

### 5-3 Project Construction Plan

#### 5-3-1 Construction Policies

The purpose of the Project is to install a telemetering system to backup the existing pump and gate facility operations and to allow prompt flood fighting activities in order to protect the Bangkok Metropolitan area from floods.

Most of the equipment to be used in the system are electronic items. Thus, a construction site manager who is familiar with the equipment must constantly pay careful attention to its handling.

Because the Project construction period is very limited and the installation sites for the monitoring stations are widely located, the construction period, construction methods, and the material and equipment procurement plan must be very carefully examined to ensure smooth Project implementation.

The construction of water level gauge installation platforms must be carried out in canals. The various drainage facilities in the canals are intricate, and the canal ground is very soft. Thus, the planning of the temporary work must be carefully made. For this reason, it is extremely important that the construction work must be managed and supervised by civil engineers who have had work experiences similar to those that will be encountered in Project construction. Thus, plans call for dispatching qualified engineers to handle Project construction.

In view of the above, it is assumed that some difficulties may arise due to the limited time of the construction period and the very poor site conditions. Thus, it is very important not only to secure qualified Japanese engineers and administrative personnel, but to secure high quality local staff and workers.

In general, Thai people are industrious, and it is assumed that there will be no problem to secure the workers for Project construction. Judging from the nature of the construction work, however, the recruitment plan must be carefully made.

### 5-3-2 Items Requiring Special Attention for Construction

- 1) Platform foundations for water level gauges and OTU station installation must be built in the water.

Navigation routes for canal barges must be carefully studied before starting to build the temporary works that will be needed to carry in and install the steel foundations because certain temporary work parts will become parts of the platform foundations.

- 2) Modifications to pump control boards and the installation of gate opening gauges must be properly made during a short period of time so as not to interrupt pump and gate operations which might result in possible flooding. Before commencing this modification and installation work, the work schedule management plan should be discussed with personnel concerned with facility operations.
- 3) It will be necessary to confer with concerned agencies regarding the connection of power source lines and TOT leased lines in order to conduct test runs of Project equipment as soon as possible.
- 4) Since the signal processing equipment, computer unit and its supporting equipment are electronic items, their temporary storage, transportation, carrying into installation sites and installation work must be carefully conducted under the supervision of specialists in order to avoid physical and chemical damage to the equipment.
- 5) Equipment that will be installed outside must be guarded by security personnel during the installation work period.
- 6) As mentioned above, Project equipment will be installed under difficult conditions. Therefore, it will be necessary to dispatch well experienced Japanese engineers to Thailand as well as securing highly qualified local staff members well in advance of Project construction commencement.

From the viewpoint of maintaining and managing Project facilities, it is desirable that many of DDS's maintenance and management staff members will participate in the equipment installation work.

### 5-3-3 Construction Management Plan

#### 1) Project Construction

##### . Construction Method:

The contractor for Project construction will undertake all of the contract work from the procurement of the telemetering system equipment and its installation and test operation, the provision of operation training, and the delivery of the completed facilities to the Thailand side.

The contract work includes a number of different types of work, such as equipment manufacturing and installation, and civil engineering facility construction. Since the manufacturing and installation of the equipment will take in a large portion of the Project cost, it is desirable for the equipment manufacturer to be the prime contractor for Project construction. The contract work also includes the relatively difficult construction of the temporary works as well as supervising the construction. Therefore, it would be desirable to have a reliable Japanese construction contractor carry out the facility construction work under the responsibility of the primary contractor.

##### . Construction Starting Time:

Judging from the rules of the Japanese grant aid cooperation system, the entire Project construction period will be limited to thirteen (13) months.

After the contract agreement, the prime contractor will design and manufacture the major Project equipment in Japan and then ship the equipment to Thailand. It will take nine (9) months for designing and manufacturing the signal processing equipment and the computer equipment that will be

the core of the Project system. Thus, the manufactured equipment will be shipped to Thailand the tenth month of the contract. Equipment installation work will start at the beginning of the eleventh month of the Project contract.

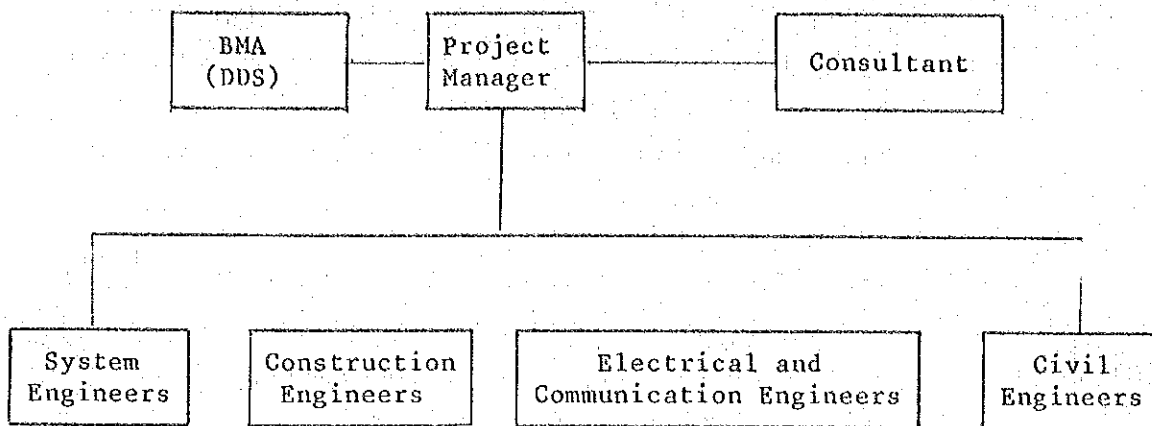
Within the allowable entire Project construction period, ie., thirteen months, only three months will be available for equipment installation, trial operation, the provision of operation training, various testings, and the delivery of the completed facilities to the Thailand side -- the Project schedule will be extremely tight. It will be necessary therefore, to ship rain gauges, water level gauges, and the materials and equipment -- all of which can be procured with relative ease -- required for OTU station houses and monitoring station foundation construction to Thailand sometime within the seventh month of the Project contract, and to complete the installation of the gauges and the station houses prior to the shipment of the mentioned electronic equipment.

. Organization for Construction Work:

The Project construction period in Thailand will be approximately six (6) months as shown in Fig. 5.2. During this limited time period, equipment transportation, facility construction, equipment installation, trial operations, operational training, and the delivery of the completed Project facilities must be carried out.

Each piece of electronic equipment is only a part of the entire system and it will be functional only after being installed in the entire system.

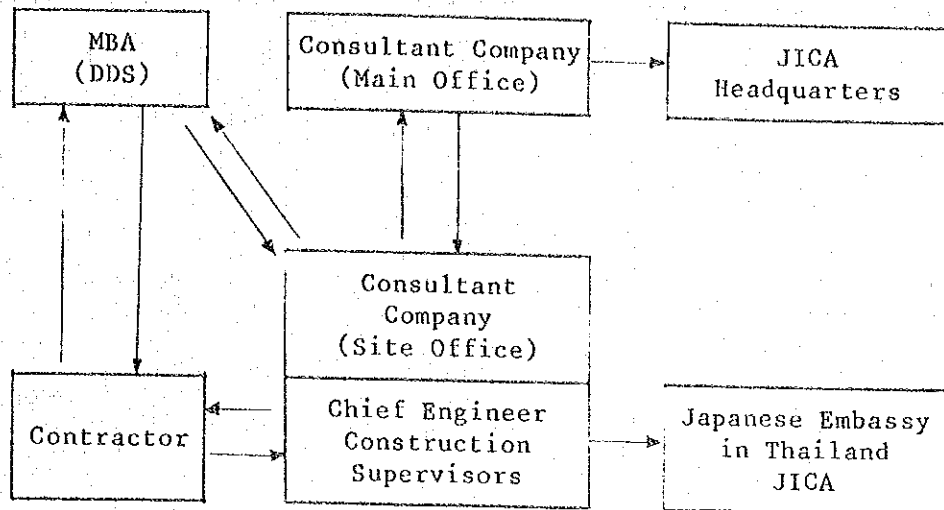
In order to complete all of the work items mentioned above during a very limited time period, it will be necessary to form the following organization for carrying out smooth Project construction work:



2) Construction Management Structure

The construction of gauge installation platforms, gauge installation work, and room interior work for the master station installation will be carried out during the first half of the approximately six-month long Project construction period. Thus, the construction supervision for the above work will be conducted by civil engineers. The installation of electronic equipment, the system's trial operations, and operational training will be conducted during the last half of the Project construction period. This work must be supervised by electrical and communications engineers.

The chief engineer, who will be in charge of the entire Project's construction work, shall attend the construction work commencement, inspect equipment manufacturing in Japan, and witness the delivery of the completed Project facilities. The chief engineer shall also be responsible for the communications between other related organizations, preparing various reports, giving guidances to related engineers, and issuing various certifications necessary for the Project construction work.



#### 5-3-4 Materials and Equipment Procurement Plan

##### 1) For Monitoring Stations' Foundation Work and Master Station's Interior Work

Materials and equipment necessary for the construction work shall be locally procured as much as possible. Since the ground soil is very soft, large sized steel piles must be used for the main members of the foundation works. Because the Project construction must be completed within a limited period of time under the rules for the Japanese grant aid cooperation system, such materials and equipment that are not obtainable in Thailand shall be procured in Japan. Materials and equipment to be procured in Thailand and Japan are listed below:

In Thailand	In Japan	Reason for procured in Japan
. Ready mixed concrete	. H-shaped steel pile (H-250)	. Long size piles are not available in Thailand
. Reinforcing bars	. Stainless steel material	. This is a special item and is not available in Thailand
. Lumber	. PVC pipe (φ600)	. Large diameter PVC pipes are not available in Thailand
. Building stone		
. Automatic doors		
. Wall materials & desks		
. Construction equipment		

2) For Equipment Installation

All equipment and tools required for the equipment installation shall be shipped from Japan. A crane required for equipment installation will be procured in Thailand.

The materials and equipment that will be procured in Thailand and Japan are listed in the following table:

In Thailand	In Japan	Reason for procured in Japan
. Crane	. Equipment for telemetering system	. Not available in Thailand
. Barge for a crane and a pile driver	. Equipment installing tools	. Not available in Thailand
. Consumptive materials	. Test equipment	. Not available in Thailand

5-3-5 Project Implementation Schedule

Project implementation will start when the Exchange of Notes (E/N) for the Project is signed by the Government of Japan and the Government of Thailand (see Fig. 5.1).

After signing E/N, BMA will make a contract agreement with a Japanese consultant necessary for the equipment procurement, equipment installation, and civil engineering facilities' construction work. After making the contract agreement, the consultant company will prepare the detailed designs, construction specifications, and tender documents. After the detailed designs, specifications, and documents are approved by the Government of Thailand and the Government of Japan, the consultant will carry out tendering for the Project work to Japanese equipment suppliers. The consultant will then witness the contract agreement between the Government of Thailand and the successful tenderer. After signing E/N, it will take about four (4) months before the contract agreement can be made. After the contract agreement, the contractor shall make the field reconnaissance surveys, the system design, the application

software design, equipment manufacturing, and equipment testing at the factory. For this work it will take nine (9) months.

As ready-made water level gauges, rain gauges, and the steel materials required for the foundation work can be easily procured, they must be shipped prior to the commencement of foundation construction work.

It will take about two and a half (2½) months to complete the foundation construction and the master station's room interior work.

After installing the equipment in the monitoring stations, it will take about three (3) months to install the master station's equipment.

Upon completing the above works, it will take about two (2) months to conduct the system's trial operations and operation training prior to delivering the completed Project facilities to the Thailand side.

It is assumed that one month will be required for equipment transportation---via sea and land---and customs inspections.

The above work periods are tabulated in Fig. 5.2, the Project Construction Schedule.

As shown in Fig. 5.2, thirteen (13) months will be required to complete all Project construction work after the contract agreement with an equipment supplier to design, manufacture, transport, and install the equipment, and to conduct the system's trial operation prior to delivery the completed Project facilities.



#### 5-4 Project cost Estimates

##### 5-4-1 Total Project Cost

The estimated total Project cost is approximately \_\_\_\_\_ yen. The entire Project cost will be borne by the Japanese side.

The foreign exchange rates used for the cost estimates were:

1 U.S.\$ = 25.269 Baht = 127.86 Yen (1 Baht = 4.905 Yen) at the end of August 1988.

##### 5-4-2 Project Cost to be Borne by the Japanese Side

The Japanese side will undertake the procurement of the various items of equipment necessary for the telemetering system, the installation of this equipment, construction of civil engineering facilities required for the equipment installation, and the provision of consultant services for this work. The estimated cost necessary for these works is approximately \_\_\_\_\_ yen.

##### 5-4-3 Project Cost to be Borne by the Thailand Side

BMA (DDS) will undertake the leveling surveys that will be necessary for installing the water level gauges. Thus, the levelling survey cost was not included in the Project cost estimate.

