

5.6 Suphanburi Province

5.6.1 General

The Suphanburi Province, the area of which is 5,358 km², is situated in the Western region. The general topography of the Province is lower plain along the Suphanburi River except for the hilly area in the northwest. Six community areas were selected for the Study. The Provincial Capital, Suphanburi, and Songpeenong Municipality were selected for the Flood Protection Master Plan, while the sanitary districts of Bang Pla Ma, Khok Khram, Phai Kong Din and Ban Laem were picked up for flood protection conceptual design.

The Provincial Capital, Suphanburi, located along the Suphan River (Upstream of the Tha Chin River) covers an area of around 9 km² with the population of 27,788. The Municipality centre is located on the left bank of Suphan River.

Songpeenong Municipality, mainly located on the right bank of the Klong Songpeenong, a tributary of the Tha Chin River, covers the area of 10.4 km² with the population of 12,848. The distance from the Municipality to the confluence with Tha Chin River is 9 km in direct distance and 12 km in channel. The Municipality officials remarked that the location of the municipality is just like the bottom of a basin and therefore they used to cope with frequent flooding. People used to have two-stories houses and the second floor is utilised for living during flooding.

5.6.2 Existing Condition

(1) Suphanburi Municipality

(a) Flood Damag

Recent flood was occurred in 1983, 1995 and 1996. The flood water level recorded at the Chaophaya Regulator located upstream of the Municipality is listed in the following table;

Flood	1995			1996		
	Start	Peak	Normal	Start	Peak	Normal
Date	9/30	10/10	10/17	10/4	10/12	10/19
Upstream	5.85	6.07	-	5.98	6.43	-
Downstrea	5.61	5.95	5.60	5.74	6.28	5.60

The inundation depth at the reference road near the market in the Municipality is 0.35 m in 1995 and 0.68 m in 1996.

(b) Cause of Flood

The major cause of floods is pointed out as follows;

- Backwater from the Suphanburi River flows into drainage pipeline system of the Municipality
- Overflow from the Suphanburi River

- Blockage of drainage pipeline and insufficient drainage capacity of Klong Pho to drain flooded water in the Municipality into the Suphanburi River

(c) Flood Protection Facility

On the left bank of Suphanburi River, a dike composed of sheet piles with concrete capping was built in 1997 (The dike height is one meter with the length of 124 m).

(d) Drainage Facility

There is no permanent drainage system in the Municipality, however, around 39 pumps had to be operated during the flood in 1995 and 1996. Drainage pump operation was as follows;

- In 1995: Oct. 4th.~ Oct. 21st
- In 1996: Sept. 25th.~ Nov. 7th

The size of these pumps are 37 units of 8~12 inches in diameter and 2 units of 30 inches.

(e) Flood Fighting

The Municipality owns 18 drainage pumps as follows;

Type	Number
Electric	9
Portable	4
Centrifugal / large	5

During the rainy season, the RID informs the Municipality the coming of flood and the Municipality closes the drainage outlets to prevent flooding. The budget for flood fighting in 1996 was around 4 million Bahts.

The flood fighting system is as follows;

- Construct temporary dikes with crushed stones, sand bags, etc. using loaders, dump trucks and graders
- Construct temporary dikes to protect the main market
- Installation of drainage pumps of RID (size: 8,12, 30 inches in diameter)

Sector X

- Recruit manpower's from the prison, student, army from the Central Command

(2) Songpeenong

(a) Flood Damage

Recent flood was occurred in 1983, 1995 and 1996. The inundation depth was around one meter in 1983. The depth of inundation in 1995 was bigger than that of 1996 and the Municipality received more severe damage in 1995. After the flood of 1995, the core area of the Municipality, the market and business area, was reclaimed around one square kilometres with about 2 m thick. Therefore, the flood damage in 1996 was decreased to a great extent because of the reclamation. Non reclaimed area is mainly swampy area and these areas were inundated in 1996.

(b) Cause of Flood

There are three main causes of flooding in Songpeenong as follows;

- Overflow from the Klong Songpeenong
- Flood flow from the west such as U Thong district, Suphan Buri and Kanchanaburi provinces as well as the heavy rainfall within the Municipality

(c) Flood Protection Facility

On the right bank of the Klong Songpeenong, along the core area of the Municipality, a dike composed of sheet piles with concrete capping has been built at a distance of 450 m as shown in Fig. 5.6.1 - ②.

(d) Drainage Facility

There is no permanent drainage facilities in the Municipality, however, the Municipality owns 8 units of drainage pumps with the diameter of 10~12 inches. In 1995, these pumps were operated almost 24 hours a day from the end of September to the end of December.

(e) Flood Fighting

Sand bags are used for building temporary dikes. Necessary materials for flood fighting such as sand are supplied by both the Municipality and PWD. Municipality also takes care of the residents living outside of the core area by supplying food and necessary commodities by boat (road is not passable during flood).

(3) Bang Pla Ma Sanitary District

Bang Pla Ma sanitary district has been flooded every year, especially the commercial area between the Suphanburi River and the National Highway which acts as a flood barrier.

(4) Phai Kong Din Sanitary District

Klong Bang Yai Hon passes through the sanitary district from east to west, while the Klong Sali flows from south and joins Klong Bang Yai Hon in the district. Although the RID had constructed the dike along the Klong, the flood plain along the Klong Bang Yai Hon is flooded every year, from October to November. For instance, the commercial area is inundated with the depth of 0.2~0.3 m on average as the dike is not exactly aligned on both banks of the Klong.

(5) Khok Khram Sanitary District

The District is located on the left bank of the Suphanburi River and protected by the flood protection dike constructed in 1996. No overflow has been occurred, however, the District has been flooded by means of backwater through the drainage pipeline system. In addition, the flood condition of the District depends on the water release from Pho Phraya regulators located on the upstream of the Suphanburi River.

(6) Ban Laem Sanitary District

The District is located on the right bank of the Suphanburi River. Although the RID constructed the dike, the most populated area is located between the river bank and the RID's dike and this is the main cause of flood in the District.

5.6.3 Related Plan and Project

(1) Suphanburi Municipality

In 1993, the PWD carried out the Feasibility Study of Drainage System and Wastewater Treatment of Ratburi and Suphanburi Community in order to improve drainage system in sub areas or construct sufficient drainage system. In due consideration of the situation abovementioned and taking into account of the results of the Feasibility Study of Drainage System and Wastewater Treatment of Suphanburi Community, the proposed drainage and flood protection plan is shown in Fig. 5.6.1 - ① and its details are as follows;

Facility	Location	Description	Const. Cost
Anchorage channel dike	Left bank of Suphanburi Riv.	(W1) H= 1.5 m, L= 2.9 km	175.49
	Right bank of Suphanburi Riv.	(W2) H= 1.5 m, L= 2.7 km	163.47
Dredging, Gate Regulator & Pumping Station	Natural channel		80.95
Total : Cost (Mil. Bahts)			419.41

(2) Songpeenong Municipality

The proposed drainage and flood protection plan is shown in Fig. 5.6.1 - ② and its details are as follows;

Facility	Location	Description	Const. Cost
Anchorage channel dike	Left bank of K. Songpeenong	(W) H= 2.0 m, L= 1.9 km	103.57
Earth dike	Left bank of K. Songpeenong	(D) H= 2.0 m, W= 4.0 m, L= 5.7 km	32.17
Raised road	Left bank of K. Songpeenong	(R1~ R10) H= 0.3~ 0.6 m, L= 18.7 km	50.48
Gate Regulator	K. Songpeenong	(G1~ G3), Size: 2.0 x 4.0 m	1.86
Pumping Station	Market area	3 station with 2 pumps, Q= 1.0 cms. each	10.05
Drainage Pipe	Market are	Circular pipe, Dia.= 0.6 m, L= 0.643 km	2.33
		Circular pipe, Dia.= 0.8 m, L= 0.476 km	2.21
Dredging	3-canals	(d) Depth= 2.0 m, W= 8.0 m, L= 7.1 km	3.71
Total : Cost (Mil. Bahts)			206.38

(3) Bang Pla Ma Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Anchorage channel dike	Left bank of Suphanburi Riv. (Densely populated area)	H= 0.8 m, L= 1.4 km	79.52
Earth dike	Left bank of Suphanburi Riv. (Low densely populated area)	H= 0.8 m, W= 4.0 m, L= 1.8 km	4.59
Gate Regulator	K. Ban Kao & K. Ban Mi	Size: 2.0 x 2.0 m (Mouth of the Klong)	0.94
Pumping Station	Market area	2 station, Q= 1.0 cms. each	3.75
Dredging	Ban Kao	Depth= 2.0 m, W= 4.0 m, L= 1.3	0.33
Total : Cost (Mil. Bahts)			89.13

(4) Phai Kong Din Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Anchorage channel dike	Left bank of K. Bang Yi Hon	Crest EL.= 4.4 m msl., L= 0.9 km	47.95
Earth dike	K. Bang Yi Hon (Low densely populated area)	Crest EL.= 4.4 m msl., L= 2.0 km	4.92
Pumping Station	Old & new market areas	2 station, Q= 1.0 cms. each	9.50
Total : Cost (Mil. Bahts)			62.37

(5) Khok Khram Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Anchorage dike	Left bank of Suphanburi	Crest EL.= 4.5 m msl., L= 1.3 km	88.45
Earth dike	Right bank of K. Bang Pla	H= 2.0 m (Crest EL.= 4.5 m), W= 1.0 m, L= 5.7 km	3.96
Raised road	Bang Pla Ma road	H= 0.5 m, L= 0.32 km	2.08
Pumping Station	Municipality area	1- station, Q= 0.5 cms. 2- station, Q= 2.0 cms.	1.10 18.30
Total : Cost (Mil. Bahts)			113.89

(6) Ban Laem Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Anchorage channel dike	Right bank of Suphanburi Riv. (Densely populated area)	(W) H= 1.8 m (Crest EL.= 4.0 m, msl.), L= 0.57 km	35.63
Earth dike	Right bank of Suphanburi Riv. (Low densely populated area)	(D) H= 1.8 m (Crest EL.= 4.0 m, msl.), W= 4.0 m, L= 2.20 km	10.89
Gate Regulator	K. Mod Tanoy	Outlets of drainage pipe	0.20
Pumping Station	Market area	2 station, Q= 1.0 cms. each	9.00
Total : Cost (Mtl. Bahts)			55.72

5.7 Nakhon Pathom Province

5.7.1 General

The Nakhon Pathom Province, the area of which is 2,168 km², borders on Suphanburi in the north, Samut Sakon and Rachaburi in the south, Bangkok and Nonthaburi in the east and Kanchanaburi and Rachaburi in the west. The general topography of the Province is low plain area and the major river passing the Province is Tha Chin River. The main causes of flooding in the Province are heavy rainfall and overflow from the Tha Chin River and Bangkok's drainage system.

The Provincial Capital, Nakhon Pathom Municipality was selected for the Flood Protection Master Plan, while the sanitary districts of Bang Len, Bang Luang and Rang Krathum were picked up for flood protection conceptual design.

The Provincial Capital, Nakhon Pathom, located along a tributary of Tha Chin River and covers an area of around 5.28 km² with the population of 97,372.

5.7.2 Existing Condition

(1) Nakhon Pathom Municipality

Flood stagnation in the Municipality is due to heavy rainfall, high water level in natural canals and insufficient capacity of drainage pipeline system.

(2) Bang Len Sanitary District

The District faces with regular floods due to the overflow from Klong Bang Len and Klong Phra Phimon, and the floods from the north.

(3) Bang Luang Sanitary District

The District faces with regular floods every year due to heavy rainfall and the overflow from Tha Chin River and Klong Bang Luang.

(4) Rang Krathum Sanitary District

The District is flooded every year due to the overflow from Klong Phra Phimon and other canals, and the floods from the upstream.

5.7.3 Related Plan and Project

(1) Nakhon Pathom Municipality

The Feasibility Study on Drainage and Wastewater Treatment System of Nakhon Pathom Province had been carried out by PWD in order to solve flood problems systematically with the local organisation. Based on the Study, the Nakhon Pathom Municipality prepared flood protection plans which comprise of the improvement of Klong Chedi Bucha and Klong Huai Chorakhe (to facilitate sufficient capacity in order to carry drainage water from the Municipality) and the construction of main drainage pipeline system for the outer area of the Municipality. However, some plans have not been implemented because of the limited budget. In due consideration of such circumstances, the proposed drainage and flood protection plan is shown in Fig. 5.7.1 - ① and its details are as follows;

Facility	Location	Description	Const. Cost
Gate Regulator	K. Huai Chorake / K. Chedi Bucha	6- gates, Size: 6.0 x 3.0 m	8.33
Pumping Station		Q= 3.0 cms	10.30
Drainage Pipe	Phetkasem road	Square pipe, 2.25 x 2.25 m, L= 3.90 km	80.73
		Square pipe, 2.50 x 2.50 m, L= 2.86 km	67.78
		Circular pipe, Dia = 0.6 m, L= 0.26 km	0.94
		Circular pipe, Dia = 1.0 m, L= 0.14 km	0.84
		Circular pipe, Dia = 1.2 m, L= 3.10 km	22.32
		Drainage ditch, 2.0 m x 1.8 m, L= 1.8 km	25.20
Total : Cost (Mil. Bahts)			216.44

(2) Len Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Earth dike	Both bank of Tha Chin	H= 0.8 m, L= 8.60 km	21.50
Gate Regulator	K. Ban Len	5- gates each of which 4.0 m in width	6.70
	K. Rang Bua	3- gates each of which 4.0 m in width	4.00
Total : Cost (Mil. Bahts)			32.20

(3) Bang Luang Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Earth dike	Right bank of Tha Chin Riv.	H= 1.0 m, L= 2.30 km	5.70
Gate Regulator	Mouth of K. Bang Luang		4.00
Total : Cost (Mil. Bahts)			9.70

(4) Rang Krathum Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Earth dike	K. Phra Phimon	H= 0.7 m, L= 3.60 km	9.00
	K. Phasi	H= 0.7 m, L= 5.40 km	13.50
Total : Cost (Mil. Bahts)			22.50

5.8 Samut Sakhon Province

5.8.1 General

The Samut Sakhon Province, the area of which is 851 km², is situated in the western side of Bangkok. The general topography of the Province is lower plain along the Tha Chin River. Many canals are developed through the Province and utilised for irrigation and inland navigation. The Provincial Capital, Samut Sakhon Municipality was selected for the Flood Protection Master Plan, while Om Noi Municipality were picked up for flood protection conceptual design.

The Provincial Capital, Samut Sakhon, located at the river mouth of Tha Chin, covers an area of around 10.3 km² with the population of 54,335. The Municipality centre is located on the left bank of the Tha Chin River. The Maha Chai Canal is connected with Tha Chin River at the eastern border of the Municipality.

5.8.2 Existing Condition

(1) Samut Sakon Municipality

(a) Flood Damage

The flood damage in 1995 and 1996 was very small. In 1997, the Municipality was inundated severely by the waves of Typhoon "Rinda". A new regulator on the Maha Chai Canal reduces the width of the canal, blocks the passage of high tide and causes the inundation along the canal. Flood damage used to occur during November, December and January. The stagnated floods in the Municipality are mainly due to the following reasons

- • Tidal effect
- • Flood from Tha Chin River
- • Wave from the sea caused by Typhoon or Depression
- • Regulator on the Maha Chai Canal
- • Land subsidence

(b) Flood Protection Facility

There is no flood protection facility in the Municipality.

(c) Drainage Facility

There is no drainage pumps in the Municipality, however, pumps of the fire fighting cars might be used for evacuation. Five existing regulators along the Maha Chai Canal equip with pumps of 6 inches in diameter and these pumps are operated only 2~3 hours during high tide (operation is very seldom).

(2) Om Noi Municipality

Flood problems in Om Noi Municipality are due to heavy rainfall and floods flowing from adjacent areas through Om Noi canal into the Municipality.

5.8.3 Related Plan and Project

(1) Samut Sakon Municipality

In 1993, the Feasibility Study of Flood Protection and Drainage System for Samut Sakon Municipality was conducted by the PWD. The components of the flood protection and drainage system were construction of polders and pump stations, improvement of drainage canals and pipelines, and installation of gate regulators. However, it is found that the present flood protection system dose not function properly. Therefore, in order to supplement the present system, the proposed drainage and flood protection plan is shown in Fig. 5.7.1 - ② and its details are as follows;

Facility	Location	Description	Const. Cost
Phase IV Polder No. 1B Others	Left bank of Tha Chin	Construction Improvement (Canal, pumping station & gate regulators)	153.00 535.00
Phase V Polder No. 4B Others		Right bank of Tha Chin	Construction Improvement (Canal, pumping station & gate regulators)
Total : Cost (Mil. Bahts)			1,399.00

(2) Om Noi Municipality

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Earth dike	K. Om Noi	H= 1.0 m, L= 15.0 km	37.40
Drainage	Phetkasein road (Om Noi Temple)	Size 2.00 x 2.00 m, L=	0.40
	Bhudamonthon 4 road (Sin Sombun Village)	20.00 m, Size 2.00 x 2.00 m	0.40
Total : Cost (Mil. Bahts)			38.20

5.9 Lopburi Province

5.9.1 General

The Lopburi Province, the area of which is 6,199 km², borders on Petchaboon and Nakhon Sawan in the north, Ayuthaya and Saraburi in the south, Nakhon Rachashima and Chaiyapoon in the east and Sing Buri and Ang Thong in the west. The topography of the Province is hilly and mountainous - about 70 % and majors river passing the Province are Pasak and Lopburi Rivers. Generally, the flooding and inundation occurred in Lopburi Province extend towards Ayuthaya Province.

The Provincial Capital, Lopburi Municipality was selected for the Flood Protection Master Plan, while the sanitary districts of Tha Wung and Tha Klong were picked up for flood protection conceptual design.

The Provincial Capital, Lopburi, located along the left bank of Lopburi River and covers an area of around 6.85 km² with the population of 31,414.

5.9.2 Existing Condition

(1) Lopburi Municipality

(a) Flood Damage

In 1995, the heavy rainfall from Sept. 17 to Oct. 18, caused rapid runoff and consequently flooding occurred in the Municipality. On top of this, the water level of Chai Nat - Pasak Irrigation Canal became higher and spillage occurred and increased inundation depth even in the Muang district from Sept. 17 to Oct. 5. Furthermore, on Oct. 2, a large amount of overflow from Chao Phraya River conveyed by the Lopburi River spilled over the Muang district .

In 1996, the heavy rainfall from Sept. 30 to Oct. 23, caused rapid runoff and consequently flooding occurred in the Municipality. On top of this, overflow from the Lopburi River added inundation depth even in the Muang district from Oct. 4 to 23. The inundation depth in the Municipality is around 0.8 m.

(2) Tha Wung Sanitary Distric

(a) Flood Damage

In 1995, overflow from the Lopburi River inundated the District from Sept. 17 to Nov. 23. On Oct. 2, a large amount of overflow from Chao Phraya River conveyed by the Lopburi River increased the inundation depth in the District.

In 1996, the heavy rainfall from Sept. 30 to Oct. 23, caused rapid runoff and consequently flooding occurred in the District. On top of this, overflow from the Lopburi River added inundation depth even in the District from Oct. 4 to 23. The inundation depth in the District is around 1.0 m.

5.9.3 Related Plan and Project

(1) Lopburi Municipality

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Raised dike	Left bank of. Lopburi Riv.	H= 2.4 m, L= 2.4 km	216.60
Dredging & Concrete	K. Ruak	Depth= 2.0 m, L= 2.0 km	22.80
	K. Sai Bua	Depth= 2.0 m, L= 1.0 km	8.60
	K. Bang Pee	Depth= 1.0 m, L= 1.5 km	8.10
Total : Cost (Mil. Bahts)			256.10

(2) Tha Wung Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Raised dike	Left bank of. Lopburi Riv.	H= 1.5 m, L= 0.7 km	2.03
Drainage Pipe		Circular pipe, Dia.= 0.6 m, L= 0.6 km	3.48
		Circular pipe, Dia.= 0.8 m, L= 1.7 km	12.41
Dredging	K. Ya Duang	L= 0.5 km	2.15
	K. Makham Thet	L= 1.0 km	4.30
	K. Ta Muk	L= 0.5 km	2.15
Total : Cost (Mil. Bahts)			26.52

(3) Tha Klong Sanitary District

The details of the proposed drainage and flood protection plan are as follows;

Facility	Location	Description	Const. Cost
Earth dike	Bang Kham Riv.	H= 1.5 m, L= 0.45 km	1.31
	K. Chao Thao	H= 1.5 m, L= 0.90 km	2.61
Drainage Pipe		Circular pipe, Dia.= 0.6 m, L= 1.3 km	7.54
		Circular pipe, Dia.= 0.8 m, L= 0.8 km	5.84
Dredging	K. Chao Thao	L= 0.9 km	3.87
Total : Cost (Mil. Bahts)			21.17

5.10 Implementation Schedule

(1) Phasing of Project Implementation and Duration of Each Phase

Project implementation generally consists of the following four phases;

- • Feasibility Study
- • Detailed Design
- • Bidding for Construction
- • Construction of Project's Components

The first two phases will take 1~1.5 years, while the bidding would be 3~4 months. The duration of construction phase depends on the type of the project's components, however, it is estimated in accordance with the construction costs as follows ;

Construction Cost (Million Bahts)	Duration of Construction (Year)
Less than 100	1
100~300	2
300~500	3
500~ 1,000	4
1,000~2,000	5
2,000~3,000	6
More than 3,000	7

(2) Year of Commencement

In the Study, the first year of project implementation was set up at 1999, however, the economic situation has been changing in Thailand, and the first year is rescheduled in the year of 2000. Also the priority is given to the project implementation as follows;

Order No.	Year of Commencement				
	First Year	Second Year	Third Year	Fourth Year	Fifth Year
1	Phichit	-	Nakhon Pathom	Phitsanulok	Uttaradit
2	Sukhothai	-	Samut Sakhon	Nakhon Pathom	Uthaitani
3	-	-	Suphan Buri	Lopburi	-

(3) Implementation Schedule

Based on the procedures abovementioned, the implementation schedule is summarised as shown in Table 5.10.1.

