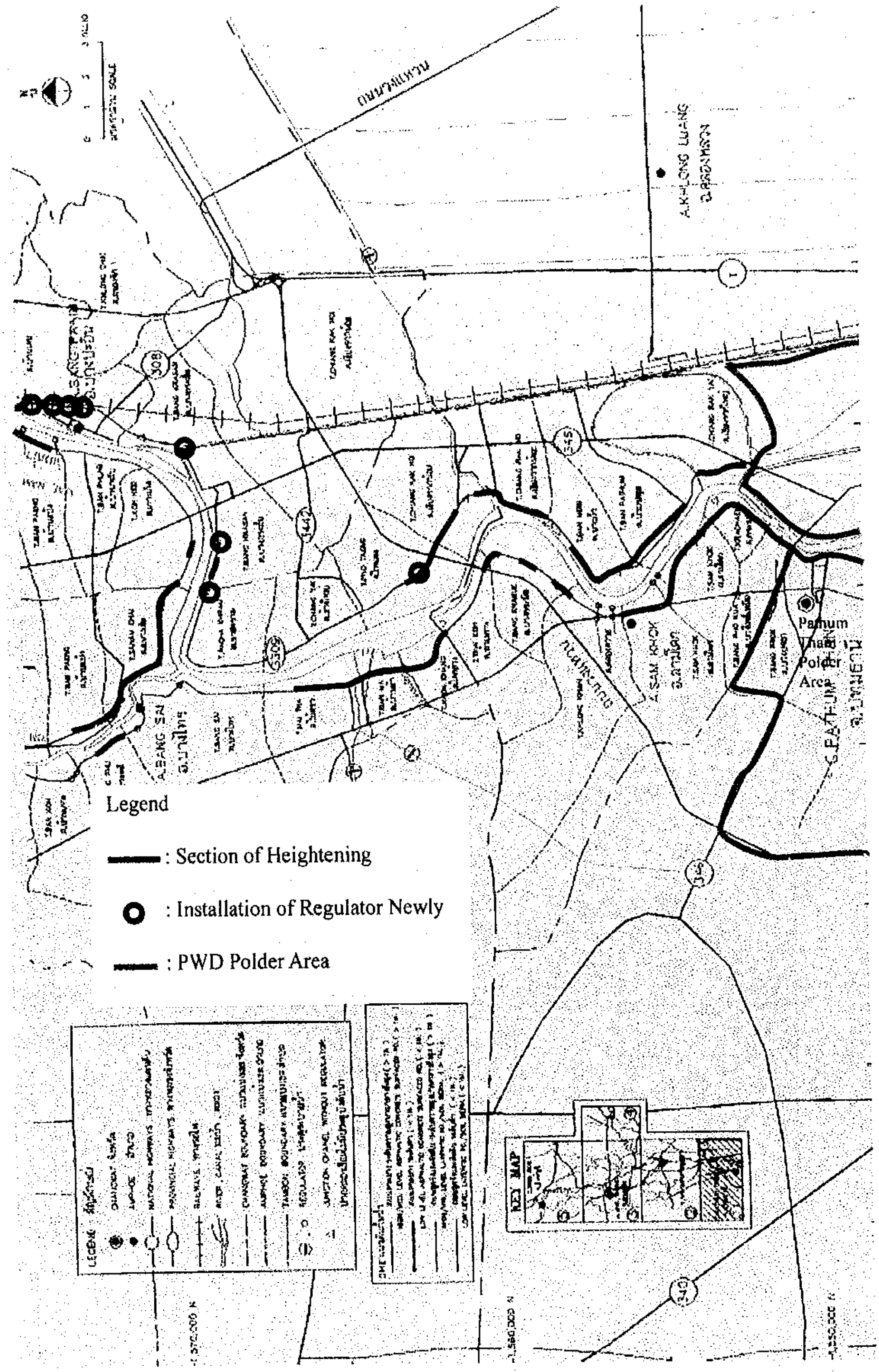
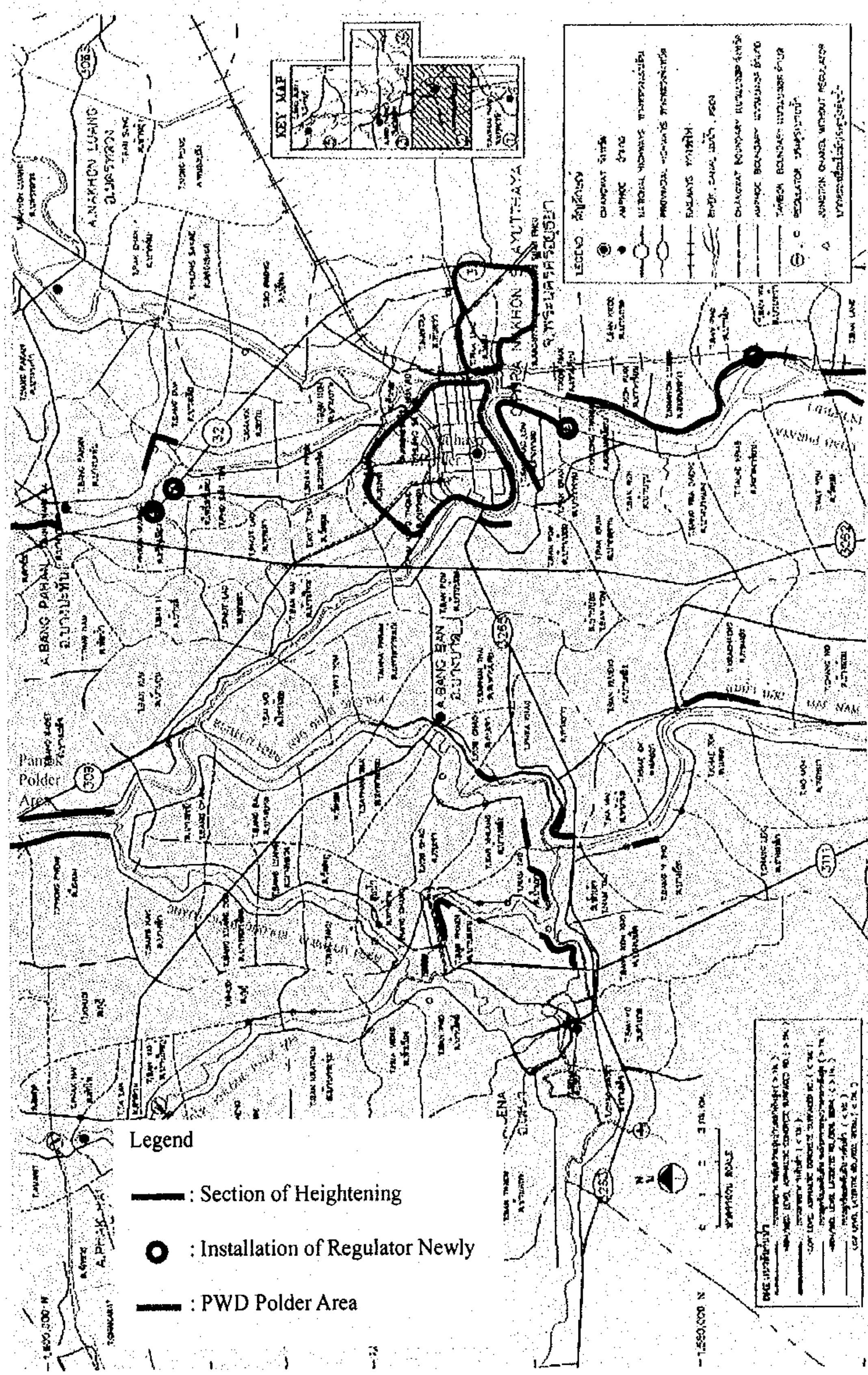
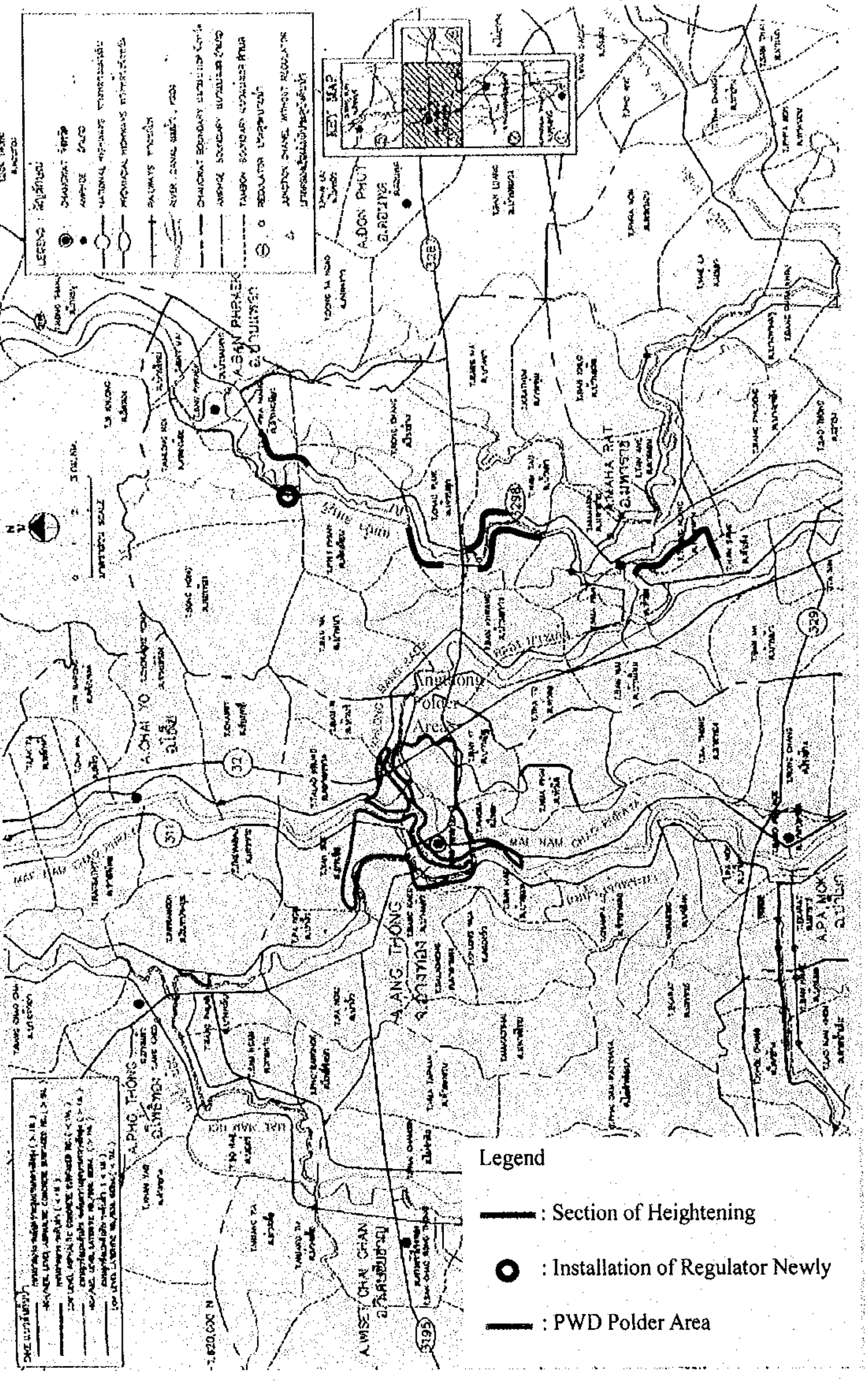


