O & M COST IN REGION III (Oct. 1981 - Sep. 1982)

O & M Office in Region III	Province	Operation Cost	Maintenance Cost Routine	Maintenance Cost Main	Total	Irrigation Area		O & M Cost per Rai or Ha
		(฿ 1,000)	(฿ 1,000)	(฿ 1,000)	(฿ 1,000)			
Nam Rik Project	Uttharadit	2,045	183	463	2,691	42,900 Rai	(6,864 ha)	63/Rai (392/ha)
Nam Pat Irrigation Project	Uttharadit	131	-	-	131	3,000	(480)	44 273
Tak Province Project	Tak	8,717	575	1,000	10,292	52,000	(8,320)	198 1,237
Sukhothai Province Project	Sukhothai	1,968	603	-	2,571	114,400	(18,304)	22 (140)
Sukhothai Ground Water Project	Sukhothai	2,140	-	-	2,140	40,000	(6,400)	54 (334)
Phitsanulok Province Project	Phitsanulok	3,128	249	2,500	5,877	263,000	(42,080)	22 (140)
Naresuan Dam Project	Phitsanulok	242	-	-	242	82,000	(13,120)	3 (18)
Phichit Province Project	Phichit	3,044	3,187	-	6,231	179,000	(28,640)	35 (218)
Nakhon Sawan Province Project	Nakhon Sawan	1,364	109	-	1,473	4,600	(736)	320 (2,001)
Kamphaengphet Province Project	Kamphaengphet	3,899	1,563	426	5,888	220,000	(35,200)	26 (167)
Pasak Left Bank Project	Phetchabun	2,122	318	5,500	7,940	32,000	(5,120)	248 (1,551)
Huai Pa Daeng Irrigation Project	Phetchabun	175	896	-	1,071	20,000	(3,200)	54 (335)
Total or Average*		28,975	7,683	9,889	46,547	1,052,900	(168,464)	44* (276)

Source: O & M Division, RID

TABLE IX-1

PERSONNEL REQUIREMENT IN PROJECT CONSTRUCTION STAGE

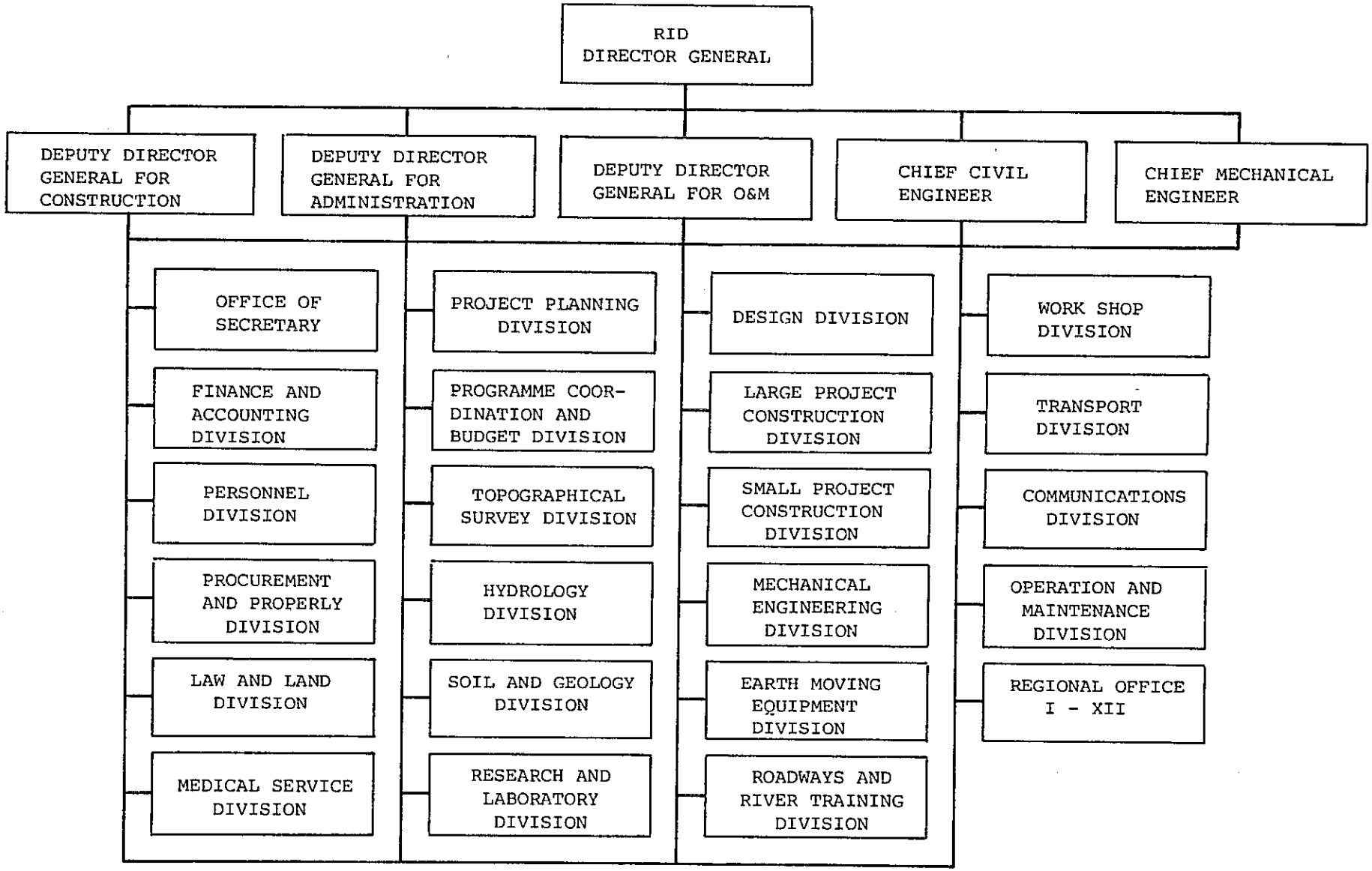
Project Staff		1984	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95
Upper Pasak													
Project Office													
Project Manager	II	1	1	1	1	1	1	1	1	1	1	1	1
Secretary	V	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	2	2	2	2	2	2	2	2
Administration Section													
Administrative Officer	III	1	1	1	1	1	1	1	1	1	1	1	1
Cashier	IV	1	1	1	1	1	1	1	1	1	1	1	1
Accountant	III	1	1	1	1	1	1	1	1	1	1	1	1
Clerk	IV	1	1	1	1	1	1	1	1	1	1	1	1
Personnel Management Officer	III	1	1	1	1	1	1	1	1	1	1	1	1
Property Custodian	III	1	1	1	1	1	1	1	1	1	1	1	1
Assistant Officer	IV	3	4	6	6	6	6	6	6	6	3	1	1
Typist	V	2	2	3	3	3	3	3	3	3	2	2	2
Driver	V	4	4	4	6	6	4	4	4	4	4	4	4
Radio Operator	V	1	1	1	1	1	1	1	1	1	1	1	1
Security Guard	VI	2	4	5	5	5	5	5	5	5	3	3	3
		18	21	25	27	27	25	25	25	25	19	17	17
Engineering Section													
Civil Engineer	III	1	1	1	1	1	1	1	1	1	1	1	1
Irrigation Engineer	III	1	1	1	1	1	1	1	1	1	1	1	1
Design Engineer	III	4	4	4	4	6	6	4	4	4	2	-	-
Junior Design Engineer	IV	6	6	6	6	9	9	6	6	6	2	1	1
Soil Engineer	III	1	1	1	1	1	1	1	1	1	1	-	-
Hydrographer	IV	1	1	1	1	1	1	1	1	1	1	1	1
Surveyor	V	6	6	6	6	9	9	6	6	6	2	2	2
Draftsman	V	6	6	6	6	6	6	6	6	6	3	-	-
Typist	V	2	2	2	2	2	2	2	2	2	1	-	-
		28	28	28	28	36	36	28	28	28	14	6	6
Construction Section													
Civil Engineer	III	1	1	1	1	1	1	1	1	1	1	-	-
Construction Engineer	III	1	1	1	1	2	2	2	2	2	1	1	1
Electro-Mechanical Engineer	IV	1	1	1	1	1	1	1	1	1	1	1	1
Draftsman	V	2	2	2	4	4	4	4	4	4	2	-	-
Mechanic	V	0	1	1	2	2	1	1	1	1	1	1	1
Electrician	V	0	1	1	2	2	1	1	1	1	1	-	-
Operator	V	1	1	1	1	1	1	1	1	1	1	1	1
Carpentor	V	1	1	1	1	1	1	1	1	1	1	1	1
Typist	V	1	1	1	1	1	1	1	1	1	1	1	-
		8	10	10	14	15	13	13	13	13	10	6	5

PERSONNEL REQUIREMENT IN PROJECT CONSTRUCTION STAGE

Project Staff		1984	'85	'86	'87	'88	'89	'90	'91	'92	'93	'94	'95
Operation Section													
On-Farm Development Engineer	III	-	-	-	-	2	2	2	2	2	2	-	-
Asst. On-Farm Development Engineer	IV	-	-	-	-	4	4	4	4	4	4	-	-
Agronomist	IV	1	1	1	1	1	1	1	1	1	1	1	1
Clerk/Typist	V	1	1	1	1	1	1	1	1	1	1	1	1
		2	2	2	2	8	8	8	8	8	8	2	2
Branch Office													
Construction Engineer	III	2	2	2	2	4	4	4	2	2	2	-	-
Clerk/Typist	V	2	2	2	2	4	4	4	2	2	2	2	2
Field Supervisor	IV	-	4	10	14	14	14	10	10	10	4	2	2
Junior Construction Engineer	IV	2	2	2	2	4	4	4	2	2	2	-	-
Mechanic	V	-	-	2	2	4	4	4	4	4	4	4	4
Junior Mechanic	V	-	-	2	2	4	4	4	4	4	4	4	4
Water Master	V	-	-	-	-	3	3	5	5	5	5	5	5
Zone Man	V	-	-	-	-	8	8	8	8	12	12	12	12
Ditch Tender	IV	-	-	-	-	50	50	50	50	90	90	90	90
		6	10	20	24	95	95	93	87	131	125	119	119
		64	73	87	97	183	179	169	163	207	178	152	151
	II	1	1	1	1	1	1	1	1	1	1	1	1
	III	15	15	15	15	22	22	20	18	18	15	7	7
	IV	16	21	29	33	92	92	85	83	123	110	99	99
	V	30	32	37	43	63	59	58	56	60	49	42	41
	VI	2	4	5	5	5	5	5	5	5	3	3	3
		64	73	87	97	183	179	169	163	207	178	152	151
												I : 1400	

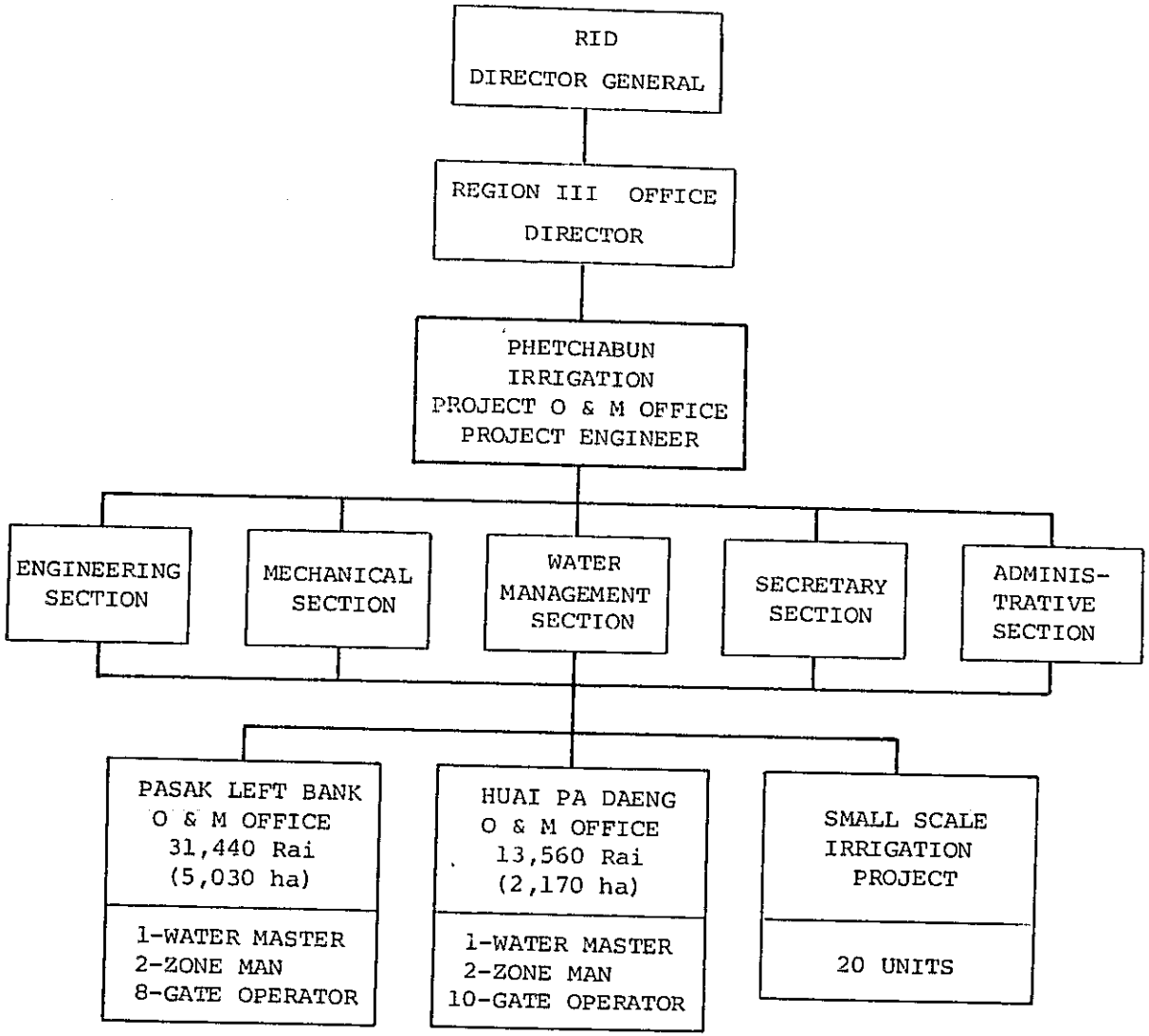
PERSONNEL REQUIREMENT FOR OPERATION AND MAINTENANCE IN PROJECT

	No.
Project Engineer	1
Secretary	1
Administrative Section	
Administrative Officer	1
Cashier	1
Accounting Clerk	1
Clerk	1
Property Custodian	1
Instrumentman	1
Aid	1
Typist	2
Security Guard	3
Engineering Section	
Sr. Engineer	1
Jr. Engineer	1
Construction Engineer	1
Hydrographer	1
Surveyor	2
O & M Section	
Irrigation Superintendent	1
Electric Engineer	1
Carpenter	1
Radio Operator	1
Workshop Section	
Mechanical Engineer	1
Mechanic	1
Operator	2
Driver	4
Agricultural Service Section	
Agronomist	1
Agri-clerk	2
Branch and Field Office	
Supervisor	2
Secretary/Typist	2
Mechanic	4
Jr. Mechanic	4
Water Master	6
Zone Man	14
Ditch Tender	110
TOTAL	177



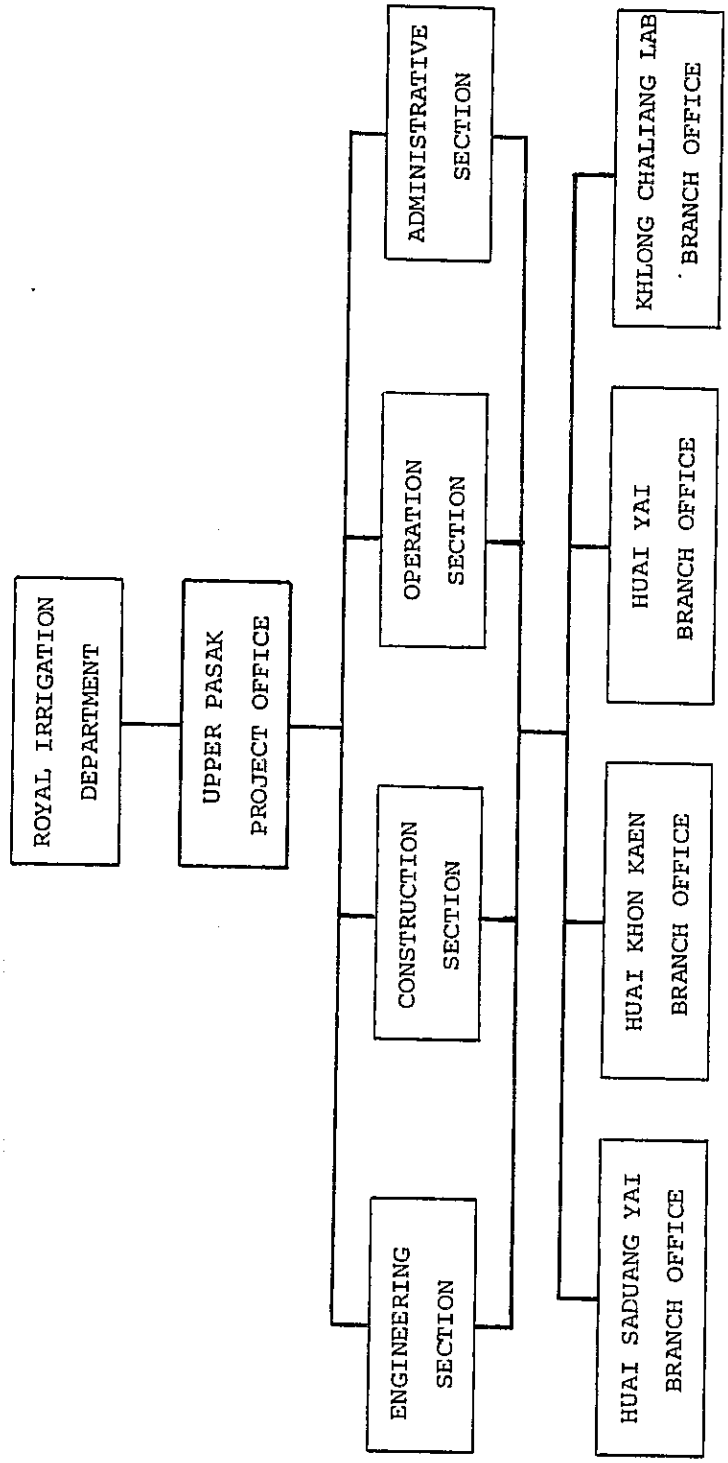
ORGANIZATION OF ROYAL IRRIGATION DEPARTMENT

