

INTERNATIONAL CO-OPERATION AGENCY (ICA)

ROYAL IRRAWADDI DEPARTMENT

MINISTRY OF AGRICULTURE AND CO-OPERATIVES

THE KINGDOM OF THAILAND

WUOH, SUNDAY

(O) I

THE IRRAWADDI RIVER WATER DIVERSION PROJECT

IN

THE KINGDOM OF THAILAND

SUPPORTING REPORT

(Pre-Feasibility Study)

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

ROYAL IRRIGATION DEPARTMENT
MINISTRY OF AGRICULTURE AND COOPERATIVES
THE KINGDOM OF THAILAND

**THE STUDY
ON
THE KOK-ING-NAN WATER DIVERSION PROJECT
IN
THE KINGDOM OF THAILAND**

SUPPORTING REPORT

(Feasibility Study)

NOVEMBER 1999

SANYU CONSULTANTS INC.
NIPPON KOEI CO., LTD.



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STUDY AREA/ LOCATION MAP

THE KOK-ING-NAN WATER
DIVERSION PROJECT
IN
THE KINGDOM OF THAILAND

Kok-Ing-Nan Diversion

LAO PDR

Meikong River

Kok Basin

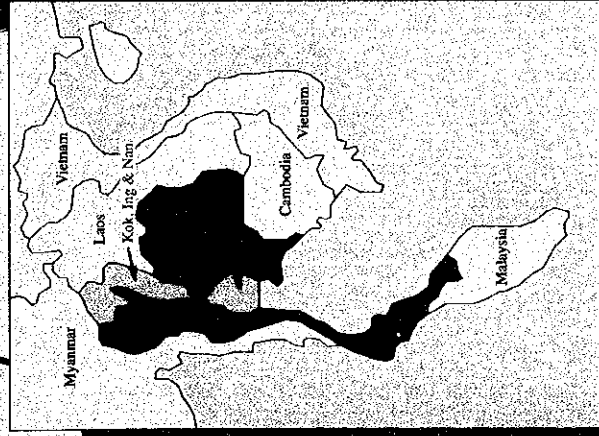
MYANMAR

Kok River

Chang River

Fang River

Lao River



LEGEND

- Existing Dam/Reservoir
- Proposed Dam/Reservoir
- River Course
- Direct/Indirect Irrigation Beneficial Area

