KINGDOM OF THAILAND

MINISTRY OF AGRICULTURE AND COOPERATIVES

ROYAL IRRIGATION DEPARTMENT

THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT (PHASE II)

VOLUME I

MAIN REPORT

SUMMARY

AUGUST 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

KINGDOM OF THAILAND

MINISTRY OF AGRICULTURE AND COOPERATIVES

ROYAL IRRIGATION DEPARTMENT

THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT (PHASE II)

VOLUME 1

MAIN REPORT

SUMMARY

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AUGUST 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

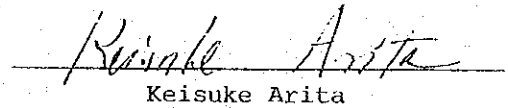
In response to the request of the Government of the Kingdom of Thailand, the Government of Japan decided to conduct a study on the East Coast Water Resources Development Project (Phase II) and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Thailand a survey team headed by Mr. H. Waki, comprising experts of Nippon Koei Co., Ltd. and Nippon Kensetsu Consultant company, from July 26 to December 22, 1982.

The team had discussions with the officials concerned of the Government of the Kingdom of Thailand over the project and conducted a field survey in the East Coast area. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Kingdom of Thailand for their close cooperation extended to the team.

August, 1983



Keisuke Arita
President
Japan International Cooperation Agency

Mr. Keisuke Arita
President
Japan International Cooperation Agency
Tokyo, Japan

August, 1983

Dear Sir,

LETTER OF TRANSMITTAL

We have the pleasure of submitting to you herewith the Final Report of the East Coast Water Resources Development Project (Phase II) for the Government of the Kingdom of Thailand.

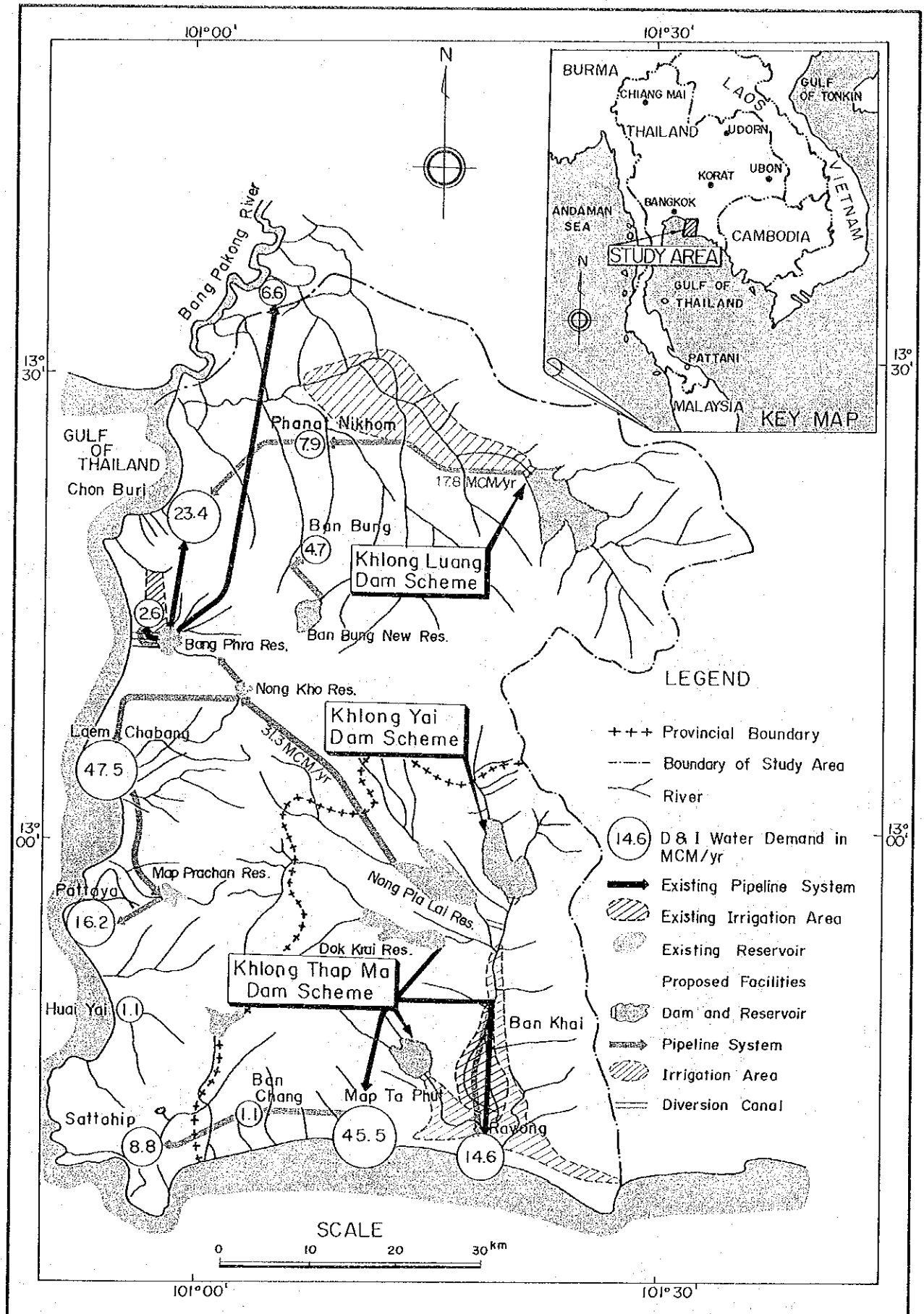
The Study was conducted by the Study Team composed of Nippon Koei Co., Ltd. and Nikken Consultant Inc. during the period from July 1982 to August 1983, including the field survey and investigation in Thailand for the five months period from July to December in 1982. The Study formulated the overall water resources development plan for the East Cost Area to cope with the future water demand and clarified the need of the development of the three dams, namely Khlong Luang, Khlong Yai and Khlong Thap Ma Dams. It was ascertained that the development of the three dams was pre-requisite for the industrial and agriculture development of the Area. We hope that the Study will serve as the base for the further progress and implementation of the project in future and accordingly contribute to the well-balanced economic and social development of the Area and Thailand.

We wish to express our sincere gratitude to the personnel of your Agency, Advisory Comittee, the Embassy of Japan in Thailand as well as to the officials and individuals of the agencies concerned of the Government of the Kingdom of Thailand for their kind assistance and cooperation extended to the Study Team.

Very truly yours,

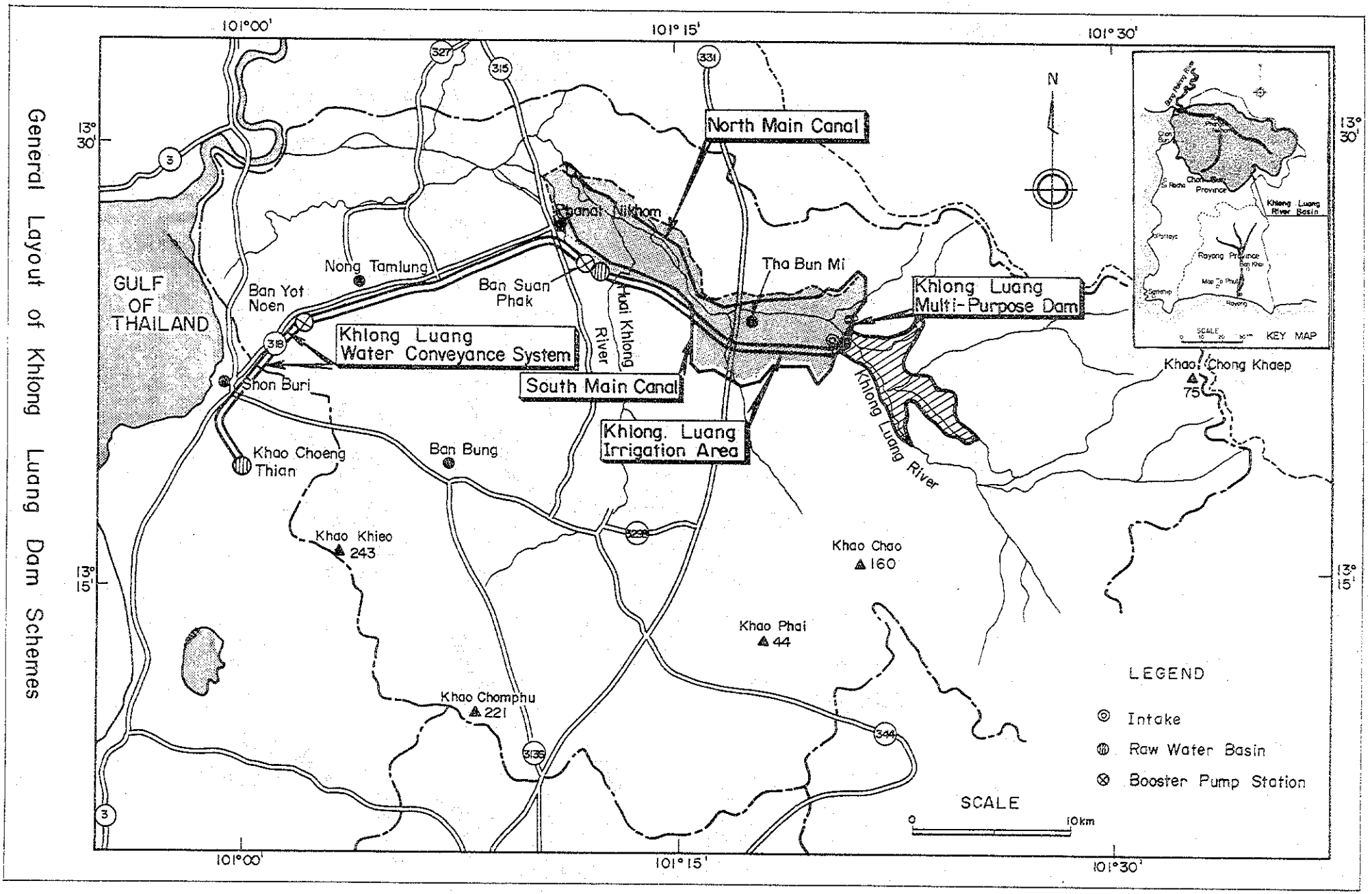
H. Waki

Haruo Waki
Team Leader
East Coast Water Resources
Development Project (Phase II)



Proposed Water Resources Development Plan

KINGDOM OF THAILAND
THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT PHASE II
JAPAN INTERNATIONAL COOPERATION AGENCY


General Layout of Khlong Luang Dam Schemes
101°00'
101° 15'
101° 30'
13° 30'
13° 15'
N
North Main Canal
Khlong Luang Multi-Purpose Dam
Khlong Luang Water Conveyance System
South Main Canal
Khlong Luang Irrigation Area
Khlong Luang River
Hai Khlong River
Chanat Nikhom
Tha Bun Mi
Nong Tamlung
Ban Yot Noen
Ban Suan Phak
GULF OF THAILAND
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Khao Choeng Thian
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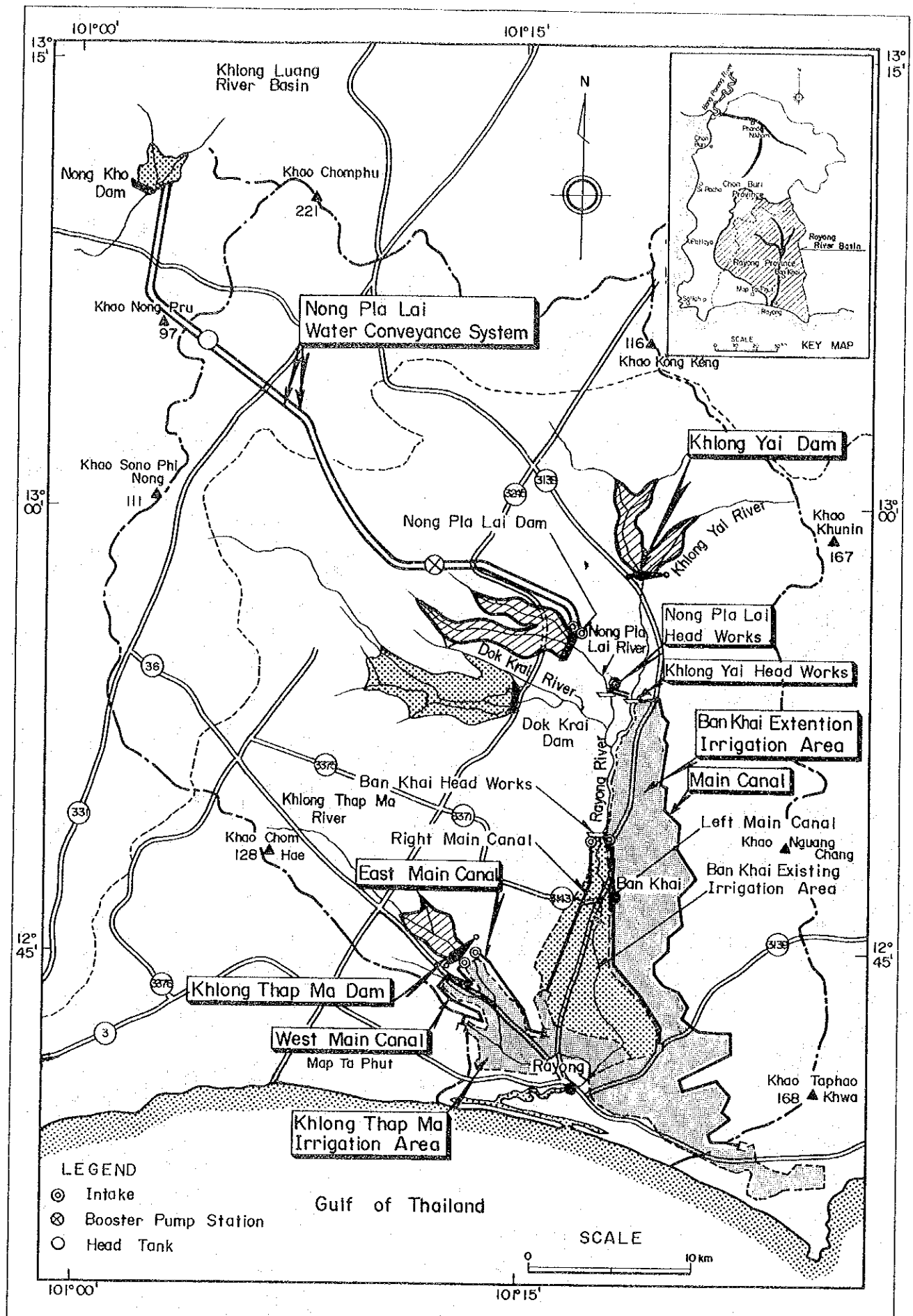
KEY MAP
Khlong Luang River Basin
Rayong Province
LEGEND
Intake
Raw Water Basin
Booster Pump Station
SCALE
0
10km



General Layout of Khlong Yai and Khlong Thap Ma Dam Schemes

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ABBREVIATIONS AND LOCAL TERMS

A. ABBREVIATION OF MEASURES

(1) Length

mm	=	millimetre
cm	=	centimetre
m	=	metre
km	=	kilometre

(2) Area

m^2	=	square metre
ha	=	hectare = $10^4 m^2$
km^2	=	square kilometre = $10^6 m^2$
rai	=	0.16 ha

(3) Volume

lit, l	=	litre = 1,000 cm^3
kl	=	kilolitre = 1 m^3
m^3	=	cubic metres
MCM	=	million cubic metres
	=	1,000,000 m^3

(4) Weight

mg	=	milligramme
g	=	gramme
kg	=	kilogramme
t	=	ton = 1,000 kg
qwt	=	quintal = 100 kg

(5) Time

s	=	second
min	=	minute
h	=	hour
d	=	day
yr	=	year

(6) Money

฿	=	Baht (unit of Thai currency US$ 1 = ฿ 23.0)
$	=	US dollar
¥	=	Japanese Yen

(7) Electric Measures

kV	=	kilovolt
kW	=	kilowatt
MW	=	megawatt = 1,000 kW
kWh	=	kilowatt hour
kVA	=	kilovolt Ampere

(8) Other Measures

mmho	=	micromho = conductance
ppm	=	parts per million
ppb	=	parts per billion
%	=	per cent
LCD	=	litre per capita per day
PS	=	0.736 kW
pH	=	scale for acidity
°	=	degree
'	=	minute
"	=	second
°C	=	degree centigrade
10^3	=	thousand
10^6	=	million
10^9	=	billion (milliard)

(9) Derived Measures Based on the Same Symbols

m^3/s	=	cubic metre per second
ton/ha	=	ton per hectare
$10^6 m^3/yr$, MCM/yr	=	million cubic meter per year

B. OTHER ABBREVIATIONS

GDP	=	gross domestic product
GRP	=	gross regional product
El.	=	elevation
HWS	=	high water surface
SD	=	sanitary district
DA	=	development area
ESS	=	Eastern Seaboard Study
FOB	=	free on board
CIF	=	cost, insurance and freight
WHO	=	World Health Organization

C. ABBREVIATION OF ORGANIZATIONS

MOAC	Ministry of Agriculture and Cooperatives
RID	Royal Irrigation Department
DOF	Department of Fisheries
LDD	Land Development Department
NESDB	National Economic and Social Development Board
NEB	National Environment Board
NSO	National Statistical Office
MOI	Ministry of Industry
DMR	Department of Mineral Resources
DIW	Department of Industrial Works
MOC	Ministry of Communications
HD	Harbor Deparment
DHW	Department of Highways
DOH	Department of Health
RTN	Royal Thai Navy
PWWA	Public Water Works Authority
MD	Meteorology Department
DOLA	Department of Local Administration
TAT	Tourism Authority of Thailand

D. LOCAL TERMS

Changwat	:	Province
Amphoe	:	District (Township)
Tambon	:	Township (Town)
Muban	:	Village
Muang	:	Administrative Center of Province
King Amphoe	:	Sub-district
Mae Nam	:	River
Khwae	:	Main tributary of a river
Huai	:	Stream, creek or small tributary
Khlong	:	Canal
Khao	:	Mountain

1. INTRODUCTION

1.1 Authority

The East Coast Water Resources Development Project, Phase II (the Study) was carried out in accordance with Implementation Arrangement, Technical Cooperation for Feasibility Study on East Coast Water Resources Development Project, Phase II, which was concluded in the date of February 22, 1982 between Japan International Cooperation Agency (JICA) and Royal Irrigation Department (RID), Ministry of Agriculture and Cooperatives, the Government of Kingdom of Thailand.