FIG. IX-1

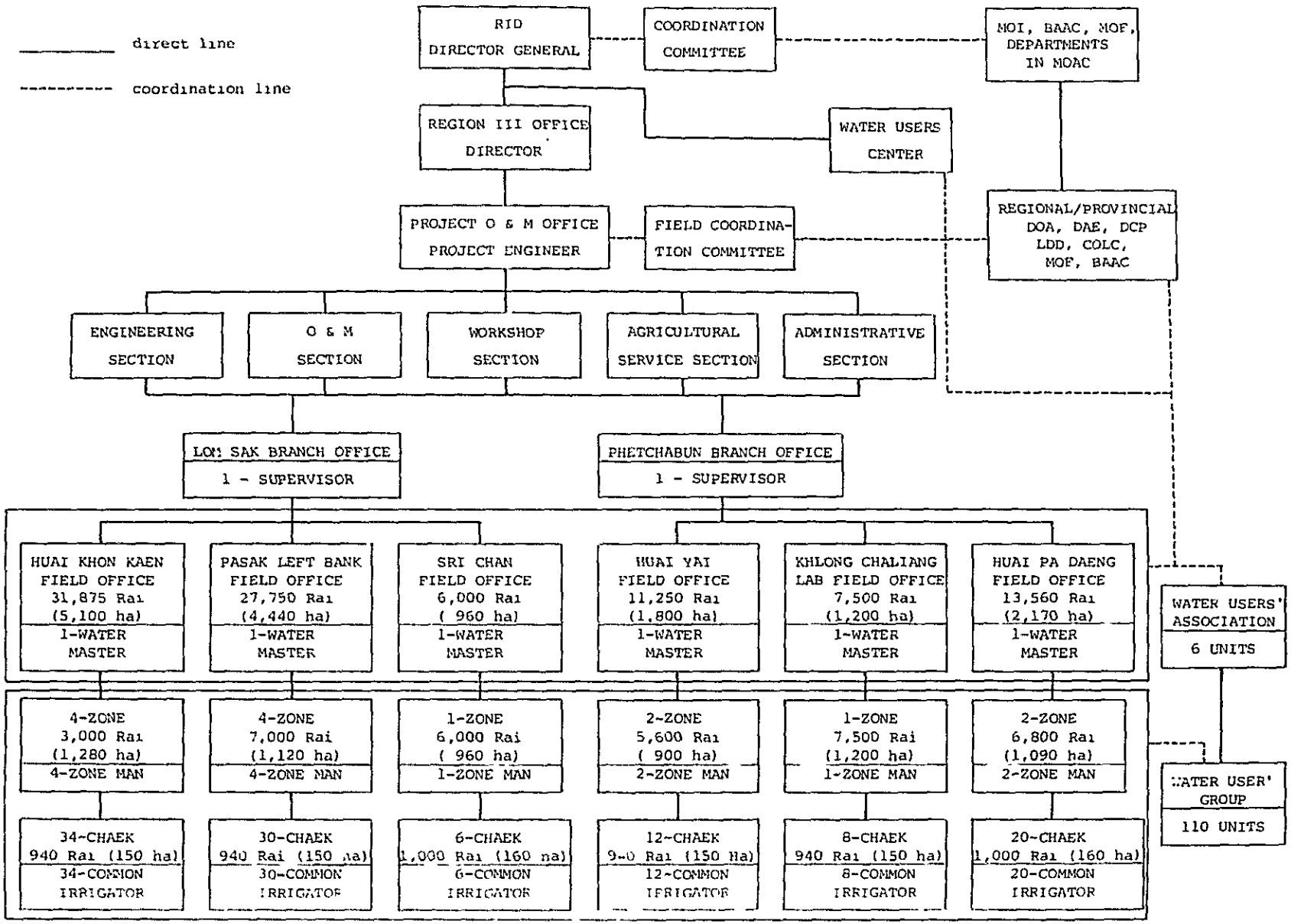


ORGANIZATION OF PHETCHABUN IRRIGATION PROJECT O & M OFFICE

FIG. IX-2



PROPOSED ORGANIZATION FOR PROJECT CONSTRUCTION OFFICE



PROPOSED ORGANIZATION FOR O & M OFFICE

FIG. IX-4

ANNEX X

CONSTRUCTION PLAN AND COST ESTIMATE

ANNEX - X

CONSTRUCTION PLAN AND COST ESTIMATE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ANNEX - X

CONSTRUCTION PLAN AND COST ESTIMATE

1. CONSTRUCTION

1.1 General

Following the conclusion of the pre-feasibility study undertaken in 1981, it has been proposed to execute the project in two stages, i.e. the Huai Khon Kaen and the Huai Yai sub-projects for Stage I and the Huai Saduang Yai and the Khlong Chaliang Lab sub-projects for Stage II.

Each sub-project comprises construction of an earthfill dam and an irrigation and drainage canal system. As the construction work of each sub-project is mainly concerned with earth works, due attention must be paid to the characteristics of earth materials which directly affects earth moving plan, selection of construction equipment, specification of dam embankment and so on.

The construction of dam and main canal would be mostly executed by heavy construction equipment. Lateral canal and other minor works would be implemented by manpowers to increase a employment opportunity of the local people in and around the project area.

1.2 Basic Assumption of Construction Planning

1.2.1 Workable Days

Earth work is mostly affected by rainfall. The workable days for embankment of impervious materials must especially be controlled by the amount of rainfall. Suspension of these earth works caused by rainfall would be assumed as following criteria according to the daily rainfall intensity.

Normal earth works	Embankment of Impervious Materials	Suspension of work
0 to 10 mm	0 to 5 mm	0 day
10 to 30	5 to 10	1 day
30 to 50	10 to 30	2 days
50 to 100	30 to 50	3 days
more than 100	more than 100	4 days

Monthly and annual mean workable days are estimated on the basis of the above criteria and the rainfall records in Phetchabun and Lom Sak as summarized below.

	LOM SAK		PHETCHABUN	
	Monthly	Annual	Monthly	Annual
	(day)		(day)	
Normal Works	27	336	27	324
Impervious Materials	24	289	24	286

The standard construction workable days stipulated in RID are 25 days per month. Therefore, the monthly mean workable days of 25 days for normal works and 22 days for embankment of impervious materials would be conservatively applied for the construction plan.

1.2.2 Definition of Earth Materials

The abbreviation of earth materials on the construction plan would be collated with the geological definition as given in the table below:

Earth Materials of the Construction Plan	Abbreviation	Geological Definition
Sand	S	S
Normal Soil	N/S	CW
Clayey Soil	C/S	Td, td
Gravel & Weathered Rock	G & W/R	Hw
Excavated Rock	R	Nw, Sw

1.2.3 Conversion Rate of Earth Materials

Earth volume is changeable according to the condition as it is. Naturally placed earth materials increase in volume after excavation and decrease after compaction. These changes in volume should be considered for estimation of produced volume by construction equipment, the earth moving plan, specification of dam embankment and so on. The conversion rate of the earth volume is assumed as follows:

Materials	Apparent Unit Weight (t/m^3)	in place	in loose	in compaction
Sand	1.7	1.00	1.20	0.95
Normal Soil	1.6	1.00	1.25	0.90
Clayey Soil	1.8	1.00	1.35	0.90
Gravel & Weathered Rock	1.9	1.00	1.20	1.00
Excavated Rock	2.5	1.00	1.50	1.20

1.3 Dam Construction

1.3.1 Earth Moving Plan

As a result of the soil mechanical and geological investigation, embankment of impervious materials would be made with talus deposits (td) and terrace deposits (Td) lying around the dam site. As the talus deposits are suitable for impervious materials, these can be used directly for the embankment of core zone. The terrace deposits obtainable from the proposed borrow areas for each dam contain a very few coarse materials and unsuitable for core materials. Hence, further investigation for better core materials should be made not only superficially but also vertically in the next stage. Blend of materials by stock piling would be proposed for the time being to conservatively estimate the embankment cost of core zone.

According to the results of laboratory test on the materials collected in the borrow areas proposed in the prefeasibility study, no suitable materials for shell zone is obtainable. The hilly ranges surrounding each reservoir are mainly covered with weathered sandstone and shale. The hillsides covered with sandstone are much suitable for the embankment of shell zone. As discussed in ANNEX II, the borrow areas for the random materials are newly proposed through the detailed field inspection. But further investigation should be made prior to the proceed to the next stage in order to confirm the quality and quantity of random materials.

Riprap, filter and drain materials would be planned to be hauled from crashing plants located at Saluong and Silalat.

Taking into account these usable materials, conversion rate of earth, construction schedule and others, the earth moving plan of each dam is confirmed as shown in TABLE X-1 to TABLE X-4.

1.3.2 Diversion Works

(1) Diversion Discharge

Dam embankment works must be safely protected from damages caused by flooding during the construction period. Ten (10)-year probable flood would be applied for design of the river diversion works. The design discharge of each dam site is estimated through hydrological analysis as given below:

Huai Saduang Yai	161.8 m^3/sec
Huai Khon Kaen	293.6 "
Huai Yai	94.6 "
Khlong Chaliang Lab	80.0 "

The stream flow at each dam site is extremely depleted during dry season. The monthly runoff and mean discharge are roughly estimated as given below on the basis of the observed runoff data at the Kaen Sida gauging station.

	Huai Saduang Yai		Huai Khon Kaen		Huai Yai		Khlong Chaliang Lab	
Month	m^3/month	m^3/sec	m^3/month	m^3/sec	m^3/month	m^3/sec	m^3/month	m^3/sec
Dec.	514,560	0.19	1,725,920	0.64	402,000	0.15	412,720	0.15
Jan.	342,720	0.13	1,149,540	0.43	267,750	0.10	274,890	0.10
Feb.	197,760	0.08	663,320	0.27	154,500	0.06	158,620	0.06
Mar.	153,600	0.06	515,200	0.19	120,000	0.04	123,200	0.05
Apr.	139,200	0.05	466,900	0.18	108,750	0.04	111,650	0.04
May	526,080	0.20	1,764,560	0.66	411,000	0.15	421,960	0.16

(2) Embankment and Diversion Procedures

In due consideration of the probable flood and the discharge during dry season above mentioned, the following procedures are set up for the embankment and the diversion.

Huai Saduang Yai (See FIG. X-1)

i) There exists no saddle at all. The left and right portion of embankment would be commenced at the onset of the wet season and filled up to EL.183.00 m by the end of the dry season first year. The embankment at the central part of the site would be remained so as to divert flooding water of 10-year recurrence. The volume of this embankment is limited within 200,000 m^3, accounting for the available capacity of construction equipment.

ii) The central portion of embankment would be filled up to EL.183.00 m by the end of the dry season. The small amount of the runoff during the dry season would be stored in the sump created by the small scaled earth closing (coffer dam), and then dewatered by pumping.

iii) The retention capacity created by the embankment up to EL.183.00 m is sufficiently large to temporally impound the runoff caused by the 10-year probable flood. Therefore, the embankment up to EL.183.00 m would function the coffer dam for the major embankment work during the wet season.

iv) The impounded flood in the retention area would be pumped out as quickly as possible through the conduit which will be constructed for a part of outlet works.

v) The major embankment up to the crest would be year-roundly implemented at the full width of dam crest.

Huai Khon Kaen (See FIG. X-2)

The dam site consists of one main gorge and two saddles.

i) The main gorge would be filled up to EL.187.50 m. The small amount of the runoff during the dry season would be stored in the sump created by the small scaled earth closing (coffer dam), and then dewatered by pumping.

ii) The retention capacity created by the embankment up to EL.187.50 m can readily impound the total runoff caused by the 10-year probable flood previously mentioned. The impounded water after flooding would be quickly pumped out through the conduit which is to be constructed for a part of outlet works.

iii) Prior to the commencement of the major embankment at the main gorge, the existing channel would be diverted into the central gorge. The embankment up to EL. 187.50 m would function the coffer dam for the main embankment at the main gorge.

iv) The embankment at the central gorge would be commenced at the onset of the second dry season and elevated up to EL. 193.00 m, dewatering the small amount of runoff during dry season by sump pumps.

v) Prior to the commencement of the major embankment at the central gorge, the river channel would be further diverted into the rightside gorge. The embankment up to EL. 193.00 m at the central gorge would function a coffer dam for the major embankment at the central gorge.

vi) The embankment up to EL. 193.00 m at the rightside gorge would be commenced at the onset of the third dry season, dewatering the runoff during the dry season by sump pumps.

vii) The major embankment at the rightside gorge would be commenced at the onset of third wet season and completed by the end of the said season.

Huai Yai (See FIG. X-3)

i) The dam site comprises one main gorge and one saddle. The dam site comprises a main gorge and a saddle. The embankment up to 202.50 m at the main gorge would be commenced at the onset of the first dry season and ended by the end of the said season. The small amount of the runoff during the dry season would be stored in the sump created by the small scaled earth closing (coffer dam), and then dewatered by pumping. The embankment at this stage is limited within 200,000 m^3, considering the available capacity of construction equipment.

ii) The retention capacity created by the embankment up to EL. 202.50 m can store almost all the flood water of 10-year probability previously mentioned. The retained water after flooding would be quickly pumped out through the conduit to be installed for a part of outlet works against the probable flood consecutively occurs. Therefore, this embankment would function a coffer dam for the major embankment.

iii) The major embankment above EL. 202.50 m would be commenced at the beginning of the wet season and would be continuously made at the full width of the dam crest by the end of the dry season.

Khlong Chaliang Lab (See FIG. X-4)

i) The embankment up to the dam crest at the saddle extending from the right abutment would be year-roundly implemented without any dewatering works.

ii) The embankment up to EL. 199.00 m at the main gorge would be commenced at the beginning of the first dry season. The retention capacity created by the embankment can store the total runoff of 10-year probability previously mentioned. The embankment volume at this stage is limited to about 100,000 m^3. The retained water after flooding would be quickly pumped out through the conduit to be installed for a part of outlet works. The main embankment above EL. 199.00 m would be year-roundly made at the full width of the dam crest.

1.3.3 Excavation of Dam Foundation

Stripping and normal soil excavation would be mainly made by bull-dozer, while weathered rock would be excavated by ripper-dozer. Rock materials would be broken by blasting and gathered by bull-dozer. After excavated, these materials would be loaded by tractor shovel and hauled by dump-truck to the spoil areas. At the spoil area, dumped materials would be spread by bull-dozer.

1.3.4 Foundation Treatment

After excavation of the dam core trench, curtain grouting would be executed. After completion of grout holes drilled by hydraulic boring machines, cement milk mixed by mortal mixer would be poured into the holes by grouting pump. For making sure the grouting condition, test hole would be drilled and grouted effect would be checked by observation of the lifted core.

1.3.5 Embankment

Dam embankment materials to be transported from the borrow area shown in TABLE X-1 to TABLE X-4, would be spreaded by bull-dozer at the specified thickness and compacted by tamping roller and tire roller.

The specified thickness of spreading and numbers of compaction runs would be proposed as follows:

Zone	Spreading (cm)	Compaction (runs)
Impervious Zone	20	6
Random Zone	40	4

Embankment should be controlled by the D-value, and also the water contents ratio would be checked throughout the construction period. In case of a low water content ratio, some amount of water would be added to the materials by tank lorry so as to approximate the optimum water content.

1.3.6 Construction of Appurtenant Structures

As the appurtenant structures of the dam, service spillway, emergency spillway and outlet structures would be constructed, useful materials excavated by back-hoe shovel at service spillway and emergency spillway would be embanked for the downstream random zone and backfill materials. The remaining or unusable materials would be hauled to the spoil area.

Concrete for these structures would be mixed by batching plant installed at the project site. Specifications of the batching plant would be proposed as follows, accounting for the proposed quantity and placement plan of concrete for the relevant structures.

Batching Plant (Fully Automatic) (0.75 m^3 mixer x 2 sets, 7.5 kw x 2)	1 set
Cement Silo (200 t)	1 set
Agitator Truck (3.2 m^3)	5 sets
Belt conveyor (L = 80 m, 11 kw)	1 set
Screw conveyor (L = 10 m, 5.5 kw)	1 set
Backet elevator (L = 25 m, 5.5 kw)	1 set

1.4 Canal Construction

1.4.1 Excavation and Filling

Stripping and surface excavation of the main canals would be mainly made by bull-dozer, and sub-surface and deep excavation, by back-hoe shovel depending on the soil condition at the working site. Weathered rock, which are hard and beyond capacity of back-hoe shovel, would be excavated by pick-hummer. Manpower would contribute to the lateral canals construction, face smoothing, compacting of canal invert and other lateral works.

The excavated materials excessive of filling requirement would be transported to a spoil area. In case of lacking is materials for filling, the materials would be supplemented from borrow area selected near the dam site. Spreading of filling materials would be mainly made by bull-dozer and supplementally by manpower. Materials for laterite pavement would be transported from a borrow area, spreaded by bull-dozer, and compacted by compactor.

1.4.2 Concrete Lining

Main canals would be lined with 6-cm thick concrete. After completion of earth works, concrete lining works would be started. Concrete would be produced by portable concrete mixer, and placed by manpower. Simple sliding concrete form removed by manpower would be used for the lining. Three or four sets of the slide forms would be required for making continuous lining works every day.

1.4.3 Related Structures

Earth works for canal related structures would be done by manpower. The structures are mainly made by reinforced concrete. The concrete would be mixed by portable mixer and placed by manpower. The structures are not so simple compared with canal lining that wooden forms would be used for these structures.

1.5 Implementation Schedule

In accordance with the order of priority for each sub-project, the four sub-projects are divided into two packages.

Package I is composed of the construction of the Huai Khon Kaen and Huai Yai sub-projects. The construction of Huai Khon Kaen dam will be started immediately after the loan arrangement and needs four years, and Huai Yai dam be started from the same year and needs three years for its completion. Canal construction of each sub-project will be completed within six months after completion of each dam.

Package II includes, the construction of the Huai Saduang Yai and Khlong Chaliang Lab sub-projects. The construction of both dams will be started in the 7th year after the commencement of the Package-I and completed in the 9th year after the commencement. The Huai Saduang Yai sub-project has no canal construction. Canal construction of the Khlong Chaliang Lab sub-project will be started in the middle of the 9th year after the commencement and completed in the 10th year after the commencement.

The chart of implementation schedule is shown in FIG. X-5.

2. COST ESTIMATE

2.1 Conditions

The following assumptions are made for the cost estimate of the project;

(1) The conversion rate between Baht and US Dollar is assumed at

US$ 1.00 = Baht 23.00

(2) All of the construction works would be executed by full contract basis. The machinery and equipment required for construction works would be provided by the contractors themselves. Therefore, depreciation cost of machinery and equipment would be taken into account to the construction cost, instead of procurement cost of machinery and equipment.

(3) Taxes on the construction materials, machinery and equipment to be imported from abroad are not included in the estimate of construction cost.

(4) The construction cost integrated by unit costs is divided into foreign and local currency portions. Local currency portion is estimated on the basis of the current price in Phetchabun province in August 1982 and of the data collected from the on-going and completed irrigation projects around the project area.
Foreign currency portion is estimated based on the CIF prices at Bangkok referring to the FOB prices of materials, machinery and equipment in Japan in July 1982.

The classification of local and foreign currency portions is defined as follows:

Local currency portion:

- labour wages,
- sand, gravel and wooden materials,
- fuel, oil etc.,
- cement,
- secondary concrete products,
- small gates for canals,
- reinforced iron bar,
- 15% of depreciation cost of construction equipment and machinery,
- inland transportation costs,
- general expenses and profit of local contractor,
- minor works,
- land aguisition and compensation, and
- administration cost.

Foreign currency portion:

- large gates for dams and canals,
- 85% of depreciation cost of construction equipment and machinery,
- expenses and fees of engineering services,
- contractor's general expenses and profit, and
- vehicles to be required for the construction supervision and O & M equipment for the project operation.

(5) The physical contingency related to the construction quantities, around 10% of the direct cost, is included in the construction cost in view of the preliminary nature of the estimate. The price contingency; 6% per annum for the foreign currency portion and 10% per annum for the local currency portion, is also included in the construction cost.

(6) The associated costs to be financed by the Government, such as the costs for strengthening the extension services, facilities of the water user's association, and improvement of the social infrastructures are not included in the estimate.

