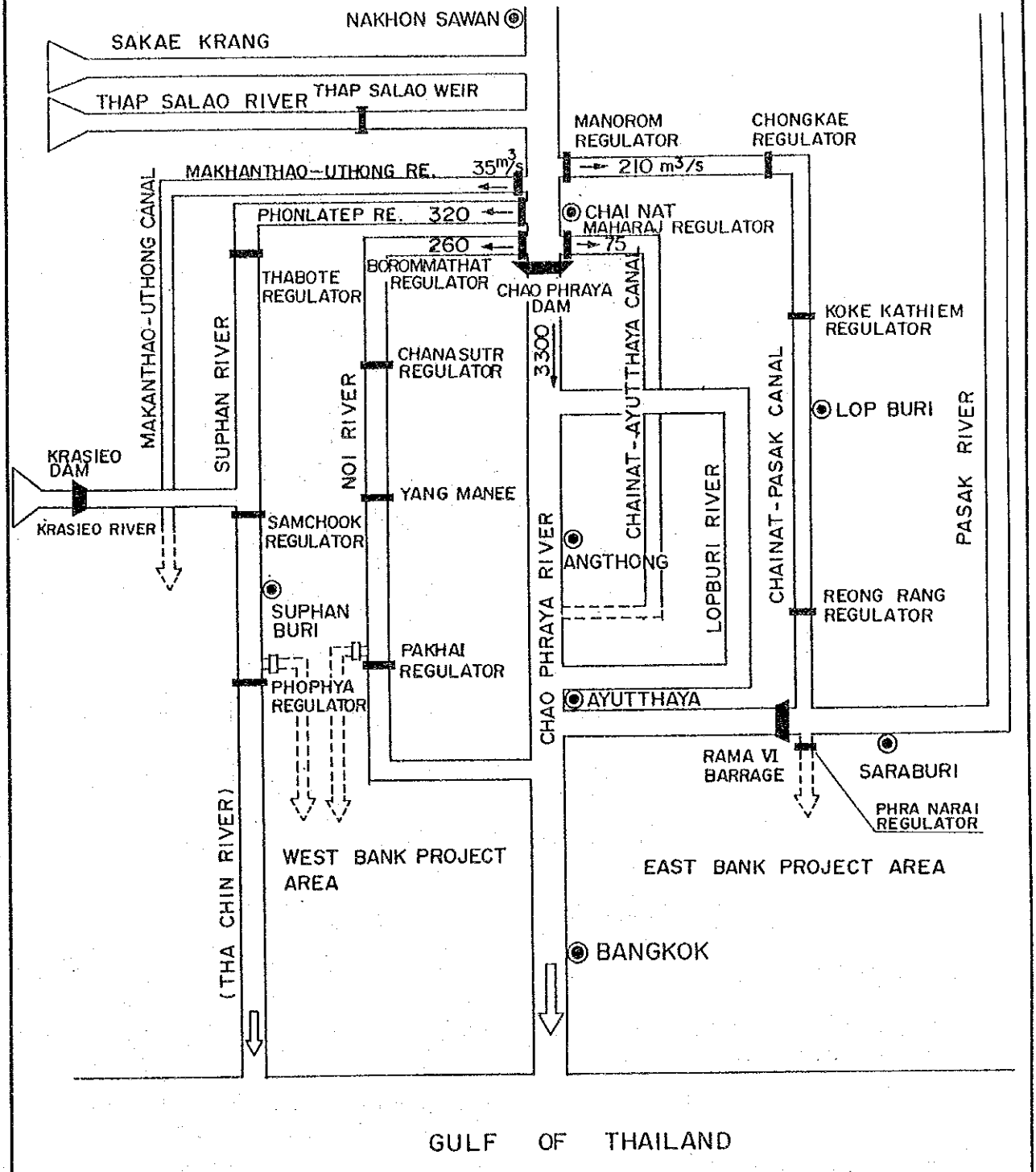


Fig. 8-3. DISTRIBUTION OF DESIGN WATER FLOW BY CHAO PHRAYA DAM TO MAIN WATERCOURSES

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

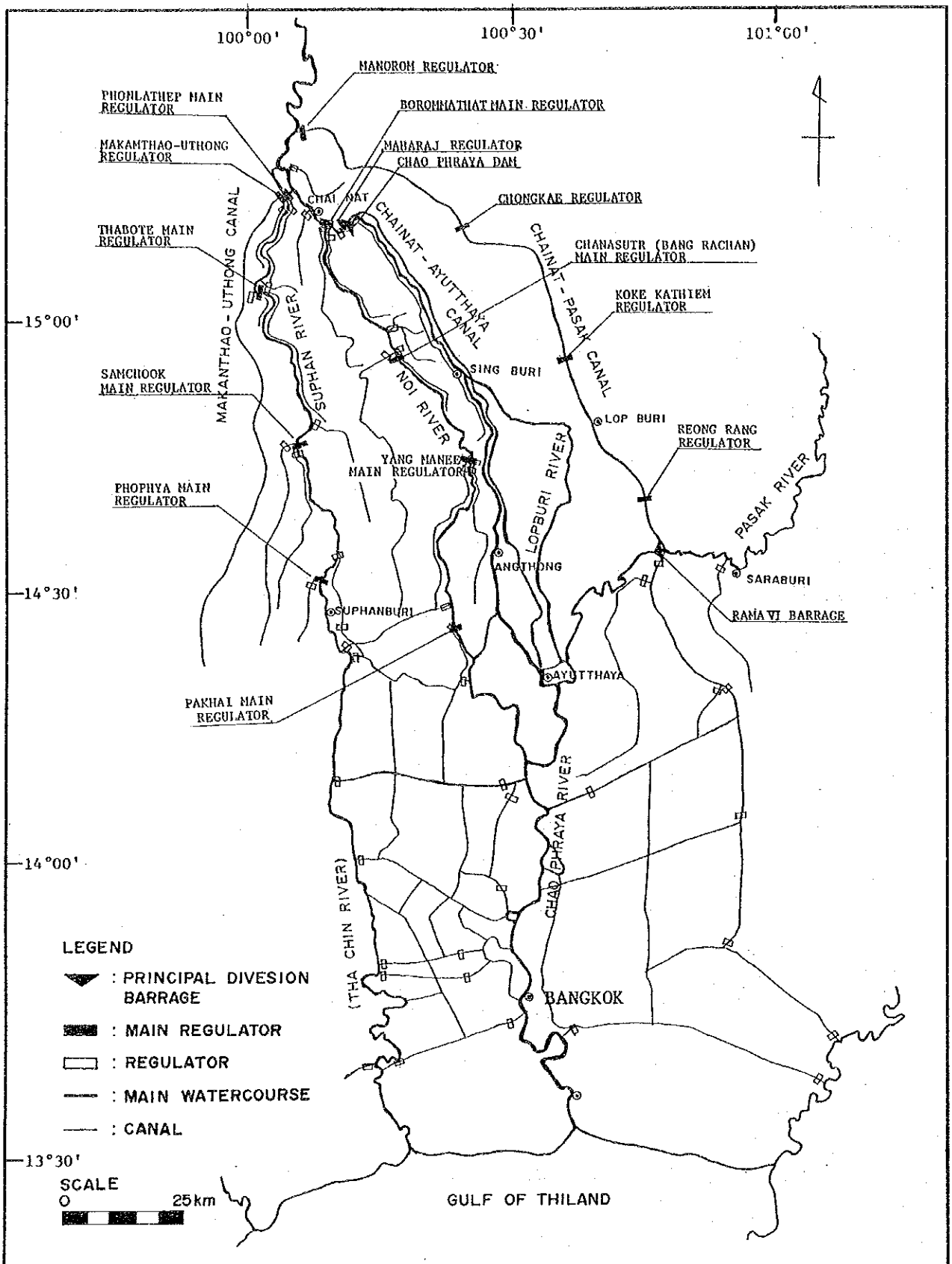


Fig. 8-4. LOCATION OF MAJOR DIVERSION STRUCTURES IN THE LOWER BASIN FROM NAKHON SAWAN

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

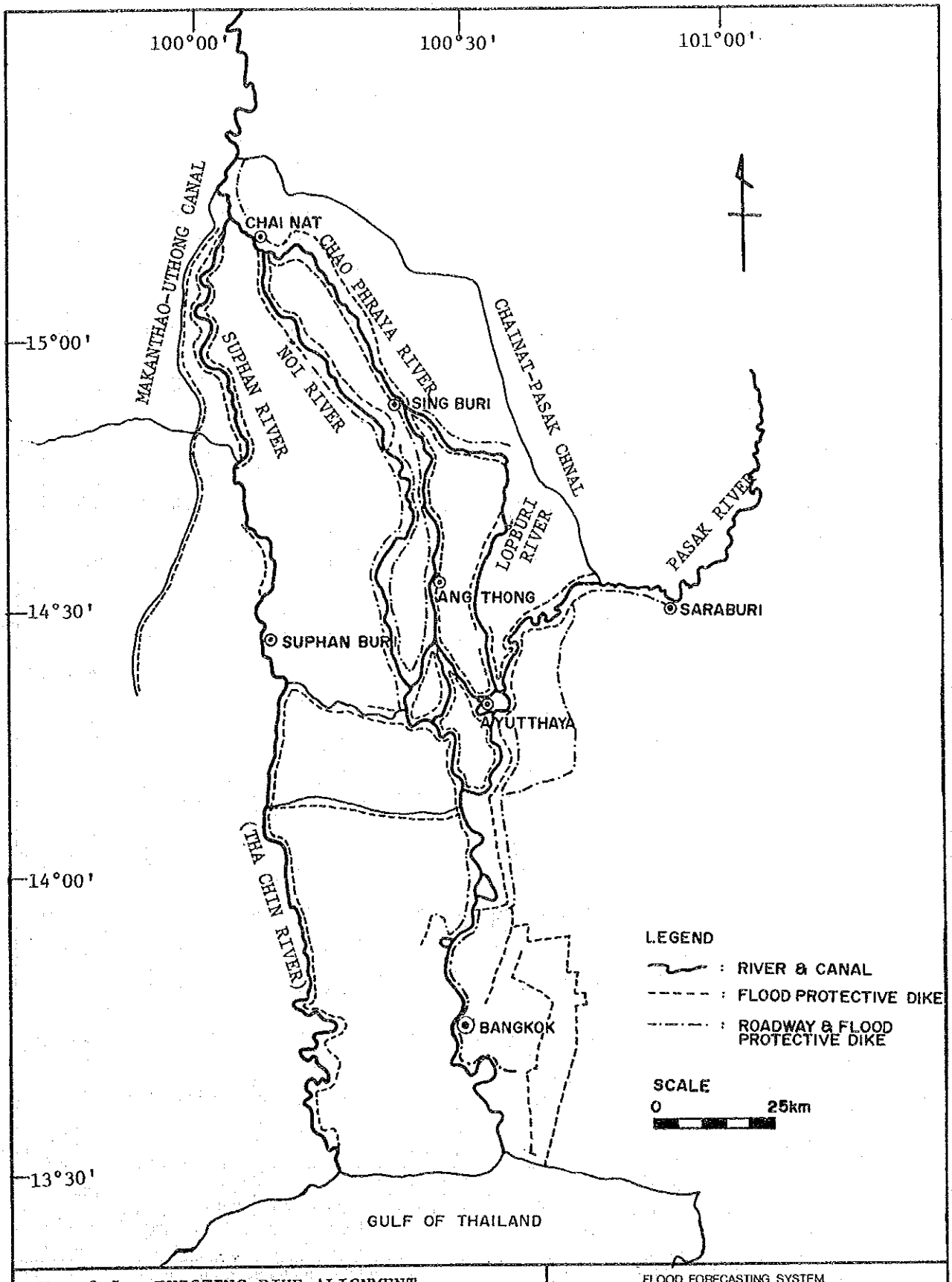


Fig. 8-5. EXISTING DIKE ALIGNMENT IN THE LOWER BASIN FROM NAKHON SAWAN

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

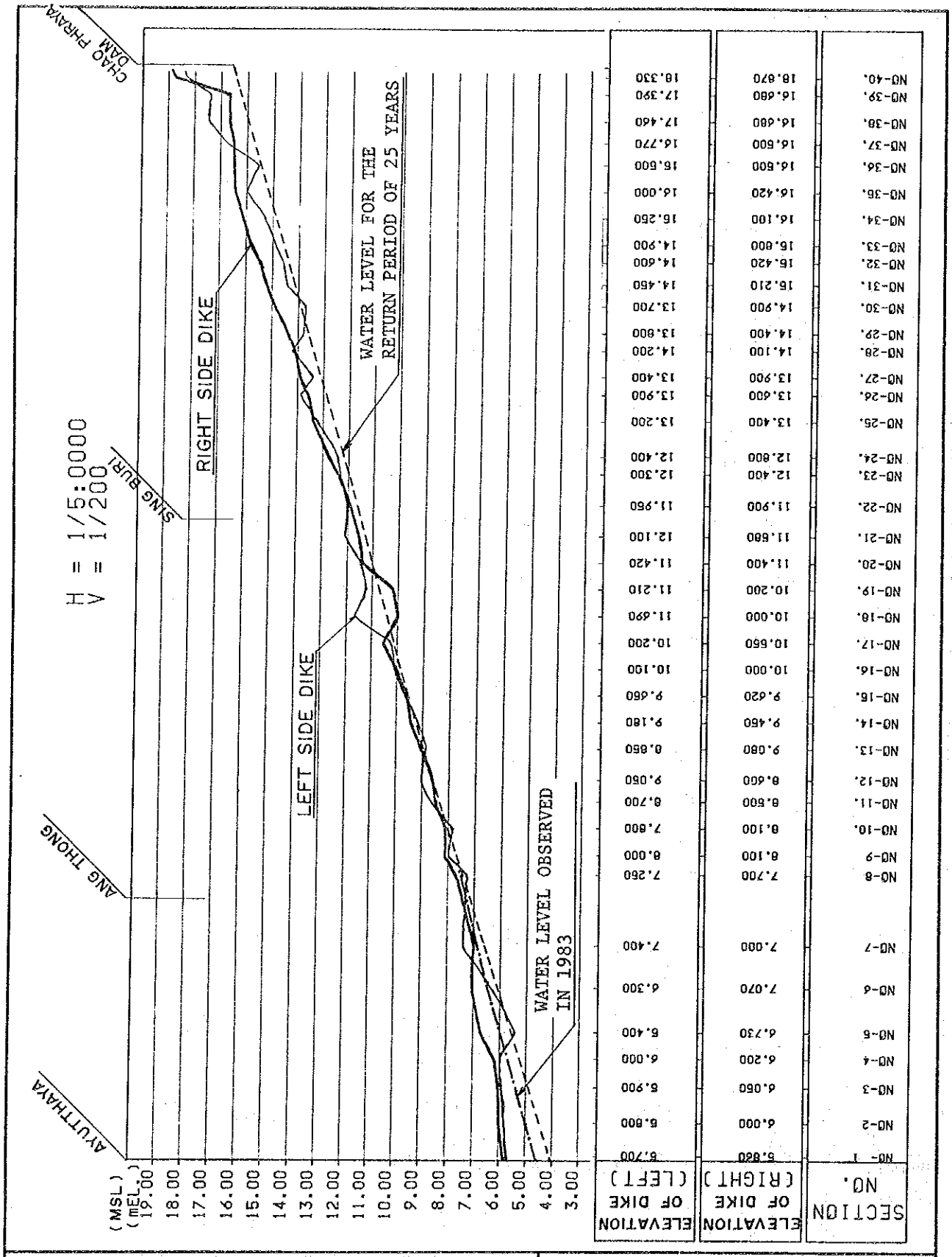


Fig. 8-6. LONGITUDINAL PROFILE OF FLOOD PROTECTION DIKE ALONG CHAO PHRAYA RIVER

FLOOD FORECASTING SYSTEM IN THE CHAO PHRAYA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

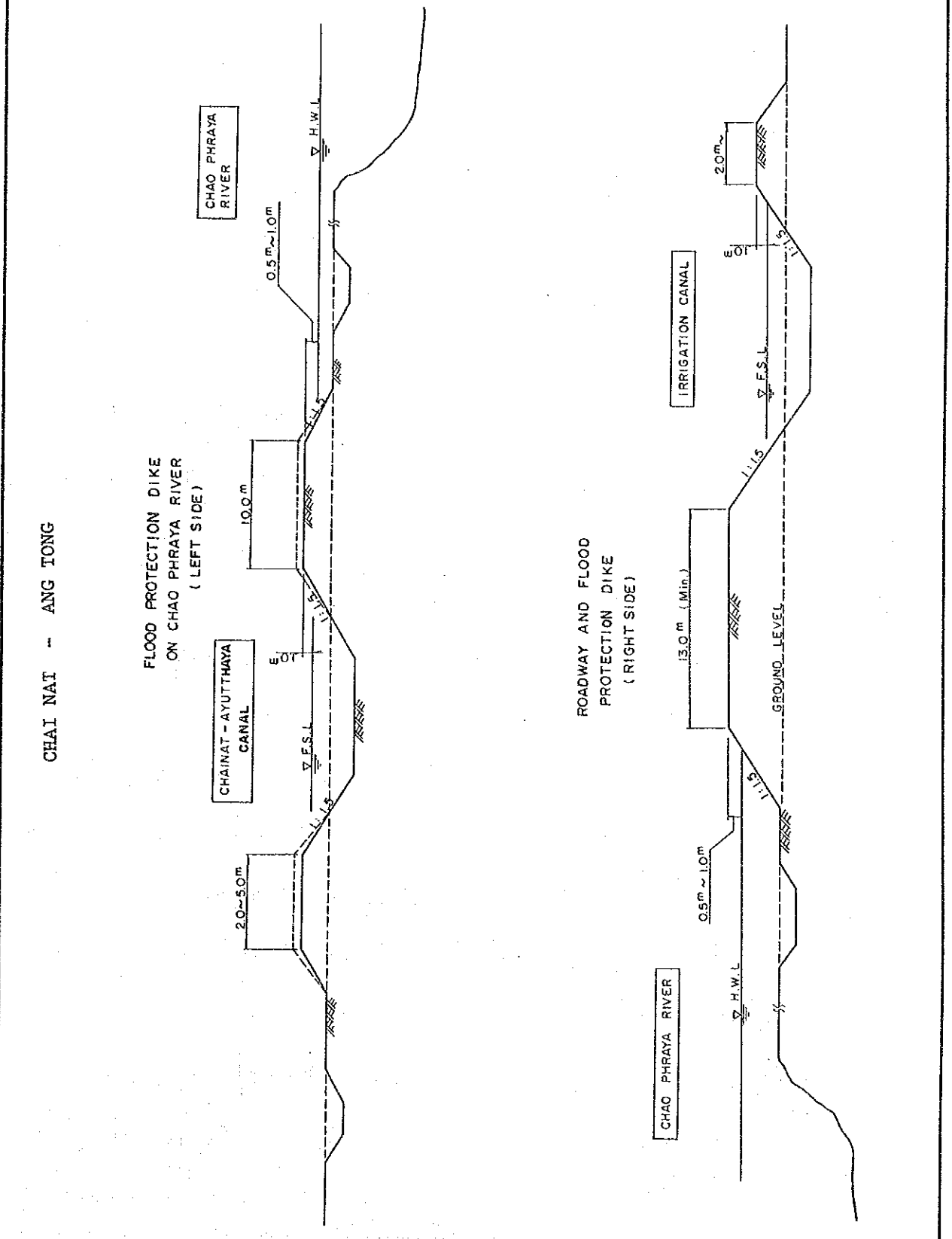


Fig. 8-7(1/2). TYPICAL CROSS SECTION OF FLOOD PROTECTION DIKE

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

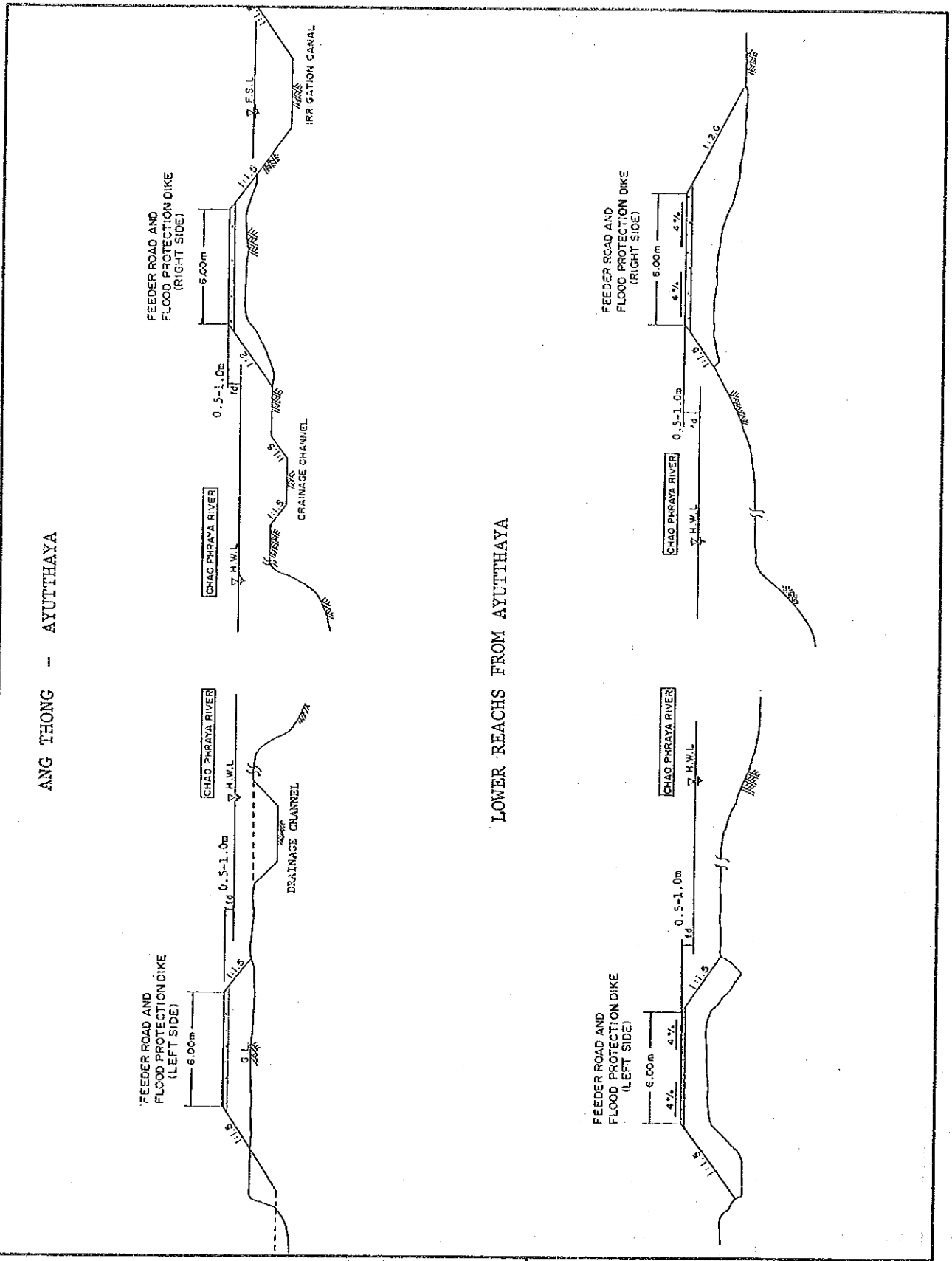
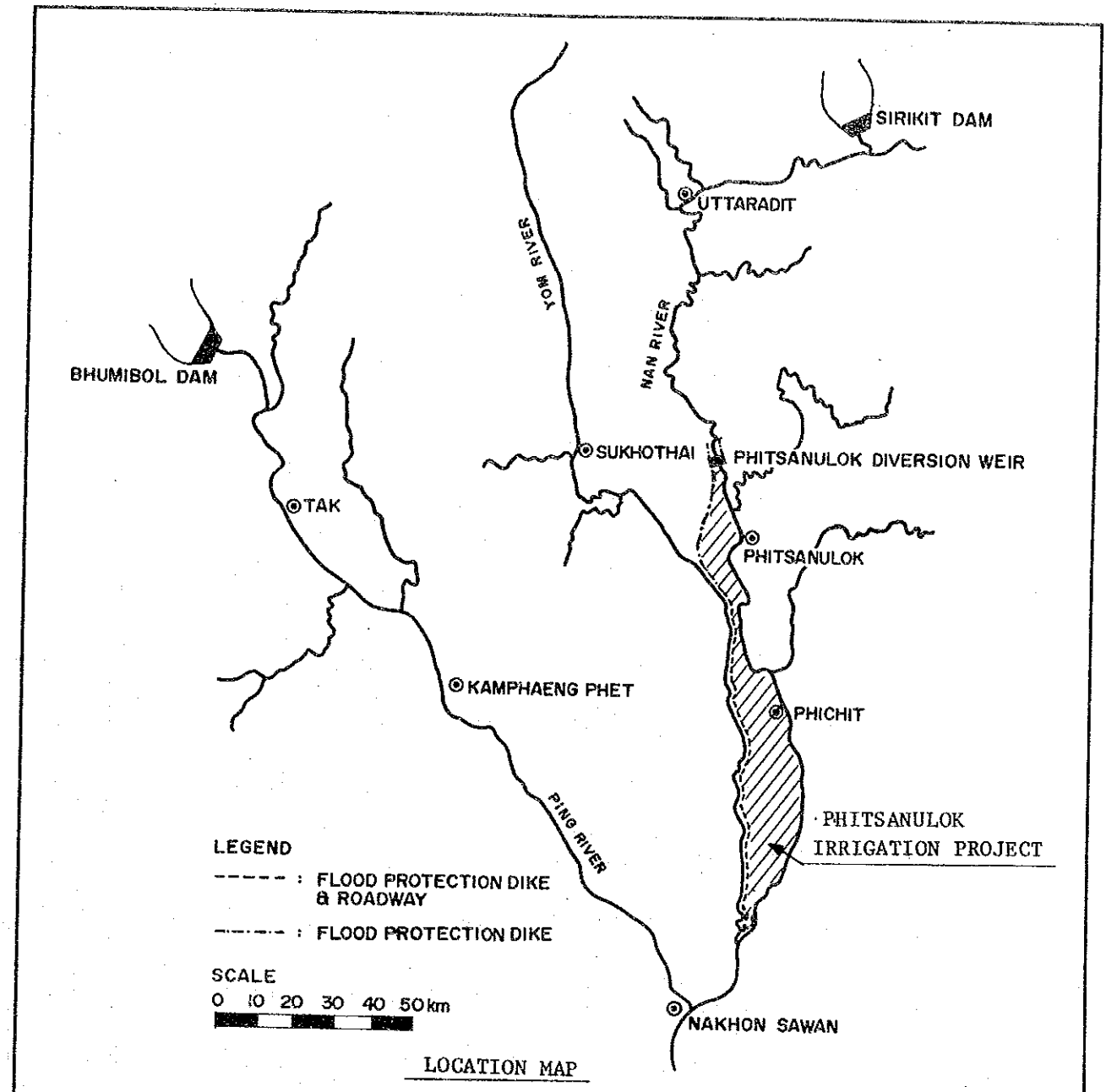
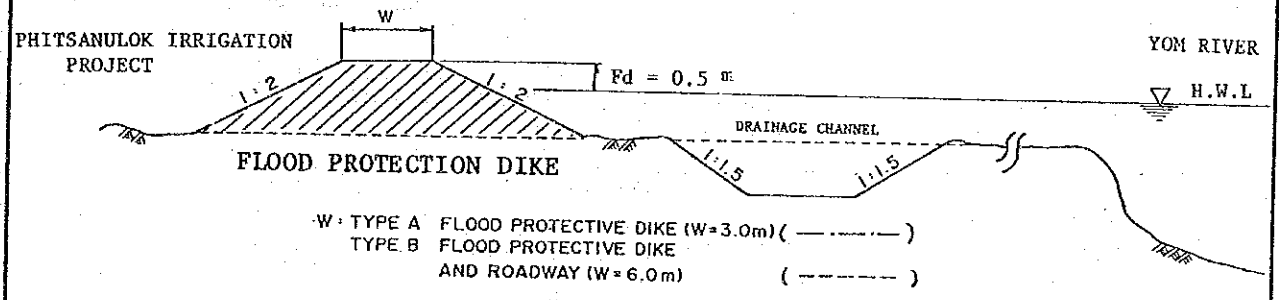