CHAO PHRAYA DELTA

Paak River

CHUTHAYA

BANGKOK

Gulf of Thailand

**STUDY AREA
LOCATION MAP**

THE KOK-ING-NAN WATER
DIVERSION PROJECT
IN
THE KINGDOM OF THAILAND

Kok-Ing-Nan Diversion

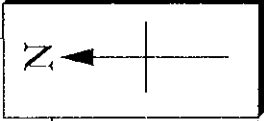
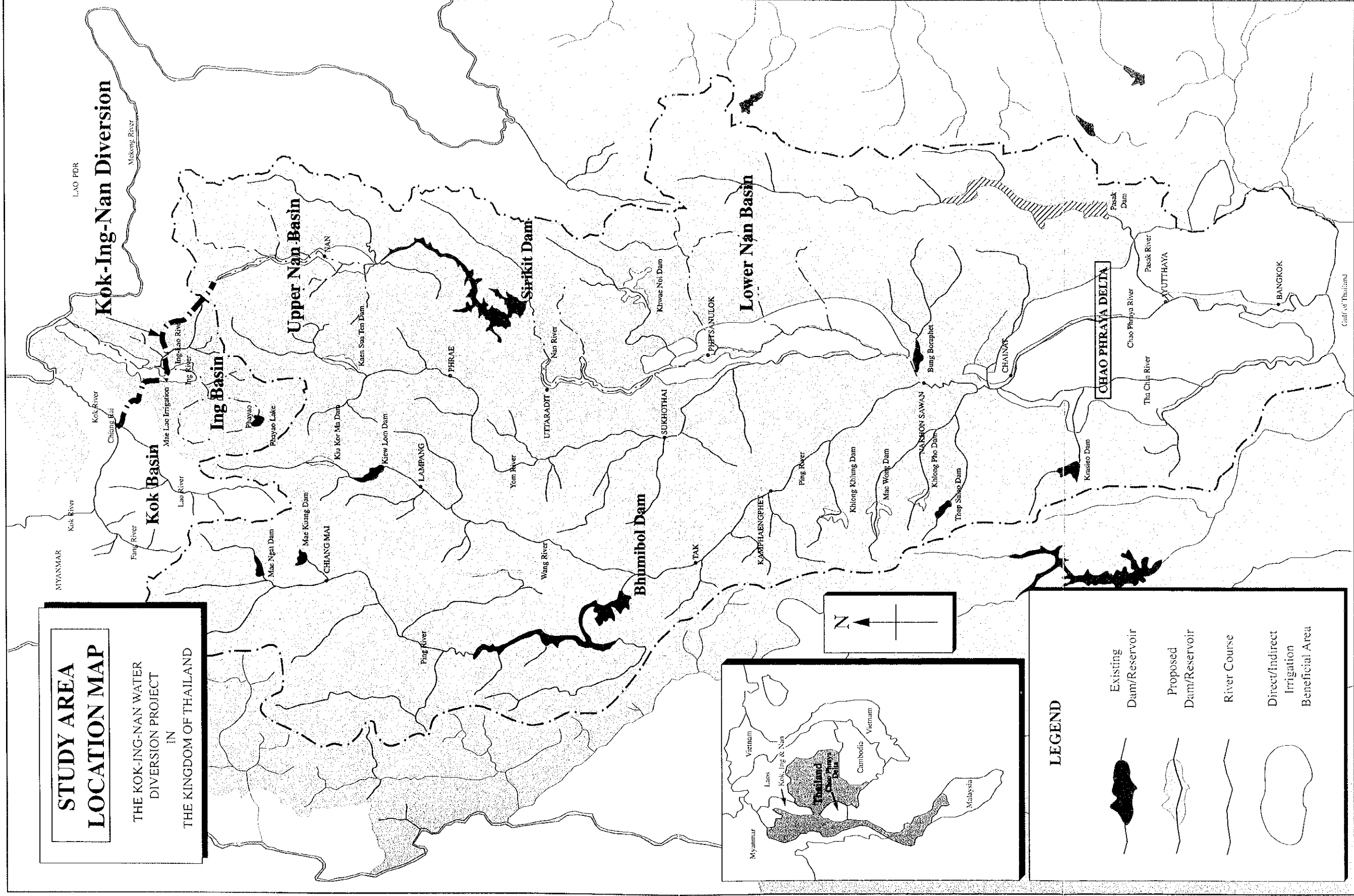
Ing Basin

