


MINISTRY OF INTERIOR
PROVINCIAL WATERWORKS AUTHORITY

FINAL REPORT
FOR
DEVELOPMENT PLAN AND FEASIBILITY STUDY
ON
PROVINCIAL WATER SUPPLY PROJECTS
IN
THE KINGDOM OF THAILAND

VOLUME I
SUMMARY

MARCH 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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国際協力事業団	
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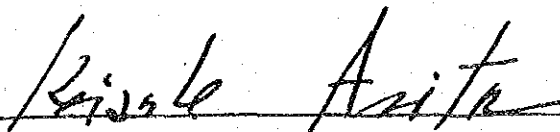
P R E F A C E

In response to the request of the Government of the Kingdom of Thailand, the Japanese Government has decided to conduct Development Plan and Feasibility Study on Provincial Water Supply Projects and entrusted the Study to the Japan International Cooperation Agency (JICA). JICA sent to the Thailand a study team headed by Mr. Osamu Wakamoto, Nihon Suido Consultants Co., Ltd. from December 1985 to December 1986.

The team had discussions with the officials concerned of the Government of the Thailand and conducted a field survey in the Study Areas and Bangkok. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries. I wish to express my deep appreciation to the officials concerned of the Government of the Thailand for their close cooperation extended to the team.

March 1987

A handwritten signature in cursive script, reading "Keisuke Arita", is written over a horizontal line.

Keisuke ARITA

President

Japan International Cooperation Agency

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S U M M A R Y

1. Introduction

1.1 Study

This report summarizes the results of the Development Plan and Feasibility Study prepared by a study team of the Japan International Cooperation Agency (JICA), from November 1985 to February 1987, on the Provincial Water Supply Projects in the Kingdom of Thailand, for the Provincial Waterworks Authority (PWA).

1.2 Study Area

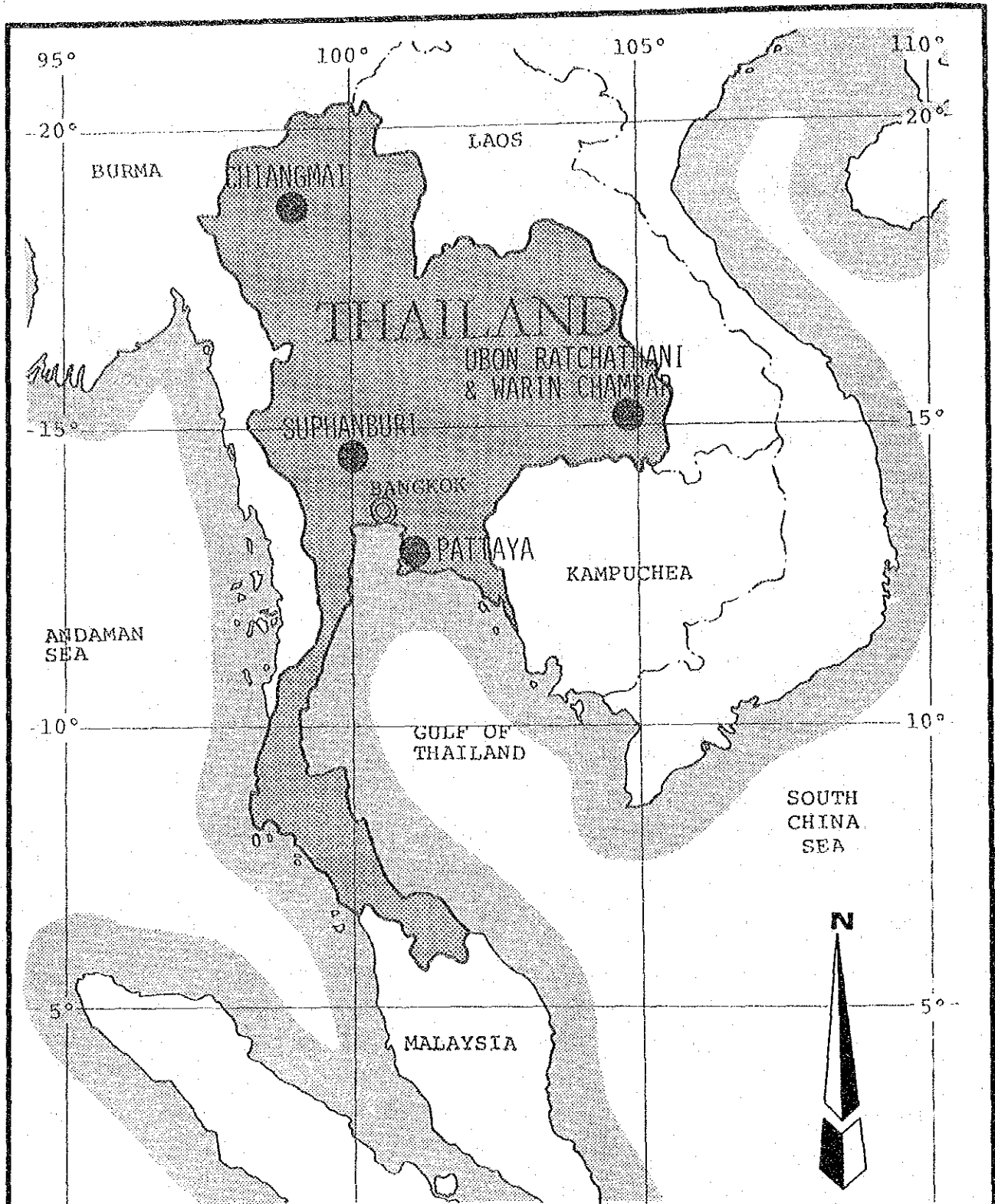
The study covers the following four areas (see Fig-S.1).

- Chiangmai and its five suburban Sanitary Districts of Mae Rim, San Kamphaeng, San Sai, Saraphi and Hang Dong
- Ubon Ratchathani and Warin Chamrap Municipalities, Ubon Sanitary District, five villages of Ban Don Klang, Ban Pak Huai Wang Nong, Ban Tha Bong Mang, Ban Hat Suan Ya and Ban Mai Klang.
- Suphanburi Municipality and Phophraya Sanitary District
- Pattaya city, Nong Preo Sanitary District and Ban Rong Po.

The current project will constitute part of 6th National Five-Year Economic and Social Development Program for 1986 - 1990 which is now being prepared.

1.3 Target Year of the Project

In accordance with the strategic policy of PWA, the Project is targeted at the year 2010 for master planning and at 2000 for feasibility study.



LEGEND

- : Location of Study Areas
 - ⊙ : CAPITAL CITY
- SCALE 1 : 10,000,000

FIGURE	LOCATION MAP
S.1	
JAPAN INTERNATIONAL COOPERATION AGENCY	

2. Population and Water Demand

As shown in Table-S.1, the combined total of populations in the four areas are projected to increase from 442 thousand in 1984 to 562 thousand in 2000 and further to 631 thousand in 2010, and that of served population likewise from 171 thousand to 346 thousand and further to 466 thousand. The incremental served population will thus need, as shown in Table-S.2, additional water supply of 67 thousand cu m/d up to 2000 and 117 thousand cu m/d up to 2010 on the top of 1985 supply of 55 thousand cu m/d. Demand comes from varied uses including domestic, public, institutional, commercial and industrial ones. In Chiangmai and Pattaya particularly, uses for tourism have a heavy weight on their future municipal development.