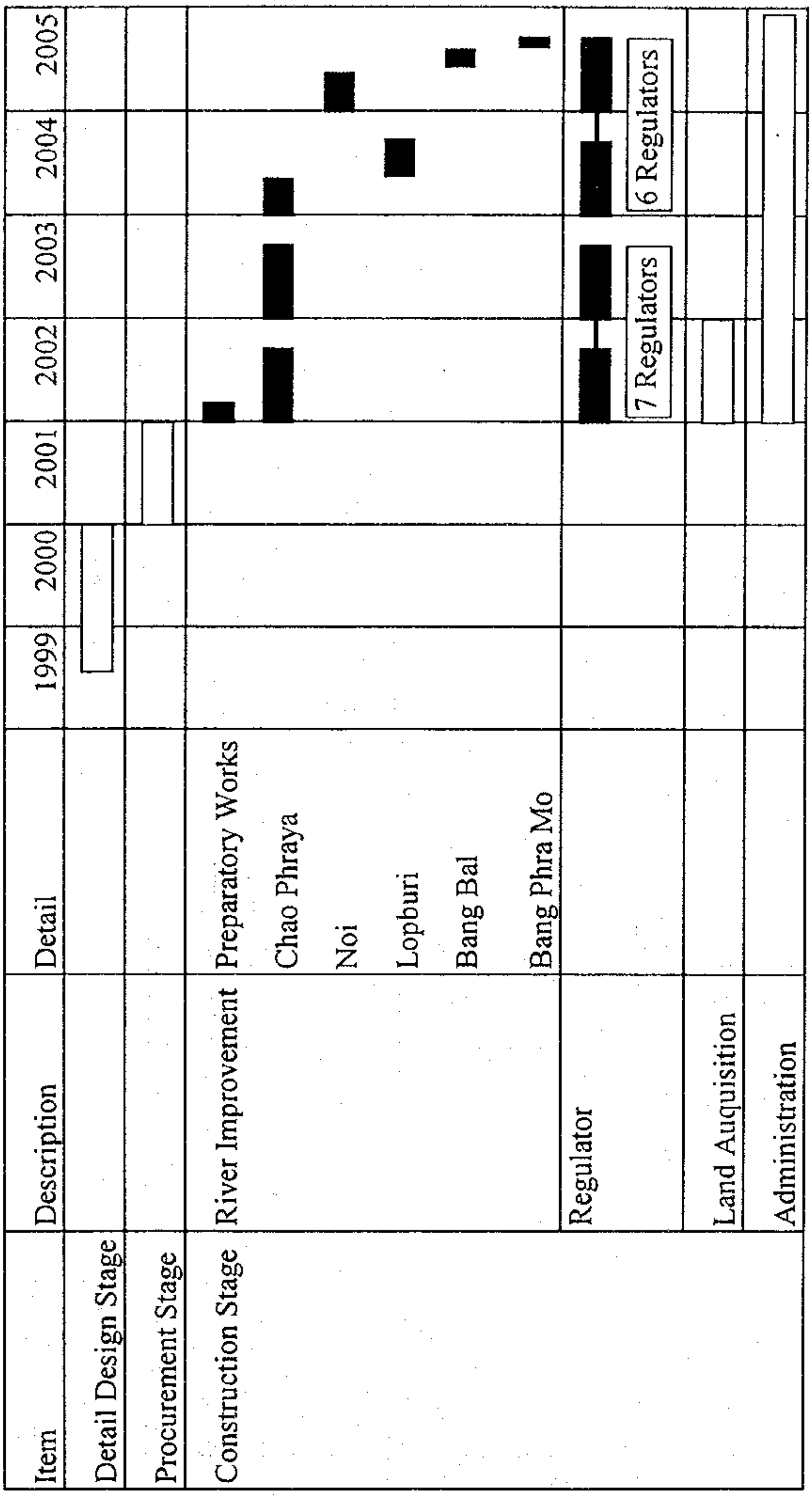
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig .7.5.10 (1/3) ALIGNMENT OF RIVER IMPROVEMENT
CTI ENGINEERING CO., LTD AND INA CORPORATION	