1.2 Study Objective

The Government issued the Fifth National Economic and Social Development Plan (the Fifth National Plan) in October, 1982, cardinal principles of which are (i) to restore the nation's economic and financial stability, (ii) to adjust the economic structure to improve the foreign trade balance and (iii) to alleviate the poverty. The Fifth National Plan places a great emphasis on Eastern Seaboard Development in order to accomplish its objectives.

The Eastern Seaboard lies along the coastal area in Chon Buri and Rayong Provinces. The natural gas oriented industrial development is being actively promoted, particularly in Sattahip-Rayong area, where the natural gas is unloaded. On the other hand the agricultural development is contemplated to be promoted in both the Khlong Luang and Rayong river basins to create the balanced socio-economic situation throughout region. Such development activities will certainly induce a rapid increase of water demand, which will cause to strain the present water demand and supply balance situation. An integrated development planning, however, is essential to ensure future efficient use of water and land resources.

The objective of the East Coast Water Resources Development Project, Phase II is to formulate the comprehensive water resources development plan over the Study Area.

1.3 Study Team and Advisory Committee

The JICA appointed a Study Team to carry out the Study with the counterpart support provided by RID. An Advisory Committee was established by JICA to review the findings by the Study Team.

The Study Team derived from time to time assistance from Colombo Plan Experts attached to RID.

The members of the Advisory Committee and Colombo Plan Experts and Study Team are as listed in Table 1 and 2.

1.4 Scope of Study

The scope of the Study covers the followings;

Part A: Study for the long-term water demand and supply balance in the Study Area

Part B: Feasibility study for Khlong Luang, Khlong Yai and Khlong Thap Ma Dams.

The Part A study was executed in Bangkok during a 5-month period from July to December, 1982 in parallel with the field survey and investigation necessary for the performance of both the Part A and Part B studies.

The field survey and investigation were accomplished in a close coordination with RID. Its outlines are as summarized hereunder.

(i) Topographic Survey
(ii) Geological Investigation and Material Survey
(iii) Groundwater Reconnaissance Survey
(iv) Flood Damage Survey
(v) Hydrological Investigation
(vi) Farm Economic Survey
(vii) Compensation and Relocation Survey
(Viii) Water Quality Analysis

1.5 Study Report

During the course of the Study, an Inception Report and Study Report on Long-Term Water Supply Plan were prepared. The Final Report which is submitted herein comprises;

Volume 1: Summary
Volume 2: Feasibility Study on Khlong Luang Dam Scheme
Volume 3: Feasibility Study on Khlong Yai Dam Scheme
Volume 4: Feasibility Study on Khlong Thap Ma Dam Scheme

It is supported by the Sectoral Reports, Priced Bill of Quantities and Data Book.

1.6 Acknowledgement

The Study Team at first makes a most cordial acknowledgement to Mr. Sunthorn Ruanglek, Director General of RID and Mr. Boonthai Otaganonta, Chief Engineer for Civil Engineering of RID for their kind assistance and advise throughout the period of the Study. A heartfelt gratitude is also made to the officials of the various departments and agencies of the Government who have given valuable advices, informations and data in performing the Study. An acknowledgement is expressed to the officials of RID for their counterpart service, provision of data and information and effectual assistance for field survey and investigation throughout the study period.

2. LONG-TERM WATER SUPPLY

2.1 Water Demand

The ultimate target of the long-term water supply plan is to formulate the most optimum water resources development and water supply plan in view of increasing importance on land and water resources development for the development of industry and the increase of agricultural production. For the purpose of the Study, the Target Years are set at 1991 as an intermediate year and at 2001 as a final year, in due consideration of the periods of the national five-year plan and the period of Eastern Seaboard Development.

The water demand comprises the domestic use, industrial use and irrigation use. A concept of river maintenance flow is introduced. In accordance with principles of water resources management, the Study Area is divided into 10 zones as shown in Fig. 1 and water demand-supply balance was elaborated zone by zone. The annual water demand is estimated at intervals of 5-year period as presented in Table 3.

The domestic water demand is projected separately for urban area and rural area, based on future population, water consumption per capita and service factor. The urban area is divided into development area and non-development area, according to the strategy of Eastern Seaboard Development. The population in urban area is predicted to increase substantially due to the increased employment opportunity in the development area; 358 x 10^3 in 1981 to 739 x 10^3 in 2001. The rural population increases to a little extent; 570 x 10^3 in 1981 to 645 x 10^3 in 2001. The domestic water demand will increase largely from 22.1 x 10^6 m^3 in 1981 to 91.5 x 10^6 m^3 in 2001, resulting from expansion of pipe-water supply services into rural area and increase of water consumption in urban area due to population increase. The number of pipe-water served population will be 898 x 10^3 in 2001; an increase of 745 x 10^3 from 1981.

The industrial water demand will grow enormously from 10.3 x 10^6 m^3 in 1981 to 88.5 x 10^6 m^3 in 2001 resulted from the proposed industrial development activities. The Study Area embraces six strategic development zones; Chon Buri for urban service industry, Laem Chabang for export processing and light industry, Sattahip for port-related industry, Map Ta Phut for chemical, petrochemical and heavy industries, Rayong for agro-industry and Pattaya for tourism industry.

The irrigation development will be implemented in both the Khlong Luang and Rayong river basins, keeping a pace with the industrial development. In the absence of the Government's long-term development plan, a provisional plan has been established by the Study Team for the period from 1982 to 2001, which comprises the development of Khlong Luang, Ban Khai Extension and Khlong Thap Ma Irrigation Schemes. According to the provisional plan, the irrigation water will increase from 81.2 x 10^6 m^3 in 1982 to 247.0 x 10^6 m^3 in 2001.

The river maintenance flow is the minimum discharge which is able to maintain water depth, flow velocity, water quality, channel stability, aquatic ecosystem and scenery to the extent necessary for navigation, fish catch, operation and maintenance of intakes, maintenance of river facilities, sea water repulsion, prevention of estuary clogging, conservation of groundwater, preservation of riparian land and people's amenity. The rate of the river maintenance flow is tentatively determined by the Study Team for each representative river of a zone in due consideration of river management under the present circumstances.

2.2 Proposed Long-Term Water Supply Plan

In order to determine the water resources development requirement, the water demand and supply balance was carefully analyzed zone by zone. As the results, under the present water resources development conditions, an accute shortage of water supply is foreseen to occur; 65.1 x 10^6 m^3 in 1991, 117.3 x 10^6 m^3 in 1996 and 149.5 x 10^6 m^3 in 2001. The coastal area suffers serious water deficit because of concentration of the industrial development zones.

The coastal area is scarce of water resources owing to geographical condition, while its backward area, the Khlong Luang and Rayong river basins are blessed with fair water resources. This naturally leads to evolve an integrated development plan of water resources and inter-zone water diversion system, in order to satisfy all the water demand throughout the Study Area.

The recommended long-term water supply plan for Target Year 2001 is shown in Fig. 1, which is ascertained to be the most optimum in view of financial requirement, technical soundness and socio-economic aspects. It is constituted by construction of 5 multiple-purpose dams, 2 intakes and 8 raw water conveyance systems including 5 inter-zone water diversion systems. The dams involved in the plan are the Khlong Luang and New Ban Bung Dams in the Khlong Luang river basin and the Nong Pla Lai, Khlong Yai and Khlong Thap Ma Dams in the Rayong river basin. Both the Khlong Luang and Nong Pla Lai Dams will fully dissolve the water deficit in Chon Buri - Pattaya area by diverting the water at rates of 11.0×10^6 m^3 and 31.3×10^6 m^3, respectively, in 2001. The existing Dok Krai Dam will properly ensure the water demand in Sattahip - Map Ta Phut area with diversion of 54.8×10^6 m^3.

2.3 Development Programme

The proposed long-term water supply plan will be implemented progressively in a stage-wise way in accordance with growth of water demand. Dams require a long time for their construction and impounding water. Therefore their construction works need to be commenced for many years beforehand based on long-term perspectives. The development programme of dams is prepared in relation to the growth of the water demand as shown in Fig. 2.

The raw water conveyance system can be constructed in a short time and can be expanded as need arises. The irrigation development will be implemented in parallel with construction of dam so that irrigation service can be attained immediately upon completion of dam.

3. FEASIBILITY STUDY

3.1 Nature of the Project

The long-term water supply plan has clearly revealed the significance of development of Khlong Luang, Khlong Yai and Khlong Thap Ma Dam Schemes. These schemes have a nature of multiple-purpose areal-development project, since they are designed as element in regional plan.

The Khlong Luang and Khlong Yai dams have the functions of irrigation water supply, domestic and industrial water supply to both the inside and outside of the basin and flood control. The Khlong Thap Ma Dam serves the irrigation water supply and flood control. The development components of the respective scheme are thus defined as follows.

Scheme	Component
1. Khlong Luang	(a) Multiple-purpose dam
	(b) Water conveyance system between dam and Chon Buri
	(c) Irrigation and drainage system
2. Khlong Yai	(a) Multiple-purpose dam
	(b) Water conveyance system between Nong Pla Lai dam and Nong Kho dam
	(c) Irrigation and drainage system in Ban Khai Extension Area
3. Khlong Thap Ma	(a) Multiple-purpose dam
	(b) Irrigation and drainage system

The feasibility study of the above-mentioned three schemes was conducted subsequent to the study for the long-term water supply plan in order to sound their technical and economic feasibility and financial viability.

3.2 Plan Formulation

The plan formulation has been accomplished in two steps. The first step is directed to ascertain the optimum land and water resources development plan, which comprises the water resources development, domestic and industrial water supply and agricultural and irrigation development. The second step is to formulate the optimum basic flood control plan by a combination of dam and river improvement.

As the results of the plan formulation study, the optimum development scales of Khlong Luang, Khlong Yai and Khlong Thap Ma Dam Schemes are determined as follows.

	Description	Unit	Khlong Luang	Khlong Yai		Khlong Thap Ma
				Khlong Yai Dam	Nong Pla Lai Dam	
(1)	Water Resources Development					
	Reservoir					
	Gross storage	10^6 m^3	169.1	71.5	200.7	74.3
	Surcharge	10^6 m^3	34.3	16.9	43.5	13.5
	Active storage	10^6 m^3	119.0	48.0	144.4	56.1
	Flood water level	El.m	40.5	48.8	47.0	26.9
	High water level	El.m	39.5	47.5	45.0	25.7
	Low water level	El.m	33.8	40.6	33.3	16.2
	Dam					
	Dam crest	El.m	42.5	50.8	49.0	28.9
(2)	Domestic and Industrial Water Supply					
	Basin use	10^6 m^3/yr	1.4	-		-
	Inter-zone	10^6 m^3/yr	11.0	31.3 to Nong Kho reservoir		-
(3)	Land Development					
	Net irrigation area	ha	6,600	7,700		2,400
	Cropping intensity	%	140	140		170

The Khlong Yai Dam Scheme is formulated with an integration of Nong Pla Lai Dam, which is being contemplated to be implemented in advance of Khlong Yai Dam. The Nong Pla Lai Dam was formulated to enable the existing Dok Krai Dam to bear the domestic and industrial water demand in Map Ta Phut - Sattahip area. It also aims at expanding the irrigation area in the basin. Further, as a consequence of the water balance study over the Study Area, an inter-zone water diversion from Nong Pla Lai Dam is projected in order to cope with the increased water demand in Chon Buri - Pattaya area.

The Khlong Yai Dam is subsequently proposed to secure the inter-zone water diversion by Nong Pla Lai Dam in one hand and to further expand the irrigation area on the other hand. With development of Khlong Yai Dam, the whole irrigable area in the Rayong river basin, consisting of the Ban Khai existing area (4,800 ha) and Ban Khai Extension Area (7,700 ha), can be fully brought under intensified agriculture with the year-round irrigation water supply.

In future Dok Krai Dam will be run properly for the domestic and industrial water supply to Map Ta Phut-Sattahip area. The Nong Pla Lai and Khlong Yai Dams will be operated as one unit to sustain the irrigation water demand in the basin and inter-zone water diversion to Chon Buri - Pataya area.

An intensified agriculture will be practiced with provision of the year-round irrigation water supply. Crops have been carefully selected in due consideration of the objective of the Fifth National Plan, soils and land capabilities in the irrigable area and livelihood of farmers. The proposed cropping patterns are shown in Fig. 3.

Preliminary assessment was carried out on rehabilitation of irrigation and drainage system in Ban Khai existing irrigation area. It concluded that the rehabilitation works are firmly justifiable from the economic viewpoint.

A basic flood control plan was established for both the Khlong Luang and Rayong river basins based on a standard project flood, which has a recurrence interval of 50 years. The plan is formed by a combination of dam and river improvement. According to the flood control study, flood damages in the Rayong river are expected to be reduced to a great extent due to regulation effects by Dok Krai, Nong Pla Lai, Khlong Yai and Khlong Thap Ma reservoirs. The Khlong Luang reservoir also contribute to flood damage reduction but its effect is limited to a narrow extent. The river improvement works along the Rayong river are evaluated not economically attractive for the present, while that along the Khlong Luang river poses to bear some economic return. A systematic flood damage statistical survey is recommended to be carried out in order to clarify the economic and financial losses more realistically.

3.3 Preliminary Design

3.3.1 Multiple-purpose Dam

A homogeneous earth fill type dam has been selected for all the dam-sites from the viewpoint of geological condition and availability of construction materials. Seepage through dam body and foundation was analyzed by applying the Finite Element Method. The Khlong Yai and Khlong Thap Ma Dams are designed with a deep core trench to intercept underseepage. For the Khlong Luang Dam, an earth blanket is proposed to be spread over the upstream area to suppress the possible leakage through intermediate zone in a depth of 7 to 20m and to control high leakage area in the left abutment.

The spillway is designed based on the design inflow flood of 500-year recurrence interval in accordance with the design criteria of RID. The spillway is capable of regulating a probable maximum flood with a sufficient freeboard.

Preliminary designs of dams are shown in DWG NO. 1 to 3. Principal features of dams and spillways are presented in Tables 4 to 6.

3.3.2 Water Conveyance System

The annual raw water transmission quantity has been projected for every 5-year period as tabulated below.

(Unit: $10^6 m^3/yr$)

Water Conveyance System	1991	1996	2001
Khlong Luang	1.4	6.7	12.4
Nong Pla Lai	4.9	14.2	31.3

Both water conveyance systems are planned to be implemented in two phases so as to be flexible to the growth of the water demand. The system capacity has been determined to be 1.3 times of the annual average supply rate in due consideration of daily and seasonal fluctuation in water consumption. Tables 4 and 5 present the principal features of the water conveyance systems by development phase.

The Khlong Luang system connects Khlong Luang Dam to Chon Buri with 56 km long pipeline in 2 rows. The system capacity is determined to be 0.26 m^3 per second for both the first and second phase works. The pipeline is ø600 mm in inside diameter and equipped with two booster pump stations.