Upper Nan Basin

Sirikit Dam

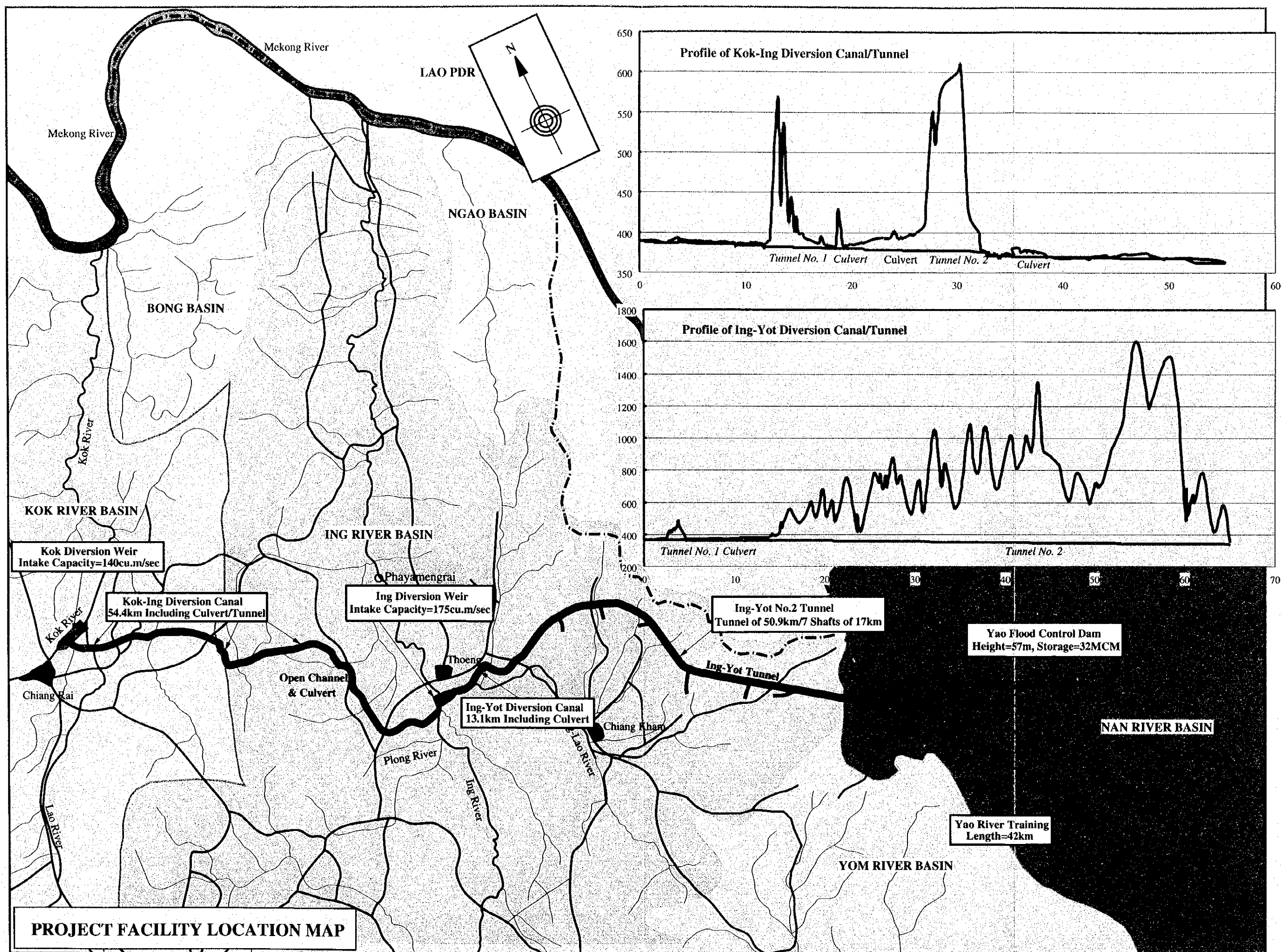
Lower Nan Basin

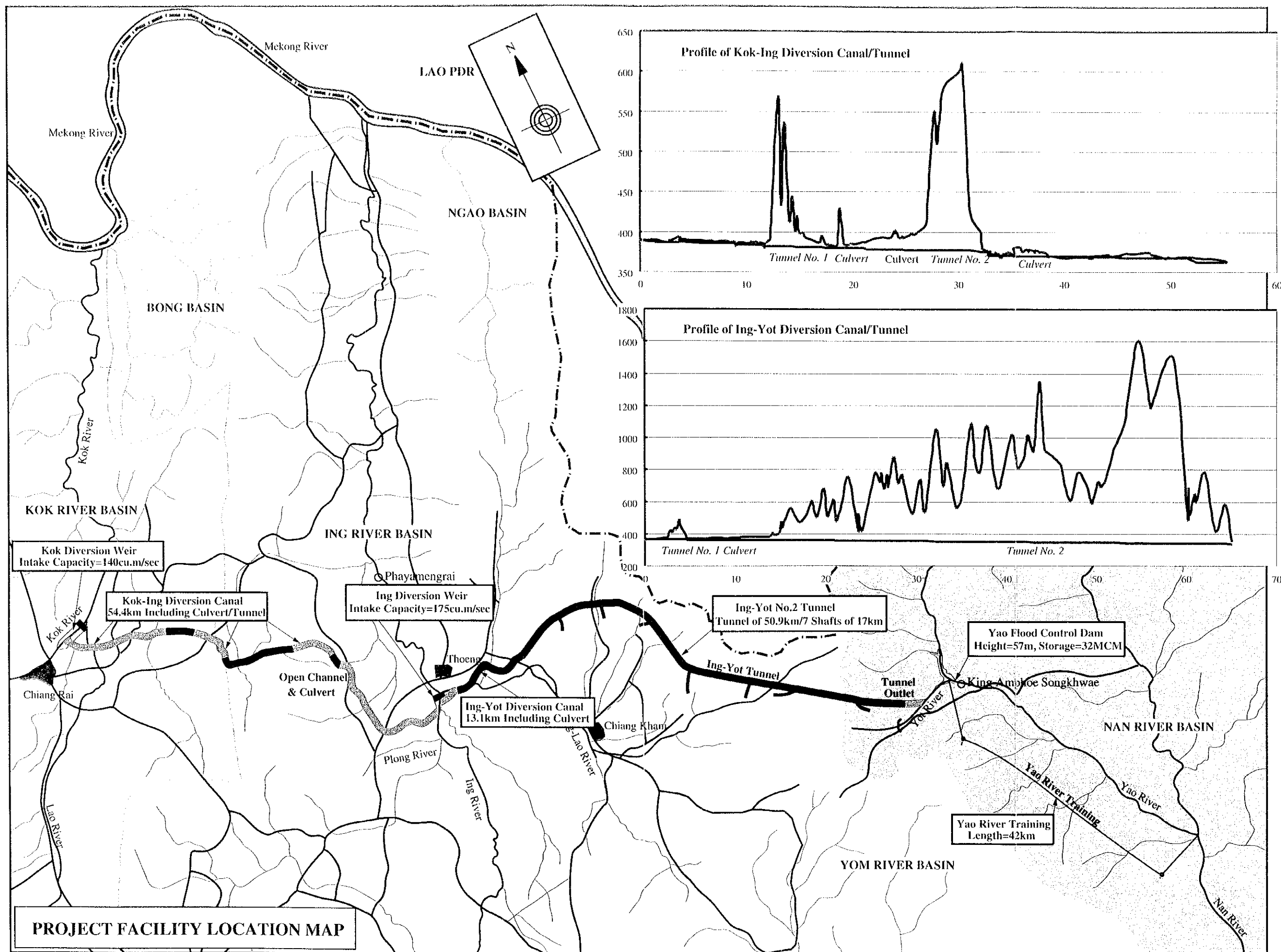
CHAO PHRAYA DELTA



LEGEND

- Existing Dam/Reservoir
- Proposed Dam/Reservoir
- River Course
- Direct/Indirect Irrigation Beneficial Area





Feasibility Study on The Kok-Ing-Nan Water Diversion Project Supporting Report

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CHAPTER 1.

INTRODUCTION



CHAPTER 1. INTRODUCTION

The Conceptual Planning Study and Feasibility Study for the proposed Kok-Ing-Nan Water Diversion Project were conducted during the period from March (Thai-side Study) or August (JICA Study) of 1996 to present. The objective of the JICA Study is to supplement and strengthen the Thai-side Study, and therefore some items of the survey, investigation and study were undertaken by the Thai-side, some by the JICA Study and some were conducted jointly by the both teams. The Chapter 1 of the Supporting Report contains the detailed description of the survey, investigation and study items in order to clarify the responsibilities and the line of demarcation between the two sides. The personnel engaged in the JICA Study are also listed in 1.5 of this Supporting Report.

1.4 Survey and Study Items Made by the JICA Study

1.5 Personnel Engaged in the Study

Chapter 1

1.4 Survey and Study Items Supported by JICA Team for Thai Side Study.

JICA Team supplements and strengthens the following items for Thai side study.