Fig. 8-7(2/2). TYPICAL CROSS SECTION OF FLOOD PROTECTION DIKE

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY



LOCATION MAP



TYPICAL CROSS SECTION

Fig. 8-8. FLOOD PROTECTION DIKE ALONG YOM RIVER

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

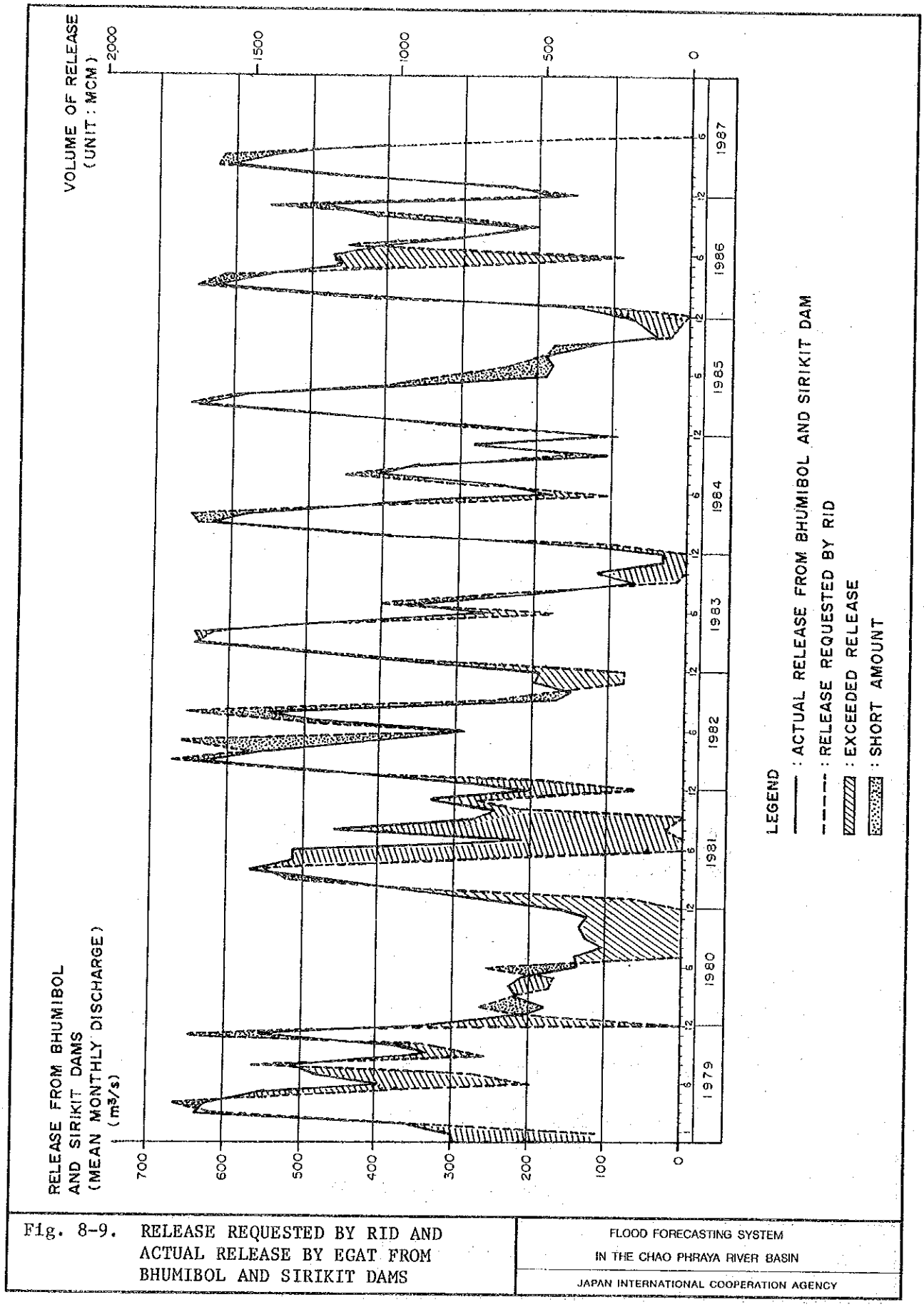
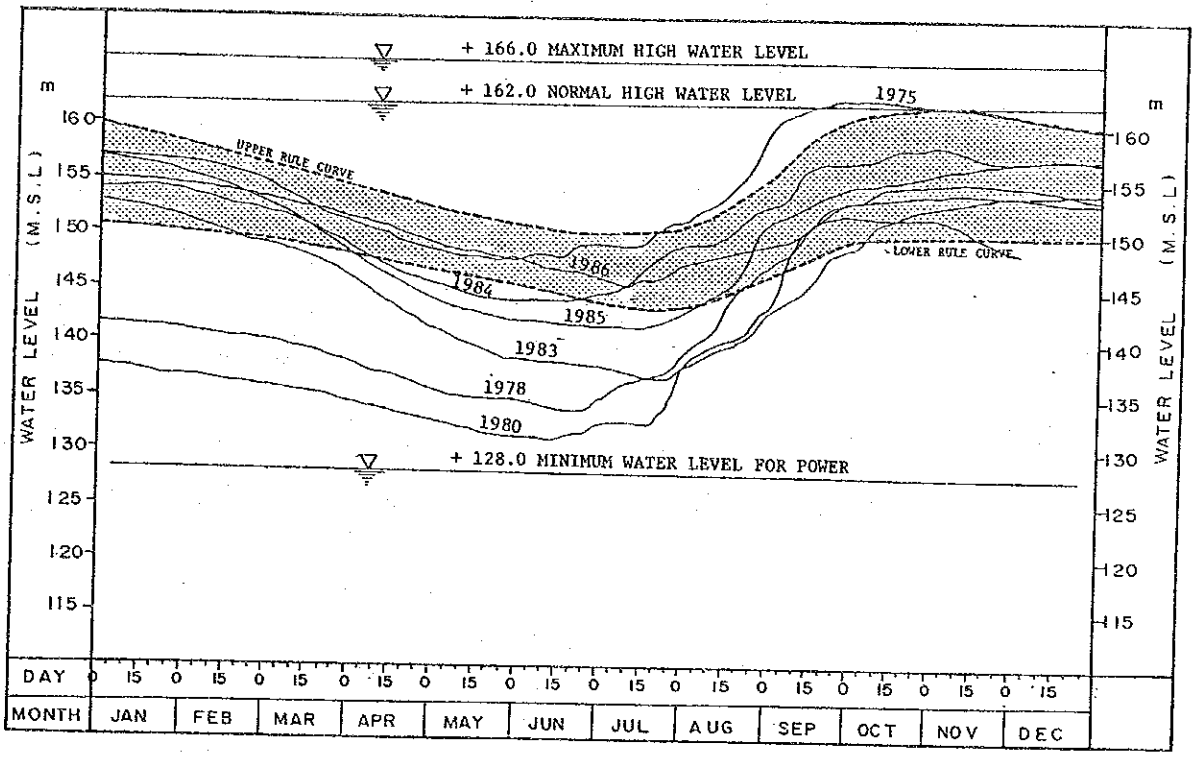


Fig. 8-9. RELEASE REQUESTED BY RID AND ACTUAL RELEASE BY EGAT FROM BHUMIBOL AND SIRIKIT DAMS

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

SIRIKIT DAM



BHUMIBOL DAM

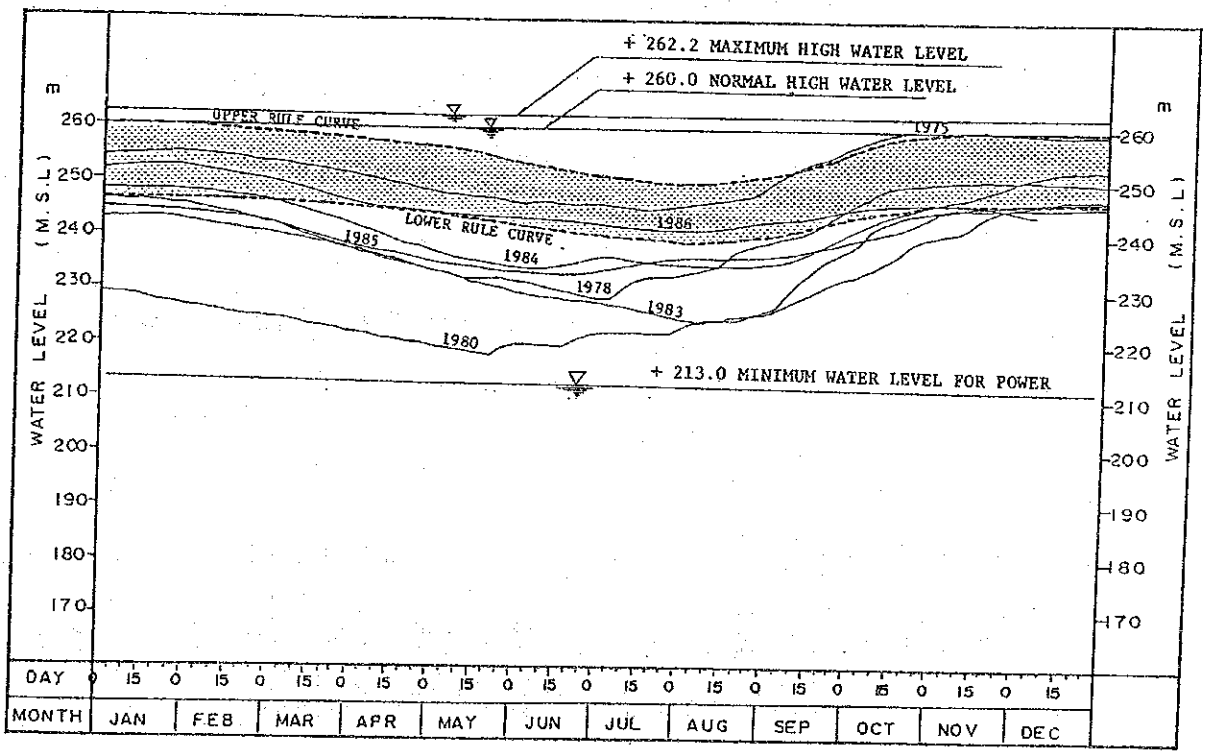


Fig. 8-10. RECORDS OF RESERVOIR WATER LEVEL (SIRIKIT AND BHUMIBOL DAMS)

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

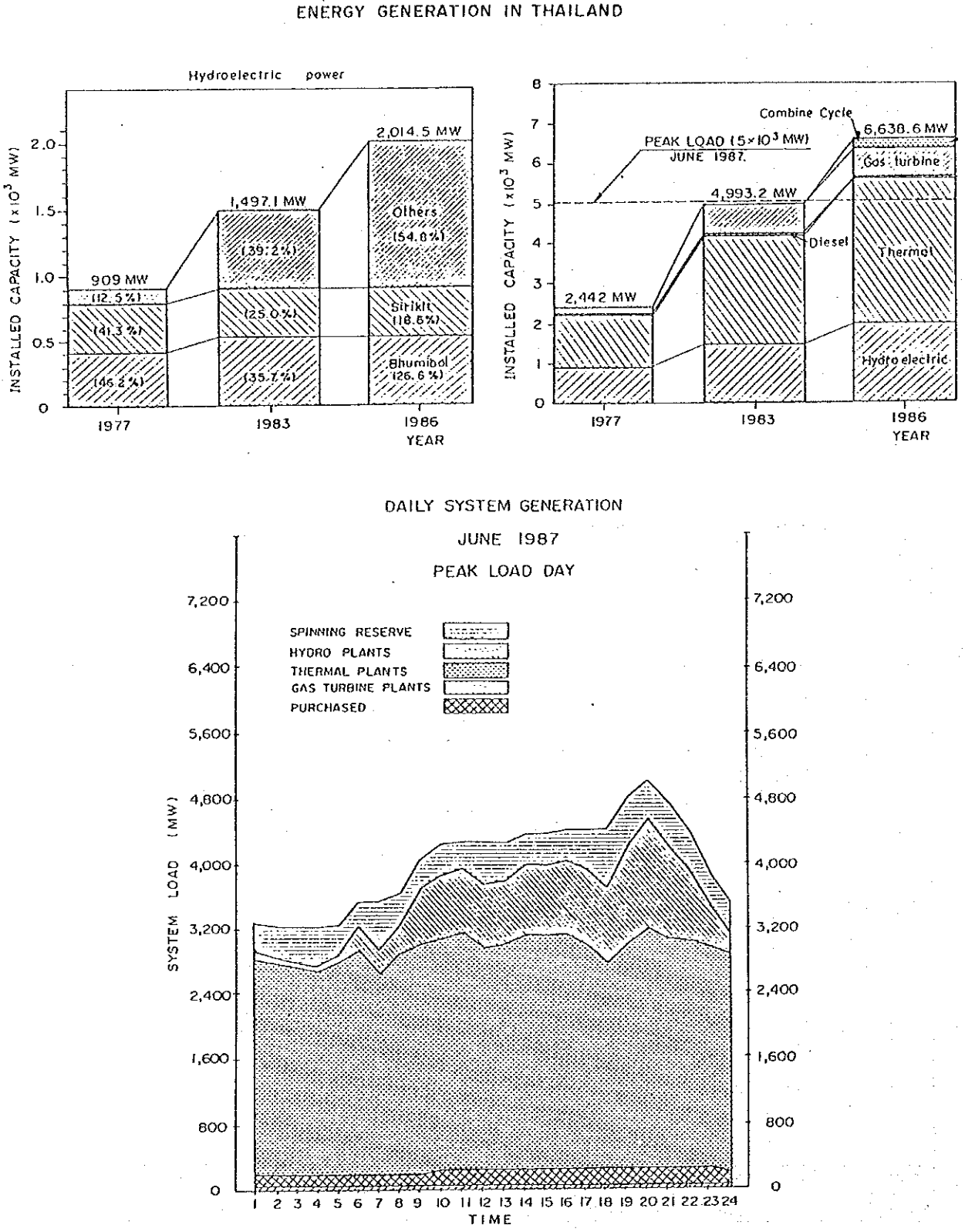


Fig. 8-11. DEMAND AND SUPPLY OF ELECTRICITY IN THAILAND

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

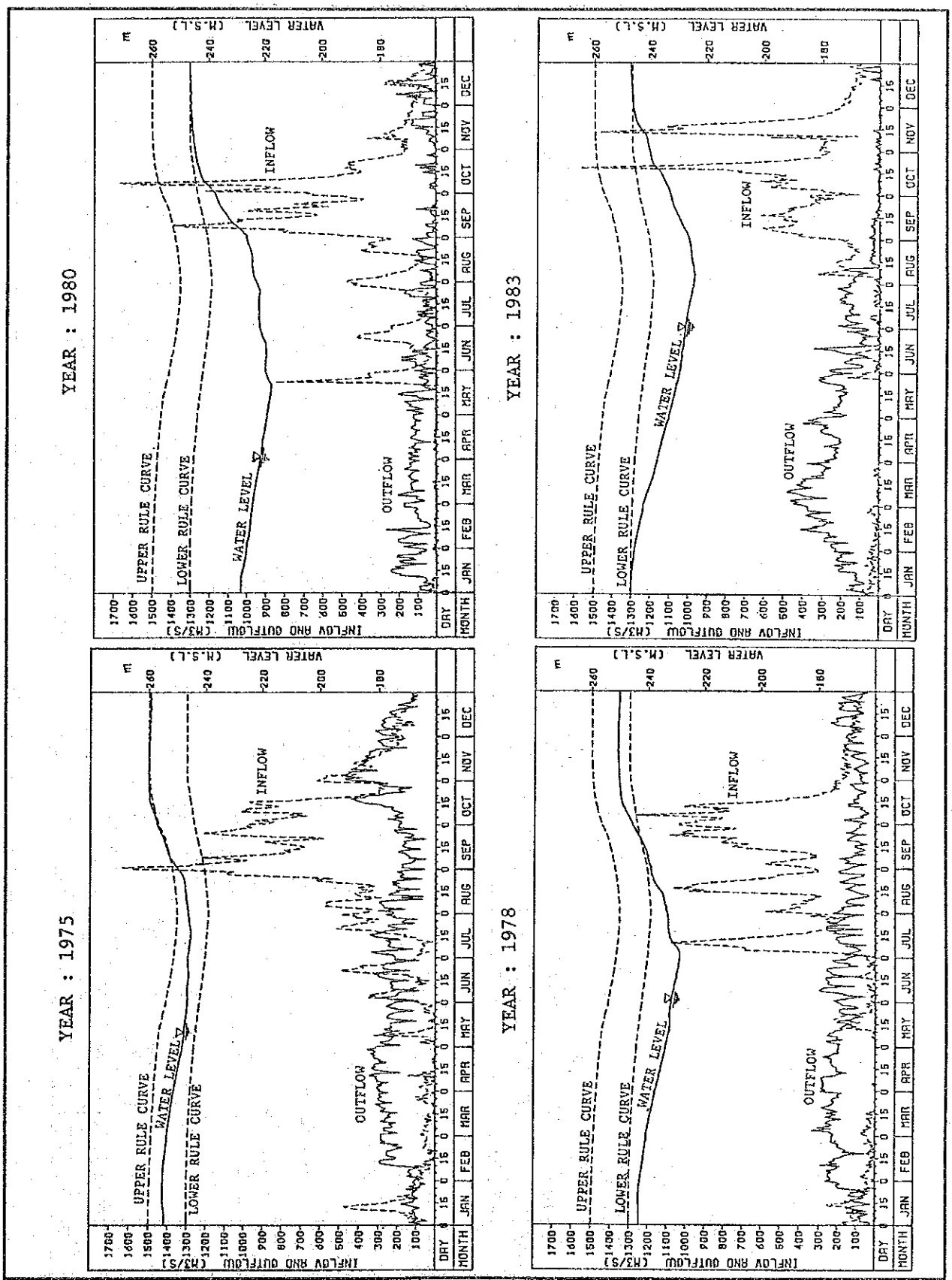


Fig. 8-12. RESERVOIR RECORD OF INFLOW AND OUTFLOW IN 1975, 1978, 1980 AND 1983 (BHUMIBOL DAM)

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

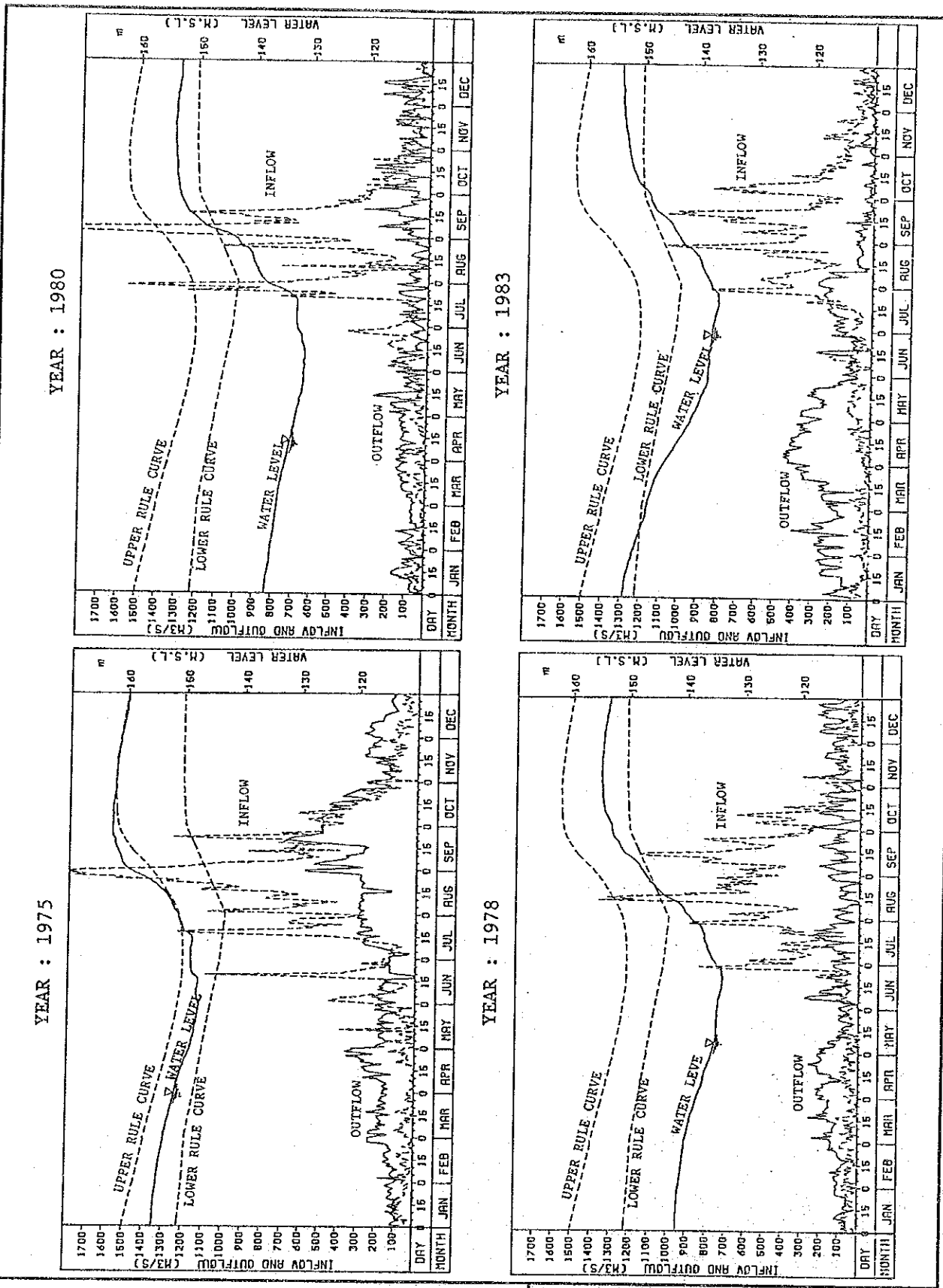


Fig. 8-13. RESERVOIR RECORD OF INFLOW AND OUTFLOW IN 1975, 1978, 1980 AND 1983 (SIRIKIT DAM)

