		2,040
2008		6		300		24		596				1,114		2,040
2009		6		300		24		596				1,114		2,040
2010		6		300		24		596				1,114		2,040

Table I.2 Disbursement Schedule of the Proposed Urban Drainage Projects

Year	Zone 1 Construct.	Zone 1 O&M	Zone 2 Construct.	Zone 2 O&M	Zone3 Construct.	Zone3 O&M	Zone4 Construct.	Zone4 O&M	Zone5 Construct.	Zone5 O&M	Zone6 Construct.	Zone6 O&M	Total Construct.	Total O&M
1990														
1991														
1992	19,855	0											19,855	0
1993	19,855	49											19,855	49
1994	19,855	98											19,855	98
1995		147			4,855	0							4,855	147
1996		147			4,855	23							4,855	170
1997		147			4,855	45							4,855	192
1998		147				68			276	0			276	215
1999		147				68			276	1			276	216
2000		147				68			276	1			276	216
2001		147				68				2	12,241	0	12,241	217
2002		147				68				2	12,241	42	12,241	259
2003		147				68				2	12,241	83	12,241	300
2004		147				68				2	12,241	125	12,241	342
2005		147	3,247	0		68				2		166	3,247	383
2006		147	3,247	14		68				2		166	3,247	397
2007		147	3,247	28		68				2		166	3,247	411
2008		147		42		68				2		166		425
2009		147		42		68				2		166		425
2010		147		42		68				2		166		425

Table I.3 Disbursement Schedule of the Total Urban Drainage Projects

Year	Zone 1 Construct.	Zone 1 O&M	Zone 2 Construct.	Zone 2 O&M	Zone3 Construct.	Zone3 O&M	Zone4 Construct.	Zone4 O&M	Zone5 Construct.	Zone5 O&M	Zone6 Construct.	Zone6 O&M	Total Construct.	Total O&M
1990	921	0	21,148	0	2,593	0	33,178	0			31,725	0	89,565	0
1991	921	3	21,148	75	2,593	12	33,178	119			31,725	124	89,565	333
1992	19,855	6	21,148	150		24	33,178	238			31,725	248	105,906	666
1993	19,855	55	21,148	225		24	33,178	358			31,725	371	105,906	1,033
1994	19,855	104		300		24	33,178	477			31,725	495	84,758	1,400
1995		153		300	4,855	24		596			31,725	619	36,580	1,692
1996		153		300	4,855	47		596			31,725	743	36,580	1,838
1997		153		300	4,855	69		596			31,725	866	36,580	1,985
1998		153		300		92		596	276	0	31,725	990	32,001	2,131
1999		153		300		92		596	276	1		1,114	276	2,256
2000		153		300		92		596	276	1		1,114	276	2,256
2001		153		300		92		596		2	12,241	1,114	12,241	2,257
2002		153		300		92		596		2	12,241	1,156	12,241	2,299
2003		153		300		92		596		2	12,241	1,197	12,241	2,340
2004		153		300		92		596		2	12,241	1,239	12,241	2,382
2005		153	3,247	300		92		596		2		1,280	3,247	2,423
2006		153	3,247	314		92		596		2		1,280	3,247	2,437
2007		153	3,247	328		92		596		2		1,280	3,247	2,451
2008		153		342		92		596		2		1,280		2,465
2009		153		342		92		596		2		1,280		2,465
2010		153		342		92		596		2		1,280		2,465

Table I.4 Water Pollution Abatement

(BOD : mg/l)