3. Water Supply System

The Development Plan proposes immediate improvement programs to rehabilitate the existing systems, together with immediate modification works to increase the production-supply capacity of the existing facilities. These immediate actions are required to be carried out prior to the Stage I expansion programs, or as part of their initial phases.

To satisfy the maximum day demand for each of the four areas as projected in Fig-S.2, the capacity expansions as presented in step-wise lines of the same Figure are planned in the facilities of the respective areas. The combined total of these capacity expansions in the four areas during the project period through 2010 will amount to 274 thousand cu m/day or 2.7 times as large as the 1985 capacity. Raw waters for the present and expanded supply will be provided from the water sources listed in Table-S.3.

4. Project Cost and Implementation Schedule

4.1 Project Cost

The combined project cost for the four areas is shown in Table-S.4. Of the total cost of 2,000 million Baht, 48 % is used for the Stage I and 52 % for the Stage II.

Table-S.1 TOTAL AND SERVED POPULATION

	<u>Present(1984)</u>	<u>2000</u>	<u>2010</u>	<u>Remarks</u>
1. Chiangmai				
Total Population	216,730	256,900	283,100	Chiangmai and 5 S.D.
Service Ratio (%)				
Chiangmai	48	70	75	
Mae Rim	41	65	70	
San Kamphaeng	29	57	65	
San Sai	-	-	50	
Saraphi	-	-	50	
Hang Dong	-	-	50	
Served Population	82,900	147,700	198,100	
Service Area (ha)	5,070	7,300	15,000	
2. Ubon and Warin				
Total Population	142,630	178,700	196,500	Ubon, Warin, Ubon SD and 5 Villages
Service Ratio (%)				
Ubon, Warin	40	61	75	
Ubon SD	-	61	75	
5 Villages	-	31	50	
Served Population	51,500	107,400	146,000	
Service Area (ha)	2,000	3,900	4,600	
3. Suphanburi				
Total Population	26,890	34,000	37,600	Suphanburi and Phophraya SD
Service Ratio (%)	75	92	94	
Served Population	20,200	31,300	35,300	
Service Area (ha)	1,200	2,300	3,100	
4. Pattaya				
Total Population	55,900	92,000	114,000	Pattaya, Nong Preo SD and Ban Rong Po
Service Ratio (%)	30	65	76	
Served Population	16,800	59,800	86,700	
Service Area (ha)	1,330	2,700	3,100	
5. Total				
Total Population	442,150	561,600	631,200	
Service Ratio (%)	39	62	74	
Served Population	171,400	346,200	466,100	
Service Area (ha)	9,600	16,200	25,800	

Table-S.2 WATER DEMAND

	<u>1985</u>	<u>2000</u>	<u>2010</u>
1. Chiangmai			
Water Consumption (m3/d)	26,300	53,000	74,800
Unaccounted-for Water			
Ratio (%)	32	23	20
Average Day Water			
Demand (m3/d)	38,400	68,900	93,700
Peak Factor			
Chiangmai		- 1.25 -	
5 SDs		- 1.35 -	
Maximum Day Water			
Demand (m3/d)	48,400	87,000	118,600
2. Ubon and Warin			
Water Consumption (m3/d)	12,400	31,100	48,700
Unaccounted-for Water			
Ratio (%)	35	23	20
Average Day Water			
Demand (m3/d)	19,100	40,300	60,900
Peak Factor		- 1.30 -	
Maximum Day Water			
Demand (m3/d)	24,800	52,400	79,100
3. Suphanburi			
Water Consumption (m3/d)	2,900	6,200	8,600
Unaccounted-for Water			
Ratio (%)	42	23	20
Average Day Water			
Demand (m3/d)	5,000	8,100	10,800
Peak Factor		- 1.35 -	
Maximum Day Water			
Demand (m3/d)	6,700	10,900	14,600
4. Pattaya			
Water Consumption (m3/d)	13,800	31,900	40,600
Unaccounted-for Water			
Ratio (%)	15	15	15
Average Day Water			
Demand (m3/d)	16,200	37,500	47,800
Peak Factor		1.25 for domestic and others	
		1.40 for tourism	
Maximum Day Water			
Demand (m3/d)	21,500	48,900	61,800
5. Total			
Water Consumption (m3/d)	55,400	122,200	172,700
Maximum Day Water			
Demand (m3/d)	101,400	199,200	274,100

