2.5 Proposed Facilities for the Feasibility Study

2.5.1 Drainage Facilities

The drainage system in each polder has been studied and recommended in the previous subsection. In this system, the allocation of discharge capacity of drainage facilities is planned as shown in Fig. C.34. Fig. C.36 shows how drainage facilities are hydraulicly effective on flood protection.

However, the degree of flood protection must be upgraded stage by stage. Existing drainage facilities are divided into three kinds i.e., primary, secondary and tertiary drainage facilities. According to the results, primary drainage facilities are ranked as high, followed by secondary and tertiary drainage facilities. Consequently, the implementation schedule is planned to start the construction of primary drainage facilities.

Taking into account of above facts, the drainage facilities as shown in Table C.20 to C.22 are proposed for the Feasibility Study. Improvement works of klongs are classified into five classes as follows.

Class I : new drain with retaining wall
Class II : widening + deepening + construction of retaining wall
Class III : deepening + construction of retaining wall
Class IV : no improvement (IV-2) or deepening (IV-1)
Class V : widening + deepening

The hydraulic studies are conducted on condition that the proposed drainage facilities for the Feasibility Study are constructed. Fig. C.36 shows the contour lines of maximum water level while Fig. C.37 shows the relationship between pump discharge and the storage capacity of klongs and retention areas. According to the results, there are some floodings in the east area of Phra Khanong Polder in which drainage facilities are not proposed.

Table C.20 Proposed Pumping Station

Pumping Station	Pump Capacity	Proposed Pump Capacity (m^3/S)			
		in M/P	in F/S	Utilized Existing	To be newly Const.
Bang Khen and Bang Sue Polder	1. Bang Khen New	15	15	9	-
	2. Bang Khen Old			12	-
	3. Bang Sue	50	36	36	-
	4. Huay Kwang	-	3	0	3
	Sub-total	65	54	57	-
Phrak-hanong Polder	1. Phra Khanong	90	90	105	-
	2. Lao	-	9	0	9
	3. Gig	3	-	-	-
	4. Kacha	6	-	-	-
	5. Campus	-	1	1	-
	Sub-total	99	100	106	9
Bang Na Polder	1. Jek	6	3	6	-
	2. Bang Oa	18	12	18	-
	3. Bang Na	21	15	15	-
	4. Bang Nang Chine	9	9	0	9
	5. Bang Lai	-	6	0	6
	6. Klet	-	9	0	9
	Sub-total	54	54	39	24
	Total	216	206	202	36

Table C.21 Proposed Drains

Location	Dimension	Proposed Length in M/P (in) (m)	Proposed closed drain	
			Size (m)	Length (m)
Bang Sue Polder	Sena Nichom Rd. 59		B1.9x1.9	2,000
	Ratchada Ditch 44		2@B2x2	100
	K. Lat Yao 49-51		B2x3	70
	Sub-total			2,170
Phrak-hanong Polder	Highway Ditch 113		2@B2x2	900
	From Ramkhamkaeng... 118 university to Saen Saep		ϕ 1.5	200
	Sub-Total			1,100
Bang Na Polder	Cross of Bang-Na-Trad Rd. 9		2@B3x3	175
	Cross of High-way 5		ϕ 2.5	35
	Sukhumvit Soi 50 54		B 2.5x2.5	700
	Connecting with K. Bang 54		B 2.5x2.5	150
	Jek and side ditch along Sukhumrit Rd. soi 50			
	Sub-total			1,060
	Total	30,000		4,330

Table C.22 Proposed Klong Improvement (1)

(Unit: km)

Polder	Drainage Area	Block No.	Klong	Rivised System in F/S						Proposed Works in F/S					
				I	II	III	IV	V	Total	I	II	III	IV	V	Total
Phra Khanong		78-85	K.Phra Khanong	-	-	3.7	3.9	-	7.6	-	-	3.7	3.9	-	7.6
		76 77	K.Tan	-	0.4	3.2	-	-	3.6	-	0.4	3.2	-	-	3.6
		63-76	K.Saen Saeb	-	1.8	3.8	7.4 (1.8+5.6)	-	13.0	-	1.8	3.8	1.8	-	7.4
			Sub-total	-	2.2	10.7	11.3	-	24.2	-	2.2	10.7	5.7	-	18.6
Bang Khen	Bang Khen	18-22	K.Bang Khen	-	-	-	3.9	6.5	10.4	-	-	-	-	-	-
		1-10	K.Lat Phrao	-	-	-	16.5	-	16.5	-	-	-	-	-	-
		11-16	K.Bang Sue	-	2.0	6.0	6.2	-	14.2	-	0.8	2.80	3.44	0.40	7.44
and	and	24-28	K.Prem Prachakon	-	-	-	7.2	-	7.2	-	-	-	-	-	-
		45	K.Kasesart	-	-	1.75	-	-	1.75	-	-	1.75	-	-	1.75
		48.49.50	K.Lat Yao	-	-	2.4	-	-	2.40	-	-	2.15	-	-	2.15
Bang Sue	Bang Sue	62	K.Toong	-	-	-	1.35	-	1.35	-	-	-	-	-	-
		57.58	K.Phya Wake	-	-	2.00	-	-	2.00	-	-	2.00	-	-	2.00
		60.61	K.Nam Kaem	-	-	-	2.4	-	2.4	-	-	-	-	-	-
		51-55	Rachada Ditch	5.20	-	-	-	-	5.20	5.20	-	-	-	-	5.20
		29-37	H.W.Side Ditch	-	-	-	5.6	-	5.6	-	-	-	-	-	-
			Sub-total	5.20	2.0	12.15	3.15	6.5	69.0	5.20	0.80	8.70	3.44	0.40	18.54
Phra Khanong	Huay Kwang	87-89	K.Lat Phrao	-	-	-	4.67	0.80	5.47	-	-	-	4.67	0.80	5.47
		56, 123-125	K.Huay Kwang	-	-	2.00	-	4.00	6.00	-	-	-	-	-	-
		132-134	K.Nasong	-	0.20	3.30	-	-	3.50	-	-	-	-	-	-
		90-96	K.Sam Sen	-	-	1.10	4.10	1.00	6.20	-	-	1.10	4.10	1.00	6.20
		129-130	H.W.Side Ditch	-	-	-	2.7	-	2.70	-	-	-	-	-	-
		126	K.Chuad Yai	-	-	-	-	2.00	2.00	-	-	-	-	-	-
		127	K.Sam Saen Noi	-	-	-	-	2.00	2.00	-	-	-	-	-	-
		118-120	Chao Khun Sing	-	-	-	2.00	0.60	2.60	-	-	-	2.00	0.60	2.60
		139	Yai Soon	-	-	-	0.40	1.20	1.60	-	-	-	0.40	1.20	1.60
		137	Ku-Nam	-	-	-	0.40	-	0.40	-	-	-	-	-	-
		122	Wat Tuk	-	-	1.8	-	1.7	3.5	-	-	-	-	-	-
		140	K.Bang Kapi	-	-	-	1.0	-	1.0	-	-	-	-	-	-
			Sub-total	-	0.20	8.2	15.27	13.3	36.97	-	-	1.10	11.17	3.60	15.87

Table C.22 Proposed Klong Improvement (2)

(Unit: km)

Polder	Drainage Area	Block No.	Klong	Rivised System in F/S						Proposed Works in F/S					
				I	II	III	IV	V	Total	I	II	III	IV	V	Total
Phra Khanong	K.Chan	99-101	N.N	-	-	-	-	4.8	4.8	-	-	-	-	0	0
		102 103	K.Bang Toei	-	-	-	3.9	-	3.9	-	-	-	0	-	0
		98	K.Bang Chala	-	-	1.3	-	-	1.3	-	-	0	-	-	0
		97	K.Phlu	-	-	-	-	1.0	1.0	-	-	-	-	0	0
			Sub-total	-	-	1.3	3.9	5.8	11.0	-	-	0	0	0	0
Phra Khanong	Lat Phrao	107	N.N	-	-	1.2	-	-	1.2	-	-	0	-	-	0
		109	Lat Pla Kao	-	-	-	-	1.2	1.2	-	-	-	-	0	0
		108	N.N	-	-	-	-	1.5	1.5	-	-	-	-	0	0
		110-114	Chan	-	4.9	2.2	-	-	7.1	-	0	0	-	-	0
		115	Sua Noi	-	-	1.0	-	-	1.0	-	-	0	-	-	0
		116 117	Song Kla Tiam	-	-	2.5	-	-	2.5	-	-	0	-	-	0
		104-106	Ta Nang	-	-	1.2	4.2	-	5.4	-	-	0	0	-	0
			Sub-total	-	4.9	8.1	4.2	2.7	19.9						
Phra Khanong	Ramkha-mhaeng (Hua Mark North)	144	K.Chit	-	-	1.3	-	-	1.3	-	-	1.3	-	-	1.3
		145	K.Gig	-	-	0.97	0.57	-	1.54	-	-	0.97	0.57	-	1.54
		148-150	K.Cacha	-	-	1.6	3.50	-	5.10	-	-	1.6	2.8	-	4.4
		151-153	R.W Side Ditch	-	-	4.0	-	-	4.00	-	-	-	0	-	0
			Sub-total	-	-	7.87	4.07	-	11.94	-	-	3.87	3.37	-	7.24
Phra Khanong	Hua Mark (South)	156 157	Sakae	-	-	2.8	-	-	2.8	-	-	0	-	-	0
		154	N.N	-	-	-	-	0.5	0.5	-	-	-	-	0	0
		155	N.N	-	-	1.6	-	-	1.6	-	-	0	-	-	0
		161	Hua Mark	-	-	1.0	-	-	1.0	-	-	0	-	-	0
			Sub-total	-	-	5.4	-	0.5	5.9	-	-	0	-	-	0
Phra Khanong	Pattana Karn	141-143 158-160	N.N	-	-	-	3.0	5.5	8.5	-	-	-	0	0	0
			Sub-total	-	-	-	3.0	5.5	8.5	-	-	-	0	0	0

Table C.22 Proposed Klong Improvement (3)

(Unit:'km)

Polder	Drainage Area	Block No.	Klong	Rivised System in F/S						Proposed Works in F/S					
				I	II	III	IV	V	Total	I	II	III	IV	V	Total
Bang Na	Bang Na	214 215	K.Bang Ao	-	-	1.0	1.1	-	2.1	-	-	1.6	0.5	-	2.1
		208~214	K.Bang Nang Chine	-	-	3.26	0.60	-	3.86	-	-	3.26	0.6	-	3.86
		165~171	K.Klet	1.2	-	5.0	-	-	6.2	1.2	-	5.0	-	-	6.2
		172~177	K.Bang Na	-	0.2	4.0	2.0	-	6.2	-	0.2	4.0	2.0	-	6.2
		190~193	K.Bang Lai	-	-	3.0	0.5	-	3.5	-	-	3.0	0.5	-	3.5
		194~197	K.Wang Bon	-	-	2.6	-	-	2.6	-	-	2.6	-	-	2.6
		206	K.Suan Aoi	-	-	-	0.6	-	0.6	-	-	-	0.6	-	0.6
		207	K.Kwang Lang	-	-	-	1.0	-	1.0	-	-	-	1.0	-	1.0
		178~184	Bang Na-Trad	-	-	-	5.95	-	5.95	-	-	-	-	-	-
		187 188	Rd. K_1	-	-	-	1.35	-	1.35	-	-	-	1.35	-	1.35
		186	" K_2	-	-	-	0.6	-	0.6	-	-	-	0.6	-	0.6
		185	" K_3	-	-	-	0.6	-	0.6	-	-	-	0.6	-	0.6
		228~230	K.Bangchak(1)	-	-	2.35	-	-	2.35	-	-	2.35	-	-	2.35
		231~232	" (2)	-	-	1.75	-	-	1.75	-	-	1.75	-	-	1.75
		226 227	K.Jek	-	-	-	1.58	-	1.58	-	-	-	0	-	0
		219	K.Bang Jek	-	-	-	1.0	-	1.0	-	-	-	-	-	0
		220 216~218	N.N (soi50)	-	-	-	2.75	-	2.75	-	-	-	-	-	0
		162~164	N.N (Branch of K.Klet)	-	-	-	3.10	-	3.10	-	-	-	-	-	0
		225	N.N (Branch of Bang Na Chine)	-	-	-	0.6	-	0.6	-	-	-	0	-	0
			Sub-total	1.2	0.2	22.96	23.33	-	47.69	1.2	0.2	23.56	7.75	-	32.71
Total				6.4	9.5	76.68	108.22	34.30	235.1	6.4	3.2	47.93	31.43	4.00	92.96

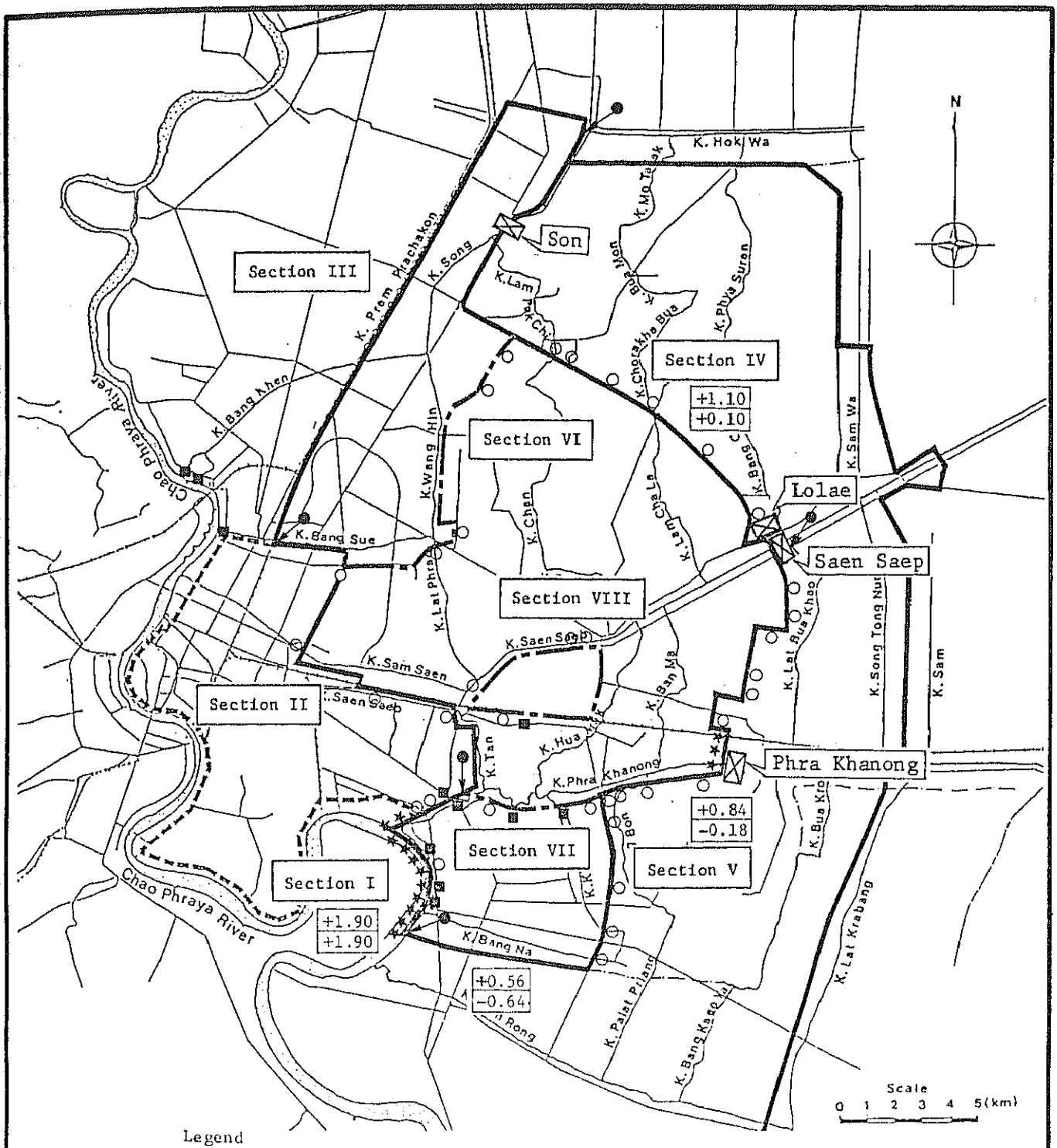
2.5.2 Hydraulic Study for Project Evaluation

In this subsection, hydraulic effects have been studied based on Table C.23.

Table C.23 Calculated Case

Case	Green Belt	Second Barrier	Land Use	F/S Facilities	Rainfall Frequency
1	O	O	1985	X	2, 5, 10, 20 Years
2	O	O	1985	O	
3	O	O	2000	X	
4	O	O	2000	O	

The results are shown in Figs. C.38 to C.45.
According to the results, flooding situation will be alleviated by about 10 cm around areas where proposed facilities are constructed. On the other hand, it is obvious that the proposed facilities will be little effective on areas where drainage facilities are not proposed in the Feasibility Study.



Legend

- Barrier to be newly constructed
- Section III — Barrier utilizing existing road & railway
- Gate to be newly constructed (4)
- ○ Gate utiliging existing wooden gate
- ■ Pumping Station with Gate
- +0.84 / -0.18 — Design Water Level (m:MSL) (Blow Figure shows Future W.L.)

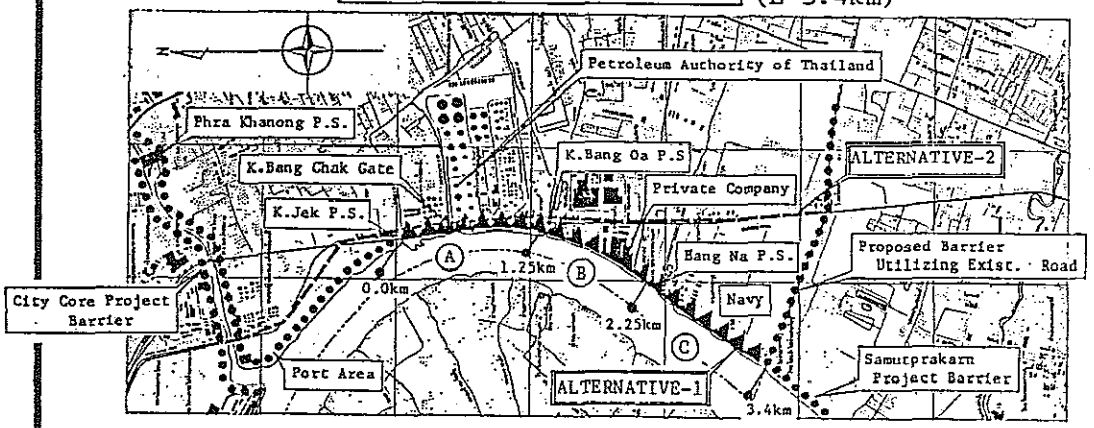
Section		Barrier: Exist. Road/Railway	Barrier: To be Constructed	Barrier: Total Length
Second Barrier	I	3.4 km	3.4 km	6.8 km
	II	19.4	-	19.4
	III	20.9	-	20.9
	IV	26.4	-	26.4
	V	28.2	1.7	29.9
Inner Barrier	VI	12.1	-	12.1
	VII	5.6	-	5.6
	VIII	13.0	-	13.0
Total		129.0 km	5.1 km	134.1 km

Fig. C.1 PROPOSED BARRIER AND GATE

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

Along Chao Phraya River (L=3.4km)

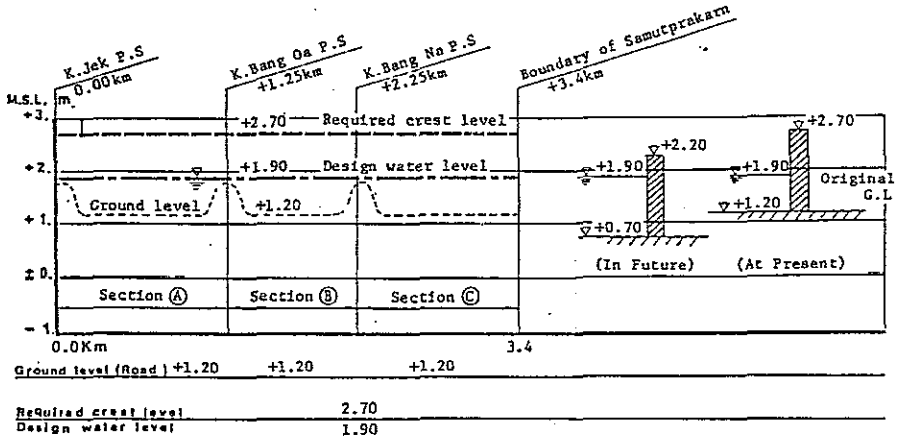


BARRIER ALIGNMENT

▲▲▲▲▲ : ALTERNATIVE-1 (Adopted in this study)

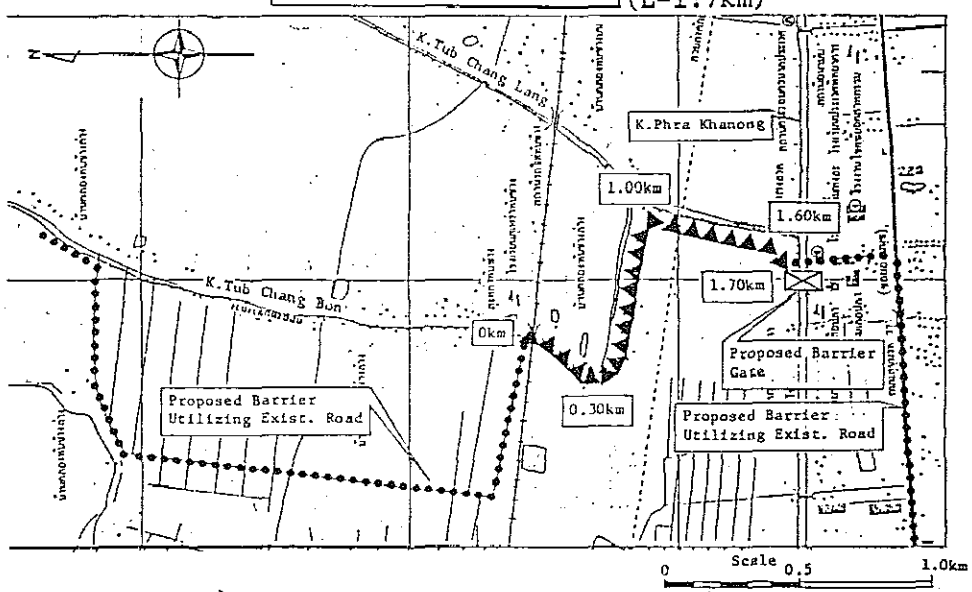
▬▬▬▬ : ALTERNATIVE-2

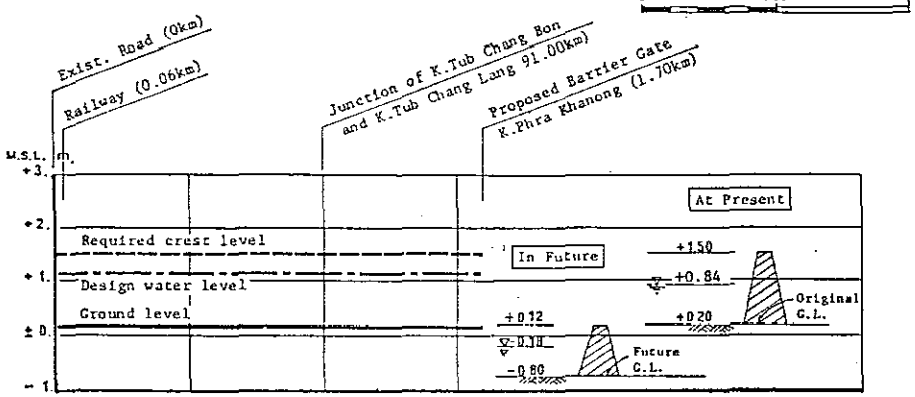
Scale 0 1 2km



Ground level (Road)	+1.20	+1.20	+1.20
Required crest level		2.70	
Design water level		1.90	

Along Tub Chang Bon (L=1.7km)





Ground level (Road)	+0.20m	
Required crest level	+1.50	
Design water level	+1.12	
Land subsidence (Settlement)	1.00 (0.30)	
Freeboard	0.30	

Legend

▲▲▲▲▲ : Barrier to be Newly Constructed

●●●●●●● : Barrier Utilizing Esisting Roads.