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

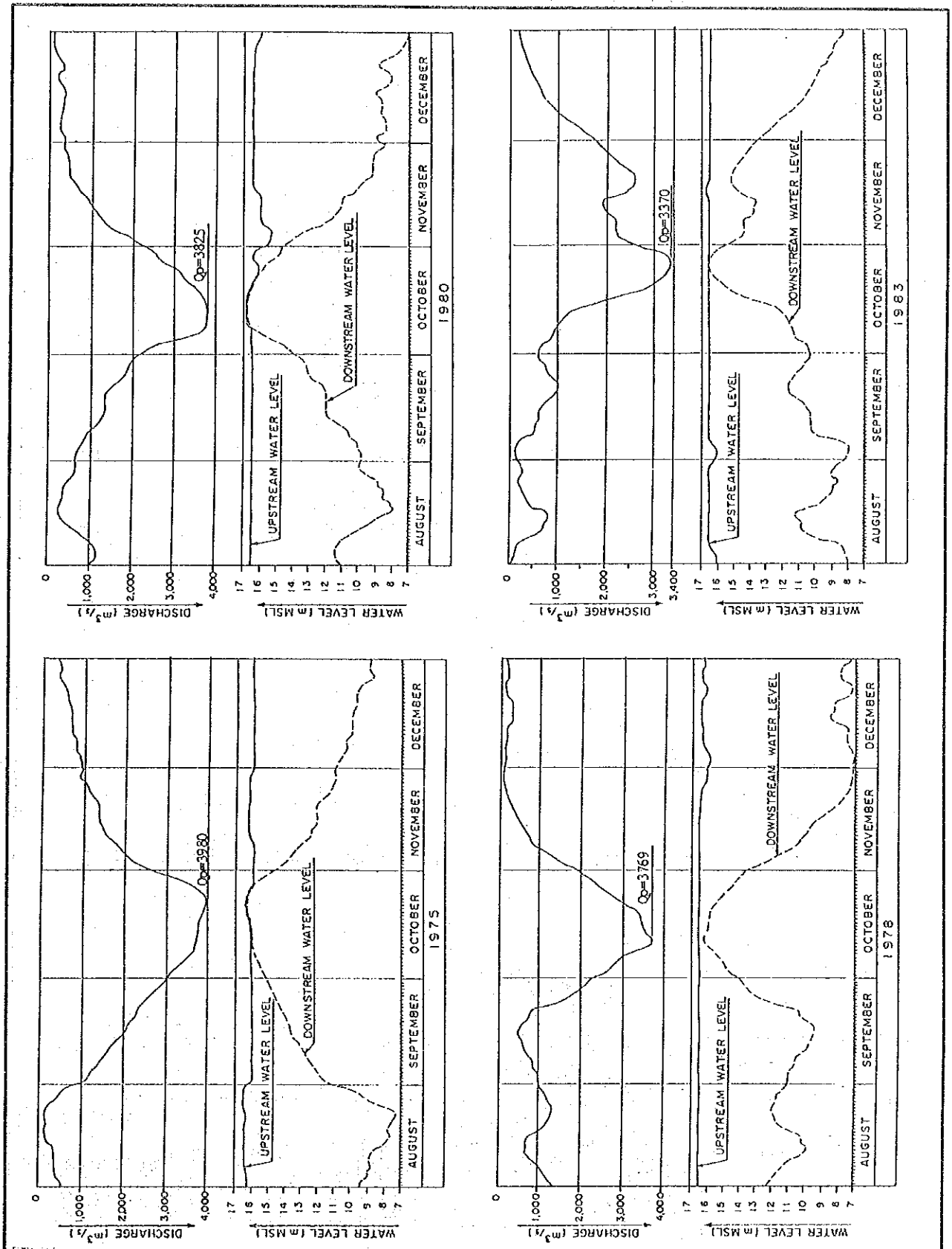


Fig. 8-14. RECORDS OF GATE OPERATION OF CHAO PHRAYA DAM

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

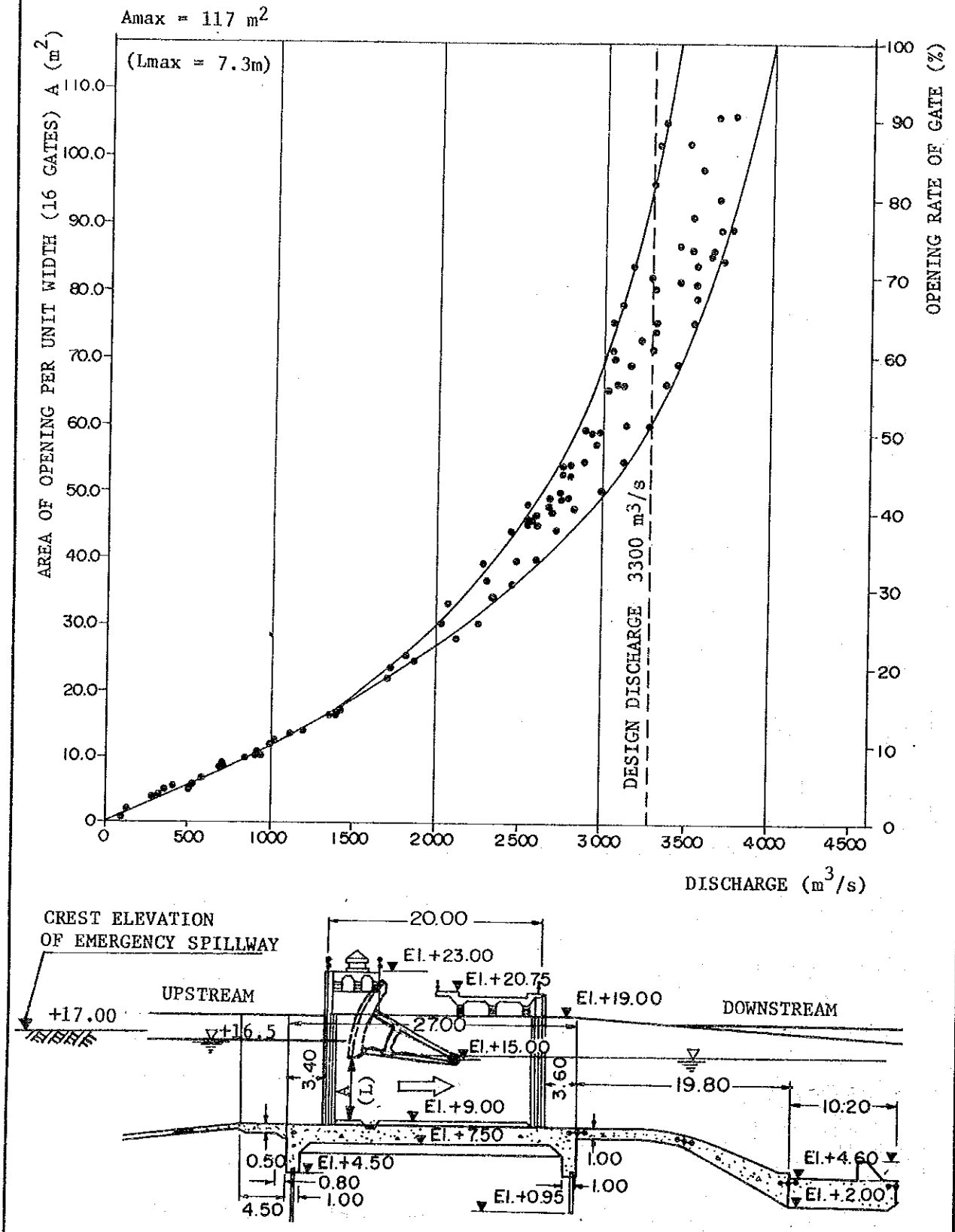
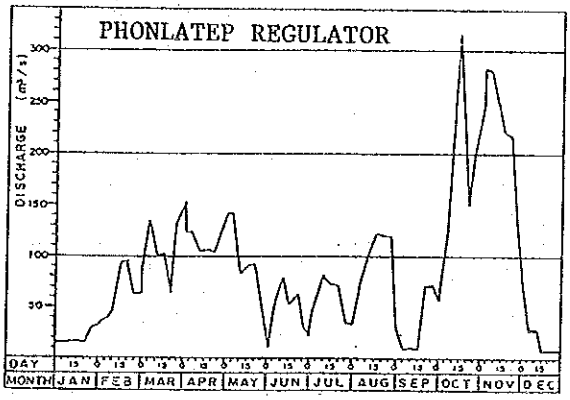
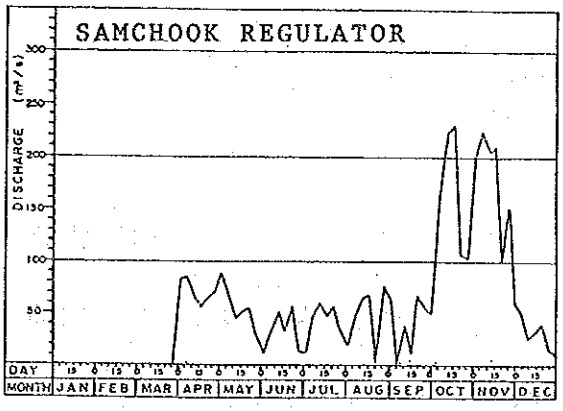


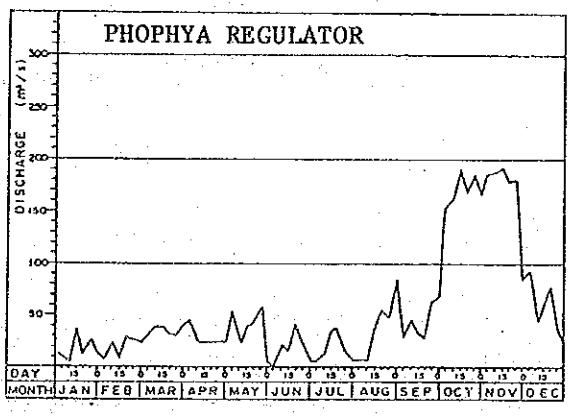
Fig. 8-15. RELATIONSHIP BETWEEN GATE OPENING AND DISCHARGE THROUGH GATE OF CHAO PHRAYA DAM

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

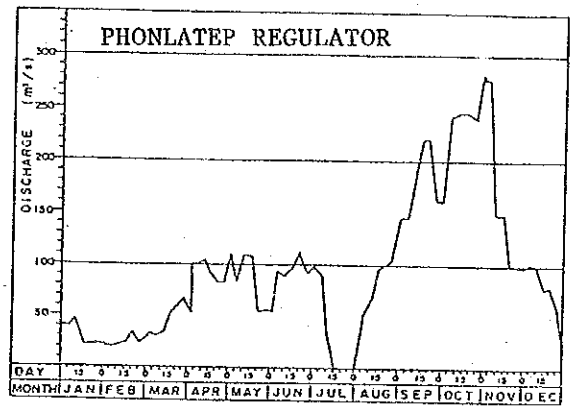
YEAR : 1975

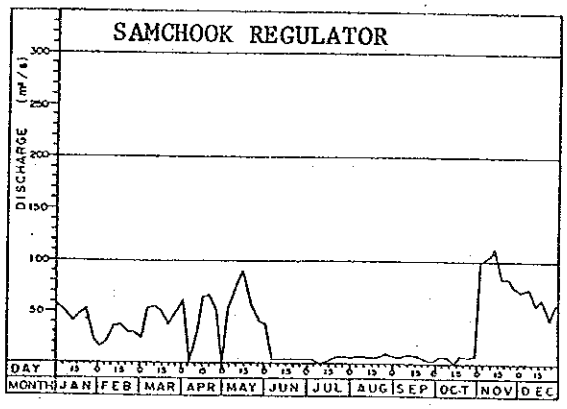






YEAR : 1978





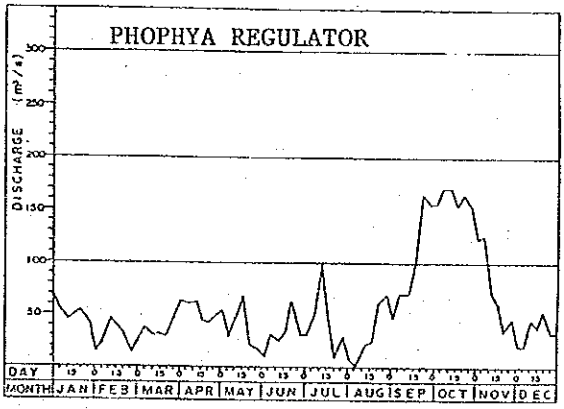
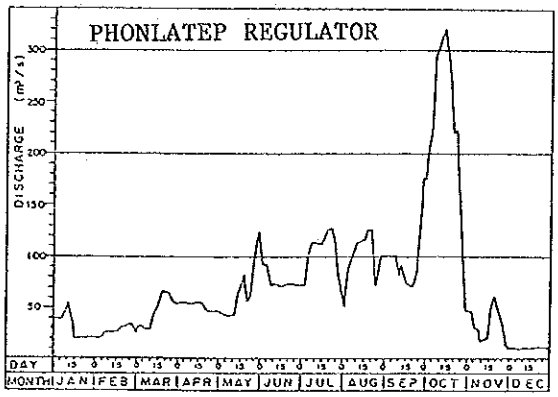
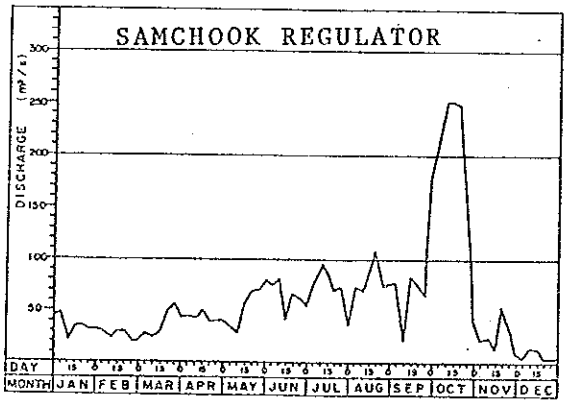


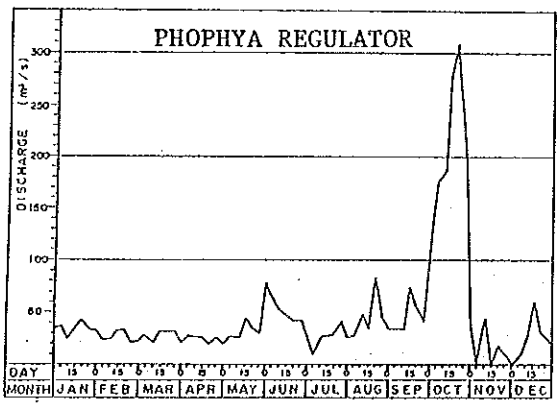
Fig. 8-16(1/2). RECORDS OF DISCHARGE THROUGH MAJOR REGULATORS ON SUPHAN RIVER

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

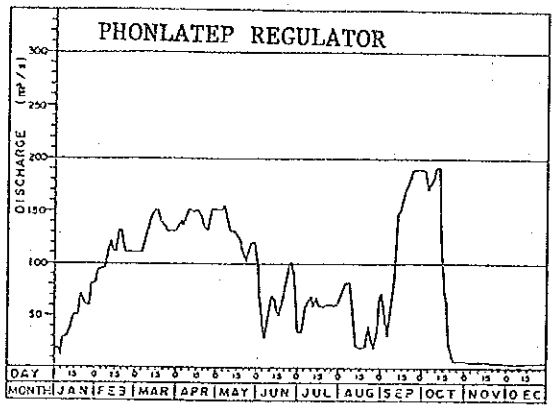
YEAR : 1980

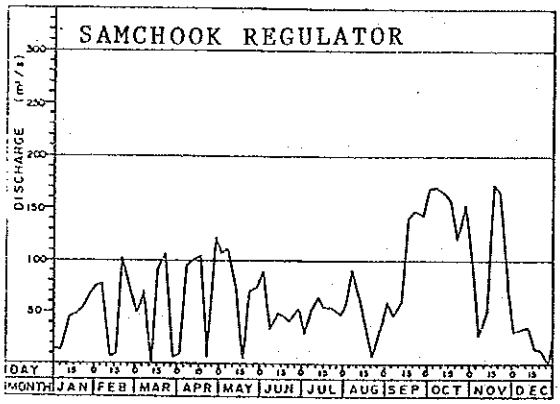






YEAR : 1983





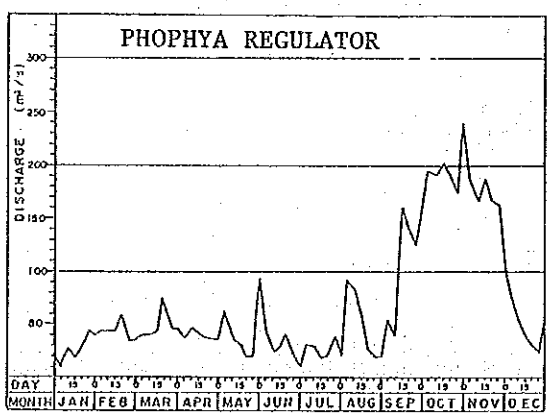
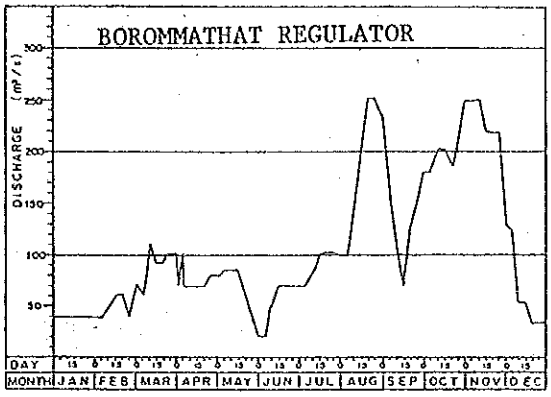
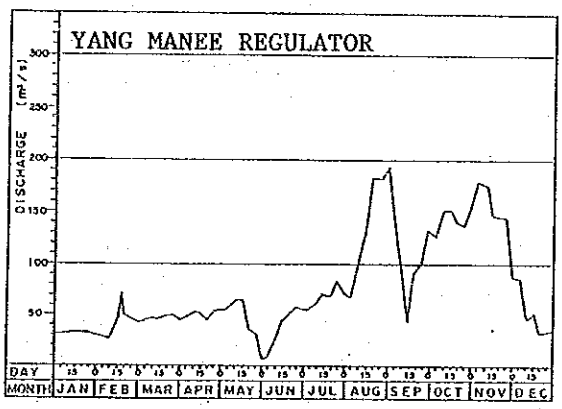


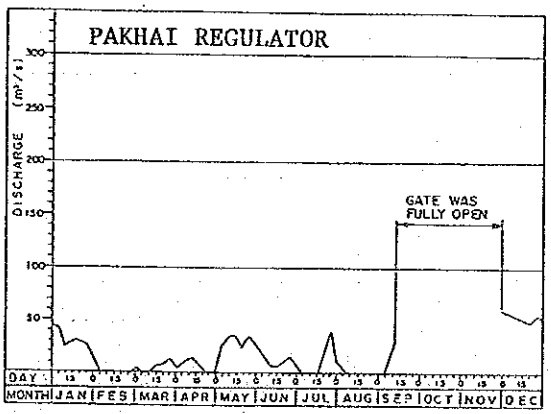
Fig. 8-16(2/2). RECORDS OF DISCHARGE THROUGH MAJOR REGULATORS ON SUPHAN RIVER

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

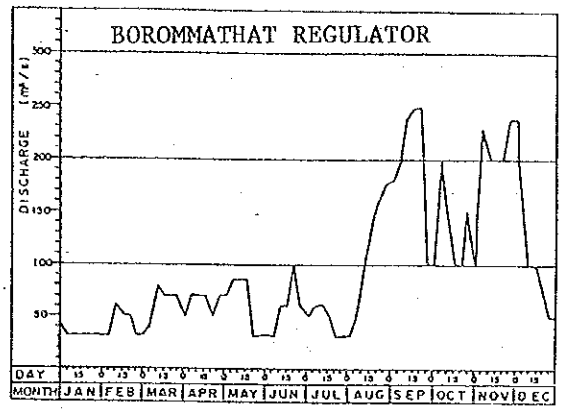
YEAR : 1975

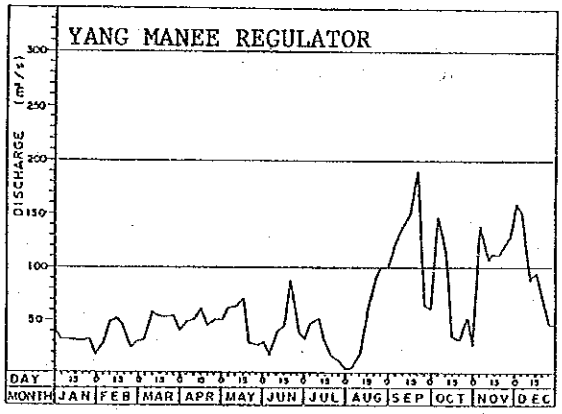






YEAR : 1978





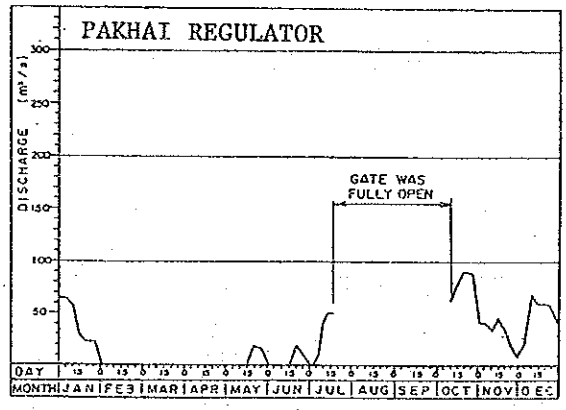
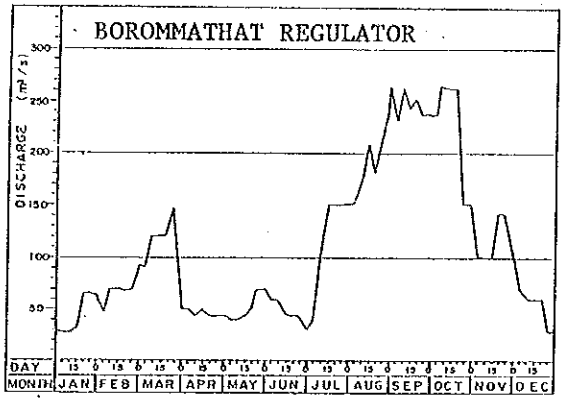


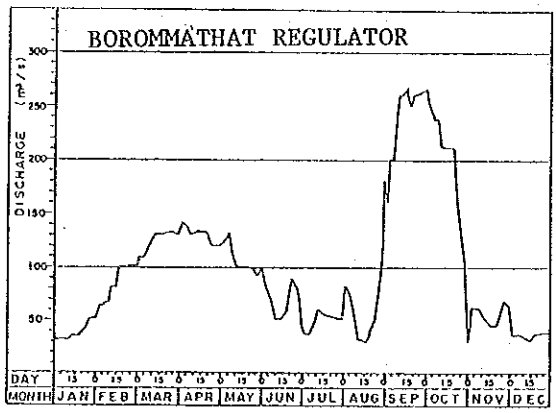
Fig. 8-17(1/2). RECORDS OF DISCHARGE THROUGH REGULATORS ON NOI RIVER

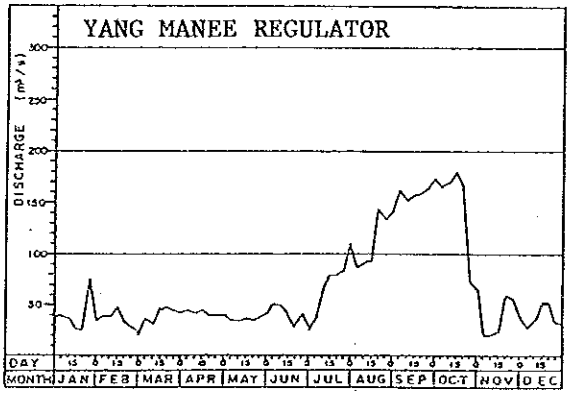
FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

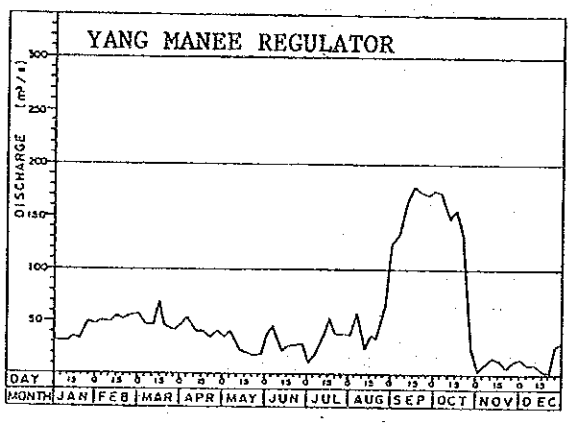
YEAR : 1980

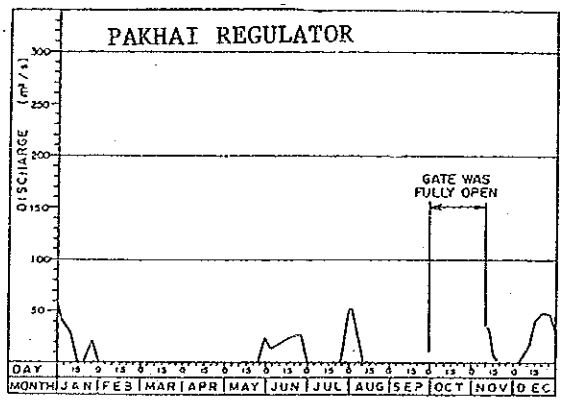


YEAR : 1983









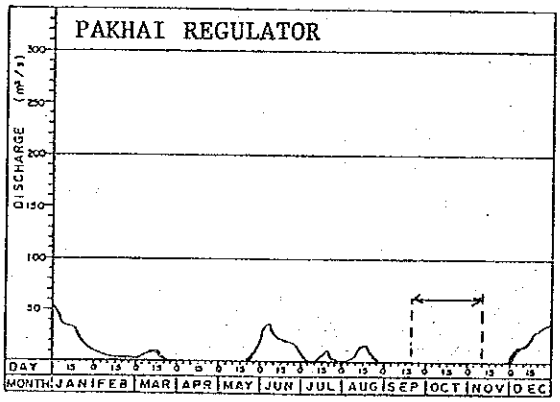
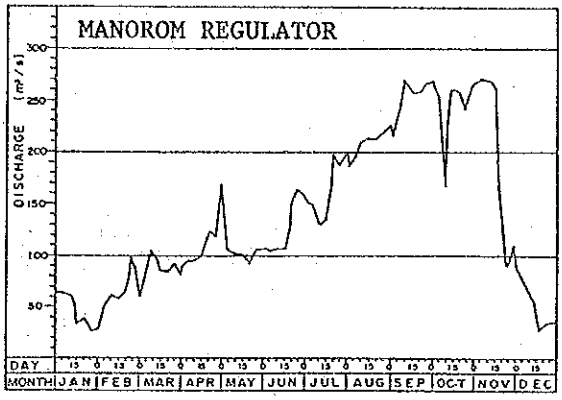
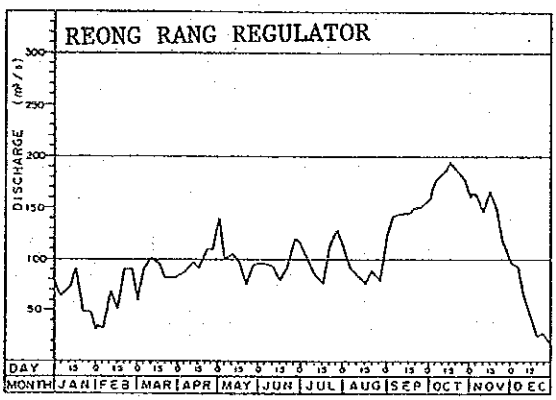


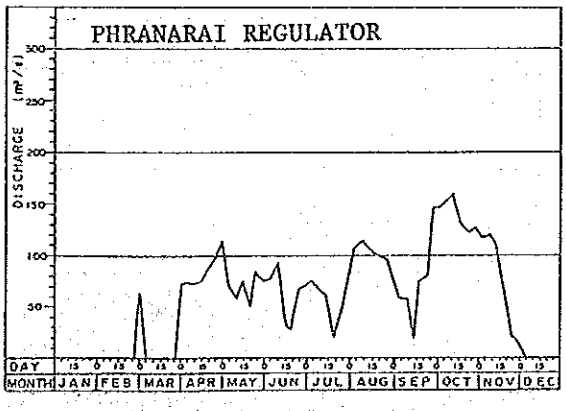
Fig. 8-17(2/2). RECORDS OF DISCHARGE THROUGH MAJOR REGULATORS ON NOI RIVER

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

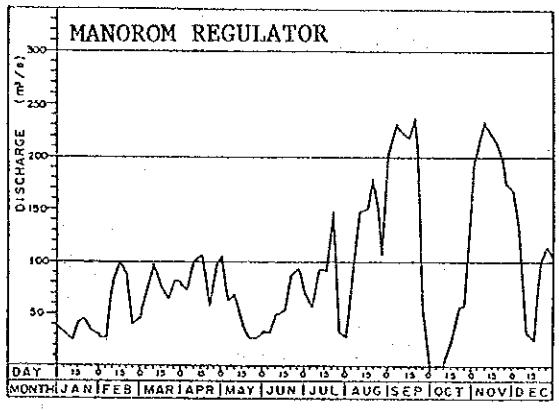
YEAR : 1975

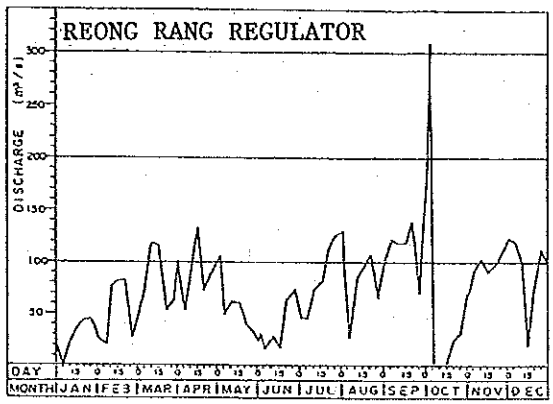






YEAR : 1978





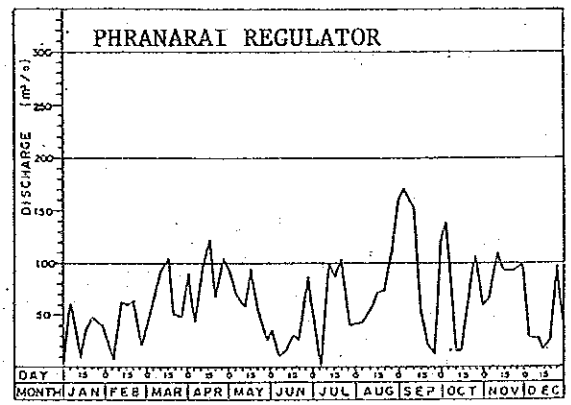
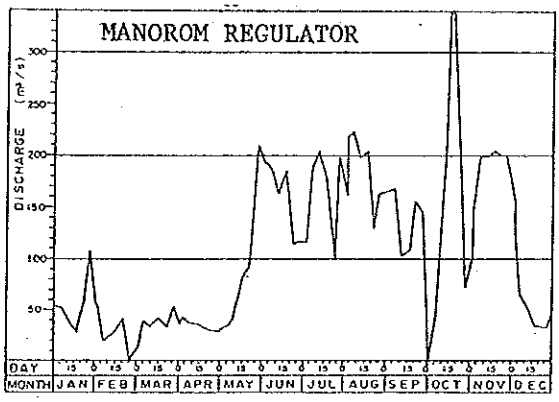
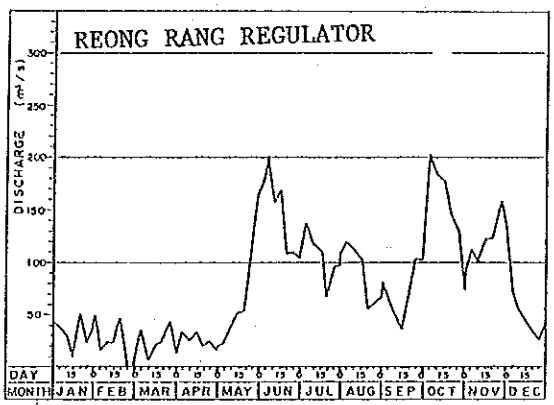