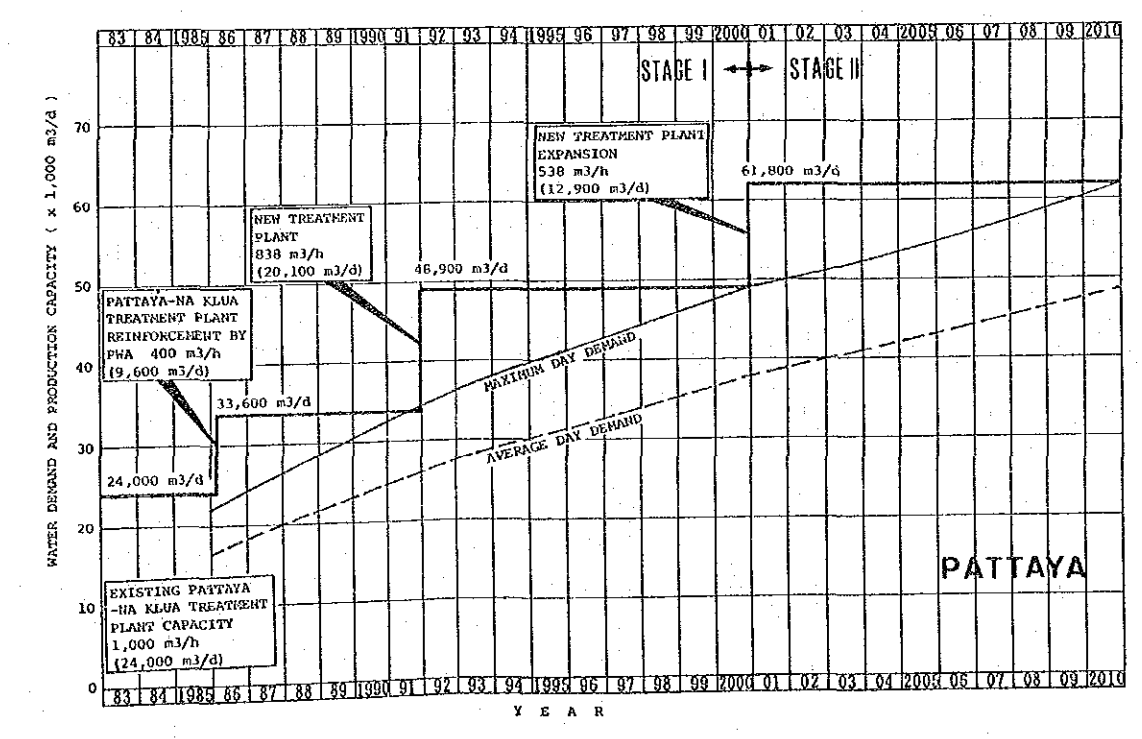
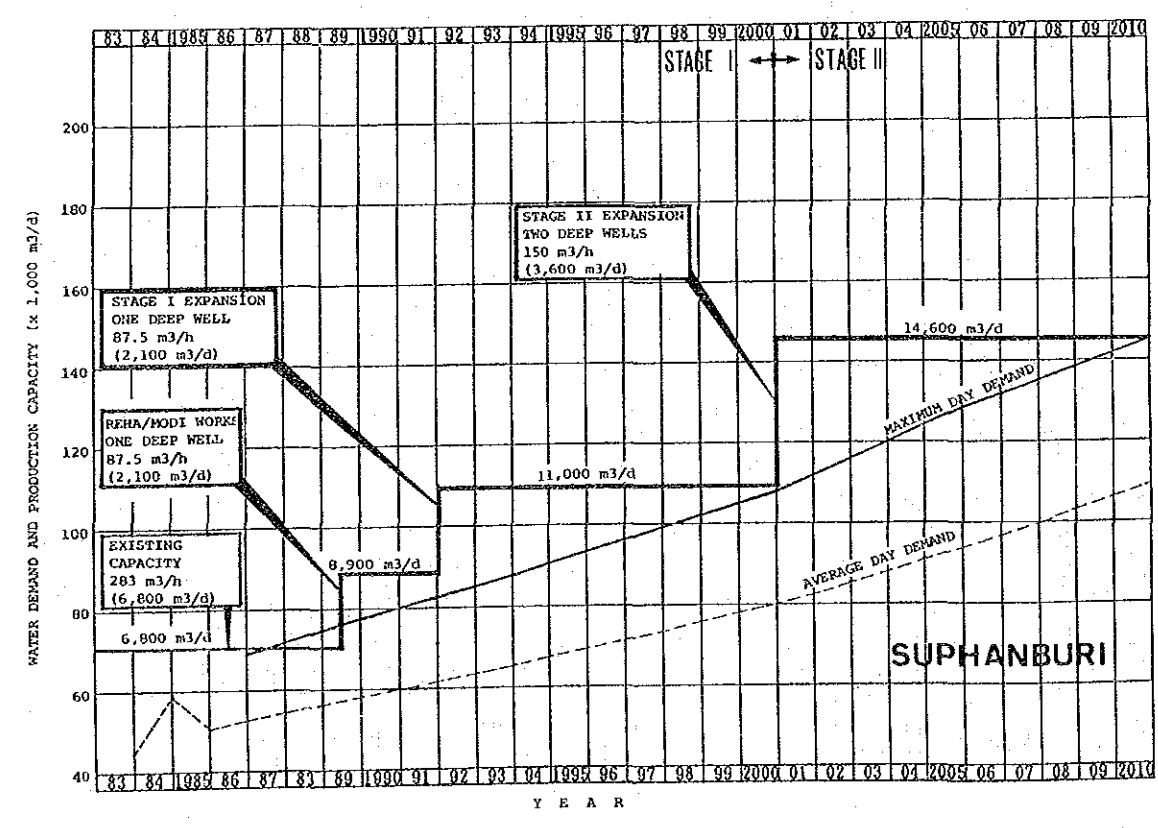
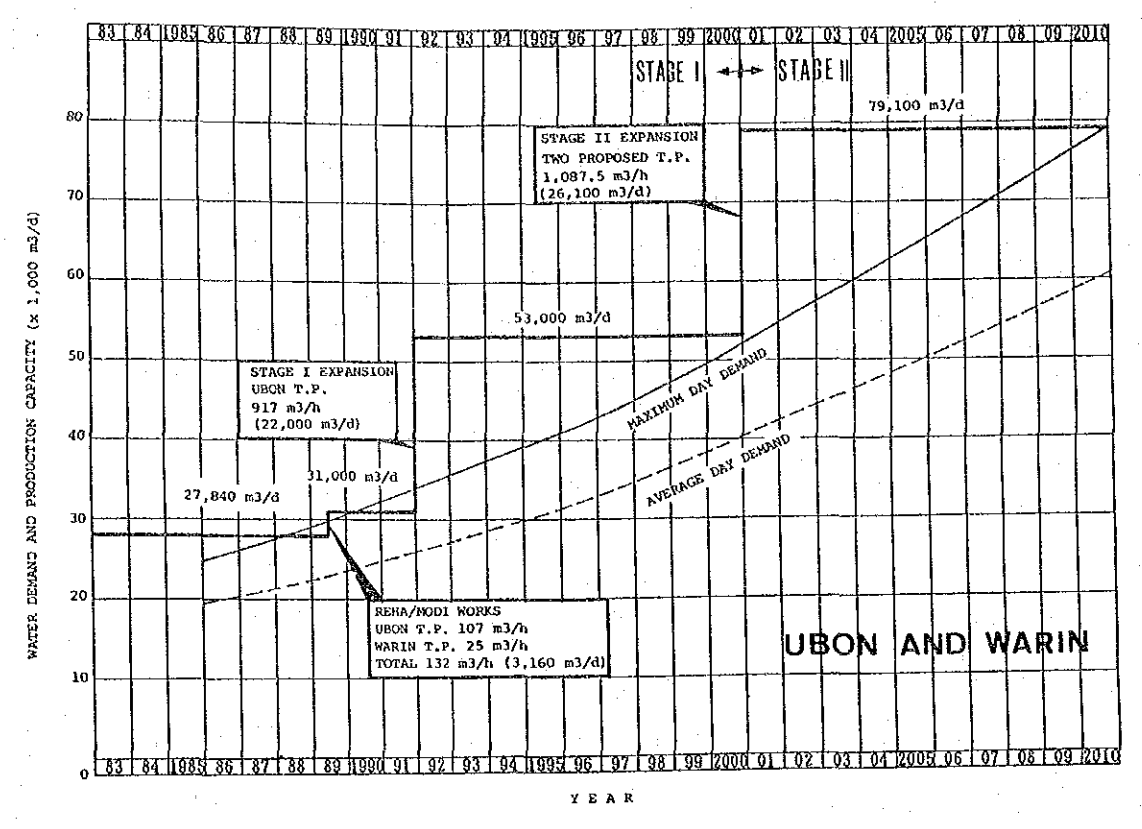
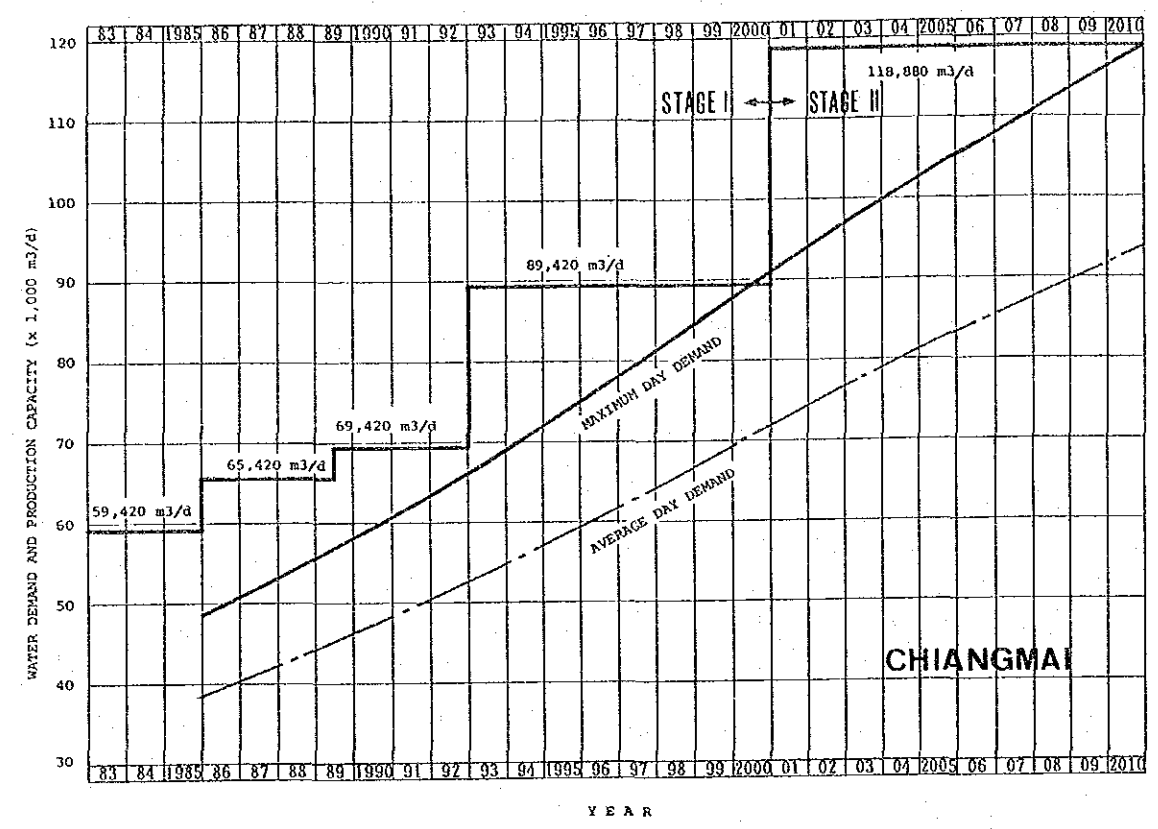