Tables

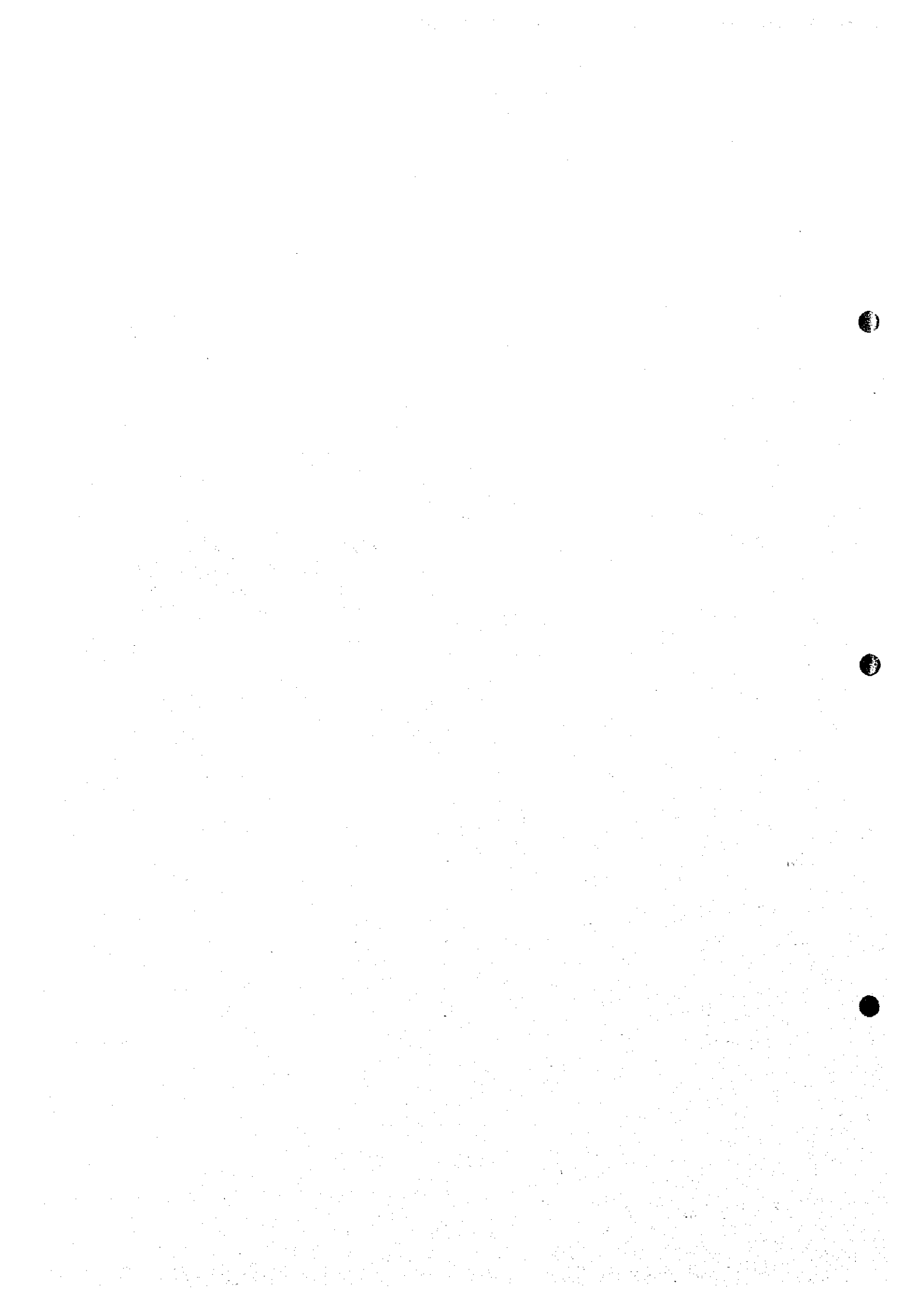


Table 2.2.1. PRINCIPAL DIKES ON BANGKOK AND VICINITY AREAS

East Bank		West Bank	
Element No.	Dike / Rd	Element No.	Dike / Rd
E1	King's Dike	W1	Southern Railway Line; many temporary cofferdams without gates
E2	Inner Dike	W2	Sukhaphiban 2 Rd.; many temporary cofferdams without gates
PD1	Nonthabun Polder	W3	Phuttamonthon IV Rd.; 2 temporary timber regulators with gates
PD2	Eastern Suburban Polder	W4	Chak Phra: West Rd.; several large klongs with timber cofferdams
PD3	City Core Polder	W5	Petch Kasem Highway; many timber cofferdams with/without gates
ED1	Bang Sai - Chaing Rak Noi Rd	W6	Local access roads west along Klong Sanam Chai; two cofferdams with gates
ED1A	Chaing Rak Noi - Tiwanon Rd	W7	Local access roads north along Klong Sanam Chai
ED2	Tiwanon Rd	W8	Saline - fresh boundary east along Klong Rat Phinit Chai
ED3	Dike along Klong Rangsit	W9	Charoen Nakhon Rd; several temporary structures with gates
ED4	RID Pakret Dike	W10	Suk Sawat Rd; several temporary structures with gates
ED5	Nonthabun Rd	W21	Access road Ban Klong Suan fresh - saline boundary
ED6	Piboon Song Kram Rd	WD1	RID Dike
ED7	Sam Sen Rd	WD2	Sam Khok - Sena Rd
ED8	Maha Rach, Sung Wad Rd, Charoen Krung Rd	WD3	Pathum Thani - Nonthaburi Bridge Rd.
ED9	Liab Mac Nam Rd	WD4	RID Dike
ED10	Port Rd	WD5	Bang Bua Thong - Nonthaburi Rd., Rama IV - Bang Kruai Rd.
ED11	Na Kaorm Rd	WD6	Charun Sanitvong Rd.
ED12	Sukhumvit Rd	WD7	Arun Amarin Rd.
		WD8	Charoen Nakhon Rd.
		WD9	Suk Sawat Rd.

Source: CHAO PHRAYA FLOOD MANAGEMENT REVIEW - 1996

Table 2.2.2 DRAINAGE PUMP CAPACITY OF BMA AREA

East Bank				West Bank			
No.	Name	Capacity (m ³ /s)	Remarks	No.	Name	Capacity (m ³ /s)	Remarks
1	K. Bang Khen (old)	9.0		1	K. San Chao	2.0	
2	K. Bang Khen (new)	12.0		2	K. Suan Qan	2.0	
3	K. Bang Son	4.0		3	K. Kai Teai	4.0	
4	K. Kruiy Ta Kaen	5.0		4	K. Chak Phra	45.0	
5	K. Bang Sue	51.0		5	K. Man	24.0	
6	K. Sam Sen	60.0		6	K. Bangkok Yai	54.0	
7	Theves	5.0		7	Wat Anong Karam	1.8	
8	K. Padung Krung Kasem	25.0		8	K. San	4.0	
9	K. Sathon	12.0		9	K. Bang Sai Kai	4.0	
10	K. Kruiy	3.0		10	K. Samrei	4.0	
11	Sathu Pradit	2.2		11	K. Bang Nam Chor	4.0	
12	Nang Lin Chi	2.0		12	K. Dao Kranong	45.0	
13	Rama IV	20.0		13	K. Bong Sakra	4.0	
14	K. Toey	30.0		14	K. Bong Pakok	6.0	
15	K. Phra Khanong	123.0		15	K. Rat Borana	9.0	
16	K. Chek	6.0		16	K. Cheang Ror	9.0	
17	K. Bang Chak	2.0		17	K. Sakra Ngam	6.0	
18	K. Bang O	18.0		18	K. Sen Pen	6.0	
19	K. Bang Na	15.0		19	K. Pahan	6.0	
20	K. Chong Non Sri	30.0					
21	K. Wat Sai	18.0					
	Sub-total	452.2			Sub-total	239.8	
22	Additional Pumps	101.0		20	Additional Pumps	70.0	
	Total	553.2			Total	309.8	

Source: BMA

Table 2.2.3 GENERAL FEATURE OF GATES/REGULATORS ON BMA AREA

Serial No.	Name	Type	Sill Level (m + MSL)	Width (m)	Height (m)	Number	Serial No.	Name	Type	Sill Level (m + MSL)	Width (m)	Height (m)	Number
1	K. Bang Khen (old)	Sluice	-2	6.40	4.30	1	42	K. Bang Lam Phu Gate	Ship Lock	-2.5	4.80	3.95	1
2	K. Bang Khen (new)	Sluice	-1.7	5.30	5.30	1	43	K. Bang Talat Gate	Sluice	-1.35	2.50	1.60	1
3	K. Bang Song	Sluice		4.00	5.00	1	44	K. Pin Klao Gate	Sluice	0.99	4.80	3.95	1
4	K. Kruey Ta Kaen	Sluice		3.20	5.00	1	45	K. Orachom Gate	Sluice		1.60	1.60	3
5	K. Bang Sue	Sluice		5.65	5.50	2	46	K. Sathon Gate	Sluice		2.50	1.60	1
6	K. Sam Sen	Sluice	-3	5.65	5.50	2	47	K. Ong Ang Gate	Ship Lock	-2.5	4.45	3.90	1
7	Inthamara 3 P.S.	Sluice		1.50	1.50	1	48	K. Wat Chong Non Sri Gate	Sluice		1.75	2.00	1
8	Mongkut Hospital P.S.	Sluice		2.00	2.00	1	49	K. Talerk Gate	Sluice		1.75	2.00	1
9	K. Sathon	Sluice		2.50	1.60	1	50	K. Ya Rung Gate	Sluice		1.75	2.00	1
10	Victory Monument P.S.	Sluice		1.50	1.60	1	51	K. Ta Huang Gate	Sluice		2.00	2.50	1
11	Phrom Yothi P.S.	Sluice		1.50	1.60	1	52	K. Suan Gate	Sluice		1.75	2.00	1
12	Bung Makkasarn P.S.	Sluice		4.00	5.90	1	53	K. Fleap Gate	Sluice		1.75	2.00	1
13	Rama IV	Sluice	-1			54	K. Phum Gate	Sluice		2.00	2.25	1	
14	K. Toey	Sluice	-2.5	6.00	6.00	1	55	K. Mai Gate	Sluice		1.75	2.00	1
15	K. Phra Khanong	Sluice	-2	6.00	6.00	3	56	K. Boath Gate	Sluice		2.00	2.50	1
		Sluice	-3	6.00	6.00	3	57	K. Wat Dan Gate	Sluice		1.75	2.00	1
16	K. Chek	Sluice	-1	4.00	4.00	2	58	K. Dan Nua Gate	Sluice		1.75	2.00	1
17	K. Bang Chak	Sluice	-1	4.00	4.00	2	59	K. Phat Gate	Sluice		2.00	2.50	1
18	K. Bang O	Sluice	-1	4.00	4.00	2	60	K. Wat Parwat Gate	Sluice		2.00	2.50	1
19	K. Bang Na	Sluice	-1	4.00	4.00	2	61	K. Bang Pong Pang Tai Gate	Sluice		2.00	2.50	1
20	K. Chong Non Shi	Sluice		1.95	2.85	1	62	K. Bang Pong Pang Nua Gate	Sluice		1.75	2.00	1
21	K. Wat Sai	Sluice		1.80	2.64	1	63	Bang Chan (Suan Siam) Gate	Sluice		5.00	4.00	1
22	Durit Gate	Sluice		3.00	3.00	1	64	Saen Saep (Bang Chan) Gate	Sluice		5.00	4.00	1
23	Saphwit Gate	Sluice	-3.5	4.00	4.00	2	65	Kranthum Sua Pla Gate	Sluice		6.00	6.00	2
24	Bang Sua Gate	Sluice		4.00	4.00	2	66	Phraya Suren Gate	Sluice		6.00	6.00	1
25	Bang Sakarn Gate	Sluice		4.10	4.05	2	67	K. Song Gate	Sluice		6.00	4.00	1
26	K. Wat Thong Ban Gate	Sluice		1.20	1.20	2	68	K. Mo Taek Gate	Sluice		4.00	4.00	1
27	K. Wat Dok Mai Gate	Sluice		2.00	2.50	1	69	K. Lam Baen Gate	Sluice		4.00	4.00	1
28	K. Rong Nam Man Gate	Sluice		1.75	2.00	1	70	K. Si West Gate	Sluice		4.00	4.00	1
29	K. Ma Now Gate	Sluice		1.75	2.00	1	71	K. Sam West Gate	Sluice		4.00	4.00	1
30	K. Bang Kho Nak Gate	Sluice		2.00	2.50	1	72	K. Sam Wa Gate	Sluice		6.00	6.00	1
31	K. Bang Kho Wat Gate	Sluice		17.50	2.00	1	73	K. Nuang East Gate	Sluice		4.00	4.00	1
32	K. Bangkok Yai Gate	Sluice		2.00	2.50	1	74	K. Saen Saep Gate	Sluice		4.00	5.00	1
33	K. Bangkok Noi Gate	Sluice		2.00	2.50	1	75	K. Bung Khwang Gate	Sluice		1.00	1.00	1
34	K. Wat Chan Nat Gate	Sluice		2.00	2.50	1	76	Railway Gate	Sluice		3.00	3.00	1
35	K. Bang Kho Lam Gate	Sluice		2.00	2.50	1	77	Lat Way Gate	Sluice		6.00	5.00	1
36	K. Suan Luang Gate	Sluice		1.75	2.00	1	78	K. King Kaew Gate	Sluice		5.00	4.00	1
37	K. Kwang Saphan	Sluice		4.00	4.00	1	79	Chued Lak Kaew Gate	Sluice		4.00	4.00	1
38	K. Wat Yan Na Wa Gate	Sluice		4.00	4.00	1	80	K. Khao Gate	Sluice		4.00	4.00	1
39	Xrang Kasem P.S.	Sluice	-4.75	4.00	4.00	1	81	Beng Phi Gate	Sluice		6.00	6.00	1
40	Tabate P.S.	Ship Lock	-2	8.80	4.50	2	82	K. Chai Tale Gate	Sluice		6.00	6.00	1

Table 2.2.4 EXISTING MAIN PUBLIC PONDS

No.	NAME/LOCATION	DISTRICT	AREA (ha.)	VOLUME (m ³)	DEPTH (m)	OWNER
1	Bung Lam Phaseng Puay	Bang Kapi	13.6	774,956	1.23-6.00	National Housing Authority
2	Ramkhamhaeng Univ.	Bang Kapi	58.3	1,086,938	0.7-3.0	Ramkhamhaeng Univ.
3	Bangkok International Airport (Don Muang)	Bang Khen	57.9	1,157,000	2	Bangkok International Airport
4	Airforce base and Hospital	Bhumipol Bang Khen	25.2	485,067	0.6-3.5	Royal Thai Air Force
5	Kasetsart Univ.	Bang Khen	15.8	248,505	0.9-2.5	Kasetsart Univ.
6	Wat Phasi Mahathat	Bang Khen	5.3	140,602	1.59-3.43	Wat Phasi Mahathat
7	Communications Authority of Thailand	Bang Khen	3.6	64,594	1.2-2.5	Communications Authority of Thailand
8	Royal Forestry Dept.	Bang Khen	1.7	57,536	2.7-4.0	Royal Forestry Dept.
9	Division of Science, Royal Thai Army	Bang Khen	2.0	35,618	0.75-2.14	Royal Thai Army
10	Bung Kum	Bung Kum	45.7	1,414,561		3.1 Bung Kum District
11	Klong Prem Central Prison	Chatuchak	10.0	252,660	0.9-2.6	Klong Prem Central Prison
12	Golf Course of State Railway of Thailand	Chatuchak	8.8	198,684	1.5-2.7	State Railway of Thailand
13	Chatuchak Park	Chatuchak	3.4	133,650	1.5-4.0	Chatuchak District
14	Dusit Zoo	Dusit	4.3	77,404	1.75-1.85	Dusit Zoo
15	Royal Turf Club	Dusit	4.0	75,643	1.0-2.0	Royal Turf Club
16	Suan Sunantha and Suan Dusit Teachers College	Dusit	3.7	44,918	0.7-1.7	Suan Sunantha and Suan Dusit Teachers College
17	Bung Rama IV	Huay Khwang	5.5	80,000		1.5 BMA
18	Tobacco Monopoly	Klong Toey	16.7	752,063		4.5 Tobacco Monopoly
19	Lumphini Park	Pathumwan	11.1	164,532	0.85-1.60	Pathumwan District
20	Royal Bangkok Sports Club	Pathumwan	3.0	34,958	1.0-2.0	Royal Bangkok Sports Club
21	Public Relation Dept.	Phaya Thai	5.3	56,173	1.0-1.2	Public Relation Dept.
22	Bung Ban Rotfai Makhasan	Phaya Thai	1.3	26,877	1.5-2.2	State Railway of Thailand
23	Bung Pi boon Wattana	Phaya Thai	1.3	25,600		2 DDS
24	Bung Nong Bon	Prawet	104.0	7,800,000		11 DDS
25	King Rama IX Park	Prawet	16.7	837,150	1.12-8.5	BMA
26	Pond in Ramkhamhaeng 2	Prawet	2.3	51,330	1.5-5.0	Ramkhamhaeng Univ.
27	Bung Makhasan	Rat:chatawi	16.5	350,000		2.1 BMA
28	Bung Song Krathiam	Minburi	7.7	200,000		3 BMA

Source: Preliminary Design Report for the Flood Protection and Drainage Systems in ESUB.

Table 2.3.1 MAJOR FEATURES OF THE PREVIOUS STUDIES FOR FLOOD MITIGATION AND DRAINAGE WORK

No. Project	Main Scheme	Return period (year)	Design Discharge (m ³ /s)	Design Water Level (m. MSL)	Allowance (m)	Year of Study	Target Year	Agencies concerned	Year of Study	
1 Greater Bangkok Plan	Perimeter canal of BKK							Litchfield, Whiting	1960	
2 Sewerage, Drainage & Flood Protection - M/P	BKK east & west bank with 11 polders							Camp, Dresser and McKee	1968	
3 City Core Project	BKK east bank	100		2.27 (M.Br.)				NEDECO, Land Marine/ Span	1984	
4 M/P & F/S for Eastern Suburban	BKK east bank drainage system with pumps	100	1,500	1.9-2.2		1942, 1980, 1983	2000	JICA for BMA	1985-1986	
5 BKK Flood Control Management		100		2.1 (M.Br.)				BPCL for NESDB	1985	
6 RID Plan	BKK west bank						1983	RID	1985	
7 Tawee Wattana Study	BKK west bank	100		2.2 (M. Br.)		1978, 1980, 1983		AIT for BMA	1985	
8 Alternative Flood Control Scheme	Greenbelt bypass Loop cut	Urban: 100 Rural: 10		2.2 (M. Br.)	0.5 (F. b.)		1983	AIT for NESDB	1985	
9 Chao Phraya 2	Sea barrier, dike & pumps	100	3,600 (Bangkok)	2.2-4.0	n.a.		1986	TAC, AIT for BMA	1987	
10 M/P for Flood Protection & Drainage in Thonburi and Samut Prakan	Drainage system with pumps	100	n.a.	1.2-2.3	0.3 (F.b.)		1983	NEDECO, Span for BMA	1987	
11 Flood Control for BKK & Vicinity	Review of previous studies & implementation schedule	n.a.	n.a.	n.a.	n.a.		n.a.	1990	Svendrup for BMA	1988
12 Lower Chao Phraya Area Develop. Proj.	Rural area of BKK west bank	10-25 for rural area		2.4 (Nonthaburi) 4.0 (Bangkok)	0.5 (F.b.)		n.a.	2006	Team, AIT for RID/ ADB	1992
13 Eastern Suburban - BKK	Flood protection & drainage system	Flood: 100 Drainage: 5	3,500 (Approx.)	1.9-2.75 (BKK - port-Nonthaburi)	0.5 (F.b.) + 0.2 (L.s.)		n.a.	2016	NEDECO, Span & WDC for BMA	1996
14 Chao Phraya Flood Management	Flood management	Urban: 100 Rural: less than 10					1995 -	AIT for NESDB/ WB	1996	

Note: M/P = Master Plan, F/S = Feasibility Study, BKK = Bangkok, M. Br. = Memorial Bridge, F.b. = Freeboard, L.s. = Land subsidence, W.B. = World Bank

Table 2.3.2 PREVIOUS STUDIES FOR FLOOD MITIGATION AND DRAINAGE WORK

No	Project	Main Contents	Agencies concerned	Year of Study
1	Greater Bangkok Plan	<ul style="list-style-type: none"> Two perimeter canals on the east and west bank of Bangkok Zoning of high level of protection (polder system) Short cut of Chao Phraya River 	Litchfield, Whiting, Bowne & Ass. Adams Howard and Greely	1960
2	Sewerage, Drainage & Flood Protection - MP	<ul style="list-style-type: none"> BKK east & west bank polder system covering 460 km² 11 polders ranging from 11-100 km² 	Camp, Dresser and McKee	1968
3	City Core Project	<ul style="list-style-type: none"> Protection of BKK city core area on the east bank Major protection barrier: 100 year return period and 5 year of land subsidence were considered 	NEDECO, Land Marine/ Span	1984
4	MP & F/S for Eastern Suburban BKK	<ul style="list-style-type: none"> Drainage system covering 500 km² of BKK east bank area Polder system with dikes, klongs, regulators, gates, retention ponds and pump stations were considered 	JICA for BMA	1985-1986
5	RID Plan	<ul style="list-style-type: none"> The system is to protect the area between the Chao Phraya River and the Tha Chin River, the west bank of BKK with polder dikes 	RID	1985
6	Taweewattana Study	<ul style="list-style-type: none"> The area covering 500 km² between the Chao Phraya River and the Tha Chin River was to be protected in line with the polder dikes proposed by RID Connection of Taweewattana and Rat Phinit Jai Canal was considered 	AIT for BMA	1985
7	Alternative Flood Control Scheme	<ul style="list-style-type: none"> By-pass (diversion) channel with the capacity of 500 m³/s along the Greenbelt, from Ban Mai to the sea Dikes from Bangsai to the River mouth and dredging from Pakkret to the estuary were also proposed 	AIT for NESDB	1985
8	Chao Phraya 2	<ul style="list-style-type: none"> Diversion channel, eastern boundary dike, control structure at Bangsai and sea barrier structure were proposed 	TAC, AIT for BMA	1987
9	MP for Flood Protection & Drainage in Thonburi and Samut Prakan	<ul style="list-style-type: none"> West side of Chao Phraya River covering 432 km² Flood barriers of new dikes, raised roads with gates and regulators Rehabilitation of existing facilities was also proposed 	NEDECO, Span for BMA	1987
10	Lower Chao Phraya West Bank Area Development Project	<ul style="list-style-type: none"> Sustainable development of RID's West Bank Project Protection of project area with dike and drainage improvement 	Team, AIT for RID/AWB	1992
11	Chao Phraya Flood Management Review	<ul style="list-style-type: none"> Identification of high priority flood management projects for on-going and flood management initiatives Preparation of a conceptual program for basin-wide flood management 	AIT for NESDB/ WB	1996
12	Eastern Suburban - BKK	<ul style="list-style-type: none"> Protection of BMA area between Chao Phraya River and King's dike Improvement of existing system and additional facilities 	NEDECO, Span & WDC for BMA	1996