Name of River	Without Project	Central	BOD Reduction		North West	BOD Reduction		South West	BOD Reduction		North East	BOD Reduction		South East	BOD Reduction		Tanjung Priok	BOD Reduction	
Ciliwung R.	21	19	0.10	1	21	0.00	0	21	0.00	0	21	0.00	0	19	0.10	1	21	0.00	0
Banjir C.	44	41	0.07	1	41	0.07	1	40	0.09	1	44	0.00	0	44	0.00	0	44	0.00	0
Krukut R.	54	50	0.07	1	49	0.09	1	48	0.11	1	54	0.00	0	54	0.00	0	54	0.00	0
Banjir C.	51	48	0.06	1	48	0.06	1	47	0.08	1	51	0.00	0	51	0.00	0	51	0.00	0
Grogol R.	85	82	0.04	1	69	0.19	1	76	0.11	1	85	0.00	0	85	0.00	0	85	0.00	0
Grogol R.	96	85	0.11	1	87	0.09	1	94	0.02	1	96	0.00	0	96	0.00	0	96	0.00	0
Cideng R.	202	143	0.29	2	202	0.00	0	202	0.00	0	202	0.00	0	202	0.00	0	202	0.00	0
Cideng R.	139	92	0.34	2	139	0.00	0	139	0.00	0	139	0.00	0	139	0.00	0	139	0.00	0
Ciliwung R.	44	23	0.48	3	44	0.00	0	44	0.00	0	44	0.00	0	43	0.02	1	44	0.00	0
Cideng R.	96	68	0.29	2	96	0.00	0	96	0.00	0	96	0.00	0	95	0.01	1	93	0.03	1
Old Angke R.	149	10	0.93	5	149	0.00	0	149	0.00	0	149	0.00	0	149	0.00	0	149	0.00	0
Suntion R.	99	99	0.00	0	99	0.00	0	99	0.00	0	94	0.05	1	99	0.00	0	99	0.00	0
Suntion R.	124	124	0.00	0	124	0.00	0	124	0.00	0	48	0.61	4	123	0.01	1	124	0.00	0
Sunter R.	45	45	0.00	0	45	0.00	0	45	0.00	0	37	0.18	1	40	0.11	1	45	0.00	0
Sunter R.	74	74	0.00	0	74	0.00	0	74	0.00	0	59	0.20	1	60	0.19	1	72	0.03	1
Total Point				20			5			5			7			6			2

Table I.5 Prioritization of Sewerage Development Project

Sewerage Zone	Central	North West	South West	North East	South East	Tanjung Priok
(Demands/Benefits)	23	11	11	17	15	13
- Population Density	5	1	1	3	5	5
- Public Land Use Rate	5	3	3	3	3	1
- Water Pollution Abatement Effect	5	3	3	3	3	1
- Communities' Sanitation Improvement	5	1	3	3	1	3
- Waterborne Disease Contraction Rate	3	3	1	5	3	3
(Adverse Effect)	10	4	2	2	6	6
- Construction Cost	5	1	1	1	3	3
- O/M Cost	5	3	1	1	3	3
(Constraints)	10	4	4	6	6	6
- Affordability	5	1	1	3	5	1
- Treatment Site Availability	5	3	3	3	1	5
Integrated Evaluation	43	19	17	25	27	25

Table I.6 Disbursment Schedule of Sewerage Develpoment Project

(Million Rp.)

Sewerage Zone	Project Cost	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Central Zone	621,378	16,046	68,352	80,779	99,420	74,565	68,352	55,924	46,603	40,390	34,176	36,771									621,378
South East Zone	116,103					5,600	26,704	31,348	30,187	22,265											116,103
North East Zone	473,013							14,440	85,142	75,682	94,603	66,222	52,031	37,841	47,052						473,013
Tanjung Priok	169,514											8,670	44,074	49,159	32,208	35,404					169,514
North West Zone	202,421													12,640	54,654	48,581	42,508	44,038			202,421
South West Zone	232,071															14,720	71,942	67,301	53,376	24,732	232,071
Total	1,814,500	16,046	68,352	80,779	99,420	80,165	95,055	101,712	161,932	138,336	128,778	111,663	96,105	99,640	133,913	98,705	114,450	111,338	53,376	24,732	1,814,500