Fig. 5.1 Planned Project Implementation Schedule

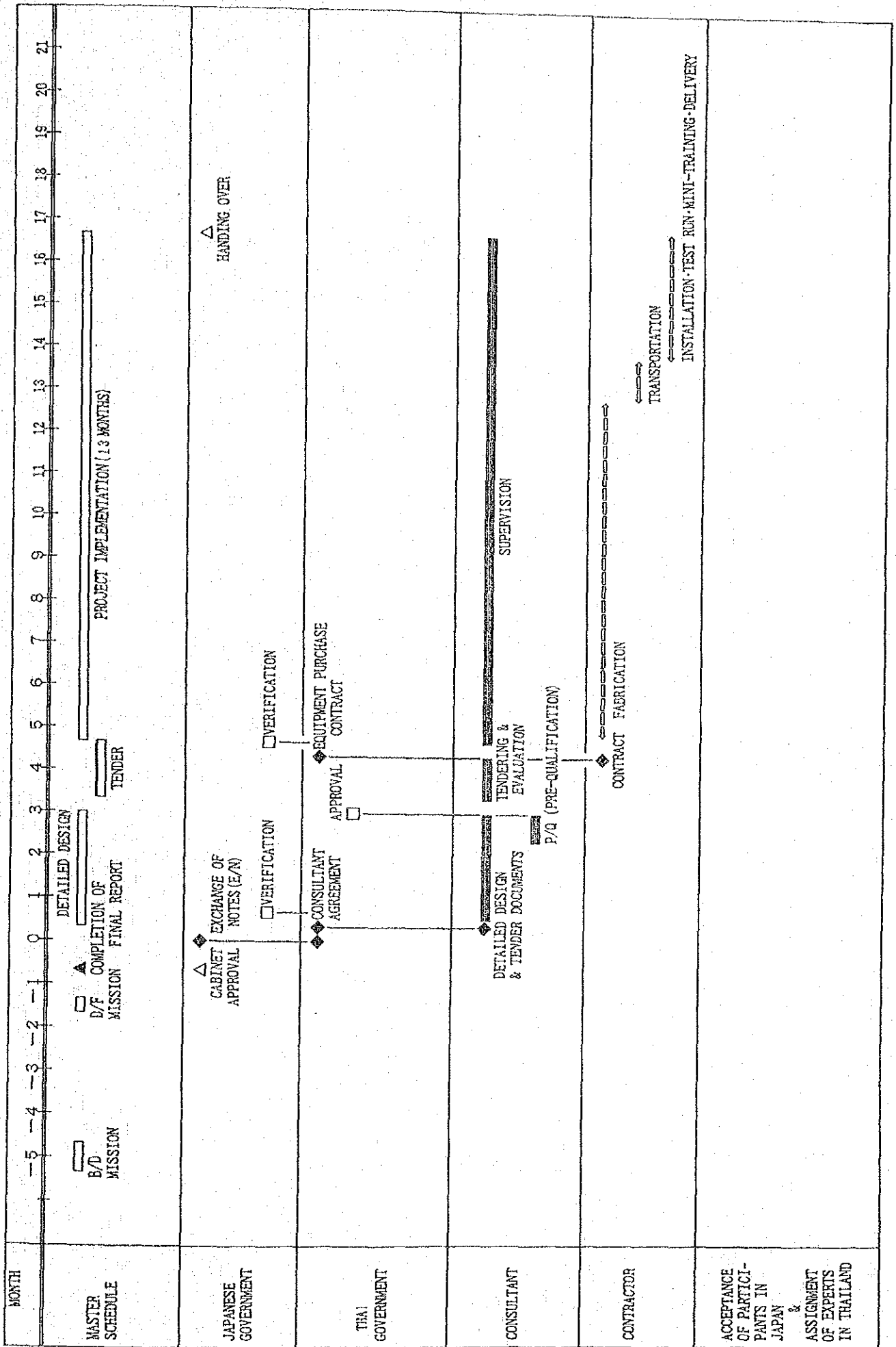
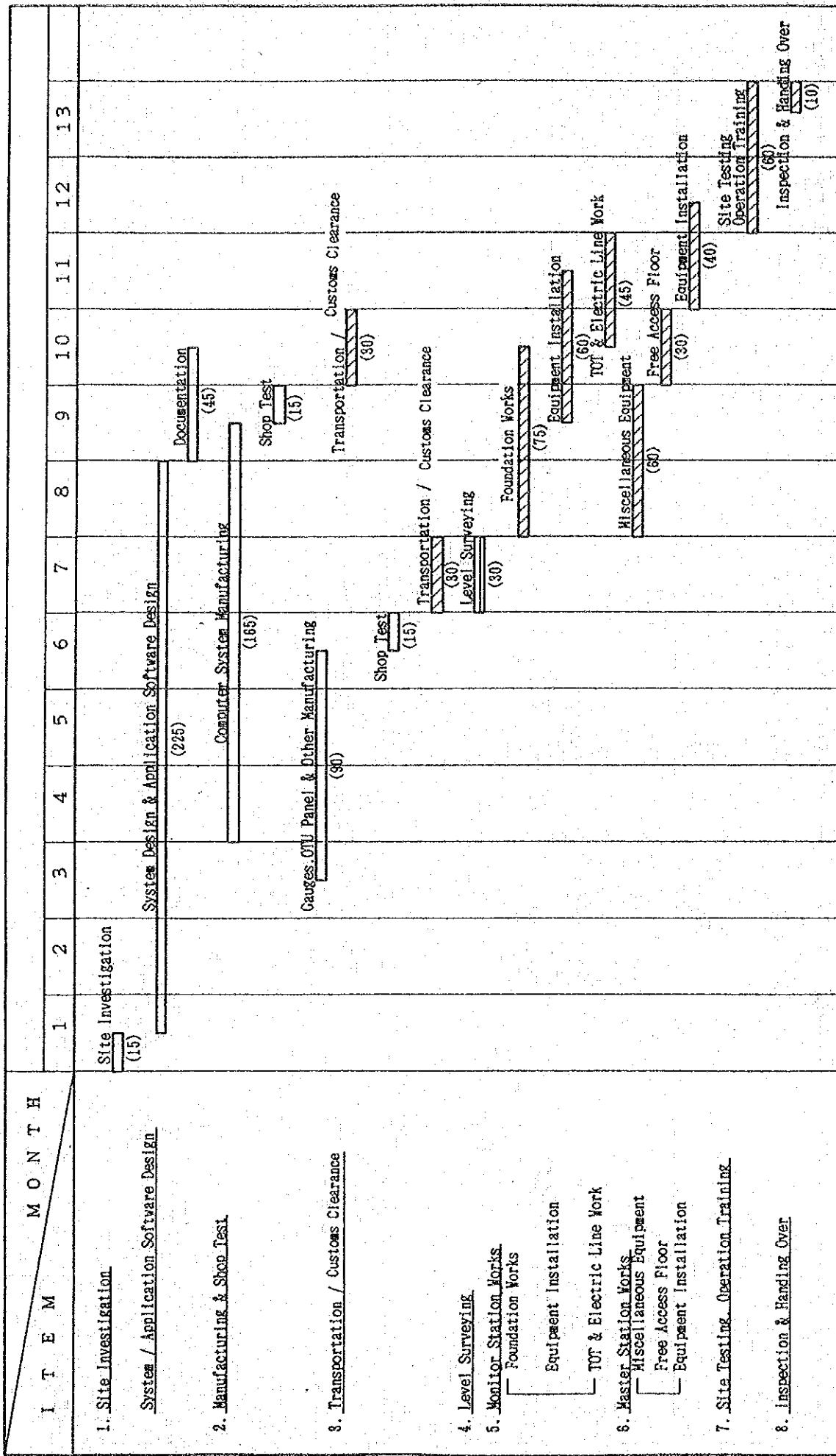
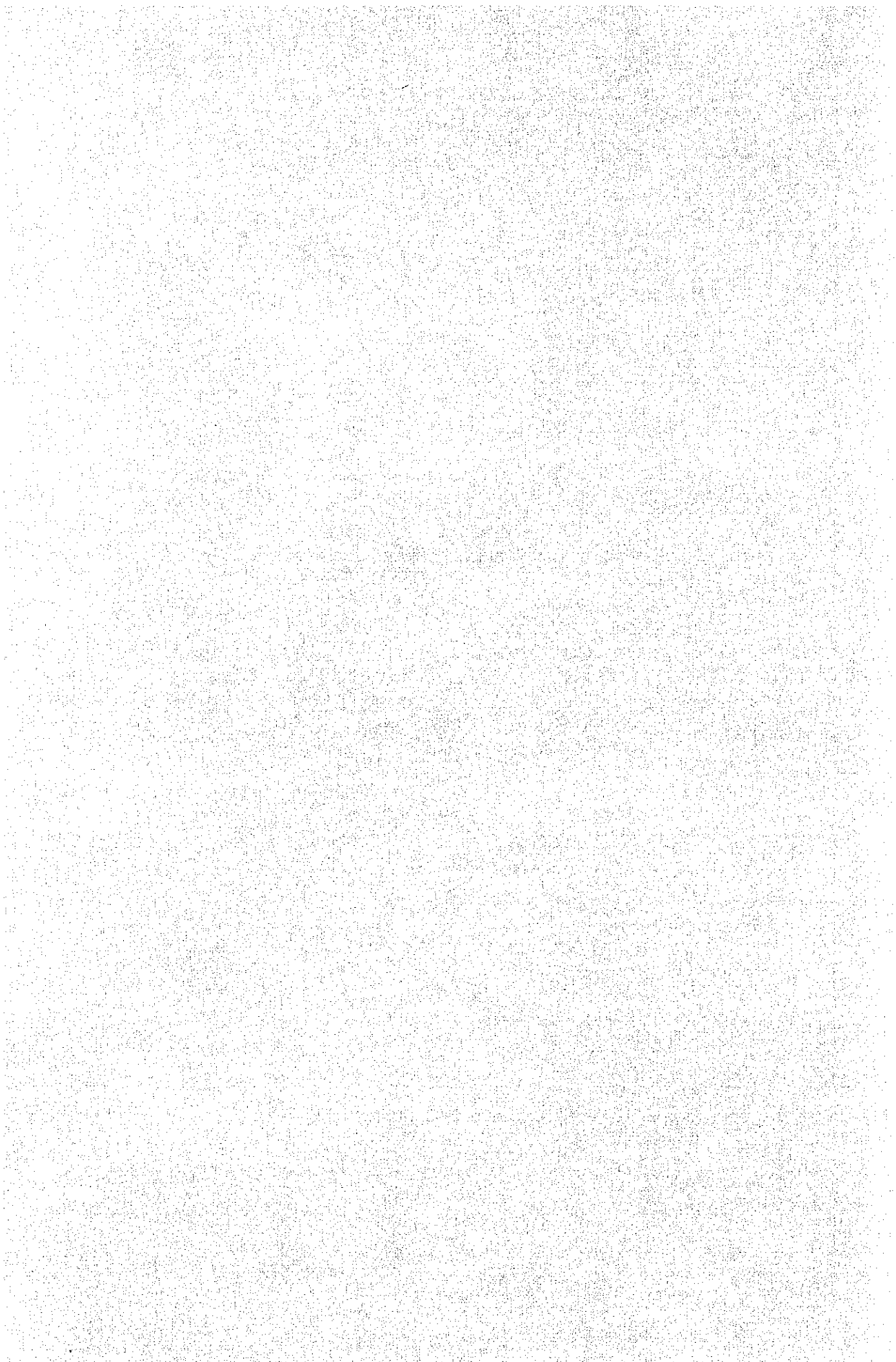


Fig. 5.2 Project Construction Schedule



**CHAPTER 6 MAINTENANCE AND MANAGEMENT PLAN**



## CHAPTER 6 MAINTENANCE AND MANAGEMENT PLAN

### 6-1 Positioning of the Flood Control Center's Organization

During the first stage of the Project facilities' operation management schedule, the Flood Control Center will be established and managed within the Technical Division of the DDS, the Project's implementation agency. It is planned to make the Flood Control Center an independent division when its management gets fairly well underway; probably from three to four years after its establishment (see Fig. 6.2 and 6.3).

6-2 Operation, Maintenance, and Management Structure

The utilization level of the collected data at the Flood Control Center shall be upgraded in accordance with the following five steps (see Fig. 6.2 and 6.3):

- |           |   |  |
|-----------|---|--|
| Step I:   | Data Collection and storing<br>Application to facilities'<br>operation management   | One or two years<br>after the Center<br>established: |
| Step II:  | Data analyses and publicity<br>activities   | 1st Stage  |
| Step III: | Hydraulic and hydrologic model<br>analyses and flood damage<br>forecasting analyses |  |
| Step IV:  | Application to flood forecasting<br>and issuing flood warnings                      |  |
| Step V:   | Application to related projects   |  |

The Flood Control Center's required staff during the 1st and 2nd stages is shown in Fig. 6.4.

### 6-3 Maintenance and Management Plan

The periodical inspection of each item of equipment will be the prime work of the Flood control Center's maintenance and management. The standard intervals for each equipment item's periodical inspection are as follows:

#### 6-3-1 Monitoring Stations

Name of Equipment	Inspection Intervals	Items to be Inspected	Inspection Method
1. Rain gauges and their recorders	1 month	Body structure	Damage check with visual inspection
	1 month	Recording paper	Paper replacement
	1 month	Receiving buckets	Obstacle check
2. Water level gauges and their recorders	1 month	Body structure	Damage check with visual inspection
	1 month	Recording paper	Paper replacement
	1 month	Wires	Check for cut and slack wire
	3 month	Batteries	Battery replacement
3. Water quality meters and their recorders	1 month	Body structure	Damage check with visual inspection
	1 month	Recording paper	Paper replacement
4. Gate opening gauges	1 month	Body structure	Damage check with visual inspection
5. Pump operation indicators	1 month	Body structure	Damage check with visual inspection
6. Others	1 month	Body structure	Cable cut check



6-3-2 Data Transmission System

Name of Equipment	Inspection Intervals	Items to be Inspected	Inspection Method
1. OTU panel	1 month	Body structure	Damage check with visual inspection
	6 month	Output level	Measure and record output level with a level meter
2. Power source equipment	1 month	Body structure	Damage check with visual inspection
	6 month	Voltage check	Measure and record input and output voltage with a voltmeter
3. Others	6 month	Batteries	Battery liquid check with visual inspection
	1 month	Body structure	Damage check with visual inspection

6-3-3 Master Station

Name of Equipment	Inspection Intervals	Items to be Inspected	Inspection Method
1. OTU panel	6 month		
(1) CPU	6 month	Fan stop of processing function	Diagnosis program, visual and sound inspection
(2) System control	6 month	Processing function	Diagnosis program
(3) Hard disc	6 month	Read and write check	Diagnosis program
(4) Floppy disc	6 month	Read and write check	Diagnosis program
(5) Magnetic tape	6 month	Read and write check	Diagnosis program
(6) Calander clock	6 month	Display check	Visual inspection

(Continues)

CONTINUED

Name of Equipment	Inspection Intervals	Items to be Inspected	Inspection Method
(7) Other interface	6 month	Processing function	Diagnosis program
(8) Fan	6 month	Fan	Visual and sound inspection
2. Man Machine interface			Diagnosis program and visual inspection
(1) Mimic panel	6 month	Processing function	Visual inspection
(2) 70-inch projector	1 month	Display function	Diagnosis program and visual inspection
(3) VDU	1 month	Display function	Trial run
(4) Color hard copier	1 month	Copying function	Trial run
(5) VTR	1 month	Video function	Trial operation
(6) Modem	1 month	Data communication function	Trial run between MD
(7) Facsimile	1 month	Data communication function	Trial run between RID
(8) Printer	1 month	Printing function	Diagnosis program
3. Telemetering panel	6 month	Signal level in line	Checking with a level meter
4. Uninterruptible power source equipment (UPS)	6 month	Input voltage	checking with a voltmeter
		Output voltage	Checking with a voltmeter
		Battery liquid	Liquid level check with visual inspection
5. Air conditioner	6 month	Cooling and heating functions	Trial operation
6. Copy machine	1 month	Copy drum, etc	Periodical inspection contract with a local supplier
	1 week	Ink supply	
7. Engineering work station	1 week	Processing function	Diagnosis program

6-4 Operation, Maintenance, and Management Costs

The Flood Control Center's operation, maintenance, and management costs are as shown in Table 6.1.