Note, MP = Master Plan, F/S = Feasibility Study, BKK = Bangkok, WB = World Bank

Table 2.3.3 DRAINAGE SYSTEM COMPONENT FOR EASTERN SUB-URBAN

No.	Item	Unit	Amount	Remark
1	Main Klong			
	Number	Klong	14	
	Total Length	km.	150	
	Average Existing Width	m.	12.0-40.0	
	Average Existing Bottom Level	m + MSL	-4.5 ~ -1.5	
	Average Improvement Bottom Level	m + MSL	-6.0 ~ -3.0	Crest bank level : 1.00 m + MSL
2	Pump Station Along Chao Phraya River			
2.1	Existing			
	Number	station	19	
	Total Pumping Capacity	m ³ /s	433	Real total pumping capacity : 388
2.2	Proposed			
	Pump Station improvement	station	4	
	Total Pumping Capacity (propose)	m ³ /s	94	Phrakhanong P.S., Bang Khen P.S.
	Total Pumping Capacity (existing + proposed)	m ³ /s	527	Bang Chak P.S. & Pracharat No.2 P.S.
3	Tunnel			
	Location : Pracharat No.2 Road (Connect Klong Prem Phrakhanong and Chao Phraya River)			
	Pumping Capacity	m ³ /s	30	
	Diameter of Tunnel	m.	3.4	
	Length	km.	1.82	
4	Regulator in Klong			
	Remove Existing Regulator	regulator	6	
	New Regulator	regulator	3	
5	Retention Pond			
5.1	Main Pond			
	Number	pond	23	
	Total Area	km ²	2.97	
	Total Retention Volume	10 ⁶ m ³	12.53	Including 9 public, 14 Private ponds
	Total Pumping Capacity From Ponds	m ³ /s	177	
5.2	Secondary Pond			
	Number	pond	37	
	Total Area	km ²	2.6	

Note : P.S. = Pump Station

Table 3.2.1 PUMPING STATIONS AND DRAINAGE GATE OF SAMUT PRAKAN (1/3)

Name of Polder / Pumping Station and Drainage Gate	Type	Code	Pump (m ³ /s)		Drainage Gate		Winch			Control Structure
			Rate	Total	Size	No.	Motor	Manual	Weight	
I. K. Samrong (Sam Rong)										
1. K. Wat Yothin	A	S1	1.5	1.5	2.00 x 4.60	1	-	#	3.0	#
			1.0	1.0						
2. K. Ta Pieuk (Sam Rong Tai 4)	A	S2	3.0	3.0	2.00 x 3.75	1	-	#	3.0	#
			1.5	1.5						
3. K. Bang Nang Kreng	A	S3	3.0	12.0	5.00 x 6.40	1	#	-	12.0	#
4. Wat Sam Rong Nua (Sam Rong Tai 1)	A	S4	1.5	3.0	2.00 x 3.75	1	-	#	3.0	#
5. Sam Rong Tai 2	A	S5	3.0	6.0	2.00 x 3.90	1	-	#	3.0	#
6. Si Nakarin Rd.	B	S6	-	-	6.00 x 4.70	1	#	-	12.0	#
7. Soi Wat Dan Sam Rong 1	A	S7	1.5	3.0	2.00 x 3.50	1	-	#	6.5	#
8. Soi Wat Dan Sam Rong 2	A	S8	3.0	6.0	2.00 x 3.50	1	-	#	6.5	#
9. K. Mahawong	A	S9	2.0	4.0	3.00 x 4.00	2	#	-	-	#
10. K. Sam Rong	B	S10								
II. B. Nang Kreng										
1. B. Nang Kreng Tai	A	N1	3.0	12.0	3.00 x 6.00	2	#	-	*	#
2. Drainage Gate No.1	C	N2	-	-	2.00 x 2.50	1	-	#	6.5	#
3. Drainage Gate No.2	C	N3	-	-	2.00 x 3.50	1	-	#	6.5	#
4. Drainage Gate No.3	C	N4	-	-	2.00 x 2.50	1	-	#	6.5	#
5. Drainage Gate No.7 (K. B. Yha Praek)	B	N5	-	-	2.00 x 2.50	1	-	#	6.5	#
6. Drainage Gate No.10 (K. Phoo Yai Paew)	C	N6	-	-	2.00 x 4.50	1	-	#	12.0	-
7. Drainage Gate No.11 (K. Paeng)	C	N7	-	-	2.00 x 2.50	1	-	#	12.0	-
8. Drainage Gate No.8	C	N8	-	-	2.00 x 3.50	1	-	#	6.5	-
9. Drainage Gate No.13 (K. Ta Siea)	C	N9	-	-	2.00 x 3.50	1	-	#	6.5	-
10. Drainage Gate No.14	C	N10	-	-	2.00 x 4.50	1	-	#	12.0	-
11. Drainage Gate No.15 (K. Ta Siea)	C	N11	-	-	2.00 x 3.50	1	-	#	6.5	-
12. Drainage Gate No.16 (K. Ta Plung)	C	N12	-	-	2.00 x 2.50	1	-	#	6.5	-
13. Drainage Gate No.17 (K. Bang Fai)	B	N13	-	-	2.00 x 4.80	1	-	#	*	-
14. Drainage Gate No.18 (K. Bang Pong)	C	N14	-	-	2.00 x 4.80	1	-	#	*	-
15. Wat Suan Som	B	N15	-	-						
III. Muang Pak Nam (Samut Prakan)										
1. K. Ta Porn	A	P1	3.0	15.0	5.00 x 4.80	1	#	-	12.0	#
2. K. Sala Dacng	B	P2	-	-	4.00 x 4.70	1	#	-	12.0	-
3. K. RID	A	P3	3.0	6.0	6.00 x 3.45	1	#	-	12.0	#
4. K. Phuttharukusa	B	P4	-	-	4.00 x 2.70	1	#	-	6.0	-
5. K. Pak Nam	A	P5	2.0	4.0	7.00 x 4.00	1	#	-	-	-
					3.00 x 4.00	1				
IV. Bang Kajao										
1. K. Bang Kra Chao	A	B1	2.0	4.0	4.00 x 6.00	1	#	-	12.0	#
2. Sta. Drainage Gate 0+218.5 dike at Siam Tank Terminal Co. and Sup Sathaporn Co.	C	B2	-	-	2.00 x 4.00	1	-	#	4.0	-
3. Sta. Drainage Gate 0+000 dike at Sup Sathaporn Co. and Nava Charoen Co.	C	B3	-	-	2.00 x 4.00	1	-	#	4.0	-
4. Sta. Drainage Gate 0+320.996 dike at Sup Sathaporn Co. and Nava Charoen Co.	C	B4	-	-	2.00 x 4.00	1	-	#	4.0	-
5. Sta. Drainage Gate 0+998.818 dike at Wat Bang Kra - Chao Nok - B. Kra Chao Rd.	C	B5	-	-	2.00 x 4.00	1	-	#	4.0	-
6. Sta. Drainage Gate 2+570.880 dike at Wat Bang Kra - Chao Nok - B. Kra Chao Rd.	C	B6	-	-	2.00 x 4.50	1	-	#	4.0	-
7. Sta. Drainage Gate 2+886.000 dike at Wat Bang Kra - Chao Nok - B. Kra Chao Rd.	C	B7	-	-	2.00 x 4.00	1	-	#	4.0	-
8. Sta. Drainage Gate 3+8338.800 dike at Wat Bang Kra - Chao Nok - B. Kra Chao Rd.	B	B8	-	-	2.00 x 4.00	1	-	#	4.0	-
9. Sta. Drainage Gate 0+482.200 dike at B. Kra Chao Rd. - K. Bang Kor Bua Bon	C	B9	-	-	2.00 x 4.00	1	-	#	4.0	-
10. Sta. Drainage Gate 0+931.27 dike at B. Kra Chao Rd. - K. Bang Kor Bua Bon	C	B10	-	-	2.00 x 4.00	1	-	#	4.0	-

(to be continued)

Table 3.2.1 PUMPING STATIONS AND DRAINAGE GATE OF SAMUT PRAKAN (2/3)

Name of Polder / Pumping Station and Drainage Gate	Type	Code	Pump (m ³ /s)		Drainage Gate		Winch			Control Structure
			Rate	Total	Size	No.	Motor	Manual	Weight	
11. Sta. Drainage Gate 0 - 031.16 dike at K. Bang Kor Bua Bon - Phet Hueng Rd.	C	B11	-	-	2.00 x 4.00	1	-	#	4.0	-
12. Sta. Drainage Gate 0+653 dike at K. Bang Kor Bua Bon - Phet Hueng Rd.	C	B12	-	-	2.00 x 4.00	1	-	#	4.0	-
13. Sta. Drainage Gate 0+943.18 dike at K. Bang Kor Bua Bon - Phet Hueng Rd.	C	B13	-	-	2.00 x 4.00	1	-	#	4.0	-
14. Sta. Drainage Gate 2+883.71 dike at Wat Bang Nam Pueng Nok - Phet Hueng Rd.	C	B14	-	-	2.00 x 4.00	1	-	#	4.0	-
15. Sta. Drainage Gate 2+295 dike at Wat Bang Nam Pueng Nok - Phet Hueng Rd.	B	B15	-	-	2.00 x 4.00	1	-	#	4.0	-
16. Sta. Drainage Gate 1+480 dike at Wat Bang Nam Pueng Nok - Phet Hueng Rd.	C	B16	-	-	2.00 x 4.00	1	-	#	4.0	-
17. Sta. Drainage Gate 0+910 dike at Wat Bang Nam Pueng Nok - Phet Hueng Rd.	C	B17	-	-	2.00 x 4.50	1	-	#	4.0	-
18. Sta. Drainage Gate 0+477 dike at Wat Bang Nam Pueng Nok - Phet Hueng Rd.	C	B18	-	-	2.00 x 4.50	1	-	#	4.0	-
19. Sta. Drainage Gate 1+279 dike at K. Wat Bang Nam Pueng - Wat Bang Nam Pueng Nok	C	B19	-	-	2.00 x 4.00	1	-	#	4.0	-
20. Sta. Drainage Gate 0+725.126 dike at K. Wat B. Nam Pueng - Wat B. Nam Pueng Nok	C	B20	-	-	2.00 x 4.00	1	-	#	4.0	-
21. K. Wat B. Nam Pueng	A	B21	2.0	4.0	2.00 x 6.00	1	#	-	12.0	#
22. Sta. Drainage Gate 0 - 031.16 dike at K. Wat B. Yor - K. Wat B. Nam Pueng	C	B22	-	-	2.00 x 4.00	1	-	#	4.0	-
23. Sta. Drainage Gate 1+ 166 (K. Dam Luk) dike at K. Wat B. Yor - K. Wat B. Nam Pueng	C	B23	-	-	2.00 x 4.50	1	-	#	4.0	-
24. Sta. Drainage Gate 0+634 dike at K. Wat B. Yor - K. Wat B. Nam Pueng	C	B24	-	-	2.00 x 4.00	1	-	#	4.0	-
25. Sta. Drainage Gate 0+347.112 at K. Wat B. Yor - K. Wat B. Nam Pueng	C	B25	-	-	2.00 x 4.00	1	-	#	4.0	-
26. Sta. Drainage Gate 1+ 446 dike at K. Wat B. Yor	C	B26	-	-	2.00 x 4.00	1	-	#	4.0	-
27. Sta. Drainage Gate 1+ 064 dike at Wat Bang Kra Sob - K. Wat B. Yor	C	B27	-	-	2.00 x 4.00	1	-	#	4.0	-
28. Sta. Drainage Gate 1+ 358.5 dike at Wat Bang Kra Sob - K. Wat B. Yor	C	B28	-	-	2.00 x 4.00	1	-	#	4.0	-
29. Sta. Drainage Gate 0+ 977.84 dike at Wat Chak Daeng - Wat Bang Kra Sob	C	B29	-	-	2.00 x 4.00	1	-	#	4.0	-
29. Sta. Drainage Gate 0+ 977.84 dike at Wat Chak Daeng - Wat Bang Kra Sob	C	B30	-	-	2.00 x 4.00	1	-	#	4.0	-
V. Samut Prakan East Side										
1. K. Praek Sa	B	E1	-	-	4.00 x 4.00	1	#	-	*	-
2. Joint Mouth Canal Drainage Gate	B	E2	-	-	4.00 x 5.20	1	#	-	*	-
3. Seaside Mouth Canal Drainage Gate	B	E3	-	-	4.00 x 5.00	1	#	-	-	#
4. K. Bang Tam Rhu	B	E4	3.0	12.0	4.00 x 5.00	1	#	-	-	#
5. K. Kao	B	E5	-	-	4.00 x 5.00	1	#	-	-	-
6. K. Bang Plee	B	E6	-	-	6.00 x 5.00	1	#	-	-	Roof
7. Chuad Lak Kaow	B	E7	-	-	4.00 x 5.00	1	#	-	-	-
8. King Fah	B	E8	-	-	4.00 x 5.00	1	#	-	-	-
VI. Ratburana										
1. Soi Suk Sawat 70 (1)	B	R1	-	-	2.00 x 4.00	1	-	#	4.0	-
2. Soi Suk Sawat 70 (2)	C	R2	-	-	2.00 x 4.40	1	-	#	4.0	-
3. Soi Suk Sawat 70 (3)	C	R3	-	-	2.00 x 4.40	1	-	#	4.0	-
4. Soi Suk Sawat 70 (4)	C	R4	-	-	2.00 x 4.40	1	-	#	4.0	-
5. Soi Suk Sawat 70 (5)	C	R5	-	-	2.00 x 4.00	1	-	#	4.0	-
6. K. Lud Tanong	A	R6	1.5	3.0	2.00 x 4.40	1	-	#	4.0	-
7. K. Lud Luang	A	R7	3.0	12.0	3.40 x 6.60	2	#	-	-	#

to be continued

Table 3.2.1 PUMPING STATIONS AND DRAINAGE GATE OF SAMUT PRAKAN (3/3)

Name of Polder / Pumping Station and Drainage Gate	Type	Code	Pump (m3/s)		Drainage Gate		Winch			Control Structure
			Rate	Total	Size	No.	Motor	Manual	Weight	
8. K. Chaeng Ron	B	R8	3.0	9.0	4.00 x 4.50	1	#	-	-	-
9. K. Lud Luang RID	B	R9	-	-	6.00 x 4.50	2	#	-	-	-
VII. K. Ta Kwen		T								
1. K. Tha Kien	A	T1	3.0	6.0	3.00 x 4.50	1	#	-	6.0	#
2. K. Thup Chin	A	T2	2.0	4.0	1.50 x 2.00	1	#	-	4.0	#
3. K. Lhod	A	T3	2.0	4.0	1.50 x 2.00	1	#	-	4.0	#
4. K. Wat Khoo Sang Rd.	C	T4	-	-	2.00 x 4.00	1	#	-	-	-
VIII. Bang Kru		K								
1. K. Kru Nai	A	K1	3.0	6.0	3.00 x 4.50	1	#	-	-	#
2. K. Ta Yuang	A	K2	3.0	6.0	3.00 x 4.50	1	#	-	-	#
3. K. Bang Chak	A	K3	3.0	6.0	3.00 x 4.50	1	#	-	-	#
4. K. Bang Chak (Pracha Uthid Rd.)	B	K4	-	-	4.00 x 4.50	1	#	-	-	-
5. Drainage Gate No. 1	C	K5	-	-	2.00 x 3.50	1	#	-	-	-
6. Drainage Gate No. 2	C	K6	-	-	2.00 x 3.50	1	#	-	-	-
7. Drainage Gate No. 3	C	K7	-	-	2.00 x 3.50	1	#	-	-	-
8. Drainage Gate No. 4	C	K8	-	-	2.00 x 3.50	1	#	-	-	-
9. Drainage Gate No. 5	C	K9	-	-	2.00 x 4.00	1	#	-	-	-
IX. West Bank Mitigation Area		W								
1. K. Kra Aom	B	W1	3.0	9.0	6.00 x 5.00	1	#	-	-	#
2. K. Suan	B	W2	3.0	18.0	6.00 x 5.00	1	#	-	-	#
3. K. Na Kua Noi Drainage Gate (K. Kra Aom Nai ~ Wat K. Suan)	C	W3	-	-	2.00 x 4.00	1	#	-	4.0	#
4. Klong 1	C	W4	-	-	2.00 x 4.00	1	#	-	4.0	-
5. Klong 2	C	W5	-	-	2.00 x 4.00	1	#	-	4.0	-
6. Klong 3	C	W6	-	-	2.00 x 4.00	1	#	-	4.0	-
7. Klong 4	C	W7	-	-	2.00 x 4.00	1	#	-	4.0	-
8. Klong 5 (Wat K. San ~ K. San)	C	W8	-	-	2.00 x 3.50	1	#	#	4.0	-
9. Klong 6	C	W9	-	-	2.00 x 4.00	1	#	-	4.0	-
10. Klong 7	C	W10	-	-	2.00 x 3.50	1	#	-	4.0	-
11. Klong 8	C	W11	-	-	2.00 x 4.00	1	#	-	4.0	-
12. K. Sa Rhai	B	W12	-	-	2.00 x 4.00	1	#	-	4.0	-
13. K. Rang Pho	C	W13	-	-	2.00 x 4.00	1	#	-	4.0	-
14. K. Rang Noi	C	W14	-	-	2.00 x 4.00	1	#	-	4.0	-
15. K. Na	B	W15	-	-	2.00 x 4.00	1	#	-	4.0	-
16. K. Rang Pho	B	W16	-	-	2.00 x 4.00	1	#	-	4.0	-
17. K. Rang Phai	C	W17	-	-	2.00 x 4.00	1	#	-	4.0	-
18. K. Rang Kae	C	W18	-	-	2.00 x 4.00	1	#	-	4.0	-
19. K. Tha Kham	C	W19	-	-	2.00 x 4.00	1	#	-	4.0	-
20. K. San Chao	C	W20	-	-	2.00 x 3.50	1	#	-	4.0	-
21. K. Ta O	B	W21	-	-	2.00 x 4.00	1	#	-	4.0	-
22. K. Wat Lao	C	W22	-	-	2.00 x 4.00	1	#	-	4.0	-
23. K. Bua	C	W23	-	-	2.00 x 3.00	1	#	-	4.0	-
24. K. Lud Kok	C	W24	-	-	2.00 x 3.00	1	#	-	4.0	-
25. K. Bang Mod	B	W25	-	-	2.00 x 4.50	1	#	-	4.0	-
26. K. Bang Khun Tien	B	W26	-	-	2.00 x 4.50	1	#	-	4.0	-

Table 4.1.1 FLOOD DAMAGE OF MAJOR DISTRICTS IN NAKHON SAWAN (1996)

Item	District	Nakhon Sawan	Chumsaeng	Lat Yao	Kao Leio	Krok Phra	Phayuha Khiri	Banphot Phisai	Total
Adjacent River		* Three rivers	Nan	Western Mt.	Ping	Chao Phraya	Chao Phraya	Ping	
Start of Flooding		28, Sept.	2, Sept.	2, Sept.	2, Sept.	26, Sept.	30, Sept.	25, Sept.	
Damaged Area		13 sub-districts (47 villages)	3 sub-districts & 1 sanitary area	5 sub-districts & 1 sanitary area	4 sub-districts	-	4 sub-districts (37 villages)	13 sub-districts (109 villages)	42 sub-districts & 2 sanitary area
Houses Damaged		5,940	8,690	-	4,330	7,816	4,500	2,014	33,290
People Affected		19,340	30,420	-	17,940	13,382	-	8,056	-
Houses Evacuated (No.)		-	-	-	5	-	-	-	5
People Evacuated (No.)		-	-	-	20	-	-	-	20
Road Section Damaged (No.)		67	79	131	78	65	53	36	509
(Cost)		-	6.9 M.B.	-	-	-	3.7 M.B.	1.4 M.B.	-
Bridge Damaged (No.)		-	-	-	3	-	2	1	6
(Cost)		-	-	-	-	-	500,000 B.	20,000 B.	-
Temple Damaged (No.)		-	-	15	5	-	-	-	20
(Cost)		-	-	-	-	-	-	-	-
School Damaged (No.)		-	-	-	8	-	-	-	8
River Bank Damaged (Section)		-	-	-	-	-	9	-	9
Irrigation Canal Damaged (Section)		-	-	-	-	-	-	2	2
(Cost)		-	-	-	-	-	-	300,000 B.	300,000 B.
Fish Pond Damaged (No.)		379	2,143	-	173	46	-	190	2,951
(Cost)		45.6 M.B.	14.3 M.B.	-	1.2 M.B.*	113,000 B.	-	12.5 M.B.	73.7 M.B.*
Live Stock Damaged (Cost)		40,000 B.	70,875 B.	-	-	-	-	500,000 B.	610,875 B.
Firm Land Affected (Cost)		52.6 M.B.	51.3 M.B.	-	79,850 B.	-	-	15 M.B.	119 M.B.
Firm Land Affected (ha.)		3,778	13,444	12,466	-	2,102	-	18,926	50,716
Paddy Field (ha.)		3,432	12,648	11,723	-	2,102	-	18,566	48,471
Other Field (ha.)		346	796	743	-	-	-	360	2,245
Rise of Flooded Water (m)		-	0.17-0.67	-	0.5-1.5	-	-	-	-
Remarks		* Ping, Nan & Chao Phraya			* Live stock included				* Live stock in Kao Leio is included

Source : Detailed Design of Flood Protection System for Nakhon Sawan Province (P.W.D.)