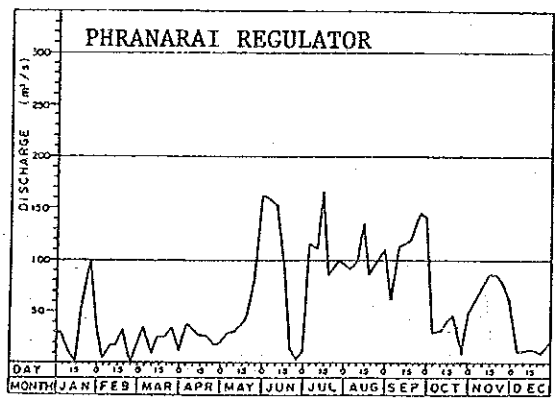
Fig. 8-18(1/2). RECORDS OF DISCHARGE THROUGH MAJOR REGULATORS ON CHAINAT-PASAK CANAL

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

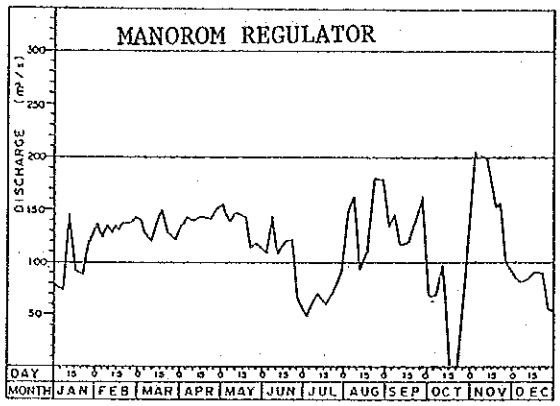
YEAR : 1980

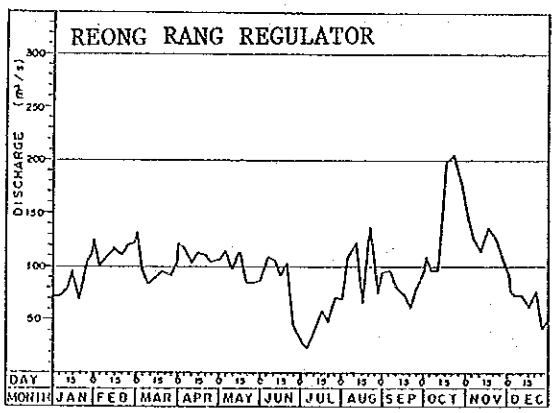






YEAR : 1983





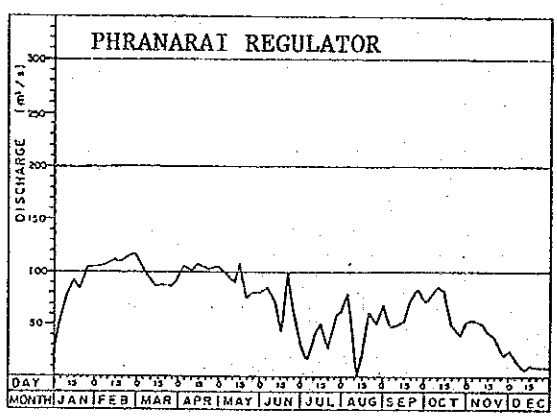


Fig. 8-18(2/2). RECORDS OF DISCHARGE THROUGH MAJOR REGULATORS ON CHAINAT-PASAK CANAL

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

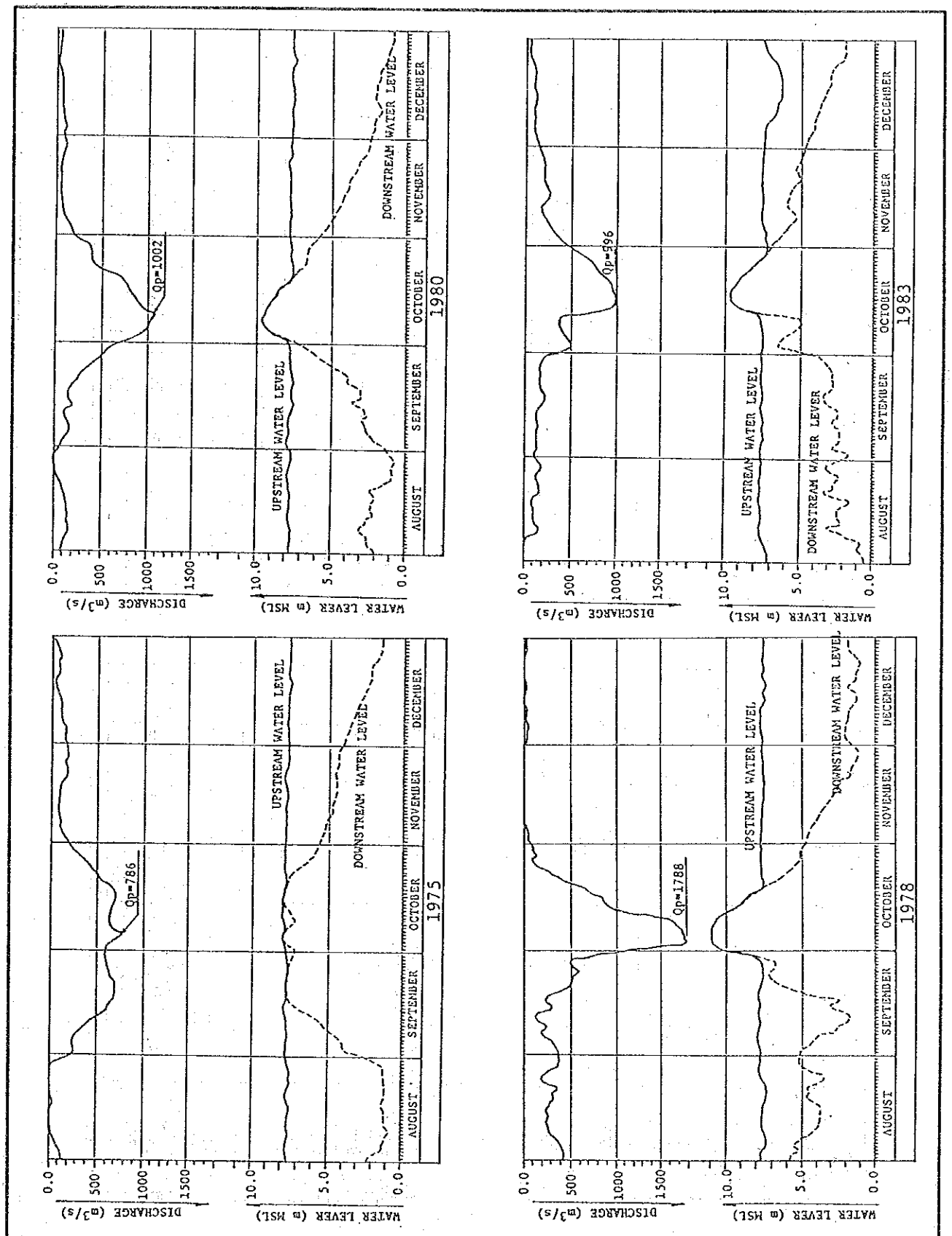


Fig. 8-19. RECORDS OF GATE OPERATION OF RAMA VI DAM

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

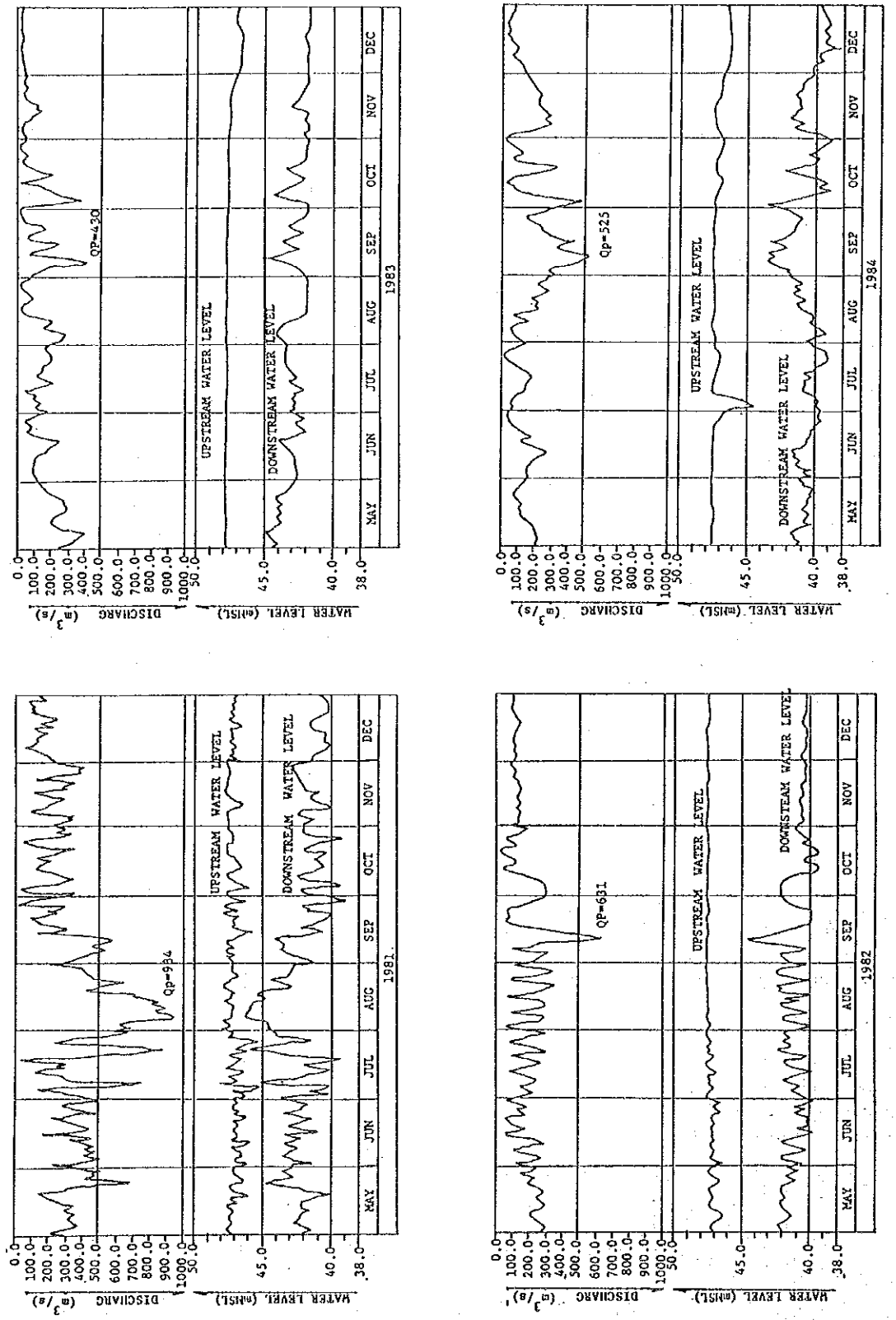


Fig. 8-20. RECORDS OF GATE OPERATION OF PHITSANULOK DIVERSION WEIR

FLOOD FORECASTING SYSTEM IN THE CHAO PHRAYA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

9. ORGANIZATION

SUPPORTING REPORT
ON
ORGANIZATION

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9. SUPPORTING REPORT ON ORGANIZATION

1. General

The study on an administrative organization that can successfully implement the flood forecasting system is herein discussed according to the following order:

(1) A brief description of institutions on national policy and budget, followed by the investigation and analysis of existing water-related institutions including those on flood forecasting and control.

(2) A description of the proposed flood forecasting system, dealing with the study on the responsible institutions and other related institutions, and the formulation of the required organization for operation and maintenance.

The institutions are presented in Fig. 9-1, Organization Chart of the Government of the Kingdom of Thailand.

2. Existing Organization

2.1 Institutions on National Policy and Budget

National Policy

National policies including those on water-related activities are prepared by the National Economic and Social Development Board (NESDB), which is under the Office of the Prime Minister, and approved by the Council of Ministers or Cabinet as five-year national economic and social development plans. The Sixth National Economic and Social Development Plan covering the period from 1986 to 1990 is presently in effect.

Budget

Budgetary processes in Thailand are influenced by the five-year plans. The Bureau of the Budget under the Office of the Prime Minister deliberates on the annual budgetary policy and ceiling of expenditures, and provides guidance to the government ministries and departments in preparing their budgetary requests. The Ministry of Finance is in charge of prescribing and controlling accounting systems, regulating the drawing and payment of funds, and compiling financial reports. Most of these functions are performed by the Comptroller General's Department of the Ministry of Finance.

The Council of Ministers reviews and approves the budget and appropriations bill in the final stage. The post-auditing of government expenditures is the responsibility of the National Audit Council.

2.2 Water-Related Institutions

The water-related institutions are analyzed and discussed hereunder.

Institution

The responsibility of implementing the national policy concerning water management is vested mainly on the following 20 agencies of the central government of Thailand, which include state enterprises, and also on the Bangkok Metropolitan Administration. As for the committee essential to water management, there exists the National Water Resources Committee whose function is described later.

(1) Ministry of Agriculture and Cooperative (MAC)

(a) Royal Irrigation Department (RID)

(b) Agricultural Land Reform Office (ALRO)

(c) Department of Fisheries (DF)

(d) Royal Forest Department (RFD)

(2) Office of the Prime Minister (OPM)

(a) Electricity Generating Authority of Thailand (EGAT)

(3) Ministry of Interior (MOI)

(a) Local Administration Department (LAD)

(b) Department of Public Works (DPW)

(c) Office of Accelerated Rural Development (OARD)

(d) Metropolitan Waterworks Authority (MWA)

(e) Provincial Waterworks Authority (PWA)

(4) Ministry of Communications (MOC)

(a) Meteorological Department (MD)

(b) Harbour Department (HD)

(c) Port Authority of Thailand (PAT)

(5) Ministry of Industry (MIn)

(a) Department of Industrial Works (DIW)

(b) Department of Mineral Resources (DMR)

(6) Ministry of Science, Technology and Energy (MSTE)

(a) National Energy Administration (NEA)

(b) National Environment Board (NEB)

(7) Ministry of Defense (MOD)

(a) Hydrographic Department (HgD), Royal Thai Navy

(8) Ministry of Public Health (MPH)

(a) Department of Health (DOH)

(9) Bangkok Metropolitan Administration (BMA)

Most of the water-related projects in provincial areas are executed by the agencies mentioned above, either directly or through their regional branch offices. Provincial Governments have many provincial offices whose staff are dispatched by the central government to perform public services including water supply and flood fighting for the province.

Function

Water-related agencies are undertaking significant activities in flood control, irrigation, hydroelectric power generation, navigation, water supply, environmental control and fisheries. Historically, the agencies execute projects assigned to each of them from the limited perspective of their own objectives, plans and capabilities to serve their special interests. The National Water Resources Committee in which the Director of RID is the Committee Secretary was established in 1987 for the purpose of coordinating plans for the development, arrangement and use of water resources of the Ministries, Bureaus and Departments concerned.

(1) Flood Control

The Royal Irrigation Department (RID) implements water flow control and drainage works for the agricultural areas in consideration of the effect to Bangkok and the provincial urban areas. Drainage works for the Bangkok metropolitan area are executed by the Department of Drainage and Sewerage (DDS) of the Bangkok Metropolitan Administration (BMA). For the Provincial Governments, the Department of Public Works (DPW) provides consulting services and executes the construction of pumping stations for drainage works, while the Local

Administration Department (LAD) manages flood fighting. The Electricity Generating Authority of Thailand (EGAT) and the Meteorological Department (MD) execute flood forecasting in a part of the Chao Phraya River Basin.

(2) Irrigation

The RID executes the construction of almost all irrigation projects in Thailand. The Agricultural Land Reform Office (ALRO) and the Office of Accelerated Rural Development (OARD) carry out some small scale irrigation projects in rural areas for their own purposes.

The National Energy Administration (NEA) undertakes some pump irrigation projects to promote the utilization of energy in the economic development of the rural areas. The Department of Public Works (DPW) executes consultancy services on demand of provincial governments.

(3) Hydroelectric Power

The Electricity Generating Authority of Thailand (EGAT) undertakes the planning and constructing of almost all hydroelectric power projects. The NEA also implements the planning of hydroelectric power generation and the harnessing of other forms of energy, and constructs small scale hydroelectric power plants.

(4) Navigation

The Harbour Department (HD) has control on dredging and maintenance of waterways in Thailand. The Port Authority of Thailand (PAT) also do it as a part of the management of some ports. The Hydrographic Department (HgD) under the Royal Thai Navy provides hydrographic information and tidal prediction services to related agencies.

(5) Water Supply

Water supply development for the metropolitan and provincial areas are carried out by the Metropolitan Waterworks Authority (MWA) and the Provincial Waterworks Authority (PWA), respectively. Groundwater resources in provincial areas have been developed by the Department of Mineral Resources (DMR), the Department of Health (DOH), the OARD and the DPW for their own purposes.

(6) Environment

The National Environment Board (NEB) is the agency responsible for checking, surveying and improving of water quality in streams. The DOH manages drinking water and the Department of Industrial Works (DIW) has control over wastewater from factories. The RID, the Royal Forest Department (RFD) and the Department of Fisheries (DF) also make observations on water quality for agricultural products, wildlife and fisheries, respectively.

(7) Fisheries

The Department of Fisheries (DF) manages fishery resources.

Functional Analysis

The activities of the foregoing agencies related to water management are summarized in Table 9-1. The circles in the table represent the level of activity and responsibility of the individual agencies according to project purpose. Duplication of functions are potential causes of inefficiency and conflict, as well as deficiency in performance.

The inefficient use of manpower and funds is apparent in a situation, with regard to irrigation in the Chao Phraya River Basin by Pasak River, i.e., RID has executed the planning and construction in the upper and lower reaches, and the NEA has done it in the middle reaches.

The potential for conflict exists in a situation where several agencies carry on planning projects for their own purposes in the same river basin. Deficiency in performance of projects is found as a situation in which no agency has clearly defined national responsibility for developing comprehensive flood control measures. The National Water Resources Committee exists to solve these problems.

2.3 Institutions on Flood Control and Forecasting

There is no existing institution carrying out integrated and comprehensive flood control including flood forecasting in Thailand. However, a few committees are concerned in flood defense, and several agencies execute related activities in the Chao Phraya River Basin such as hydrological observation and analysis, flood forecasting, flood fighting, river improvement and water flow control of the main stream, and drainage works, as shown in Table 9-2.

The related functions and analysis of these committees and executing agencies are briefly described herein, while the organization charts of the related institutions are presented in Figs. 9-2 to 9-14. For reference, an outline of flood forecasting in Japan with the flood forecasting system in Tone River as an example is provided as APPENDIX.

Committees

(1) Civil Defence Committee

The Civil Defence Act of Thailand stipulates that every civilian and military unit concerned shall cooperate and be ready at all times to effectively execute defence against any public disaster and any action of destruction. Policy determination and major decision-making concerning the protection and relief of damage caused by natural disasters and any action causing destruction to properties of the people or the state are implemented by the Civil Defence Committee,

which was created in 1979 in accordance with the Civil Defence Act.

After a severe damage, especially those caused by flood, fire, etc., the Committee executes some countermeasures and provides financial assistance to victims in accordance with the information and data compiled by the Local Administration Department (LAD) of the Ministry of Interior, which acts as Secretariat of the Committee.

(2) Bangkok Metropolitan Region Development Committee

The Committee undertakes policy determination and planning with regard to flooding problems, traffic problems, housing development, etc., in the Bangkok Metropolitan Region (BMR) where Bangkok Metropolis and the five provinces of Nonthaburi, Samut Prakan, Nakhon Pathom, Pathum Thani and Samut Sakhon are located. The Committee was created in 1986 by the order of the Prime Minister and was organized to expand the area of responsibility of the Bangkok Metropolitan Region Flood Protection Committee which was established after the flood in 1983.

For the purposes of flood protection, a Sub-Committee and its Technical Coordination Center have been established. The Secretariat of this Sub-Committee is the Department of Drainage and Sewerage (DDS) under the BMA which has the responsibility to collect some informaiton concerning floods. Policy decisions concerning flood problems in BMR is not tasked mainly with the Civil Defence Committee but also to the BMR Development Committee and its Sub-Committee.

Executing Agencies

(1) Royal Irrigation Department (RID)

RID executes hydrological observation and analysis for irrigation projects and the natural stream in the whole river basin, although it does not undertake flood forecasting at present. With regard to flood control, improvement of the river channel, water flow control, drainage works and flood fighting are executed for damage mitigation of agricultural products. However, these activities and the development of dams and retarding basins have not been implemented comprehensively for flood mitigation in the river basin.

(2) Meteorological Department (MD)

MD observes hydrological data for flood prediction and weather forecast in the whole Chao Phraya River Basin. Flood forecasting on the Pasak River in the Chao Phraya River Basin is carried out as one of the meteorological information services. The predicted data in the form of a weekly weather report is furnished to LAD for purposes of flood defense.

(3) Electricity Generating Authority of Thailand (EGAT)

EGAT controls the discharge of major dams on tributaries of the Chao Phraya River for the hydroelectric power supply. Flood forecasting on the Chao Phraya River with hydrological data collection from agencies such as RID (discharge data), MD (rainfall data) and the Hydrographic Department (tidal data) is carried out, and the results are informed to RID and the DDS of BMA on demand in the flood season. However, there is no organizational framework as to the dissemination of results. Hydrological observations for the discharge control of dams are executed around the dams.

(4) Harbour Department (HD)

HD executes dredging and maintenance of waterways on the Chao Phraya River upstream of the Krungthep Bridge. It observes water level data for navigation.

(5) Port Authority of Thailand (PAT)

PAT carries out dredging and maintenance of waterways on the Chao Phraya River between the Krungthep Bridge and 20 km to the sea from the river mouth. It observes water level for navigation.

(6) Local Administration Department (LAD)

LAD acts as the Secretariat of the Civil Defence Committee, and it is responsible for conducting civil defense, including flood defense, either before, during or after the disaster, especially in provincial areas, with the cooperation of other agencies concerned.

Information on disasters such as flood, earthquake, fire, etc., is transmitted officially from the news sources through LAD which has a radio network with the provincial and district governments to the Civil Defence Committee.

(7) Department of Public Works (DPW)

With regard to drainage works, DPW undertakes consulting services and the construction of pumping stations in accordance with the demand of provincial governments.

(8) Bangkok Metropolitan Administration (BMA)

The Department of Drainage and Sewerage (DDS) of BMA is responsible for drainage, including the improvement of the mainstream of the Chao Phraya River in Bangkok. For the purpose of flood protection including flood fighting in Bangkok, DDS has established the Flood Protection

Center which was created in 1973 as a temporary organization in the rainy season.

DDS observes hydrological data and collects some hydrological data from agencies like RID (discharge data), MD (rainfall data), EGAT (flood prediction data) and Hydrographic Department (tidal data), for drainage works and flood protection.

(9) Provincial Governments (PG)

Provincial Governments execute drainage works and flood fighting, especially in urban areas. Provincial Governments have little capability in terms of major drainage works; therefore, they turn for assistance to RID and DPW.

With regard to flood fighting, the provincial administration office under each Provincial Government, where officers are dispatched from LAD, manages flood fighting. This office has an annual budget of approximately 1.0 million bahts for civil defense which includes flood fighting.

Organizational Analysis

The following comments are made on the organizational aspects of flood control and forecasting in the Chao Phraya River Basin.

(1) On flood control, there is no institution and legal framework executing integrated and comprehensive river administration such as water flow control, management of dams, improvement of retarding basin and river improvement. However, the RID executes a more comprehensive flood control compared with the other agencies.

(2) With regard to flood forecasting, no institution comprehensively implements monitoring, controlling,

coordinating and reviewing of flood forecasting such as hydrological observation, its collection, flood prediction and its dissemination. Also, there is no clear relationship and legal framework on coordination among the agencies concerned in flood forecasting such as the EGAT, MD, RID, BMA, LAD and so on.

(3) The LAD is responsible for directing flood fighting activities in Thailand and it supervises them in the provincial urban area due to budgetary constraint, but the comprehensive and systematic control on flood fighting in the Chao Phraya River Basin is not carried out.

3. Organization For Proposed Flood Forecasting System

3.1 Responsible Institution and other Related Institutions on the Proposed Flood Forecasting System

Responsible Institution

The flood forecasting system is an essential prerequisite to any comprehensive flood control project in the Chao Phraya River Basin. The Royal Irrigation Department (RID) is adequately capable as the responsible institution for the proposed flood forecasting system, since it is tasked with a rather comprehensive flood control in the basin compared to other agencies. Presently staffed with around 6,900 officials and 40,000 permanent employees, it has functions related to flood forecasting such as hydrological observation and analysis, and is equipped with a telecommunication system for the purpose. The organization chart of RID is presented in Fig. 9-5.

The functions of the related divisions and regional offices in the Chao Phraya River Basin are briefly discussed herein, together with the staffing of these divisions and a typical regional office. The framework of staff of the related offices are shown in Tables 9-3 to 9-9.

(1) Hydrology Division

As shown in Fig. 9-15, the Hydrology Division has three hydrological field investigation offices in the Chao Phraya River Basin, namely, Chiang Mai, Phitsanulok and Chai Nat.

This division undertakes hydrological observation, analysis and data filing for the investigation and study of hydrological phenomenon in the river basin, especially the mainstream. It is presently staffed with around 100 officials and 640 permanent employees, including the regional field staff.

The above functions include discharge observation, daily collection of weather forecast maps from MD and repair of recording gauges. The study of flood forecasting on the Pasak River is executed together with MD.

(2) O&M Division

This division is in charge mainly of the operation and maintenance of constructed river structures and water flow control in agricultural areas. For these activities, the division collects hydrological data from regional irrigation offices (Nos. 1, 2, 3, 7 & 8) and executes hydrological analysis in irrigation canals. At present, it has around 410 officials and 1,600 permanent employees.

(3) Communications Division

This division executes communication services for RID such as hydrological data transmission between the regional offices and the O&M Division by radio and telephone. Also, it carries out maintenance of communication facilities. At present, this division is staffed with around 30 officials and 310 permanent employees.

(4) Data Processing Division

With the use of a computer system this division does the data processing and filing for RID, including hydrological data filing for the Hydrology Division and the O&M Division, and the maintenance of its computer system. At present, the division has around 20 officials and 20 permanent employees.

(5) Regional Office (Nos. 1, 2, 3, 7 & 8)

As shown in Fig. 9-16, the RID has five (5) regional irrigation offices in the Chao Phraya River Basin, namely, Chiang Mai, Lampang, Phitsanulok, Chai Nat and Lop Buri. These regional offices are tasked with the operation, maintenance and improvement of irrigation projects in the respective regions and their operations include water distribution, drainage works, flood fighting and hydrological data observation for the agricultural area, in cooperation with the O&M Division.

Regional Office No. 7 (Chai Nat) with around 300 officials and 3,870 permanent employees including the 23 project office personnel, and the Chaochet Project Office under this regional office, which is in turn manned by around 20 officials and 260 permanent employees including the 3 branch project office personnel, are presented as examples of a regional office and a project office.

Other Related Institutions

Since hydrological data will be collected from other institutions related to the proposed flood forecasting system in the Chao Phraya River Basin such as the EGAT, MD and PAT, and the predicted flood data will be disseminated to EGAT, BMA and LAD, brief descriptions of the functions of these institutions are presented herein.

(1) Electricity Generating Authority of Thailand (EGAT)

The Meteo-Hydrology Division of the Survey and Ecology Department of EGAT has the main responsibility of observing, collecting and providing information on meteorology, hydrology and hydrography for EGAT and other interested parties.