Table 6.1 Operation, Maintenance, and Management Costs of the Flood Control Center

Item	Amount (unit: baht/year)	Percentage (%)
1. Personnel expenditures (35 persons)	2,352,000	32.7
2. TOT lines' lease fee (25 lines)	900,000	12.5
3. Electricity rates	60,000	0.8
4. Consumptive items (record paper, printer paper, etc)	1,740,000	24.2
5. Patrol vehicles' maintenance cost	150,000	2.1
6. Inspection, Repairing and contingencies	2,000,000	27.7
Total	7,202,000 Baht/year	100.0%

The operation, maintenance, and management costs will be approximately 0.1% of the BMA's annual budget (7,105 million bahts in 1987) and the financial burden to BMA will be very small.

Furthermore, the present personnel of BMA (DDS) will be assigned to the Flood Control Center. Thus, excluding the personnel expenditures, the Center's actual operation, maintenance, and management costs will be approximately 5 million bahts per year.

Fig. 6-1 Positions of the Flood Control Center within the DDS Organization

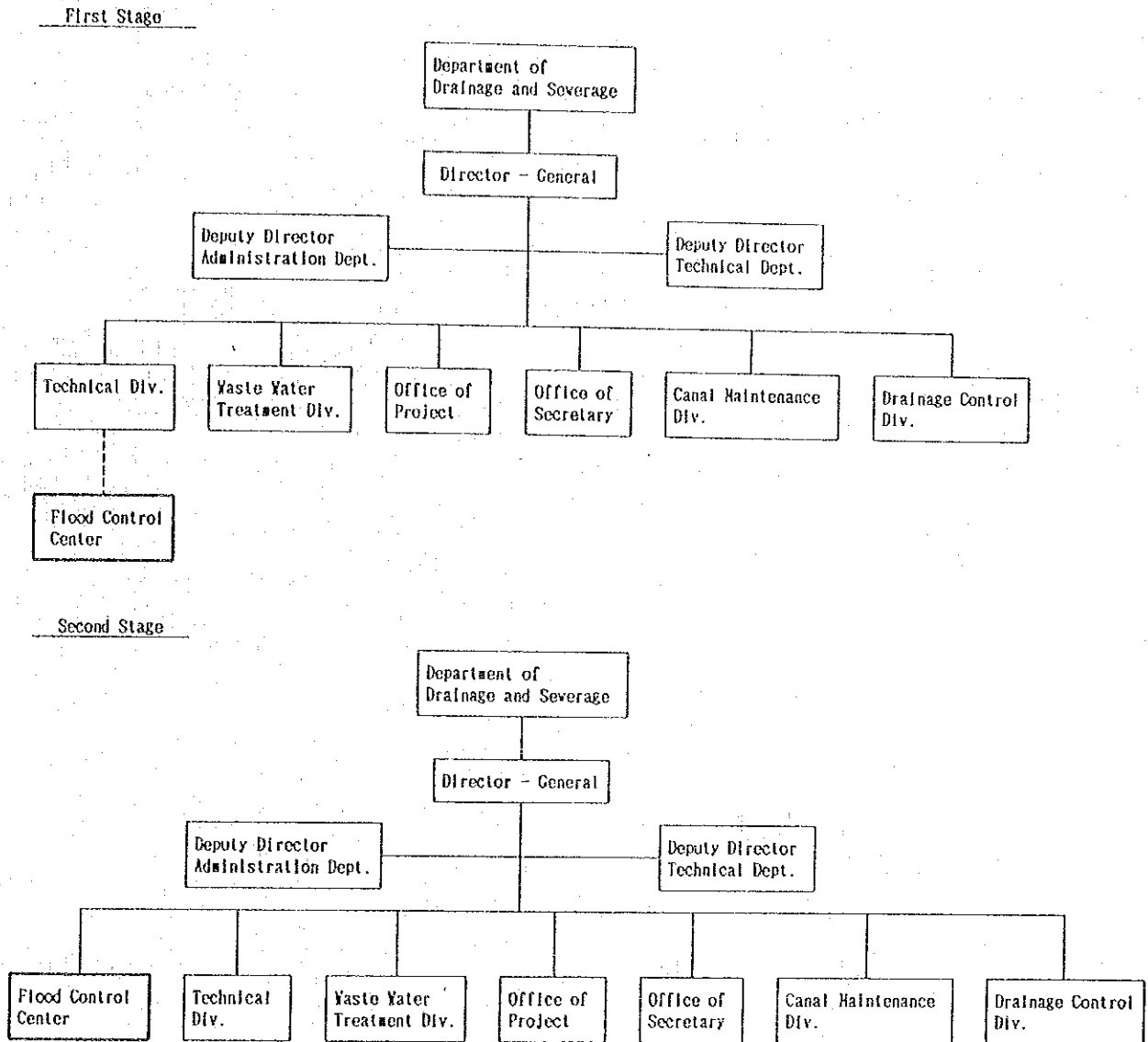


Fig. 6.2 Flood Control Center's Structure and its Duties

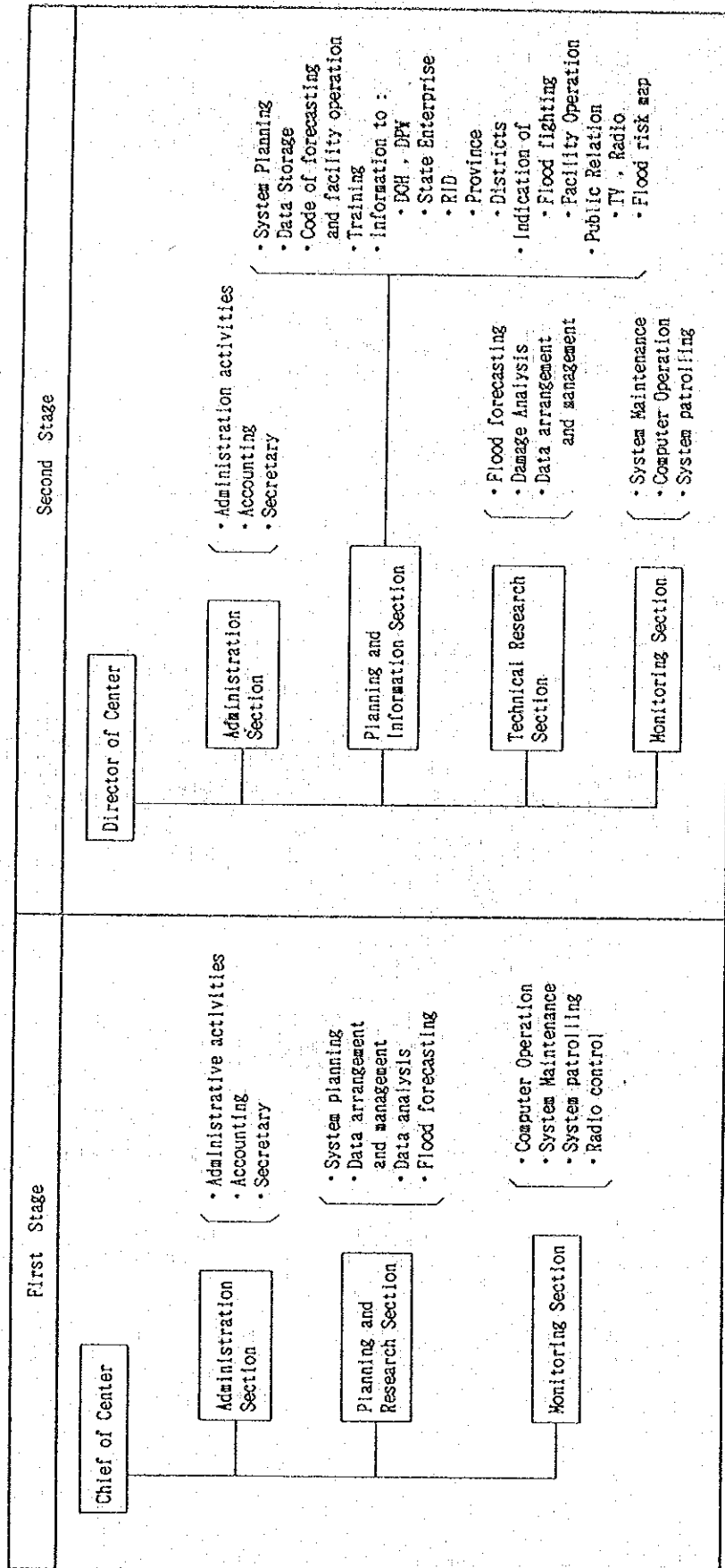


Fig. 6.3 Step by Step Utilization Plan of Collected Data

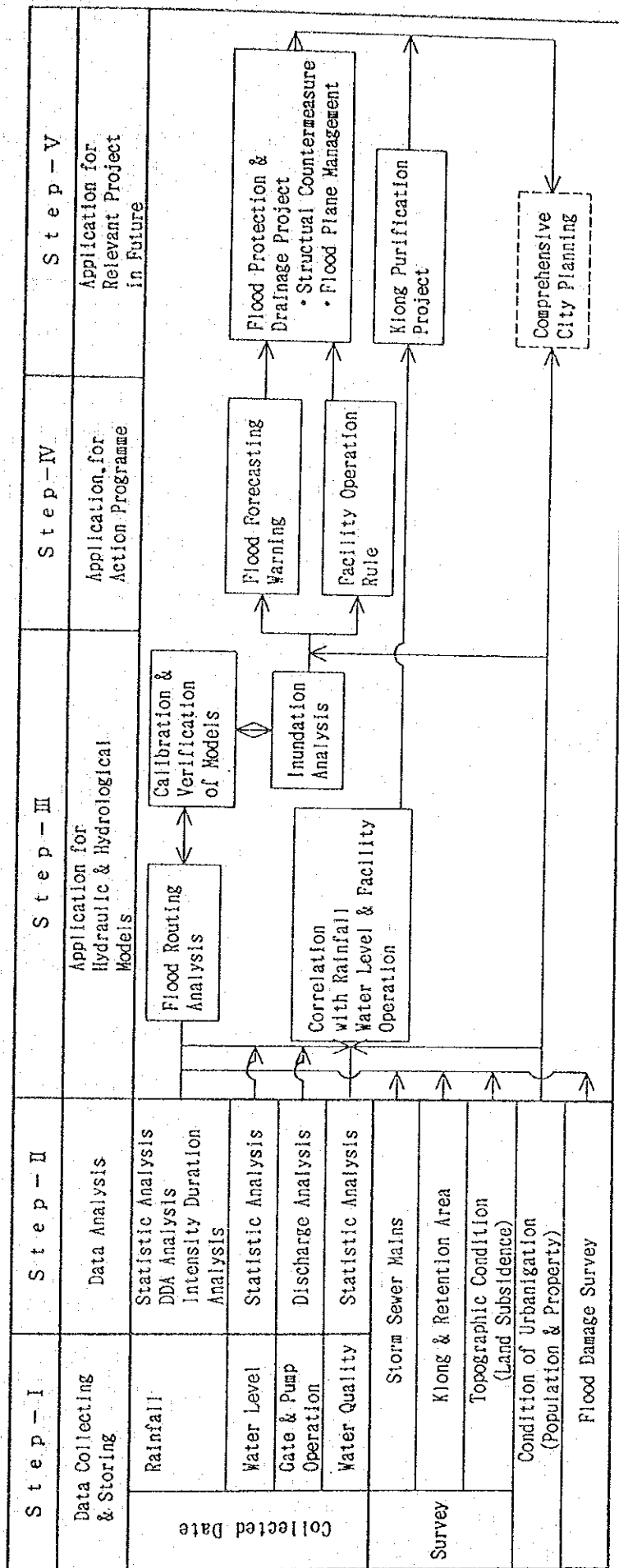


Fig. 6.4 Flood Control Center's Staff Planning

Function	Position	Job Description	Technical Field (Qualification)	Number of Personnel	
				First Stage	Second Stage
	Director Chief/Deputy Director	Over all management "	Civil or Sanitary Engineering — do —	1	1
Administration	Senior Officer	All administrative activities	Business administration	1	1
	Account Officer	Cash flow administration	— do —	1	1
	Secretary	Assisting superior officer	High school Diploma	1	2
Planning and Information	Senior Engineer	Flood Control Center System Planning	Civil Engineering	1	1
	Engineer	Management of Data Code making for Forecasting and Facility Ops.	Urban Drainage Engineering	1	2
	Engineer	Information and Indication Public Relation	Civil Engineering		2
	Engineer	Water Quality Improvement Planning	Sanitary Engineering		2
	Clerk, Typist	Assisting Engineers	High School Diploma		2
Technical Research	Senior Engineer	Flood Forecasting and Warning Analysis	Urban Hydrological Engineering	1	1
	Engineer	Computer Soft Programming and Simulation Analysis	Hydraulic / Hydrological Engineering	1	2
	Engineer	Flood Damage Analysis	Civil Engineering		2
	Technical Assistant	Data Arrangement	Civil Engineering		2
Monitoring and Maintenance	Senior Engineer	Computer System Maintenance	Computer System Engineering	1	1
	Engineer	Electrical Equipment Maintenance	Electrical Engineering (Telecommunication Engineering)	2	2
	Technical Assistant	Monitoring at Center	Civil Engineering	6 (2person× 3shift/day)	6 (2person× 3shift/day)
	Technician	System Patrolling	Civil Engineering	2	4
Total				19	35

## CHAPTER 7 PROJECT EVALUATION





## CHAPTER 7 PROJECT EVALUATION

### 7-1 Effects of the Project Implementation

It is extremely difficult to make a quantitative economic analysis in order to evaluate the effects of the Flood Control Center. This is also true for evaluating the education improvement project or a public health improvement project. The Bangkok metropolitan area is suffering from flood damage every year. In particular, the 1983 flood inundated a part of the Bangkok City for approximately three(3) months and hindered the function of the city. The flood had an immeasurable impact on social and economic activities. The Flood Control Center will greatly contribute to the reduction of flood damages.