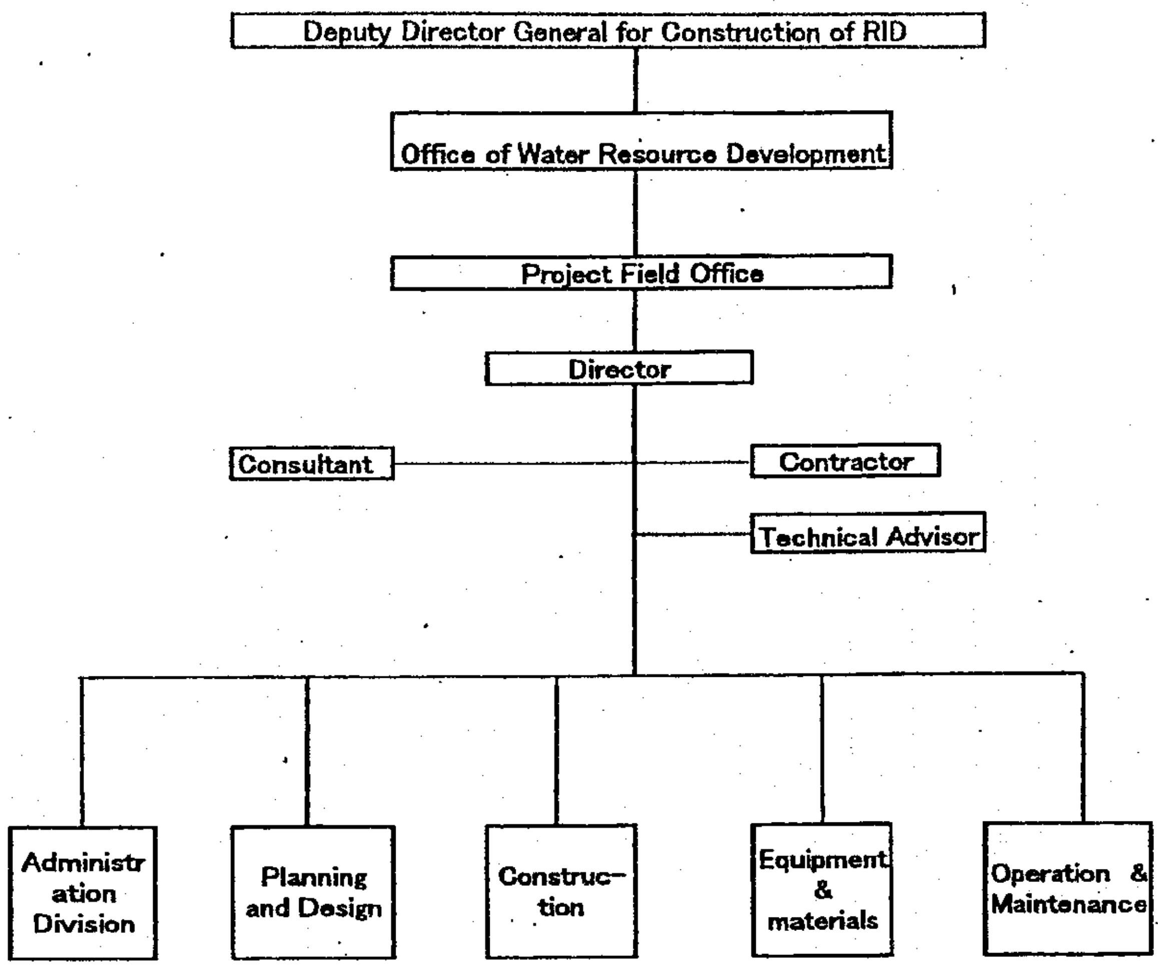
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig .7.5.10 (2/3) ALIGNMENT OF RIVER IMPROVEMENT
CTI ENGINEERING CO., LTD AND INA CORPORATION	