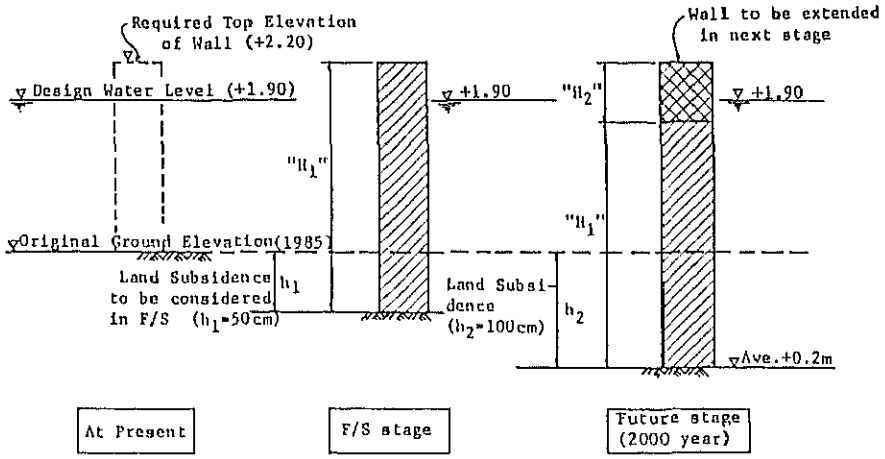
Note : Figure in Parenthesis shows future elevation considering land subsidence and settlement

Fig. C.2 ALIGNMENT AND PROFILE OF FLOOD PROTECTION BARRIER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

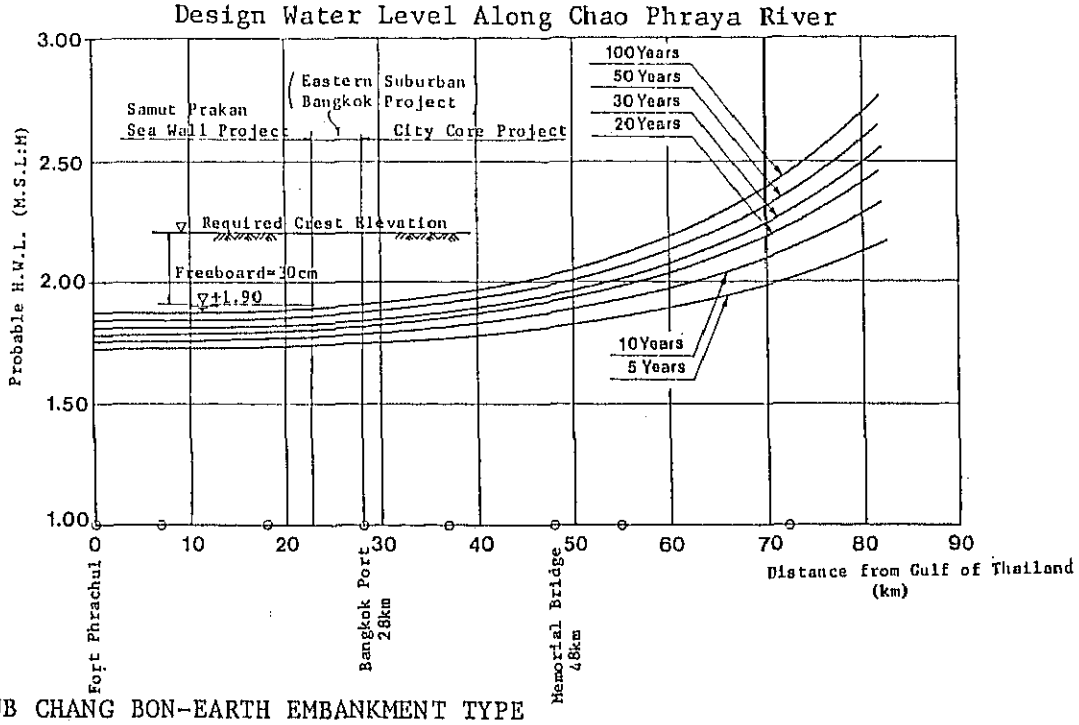
JICA 1986 2529(1)

I. ALONG CHAO PHRAYA RIVER-CONCRETE WALL TYPE

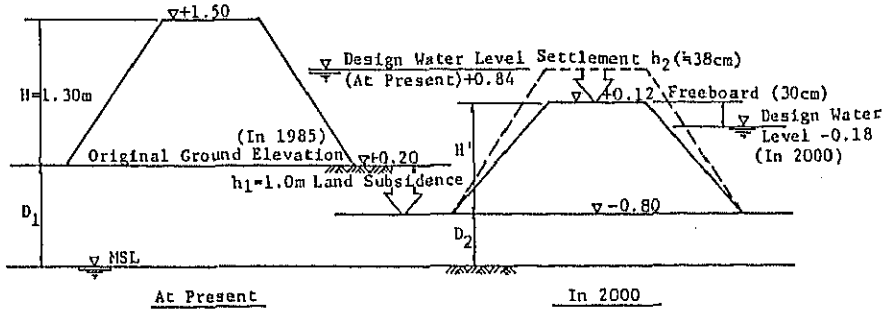


Legend

"H_1" : Proposed Wall Height (Ave. 1.50m)
"H_2" : Wall height to be Extended in Next Stage (Ave. 2.00)
h_1 : Land Subsidence to be considered in F/S (50cm)
h_2 : Expected Land Subsidence in 2000 (100cm)



II. ALONG TUB CHANG BON-EARTH EMBANKMENT TYPE



Legend

H :Proposed Dike Height (Include Freeboard, Settlement)
H':Dike Height In 2000
h_1:Land Subsidence
h_2:Dike Settlement
D_1:Original Ground Elevation (1985), to be Assumed in +0.20
D_2:Ground Elevation (2000)

Fig. C.3 FLOOD PROTECTION BARRIER HEIGHT

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

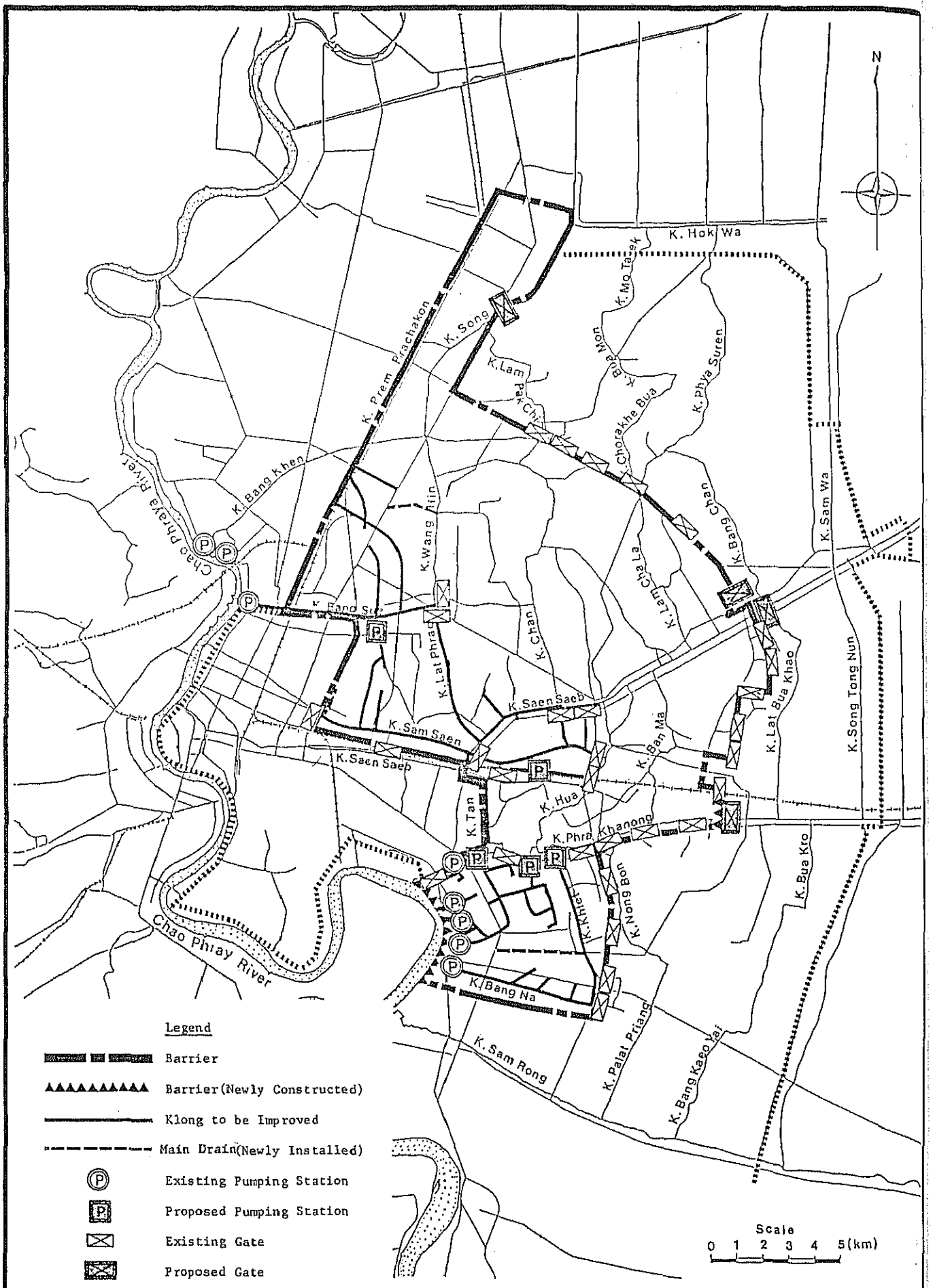


Fig. C.4 PROPOSED SYSTEM IN THE FEASIBILITY STUDY

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

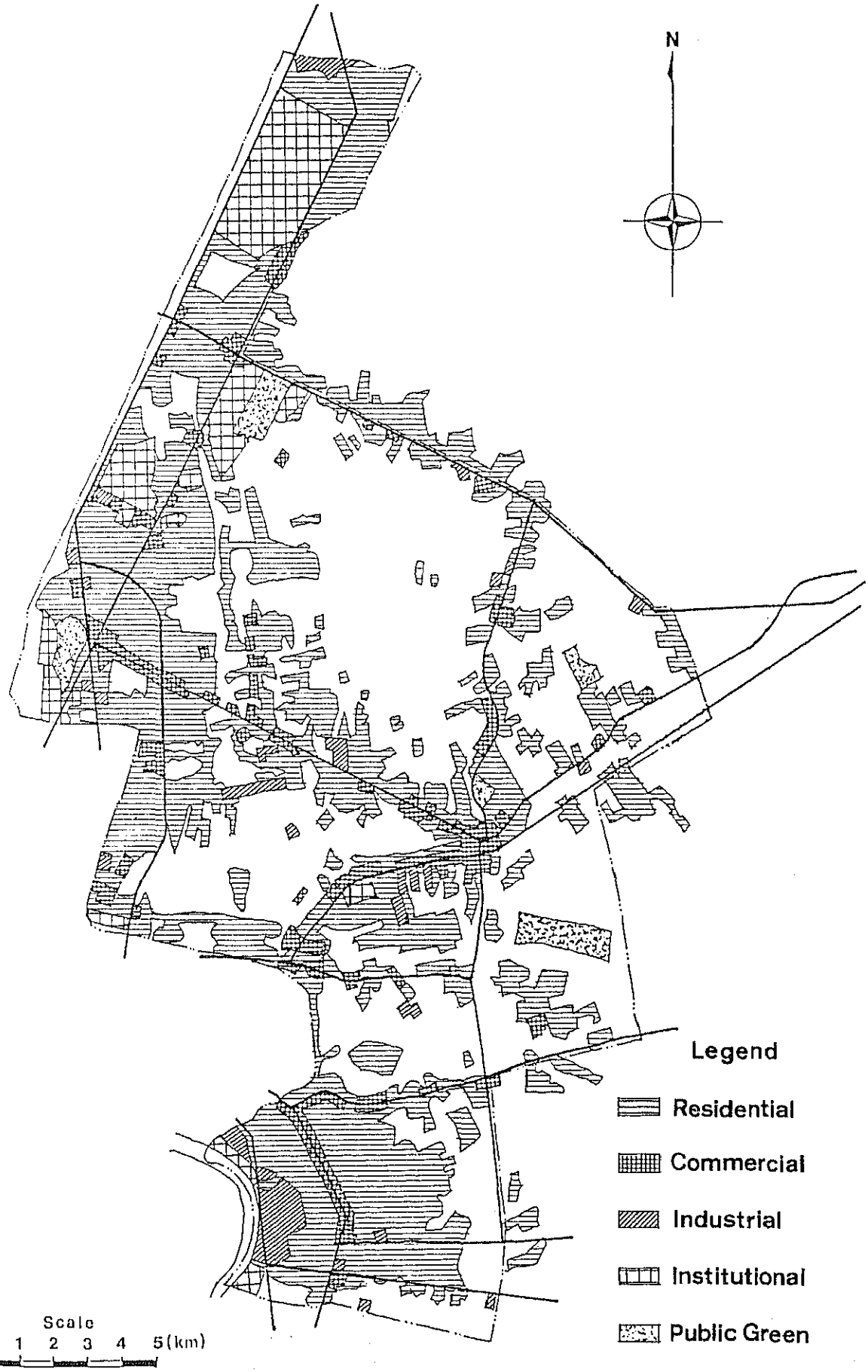


Fig. C.5 LAND USE IN STUDY AREA IN 1983

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

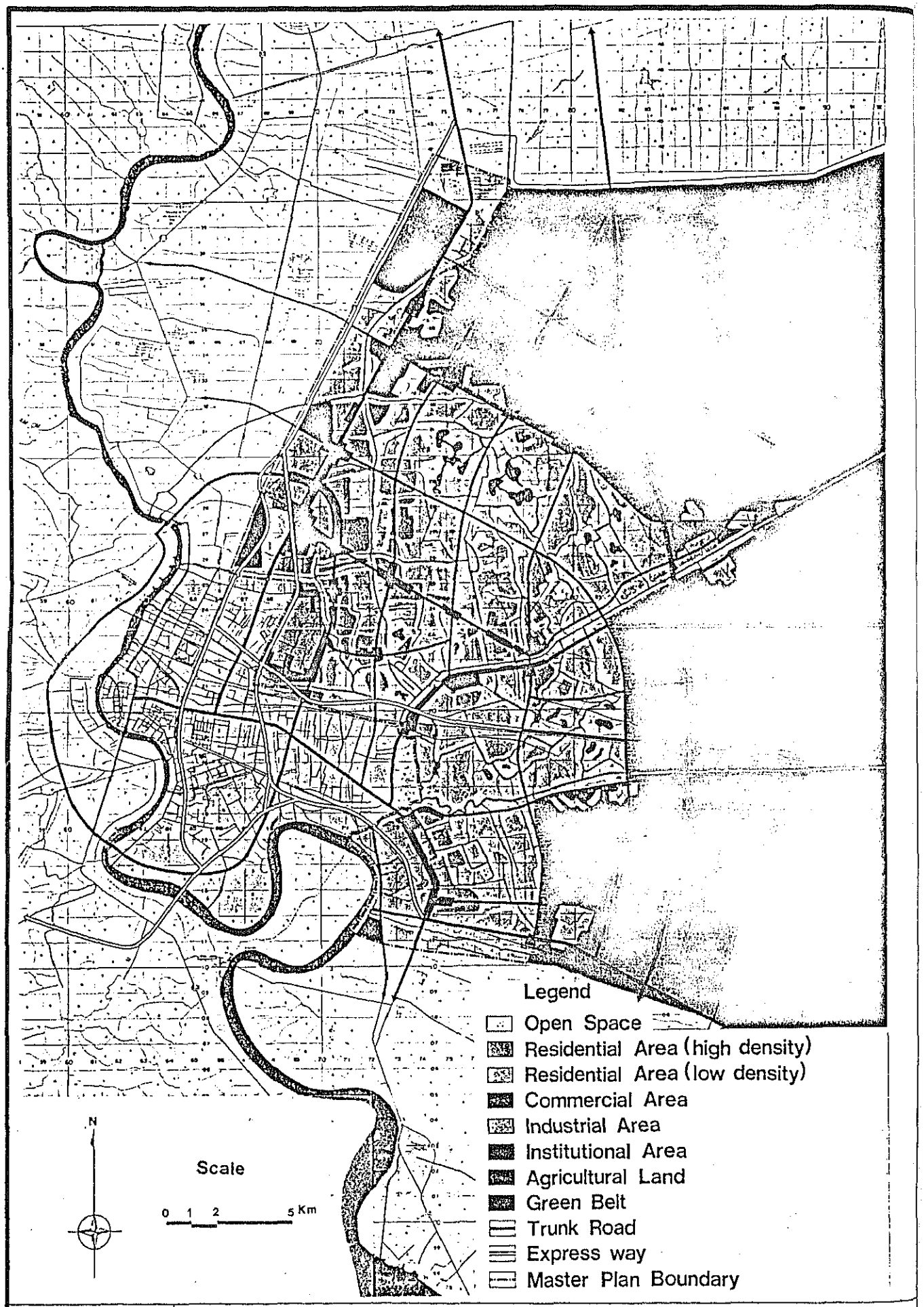


Fig. C.6 LAND USE PLAN FOR STUDY AREA IN 2000

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

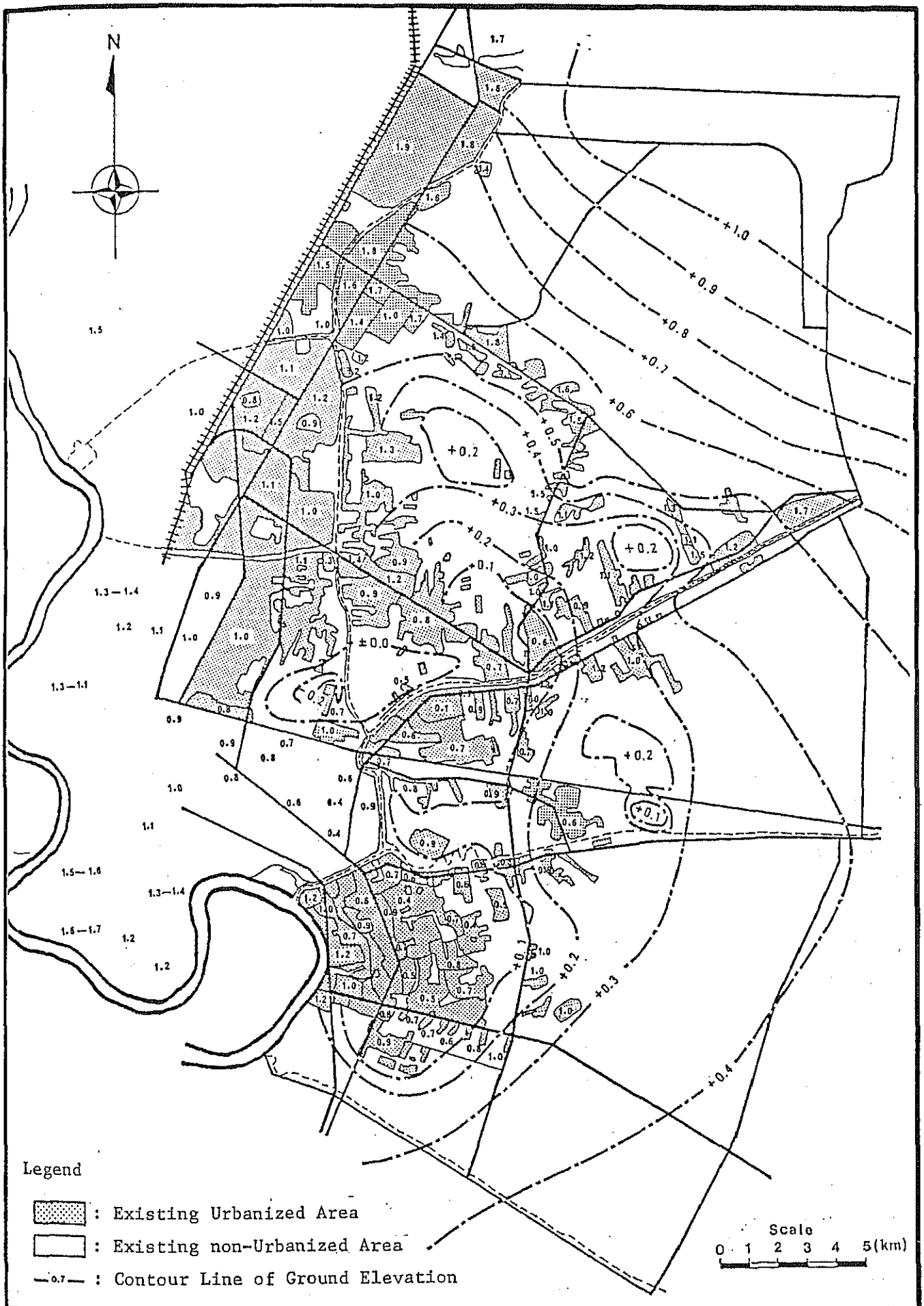


Fig. C.7 GROUND ELEVATION IN THE STUDY AREA IN 1984

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

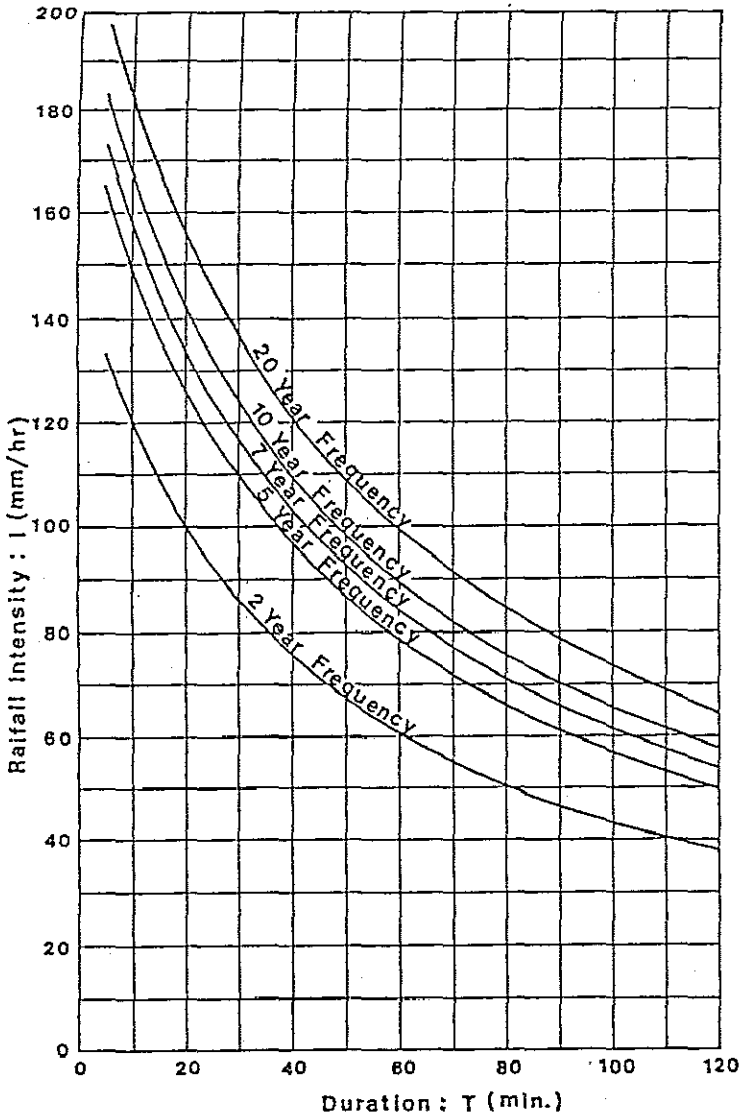
JICA 2529B.E 1986A.D

Land Use in Master Plan Area

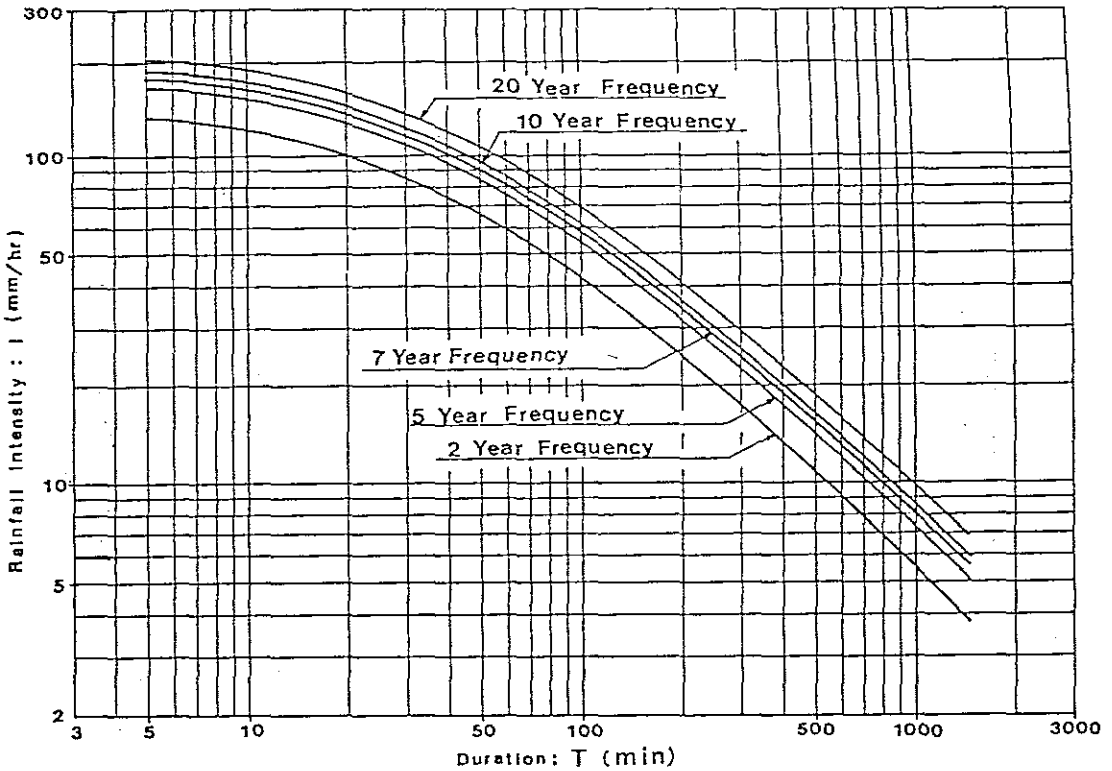
Land Use	Area
Urbanized	216 km^2
Non-Urbanized	44 km^2
Total	260 km^2

Fig. C.8 ESTIMATED GROUND LEVEL IN URBANIZED AREA IN 2000

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



Case A'



Case B'

Rainfall Intensity–Duration Formula

2 Year Probability	: $i = \frac{5,690}{t + 37}$	
5 " "	: $i = \frac{7,600}{t + 40}$	
7 " "	: $i = \frac{8,230}{t + 41}$	
10 " "	: $i = \frac{8,850}{t + 42}$	
20 " "	: $i = \frac{10,040}{t + 44}$	

Note : 1. Case A' is used for the case when the time of concentration is within 2 hours.