2.2 Estimate of Construction Cost

The total construction costs of the project are estimated at ฿4,484 million, which comprise ฿2,460 million of local currency and ฿2,024 million (US$88 million equivalent) of foreign currency. The summary of the construction cost are shown in TABLE X-5, while the package wise construction cost and the construction cost for each sub-project are shown in TABLE X-6 and TABLE X-7 respectively. The breakdown of the cost estimate is shown in TABLE X-8 through TABLE X-17.

The summary of unit costs estimated in detail is as shown in TABLE X-18 through TABLE X-21.

2.3 Annual Disbursement Schedule

The annual disbursement schedule is worked out based on the construction implementation schedule. The details are stated in TABLE X-22.

Year	Foreign Currency (10^6 ฿)	Local Currency (10^6 ฿)	Total (10^6 ฿)
1984	31.2	20.7	51.9
1985	55.1	53.5	108.6
1986	229.6	211.6	441.2
1987	321.0	336.9	657.9
1988	386.7	437.9	824.5
1989	265.5	383.4	648.9
1990	236.5	299.7	536.2
1991	233.2	303.5	536.6
1992	237.1	308.0	545.1
1993	27.9	105.4	133.3
Total	2,023.7	2,460.4	4,484.1

3. ANNUAL OPERATION AND MAINTENANCE COSTS

The annual operation and maintenance costs include the salaries of project administration and water control staffs, the materials and labour costs for repair and maintenance of project facilities, the cost for operation, repair and maintenance of O & M equipment, and running cost of project facilities. The annual operation and maintenance costs are estimated at ฿1,341/ha (TABLE X-23, 24) on an average.

4. REPLACEMENT COST

Some of the facilities, especially mechanical works have shorter useful life than the civil works and require replacement at a certain time within the project useful life. The TABLE X-25 shows the useful life and replacement costs of the mechanical works.

TABLE X-1

EARTH MOVING SCHEDULE

(HUAI SADUANG YAI)

(Unit: m^3)

Excavation	Embankment		Impervious Zone	Random Zone		Riprap	Filter, Sand and Gravel	Service Spillway	Rock	Deposit
				Upper-stream	Down-stream					
Location	Material	Volume	(179,200)	(480,600)	(340,600)	(29,300)	(41,900)	(7,200)	(2,400)	186,200
Dam	n/s	101,100								101,100
	W/R	1,800								1,800
Service Spillway	n/s	44,800						8,000 (7,220)		36,800
	W/R	84,800			67,800 (67,800)					17,000
	R	87,600			68,100 (81,700)				2,000 (2,400)	17,500
Emergency Spillway	n/s	5,200								5,200
	W/R	7,800			6,200 (6,200)					1,600
	R	13,000			10,400 (12,500)					2,600
Canal	n/s	2,600								2,600
Borrow Area	td	150,000	150,000 (135,000)							
	Td	25,700	*25,700 (23,100)							
	G~W/R	674,100	*21,100 (21,100)	480,600 (480,600)	172,400 (172,400)					
Quarry Site	Riprap	24,500				24,500 (29,300)				
	Sand & Gravel	44,200					44,200 (41,900)			

Note: *: Stock pile

TABLE X-2

EARTH MOVING SCHEDULE
(HUAI KHON KAEN)

(Unit: m^3)

Excavation		Embankment	Impervious Zone	Random Zone		Riprap	Filter, Sand and Gravel	Service Spillway	Rock	Deposit
				Upper-stream	Down-stream					
Location	Material	Volume	(544,200)	(1,637,500)	(1,195,500)	(86,700)	(114,400)	(38,000)	(7,800)	434,500
Dam	n/s	283,600								283,600
	W/R	4,500								2,700
Service Spillway	n/s	107,500						42,200 (38,000)		65,300
	W/R	170,500			136,400 (136,400)					34,100
	R	168,700			128,500 (154,200)				6,500 (7,800)	33,700
Emergency Spillway	n/s	9,800								9,800
	W/R	5,300			4,200 (4,200)					1,100
	R	8,900			7,100 (8,500)					1,800
Drainage Canal	n/s	2,400								2,400
Borrow Area (Down-stream)	td	200,000	200,000 (180,000)							
	Td	202,400	*202,400 (182,100)							
Borrow Area (Upper-stream)	Td	202,400	*202,400 (182,100)							
	G~W/R	2,529,700		1,637,500 (1,637,500)	892,200 (892,200)					
Quarry Site	Riprap	72,300				72,300 (86,700)				
	Sand & Gravel	120,500					120,500 (114,400)			

Note: *: Stock pile

EARTH MOVING SCHEDULE
(HUAI YAI)

(Unit: m^3)

Excavation \ Embankment			Impervious Zone	Random Zone		Riprap	Filter, Sand and Gravel	Service Spillway	Rock	Deposit
				Upper-stream	Down-stream					
Location	Material	Volume	(152,300)	(349,000)	(270,900)	(31,400)	(42,500)	(16,600)	(1,700)	200,300
Dam	n/s	96,800								96,800
	W/R	2,200								2,200
Service Spillway	n/s	72,900						18,400 (16,600)		54,500
	W/R	10,700			8,600 (8,600)					2,100
	R	126,100			99,400 (119,200)				1,500 (1,700)	25,200
Emergency Spillway	n/s	9,900								9,900
	W/R	2,900			2,300 (2,300)					600
	R	4,900			3,900 (4,700)					1,000
Canal	n/s	8,000								8,000
Borrow Area	Td	84,700	*84,700 (76,200)							
	G~W/R	561,200	*76,100 (76,100)	349,000 (349,000)	136,100 (136,100)					
Quarry Site	Riprap	26,200				26,200 (31,400)				
	Sand & Gravel	44,800					44,800 (42,500)			

Note: *: Stock pile

TABLE X-4

EARTH MOVING SCHEDULE

(KHLONG CHALIANG LAB)

(Unit: m^3)

Excavation \ Embankment			Impervious Zone	Random Zone		Riprap	Filter, Sand and Gravel	Service Spillway	Rock	Deposit
				Upper-stream	Down-stream					
Location	Material	Volume	(158,800)	(323,800)	(305,000)	(53,400)	(61,100)	(37,800)	(2,000)	153,400
Main Dam	n/s	138,800								138,800
	W/R	3,000								3,000
Service Spillway	n/s	15,000						12,000 (10,800)		3,000
	W/R	20,100						16,100 (16,100)		4,000
	R	15,400						9,100 (10,900)	1,700 (2,000)	4,600
Borrow Area	td	176,500	176,500 (158,800)							
	G~W/R	556,800		286,900 (286,900)	269,900 (269,900)					
Quarry Site	Riprap	44,500				44,500 (53,400)				
	Sand & Gravel	64,300					64,300 (61,100)			

SUMMARY OF CONSTRUCTION COST

	Item	Total (10^3 Baht)	Foreign Currency (10^3 Baht)	Local Currency (10^3 Baht)
1.	Direct Construction Cost	1,984,979	1,032,359	952,620
1.1	Dam Construction			
	- Preparatory Works	107,523	75,302	32,221
	- Dam	1,027,013	606,822	420,191
	- Service Spillway	276,176	128,645	147,531
	- Emergency Spillway	22,279	9,254	13,025
	- Outlet Works	26,519	8,302	18,217
	- Overhead	51,082	28,990	22,092
	- Profit	94,866	53,839	41,027
	- Tax	52,976	30,065	22,911
	Sub-Total	1,658,434	941,219	717,215
1.2	Canal Construction			
	- Preparatory Works	33,124	12,692	20,432
	- Main Canal	167,097	58,397	108,700
	- Lateral Canal	45,044	6,299	38,745
	- Drainage Canal	5,685	2,505	3,180
	- Overhead	9,476	2,973	6,503
	- Profit	16,967	5,364	11,603
	- Tax	9,152	2,910	6,242
	Sub-Total	286,545	91,140	195,405
1.3	Office and Quarters	40,000	-	40,000
2.	Land Acquisition & Compensation			
	- Dam (Compensation)	2,200	-	2,200
	- Canal (Acquisition)	6,350	-	6,350
	Sub-Total	8,550	-	8,550
3.	O & M Equipment	45,229	41,879	3,350
4.	Administration	146,252	-	146,252
	Total	2,185,010	1,074,238	1,110,772
5.	Physical Contingency	218,498	107,423	111,075
6.	Engineering Services	253,920	196,710	57,210
	Total	2,657,428	1,378,371	1,279,057
7.	Price Contingency	1,826,651	645,313	1,181,338
	GRAND TOTAL	4,484,079	2,023,684	2,460,395

CONSTRUCTION COST FOR PACKAGE

(Unit: 10^3 Baht)

Item	PACKAGE I Huai Khon Kaen, Huai Yai			PACKAGE II Huai Saduang Yai, Khlong Chaliang Lab		
	Total	Foreign	Local	Total	Foreign	Local
1. Direct Construction Cost	1,392,424	723,127	669,297	592,555	309,232	283,323
1.1 Dam Construction						
- Preparatory Works	72,127	51,119	21,008	35,396	24,183	11,213
- Dam	686,133	409,668	276,465	340,880	197,154	143,726
- Service Spillway	184,027	91,154	92,873	92,149	37,491	54,658
- Emergency Spillway	18,396	6,250	12,146	3,883	3,004	879
- Outlet Works	12,778	4,121	8,657	13,741	4,181	9,560
- Overhead	34,071	19,680	14,391	17,011	9,310	7,701
- Profit	63,274	36,549	26,725	31,592	17,290	14,302
- Tax	35,333	20,410	14,923	17,643	9,655	7,988
Sub-Total	1,106,139	638,951	467,188	552,295	302,268	250,027
1.2 Canal Construction						
- Preparatory Works	30,647	11,911	18,736	2,477	781	1,696
- Main Canal	154,100	54,251	99,849	12,997	4,146	8,851
- Lateral Canal	36,312	5,314	30,998	8,732	985	7,747
- Drainage Canal	5,503	2,423	3,080	182	82	100
- Overhead	8,257	2,674	5,583	1,219	299	920
- Profit	15,138	4,915	10,223	1,829	449	1,380
- Tax	8,248	2,688	5,560	904	222	682
Sub-Total	258,205	84,176	174,029	28,340	6,964	21,376
1.3 Office and Quarters	28,080	-	28,080	11,920	-	11,920
2. Land Acquisition and Compensation						
- Dam (Compensation)	1,080	-	1,080	1,120	-	1,120
- Canal (Acquisition)	5,575	-	5,575	775	-	775
Sub-Total	6,655	-	6,655	1,895	-	1,895
3. O & M Equipment	21,141	19,575	1,566	24,088	22,304	1,784
4. Administration	71,965	-	71,965	74,287	-	74,287
Total	1,492,185	742,702	749,483	692,825	331,536	361,289
5. Physical Contingency	149,217	74,270	74,947	69,281	33,153	36,128
6. Engineering Service	153,334	118,787	34,547	100,586	77,923	22,663
Total	1,794,736	935,759	858,977	862,692	442,612	420,080
7. Price Contingency	947,109	344,071	603,038	879,542	301,242	578,300
GRAND TOTAL	2,741,845	1,279,830	1,462,015	1,742,234	743,854	998,380

CONSTRUCTION COST FOR SUB-PROJECT

(Unit: 10^3 Baht)

	Huai Saduang Yai			Huai Khon Kaen			Huai Yai			Khlong Chaliang Lab		
	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C	Total	F.C	L.C
1. Direct Construction Cost	285,792	160,415	125,377	1,062,209	553,351	508,858	330,215	169,776	160,439	306,763	148,817	157,946
1.1 Dam Construction												
- Preparatory Works	18,217	12,834	5,383	54,212	38,567	15,645	17,915	12,552	5,363	17,179	11,349	5,830
- Dam	160,183	94,601	65,582	537,705	322,650	215,055	148,428	87,018	61,410	180,697	102,553	78,144
- Service Spillway	57,519	28,384	29,135	116,022	55,846	60,176	68,005	35,308	32,697	34,630	9,107	25,523
- Emergency Spillway	3,883	3,004	879	16,612	4,902	11,710	1,784	1,348	436	-	-	-
- Outlet Works	7,064	2,351	4,713	6,020	2,275	3,745	6,758	1,846	4,912	6,677	1,830	4,847
- Overhead	8,640	4,941	3,699	25,570	14,848	10,722	8,501	4,832	3,669	8,371	4,369	4,002
- Profit	16,046	9,176	6,870	47,487	27,575	19,912	15,787	8,974	6,813	15,546	8,114	7,432
- Tax	8,960	5,124	3,836	26,518	15,399	11,119	8,815	5,011	3,804	8,683	4,531	4,152
Sub-Total	280,512	160,415	120,097	830,146	482,062	348,084	275,993	156,889	119,104	271,783	141,853	129,930
1.2 Canal Construction												
- Preparatory Works	-	-	-	26,423	10,456	15,967	4,224	1,455	2,769	2,477	781	1,696
- Main Canal	-	-	-	132,458	47,897	84,561	21,642	6,354	15,288	12,997	4,146	8,851
- Lateral Canal	-	-	-	23,147	2,967	20,180	13,165	2,347	10,818	8,732	985	7,747
- Drainage Canal	-	-	-	3,402	1,419	1,983	2,101	1,004	1,097	182	82	100
- Overhead	-	-	-	6,489	2,195	4,294	1,768	479	1,289	1,219	299	920
- Profit	-	-	-	12,053	4,078	7,975	3,085	837	2,248	1,829	449	1,380
- Tax	-	-	-	6,731	2,277	4,454	1,517	411	1,106	904	222	682
Sub-Total	-	-	-	210,703	71,289	139,414	47,502	12,887	34,615	28,340	6,964	21,376
1.3 Office and Quarters	5,280	-	5,280	21,360	-	21,360	6,720	-	6,720	6,640	-	6,640
2. Land Acquisition												
- Dam (Compensation)	840	-	840	640	-	640	440	-	440	280	-	280
- Canal (Acquisition)	-	-	-	4,550	-	4,550	1,025	-	1,025	775	-	775
Sub-Total	840	-	840	5,190	-	5,190	1,465	-	1,465	1,055	-	1,055
3. O & M Equipment	20,067	18,581	1,486	15,110	13,991	1,119	6,031	5,584	447	4,021	3,723	298
4. Administration	24,629	-	24,629	57,458	-	57,458	14,507	-	14,507	49,658	-	49,658
Total	331,328	178,996	152,332	1,139,967	567,342	572,625	352,218	175,360	176,858	361,497	152,540	208,957
5. Physical Contingency	33,132	17,899	15,233	113,996	56,734	57,262	35,221	17,536	17,685	36,149	15,254	20,895
6. Engineering Services	41,706	32,309	9,397	40,774	70,322	20,452	62,560	48,465	14,095	58,880	45,614	13,266
Total	406,166	229,204	176,962	1,344,737	694,398	650,339	449,999	241,361	208,638	456,526	213,408	243,118
7. Price Contingency	390,116	155,738	234,378	735,349	264,010	471,339	211,760	80,061	131,699	489,426	145,504	343,922
GRAND TOTAL	796,282	384,942	411,340	2,080,086	958,408	1,121,678	661,759	321,422	340,337	945,952	358,912	587,040

TABLE X-7

BREAKDOWN OF DIRECT CONSTRUCTION COST OF DAM AND CANAL
HUAI SADUANG YAI SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
I. DAM CONSTRUCTION			141,174,000	105,692,000
1. Preparatory Works		L.S.	12,834,000	5,383,000
2. Dam			94,601,000	65,582,000
Earth works			83,145,400	58,028,800
- Excavation at dam site	m^3	102,900	2,439,500	1,026,100
- Spoiling	m^3	102,900	3,731,800	2,085,200
- Excavation at borrow area and stockpile	m^3	896,600	24,502,700	10,334,500
- Hauling	m^3	896,600	19,613,000	11,086,300
- Excavation at quarry site	m^3	68,700	18,027,000	24,628,200
- Embankment	m^3	1,074,000	14,566,200	7,704,700
- Others (Sod facing etc.)			265,200	1,163,800
Curtain grouting	m	12,500	6,951,500	4,430,900
Miscellaneous		L.S.	4,504,800	3,123,000
3. Service Spillway			28,384,000	29,135,000
Earth works			21,597,100	6,781,200
- Excavation	m^3	217,200	17,678,900	4,547,700
- Spoiling	m^3	71,300	2,044,600	1,140,300
- Hauling	m^3	145,900	1,873,600	1,093,200
Concrete works	m^3	9,200	3,616,100	19,744,700
Others (Mortal spray etc.)			1,819,800	1,222,300
Miscellaneous		L.S.	1,351,700	1,387,400
4. Emergency Spillway			3,004,000	879,000
Earth works			2,861,300	837,800
- Excavation	m^3	26,000	2,473,100	614,400
- Spoiling	m^3	9,400	164,800	93,700
- Hauling	m^3	16,600	223,400	129,700
Miscellaneous			143,100	41,900
5. Outlet Works			2,351,000	4,713,000
Earth works			312,000	144,800
- Excavation	m^3	8,800	304,200	141,200
- Spoiling	m^3	3,800	7,800	3,600
Concrete works	m^3	2,183	721,900	4,124,600
Steel	t	11	-------	220,000
Gate	Nos.	5	1,206,000	-------
Miscellaneous			112,000	224,500

BREAKDOWN OF DIRECT CONSTRUCTION COST
HUAI KHON KAEN SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
I. DAM CONSTRUCTION			424,240,000	306,331,000
1. Preparatory Works			38,567,000	15,645,000
2. Dam			322,650,000	215,055,000
Earth works			296,998,000	198,257,500
- Excavation at dam site	m^3	288,100	6,829,800	2,873,800
- Spoiling	m^3	288,100	10,444,400	5,836,000
- Excavation at borrow area and stockpile	m^3	3,539,300	86,461,400	40,398,400
- Hauling	m^3	3,539,300	80,909,400	46,674,600
- Excavation at quarry site	m^3	192,800	50,966,700	69,048,900
- Embankment	m^3	3,586,100	60,467,000	30,272,300
- Others (Sod facing etc.)			919,300	3,153,500
Curtain grouting	m	18,500	10,288,200	6,557,700
Miscellaneous		L.S.	15,364,300	10,240,700
3. Service Spillway			55,846,000	60,176,000
Earth works			42,366,200	13,673,500
- Excavation	m^3	446,700	34,681,700	9,270,800
- Spoiling	m^3	133,100	3,753,700	2,093,500
- Hauling	m^3	313,600	3,930,800	2,309,200
Concrete works	m^3	19,200	7,396,000	41,074,000
Others (Mortal spray etc.)			3,424,700	2,563,300
Miscellaneous			2,659,300	2,865,500
4. Emergency Spillway			4,902,000	11,710,000
Earth works			2,155,410	708,400
- Excavation	m^3	24,000	1,812,440	508,600
- Spoiling	m^3	12,700	190,850	111,400
- Hauling	m^3	11,300	152,120	88,400
Concrete	m^3	7,600	2,513,300	10,444,700
Miscellaneous		L.S.	233,400	557,600