By knowing precisely the information concerning rainfall, water level heights, gates opening conditions, and pumps operating conditions, the Flood Control Center will play a very important role in make effective use of flood fighting and relief activities, the operations of various facilities, to prevent floodings, and, as a result, to improve the public well-being. Most importantly, the Flood Control Center's System will help to save human lives during flood seasons.

Furthermore, the indirect effect of the Flood Control Center will be to promote development plans and flood protection projects, increase individual and public assets, and to increase an individuals' willingness to work.

Compared to the construction of flood protection works, the costs required for constructing the Flood Control Center is considerably less, the time needed to complete the Center's construction is much shorter, and the effects derived by the Center will be much greater -- this is the peculiarity of the Project.

The Flood Control Center's definite effects are as follows:

- . Stability of livelihood and the improvement of public health.

- . Flood forecasting will be possible and flood damage will be minimized by pre-operating the pumps and gates.
- . It will be possible to pre-announce flood information to residents.
- . It will be possible to minimize problems related to gate openings and closings during rainy seasons.
- . It will be easier to manage low water during dry seasons.
- . It will be possible to provide the information needed for the improvement plan of flood protection and drainage facilities.
- . It will be possible to provide the information needed for a water quality management plan.
- . It will be possible to provide the information needed for an urban development plan (land use plan).

## 7-2 Propriety of the Project Implementation

1) Management Capabilities of the Project Implementation Agency  
DDS, the Project implementation agency, had 459 staff members in 1987. Sixty-one (61) of them were engineers: forty (40) civil engineers; six (6) electric engineers; nine (9) mechanical engineers; and six (6) sanitary engineers. These engineers have sufficient basic technical knowledge that is related to the Project's equipment system operation and for the utilization of the collected data. Therefore, it will be possible to upgrade their basic capabilities through on-the-job training so that, in a short period of time, they will have a complete understanding of equipment management.

### 2) Propriety of Financial Load

The estimated Flood Control Center's operational, maintenance, management costs are 7.2 million bahts/year.

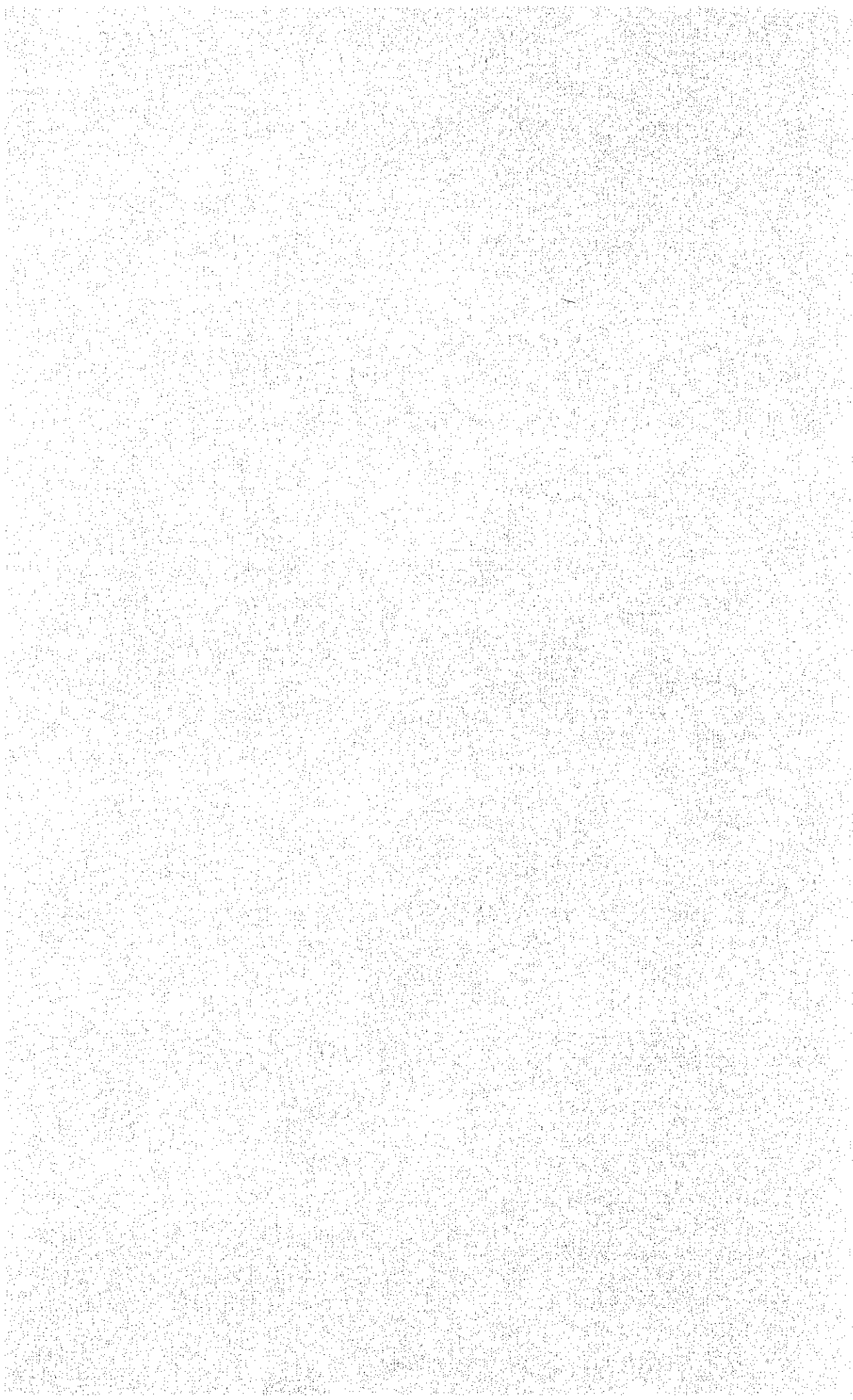
The comparisons of the costs to BMA's and DDS's 1987 budgets are as follows:

	<u>Percentage of the estimated costs</u>
BMA's budget: 7.105 billion bahts/year	0.1%
(DDS's budgets: 645 million bahts/year	1.1%)

As shown above, the percentage of the Center's annual operation, maintenance, and management costs within the BMA and DDS's budgets is very small. The financial load on BMA and DDS will be practically nil.



## CHAPTER 8 CONCLUSION AND RECOMMENDATIONS



## CHAPTER 8 CONCLUSION AND RECOMMENDATIONS

### 8-1 Conclusion

For flood prevention measures in an urban area, especially in a metropolis, it is not sufficient merely to strengthen the physical structures of the flood protection facilities, such as pumping stations, gates, and levees. Special attention must be paid to the fact that operations and management techniques of these facilities greatly effects the extent of flood damage.

For the above reasons, the introduction of the Flood Control Center's flood protection telemetering system is essential for the effective use and efficient operations of the existing flood protection facilities.

As a conclusion, Project implementation with Japanese grant aid cooperation is justifiable judging from all the related aspects, and the Study Team strongly urges that the Project be implemented as early as possible.



8-2 Recommendations

- o After making the equipment and material procurement contract agreement, it will take thirteen (13) months to complete the Project. It will, therefore, be necessary to make the consulting service contract immediately after the signing of the Exchange of Notes for the Project, and to make the material procurement contract agreement at a very early stage.
- o Establishment of a step by step training program will be required for the Project facilities' operations and management and for the effective use of collected data. Therefore, a one or two year period of Japanese technical cooperation will be necessary; after that, Thai engineers will be able to manage the Project facilities by themselves.
- o For the development of technical management capabilities of DDS Center staff members who possess sufficient basic knowledge, it will be necessary 1 to provide technical cooperation by specialists dispatched from Japan, and 2 to make spot contracts with equipment suppliers for the maintenance and management work of the Project facilities.
- o Since land subsidence in the Project Area is significant, it will be necessary to conduct the leveling surveys at each water level observation station once a year in order to obtain correct water level readings.

## APPENDICES

- APPENDIX - A : STAFFING OF STUDY TEAM  
FIELD SURVEY SCHEDULE  
LIST OF INTERVIEWEE
- APPENDIX - B : MINUTES OF DISCUSSIONS (March 24, 1988)
- APPENDIX - C : MINUTES OF DISCUSSIONS (June 14, 1988)
- APPENDIX - D : MINUTES OF DISCUSSIONS (September 9, 1988)
- APPENDIX - E : LIST OF COLLECTED DATA
- APPENDIX - F : COUNTRY DATA



**APPENDIX - A : STAFFING OF STUDY TEAM  
FIELD SURVEY SCHEDULE  
LIST OF INTERVIEWEE**



APPENDIX - A.1 STAFFING OF STUDY TEAM

The Study Team of Basic Design Study was formed having the following nine members.

Name	Part in Team	Affiliation
(1) Mr. Koichi BABA	: Team Leader	Director, office of Disaster Protection, River Bureau, Ministry of Construction
(2) Mr. Haruki TAKAHASHI	: Flood Protection & Drainage Planner	Assistant-Chief, Design Sec., Planning Div., Japan Sewerage Works Agency
(3) Mr. Hideto GOSHU	: Telecommunication Planner	Chief of Telecommunication Div. Hokuriku Regional Construction Bureau, Mcc
(4) Mr. Toshio NAMAI	: Project Coordinator	Grant Aid Planning & Survey Dept., JICA
(5) Mr. Kazuyuki MATSUO	: Project Manager	Water Resources Dept. PCI
(6) Mr. Hikoroku OTSUKA	: Data Monitoring System Designer	- do -
(7) Mr. Haruyuki GOTO	: Data Transmission System Designer	- do -
(8) Mr. Shigehisa OKAYAMA	: Data Management & Display System Designer	Consulting Dept. PCI
(9) Mr. Yasuhiro HAMAMOTO	: Facilities Designer	- do -

APPENDIX - A.2 FIELD SURVEY SCHEDULES

No.	Date	Itinerary	Contents
	1988		
1	6/6 Mon.	Tokyo Bangkok	(JL 717) Arrived at Bangkok
2	6/7 Tue.		Courtesy call to JICA office, DDS, & TOT Explanation and Discussion of I/R with DDS, (1st meeting)
3	6/8 Wed.		Inspection and Discussion with MEA and TOT Courtesy call to Director General of DDS, and site surveying
4	6/9 Thu.		Courtesy call and Discussion with BMA and CAT Inspection of new DDS office, 2nd Meeting
5	6/10 Fri.		Discussion with TOT, PTD & BMA, Site surveying
6	6/11 Sat.		Meeting of study team, Data arrangement
7	6/12 Sun.		" "
8	6/13 Mon.		3rd Meeting Discussion with TOT & PTD
9	6/14 Tue.		Signing on M/D Reporting to EOJ, and JICA office, Governmental staffs departed BKK (TG-740)
10	6/15 Wed.	BKK Tokyo	Site Survey, (6 sites)
11	6/16 Thu.		Site Survey, (7 sites)
12	6/17 Fri.		Site Survey, (9 sites)
13	6/18 Sat.		Site Survey, (7 sites)
14	6/19 Sun.		
15	6/20 Mon.		Inspection to the system of MD & RID
16	6/21 Tue.		Data arrangement
17	6/22 Wed.		Data arrangement
18	6/23 Thu.		Data arrangement
19	6/24 Fri.		Discussion for application of collection data with proposed system Inspection to existing pump control panel
20	6/25 Sat.		Arrangement of Technical Note

APPENDIX - A.2 FIELD SURVEY SCHEDULES

No.	Date	Itinerary	Contents
	1988		
1	6/26 Sun.		
2	6/27 Mon.		4th Meeting Data arrangement
3	6/28 Tue.		Discussion with TOT
4	6/29 Wen.		Data arrangement Arrangement of Technical Note
5	6/30 Thu.		5th Meeting Inspection to DDS new office
6	7/1 Fri.		Meeting with JICA office Final meeting with DDS
7	7/2 Sat.		Meeting of study team for making work schedule in Japan
8	7/3 Sun.	BKK Tokyo	Departed BKK (TG 740)



APPENDIX - A.3 LIST OF INTERVIEWEE

BMA

Mr. Wicha Jiwalai	Deputy Governor
Mr. Anuchit Sodsathit	Director General of Policy and Planning