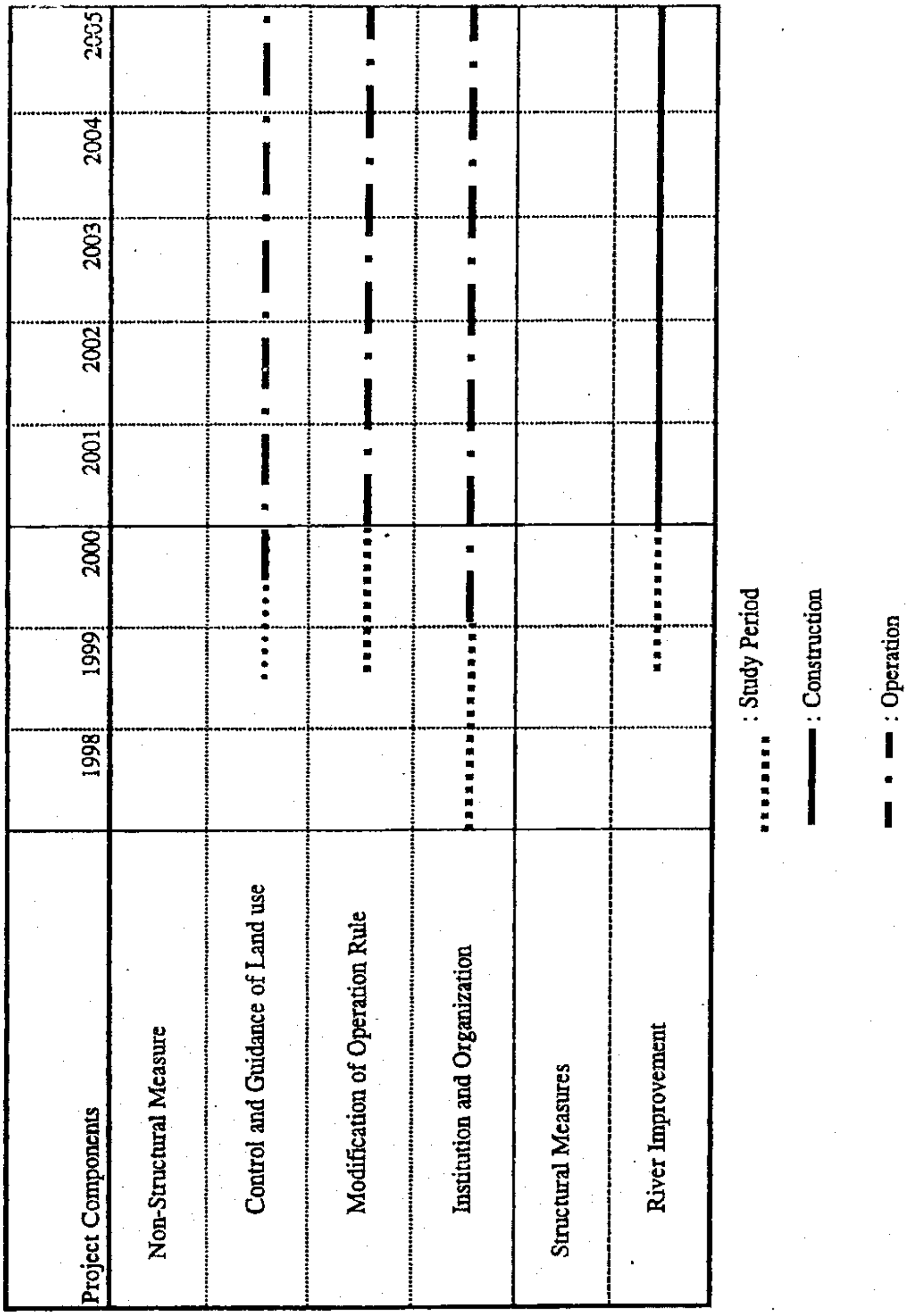
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig.7.5.10 (3/3) ALIGNMENT OF RIVER IMPROVEMENT
CTI ENGINEERING CO., LTD AND INA CORPORATION	



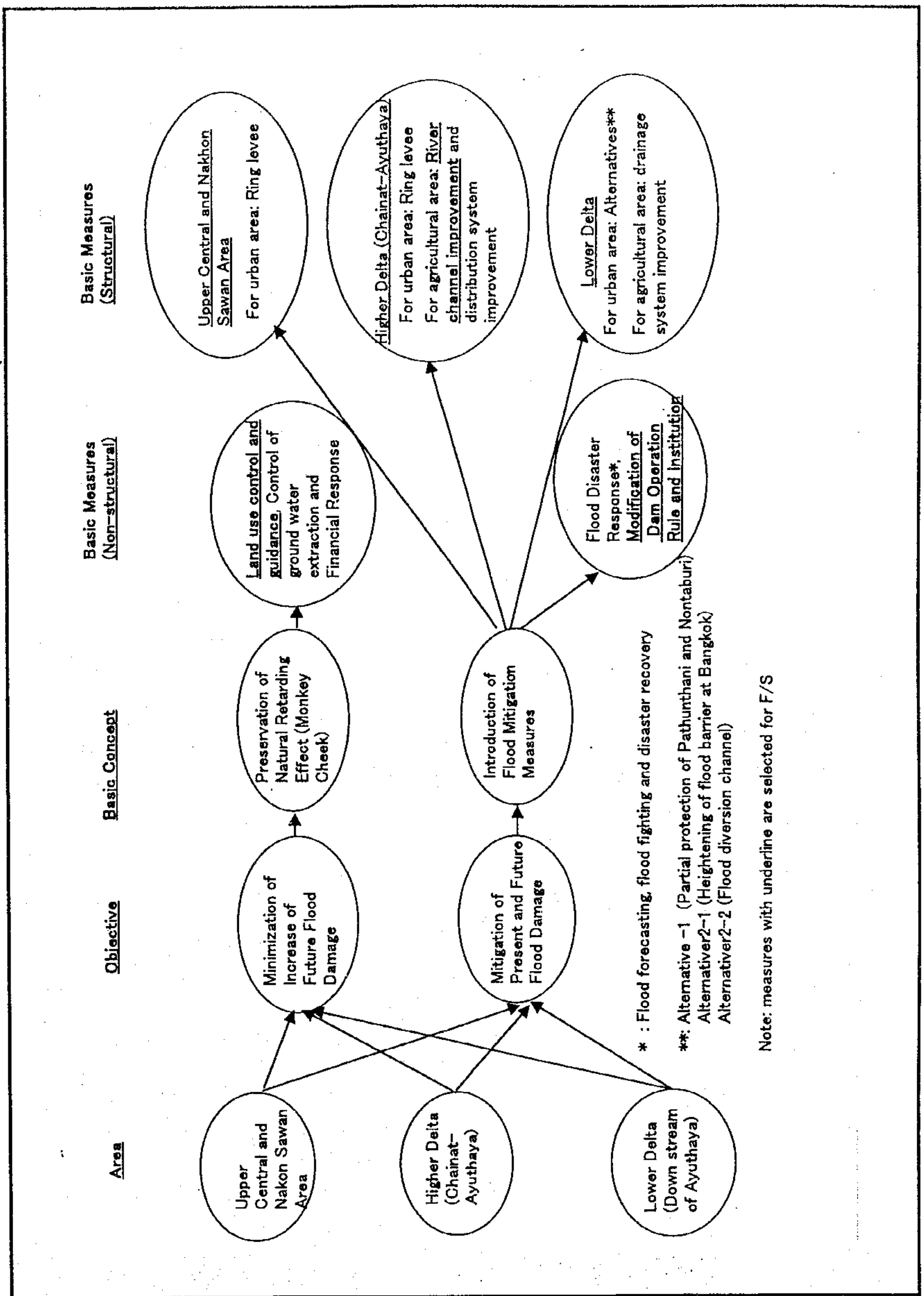
STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig. 7.5.11
CTI ENGINEERING CO., LTD AND INA CORPORATION	CONSTRUCTION PLAN OF PROPOSED RIVER IMPROVEMENT PROJECT