BREAKDOWN OF DIRECT CONSTRUCTION COST
HUAI KHON KAEN SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
5. Outlet Works			2,275,000	3,745,000
Earth works			482,600	239,800
- Excavation	m^3	13,200	457,500	228,400
- Spoiling	m^3	4,400	25,100	11,400
Concrete works	m^3	990	327,400	2,769,500
Steel	t	20	-	400,000
Gate	Nos.	9	1,357,500	158,100
Miscellaneous		L.S.	108,400	178,400
II. CANAL CONSTRUCTION			62,739,000	122,691,000
1. Preparatory Works		L.S.	10,456,000	15,967,000
2. Main Canal			47,897,000	84,561,000
Earth works			16,504,100	13,198,200
- Stripping	m^3	97,900	1,115,800	499,200
- Excavation	m^3	329,300	4,671,900	1,789,400
- Embankment	m^3	368,500	5,011,100	2,173,900
- Borrow pit and/or spoiling	m^3	156,800	3,226,800	1,648,800
- Laterite pavement	m^3	37,900	1,773,400	854,100
- Smoothing	m^2	924,000	705,100	6,232,800
Concrete lining	m^3	21,000	24,588,500	42,595,300
Related structures			2,450,600	21,080,300
- Culvert	Nos.	31	425,300	4,268,500
- Inverted siphon	Nos.	7	145,900	1,683,100
- Drop	Nos.	14	80,600	984,100
- Check	Nos.	22	70,600	1,885,800
- Check cum drop	Nos.	10	48,600	904,800
- Farm turnout	Nos.	33	21,500	398,500
- Turnout	Nos.	20	34,700	781,500
- Spillway	Nos.	16	33,300	609,900
- Measuring device	Nos.	-	-	-
- Cross drain	Nos.	21	1,038,900	6,999,900
- Bridge	Nos.	17	551,200	2,564,200
Miscellaneous		L.S.	4,354,300	7,687,400

BREAKDOWN OF DIRECT CONSTRUCTION COST
HUAI KHON KAEN SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
3. Lateral and Sub-Lateral Canal			2,967,000	20,180,000
Earth works			2,076,300	9,272,300
- Stripping	m^3	47,700	-	1,145,700
- Excavation	m^3	132,100	-	3,169,600
- Embankment	m^3	99,300	148,900	1,201,500
- Borrow pit and/or spoiling	m^3	69,500	1,139,400	660,000
- Laterite pavement	m3	11,900	475,700	362,800
- Smoothing	m^2	386,300	312,300	2,732,700
Related structures			621,400	9,073,500
- Culvert	Nos.	9	37,900	420,600
- Inverted siphon	Nos.	10	96,700	1,185,600
- Drop	Nos.	24	131,000	1,590,700
- Check	Nos.	64	63,800	1,848,100
- Check cum drop	Nos.	28	152,800	2,332,100
- Farm turnout	Nos.	99	42,900	799,000
- Turnout	Nos.	1	1,300	32,000
- Spillway	Nos.	3	6,200	114,400
- Measuring device	Nos.	22	37,200	476,100
- Cross drain	Nos.	-	-	-
- Bridge	Nos.	1	51,600	274,900
Miscellaneous		L.S.	269,800	1,834,600
4. Drainage Canal			1,419,000	1,983,000
Earth works			1,140,600	657,500
- Excavation	m^3	24,600	1,140,600	657,500
Related structures			149,900	1,145,200
- Cross drain	Nos.	5	149,900	1,145,200
- Culvert	Nos.	-	-	-
Miscellaneous		L.S.	129,000	180,300

BREAKDOWN OF DIRECT CONSTRUCTION COST
HUAI YAI SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
I. DAM CONSTRUCTION			138,072,000	104,818,000
1. Preparatory Works			12,552,000	5,363,000
2. Dam			87,018,000	61,410,000
Earth works			74,533,100	53,169,100
- Excavation at dam site	m^3	99,000	2,347,200	986,500
- Spoiling	m^3	99,000	3,593,200	2,007,700
- Excavation at borrow area and stockpile	m^3	806,700	20,721,700	8,446,500
- Hauling	m^3	806,700	17,447,300	9,857,100
- Excavation at quarry site	m^3	71,000	18,723,800	24,235,900
- Embankment	m^3	847,800	11,258,000	6,268,300
- Others (Sod facing etc.)			441,900	1,367,100
Curtain grouting	m	15,000	8,341,800	5,317,100
Miscellaneous		L.S.	4,143,700	2,924,300
3. Service Spillway			35,308,000	32,697,000
Earth Works			27,109,700	8,319,600
- Excavation	m^3	209,700	22,731,300	5,824,600
- Spoiling	m^3	81,800	2,612,100	1,457,300
- Hauling	m^3	127,900	1,766,300	1,037,700
Concrete works	m^3	9,710	3,966,300	20,959,100
Others (Mortal spray etc.)			2,550,900	1,861,900
Miscellaneous			1,681,300	1,557,000
4. Emergency Spillway			1,348,000	436,000
Earth works			1,284,100	415,500
- Excavation	m^3	17,700	1,034,400	269,400
- Spoiling	m^3	11,500	166,200	97,600
- Hauling	m^3	6,200	83,500	48,500
Miscellaneous			64,200	20,800

BREAKDOWN OF DIRECT CONSTRUCTION COST
HUAI YAI SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
5. Outlet Works			1,846,000	4,912,000
Earth works			227,100	111,500
- Excavation	m^3	6,300	214,000	105,500
- Spoiling	m^3	2,300	13,100	6,000
Concrete works	m^3	2,100	694,500	4,009,400
Steel	t	20	-	400,000
Gate	Nos.	8	837,500	158,133
Miscellaneous			87,800	233,900
II. CANAL CONSTRUCTION			11,160,000	29,972,000
1. Preparatory Works		L.S.	1,455,000	2,769,000
2. Main Canal			6,354,000	15,288,000
Earth works			1,700,500	1,534,100
- Stripping	m^3	12,900	147,600	66,000
- Excavation	m^3	40,800	590,700	226,200
- Embankment	m^3	31,700	430,400	186,700
- Borrow pit and/or spoiling	m^3	18,600	304,600	176,500
- Laterite pavement	m^3	2,900	134,900	65,000
- Smoothing	m^2	119,300	92,300	813,700
Concrete lining	m^3	2,700	3,090,900	5,391,600
Related structures			485,800	6,973,200
- Culvert	Nos.	7	48,100	470,100
- Inverted siphon	Nos.	1	13,400	164,100
- Drop	Nos.	21	121,000	1,476,100
- Check	Nos.	-	-	-
- Check cum drop	Nos.	9	43,800	814,300
- Farm turnout	Nos.	8	5,700	105,400
- Turnout	Nos.	2	2,600	64,100
- Spillway	Nos.	3	6,200	114,400
- Measuring device	Nos.	-	-	-
- Cross drain	Nos.	5	314,400	1,996,700
- Bridge	Nos.	17	430,600	1,768,000
Miscellaneous		L.S.	577,700	1,389,900

BREAKDOWN OF DIRECT CONSTRUCTION COST
HUAI YAI SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
3. Lateral and Sub-Lateral Canal			2,347,000	10,818,000
Earth works			1,609,600	4,105,200
- Stripping	m^3	19,900	-	476,700
- Excavation	m^3	32,600	-	783,500
- Embankment	m^3	59,100	88,600	714,900
- Borrow pit and/or spoiling	m^3	52,900	995,600	485,700
- Laterite pavement	m^3	9,300	370,300	282,400
- Smoothing	m^2	195,500	155,100	1,362,000
Related structures			524,600	5,729,900
- Culvert	Nos.	4	22,500	227,500
- Inverted siphon	Nos.	4	47,000	594,500
- Drop	Nos.	20	109,200	1,325,600
- Check	Nos.	21	20,900	606,400
- Check cum drop	Nos.	14	76,400	1,166,100
- Farm turnout	Nos.	44	24,600	437,100
- Turnout	Nos.	-	-	-
- Spillway	Nos.	5	10,400	190,600
- Measuring device	Nos.	3	7,100	82,300
- Cross drain	Nos.	-	-	-
- Bridge	Nos.	4	206,500	1,099,800
Miscellaneous		L.S.	213,400	983,500
4. Drainage Canal			1,004,000	1,097,000
Earth works			863,600	497,800
- Excavation	m^3	19,600	863,600	497,800
Related structures			49,600	499,700
- Cross drain	Nos.	-	-	-
- Culvert	Nos.	3	49,600	499,700
Miscellaneous		L.S.	91,300	99,800

BREAKDOWN OF DIRECT CONSTRUCTION COST
KHLONG CHALIANG LAB SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
I. DAM CONSTRUCTION			124,839,000	114,344,000
1. Preparatory Works			11,349,000	5,830,000
2. Dam			102,553,000	78,144,000
Earth works			92,109,000	70,878,800
- Excavation at dam site	m^3	141,800	3,361,900	1,413,200
- Spoiling	m^3	141,800	5,145,600	2,875,200
- Excavation at borrow area and stockpile	m^3	805,300	22,052,000	9,298,500
- Hauling	m^3	805,300	20,202,000	11,412,100
- Excavation at quarry site	m^3	108,800	29,153,500	36,620,700
- Embankment	m^3	904,100	11,489,700	7,051,000
- Others (Sod facing etc.)			704,300	2,208,100
Curtain grouting	m	10,000	5,561,200	3,544,700
Miscellaneous		L.S.	4,883,500	3,721,200
3. Service Spillway			9,107,000	25,523,000
Earth works			4,334,100	1,840,300
- Excavation	m^3	50,500	3,598,100	1,411,700
- Spoiling	m^3	11,600	280,600	156,700
- Hauling	m^3	38,900	455,400	271,900
Concrete works	m^3	10,200	3,957,800	21,849,400
Others (Mortal spray etc.)			382,100	618,600
Miscellaneous			433,700	1,215,400
4. Outlet Works			1,830,000	4,847,000
Earth works			220,500	103,300
- Excavation	m^3	6,000	205,700	96,600
- Spoiling	m^3	2,590	14,800	6,700
Concrete works	m^3	2,242	741,400	4,123,300
Steel	t	11.6	-	232,000
Gate	Nos.	8	781,500	158,100
Miscellaneous			87,200	230,800

BREAKDOWN OF DIRECT CONSTRUCTION COST
KHLONG CHALIANG LAB SUB-PROJECT

Work Item	Unit	Q'ty	Foreign Currency (฿)	Local Currency (฿)
II. CANAL CONSTRUCTION			5,994,000	18,394,000
1. Preparatory Works		L.S.	781,000	1,696,000
2. Main Canal			4,146,000	8,851,000
Earth works			1,445,600	1,304,400
- Stripping	m^3	11,500	131,000	58,600
- Excavation	m^3	30,700	502,000	192,800
- Embankment	m^3	30,800	419,400	182,000
- Borrow pit and/or spoiling	m^3	7,900	130,200	75,400
- Laterite pavement	m^3	3,900	181,700	87,500
- Smoothing	m^2	97,700	81,300	708,100
Concrete lining	m^3	1,800	2,107,400	3,674,900
Related structures			216,300	3,067,100
- Culvert	Nos.	3	20,600	201,500
- Inverted siphon	Nos.	1	13,400	164,100
- Drop	Nos.	13	74,900	913,800
- Check	Nos.	2	5,400	132,300
- Check cum drop	Nos.	11	53,500	995,300
- Farm turnout	Nos.	11	7,900	145,000
- Turnout	Nos.	2	2,600	64,100
- Spillway	Nos.	3	6,200	114,400
- Measuring device	Nos.	-	-	-
- Cross drain	Nos.	2	31,800	336,600
- Bridge	Nos.	-	-	-
Miscellaneous		L.S.	376,900	804,600
3. Lateral and Sub-Lateral Canal			985,000	7,747,000
Earth works			509,900	2,592,900
- Stripping	m^3	13,300	-	318,800
- Excavation	m^3	37,400	-	898,500
- Embankment	m^3	31,800	47,700	385,100
- Borrow pit and/or spoiling	m^3	15,400	251,800	145,900
- Laterite pavement	m^3	3,200	126,700	96,600
- Smoothing	m^2	116,700	83,700	748,000

BREAKDOWN OF DIRECT CONSTRUCTION COST
KHLONG CHALIANG LAB SUB-PROJECT

Work Item	Unit	Q'ty	Foreign	Local
Related structures			386,400	4,449,900
- Culvert	Nos.	2	8,400	93,500
- Inverted siphon	Nos.	2	19,300	237,100
- Drop	Nos.	35	191,000	2,319,700
- Check	Nos.	17	17,000	490,900
- Check cum drop	Nos.	5	27,300	416,500
- Farm turnout	Nos.	23	10,000	185,600
- Turnout	Nos.	1	1,300	32,000
- Spillway	Nos.	1	2,100	38,100
- Measuring device	Nos.	4	6,800	86,600
- Cross drain	Nos.	-	-	-
- Bridge	Nos.	2	103,200	549,900
Miscellaneous		L.S.	89,600	704,300
4. Drainage Canal			82,000	100,000
Earth works			70,500	40,600
- Excavation	m^3	1,600	70,500	40,600
Related structures			4,800	50,500
- Cross drain	Nos.	1	4,800	50,500
- Culvert	Nos.	-	-	-
Miscellaneous		L.S.	7,500	9,100

BREAKDOWN OF DIRECT CONSTRUCTION COST OF OFFICE AND QUARTERS

	Description	Unit	Q'ty	Local Currency (10^3 ฿)
1.	Main Office	m^2	1,700	8,000
2.	Branch Office	m^2	1,000	4,000
3.	Repair Shop	m^2	900	2,000
4.	Store House	m^2	5,000	10,000
5.	Quarters	m^2	3,000	7,000
6.	Motor Pool	m^2	11,500	4,000
7.	Land Preparation for Office Yard including Fencing, etc.	m^2	150	5,000
	Total			40,000

COST ESTIMATE OF LAND ACQUISITION AND COMPENSATION

Item	Unit	Q'ty	Amount (10^3 Baht)
1. Huai Saduang Yai			
- Dam	Nos.	21	840
2. Huai Khon Kaen			
- Dam	Nos.	16	640
- Canal & Road	ha	145	4,550
3. Huai Yai			
- Dam	Nos.	11	440
- Canal & Road	ha	32	1,025
4. Khlong Chaliang Lab			
- Dam	Nos.	7	280
- Canal & Road	ha	24	775
Total			8,550

PROCUREMENT COST OF MAJOR EQUIPMENT FOR OPERATION AND MAINTENANCE

(Unit: 10^3 ¥)

No.	Equipment	Unit Price	Required No.	Amount
I.	VEHICLE AND EQUIPMENT			
1.	Backhoe, 0.3 m^3	12,360	6	74,160
2.	Bulldozer, 11 ton	13,080	3	39,240
3.	Wheel loader, 1.2 m^3	9,324	2	18,648
4.	Motor grader, 9.5 ton	12,240	1	12,240
5.	Water tanker, 5 m^3	5,880	2	11,760
6.	Tire roller, 8-10 ton	8,880	2	17,760
7.	Tamper, 80 kg	293	5	1,465
8.	Soil compactor, 90 kg	264	5	1,320
9.	Portable concrete mixer, 0.2 m^2	524	2	1,048
10.	Submersible pump, ø150	636	2	1,272
11.	Generator, 5 kVA	612	2	1,224
12.	Trailer truck, 28 ton	16,680	1	16,680
13.	Dump truck, 11 ton	9,192	2	18,384
14.	Dump truck, 2 ton	1,884	3	5,652
15.	Cargo truck w/crane, 4 ton	4,872	2	9,744
16.	Cargo truck w/crane, 2 ton	2,904	3	8,712
17.	Ordinary truck, 6 ton	3,948	2	7,896
18.	Truck, 1.5 ton pick-up type	1,716	6	10,296
19.	Jeep, four wheel drive	2,064	5	10,320
20.	Sedan, 6 persons	1,800	2	3,600
21.	Repair shop tools		L.S.	13,579
22.	Spare parts (20% of the above)		L.S.	57,000
II.	TELECOMMUNICATION SYSTEM		1 set	95,000
	Total			437,000 (41,879 x 10^3₱)

Note: Excluding Import Tax (US$1 = ₱23 = ¥240)

ADMINISTRATION EXPENSES

(Construction Stage)

(Unit: 10^3 Baht)

Year	Staff Salary	Labour Wage	Office Expenses	Equipment Running Cost	Other Related Cost	Total
1984	4,584	450	450	1,000	640	7,124
1985	5,136	510	500	1,000	710	7,856
1986	6,048	600	600	1,000	820	9,068
1987	6,696	660	650	1,000	900	9,906
1988	12,816	1,280	1,250	2,000	1,730	19,076
1989	12,576	1,250	1,250	2,000	1,700	18,776
1990	11,820	1,180	1,200	2,000	1,620	17,820
1991	11,364	1,130	1,200	2,000	1,560	17,254
1992	14,484	1,140	1,200	2,000	1,880	20,704
1993	12,528	1,250	1,200	2,000	1,690	18,668
Total	98,052	9,450	9,500	16,000	13,250	146,252

STAFF SALARY FOR THE PROJECT OFFICE

(Construction Stage)

Year	Grade II (1)	Grade II (2)	Grade III (1)	Grade III (2)	Grade IV (1)	Grade IV (2)	Grade V (1)	Grade V (2)	Grade VI (1)	Grade VI (2)	Total Amount (10^3₱)
1984	1	120	15	1,440	16	1,152	30	1,800	2	72	4,584
1985	1	120	15	1,440	21	1,512	32	1,920	4	144	5,136
1986	1	120	15	1,440	29	2,088	37	2,220	5	180	6,048
1987	1	120	15	1,440	33	2,376	43	2,580	5	180	6,696
1988	1	120	22	2,112	92	6,624	63	3,780	5	180	12,816
1989	1	120	22	2,112	92	6,624	59	3,540	5	180	12,576
1990	1	120	20	1,920	85	6,120	58	3,480	5	180	11,820
1991	1	120	18	1,728	83	5,976	56	3,360	5	180	11,364
1992	1	120	18	1,728	123	8,856	60	3,600	5	180	14,484
1993	1	120	15	1,440	110	7,920	49	2,940	3	108	12,528
Total	10	1,200	175	16,800	684	49,248	487	29,220	44	1,584	98,052

COST ESTIMATE OF ENGINEERING SERVICE

(1982 Price Level)

(Unit: 10^3฿)

Item	Total Amount	Huai Saduang Yai Amount	Huai Khon Kaen Amount	Huai Yai Amount	Khlong Chaliang Lab Amount
1. Detailed Design Stage					
1.1 Remuneration/1 (250 M/M)	48,000	7,296	16,380	12,480	11,904
1.2 Direct Cost	28,666	4,357	9,747	7,453	7,109
Sub-total	76,666	11,653	26,067	19,933	19,013
2. Construction Supervision Stage					
2.1 Remuneration/1 (578 M/M)	110,976	18,816	40,512	26,688	24,960
2.2 Direct Cost	66,278	11,237	24,195	15,939	14,907
Sub-total	177,254	30,053	64,707	42,627	39,867
TOTAL	253,920	41,706	90,774	62,560	58,880

/1: 50% of total M/M is allotted to foreign consultant.