Survey and Study Items	Thai	JICA
Chapter 2 River Basin		
2.1 Basin Area		
(1) Project area in the Kok, Ing and Yao river basins	○	○
(2) Whole Kok, Ing and upper Nan basins to grasp the potential irrigation area	—	○
(3) Upper and lower Chao Phraya Basin, which is the beneficial area of the Project	—	○
2.2 Land Use		
(1) Project area	○	○
(2) Whole Kok, and Ing Basin and Chao Phraya basin	—	○
2.3 General Meteorology: including rainfall (Data collection & analysis)	○	—
2.4 Hydrological study		
(1) Data Collection and compilation of the Kok, Ing and upper Nan river	○	—
(2) Data Collection and compilation of the rivers in Chao Phraya basin	—	○
(3) Analysis of runoff and sediment at the Kok and Ing river	○	○
(4) Analysis of runoff variation in the rivers of Chao Phraya basin	—	○
(5) Analysis of flood discharge for Project facility site	○	○
(6) Analysis of the Mekong river runoff	—	○
2.5 Watershed study by analysis of Sattelite image for Kok, Ing and Yao basins	—	○
2.6 Flood and inundation area survey in the lower Ing basin	—	○
2.7 Survey for tributary conditions in mountains along tunnel route	—	○
Chapter 3 Socio-Economic and Agricultural Conditions		
3.1 Demography		
(1) Population study in the Kok, Ing and Yao basin	○	○
(2) Population study in whole Chao Phraya basin including future population (2016)	—	○
(3) Social infrastructure in the Kok, Ing and Yao basins	—	○
(4) Analysis of gross basin products (G.B.P.) in the Kok, Ing and Chao Phraya basin	—	○
(5) Analysis of income and expenditure in the Kok, Ing and Chao Phraya basin	—	○
(6) Poverty analysis in the Kok, Ing and Chao Phraya basin	—	○
(7) General Socio-economic study for three specific irrigation project areas	○	—
3.2 Agricultural conditions		
(1) Farm land use variation in the Kok and Ing basins	○	○
(2) Farm land use variation in the Chao Phraya basin	—	○
(3) Paddy cultivation status in the Kok, Ing and Chao Phraya basins	—	○
(4) Diversified agriculture study in the Kok, Ing and Chao Phraya basins	—	○
(5) Livestock breeding study in the Kok, Ing and Chao Phraya basins	—	○
(6) Freshwater fish culture study	—	○
(7) Study on agricultural development policy in the revised 8th Plan	—	○
(8) Study on future agricultural development in the Project beneficial area	—	○
(9) Study on crop and fish culture budget in the Lower Nan and Delta	—	○
(10) General agriculture condition study for three specific irrigation project area	○	—

Survey and Study Items	Thai	JICA
Chapter 4 Water Resources Development and Management in Upper Chao Phraya Basin		
4.1 Limited water resources in Chao Phraya Basin		
(1) Potential water and farm land resources in Southeast Asia	—	○
(2) Potential water resources in river basins of Thailand	○	○
4.2 Existing and future water resources development		
(1) Existing and future large, medium and small dams	○	○
(2) Existing and future irrigation area	○	○
(3) Estimation of irrigation water demand at present and in future	—	○
(4) Analysis of decreasing water resources in upper Chao Phraya basin	—	○
4.3 Water Resources Management		
(1) Watershed Management	—	○
(2) River flow and water sources management	—	○
(3) Water diversion and distribution management	—	○
(4) Water Use, management	—	○
Chapter 5 water Demand Projection in Beneficial Area		
5.1 Irrigated and Diversified Agricultural Condition		
(1) Data collection and analysis of existing irrigated agriculture in Delta	—	○
(2) Review of CPBWMS report by NESDD	—	○
(3) Review of Agricultural and Irrigation Patterns in the Central Plain by DORAS	—	○
(4) Survey for 25 large irrigation project area in Delta and Phitsanulok project	—	○
(5) Analysis of current situation and future trend of diversified crops in Delta	—	○
(6) Irrigation water demand study in the Delta and the lower Nan	—	○
(7) Domestic, industrial and other water demand study in Delta	—	○
(8) Overall water demand study in the beneficial area	—	○
(9) Study on groundwater problems in Chao Phraya Delta	—	○
5.2 Water demand projection based on development scenarios	—	○
Chapter 6 Identification of Kok—Ing—Nan Project		
6.1 Necessity of additional water in Delta		
(1) Analysis of current water shortage for irrigation in Chao Phraya basin	—	○
(2) Necessity of stable irrigation water for diversified crops in dry season	—	○
(3) Necessity of paddy cultivation and its water supply at the conservation area	—	○
(4) Necessity of domestic and industry water in the Delta	—	○
6.2 Alternative Transbasin Study		
(1) Alternative transbasin study carried out by Thai government in the past	○	○
(2) Study on water agreement in Mekong River Committee	—	○
Chapter 7 Proposal for Modified Operation of Sirikit Reservoir		
7.1 Necessity of additional water in Delta	○	○
7.2 Improvement of operation rule of reservoir		
(1) Study on the downstream outflow at Sirikit dam	—	○
(2) Study on irrigation outflow in wet season	—	○
(3) Reservoir operation study	—	○
(4) Improved operation rule	—	○