This division executes flood forecasting, including collection of information on dam control which is managed by the System Operation Department of EGAT, and hydrological data collection from MD, RID and the Hydrographic Department of the Royal Thai Navy.

For the proposed flood forecasting system, RID will collect hydrological data and information on dam control from the Meteo-Hydrology Division of EGAT, and provide this division with the predicted flood data.

(2) Meteorological Department (MD)

The Hydro-Meteorology Division of MD executes flood forecasting and hydro-meteorological observation such as water level and rainfall observation for the purpose of studying hydro-meteorological phenomena. On the other hand, rainfall observation for weather forecasting is carried out by the Meteorological Observations Division, while the Weather Forecast Division executes weather prediction. Weekly weather reports are published by the Climatology Division.

For the proposed flood forecasting system, RID will collect hydrological data from the Hydro-Meteorology Division and the Meteorological Observations Division, and weather information from the Weather Forecast Division.

(3) Port Authority of Thailand (PAT)

The RID will obtain water level data from the Marine Survey Division of the Marine Department of PAT which implements water level observation for navigation.

(4) Department of Drainage and Sewerage (DDS), Bangkok Metropolitan Administration (BMA)

Various information for flood defense are collected by the Technical Division of DDS which is in charge of the Secretarial Group of the Flood Protection Center, a temporary organization of DDS in the rainy season. The organization chart of the Flood Protection Center is described in Fig. 9-13.

For the proposed flood forecasting system, it is desirable for RID to furnish the predicted flood data to this Technical Division.

(5) Local Administration Department (LAD)

The Investigation Procedure and Law Division maintains a radio network with the other divisions of LAD, with other Departments and Ministries, and with all provincial governments. Through this radio network, LAD's Civil Defence Division which is responsible in collecting information on flood and conducting flood protection, especially for provincial areas, is able to communicate with all provincial governments. It is, therefore, desirable for RID to inform the predicted flood data to the Civil Defence Division of LAD.

3.2 Organization for Proposed Flood Forecasting System Based on Existing Facilities (Step 1)

Organizational Setup

The proposed organizational setup is presented in Fig. 9-17. The appropriate administrative structure for the proposed flood forecasting system is formulated based on the existing organization of RID, with the enhancement of some of RID's activities. In this connection, it is desirable that a Flood Forecasting Committee be set up in RID to render decisions on the predicted flood data and thus provide adequate and prompt response for flood fighting. As mentioned in the preceding section, the operation and maintenance of the flood forecasting system will be carried out by the existing divisions in RID such as the Hydrology Division, the O&M Division, the Communications Division, the Data Processing Division and the Regional Offices, in consideration of the required activity described later.

With regard to the other related institutions, meteorological information, scheduled dam discharge volume and some hydrological data will be collected by RID from MD, EGAT and PAT. Predicted flood data will be furnished by RID to EGAT for reference on dam control, and to BMA and LAD for the flood fighting in the metropolitan and provincial areas. Response to inquiries from these related agencies and others interested in the predicted flood data will be made.

Flood Forecasting Committee in RID

The Flood Forecasting Committee shall be authorized to plan and modify the flood forecasting system. It can also decide on the date and time to start the flood forecasting activities in the flood season.

The members of the Committee are shown in Table 9-10. Since the Chairman will manage the flood forecasting activities, it is desirable for him to be conversant on flood control and

flood fighting which are the main objectives of flood forecasting, and be able to coordinate with the related divisions of RID.

The Deputy Director General for Operation and Maintenance may be the chairman, because he is in charge of the O&M Division which is responsible for water flow control and the Regional Offices which undertake drainage works and flood fighting for agricultural areas. Since it is assumed that he is well versed on flood control and considering that he is occupying a respectable position, it is believed that he will be able to coordinate the activities of the related divisions of RID.

As the Secretariat of this committee, the Hydrology Division is believed capable because the primary works on flood forecasting are hydrological analysis and flood prediction. It should be noted that this division undertakes hydrological observation and analysis of the mainstream of the Chao Phraya River, and it is presently making studies on the flood forecasting system.

To supervise the flood forecasting activities, it is desirable that the Directors of the Divisions concerned in the operation and maintenance of the proposed flood forecasting system such as the Hydrology Division, the O&M Division, the Communications Division and the Data Processing Division shall serve as members of the committee. Directors of the Regional Offices (Nos. 7 and 8) shall serve as members upon instructions of the Committee Chairman, depending on the predicted flood area, its scale, etc., because the regional offices are in charge of flood fighting in agricultural areas.

It is also desirable that the Directors of the Project Planning Division and the Design Division shall serve us members of the committee for the purposes of future project planning and protection against floods, respectively. This is because the Project Planning Division is responsible for project monitoring and evaluation in RID, and the Design

Division is familiar with the design and structural stability of riparian structures.

Executing Offices in RID

(1) Required Activities

The main activities required for the Step 1 Flood Forecasting System are observation of hydrological data such as water level and rainfall data, and transmission of hydrological data by radio; collection of hydro-meteorological information by hand such as the scheduled discharge of RID's O&M Division and the weather forecast maps of MD; flood prediction, its dissemination and public response of predicted flood data, related data input and compilation by computer; and, collection and storage of all basic data for the formulation of the flood control plan.

The maintenance of related facilities and training for operation staff are also important. The details on operation and maintenance are presented in Table 9-11.

(2) Assignment of Required Activities

The assignment of the required activities to the related offices is proposed hereunder in consideration of the existing activities concerned. The existing activities and assignment of required activities are tabulated in Table 9-12.

The Hydrology Division shall take the responsibility of hydrological observation, collection of hydro-meteorological information, flood prediction, the collection and storage of all basic data concerning flood control, and the maintenance of gauging stations. The O&M Division shall distribute appropriate information to the public by radio and telephone facilities. The Communications Division shall be

obliged to execute hydrological data transmission and predicted data dissemination by radio, together with the maintenance of telecommunication facilities.

The Data Processing Division shall be responsible for imputing and compiling related data by computer, including maintenance of computer facilities. The Regional Offices shall also be in charge of hydrological data observation.

(3) Framework of Staff

Some engineers and support staff such as hydrologists, computer engineers, civil engineers, etc., have to be stationed for the proposed organization. The framework of the staff in the related offices of RID is presented as reference in Table 9-13.

Related Institution

Several data for the proposed flood forecasting system such as weather prediction, rainfall and water level data and scheduled dam discharge are furnished to RID by MD, EGAT and PAT. Predicted flood data by RID are relayed to EGAT, BMA and LAD. These related institutions and their required activities for the flood forecasting system are tabulated in Table 9-14.

3.3 Organization for Proposed Flood Forecasting System Based on Updated Facilities (Step 2)

Organizational Setup

The proposed organizational setup is presented in Fig. 9-18. An integrated organization to execute the flood forecasting is desirable, because a great number of data has to be analyzed effectively and systematically, and it is better to bring related facilities together. In this context, a Flood Forecasting Center (FFC) which functions as a permanent office for the proposed flood forecasting system in RID is deemed adequate. Cooperation among the proposed Center, the related

offices in RID and other related institutions will be needed to implement the system smoothly.

A Chairman will be needed to manage the Flood Forecasting Center, and an Advisory Committee under the Chairman will be created to evaluate predicted flood data and to promptly provide adequate flood fighting activities.

Operation and maintenance of the flood forecasting system will be imposed on the Administrative Section, the Flood Prediction Section, the Communications Section and the Data Processing Section, in consideration of the required activities that will be mentioned later in detail.

With regard to the other related institutions, information on weather prediction and scheduled discharge released from the main water control structures will be collected from MD and EGAT. The dissemination of predicted flood data will be made to EGAT as reference on dam control and to BMA and LAD for the flood fighting in the metropolitan and provincial areas. Response to inquiries from these related agencies and others concerned will be made.

Chairman

The FFC Chairman must have adequate knowledge on flood control and flood forecasting, and he has to be in a respectable position to be able to coordinate the activities of related offices in RID.

The Chairman shall decide on the date to start activities in the flood season, and shall also be empowered to make plans and decisions on the future improvement of the flood forecasting system, including training of the staff.

Advisory Committee

The members of the Advisory Committee are shown in Table 9-15. The Advisory Committee shall make proposals for the improvement of the flood forecasting system and evaluate calculations on the predicted flood data for adequate and prompt response to flood fighting. In this context, it is deemed appropriate that the Directors of the Hydrology Division, the O&M Division, the Communications Division, the Data Processing Division, and the Design Division which are concerned in hydrological analysis, water flow control, telecommunications system, computer system and design of riparian structures, respectively, shall serve as members of the Committee.

The Director of the Project Planning Division is also desirable to be a member of the Committee in consideration of RID's future plans for flood forecasting and flood control, since this division is in charge of monitoring and evaluation of RID's projects. Directors of the Regional Offices (Nos. 7 and 8) shall serve as members of the Committee upon instructions of the Committee Chairman, in accordance with the predicted flood area and scale, because regional offices are in charge of flood fighting for agricultural areas.

Executing Office under the Flood Forecasting Center in RID

(1) Required Activities

The main activities required of the proposed flood forecasting system are collection by hand and by facsimile (FAX) of hydro-meteorological information such as weather forecast maps of MD and scheduled discharge of RID's O&M Division and EGAT; flood prediction, its dissemination, public response concerning flood prediction, basic data collection for formulation of flood control, compilation by computer and storage of flood control data, and maintenance of the related facilities and system. Details on operation and maintenance are presented in Table 9-16.

(2) Assignment of Required Activities

The required activities mentioned above will be assigned to several sections under the Flood Forecasting Center such as the Administrative Section, the Flood Prediction Section, the Communications Section and the Data Processing Section.

The substations to be installed in Regional Offices (Nos. 1, 2, 3, 7 and 8) for the purpose of inspecting the related telecommunication facilities, and the data management system, shall be administered by the Communications Section. The details of the assignment are shown in Table 9-17.

(3) Framework of Staff

Some engineers and support staff such as hydrologists, computer engineers, communications engineers, etc., have to be stationed for the proposed organization. The framework of the staff in the executing office of the Flood Forecasting Center is presented in Table 9-18.

Related Institutions

Some information concerning weather forecast and scheduled dam discharge are furnished to RID by MD and EGAT. Predicted flood data are disseminated by RID to EGAT, BMA and LAD. These related institutions and their required activities for the flood forecasting system are presented in Table 9-19.

TABLES

Table 9-1. WATER-RELATED AGENCIES IN THAILAND

ACTIVITIES \ AGENCIES		MAC				OPM	MOI					MOC			MIn		MSTE		MOD	MPH	BMA
		RID	ALRO	DF	RFD	EGAT	LAD	DPW	OARD	MWA	PWA	MD	HD	PAT	DTW	DMR	NEA	NEB	HgD	DOH	DDS
DATA COLLECTION & RESEARCH	Flood Control	●				●	●					●									●
	Irrigation	◉	●					●	●								●				
	Hydropower					◉											●				
	Navigation												◉	●					●		
	Water Supply							●	●	◉	◉					●				●	
	Environmental Control	●		●	●										●			◉		●	
	Fisheries			◉																	
PLANNING & DESIGN	Flood Control	●						●													●
	Irrigation	◉	●					●	●								●				
	Hydropower					◉											●				
	Navigation												◉	●					●		
	Water Supply							●	●	◉	◉					●				●	
	Environmental Control	●		●	●										●			◉		●	
	Fisheries			◉																	
CONSTRUCTION	Flood Control	●						●			●										●
	Irrigation	◉	●						●								●				
	Hydropower					◉											●				
	Navigation												◉	●							
	Water Supply							●	●	◉	◉					●				●	
	Fisheries			◉																	
OPERATION & MAINTENANCE	Flood Control	●									●										●
	Irrigation	◉	●						●								●				
	Hydropower					◉											●				
	Navigation												◉	●							
	Water Supply							●	●	◉	◉					●				●	
	Environmental Control	●		●	●										●			◉		●	
	Fisheries			◉																	

Note: ◉ Major Activity ● Minor activity

Table 9-2. AGENCIES EXECUTING FLOOD CONTROL AND FORECASTING IN THE CHAO PHRAYA RIVER BASIN

Agencies	Hydrological Observation & Analysis	Flood Forecasting	Flood Fighting	River Improvement & Water Flow Control of Mainstream	Drainage Works
Royal Irrigation Department	●		•	●	●
Meteorological Department	●	•			
Electricity Generating Authority of Thailand	•	•			
Bangkok Metropolitan Administration	•		•	•	•
Harbour Department	•				
Port Authority of Thailand	•				
Local Administration Department			•		
Department of Public Works					•
Provincial Government			•		•

Note: ● Major Activity, • Minor Activity

Table 9-3(1/2). NUMBER OF PERSONNEL IN THE HYDROLOGY DIVISION OF RID

Office and Designation	Official	Permanent Employee	Total
Director	1	-	1
1. Management Support Branch			
Hydrologist	2	0	2
Support Staff /1	8	12	20
2. Equipment Procurement and Precision Control Branch			
Civil Engineer/Technician	2	0	3
Electrical Engineer/Technician	1	0	1
Mechanical Engineer/Technician	3	0	3
Hydrologist/Technician	0	0	0
Support Staff /1	4	23	27
3. Sediment Investigation Branch			
Hydrologist/Technician	9	0	9
Support Staff /1	0	1	1
4. Data Processing and Statistics Branch			
Hydrologist/Technician	15	0	15
Support Staff /1	4	45	49
5. Research and Applied Hydrology Branch			
Hydrologist/Technician	11	0	11
Support Staff /1	0	1	1
6. Hydrological Field Investigation Branch			
Hydrologist	2	0	2
- Upper Northern Region (Chiang Mai) /2			
Hydrologist/Technician	3	0	3
Support Staff /1	3	72	75
- Lower Northern Region (Phitsanulok) /2			
Hydrologist/Technician	2	0	2
Support Staff /1	0	78	78
- Central Region (Chai Nat) /2			
Hydrologist/Technician	2	0	2
Support Staff /1	3	42	45

Table 9-3(2/2). NUMBER OF PERSONNEL IN THE HYDROLOGY DIVISION OF RID

Office and Designation	Official	Permanent Employee	Total
- Upper Northeastern Region			
Hydrologist/Technician	2	0	2
Support Staff /1	1	59	60
- Lower Northeastern Region			
Hydrologist/Technician	2	0	2
Support Staff /1	2	98	100
- Eastern Region			
Hydrologist/Technician	4	0	4
Support Staff /1	2	54	56
- Western Region			
Hydrologist/Technician	3	0	3
Support Staff /1	2	78	80
- Southern Region			
Hydrologist/Technician	3	0	3
Support Staff /1	1	79	80
Total	97	642	739

Note: /1 Consist of Administrative Officers, clerks, draftsmen, drivers, laborers, etc.

/2 Three (3) regional hydrology offices are in charge of the administration of the Chao Phraya River Basin.

Table 9-4(1/2). NUMBER OF PERSONNEL IN THE OPERATIONS AND MAINTENANCE DIVISION OF RID

Office and Designation	Official	Permanent Employee	Total
Director	1	-	1
1. Management Support Branch			
Support Staff /1	27	28	55
2. Engineering Branch			
Irrigation Engineer/Technician	6	0	6
Civil Engineer/Technician	15	0	15
Support Staff /1	4	28	32
3. Revenue Branch			
Civil Engineer	1	0	1
Support Staff /1	16	28	44
4. Irrigated Agriculture Branch			
Irrigation Engineer/Technician	5	0	5
Civil Engineer/Technician	3	0	3
Agronomist/Technician	28	0	28
Agricultural Engineer/Technician	17	0	17
Support Staff /1	8	715	723
5. On-Farm Water Management Branch			
Irrigation Engineer/Technician	32	0	32
Civil Engineer/Technician	3	0	3
Support Staff /1	6	8	14
6. Water Control and Coordination Branch			
Irrigation Engineer/Technician	20	0	20
Civil Engineer/Technician	1	0	1
Hydrologist/Technician	4	0	4
Support Staff /1	1	24	25
7. Improvement and Maintenance Programming Branch			
Irrigation Engineer/Technician	19	0	19
Civil Engineer/Technician	1	0	1
Support Staff /1	3	9	12
8. On-Farm Development Branch			
Irrigation Engineer/Technician	2	0	2
Civil Engineer/Technician	73	0	73
Mechanical Engineer/Technician	5	0	5
Support Staff /1	3	528	531

Table 9-4(2/2). NUMBER OF PERSONNEL IN THE OPERATIONS AND MAINTENANCE DIVISION OF RID

Office and Designation	Official	Permanent Employee	Total
9. Irrigation System Development Project I			
Civil Engineer/Technician	32	0	32
Mechanical Engineer/Technician	3	0	3
Support Staff /1	1	165	166
10. Irrigation System Development Project II			
Civil Engineer/Technician	24	0	24
Irrigation Engineer/Technician	1	0	1
Support Staff	0	32	32
11. Irrigation System Development Project III			
Civil Engineer/Technician	36	0	36
Irrigation Engineer/Technician	4	0	4
Mechanical Engineer/Technician	1	0	1
Support Staff /1	2	37	39
Total	408	1,602	2,010

Note: /1 Consist of Administrative Officers, clerks, draftsmen, drivers, laborers, etc.

Table 9-5(1/2). NUMBER OF PERSONNEL IN THE COMMUNICATIONS DIVISION OF RID

Office and Designation	Official	Permanent Employee	Total
Director	1	-	1
1. Management Support Branch			
Support Staff /1	4	14	18
2. Engineering Branch			
Communications Engineer	5	0	5
Communications Technician	0	3	3
Support Staff /1	0	1	1
3. Services Branch			
Communications Technician	1	0	1
Communications Support Staff	2	234	236
4. Maintenance Branch			
COmmunications Technician	12	0	12
Communications Technician	0	48	48
5. Inventory and Stock Branch			
Support Staff /1	3	9	12
Total	28	309	337

Note: /1 Consist of Administrative Officers, clerks, draftsmen, drivers, laborers, etc.

/2 Detail number of staff directly related to communication works is in the next page.

Table 9-5(2/2). NUMBER OF PERSONNEL IN THE COMMUNICATIONS DIVISION OF RID

	Head Office	Regional Offices											
		1	2	3	4	5	6	7	8	9	10	11	12
Communications Engineer	2	0	0	0	0	0	0	0	0	0	0	0	0
Communications Technician													
- Radio Technician	10	2	1	1	0	1	2	1	2	1	1	2	2
- Telephone Technician	12	2	1	1	1	1	2	1	2	1	1	1	1
- Cable Works Technician	14	0	1	1	1	0	1	1	2	0	1	0	4
Operator													
- Radio	55	6	6	10	6	3	10	5	7	7	8	4	5
- Telephone	15	3	6	2	4	4	6	2	5	4	4	1	5
Total	108	13	15	15	12	9	21	10	18	13	15	8	17

Table 9-6. NUMBER OF PERSONNEL IN THE DATA PROCESSING DIVISION OF RID

Office and Designation	Official	Permanent Employee	Total
Director	1	-	1
1. Management Support Branch			
Support Staff /1	7	4	11
2. System Management Branch			
Computer Engineer/Technician	1	0	1
Support Staff /1	0	0	0
3. System Engineering Branch			
Computer Engineer	1	0	1
Support Staff /1	0	0	0
4. Data Bank Branch			
Computer Engineer	3	0	3
5. Computer Branch			
Computer Engineer	6	0	6
Key Puncher	0	12	12
Total	19	16	35

Note: /1 Consist of Administrative Officers, clerks, draftsmen, drivers, laborers, etc.

Table 9-7. NUMBER OF PERSONNEL IN REGIONAL OFFICE NO. 7 OF RID

Office and Designation	Official	Permanent Employee	Total
Regional Director	1	-	1
1. Management Support Branch	25	85	110
2. Civil Engineering Branch	16	20	36
3. Operation and Maintenance Branch	9	8	17
4. Mechanical Engineering Branch	9	81	90
5. Operation and Maintenance Project Office			
- Phraya Banlu Project	24	164	188
- Chaochet Bang Yihon Project	16	257	273
- Phra Pimon Project	12	149	161
- Chao Phraya Dam Project	9	176	185
- Channasutr Project	22	422	444
- Yang Mani Project	8	299	307
- Borommathat Project	16	296	312
- Thabote Project	10	212	222
- Phonlatep Project	13	195	208
- Samchook Project	18	263	281
- Don Chedi Project	10	156	166
- Phophraya Project	19	333	352
- Pakhai Project	10	227	237
- Bang Ban Project	10	129	139
- Phasi Charoen Project	13	159	172
- Kra Sieo Project	6	124	130
6. Provincial Irrigation Project Office			
- Uthathani Irrigation Project	4	112	116
- Chai Nat Irrigation Project	6	2	8
- Sing Buri Irrigation Project	2	0	2
- Suphan Buri Irrigation Project	5	3	8
- Ang Thong Irrigation Project	2	0	2
- Nonthaburi Irrigation Project	2	1	3
- Samut Sakorn Irrigation Project	2	0	2
Total	298	3,873	4,171

Table 9-8. NUMBER OF PERSONNEL IN THE CENTRAL OFFICE OF REGIONAL OFFICE NO. 7 OF RID

Office and Designation	Official	Permanent Employee	Total
Regional Director	1	-	1
1. Management Support Branch			
Support Staff /1	25	85	110
2. Civil Engineering Branch			
Civil Engineer/Technician	10	0	10
Surveying Engineer/Technician	6	0	6
Support Staff /1	0	20	20
3. Operation and Maintenance Branch			
Irrigation Engineer/Technician	7	0	7
Civil Engineer/Technician	1	0	1
Agricultural Engineer/Technician	1	0	1
Support Staff /1	0	8	8
4. Mechanical Engineering Branch			
Mechanical Engineer/Technician	5	0	5
Electrical Engineer/Technician	4	0	4
Support Staff	0	81	81
Total	60	194	254

Note: /1 Clerk, Surveying Technician, Agricultural Technician, Communications Technician, etc.

Table 9-9. NUMBER OF PERSONNEL IN THE CHAOCHET BANG YIHON PROJECT OFFICE UNDER REGIONAL OFFICE NO. 7

Office and Designation	Official	Permanent Employee	Total
Chief of Project Office (Irrigation Engineer)	1	-	1
1. Administrative Section			
Support Staff /1	1	24	25
2. Engineering Section			
Irrigation Engineer/Technician	3	0	23
Surveying Technician	0	2	2
Construction Technician	0	1	1
Support Staff /1	0	25	25
3. Management and Maintenance Section			
Irrigation Engineer	1	0	1
Agricultural Engineer	1	0	1
Support Staff /1	0	7	7
4. Mechanical Section			
Communications Technician	1	0	1
Support Staff /1	0	17	17
5. Operation and Maintenance Section I (Hua Ngan-Amphur Sena)			
Irrigation Engineer/Technician	2	0	2
Support Staff /1	1	80	81
6. Operation and Maintenance Section II (Amphur Bang Sai-Lod Bua Losing)			
Irrigation Engineer/Technician	2	0	2
Construction Technician	0	1	1
Support Staff /1	0	59	59
7. Operation and Maintenance Section III (Amphur Bang Plama-Song Pi Nang)			
Irrigation Engineer/Technician	2	0	2
Support Staff /1	0	62	62
Total	16	257	273

Note: /1 Driver, skilled field laborers, laborers, clerks, etc.

Table 9-10. MEMBERS OF THE FLOOD FORECASTING COMMITTEE IN RID (STEP 1)

Position in RID	Position in Committee
1. Deputy Director General for O&M	Chairman
2. Director of Hydrology Division	Member and Secretary
3. Director of O&M Division	Member
4. Director of Communications Division	- do -
5. Director of Data Processing Division	- do -
6. Director of Project Planning Division	- do -
7. Director of Design Division	- do -
8. Directors of Regional Offices /1 (Nos. 7 and 8)	- do -

Note: /1 Directors of Regional Offices shall serve as members upon instructions of the Chairman, in accordance with predicted flood area and scale.

Table 9-11(1/2). REQUIRED ACTIVITIES IN RID FOR THE FLOOD FORECASTING SYSTEM IN THE CHAO PHRAYA RIVER BASIN (STEP 1)

Particulars	Required Activities	
	Flood Season	Non-Flood Season
1. Administrative Affairs	Execution of administrative affairs	Execution of administrative affairs
2. Hydrological Data Observation	Execution of hourly or daily observation of hydrological data such as rainfall and water level by automatic recording or non-recording gauge	
3. Hydrological Data Transmission	Daily transmission of hydrological data by radio including scheduled discharge from RID's gauging station and other agencies /1 to RID's head office by radio	Study on improvement of telecommunication system
4. Collection of Hydro-meteoro-logical Information	Daily collection by hand of hydro-meteorological information such as scheduled discharge from O&M Division and weather forecast map from MD /2	Collection from time to time meteorological data of MD /2
5. Flood Prediction	Prediction by computer level at prediction point Evaluation by computer of unsual and/or predicted data	Study on improvement of flood prediction model
6. Dissemination of Predicted Flood Data	Transmission by radio of results of flood prediction to Regional Offices and other related agencies /3	
7. Public Response	Response by radio and/or telephone to inquiries on information of predicted data from related agencies and news source	

Table 9-11(2/2). REQUIRED ACTIVITIES IN RID FOR THE FLOOD FORECASTING SYSTEM IN THE CHAO PHRAYA RIVER BASIN (STEP 1)

Particulars	Required Activities	
	Flood Season	Non-Flood Season
8. Data Input and Compilation by Computer	Input and compilation by computer of hydrological and predicted data	Input and compilation by computer of basic data on flood control including flood forecasting Study on improvement of computer system and the program for data compilation
9. Flood Control Data Collection and Storage	Collection and storage of data for formulation of flood control	Collection and storage of data for formulaiton of flood control
10. Maintenance of Related Facilities	Daily usual inspection of related facilities and surrounding conditions /4	Weekly usual inpsection of related facilities and surrounding conditions
11. Training		Training in operation and maintenance of related facilities and flood forecasting system

Note: /1 MD, PAT and EGAT.

/2 Presently, MD furnishes weather forecast maps to RID on demand.

/3 EGAT, LAD and BMA.

/4 Usual inspection are carried out by the operation staff.

/5 Special inspection covering both external and internal inspections including the change of parts are done by a highly trained engineer. This is carried out monthly, annually, before the flood season, and in emergency situations when an abnormal condition has been detected during the usual inspection.

Table 9-12. ASSIGNMENT IN RID OF REQUIRED ACTIVITIES FOR THE FLOOD FORECASTING SYSTEM IN THE CHAO PHRAYA RIVER BASIN (STEP 1)

	Office	Existing Related Activity	Required Activity
1.	Head Office		
	Hydrology Division	Hydrological data observation and storage to study and analyze hydrological phenomena in the Chao Phraya River; and repair of gauging facilities	Hydrological data observation /1; collection of hydro-metrorological information; flood prediction; data collection and storage on flood control; and inspection of gauging station /2
	O&M Division	Public response on flood and water flow control of Chao Phraya River	Public response on predicted flood data
	Communications Division	Communication services for RID offices and other related agencies by radio and telephone including repair and maintenance	Hydrological data /3 transmission; dissemination of predicted data; and maintenance of telecommunication facilities /4
	Data Processing Division	Processing and compilation of RID's data by computer	Data input and compilation by computer; and maintenance of computer facilities
2.	Regional Offices	Hydrological data observation	Hydrological data observation /1

Note: Administrative affairs and training are performed by all the divisions of RID mentioned above for their respective personnel.

/1 Presently executed by the Hydrology Division and Regional Offices of RID, MD and PAT.

/2 Special inspection of gauging stations under Regional Offices are executed by the Hydrology Division, since there are only a few gauging stations in Regional Offices: one recording raingauge and three non-recording raingauges.