TABLE X-17

LIST OF MATERIAL COST (1)

No.	Item	Unit	Cost (฿)	Remarks
1.	Aggregate (Produced at Saluong Crashuing Plant, Phetchabun)			
	Aggregate for Concrete	m	110	no included transportation
	Aggregate of Ø 3/8 Inch	m	120	
	Stone of Ø 30 cm	m	80	
	Sand		260	
	Aggregate (Produced at Silalat Crashing Plant, Lom Sak)			
	Aggregate for concrete	m	180	
	Aggregate of Ø 3/8 inch	m	120	
	Stone of Ø 30 cm	m	160	
	Sand	m	240	
2.	Cement			
	Portland Cement	bag	98	1 bag = 50 kg
	White Cement	bag	260	
3.	Brick	pc	0.2	
4.	Wood			
	Soft	m	6,040	for wooden form
	Hard	m	9,000	for house
5.	Nail	kg	14	
6.	Irom bar			
	Reinforced Iron bar	kg	10	
	Wire for Binding	kg	14	

LIST OF MATERIAL COST (2)

No.	Item	Unit	Cost (฿)	remarks
7. Fuel				
	Gasoline	liter	11.68	
	Diesel Oil	liter	7.67	
8. Angle Steel				
	L 40,40.3-6 m	Stick	110	
	L 30,30.3-6 m	Stick	85	
	L 50,50.4-6 m	Stick	180	
	L 40,40.4-6 m	Stick	145	
	L 50,05.5-6 m	Stick	220	
	L 1/4"x2 1/2"	Stick	340	
9. Steel Pipe				
	Ø 1/2	Stick	60	
	Ø 3/4	Stick	90	
	Ø 1	Stick	120	
	Ø 1 1/4	Stick	150	
	Ø 1 1/2	Stick	180	
	Ø 2	Stick	240	
	Ø 1 1/2	Stick	340	
	Ø 3	Stick	420	
10. Dynamite				
	Dynamite	kg	125.7	
	Detonator	pc.	16.0	

LIST OF MATERIAL COST (3)

No.	Item	Unit	Cost (₱)	Remarks
11.	PVC Pipe			
	Ø 1/2	Stick	40	
	Ø 3/4	Stick	45	
	Ø 1	Stick	70	
	Ø 1 1/2	Stick	120	
	Ø 2	Stick	180	
	Ø 2 1/2	Stick	300	
	Ø 3	Stick	400	
	Ø 4	Stick	650	
12.	Sod	m^2	6	
13.	RC Pipe			
	Ø 300 x 1,000	pc	450	
	Ø 600 x 1,000	pc	1,000	
	Ø 800 x 1,000	pc	1,200	
	Ø 1,000 x 1,000	pc	1,300	
14.	PC Pipe			
	Ø 400 x 4,000	pc	4,070	
	Ø 500 x 4,000	pc	5,030	
	Ø 600 x 4,500	pc	6,960	
	Ø 700 x 4,500	pc	8,890	
	Ø 800 x 5,000	pc	12,100	
	Ø 900 x 5,000	pc	13,590	
	Ø 1,000 x 5,000	pc	15,730	
	Ø 1,200 x 5,000	pc	20,660	
	Ø 1,500 x 5,000	pc	27,500	

UNIT COST OF MATERIAL (4)

No.	Item	Unit	Cost (₱)	Remarks
15.	I-PC Concrete Girder			
	4.0 m	pc	950	
	5.0 m	pc	1,200	
	6.0 m	pc	1,450	
	7.0 m	pc	1,800	
	8.0 m	pc	2,050	
	9.0 m	pc	2,650	
	10.0 m	pc	2,950	
	12.0 m	pc	5,100	
16.	Solid Box Girder			
	0.16m x 1.0m x 5.0m	pc	3,400	
	0.19m x 1.0m x 6.0m	pc	4,600	
	0.22m x 1.0m x 7.0m	pc	5,900	
	0.25m x 1.0m x 8.0m	pc	7,400	
	0.31m x 1.0m x 9.0m	pc	10,200	
	0.35m x 1.0m x 10.0m	pc	12,500	
17.	Hollow Box Girder			
	0.30m x 1.0m x 6.0m	pc	5,900	
	0.40m x 1.0m x 8.0m	pc	9,400	
	0.40m x 1.0m x 10.0m	pc	13,000	
	0.50m x 1.0m x 12.0m	pc	18,200	
	0.60m x 1.0m x 14.0m	pc	22,800	
	0.70m x 1.0m x 16.0m	pc	30,000	
	0.70m x 1.0m x 20.0m	pc	47,500	

LIST OF UNIT COST BY MANPOWER (1)

No.	Item	Unit	Unit Cost (Baht)	Currency Foreign (Baht)	Currency Local (Baht)
1.	Excavation by Manpower				
	Sand	m^3	14.4	-	14.4
	Normal Soil	m^3	24.0	-	24.0
	Clayey Soil	m^3	29.0	-	29.0
	Gravel	m^3	33.0	-	33.0
2.	Excavation by Manpower W/H Pick Hummer				
	Weathered Rock	m^3	174.5	52.3	122.2
3.	Excavation by Blasting				
	Rock	m^3	163.7	135.6	28.1
4.	Hauling by Manpower				
	L = 20 m	m^3	13.2	-	13.2
	L = 40 m	m^3	17.4	-	17.4
	L = 60 m	m^3	20.4	-	20.4
	L = 80 m	m^3	24.0	-	24.0
	L = 100 m	m^3	25.2	-	25.2
	L = 200 m	m^3	25.8	-	25.8
5.	Compacting				
5-1	Compacting by Manpower	m^3	16.8	-	16.8
5-2	Compacting by Compactor	m^3	13.6	1.5	12.1
6.	Smoothing of Face excavated or filled up	m^2	1.2	-	1.2
7.	Concrete Mixed by Portable Mixer				
7-1	Plain Concrete	m^3	1,511.2	263.9	1,247.3
7-2	Reinforced Concrete	m^3	1,597.2	256.3	1,340.9
7-3	Lean Concrete	m^3	1,363.5	277.9	1,085.6
7-4	Lining Concrete	m^3	1,689.7	284.2	1,405.5
	Mixed by Batcher Plant				
7-5	Plain Concrete	m^3	1,619.2	338.3	1,280.9
7-6	Rein Forced Concrete	m^3	1,705.0	330.7	1,374.3
7-7	Lean Concrete	m^3	1,680.1	385.3	1,294.8
7-8	Lining Concrete	m^3	1,797.6	358.6	1,439.0
8.	Mortal	m^3	1,273.3	121.4	1,151.9
9.	Form for Concrete				
9-1	Wooden Form	m^3	283.8	-	283.8
9-2	Metal Form	m^3	111.4	64.6	46.8
10.	Processing and Assembling of Reinforced Iron Bar	t	11,882.0	-	11,882.0

LIST OF UNIT COST BY MANPOWER (2)

No.	Item	Unit	Unit Cost (Baht)	Currency Foreign (Baht)	Currency Local (Baht)
11.	Stone Masonry	m^3	1,406.1	248.6	1,157.5
12.	Sod Facing	m^3	25.3	-	25.3
13.	Wooden Scaffolding	m^3	121.1	-	121.1
14.	Drainage by Pump	m^3	380.3	94.4	285.9
15.	Drilling for curtain Grouting				
15-1	Grout Hole Drilling	m	548.3	438.9	109.4
15-2	Test Hole Drilling	m	1,113.9	824.2	289.7
16	Grouting of Cement Milk	m	250.9	34.8	216.1
17.	Anchor Bar	pc	3,387.5	2,442.9	944.6
18.	Mortal Spraying	m^2	229.7	90.5	139.2

LIST OF UNIT COST BY USING (1) CONSTRUCTION EQUIPMENT

No.	Item	Unit	Unit Cost (Baht)	Currency Foreign (Baht)	Currency Local (Baht)
Eq 1	Excavation by Bulldozer (11 ton)				
1-1	Sand	m^3	14.2	9.8	4.4
1-2	Normal Soil	m^3	16.5	11.4	5.1
1-3	Clayey Soil	m^3	19.8	13.7	6.1
1-4	Gravel	m^3	19.8	13.7	6.1
Eq 2	Excavation by Bulldozer (21 ton)				
2-1	Sand	m^3	13.3	9.0	4.3
2-2	Normal Soil	m^3	15.5	10.5	5.0
2-3	Clayey Soil	m^3	18.7	12.7	6.0
2-4	Gravel	m^3	18.7	12.7	6.0
2-5	Excavated Rock	m^3	26.7	18.1	8.6
Eq 3	Excavation by 21 ton Ripper				
3-1	Weathered Rock	m^3	11.7	9.0	2.7
Eq 4	Excavation by Bulldozer (32 ton)				
4-1	Sand	m^3	10.9	7.3	3.6
4-2	Normal Soil	m^3	12.9	8.6	4.3
4-3	Clayey Soil	m^3	15.4	10.3	5.1
4-4	Gravel	m^3	15.4	10.3	5.1
4-5	Excavation Rock	m^3	22.0	14.7	7.3
Eq 5	Excavation by 32 ton Ripper				
5-1	Weathered	m^3	10.1	6.8	3.3
Eq 6	Excavation by Back-Hoe Shovel (0.35 m^3)				
6-1	Sand	m^3	19.8	14.3	5.5
6-2	Normal Soil	m^3	19.5	14.1	5.4
6-3	Clayey Soil	m^3	25.2	18.2	7.0
6-4	Gravel & Weathered Rock	m^3	27.8	20.1	7.7
6-5	Excavated Rock	m^3	55.3	40.0	15.3
Eq 7	Excavation by Back-Hoe Shovel (0.7 m^3)				
7-1	Sand	m^3	16.5	12.1	4.4
7-2	Normal Soil	m^3	17.8	13.0	4.8
7-3	Clayey Soil	m^3	21.0	15.4	5.6
7-4	Gravel & Weathered Rock	m^3	22.1	16.9	5.2
7-5	Excavated Rock	m^3	46.4	33.9	12.5

LIST OF UNIT COST BY USING (2)
CONSTRUCTION EQUIPMENT

No.	Item	Unit	Unit Cost (Baht)	Foreign (Baht)	Local (Baht)
Eq 8	Excavation by Back-Hoe Shovel (1.2 m^3)				
8-1	Sand	m^3	17.6	13.3	4.3
8-2	Normal Soil	m^3	19.1	14.4	4.7
8-3	Clayey Soil	m^3	22.5	17.0	5.5
8-4	Gravel & Weathered Rock	m^3	24.8	18.7	6.1
8-5	Excavated Rock	m^3	49.6	37.4	12.2
Eq 9	Excavation by Power Shovel (0.7 m^3)				
9-1	Impervious Materials	m^3	22.5	16.5	6.0
Eq 10	Excavation by Power Shovel (1.2 m^3)				
10-1	Impervious Materials	m^3	24.1	18.2	5.9
Eq 11	Loading by Tractor Shovel (1.2 m^3)				
11-1	Sand	m^3	18.6	13.4	5.2
11-2	Normal Soil	m^3	18.6	13.4	5.2
11-3	Clayey Soil	m^3	18.6	13.4	5.2
11-4	Gravel & Weathered Rock	m^3	11.6	5.6	6.0
11-5	Excavated Rock	m^3	11.6	5.6	6.0
Eq 12	Loading by Tractor Shovel (1.8 m^3)				
12-1	Sand	m^3	17.9	12.5	5.4
12-2	Normal Soil	m^3	17.9	12.5	5.4
12-3	Clayey Soil	m^3	17.9	12.5	5.4
12-4	Gravel & Weathered Rock	m^3	20.5	14.3	6.2
12-5	Excavated Rock	m^3	20.5	14.3	6.2
Eq 13	Loading by Tractor Shovel (2.2 m^3)				
13-1	Sand	m^3	18.2	13.2	5.0
13-2	Normal Soil	m^3	18.2	13.2	5.0
13-3	Clayey Soil	m^3	18.2	13.2	5.0
13-4	Gravel & Weathered Rock	m^3	20.8	15.1	5.7
13-5	Excavated Rock	m^3	20.8	15.1	5.7
Eq 14	Loading by Tractor Shovel (3.2 m^3)				
14-1	Sand	m^3	19.7	13.4	6.3
14-2	Normal Soil	m^3	19.7	13.4	6.3
14-3	Clayey Soil	m^3	19.7	13.4	6.3
14-4	Gravel & Weathered Rock	m^3	22.5	15.3	7.2
14-5	Excavated Rock	m^3	22.5	15.3	7.2

LIST OF UNIT COST BY USING (3)
CONSTRUCTION EQUIPMENT

No.	Item	Unit	Unit Cost (Baht)	Currency Foreign (Baht)	Currency Local (Baht)
Eq 15	Hauling by Dump Truck 8 ton				
15-1	Sand	m^3	0.0067L + 14.1	0.0042L + 8.9	0.0025L + 5.2
15-2	Normal Soil	m^3	0.0063L + 13.3	0.0040L + 8.4	0.0023L + 4.9
15-3	Clayey Soil	m^3	0.0074L + 14.9	0.0048L + 9.4	0.0026L + 5.5
15-4	Gravel & Weathered Rock	m^3	0.0072L + 15.7	0.0044L + 9.9	0.0028L + 5.8
15-5	Excavated Rock	m^3	0.0098L + 20.7	0.0062L + 13.0	0.0036L + 7.7
Eq 16	Hauling by Dump Truck 11 ton				
16-1	Sand	m^3	0.0057L + 12.1	0.0036L + 7.6	0.0021L + 4.5
16-2	Normal Soil	m^3	0.0067L + 12.5	0.0039L + 7.7	0.0028L + 4.8
16-3	Clayey Soil	m^3	0.0065L + 13.4	0.0041L + 8.6	0.0024L + 4.8
16-4	Gravel & Weathered Rock	m^3	0.0068L + 14.4	0.0043L + 9.1	0.0025L + 5.3
16-5	Excavated Rock	m^3	0.0090L + 19.0	0.0057L + 12.0	0.0033L + 7.0
Eq 17	Hauling by Dump Truck (20 ton)				
17-1	Sand	m^3	0.0109L + 22.9	0.0070L + 14.6	0.0039L + 8.3
17-2	Normal Soil	m^3	0.0102L + 21.6	0.0065L + 13.8	0.0037L + 7.8
17-3	Clayey Soil	m^3	0.0116L + 24.3	0.0074L + 15.5	0.0042L + 8.8
17-4	Gravel & Weathered Rock	m^3	0.0122L + 25.7	0.0078L + 16.4	0.0044L + 9.3
17-5	Excavated Rock	m^3	0.0161L + 33.8	0.0103L + 21.6	0.0058L + 12.2
Eq 18	Hauling by Dump Truck (32 ton)				
18-1	Sand	m^3	0.0103L + 21.6	0.0065L + 13.7	0.0038L + 7.9
18-2	Normal Soil	m^3	0.0098L + 20.4	0.0062L + 12.9	0.0036L + 7.5
18-3	Clayey Soil	m^3	0.0109L + 23.0	0.0069L + 14.6	0.0040L + 8.4
18-4	Gravel & Weathered Rock	m^3	0.0115L + 24.3	0.0073L + 15.4	0.0042L + 8.9
18-5	Excavated Rock	m^3	0.0152L + 31.9	0.0096L + 20.2	0.0056L + 11.7

LIST OF UNIT COST BY USING (4)
CONSTRUCTION EQUIPMENT

No.	Item	Unit	Unit Cost (Baht)	Currency Foreign (Baht)	Currency Local (Baht)
Eq 19	Spreading by Bulldozer (11 ton Bulldozer)				
19-1-1	Sand	m^3	7.4	5.1	2.3
19-1-2	Normal Soil	m^3	8.3	5.7	2.6
19-1-3	Clayey Soil	m^3	8.3	5.7	2.6
19-1-4	Gravel & Weathered Rock	m^3	6.8	4.7	2.1
19-1-5	Excavated Rock	m^3	6.4	4.4	2.0
	(21 ton Bulldozer)				
19-2-1	Sand	m^3	10.3	7.0	2.3
19-2-2	Normal Soil	m^3	11.6	7.9	3.7
19-2-3	Clayey Soil	m^3	11.8	8.0	3.8
19-2-4	Gravel & Weathered Rock	m^3	9.5	6.4	3.1
19-2-5	Excavated Rock	m^3	8.9	6.0	2.9
Eq 20	Compaction by Tire Roller (10 - 28 ton)				
20-1	Random Materials	m^3	2.4	1.5	0.9
Eq 21	Compaction by Tamping Roller (17 ton)				
21-1	Impervious Materials	m^3	10.6	7.6	3.0
Eq 22	Compaction by Tamping Roller (30 ton)				
22-1	Impervious Materials	m^3	15.5	11.0	4.5
Eq 23	Compaction by Vibration Roller (15 ton)				
23-1	Random Materials	m^3	17.0	12.8	4.2
Eq 24	Compaction by Vibration Roller (3 ton)				
24-1	Filter Materials	m^3	11.2	7.9	3.3
Eq 25	Water Content Control by Water Tank Rolley	d	2,462	1,144	1,318
Eq 26	Transportation by Truck (10 ton)				
26-1	1 way	way	3,878	2,318	1,560
26-2	1 ton	ton	387	231	156
Eq 27	Transportation by Tailor (32 ton)				
27-1	1 way	way	9,282	4,839	4,443
27-2	1 ton	ton	927	483	444
Eq 28	Lifting by Truck W/H 2 t Crane	d	1,604	975	629
Eq 29	Lifting by Truck Crane (25 ton)	d	9,536	6,414	3,122
Eq 30	Maintenance of Construction Road by Motor Grader	d	3,919	2,527	1,392

LIST OF OPERATION COST PER DAY FOR CONSTRUCTION EQUIPMENT

No.	Item	Unit	Unit Cost (Baht)	Currency Foreign (Baht)	Currency Local (Baht)	Remarks
OP-1	11 ton Bulldozer	d	3,914	2,696	1,218	Excavation
OP-2	21 ton Bulldozer	d	8,016	5,434	2,582	- do -
OP-3	21 ton Bulldozer with Ripper	d	8,462	6,520	1,942	- do -
OP-4	32 ton Bulldozer	d	11,587	7,723	3,864	- do -
OP-5	32 ton Bulldozer with Ripper	d	14,356	9,665	4,691	- do -
OP-6	0.35 m^3 Back-Hoe Shovel	d	3,314	2,394	920	Excavation & Loading
OP-7	0.7 m^3 Back-Hoe Shovel	d	5,533	4,044	1,490	- do -
OP-8	1.2 m^3 Back-Hoe Shovel	d	10,164	7,652	2,512	- do -
OP-9	0.7 m^3 Power Shovel	d	5,534	4,044	1,490	- do -
OP-10	1.2 m^3 Power Shovel	d	10.164	7,652	2,512	- do -
OP-11	1.2 m^3 Tractor Shovel	d	3,440	2,471	969	- do -
OP-12	1.8 m^3 Tractor Shovel	d	4,946	3,454	1,492	- do -
OP-13	2.2 m^3 Tractor Shovel	d	6,162	4,458	1,704	Loading
OP-14	3.2 m^3 Tractor Shovel	d	9,669	6,557	3,112	- do -
OP-15	8 ton Dump Truck	d	2,180	1,371	809	- do -
OP-16	11 ton Dump Truck	d	2,744	1,731	1,013	- do -
OP-17	20 ton Dump Truck	d	8,850	5,651	3,199	- do -
OP-18	32 ton Dump Truck	d	13,375	8,473	4,902	- do -
OP-19	11 & 21 ton Bulldozer	d	-	-	-	Spreading
OP-20	Tire Roller (10 - 28 ton)	d	3,090	1,919	1,171	Compacting
OP-21	Tamping Roller (17 t)	d	8,937	6,389	2,548	- do -
OP-22	Tamping Roller (30 t)	d	14,889	10,601	4,288	- do -
OP-23	Vibration Roller (15 t)	d	7,510	5,651	1,859	- do -
OP-24	Vibration Roller (3 t)	d	1,402	990	412	- do -
OP-25	Water Tank Rolley (5,000 t)	d	2,462	1,144	1,318	Water Content Control
OP-26	Truck (10 t)	d	2,735	1,621	1,114	Transportion
OP-27	Trailor 32 t	d	6,491	3,384	3,107	- do -
OP-28	Truck w/h 2 t Crane	d	1,604	975	629	- do -
OP-29	Truck Crane (25 ton)	d	9,536	6,414	3,122	Lifting
OP-30	Motor Grader (3.1 m Blade)	d	3,919	2,527	1,392	Maintenance of Road