Table 4.2.1 DRAINAGE AND FLOOD PROTECTION SYSTEM FOR CHAINAT, IT'S VICINITY AND WAT SING

Type	Location	Muang Chai Nat			Ban Kluay			Tha Chai			Had Tha Sao			Wat Sing				
		Facility	Unit	Quantity	E. Cost	S/total	Quantity	E. Cost	S/total	Quantity	E. Cost	S/total	Quantity	E. Cost	S/total	Quantity	E. Cost	S/total
Flood Protection	Asphaltic Road (H=0.35m)	m	288	0.5														
	Asphaltic Road (H=0.5m)	m																
	Asphaltic Road (H=0.7m) with Retaining Wall (H=0.7m)	m	187	6.7														
	Asphaltic Road (H=1.1m)	m																
	Asphaltic Road (H=1.6m)	m																
	Walkway along Road (H=0.5m)	m	2,122	2.6														
	Unpaved Gravel Road (H=1.0m)	m																
	Earth Dike along Road (H=1.0m)	m	95	0.1														
	Flood Protection Wall (H=0.8m, 1.0m)	m																
	Flood Protection Wall (H=0.5m)	m	1,600	8.6														
Flood Protection Wall (H=0.5m - 1.5m)	m																	
Flood Protection Wall (H=1.6m) with Riprap (H=0.5m) with Riprap (H=1.0m)	m	150	4.0															
Riprap	m																	
Retaining Wall	m																	
Pump House Station	station	1	4.5															
Pump 0.36 cms.	set	3	5.7															
Mobile Pump Sump	station																	
Mobile Pump 0.35 cms	set																	
Mobile Pump 0.5 cms	set																	
Drainage Pipe	lump sum	1	21.3															
Pipe Jacking Dia. 1.0 m	m																	
Box Culvert (1.5 m x 1.5 m)	m																	
Gate	m																	
Sluice Gate on Pipe Dia. 1.0 m	set																	
Sluice Gate on Pipe Dia. 1.5 m	set																	
Sluice Gate on Pipe Dia. 0.4 m, 0.5 m	set																	
Xlong Improvement with Concrete Lining	m																	
Xlong Improvement	m																	
Concrete Ditch	m																	
Total			31.5															
			54.0															
Contingency 20%			10.8															
Profit + Administration 15%			9.7															
Val. 10%			7.4															
Grand Total			82.0															

Note : Cost = Million Bahts, E. Cost = Estimated Cost, S/total = Sub total

Table 4.3.1 FLOOD PROTECTION AND DRAINAGE SYSTEM FOR SING BURI, IN BURI AND PROM BURI

Type	Location		Sing Buri		In Buri		Prom Buri		Pak Bang	
	Facility	Unit	Quantity	E. Cost	Quantity	E. Cost	Quantity	E. Cost	Quantity	E. Cost
	Flood Protection	New Dike	m	24,200	993.4	11,000	472.4	4,500	84.7	5,450
	Old Dike Renovation	m	3,060	41.7						
	Sub-total			1,035.1		472.4		84.7		175.9
Drainage	Drainage Pump	Nos.			6	50.0				
	0.4 ~ 0.7 cms	Nos.	15	251.5						
	1.0 ~ 8.0 cms	Nos.	1	10.5					3	23
	1.2 cms (City Hall Area)	Nos.								
	0.4 cms & 0.5 cms	Nos.								
	0.5 cms & 0.7 cms	Nos.					2	17		
	Mobile Pump 1.0 ~ 2.5 cms	Nos.	10	95.6						
	Main Drainage Pipe									
	(Dia. 0.6 ~ 1.2m)	m	21,410	116.4						
	(Dia. 0.6 ~ 1.5 m)	m			9,100	49.4			4,100	22.6
	City Hall Area (Dia. 0.6 ~ 1.5 m)	m	1,950	10.4						
	Regulator & Gates	Nos.	10	13.7					2	1.6
	Drainage Ditch	m	2,680	2						
	Sub-total			500.1		104.2		41.2		53.6
Total				1,535.2		576.6		125.9		229.5
Contingency 10.0%				153.5		57.7		12.6		22.9
Proceedings 3.5%				59.1		22.1		4.8		8.8
Profit 6.5%				113.6		42.7		9.3		17
Tax 7.96%				148.2		55.7		12.2		22.1
Grand Total				2,009.6		754.8		164.8		300.3

Note : Cost = Million Bahts, E. Cost = Estimated Cost

**Table 4.5.1 OVERALL FLOOD PROTECTION AND DRAINAGE SYSTEM
OF AYUTHAYA AND ITS VICINITY**

Polder Name		Area (m ²)	Facility	Unit	Quantity	Estimated Cost	Total Cost
A-1	Ko Muang/ Phu Kao Thong	13.0	Flood Barrier	m	16,030	157.5	324.4
			Regulator / Gate	Nos.	10	48.6	
			Bridge Improvement	Nos.	2	4.4	
			Pump Station (27.5 cms)	Nos.	4	100.1	
			Canal Improvement	cum.	100,540	5	
			Main Drain	m	180	7.6	
			Control Building	Nos.	2	0.7	
A-2	Ayothaya	6.8	Flood Barrier	m	17,450	197.8	306.2
			Regulator / Gate	Nos.	16	38.2	
			Bridge Improvement	Nos.	4	8.8	
			Pump Station (15.0 cms)	Nos.	2	55	
			Canal Improvement	cu.m	126,400	6.3	
A-3	Huntra	5.4	Flood Barrier	m	11,820	72.3	119.3
			Regulator / Gate	Nos.	11	8.8	
			Bridge Improvement	Nos.	2	4.4	
			Pump Station (9.0 cms)	Nos.	1	32	
			Canal Improvement	cu.m	35,850	1.8	
A-4	Maheyong	3.5	Flood Barrier	m	8,560	144.8	206.2
			Regulator / Gate	Nos.	7	9.4	
			Bridge Improvement	Nos.	2	4.4	
			Pump Station (9.0 cms)	Nos.	1	32	
			Canal Improvement	cu.m	34,400	1.7	
			Main Drain	m	320	13.4	
			Control Building	Nos.	1	0.4	
A-5	Ban Pom	1.8	Flood Barrier	m	6,570	51	78.1
			Regulator / Gate	Nos.	2	4	
			Pump Station (6.0 cms)	Nos.	1	22.5	
			Canal Improvement	cu.m	12,200	0.6	
A-6	Wat Chaiwathanaram	1.5	Flood Barrier	m	5,760	49	67.8
			Regulator / Gate	Nos.	2	4	
			Pump Station (3.0 cms)	Nos.	1	13.5	
			Canal Improvement	cu.m	26,270	1.3	
A-7	San Pao Lom	5.0	Flood Barrier	m	9,970	90.3	140.2
			Regulator / Gate	Nos.	8	22.1	
			Bridge Improvement	Nos.	1	2.2	
			Pump Station (6.0 cms)	Nos.	1	22.5	
			Canal Improvement	cu.m	62,060	3.1	
Grand Total							1241.7
Contingency 20%							248.3
Engineering Service 5 %							74.5
Preliminary Project Cost							1,564.50

Remark : Cost = Million Bahts

Table 4.7.1 GATE AND PUMP FOR NONTHABURI - EAST BANK

No.	Location	Gate		Existing pump			Required pump	Note
		Size (m)	Number	Unit. capa. (m ³ /s)	Number	Total capa. (m ³ /s)	Total capa. (m ³ /s)	
1	Kl. Bang Khen Kao	6	1	3	3	9	21	Control & drainage Movable pump
2	Kl. Bang Boon Nak	4	1	0.5	2	1	1.5	
3	Kl. Bang Khun Tien	4	1	0.5	3	1.5	3	
4	Kl. Bang Tanao Si	4	1	3	2	6	12	
5	Kl. Bang Kwang	2.1x 2.4	1	-	-	-	1.5	
6	Kl. Bang Phrack 1	6	1	3	2	6	9	
7	Kl. Bang Phrack 2	2.7x 3.0	1	0.5	3	1.5	1.5	
8	Kl. Makham Phrong	2.7x 3.0	1	0.5	3	1.5	9	
9	Kl. Bang Sue Noi	6	1	3	2	6	12	
10	Kl. Bang Kra Sor	4	1	0.5	2	1	9	
11	Kl. Bang Soi Thong	4	1	0.5	3	1.5	9	
12	Kl. Bang Thorance	4	1	3	2	6	12	
13	Kl. Wat Tam Nuk	2.0x 2.4	1	-	-	-	3	
14	Kl. Tha Sai	4	1	0.5	3	1.5	6	
15	Kl. Bang Talad	6	1	3	4	12	30	
				Total		54.5	139.5	

Table 4.7.2 GATE AND PUMMP FOR NONTHABURI - WEST BANK

No.	Location	Gate		Required pump		
		Size (m)	Number	Unit. capa. (m ³ /s)	Number	Total capa. (m ³ /s)
1	Kl. Bang Yai	4	2	3	2	6
2	Kl. Bang Prapimol	5	3	3	2	6
3	Kl. Bang Lemnua	6	1	1.5	2	3
4	Kl. Pra Udom	5	4	3	4	12
5	Kl. Bang Pum	5	1	0.75	2	1.5
6	Kl. Bang Wat	4	1	0.75	2	1.5
7	Kl. Bang Plub	5	2	0.75	2	1.5
8	Kl. Bang Noy	5	1	0.75	2	1.5
9	Kl. Bang Bua Thong	6	4	3	4	12
10	Kl. Watdaeng	4	1	1.5	2	3
11	Kl. Lummadan	6	1	0.75	2	1.5
12	Kl. Bang Suanpik	5	1	0.75	2	1.5
13	Kl. Om Non	5	7	3	5	15
14	Kl. Bang Sri Thong	4	1	0.5	3	1.5
15	Kl. Bang Pai Yai	3	1	0.75	2	1.5
16	Kl. Bang Pai Noy	3	1	0.75	2	1.5
17	Kl. Bang Kruay	4	4	3	2	6
18	Kl. Bangkok Noi	12.5	5	3	4	12
19	Kl. Bang Na	1.5	1	1.5	2	3
20	Kl. Ku Kwang	4	1	0.75	2	1.5
				Total		94.5

Table 4.8.1 IMPLEMENTATION SCHEDULE OF FLOOD PROTECTION AND DRAINAGE SYSTEM OF MAJOR URBAN AREAS (NAKHON SAWAN TO NONTHABURI)

No. Protection Area	Description	Facility	Return Period		Return Period (yr)	Dike Elevation (m)	Implementation plan													C. Cost (Mill. Baht)					
			Local Facility	Return Period (yr)			Return Period (yr)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011		2012	2013	2014	2015	2016
1	N. Sawan (West Bank) P. Muni.	Dike	24.4-28.7	100	28.0-29.0	0.4	21.0	61.5																	1,475.1
	Muang N. Sawan						105.8																		2,690.0
	Chumtseang																								48.7
	Keok Phra																								48.6
	S. D.																								136.2
	S. D.																								82.0
2	Chaiyaphum / East					0.5	11.2	2.2																	54.2
	A. Muang Chai Nat	Dike	17.6-18.7	100	18.7-19.0		4.0	1.1																	120.4
	East bank	Dike	17.0-17.8	100	18.1-18.6		7.2	1.1																	63.5
	Ban Kruay	Dike	17.5-18.6	100	18.5-18.9		6.4	1.8																	56.9
	Chai Nat / West	Dike	17.6-18.2	100	18.5-18.9		3.1	1.1																	62.4
	Tha Chai	Dike	18.2-19.2	100	19.0-19.15		3.3	0.7																	2,009.8
	Had Tha Sro	Dike	18.2-19.2	100	19.0-19.15		3.3	0.7																	1,144.0
	Had Tha Sro Muni.	Road	18.5-18.6	100	20		0.5	1.0																	606.0
3	Sing Buri	Dike	15.06	100	15.25	0.5	11.98	35.5																	82.5
	Sub-area 1&5						6.15	35.5																	147.3
	Sub-area 7&8						4.99																		754.8
	Sub-area 2&6						0.69																		474.1
	Sub-area 3						0.15																		135.4
	In Buri						3.32	3.4																	145.9
	Sub-area 2&3						1.71	1.5																	462.4
	Sub-area 4						0.51	0.5																	165.0
	Sub-area 1						1.10	1.4																	147.1
	Phrom Buri						2.37	2.5																	153.3
	Bang Nam Chio	Dike	RID D.	100			1.23	1.2																	2,000.6
	Sub-area 1,2																								726.7
	Sub-area 2						0.51	0.5																	949.5
	Sub-area 1&3						0.63	0.8																	324.1
4	Ang Thong	Dike	8.3-8.75	100	9.0	0.2	12.87	27.00																	804.2
	Talat Luang (W. bank)	Dike	8.3-8.75	100	9.0	0.2	6.07	5.0																	1,029.8
	Bang Keo (E. bank)	Dike	8.3-8.4	100	9.0	0.2	1.52	3.0																	591.4
	Talat Keut	Dike		100	9.0	0.2	7.46	13.5																	419.4
	Panok (S.D)			100			7.80	12.0																	172.0
5	Ayatbaya	Road	4.6-6.1	100	6.0		18.41	39.5																	1,606.8
	Ko Muang	Road	4.7-6.1	100	6.0		13.0	27.5																	292.9
	Ayatbaya	Road	4.7-6.1	100	6.0		5.41	12.0																	705.5
	Pachum Thani	Rd., Dike	2.0-2.6	100	3.7-4.0	0.4-0.6**	119.4	103.0																	618.4
	Muang Pathum T.	Road	2.5-3.4	100	3.7-4.0	0.4-0.6**	8.8	16.0																	3,715.3
	B. Luang / Chiang Rak	Road	2.5-3.4	100	3.7-4.0	0.4-0.6**	39.5	36.0																	
	B. Pho Sai / B. Luang	Road	2.5-2.7	100	3.7-3.8	0.4-0.6**	71.1	51.0																	
7	Nonthaburi						252.5	224.0																	
	Pak Kret	East bank	2.6	100	2.85-3.0	0.5**	82.5*	54.5																	
	Pak Kret	East bank	3.15	100	2.85-3.15	0.5**	3.0	15.0																	
	Nonthaburi	Road		100	2.85-3.15	0.5**	150.0	94.5																	
	Nonthaburi	East bank	1.33-1.58	100	2.85-3.15	0.5**	3.0	15.0																	
	B. Krui, B. Bus Thong	West bank	1.43-2.23	100	2.85-3.15	0.5**	150.0	94.5																	
	Patra Area	West bank					566.4	516.9																	
K																									

Note: ■ Detailed Design, □ Bidding, ■ Under Construction, ■ Implementation, * Total area of East Bank, ** 0.4-Concrete dike, 0.6 : Earth dike, *** Including land subsidence : 0.2m P. Area = Polder Area, P. Capas. = Pump Capacity, P. Muni. = Provincial, Municipality, Muni. = Municipality, S.D. = Sanitary District, D / W = Dike & Wall, C. Cost = Construction Cost (Price level : 1997), F. board is depends on the flood situation along the dike

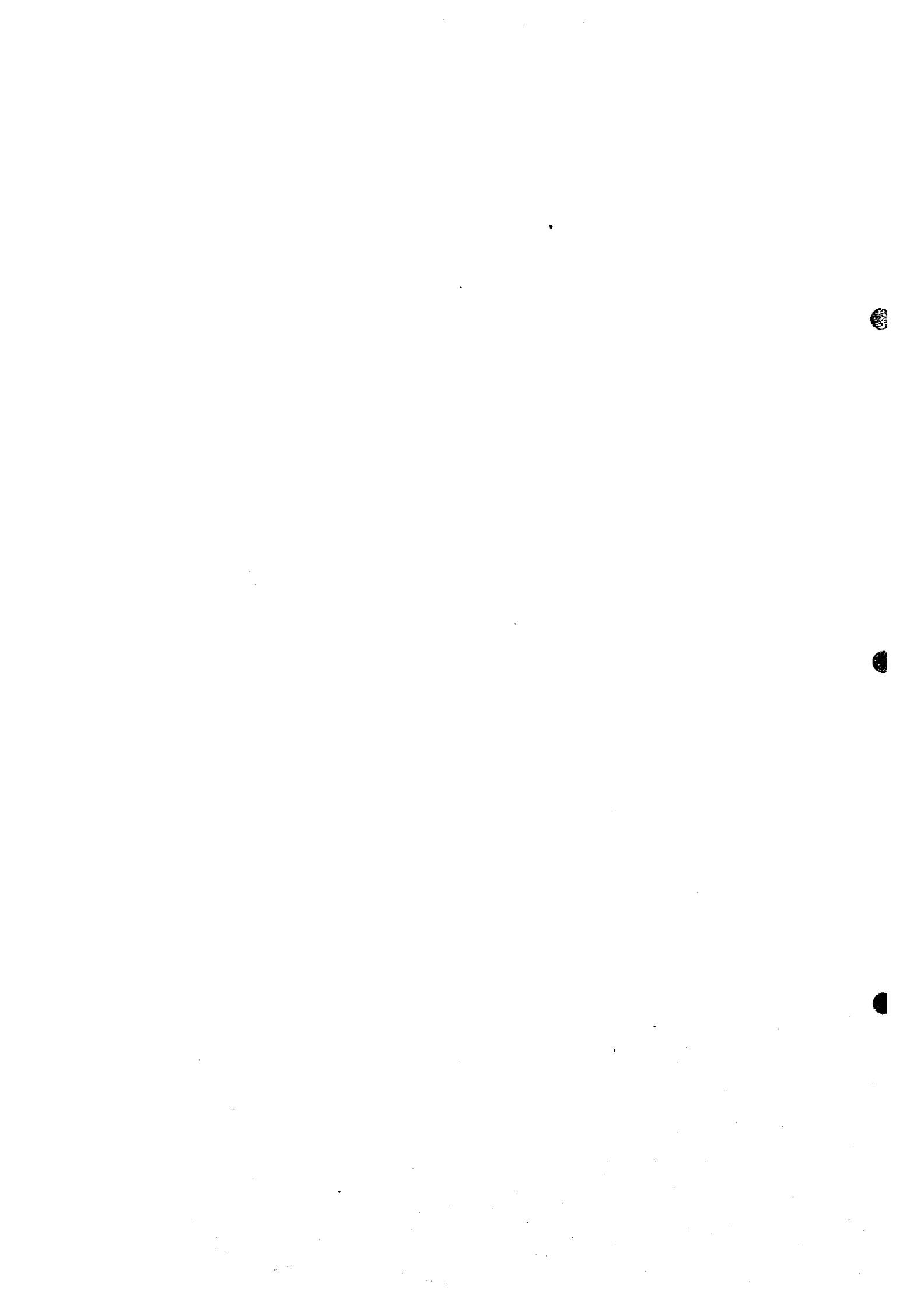
Table 5.10.1 IMPLEMENTATION SCHEDULE OF FLOOD PROTECTION AND DRAINAGE SYSTEM OF SECONDARY PRIORITY AREAS

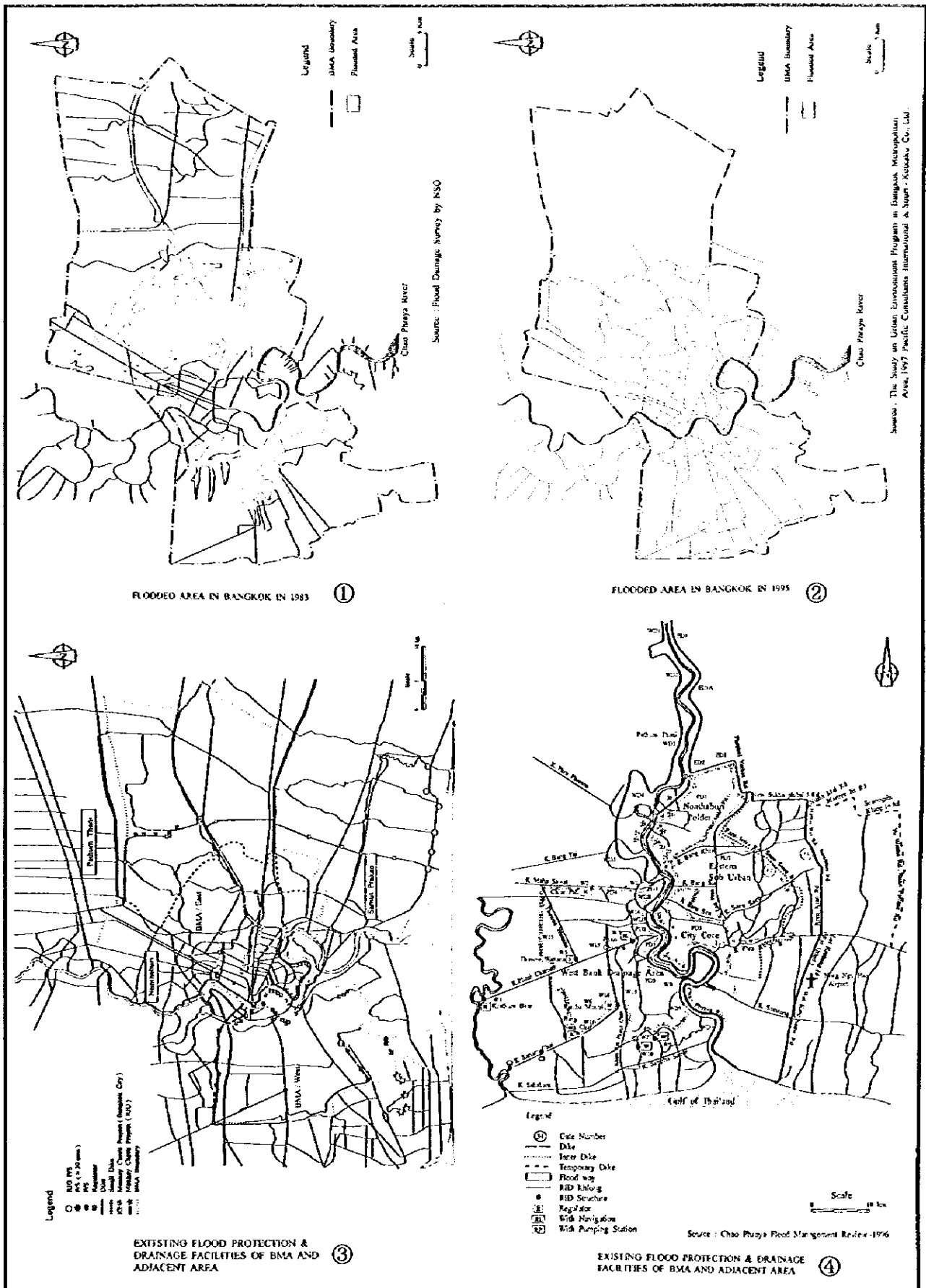
No.	Location	Description	Flood Protection Plan		P. Caps. (cms)	Implementation plan													C. Cost (Mill. Bahts)	Remarks								
			Facility	Return Period No. of Drain./Flood Pump St.		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010			2011	2012	2013	2014	2015	2016	2017	2018
1	Subthotai Sawankhalok	P. Muni. Muni.	Polder	5 100	3	24.0																				312.3		
		Dike	5 100	2	16.0																						331.2	
2	Uttaradit	P. Muni.	Polder	5 100	1	10.0																					341.3	
3	Phitsanulok	P. Muni.	Polder	5 100	3	59.0																					766.5	
	B. Rakkam	S.D.	Polder	5 100	2	6.0																					141.2	
	B. Krathum	S.D.	Polder	5 100	1	8.5																					137.3	
	Phrom Phiram	S.D.	Polder	5 100	1	1.0																					81.5	
4	Phichit	P. Muni.	Polder	5 100	2	14.0																					275.1	
	Thaplan Hin	Muni.	Polder	5 100	2	10.0																					312.7	
	B. Muang Nak	Muni.	Polder	5 100	3	14.0																					325.4	
	Pho Thale	S.D.	Polder	5 100	3	12.0																					174.3	
5	Uthai Thani	P. Muni.	Polder	5 100	1	14.0																					230.1	
6	Suphan Buri	P. Muni.	Polder	5 100																							643.0	
	Songseong	Muni.	Polder	5 100	3	6.0																					317.0	
	Phai Khong Din	S.D.	Polder	5 100	2	2.0																					95.8	
	Ben Leam	S.D.	Polder	5 100	2	2.0																					85.6	
	B. Pia Ma	S.D.	Polder	5 100	2	2.0																					136.9	
	Khoek Khram	S.D.	Polder	5 100	3	2.5																					174.9	
7	Nakhon Phathom	P. Muni.		5 100	1	3.0																					332.5	
	Rang Krathum	S.D.	Polder	5 100	Nil	-																					34.6	
	B. Luang	S.D.	Polder	5 100	Nil	-																					14.9	
	B. Leng	S.D.	Polder	5 100	Nil	-																					49.5	
8	Samut Sakhon	P. Muni.	Polder	5 100	7	-																					3,968.2	
	Om Noi		Dike	5 100	Nil	-																					58.7	
9	Lop Buri	P. Muni.	Dike	5 100	**	**																					393.4	
	Tha Wung	S.D.	Polder	5 100	Nil	-																					40.7	
	Tha Kleng	S.D.	Polder	5 100	Nil	-																					32.5	
10																											total	9,809.1