The Nong Pla Lai system links Nong Pla Lai Dam with Nong Kho Dam with 53 km long pipeline in two rows. The system capacity is 0.65 m^3 per second for both the first and second phase works. The pipeline is divided into two reaches; the upstream reach with a length of 33 km is ø900 mm in inside diameter and is equipped with a booster pump station. The downstream reach is 20 km in length and ø800 mm in inside diameter.

DWG NO. 4 and 5 show the alignment of the Khlong Luang and Nong Pla Lai systems respectively.

3.3.3 Irrigation and Drainage System

The Khlong Luang irrigation area with a net area of 6,600 ha is located immediately downstream from the proposed damsite and is divided into North Area with 3,100 ha and South Area with 3,500 ha as shown in DWG NO. 6. The South and North Main Canals are 31.1 km and 21.8 km respectively and are designed in concrete lining. The principal features of the irrigation and drainage facilities are presented in Table 4.

The Ban Khai Extension Area extends along the Left Main Canal of Ban Khai existing area as shown in DWG NO. 7. Two headworks will be constructed, namely, Nong Pla Lai headwork and Khlong Yai headwork. Their diversion weir consists of concrete weir and earth embankment dikes. The concrete weir is designed as a floating type. A diversion canal between the both headworks is lined with concrete and has a discharge capacity of 4.9 m^3 per second. The main canal is 45.2 km in length and is designed in trapezoidal cross section and with concrete lining. The principal features of the irrigation and drainage facilities are summarized in Table 5.

The Khlong Thap Ma irrigation area with a net area of 2,400 ha lies along the both banks of the Khlong Thap Ma river and will be served by two main canal systems as shown in DWG NO. 8. The West Main Canal serves 1,150 ha and is lined with concrete. The East Main Canal commands 1,250 ha and is also lined with concrete. The principal features of the irrigation and drainage facilities are as summarized in Table 6.

3.4 Investment Cost

The investment cost was estimated on the basis of the international competitive bidding and based on the 1982 price level. It consists of direct construction cost, compensation and relocation cost, administration cost of executive agencies, engineering services and physical and price contingencies. The estimated investment costs are shown in Tables 7 to 9 and are summarized below.

(Unit: ฿ 10^6)

Schemes	Foreign Currency Portion	Local Currency Portion	Total
Khlong Luang	1,902	2,664	4,566
First stage	1,419	2,517	3,936
Second stage	483	147	630
Khlong Yai	3,154	4,426	7,580
First stage	2,387	4,150	6,537
Second stage	767	276	1,043
Khlong Thap Ma	391	1,200	1,591

The investment cost of Nong Pla Lai Dam is updated and incorporated into the investment cost of Khlong Yai Dam Scheme for the purpose of economic and financial analyses.

Disbursement schedule of the investment cost is shown in Tables 10 to 12.

3.5 Implementation Programme

The implementation programme is prepared in the light of the predicted water demand and supply balance situation and is shown in Figs. 4 to 6.

The Khlong Luang and Khlong Yai Dam Schemes are programmed to be implemented in two stages. The first stage comprises a multiple-purpose dam, first phase of water conveyance system and irrigation and drainage system. The second stage is the construction of the second phase water conveyance system. The implementation programmes of the three contemplated Schemes are summarized hereunder.

Schemes	Implementation Schedule	
	First Stage	Second Stage
Khlong Luang	1985 - 1991	1992 - 1996
Khlong Yai	1984 - 1991	1992 - 1996
Khlong Thap Ma	1985 - 1989	-

The Khlong Luang and Khlong Yai Multiple-purpose Dams and their associated water conveyance systems have to commence operation in 1991 at the latest. Otherwise Chon Buri - Pattaya development area would incur a serious shortage of domestic and industrial water. Additional investigation and detail design of the dams thus have been planned to take place from the 1985 dry season.

3.6 Benefit

The project benefits are derived from the domestic and industrial water supply, agricultural development and flood control. The water supply and agricultural benefits increase year after year in accordance with increase of water demand and expansion of irrigation area and agricultural supporting systems. The annual project benefits at full development stage are estimated as follows.

(Unit: ฿ 10^6/yr)

Scheme	Water Supply	Agricultural Development	Flood Control	Total
Khlong Luang	423.3	180.7	49.8	653.8
Khlong Yai	793.6	198.2	57.2	1,049.0
Khlong Thap Ma	-	81.7	19.5	101.2

The benefits of Khlong Yai Dam Scheme are resulted from a joint operation of Khlong Yai and Nong Pla Lai Multiple-purpose Dams.

3.7 Economic Evaluation

The economic feasibility was evaluated by economic internal rate of return (EIRR). Useful life is assumed to be 50 years. The EIRR is computed for 5 cases as tabulated below.

(%)

Case	Khlong Luang	Khlong Yai	Khlong Thap Ma
(1) Standard	16.1	15.0	12.1
(2) 10% of Cost Increase	13.5	11.3	11.1
(3) 10% of Benefit Decrease	13.3	11.0	11.0
(4) (2) + (3)	11.2	8.6	10.0
(5) Delay in Construction for 2 years	11.0	9.1	10.1

As shown in the above, all the Schemes indicate the high economic feasibility.

3.8 Financial Analysis

The investment cost was allocated to each component by means of a separable cost-remaining benefit method as shown below.

(Unit: ฿ 10^6)

Project Components	Foreign Currency Portion	Local Currency Portion	Total
Khlong Luang Dam Scheme			
Water Supply	1,112	867	1,979
Agricultural Development	684	1,557	2,241
Flood Control	106	240	346
Total	1,902	2,664	4,566
Khlong Yai Dam Scheme			
Water Supply	2,356	2,644	5,000
Agricultural Development	593	1,360	1,953
Flood Control	205	422	627
Total	3,154	4,426	7,580
Khlong Thap Ma Dam Scheme			
Agricultural Development	326	984	1,310
Flood Control	65	216	281
Total	391	1,200	1,591

Financial aspect of the Scheme is evaluated by respective component paying particular attention to the repayability of the Scheme to the international loan. International loan is assumed to be financed with an interest rate of 3.5% per annum and a term of 30 years including 10 years of grace period. Repayability is examined based on the project cost allocated to each project component and revenue expected to be collected through water tariff.

Water tariff on domestic and industrial water supply is assumed to be ฿ 4.0/m^3. Water tariff on irrigation water is broadly assumed to be equivalent to the annual O&M cost. It is estimated to be ฿ 670 per ha for the Khlong Luang Scheme, ฿ 530 per ha for the Khlong Yai Scheme and ฿ 960 per ha for the Khlong Thap Ma Scheme.

International loan is expected to be repayed in due schedule, with the Government's subsidy given at the appropriate time as presented in Tables 13 to 17.

3.9 Executive Agencies

RID will be responsible for implementation, operation and maintenance of dam and irrigation components. An appropriate agency would be appointed for the implementation, operation and maintenance of the raw water conveyance system. The Center for the Integrated Plan of Operation (CIPO) established within National Economic and Social Development Board (NESDB) will coordinate all the activities of the agencies with the activities related to the Eastern Seaboard Development.

3.10 Environmental Aspects

Environmental aspects were preliminarily evaluated according to the standard established by National Environmental Board. The standard comprises four categories namely, physical resources, ecological resources, human use values and quality of life values. It is clarified that the proposed development activities will induce positive impact on human use value and quality of life values greatly. Impact on such items as water quality and fauna and flora will be minimized or avoided by guaranteeing the river maintenance flow to the downstream of the river.

4. CONCLUSION AND RECOMMENDATION

As a result of feasibility study, Khlong Luang, Khlong Yai and Khlong Thap Ma Dam Schemes are proved to be technically, economically and financially feasible. In order to accomplish the objectives of the Fifth National Plan, an earliest implementation of these Schemes are cordially recommended.

In particular, Khlong Luang, Khlong Yai and Nong Pla Lai Multiple-purpose Dams are recommended to be realized as earlier as possible to save the Study Area from water deficit, which is being foreseen to occur within a couple of years. It is therefore storongly desired to commence the detail engineering works such as detailed field investigation and design and preparation of tender documents at latest in 1984 for Nong Pla Lai Dam and 1985 for Khlong Luang and Khlong Yai Dams.

The implementations of Khlong Luang and Nong Pla Lai water conveyance systems are proposed to be proceeded in two phases so as to be flexible with possible increase and decrease in water demand. However, the first phase works of the both systems should commission in service in 1991 at the latest in order to save Chon Buri - Pattaya area from water deficit.

The irrigation development is recommended to be carried out in parallel with implementation of multiple-purpose dam so that the intensified agriculture with the year-round irrigation water supply can be practiced soon after completion of the dam. The rehabilitation works of irrigation and drainage system in Ban Khai existing area are also recommended to be materialized at an earliest date.

TABLES

Table 1 MEMBERS OF ADVISORY COMMITTEE AND COLOMBO PLAN EXPERTS

Advisory Committee		
Chairman	Mr. S. Kishimoto	, MOC
Members	Mr. T. Endo	, MAFF
	Mr. H. Tashiro	, MAFF
	Mr. T. Miyazato	, MAFF
	Mr. S. Ohno	, MOC
	Mr. K. Ooyabu	, WRDPC
Coordinator	Mr. K. Miyoshi	, JICA
	Mr. M. Fuwa	, JICA
Colombo Plan Experts	Mr. K. Kimura	, MAFF
	Mr. T. Miyazaki	, MAFF
	Dr. K. Uno	, MAFF

Note; MOC : Ministry of Construction
MAFF : Ministry of Agriculture, Forest and Fishery
WRDPC: Water Resources Development Public Cooperation

Table 2 MEMBERS OF STUDY TEAM

Team Leader	Dr. H. Waki	, NK
Deputy Team Leader	Mr. K. Endo	, NK
Members	Mr. K. Takebayashi	, NIKKEN
	Mr. S. Iohara	, NIKKEN
	Mr. S. Kudo	, NK
	Mr. S. Uchizawa	, NK
	Mr. M. Shimamura	, NK
	Mr. H. Nakano	, NK
	Mr. M. Takasugi	, NK
	Mr. T. Okamoto	, NK
	Mr. Y. Ohshima	, NK
	Mr. I. Araki	, NK

Note; NK : Nippon Koei Co., Ltd.
NIKKEN: Nikken Consultant, Inc.

Table 3 ANNUAL WATER DEMAND

(Unit: $10^6 m^3/yr$)

Water Use	Zones										Study Area
	1	2	3	4	5	6	7	8	9	10	
Year: 1986											
Domestic	3.2	12.5	0.1	5.1	4.4	0.4	1.6	0.7	0.9	4.2	33.1
Industrial	7.6	0	2.3	7.5	0.7	0	3.9	0	33.0	1.6	56.6
Irrigation	0	15.4	0	0	0	0	0	0	0	140.9	156.3
Maint. flow	2.3	0	1.0	3.2	2.5	0	0	0	0	12.0	21.0
Total	13.1	27.9	3.4	15.8	7.6	0.4	5.5	0.7	33.9	158.7	267.0
Year: 1991											
Domestic	5.1	12.8	0.2	7.1	8.0	0.8	2.9	0.9	1.6	6.0	45.4
Industrial	10.9	0	2.3	16.0	0.7	0	3.9	0	35.8	1.6	71.2
Irrigation	60.1	15.4	0	0	0	0	0	0	0	140.9	216.4
Maint. flow	2.3	0	1.0	3.2	2.5	0	0	0	0	12.0	21.0
Total	78.4	28.2	3.5	26.3	11.2	0.8	6.8	0.9	37.4	160.5	354.0
Year: 1996											
Domestic	6.9	17.9	0.3	12.4	11.2	1.0	3.9	1.0	2.8	9.3	66.7
Industrial	10.9	0	2.3	19.5	0.7	0	3.9	0	38.5	1.6	77.4
Irrigation	60.1	15.4	0	0	0	0	0	0	0	171.5	247.0
Maint. flow	2.3	0	1.0	3.2	2.5	0	0	0	0	22.5	31.5
Total	80.2	33.3	3.6	35.1	14.4	1.0	7.8	1.0	41.3	204.9	422.6
Year: 2001											
Domestic	8.3	23.4	0.3	19.8	15.5	1.1	4.9	1.1	4.2	12.9	91.5
Industrial	10.9	0	2.3	27.8	0.7	0	3.9	0	41.3	1.6	88.5
Irrigation	60.1	15.4	0	0	0	0	0	0	0	171.5	247.0
Maint. flow	2.3	0	1.0	3.2	2.5	0	0	0	0	22.5	31.5
Total	81.6	38.8	3.6	50.8	18.7	1.1	8.8	1.1	45.5	208.5	458.5

Note: Figures are expressed in terms of source water demand.

Table 4 PRINCIPAL FEATURES OF KHLONG LUANG DAM SCHEME

1.	MULTIPLE-PURPOSE DAM	
1.1	Hydrology	
	(a) Catchment area	526 km^2
	(b) Annual average inflow	3.97 m^3/s
	(c) Design flood for spillway (500-year flood)	1,460 m^3/s
	(d) Extra-ordinary flood (Probable maximum)	2,520 m^3/s
1.2	Reservoir	
	(a) High water level	El. 39.5 m
	(b) Low water level	El. 33.8 m
	(c) Flood water level	El. 40.5 m
	(d) Extra-ordinary flood water level	El. 40.9 m
	(e) Gross storage	169.1x10^6 m^3
	(f) Surcharge	34.3x10^6 m^3
	(g) Active storage	119.0x10^6 m^3
	(h) Dead storage	15.8x10^6 m^3
	(i) Reservoir area at HWL	32.2 km^2
1.3	Main Dam	
	(a) Type	Homogeneous earthfill
	(b) Crest elevation	El. 42.5 m
	(c) Dam height above riverbed	14.5 m
	(d) Crest length	3,820 m
	(e) Crest width	8.0 m
	(f) Slope, upstream	1 : 2.6
	downstream	1 : 2.4
	(g) Embankment volume;	
	Earthfill, including blanket	2,605,000 m^3
	Filter	213,000 m^3
	Rock riprap	154,000 m^3

1.4 Saddle Dam

(a)	Type	Homogeneous earthfill
(b)	Crest elevation	El. 42.5 m
(c)	Dam height above original ground surface	7.5 m
(d)	Crest length	2,250 m
(e)	Crest width	8.0 m
(f)	Slope, upstream	1 : 2.6
	downstream	1 : 2.4
(g)	Embankment volume;	
	Earthfill	215,000 m^3
	Filter	53,000 m^3
	Rock riprap	31,000 m^3

1.5 Spillway

(a)	Type	Non-gated side channel weir
(b)	Overflow weir crest elevation	El. 39.5 m
(c)	Overflow weir width	70.0 m
(d)	Length of chuteway, including stilling basin	90.0 m

2. WATER CONVEYANCE SYSTEM

		First Phase	Second Phase
2.1	Intake		
(a)	Location	Khlong Luang Dam	
(b)	Design discharge	15.3 m^3/min	15.3 m^3/min
(c)	Type of pump	Horizontal double suction volute pump	
(d)	Pump capacity	110 kW/unit	110 kW/unit
(e)	Number of unit	2	1
(f)	Floor area of pump station	15.3 m^2	
2.2	Pipeline		
(a)	Type of pipe	Coating steel pipe	
(b)	Inside diameter of pipe	ø600 mm	ø600 mm
(c)	Number of row	1	1
(d)	Length of pipeline	56 km	56 km

	First Phase	Second Phase
2.3 Booster Pump Station No.1		
(a) Location	Ban Suan Phak	
(b) Design discharge	14.5 m^3/min	14.5 m^3/min
(c) Type of pump	Horizontal double suction volute pump	
(d) Pump capacity	190 kW/unit	190 kW/unit
(e) Number of unit	2	1
(f) Floor area pump station	162.5 m^2	
2.4 Booster Pump Station No.2		
(a) Location	Ban Yat Noen	
(b) Design discharge	13.6 m^3/min	13.6 m^3/min
(c) Type of pump	Horizontal double suction volute pump	
(d) Pump capacity	160 kW/unit	160 kW/unit
(e) Number of unit	2	1
(f) Floor area of pump station	162.5 m^2	
2.5 Raw Water Basin No.1		
(a) Location	Ban Yat Noen	
(b) Storage capacity	180 m^3	
2.6 Raw Water Basin No.2		
(a) Location	Khao Choeng Thian	
(b) Storage capacity	4,200 m^3	

3. IRRIGATION AND DRAINAGE SYSTEM

	North Area	South Area
3.1 Net Irrigation Area	3,100 ha	3,500 ha
3.2 Intake		
(a) Location	Khlong Luang Reservoir	
(b) Design discharge	4.81 m^3/s	5.94 m^3/s
(c) Diameter of outlet conduit	ø2,000 mm	ø2,000 mm
(d) Length of outlet conduit	54.0 m	300.0 m
(e) Intake gate (BxH)	2.0m x 2.0m	2.0m x 2.0m

		North Area	South Area
3.3	Main Canals		
	(a) Type of canal	Trapezoidal, lined with concrete	
	(b) Side slope	1 : 1.5	
	(c) Effective width of inspection road	5.0 m	
	(d) Length	31.1 km	21.8 km
3.4	Lateral and Sub-Lateral Canals		
	(a) Type of canal	Trapezoidal, unlined	
	(b) Side slope	1 : 1.5	
	(c) Effective width of inspection road	3.0 m	
	(d) Total length	15.0 km	19.0 km
3.5	Canal Structures	158 nos.	241 nos.
3.6	Drainage		
	(a) New drains	27 km	
	(b) Improved drains	10 km	
	(c) Structures	45 nos.	