Survey and Study Items	Thai	JICA
Chapter 8 Project Water Diversion Plan		
8.1 Analysis of surplus water in the Kok and Ing rivers for water diversion	○	○
(1) Inventory survey of the existing and future irrigation projects	○	○
(2) Study on irrigation area and demand based on the inventory survey	○	○
(3) Water balance study based on the river inflow and irrigation demand	○	○
(4) Analysis of surplus water available for water diversion	○	○
8.2 Proposed water diversion plan		
(1) Study on optimum diversion capacity	○	○
(2) Improved operation rule of Sirikit Reservoir	○	○
8.3 Future possible water diversion plan		
(1) Pumping water diversion from Lower Ing river	—	○
(2) Kok hydropower dam	○	○
Chapter 9 Project Water Allocation Plan		
(1) Study on possible beneficial area in Lower Nan and Delta	—	○
(2) Proposed scenarios of 6 alternative plans	—	○
Chapter 10 Irrigated Agriculture projects in Kok, Ing & Upper Nan Basin		
10.1 Potential irrigable area at full development	—	○
(1) Classification of proposed irrigation projects on small basin basis	—	○
(2) Study on irrigation projects proposed by peoples and agencies	—	○
10.2 Feasibility study for three specific irrigation projects	○	—
10.3 Classification of proposed irrigation projects on small basin basis	○	○
10.4 Study on irrigation projects proposed by peoples and agencies	○	○
10.5 Associate irrigation project		
(1) Selection of proposed irrigation area along the water diversion route	—	○
(2) Development plan by irrigation canal and pump	—	○
Chapter 11 Project Facility Plan		
11.1 Topographical Survey		
(1) Aerophoto survey map with scale of 1 to 10,000 in Kok and Ing basin, the area along tunnel route, and Yao basin. (Total 81 sheets)	○	—
(2) River profile and cross section survey of 200 km (63 sheets)	○	—
(3) Water diversion route survey of 50km (20 sheets) Plain map survey at Kok intake, Ing weir site and Yao damsite	○	—
(4) Additional profile survey for Ing river and Ing—Lao river (77 sheets)	—	○
11.2 Observation of river flow fluctuation in Kok and Ing	—	○
11.3 Geological investigation works		
(1) 12 core borings with 880 m length at tunnel inlet	○	—
(2) 45 core borings with 2,300 m length at weir site, damsite and tunnel route	○	—
(3) 7 deep core borings with 1,490m at tunnel route	—	○
(4) Seismic reflection prospecting for 31.2km in tunnel route	○	—
(5) Electromagnetic prospecting survey for 12 lines of 13.5km in tunnel	—	○
(6) Construction material survey at damsite	○	—