Note: Feasibility Study & Detailed Design. Implementation. P. Muni. = Provincial Municipality, Muni. = Municipality, S.D. = Sanitary District, P. Capa. = Pump Capacity
 C. Cost = Construction Cost (Price level : 1998)



Figures

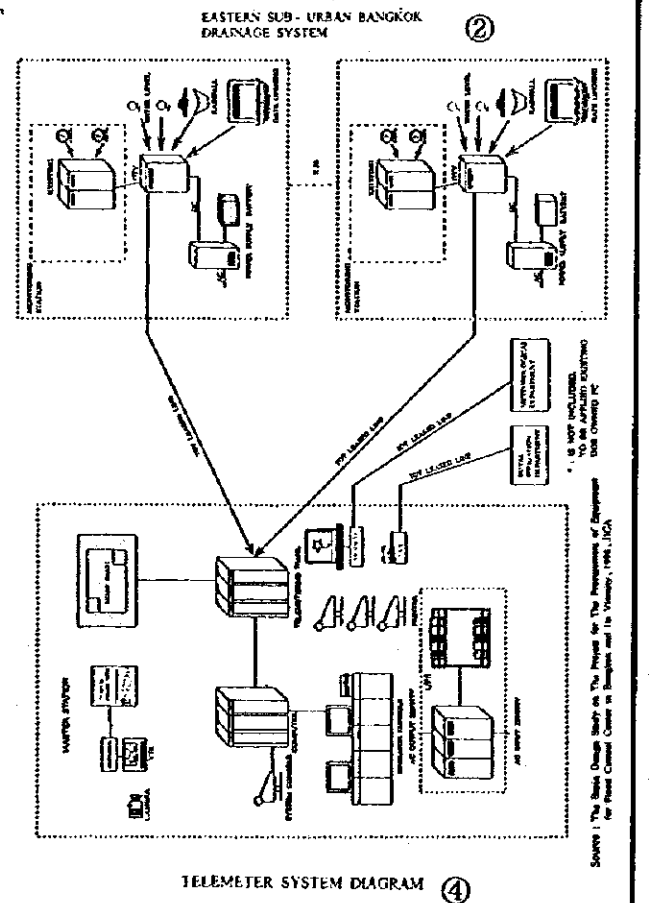
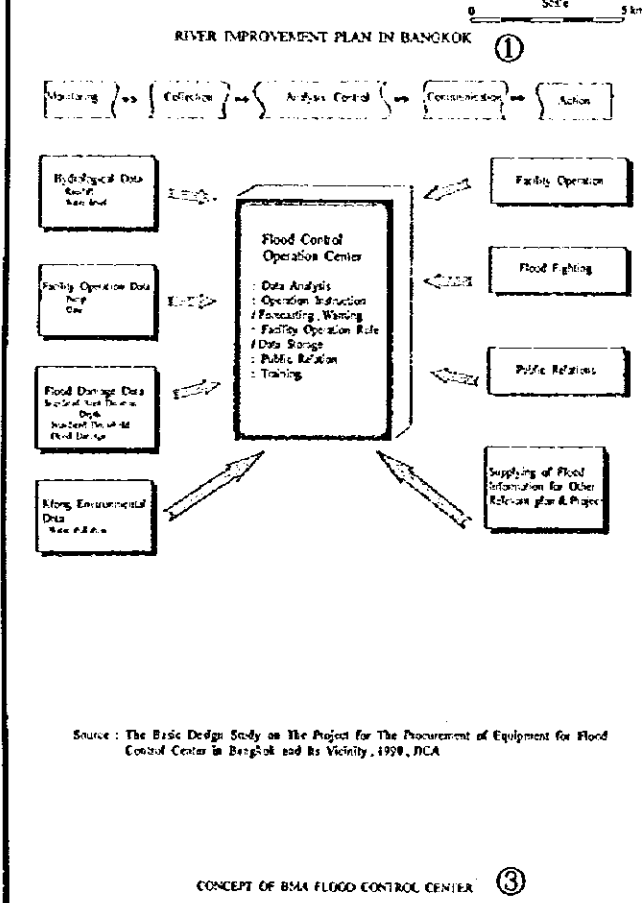
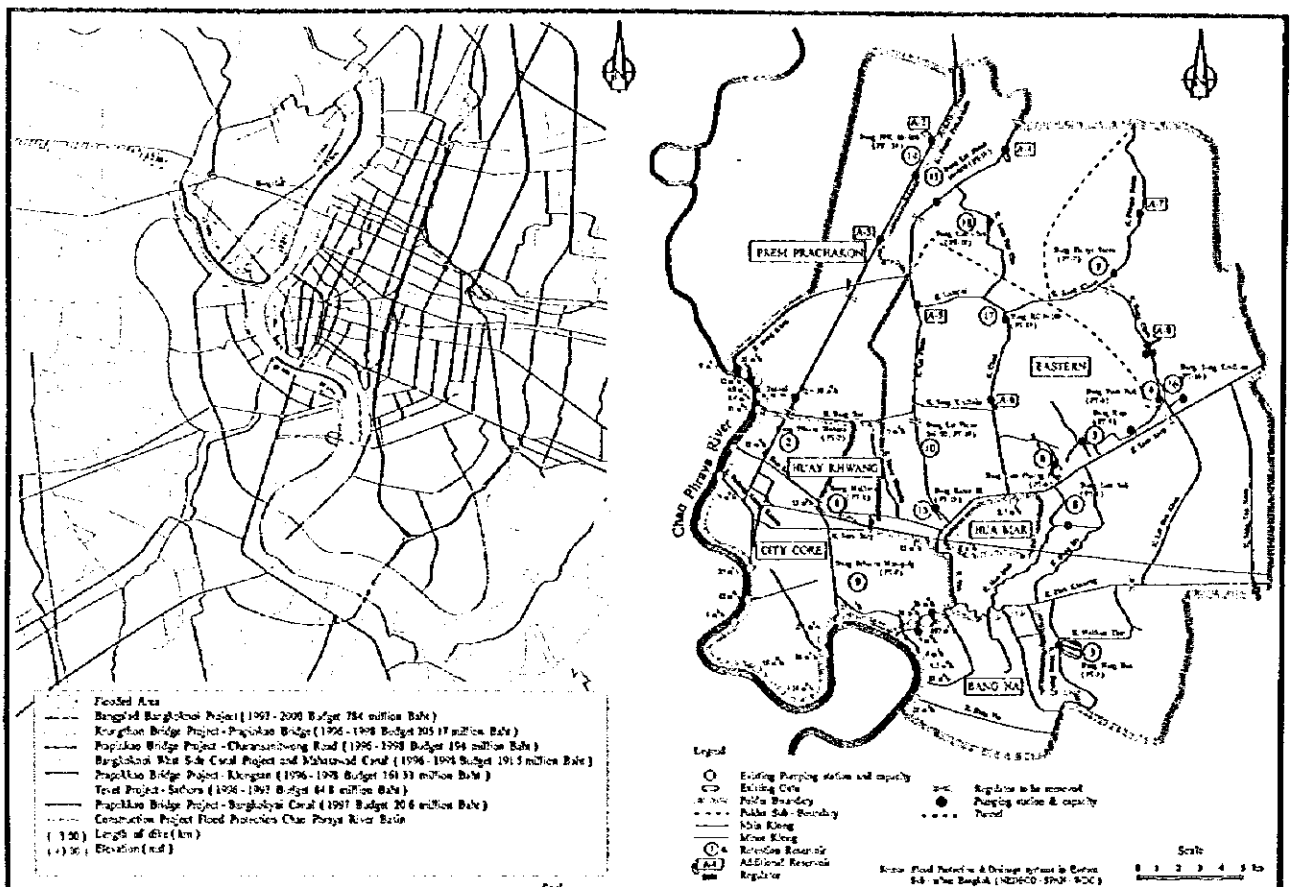




STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

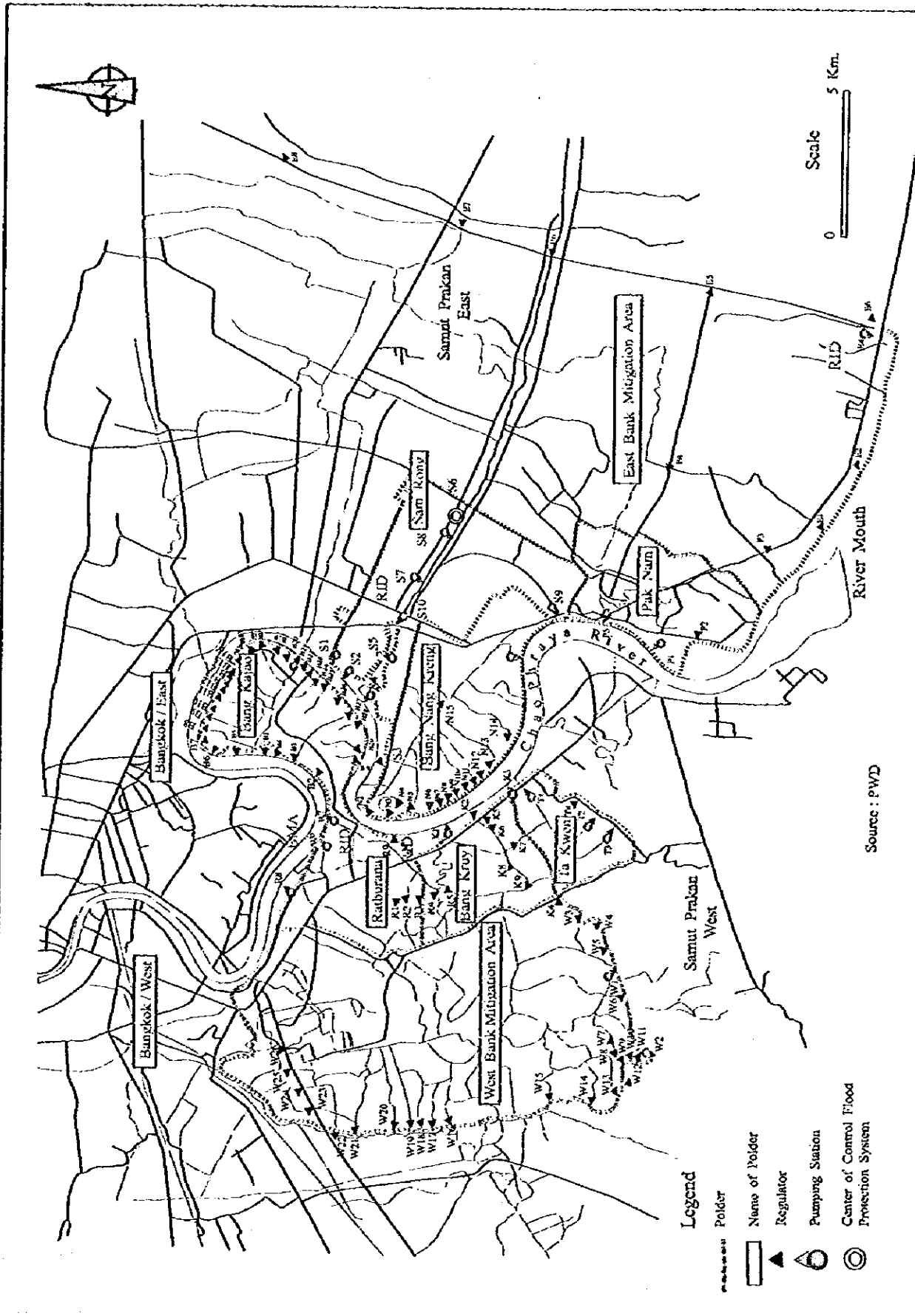
CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 2.1.1
 FLOODED AREA, AND EXISTING FLOOD PROTECTION AND DRAINAGE FACILITIES OF BMA AND ADJACENT AREA



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN
CTI ENGINEERING CO., LTD AND INA CORPORATION

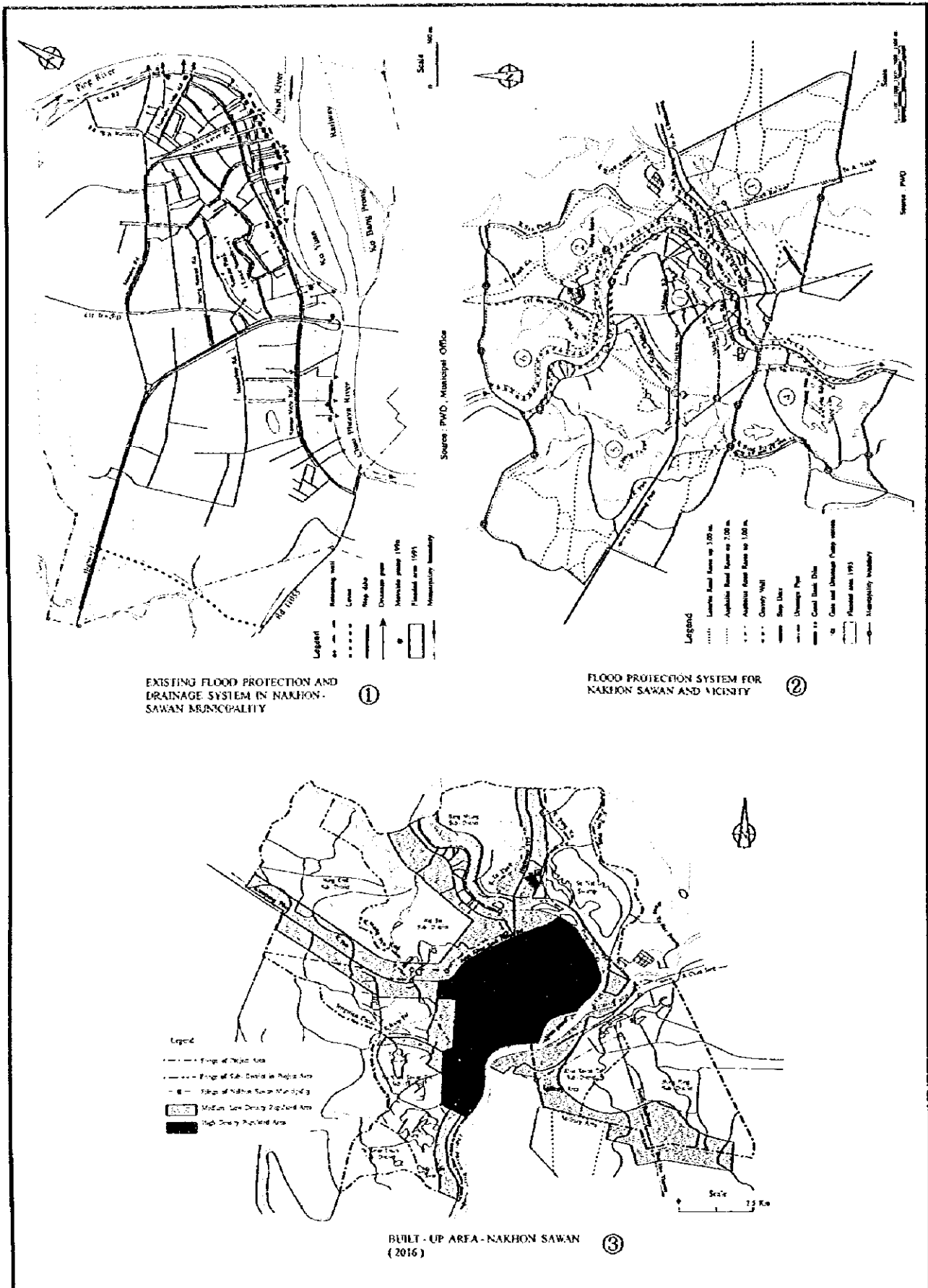
Fig. 2.3.1
RIVER IMPROVEMENT PLAN, EASTERN SUB-URBAN DRAINAGE SYSTEM AND OUTLINE OF FCC OF BMA