2. For case B', the time of concentration is between 2 hours and 24 hours

Fig. C.9 RAINFALL INTENSITY-DURATION CURVES

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

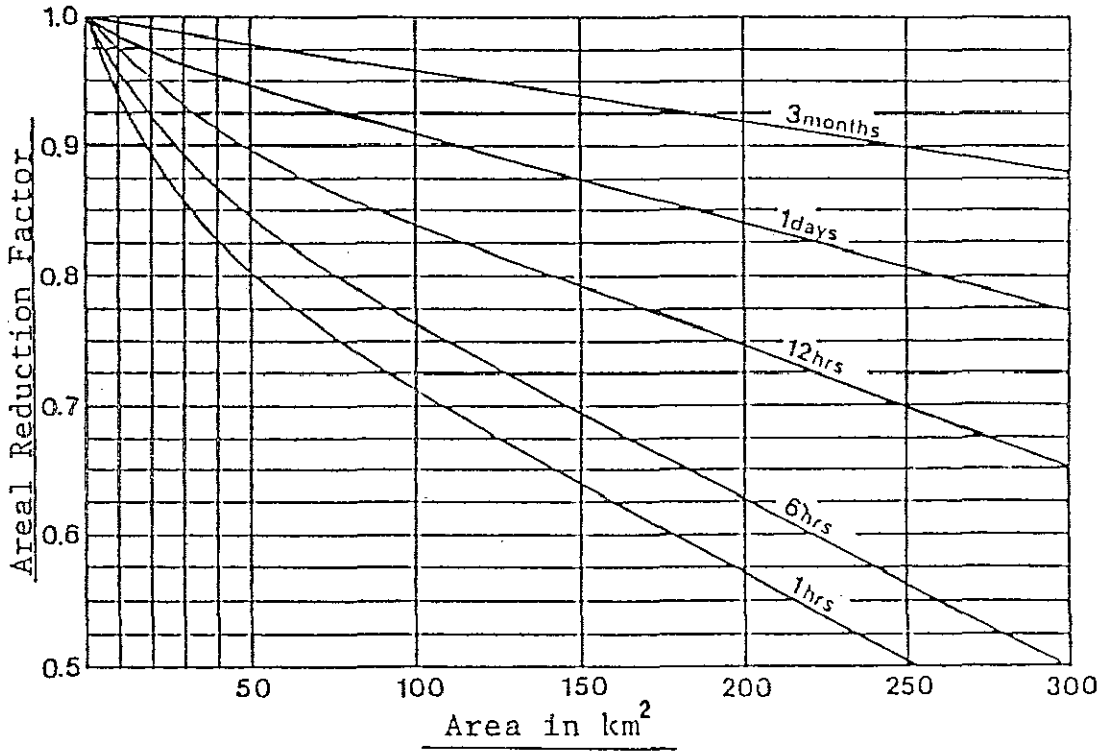


Fig. C.10	RAINFALL AREAL REDUCTION FACTOR

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

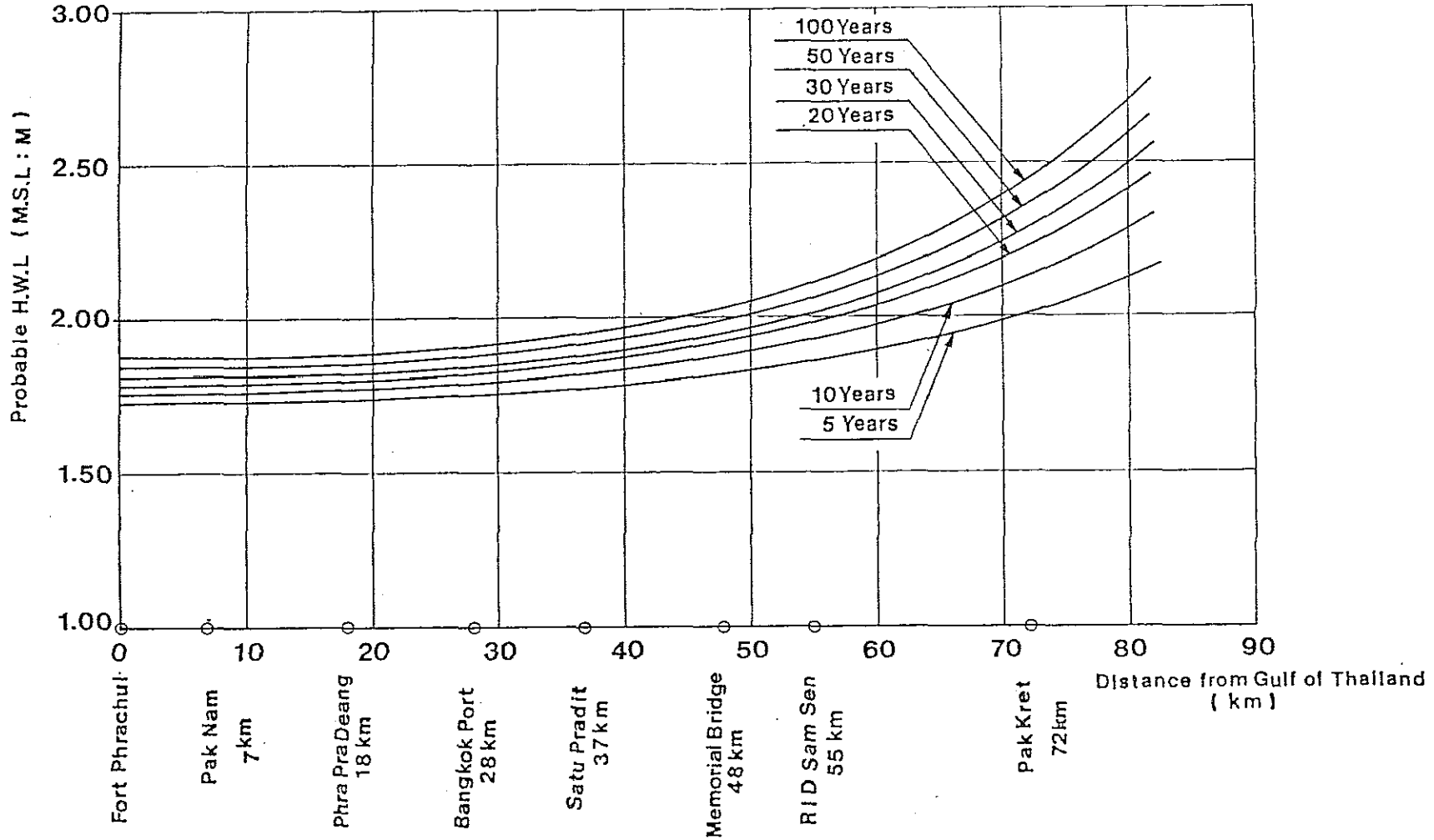


Fig. C.11 PROBABLE FLOOD WATER LEVEL OF CHAO PHRAYA RIVER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529 B.E 1986 A.D

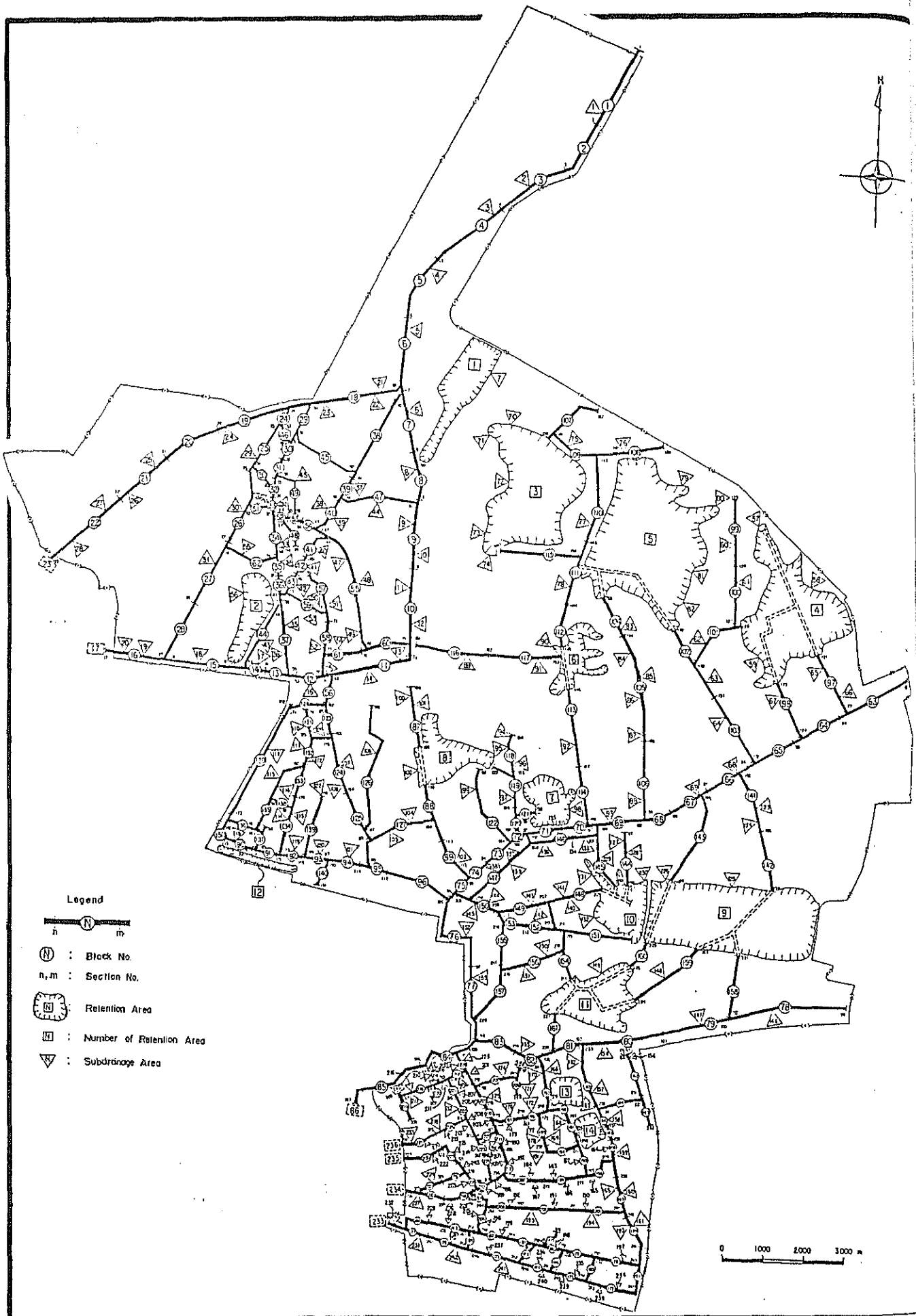
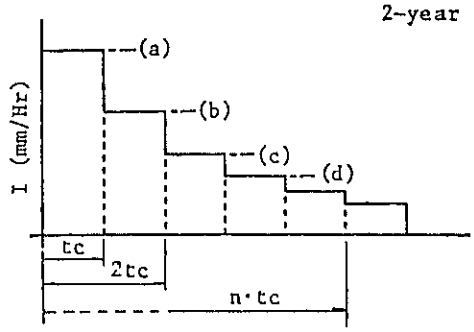


Fig. C.12 KLONG NETWORK IN THE STUDY AREA

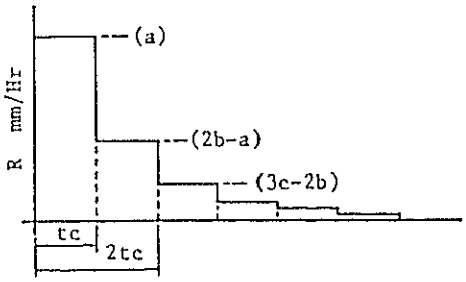
FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E. 1986A.D.

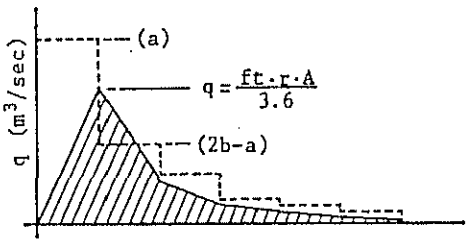
(A) Rainfall Intensity - Duration Curve



(B) Hyetograph

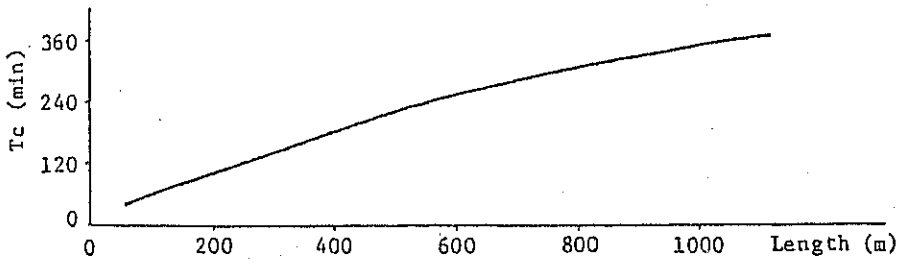


(C) Hydrograph



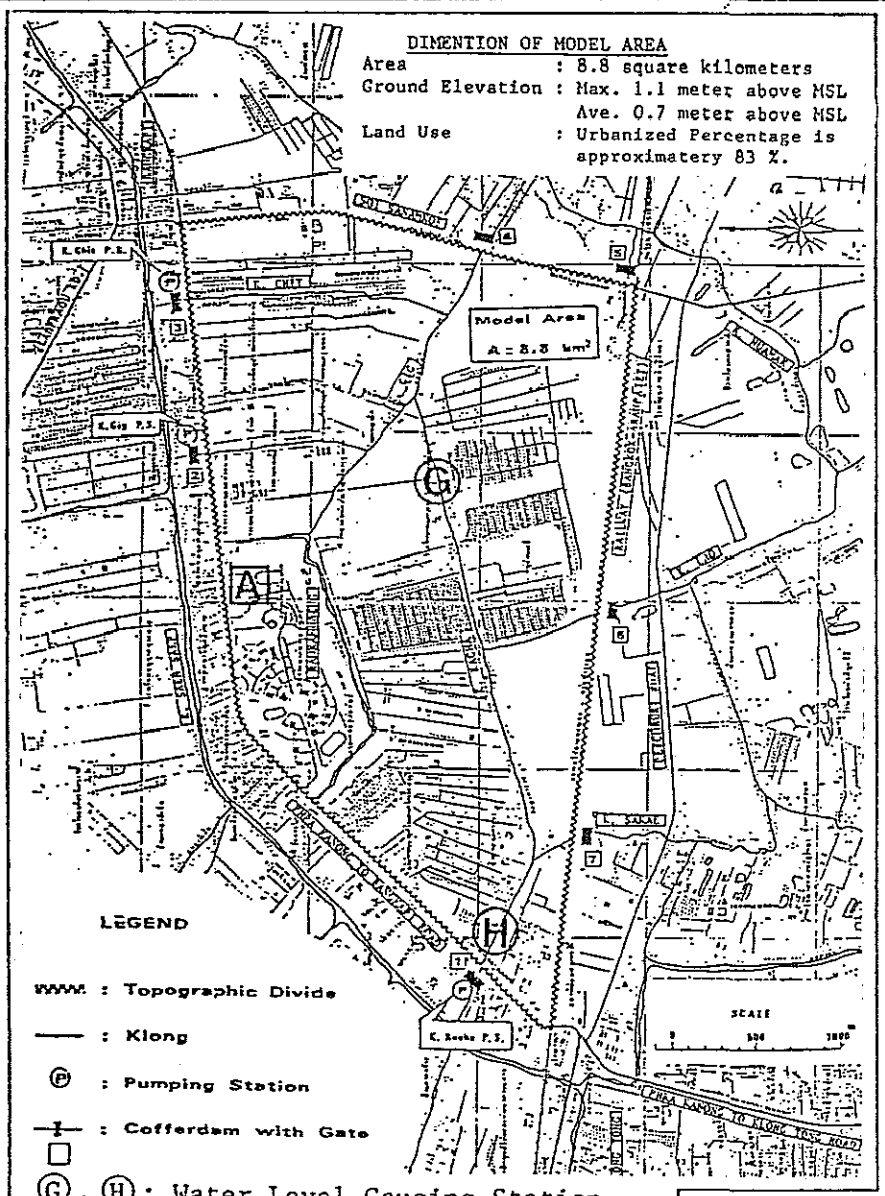
(D) Tc : Time of Concentration

Time of Concentration (Tc) VS Average Slope Length in Sub-Drainage Area



notice ; Calibrated by Run-off Model Area's Simulation

Fig. C.13 TRANSFORMATION OF RAINFALL INTO RUNOFF



LOCATION MAP OF MODEL AREA

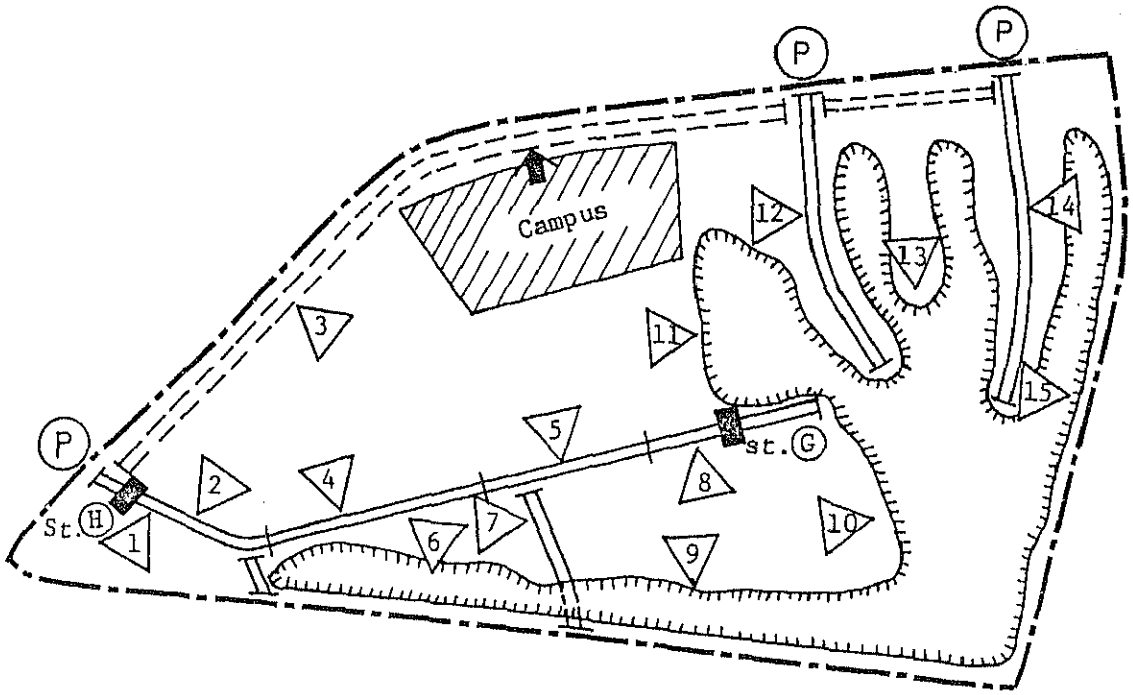
Typical Dimensions of Existing Klongs

Dimension Name	Length	Typical Section Width	Depth	Bottom Elev.	Remarks
Klong Kacha	3.5 Km	8.0 m	1.5 m	El.-1.2 m	
Kong Gig	2.0	11.0	1.8	El.-1.8	
Klong Sakae	0.3	5.5	2.3	El.-1.1	
Klong Lao	0.7	13.0	2.4	El.-1.5	
None Name	0.9	6.5	1.7	El.-1.2	
Klong Chit	1.6	-	-	-	
Total	9.0 Km	-	-	-	

Existing Facilities of Flood Protection for Model Area

Facilities	Place	Name of Klong	Size	Installed Month/Year	Operation	Remarks
Pump	1	K. KACHA	ϕ24" x 2 Unit	1982	Manual	Submersible Sewerage Pump
			ϕ20" x 1			
			ϕ14" x 2			
	2	K. GIG	ϕ14" x 1	1982	Manual	"
			ϕ12" x 1			
	3	K. CHIT	ϕ12" x 1	1982	Manual	"
Gate	1	K. KACHA	H m W m leaf 2.50x2.00x2	1981	Manual	Wooden Gate Leaf
	2	K. GIG	H m W m 2.35x2.00	1981	Manual	"
	3	K. CHIT	H m W m 2.10x2.00	1981	Manual	"
	4	K. GIG	H m W m 2.50x2.00	1981	Manual	"
	5	NONE	H m W m 2.10x2.00	1981	Manual	"
	6	K. LAO	H m W m 2.30x2.00	1981	Manual	"
	7	K. SAKAE	H m W m 3.00x2.00	1981	Manual	"

Fig. C.14 LOCATION MAP OF MODEL AREA AND DIMENSIONS OF DRAINAGE FACILITIES FOR MODEL AREA



Legend

- Klong
- Pipe, Box culvert
- (P) Pumping Station
- 5 Sub-drainage Area
- Retention Area
- st.(G) Water Level Gauging Station

No.of Sub-Drainage Area	Area (km^2)
1	0.22
2	0.31
3	0.37
4	0.16
5	0.32
6	0.14
7	0.14
8	0.36
9	0.37
10	0.18
11	0.33
12	0.13
13	0.14
14	0.19
15	0.15
Campus	0.43
Retention Area	4.56
Total	9.00

Fig. C.15 SCHEMATIC MODEL OF RUN OFF MODEL AREA

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

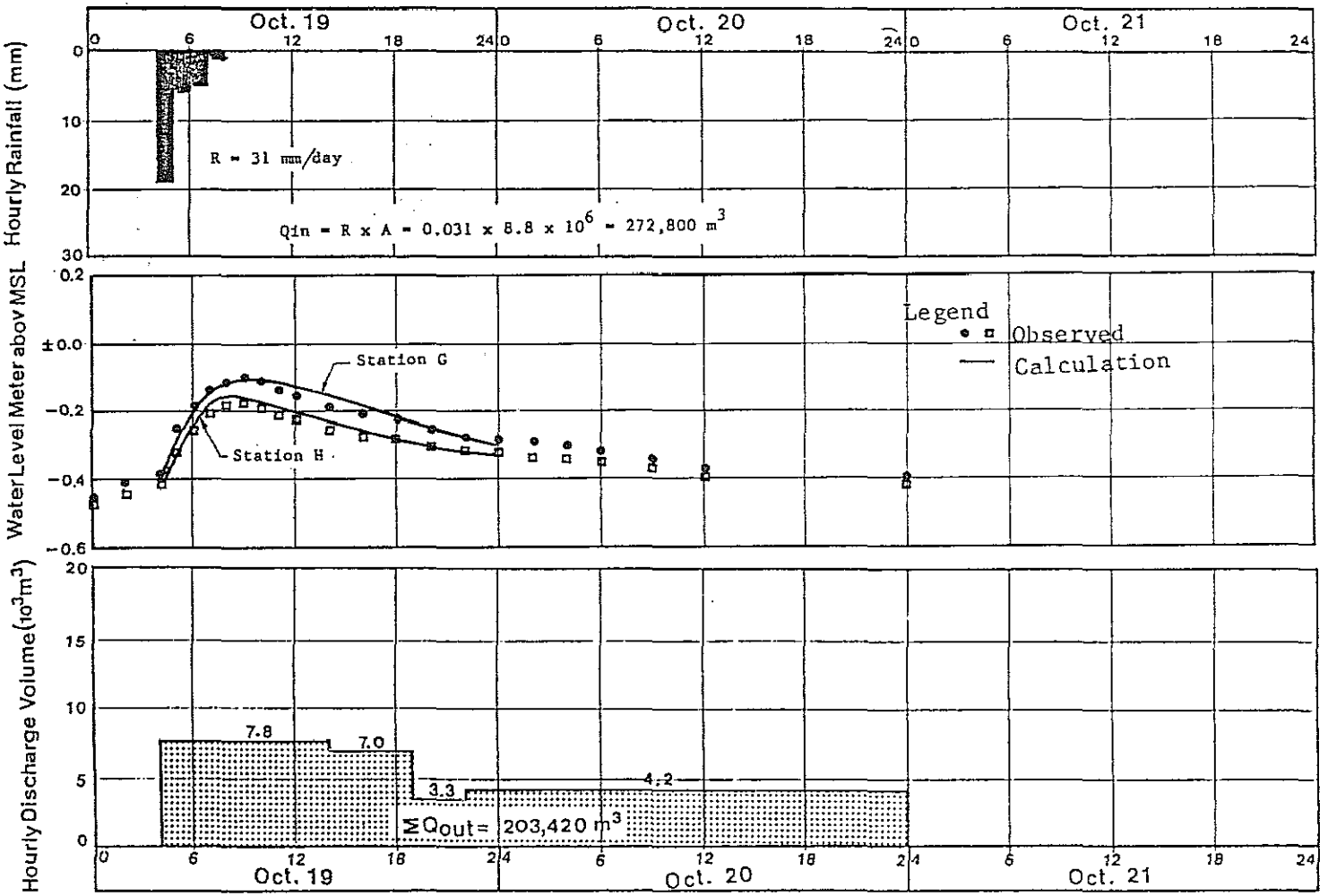


Fig. C.16 CALIBRATION OF WATER LEVEL AT KLONG KACHA (1)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

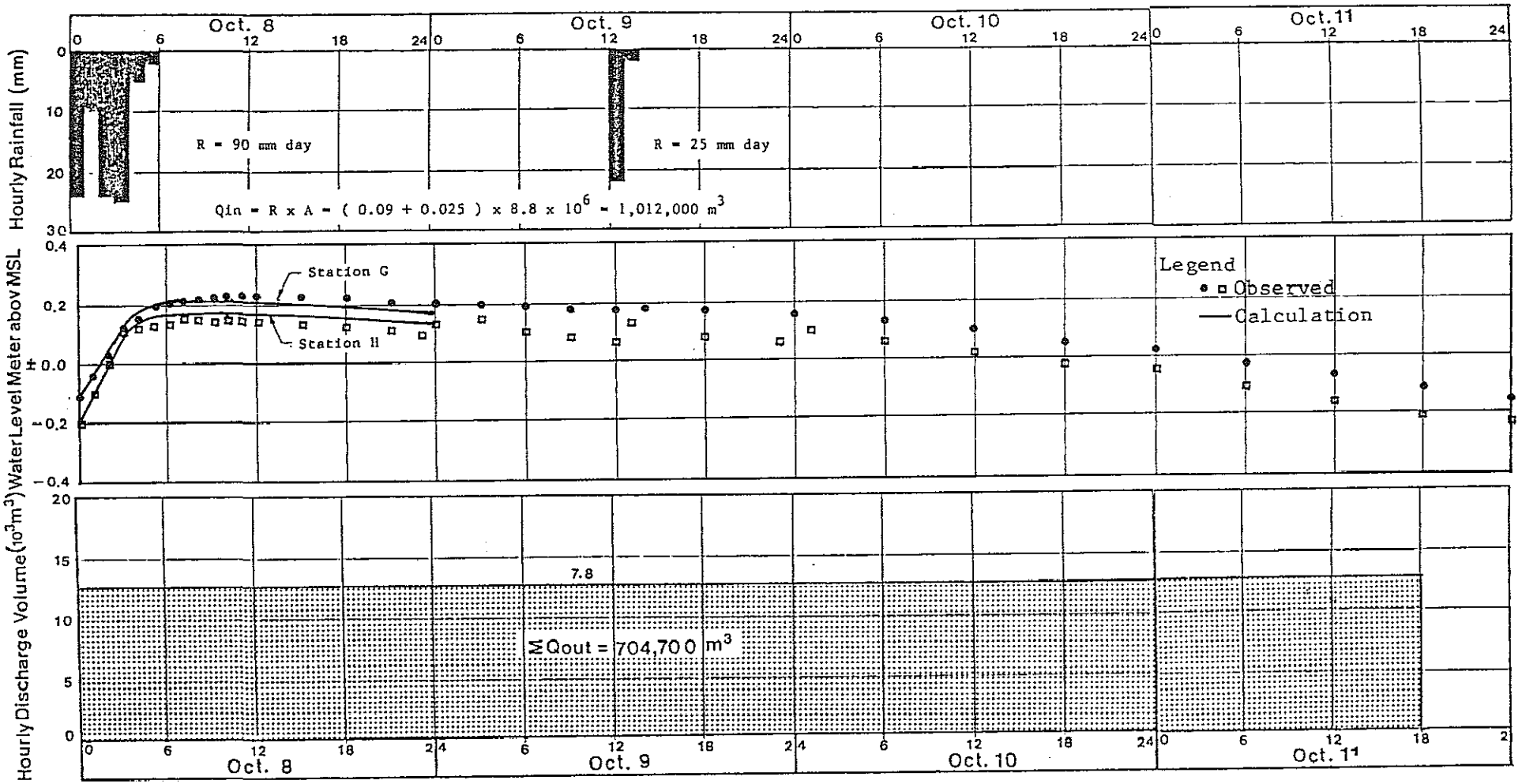
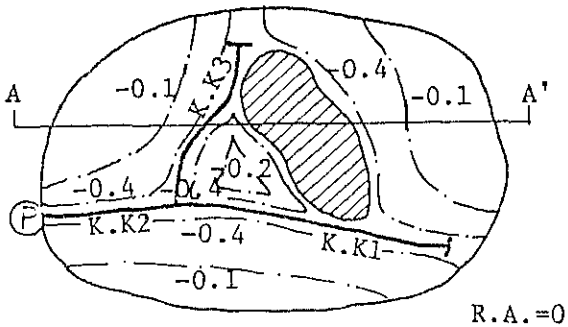


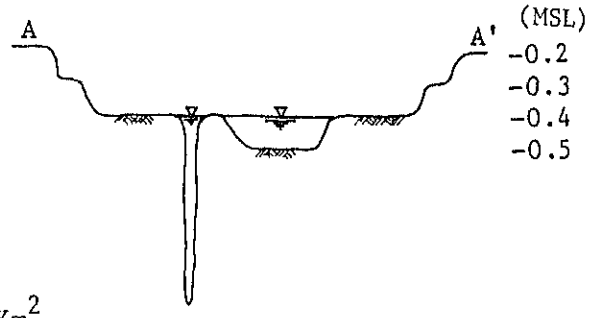
Fig. C.17 VERIFICATION OF MODEL AT KLONG AT KLONG KACHA (2)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

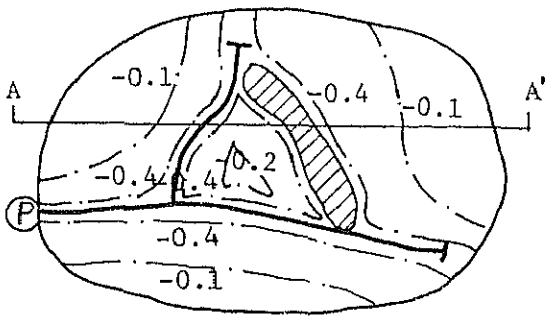
CASE-1

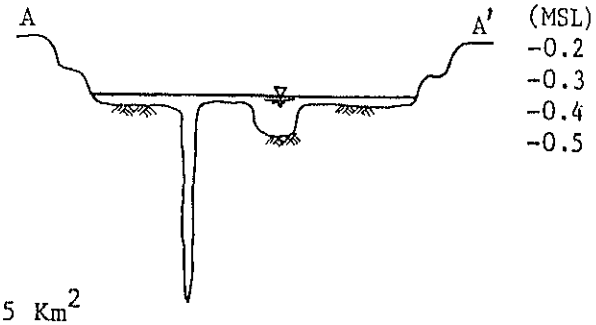




R.A.=0.5 Km^2

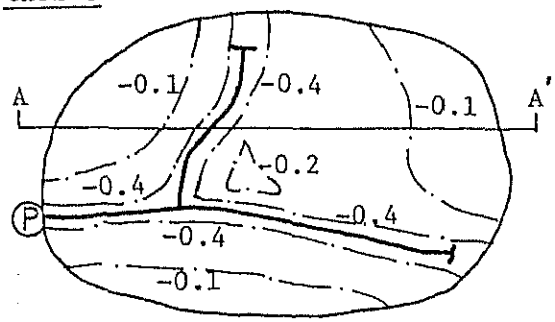
CASE-2

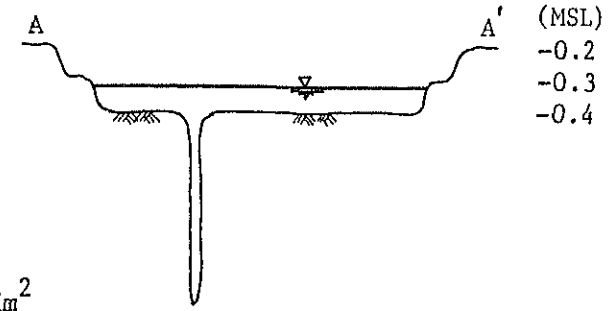




R.A.= 0.25 Km^2

CASE-3





R.A.=0 Km^2

Legend:

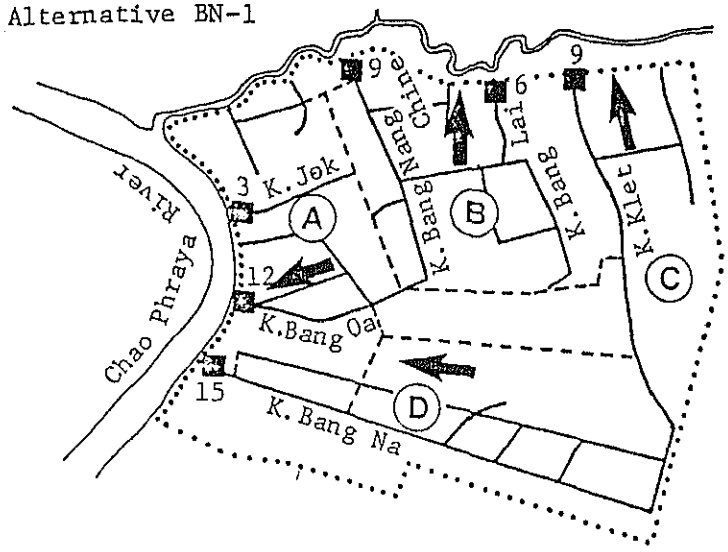
: Retention Area (R.A.)