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig. 7.6.1 ORGANIZATION FOR PROJECT IMPLEMENTATION (RIVER IMPROVEMENT)
CTI ENGINEERING CO., LTD AND INA CORPORATION	



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BAS	Fig. 7.6.2 IMPLEMENTATION SCHEDULE OF THE URGENT PROJECT
CTI ENGINEERING CO., LTD AND INA CORPORATION	



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig.8.1.1 OUTLINE OF THE MASTER PLAN
CTI ENGINEERING CO., LTD AND INA CORPORATION	

Appendices

Appendix 1 River Basin Management in Other Countries

Appendix 1 River Basin Management in other Countries

Appendix - 1 - 1 COMPARISON ON FLOOD PROTECTION LEVELS OF RIVERS IN THE WORLD

Country			France			UK	Germany	Netherlands	Italy	USA	Japan
River	Name of River		Seine	Loire	Rhone	Thames	Rhein	Rhein	Po	Mississippi	Tone
	Catchment Area (km2)		79,000	115,000	98,000	12,000	184,000	16,000	75,000	3,221,000	17,000
	Population (1,000 person)		17,000	8,400	13,000	12,000	37,000	8,300	15,000	60,000	9,100
	Population Density (person/km2)		170	73	143	1,010	324	524	226	19	540
	Mean Annual Rainfall (mm)		615	799	831	759	892	802	797	859	1,155
	Disaster	Notorious Disaster	Jan. 1910 Flood	Oct. 1866 Flood	May 1856 Flood	Feb. 1953 High Tide	Jan. 1926 Flood	Feb. 1953 High Tide	Nov. 1951 Flood	1927 Flood	Sep. 1947 Flood
		Damage Recorded	8.7km2 inundated in Paris	-	2,740km2 inundated	650km2 of Farmland inundated, 132 persons dead & 34,000 affected	6km2 inundated & 500 persons affected	2,000km2 inundated & 1,835 persons dead	1,131km2 inundated	67,000km2 inundated, 214 persons dead & 640,000 affected	2,300km2 inundated
		Type of Flood	Bank overflow	Levee breach	-	High tide	Bank overflow	High tide	Levee breach	Bank overflow	Levee breach
	Maximum Discharge Recorded	Discharge (m3/s)	2,310	6,411	4,650	714	11,100	13,000	10,300	58,900	17,000
		Specific Discharge (m3/s/100km2)	5.3	15.2	22.9	7.2	7.7	8.1	14.7	2.0	332.4
	Plan	Design Discharge (m3/s)	-	5,000	-	-	13,300	16,500	-	76,700	16,000
		Specific Discharge (m3/s/100km2)	-	11.9	-	-	9.2	10.3	-	2.6	312.9
		Design Scale (year)	180	100	-	1,000	120% of 80-year	10,000 to 1,250	100	500	200
		Cause of Flood	Melting snow	Rainfall & melting snow	Rainfall & melting snow	High tide	Rainfall & melting snow	High tide, rainfall &	Rainfall & melting snow	Melting snow	Intensified rainfall
	Flood Protection Facilities		Dam & levee	Dam, levee & floodway	Dam, levee & retarding basin	Watergate & levee	Levee & movable wall	Watergate & levee	Levee, floodway & retarding basin	Levee, floodway & retarding basin	Dam, Levee & retarding basin
Major City	Name of City		Paris	Tours	Lyon	London	Koln	Rotterdam	Ferrara	Some	Tokyo
	Population (1,000 person)		2,190	348	410	6,770	976	576	141	6,417	8,350
	Population Density (person/km2)		20,900	-	-	4,400	2,600	2,900	352	24	14,100
	Flood Area	Area (km2)	8.7	-	-	116	14	-	-	144,300	277
		Population (1,000 person)	151 (6.9%)	-	-	641 (9.5%)	240 (24.5%)	-	-	950 (14.8%)	3,890 (46.6%)
		Population Density (person/km2)	17,400	-	-	5,600	17,200	-	-	7	14,000

Appendix – 1 - 2 NON-STRUCTURE MEASURES IN FRANCE

Item		Law and Regulation	Objective Disaster	Purpose	Contents
Land Use Control	POS (Land Use Plan)	• Actually Implemented since 1967 • The law enacted in 1987	-	• Land use plan for cities, towns and villages to control urbanization	• To indicate the magnitude and frequency of expected disaster
	PSS (Plan for Flood Hazard Area)	• 1935 enacted	• Flood	• Regulation to conserve the flow and retarding capacity of rivers	• Flood hazard areas to be classified into A-zone with large discharge and high velocity and B-zone with stagnant water • In A-zone, rejection of construction of buildings • In B-zone, acceptance of construction of buildings satisfying the regulation
	Urban Planning Law	• 1977 enacted	• Flood • Erosion • Land subsidence • Land slide • Avalanche • Earthquake	• Permission of construction and land use in hazard areas to protect human lives and assets	• Control of new housing in hazard areas
	PER (Natural Disaster Information Plan)	• 1982 & 1987 enacted	• Flood • Land slide • Avalanche • Earthquake	• Public relations on disaster and hazard areas • Induction to the appropriate land use in hazard areas to mitigate damage • Effective application of the natural disaster insurance in hazard areas	• Zoning in hazard areas • Red zone : No building construction permitted • Blue zone : Strong measures applied to mitigate damage
Flood Warning		• No law exists	• Flood	• Exact and prompt forecast and transmission of water level	• Transmission of water level information along 16,000km of river stretch
Natural Disaster Insurance		• 1982 enacted	• Natural disaster in general (no clear definition exists)	• Aid for people suffered from disaster	• The additional insurance for natural disaster is 9% of the basic insurance fee