Source : PWD

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN
 CTI ENGINEERING CO., LTD AND INA CORPORATION

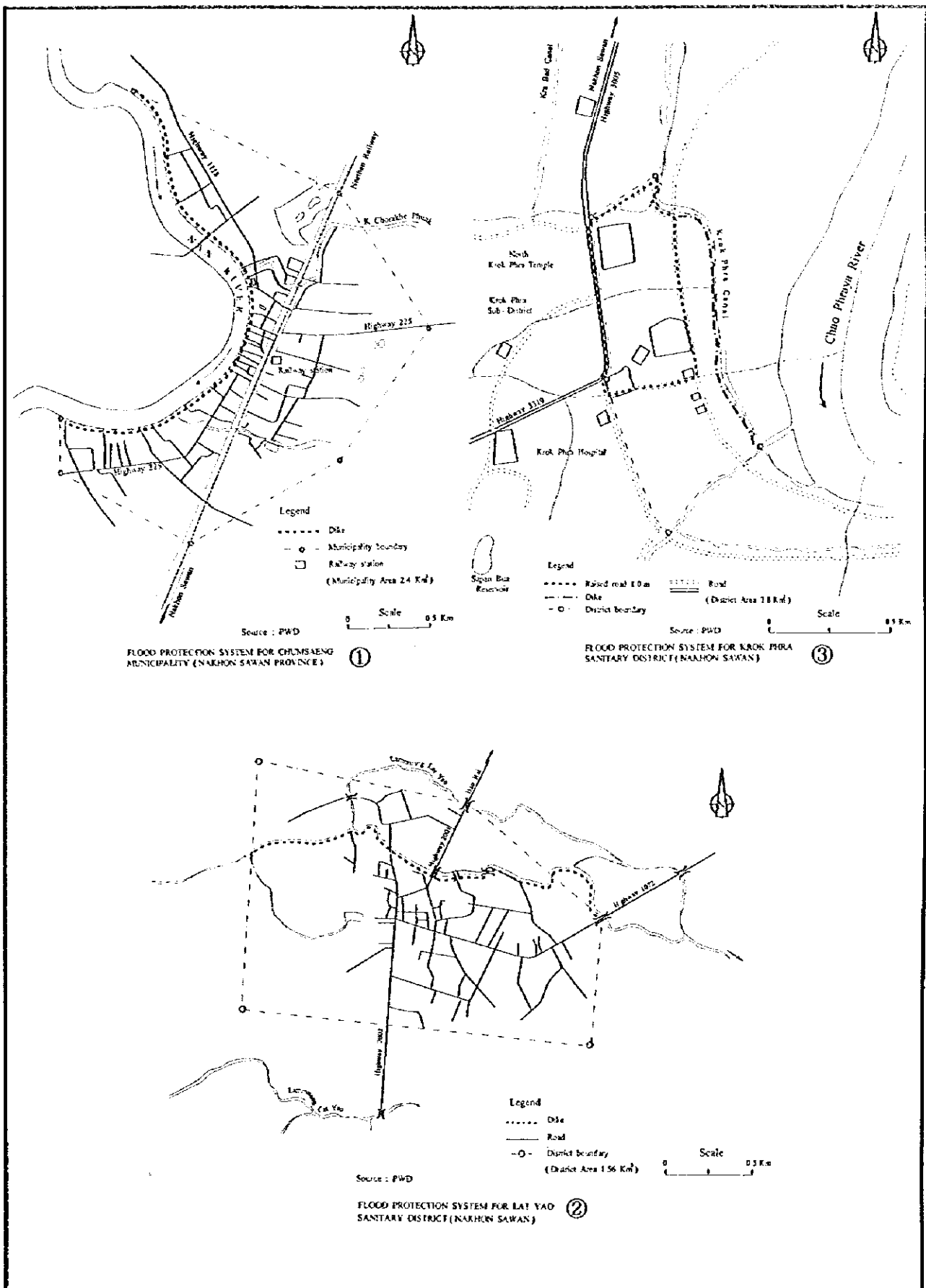
Fig. 3.2.1
FLOOD PROTECTION AND DRAINAGE FACILITIES OF SAMUT PRAKAN



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

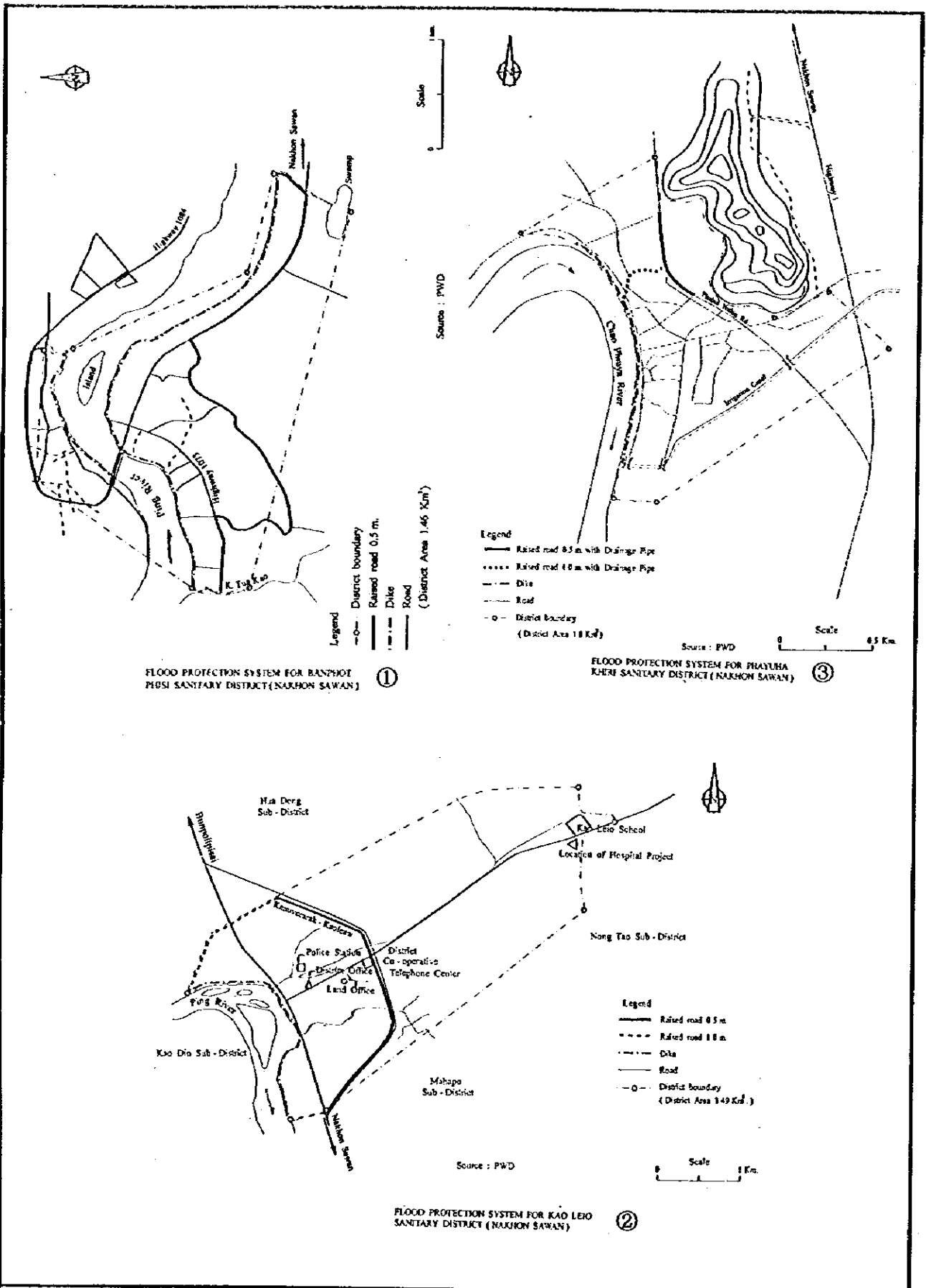
Fig. 4.1.1
EXISTING / PLANNED FLOOD PROTECTION AND DRAINAGE SYSTEM AND BUILTUP AREA OF NAKHONSAWAN



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

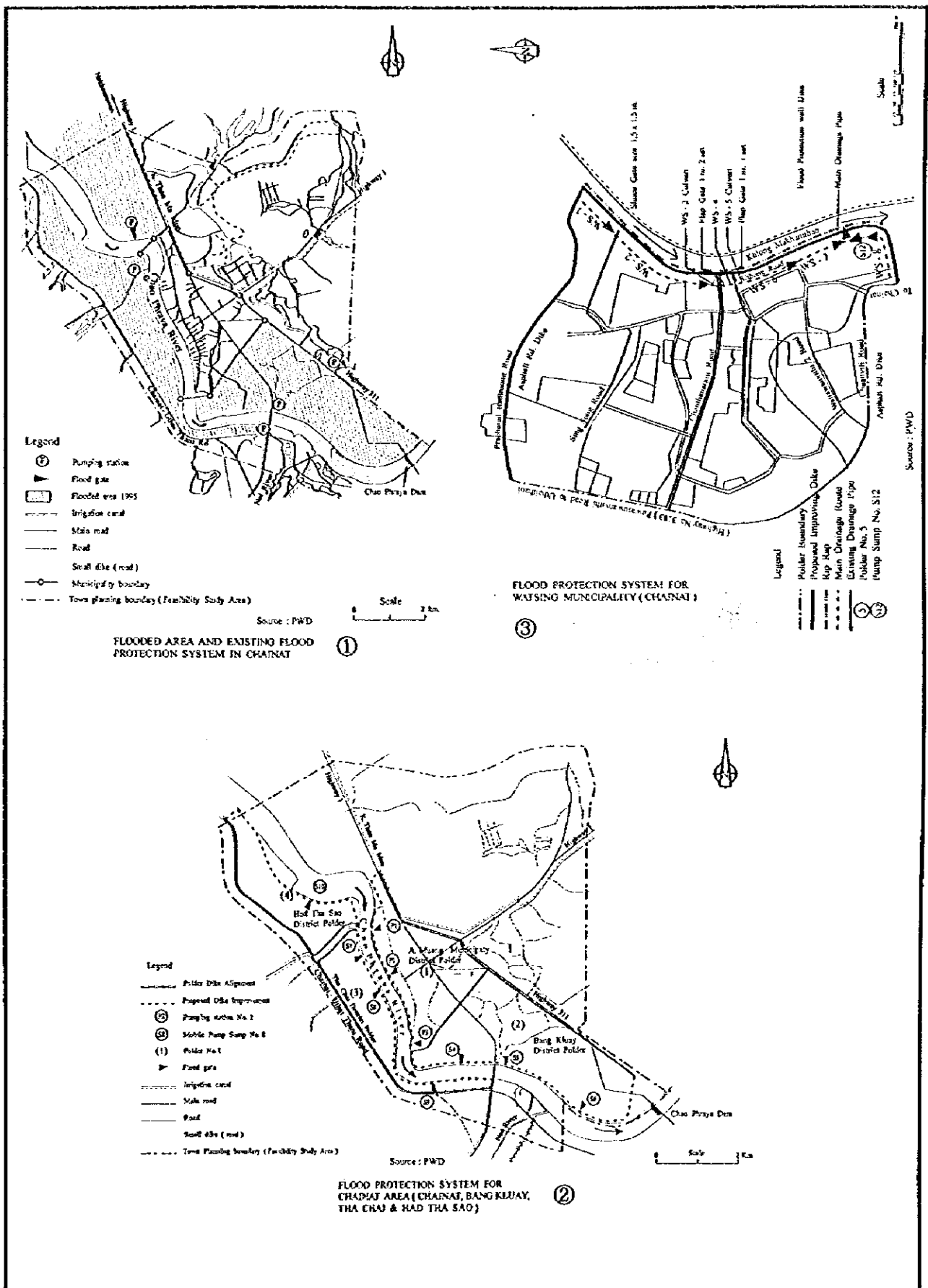
Fig. 4.1.2 FLOOD PROTECTION AND DRAINAGE SYSTEM OF CHUMSAENG, LAT YAO AND KROK PHRA



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.1.3 FLOOD PROTECTION AND DRAINAGE SYSTEM OF BANPHOT PHISI, KAO LEIO AND PHAYUHA KHIRI



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig. 4.2.1
EXISTING / PLANNED FLOOD PROTECTION AND DRAINAGE SYSTEM OF CHAINAT AND WAT SING

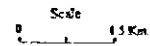
CTI ENGINEERING CO., LTD AND INA CORPORATION



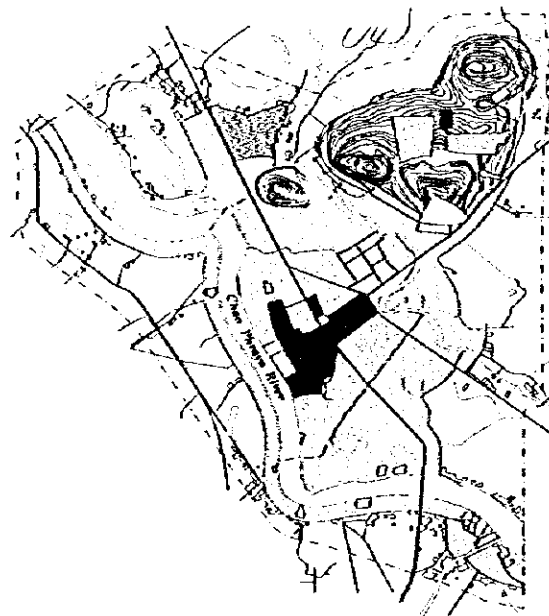
Legend

- Overall Town Planning Boundary
- - - A Muang Chainat Municipal District
- Highway
- ~ River, Canal, Stream
- Irrigation Canal

- ▭ Residential Area
- ▭ Commercial Area
- ▭ Industrial Area and Goods Store
- ▭ Education Area
- ▭ Religion Area
- ▭ Governmental Institution and Infrastructure Area
- ▭ Land and Agricultural Area and Open Area for Recreational Environment Quality Control Environmental Quality Control



PRESENT LAND USE - A MUANG CHAINAT COMMUNITY AREA (1996)

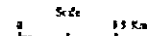


Legend

- Overall Town Planning Boundary
- - - A Muang Chainat Municipal District
- Highway
- ~ River Canal Stream
- Irrigation Canal

Legend on Land Use

- ▭ Commercial and High Density Residential Area
- ▭ Medium Density Residential Area
- ▭ Low Density Residential Area
- ▭ Governmental Institution and Infrastructure Area
- ▭ Industrial Area
- ▭ Education Area
- ▭ Religion Area
- ▭ Open Area for Recreation and Environmental Conservation

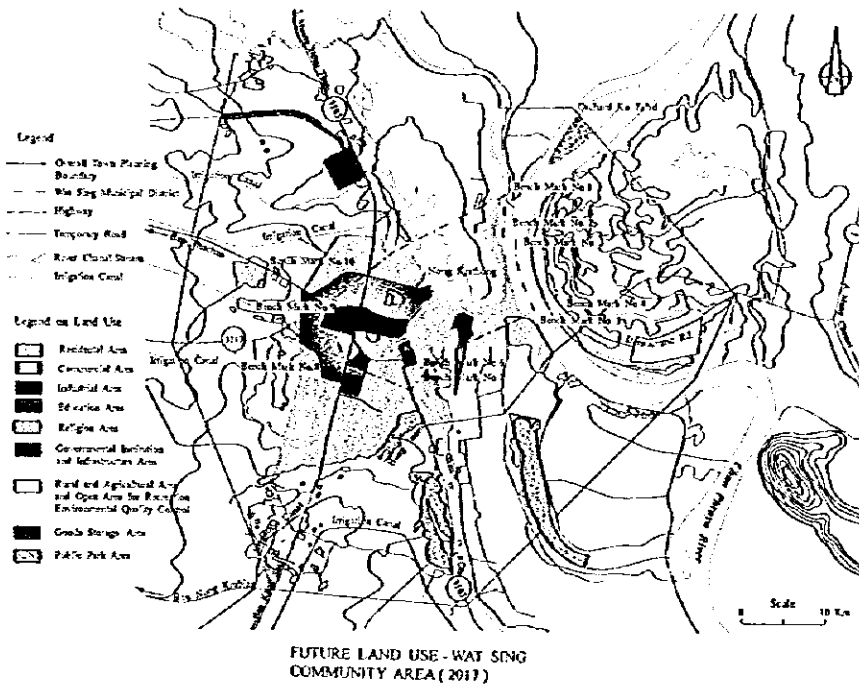
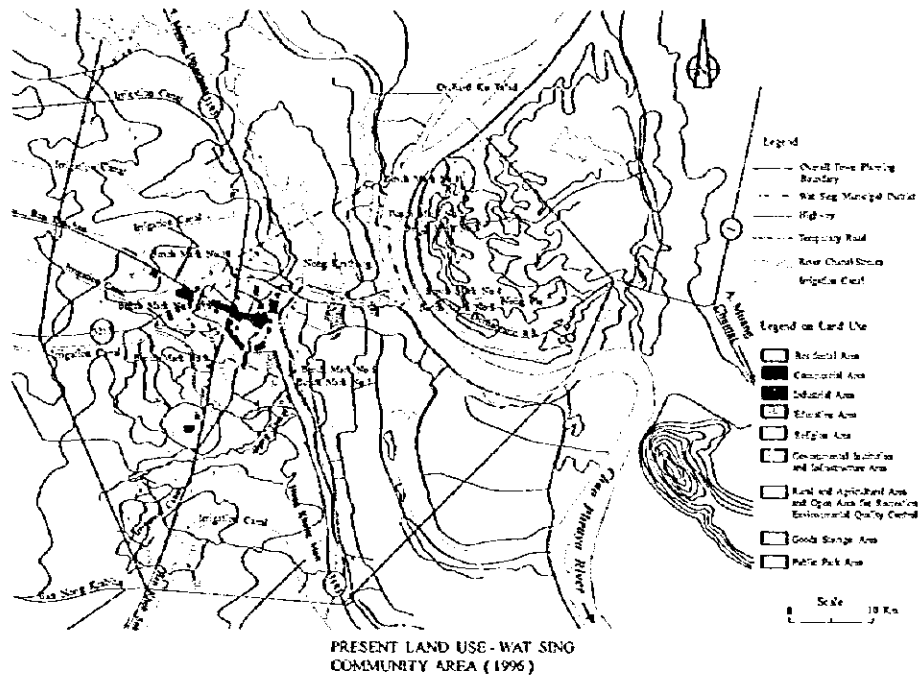


FUTURE LAND USE - A MUANG CHAINAT COMMUNITY AREA (2017)

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.2.2 EXISTING / FUTURE LAND USE PLAN OF CHAINAT

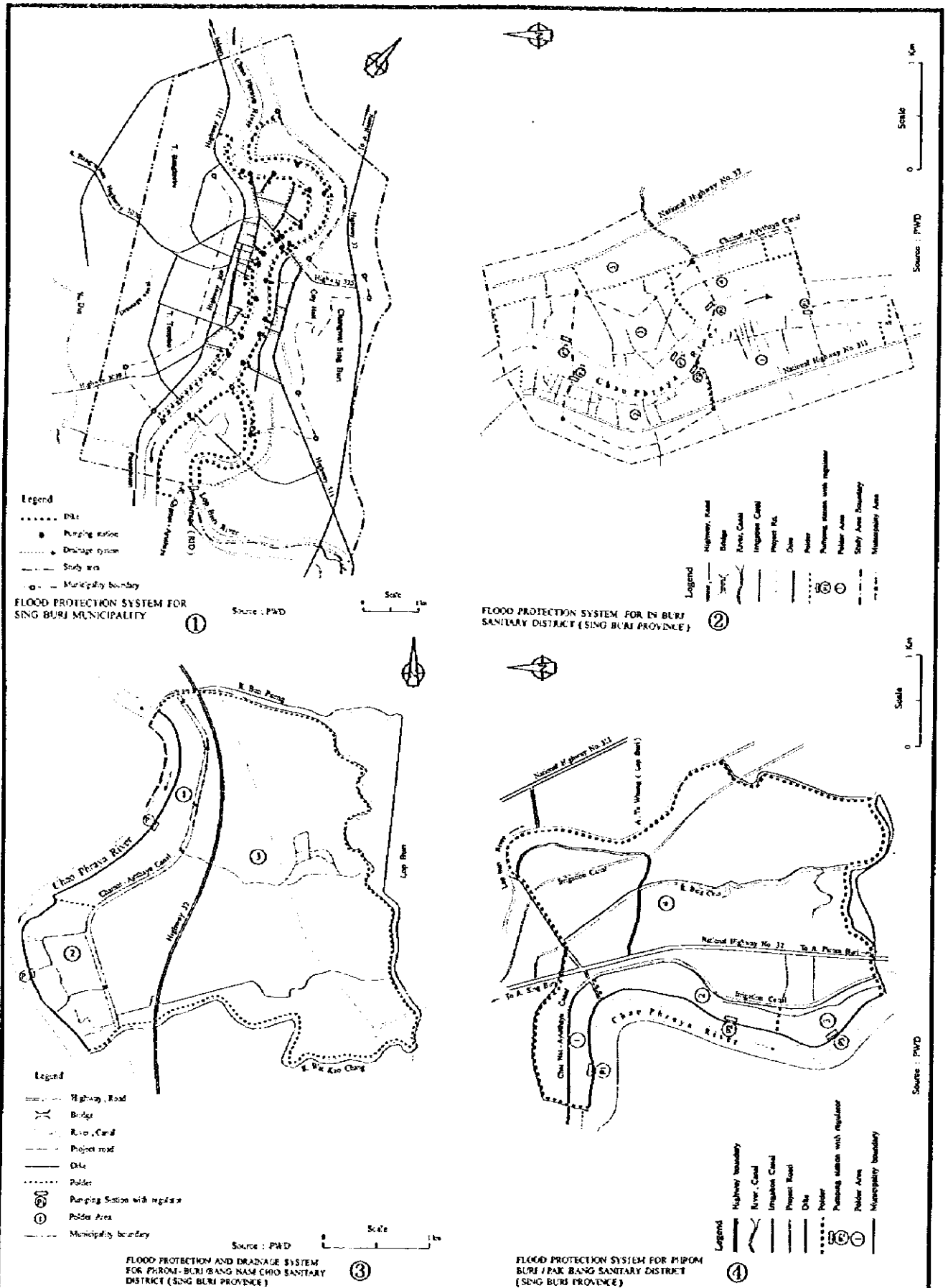


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.2.3

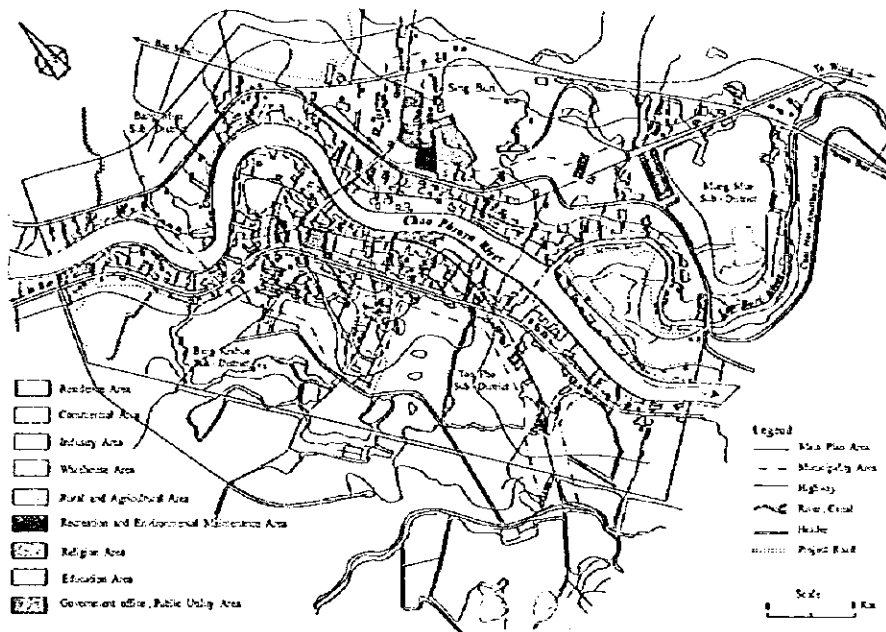
EXISTING / FUTURE LAND USE PLAN OF WAT SING



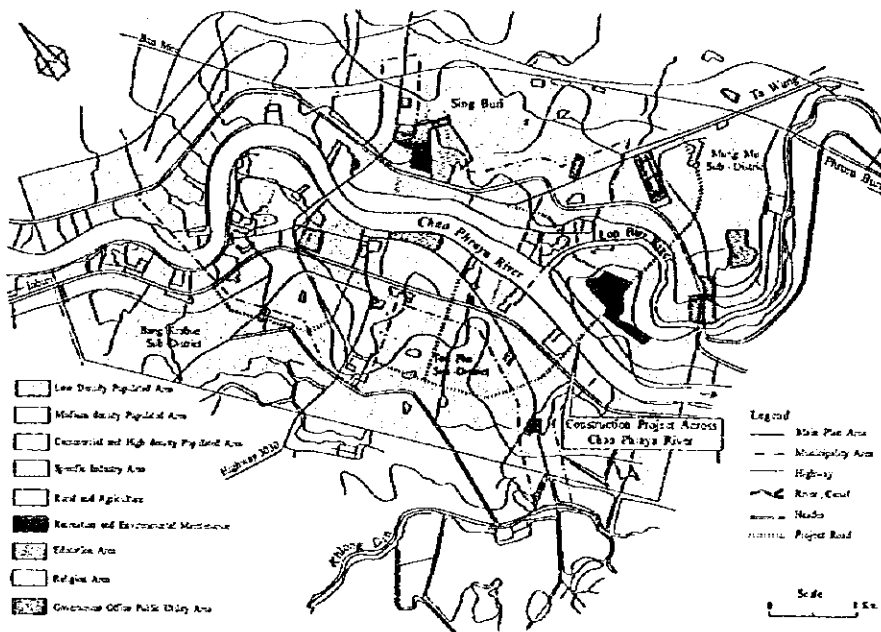
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.3.1
FLOOD PROTECTION AND DRAINAGE SYSTEM OF SING BURI, IN BURI AND PHROMBURI



PRESENT LAND-USE SING BURI MUNICIPALITY (1994)