Table 5 PRINCIPAL FEATURES OF KHLONG YAI DAM SCHEME

1.	MULTIPLE-PURPOSE DAM		
1.1	Hydrology		
	(a)	Catchment area	218 km^2
	(b)	Annual average inflow	2.76 m^3/s
	(c)	Design flood for spillway (500-year flood)	1,230 m^3/s
	(d)	Extra-ordinary flood (Probable maximum)	1,950 m^3/s
1.2	Reservoir		
	(a)	High water level	El. 47.5 m
	(b)	Low water level	El. 40.6 m
	(c)	Flood water level	El. 48.8 m
	(d)	Extra-ordinary flood water level	El. 49.4 m
	(e)	Gross storage	71.5 x $10^6 m^3$
	(f)	Surcharge	16.9 x $10^6 m^3$
	(g)	Active storage	48.0 x $10^6 m^3$
	(h)	Dead storage	6.6 x $10^6 m^3$
	(i)	Reservoir area at HWL	11.9 km^2
1.3	Dam		
	(a)	Type	Homogeneous earthfill
	(b)	Crest elevation	El. 50.8 m
	(c)	Dam height above riverbed	17.3 m
	(d)	Crest length	3,980 m
	(e)	Crest width	80 m
	(f)	Slope, upstream	1 : 3.0
		downstream	1 : 2.6
	(g)	Embankment volume	
		Earthfill	2,051.000 m^3
		Filter	254,000 m^3
		Rock riprap	190,000 m^3

1.4 Spillway

(a)	Type	Non-gated side-channel weir
(b)	Overflow weir crest elevation	El. 47.5 m
(c)	Overflow weir width	70.0 m
(d)	Length of chuteway, including stilling basin	160.0 m

1.5 River Outlet

(a)	Design discharge	8.7 m^3/s
(b)	Diameter of conduit	ø1,500 mm
(c)	Length of conduit	90 m
(d)	Regulating gate	1.5m x 1.5m
(e)	Valve	Hollow-jet

2. WATER CONVEYANCE SYSTEM

		First Phase	Second Phase
2.1	Intake		
(a)	Location	Nong Pla Lai Dam	
(b)	Design discharge	19.4 m^3/min	19.4 m^3/min
(c)	Type of pump	Horizontal double suction volute pump	
(d)	Pump capacity	390 kW/unit	390 kW/unit
(e)	Number of unit	3	2
(f)	Floor area of pump station	259 m^2	
2.2	Pipeline		
(a)	Type of pipe	Coating steel pipe	
(b)	Inside diameter of pipe		
	Between intake and head tank	ø900 mm	ø900 mm
	Between head tank and Nong Kho Dam	ø800 mm	ø800 mm
(c)	Number of row	1	1
(d)	Length of pipeline		
	Between intake and head tank	30 km	30 km
	Between head tank and Nong Kho Dam	23 km	23 km

		First phase	Second phase
2.3	Booster Pump Station		
	(a) Location	Ban Thap Thong	
	(b) Design discharge	19.4 m^3/min	19.4 m^3/min
	(c) Type of pump	Horizontal double suction volute pump	
	(d) Pump capacity	3	2
	(f) Floor area of pump station	259 m^2	
2.4	Head Tank		
	(a) Location	Ban Khao Khayai	
	(b) Storage capacity	2,327 m^3	
	(c) High water level	El. 118.0 m	
	Low water level	El. 115.0 m	
3.	IRRIGATION AND DRAINAGE SYSTEM		
3.1	Net Irrigation Area	7,700 ha	
3.2	Nong Pla Lai Headworks		
	(a) Location	Nong Pla Lai river	
	(b) Design flood	200 m^3/s	
	(c) Flood water level	El. 27.05 m	
	(d) Design intake discharge	4.90 m^3/s	
	(e) Design intake water level	El. 25.46 m	
	(f) Type of diversion weir	Floating type	
	(g) Height of weir above riverbed	3.56 m	
	(h) Length of fixed weir	60 m	
	(i) Crest elevation of fixed weir	El. 25.56 m	
	(j) Width of scouring sluice	3.0 m	
	(k) Sill elevation of intake	El. 23.96 m	
	(l) Intake gate (B x H)	2.5m x 2.0m	
	(m) Number of intake gate	2	

3.3 Diversion Channel

(a)	Design discharge	4.9 m^3/s
(b)	Type	Trapezoidal, lined with concrete
(c)	Bottom width	2.0 m
(d)	Length	1,800 m

3.4 Khlong Yai Headworks

(a)	Location	Khlong Yai river
(b)	Design flood	280 m^3/s
(c)	Flood water level	El. 26.57 m
(d)	Design intake discharge	11.09 m^3/s
(e)	Design intake water level	El. 25.00 m
(f)	Type of diversion weir	Floating type
(g)	Height of weir above riverbed	4.1 m
(h)	Length of fixed weir	95.0 m
(i)	Crest elevation of fixed weir	El. 25.1 m
(j)	Width of scouring sluice	8.0 m
(k)	Sill elevation of intake	El. 23.0 m
(l)	Intake gate (B x H)	4.0 m x 3.0 m
(m)	Number of intake gate	2

3.5 Main Canal

(a)	Type of canal	Trapezoidal, lined with concrete
(b)	Side slop	1:1.5
(c)	Effective width of inspection road	5.0 m
(d)	Length	45.2 km

3.6 Lateral and Sub-Lateral Canals

(a)	Type of canal	Trapezoidal, unlined
(b)	Side slop	1:1.5
(c)	Effective width of inspection road	3.0 m
(d)	Total length	123 km

3.7	Canal Structures	503 nos.
3.8	Drainage	
	(a) New drains	81 km
	(b) Improved drains	43 km
	(c) Structures	59 km

Table 6 PRINCIPAL FEATURES OF KHLONG THAP MA DAM SCHEME

1.	MULTIPLE-PURPOSE DAM	
1.1	Hydrology	
	(a) Catchment area	158 km^2
	(b) Annual average in flow	1.75 m^3/s
	(c) Design flood for spillway (500-year flood)	920 m^3/s
	(d) Extra-ordinary flood (Probable maximum)	1,540 m^3/s
1.2	Reservoir	
	(a) High water level	El. 25.7 m
	(b) Low water level	El. 16.2 m
	(c) Flood water level	El. 26.9 m
	(d) Extra-ordinary flood water level	El. 27.5 m
	(e) Gross storage	74.3x10^6 m^3
	(f) Surcharge	13.5x10^6 m^3
	(g) Active storage	56.1x10^6 m^3
	(h) Dead storage	4.7x10^6 m^3
	(i) Reservoir area at HWL	10. 5 km^2
1.3	Main Dam	
	(a) Type	Homogeneous earthfill
	(b) Crest elevation	El. 28.9 m
	(c) Dam height above riverbed	20.4 m
	(d) Crest length	810 m
	(e) Crest width	8.0 m
	(f) Slope, upstream	1 : 3.1
	downstream	1 : 2.6
	(g) Embankment volume	
	Earthfill	1,182,000 m^3
	Filter	92,000 m^3
	Rock riprap	71,000 m^3
1.4	Saddle Dam	
	(a) Type	Homogeneous earthfill
	(b) Crest elevation	El. 28.9 m
	(c) Dam height above original ground surface	3.3 m
	(d) Crest length	420 m
	(e) Crest width	8.0 m
	(f) Slope, upstream	1 : 3.1
	downstream	1 : 2.6

(g)	Embankment volume		
	Earth fill	35,000 m^3	
	Filter	9,000 m^3	
	Rock Riprap	5,000 m^3	
1.5	Spillway		
(a)	Type	Non-gated side-channel weir	
(b)	Overflow weir crest elevation	El. 25.7 m	
(c)	Overflow weir crest width	50.0 m	
(d)	Length of chuteway, including stilling basin	235 m	
2.	IRRIGATION AND DRAINAGE SYSTEM	East Area	West Area
2.1	Net Irrigation Area	1,250 ha	1,150 ha
2.2	Intake		
(a)	Location	Khlong Thap Ma Reservoir	
(b)	Discharge capacity	1.80 m^3/s	1.66 m^3/s
(c)	Diameter of outlet conduit	ø1,300 mm	ø1,300 mm
(d)	Length of outlet conduit	100 m	87 m
(e)	Intake gate (B x H)	1.3m x 1.3m	1.3m x 1.3m
2.3	Main Canals		
(a)	Type of canal	Trapezoidal, lined with concrete	
(b)	Side slope	1 : 1.5	
(c)	Effective width of inspection road	5.0 m	
(d)	Length	5.3 km	11.3 km
2.4	Lateral and Sub-lateral Canals		
(a)	Type of canal	Trapezoidal, unlined	
(b)	Side slope	1 : 1.5	
(c)	Effective width of inspection road	5.0 m	
(d)	Total length	17 km	21 km
2.5	Canal structures	73 nos.	105 nos.
2.6	Drainage		
(a)	New drains	31 km	
(b)	Improved drains	8 km	
(c)	Structures	10 nos.	

Table 7 INVESTMENT COST OF KHLONG LUANG DAM SCHEME

(Unit: ฿ 10^3)

	Description	First Stage			Second Stage		
		Foreign Currency Portion	Local Currency Portion	Total	Foreign Currency Portion	Local Currency Portion	Total
I.	Dam						
1.	Preparatory Works	12,860	21,380	34,240			
2.	Care of River	3,210	5,340	8,550			
3.	Dam	313,780	510,920	824,700			
4.	Spillway	7,600	23,480	31,080			
5.	Contractor's Administration Cost	11,810	19,640	31,450			
6.	Contractor's Profit	21,930	36,470	58,400			
7.	Tax	-	30,550	30,550			
	Sub-total	371,190	647,780	1,018,970			
8.	Compensation & Relocation		272,020	272,020			
9.	Engineering Services	71,330	30,570	101,900			
10.	Administration Cost of Executive Agency	-	20,380	20,380			
	Sub-total	442,520	970,750	1,413,270			
11.	Physical Contingency	66,380	145,610	211,990			
	Sub-total	508,900	1,116,360	1,625,260			
12.	Price Contingency	243,890	600,400	844,290			
	Total	752,790	1,716,760	2,469,550			
II.	Raw Water Conveyance System						
1.	Preparatory Works	16,140	3,860	20,000	13,590	2,070	15,660
2.	Civil Works	3,650	17,700	21,350	-	-	-
3.	Mechanical Works	135,680	20,700	156,380	131,280	20,650	151,930
4.	Electrical Works	22,070	210	22,280	4,650	60	4,710
5.	Contractor's Administration Cost	6,210	1,490	7,700	5,230	800	6,030
6.	Contractor's Profit	11,540	2,760	14,300	9,720	1,480	11,200
7.	Tax	-	7,480	7,480	-	5,860	5,860
	Sub-total	195,290	54,200	249,490	164,470	30,920	195,390
8.	Compensation	-	300	300	-	-	-
9.	Engineering Services	13,970	6,000	19,970	10,940	4,690	15,630
10.	Administration Cost of Executive Agency/1	-	21,680	21,680	-	7,320	7,320
	Sub-total	209,260	82,180	291,440	175,410	43,430	218,840
11.	Physical Contingency	31,390	12,320	43,710	26,310	6,520	32,830
	Sub-total	240,650	94,500	335,150	201,720	49,950	251,670
12.	Price Contingency	147,620	76,080	223,700	281,430	96,880	378,310
	Total	388,270	170,580	558,850	483,150	146,830	629,980
III.	Irrigation						
1.	Preparatory Works	8,000	44,300	52,300			
2.	Intake Structure	8,700	19,200	27,900			
3.	Canal Construction	70,800	168,900	239,700			
4.	Contractor's Administration Cost	3,060	8,150	11,210			
5.	Contractor's profit	5,690	15,140	20,830			
6.	Tax	-	10,890	10,890			
	Sub-total	96,250	267,080	363,330			
7.	Compensation & Relocation	-	9,150	9,150			
8.	Engineering Services	33,060	14,170	47,230			
9.	Administration Cost of Executive Agency/2	21,800	19,900	41,700			
	Sub-total	151,110	310,300	461,410			
10.	Physical Contingency	22,680	46,540	69,220			
	Sub-total	173,790	356,840	530,630			
11.	Price Contingency	103,820	272,760	376,580			
	Total	277,610	629,600	907,210			
	Grand Total	1,418,670	2,516,940	3,935,610	483,150	146,830	629,980

/1: Including comission to PEA

/2: Including cost for O&M equipment

Table 8 INVESTMENT COST OF KHLONG YAI DAM SCHEME

(Unit: ฿10³)

Description	First Stage			Second Stage		
	Foreign Currency Portion	Local Currency Portion	Total	Foreign Currency Portion	Local Currency Portion	Total
I. Khlong Yai Dam						
1. Preparatory Works	12,120	20,320	32,440			
2. Care of River	3,030	5,080	8,110			
3. Main Dam	275,950	448,020	723,970			
4. Intake	7,170	7,540	14,710			
5. Spillway	19,990	52,550	72,540			
6. Contractor's Administration Cost	11,140	18,670	29,810			
7. Contractor's Profit	20,690	34,680	55,370			
8. Tax	-	28,960	28,960			
Sub-total	350,090	615,820	965,910			
9. Compensation & Relocation	-	87,800	87,800			
10. Engineering Services	67,610	28,980	96,590			
11. Administration Cost of Executive Agency	-	19,320	19,320			
Sub-total	417,700	751,920	1,169,620			
12. Physical Contingency	62,660	112,790	175,450			
Sub-total	480,360	864,710	1,345,070			
13. Price Contingency	227,100	512,750	739,850			
Total	707,460	1,377,460	2,084,920			
II. Nong Pla Lai Dam						
1. Preparatory Works	14,180	25,710	39,890			
2. Diversion & Coffer	82,410	155,710	238,120			
3. Dam	232,230	378,390	610,620			
4. Spillway	32,420	103,260	135,680			
5. Intake	7,490	5,420	12,910			
6. Contractor's Administration Cost	12,910	23,400	36,310			
7. Contractor's Profit	23,970	43,450	67,420			
8. Tax	-	35,260	35,260			
Sub-total	405,610	770,600	1,176,210			
9. Compensation & Relocation	-	242,290	242,290			
10. Engineering Services	82,330	35,290	117,620			
11. Administration Cost of Executive Agency	-	23,520	23,520			
Sub-total	487,940	1,071,700	1,559,640			
12. Physical Contingency	73,190	160,760	233,950			
Sub-total	561,430	1,232,460	1,793,590			
13. Price Contingency	152,040	380,350	532,390			
Total	713,170	1,612,810	2,325,980			
III. Raw Water Conveyance System						
1. Preparatory Works	24,100	5,860	29,960	21,540	4,240	25,780
2. Civil Works	3,200	16,030	19,230	-	-	-
3. Mechanical Works	215,980	42,410	258,390	210,690	42,350	253,040
4. Electrical Works	21,870	190	22,060	4,660	50	4,710
5. Contractor's Administration Cost	9,280	2,260	11,540	8,290	1,630	9,920
6. Contractor's Profit	17,230	4,190	21,420	15,400	3,030	18,430
7. Tax	-	11,210	11,210	-	9,640	9,640
Sub-total	291,660	82,150	373,810	260,580	60,940	321,520
8. Compensation & Relocation	-	300	300	-	-	-
9. Engineering Services	20,940	8,970	29,910	18,010	7,720	25,730
10. Administration Cost of Executive Agency	-	26,660	26,660	-	12,860	12,860
Sub-total	312,600	118,080	430,680	278,590	81,520	360,110
11. Physical Contingency	46,890	17,710	64,600	41,790	12,230	54,020
Sub-total	359,490	135,790	495,280	320,380	93,750	414,130
12. Price Contingency	226,350	112,520	338,870	446,840	182,240	629,080
Total	585,840	248,310	834,150	767,220	275,990	1,043,210
IV. Irrigation						
1. Preparatory Works	11,800	54,200	66,000			
2. Diversion Structure	33,600	62,500	96,100			
3. Canal Construction	84,800	209,700	294,500			
4. Contractor's Administration Cost	4,560	11,420	15,980			
5. Contractor's Profit	8,460	21,220	29,680			
6. Tax	-	15,520	15,520			
Sub-total	143,220	374,560	517,780			
7. Compensation & Relocation	-	44,400	44,400			
8. Engineering Services	47,120	20,190	67,310			
9. Administration Cost of Executive Agency	24,130	27,820	51,950			
Sub-total	214,470	466,970	681,440			
10. Physical Contingency	32,170	70,050	102,220			
Sub-total	246,640	537,020	783,660			
11. Price Contingency	133,710	374,210	507,920			
Total	380,350	911,230	1,291,580			
Grand Total	2,386,820	4,149,810	6,536,630	767,220	275,990	1,043,210