FIG. 1.1 IMPLEMENTATION PROGRAMME OF URBAN DRAINAGE DEVELOPMENT

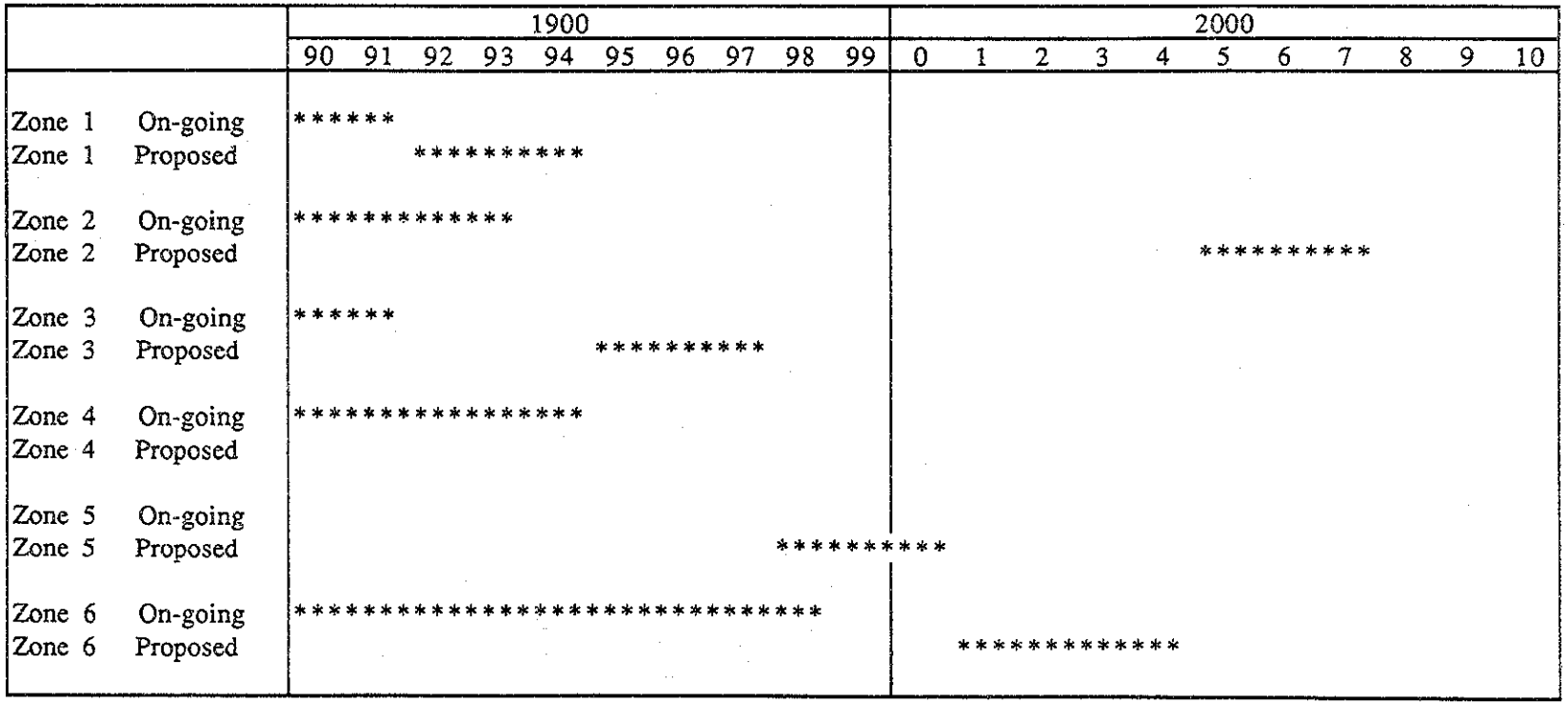
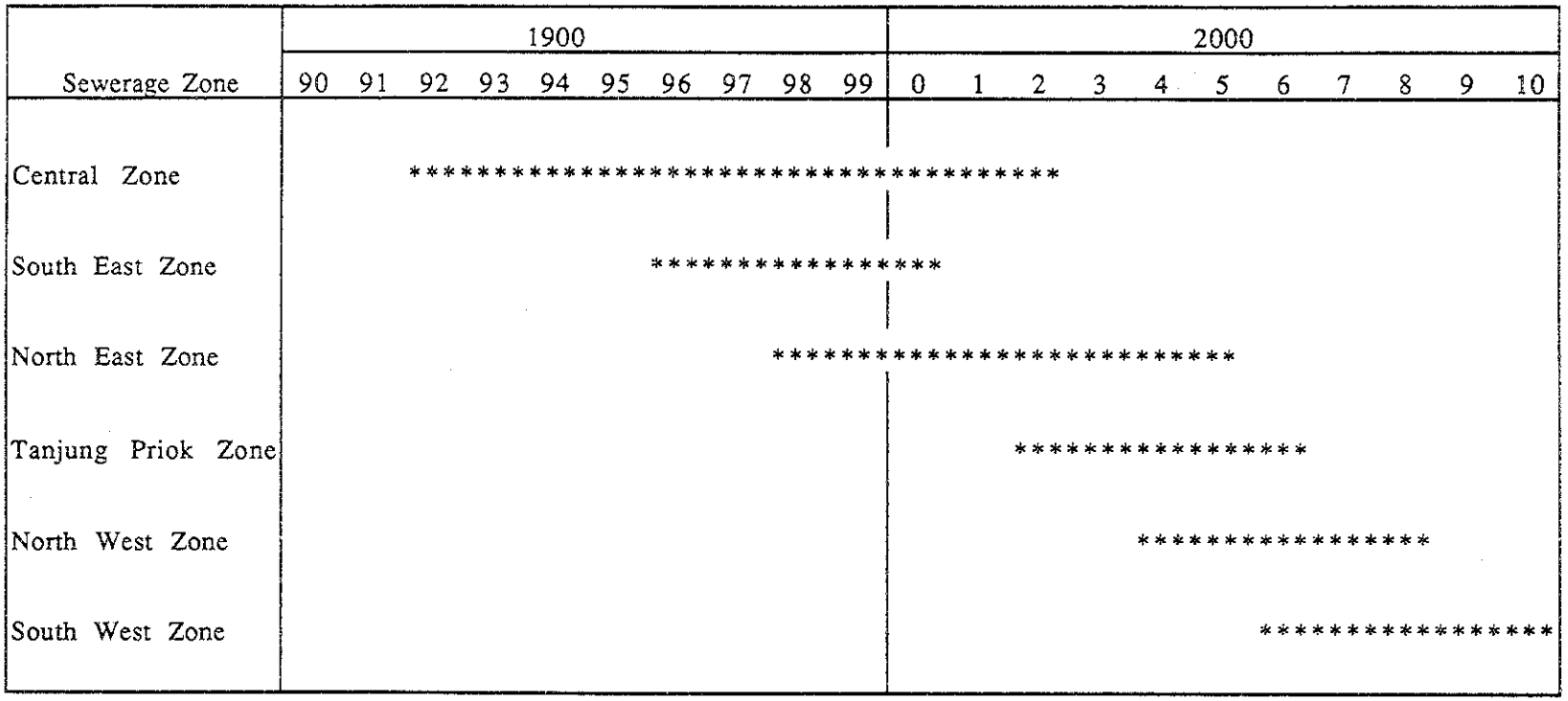