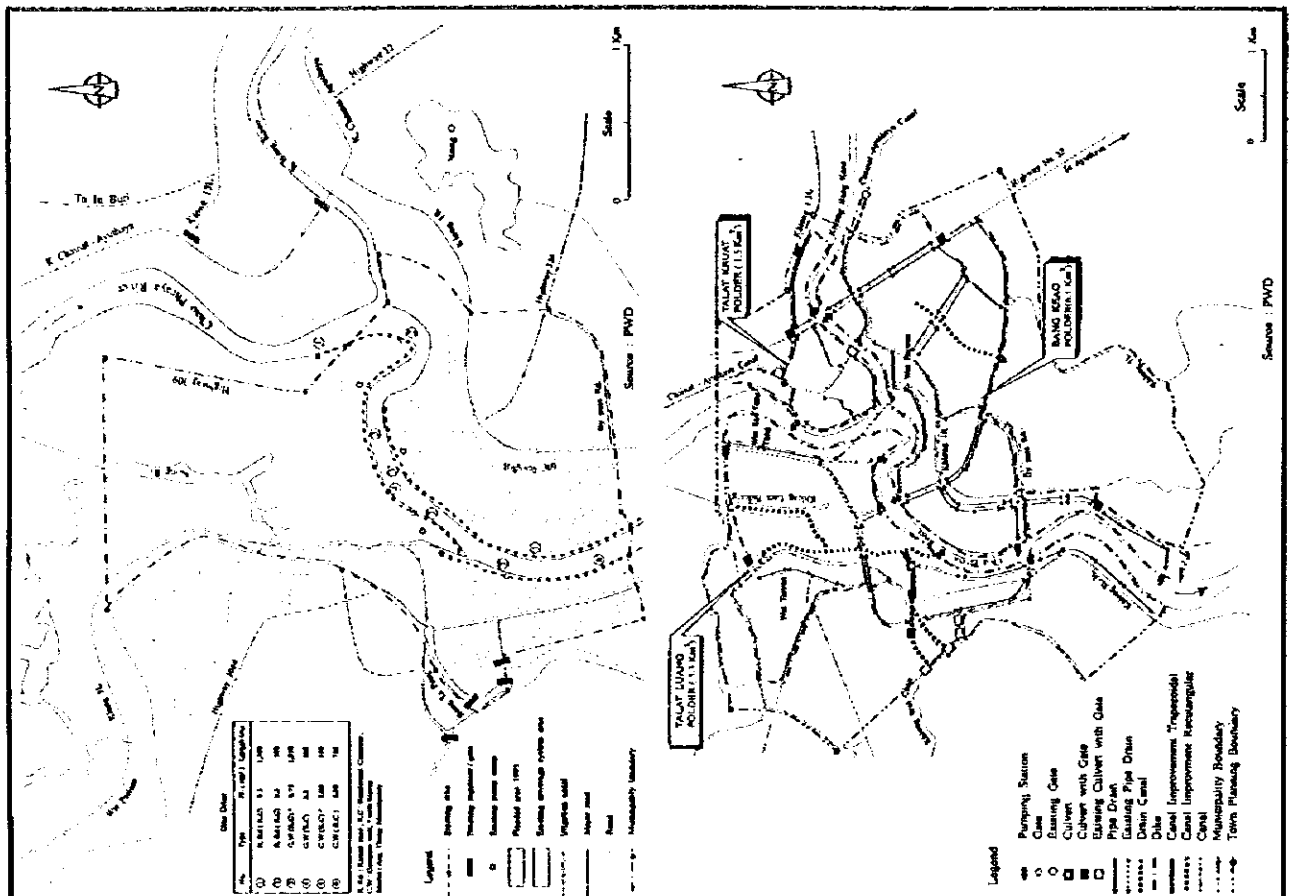


FUTURE LAND USE - SING BURI MUNICIPALITY

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

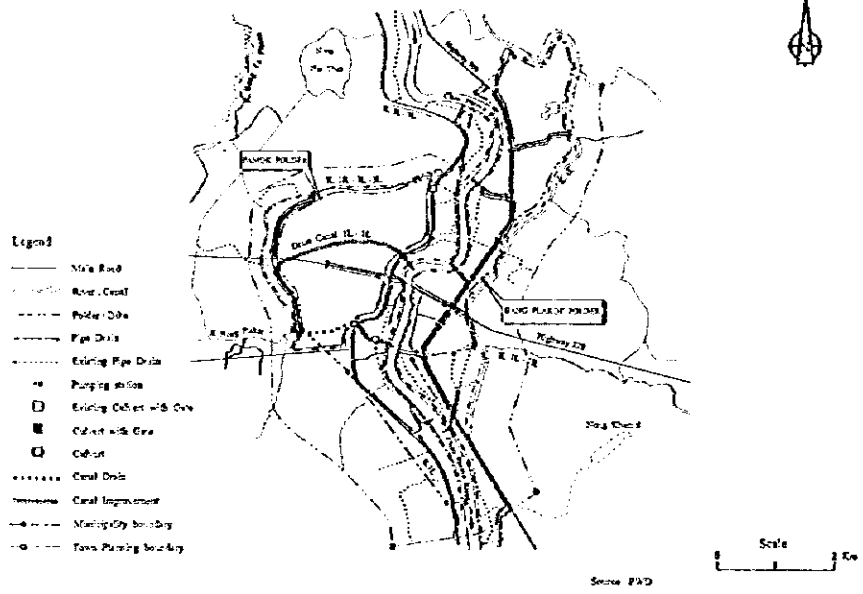
CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.3.2 EXISTING / FUTURE LAND USE PLAN OF SING BURI



EXISTING FLOOD PROTECTION AND DRAINAGE SYSTEM IN ANG THONG MUNICIPALITY ①

FLOOD PROTECTION SYSTEM FOR ANG THONG MUNICIPALITY ②



FLOOD PROTECTION SYSTEM FOR PAMOK (ANG THONG PROVINCE) ③

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

Fig. 4.1
EXISTING / PLANNED FLOOD PROTECTION AND DRAINAGE SYSTEM OF ANG THONG AND PAMOK

CTI ENGINEERING CO., LTD AND INA CORPORATION

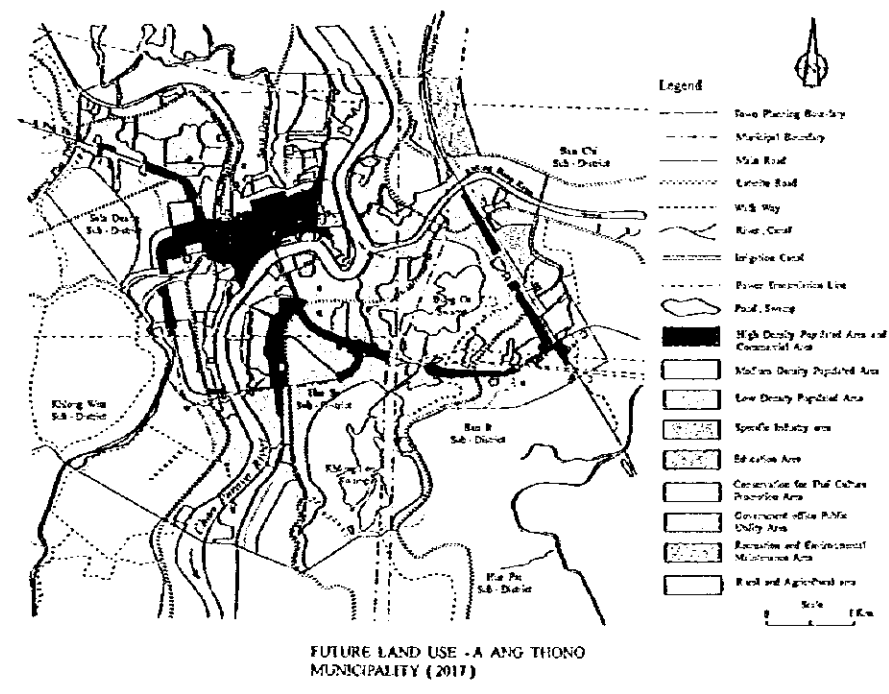
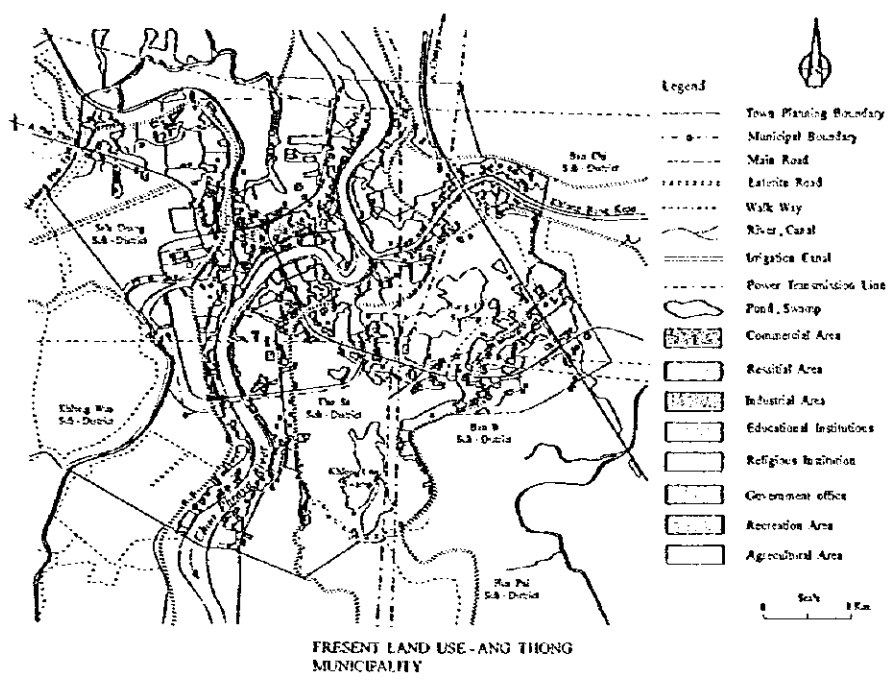
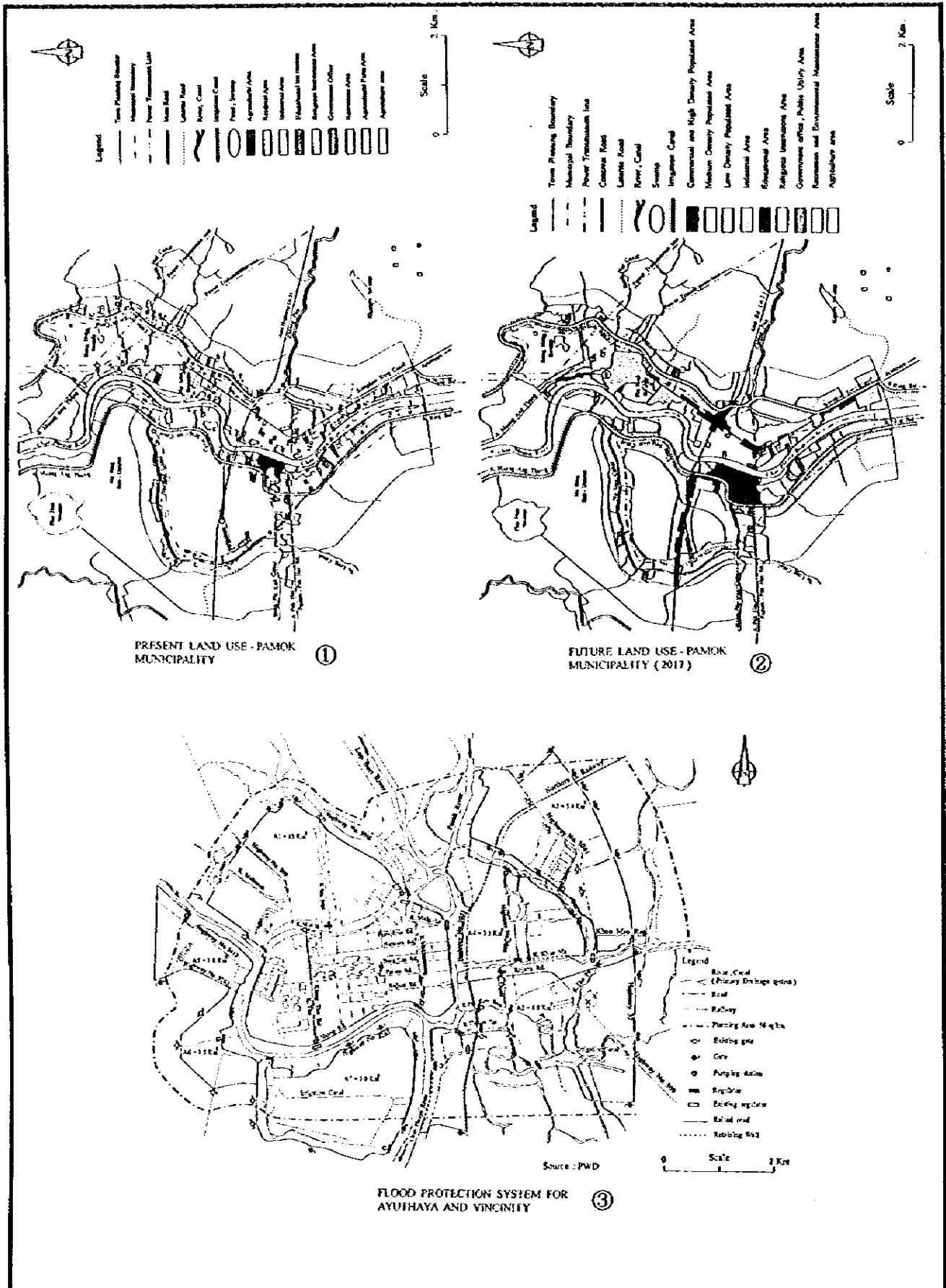


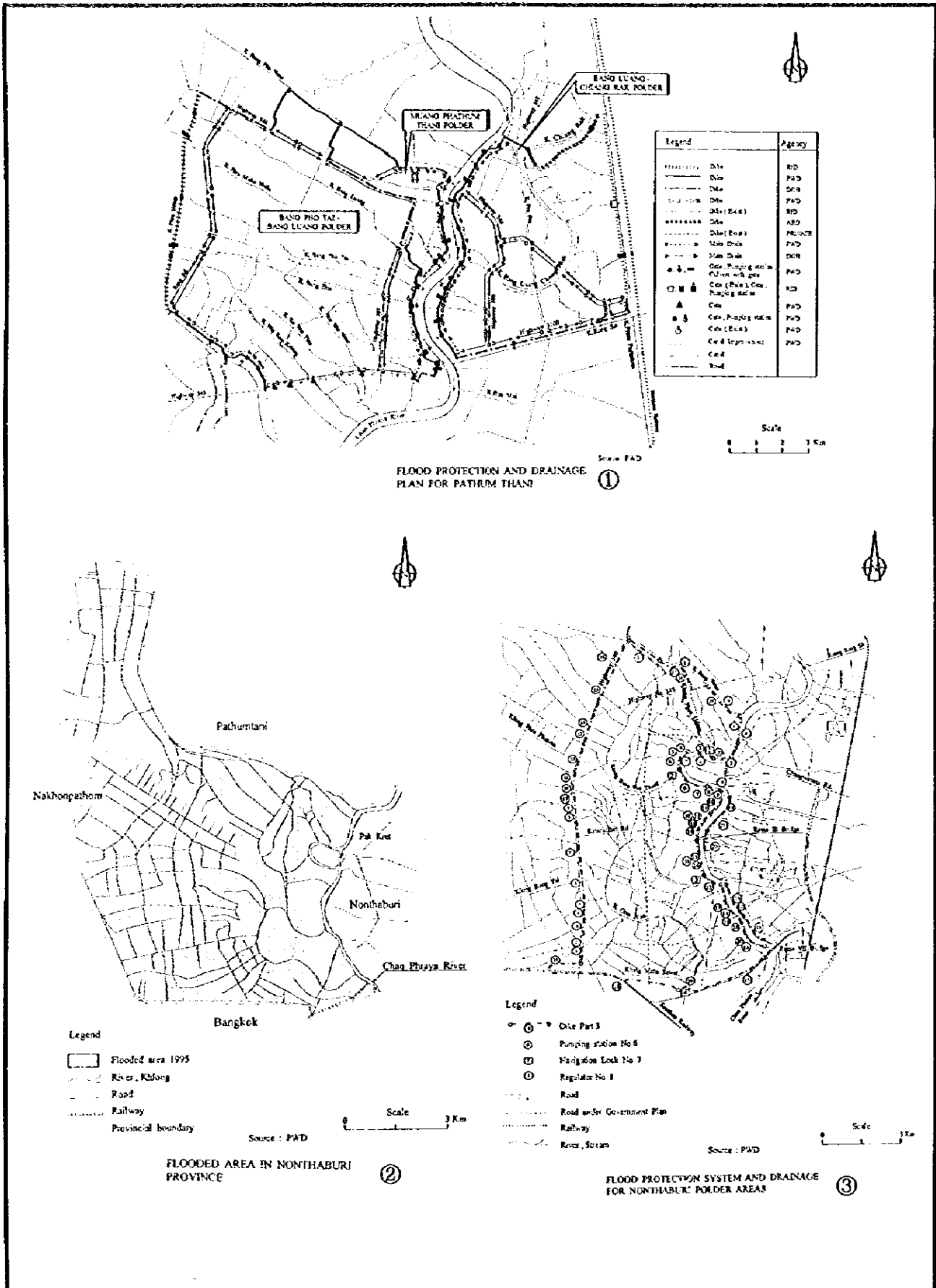
Fig. 4.4.2
EXISTING / FUTURE LAND USE PLAN OF ANG THONG



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

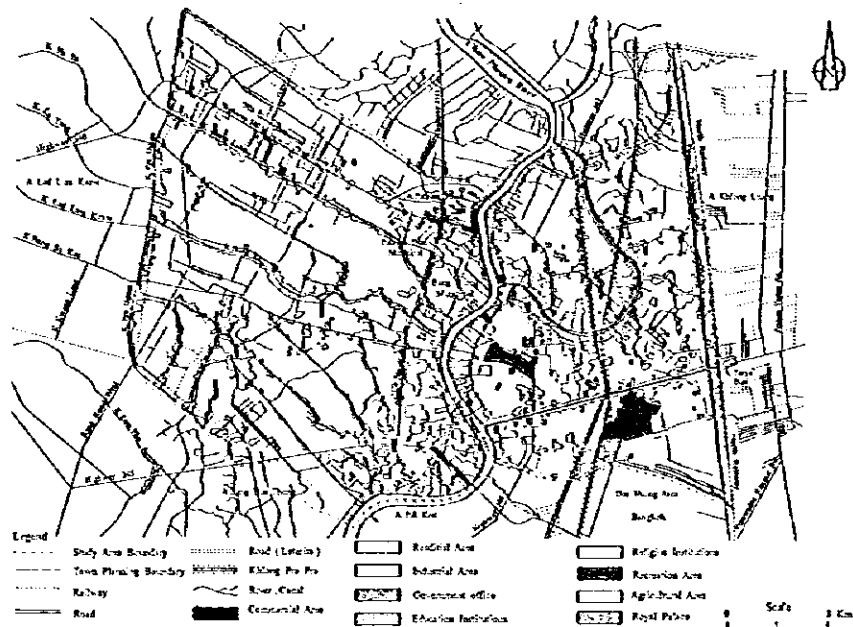
Fig. 4.4.3
EXISTING / FUTURE LAND USE PLAN OF PAMOK, FLOOD PROTECTION AND DRAINAGE FACILITIES OF AYUTHAYA



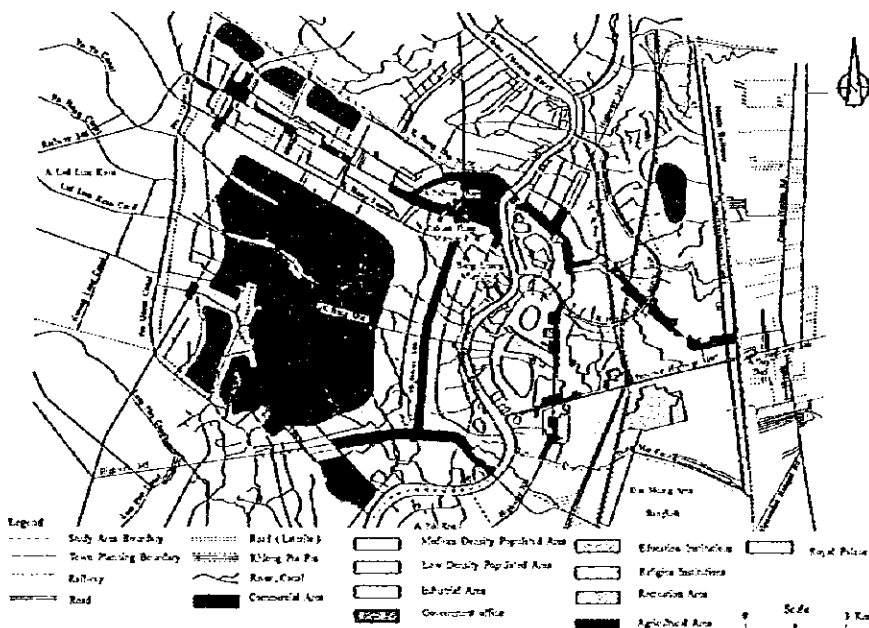
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.6.1
FLOOD PROTECTION AND DRAINAGE SYSTEM OF PATHUM THANI AND NONTHABURI, FLOODED AREA OF NONTHABURI



PRESENT LAND-USE PATHUM THANI
STUDY AREA (1992)