Table 9 INVESTMENT COST OF KHLONG THAP MA DAM SCHEME

(Unit: ฿10^3)

Description	Foreign Currency Portion	Local Currency Portion	Total
I. Dam			
1. Preparatory Work	5,140	9,250	14,390
2. Care of River	1,290	2,310	3,600
3. Dam	118,130	189,830	307,960
4. Spillway	10,270	40,700	50,970
5. Contractor's Administration Cost	4,720	8,470	13,190
6. Contractor's Profit	8,760	15,740	24,500
7. Tax	-	12,820	12,820
Sub-total	148,310	279,120	427,430
8. Compensation & Relocation	-	294,300	294,300
9. Engineering Services	29,920	12,820	42,740
10. Administration Cost of Executive Agency	-	8,550	8,550
Sub-total	178,230	594,790	773,020
11. Physical Contingency	26,740	89,220	115,960
Sub-total	204,970	684,010	888,980
12. Price Contingency	89,520	297,460	386,980
Total	294,490	981,470	1,275,960
II. Irrigation and Drainage System			
1. Preparatory Work	3,100	18,900	22,000
2. Intake Structure	6,300	10,600	16,900
3. Canal Construction	24,400	58,100	82,500
4. Contractor's Administration Cost	1,180	3,070	4,250
5. Contractor's Profit	2,200	5,690	7,890
6. Tax	-	4,130	4,130
Sub-total	37,180	100,490	137,670
7. Compensation & Relocation	-	11,090	11,090
8. Engineering Services	12,530	5,370	17,900
9. Administration Cost of Executive Agency	8,930	5,730	14,660
Sub-total	58,640	122,680	181,320
10. Physical Contingency	8,800	18,400	27,200
Sub-total	67,440	141,080	208,520
11. Price Contingency	29,560	77,300	106,860
Total	97,000	218,380	315,380
Grand Total	391,490	1,199,850	1,591,340

Table 10 DISBURSEMENT SCHEDULE OF INVESTMENT COST, KHLONG LUANG DAM SCHEME

FIRST STAGE

(Unit: ฿ 10^3)

Item	Summary			1985		1986		1987		1988		1989		1990		1991	
	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Compensation & Relocation	281,470	-	281,470	-	136,010	-	136,010	-	2,750	-	3,950	-	2,750	-	-	-	-
2. Dam	1,018,970	371,190	647,780	-	-	11,140	19,430	96,510	161,950	111,360	187,860	118,780	220,240	33,400	58,300	-	-
3. Water Conveyance System	249,490	195,290	54,200	-	-	-	-	-		42,960	11,920	64,450	17,880	64,450	17,880	23,430	6,520
4. Irrigation	363,330	96,250	267,080	-	-	-	-	-	20,650	29,310	80,350	31,890	78,820	27,260	67,870	7,790	19,390
Sub-total	1,913,260	662,730	1,250,530	-	136,010	11,140	155,440	96,510	185,350	183,630	284,080	215,120	319,690	125,110	144,050	31,220	25,910
5. Engineering Services	169,100	118,360	50,740	11,890	5,090	19,260	8,260	19,690	8,240	23,950	10,060	24,900	11,080	12,310	5,280	6,360	2,730
6. Administration Cost of Exec. Agency	83,760	21,800	61,960	-	3,030	-	5,280	-	5,920	4,360	12,980	8,720	16,070	4,360	12,150	4,360	6,530
Sub-total	2,166,120	802,890	1,363,230	11,890	144,130	30,400	168,980	116,200	199,510	211,940	307,120	248,740	346,840	141,780	161,480	41,940	35,170
7. Physical Contingency	324,920	120,450	204,470	1,780	21,620	4,560	25,340	17,430	29,920	31,790	46,070	37,320	52,030	21,270	24,220	6,300	5,270
Sub-total	2,491,040	923,340	1,567,700	13,670	165,750	34,960	194,320	133,630	229,430	243,730	353,190	286,060	398,870	163,050	185,700	48,240	40,440
8. Price Contingency	1,444,570	495,330	949,240	2,280	34,810	9,080	64,320	48,170	106,480	114,400	215,630	167,880	307,750	116,390	176,190	37,130	44,060
Grand Total	3,935,610	1,418 670	2,516,940	15,950	200,560	44,040	258,640	181,800	335,910	358,130	568,820	453,940	706,620	279,440	361 890	85,370	84,500

SECOND STAGE

Item	Summary			1992		1993		1994		1995		1996	
	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Water Conveyance System	195,390	164,470	30,920	-	-	36,180	6,810	54,280	10,200	54,280	10,200	19,730	3,710
2. Irrigation	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-total	195,390	164,470	30,920	-	-	36,180	6,810	54,280	10,200	54,280	10,200	19,730	3,710
3. Engineering Services	15,630	10,940	4,690	2,620	1,130	2,410	1,030	2,410	1,030	2,410	1,030	1,090	470
4. Administration Cost of Exec. Agency	7,820	-	7,820	-	250		1,720	-	2,460	-	2,470	-	920
Sub-total	218,840	175,410	43,430	2,620	1,380	38,590	9,560	56,690	13,690	56,690	13,700	20,820	5,100
5. Physical Contingency	32,830	26,310	6,520	390	210	5,790	1,430	8,500	2,060	8,500	2,060	3,130	760
Sub-total	251,670	201,720	49,950	3,010	1,590	44,380	10,990	65,190	15,750	65,190	15,760	23,950	5,860
6. Price Contingency	378,310	281,430	96,880	3,020	2,140	51,430	17,500	86,810	29,190	98,970	33,680	41,200	14,370
Grand Total	629,980	483,150	146,830	6,030	3,730	95,810	28,490	152,000	44,940	164,160	49,440	65,150	20,230

Table 11 DISBURSEMENT SCHEDULE OF INVESTMENT COST, KHLONG YAI DAM SCHEME

FIRST STAGE

(Unit: ฿10^3)

Item	Summary			1984		1985		1986		1987		1988		1989		1990		1991	
	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Compensation & Relocation	374,790	-	374,790	-	121,140	-	165,050	-	57,220	-	13,320	-	9,180	-	8,880	-	-	-	-
2. Khlong Yai Dam	965,510	350,090	615,820	-	-	-	-	10,500	18,480	101,530	166,270	105,020	178,590	101,530	197,060	31,510	55,420	-	-
3. Nong Pla Lai Dam	1,176,210	405,610	770,600	-	-	48,670	92,470	231,200	439,240	125,740	238,890	-	-	-	-	-	-	-	-
4. Water Conveyance System	373,810	291,660	82,150	-	-	-	-	-	-	-	-	64,160	18,070	96,250	27,110	96,250	27,110	35,000	9,860
5. Irrigation	517,780	143,220	374,560	-	-	-	-	-	21,430	19,620	52,190	39,720	90,380	41,900	102,260	32,650	84,240	9,330	24,060
Sub-total	3,408,500	1,190,580	2,217,920	-	121,140	48,670	257,520	241,700	536,370	246,890	470,670	208,900	296,220	239,680	335,310	160,410	166,770	44,330	33,920
6. Engineering Service	311,430	218,000	93,430	13,720	5,880	40,060	17,170	49,560	21,240	42,160	17,690	27,560	11,620	24,750	11,180	14,320	6,130	5,870	2,520
7. Administration of Exec. Agency	121,450	24,130	97,320	-	2,850	-	10,710	-	16,270	4,830	15,240	7,230	15,470	4,830	18,230	4,830	12,640	2,410	5,910
Sub-total	3,841,380	1,432,710	2,408,670	13,720	129,870	88,730	285,400	291,260	573,880	293,880	503,600	243,690	323,310	269,260	364,720	179,560	185,540	52,610	42,310
8. Physical Contingency	576,220	214,910	361,310	2,060	19,480	42,810	43,690	86,080	44,080	44,080	75,550	36,540	48,500	40,390	54,700	26,940	27,830	7,880	6,360
Sub-total	4,417,600	1,647,620	2,769,980	15,780	149,350	102,040	328,210	334,950	659,960	337,960	579,150	280,250	371,810	309,650	419,420	206,300	213,370	60,490	48,670
9. Price Contingency	2,119,030	739,200	1,379,830	1,260	14,940	16,980	68,920	87,000	218,450	121,840	268,790	131,530	226,990	181,720	323,610	147,400	202,430	51,470	55,700
Grand Total	6,536,630	2,386,820	4,149,810	17,040	164,290	119,020	397,130	421,950	878,410	459,800	847,940	411,780	598,800	491,370	743,030	353,900	415,800	119,600	104,410

SECOND STAGE

Item	Summary			1992		1993		1994		1995		1996	
	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C	F.C.	L.C.	F.C.	L.C.
1. Water Conveyance System	321,520	260,580	60,940	-	-	57,330	13,410	85,990	20,110	85,990	20,110	31,270	7,310
Sub-total	321,520	260,580	60,940	-	-	57,330	13,410	85,990	20,110	85,990	20,110	31,270	7,310
2. Engineering Services	25,730	18,010	7,720	4,330	1,850	3,960	1,700	3,960	1,700	3,960	1,700	1,800	770
3. Administration of Exec. Agency	12,860	-	12,860	-	340	-	2,830	-	4,090	-	4,090	-	1,510
Sub-total	360,110	278,590	81,520	4,330	2,190	61,290	17,940	89,950	25,900	89,950	25,900	33,070	9,590
4. Physical Contingency	54,020	41,790	12,230	660	340	9,190	2,690	13,490	3,880	13,490	3,880	4,960	1,440
Sub-total	414,130	320,380	93,750	4,990	2,530	70,480	20,630	103,440	29,780	103,440	29,780	38,030	11,030
5. Price Contingency	629,080	446,840	182,240	4,970	3,440	81,680	32,870	137,750	55,180	157,040	63,680	65,400	27,070
Grand Total	1,043,210	767,220	275,990	9,960	5,970	152,160	53,500	241,190	84,960	260,480	93,460	103,430	38,100

Table 12 DISBURSEMENT SCHEDULE OF INVESTMENT COST, KHLONG THAP MA DAM SCHEME

(Unit: ฿ 10^3)

Item	Summary			1985		1986		1987		1988		1989	
	Total	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.	F.C.	L.C.
1. Compensation & Relocation	305,390	-	305,390	-	147,150	-	149,370	-	4,430	-	3,330	-	1,110
2. Dam	427,430	148,310	279,120	-	-	4,450	8,370	57,840	94,900	48,940	83,740	37,080	92,110
3. Irrigation	137,670	37,180	100,490	-	-	-	9,510	15,620	39,010	13,500	31,960	8,060	20,010
Sub-total	870,490	185,490	685,000	-	147,150	4,450	167,250	73,460	138,340	62,440	119,030	45,140	113,230
4. Engineering Services	60,640	42,450	18,190	7,500	3,210	7,460	3,200	10,290	3,980	9,700	3,910	7,500	3,890
5. Administration Cost of Exec. Agency	23,210	8,930	14,280	-	2,680	-	3,300	2,680	3,160	3,570	2,550	2,680	2,590
Sub-total	954,340	236,870	717,470	7,500	153,040	11,910	173,750	86,430	145,480	75,710	125,490	55,320	119,710
6. Physical Contingency	143,160	35,540	107,620	1,130	22,960	1,790	26,060	12,960	21,830	11,360	18,820	8,300	17,950
Sub-total	1,097,500	272,410	825,090	8,630	176,000	13,700	199,810	99,390	167,310	87,070	144,310	63,620	137,660
7. Price Contingency	493,840	119,080	374,760	1,450	36,960	3,560	66,120	35,810	77,430	40,880	88,080	37,380	106,170
Grand Total	1,591,340	391,490	1,199,850	10,080	212,960	17,260	265,930	135,200	244,740	127,950	232,390	101,000	243,830

Table 13 FINANCIAL STATEMENT OF KHLONG LUANG DAM SCHEME, DOMESTIC AND INDUSTRIAL WATER SUPPLY COMPONENT

(Unit: $B10^3$)

No.	Year	Loan Disbursement	Accumulated Loan	Revenue (A)	Expenditure					Gross Income (A)-(B)	Government Subsidy	Total Income	Accumulated Income
					OM & R Cost (1)	OM & R Cost (2)	Repayment on Loan Interest	Repayment on Loan Capital	Total (B)				
1.	1985	5,100	5,100	0	0	0	178	0	178	-178	178	0	0
2.	1986	11,330	16,430	0	0	0	575	0	575	-575	575	0	0
3.	1987	59,760	76,190	0	0	0	2,666	0	2,666	-2,666	2,666	0	0
4.	1988	145,710	221,900	0	0	0	7,766	0	7,766	-7,766	7,766	0	0
5.	1989	201,470	423,370	0	0	0	14,817	0	14,817	-14,817	14,817	0	0
6.	1990	156,840	580,210	0	0	0	20,307	0	20,307	-20,307	20,307	0	0
7.	1991	48,940	629,150	13,120	8,200	5,730	22,020	0	35,950	-22,830	22,830	0	0
8.	1992	6,040	635,190	17,600	11,000	6,530	22,231	0	39,762	-22,162	22,162	0	0
9.	1993	95,810	731,000	21,760	13,600	7,330	25,585	0	46,515	-24,755	24,755	0	0
10.	1994	151,990	882,990	26,240	16,400	8,230	30,904	255	55,790	-29,550	29,550	0	0
11.	1995	164,150	1,046,885	30,400	19,000	9,030	36,640	821	65,492	-35,092	35,092	0	0
12.	1996	65,160	1,111,223	34,880	21,800	12,430	38,892	3,809	76,932	-42,052	42,052	0	0
13.	1997	0	1,107,414	39,360	24,600	13,330	38,759	11,095	87,784	-48,424	48,424	0	0
14.	1998	0	1,096,319	43,840	27,400	14,230	38,371	21,168	101,170	-57,330	57,330	0	0
15.	1999	0	1,075,150	48,000	30,000	15,030	37,630	29,010	111,671	-63,671	63,671	0	0
16.	2000	0	1,046,140	52,480	32,800	15,930	36,614	31,457	116,802	-64,322	64,322	0	0
17.	2001	0	1,014,682	56,960	35,600	16,830	35,513	31,759	119,703	-62,743	62,743	0	0
18.	2002	0	982,923	56,960	35,600	16,830	34,402	36,550	123,382	-66,422	66,422	0	0
19.	2003	0	946,373	56,960	35,600	16,830	33,123	44,149	129,702	-72,742	72,742	0	0
20.	2004	0	902,223	56,960	35,600	16,830	31,577	52,357	136,365	-79,405	79,405	0	0
21.	2005	0	849,866	56,960	35,600	16,830	29,745	55,615	137,790	-80,830	80,830	0	0
22.	2006	0	794,251	56,960	35,600	16,830	27,798	55,615	135,844	-78,884	78,884	0	0
23.	2007	0	738,636	56,960	35,600	54,930	25,852	55,615	171,997	-115,037	115,037	0	0
24.	2008	0	683,021	56,960	35,600	16,830	23,905	55,615	131,951	-74,991	74,991	0	0
25.	2009	0	627,406	56,960	35,600	16,830	21,959	55,615	130,004	-73,044	73,044	0	0
26.	2010	0	571,791	56,960	35,600	16,830	20,012	55,615	128,058	-71,098	71,098	0	0
27.	2011	0	516,176	56,960	35,600	16,830	18,066	55,615	126,111	-69,151	69,151	0	0
28	2012	0	460,561	56,960	35,600	27,530	16,119	55,615	134,864	-77,904	77,904	0	0
29.	2013	0	404,946	56,960	35,600	16,830	14,173	55,615	122,218	-65,258	65,258	0	0
30.	2014	0	349,331	56,960	35,600	16,830	12,226	55,360	120,017	-63,057	63,057	0	0
31.	2015	0	293,971	56,960	35,600	16,830	10,289	54,793	117,512	-60,552	60,552	0	0
32.	2016	0	239,178	56,960	35,600	16,830	8,371	51,805	112,607	-55,647	55,647	0	0
33.	2017	0	187,372	56,960	35,600	16,830	6,558	44,520	103,508	-46,548	46,548	0	0
34.	2018	0	142,852	56,960	35,600	16,830	4,999	34,446	91,876	-34,916	34,916	0	0
35.	2019	0	108,406	56,960	35,600	16,830	3,794	26,604	82,829	-25,869	25,869	0	0
36.	2020	0	81,801	56,960	35,600	16,830	2,863	24,157	79,450	-22,490	22,490	0	0
37.	2021	0	57,644	56,960	35,600	16,830	2,017	23,855	78,303	-21,343	21,343	0	0
38.	2022	0	33,788	56,960	35,600	16,830	1,182	19,065	72,677	-15,717	15,717	0	0
39.	2023	0	14,723	56,960	35,600	54,930	515	11,465	102,511	-45,551	45,551	0	0
40.	2024	0	3,258	56,960	35,600	16,830	114	3,258	55,802	1,158	0	1,158	1,158
41.	2025	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	5,688
42.	2026	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	10,218
43.	2027	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	14,748
44.	2028	0	0	56,960	35,600	27,530	0	0	63,130	-6,170	0	-6,170	8,578
45.	2029	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	13,108
46.	2030	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	17,638
47.	2031	0	0	56,960	35,600	201,630	0	0	237,230	-180,270	162,632	-17,638	0
48.	2032	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	4,530
49.	2033	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	9,060
50.	2034	0	0	56,960	35,600	16,830	0	0	52,430	4,530	0	4,530	13,590