Appendix – 1 - 3 NATURAL DISASTER INSURANCE SYSTEM IN EUROPEAN COUNTRYIES AND USA

Name of Country	Category of Insurance	Objective Assets	Objective Disaster of Insurance	
			Applied for	Not Applied for
France	• Property Insurance (government & private)	• Movable estate • Immovable estate	• Direct damage inflicted by unordinary natural phenomenon	• Estates provided against law and regulations
UK	• House holders' insurance (private)	• Buildings • Households	• Earthquake • Storm and flood • Land subsidence and land slide	• Facilities outside housing such as fencing, gates, pools, etc. • Coastal erosion
Germany	• Natural disaster insurance (Building Insurance Committee)	• Buildings	• Storm, flood, inundation • Thunder • Snow, avalanche • Land slide, earthquake, land subsidence	• Buildings provided against law and regulations
Switzerland	• Fire insurance (states & private)	• Buildings • Households	• Flood damage • Wind damage	• None
Spain	• Fire insurance (government)	• Any assets	• Flood, hurricane • Earthquake • Land slide • Eruption	• Nationwide disaster • Damage by thunder, snow, wind, rainfall
Netherlands	• No insurance system	-	-	-
Belgium	• Fire insurance (private)	• Buildings • Households	• Storm, typhoon, fog • Earthquake	• Flood
Italy	• Natural disaster insurance (private)	• For storm, housings and household • For earthquake, factories, warehouses, hospitals, schools and buildings • For flood, the same as above plus their contents		
Greece	• Fire insurance (private) • Total housing fire insurance (private)	• Buildings • Households	• Earthquake • Flood • Storm	• Land subsidence and land slide resulting from the nature of ground • Facilities outside housing
USA	• Flood insurance (government)	• Buildings • Households	• Inundation from rivers or lakes • Flood caused by high tide • Land slide debris flow induced by the above	• Damage by rainfall, snow, freezing, etc.

Appendix 2 Study Procedure for Distribution System Improvement

Appendix 2 Study Procedure for Distribution System Improvement

1 Procedure for Study

The procedure to conduct the study on distribution system improvement in natural retarding basin is, in principle, considered as follows (refer to Figs.1.1 and 1.2):

- Collection of Basic Data for Natural Retarding Basin
- Division of Natural Retarding Basin into Several Blocks considering Inundation Condition, Land Use, Topography, etc.
- Identification of Present Issues for Distribution of Inundation Water in Each Block
- Classification and Prioritization of Blocks based on the Issues
- Selection of Pilot Areas by the Issues
- Formulation of Hydraulic Model for the Pilot Areas
- Calibration and Verification of Hydraulic Model
- Simulation of Several Cases Changing the Boundary Conditions
- Identification of Effectiveness
- Cost Estimation
- Selection of Suitable Project Scale
- Preliminary Design and Implementation Schedule
- Project Evaluation and Confirmation of Project Viability

2 Explanation of Procedure

(1) Collection of Basic Data

To conduct the study on distribution system improvement in natural retarding basin, the following basic data at least will be required:

Item	Contents	Remarks
Topography Map	Scale with 1/10,000 to 1/25,000	Contour line with 0.5 m interval and covering the area of 6,600 km2
Land Use Map	Scale with less than 1/50,000	Including classification of variety of paddy
Inundation Map	Scale with less than 1/50,000	
Irrigation and Drainage System Map	Scale with less than 1/50,000	Capacity of irrigation and drainage system
Structures and facilities	Intake, drainage and other related structures and facilities	With dimension of facilities and operation rule
Damage	Assent and contents of damage with damage rate	Data with Ampore level
Ongoing improvement plan and future development	Contents of improvement and future development	
Organization for Operation and Maintenance	Contents of operation and maintenance and their capacity	
Others	Survey results of channel, previous report on related study	

(2) Division of Natural Retarding Basin into Several Blocks

Natural retarding basin of 6,600 km^2 is divided into several blocks to identify the issues to improve the distribution system. The division is made considering such condition as topography, land use, inundation and so on. As the indicative area size of division, about 100 km^2 is considered as an example.

(3) Identification of Present Issues for Distribution of Inundation Water

For each divided block, the issues for distribution of inundation water are identified through the field investigation, interview survey, etc. It is presumed that the issues are mainly concerned with distribution channel system, channel capacity, flow control facilities, monitoring system and so on.

(4) Classification and Prioritization of Blocks based on the Issues

Based on the similarity of above issues identified, blocks are classified into several groups such as group of the areas with issues related to distribution channel system, channel capacity, and so on. Typical bocks to represent the groups are selected and the priority for such blocks is examined considering the significance of issues.

(5) Selection of Pilot Area

Pilot areas are selected considering the priority of blocks as well as significance of issues. The number of the pilot areas will be about 3 areas for each groups, though it subjects to change depending on the number of blocks, if the number of blocks is larger, the number of the pilot areas will be less.

(6) Formulation of Hydraulic Model

For the pilot areas, hydraulic models are formulated. The calculation method applied for the hydraulic model will be the two-dimensional unsteady flow calculation method, to examine the effectiveness of the distribution of inundation water toward North and South direction as well as East and West directions.

Considering the features of the study area, the hydraulic model will be expressed on the basis of tank model as shown in Fig. 1.2.

(7) Calibration and Verification of Hydraulic Model

It is necessary to calibrate the hydraulic model to verify the adequacy of the model using the observed data on inundation such as inundation water depth, area and duration. For calibration and verification, it is recommended that the inundation record of 1995 and 1996 be adopted. In this process, the confirmation of boundary conditions is also essential.

(8) Simulation of Several Cases Changing the Boundary Conditions

To identify the effectiveness of the improvement of distribution system, several cases of simulation will be examined changing the conditions such as channel network, channel capacities and flow control facilities. For the simulation, the typical flooding patterns to represent the big scale, medium scale and small scale floods selected from 45 years flooding patterns should be applied

(9) Identification of Effectiveness

Based on the simulation results, the effectiveness of the improvement of distribution system is identified in a manner of reduction of inundation volume, depth and period as well as the flood damage in the area. Effectiveness for each case is finally evaluated in a monetary term as the benefit.

(10) Estimation of the Cost

The cost required for the distribution system improvement is preliminary estimated for each case.