Dimension of Klongs

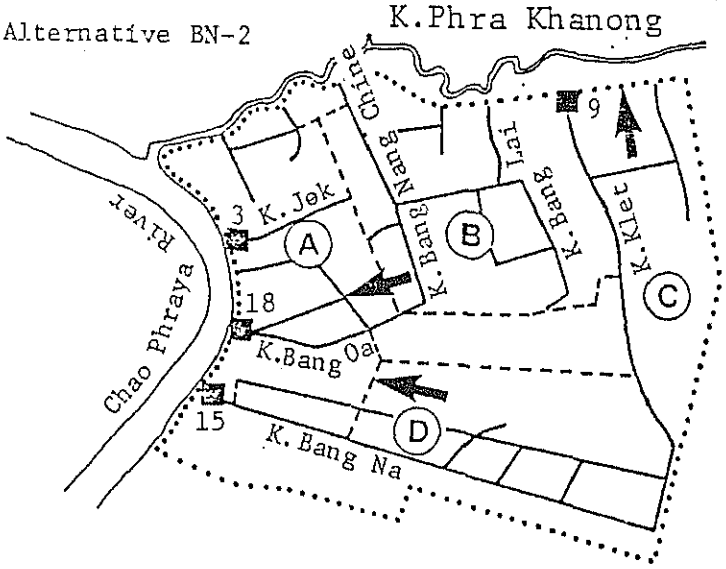
Name of Klong	Length (Km) x Width (m)
K. K1	0.9 x 12.0
K. K2	1.0 x 15.0
K. K3	0.8 x 11.0

Fig. C.18 EFFECT OF RETENTION AREA FOR ALLEVIATING FLOODING

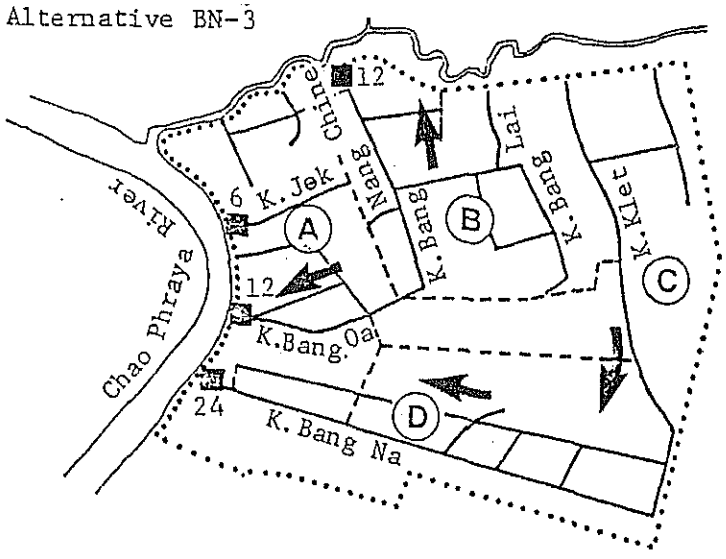
Alternative BN-1



Alternative BN-2



Alternative BN-3



Legend

- Boundary of Polder
- Klong
- Pipe, Box Culvert
- 5 Pumping Station with Future Capacity (m^3/s)

Fig. C.19 ALTERNATIVES FOR DRAINAGE SYSTEM IN BANG NA POLDER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

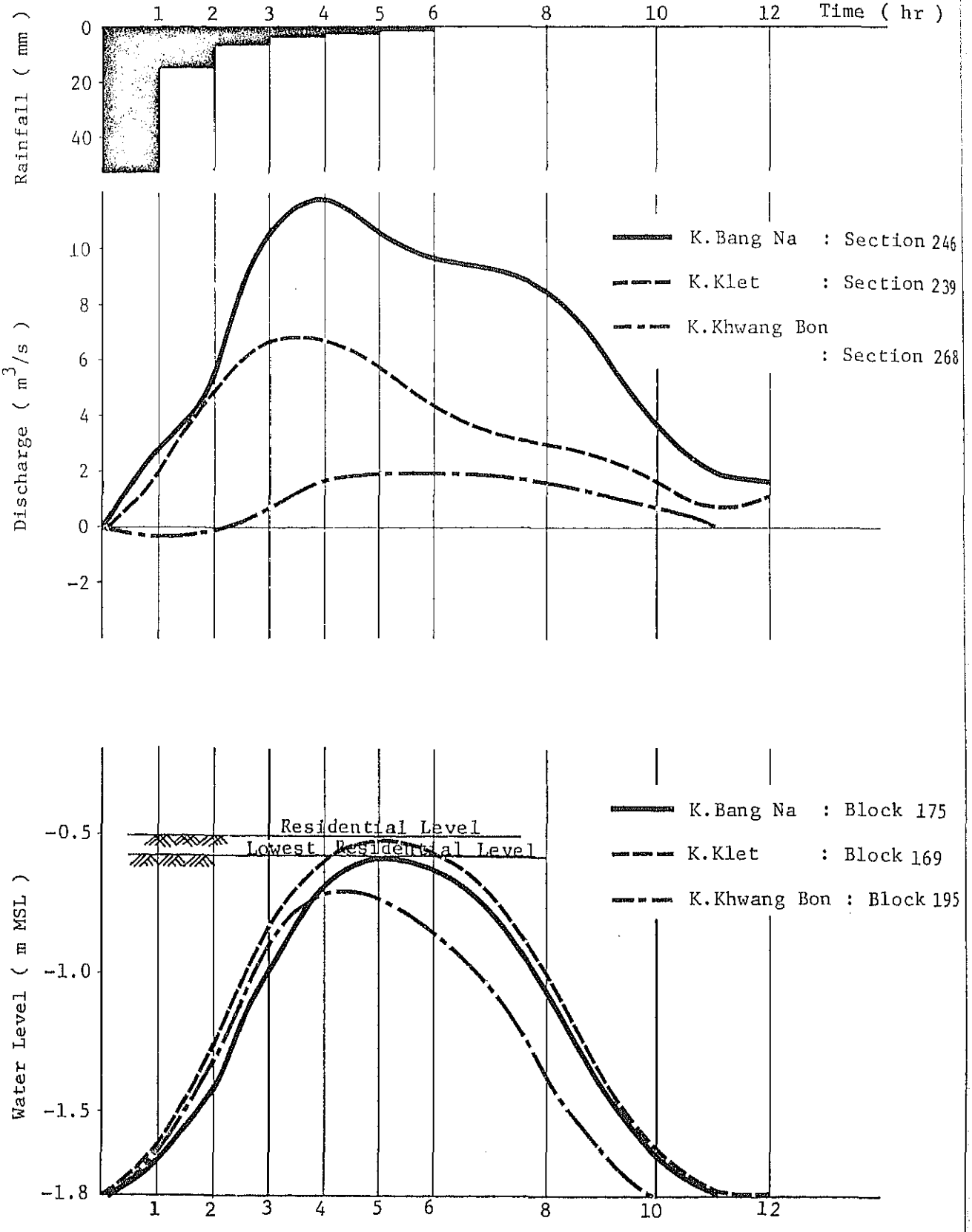


Fig. C.20 DISCHARGE AND WATER LEVEL IN BANG NA POLDER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

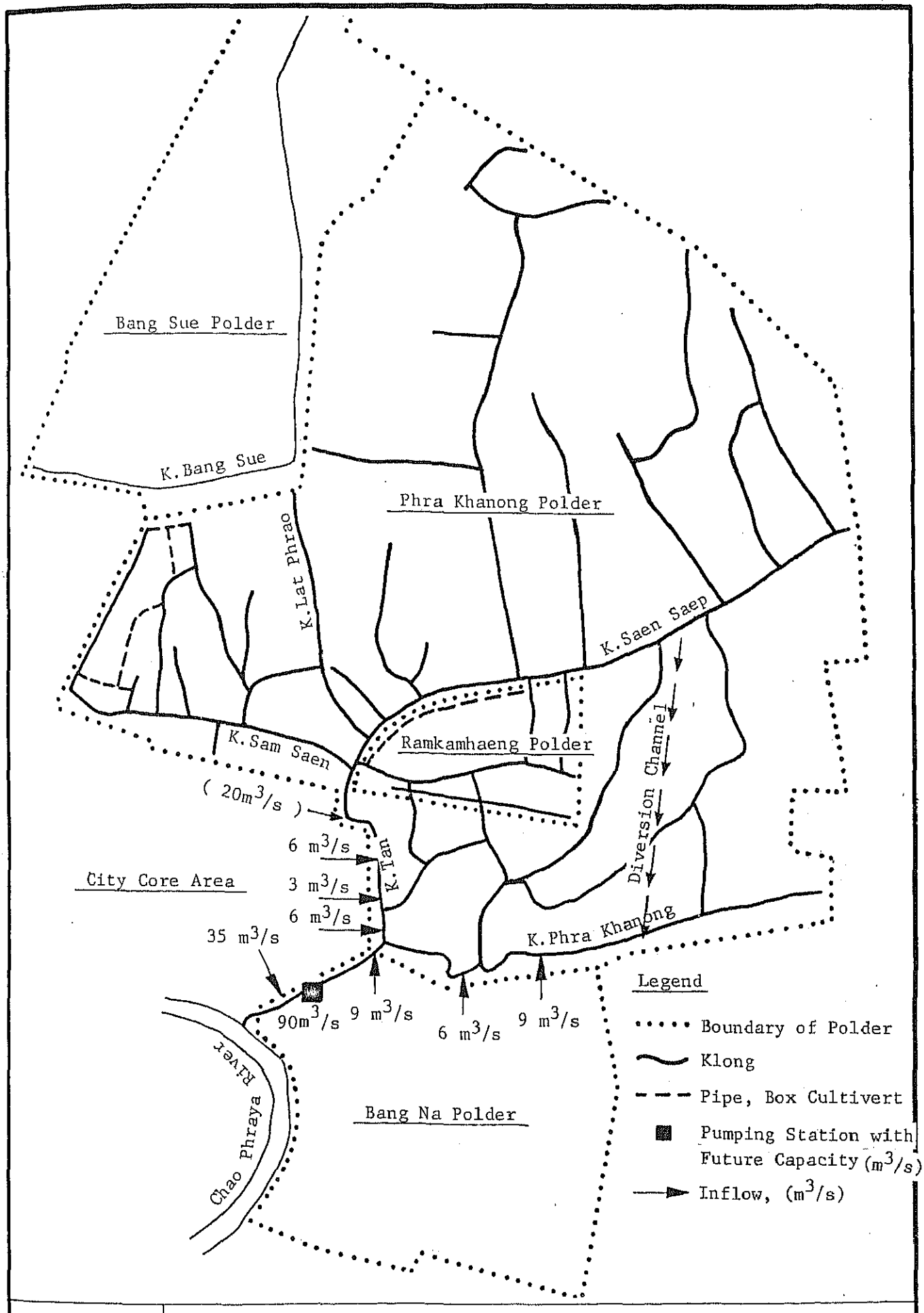


Fig. C.21 ALTERNATIVES FOR DRAINAGE SYSTEM IN PHRA KHANONG POLDER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

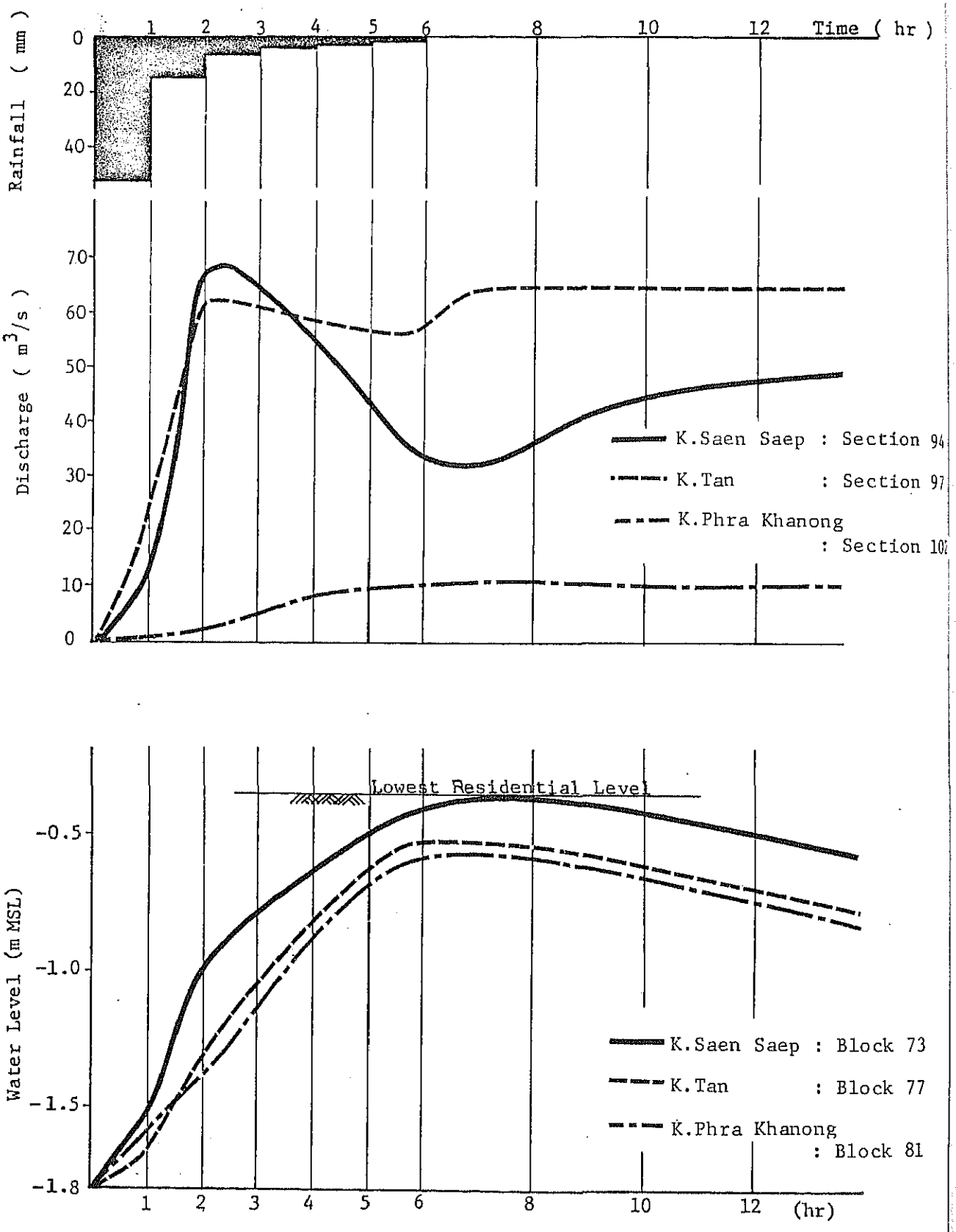
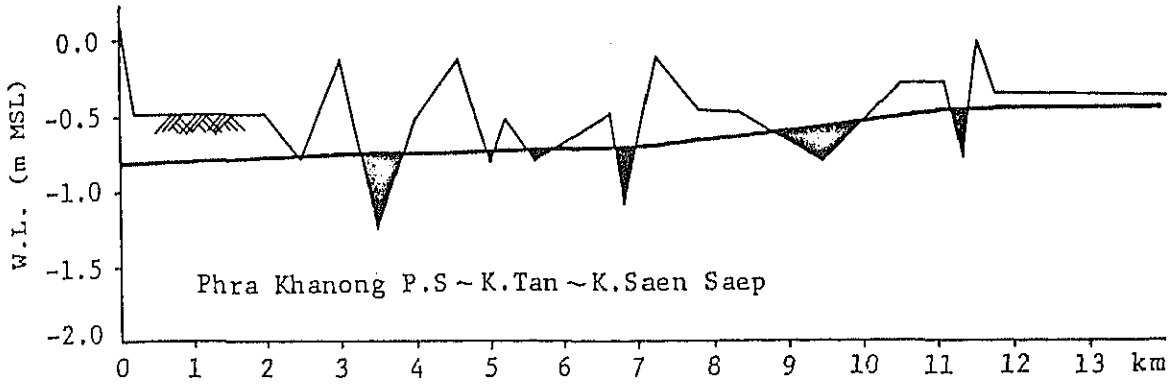
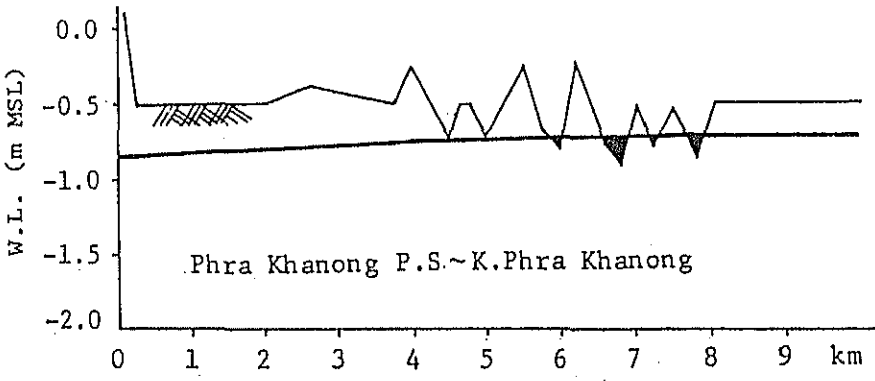


Fig. C.22 DISCHARGE AND WATER LEVEL IN PHRA KHANONG POLDER





Legend

Ground Level

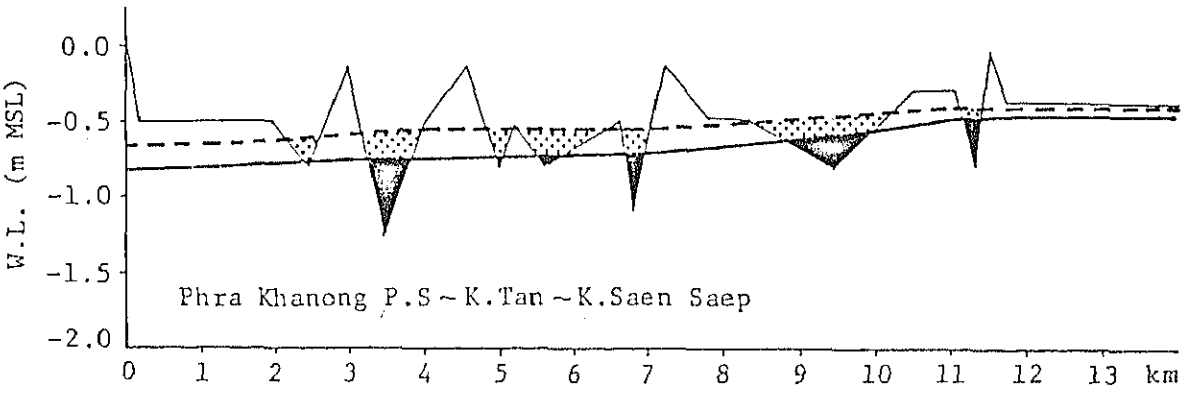
$90m^3/s$
(Without $20m^3/s$)

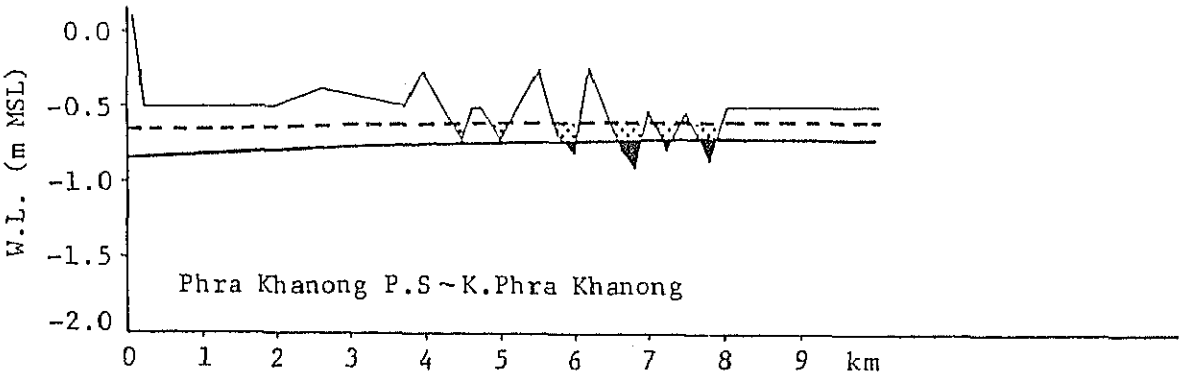
Overflow from Klong

Fig. C.23 PROFILE OF MAXIMUM WATER LEVEL(PHRA KHANONG P.S; $90m^3/S$)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D





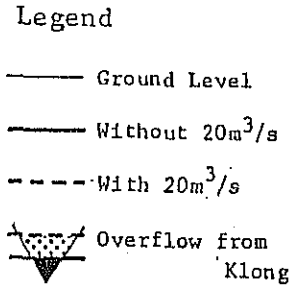
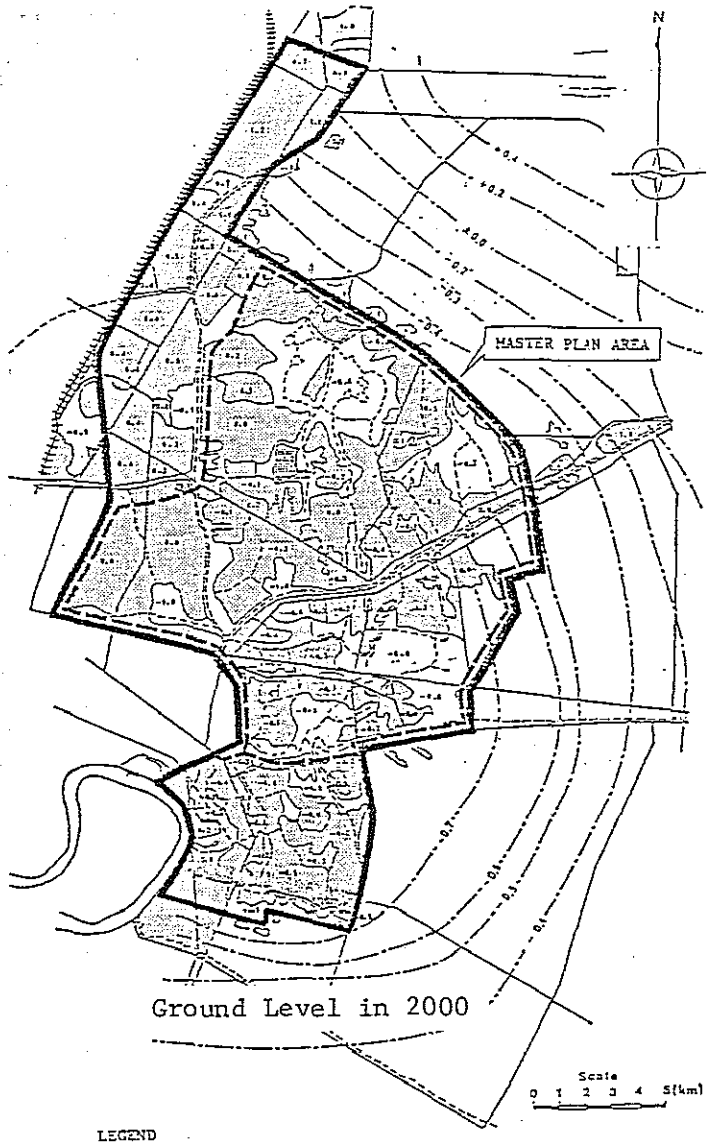
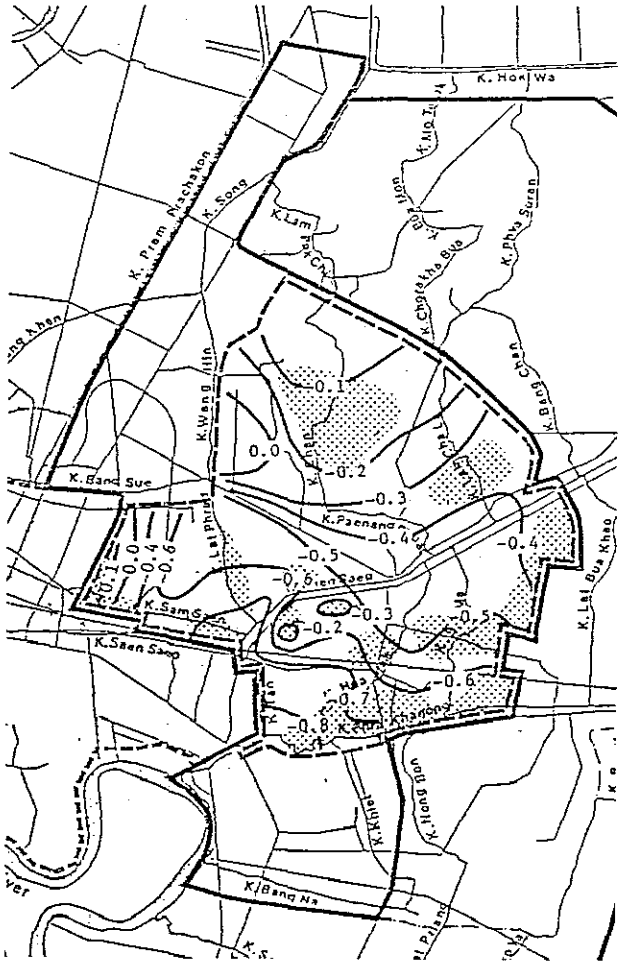