ANNUAL DISBURSEMENT SCHEDULE OF CONSTRUCTION COST

	Total		1984		1985		1986		1987		1988		1989		1990		1991		1992		1993	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
1. Huai Saduang Yai Sub-Project																						
- Direct Construction Cost	160,415	125,377	-	-	-	-	-	-	-	-	-	-	8,750	6,838	49,583	38,752	58,332	45,592	43,750	34,195	-	-
- Land Acquisition	-	840	-	-	-	-	-	-	-	-	-	840	-	-	-	-	-	-	-	-	-	-
- O & M Equipment	18,581	1,486	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18,581	1,486	-	-
- Administration	-	24,629	-	-	-	-	-	-	-	-	-	2,518	-	2,479	-	2,816	-	7,644	-	9,172	-	-
- Physical Contingency	17,899	15,233	-	-	-	-	-	-	-	-	-	335	875	932	4,958	4,157	5,833	5,324	6,233	4,485	-	-
- Engineering Services	32,309	9,397	-	-	-	-	-	-	-	-	7,028	2,044	1,999	582	6,890	2,004	9,502	2,763	6,890	2,004	-	-
Sub-Total	229,204	176,962	-	-	-	-	-	-	-	-	7,028	5,737	11,624	10,831	61,431	47,729	73,667	61,323	75,454	51,342	-	-
- Price Contingency	155,738	234,378	-	-	-	-	-	-	-	-	2,941	4,426	5,854	10,274	36,480	54,581	50,791	83,272	59,672	81,825	-	-
Total	384,942	411,340	-	-	-	-	-	-	-	-	9,969	10,163	17,478	21,105	97,911	102,310	124,458	144,595	135,126	133,167	-	-
2. Huai Khon Kaen Sub-Project																						
- Direct Construction Cost	553,351	508,858	-	-	26,294	19,818	105,177	79,271	143,353	123,345	148,811	134,796	117,367	128,538	12,349	23,088	-	-	-	-	-	-
- Land Acquisition	-	5,190	-	640	-	-	-	910	-	1,820	-	1,365	-	455	-	-	-	-	-	-	-	-
- O & M Equipment	13,991	1,119	-	-	-	-	-	-	-	-	-	-	-	-	13,991	1,119	-	-	-	-	-	-
- Administration	-	57,458	-	5,414	-	5,971	-	6,892	-	7,529	-	10,186	-	10,026	-	11,240	-	-	-	-	-	-
- Physical Contingency	56,734	57,262	-	605	2,629	2,578	10,518	8,708	14,335	13,269	14,881	14,635	11,737	13,902	2,634	3,565	-	-	-	-	-	-
- Engineering Services	70,322	20,452	15,722	4,572	4,472	1,301	6,414	1,866	9,265	2,695	14,729	4,284	15,917	4,628	3,803	1,106	-	-	-	-	-	-
Sub-Total	694,398	650,339	15,722	11,231	33,395	29,668	122,109	97,649	166,953	148,658	178,421	165,266	145,021	157,549	32,777	40,318	-	-	-	-	-	-
- Price Contingency	264,010	471,339	1,943	2,358	6,378	9,820	32,050	45,318	56,467	90,757	74,672	127,512	73,036	149,468	19,464	46,106	-	-	-	-	-	-
Total	958,408	1,121,678	17,665	13,589	39,773	39,488	154,159	142,967	233,420	239,415	253,093	292,778	218,057	307,017	52,241	86,424	-	-	-	-	-	-
3. Huai Yai Sub-Project																						
- Direct Construction Cost	169,776	160,439	-	-	8,557	6,781	48,493	38,423	58,731	49,916	49,821	55,007	4,174	10,312	-	-	-	-	-	-	-	-
- Land Acquisition	-	1,465	-	440	-	-	-	308	-	513	-	204	-	-	-	-	-	-	-	-	-	-
- O & M Equipment	5,584	447	-	-	-	-	-	-	-	-	5,584	447	-	-	-	-	-	-	-	-	-	-
- Administration	-	14,507	-	1,710	-	1,885	-	2,176	-	2,377	-	3,205	-	3,154	-	-	-	-	-	-	-	-
- Physical Contingency	17,536	17,685	-	215	856	867	4,849	4,091	5,873	5,280	5,541	5,886	417	1,346	-	-	-	-	-	-	-	-
- Engineering Services	48,465	14,095	12,022	3,496	3,420	995	6,414	1,866	8,315	2,418	14,729	4,284	3,565	1,036	-	-	-	-	-	-	-	-
Sub-Total	241,361	208,638	12,022	5,861	12,833	10,528	59,756	46,864	72,919	60,504	75,675	69,033	8,156	15,848	-	-	-	-	-	-	-	-
- Price Contingency	80,061	131,699	1,485	1,230	2,451	3,484	15,684	21,749	24,663	36,938	31,671	53,263	4,107	15,015	-	-	-	-	-	-	-	-
Total	321,422	340,337	13,507	7,091	15,284	14,012	75,440	68,613	97,582	97,442	107,346	122,296	12,263	30,883	-	-	-	-	-	-	-	-
4. Khlong Chaliang Lab Sub-Project																						
- Direct Construction Cost	148,817	157,946	-	-	-	-	-	-	-	-	-	-	7,737	7,397	43,845	41,923	51,583	49,321	41,865	46,716	3,787	12,589
- Land Acquisition	-	1,055	-	-	-	-	-	-	-	-	-	280	-	-	-	-	-	310	-	465	-	-
- O & M Equipment	3,723	298	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,489	119	2,234	179
- Administration	-	49,658	-	-	-	-	-	-	-	-	-	3,167	-	3,117	-	3,564	-	9,610	-	11,532	-	18,668
- Physical Contingency	15,254	20,895	-	-	-	-	-	-	-	-	-	344	774	1,051	4,385	4,549	5,158	5,924	4,335	5,883	602	3,144
- Engineering Services	45,614	13,266	-	-	-	-	-	-	-	-	11,467	3,335	3,262	949	5,939	1,727	7,602	2,211	9,267	2,695	8,077	2,349
Sub-Total	213,408	243,118	-	-	-	-	-	-	-	-	11,467	7,126	11,773	12,514	54,169	51,763	64,343	67,376	56,956	67,410	14,700	36,929
- Price Contingency	145,504	343,922	-	-	-	-	-	-	-	-	4,799	5,498	5,928	11,872	32,167	59,194	44,363	91,493	45,043	107,434	13,204	68,431
Total	358,912	587,040	-	-	-	-	-	-	-	-	16,266	12,624	17,701	24,386	86,336	110,957	108,706	158,869	101,999	174,844	27,904	105,360

FIG. X-22

ANNUAL OPERATION & MAINTENANCE COST

(Unit: 10^3฿)

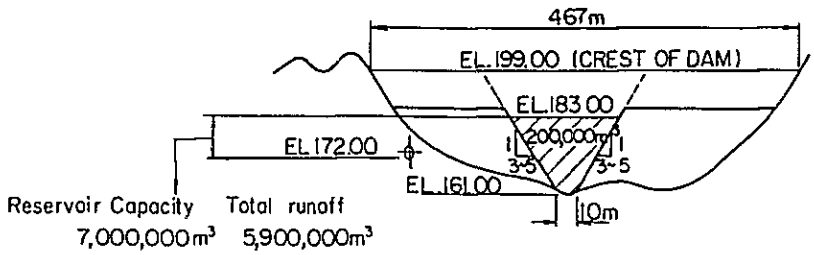
Item	Total	Huai Saduang Yai	Huai Khon Kaen	Huai Yai	Khlong Chaliang Lab
1. Salaries & Wages					
1.1 Staff salaries (TABLE X-24)	7,248	2,913	2,422	1,146	767
1.2 Labour wages 180 M/M @1,500฿	270	120	90	36	24
2. Office Expenses	231	102	77	31	21
3. Operation Cost					
3.1 Gate operation of dam and vehicles	620	275	207	83	55
3.2 Depreciation of O & M equipment and gates	2,981	1,312	1,001	398	270
4. Maintenance Cost	6,210	2,755	2,075	828	552
5. Miscellaneous	543	241	181	72	49
Total	18,103	7,718	6,053	2,594	1,738
Per Ha (฿/ha)	1,341	1,288	1,342	1,441	1,448

STAFF SALARY AT O & M STAGE

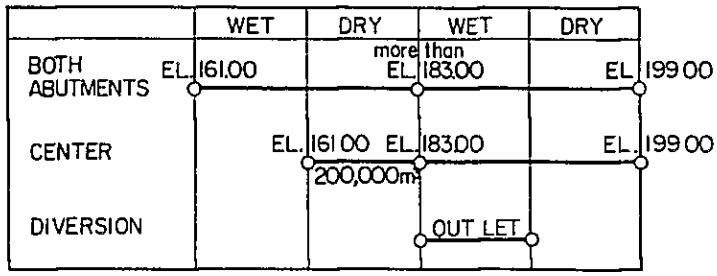
Item	Required Number	Monthly Unit Rate (฿)	Yearly Amount (10^3 ฿)
1. Project Office	2		180
(1) Project Engineer	1	10,000	120
(2) Secretary	1	5,000	60
2. Administrative Section	12		696
(1) Administrative Officer	1	8,000	96
(2) Cashier	1	6,000	72
(3) Accounting Clerk	1	5,000	60
(4) Clerk	1	5,000	60
(5) Property Custodian	1	5,000	60
(6) Instrumentman	1	5,000	60
(7) Aid	1	5,000	60
(8) Typist	2	5,000	120
(9) Security Guard	3	3,000	108
3. Engineering Section	6		432
(1) Sr. Engineer	1	8,000	96
(2) Jr. Engineer	1	6,000	72
(3) Construction Engineer	1	6,000	72
(4) Hydrographer	1	6,000	72
(5) Surveyor	2	5,000	120
4. O & M Section	4		288
(1) Irrigation Superintendent	1	8,000	96
(2) Electric Engineer	1	6,000	72
(3) Carpentor	1	5,000	60
(4) Radio Operator	1	5,000	60
5. Workshop Section	8		528
(1) Mechanical Engineer	1	8,000	96
(2) Mechanic	1	6,000	72
(3) Operator	2	5,000	120
(4) Driver	4	5,000	240
6. Agricultural Service Section	3		168
(1) Agronomist	1	8,000	96
(2) Agri-clerk	2	6,000	72
7. Branch and Field Office	119		4,956
(1) Supervisor	2	8,000	192
(2) Secretary/Typist	2	5,000	120
(3) Mechanic	4	6,000	288
(4) Jr. Mechanic	4	5,000	240
(5) Water Master	5	5,000	300
(6) Zone Man	12	4,000	576
(7) Ditch Tender	90	3,000	3,240
Total	154		7,248

REPLACEMENT COST AND USEFUL LIFE

Item	Useful Life	Replacement Cost
	(years)	(10^3 ฿)
1. Huai Saduang Yai Sub-Project		
1.1 O & M Equipment	10	20,067
1.2 Project Facilities		
- Intake facilities, gate	25	1,206
- Irrigation facilities, gate	25	3,449
2. Huai Khon Kaen Sub-Project		
2.1 O & M Equipment	10	15,110
2.2 Project Facilities		
- Intake facilities, gate	25	1,444
- Irrigation facilities, gate	25	3,485
3. Huai Yai Sub-Project		
3.1 O & M Equipment	10	6,031
3.2 Project Facilities		
- Intake facilities, gate	25	924
- Irrigation facilities, gate	25	982
4. Khlong Chaliang Lab Sub-Project		
4.1 O & M Equipment	10	4,021
4.2 Project Facilities		
- Intake facilities, gate	25	868
- Irrigation facilities, gate	25	813

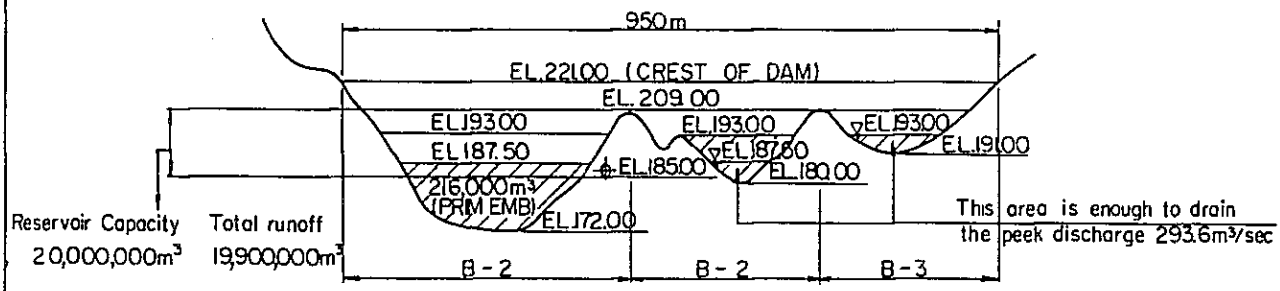


ALLOTMENT OF EMBANKMENT

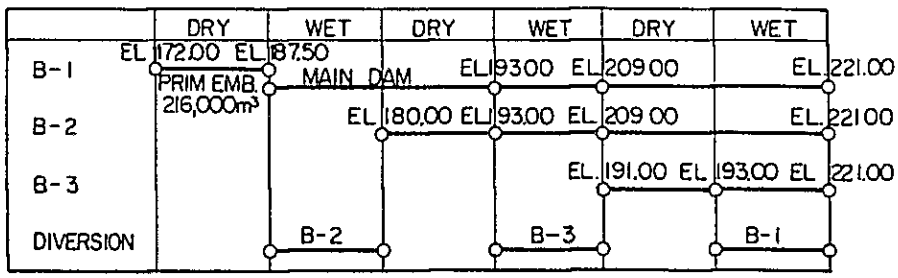


SCHEDULE OF DIVERSION

RELATION OF EMBANKMENT AND DIVERSION
(1) HUAI SADUANG YAI DAM

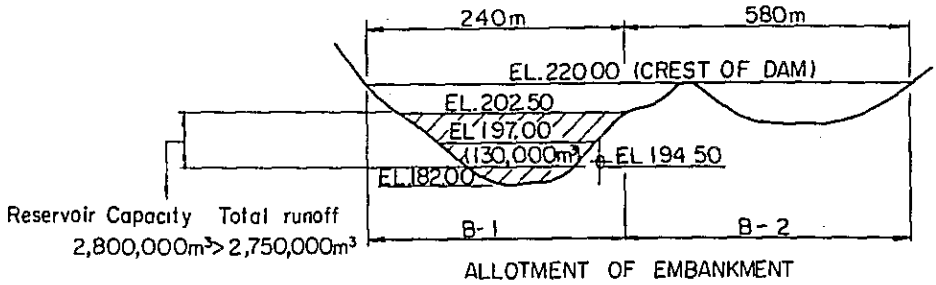


ALLOTMENT OF EMBANKMENT

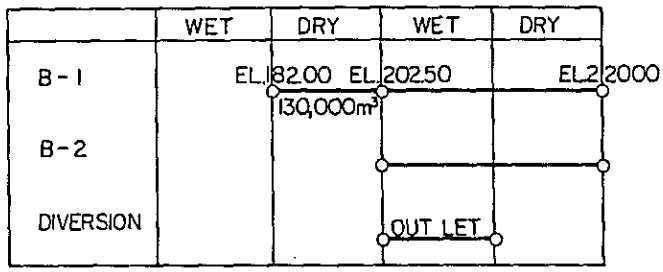


SCHEDULE OF DIVERSION

RELATION OF EMBANKMENT AND DIVERSION
(2) HUAI KHON KAEN DAM

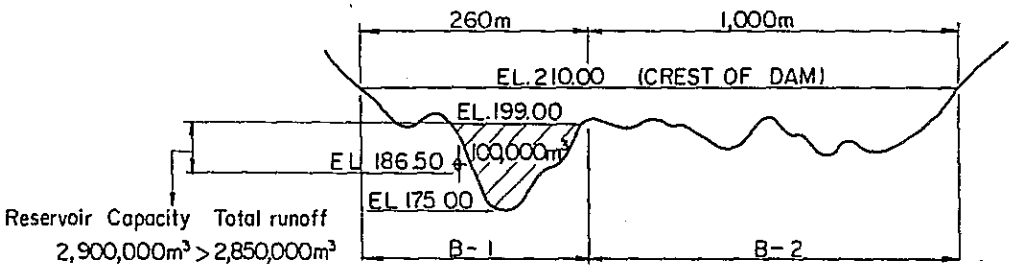


ALLOTMENT OF EMBANKMENT

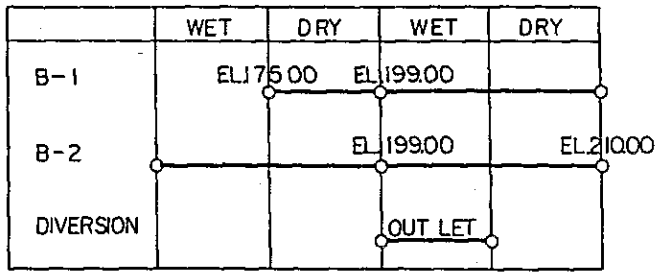


SCHEDULE OF DIVERSION

RELATION OF EMBANKMENT AND DIVERSION
(3) HUAI YAI DAM



ALLOTMENT OF EMBANKMENT



SCHEDULE OF DIVERSION

RELATION OF EMBANKMENT AND DIVERSION
(4) KHLONG CHALIANG LAB DAM

PROJECT IMPLEMENTATION SCHEDULE

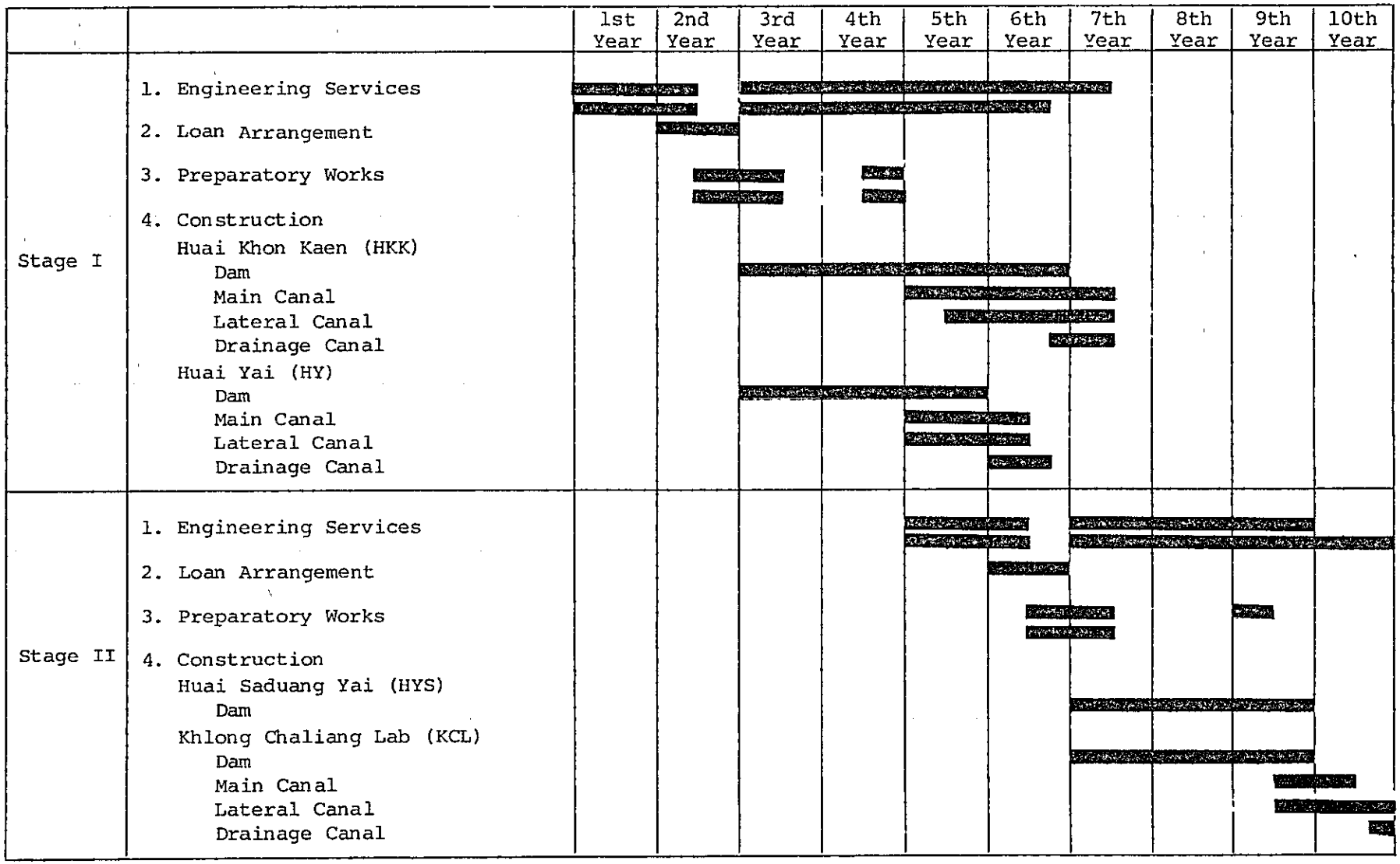


FIG. X-5

ANNEX XI
PROJECT EVALUAION

ANNEX - XI

PROJECT EVALUATION

TABLE OF CONTENTS

LIST OF TABLES

ANNEX - XI

PROJECT EVALUATION

1. GENERAL

The project evaluation is carried out in order to ascertain the feasibility of the project in view of economic, financial and socio-economic aspects.