FIGURE
S.2
WATER SUPPLY PLAN
JAPAN INTERNATIONAL COOPERATION AGENCY

Table-S.3 WATER SOURCES

	<u>Present</u>	<u>2000</u>	<u>2010</u>
1. Chiangmai			
Chiangmai	Ping River, Mae Tang Irrigation Canal	Ping River, Canal	Ping River, Canal
Mae Rim	Mae Sa Rivulet	Mae Sa Rivulet	Mae Sa Rivulet
San Kamphaeng	Deep Wells	Deep Wells	Deep Wells
San Sai	-	-	do
Saraphi	-	-	do
Hang Dong	-	-	do
2. Ubon and Warin	Mun River, Mun Noi River	Mun River, Mun Noi River	Mun River, Mun Noi River
3. Suphanburi	Deep Well, Tha Chin River	Deep Wells, Tha Chin River	Deep Wells, Tha Chin River
4. Pattaya	Mab Prachan Reservoir	Mab Prachan Res., Nong Kho Res.	Mab Prachan Res., Nong Kho Res., Nong Pla Lai Res.

Table-S.4 PROJECT COST

Unit: 1,000 Baht

	Stage I		<u>Subtotal</u>	Stage II	<u>Total</u>
	<u>Reha/Modi</u>	<u>Expansion</u>		<u>Expansion</u>	
1. Chiangmai	30,000	279,500	309,500	532,100	841,600
2. Ubon and Warin	18,100	201,100	219,200	253,500	472,700
3. Suphanburi	32,500	29,900	62,400	53,500	115,900
4. Pattaya	34,400	346,400	380,800	216,100	596,900
Total	115,000	856,900	971,900	1,055,200	2,027,100

The percentage of total cost for rehabilitation and modification works in Stage I will be approximately 10 % in cases of Chiangmai, Ubon-Warin, and Pattaya respectively. In case of Suphanburi, however, more than half of total cost is directed to the same purposes.

4.2 Implementation Schedule

Implementation will proceed as shown in Fig-S.3, which has been prepared, taking into consideration of the guidelines of OECF and the prevailing practices in Thailand.

5. Financing Plan for Stage I Implementation

As shown in Table-S.5, capital investment of Stage I for the four projects will amount to 972 million Baht, which will be financed by foreign loans (80 %) and local loans (20 %). The total funds requirements including debt service during the project period of Stage I on a cash flow basis will thus amount to 1,910 million Baht which can be covered by internal cash generation together with the foreign and local loans, without PWA internal finance or Government subsidies.

Table-S.6 below shows the combined cash flow forecast for the four waterworks based on the assumption that the water tariffs will be increased every three years at the rate of 3.3 % per annum. Also shown in Table-S.7 and S.8 are the combined cash flow of these waterworks forecast as sensitivity study on the assumptions (1) that the water tariffs will be increased every year at the rate of 3.3 % and (2) that the water tariffs will be kept unchanged up to the year 2000.

All these tables support the financial feasibility of the current project for these four waterworks, by showing positive accumulative operating surpluses through out the project period.

As for another sensitivity study, the combined cashflow of the four waterworks is forecast in Table-S.9 on the assumption that water sales will increase only half as much as originally projected in this Feasibility Study, with water tariffs increasing every three years at the rate of 3.3

Table-S.5 TENTATIVE FINANCING PLAN FOR STAGE I IMPLEMENTATION
Unit: 1,000 Baht

	<u>CM</u>	<u>UBW</u>	<u>SUP</u>	<u>PAT</u>	<u>TOTAL</u>	<u>(%)</u>
1. Sources of Funds						
Internal Cash Generation	395,500	179,900	54,300	308,300	938,000	(49.1%)
Outside Sources:						
- Foreign Financial Institution (OECF)	247,600	175,400	49,900	304,700	777,600	(40.7%)
- Local Financial Institution	61,900	43,800	12,500	76,200	194,400	(10.2%)
Total	705,000	399,100	116,700	689,200	1,910,000	(100.0%)
2. Application of Funds						
Capital Expenditure	309,500	219,200	62,400	380,900	972,000	(50.9%)
Debt Service	395,500	179,900	54,300	308,300	938,000	(49.1%)
Total	705,000	399,100	116,700	689,200	1,910,000	(100.0%)

(Note) CM: Chiangmai, UBW: Ubon and Warin, SUP: Suphanburi, PAT: Pattaya

Table-S.6 CASH FLOW PROJECTED (x 1,000 Baht) AT CURRENT PRICE (FOUR CITIES COMBINED)