Fig. C.24	INFLUENCE OF INFLOW ($20m^3/S$) FROM CORE AREA IN KLONGS PHRA KHANONG, TAN AND SAEN SAEP

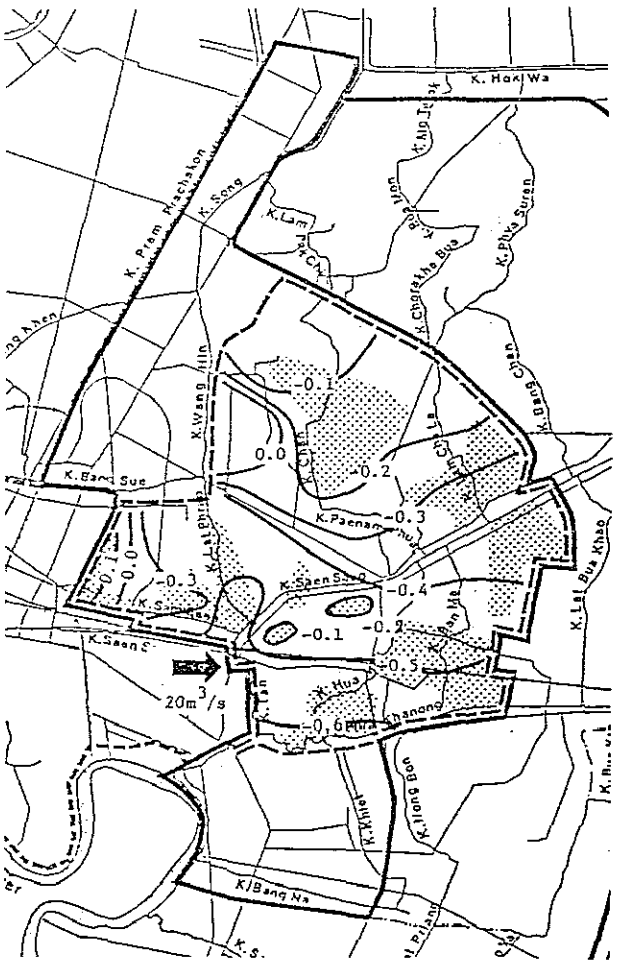
FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



Ground Level in 2000



without 20 m^3/s



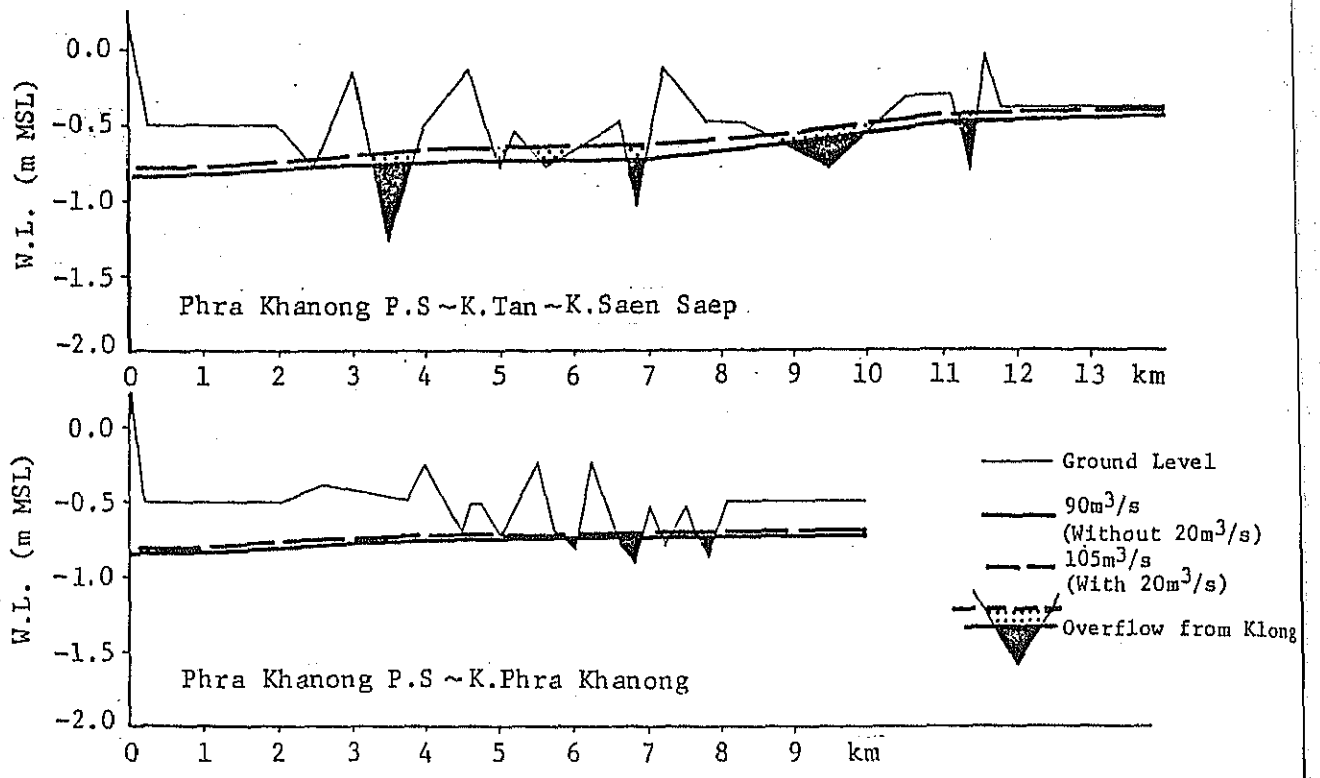
with 20 m^3/s

Highest Water Level in Phra Khanong Polder
without, with inflow from City Core Area.(meter)

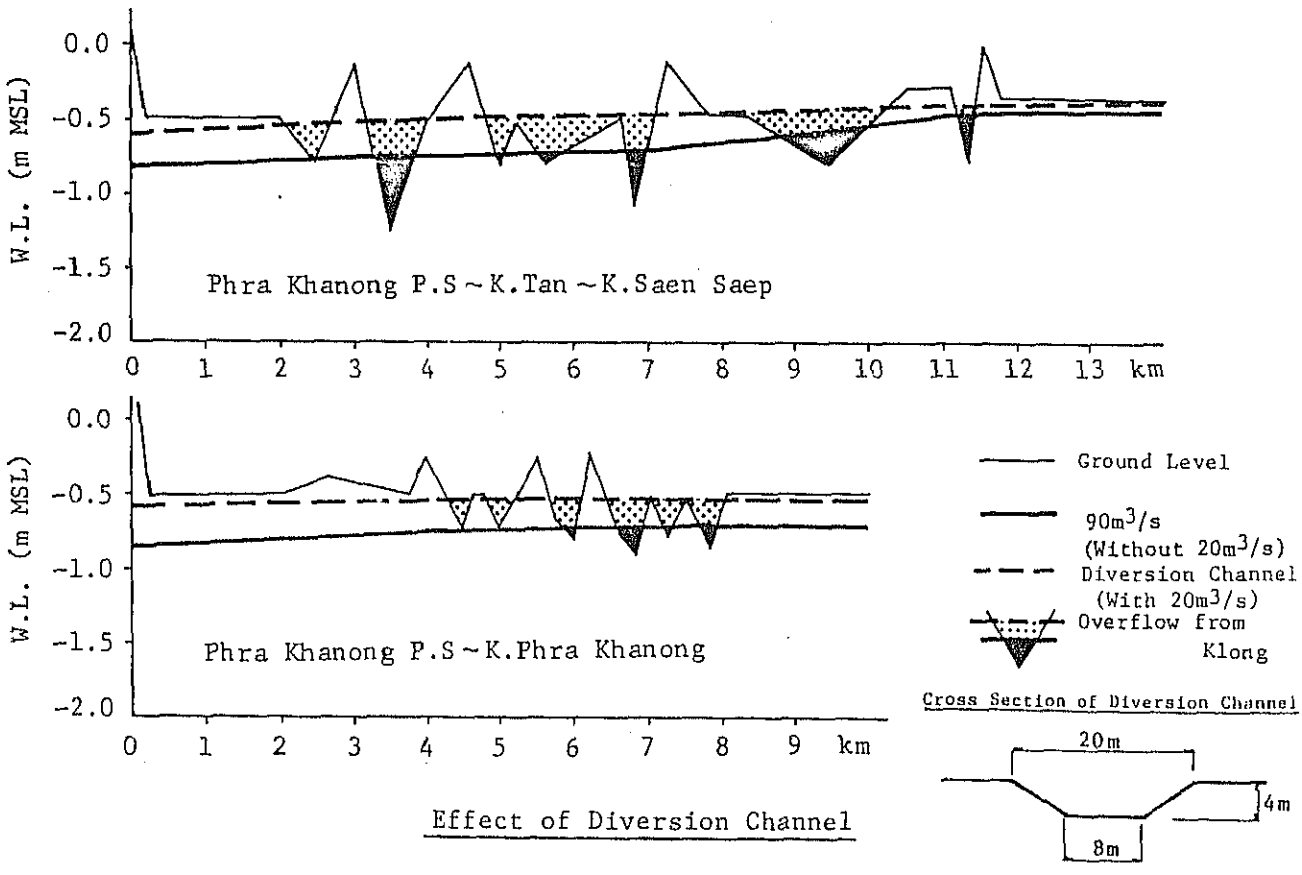
Fig. C.25 INFLUENCE OF ADDITIONAL INFLOW FROM CITY CORE AREA

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D



Effect of Increasing of Pump Capacity at Phra Khanong P.S



Effect of Diversion Channel

Fig. C.26 INFLUENCE OF INFLOW ($20m^3/S$) FROM CORE AREA

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

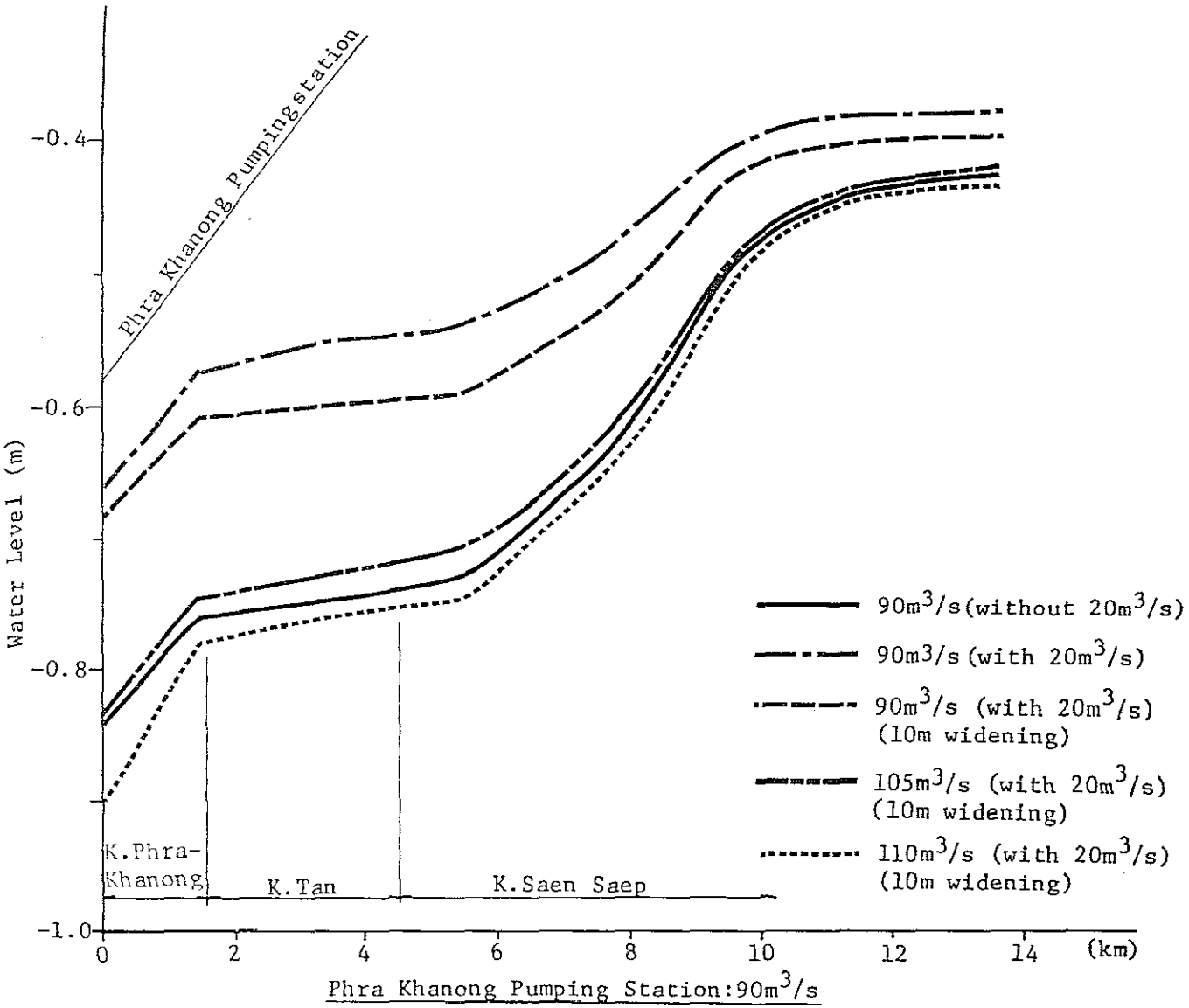


Fig. C.27 EFFECT OF WIDENING OF KLONG TAN

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

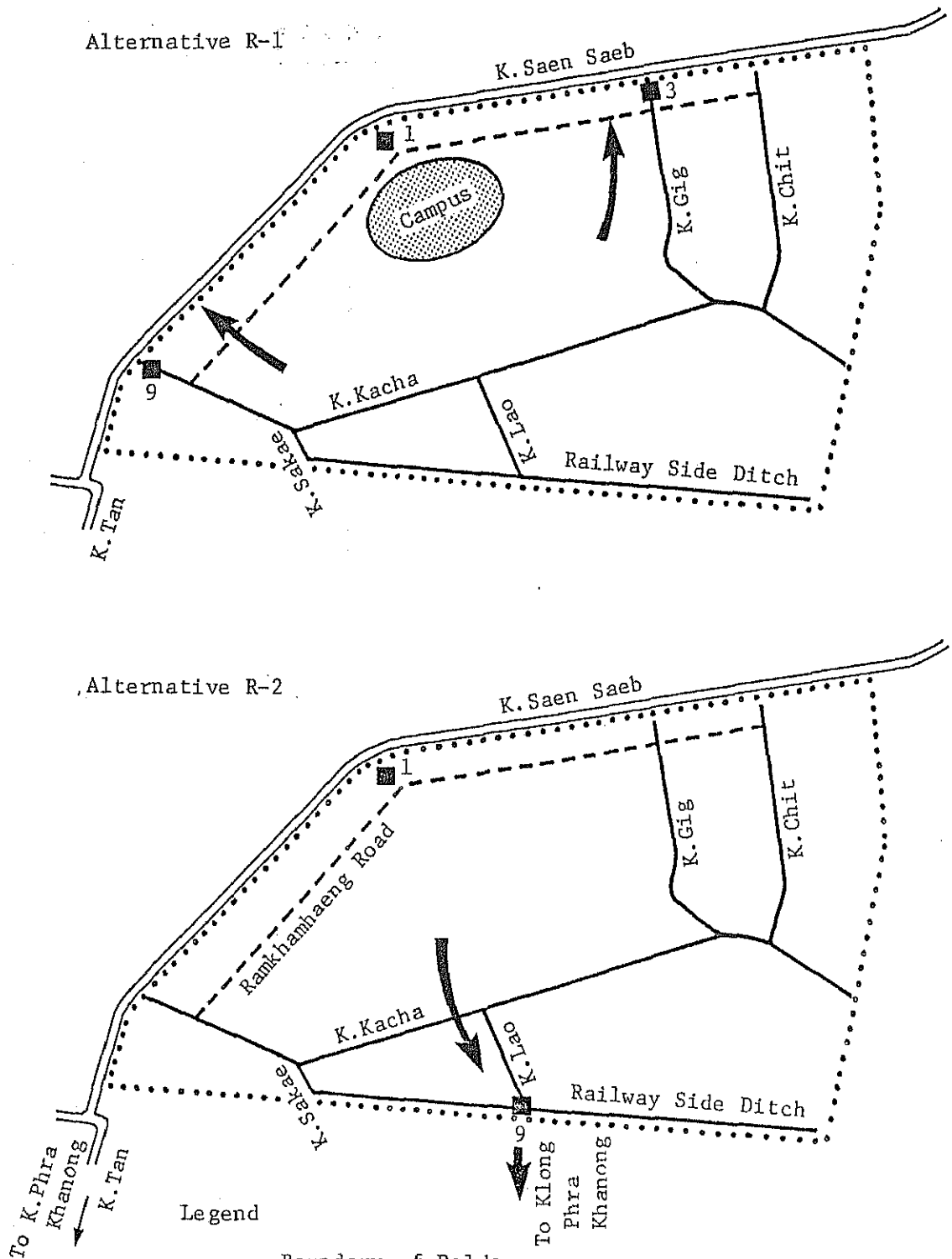


Fig. C.28	ALTERNATIVES FOR DRAINAGE SYSTEM IN RAMKHAMHAENG POLDER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

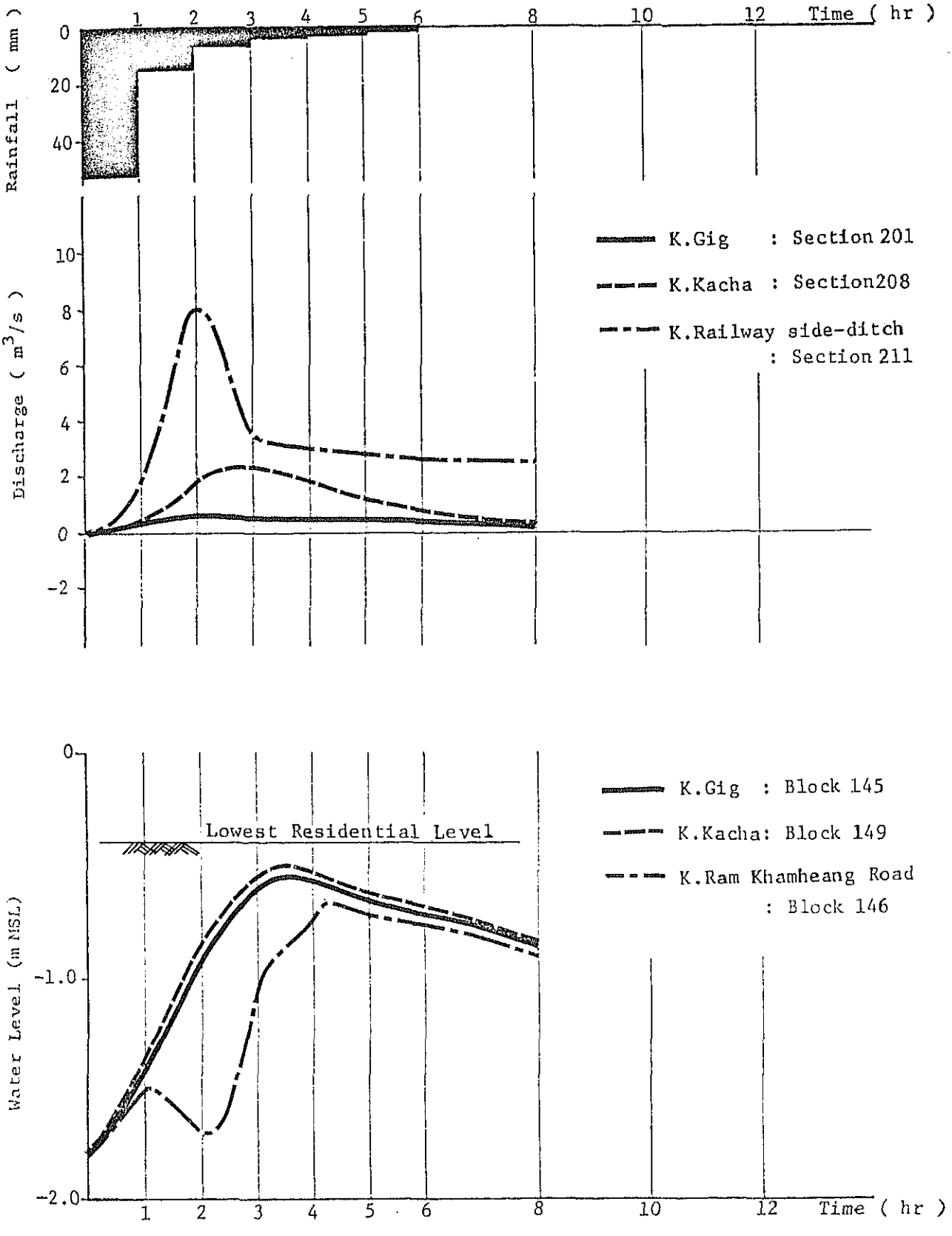
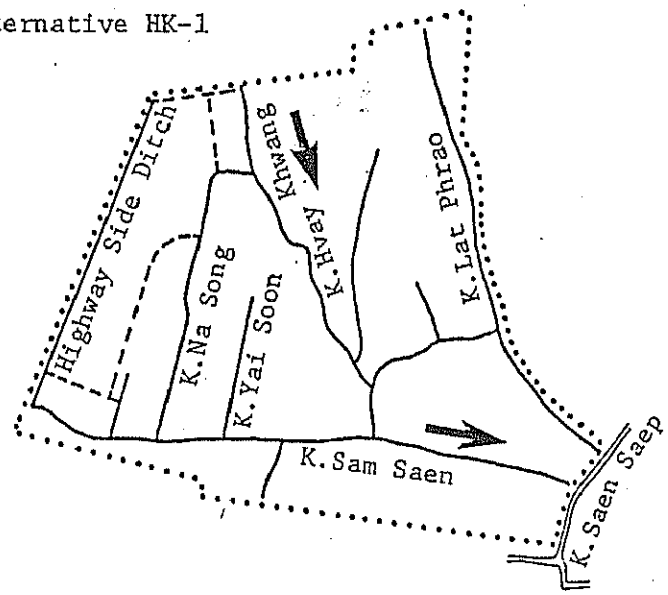


Fig. C.29 DISCHARGE AND WATER LEVEL IN RAM KHAMHEANG POLDER

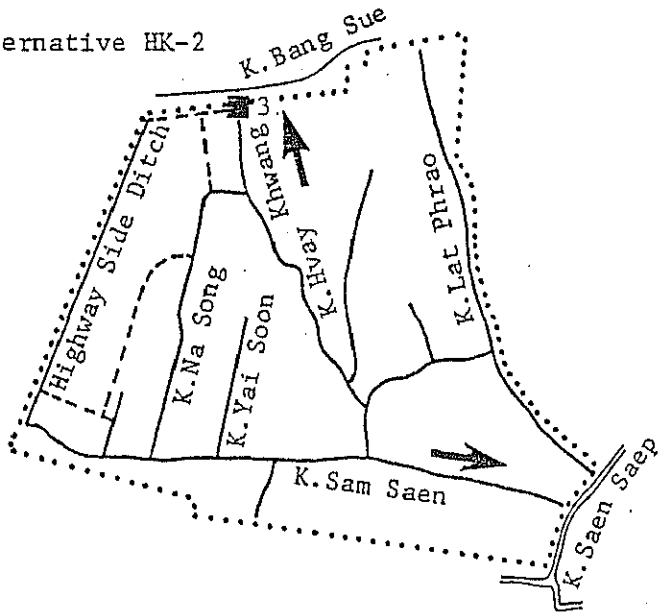
FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

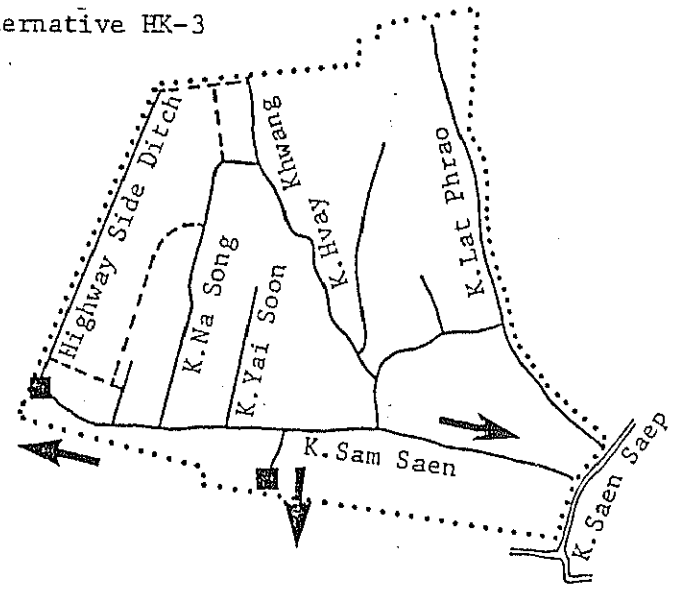
Alternative HK-1



Alternative HK-2



Alternative HK-3



Legend

- ····· Boundary of Drainage Area
- ~ Klong
- ----- Pipe, Box Culvert
- ■ 5 Pumping Station with Future Capacity (m^3/s)