FIG. I.2 IMPLEMENTATION PROGRAMME OF SEWERAGE DEVELOPMENT



APPENDIX J

PROJECT EVALUATION

APPENDIX J PROJECT EVALUATION

1 Economic, Social and Environmental Evaluation

1.1 Urban Drainage Development

1.1.1 Average Annual Flood Damages by Inundation Area

Table J.1 and Fig. J.1 show the combined amount of average annual direct flood damages to houses, shops and factories per ha in 96 ununddation areas over the whole study area for 1988.

Higher flood damages derive from the combination of three factors : the depth of inundation, the duration of inundation and the value of property to be affected. Observing the above table and figure, one finds that people suffer from flood damages over the wide expanse of the study area although the degree of the damages differs from one inundation area to another.

Table J.2 and Fig. J.2 show the flood damages per ha in each inundation area for the target year of 2010. Comparing Fig. J.2 with Fig. J.1 one notices that flood damages aggravate in most of inundation areas as time passes. This situation is brought on by the growth of population and the resultant increase of damageable property.

In the event urban drainage projects now being implemented and the new urban drainage projects envisaged under this study are completed, flood damages prevalent over the whole study area illustrated in Fig. J.2 will virtually disappear.

1.1.2 Benefits and Costs of Urban Drainage Projects

The major benefit of urban drainage projects is the removal or mitigation of flood damages.

The average annual flood damages in 1988 are estimated at Rp. 47,061.0 million. They will increase to Rp. 160,979.7 million in 2010. If all the required urban drainage projects are finished by that time, people will get the benefit of the above mentioned amount in 2010. It means that the

benefit people will get in the same year is Rp. 12,577 on the per capita basis.