DDS

Mr. Sante Thrachoo	Director General
Mr. Siri Prempree	Deputy Director Administration Dept
Mr. Mana Noppun	Deputy Director Technical Dept
Mr. Somchitt Kottiyavaro	Chief, Technical Division

Counterpart

Mr. Somporn Wangwongwirj	Civil Engineer Drainage Control Division
Mr. Phisit Jenkeitfu	Sanitation Engineer Drainage Control Division
Mr. Anuchit Thitikavin	Civil Engineer Drainage Control Division
Mr. Vitoon Kongkasuwanna	Electrical Engineer Waste Water Treatment Division
Mr. Jane Varaha	Mechanical Engineer Drainage Control Division
Mr. Wichai Somboon	Civil Engineer Technical Division
Ms. Aungsna Suangkawe	Statistician Technical Division
Mr. Sacha Watanasarnveikul	Civil Engineer Control Maintenance Division
Mr. Kriangkrai Phamornpol	Electrical Engineer Technical Division

TOT

Mr. Kaitboon	Manager Customer Service Center
Mr. Pattanawit Khosittham	Chief Metropolitan Commercial Service Div.
Mr. Tanadkit Karnpech	Senior Engineer Customer Service Center Section

CAT

Mr. Karrom	Chief, Customer Service Center
Mr. Rapeebhan	Chief, Administration Section

PTD

Mr. Rianchi Reowilaisk	Chief, Frequency Assignment Section
Mr. Thongtaweeep Khantikul	Senior Engineer

RID

Mr. Suphot	Chief, Computer Section
Mr. Chairat	System Manager Computer Section
Mrs. La-Ong	Chief, Data Bank Section
Mr. Virat	Water Management Div. Operation & Maintenance Section

MD

Mr. Tawatchai Iempairote	Chief, Data Processing Section Computer Center Climatology Div.
Mr. Preecha Tanittiraporn	Chief, System Development Section

MEA

Mr. Bandit Tawanawong	Chief, Relay Communication and Telemeter Div. Power System Maintenance Dept
-----------------------	---

JICA Expert

Mr. Sigeo Kanai	BMA (Drainage & Sewerage Engineer)
Mr. Kiyoshi Hasegawa	MMA (Sanitary Engineer)
Mr. Hideaki Sekioka	RID (Irrigation Engineer)

EOJ

Mr. Hideo Matsuda	(First secretary)
-------------------	-------------------

JICA Thai Office

Mr. Tstomu Saito	(Resident Representative)
Mr. Takahito Hino	(Assistant Resident Representative)

APPENDIX - B : MINUTES OF DISCUSSIONS  
(MARCH 24, 1988)



MINUTES OF DISCUSSIONS

ON

THE PRELIMINARY STUDY ON THE PROJECT FOR THE PROCUREMENT OF  
EQUIPMENT FOR FLOOD CONTROL CENTER IN BANGKOK AND ITS VICINITY

IN

THE KINGDOM OF THAILAND

In response to the request made by the Government of the Kingdom of Thailand for grant aid for the Project for the Procurement of Equipment for Flood Control Center in Bangkok and its Vicinity (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a Preliminary Study on the Project and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent a Preliminary Study Team headed by Mr. Hozumi NISHIDA, Assessor for Restoration, Disaster Protection and Restoration Division, River Bureau, Ministry of Construction from March 16 to 25, 1988.

The Team had a series of discussions with the authorities concerned of the Government of the Kingdom of Thailand and conducted a field survey in Bangkok and its Vicinity. As a result of the study, both parties have agreed to recommend to their respective Governments that the major points of understanding reached between them as attached herewith should be examined towards the realization of the Project.

Bangkok, March 24, 1988

Hozumi Nishida

Mr. Hozumi NISHIDA  
Leader,  
The Preliminary Study Team  
Japan International Cooperation  
Agency (JICA)

Santa Throchar

Mr. S  
Direc  
Depar  
Bangko

ATTACHMENT

1. The objectives of the Project is to provide necessary equipments for the introduction of a new monitoring and data management system for Flood Control Center which is "Telemetering" and "On-Line System" for Flood protection and drainage operation in Bangkok and its Vicinity.
2. The Bangkok Metropolitan Administration (BMA) is responsible for the administration and execution of the Project.
3. The Japanese Study Team will convey to the Government of Japan the desire of the Government of the Kingdom of Thailand that the former takes necessary measures to cooperate by providing the equipments listed in Annex I within the scope of Japanese economic cooperation programme in grant form.
4. The Requested Master Station and Monitor Stations of the Project are located in Bangkok and its Vicinity areas which are shown in Annex II.
5. The Thai side has understood Japan's Grant Aid System explained by the Team which includes a principle use of a Japanese Consultant Firm and a Japanese Contractor for the implementation of the Project.
6. A Basic Design Study Team will be sent at an earlier date in order to collect further data and information and to make the Basic Design of the Project which is regarded as practicable through the report of the Preliminary Study.

H.N.

Sante Thrachon

Annex I Requested Equipments

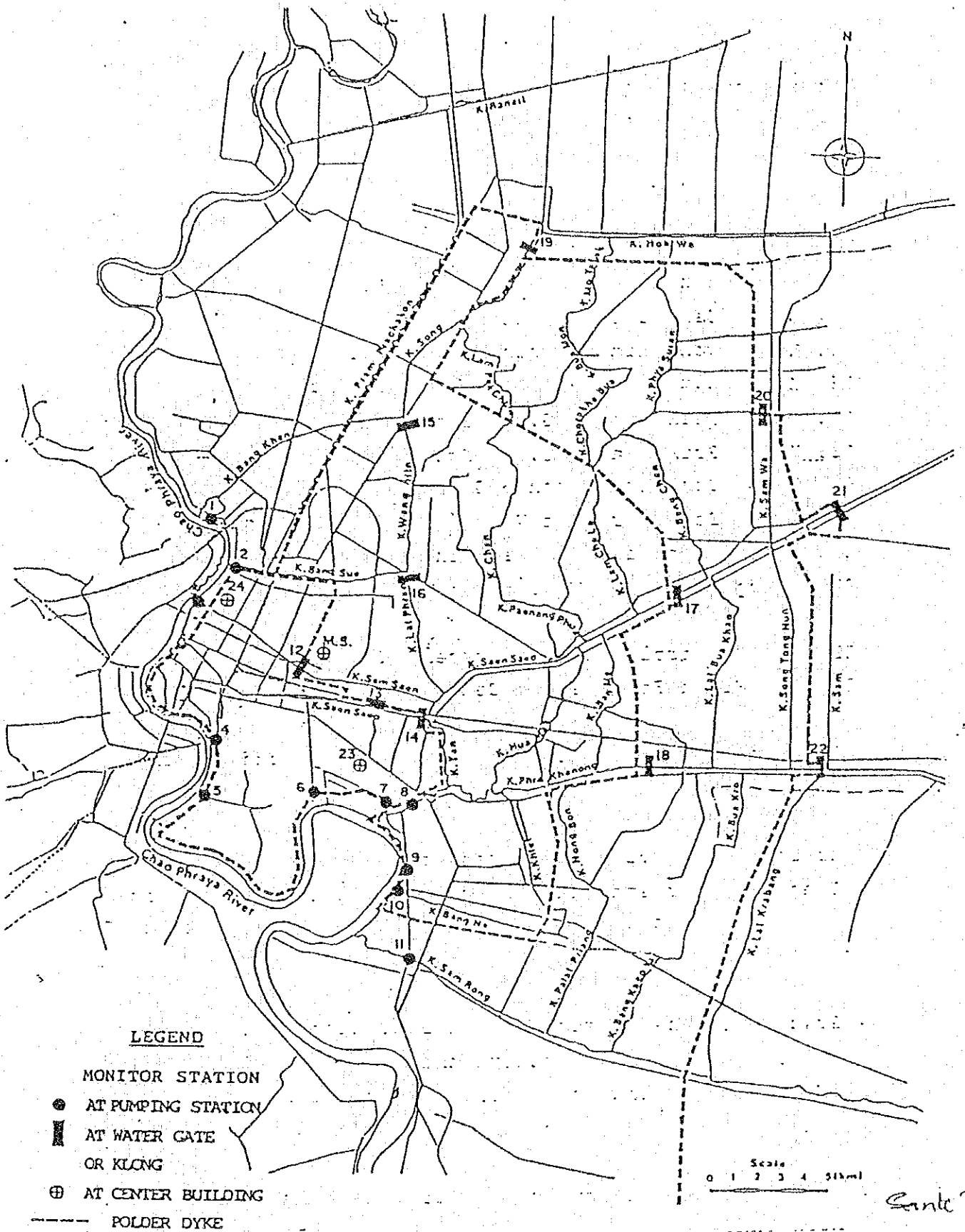
- 1) Master Station
  - \* Main Computer 1 set
  - \* Transmission Equipment 1 set
  - \* Uninterruptible Power Supply Unit 1 set
  - \* System/Application Software 1 set
  - \* Man/Machine Interface Sub-System 1 set
  - \* Cables 1 set
  - \* Free Access Floor 1 set
  
- 2) Monitor Stations (22 stations)
  - \* Out Station Terminal Unit (O.T.U.) & Cabinet 22 sets
  - \* O.T.U. Software 22 sets
  - \* Power Supply Unit 22 sets
  - \* Modification of Existing Panel 1 set
  - \* Rain-Gauge 20 sets
  - \* Water-Level-Gauge 44 sets
  - \* Cables 1 set
  - \* O.T.U. House 22 sets
  
- 3) Monitor Stations at Royal Irrigation Department (RID)  
and Meteorological Department (MD) (2 stations)
  - \* O.T.U. and Cabinet 2 sets
  - \* O.T.U. Software 2 sets
  - \* Power Supply Unit 2 sets
  
- 4) Others
  - \* Spare Parts 1 set
  - \* Test Equipment 1 set
  - \* TOT Telephone Line 1 set

H.N.

Sante Thirachon



Annex II Location Map of Master Station and Monitor Stations



LEGEND

MONITOR STATION

● AT PUMPING STATION

▮ AT WATER GATE OR KLONG

⊕ AT CENTER BUILDING

--- POLDER DYKE

Scale  
0 1 2 3 4 5 km

Sante Thwadi

H.K.

APPENDIX - C : MINUTES OF DISCUSSIONS  
(JUNE 14, 1988)



MINUTES OF DISCUSSIONS

ON

THE BASIC DESIGN STUDY ON THE PROJECT FOR THE PROCUREMENT OF  
EQUIPMENT FOR FLOOD CONTROL CENTER IN BANGKOK AND ITS VICINITY

IN

THE KINGDOM OF THAILAND

In response to the request made by the Government of the Kingdom of Thailand for grant aid for the Project for the Procurement of Equipment for Flood Control Center in Bangkok and its Vicinity (hereinafter referred to as "the Project"), the Government of Japan decided to conduct a Basic Design Study on the Project and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand the Basic Study Team headed by Mr. Koichi BABA, Director, Office of Disaster Protection, Disaster Protection and Restoration Division, River Bureau, Ministry of Construction from June 6 to July 3, 1988.

The Team had a series of discussions with the authorities concerned of the Government of the Kingdom of Thailand and conducted a field survey in Bangkok and its Vicinity.

As a result of the study, both parties have agreed to recommend to their respective Governments that the major points of understanding reached between them as attached herewith should be examined towards the realization of the Project.

Bangkok, June 14, 1988

*Koichi Bata*

Mr. Koichi BABA

Leader

The Basic Design Study Team

Japan International Cooperation Agency  
(JICA)

*Sante Thrachoo*

Mr. Sante Thrachoo

Director General

Department of Drainage and Sewerage

Bangkok Metropolitan Administration  
(BMA)

ATTACHMENT

1. The objective of the Project is to provide necessary equipment for the introduction of a new monitoring and data management system for Flood Control Center which is "Telemetry and On-Line System" for flood protection and drainage operation in Bangkok and its Vicinity.
2. The principal terms concerned to the Master Station, Monitoring Stations and data transmission procedures between the Master Station and RID and MD are as follows.
  - 2-1. Tentative layout plan of the Master Station in New DDS building is shown in Annex I.
  - 2-2. Location map of Monitoring Stations (OTU) will be finalized by July 1, 1988 considering Requested Equipment shown in Annex II, imaged location map shown in Annex III and conclusion of site survey.
  - 2-3. Data transmission procedures between the Master Station and RID and MD are utilizations of Facsimiles, but the on line system should be studied by the team and the result will be incorporated in the final report.
3. The activities of the Flood Control Center are as follows:
  - 3-1. Collection of flood information.
  - 3-2. Analysis, prediction, warning, data supply for operation of the Flood Control and Drainage Facilities.
  - 3-4. Storage of flood information.
  - 3-5. Public relations
  - 3-6. Collection of water quality data, establishment of operational rules for water quality control.
  - 3-7. Training for staff in the Center.
4. The Bangkok Metropolitan Administration (BMA) is responsible for the administration and execution of the Project.
5. The proposed data transmission line for the Project is determined to utilize the leased line of TOT. This determination was considered based on following items.
  - 5-1. Utilization of radio line is in danger of radio hindrance with high-rized buildings due to rapidly urbanization of Bangkok City.
  - 5-2. Existing TOT's network is considered to easy use for the Project based on the site survey and discussion with TOT's technicians.