Description	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
(A) Water Production (x1000 m ³)	30,408	32,330	34,055	35,929	37,757	39,583	42,119	44,319	46,419	48,257	50,012	51,748	53,394	54,965	56,562
(B) Unaccounted for Water (C)	29	28	27	26	25	25	24	24	23	23	22	22	22	21	21
(C) Water Sales (x1000 m ³)	21,597	23,258	24,846	26,543	28,215	29,861	31,955	33,868	35,698	37,391	38,869	40,394	41,855	43,225	44,523
(D) No. of Connections	40,159	42,702	45,422	48,140	50,996	53,883	57,225	60,212	62,913	65,252	67,250	69,079	70,841	72,448	74,017
(E) Average Water Tariff (Baht/m ³)**	7.36	7.36	7.36	8.13	8.13	8.13	8.97	8.97	8.97	9.88	9.88	9.88	10.87	10.87	10.87
1. Operating Revenue:															
1.1 Water Sales	158,881	171,203	183,024	215,729	229,516	242,947	286,492	303,639	319,991	369,377	383,736	398,621	454,999	459,688	484,719
1.2 Connection Fees	11,128	11,956	12,711	13,994	14,578	12,348	21,088	15,469	14,826	14,093	12,007	11,088	11,792	10,830	10,551
1.3 Service Charges	5,387	5,725	6,087	7,110	7,530	7,878	9,317	9,807	10,251	11,725	12,088	12,419	14,041	14,380	14,572
1.4 Other Revenue	841	905	967	1,135	1,206	1,280	1,522	1,584	1,658	1,901	1,963	2,033	2,317	2,385	2,459
Total 1.	176,199	189,749	202,747	237,918	252,877	264,380	318,348	331,426	346,648	397,006	409,700	424,063	483,034	497,155	512,278
2. Expenses:															
2.1 Operation & Maintenance															
- Personnel Cost	18,425	20,060	22,498	24,741	27,627	33,693	38,766	42,288	45,885	50,326	54,358	58,294	63,252	68,435	73,442
- Electricity & Fuel Cost	17,949	19,543	21,053	22,734	24,488	26,218	28,431	30,500	32,598	34,585	36,641	38,886	41,133	43,493	46,063
- Chemical Cost	4,900	5,363	5,845	6,345	6,884	7,455	8,195	8,917	9,645	10,359	11,103	11,876	12,564	13,481	14,847
- Connection Cost	4,526	4,698	5,134	5,223	5,770	5,036	7,989	6,501	6,050	5,368	4,720	4,533	4,492	4,275	4,295
- Raw Water Cost	3,095	3,559	4,004	3,846	4,339	4,912	9,875	8,304	10,281	12,149	13,723	15,468	17,150	18,965	20,882
- Other Cost	5,328	5,722	6,221	6,696	7,264	7,998	9,095	9,569	10,273	10,983	11,605	12,297	13,082	13,833	14,506
Sub-total 2.1	54,223	58,945	64,764	69,685	76,372	85,313	104,283	108,809	117,944	127,598	136,527	146,212	157,091	168,443	180,538
2.2 Share of Head & Regional Office Overhead Expenses	26,272	29,206	32,213	35,371	38,792	41,873	47,238	50,752	54,817	59,827	62,718	67,060	71,620	76,161	81,083
2.3 Debt Service	12,050	11,960	14,267	18,101	31,127	51,211	66,389	88,520	92,085	87,988	83,890	110,987	106,244	101,501	73,886
Total 2.	92,545	100,111	111,234	123,157	146,292	178,397	217,910	248,181	264,846	274,412	283,135	324,258	334,956	346,106	335,397
3. Net Cash Flow Surplus:															
3.1 Annual	83,654	89,638	91,513	114,761	106,585	85,982	100,438	83,245	81,802	122,594	126,565	99,804	148,078	151,048	176,970
3.2 Cumulative	83,654	173,292	264,805	379,566	486,151	572,133	672,572	755,817	837,619	959,212	1,086,777	1,186,581	1,534,659	1,485,707	1,662,578
4. Unit Cost of Water after Debt Service (Baht/m³)*	3.86	3.88	4.04	4.21	4.71	5.49	6.14	6.71	6.85	6.83	6.82	7.55	7.54	7.56	7.11

Note: * [(Total 2.) x (0.1 Water Sales) / (Total 1.)] / (3. Water Sales m³)

** Based upon the assumption that the water tariff increases every 3 years at the rate of 3.3 % per annum.

Table-S.7 CASH FLOW PROJECTED (x 1,000 Baht) AT CURRENT PRICE FOUR CITIES COMBINED

Description	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
(A) Water Production (x1000 m ³)	30,408	32,330	34,055	35,929	37,757	39,583	42,118	44,319	46,419	48,257	50,012	51,748	53,394	54,965	56,562
(B) Unaccounted for Water (x)	28	28	27	26	25	25	24	24	23	23	22	22	22	21	21
(C) Water Sales (x1000 m ³)	21,597	23,258	24,845	26,543	28,215	29,861	31,955	33,868	35,598	37,391	38,869	40,394	41,855	43,225	44,523
(D) No. of Connections	40,169	42,702	45,422	48,140	50,956	53,883	57,225	60,212	62,913	65,252	67,250	69,079	70,841	72,448	74,017
(E) Average Water Tariff (Baht/m ³)**	7.35	7.50	7.86	8.13	8.40	8.58	8.97	9.26	9.57	9.88	10.20	10.53	10.87	11.22	11.59
1. Operating Revenue:															
1.1 Water Sales	158,881	176,852	185,303	215,729	237,090	259,246	285,492	313,660	341,459	369,377	398,599	425,364	454,999	485,198	517,239
1.2 Connection Fees	11,128	12,950	13,564	13,994	15,162	16,177	21,988	17,012	15,820	14,093	12,403	11,832	11,792	11,187	11,259
1.3 Service Charges	5,387	5,914	6,496	7,110	7,778	8,407	9,317	10,130	10,938	11,725	12,487	13,253	14,041	14,894	15,656
1.4 Other Revenue	841	935	1,032	1,185	1,245	1,345	1,522	1,637	1,769	1,901	2,028	2,189	2,317	2,464	2,624
Total 1.	176,199	196,010	216,349	237,918	261,222	282,116	318,348	342,363	369,904	397,006	423,220	452,513	483,034	513,551	546,546
2. Expenses:															
2.1 Operation & Maintenance															
- Personnel Cost	18,425	20,060	22,498	24,741	27,627	33,593	38,756	42,288	45,885	50,326	54,358	58,294	63,252	68,435	73,442
- Electricity & Fuel Cost	17,949	19,543	21,053	22,734	24,488	26,218	28,431	30,500	32,588	34,585	36,541	38,886	41,133	43,493	46,063
- Chemical Cost	4,900	5,363	5,845	6,345	6,884	7,456	8,196	8,917	9,645	10,359	11,103	11,876	12,654	13,481	14,347
- Connection Cost	4,526	4,598	5,134	5,323	5,770	5,036	7,989	6,501	6,050	5,368	4,720	4,533	4,492	4,275	4,295
- Raw Water Cost	3,095	3,559	4,004	3,846	4,339	4,912	9,863	8,317	10,272	12,130	13,752	15,448	17,109	18,976	20,854
- Other Cost	5,328	5,722	6,221	6,596	7,264	7,998	9,096	9,669	10,273	10,983	11,505	12,297	13,082	13,833	14,506
Sub-total 2.1	54,223	58,945	64,754	69,685	76,372	85,313	102,340	106,191	114,712	123,762	132,179	141,533	151,732	162,494	174,069
2.2 Share of Head & Regional Office Overhead Expenses	26,272	29,206	32,213	35,371	38,792	41,873	47,238	50,752	54,817	58,827	62,718	67,060	71,620	76,151	81,083
2.3 Debt Service	12,050	11,950	14,267	18,101	31,127	51,211	66,899	88,620	92,085	87,988	83,880	110,987	106,244	101,501	73,686
Total 2.	92,545	100,111	111,234	123,157	146,292	178,397	215,968	245,563	261,614	270,566	278,787	319,380	329,596	340,156	328,777
3. Net Cash Flow Surplus:															
3.1 Annual	83,654	95,900	105,115	114,761	114,930	103,719	102,390	96,800	108,290	126,440	144,433	133,133	153,488	173,404	217,869
3.2 Cumulative	83,654	179,554	284,669	399,430	514,360	618,079	720,460	817,260	925,550	1,051,990	1,186,423	1,329,556	1,482,993	1,656,398	1,874,266
4. Unit Cost of Water after Debt Service (Baht/m ³)*	3.86	3.88	4.04	4.21	4.71	5.49	5.08	5.64	5.76	6.73	6.72	7.43	7.42	7.43	6.97