It sometimes happens that a water-borne epidemic breaks out in the flood season due to the spilling and spreading of wastewater. After urban drainage projects are completed, not only the breakouts of such a scourge, but also the contraction rate of general water-borne diseases, will be reduced. This is another benefit. The third benefit is that the people of the study area will be freed from the mental stresses or psycological burdens they may experience in time of floods.

Fourthly, the areas where floods usually hit will regain their normal natural conditions, that is to say, pleasant environment will be created as a result of urban drainage development. It will be eventually reflected in the price of land in the related areas by enhancing its economic value.

However, in conducting the economic analysis of urban drainage development only the benefit of flood damage reduction was taken into account because of the difficulties in quantifying other benefits.

The initial cost of urban drainage projects now being implemented sums up to Rp. 543,036 million at 1990 prices. In addition, new urban drainage projects are being planned under this study. The initial cost of such projects is estimated at Rp. 133,661 million. Thus, the total initial cost comes to Rp. 676,697 million.

The combined annual O/M cost of on-going and new urban drainage projects is calculated at Rp. 2,465 million.

Economic analysis was conducted by incorporating all the on-going and future urban drainage projects over the entire study area.

In performing such an analysis, cost must be converted into economic cost. Specifically, land acquisition cost was eliminated because firstly it is difficult to determine the economic value of land, and secondly the economic value of land in the "without project" situation will be sufficiently offset by the incremental economic value of land in the "with project" situation. Also, labor cost was deducted by 20% because labor

market, especially the market of unskilled labor in the study area is characterized by the surplus of supply as the unemployment rate of 90.37% in 1987 indicates.

The resultant initial cost in economic terms of the on-going and new urban drainage projects works out at Rp. 449,026 million and Rp. 100,621 million respectively, adding up to Rp. 549,647 million.

The annual O/M cost in economic terms works out at Rp. 2,263 million (Refer to Table J.3).

1.1.3 Economic Evaluation

In marking cost benefit streams, project life is assumed to be 50 years starting in 1990 and ending in 2039. Also, in calculating benefit cost ratio (B/C) and net present value (NPV), opportunity cost of capital is assumed to be 10%.

The initial cost of on-going urban drainage projects was distributed over years based on the existing implementation schedules. The initial cost of new urban drainage projects was divided into yearly allocations based on the priority order of six (6) drainage zones. Replacement cost was not taken into account in making the cost stream. The annual O/M cost was assigned to each year on the assumptions that the requirements for the said cost goes in parallel with the extent of the cumulative dibursement of the initial cost.

Flood damages, i.e. potential benefit was assumed to increase from 1990 to 2010 following an upward straight line. Potential benefit in a certain year will turn into real benefit in proportion to the cumulative cost realized up to the said year.
Table J.4 shows cost benefit streams of urban drainage development over the project life period of 50 years.

As Table J.7 shows the NPV and B/C work out at Rp. 434,822 million and 2.15, respectively.

The economic internal rate of return is calculated at 20.2% as shown in Table J.8.

It follows from the above results that the urban drainage projects of the study area is economically feasible.

1.2 Sewerage Development

1.2.1 Reduction of Pollution Load

The study area is divided into three (3) areas in accordance with future population density. These areas differ in sewerage/sanitation development needs.

In the sewerage development area with a high population density, pollution load generation represented by BOD is estimated to reach 229,811 kg/day in 2010. In the on-site sanitation development area with a medium population density BOD is projected to reach 213,940 kg/day in the said year.

The remaining area with a low population density has no urgent needs for wastewater reduction measures. Future BOD in this area will add up to 101,494 kg/day. Thus, the total BOD of the study area in 2010 works out at 545,245 kg/day.

After sewerage development BOD is expected to be reduced by 192,251 kg/day to 37,560 kg/day or 16.3%. Likewise, when on-site sanitation development is completed BOD will go down by 105,319 kg/day to 108,621 kg/day or 50.8%. That is to say, the pollution load of the study area will be cut by 297,570 kg/day to 247,675 kg/day or 45.0% under the "with project" situation.

When industrial effluent control measures are introduced, the pollution load of the study area will be further reduced by 95,036 kg/day to 141,165 kg/day or 26.0% (Refer to Table H.45).