Fig. C.30	ALTERNATIVE FOR DRAINAGE SYSTEM IN WEST HUAY KWANG DRAINAGE AREA

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

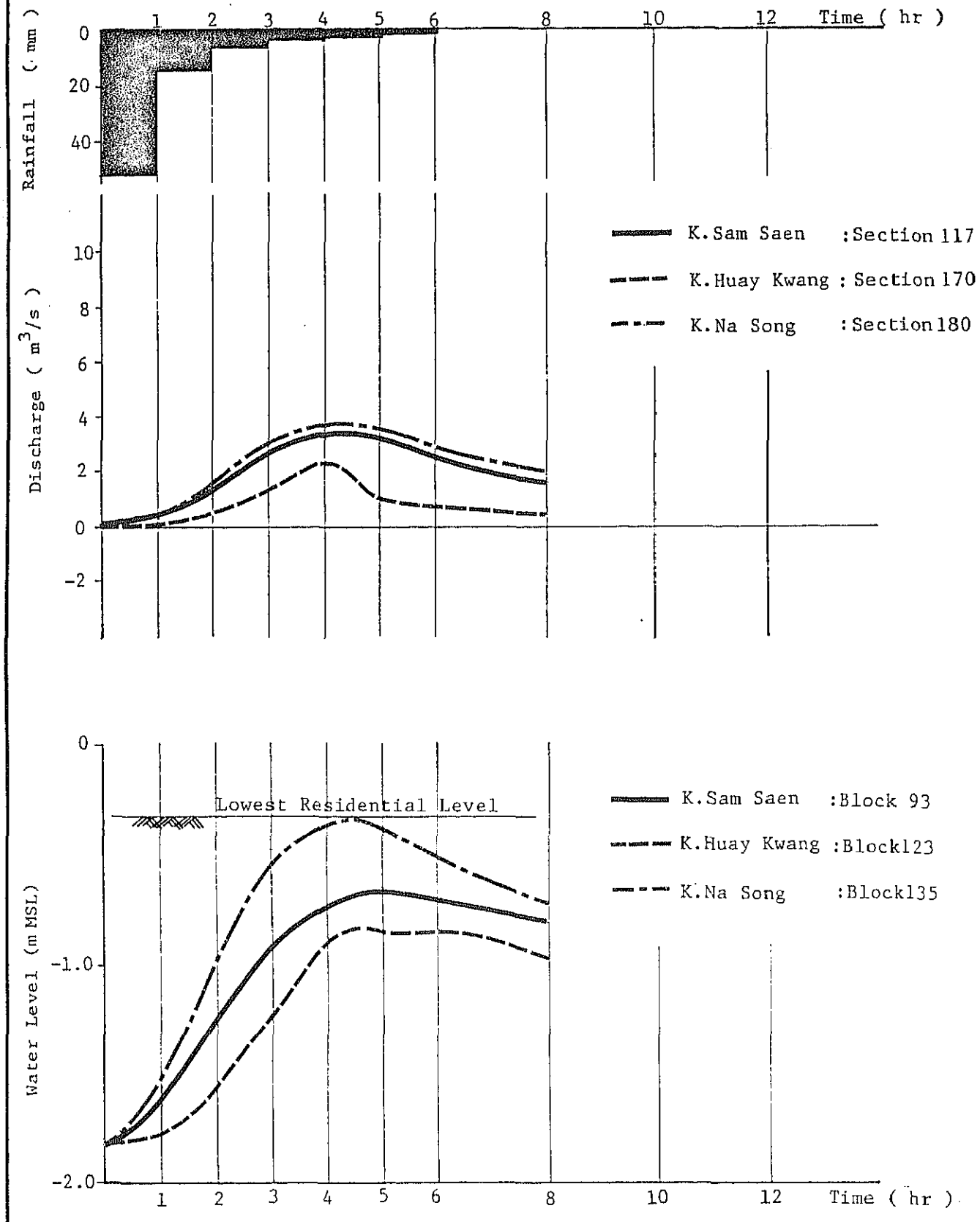
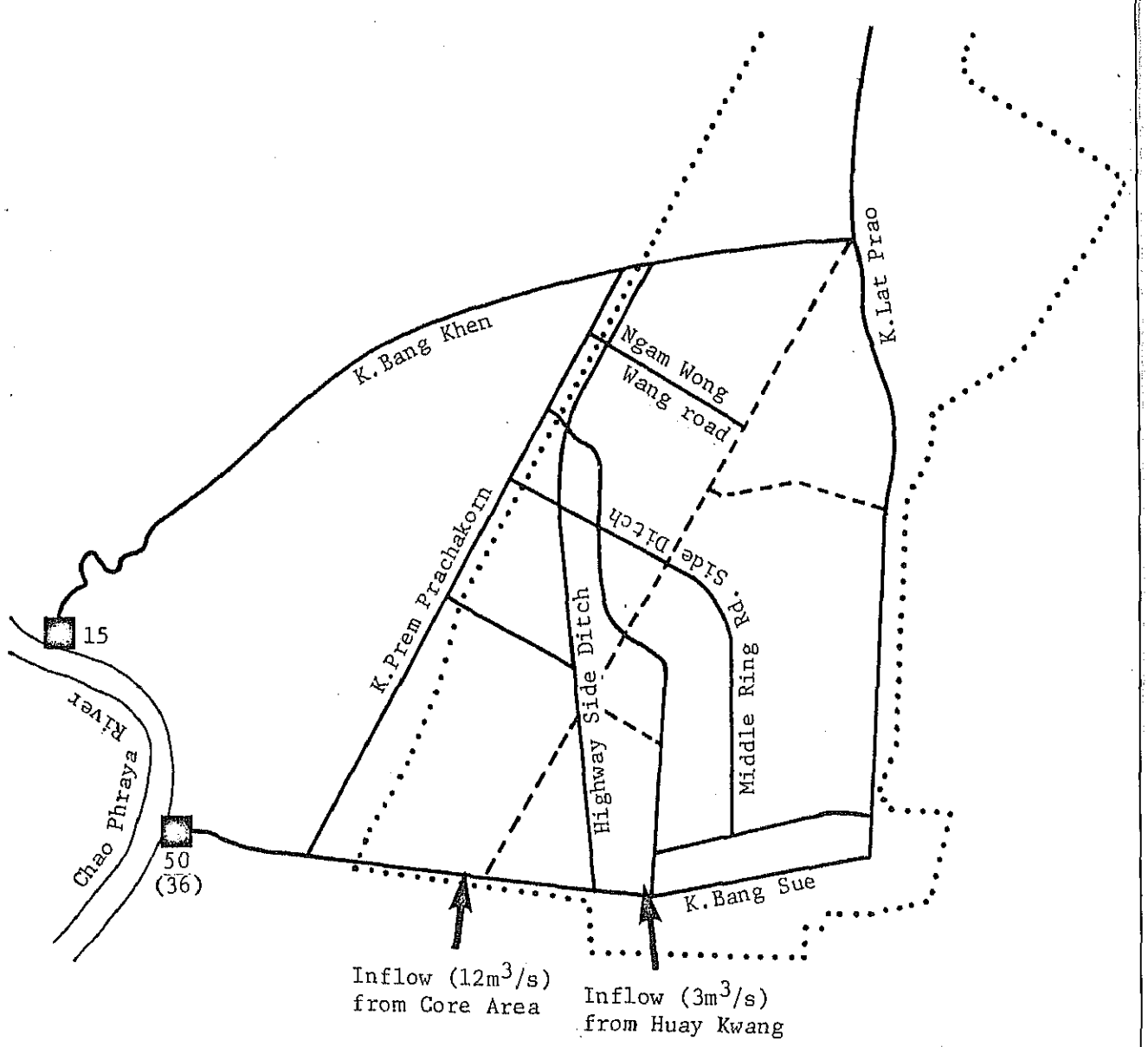


Fig. C.31 DISCHARGE AND WATER LEVEL IN WEST HUAY KHWANG DRAINAGE AREA

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D



Legend

- Boundary of Drainage Area
- Klong
- Pipe, Box Culvert
- 15 — Pumping Station with Future Capacity (m^3/s)

Fig. C.32 ALTERNATIVES FOR DRAINAGE SYSTEM IN BANG SUE DRAINAGE AREA

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

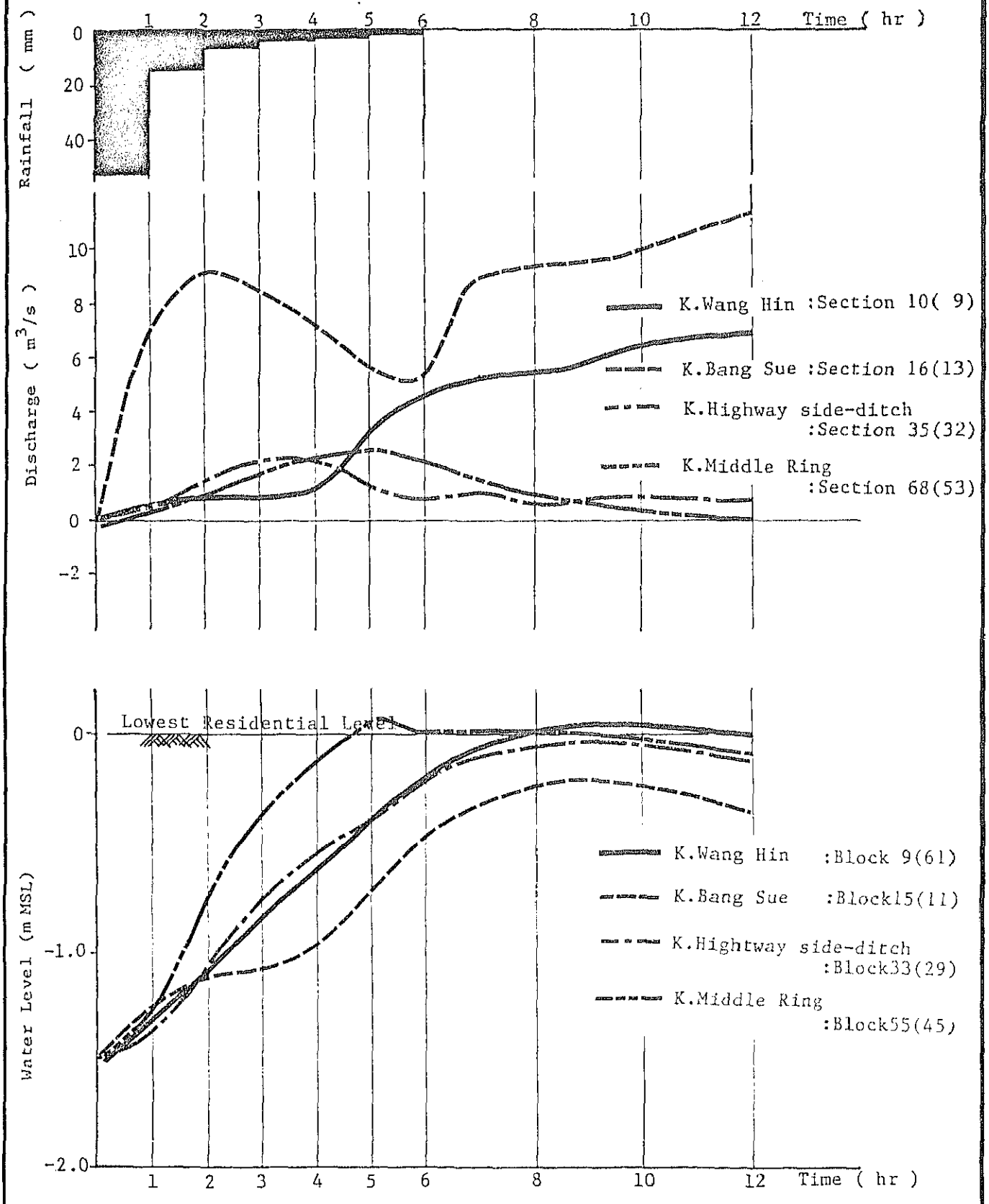


Fig. C.33 DISCHARGE AND WATER LEVEL IN BANG KEN-BANG SUE POLDER

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

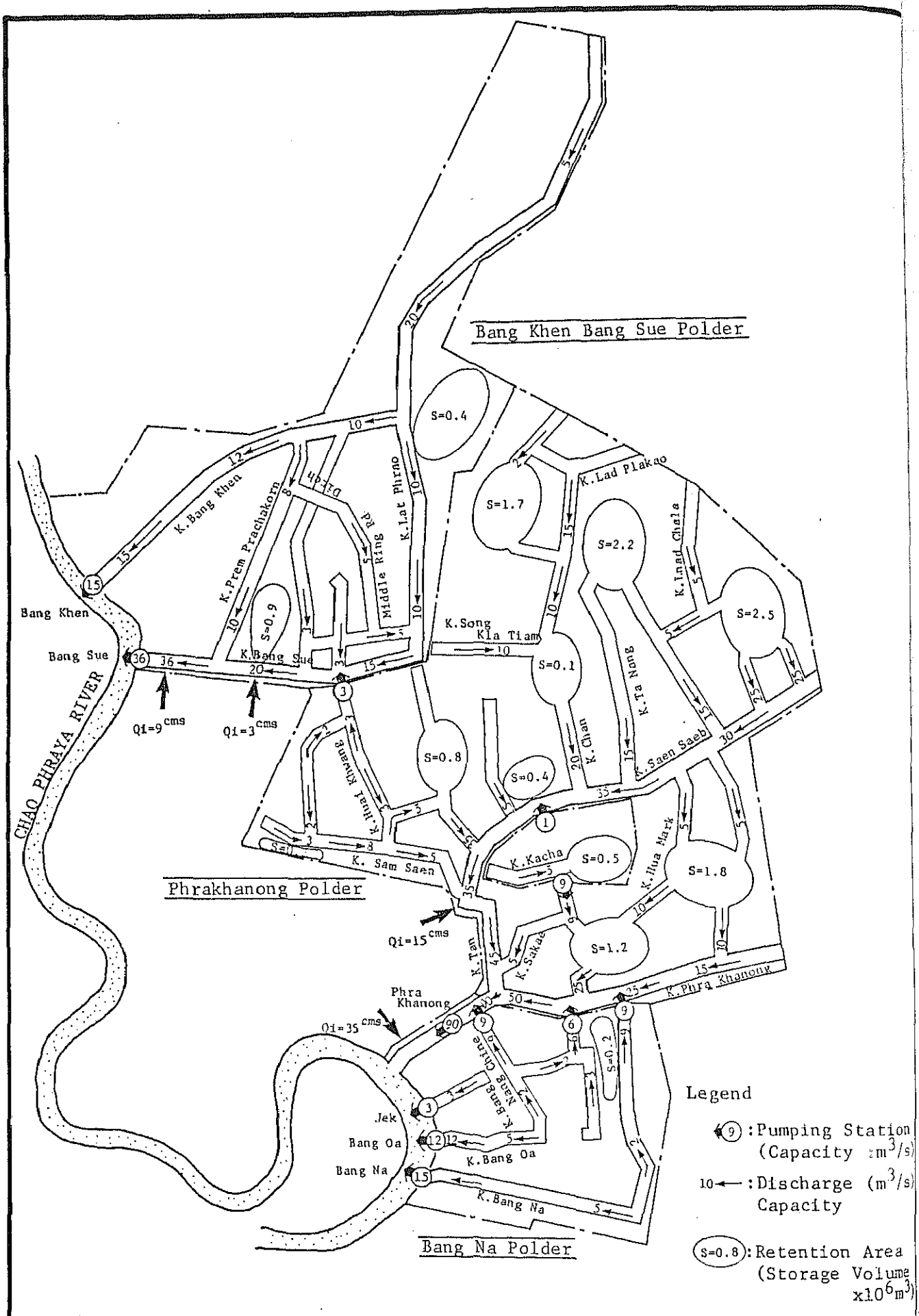
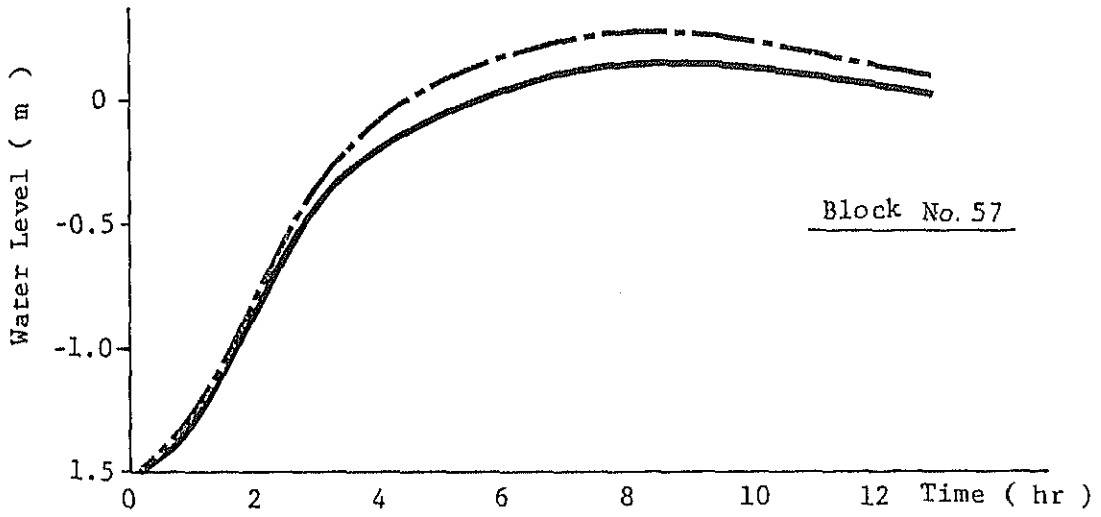
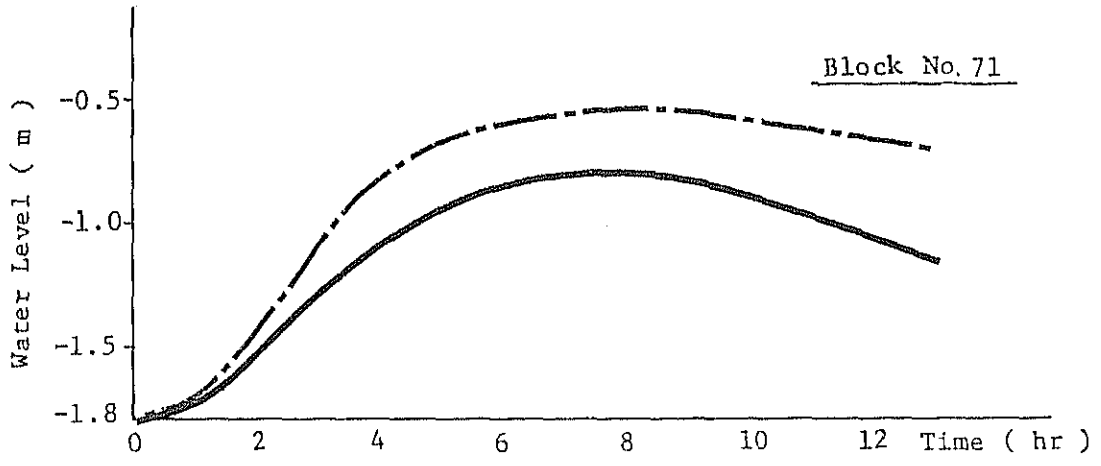
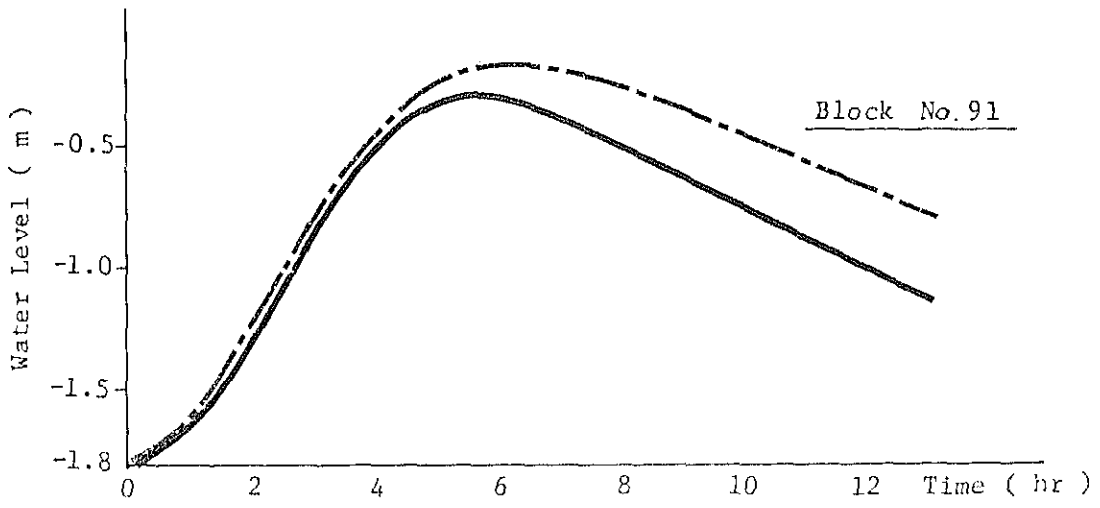


Fig. C.34 PLANNED DISCHARGE

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK







Legend

Water level with improvement of primary drainage facility

Water level with improvement of secondary drainage facility

Fig. C.35 EFFECT ON ALLEVIATION OF FLOOD BY STAGED DRAINAGE FACILITIES

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

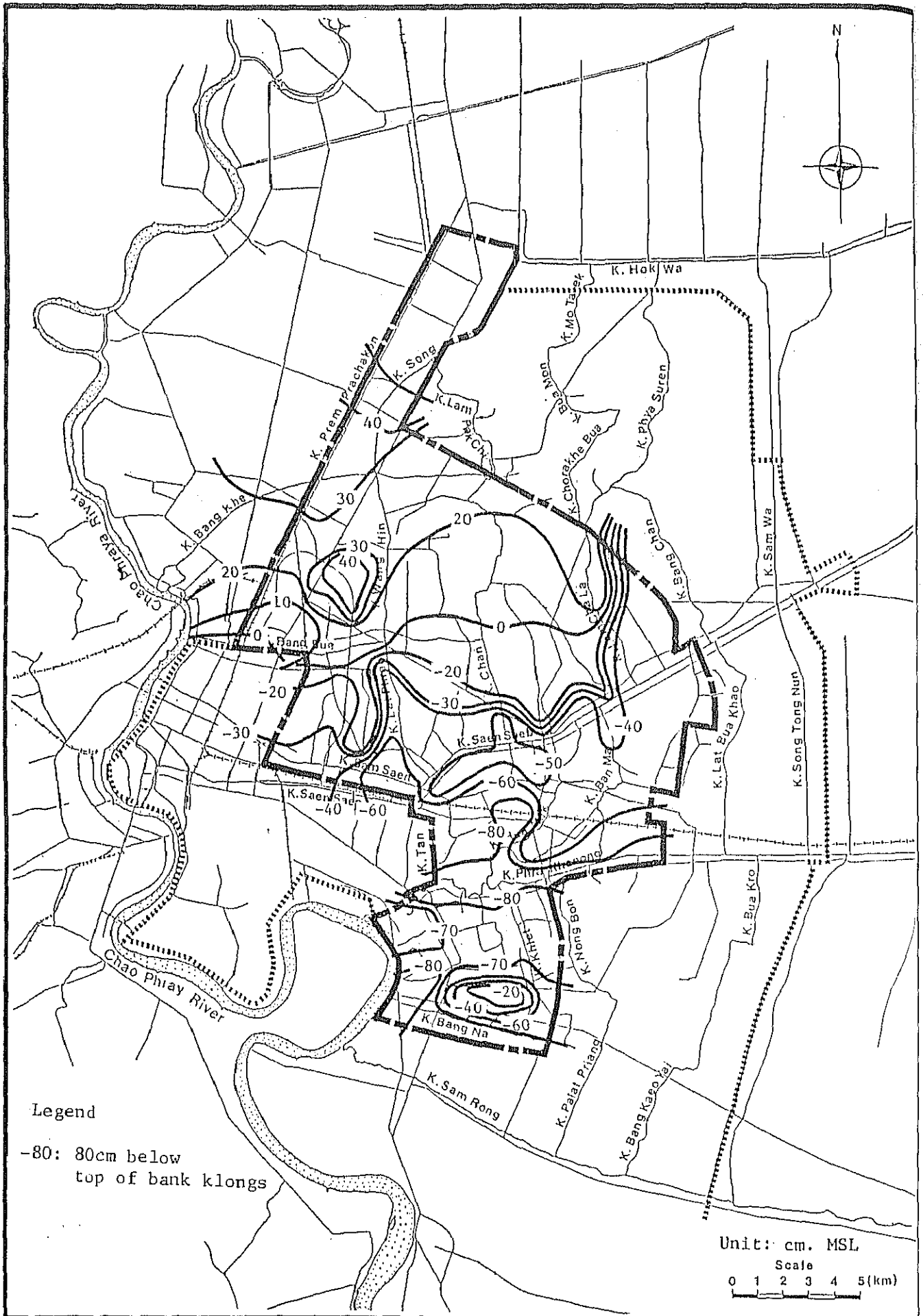
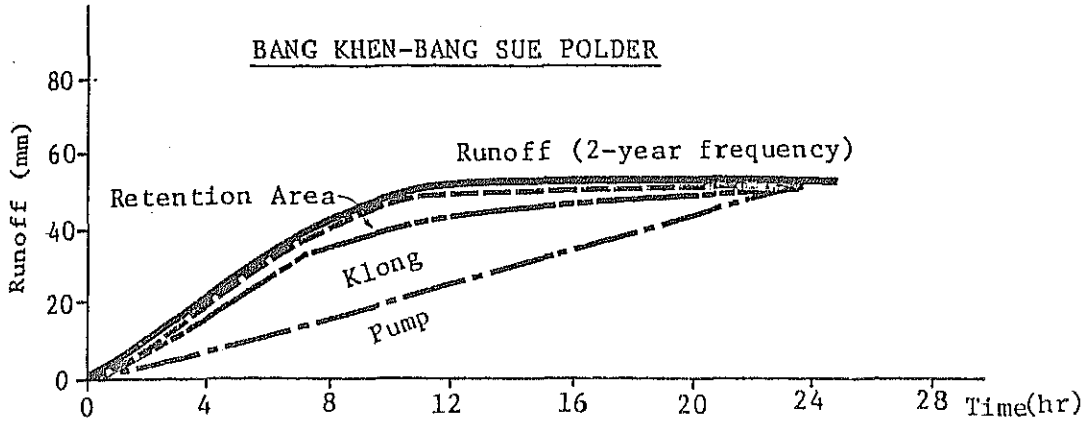
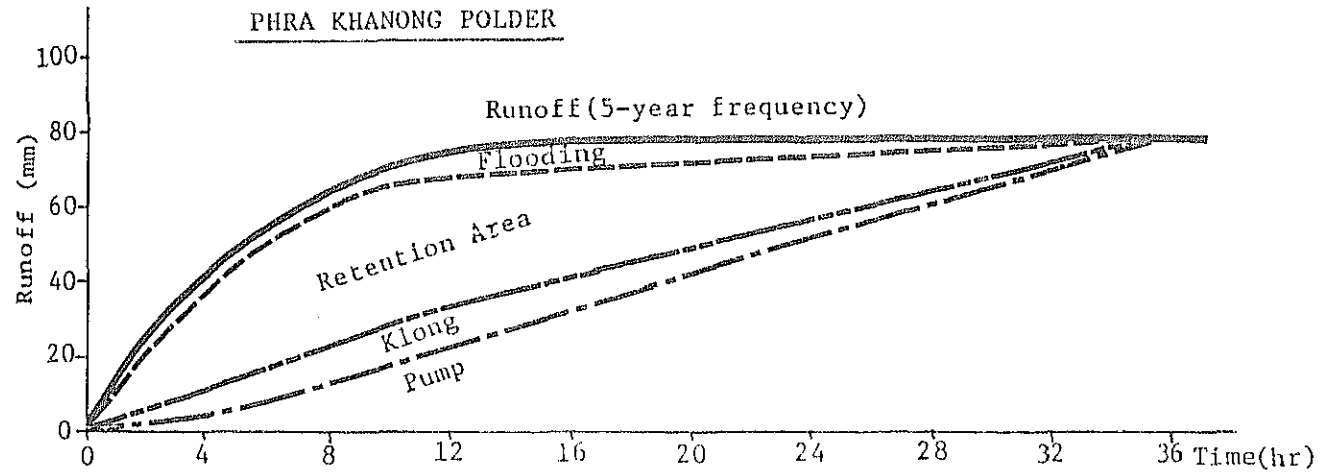


Fig. C.36 CONTOUR LINE OF MAXIMUM WATER LEVEL (DESIGN RAINFALL, PROPOSED FACILITIES)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D.