The economic feasibility for the project is firstly evaluated by calculating the internal rate of return (IRR) and the net present value (NPV) at the discount rate of 10%. Further, sensitivity analysis is made in order to elucidate the economic viability of the project against the possible changes in estimates of the project costs and benefits from the values used in the basic case, which are considered for the calculation of IRR, and different discount rates of 8% and 12% for the calculation of NPV.

Secondary, the financial feasibility is evaluated by calculating the capacity to pay for the typical farmer and by preparing the repayment schedule of project capital cost. The calculation of capacity to pay is to confirm the soundness of the project from the farmers' viewpoint. The repayment schedule is made to estimate the annual subsidy by the Government based on the estimated fund requirements with the assumed financial terms of the conceivable loan and the expected revenue from the project.

Finally, intangible socio-economic impacts and indirect benefits of the project are briefly studied in due consideration of the effects of the project on the regional development.

2. ECONOMIC EVALUATION

2.1 Basic Assumptions

For the economic evaluation of the project, the following basic assumptions are established.

i) The construction period for each sub-project is as follows:

- Huai Saduang Yai ; 3.5 years
- Huai Khon Kaen ; 5.0 years
- Huai Yai ; 4.5 years
- Khlong Chaliang Lab ; 4.5 years
- Overall ; 8.5 years

ii) Only the agricultural benefit and the benefit of the water release for the downstream use and the municipal water are counted in the evaluation, and any benefit to be derived from the fishery and micro hydropower generation are not taken into account.

iii) The current prices as of the August 1982 are used in the evaluation.

iv) The exchange rate of Thai Baht to US Dollar is taken to be ฿ 23.0 equivalent to US$ 1.0.

v) The economic useful life of the project is taken as 50 years.

2.2 Evaluation of Economic Resources

2.2.1 Standard Conversion Factor (SCF)

Tariff and trade restrictions introduce a distortion in the price relationships between traded goods and non-traded goods. The benefits of the project are evaluated at world market prices. In order to estimate the project cost comparable to the benefits, a SCF is applied to the price of non-traded goods and consumption. In the absence of trade restrictions, the SCF would be 0.79, according to the calculation made by the World Bank in the STaff Working Paper No. 299, 1978.

2.2.2 Economic Prices for Agricultural Outputs and Inputs

The economic prices of farm products such as rice, tobacco and mung beans and farm inputs such as fertilizers and plant protection are estimated based on the projected international market prices forecasted by IBRD in the long term range in 1982 constant US Dollar. The domestic components are adjusted by the SCF of 0.79 (ANNEX - IV).

2.2.3 Economic Opportunity Cost of Farm Labour

At present, a large part of farming works are generally operated by family labours except for transplanting and harvesting of paddy. Seasonal labours required for the transplanting and harvesting of paddy are mainly hired from small-hold farmers and tenant farmers at the rate of ฿ 30/man-day, while the financial wage rate is ฿ 60/man-day. On the other hand, the present net benefit per labour force per day is estimated at ฿ 29.1/man-day, which can be compared with the seasonal labour cost of ฿ 30/man-day. From the above, ฿ 30/man-day is deemed to be economic opportunity cost of farm labour.

2.2.4 Economic Opportunity Cost of Unskilled Construction Labour

Experiences elsewhere indicate that labourers would require 25 - 30% premium to shift from agriculture to construction, since the latter is harder physical work than the former. Thus, the economic opportunity cost

of unskilled construction labour would be ฿ 40/man-day, which is equivalent to 67% of the financial wage rate.

2.2.5 Construction Conversion Factor (CCF)

The construction of project facilities is carried out by equipment, skilled and unskilled labours. For the economic analysis, the construction conversion factor is estimated as follows:

(a) Traded component:

This component includes imported materials. Since it is traded, the conversion factor is 1.00. About 52% of the capital cost is included in this category.

(b) Non-traded component:

This component includes skilled labour and locally manufactured materials. The SCF of 0.79 is used as the conversion factor. About 45% of the capital cost is included in this category.

(c) Unskilled labour:

As estimated in section 2.2.4 hereof, the conversion factor of 0.67 is applied to this item. About 3% of the capital cost is included in this category.

Thus, the CCF (the weighed average of the above components) is calculated to be 0.895.

2.3 Economic Costs

2.3.1 Capital Cost

The capital cost broadly comprises:

i) cost for preparatory works,

ii) construction cost for project facilities including the contractor's overhead costs, profit and contract tax,

iii) cost for land acquisition, and compensation,

iv) procurement cost of O & M equipment (first procurement only),

v) administration expenses,

vi) engineering services,

vii) physical contingencies, and

viii) price contingencies.

Among the costs mentioned above, all the costs except the contractor's profit, contract tax, land acquisition and price contingencies are counted as the net capital cost to be considered in the economic evaluation. This net capital cost is further converted into the economic capital cost by applying the CCF estimated in section 2.2.5 hereof.

The economic capital cost thus estimated and its annual disbursement for each sub-project are as fhown below:

(Unit: 10^3฿)

Year	Huai Saduang Yai	Huai Khon Kaen	Huai Yai	Khlong Chaliang Lab
1st year	10,708	22,343	14,908	15,608
2nd year	18,837	52,276	19,475	20,388
3rd year	91,570	182,168	88,885	88,925
4th year	113,238	261,625	111,231	110,572
5th year	106,364	284,899	120,637	104,400
6th year		250,815	20,011	43,340
7th year		60,592		
Total	340,717	1,114,718	375,147	383,233

2.3.2 Sunk Cost

The following past investment by RID is taken as the sunk cost in the economic evaluation:

i) 24 million Baht (as of 1968); 91.1 million Baht equivalent as of 1982, for the construction of weir and canal system for the Pasak Left Bank service area,

ii) 31.9 million Baht (as of 1982) for the construction of the Sri Chan diversion weir which is under construction and scheduled to be completed by 1984.

Other than the above costs, the farmers in the project area have invested a certain amount of money for the construction of village-level irrigation facilities, but these investments are not taken in the economic evaluation of the project. Instead, the costs for the improvement of canal system and total costs for on-farm development are taken into account as mentioned in section 2.3.3 hereof.

2.3.3 Other Construction Cost

In order to attain the projected benefits in the project area, it is necessary to invest the further costs other than the above-mentioned for the

improvement of main and lateral canal systems particularly in the Pasak Left Bank service area and the Sri Chan service area and for the on-farm development in whole project area.

The economic costs for the improvement of main and lateral canal system in the Pasak Left Bank service area and the Sri Chan service area are estimated at 73.7 million Baht and 18.3 million Baht at the present price level respectively. All these works will be done by RID. As for the on-farm development, all the works will be done by farmers themselves. The costs for these works are estimated using the economic opportunity cost of unskilled construction labour of ฿ 40/man-day. The estimated costs for the respective areas are as shown below:

(Unit: 10^3฿)

Service Area	On-farm Development Cost
Sri Chan	116
Pasak Left Bank	1,014
Huai Khon Kaen	1,814
Huai Yai	726
Khlong Chaliang Lab	484

2.3.4 Annual Operation and Maintenance Costs

The annual O & M costs estimated in ANNEX - X include the depreciation costs of O & M equipment and gates. In the economic evaluation, these costs are already counted as the replacement costs, and accordingly the depreciation costs of O & M equipment and gates are excluded from the O & M costs estimated in ANNEX - X. The O & M costs after exclusion of the said depreciation costs are further converted into the economic costs using the CCF of 0.895 as shown below:

(Unit: 10^3฿)

Sub-project	Economic O & M Cost
Huai Saduang Yai	5,733
Huai Khon Kaen	4,522
Huai Yai	1,965
Khlong Chaliang Lab	1,314

2.3.5 Replacement Costs

The replacement costs estimated in ANNEX - X are converted into the economic costs using the conversion factor of 1.0 for the gates for the outlet works of dams and O & M equipment, and the SCF of 0.79 for the gates of canal structures. The estimated costs are as shown below:

(Unit: 10^3฿)

Sub-project	Economic Costs for Replacement
Huai Saduang Yai	23,998
Huai Khon Kaen	19,288
Huai Yai	7,711
Khlong Chaliang Lab	5,511

2.4 Project Benefits

2.4.1 Agricultural Benefit

The agricultural benefit is evaluated as the difference of net income from crops in future between "without project" and "with project". The benefit will come out immediately after the completion of dam construction, even before the completion of the total canal works. The benefit is expected to increase year by year after start of irrigation and attain its maximum level after 5 years from the start of irrigation.

The anticipated annual incremental benefit of each sub-project area is as shown in Table XI-1.

2.4.2 Benefits of Water Release for Downstream Use and Municipal Water

A certain amount of water will be released from all four dams throughout the year for the downstream use, and municipal water for Lom Sak city will also be released from the Khon Kaen dam throughout the year. The values of these water are evaluated in monetary terms on the assumption that as the alternative use, these water is used for the crop production which is the most beneficial use.

The valuation is made based on the annual incremental agricultural benefit in each sub-project area. The water values thus calculated are shown below:

Sub-Project	Water Value (10^3฿)
Huai Saduang Yai	10,958
Huai Khon Kaen	54,010
Huai Yai	11,920
Khlong Chaliang Lab	11,509

The water values calculated in the above are also counted as the project benefit in the economic evaluation.

2.5 Internal Rate of Return (IRR)

Using the costs and benefits estimated in the above, the cost and benefit streams are firstly prepared as shown in Table XI-2 through Table XI-5, then, the IRRs are calculated for the respective sub-projects, each development stage and the overall cases. The calculated results are as shown below:

Sub-Project	IRR (%)
Huai Saduang Yai	14.0
Huai Khon Kaen	14.2
Huai Yai	14.7
Khlong Chaliang Lab	10.4
Package-I Development/1	14.3
Package-II Development/2	13.1
Overall Case - I/3	14.3
Overall Case - II/4	13.9

Note: /1 ; Huai Khon Kaen + Huai Yai,

/2 ; Huai Saduang Yai + Khlong Chaliang Lab,

/3 ; in case the construction of all the sub-projects are started concurrently,

/4 ; in case the respective sub-projects are implemented according to the implementation schedule.

2.6 Net Present Value (NPV)

In order to assess the project viability from the economic viewpoint, the net present values at the discount rate of 10% are also calculated for the respective sub-projects, each development stage and the said two overall cases, and their calculated results are shown below:

Sub-Project	NPV (10^3฿)
Huai Saduang Yai	183,643
Huai Khon Kaen	321,165
Huai Yai	119,589
Khlong Chaliang Lab	7,694
Package-I Development	440,754
Package-II Development	191,337
Overall Case - I	768,189
Overall Case - II	632,091

2.7 Sensitivity Analysis

In order to evaluate further the soundness of the project to the possible changes of economic conditions in future, the sensitivity analyses are made for the following critical conditions in terms of IRR:

i) cost increase for 20% due to unforeseen geological and topographical conditions and increase of material costs (Case - I),

ii) benefit decrease for 20% due to decrease of forecasted market price of agricultural products and lower production than the expected (Case - II),

iii) simultaneity of the above two cases (Case - III), and

iv) extension of construction period for two years due to inefficiency of contractor or other reasons (Case - IV).

In addition, the NPVs at two discount rates, i.e. 8% and 12%, are calculated for the examination of the project viability.

The following tables shows the results of sensitivity analyses for the respective sub-projects.

Sub-Project	IRR (%)				NPV (10^3฿)	
	Case-I	Case-II	Case-III	Case-IV	8%	12%
Huai Saduang Yai	13.0	12.1	11.1	13.5	386.056	67,962
Huai Khon Kaen	12.2	11.7	10.0	12.8	658,199	124,446
Huai Yai	12.5	12.1	10.2	13.1	233,357	51,904
Khlong Chaliang Lab	8.8	8.4	7.0	9.7	59,449	-17,698

From the above calculated results, it can be said that the project would be still sound even in the worst case, i.e. 20% increase of the cost and 20% decrease of the benefit, if the soft loan is expected from bilateral or international organization.

3. FINANCIAL EVALUATION

3.1 General

The financial feasibility of the project is evaluated from the viewpoint of farmer's economy. In this connection, the assessment on the amount of water charge to be collected from the water users is made on preliminary basis. The study on the capability of capital cost repayment is also made on the project level by preparing the cash flow table.

3.2 Financial Cost

Based on the current market prices and costs as of August 1982, the financial cost of each sub-project is estimated as follows (ANNEX - X):

(Unit: 10^3฿)

Sub-Project	Foreign Currency	Local Currency	Total
Huai Saduang Yai	384,942	411,340	796,282
Huai Khon Kaen	958,408	1,121,678	2,080,086
Huai Yai	321,422	340,337	661,759
Khlong Chaliang Lab	358,912	587,040	945,952
TOTAL	2,023,684	2,460,395	4,484,079

In this estimate, the physical contingencies of 10%, and the price contingencies of 10% per annum for the local currency portion and 6% per annum for the foreign currency portion are considered to be the direct cost. Table X-21 of ANNEX - X shows the annual disbursement schedule of the said financial costs for the respective sub-project areas.

3.3 Capacity to pay

In order to evaluate the project feasibility from the financial aspect of farmers, typical farm budget analyses are made under both "with project" and "without project" conditions as shown in ANNEX - IV. The capacity to pay expected under "with project" condition is as shown below:

Sub-Project	Capacity to pay (฿/family/year)
Huai Saduang Yai	7,749
Huai Khon Kaen	8,038
Huai Yai	9,786
Khlong Chaliang Lab	8,124

3.4 Water Charge

When the project facilities are completed and water is released to farm, but if the water charge is not collected, all the cost of the project will have to be borne by the Government, and such expenditure will become a heavy burden to the Government. It is generally understood that the water charge is imposed to the water users, and the water charges thus collected is spent for the payment of O & M expenditures incurred to the project and for the repayment of the capital cost of the project. In Thailand, however, the farmers traditionally do not pay any water charge directly, but contribute indirectly by paying tax on surplus rice production export tax and an export premium for rice export, land tax, etc.

The annual O & M costs required for each sub-project are estimated at ฿ 206/rai for the Huai Saduang Yai, ฿ 215/rai for the Huai Khon Kaen, ฿ 231/rai for the Huai Yai and ฿ 232/rai for the Khlong Chaliang Lab. These correspond to about 23% of the capacity to pay in the Huai Saduang Yai sub-project area, 24% in the Huai Khon Kaen sub-project area, 24% in the Huai Yai sub-project area and 27% in the Khlong Chaliang Lab sub-project area. On the other hand, the annual scale of amount for the repayment of foreign currency portion of the capital cost is estimated at ฿ 620/rai in the Huai Saduang Yai sub-project area (dam cost only), ฿ 1,635/rai in the Huai Khon Kaen sub-project area, ฿ 1,553/rai in the Huai Yai sub-project and ฿ 2,602/rai in the Khlong Chaliang Lab at the interest rate of 3.5%. These repayments would not be covered obviously with the capacity to pay from the viewpoint of the farmer's economy.

The water charge to be collected from the water users should be within a reasonable range in the capacity to pay that could still give sufficient incentive to the farmers. With this view, the prospective water charge is recommended to cover the required O & M costs. This prospective water charge would be the project revenue in the financial evaluation on the project.

3.5 Repayment of Project Cost

The financial evaluation of the project is made by examining the repayment capability for the capital cost of the project. For the examination, the cash flow tables using the anticipated project revenue and fund requirement are prepared.

In the examination of repayment capability, it is assumed that the capital required for the project implementation will be arranged under the following conditions:

i) For the foreign currency portion, the capital is financed by bilateral or international organizations with an interest rate of 3.5% per annum for a repayment period of 30 years including 10-year grace period.

ii) For the local currency portion, the capital is financed by the budget allocation of the Government with no repayment.

Based on the above conditions, the repayment schedule for the foreign currency portion is prepared for the Package-I Development and the Overall Case - II as shown in Table XI-6 through Table XI-7.

4. SOCIO-ECONOMIC IMPACTS AND INDIRECT BENEFITS

In addition to the direct benefits stipulated in the economic evaluation, favourable but intangible socio-economic impacts and indirect benefits are expected from the implementation of the project.

4.1 Foreign Exchange Earning

After completion of the project, production of paddy, mung beans and tobacco will increase to about 63,460 tons of paddy, 3,050 tons of mung beans and 6,760 tons of tobacco per annum from the present production of 23,830 tons of paddy, 1,000 tons of mung beans and 1,600 tons of tobacco. Out of these increased productions, it is expected that the marketable rice, mung beans and tobacco would be about 30,800 tons, 2,400 tons and 5,400 tons after deducting the local consumption. These surplus would increase the annual amount of exports, resulting in the earning of foreign exchange amounting to around 464 million Baht.

4.2 Increase of Employment Opportunity to Local People

Employment opportunity to the local people will be increased by the project implementation, and a favourable impact will be given to the national economy. Furthermore, the employee will be able to gain more experience, technical know-how, skillfulness in the various working fields. These accumulations would be applied to the future development in the region.