Survey and Study Items	Thai	JICA
11.4 Analysis of Geological Condition		
(1) Kok intake, diversion canal route, Ing weir, Yao dam, etc.	○	○
(2) Tunnel route and inlet and outlet	○	○
11.5 Alternative site and route of the Project facility		
(1) Two alternative routes in conceptual plan	○	○
(2) JICA B route	—	○
(3) Alternative Ing site and Ing-Yot tunnel route	○	○
(4) Yao damsite	○	○
11.6 Preliminary Design of Project facility		
(1) Kok intake and canal in Kok basin	○	○
(2) Kok-Ing No.1 and No.2 tunnel	○	○
(3) Diversion canal in Tak and Ing basin	○	○
(4) Ing diversion weir and Ing-Yot canal	○	○
(5) Ing-Yot long tunnel	○	○
11.7 Yao dam and river training	○	○
11.8 Construction Plan		
(1) Canal culvert and weir	—	○
(2) Tunnel excavation method and schedule	—	○
(3) Dam excavation and embankment plan and schedule	—	○
(4) Overall construction schedule	—	○
11.9 Project Cost Estimation		
(1) Approximate cost estimation	○	—
(2) Detailed cost estimation classifying into F/C and L/C	—	○
(3) Other related projects and works	—	○
Chapter 12 Implementation Program		
12.1 Implementation Schedule	—	○
12.2 Disbursement Schedule	—	○
12.3 O/M plan and cost	—	○
Chapter 13 Project Evaluation		
13.1 Evaluation of 6 alternative plans	—	○
13.2 Estimation of project benefit for water supply, agriculture and hydropower	—	○
13.3 Raw water cost analysis	—	○
13.4 Farmer's income analysis	—	○
13.5 Financial plan	—	○
13.6 Indirect ripple impact	—	○

In addition to the above survey and study, JICA has the following supplemental and strengthen work for Thai side study.

1. Technical transfer for tunnel design and construction work and environmental impact items by the large scale canal, tunnel and dam construction and its mitigation measures.
2. Preparation of the detailed geological investigation result and its analysis report
3. Preparation of the detailed cost estimation documents for the water diversion project including unit price analysis for all works such as canal dam tunnel, etc.
4. Seminar and assist of public relation about the project component
5. Preparation of special documents for public relation

1.5 Personnel Engaged in the Study

(1) JICA Advisory Committee

The JICA Advisory Committee consists of a total of 4 advisory experts, headed by Mr. Hidetomi Oi, leader/water diversion planner.

JICA Advisory Committee

	Assignment	Name
1	Leader/Water Diversion Planner	Mr. Hidetomi Oi
2	Environmental Specialist	Mr. Kenichi Tanaka
3	Water Resources Planner	Mr. Hideo Tamura
4	- do -	Mr. Tosiya Koga
5	Irrigated Agriculture Planner	Mr. Yugo Matsuda
6	- do -	Mr. Shin Imai

(2) JICA Study Team

The Study Team comprises a total of 19 planner/experts headed by Mr. Shoichiro Higuchi. The members and their assignments are as follows;

	Designation	Name of Experts
1	Team Leader	Shoichiro HIGUCHI
2	Environment/Leader	Shinichi ISODA
3	Water Resources Development	Yoshiaki KIMURA
4	Water Demand Projection	Yasushi MIYAZAKI
5	Hydraulics/Hydrology	Akira SUGIMOTO
6	Irrigation Planning	Kitla THEPALAGLEKHA
7	Agriculture Development	Paitoon PALAYASOOT
8	Water Management	Masaaki UEDA
9	Facility Design (Tunnel)	Masaru MATSUYAMA
10	Facility Design (Dam)	Yukio AZEGAMI
11	Facility Design (Diversion Canal)	Hiroshi HAYATA
12	Facility Design (River Training)	Masanobu SAKAMOTO
13	Geological Analysis	Kazuyoshi OSAWA
14	Construction Planning/Cost Estimate	Toshiharu KANAI
15	Socio-Economy/Project Evaluation	Nobuki TOYOOKA
16	Environment (Watershed Management)	Timothy G. FLOWER
17	Environment (Rural Community)	Masami WATANABE
18	Environment (Organization/Institution)	Nicholas J. BONVOISIN
19	Environment (General Ecology)	Ravi V. SUNDARAM
20	Seismic Survey A	Kazunori WADA
21	Seismic Survey B	Mitsuyoshi SAITO
22	GIS Analysis	Ryota NAGASAWA
23	Coordinator	Akane CHIBA