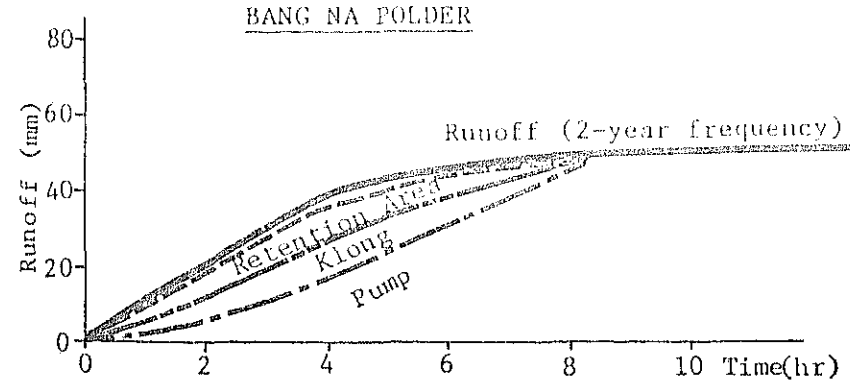
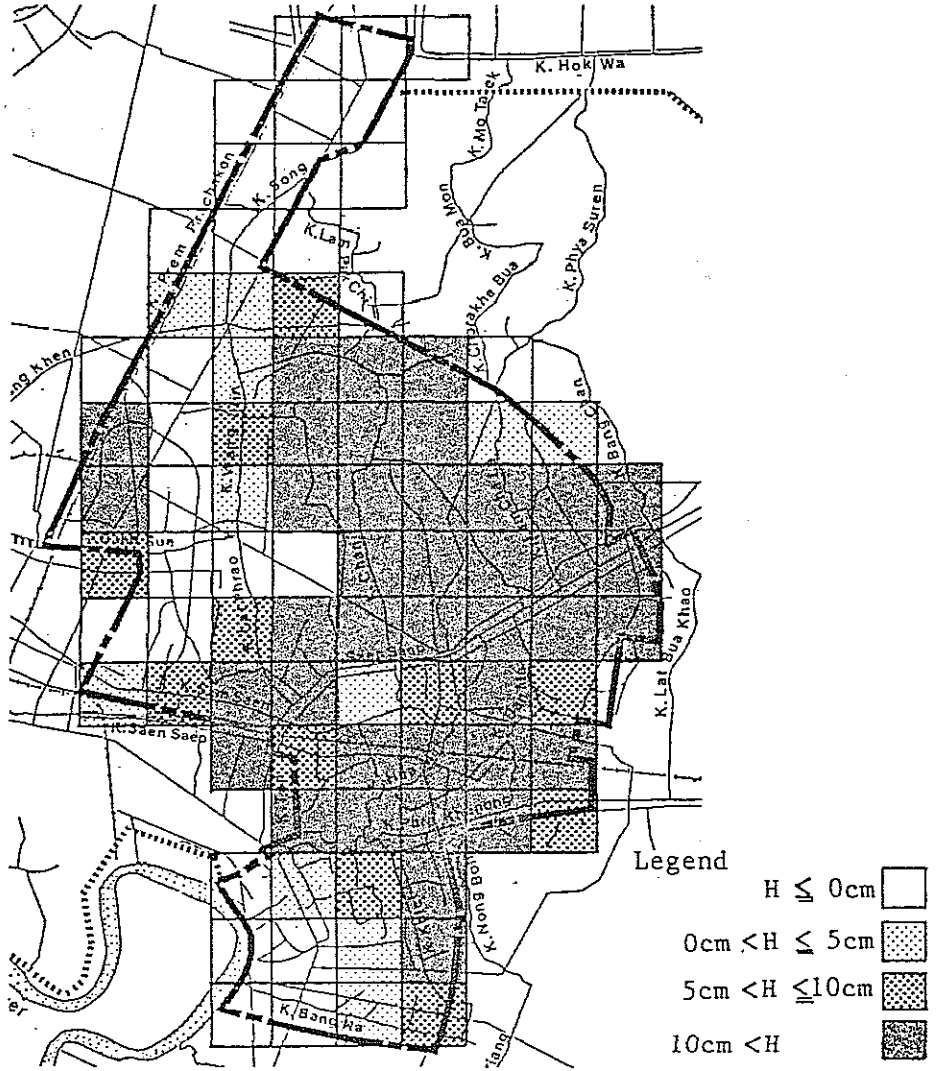


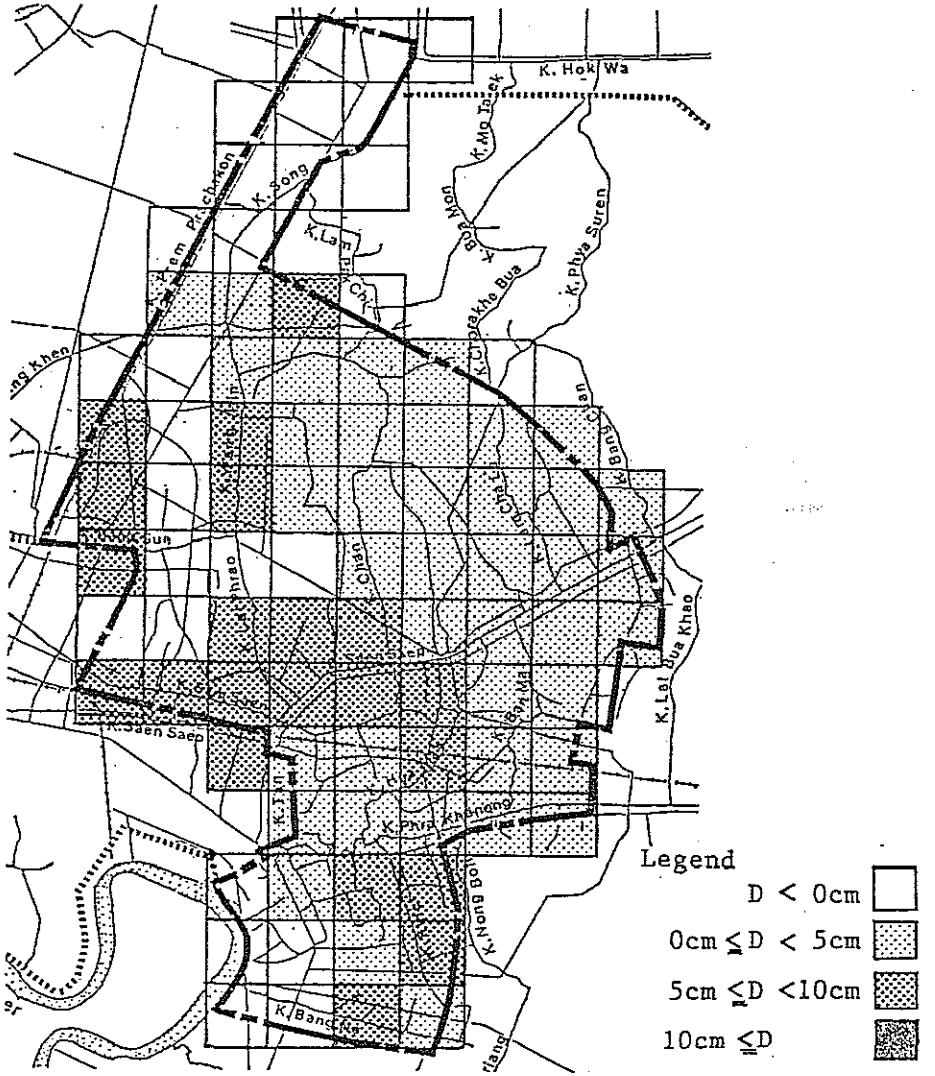
Fig. C.37	RELATIONSHIP BETWEEN PUMP DISCHARGE AND STORAGE CAPACITY

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D



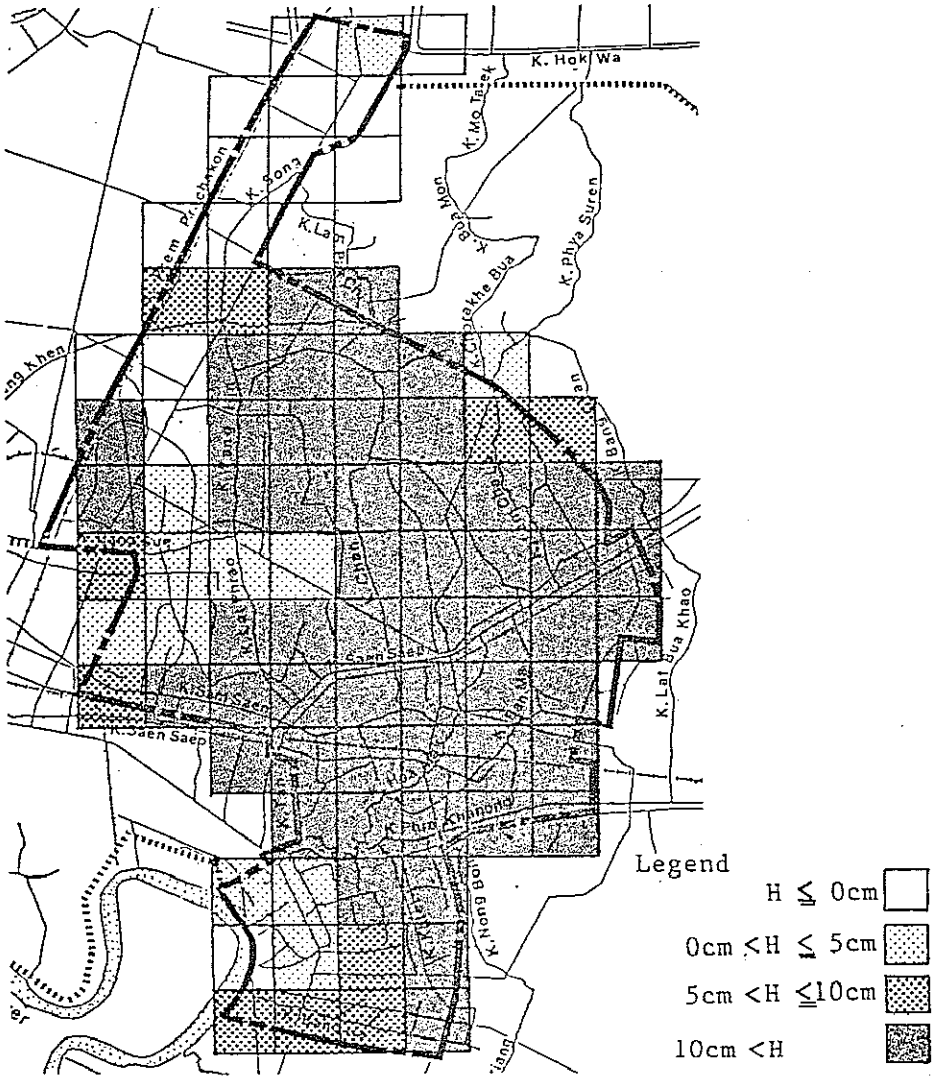
Flood Depth without Facilities



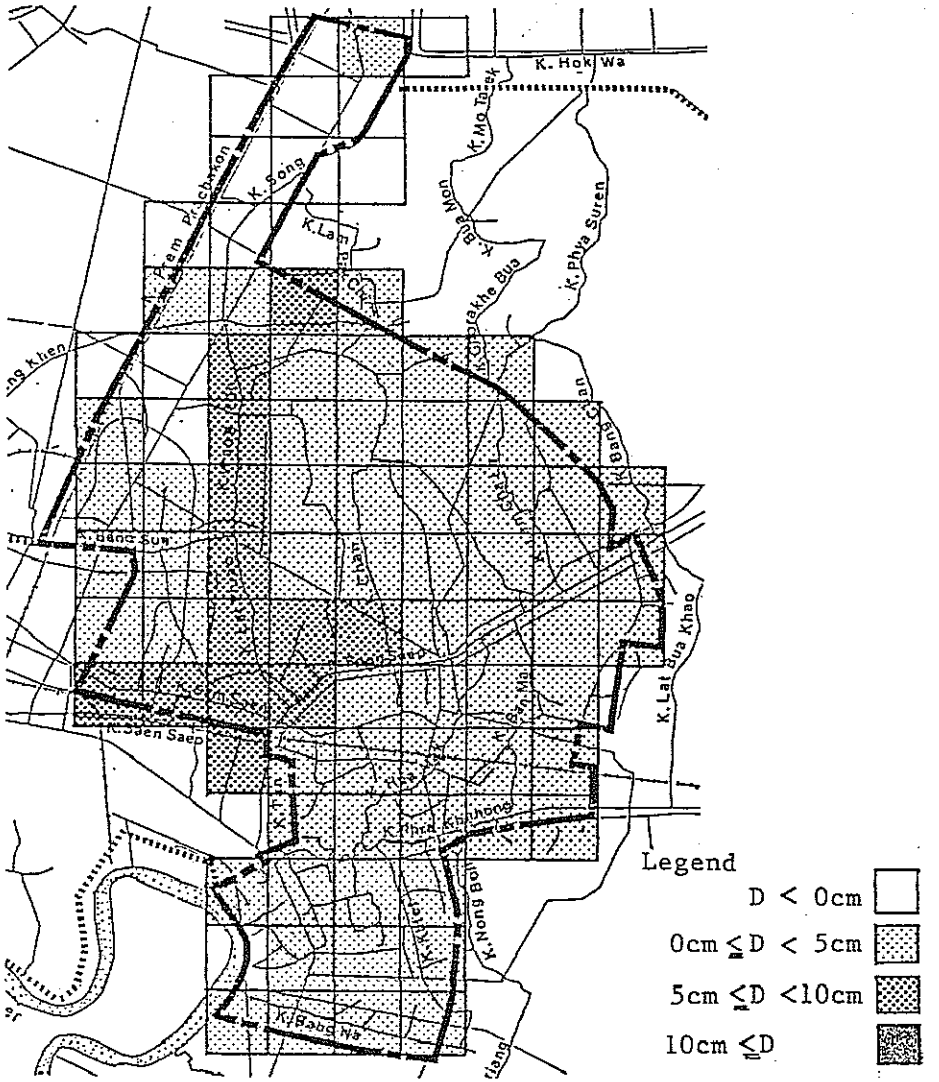
Reduced Depth with Facilities

Fig. C.38	EFFECT OF PROPOSED FACILITIES (AD 1985, 2-YEAR FREQUENCY)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



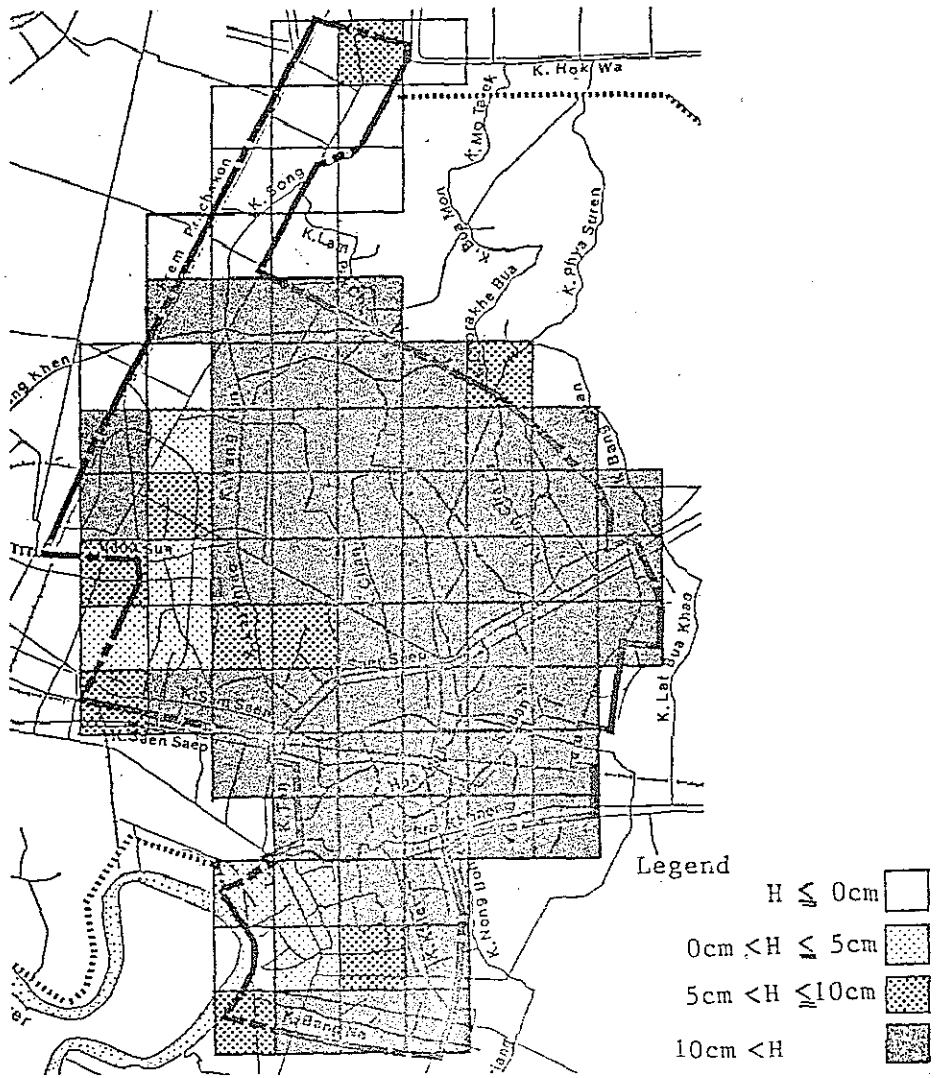
Flood Depth without Facilities



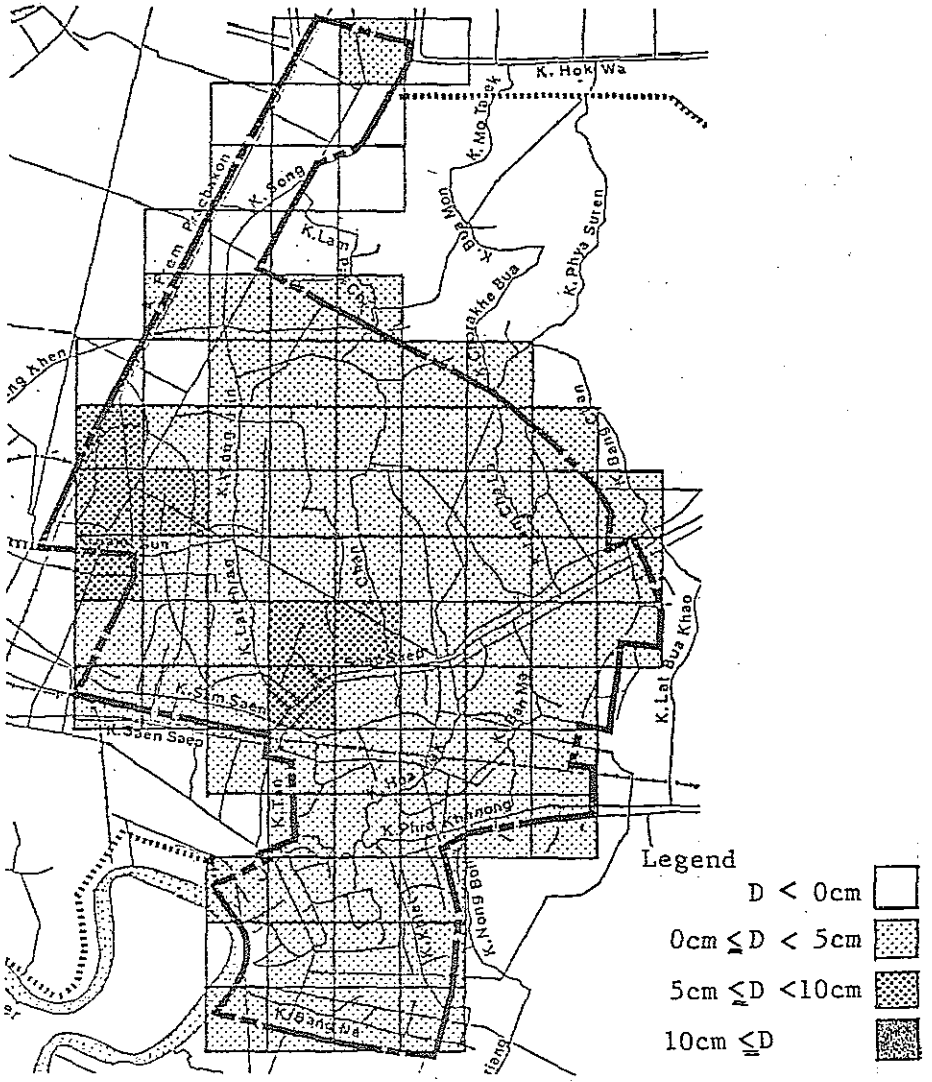
Reduced Depth with Facilities

Fig. C.39	EFFECT OF PROPOSED FACILITIES (AD 1985, 5-YEAR FREQUENCY)
FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK	

JICA 2529 B.E 1986 A.D



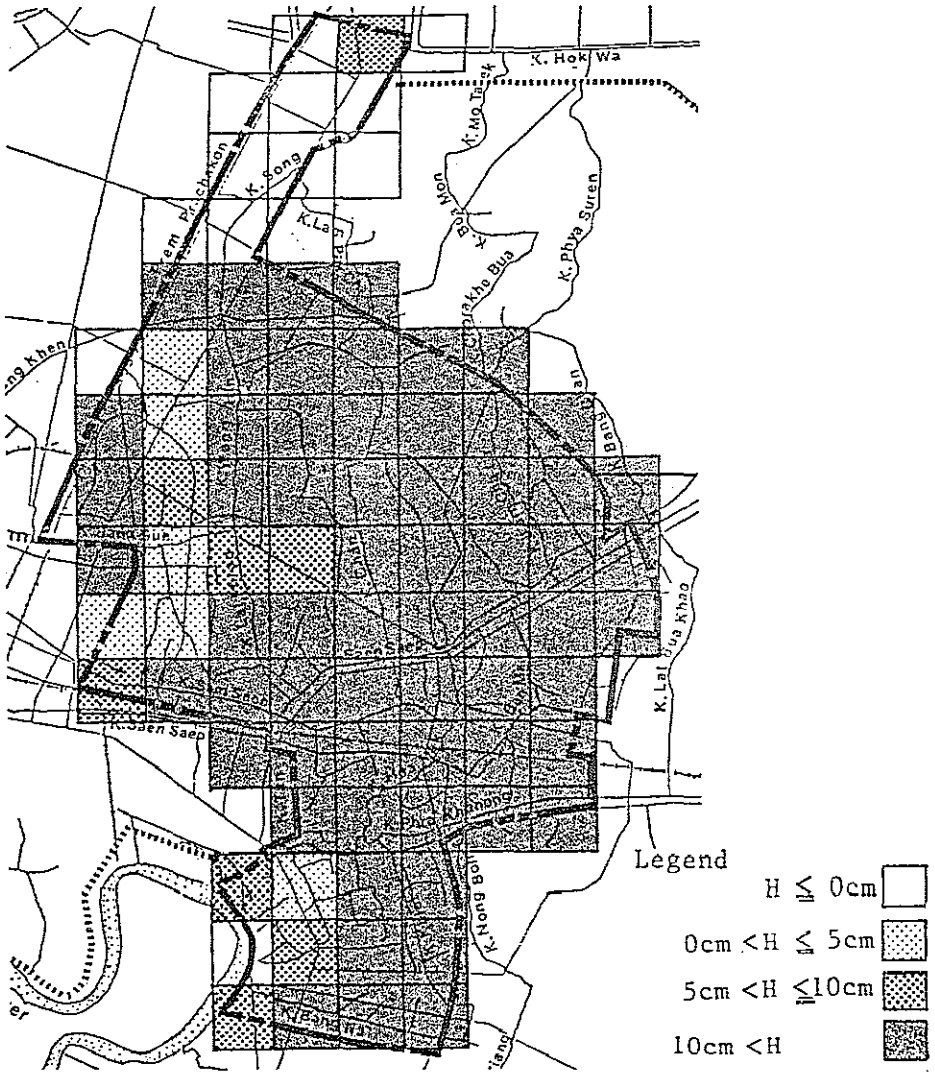
Flood Depth without Facilities



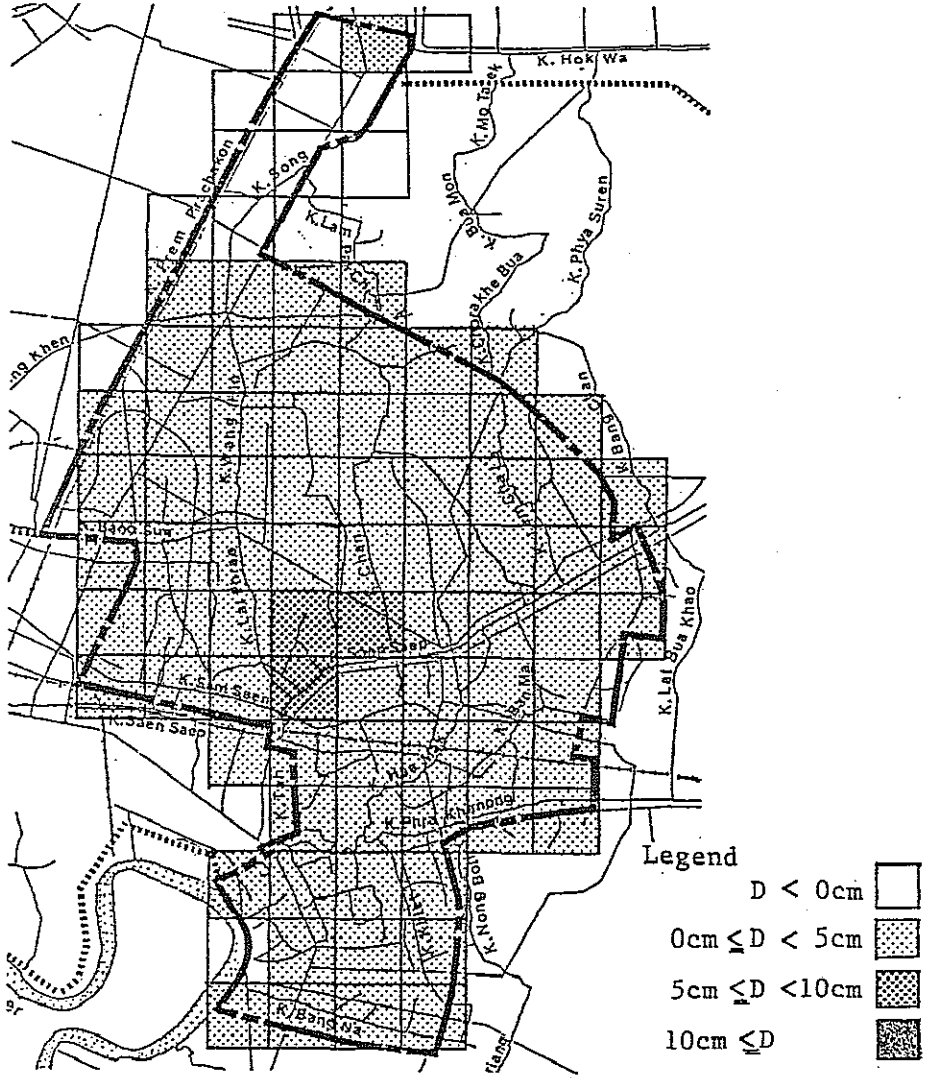
Reduced Depth with Facilities

Fig. C.40 EFFECT OF PROPOSED FACILITIES (AD 1985, 10-YEAR FREQUENCY)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