1.2.2 Socio-Economic Survey Related to Contraction of Deseases

A sampling questionnaire survey was carried out to know the water color/smell of rivers/canals, the practice of industrial wastes dumping in rivers/canals and water supply service ratio in each of 29 Kecamatans.

Surveyors visited houses with a fixed form of questionnaire and asked questions of householders or equivalents. The number of samples totaled 2560.

The results are presented in Table J.9, J.10, J.11, J.12 and Fig.J.3, J.4, J.5 and J.6.

Focussing on the ratio of respondents who answered that the water color of near-by rivers/canals was black in Table J.9, one observes that as much as 72.4% of water courses in Jakarta Utara are regarded as black-colored. In Jakarta Barat also, the ratio is as high as 69.9%. The ratio is 60.2% and 51.5% for Jakarta Pusat and Timur, respectively. Jakarta Selatan alone is moderate in the extent of pollution with the ratio of 19.6%. The total average across the study area works out at 51.3%. That is to say, more than a half of the water courses of Jakarta are considered black-colored. One can get an overview of the distribution of the ratios in Fig. J.3.

Likewise, shedding a spot light on the ratio of respondents who answered that the water smell of near-by rivers/canals was strong is Table J.10, one notices that 41.9% of the water courses in Jakarta Barat are regarded as emanating strong odor. 25.5% of the water courses in Jakarta Timur stink. The ratio is 23.5% for Jakarta Pusat and 18.6% for Jakarta Utara. Jakarta Selatan has the lowest ratio of 11.6%. The total average across the study area works out at 23.3%. It means that about one fourth of the water courses of Jakarta are considered to emit strong smell. An overview of the distribution of the ratios can been gotten in Fig. J.4.

Table J.11 shows that the dumping of industrial wastes are seen as widely practised over the entire study area : the ratio of respondents who answered that industrial wastes dumping was practised in near-by rivers/canals reaches 76.8% with no marked difference in the ratios among five (5) Wilayahs.

Fig. J.5 illustrates the distribution of the ratios by Kecamatan.

Water supply service ratio by Kecamatan is presented in Table J.12. According to the table 86.0% of people in Jakart Utara are served with water supply. Service ratio in Jakarta Pusat and Barat is 52.7% and 34.9%, respectively. The ratio is very low in the remaining Wilayahs. The total average across the study area works out at 30.8%.

1.2.3 Correlation between Water Color/Smell of Rivers and Diseases Contraction Rate

Various factors contribute to the black coloration and odor emission of river water. The analysis of the JICA Study Team reveals that population density is a major contributing factor as shown in Table J.13. The dumping of industrial wastes is also found to be one of the factors.

In the event the sewerage and on-site sanitation project is fully implemented the existing relationship betwen population density and water color/smell of rivers will be nullified.

On the assumptions that the extent of coloring and stinking of river water goes hand in hand with the level of water pollution and also that the level of water pollution is related to the rate of diseases contraction multiple correlation/regression analysis was conducted between water color/smell and diseases contraction rate.

Fig. J.7 and J.8 are a graphical expression of the correlationship between the water color/smell of rivers and diseases contraction rate. Table J.14 attests to the existence of a significant correlationship between the two independent variables and the dependant varible.

Table J.15 and Fig. J.9 show that water color and smell are also correlated. As regard to infantile mortality rate, it turned out that there is little correlationship between water color/smell and the rate. However, it was found out that there lies a significant negative correlationship between water supply service ratio and the infantile mortality rate. Infants, having little resistance to the germs, easily fall victim to polluted drinking water.

This seems to be the reasons behind the above-mentioned relationship(Ref. Table J.16 and Fig. J.10).

1.2.4 Benefits of Sewerage Development

As a part of the sampling questionnaire survey mentioned in 1.2.2, questions concerning the effects of sewerage development on rivers and diseases contraction were asked of the respondents. The results are tabulated in Table J.17 and J.18.

Table J.17 points out that the majority of respondents expect that obnoxious odor and black color of river water will be removed as a result of sewerage development. It reflects the existing circumstances where people suffer from polluted river water and also people's strong desire for the rectification of such a situation.

At the same time the table shows people's expectations on the revival of various uses of rivers such as irrigation, washing, industry, bathing and fishing ground.