Note: * [(Total 2.) x (1.1 Water Sales) / (Total 1.)] / (2. Water Sales m³)
 ** Based upon the assumption that the water tariff increases every year at the rate of 3.3 %

Table-S-8 CASH FLOW PROJECTED (\$,000 Baht) AT CURRENT PRICE (FOUR CITIES COMBINED)

Description	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. Operating Revenue:															
1.1 Water Sales	30,408	32,330	34,055	35,929	37,757	39,583	42,118	44,919	46,419	48,257	50,012	51,748	53,394	54,955	56,552
(A) Unaccounted for Water (A)	29	28	27	26	25	25	24	24	23	23	22	22	22	21	21
(B) Water Sales (B) (x1000 \$)	21,597	23,258	24,845	26,543	28,215	29,861	31,955	33,868	35,698	37,391	38,889	40,394	41,855	43,225	44,623
(C) No. of Connections	40,169	42,702	45,422	48,140	50,996	53,883	57,225	60,212	62,913	65,252	67,250	69,079	70,841	72,448	74,017
(D) Average Water Tariff (Baht/m ³)**	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26	7.26
1.2 Connection Fees	156,795	168,852	180,379	192,701	204,837	216,788	231,993	245,879	259,168	271,458	282,191	293,252	303,859	313,814	323,964
1.3 Service Charges	11,128	11,956	12,711	12,695	13,316	11,202	17,356	13,554	12,201	10,522	8,955	8,279	7,987	7,335	7,146
1.4 Other Revenue	5,387	5,725	6,087	6,450	6,831	7,147	7,667	8,071	8,436	8,754	9,025	9,273	9,510	9,726	9,937
Total 1.	831	895	956	1,018	1,081	1,130	1,238	1,289	1,349	1,403	1,449	1,501	1,552	1,598	1,647
174,104	187,387	200,090	212,817	226,015	236,215	258,194	268,729	281,088	292,067	301,556	312,237	322,838	332,392	342,609	
2. Expenses:															
2.1 Operation & Maintenance															
- Personnel Cost	18,425	20,060	22,498	24,741	27,627	33,693	38,756	42,288	45,885	50,326	54,358	58,294	63,252	68,435	73,442
- Electricity & Fuel Cost	17,949	19,934	21,714	23,643	25,743	26,878	30,668	33,292	35,944	38,539	41,295	44,218	47,187	50,249	53,524
- Chemical Cost	4,960	5,363	5,845	6,345	6,884	7,486	8,196	8,917	9,645	10,359	11,103	11,876	12,684	13,481	14,847
- Connection Cost	4,526	4,698	5,134	5,323	5,770	5,036	7,989	6,501	6,050	5,368	4,720	4,533	4,492	4,275	4,295
- Raw Water Cost	3,095	3,559	4,004	3,846	4,339	4,912	9,875	8,304	10,281	12,149	13,723	15,468	17,150	18,955	20,882
- Other Cost	5,328	5,755	6,277	6,773	7,370	8,054	9,284	9,904	10,556	11,316	11,997	12,747	13,592	14,403	15,135
Sub-total 2.1	54,223	59,370	65,471	70,672	77,733	86,029	106,726	111,818	121,596	131,912	141,531	152,023	163,716	175,754	188,588
2.2 Share of Head & Regional Office Overhead Expenses	25,929	27,905	29,798	31,675	33,633	35,138	38,390	39,924	41,742	43,364	44,755	46,323	47,892	49,302	50,812
2.3 Debt Service	12,050	11,960	14,267	16,101	31,127	51,211	66,389	88,620	92,085	87,988	83,890	110,387	106,244	101,501	73,686
Total 2.	92,202	99,235	109,536	120,448	142,492	172,378	211,506	240,362	255,423	263,264	270,176	308,333	317,853	326,558	313,166
3. Net Cash Flow Surplus:															
3.1 Annual	81,902	88,152	90,554	92,368	83,522	63,837	46,688	28,367	25,564	28,803	31,380	2,904	4,986	5,834	29,444
3.2 Cumulative	81,902	170,054	260,608	352,976	436,498	500,334	547,022	575,389	601,054	629,857	661,236	664,140	669,126	674,950	704,404
4. Unit Cost of Water after Debt Service (Baht/m ³)*	3.84	3.84	3.97	4.11	4.58	5.30	5.95	6.49	6.60	6.54	6.50	7.19	7.15	7.13	6.64

Note: * [(Total 2.) x (1.1 Water Sales) / (Total 1.)] / (3. Water Sales m³)

** Based upon the assumption that the water tariff remains unchanged up to 2000.

Table-S-9 CASH FLOW PROJECTED (x 1,000 Baht) AT CURRENT PRICES (FOUR CITIES COMBINED)

Description	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
(A) Water Production (x1000 m ³)	30,418	31,374	32,237	33,174	34,087	35,000	36,268	37,359	38,419	39,338	40,215	41,933	41,906	42,892	43,490
(B) Unaccounted for Water (x)	29	29	28	27	27	26	26	25	25	25	25	25	24	24	24
(C) Water Sales (x1000 m ³)***	21,597	22,427	23,221	24,070	24,906	25,729	26,776	27,732	28,648	29,494	30,233	30,995	31,726	32,411	33,110
(D) No. of Connections	40,159	41,436	42,796	44,155	45,583	46,776	48,597	50,181	51,541	52,711	53,710	54,624	55,505	56,309	57,093
(E) Average Water Tariff (Baht/m ³)**	7.36	7.36	7.36	8.13	8.13	8.13	8.97	8.97	8.97	9.88	9.88	9.98	10.37	10.87	10.87
1. Operating Revenue:															
1.1 Water Sales	158,954	165,066	170,909	195,588	202,484	209,176	240,181	248,769	256,969	291,401	298,703	305,237	344,863	352,309	359,906
1.2 Connection Fees	11,128	11,542	11,920	12,561	12,903	11,738	16,108	13,788	12,977	12,611	11,568	11,108	11,460	10,979	10,839
1.3 Service Charges	5,387	5,556	5,737	6,249	6,459	6,633	7,352	7,597	7,819	8,556	8,738	8,903	9,714	9,874	10,029
1.4 Other Revenue	841	873	904	988	1,023	1,050	1,181	1,213	1,250	1,371	1,402	1,437	1,579	1,513	1,650
Total 1.	176,310	183,037	189,469	215,486	222,869	228,597	284,822	271,357	279,014	313,938	320,411	327,685	367,616	374,774	382,425
2. Expenses:															
2.1 Operation & Maintenance	18,425	19,242	20,461	21,593	23,026	26,059	28,595	30,356	32,155	34,375	36,392	38,359	40,838	43,430	45,933
- Personnel Cost	17,949	18,746	19,501	20,341	21,218	22,083	23,190	24,224	25,288	26,267	27,295	28,417	29,541	30,721	32,006
- Electricity & Fuel Cost	4,900	5,131	5,372	5,622	5,892	5,178	5,548	5,908	7,273	7,629	8,901	8,388	8,782	9,190	9,874
- Chemical Cost	4,526	4,612	4,830	4,925	5,148	4,781	6,257	5,513	5,288	4,947	4,823	4,529	4,509	4,401	4,411
- Connection Cost	3,095	3,327	3,550	3,471	3,717	4,003	6,465	5,700	6,688	7,622	8,409	9,281	10,122	11,030	11,988
- Raw Water Cost	5,928	5,525	5,775	6,012	6,296	6,663	7,212	7,498	7,801	8,155	8,465	8,813	9,205	9,580	9,917
- Other Cost	54,223	56,584	59,489	61,954	65,297	69,768	78,288	80,200	84,472	88,997	93,187	97,788	102,998	108,353	114,129
Sub-total 2.1	26,272	27,739	29,243	30,821	32,532	34,073	36,755	38,512	40,545	42,549	44,495	46,566	48,946	51,217	53,678
2.2 Share of Head & Regional Office Overhead Expenses	12,050	11,950	14,257	18,101	31,127	51,211	66,383	88,620	92,085	87,988	83,890	110,987	106,244	101,501	73,586
2.3 Debt Service	92,545	96,283	102,998	110,877	128,957	155,052	181,432	207,632	217,101	219,533	221,572	255,441	258,188	261,071	241,493
Total 2.	83,766	86,754	86,472	104,609	93,912	73,545	83,390	84,035	61,913	94,405	98,639	72,244	108,428	113,703	140,982
3. Net Cash Flow Surplus:	83,766	170,520	256,991	361,501	455,513	529,058	612,448	876,483	738,395	832,800	931,639	1,063,883	1,113,311	1,227,014	1,367,947
3.1 Annual	3.86	3.87	4.00	4.18	4.70	5.51	6.15	6.85	6.98	6.91	6.93	7.70	7.63	7.57	8.86
3.2 Cumulative															
4. Unit Cost of Water after Debt Service (Baht/m ³)*															