Flood Depth without Facilities

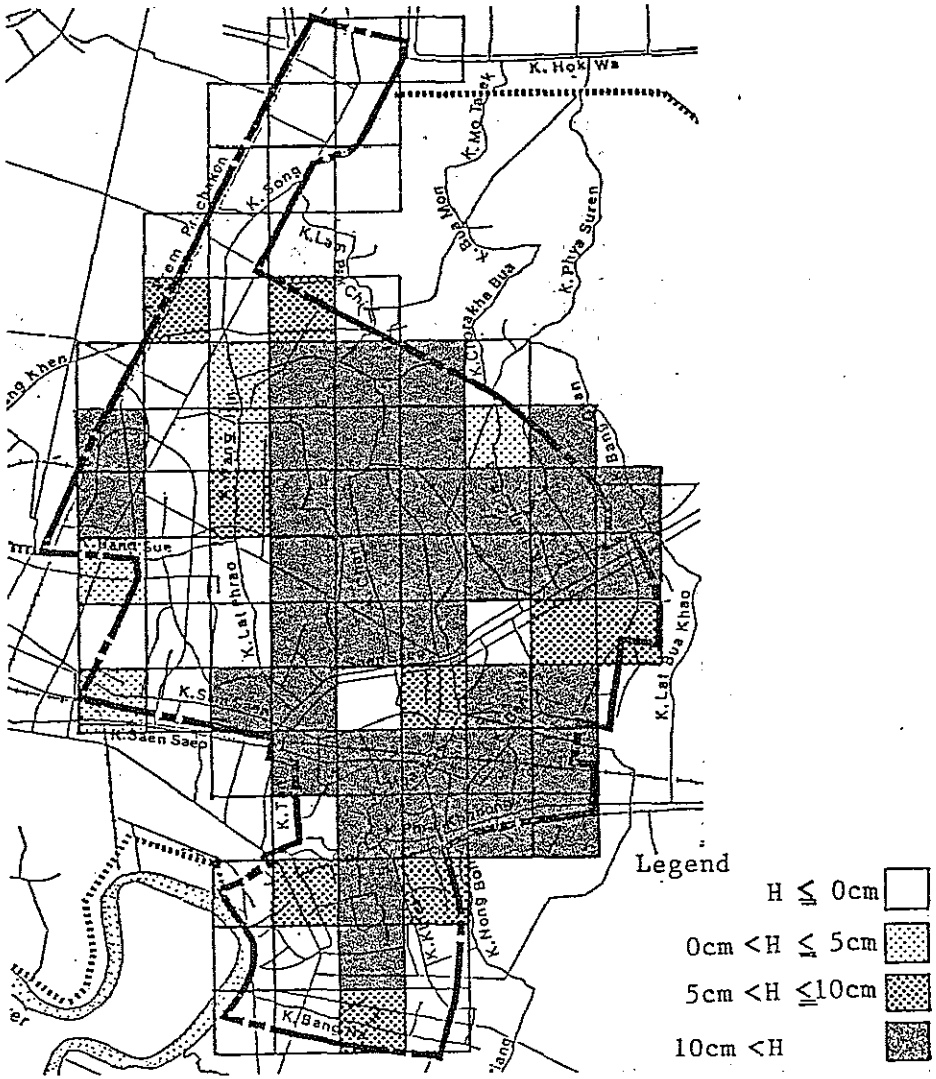


Reduced Depth with Facilities

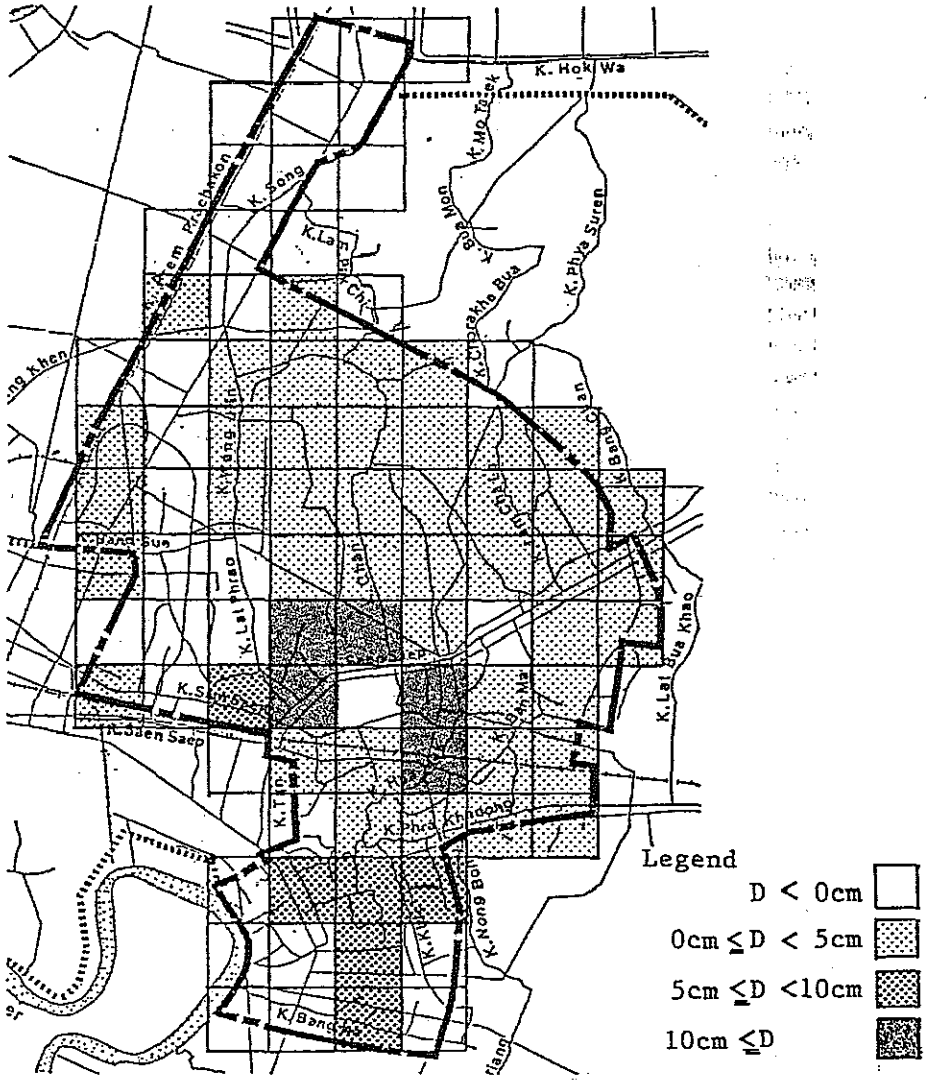
Fig. C.41	EFFECT OF PROPOSED FACILITIES (AD 1985, 20-YEAR FREQUENCY)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D



Flood Depth without Facilities

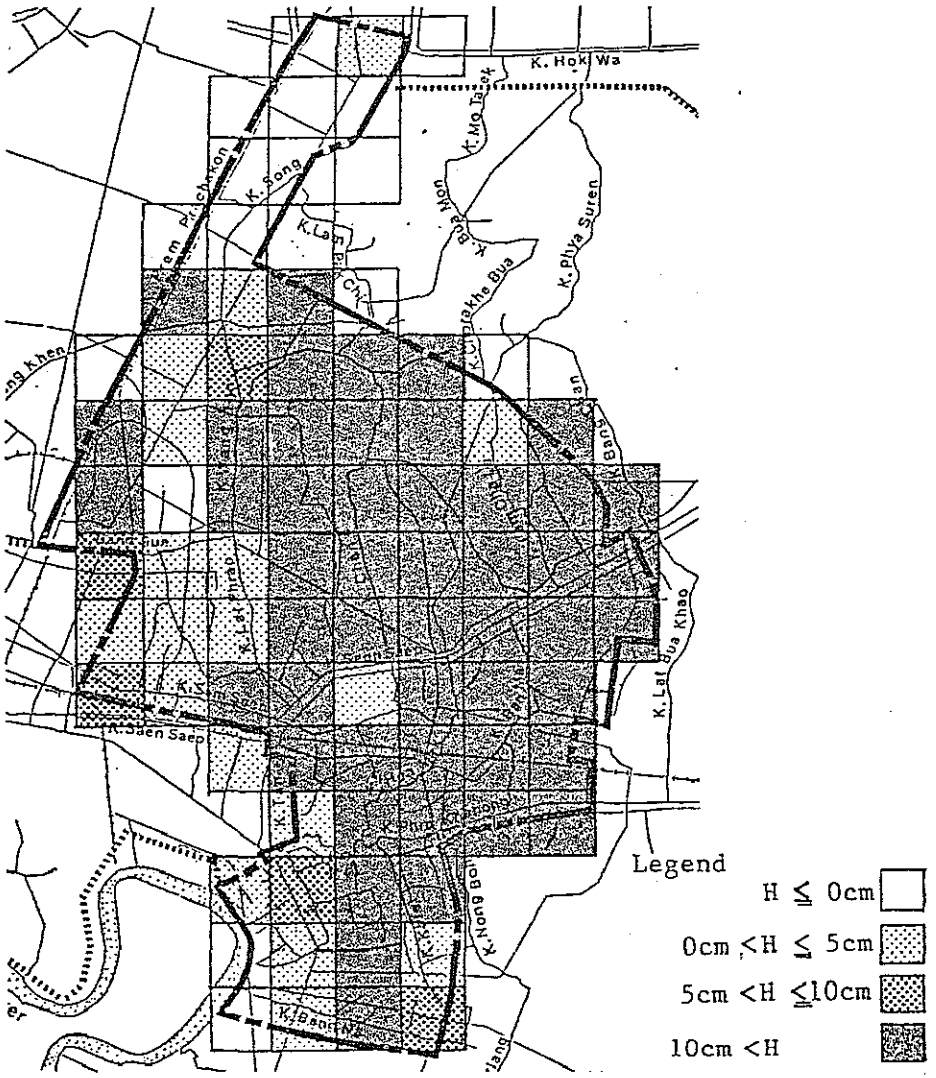


Reduced Depth with Facilities

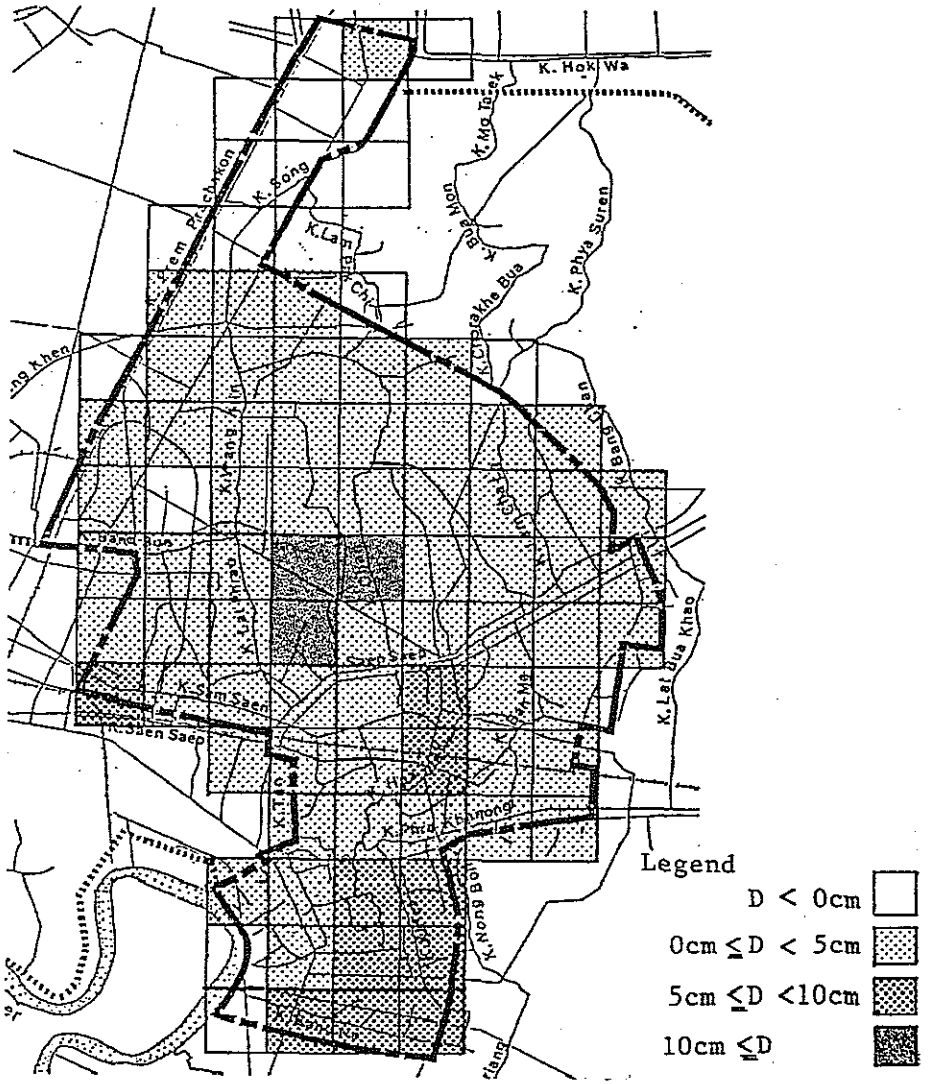
Fig. C.42 EFFECT OF PROPOSED FACILITIES (AD 2000, 2-YEAR FREQUENCY)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529(1986)



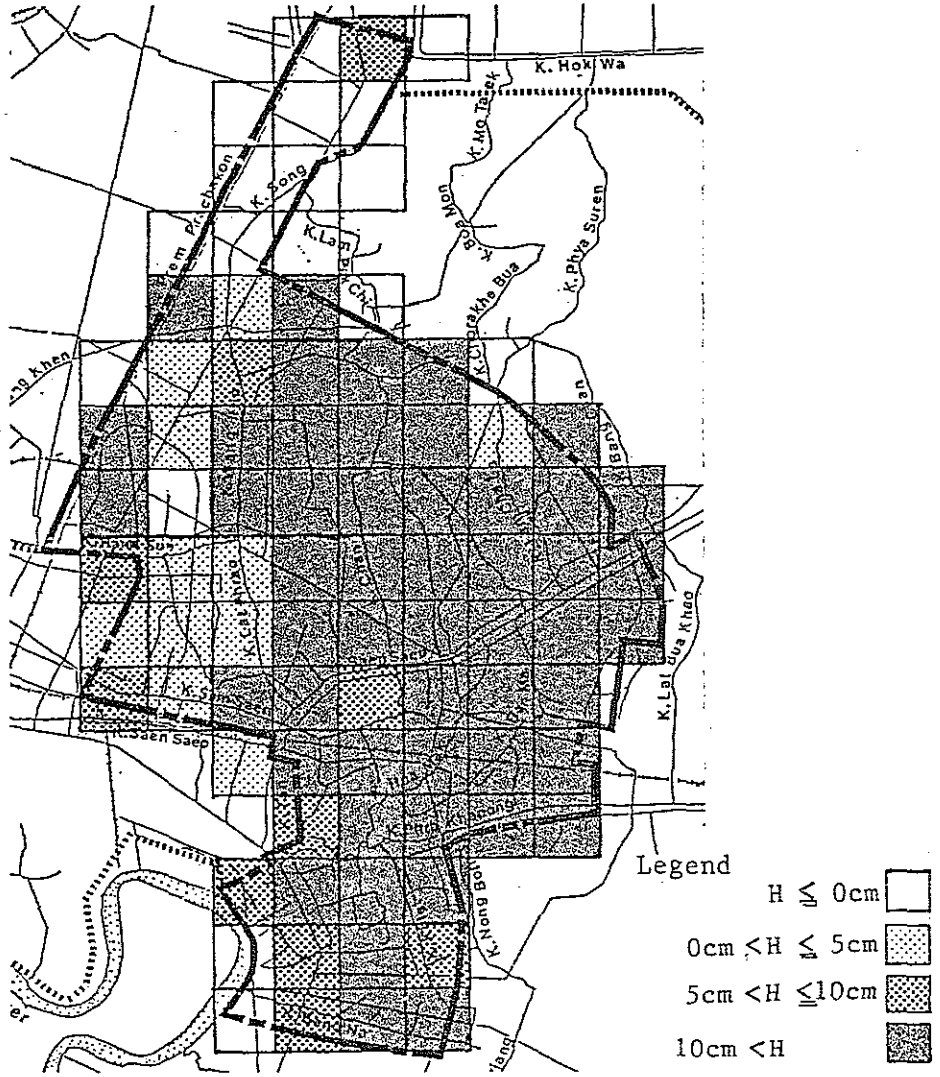
Flood Depth without Facilities



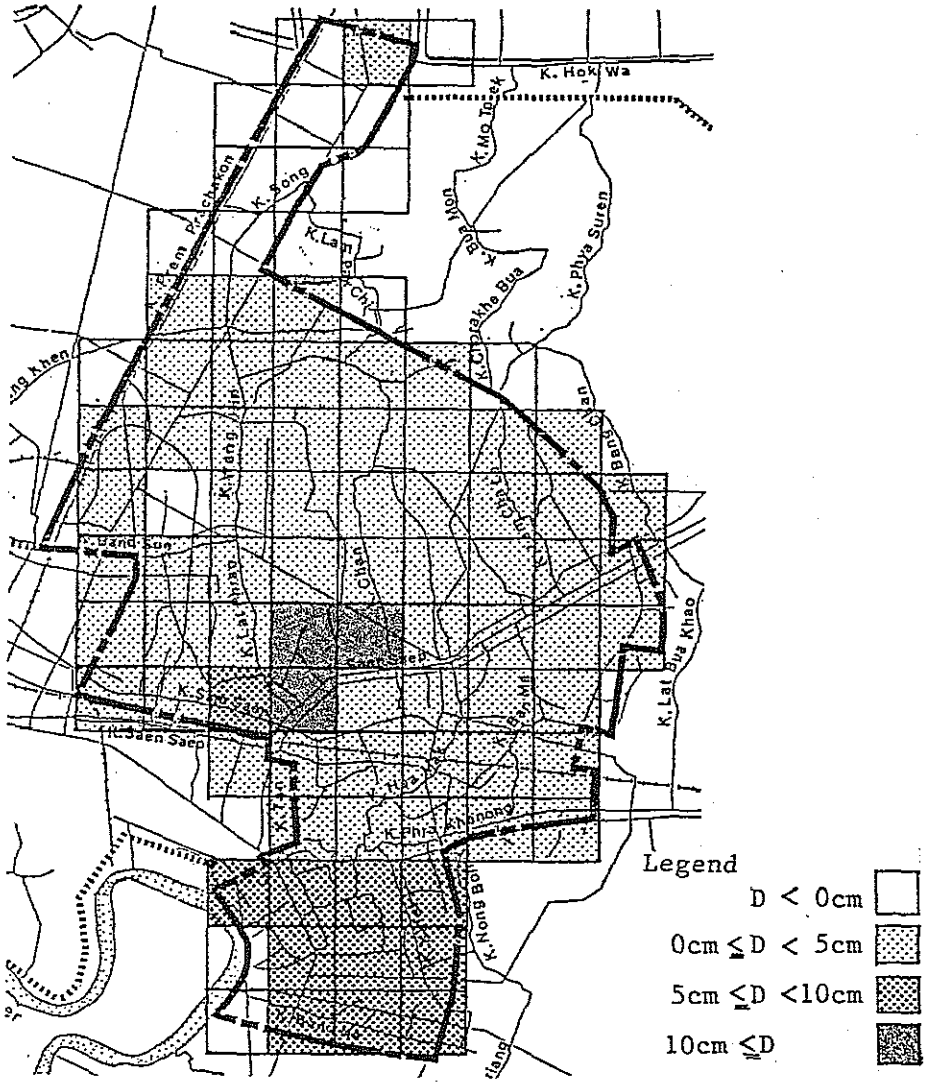
Reduced Depth with Facilities

Fig. C.43	EFFECT OF PROPOSED FACILITIES (AD 2000, 5-YEAR FREQUENCY)
FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK	

JICA 2529 B.E 1986 A.D



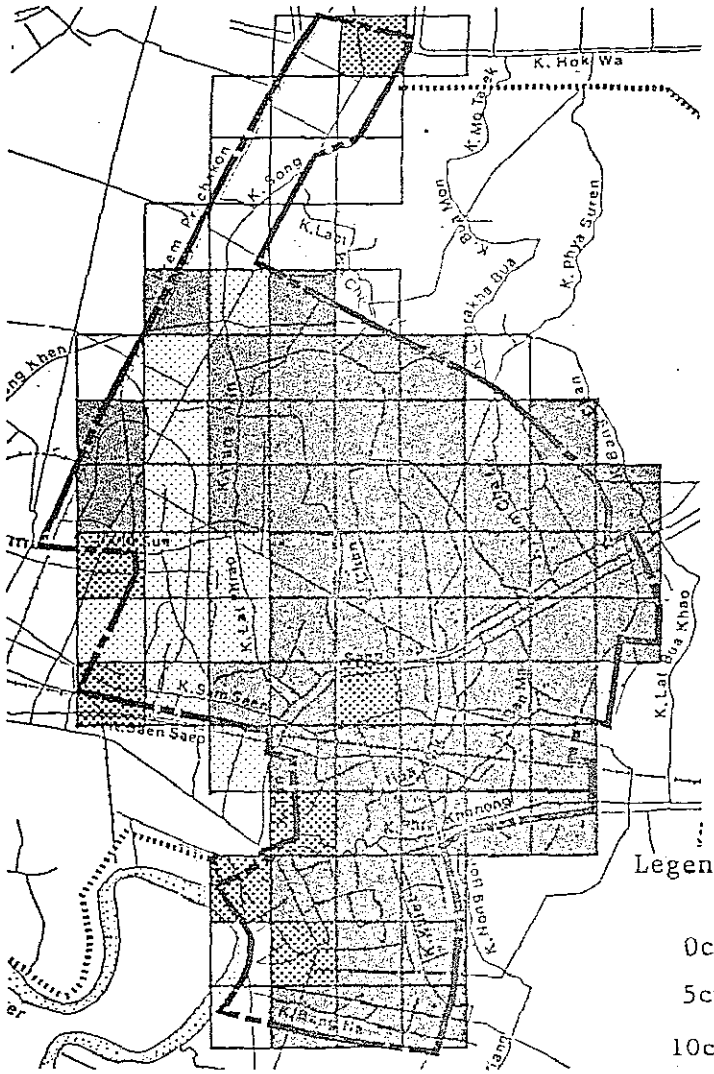
Flood Depth without Facilities



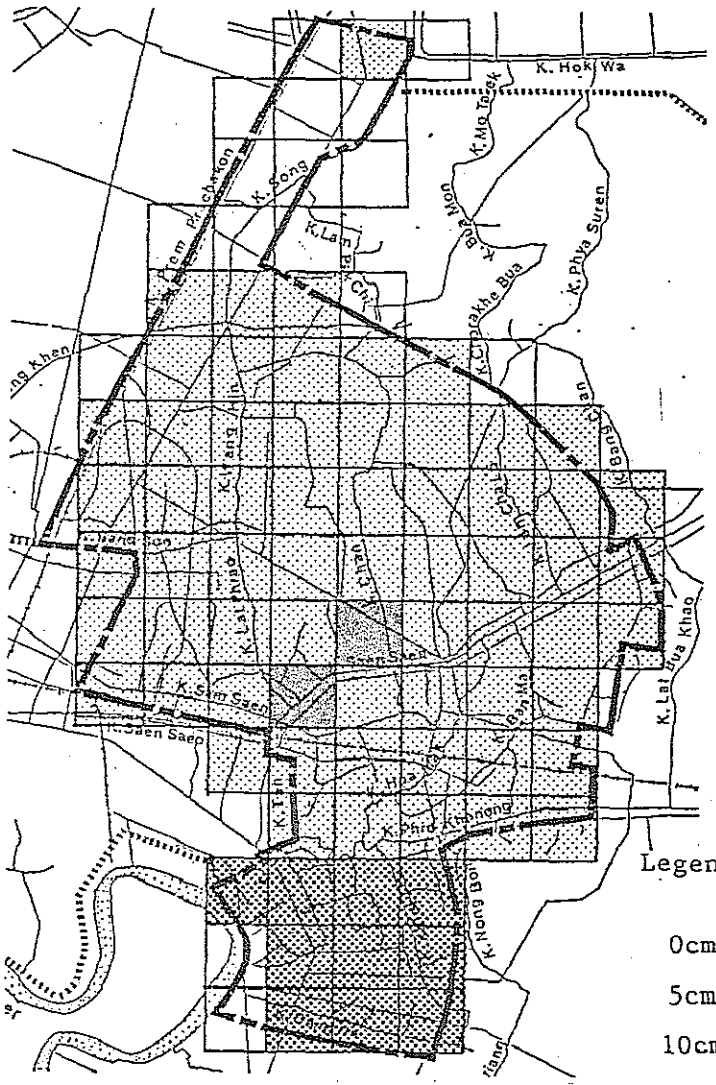
Reduced Depth with Facilities

Fig. C.44	EFFECT OF PROPOSED FACILITIES (AD 2000, 10-YEAR FREQUENCY)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK



Flood Depth without Facilities



Reduced Depth with Facilities

Fig. C.45	EFFECT OF PROPOSED FACILITIES (AD 2000, 20-YEAR FREQUENCY)

FEASIBILITY STUDY ON FLOOD PROTECTION/DRAINAGE PROJECT IN EASTERN SUBURBAN-BANGKOK

JICA 2529B.E 1986A.D

APPENDIX D

FACILITY PLANNING

APPENDIX D FACILITY PLANNING

Table of Contents

1. Flood Protection Barrier D-1

   1.1 Along the Chao Phraya River D-1
   1.2 Along KLong Tub Chang Bon D-2

2. Pumping Station D-3

3. Gate D-6

4. Klong Improvement D-9

List of Tables

Table D.1 Proposed Barrier Along Chao Phraya River C-2

Table D.2 Proposed Barrier Along Klong Tub Chang Bon D-3

Table D.3 Proposed Pump Capacity and Design Water Level D-3

Table D.4 Proposed Pumping Station D-6

Table D.5 Existing Pump Controlled by DDS and RID D-8

Table D.6 Classification of Retaining Wall Construction D-10

Table D.7 Summary of Proposed Retaining Wall and Dredging for Klong Improvement (1) D-15

Table D.7 Summary of Proposed Retaining Wall and Dredging for Klong Improvement (2) D-16

Table D.7 Summary of Proposed Retaining Wall and Dredging for Klong Improvement (3) D-17

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (1) D-18

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (2) D-19

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (3) D-20

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (4) D-21

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (5) D-22

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (6) D-23

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (7) D-24

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (8) D-25

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (9) D-26

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (10) D-27

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (11) D-28

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (12) D-29

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (13) D-30

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (14) D-31

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (15) D-32

Table D.8 Proposed Retaining Wall and Dredging for Klong Improvement (16) D-33

List of Figures

Fig. D.1 Proposed Facilities in the Feasibility Study D-34

Fig. D.2 Alignment and Typical Design of Flood Protection Barrier D-35

Fig. D.3 Alternatives for Study on Flood Protection Barrier D-36

Fig. D.4 Typical Design of Pumping Station D-37

Fig. D.5 Location and Typical Design of Proposed Gates D-38

Fig. D.6 Selection of Retaining Wall Type D-39

Fig. D.7 Typical Section of Retaining Wall D-40

Fig. D.8 Typical Design of Retaining Wall D-41

Fig. D.9 Foundation for Drain D-42

Fig. D.10 Jacking Method for Construction of Drain under Highway .. D-43

APPENDIX D FACILITY PLANNING

1. FLOOD PROTECTION BARRIER

1.1 Along the Chao Phraya River

The 3.4 km length barrier is divided into 3 sections from A to C depending on the land use conditions along the river as shown in Fig. C.2. The existing facilities located along the river bank for each section are as follows:

Section A : Quay wall of National Petroleum Authority, concrete panel wall type, length of 1.25 km

Section B : Retaining wall of private companies, concrete panel wall type, length of 1.00 km

Section C : Retaining wall of Navy, concrete panel wall type, length of 1.15 km

Considering the existing conditions of structure and land use, two types (concrete wall and earth embankment) are envisaged as the structural alternatives for 3.4 km long barrier. Under the consideration of utilizing the existing retaining wall as much as possible and the existing land use, the concrete wall type is adopted in this project as shown in Fig.D.3.

For the flood barrier of the proposed concrete wall type, cut-off wall is planned to protect subsoil failure generated by the seepage due to the water level difference of in and out. Owing to the utilization of local materials, concrete sheet pile is adopted for the cut-off wall and the length of the pile is 7 m from the analysis of seepage. The cement mortar is planned to be grauted in joint of the each piles in order to make tight cut-off wall as shown in Fig.D.2. The structural dimensions are as follows:

Table D.1 Proposed Barrier Along Chao Phraya River

Barrier Type	:	Concrete wall with concrete sheet pile support
Length	:	3.4 km
Height	:	1.5 m

1.2 Along Klong Tub Chang Bon

The east bank area of the Klong Tub Chang Bon of 1.7 km, where the barrier is proposed, is not urbanized at present and there remains swampy area. In the short distance of this section, there is the Klong Phra Khanong where several houses are directly faced to the klong. Considering the present site conditions, three types of barrier are envisaged as the structural alternatives as shown in Fig.D.3.

Alternative 1) Earth Embankment Type
Alternative 2) Concrete Wall Type
Alternative 3) Concrete Panel Wall Type

In case of Alternative 1 and 2, the barrier are constructed keeping away from the existing klong bank for the safety for bank slope failure.

Alternative 3) is constructed by vertical retaining wall, therefore, its construction cost is higher than others. Amongst the three types of the barrier structure, the earth embankment type is adopted in this project considering the existing land use conditions, economical and safety points of view. Top width of 5 meters of embankment is adopted for traffic use for the maintenance of the barrier and the klong as shown in Fig. D.2.