K. Baba

3, 30/10/87

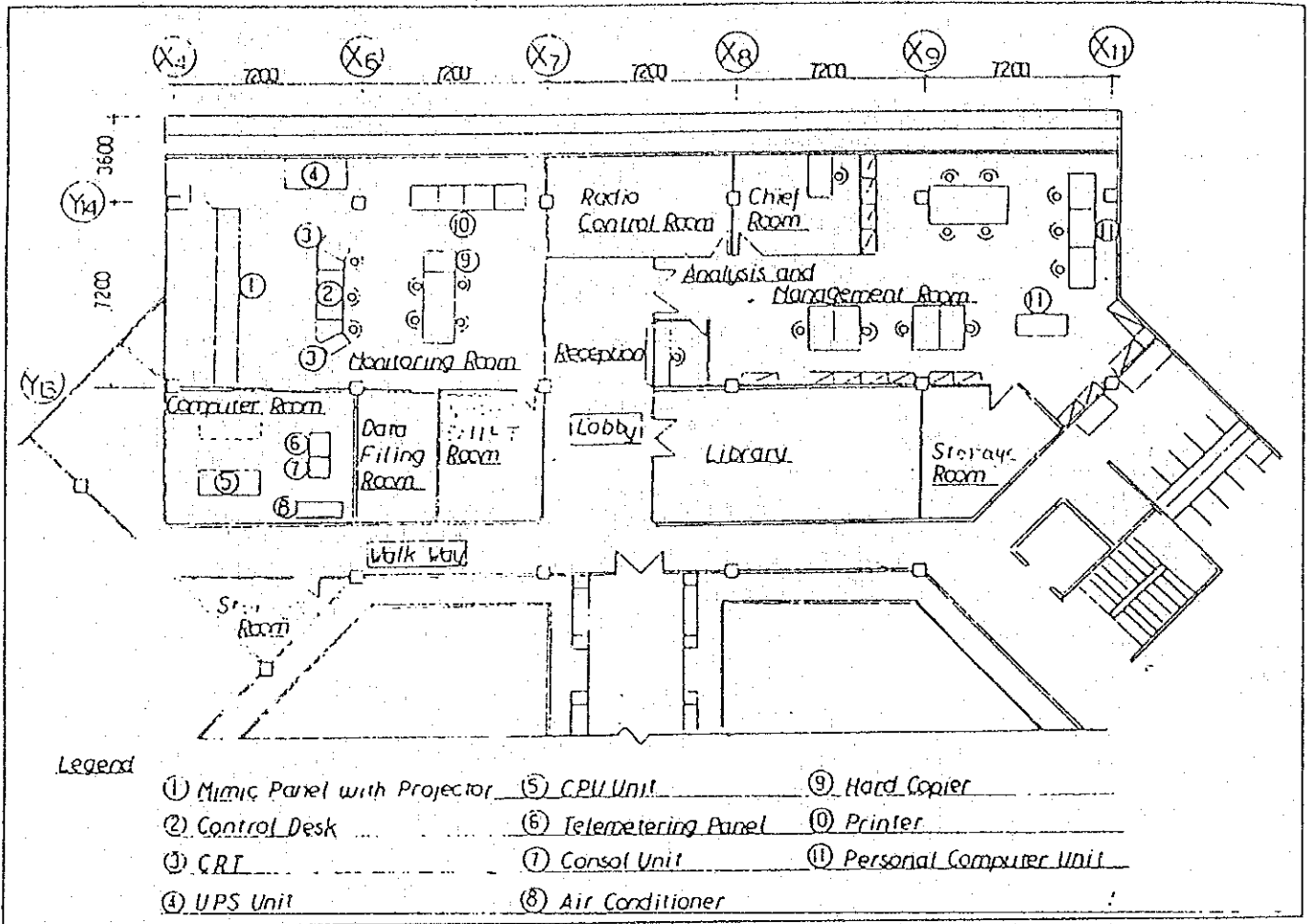
6. Grant Aid Program

- 6-1. The Thai side has understood Japan's Grant Aid System explained by the Team which includes a principle use of a Japanese Consultant Firm and Japanese Contractor(s) for the implementation of the Project.
- 6-2. The Japanese Study Team will convey to the Government of Japan the request of the Government of the Kingdom of Thailand that the former take necessary measures to cooperate by providing the equipment listed in Annex II within the scope of Japanese economic cooperation program in grant form.
- 6-3. The Government of the Kingdom of Thailand will take necessary measures listed in Annex IV on condition that the Grant Aid would be extended to the Project.

K. Baba

Shinji Thirachit

Annex 1: Tentative Layout Plan of the Master Station



K. Bata

Sande Thacker

## Annex II: Requested Equipment

### 1) Master Station

* Main Computer	1 set
* Transmission Equipment	1 set
* Uninterruptible Power Supply Unit	1 set
* System/Application Software	1 set
* Man/Machine Interface Sub-system	1 set
* Air conditioner	1 set
* Cables	1 set
* Free Access Floor	1 set

### 2) Monitoring Stations (26 stations)

* Out Station Terminal Unit(O.T.U.) & Cabinet	26 sets
* O.T.U. Software	26 sets
* Power Supply Unit	26 sets
* Modification of Existing Panel	1 set
* Rain-Gauge	21 sets
* Water-Level-Gauge	46 sets
* Cables	1 set
* O.T.U. House	26 sets
* DO and Water conductivity meter	2 set

### 3) Others

* Spare Parts	1 set
* Test Equipment	1 set
* TOT Telephone Line	1 set
* Personal computer	1 set
* 4WD-Vehicle(for Patrol and Inspection)	2
* Facsimile	4 sets
* Copymachine	1 set

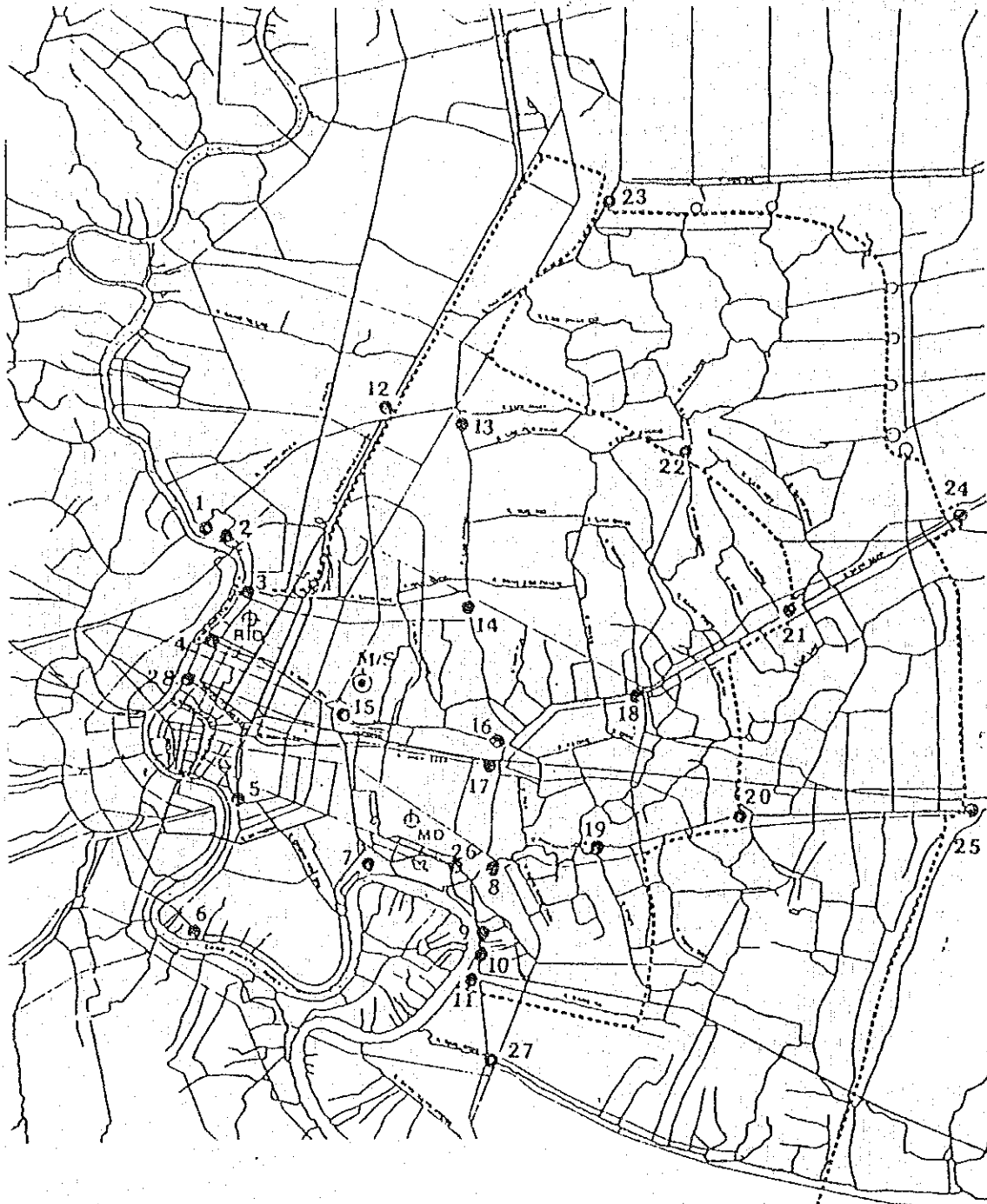
NOTE: Quantities of requested equipment concerned to Monitor Stations are not determined yet, and will be finalized during field survey by July 1, 1988.

K. Bista

Sanku Timaklon

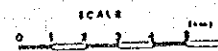


Annex III: Imaged Location Map of Monitoring Stations



LEGEND:

- Imaged Monitoring Station
- ⊙ Master Station
- ⊕ RID (Royal Irrigation Department)
- ⊕ MD (Meteorological Department)
- Polder Dyke



K. Bata

Scale Thredder

Annex IV: Undertakings by the Government of Thailand

- 1) To acquire the required site for installation of Monitoring Stations (OTU).
- 2) To prepare and clear for installation of required equipment to existing facilities managed by RID.
- 3) To provide facilities for distribution of electricity, telephone line, and other incidental facilities to the Project site.
  1. Electricity distributing line to the site.
  2. Leased telephone line to the site.
- 4) To bear commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.
- 5) To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the Project at the port of disembarkation.
- 6) To accord Japanese Nationals whose services may be required in connection with the supply of products and the services under the verified contract such facilities as may be necessary for their entry into Thailand and stay therein for the performance of their work.
- 7) To ensure the proper and effective operation and maintenance of equipment under the Grant.
- 8) To bear all the expenses other than those to be borne by the Grant, necessary for the transportation and installation of the equipment at Monitoring Stations.

K. Bata

Santi Thirachote.



APPENDIX - D : MINUTES OF DISCUSSIONS  
(SEPTEMBER 9, 1988)



MINUTES OF DISCUSSIONS  
ON  
THE DRAFT FINAL REPORT OF THE BASIC DESIGN STUDY  
ON  
THE PROJECT FOR THE PROCUREMENT OF EQUIPMENT  
FOR FLOOD CONTROL CENTER IN BANGKOK AND ITS VICINITY  
IN  
THE KINGDOM OF THAILAND

In response to the request of the Government of Thailand, the Government of Japan decided to conduct a basic design study on the Project for the Procurement of Equipment for Flood Control Center in Bangkok and its Vicinity (hereinafter referred to as "the Project"), and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Thailand the basic design study team from June 6 to July 3, 1988.

As a result of the study, JICA prepared a Draft Final Basic Design Report on the study and dispatched a mission, headed by Mr. Kouichi Baba, Director of Office of Disaster Protection, River Bureau, Ministry of Construction to explain and discuss it from September 4 to 10, 1988.

The team had a series of discussions on the Project with the officials concerned of the Government of the Kingdom of Thailand headed by Mr. Sante Thrachoo, Director-General of Department of Drainage and Sewerage, Bangkok Metropolitan Administration.

After clarifying its contents, both parties have agreed to recommend to their respective Governments that the major points of understanding reached between them, as attached herewith, should be examined towards the realization of the Project.

September 9, 1988  
Bangkok, Thailand

*Kouichi Baba*

---

Mr. Kouichi Baba  
Leader,  
The Basic Design Study Team  
Japan International Cooperation Agency  
(JICA)

*Sante Thrachoo*

---

Mr. Sante Thrachoo  
Director General,  
Department of Drainage and Sewerage  
Bangkok Metropolitan Administration

ATTACHMENT

Major Points of Understanding :

1. The Thai side agreed in principle to the basic design proposed in the Draft Final Report.
2. The Thai side understood the system of Japan's Grant Aid Program and confirmed the measures to be taken by the Thai side towards to realization of the Project as agreed upon in the "Minutes of Discussions" signed on June 14, 1988.
3. For Project Implementation under the system of Japan's Grant Aid Program, the boundaries of responsibility for the Project Construction are shown in Annex I.
4. Fifty (50) copies of the Final Report on the Project will be submitted to the Kingdom of Thailand.

*K. Baba*

*Senkai Thirachan*

Annex I The Boundary of Responsibility for Project Construction

I-1: Undertakings by the Japanese Side

- 1) Design of telemetering system.
- 2) Provision and installation of equipment necessary for the telemetering system.
- 3) Facility construction necessary for installing monitoring station equipment.
- 4) Room interior work for installing master station equipment.
- 5) Partial modifications to the existing pump's operation panels to pick up pump operation signals.
- 6) Shipping of Project equipment via sea and land to the Project sites.
- 7) Provision of consulting services for Project equipment procurement and facility construction.

I-2: Undertakings by the Thai Side

- 1) Acquisition of the required site for the installation of the Flood Control Center (master station).
- 2) Securing of sufficient space, prior to the commencement of the construction work, necessary for Project facility construction.
- 3) Securing of access roads necessary for transporting the construction materials and equipment.
- 4) Exemption of taxes and taking necessary measures for obtaining customs clearance, at the port of disembarkation, for the materials and equipment being brought into Thailand for Project use.
- 5) Conduction leveling surveys necessary for water level gauge installation.
- 6) Establishment of the maintenance and management structure for all Project facilities.
- 7) Taking appropriate measures necessary for smooth Project implementation.
- 8) Immediate establishment of the organization of Flood Control Center Project.