Note: * [(Total 2) x (C.1 Water Sales) / (Total 1.)] / (C. Water Sales m³)

** Based upon the assumption that the water tariff increases every three years at the rate of 3.3 % per annum

*** Based upon the assumption that the increase in water sales is half as originally forecast. (See Table-S-5)

% per annum. Even on this assumption, the forecast supports the financial feasibility of the project by registering positive accumulative operating surpluses throughout the project period.

6. Project Justification

The project for Stage I is technically feasible and provides the least cost solution for providing water supply as needed in the four project areas through the year 2000.

As discussed in Section 5 above, each of the four waterworks will produce no adverse cash flow effects on PWA accounts during the project period. Table-S.10 reveals that the combined effects of the project on the four waterworks calculated in terms of FIRR and EIRR are extremely favorable, particularly for the three large-sized waterworks, Chiangmai, Ubon-Warin and Pattaya.

The capital investment under the current project will thus contribute to further enhancement of the already high operating returnability of these three waterworks. This kind of investment will doubtless strengthen the financial status of PWA, which will in turn facilitate capital investment of other waterworks with poorer returnability, by way of cross-subsidies among its member waterworks.

Table-S.10 FINANCIAL AND ECONOMIC EFFECTS OF THE PROJECTS
IN TERMS OF FIRR AND EIRR

<u>Area</u>	<u>FIRR</u>	<u>EIRR</u>
Chiangmai	10.8 %	16.6 %
Ubon - Warin	8.8 %	14.4 %
Suphanburi	3.3 %	9.4 %
Pattaya	5.6 %	11.4 %

Though such indicators as FIRR and EIRR for Suphanburi do not look so favorable, it is to be noted that capital investment for the waterworks under the current project has to be directed largely to rehabilitation and

modification of the facilities.

Implementation of the project will, as referred to above, improve the water supply and other environmental situation and health of the people in the four project areas on one hand, and will strengthen PWA's financial and operating status on the other hand.

CHIANGMAI

CHIANGMAI

A. Introduction

This report summarizes the results of a comprehensive master plan and feasibility study conducted by a study team of the Japan International Cooperation Agency (JICA), which are presented in this volume of the Report entitled "DEVELOPMENT PLAN AND FEASIBILITY STUDY ON PROVINCIAL WATER SUPPLY PROJECTS IN THE KINGDOM OF THAILAND, CHIANGMAI".

The study area covers Chiangmai Municipality and its neighboring Sanitary Districts, Mae Rim, San Kamphaeng, San Sai, Saraphi and Hang Dong, located some 700 km north of Bangkok. Chiangmai is a well known tourist spot in Asia and the second largest city in Thailand, and also serves as a center of administration, education, commerce and traffic in the northern districts. The city is expanding steadily and expected to absorb the surrounding five sanitary districts in the future. Of these five sanitary districts, those connected to PWA System are only two, Mae Rim and San Kamphaeng. Among the rest three, Hang Dong has a public water system not belonging to PWA, but other two have no water supply.

The current project purports to prepare a comprehensive development plan of water supply in the study area mentioned above up to the year 2010, and to study the feasibility of the early stage of the plan for implementation.

The population and water supply service ratio of Chiangmai and each of the five sanitary districts are forecast as in Table-ES.1.

In view of the uncertainties in the future development of Chiangmai and five sanitary districts as well as of the internal administrative reasons of PWA, project implementation is planned to be divided into two stages, i.e., Stage I up to the year 2000 and Stage II through 2010.

Table-ES.1 POPULATION AND SERVICE RATIO FORECAST

<u>Area</u>	1985		2010	
	<u>Popu- lation</u>	<u>Service Ratio</u>	<u>Popu- lation</u>	<u>Service Ratio</u>
Chiangmai	155,000	52 %	199,000	75 %
Mae Rim	11,100	42 %	13,600	70 %
San Kamphaeng	17,000	34 %	26,100	65 %
San Sai	22,200	-	24,700	50 %
Saraphi	8,800	-	13,000	50 %
Hang Dong	5,200	-	6,700	50 %
Total	219,300		283,100	

The Development Plan also proposes an immediate improvement program to rehabilitate the existing system, together with immediate modification works to increase the production-supply capacity of the existing facilities. These immediate actions are required to be carried out prior to the Stage I expansion program, or as part of its initial phase.

This is because the existing production facilities of Chiangmai, Mae Rim and San Kamphaeng whose nominal capacity exceeds demand are failing to supply safe water unceasingly, hindered by deteriorations in treatment facilities and damages in pipelines.

B. Strategies to the Targets

Of the five Sanitary Districts, Stage I implementation will be extended only to Mae Rim and San Kamphaeng which are already PWA member waterworks. Both of them are proposed to be merged with Chiangmai Waterworks, the reason being that Mae Rim service area actually crosses over a part of Chiangmai jurisdiction, and San Kamphaeng has a high prospect to be connected with Chiangmai in future because of an industrial zone planned to be developed in their midway. In addition, merger will reduce their operation expenses in total.

Because of their unreadiness, the development of water supply in San Sai, Saraphi and Hang Dong sanitary districts is planned to be postponed to Stage II of the Development Plan.