(11) Selection of Suitable Project Scale

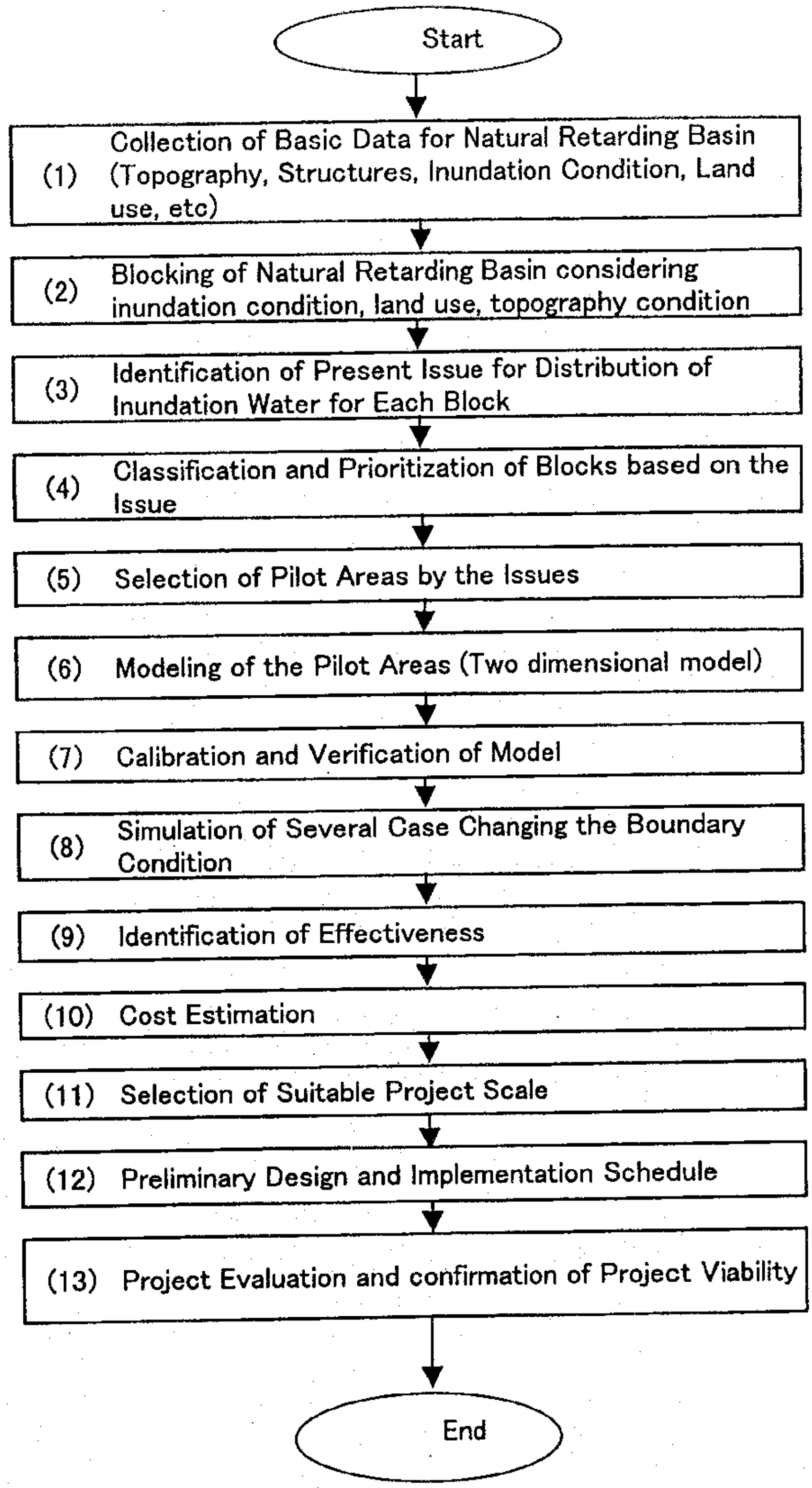
The suitable project scale for distribution system improvement for each pilot area is selected through the comparison between cost and benefit. The total cost required for whole areas and the total benefit derived from the whole areas are calculated accumulating the cost and benefit for each area based on the results of pilot areas. Financial affordability for the implementation of whole areas is also considered for the selection.

(12) Preliminary Design and Implementation Schedule

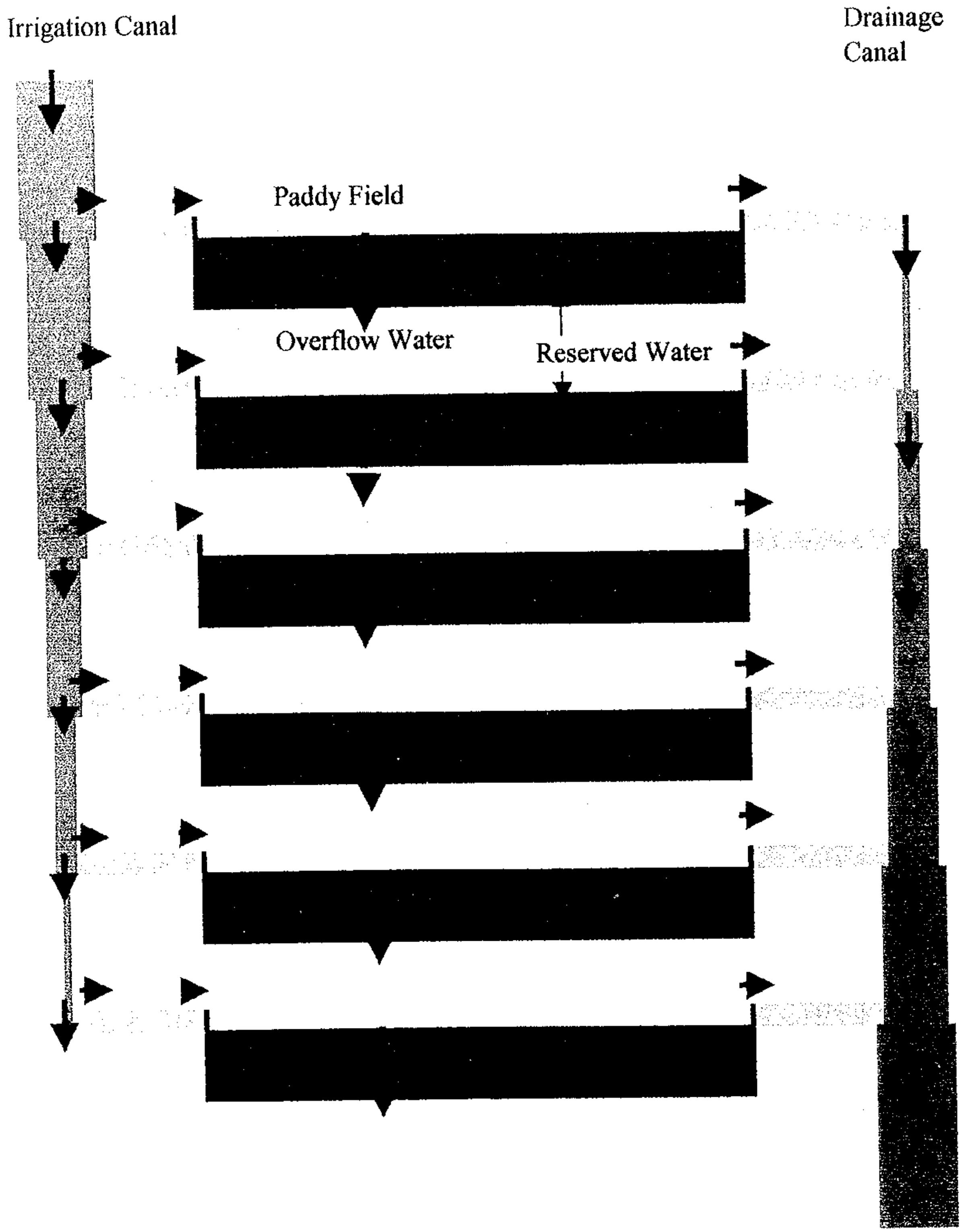
For the suitable project scale, the preliminary design for necessary facilities and channel improvement is made and implementation schedule is prepared considering the priority.