K. Baba

Sankh Thirachit



MEMO OF DISCUSSIONS  
ON  
SEPTEMBER 7, 1988 MEETING  
AT  
DDS EXHIBITION ROOM

- (1) Map of major west side BMA area of Chao Phraya River shall be shown on the mimic panel as discussed.
- (2) Master Station main computer shall be backed up at leased 60 minutes by Uninterruptible Power Supply Battery instead of 30 minutes on the draft final report.
- (3) Zero point of water level shall be used Mean Sea Level (M.S.L). Only for Printer output reporting, Zero point shall be selectable M.S.L or DDS zero point by operator. DDS zero point means M.S.L plus 35.03 meter and print out 4-digit as XX.XX m.
- (4) BMA Public Related operation such as extra display output to Director's Room will not be included this time and shall be planed at future stage.

*A. Baba*

*Simle Thachas*

**APPENDIX - E : LIST OF COLLECTED DATA**



APPENDIX - E LIST OF COLLECTED DATA

1. Maps

- (1) 1:10,000 Map A = 2,000 km<sup>2</sup> (blue copy)
- (2) 1: 4,000 Map A = 300 km<sup>2</sup> (blue copy)

2. Data from TOT

- (1) Telephone Exchange Station Location Map
- (2) Telephone Line Route Map (Flood Control Center to Monitoring Stations)
- (3) Statistic Table of Telephone Line Repairs
- (4) Annual Report -1986-
- (5) Answers to questionnaire

3. Data from PTD

- (1) Ministerial Regulation (B.E. 2498)
- (2) Supplementary Details for Requesting Radio Frequencies

4. Data from MD

- (1) Data for new computer system
- (2) Location map of existing rainfall guage

5. Data from MEA

- (1) Brochure of SCADA System

6. Data from RID

- (1) As-built Drawings
  - Phrakhanong P.S                      K. Song W.G
  - Sam Rong P.S                         K. Phrakhanong (Lat Khrvan) W.G
  - Bang Khen North P.S
  - Bang Khen South P.S
  - Sam Sen P.S

- (2) Drawings of Computer system in IEC  
Outline drawing of each Computer  
Block Diagram of Computer Configuration  
Operating time record data of each Computer

7. Data from DDS

- (1) As-built Drawings  
Bank Na P.S Krung Kasem P.S  
Bang On P.S Navigation Lock at upstream of Krung Kasem  
Bang Chak P.S  
Bang Chak P.S
- (2) Pump Operation Panel data
- (3) Frequencies of existing radio equipment  
F<sub>1</sub> ... 155.80 MHz  
F<sub>2</sub> ... 155.85 MHz  
F<sub>3</sub> ... 155.90 MHz  
F<sub>4</sub> ... 155.95 MHz
- (4) List of micro computer
- (5) Drawing of master plan for Flood Protection and Drainage at Thonburi and Samut Phrakan West Project
- (6) Drawing of Rin Daen New Office Building (6F)
- (7) Statistical Profile of the Bangkok Metropolitan Administration - 1986-
- (8) DDS annual budget
- (9) Hydrological data observed by DDS

**APPENDIX - F : COUNTRY DATA**



MACRO ECONOMIC TARGETS OF THE SIXTH PLAN COMPARED  
WITH RESULTS OF THE FOURTH AND FIFTH PLANS

Item	Fourth Plan (1977-1981) (Actual)	Fifth Plan (1982-1986) (Actual)	Sixth Plan (1987-1991) (Targets)
1. Real Economic Growth (%) (Average Rate Per Annum)			
1.1 GDP	7.1	4.4	5.0
1.2 Agriculture	3.5	2.1	2.9
1.3 Manufacturing	8.7	5.1	6.6
1.4 Mining	10.1	6.1	6.4
1.5 Electricity	11.7	8.0	6.1
1.6 Construction	9.5	3.6	5.1
1.7 Services	8.2	5.6	5.3
2. Real Expenditure Growth (%) (Average Rate Per Annum)			
2.1 Consumption			
- Private Sector	5.5	4.3	3.7
- Public Sector	10.2	3.3	5.3
2.2 Investment			
- Private Sector	8.6	-0.8	8.1
- Public Sector	12.9	1.8	1.0
3. Export & Import of Goods			
3.1 Real Growth Rate Per Annum (%)			
- Export	20.0	8.4	10.7
- Import	24.8	2.9	9.5
3.2 Average Value Per Annum (Current Prices)			
- Export (Million Baht)	-	177,500	290,700
- Import (Million Baht)	-	233,100	326,700
3.3 Trade Deficit (Million Baht)	45,000	55,600	36,000
4. Current Account Deficit (Average Value Per Annum)	37,400	36,000	11,800
5. Government Finance/GDP (%)			
5.1 Revenue	14.2	14.6	15.2
5.2 Expenditure	17.5	18.2	17.3
5.3 Financial Deficit	3.3	3.6	2.1
6. Population Growth Rate Per Annum (%)			
6.1 Whole Country	-	1.7 /1	1.3 /2
6.2 Bangkok Metropolitan Area	-	2.7 /1	2.5 /2
6.3 Other Areas	-	1.4 /1	0.8 /2
7. Consumer Price Escalation Per Annum (%)	10.6	2.9	2.3
8. Per Capita Income (Baht)	-	21,395 /1	27,783 /2

Note: /1 In 1986.  
/2 In 1991.

Source: Summary of the Sixth National Economic and Social Development Plan (1981-1991), NESDB.



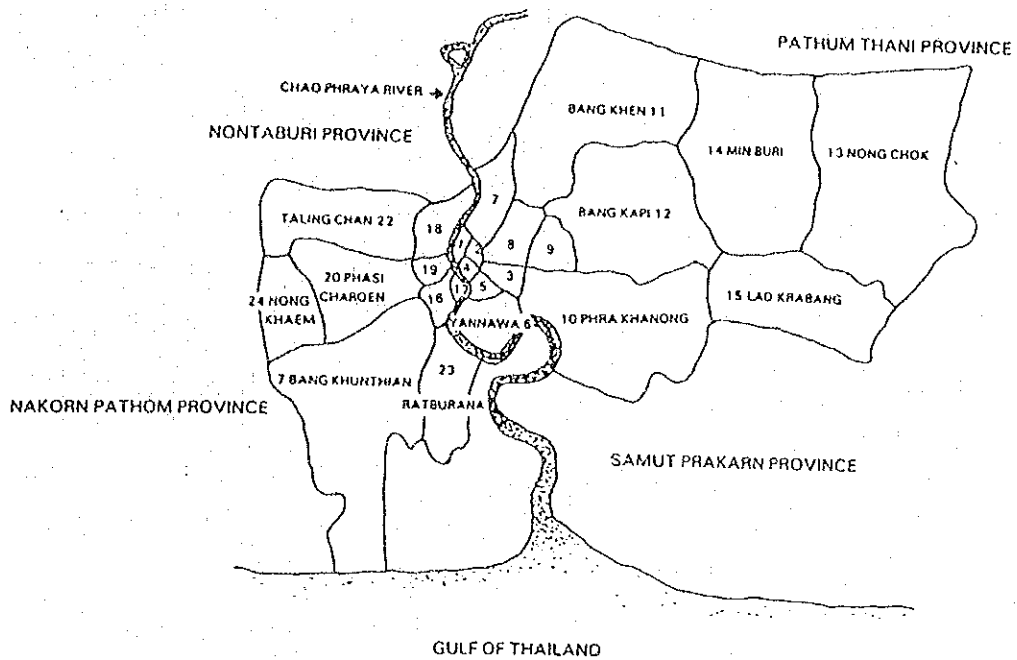
GROSS DOMESTIC PRODUCT AND GROSS NATIONAL PRODUCT  
AT CURRENT MARKET PRICES (1981-1985)

Unit: Million Baht

Industrial Origin	1981	1982	1983	1984	1985
Agriculture	187,886	188,742	204,443	193,438	182,279
Mining and Quarrying	13,373	14,807	16,480	21,291	29,279
Manufacturing	158,272	164,659	176,200	196,793	207,691
Construction	42,008	43,040	47,129	52,772	53,758
Electricity and Water Supply	10,743	14,454	16,319	18,884	21,645
Transportation and Communications	57,281	63,133	73,708	83,588	96,254
Wholesale and Retail Trade	150,293	159,849	165,812	181,993	190,676
Banking, Insurance and Real Estate	52,025	61,021	71,722	80,577	89,751
Ownership of Dwellings	8,441	9,912	11,210	12,337	13,706
Public Administration and Defence	30,645	37,349	42,551	43,182	47,058
Services	75,229	89,170	98,680	106,704	115,467
Gross Domestic Product (GDP)	<u>786,166</u>	<u>846,136</u>	<u>924,254</u>	<u>991,559</u>	<u>1,047,564</u>
Net Factor Income	-21,787	-26,376	-25,370	-31,776	-37,081
Gross National Product (GNP)	<u>764,379</u>	<u>819,760</u>	<u>898,884</u>	<u>959,783</u>	<u>1,010,483</u>
Per Capita GNP (Baht)	16,096	16,906	18,174	19,044	19,697

Source: Statistical Yearbook 1985-1986, National Statistical Office

POPULATION DENSITY IN BANGKOK BY DISTRICTS 1986



Bangkok Statistics of the year 1986

No. of Districts	No. of Sub-districts	Area sq. km.	No. of Population	No. of Houses	Density Population/Km <sup>2</sup>	No. of Slums
1. Phra Nakhon	12	5.536	111,875	22,562	20,209	14
2. Pom Prab Sattru Pai	5	1.931	87,955	16,895	45,548	7
3. Pathumwan	4	8.365	143,199	25,743	17,111	12
4. Sampanthawong	3	1.416	51,121	14,509	36,102	2
5. Bang Rak	5	5.536	90,672	23,818	16,379	5
6. Yan Nawa	8	34.315	415,703	69,882	11,263	45
7. Dusit	6	22.210	562,990	54,996	25,348	65
8. Phya Thai	5	21.110	359,604	42,632	17,035	15
9. Huai Khwang	4	19.500	255,774	43,933	26,924	26
10. Phra Khanong	9	143.559	629,386	131,721	4,384	75
11. Bang Khen	9	169.310	548,078	88,501	3,237	32
12. Bang Kapi	8	158.781	409,785	99,233	2,581	15
13. Nong Chok	8	236.261	57,704	7,562	244	—
14. Min Buri	7	174.331	74,052	12,056	425	2
15. Lad Krabang	6	123.850	59,070	12,578	477	2
16. Thon Buri	5	8.626	274,176	40,114	31,785	23
17. Klong San	4	6.051	143,719	26,302	23,751	20
18. Bangkok Noi	8	23.304	294,938	59,784	12,656	42
19. Bangkok Yai	2	6.180	106,732	20,842	17,271	15
20. Phasi Charoen	10	53.947	228,202	44,372	4,230	23
21. Bang Khun Thian	7	181.156	265,453	46,928	1,465	16
22. Taling Chan	8	79.698	90,135	16,339	1,131	5
23. Rat Burana	4	42.874	148,166	25,773	3,456	16
24. Nong Khaem	3	48.282	60,426	11,851	1,251	2
<b>Total</b>	<b>24</b>	<b>150</b>	<b>5,468,915</b>	<b>958,926</b>	<b>3,486</b>	<b>479</b>

## Population

Since it was established as a capital city in 1782 up to 1900, Bangkok Metropolis grew slowly. The population was only 600,000 and the urbanized area was about 18 square kilometres. After the Second World War, the city was boomed with heavy public investment in national infrastructure and public utilities throughout the city. The rate of growth in population and urbanized area can be seen from the following table:

Year	Population ('000 )	Urbanized Area (Km <sup>2</sup> )
1900	600	18.3
1936	650	43.1
1945	800	55.0
1953	960	66.8
1958	1,622	96.4
1971	3,075	183.7
1977	4,800	220.7
1980	5,200	270.0
1984	5,300	290.0
1986	5,468	-

## Population in Bangkok By Districts 1982 - 1986

District	1982	1983	1984	1985	1986
1. Phra Nakhon	117,649	113,376	112,332	114,124	111,875
2. Pom Prab Sattru Pai	189,207	92,950	89,330	89,539	87,955
3. Pathumwan	233,978	114,820	157,330	155,868	143,199
4. Sampantawong	75,581	53,504	52,816	52,397	51,120
5. Bang Rak	141,667	88,869	88,197	91,088	90,672
6. Yan Nawa	386,843	392,279	396,420	410,288	415,703
7. Dusit	546,868	550,369	558,832	565,339	562,990
8. Phya Thai	520,507	346,319	357,726	360,603	359,604
9. Huai Khwang	231,069	235,739	239,742	247,274	255,774
10. Phra Khanong	559,812	578,541	594,902	614,854	629,386
11. Bang Khen	429,977	457,544	483,717	520,861	548,078
12. Bang Kapi	314,780	335,171	356,033	386,005	409,785
13. Nong Chok	51,799	54,011	54,952	56,863	57,704
14. Min Buri	61,349	64,266	66,966	70,289	74,052
15. Lad Krabang	45,303	48,836	50,541	56,023	59,070
16. Thon Buri	268,662	267,767	267,616	273,542	274,176
17. Klong San	139,310	139,736	139,444	142,590	143,719
18. Bangkok Noi	388,325	283,296	285,265	291,035	294,938
19. Bangkok Yai	103,365	104,024	104,716	107,486	106,732
20. Phasi Charoen	196,138	207,409	211,125	219,606	228,202
21. Bang Khun Thian	223,388	232,532	240,835	254,597	265,453
22. Taling Chan	72,608	78,995	81,349	85,559	90,135
23. Rat Burana	122,614	127,726	131,550	140,245	148,166
24. Nong Khaem	47,487	50,248	52,946	57,303	60,426
Total	5,468,286	5,018,327	5,174,682	5,363,378	5,468,915

Source: Local Administration and Registration Division, Department of  
Permanent Secretary for BMA