/3 All related hydrological data including those of RID, MD, PAT and EGAT are transmitted by this division.

/4 Maintenance of new telecommunication facilities to be installed in RID, MD, BMA, EGAT, LAD and PAT are carried out by the Communications Division.

Table 9-13. FRAMEWORK OF STAFF IN RID FOR THE FLOOD FORECASTING SYSTEM IN THE CHAO PHRAYA RIVER BASIN (STEP 1)

	Office	Position	Number of Personnel
1.	Head Office		
	Hydrology Division	Chief Hydrologist	1
		Hydrologist	2
		Support Staff	2
		Observer (per gauging Station under the Division) /1	1
		Staff for special inspection /2	2
	O&M Division	Irrigation/Civil Engineer	1
		Support Staff	1
	Communication Division	Chief Communications Engineer	1
		Communications Engineer	1
		Communications Support Staff	3
		Support Staff	1
		Staff for Special Inspection /3	2
	Data Processing Division /4	Chief Computer Engineer	1
		Computer Engineer	1
		Support Staff	1
2.	Regional Offices	Observer (per gauging station under regional offices)	1

Note: /1 Presently stationed.

/2 Special inspection of gauging facilities, including the gauge under Regional Offices, are carried out by a crew of 2 consisting of one mechanical engineer and one support staff, in consideration of monthly inspection, location of gauging station, and number and kind of gauging station: 27 recording gauge stations, 12 vertical staff and 5 non-recording raingauge. Level check of vertical staff gauge are needed from time to time.

/3 Special inspection of telecommunication facilities are carried out by a crew of 2 consisting of one telecommunication engineer and one support staff, in consideration of around 40 telecommunication facilities, monthly inspection and location of facilities.

/4 The computer engineer and support staff concurrently execute special inspection of computer facilities, supposed to be carried out by a crew of 2 consisting of one computer engineer and one support staff.

Table 9-14. RELATED INSTITUTIONS AND REQUIRED ACTIVITIES FOR THE FLOOD FORECASTING SYSTEM (STEP 1)

Related Institution		Required Activity
(1) Electricity Generating Authority of Thailand	Meteo-Hydrology Division of the Survey and Ecology Department	Informs the scheduled dam discharge to RID and gathers the predicted flood data from RID
(2) Meteorological Department	Weather Forecast Division	Furnishes meteorological data such as weather forecast maps to RID /1
	Hydro-Meteorology Division and Meteorological Observations Division	Furnishes the rainfall and water level data to RID
(3) Port Authority of Thailand	Marine Survey Division of the Marine Department	Furnishes the water level data to RID
(4) Bangkok Metropolitan Administration	Technical Division under the Department of Drainage and Sewerage	Receive the predicted flood data from RID
(5) Local Administration Department	Civil Defense Division	Gathers the predicted flood data from RID

Note: /1 Presently, the weather forecast map of MD is furnished to RID on demand.

Table 9-15. MEMBERS OF THE ADVISORY COMMITTEE FOR FLOOD FORECASTING CENTER IN RID (STEP 2)

Position in RID	Position in Committee
1. Chairman of Flood Forecasting Center	Chairman
2. Chief of Flood Prediction Section	Member and Secretary
3. Director of Hydrology Division	Member
4. Director of O&M Division	- do -
5. Director of Communications Division	- do -
6. Director of Data Processing Division	- do -
7. Director of Project Planning Division	- do -
8. Director of Design Division	- do -
9. Director of Regional Offices /1 (Nos. 1, 2, 3, 7 and 8)	- do -

Note: /1 Directors of Regional Office shall serve as members upon instructions of the Chairman, in accordance with predicted flood area and scale.

Table 9-16(1/2). REQUIRED ACTIVITIES OF EXECUTING OFFICES UNDER THE FLOOD FORECASTING CENTER IN RID (STEP 2)

Particulars		Required Activities	
		Flood Season	Non-Flood Season
1.	Administrative Affairs	Execution of administrative affairs	Execution of administrative affairs
2.	Collection of Hydro-meteorological Information	Daily collection by hand and FAX of meterological data and scheduled discharge /1	Collection from time to time of meterological data of MD
3.	Flood Prediction	Prediction by computer of water level at prediction point /2	Study on improvement of flood prediction model
		Evaluation by computer of unusual data and predicted data /2	Evaluation by computer of unusual data
4.	Dissemination of Predicted Flood Data	Dissemination of predicted data to Regional Offices and other related agencies /2, /3	
5.	Public Response	Response by telephone to inquiries on flood prediction from related agencies and news source	
6.	Flood Control Data Collection, Compilation and Storage	Collection of basic data on flood control; compilation of these data by computer; storage of all basic data	

Table 9-16(2/2). REQUIRED ACTIVITIES OF EXECUTING OFFICES UNDER THE FLOOD FORECASTING CENTER IN RID (STEP 2)

Particulars	Required Activities	
	Flood Season	Non-Flood Season
7. Maintenance of Related Facilities and System /4	Daily usual inspection of related facilities and surrounding conditions /5	Weekly usual insepction of related facilities and surrounding conditions
		Special inspection of related facilities /6
		Study on improvement of the telecommunication system
		Study on improvement of computer system and the program for data storage
8. Training		Training on operation and maintenance of related facilities and flood forecasting system

Note: /1 Information and data on weather prediction, scheduled discharge from the main water control structures are collected from MD, RID's O&M Division and EGAT. Presently, MD hands weather forecast maps to RID on demand.

/2 Flood prediction and its dissemination are executed every six hours.

/3 EGAT, LAD and BMA.

/4 Related facilities mean telecommunication facilities such as telemetering, radar and gauge, etc., and data management facilities such as computer, etc.

/5 Usual inspection is carried out by the operation staff.

/6 Special inspection covering both external and internal inspections including the change of parts is done by a highly trained engineer. This is carried out monthly, annually, before the flood season, and in emergency situations when an abnormal condition has been detected during the usual inspection.

Table 9-17. ASSIGNMENT OF REQUIRED ACTIVITIES FOR EXECUTING OFFICES UNDER THE FLOOD FORECASTING CENTER IN RID (STEP 2)

Office	Required Activity
Administrative Section	Administrative affairs
Flood Prediction Section	Collection of hydro-meteorological information; flood prediction; its dissemination; and public response.
Communications /1 Section	Maintenance and study of telecommunication system and facilities such as radar, telemetering and gauging facilities including all related facilities which are administered by substation.
Data Processing Section	Flood control data collection, compilation and storage; and maintenance and study of data management system and facilities such as computer.

Note: /1 Substations of Communications Section will be installed in Regional Offices (Nos. 1, 2, 3, 7 and 8) for the inspection of related facilities.

Table 9-18. FRAMEWORK OF STAFF FOR EXECUTING OFFICES UNDER THE FLOOD FORECASTING CENTER IN RID (STEP 2)

Office	Position	Number of Personnel
Administrative Section	Clerical staff	3
Flood Prediction /1	Chief Engineer	1
	Hydrologist	2
	Support Staff	2
Communications Section		
Head Office /2	Chief Engineer	1
	Communications Engineer	2
	Support Staff	2
Substation /3 (Per Regional Office)	Communications Engineer	1
	Support Staff	1
	Staff for Special Inspection	2
Data Processing Section /4	Chief Engineer	1
	Hydrologist	1
	Computer Engineer	1
	Support Staff	2

Note: /1 Flood prediction and its dissemination in flood season are executed every six hours with 2 groups. One group consists of one hydrologist and one support staff. Other sections' staff would assist in flood season on demand of the Chairman.

/2 Special inspection of telecommunication facilities will be concurrently executed by communications engineer and support staff.

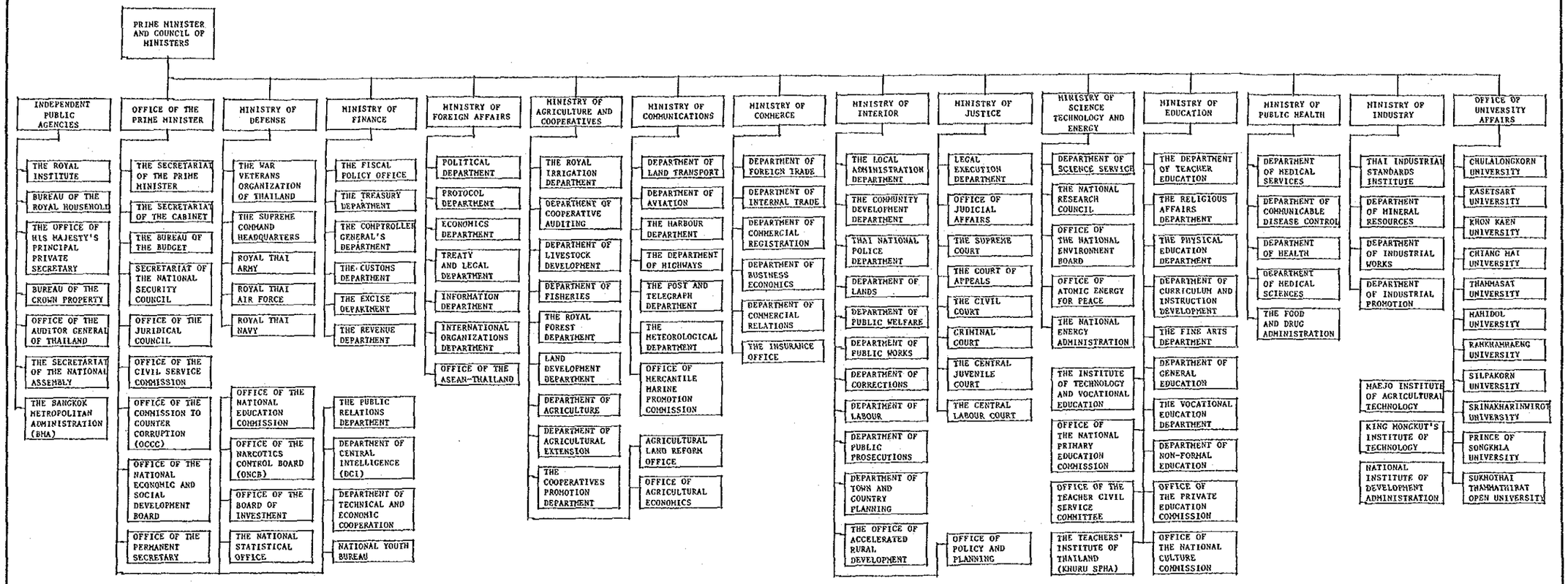
/3 Special inspection of related facilities in each substation such as telemetering, radar and gauging facilities will be carried out by a crew of 2 consisting of one commnications engineer and one support staff, in cooperation with communications engineers of head office and substation.

/4 Special inspection of computer facilities are executed by a crew of 2 consisting of a computer engineer and a support staff. The computer engineer and support staff will concurrently execute special inspection of computer facilities.

Table 9-19. RELATED INSTITUTIONS AND REQUIRED ACTIVITIES FOR THE FLOOD FORECASTING SYSTEM (STEP 2)

Related Institution		Required Activity
(1) Electricity Generating Authority of Thailand	Meteo-Hydrology Division of the Survey and Ecology Department	Informs the scheduled dam discharge to RID and gathers the predicted flood data from RID
(2) Meteorological Department	Weather Forecast Division	Furnishes meteorological data such as weather forecast maps to RID /1
(3) Bangkok Metropolitan Administration	Technical Division under the Department of Drainage and Sewerage	Gathers the predicted flood data from RID
(4) Local Administration Department	Civil Defense Division	Gathers the predicted flood data from RID

Note: /1 Presently, MD furnishes weather forecast maps to RID on demand.



STATE ENTERPRISES

OFFICE OF THE PRIME MINISTER
- THE ELECTRICITY GENERATING AUTHORITY OF THAILAND
- THE TOURISM AUTHORITY OF THAILAND
- THE ZOOLOGICAL PARK ORGANIZATION
- THE SPORTS ORGANIZATION OF THAILAND
- THE MASS COMMUNICATIONS ORGANIZATION OF THAILAND
- THAI REDIFFUSION CO., LTD.

MINISTRY OF DEFENCE
- THE PRESERVED FOOD ORGANIZATION
- THE GLASS ORGANIZATION
- THE TEXTILE ORGANIZATION
- THE BATTERY ORGANIZATION

MINISTRY OF FINANCE
- THE GOVERNMENT LOTTERY BUREAU OF THAILAND
- THAILAND TOBACCO MONOPOLY
- THE BANK OF THAILAND
- THE GOVERNMENT SAVINGS BANK
- THE GOVERNMENT HOUSING BANK
- KRUNG THAI BANK, LTD.
- BANK OF AGRICULTURE AND AGRICULTURAL COOPERATIVES
- THE SYNDICATE OF THAI HOTELS AND TOURISTS ENTERPRISES, LTD.
- NORTHEAST JUTE MILL CO., LTD.
- THE CHOLBURI SUGAR CORPORATION, LTD.
- LIQUOR DISTILLERY ORGANIZATION
- PLAYING CARDS FACTORY
- THE DHIPAYA INSURANCE CO., LTD.
- THAI MARBLE CORPORATION, LTD.

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- MARKETING ORGANIZATION FOR FARMERS
- THE FOREST INDUSTRY ORGANIZATION
- THE DAIRY FARMING PROMOTION ORGANIZATION OF THAILAND
- THE FISH MARKETING ORGANIZATION
- THE GOVERNMENT COLD STORAGE ORGANIZATION
- OFFICE OF THE RUBBER REPLANTING AID FUND
- THE THAI PLYWOOD CO., LTD.
- RUBBER ESTATE ORGANIZATION

MINISTRY OF COMMUNICATIONS
- PORT AUTHORITY OF THAILAND
- THE STATE RAILWAY OF THAILAND
- THE EXPRESS TRANSPORTATION ORGANIZATION OF THAILAND
- THE TELEPHONE ORGANIZATION OF THAILAND
- THE BANGKOK MASS TRANSIT AUTHORITY
- THAI AIRWAYS INTERNATIONAL, LTD.
- THAI AIRWAYS CO., LTD.
- AIRPORTS AUTHORITY OF THAILAND
- AERONAUTICAL RADIO OF THAILAND, LTD.
- THE TRANSPORT CO., LTD.
- THAI MARITIME NAVIGATION CO., LTD.
- THE COMMUNICATIONS AUTHORITY OF THAILAND

MINISTRY OF INTERIOR
- THE METROPOLITAN ELECTRICITY AUTHORITY
- THE PROVINCIAL ELECTRICITY AUTHORITY
- THE METROPOLITAN WATER WORKS AUTHORITY
- THE EXPRESSWAY AND RAPID TRANSIT AUTHORITY OF THAILAND
- NATIONAL HOUSING AUTHORITY
- THE PROVINCIAL WATER WORKS AUTHORITY
- THE MARKETING ORGANIZATION

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- THE PUBLIC WAREHOUSE ORGANIZATION

MINISTRY OF EDUCATION
- THE BUSINESS ORGANIZATION OF THE TEACHER'S INSTITUTE

MINISTRY OF PUBLIC HEALTH
- THE GOVERNMENT PHARMACEUTICAL ORGANIZATION

MINISTRY OF INDUSTRY
- THE INDUSTRIAL ESTATE AUTHORITY OF THAILAND
- THE MINES ORGANIZATION
- OFFSHORE MINING ORGANIZATION
- BANG PA-IN PAPER MILL
- THE ALUM ORGANIZATION
- SUGAR FACTORIES, INC.
- NARAYANA PHAND
- PETROLEUM AUTHORITY OF THAILAND