(13) Project Evaluation and Confirmation of Project Viability

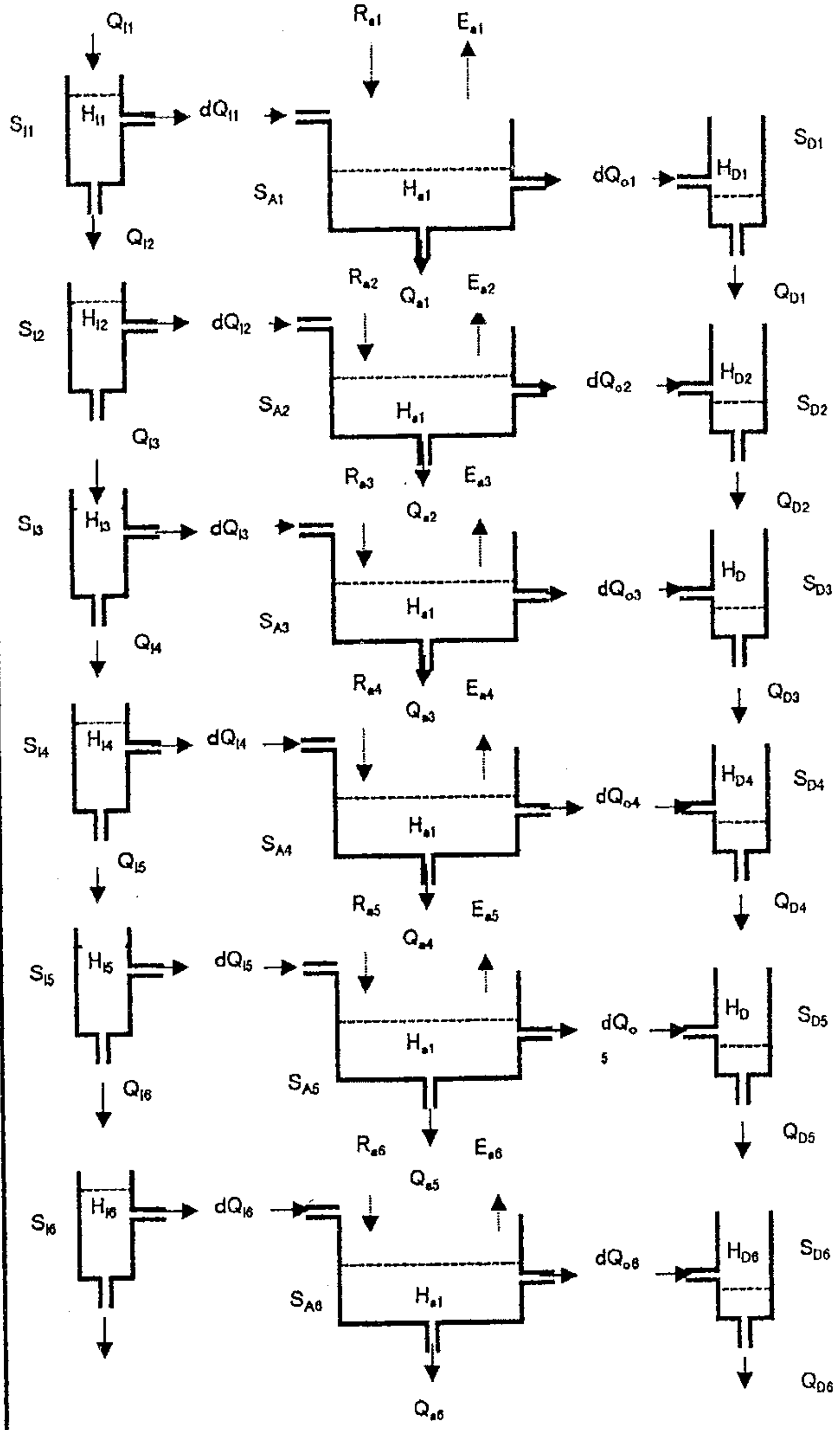
The project of distribution system improvement is finally evaluated based on the total cost and benefit and confirmed the economic viability. The project evaluation is also made from the technical, social and environmental points of view.



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.1.1 STUDY PROCEDURE FOR FLOOD DISTRIBUTION SYSTEM
CTI ENGINEERING CO.,LTD. AND INA CORPORATION	



STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAOPHRAYA RIVER BASIN	Fig.1.2 (1/2) SIMULATION MODEL FOR FLOOD DISTRIBUTION SYSTEM
CTI ENGINEERING CO., LTD. AND INA CORPORATION	



Legend:

SI1, SI6: Irrigation Canal Tank
QI1,QI6: Irrigation Canal Flow
dQI1, dQI6: Discharge from Irrigation Canal to Paddy Field
HI1, HI6: Water Level at Irrigation Canal Tank

SA1, SA6: Paddy Field Tank
Ha1, Ha6: Water Level at Paddy Field Tank
Ra1, Ra6: Rainfall to Paddy Field Tank
Ea1, Ea6: Evapolation from Paddy Field Tank
Qa1, Qa6: Overflow Discharge from Paddy Tank to the other Paddy Tank
dQo1, dQo6: Discharge from Paddy Tank to Discharge Channel Tank

SD1, SD6: Drainage Channel Tank
QD1, QD6: Discharge Channel Flow
HD1, HD6: Water Level at Drainage Channel Tank

STUDY ON INTEGRATED PLAN FOR FLOOD MITIGATION IN CHAO PHRAYA RIVER BASIN	Fig.1.2 (2/2) SIMULATION MODEL FOR FLOOD DISTRIBUTION SYSTEM
CTI ENGENEERING CO., LTD AND INA CORPORATION	

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