Note: OM & R (1): OM & R cost for distribution and purification

OM & R (2): OM & R cost for [illegible]

Table 14 FINANCIAL STATEMENT OF KHLONG LUANG DAM SCHEME, IRRIGATION COMPONENT

(Unit: $B10^3$)

No.	Year	Loan Disbursement	Accumulated Loan	Outflow				Inflow			Balance of Payment (B) - (A)
				O M&R Cost	Repayment on Loan Interest	Repayment on Loan Capital	Total (A)	Project Revenue	Government Subsidy	Total (B)	
1	1985	8,610	8,610	0	301	0	301	0	301	301	0
2	1986	27,740	36,350	0	1,272	0	1,272	0	1,272	1,272	0
3	1987	98,200	134,550	0	4,709	0	4,709	0	4,709	4,709	0
4	1988	182,700	317,250	0	11,103	0	11,103	0	11,103	11,103	0
5	1989	218,230	535,480	0	18,741	0	18,741	0	18,741	18,741	0
6	1990	112,200	647,680	1,330	22,668	0	23,998	1,320	22,668	23,998	0
7	1991	36,430	684,110	3,590	23,943	0	27,533	3,590	23,943	27,533	0
8	1992	0	684,110	4,420	23,943	0	28,363	4,420	23,943	28,363	0
9	1993	0	684,110	4,420	23,943	0	28,363	4,420	23,943	28,363	0
10	1994	0	684,110	4,420	23,943	430	28,794	4,420	24,374	28,794	0
11	1995	0	683,679	4,420	23,928	1,817	30,166	4,420	25,746	30,166	0
12	1996	0	681,862	4,420	23,865	6,727	35,012	4,420	30,592	35,012	0
13	1997	0	675,134	4,420	23,629	15,862	43,912	4,420	39,492	43,912	0
14	1998	0	659,272	4,420	23,074	26,774	54,268	4,420	49,848	54,268	0
15	1999	0	632,498	26,220	22,137	32,384	80,741	4,420	76,321	80,741	0
16	2000	0	600,114	4,420	21,003	34,205	59,629	4,420	55,209	59,629	0
17	2001	0	565,908	4,420	19,806	34,205	58,432	4,420	54,012	58,432	0
18	2002	0	531,700	4,420	18,609	34,205	57,235	4,420	52,815	57,235	0
19	2003	0	497,497	4,420	17,412	34,205	56,037	4,420	51,617	56,037	0
20	2004	0	463,292	4,420	16,215	34,205	54,840	4,420	50,420	54,840	0
21	2005	0	429,086	4,420	15,018	34,205	53,643	4,420	49,223	53,643	0
22	2006	0	394,881	4,420	13,820	34,205	52,446	4,420	48,026	52,446	0
23	2007	0	360,675	4,420	12,623	34,205	51,249	4,420	46,829	51,249	0
24	2008	0	326,470	4,420	11,426	34,205	50,051	4,420	45,631	50,051	0
25	2009	0	292,264	26,220	10,229	34,205	70,654	4,420	66,234	70,654	0
26	2010	0	258,059	4,420	9,032	34,205	47,657	4,420	43,237	47,657	0
27	2011	0	223,853	4,420	7,834	34,205	46,460	4,420	42,040	46,460	0
28	2012	0	189,648	4,420	6,637	34,205	45,263	4,420	40,843	45,263	0
29	2013	0	155,442	4,420	5,440	34,205	44,065	4,420	39,645	44,065	0
30	2014	0	121,237	26,930	4,243	33,775	64,948	4,420	60,528	64,948	0
31	2015	0	87,462	4,420	3,061	32,388	39,869	4,420	35,449	39,869	0
32	2016	0	55,074	4,420	1,927	27,478	33,825	4,420	29,405	33,825	0
33	2017	0	27,596	4,420	965	18,343	23,728	4,420	19,308	23,728	0
34	2018	0	9,253	4,420	323	7,431	12,175	4,420	7,755	12,175	0
35	2019	0	1,821	26,220	63	1,821	28,105	4,420	23,685	28,105	0
36	2020	0	0	4,420	0	0	4,420	4,420	0	4,420	0
37	2021	0	0	4,420	0	0	4,420	4,420	0	4,420	0
38	2022	0	0	4,420	0	0	4,420	4,420	0	4,420	0
39	2023	0	0	4,420	0	0	4,420	4,420	0	4,420	0
40	2024	0	0	4,420	0	0	4,420	4,420	0	4,420	0
41	2025	0	0	4,420	0	0	4,420	4,420	0	4,420	0
42	2026	0	0	4,420	0	0	4,420	4,420	0	4,420	0
43	2027	0	0	4,420	0	0	4,420	4,420	0	4,420	0
44	2028	0	0	4,420	0	0	4,420	4,420	0	4,420	0
45	2029	0	0	26,220	0	0	26,220	4,420	21,800	26,220	0
46	2030	0	0	4,420	0	0	4,420	4,420	0	4,420	0
47	2031	0	0	4,420	0	0	4,420	4,420	0	4,420	0
48	2032	0	0	4,420	0	0	4,420	4,420	0	4,420	0
49	2033	0	0	4,420	0	0	4,420	4,420	0	4,420	0
50	2034	0	0	4,420	0	0	4,420	4,420	0	4,420	0

Table 15 FINANCIAL STATEMENT OF KHLONG YAI DAM SCHEME, DOMESTIC AND INDUSTRIAL WATER SUPPLY COMPONENT

(Unit: $B10^3$)

No.	Year	Loan Disburse-ment	Accu-mulated Loan	Revenue (A)	Expenditure					Gross Income (A)-(B)	Government Subsidy	Total Income	Accu-mulated Income
					OM & R Cost(1)	OM & R Cost(2)	Repayment on Loan Interest	Repayment on Loan Capital	Total (B)				
1.	1984	12,100	12,100	0	0	0	423	0	423	-423	423	0	0
2.	1985	76,430	88,530	0	0	0	3,098	0	3,098	-3,098	3,098	0	0
3.	1986	293,770	382,300	0	0	0	13,380	0	13,380	-13,380	13,380	0	0
4.	1987	293,710	676,010	0	0	0	23,660	0	23,660	-23,660	23,660	0	0
5.	1988	258,430	934,440	8,020	0	4,170	32,705	0	36,875	-28,855	28,855	0	0
6.	1989	332,540	1,266,980	8,240	0	4,170	44,344	0	48,514	-40,274	40,274	0	0
7.	1990	248,560	1,515,540	8,440	0	4,170	53,043	0	57,213	-48,773	48,773	0	0
8.	1991	73,100	1,588,640	24,320	9,800	15,500	55,602	0	80,902	-56,582	56,582	0	0
9.	1992	9,960	1,598,600	30,600	13,600	17,200	55,951	0	86,751	-56,582	56,151	0	0
10.	1993	152,160	1,750,760	36,560	17,200	18,900	61,276	605	97,981	-61,421	61,421	0	0
11.	1994	241,190	1,991,345	42,840	42,000	20,600	69,697	4,426	115,723	-72,883	72,883	0	0
12.	1995	260,480	2,247,398	48,800	24,600	22,300	78,658	19,115	144,673	-95,873	95,873	0	0
13.	1996	103,430	2,331,713	55,080	28,400	27,100	81,609	33,800	170,910	-115,830	115,830	0	0
14.	1997	0	2,297,913	66,180	35,200	30,200	80,426	46,722	192,548	-126,368	126,368	0	0
15.	1998	0	2,251,191	77,260	42,000	33,300	78,791	63,349	217,440	-140,180	140,180	0	0
16.	1999	0	2,187,842	88,680	49,000	36,400	76,574	75,777	237,751	-149,071	149,071	0	0
17.	2000	0	2,112,065	99,760	55,800	39,500	73,922	79,432	248,654	-148,894	148,894	0	0
18.	2001	0	2,032,633	110,860	62,600	42,600	71,142	79,930	256,272	-145,412	145,412	0	0
19.	2002	0	1,952,703	110,860	62,600	42,600	68,344	87,538	261,082	-150,222	150,222	0	0
20.	2003	0	1,865,165	110,860	62,600	42,600	65,280	99,597	270,078	-159,218	159,218	0	0
21.	2004	0	1,765,567	110,860	62,600	42,600	61,794	112,621	279,616	-168,756	168,756	0	0
22.	2005	0	1,652,946	110,860	62,600	42,600	57,853	117,793	280,846	-169,986	169,986	0	0
23.	2006	0	1,535,153	110,860	62,600	42,600	53,730	117,793	276,723	-165,863	165,863	0	0
24.	2007	0	1,417,360	110,860	62,600	86,000	49,607	117,793	316,000	-205,140	205,140	0	0
25.	2008	0	1,299,567	110,860	62,600	42,600	45,484	117,793	268,477	-157,617	157,617	0	0
26.	2009	0	1,181,774	110,860	62,600	42,600	41,362	117,793	264,355	-153,495	153,495	0	0
27.	2010	0	1,063,981	110,860	62,600	42,600	37,239	117,793	260,232	-149,372	149,372	0	0
28.	2011	0	946,188	110,860	62,600	42,600	33,116	117,793	256,109	-145,249	145,249	0	0
29.	2012	0	828,395	110,860	62,600	57,600	28,993	117,793	266,986	-156,126	156,126	0	0
30.	2013	0	710,602	110,860	62,600	42,600	24,871	117,188	247,259	-136,399	136,399	0	0
31.	2014	0	593,414	110,860	62,600	42,600	20,769	113,366	239,335	-128,475	128,475	0	0
32.	2015	0	480,047	110,860	62,600	42,600	16,801	98,678	220,679	-109,819	109,819	0	0
33.	2016	0	381,369	110,860	62,600	42,600	13,347	83,992	202,540	-91,680	91,680	0	0
34.	2017	0	297,377	110,860	62,600	42,600	10,408	71,071	186,679	-75,819	75,819	0	0
35.	2018	0	226,306	110,860	62,600	42,600	7,920	54,444	167,564	-56,704	56,704	0	0
36.	2019	0	171,862	110,860	62,600	42,600	6,015	42,016	153,231	-42,371	42,371	0	0
37.	2020	0	129,846	110,860	62,600	42,600	4,544	38,361	148,105	-37,245	37,245	0	0
38.	2021	0	91,485	110,860	62,600	42,600	3,201	37,863	146,264	-35,404	35,404	0	0
39.	2022	0	53,622	110,860	62,600	42,600	1,876	30,255	137,331	-26,471	26,471	0	0
40.	2023	0	23,367	110,860	62,600	86,000	817	18,195	167,613	-56,753	56,753	0	0
41.	2024	0	5,171	110,860	62,600	42,600	181	5,171	110,552	308	0	308	308
42.	2025	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	5,968
43.	2026	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	11,628
44.	2027	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	17,288
45.	2028	0	0	110,860	62,600	57,600	0	0	120,200	-9,340	0	-9,340	7,948
46.	2029	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	13,608
47.	2030	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	19,268
48.	2031	0	0	110,860	62,600	349,400	0	0	412,000	-301,140	281,872	-19,268	0
49.	2032	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	5,660
50.	2033	0	0	110,860	62,600	42,600	0	0	105,200	5,660	0	5,660	11,320

Note: OM & R Cost (1); OM & R cost for distribution and purification.
OM & R Cost (2); OM & R cost for raw water conveyance.

Table 16 FINANCIAL STATEMENT OF KHLONG YAI DAM SCHEME, IRRIGATION COMPONENT

(UNIT: $B10^3$)

No.	Year	Loan Disbursement	Accumulated Loan	Outflow				Inflow			Balance of Payment (B) - (A)
				OM & R Cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (A)	Project Revenue	Government Subsidy	Total (B)	
1	1984	2,560	2,560	0	89	0	89	0	89	89	0
2	1985	27,520	30,080	0	1,052	0	1,052	0	1,052	1,052	0
3	1986	70,250	100,330	0	3,511	0	3,511	0	3,511	3,511	0
4	1987	109,710	210,040	0	7,351	0	7,351	0	7,351	7,351	0
5	1988	125,300	335,340	0	11,736	0	11,736	0	11,736	11,736	0
6	1989	129,550	464,890	0	16,271	0	16,271	0	16,271	16,271	0
7	1990	95,520	560,410	2,150	19,614	0	21,764	2,150	19,614	21,764	0
8	1991	33,020	593,430	3,070	20,770	0	23,840	3,070	20,770	23,840	0
9	1992	0	593,430	4,050	20,770	0	24,820	4,050	20,770	24,820	0
10	1993	0	593,430	4,050	20,770	128	24,948	4,050	20,898	24,948	0
11	1994	0	593,302	4,050	20,765	1,504	26,319	4,050	22,269	26,319	0
12	1995	0	591,798	4,050	20,712	5,016	29,779	4,050	25,729	29,779	0
13	1996	0	586,781	4,050	20,537	10,502	35,089	4,050	31,039	35,089	0
14	1997	0	576,279	4,050	20,169	16,767	40,986	4,050	36,936	40,986	0
15	1998	0	559,512	4,050	19,582	23,244	46,877	4,050	42,827	46,877	0
16	1999	0	536,268	28,180	18,769	28,020	74,969	4,050	70,919	74,969	0
17	2000	0	508,247	4,050	17,788	29,671	51,510	4,050	47,460	51,510	0
18	2001	0	478,576	4,050	16,750	29,671	50,471	4,050	46,421	50,471	0
19	2002	0	448,904	4,050	15,711	29,671	49,433	4,050	45,383	49,433	0
20	2003	0	419,233	4,050	14,673	29,671	48,394	4,050	44,344	48,394	0
21	2004	0	389,561	4,050	13,634	29,671	47,356	4,050	43,306	47,356	0
22	2005	0	359,890	4,050	12,596	29,671	46,317	4,050	42,267	46,317	0
23	2006	0	330,218	4,050	11,557	29,671	45,279	4,050	41,229	45,279	0
24	2007	0	300,547	4,050	10,519	29,671	44,240	4,050	40,190	44,240	0
25	2008	0	270,875	4,050	9,480	29,671	43,202	4,050	39,152	43,202	0
26	2009	0	241,204	28,180	8,442	29,671	66,293	4,050	62,243	66,293	0
27	2010	0	211,532	4,050	7,403	29,671	41,125	4,050	37,075	41,125	0
28	2011	0	181,861	4,050	6,365	29,671	40,086	4,050	36,036	40,086	0
29	2012	0	152,189	4,050	5,326	29,671	39,048	4,050	34,998	39,048	0
30	2013	0	122,518	4,050	4,288	29,543	37,881	4,050	33,831	37,881	0
31	2014	0	92,974	29,870	3,254	28,167	61,291	4,050	57,241	61,291	0
32	2015	0	64,807	4,050	2,268	24,655	30,973	4,050	26,923	30,973	0
33	2016	0	40,152	4,050	1,405	19,169	24,624	4,050	20,574	24,624	0
34	2017	0	20,982	4,050	734	12,904	17,688	4,050	13,638	17,688	0
35	2018	0	8,078	4,050	282	6,427	10,759	4,050	6,709	10,759	0
36	2019	0	1,651	28,180	57	1,651	29,888	4,050	25,838	29,888	0
37	2020	0	0	4,050	0	0	4,050	4,050	0	4,050	0
38	2021	0	0	4,050	0	0	4,050	4,050	0	4,050	0
39	2022	0	0	4,050	0	0	4,050	4,050	0	4,050	0
40	2023	0	0	4,050	0	0	4,050	4,050	0	4,050	0
41	2024	0	0	4,050	0	0	4,050	4,050	0	4,050	0
42	2025	0	0	4,050	0	0	4,050	4,050	0	4,050	0
43	2026	0	0	4,050	0	0	4,050	4,050	0	4,050	0
44	2027	0	0	4,050	0	0	4,050	4,050	0	4,050	0
45	2028	0	0	4,050	0	0	4,050	4,050	0	4,050	0
46	2029	0	0	28,180	0	0	28,180	4,050	24,130	28,180	0
47	2030	0	0	4,050	0	0	4,050	4,050	0	4,050	0
48	2031	0	0	4,050	0	0	4,050	4,050	0	4,050	0
49	2032	0	0	4,050	0	0	4,050	4,050	0	4,050	0
50	2033	0	0	4,050	0	0	4,050	4,050	0	4,050	0