Fig. 9-1. ORGANIZATION CHART OF THE GOVERNMENT OF THE KINGDOM OF THAILAND

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

FIGURES

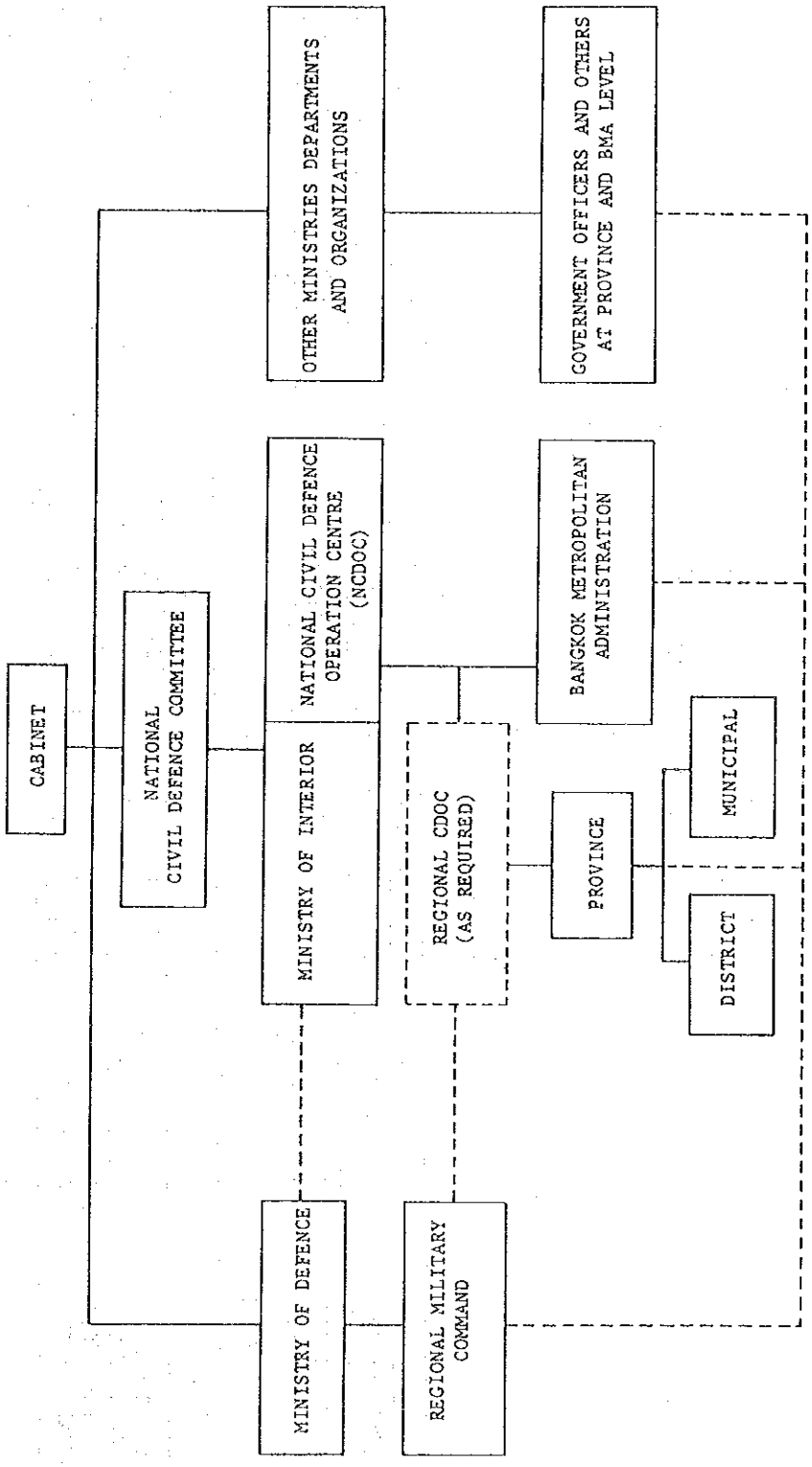

Fig. 9-2. ORGANIZATION CHART OF THE CIVIL DEFENCE COMMITTEE

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

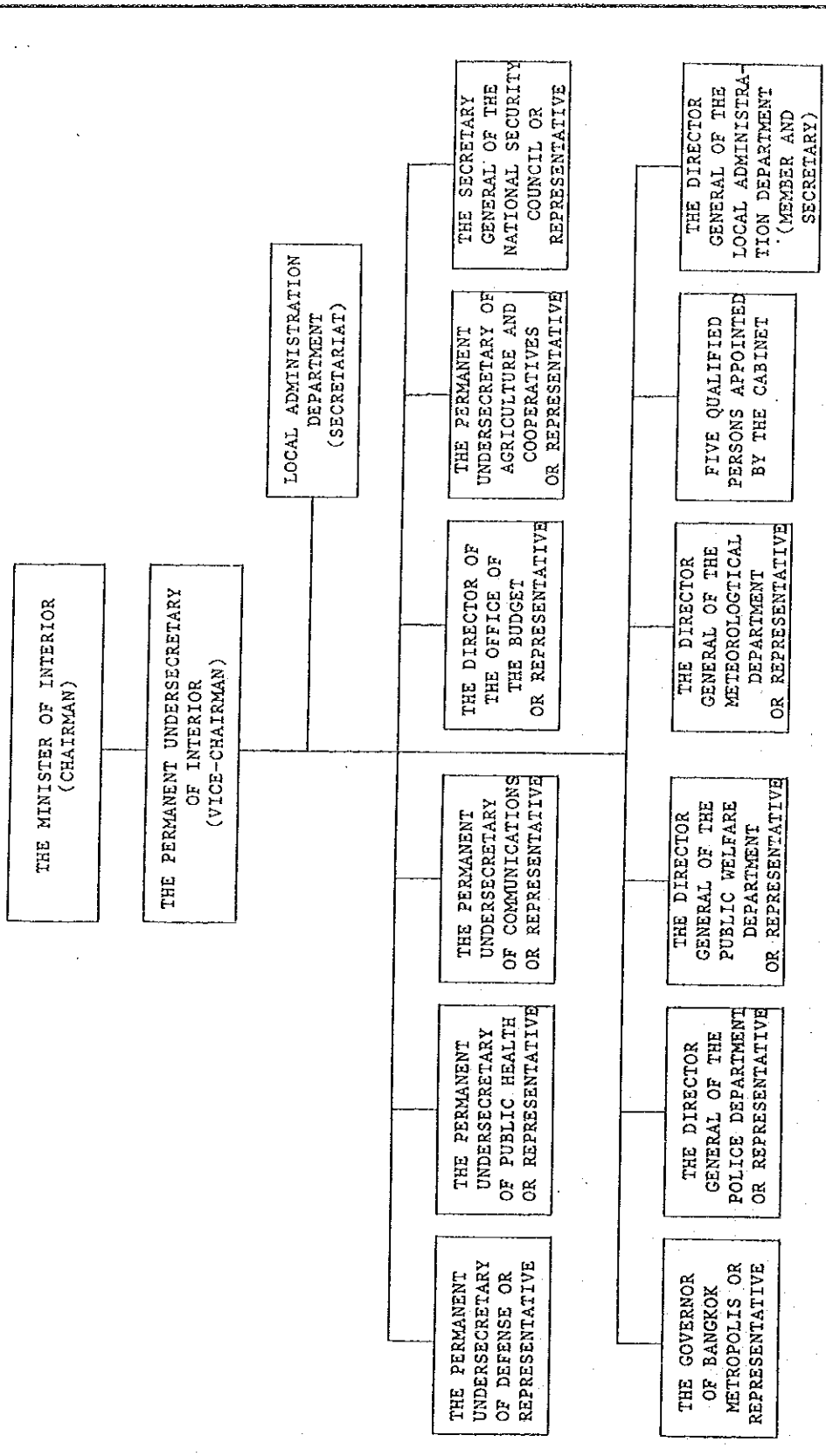

Fig. 9-3. ORGANIZATION CHART OF THE NATIONAL CIVIL DEFENCE COMMITTEE

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

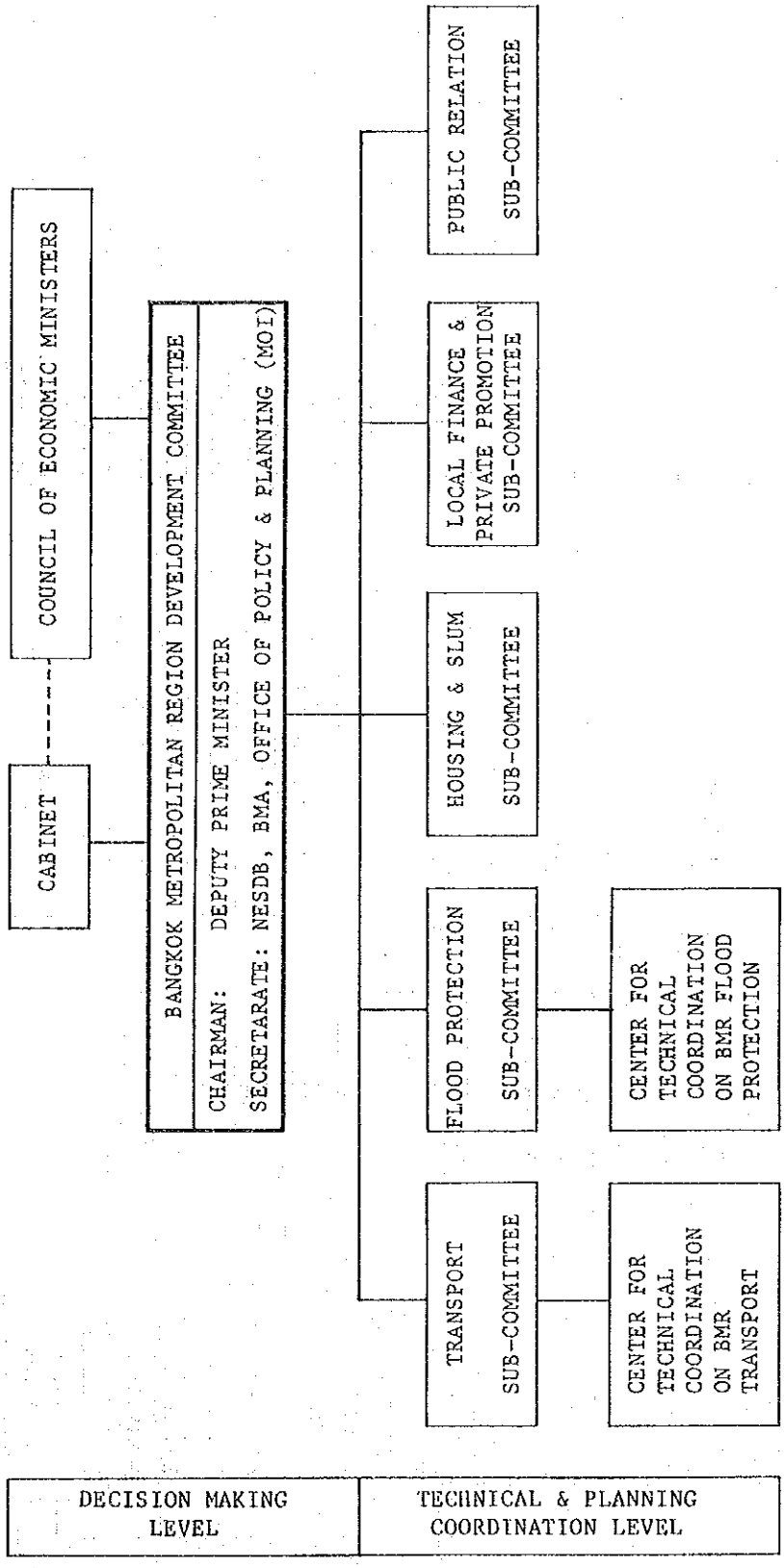

Fig. 9-4. ORGANIZATION CHART OF THE BANGKOK METROPOLITAN REGION DEVELOPMENT COMMITTEE

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

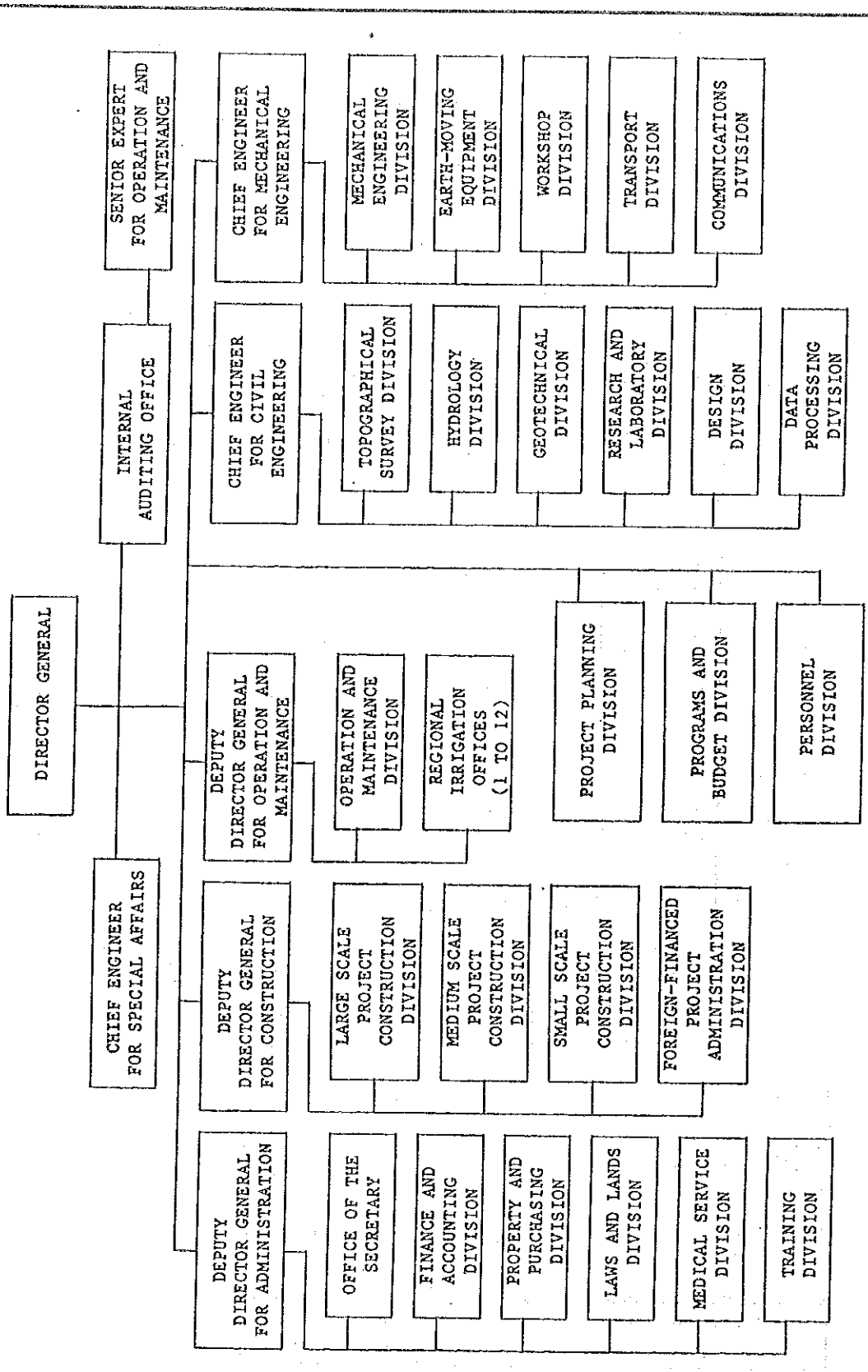

Fig. 9-5. ORGANIZATION CHART OF THE ROYAL IRRIGATION DEPARTMENT

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

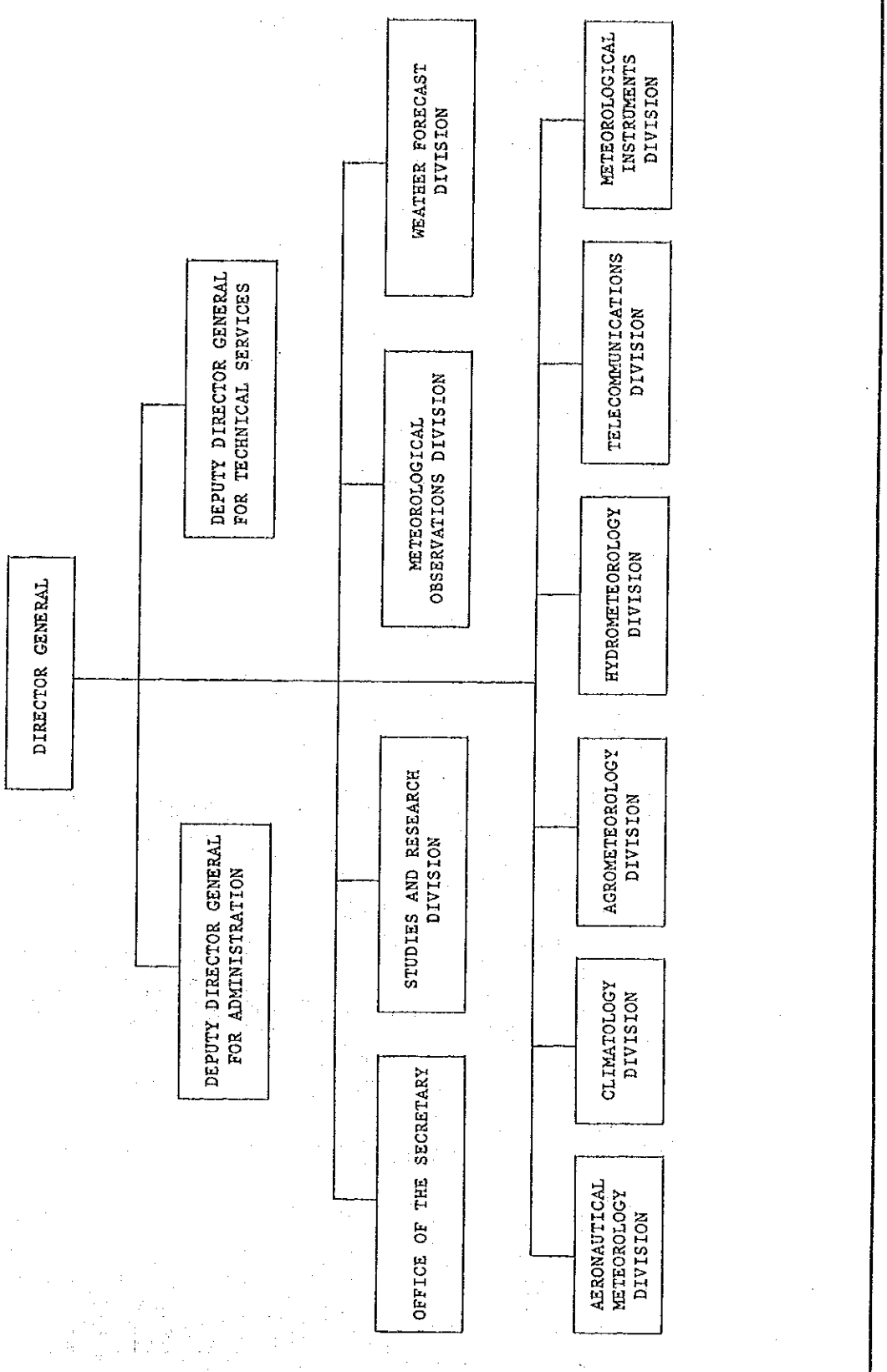

Fig. 9-6. ORGANIZATION CHART OF THE METEOROLOGICAL DEPARTMENT

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

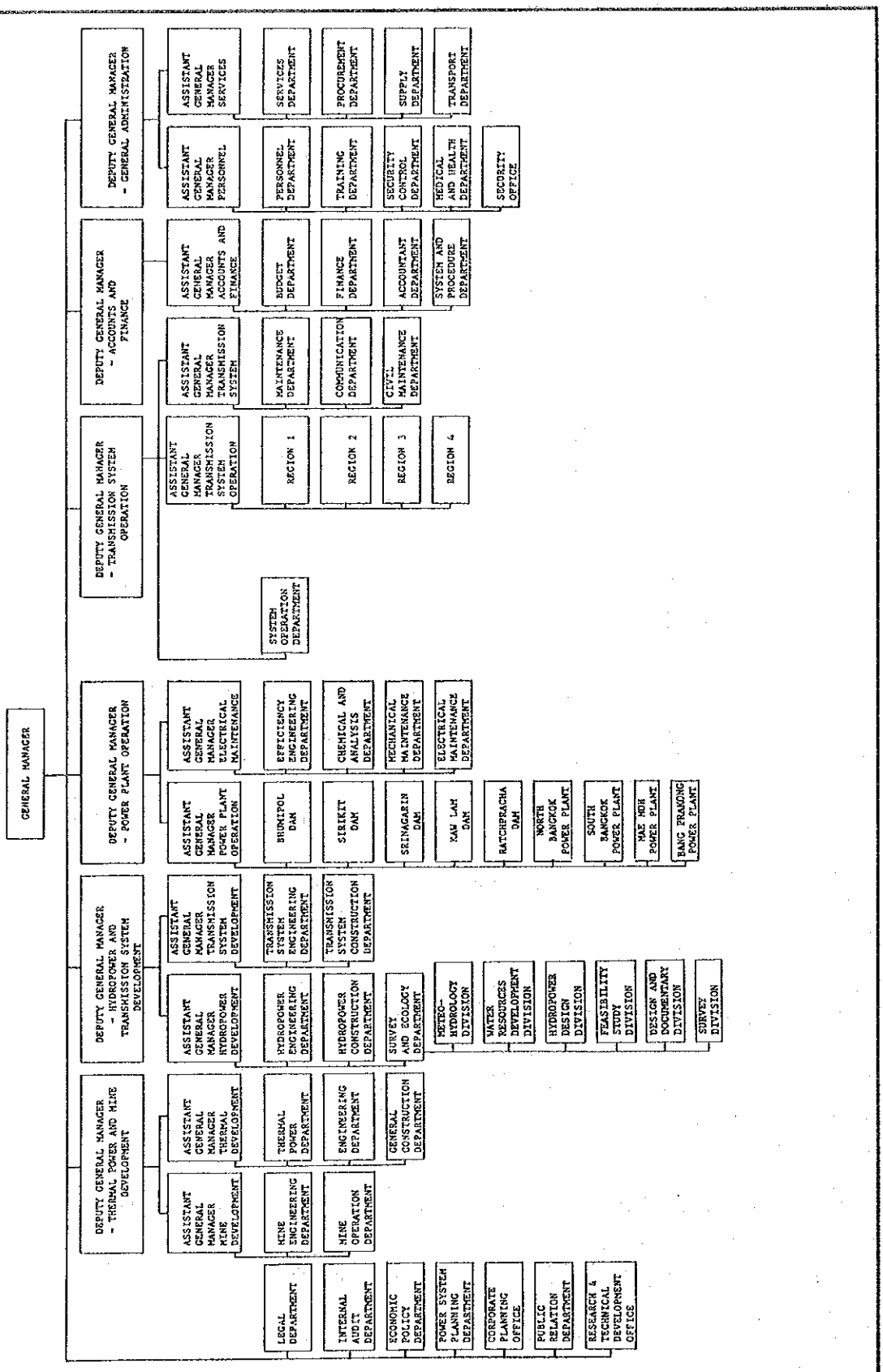

Fig. 9-7. ORGANIZATION CHART OF THE ELECTRICITY GENERATING AUTHORITY OF THAILAND

FLOOD FORECASTING SYSTEM
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JAPAN INTERNATIONAL COOPERATION AGENCY

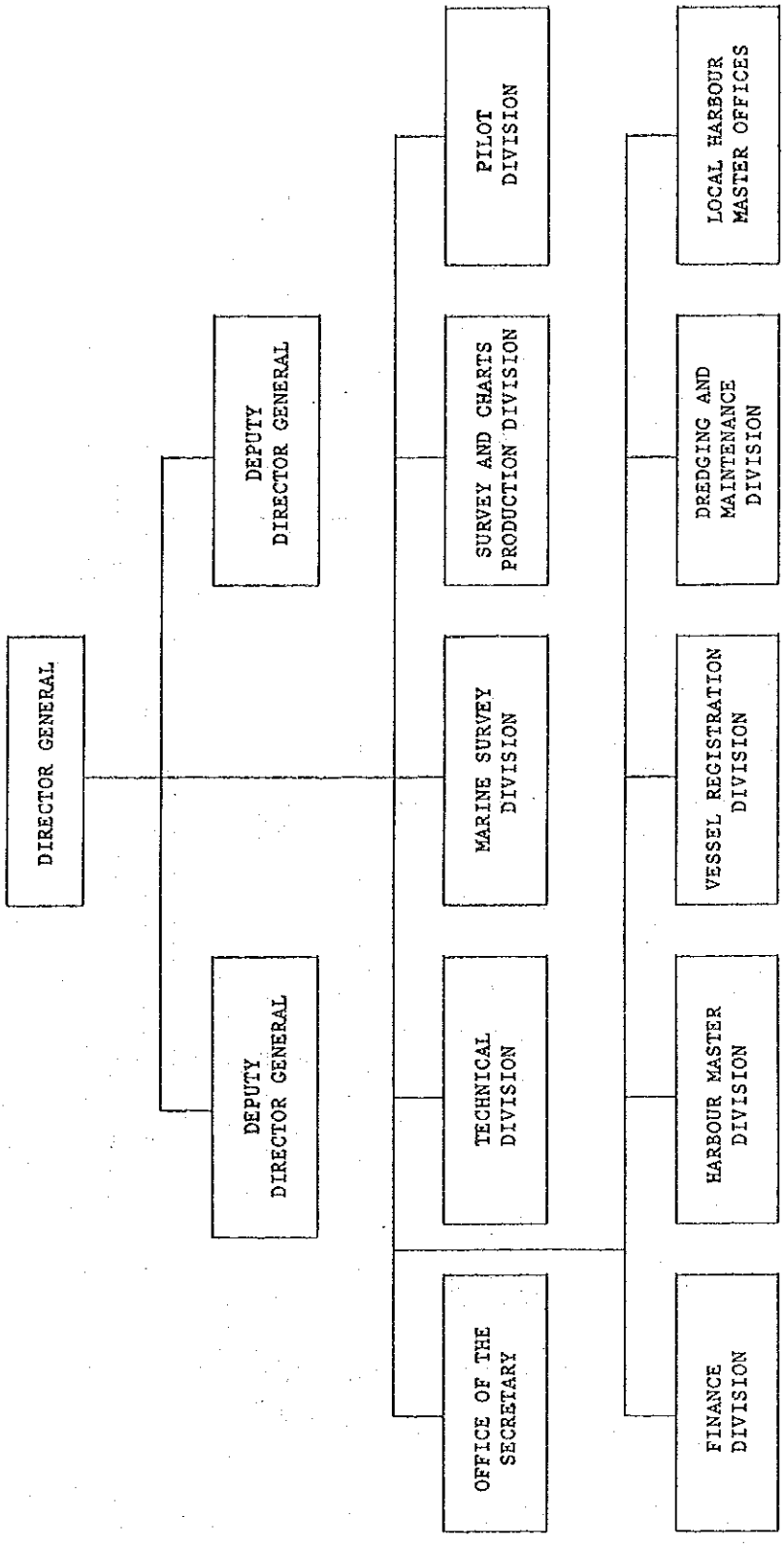

Fig. 9-8. ORGANIZATION CHART OF THE HARBOUR DEPARTMENT

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

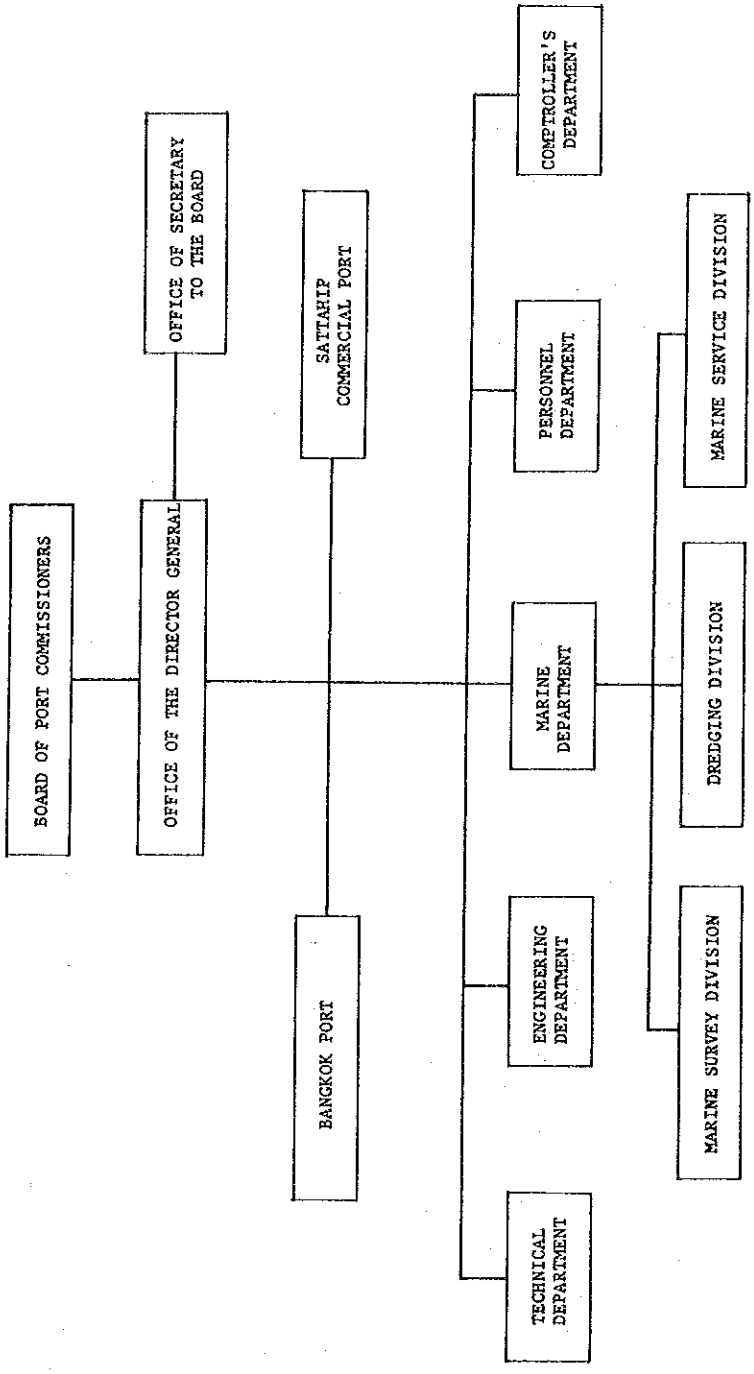

Fig. 9-9. ORGANIZATION CHART OF THE PORT AUTHORITY OF THAILAND

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

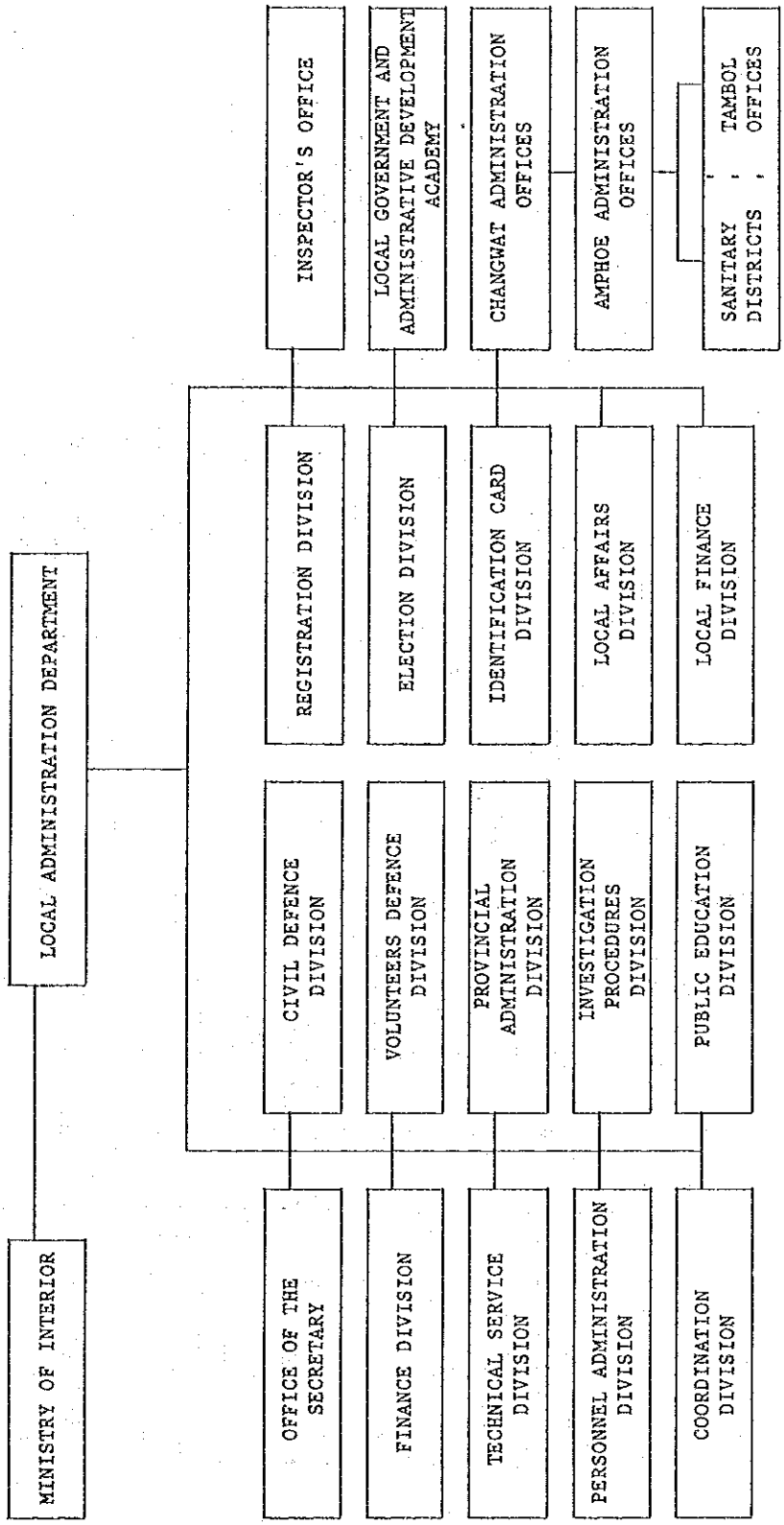

Fig. 9-10. ORGANIZATION CHART OF THE LOCAL ADMINISTRATION DEPARTMENT

FLOOD FORECASTING SYSTEM
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JAPAN INTERNATIONAL COOPERATION AGENCY

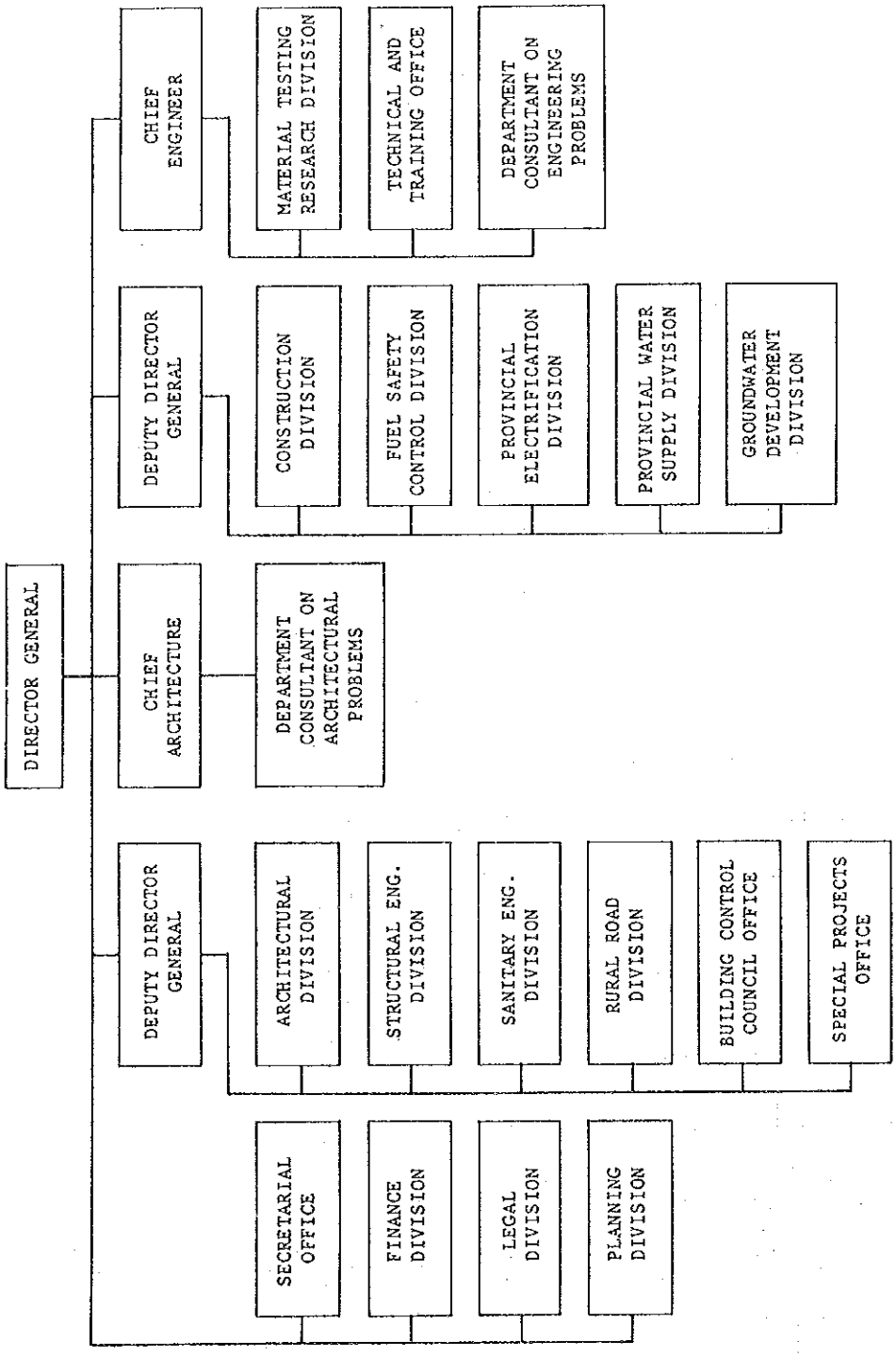

Fig. 9-11. ORGANIZATION CHART OF THE DEPARTMENT OF PUBLIC WORKS

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

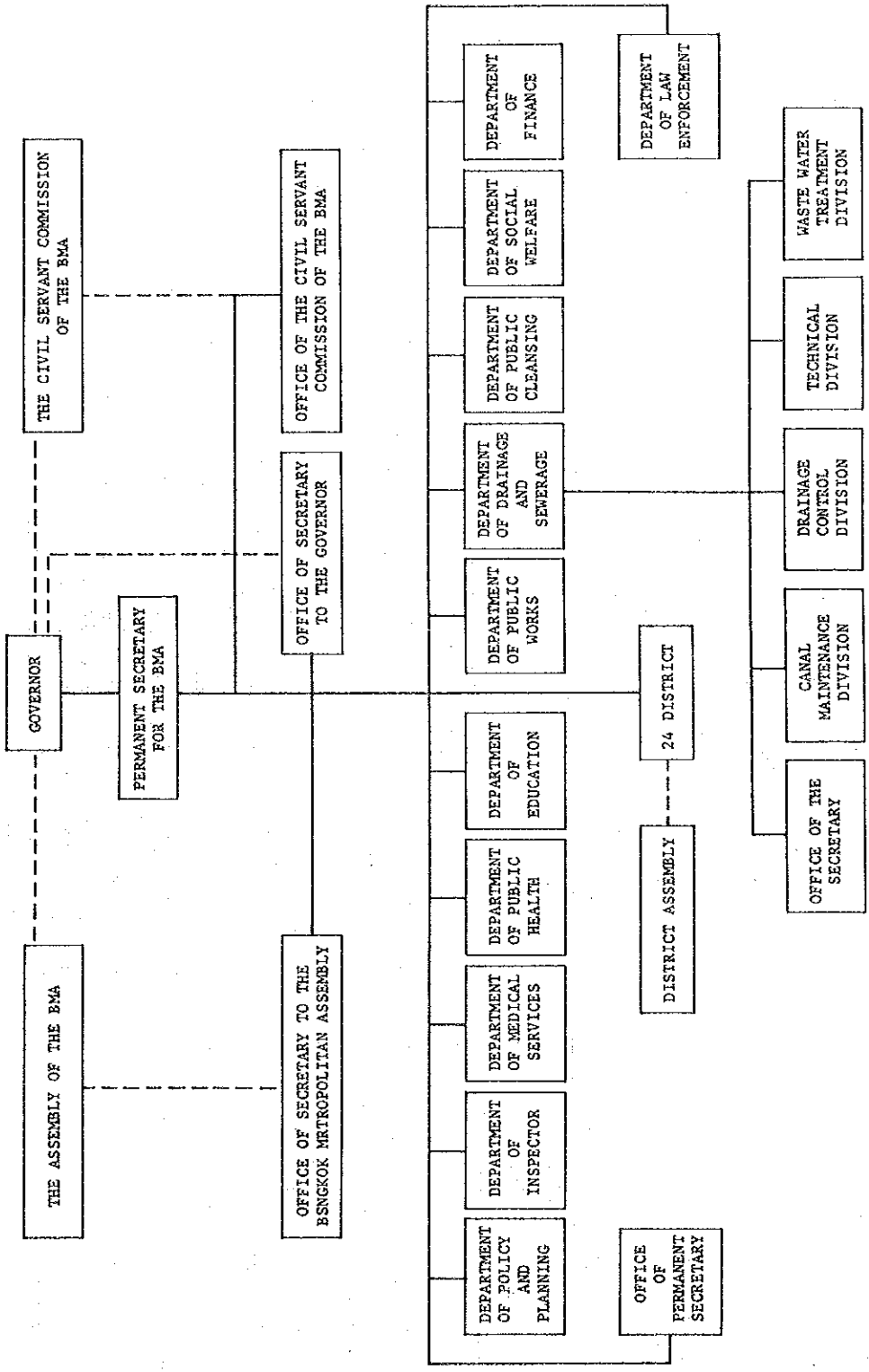

Fig. 9-12. ORGANIZATION CHART OF THE BANGKOK METROPOLITAN ADMINISTRATION

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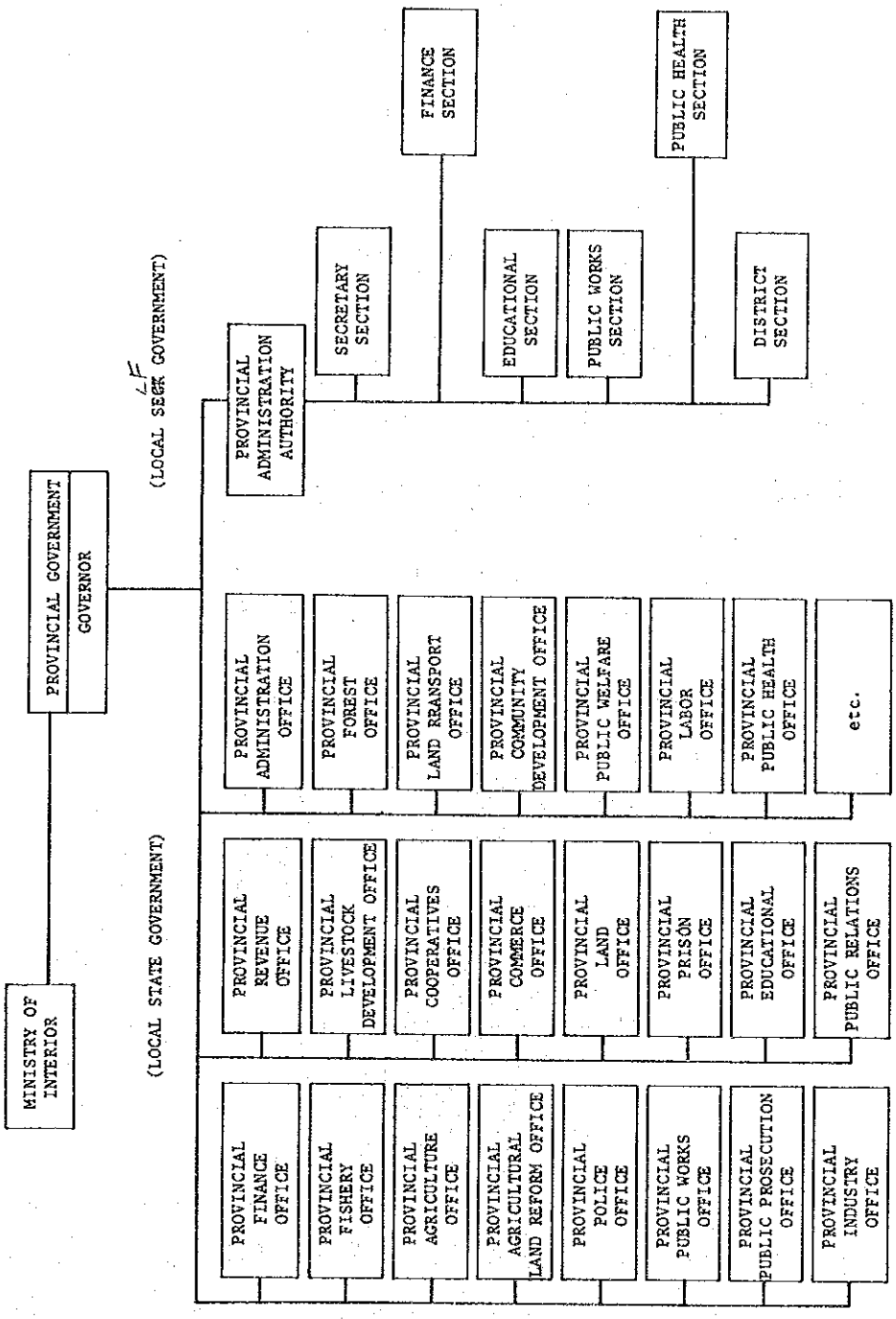

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FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

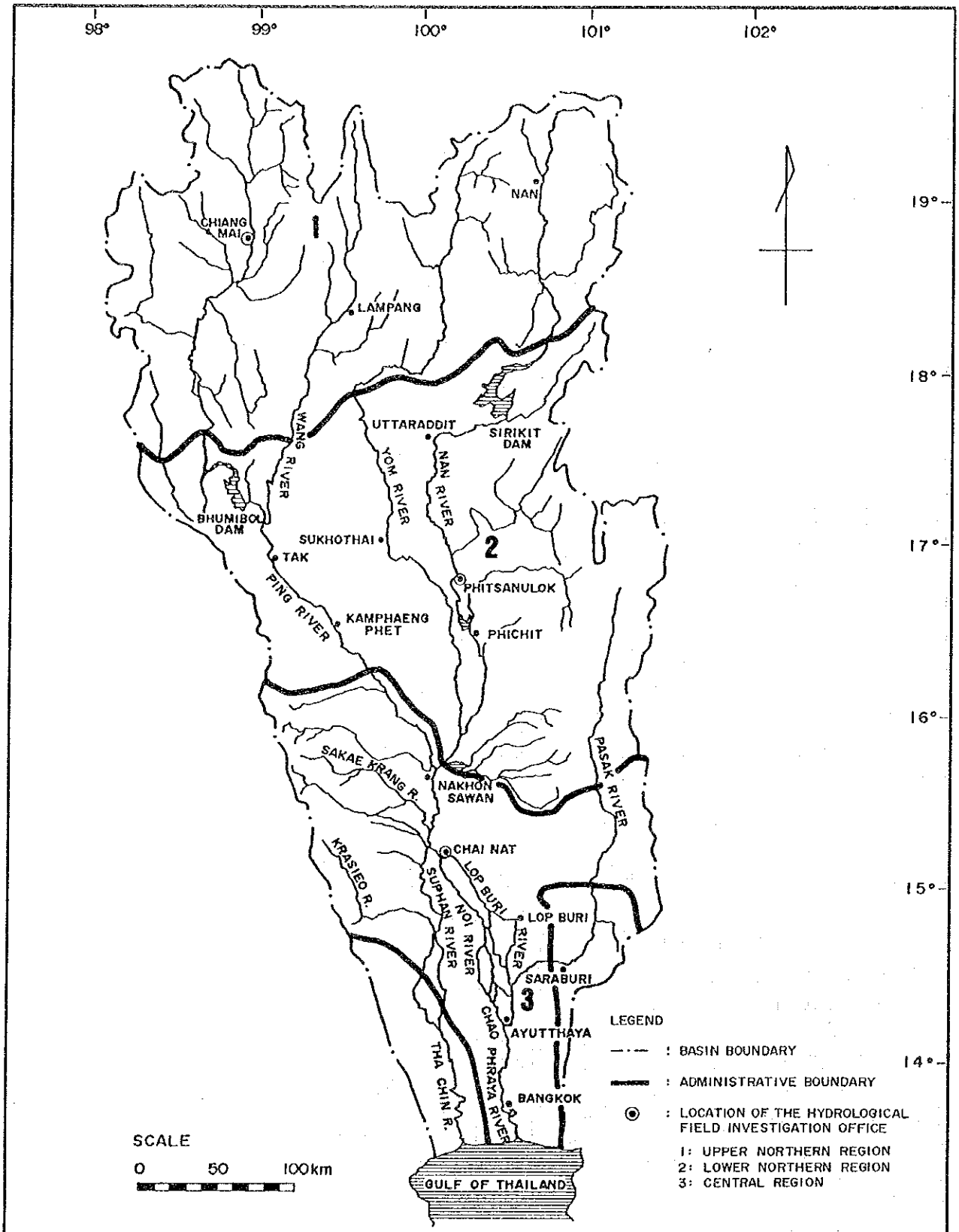

Fig. 9-15. LOCATION MAP OF HYDROLOGICAL FIELD INVESTIGATION OFFICES OF RID'S HYDROLOGY DIVISION

FLOOD FORECASTING SYSTEM
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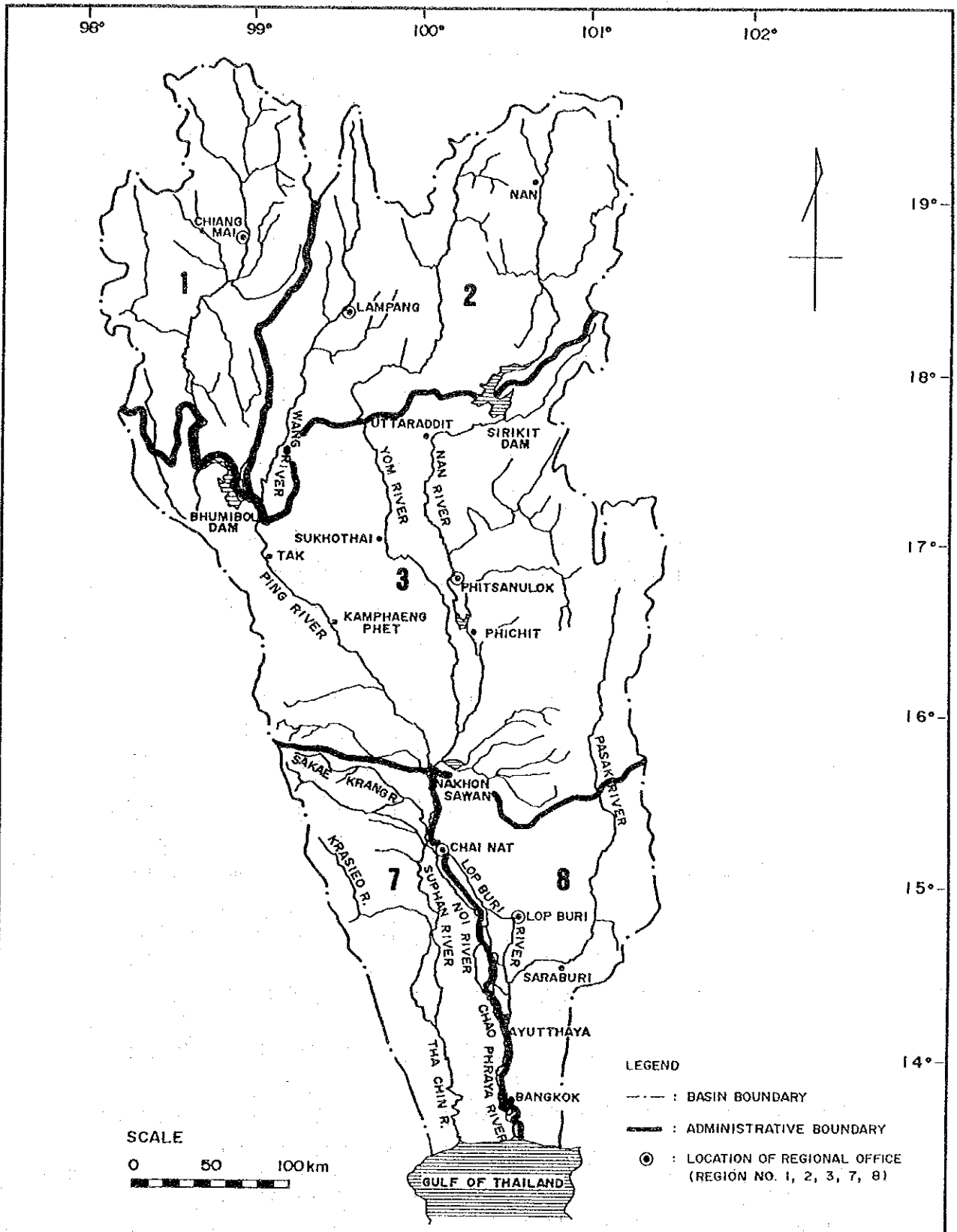

Fig. 9-16. LOCATION MAP OF RID REGIONAL OFFICES

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

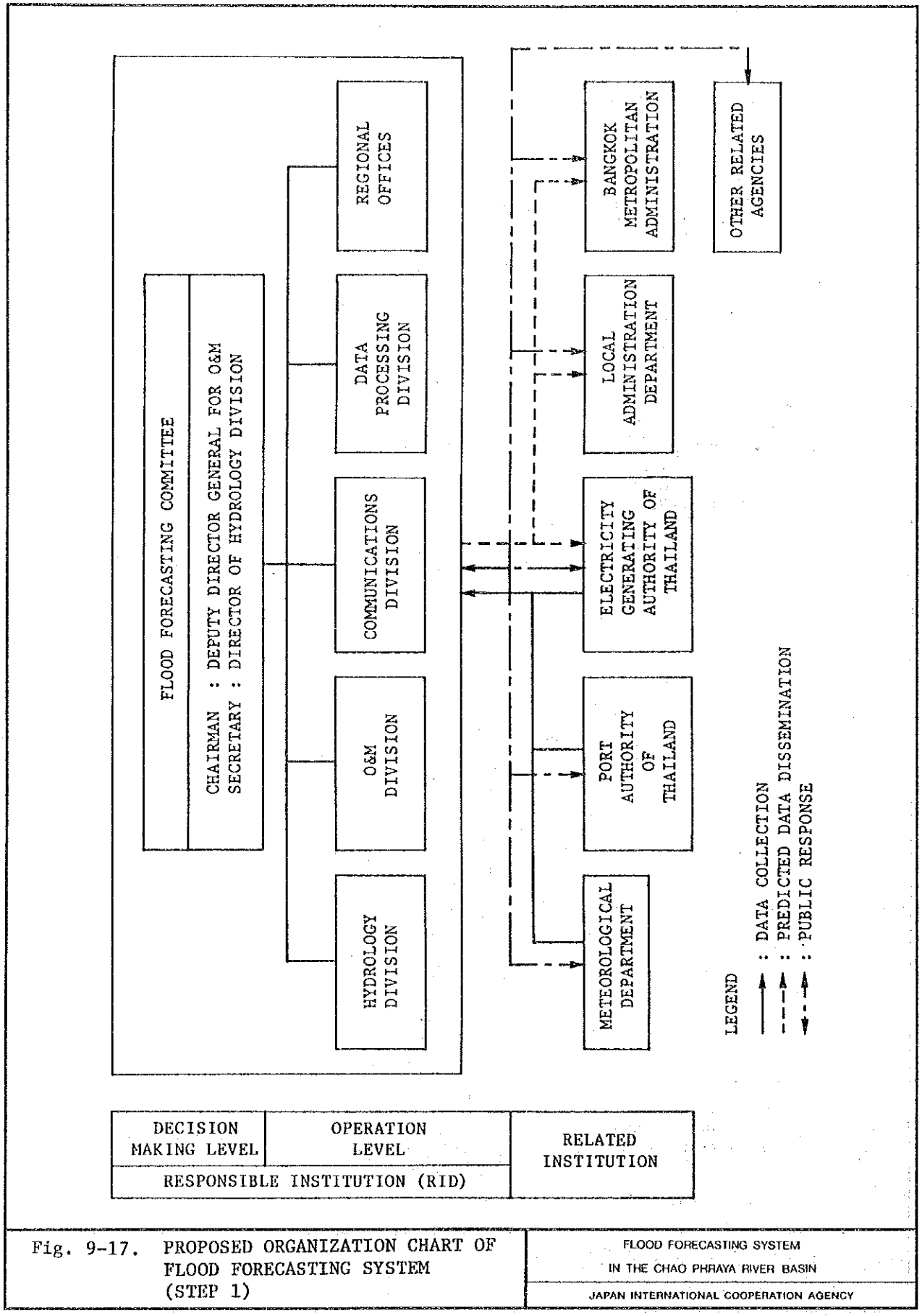

Fig. 9-17. PROPOSED ORGANIZATION CHART OF FLOOD FORECASTING SYSTEM (STEP 1)

FLOOD FORECASTING SYSTEM
IN THE CHAO PHRAYA RIVER BASIN
JAPAN INTERNATIONAL COOPERATION AGENCY

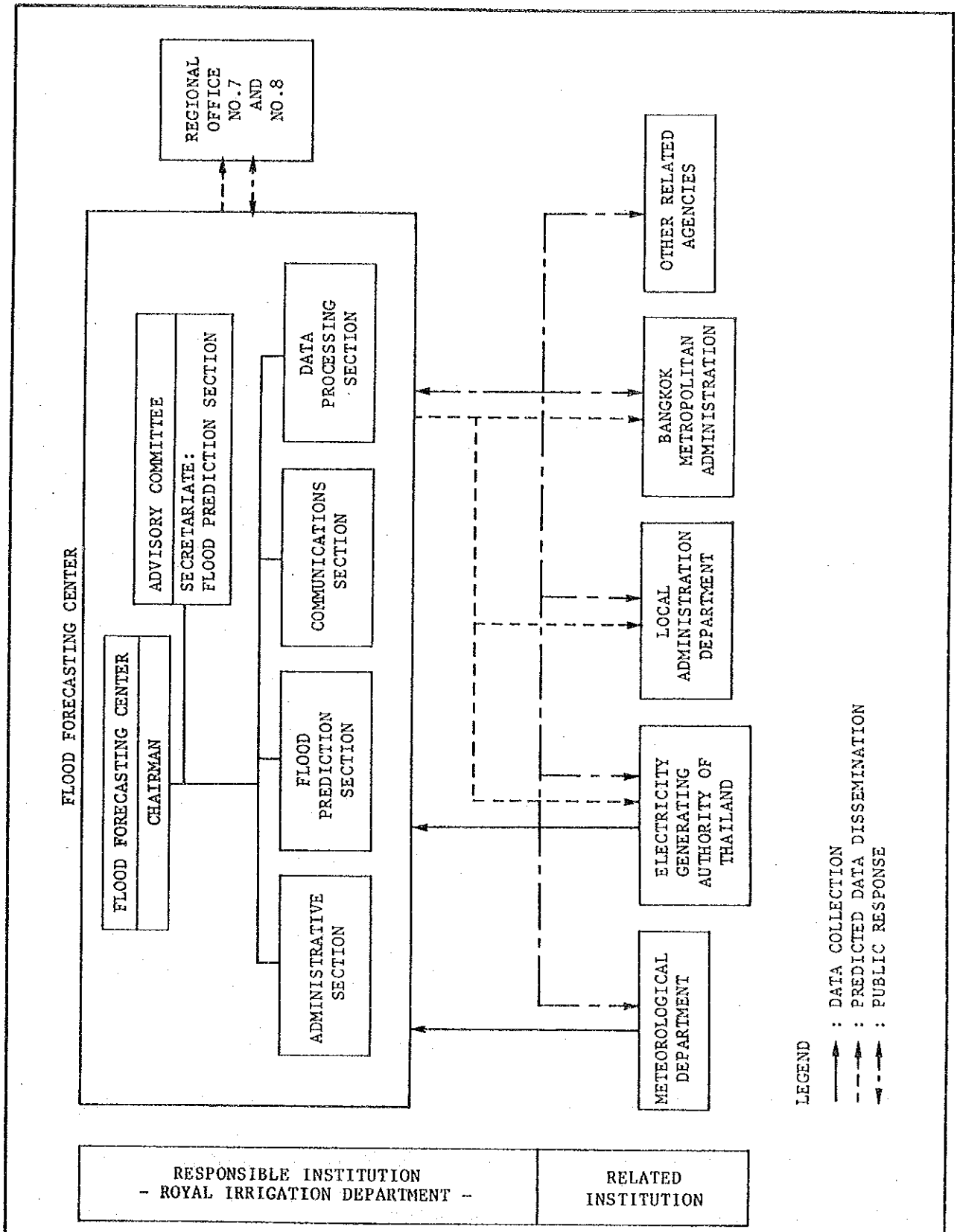

Fig. 9-18. PROPOSED ORGANIZATION CHART FOR FLOOD FORECASTING CENTER (STEP 2)

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APPENDIX

FLOOD FORECASTING SYSTEM IN JAPAN

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FLOOD FORECASTING SYSTEM IN JAPAN

The organizational setup of the Government of Japan is presented in Fig. 9A-1. An outline of flood forecasting in Japan is herein made and the flood forecasting system in the Tone River, which may be useful in the formulation of the flood forecasting system in the Chao Phraya River Basin, is presented as an example.

1. Outline of Flood Forecasting

Flood forecasting in Japan is executed by both the Ministry of Construction and the Meteorological Agency under the Ministry of Transport in accordance with the Flood Defense Law and the Meteorological Service Law (refer to Table 9A-1). In accordance with the Flood Defense Law, the Minister of Construction and the Director-General of the Meteorological Agency are held jointly responsible for flood forecasting on rivers running through two or more prefectures, or those having a large catchment area where flood might cause serious damage to the national economy as a whole designated by the Minister of Construction and the Minister of Transport (17 river basins, refer to Table 9A-2). In other rivers, flood forecasting is executed by the Meteorological Agency (refer to Table 9A-1). The flood forecasting system in the former important rivers is discussed in the following paragraphs.

According to the Basic Agreement on Flood Forecasting issued jointly by the Ministry of Construction and the Meteorological Agency which was concluded to assure smooth implementation of joint activities, the regional construction bureau or the local construction office under the Ministry of Construction and the district meteorological observatories under the Meteorological Agency execute flood forecasting jointly. For its part, the regional construction bureau or the local construction office undertakes the drafting of flood forecast