Table J.18 tells that people place a high hope on the role of sewerage development in reducing the incidences of water-borne diseases. Specifically, the majority of people expect that the introduction of sewerage will be effective in reducing the contraction of gastro-enteritis and typhoid.
Also, a considerable number of people expects that people will be less susceptible to malaria, diphtheria and cholera. The reduction of dysentery and DHF is also cited by a certain number of people.
Against the above background the JICA Study Team tried to estimate the disease reduction effects of sewerage and on-site sanitation development, using the regression equation defining the relationship between water color/smell of rivers and disease contraction rate as shown in Table J.14.

The disease reduction effects are quantitatively expressed as the difference in medical cost between the "without project" and with project" situations.

In the "without project" situation the water color/smell of rivers will worsen or at least maintain the status quo in the coming years. It means

that the existing disease contraction rate will rise or at least remain as it is in the future. Whereas, in the "with project" situation the water color/smell of rivers will be reduced as sewerage and on-site sanitation development is implemented, eventually regaining their normal natural state in the target year of 2010. In other words, disease contraction rate will decline as the wastewater disposal project progresses until it hits a certail fixed level in 2010.

When a disease contraction rate is multiplied by population in a certain year, the number of patients in the same year is obtained. Again, when this number of patients is multiplied by average medical cost per patient, the total medical cost in the said year is worked out.

Averge medical cost per patient was estimated based on the actual data on the contraction rate, medical cost per patient, the number of days in the bed and mortality rate for major water-borne diseases, labor force participation rate, wages/salaries per worker per day, and labor cost per worker (Refer to Table J.19 and J.20).

The difference in medical cost between the "without project" situation and the "with project" situation constitutes one major benefit of the wastewater disposal project. As Table J.21 shows, it is estimated to reach Rp. 90,248 million in 2010.

Besides the three benefits of medical cost reduction, creation of pleasant river-side environment and revival of river water uses which have already been mentioned, there are other benefits to be counted such as preservation of river water quality for urban water use and recycling of wastewater sludge as fertizer.

2. Financial Evaluation

2.1 People's Willingness to Pay

Sampling questionnaire surveys were carried out to know how much the people of the study area are willing to pay in the event sewerage or a certain type of on-site sanitation facilities is constructed in their area, thereby receiving direct services from it. The number of samples reached 2,560 for households and 1,000 for establishments/installations.

The purposes of the surveys are:

1) To know people's affordability for sewerage or sanitation services.

2) To take into account the affordability in determining the financial burden beneficiaries should shoulder.

3) To know area-wise priorities in sewerage/sanitation development.

2.1.1 Average Willingness to Pay per Property

As a result of the surveys it is found out that the average monthly services charge a household is willing to pay is Rp. 574 for public toilet, Rp. 1,316 for individual toilet with treatment and Rp. 1,846 for sewerage. They account for 0.22%, 0.51% and 0.71% of the average monthly household income, respectively. As regard to income class-wise amount, households of the High, Middle, and Low Income Classes are prepared to pay Rp. 4,962 (0.68%), Rp. 2,513 (0.74%) and Rp. 907 (0.60%) for sewerage services, respectively (Refer to Table J.22).

This study attaches a special importance to sewerage development. Therefore, the analysis will henceforward center on the matters related to it.

Wilayah wise, Jakarta Selatan has the highest willingness to pay of Rp. 2,635. It is followed by Jakarta Barat with Rp. 1,829. The third and fourth places are occupied by Jakarta Pusat with Rp. 1,703 and Jakarta Utara with

Rp. 1,626, respectively. Jakarta Timur wants to pay the lowest amount of Rp. 1,263.

From the stand point of Kecamatan, a household in Tanah Abang is willing to pay the highest amount of Rp. 4,414 per month. Other Kecamatans with the amount of more than Rp. 3,000 are Pasar Minggu and Penjaringan. Taman Sari has the lowest monthly willingness to pay of Rp. 698. Other Kecamatans with the willingness to pay of less than Rp. 1,000 are Sawah Besar, Tanjung Priok, Cakung, Kramat Jati and Koja (Refer to Table J.23).