Table 17 FINANCIAL STATEMENT OF KHLONG THAP MA DAM SCHEME, IRRIGATION COMPONENT

(Unit: $B10^3$)

No.	Year	Loan Disbursement	Accumulated Loan	Outflow				Inflow			Balance of Payment
				OM & R Cost	Repayment of Loan Interest	Repayment of Loan Capital	Total (A)	Project Revenue	Government Subsidy	Total (B)	(B) - (A)
1	1985	8,590	8,590	0	300	0	300	0	300	300	0
2	1986	14,060	22,650	0	792	0	792	0	792	792	0
3	1987	112,630	135,280	0	4,734	0	4,734	0	4,734	4,734	0
4	1988	107,290	242,570	0	8,489	0	8,489	0	8,489	8,489	0
5	1989	84,070	326,640	690	11,432	0	12,122	690	11,432	12,122	0
6	1990	0	326,640	2,290	11,432	0	13,722	2,290	11,432	13,722	0
7	1991	0	326,640	2,290	11,432	0	13,722	2,290	11,432	13,722	0
8	1992	0	326,640	2,290	11,432	0	13,722	2,290	11,432	13,722	0
9	1993	0	326,640	2,290	11,432	0	13,722	2,290	11,432	13,722	0
10	1994	0	326,640	2,290	11,432	429	14,151	2,290	11,861	14,151	0
11	1995	0	326,210	2,290	11,417	1,132	14,839	2,290	12,549	14,839	0
12	1996	0	325,078	2,290	11,377	6,764	20,431	2,290	18,141	20,431	0
13	1997	0	318,314	2,290	11,140	12,128	25,559	2,290	23,269	25,559	0
14	1998	0	306,185	11,220	10,716	16,332	38,268	2,290	35,978	38,268	0
15	1999	0	289,853	2,290	10,144	16,332	28,766	2,290	26,476	28,766	0
16	2000	0	273,521	2,290	9,573	16,332	28,195	2,290	25,905	28,195	0
17	2001	0	257,189	2,290	9,001	16,332	27,623	2,290	25,333	27,623	0
18	2002	0	240,857	2,290	8,430	16,332	27,052	2,290	24,762	27,052	0
19	2003	0	224,525	2,290	7,858	16,332	26,480	2,290	24,190	26,480	0
20	2004	0	208,193	2,290	7,286	16,332	25,908	2,290	23,618	25,908	0
21	2005	0	191,861	2,290	6,715	16,332	25,337	2,290	23,047	25,337	0
22	2006	0	175,529	2,290	6,143	16,332	24,765	2,290	22,475	24,765	0
23	2007	0	159,197	2,290	5,571	16,332	24,193	2,290	21,903	24,193	0
24	2008	0	142,865	11,220	5,000	16,332	32,552	2,290	30,262	32,552	0
25	2009	0	126,533	2,290	4,428	16,332	23,050	2,290	20,760	23,050	0
26	2010	0	110,201	2,290	3,857	16,332	22,479	2,290	20,189	22,479	0
27	2011	0	93,869	2,290	3,285	16,332	21,907	2,290	19,617	21,907	0
28	2012	0	77,537	2,290	2,713	16,332	21,335	2,290	19,045	21,335	0
29	2013	0	61,205	10,730	2,142	16,332	29,204	2,290	26,914	29,204	0
30	2014	0	44,873	2,290	1,570	15,902	19,763	2,290	17,473	19,763	0
31	2015	0	28,971	2,290	1,013	15,199	18,503	2,290	16,213	18,503	0
32	2016	0	13,771	2,290	482	9,568	12,340	2,290	10,050	12,340	0
33	2017	0	4,203	2,290	147	4,203	6,640	2,290	4,350	6,640	0
34	2018	0	0	11,220	0	0	11,220	2,290	8,930	11,220	0
35	2019	0	0	2,290	0	0	2,290	2,290	0	2,290	0
36	2020	0	0	2,290	0	0	2,290	2,290	0	2,290	0
37	2021	0	0	2,290	0	0	2,290	2,290	0	2,290	0
38	2022	0	0	2,290	0	0	2,290	2,290	0	2,290	0
39	2023	0	0	2,290	0	0	2,290	2,290	0	2,290	0
40	2024	0	0	2,290	0	0	2,290	2,290	0	2,290	0
41	2025	0	0	2,290	0	0	2,290	2,290	0	2,290	0
42	2026	0	0	2,290	0	0	2,290	2,290	0	2,290	0
43	2027	0	0	2,290	0	0	2,290	2,290	0	2,290	0
44	2028	0	0	11,220	0	0	11,220	2,290	8,930	11,220	0
45	2029	0	0	2,290	0	0	2,290	2,290	0	2,290	0
46	2030	0	0	2,290	0	0	2,290	2,290	0	2,290	0
47	2031	0	0	2,290	0	0	2,290	2,290	0	2,290	0
48	2032	0	0	2,290	0	0	2,290	2,290	0	2,290	0
49	2033	0	0	2,290	0	0	2,290	2,290	0	2,290	0
50	2034	0	0	2,290	0	0	2,290	2,290	0	2,290	0

FIGURES

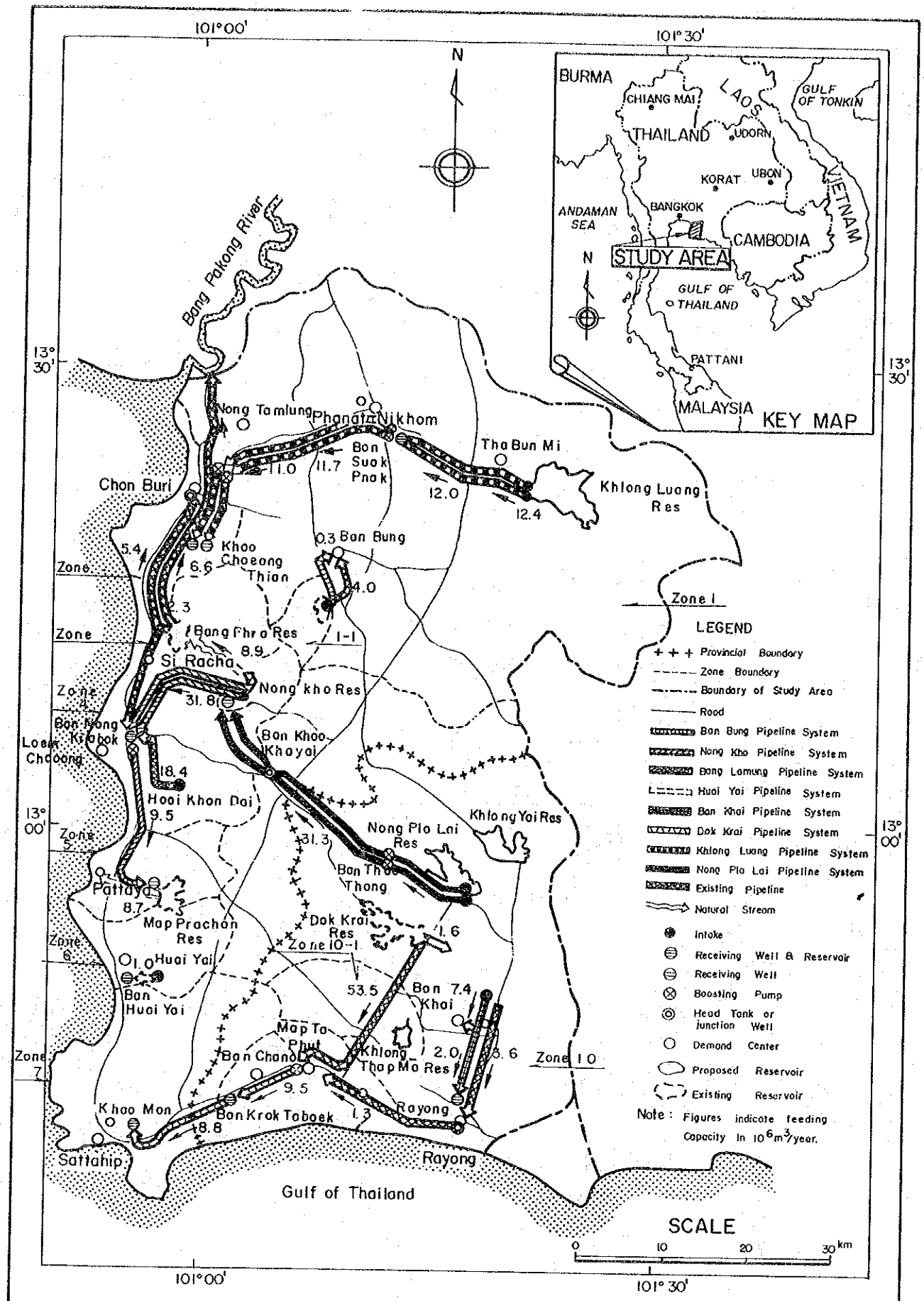

Fig. 1 General Layout of Proposed Development Plan for 2001

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THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT PHASE II
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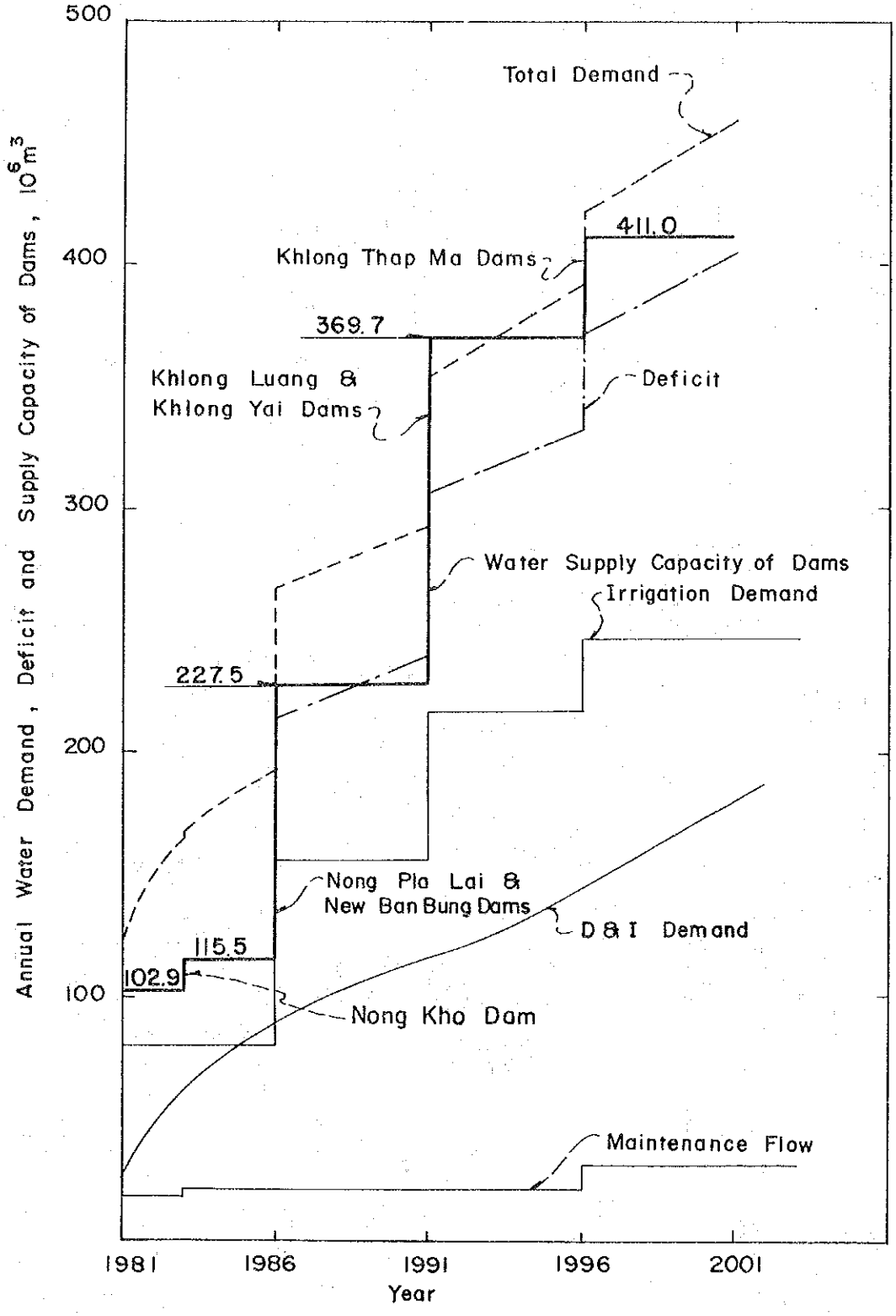

Fig. 2 Relationship among Water Demand, Deficit and Water Supply Capacity of Dams

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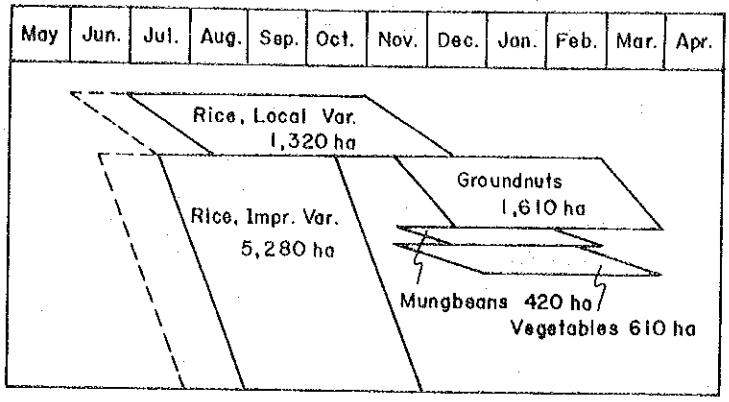
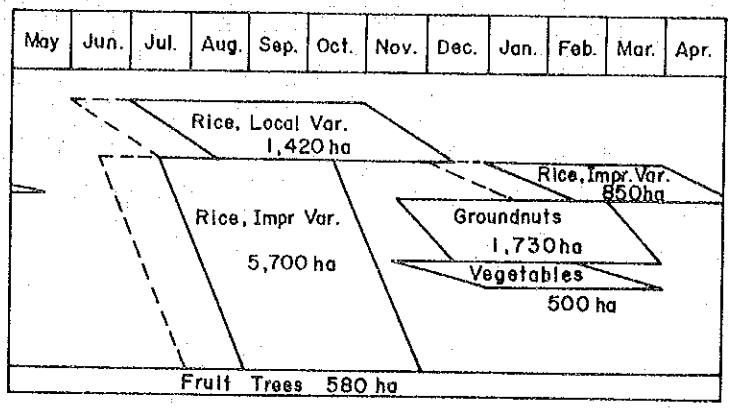
(1) KHLONG LUANG IRRIGATION AREA



(2) BAN KHAI EXTENSION AREA



(3) KHLONG THAP MA IRRIGATION AREA

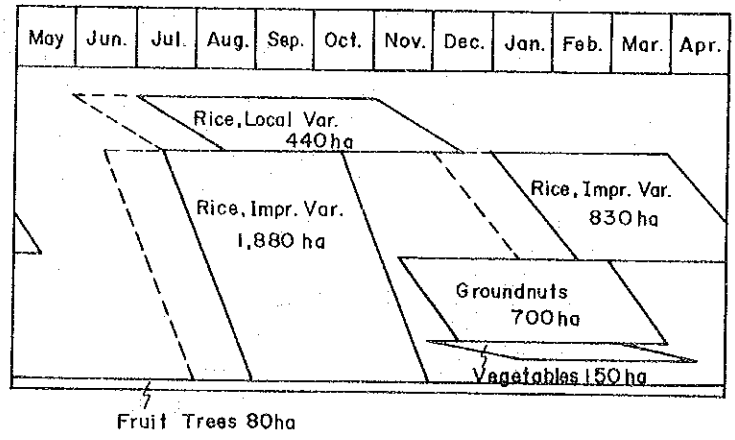


Fig. 3 Proposed Cropping Patterns

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	WORK ITEMS	Q'ty
FIRST STAGE	1. Multi - purpose Dam	
	1.1. Investigation & Design	
	1.2. Tender & Contract Award	
	1.3. Land Acquisition & Compensation	
	1.4. Mobilization & Preparatory Work	
	1.5. Care of River	
	1.6. Main Dam	Ex. 1971,000 m³ Em. 2972,000 m³
	1.7. Spillway	Conc. 6,800m³
	1.8. Saddle Dam	Em. 298,000m³
	2. Water Conveyance System	
	2.1. Investigation & Design	
	2.2. Tender & Contract Award	
	2.3. Land Acquisition	
	2.4. Mobilization & Preparatory Work	
	2.5. Intake	0.26m³/s 110kw x 2
	2.6 Pipeline	ø 600mm 55.5 km
	2.7. Booster P/S	190kwx2 | 160kwx2
	2.8. Receiving Facilities	Conc. 1,900 m³
	3. Irrigation & Drainage System	
	3.1. Investigation & Design	
	3.2. Tender & Contract Award	
	3.3. Land Acquisition	
	3.4. Mobilization & Preparatory Work	
	3.5. Intake	N: Conc. 800m³ S: Conc. 2,200m³
	3.6. Main Canal	N: 31.1km S: 21.8km
	3.7. Latral Canal	N: 15 km S: 19 km
	3.8. Drainage Canal	37 km
SECON STAGE	4. Water Coveyance	
	4.1. Review of Design	
	4.2. Tender & Contract Award	
	4.3. Mobilization & Preparatory Work	
	4.4. Intake	0.26m³/s 110kw
	4.5. Pipeline	ø 600mm 55.5 km
	4.6 Booster P/S	190kw | 160kw