depending on the administrative situation of the rivers and the judgment from hydrological conditions; while, the district meteorological observatory performs its part of drafting flood forecast depending primarily on the judgment from the meteorological conditions. In accordance with the Flood Defense Law, the flood forecast is promptly transmitted through the dissemination network, as exemplarily shown in Fig. 9A-2, to offices such as the prefectural government, the press and other information media, and other parties concerned.

Under the Flood Defense Law, the Minister of Construction is held responsible in issuing flood defense warning with regard to rivers, lakes and/or seacoasts where flood or storm tide might cause damage to the national economy as a whole (refer to Table 9A-1). Rivers in 108 river basins have been designated by the Minister of Construction (refer to Table 9A-3) and flood defense warning on the others are executed by the prefectural government concerned and the Meteorological Agency (refer to Table 9A-1).

The flood defense warning by the Regional Construction Bureau or the Local Construction Office of the Ministry of Construction is transmitted to the prefectural government concerned which, in turn, transmits the information to the local governments of the cities, towns and villages, and/or the flood defense administrators, through the dissemination network as exemplarily shown in Fig. 9A-3. Under the Disaster Countermeasures Law, the officials of prefectural governments, mayors, heads of towns and villages, and/or the flood defense administrators are authorized to issue advices and/or instructions to the people concerned for evacuation from their habitation to prevent any possible loss of life and property due to the anticipated flood. In case the mayor or the head of the town/village is not able to do so, the local police authorities are entitled to execute this job as proxy.

2. Flood Forecasting System in the Tone River

2.1 General Description of the Tone River

The Tone River lies in a slightly eastward direction from the central part of Japan. It runs through political, economic and cultural centers with its main river course stretching to some 322 km. Its catchment area is 16,840 km2. (Refer to Fig. 9A-4.)

The river originates in Mt. Oominakami which is located 1,900 m above sea level in Minakami Town, Tone County, Gunma Prefecture, in the northwestern part of the Kanto Region. It flows southward until Yattajima, receiving tributaries in the mountain area and joining with the Katashina and Karasu rivers. From Yattajima, it runs in a flat land and then changes its course southeastward. Then, it is joined by the Watarase River at slightly upstream of Kurihashi Town, Saitama Prefecture, and at Sekiyado the Edo River branches off from the mainstream.

The mainstream of the Tone River flows further eastward. It is joined by the Kinu River and other rivers, and meets the Hitachi-Tone River at Hasaki Town which is located near the mouth of the Tone River. Then, at the vicinity of Choshi City, the river pours into the Pacific Ocean.

2.2 Data Collection and Flood Prediction

Hydrological data collection and flood prediction are effectively executed by the Kanto Regional Construction Bureau, Ministry of Construction, through integrated communication systems such as the river information system. The organization chart of the Ministry of Construction is shown in Fig. 9A-5.

The river information system consists of the administrative center, control center, subcenter and monitor station which are linked together as an online real time system.

Observation stations scattered over the administrative district transmit hydrological data to monitor stations and subcenters through the telemetry circuit and the transmitted data are relayed to the subcenters through the exclusive microwave circuit with higher reliability and efficiency, as shown in Fig. 9A-6.

Subcenters, control centers and administrative centers are further interconnected by way of a duplex communication system. This system has the following functions in relation to flood prediction which is executed by the control center or the subcenter.

Administrative Center (Head Office of Ministry of Construction)

The Administrative Center grasps the condition of flood in the whole of Japan comprehensively.

Control Center (Kanto Regional Construction Bureau)

The observation data (rainfall, water level, dam capacity) transmitted by the River Information System (online real-time system) are stored in an electronic computer. By using these stored data, runoff volume in the upper reaches of a dam is estimated by the runoff calculation method based on the storage function method. Further calculation for regulation effect by the reservoir, tracing the waterway of a river and the volume of water in a regulating reservoir, etc., is conducted and, judging from the results of these calculations, the water level of a river at a flood prediction point is estimated. When any difference is found between a value actually observed and an estimated value, calculation thereof is to be conducted one after another by means of feeding back, attaching importance to the value actually observed.