Analysis revealed that the extent of people's willingness to pay for sewerage services depends on the size of their income and the floor area of their house (Refer to Table J.24 and J.25).

Regarding the willingness to pay for establishments/institutions, a shop and a factory on average will pay a monthly sum of Rp. 5,394 and Rp. 6,050 respectively.

The willingness to pay for other establishments/institutions ranges from Rp. 5,328 to Rp. 10,332. It was found out that there exists a correlation between the floor area of an establishments/institution and the willingness to pay (Refer to Table J.25).

2.1.2 Estimation of Total Willingness to Pay

By estimating the total willingness to pay over the whole study area, one can measure the degree of importance people attach to the development of sewerage. It will provide a useful information in determining the extent of financial burden beneficiaries should bear.
Total willingness to pay for households in a Kelurahan can be calculated by multiplying the number of households by the average willingness to pay per household in the same Kelurahan. The same procedure is followed for establishments/institutions (Refer to Fig. J.11 and Table J.26).

The results in the form of total willingness to pay of houses, shops and factories for sewerage facilities by Kelurahan in 1988 and 2010 are presented in Table J.27 and J.28. Sum total of the willingness to pay for all properties over the whole study area works out at Rp. 39,167 million in 1988

and will reach Rp. 97,562 million in the target year of 2010 at 1990 prices as shown in Table J.29.

Furthermore, to know and determine zonal preferences/priorities, total willingness to pay of houses, shops, and factories in a Kecamatan was divided by the area in that Kecamatan. The results are shown in Table J.30 and J.31, and as their visualized form in Fig. J.12. and J.13.

Fig. J.13 shows the estimated zonal distribution of affordability for sewerage services in 2010. The figure along with the corresponding table was utilized to determine the priority order of the six (6) sewerage development zones.

2.2 Beneficiaries' Payment

The analysis of survey results shows that the existing households, establishments and institutions of the study area can afford to disburse the total amount of Rp. 39,167 million per annum for the provision of sewerage services as mentioned already. In the target year of 2010 the affordability is expected to rise to Rp. 97,562 million.

It is to be noted that the affordability for sewerage services expresses the limit of the affordability for any types of wastewater disposal services.

Alleviation of water pllution over the whole study area is estimated to demand an initial cost amounting to Rp. 3,341,602 million over the implementation period of 18 years. In addition, O/M cost totaling Rp. 22,662 million will be annually required over the project life period of 50 years.

It is apparent from the above that it is difficult for the beneficiaries to bear both the initial and O/M cost. It is also apparent that they are sufficiently capable of shouldering O/M cost.

The JICA Study Team defends the stance that sewerage is one of the basic human needs to be commonly used like public road. From this standpoint it seems not advisable to unduly burden the beneficiaries. Moreover, the governemnt of Indonesia now takes the position that the beneficiaries should at least pay O/M cost.

For these reasons it is commended that the beneficiaries shoulder O/M cost.

As regard to beneficiaries' payment in the sewerage development area, it was found out that the tariff of sewerage services charge recently approved by the Government can be basically applied along with the tariff of environmental charge now actually in force in Bandung.

Sewerage services charge will be collected from the beneficiaries with conventional house connections based on the floor area of their buildings.

The monthly charge per m^2 of floor area will be Rp. 28 for households, Rp. 50 for shops, hotels and restaurants, Rp. 106 for factories, Rp. 56 for social institutions, and Rp. 182 for large commercial buildings and large hotels.

The total annual average services charge will reach Rp. 32,930 million in 2010.

As for the beneficiaries in the interceptor areas, lump sump environmental charge will be applied. The monthly charge will be Rp. 1,000 for a house, Rp. 2,500 for an establishment/institution, Rp. 50,000 for a high rise building.

The total annual environmental charge will reach Rp. 6,177 million in 2010.

The combined annual income from both charges come to Rp. 39,107 million, which is sufficient to cover the estimated annual O/M cost of Rp. 18,067 million.

Turning to the on-site sanitation development area, the annual O/M cost is estimated to reach Rp. 4,595 million in 2010. This amount is required for the operation & maintenance of public toilet, sludge treatment and vacuum trucks. The number of beneficiaries is estimated at 859,500 in the same year. It means that the annual O/M cost will be recovered if Rp. 446 is monthly charged per household.