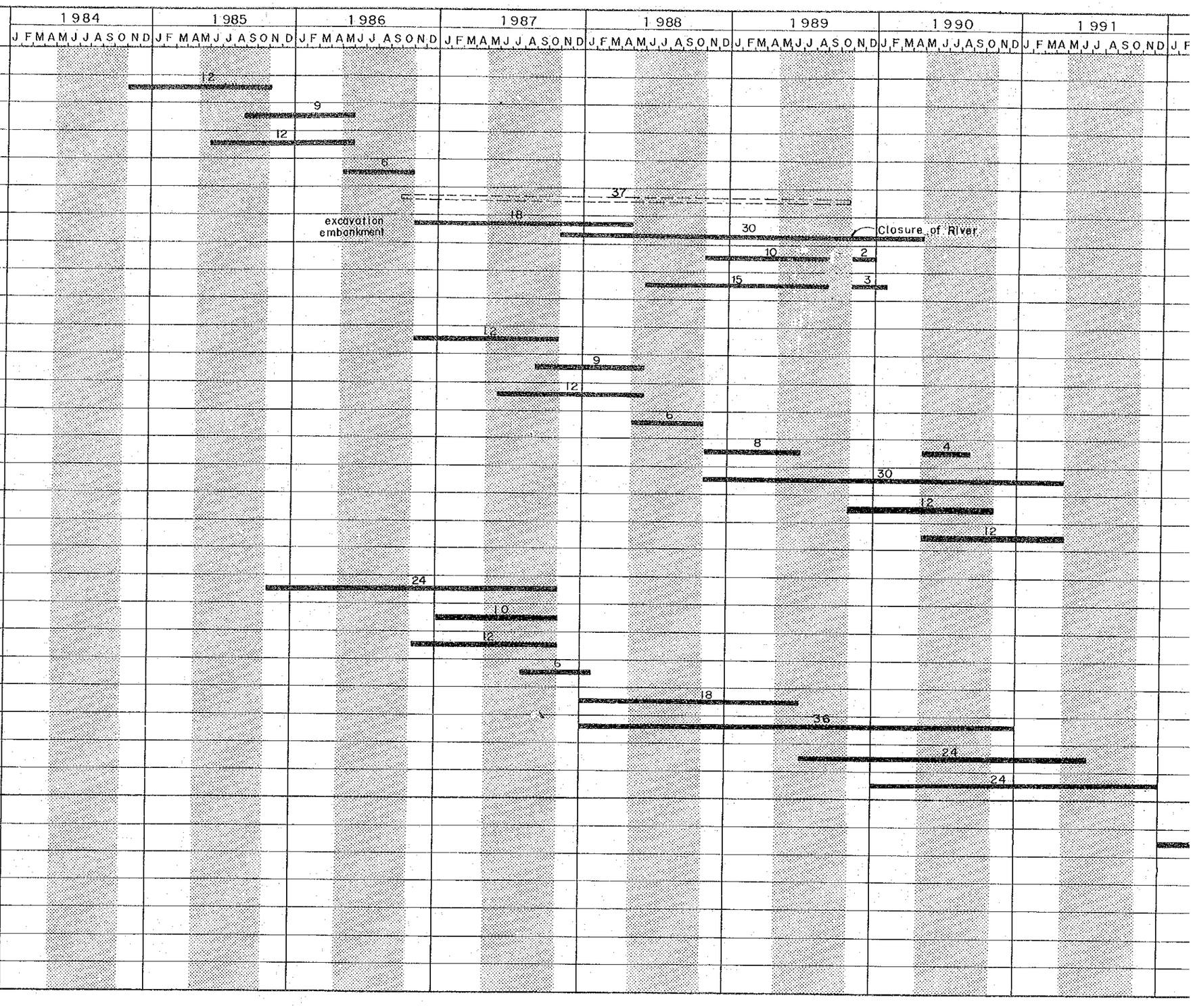
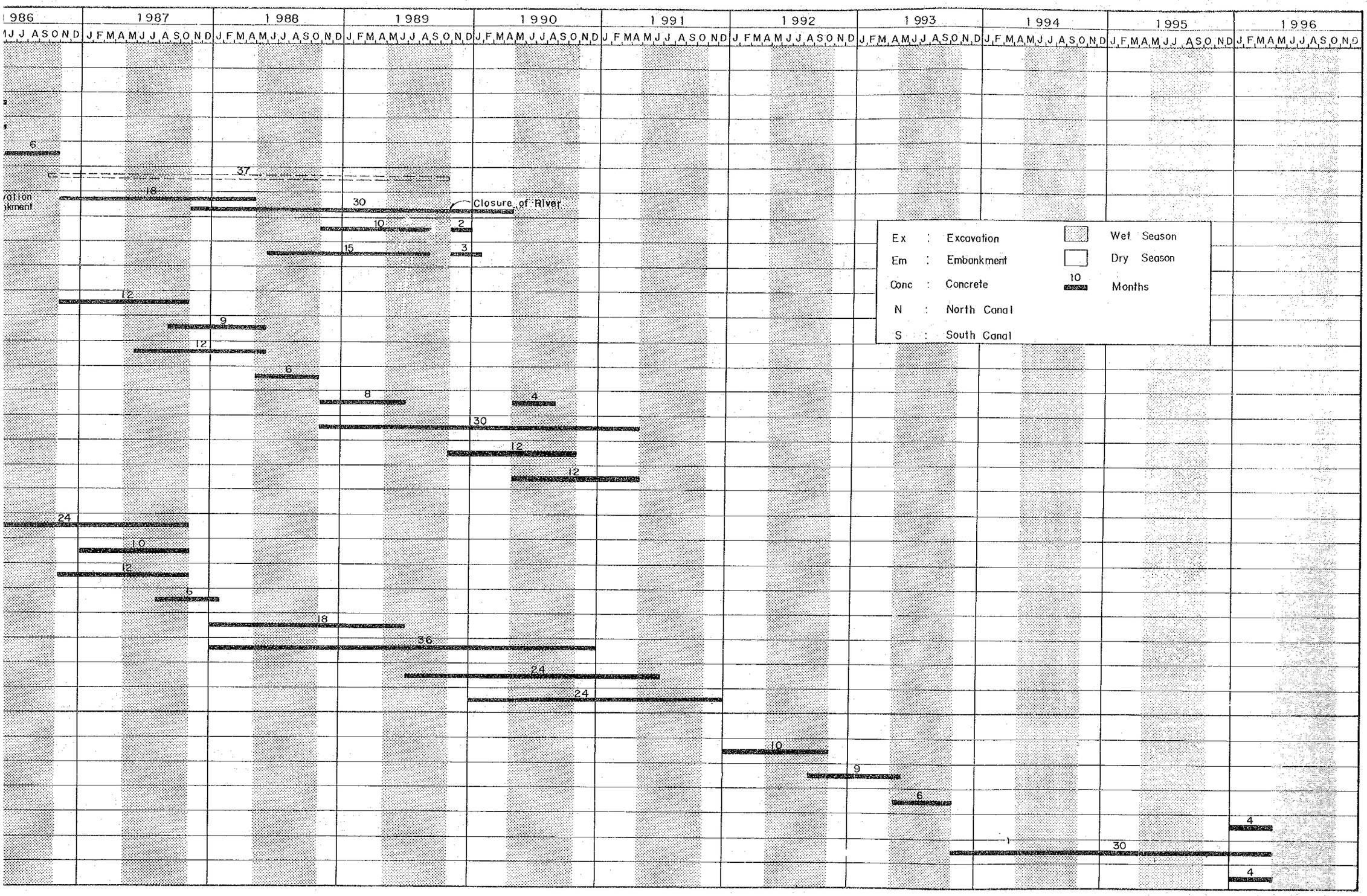


Fig. 4 Implementation Schedule of Khlong Luang Dam Scheme



tion Schedule of Khlong Luang Dam Scheme

KINGDOM OF THAILAND
THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT PHASE II
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	WORK ITEMS	Q'ty
FIRST STAGE	1. Nong Pla Lai Dam	
	1.1. Investigation & Design	
	1.2. Tender & Contract Award	
	1.3. Land Acquisition & Compensation	
	1.4. Mobilization & Preparatory Work	
	1.5. Care of River	
	1.6. Main Dam	Ex. 527,000m³ Em 2,500,000m³
	1.7. Spillway	Conc. 18,000m³
	2. Khlong Yai Dam	
	2.1. Investigation & Design	
	2.2. Tender & Contract Award	
	2.3. Land Acquisition & Compensation	
	2.4. Mobilization & Preparatory Work	
	2.5. Care of River	
	2.6. Main Dam	Ex. 1,331,000m³ Em 2495,000m³
	2.7. Spillway	Conc. 13,000m³
	3. Water Conveyance System	
	3.1. Investigation & Design	
	3.2. Tender & Contract Award	
	3.3. Land Acquisition & Compensation	
	3.4. Mobilization & Preparatory Work	
	3.5 Intake	194m³/min 390kw x 2
	3.6. Pipeline	ϕ900mm 30km
	3.7. Booster P/S	19.4m³/min 290kw x 3
	3.8. Head Tank	Conc. 1,120m³
	4. Irrigation & Drainage System	
	4.1. Investigation & Design	
	4.2. Tender & Control Award	
	4.3. Land Acquisition & Compensation	
	4.4. Mobilization & Preparatory Work	
	4.5. Nong Pla Lai Headworks	Conc. 5,600m³
	4.6. Khlong Yai Headworks	Conc. 7,860m³
	4.7. Main Canal	45.2 km
	4.8. Lateral Canal	123 km
	4.9. Drainage Canal	124 km
SECOND STAGE	5. Water Conveyance System	
	5.1. Review of Design	
	5.2. Tender & Contract Awrd	
	5.3. Mobilization & Preparatory Work	
	5.4. Intake	19.4m³/min 390kw x 2
	5.5. Pipeline	ϕ900mm 30 km
	5.6. Booster P/S	19.4m³/min 290kw x 2

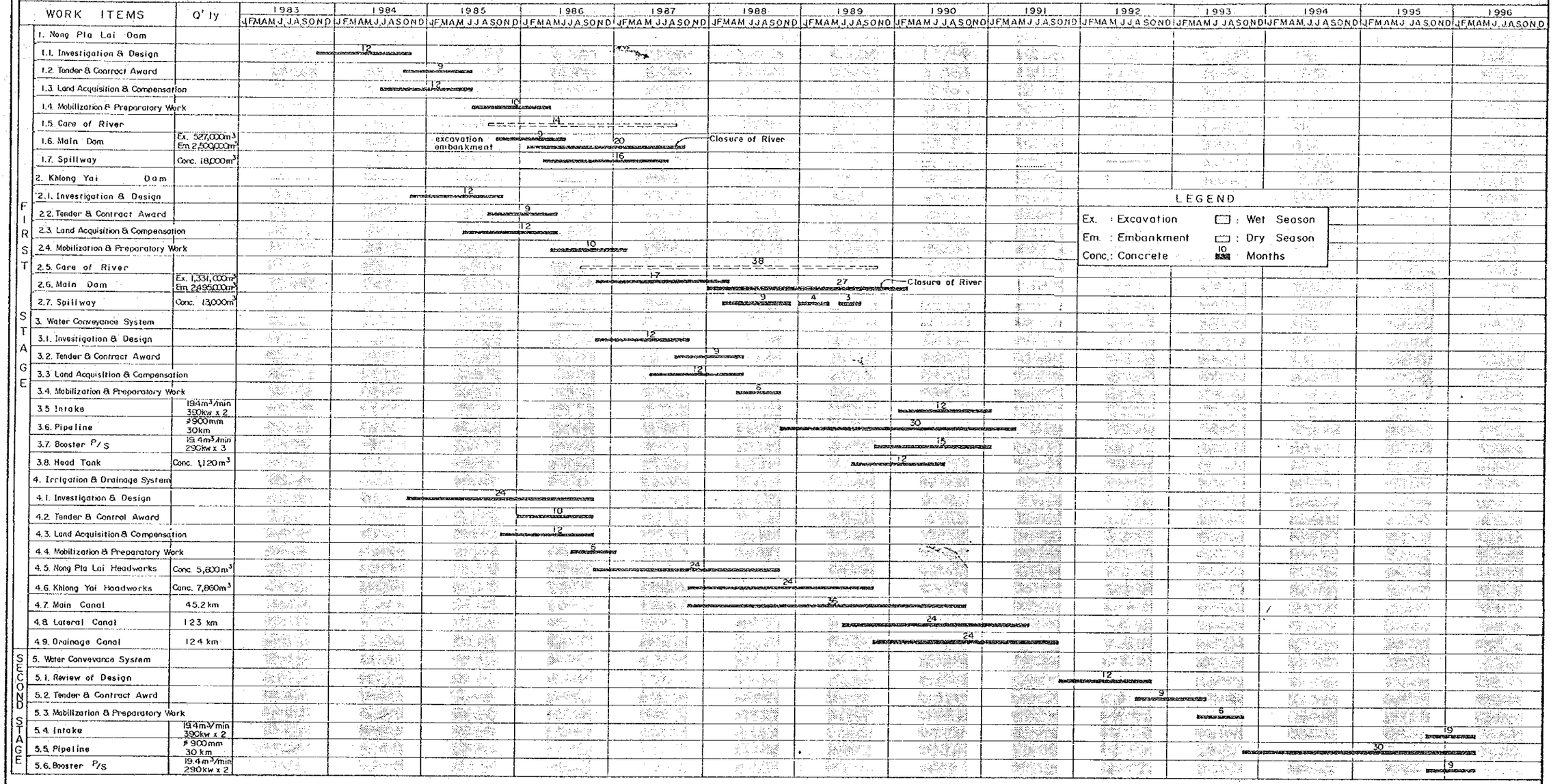

Fig. 5 Implementation Schedule of Khlong Yai Dam Scheme

KINGDOM OF THAILAND
THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT PHASE II
JAPAN INTERNATIONAL COOPERATION AGENCY

WORK ITEMS	Quantity	1984	1985	1986	1987	1988	1989	1990	1991
		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
1. Multi – purpose Dam									
1·1 Investigation & Design			12						
1·2 Tender & Contract Award			9						
1·3 Land Acquisition & Compensation			12						
1·4 Mobilization & Preparatory Work				6					
1·5 Care of River					24				
1·6 Main Dam	Ex. 568,000m³ Em. 1,345,000m³			excavation embankment	17	15 — Closure of River			
1·7 Spillway	Conc. 12,000m³					10			
1·8 Saddle Dam	Em. 49,000m³					3 2			
2. Irrigation									
2·1 Investigation & Design			18						
2·2 Tender & Contract Award				10					
2·3 Land Acquisition & Compensation				12					
2·4 Mobilization & Preparatory Work				8					
2·5 Intake	Conc. 1,400m³				18				
2·6 Main Canal	E : 5.3 km W : 11.3 km				24				
2·7 Lateral Canal	E : 17 km W : 21 km					18			
2·8 Drainage Canal	39 km						18		

LEGEND

Ex. : Excavation — Wet Season

Em : Embankment — Dry Season

Conc : Concrete — 10 Months

W : West Canals — E : East Canals

Fig. 6 Implementation Schedule of Khlong Thap Ma Dam Scheme

KINGDOM OF THAILAND
THE EAST COAST WATER RESOURCES DEVELOPMENT PROJECT PHASE II
JAPAN INTERNATIONAL COOPERATION AGENCY