4.3 Improvement of Local Transportation

The local transportation will be improved much by the construction of the operation and maintenance roads along the irrigation canals. The expanded road system will not only enhance the economic activity in and around the project area but also contribute to inter-regional accessibility and communication.

4.4 Improvement of Environmental Sanitation

The construction of the project works would have a possitive effect on the overall ecology of the project area. The health and sanitary conditions would become better with drainage improvement as well as supply of fresh water through the irrigation canals.

4.5 Increase of Fish Production

Although fish is an important source of protein in rural area, the marketing of fish is largely undeveloped; rather, fishing activity in the area is limited to self-sufficiency. After creation of the reservoirs, however, the potential fish production in the area will be increased to great extent, and it would be possible for the settlers to manage fish culture. For their fish culture, the government fisheries offices concerned should be invited to provide their assistance to the settlers.

The most productive reservoirs is likely to be that with a large surface area in relation to depth. In this view, the Saduang Yai reservoir will be the most productive one, followed by the Huai Khon Kaen, Huai Yai and Khlong Chaliang Lab reservoirs. The production and net fishery benefit from these reservoirs are estimated as follows:

Reservoir	Area	Amount of Fish Production	Net Benefit
	(rai)	(tons/year)	(10^3฿/year)
Saduang Yai	906 (145 ha)	9.1	102
Huai Khon Kaen	625 (100 ha)	6.3	70
Huai Yai	468 (75 ha)	4.7	53
Khlong Chaliang Lab	225 (36 ha)	2.2	25
TOTAL	2,224 (356 ha)	22.3	250

4.6 Possibility of Micro Hydropower Development

The proposed storage dams, particularly for the Huai Khon Kaen dam, provide a possibility of micro hydropower development, if the water head between the surface water level of the reservoir and the tail water level of the outlet work of dam is effectively harnessed. According to the result of preliminary study, around 2.8 x 10^6 kWh of annual energy output will be produced by operating a micro hydropower plant with an installed capacity of 450 kW.

4.7 Increase of Tourism Opportunity

The creation of reservoir will induce a significant increase of recreational opportunities to the region. The recreational activities will include fishing, boating, swimming, camping, picnicing and just simply enjoying the outdoor experiences of the reservoir setting. Many reservoirs constructed in past years have become the recreation centers of the present, and this will undoubtedly be repeated in the future.

ANNUAL INCREMENTAL BENEFIT

(Unit: 10^3฿)

Year	Huai Saduang Yai	Huai Khon Kaen	Huai Yai	Khlong Chaliang Lab	Total Incremental Benefit
	(33,750 rai)	(31,880 rai)	(11,250 rai)	(7,500 rai)	(84,380 rai)
1st	91,155	113,841	42,762	26,178	273,936
2nd	104,109	130,702	48,336	29,869	313,016
3rd	113,980	142,955	52,367	32,565	341,867
4th	123,631	152,529	55,442	34,596	366,198
5th	134,665	163,377	58,925	36,922	393,889

COST AND BENEFIT STREAM
(Huai Saduang Yai)

(Unit: 10^3฿)

No.	Year	Cost					Benefit		
		Capital Cost	Other Cost	O/M Replacem't Cost	Sunk Cost	Total Cost	Agricultural Benefit	Downstream use & Municipal W.	Total Benefit
1	1982				112,133	112,133			
2	1983					0			
3	1984					0			
4	1985					0			
5	1986					0			
6	1987					0			
7	1988	10,708				10,708			
8	1989	18,837				18,837			
9	1990	91,570	25,265			116,835			
10	1991	113,238	33,688			146,926			
11	1992	106,364	25,265			131,629			
12	1993			3,881		3,881	91,155	10,958	102,113
13	1994			4,432		4,432	104,109	:	115,067
14	1995			4,850		4,850	113,980	:	124,938
15	1996			5,263		5,263	123,631	:	134,589
16	1997			5,733		5,733	134,665	:	145,623
:	:			:		:	:	:	:
21	2002			25,800		25,800	:	:	:
22	2003			5,733		5,733	:	:	:
:	:			:		:	:	:	:
31	2012			25,800		25,800	:	:	:
32	2013			5,733		5,733	:	:	:
:	:			:		:	:	:	:
36	2017			9,664		9,664	:	:	:
37	2018			5,733		5,733	:	:	:
:	:			:		:	:	:	:
41	2022			25,800		25,800	:	:	:
42	2023			5,733		5,733	:	:	:
:	:			:		:	:	:	:
51	2032			25,800		25,800	:	:	:
52	2033			5,733		5,733	:	:	:
:	:			:		:	:	:	:
61	2042			5,733		5,733	134,665	10,958	145,623

COST AND BENEFIT STREAM
(Huai Khon Kaen)

(Unit: 10^3฿)

No.	Year	Cost					Benefit		
		Capital Cost	Other Cost	O/M Replacem't Cost	Sunk Cost	Total Cost	Agricultural Benefit	Downstream Use & Municipal W.	Total Benefit
1	1982				10,867	10,867			
2	1983					0			
3	1984	22,343				22,343			
4	1985	52,276				52,276			
5	1986	182,168				182,168			
6	1987	261,625				261,625			
7	1988	284,899	3,218			288,177			
8	1989	250,815	4,290			255,105			
9	1990	60,592	3,218	3,152		66,962	113,841	54,010	167,851
10	1991			3,618		3,618	130,702	:	184,712
11	1992			3,957		3,957	142,955	:	196,965
12	1993			4,224		4,224	152,529	:	206,539
13	1994			4,522		4,522	163,377	:	217,387
:	:			:		:	:	:	:
19	2000			19,632		19,632	:	:	:
20	2001			4,522		4,522	:	:	:
:	:			:		:	:	:	:
29	2010			19,632		19,632	:	:	:
30	2011			4,522		4,522	:	:	:
:	:			:		:	:	:	:
34	2015			8,700		8,700	:	:	:
35	2016			4,522		4,522	:	:	:
:	:			:		:	:	:	:
39	2020			19,632		19,632	:	:	:
40	2021			4,522		4,522	:	:	:
:	:			:		:	:	:	:
49	2030			19,632		19,632	:	:	:
50	2031			4,522		4,522	:	:	:
:	:			:		:	:	:	:
59	2040			4,522		4,522	163,377	54,010	217,387

COST AND BENEFIT STREAM
(Huai Yai)

(Unit: 10^3฿)

No.	Year	Cost					Benefit		
		Capital Cost	Other Cost	O/M Replacem't Cost	Sunk Cost	Total Cost	Agricultural Benefit	Downstream Use & Municipal W.	Total Benefit
1	1982				0	0			
2	1983					0			
3	1984	14,908				14,908			
4	1985	19,475				19,475			
5	1986	88,885				88,885			
6	1987	111,231	73			111,304			
7	1988	120,637	363			121,000			
8	1989	20,011	290	1,427		21,728	42,762	11,920	54,682
9	1990			1,611		1,611	48,336	:	60,256
10	1991			1,747		1,747	52,367	:	64,287
11	1992			1,849		1,849	55,442	:	67,362
12	1993			1,965		1,965	58,925	:	70,845
:	:			:		:	:	:	:
18	1999			7,996		7,996	:	:	:
19	2000			1,965		1,965	:	:	:
:	:			:		:	:	:	:
28	2009			7,996		7,996	:	:	:
29	2010			1,965		1,965	:	:	:
:	:			:		:	:	:	:
33	2014			3,645		3,645	:	:	:
34	2015			1,965		1,965	:	:	:
:	:			:		:	:	:	:
38	2019			7,996		7,996	:	:	:
39	2020			1,965		1,965	:	:	:
:	:			:		:	:	:	:
48	2029			7,996		7,996	:	:	:
49	2030			1,965		1,965	:	:	:
:	:			:		:	:	:	:
58	2039			1,965		1,965	58,925	11,920	70,845

COST AND BENEFIT STREAM
(Khlong Chaliang Lab)

(Unit: 10^3฿)

No.	Year	Cost					Benefit		
		Capital Cost	Other Cost	O/M Replacem't Cost	Sunk Cost	Total Cost	Agricultural Benefit	Down-Stream Use & Municipal W.	Total Benefit
1	1982				0	0			
2	1983					0			
3	1984					0			
4	1985					0			
5	1986					0			
6	1987					0			
7	1988	15,608				15,608			
8	1989	20,388				20,388			
9	1990	88,925				88,925			
10	1991	110,572				110,572			
11	1992	104,400	145			104,545			
12	1993	43,340	339	932		44,611	26,178	11,509	37,687
13	1994			1,063		1,063	29,869	:	41,378
14	1995			1,159		1,159	32,565	:	44,074
15	1996			1,231		1,231	34,596	:	46,105
16	1997			1,314		1,314	36,922	:	48,431
:	:			:		:	:	:	:
22	2003			5,335		5,335	:	:	:
23	2004			1,314		1,314	:	:	:
:	:			:		:	:	:	:
32	2013			5,335		5,335	:	:	:
33	2014			1,314		1,314	:	:	:
:	:			:		:	:	:	:
37	2018			2,804		2,804	:	:	:
38	2019			1,314		1,314	:	:	:
:	:			:		:	:	:	:
42	2023			5,335		5,335	:	:	:
43	2024			1,314		1,314	:	:	:
:	:			:		:	:	:	:
52	2033			5,335		5,335	:	:	:
53	2034			1,314		1,314	:	:	:
:	:			:		:	:	:	:
62	2043			1,314		1,314	36,922	11,509	48,431

FINANCIAL CASH FLOW STATEMENT (Package I)

(Unit: 10^3B)

Year	Year in Order	Loan Disbursement	Accumulated Loan	Cash Outflow: O & M Cost	Cash Outflow: Repaym't of Loan Interest	Cash Outflow: Repaym't of Loan Capital	Cash Outflow: Total Outflow (A)	Cash Inflow: Project Revenue	Cash Inflow: Governm't Subsidy	Cash Inflow: Total Inflow (B)	Balance Repayment (B)-(A)
1984	1	31,172	31,172	-	1,091.0	-	1,091.0	-	1,091.0	1,091.0	0
1985	2	55,057	86,229	-	3,018.0	-	3,018.0	-	3,018.0	3,018.0	0
1986	3	229,599	315,828	-	11,054.0	-	11,054.0	-	11,054.0	11,054.0	0
1987	4	321,002	636,830	-	22,289.1	-	22,289.1	-	22,289.1	22,289.1	0
1988	5	360,439	997,269	-	34,904.4	-	34,904.4	-	34,904.4	34,904.4	0
1989	6	230,320	1,227,589	1,883	42,965.6	-	44,848.6	1,883	42,965.6	44,848.6	0
1990	7	52,241	1,279,830	6,346	44,794.1	-	51,140.1	6,346	44,794.1	51,140.1	0
1991	8		1,279,830	7,148	44,794.1	-	51,942.1	7,148	44,794.1	51,942.1	0
1992	9		1,279,830	7,737	44,794.1	-	52,531.1	7,737	44,794.1	52,531.1	0
1993	10		1,279,830	8,248	44,794.1	1,558.6	54,600.7	8,248	46,352.7	54,600.7	0
1994	11		1,278,271.4	8,647	44,739.5	4,311.5	57,698.0	8,647	49,051.0	57,698.0	0
1995	12		1,273,959.9	8,647	44,588.6	15,791.4	69,027.0	8,647	60,380.0	69,027.0	0
1996	13		1,258,168.5	8,647	44,035.9	31,841.5	84,524.4	8,647	75,877.4	84,524.4	0
1997	14		1,226,327.0	8,647	42,921.4	49,863.5	101,431.9	8,647	92,784.9	101,431.9	0
1998	15		1,176,463.5	8,647	41,176.2	61,379.5	111,202.7	8,647	102,555.7	111,202.7	0
1999	16		1,115,084.0	8,647	39,027.9	63,991.5	111,666.4	8,647	103,019.4	111,666.4	0
2000	17		1,051,092.5	8,647	36,788.2	63,991.5	109,426.7	8,647	100,779.9	109,426.7	0
2001	18		987,101.0	8,647	34,548.5	63,991.5	107,187.0	8,647	98,540.0	107,187.0	0
2002	19		923,109.5	8,647	32,308.8	63,991.5	104,947.3	8,647	96,300.3	104,947.3	0
2003	20		859,118.0	8,647	30,069.1	63,991.5	102,707.6	8,647	94,060.6	102,707.6	0
2004	21		795,126.5	8,647	27,829.4	63,991.5	100,467.9	8,647	91,820.9	100,467.9	0
2005	22		731,135.0	8,647	25,589.7	63,991.5	98,228.2	8,627	89,581.2	98,228.2	0
2006	23		667,143.5	8,647	23,350.0	63,991.5	95,988.5	8,647	87,341.5	95,988.5	0
2007	24		603,152.0	8,647	21,110.3	63,991.5	93,748.8	8,647	85,101.8	93,748.8	0
2008	25		539,160.5	8,647	18,870.6	63,991.5	91,509.1	8,647	82,662.1	91,509.1	0
2009	26		475,169.0	8,647	16,630.9	63,991.5	89,269.4	8,647	80,622.4	89,269.4	0
2010	27		411,177.5	8,647	14,391.2	63,991.5	87,029.7	8,647	78,382.7	87,029.7	0
2011	28		347,186.0	8,647	12,151.5	63,991.5	84,790.0	8,647	76,143.0	84,790.0	0
2012	29		283,194.5	8,647	9,911.8	63,991.5	82,550.3	8,647	73,903.3	82,550.3	0
2013	30		219,203.0	8,647	7,672.1	62,432.9	78,752.0	8,647	70,105.0	78,752.0	0
2014	31		156,770.1	8,647	5,487.0	59,680.1	73,814.1	8,647	65,167.1	73,814.1	0
2015	32		97,090.0	8,647	3,398.2	48,200.1	60,245.3	8,647	51,598.3	60,245.3	0
2016	33		48,889.9	8,647	1,711.1	32,150.0	42,508.1	8,647	33,861.1	42,508.1	0
2017	34		16,739.9	8,647	585.9	14,128.1	23,361.0	8,647	14,714.0	23,361.0	0
2018	35		2,611.8	8,647	91.4	2,611.8	11,350.2	8,647	2,703.2	11,350.2	0
2019	36		0	8,647	0	0	8,647.0	8,647	0	8,647.0	0

FINANCIAL CASH FLOW STATEMENT (Overall Case II)

(Unit: 10^3฿)

Year	Year in Order	Loan Disbursement	Accumulated Loan	Cash Outflow: O & M Cost	Cash Outflow: Repaym't of Loan Interest	Cash Outflow: Repaym't of Loan Capital	Cash Outflow: Total Outflow (A)	Cash Inflow: Project Revenue	Cash Inflow: Governm't Subsidy	Cash Inflow: Total Inflow (B)	Balance Repayment (B)-(A)
1984	1	31,172	31,172	-	1,091.0	-	1,091.0	-	1,091.0	1,091.0	0
1985	2	55,057	86,229	-	3,018.0	-	3,018.0	-	3,018.0	3,018.0	0
1986	3	229,599	315,828	-	11,054.0	-	11,054.0	-	11,054.0	11,054.0	0
1987	4	321,002	636,830	-	22,289.1	-	22,289.1	-	22,289.1	22,289.1	0
1988	5	386,674	1,023,504	-	35,822.6	-	35,822.6	-	35,822.6	35,822.6	0
1989	6	265,499	1,289.003	1,883	45,115.1	-	46,998.1	1,883	45,115.1	46,998.1	0
1990	7	236,488	1,525,491	6,346	53,392.2	-	59,738.2	6,346	53,392.2	59,738.2	0
1991	8	233,164	1,758,655	7,148	61,552.9	-	68,700.9	7,148	61,552.9	68,700.9	0
1992	9	237,125	1,995,780	7,737	69,852.3	-	77,589.3	7,737	69,852.3	77,589.3	0
1993	10	27,904	2,023,684	14,705	70,828.9	1,558.6	87,092.5	14,705	72,387.5	87,092.5	0
1994	11		2,022,125.4	16,019	70,774.4	4,311.5	91,104.9	16,019	75,085.9	91,104.9	0
1995	12		2,017,813.9	16,709	70,623.5	15,791.4	103,123.9	16,709	86,414.9	103,123.9	0
1996	13		2,002,022.5	17,361	70,070.8	31,841.5	119,273.3	17,361	101,912.3	119,273.3	0
1997	14		1,970,181.0	18,103	68,956.3	51,175.2	138,234.5	18,103	120,131.5	138,234.5	0
1998	15		1,919,005.8	18,103	67,165.2	64,450.2	149,718.4	18,103	131,615.4	149,718.4	0
1999	16		1,854,555.6	18,103	64,909.4	76,274.6	159,287.0	18,103	141,184.0	159,287.0	0
2000	17		1,778,281.0	18,103	62,239.8	87,932.8	168,275.6	18,103	150,172.6	168,275.6	0
2001	18		1,690,348.2	18,103	59,162.2	99,789.0	177,054.2	18,103	158,951.2	177,045.2	0
2002	19		1,590,559.2	18,103	55,669.6	101,184.2	174,956.8	18,103	156,853.8	174,956.8	0
2003	20		1,489,375.0	18,103	52,128.1	101,184.2	171,415.3	18,103	153,312.3	171,415.3	0
2004	21		1,388,190.8	18,103	48,586.7	101,184.2	167,873.9	18,103	149,770.9	167,873.9	0
2005	22		1,287,006.6	18,103	45,045.2	101,184.2	164,332.4	18,103	146,229.4	164,332.4	0
2006	23		1,185,822.4	18,103	41,503.8	101,184.2	160,791.0	18,103	142,688.0	160,791.0	0
2007	24		1,084,638.2	18,103	37,962.3	101,184.2	157,249.5	18,103	139,146.5	157,249.5	0
2008	25		983,454.0	18,103	34,420.9	101,184.2	153,708.1	18,103	135,605.1	153,708.1	0
2009	26		882,269.8	18,103	30,879.4	101,184.2	150,166.6	18,103	132,063.6	150,166.6	0
2010	27		781,085.6	18,103	27,338.0	101,184.2	147,625.2	18,103	129,522.2	147,625.2	0
2011	28		679,901.4	18,103	23,796.5	101,184.2	143,083.7	18,103	124,980.7	143,083.7	0
2012	29		578,717.2	18,103	20,255.1	101,184.2	139,542.3	18,103	121,439.3	139,542.3	0
2013	30		477,533.0	18,103	16,713.7	99,625.6	134,442.3	18,103	116,339.3	134,442.3	0
2014	31		377,907.4	18,103	13,226.8	96,872.8	128,202.6	18,103	110,099.6	128,202.6	0
2015	32		281,034.6	18,103	9,836.2	85,392.8	113,332.0	18,103	95,229.0	113,332.0	0
2016	33		195,641.8	18,103	6,847.5	69,342.7	94,293.2	18,103	76,190.2	94,293.2	0
2017	34		126,299.1	18,103	4,420.5	50,009.0	72,532.5	18,103	54,429.5	72,532.5	0
2018	35		76,290.1	18,103	2,670.2	36,734.1	57,507.3	18,103	39,404.3	57,507.3	0
2019	36		39,556.0	18,103	1,384.5	24,909.7	44,397.2	18,103	26,294.2	44,397.2	0
2020	37		14,646.3	18,103	512.6	13,251.5	31,867.1	18,103	13,764.1	31,867.1	0
2021	38		1,394.8	18,103	48.8	1,394.8	19,546.6	18,103	1,443.6	19,546.6	0
2022	39		0	18,103	0	0	18,103.0	18,103	0	18,103.0	0

JICA