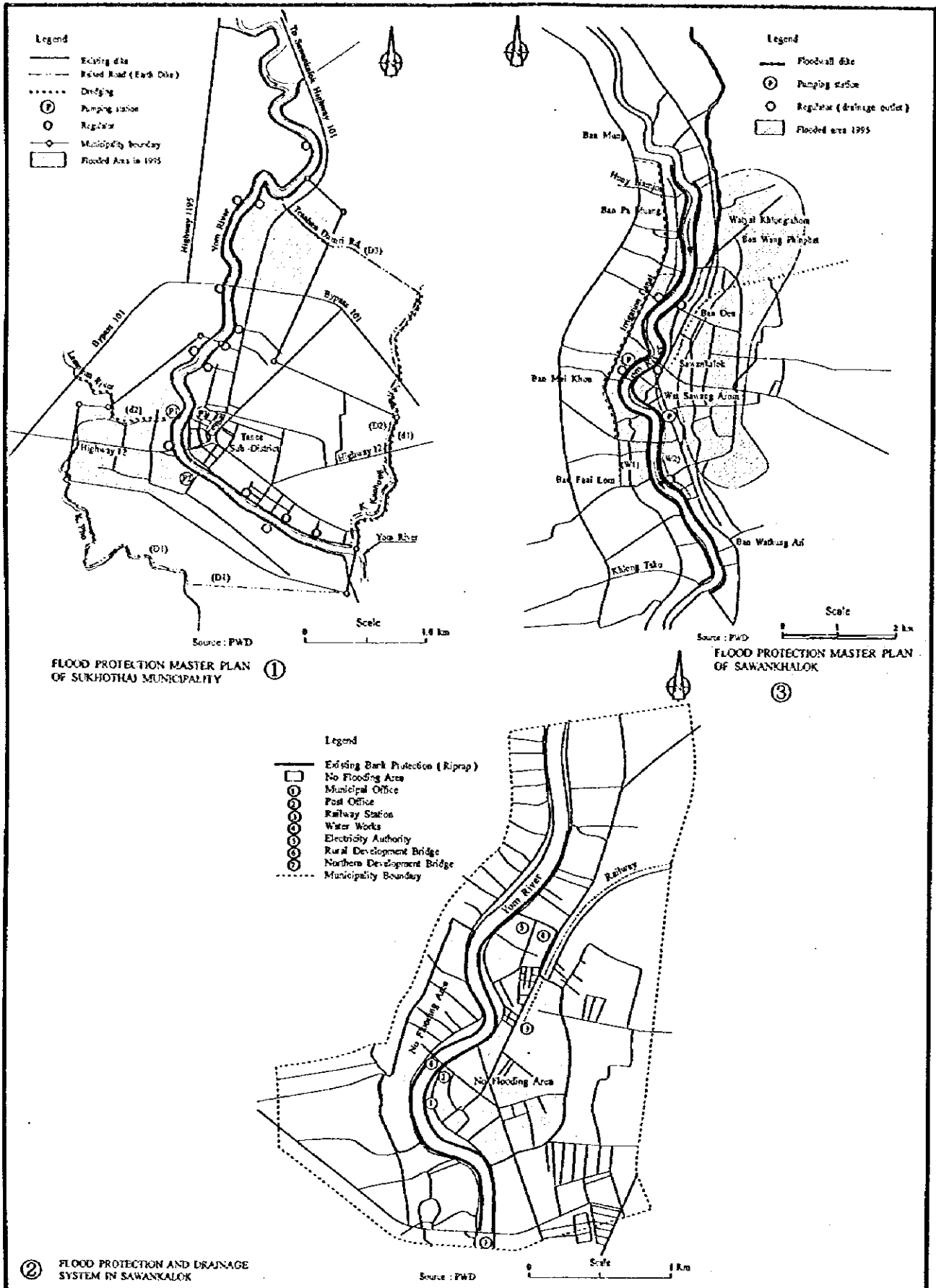
FUTURE LAND USE PATHUM THANI
STUDY AREA (2017)

STUDY ON INTEGRATED PLAN FOR FLOOD
MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 4.6.2

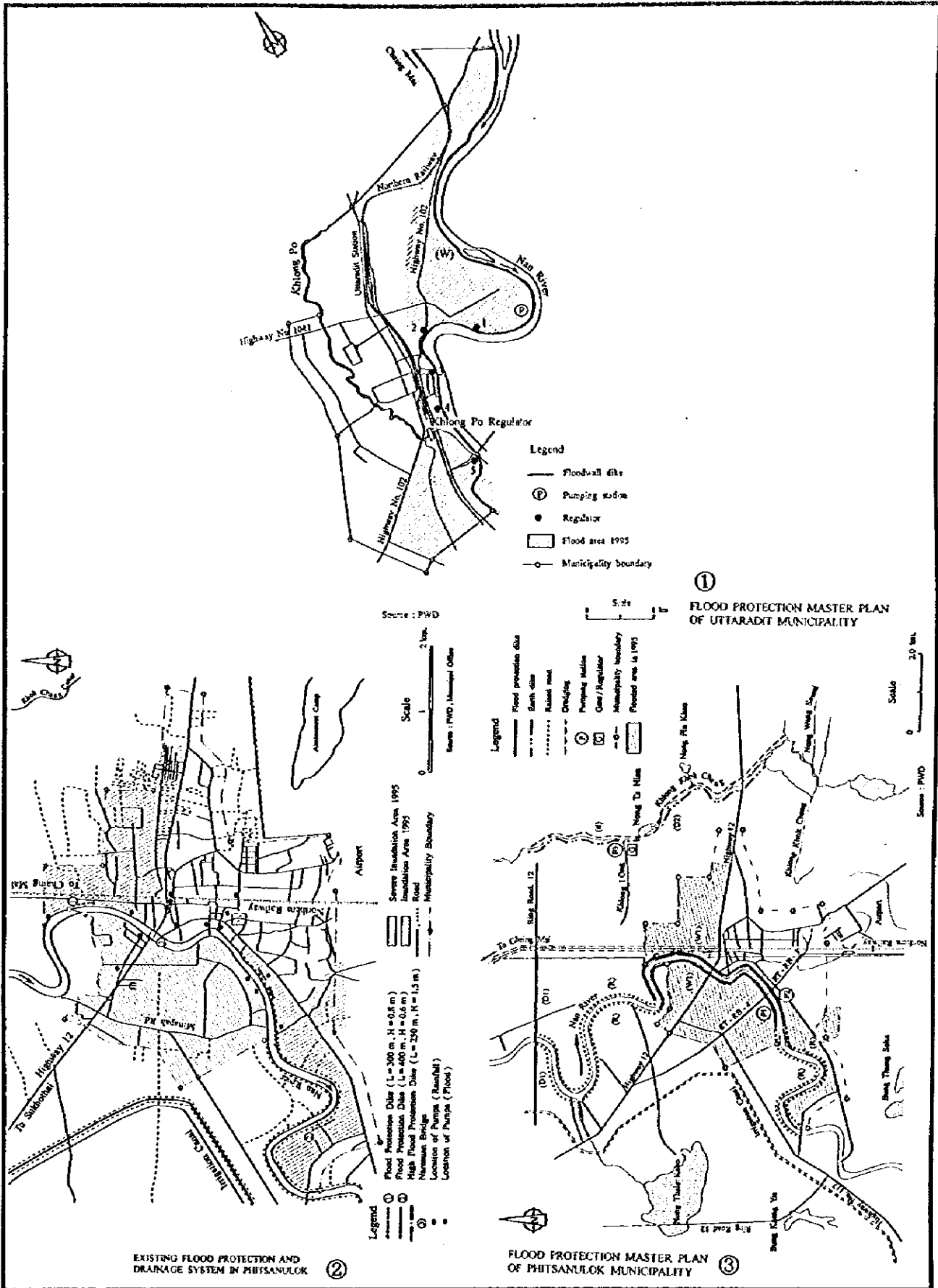
EXISTING / FUTURE LAND USE PLAN OF PATHUM THANI



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

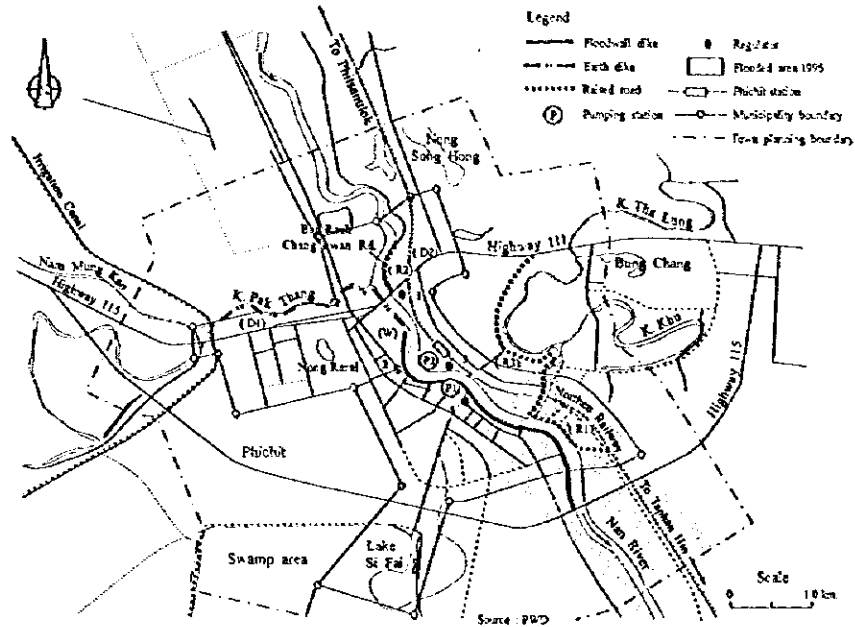
Fig. 5.1.1
FLOOD PROTECTION AND DRAINAGE SYSTEM OF SUKHOThAI AND SAWANKHALOK



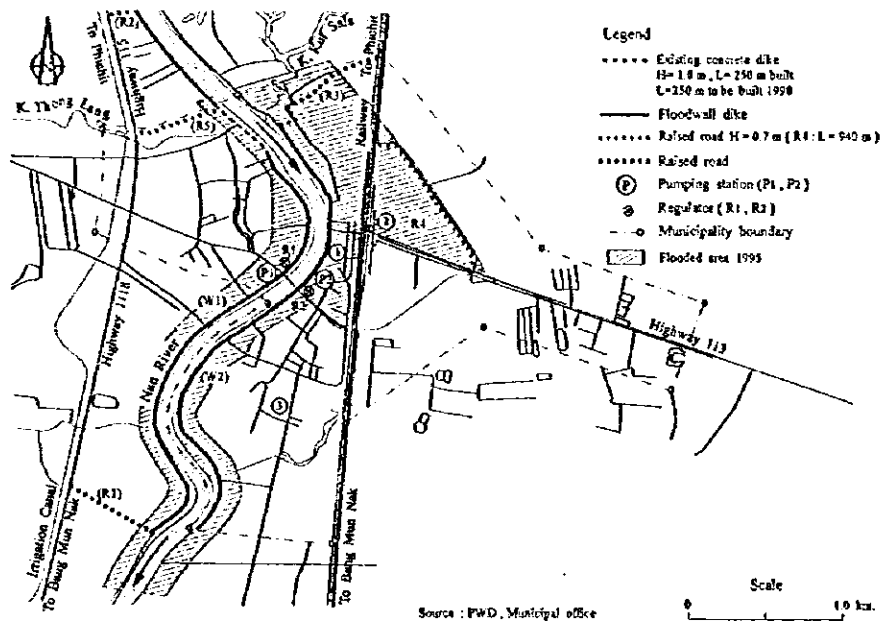
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 5.2.1 FLOOD PROTECTION AND DRAINAGE SYSTEM OF UTTARADIT AND PHITSANULOK



FLOOD PROTECTION MASTER PLAN OF PHICHIT MUNICIPALITY



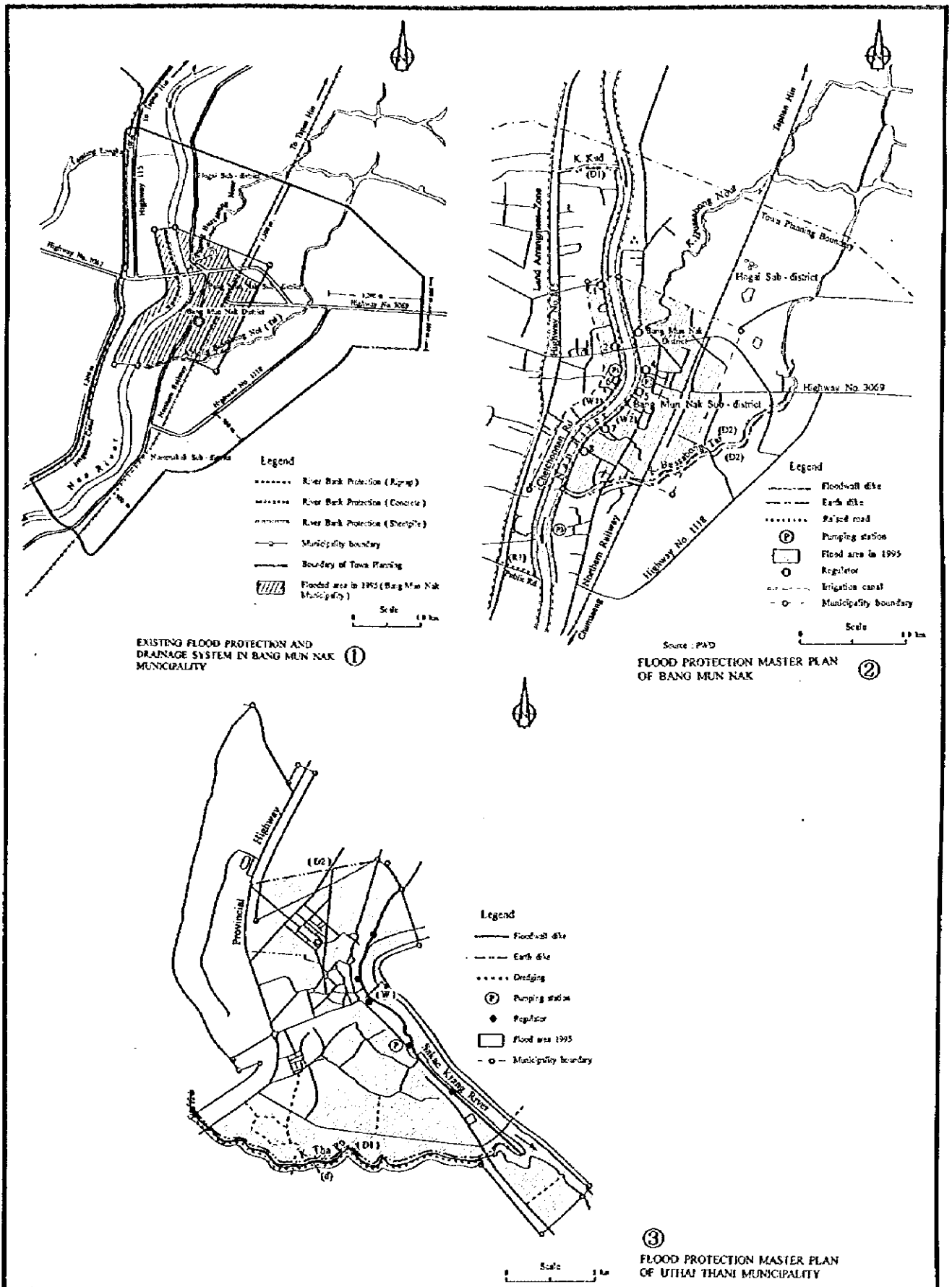
FLOOD PROTECTION MASTER PLAN OF TAPHAN HIN MUNICIPALITY

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

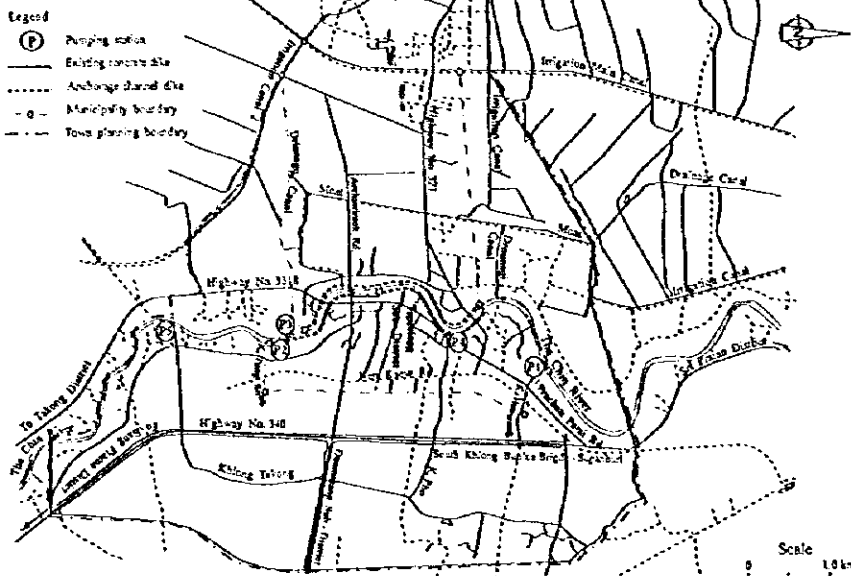
Fig. 5.4.1

FLOOD PROTECTION AND DRAINAGE SYSTEM OF PHICHIT AND TAPHAN HIN

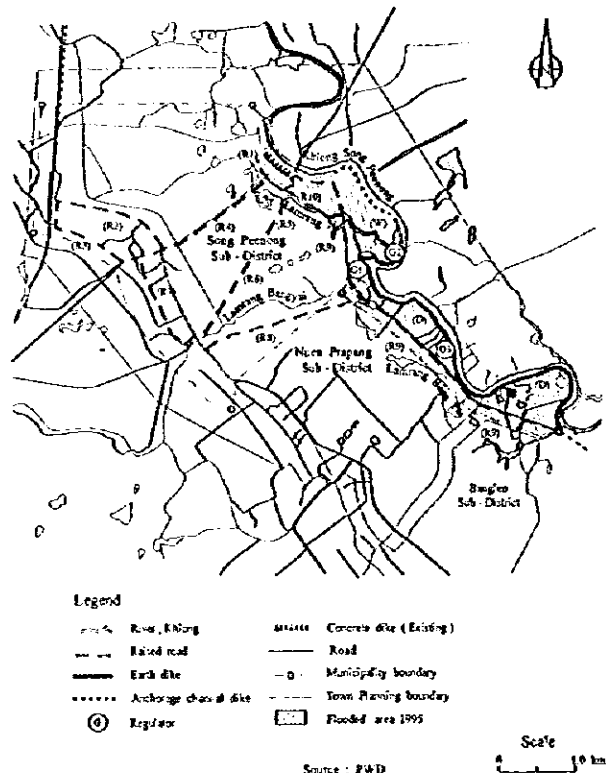


STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN
CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 5.4.2
FLOOD PROTECTION AND DRAINAGE SYSTEM OF BANG MUN NAK AND UTHAI THANI



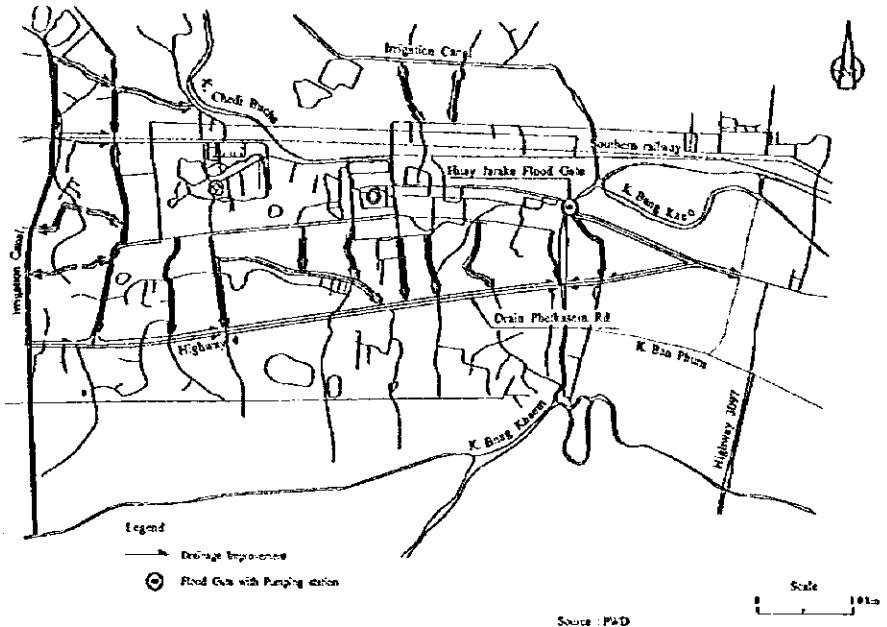
Source : PWD
FLOOD PROTECTION MASTER PLAN OF SUPHANBURI MUNICIPALITY ①



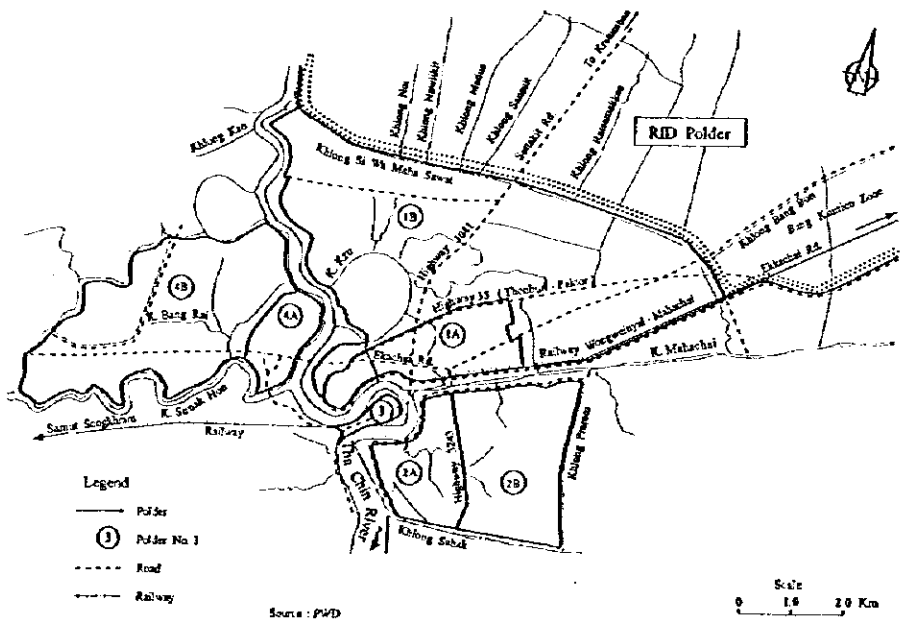
Source : PWD
FLOOD PROTECTION MASTER PLAN OF SONGPEENONG ②

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN
CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 5.6.1
FLOOD PROTECTION AND DRAINAGE SYSTEM OF SUPHANBURI AND SONGPEENONG



FLOOD PROTECTION MASTER PLAN OF NAKHON PATHOM MUNICIPALITY ①



FLOOD PROTECTION MASTER PLAN OF SAMUT SAKHON MUNICIPALITY ②

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN

CTI ENGINEERING CO., LTD AND INA CORPORATION

Fig. 5.7.1
FLOOD PROTECTION AND DRAINAGE SYSTEM OF NAKHON PATHOM AND SAMUTSAKHON