### Canals and Sewers under the responsibility fo BMA in 1986

Districts	Canals (number)	Length (metres)	Sewers Length (metres)
Phra Nakhon	7	5,372.80	24,877
Pom Prab Sattru Pai	7	5,149.00	12,559
Pathumwan	14	16,095.00	17,612
Sampanthawong	2	2,780.00	15,388
Bang Rak	7	1,971.00	26,500
Yan Nawa	69	49,244.00	28,049
Dusit	57	86,422.00	62,837
Phya Thai	12	24,625.00	112,151
Huai Khwang	11	28,527.00	154,032
Phra Khanong	59	132,076.00	260,706
Bang Khen	27	104,005.00	171,667
Bang Kapi	54	171,732.00	172,020
Nong Chok	107	233,595.00	3,547
Min Buri	59	160,034.00	4,123
Lad Krabang	36	110,795.00	3,127
Thon Buri	62	38,809.00	34,363
Klong San	22	21,159.00	19,006
Bangkok Noi	58	56,239.00	58,350
Bangkok Yai	41	37,279.00	23,529
Phasi Charoen	59	111,577.00	34,570
Bang Khun Thian	12	6,370.00	17,201
Taling Chan	26	92,850.00	4,240
Rat Burana	67	80,707.00	27,217
Nong Khaem	28	63,585.00	13,345
Sewer-Line Maintenance Section 1-3			810,935
<b>Total</b>	<b>893</b>	<b>1,640,997.00</b>	<b>2,111,851</b>

Source: Technical Division, Department of Drainage and Sewerage

### Statistics on number of Permits of building construction By the year 1982 - 1986

Types of Buildings	1982	1983	1984	1985	1986
1. Commercial and Residential Bldg.	24	25	18	25	18
2. Warehouse	-	-	1	8	21
3. Commercial Building	2	5	6	22	14
4. Market	5	10	5	4	5
5. Parking Lot	2	5	6	5	6
6. School	64	50	44	54	67
7. Housing	72	88	95	78	58
8. Factory	30	21	27	20	13
9. Office	26	44	36	49	57
10. Sport Place	13	13	7	16	19
11. Hotel	8	20	20	9	5
12. Cinema	5	5	1	2	1
13. Petrol & Gas Station	28	53	62	85	53
14. Bridge & Dike	9	16	27	27	40
15. Hospital	4	5	2	4	4
16. Crematorium	1	1	-	-	-
<b>Total</b>	<b>293</b>	<b>361</b>	<b>357</b>	<b>408</b>	<b>381</b>

**Statistics on Annual Estimated Budget  
Fiscal Year 1982 - 1986**

(Million Baht)

	1982	1983	1984	1985	1986
1. Public Works	952.1	910.0	1,216.13	1,339.8	1,949.0
2. Education	912.3	887.0	936.12	1,007.9	993.2
3. Central Fund	738.1	624.4	598.16	707.9	707.0
4. Administration	519.5	636.2	611.22	639.3	611.0
5. Medical and Health Services	394.3	487.1	611.09	610.7	667.1
6. Public Cleansing	308.2	618.4	569.67	778.1	573.4
7. Drainage and Sewerage	277.2	387.5	752.04	715.3	802.5
8. Social Welfare	116.6	122.6	167.13	207.1	296.8
9. Debt Payment	7.3	3.6	2.17	—	—
10. BMA Commercial	55.5	115.0	183.82	253.7	66.3
<b>Total</b>	<b>4,281.1</b>	<b>4,791.8</b>	<b>5,647.55</b>	<b>6,259.8</b>	<b>6,666.3</b>

Source: Budget Division, Department of Permanent Secretary for BMA

**Per Capita Income By Regions  
1981 -1985**

unit : Baht

	1981	1982	1983	1984	1985
Whole Kingdom	16,469	17,359	18,584	19,551	20,263
Northeastern	6,581	7,185	8,107	8,009	8,124
Northern	11,064	11,355	12,375	12,781	13,353
Southern	13,496	13,419	15,058	15,200	15,358
Eastern	21,968	23,284	24,038	25,210	25,603
Western	20,230	21,157	20,055	21,228	21,047
Central	13,327	13,903	14,570	16,146	16,749
Bangkok Metropolitan Region (BMR)	46,891	49,539	52,150	56,092	59,003
Bangkok Metropolis	54,207	57,012	60,073	65,133	68,532

Source: National Accounts Division, Office of The National Economic and Social Development Board

BUDGET OF DDS (FISCAL YEAR)

(million Baht)

No.	I T E M	1 9 8 3	1 9 8 4	1 9 8 5	1 9 8 6	1 9 8 7
1	Salary	14.7	15.1	15.8	16.9	18.1
2	Wages (Permanent Employee)	38.4	41.6	44.4	48.0	49.6
3	Wages (Temporary Employee)	12.0	11.2	3.7	4.5	6.4
4	Commission	11.9	15.7	12.3	12.2	11.9
5	General Expense	6.3	12.5	8.8	4.6	7.4
6	Utility Expense	14.3	35.8	27.5	42.5	33.5
7	Material Expense	18.1	14.8	37.4	13.1	17.0
8	Office Supplies Expense	14.7	5.7	12.5	1.8	11.4
9	Land & Construction Expense	60.5	58.2	77.7	258.7	359.5
10	Subsidy	—	231.7	64.7	7.0	16.7
11	Other Expense	25.3	132.1	96.7	57.4	16.0
12	Obligated Expense	45.9	60.0	51.5	37.9	2.5
13	Reserved Fund	25.5	19.2	39.9	40.7	35.5
14	Project Fund	56.3	90.2	27.2	24.1	59.7
	T O T A L	343.8	743.4	520.1	569.4	645.0

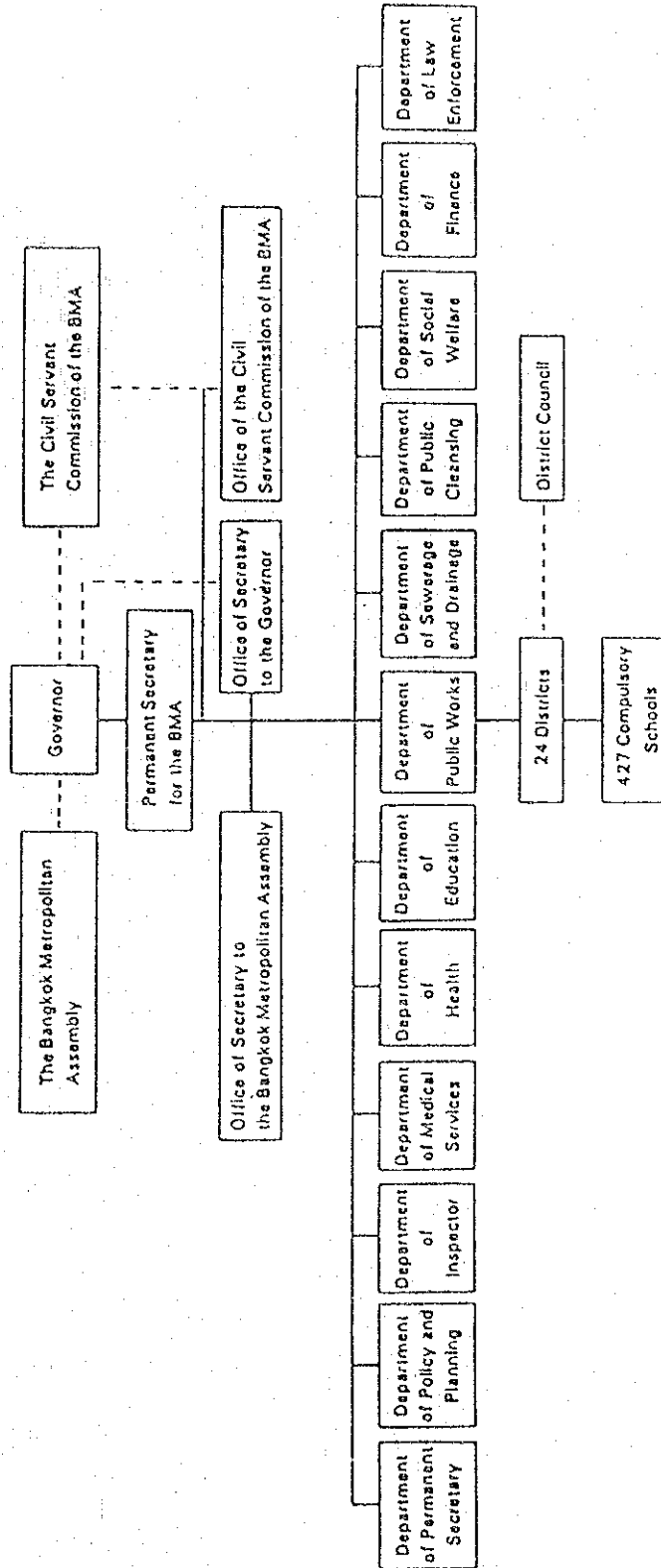
Remark: Summation of Item No. 9,10,12,13 and 14 is the cost of flood Protection structures.

BUDGET OF D D S (1988)

(1,000 Baht)

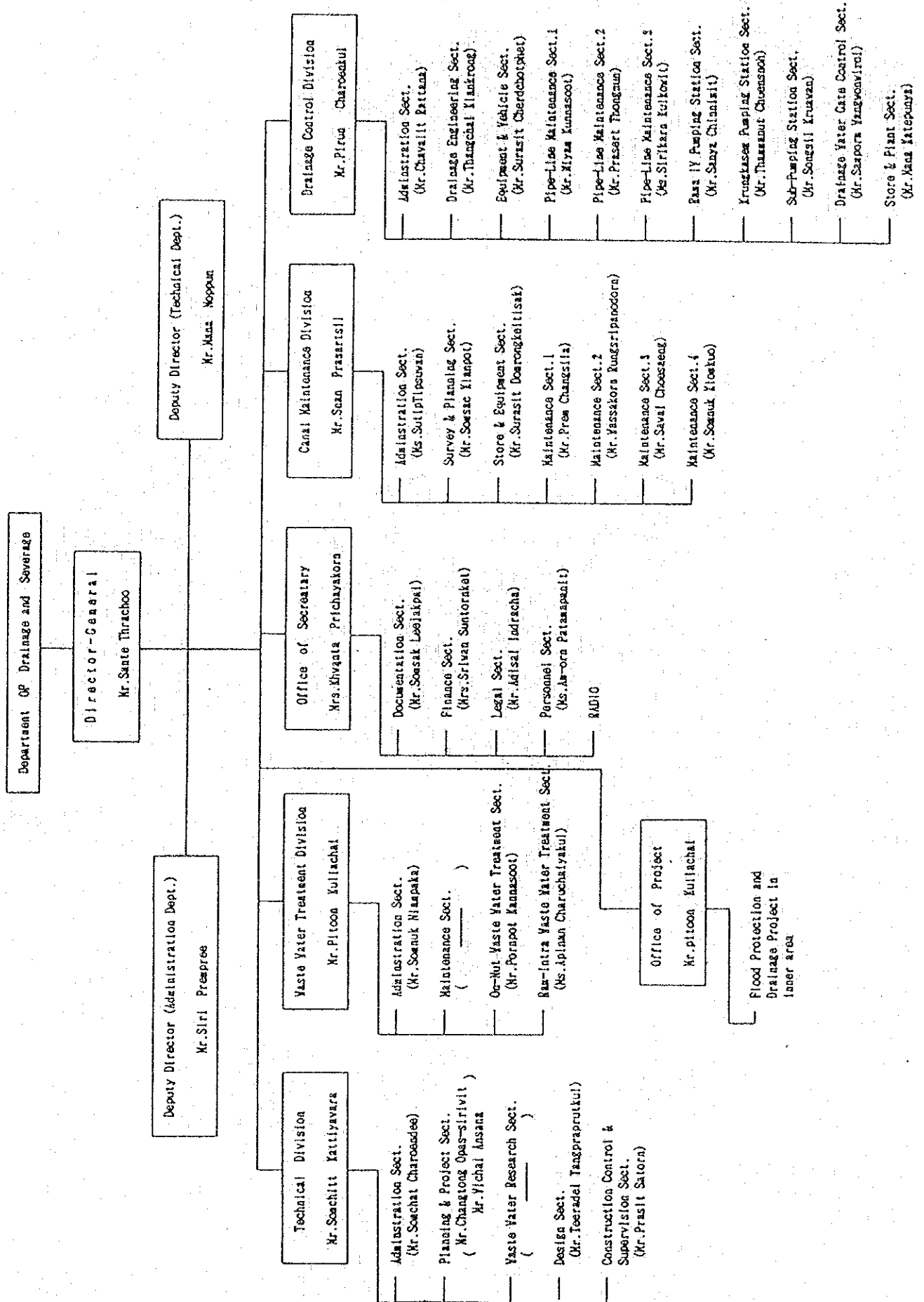
I T E M	TOTAL	ACTIVITY EXPENSE	SALARY & WAGES	OTHERS	REMARKS
General Administration	8,989	—	5,161	3,828	
General Administration Activity	5,909	—	3,288	2,621	
Technical Activity	3,080	—	1,873	1,297	
Flood Protection & Waste Water Treatment	528,837	322,167	71,365	135,305	
Drainage Control	169,692	35,455	36,732	97,505	
Canal Maintenance	296,626	243,384	28,409	24,833	
Improve Flow Efficiency of Canal Project	42,598	40,500	1,965	133	
Flood Protection & Drainage Project	11,828	11,828	—	—	
Waste Water Treatment Activity	8,090	—	2,303	5,787	
Special Budget (Drainage & Waste Water Treat.)	26,640	26,640	—	—	
<b>T O T A L</b>	<b>564,468</b>	<b>348,807</b>	<b>76,526</b>	<b>139,133</b>	

# ORGANIZATION OF THE BANGKOK METROPOLITAN ADMINISTRATION





ORGANIZATION OF THE DEPARTMENT OF DRAINAGE AND SEWERAGE  
(1988. 6)









JICA