Composite water consumption is projected to be increased up to two times as large as the present level in coming 13 years, from 26,200 cu m/day in 1985 to 53,000 cu m/day in 2000, and further to 74,900 cu m/day in 2010. Domestic demand will increase reflecting both population growth and per capita consumption increase (from 143 lpcd in 1985 to 185 lpcd in 2000), and tourism demand is projected to expand at a higher rate than the domestic one.

The estimated costs are summarized in Table-ES.2 for implementing the strategic plans as shown in Fig-ES.1.

Table-ES.2 TOTAL COST FOR DEVELOPMENT PLAN

Unit:1,000 Baht

Item	Stage I		Stage II	Total	
	Rehabili. and Modifi.	Expansion	(2000-2010) Expansion	Stages I and II	
Land and Facilities	22,400	202,400	224,800	260,000	484,800
Engineering Service	2,500	22,200	24,700	28,200	52,900
Administration Cost	200	2,300	2,500	2,900	5,400
Physical Contingencies	1,800	15,800	17,600	20,400	38,000
Price Contingencies	3,100	36,800	39,900	220,600	260,500
Total	30,000	279,500	309,500	532,100	841,600

C. Proposed Water Supply, 1987-2000

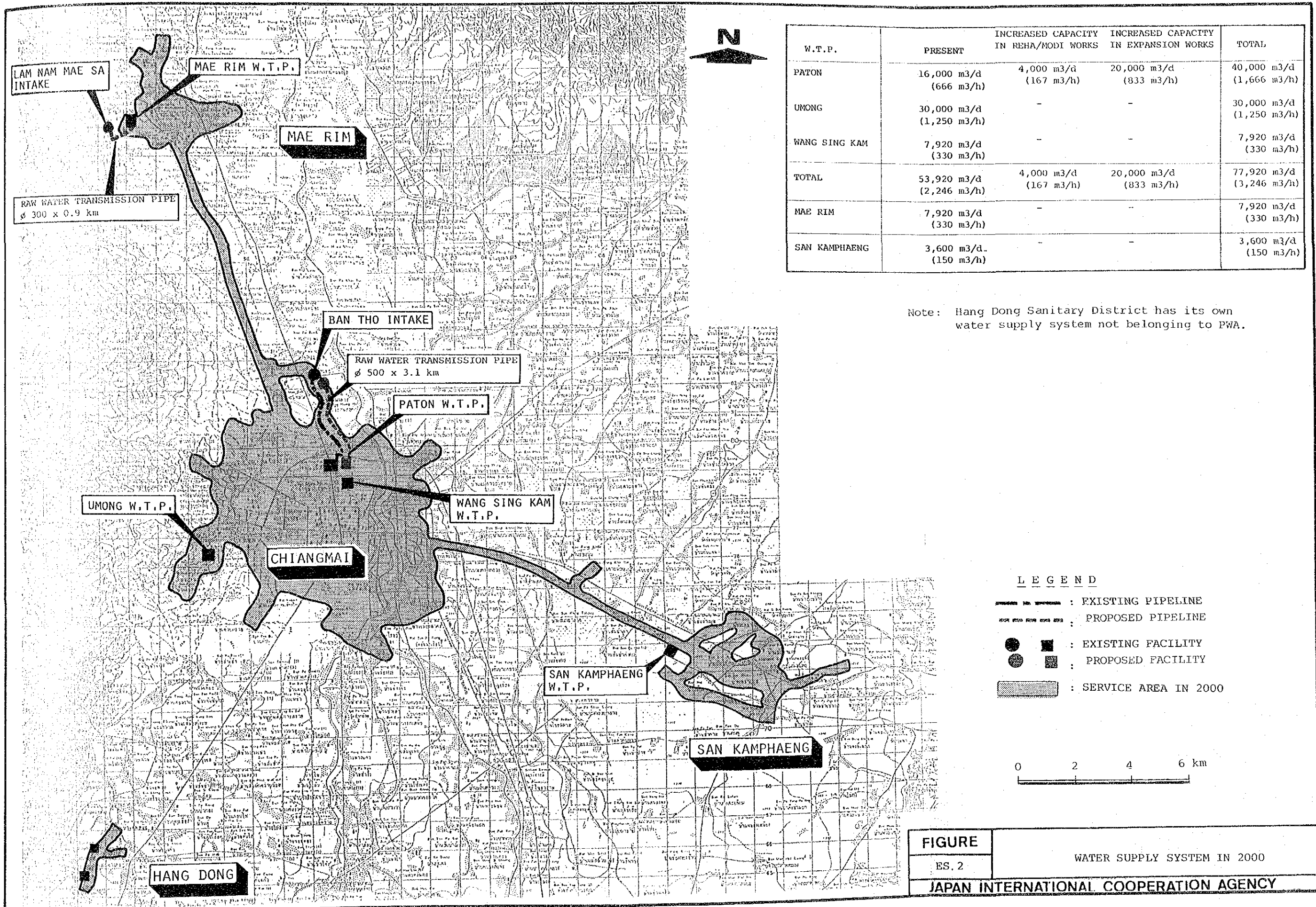
The components of the proposed water supply system for Stage I together with the service area to be covered are illustrated in Fig-ES.2. Rehabilitation and modification works will provide needed improvement of the existing facilities, particularly to increase the supply capacity to meet water demand which is expected to intensify around 1990.

The Stage I Expansion for Chiangmai, Mae Rim and San Kamphaeng is designed as shown on Table-ES.3, with implementation proposed to proceed as Fig-ES.3.

Table-ES.3 SUMMARY OF STAGE I EXPANSION

<u>Item</u>	<u>Chiangmai</u>	<u>Mae Rim</u>	<u>San Kamphaeng</u>	<u>Total</u>
Service Area (ha)	50,400	9,200	13,400	73,000
Served Population	126,700	8,200	12,800	147,658
Water Source	Ping River & Irrigation Canal	Lam Nam Me Sa	Groundwater	
Max. Day Demand (m ³ /d)	76,500	6,700	3,800	87,000
Distribution Pipeline (km)	105	21	9	135
Service Connection	4,900	310	1,000	6,210

The proposed project and its costs are summarized in Table-ES.4. The estimated capital investment cost of the project, totaling 309,500 thousand Baht at current prices allowing for price increases of 3.3 percent per annum is realistic, based on preliminary designs plus an allowance of 7 % for physical contingencies.



W.T.P.	PRESENT	INCREASED CAPACITY IN REHA/MODI WORKS	INCREASED CAPACITY IN EXPANSION WORKS	TOTAL
PATON	16,000 m ³ /d (666 m ³ /h)	4,000 m ³ /d (167 m ³ /h)	20,000 m ³ /d (833 m ³ /h)	40,000 m ³ /d (1,666 m ³ /h)
UMONG	30,000 m ³ /d (1,250 m ³ /h)	-	-	30,000 m ³ /d (1,250 m ³ /h)
WANG SING KAM	7,920 m ³ /d (330 m ³ /h)	-	-	7,920 m ³ /d (330 m ³ /h)
TOTAL	53,920 m³/d (2,246 m³/h)	4,000 m³/d (167 m³/h)	20,000 m³/d (833 m³/h)	77,920 m³/d (3,246 m³/h)
MAE RIM	7,920 m ³ /d (330 m ³ /h)	-	-	7,920 m ³ /d (330 m ³ /h)
SAN KAMPHAENG	3,600 m ³ /d (150 m ³ /h)	-	-	3,600 m ³ /d (150 m ³ /h)

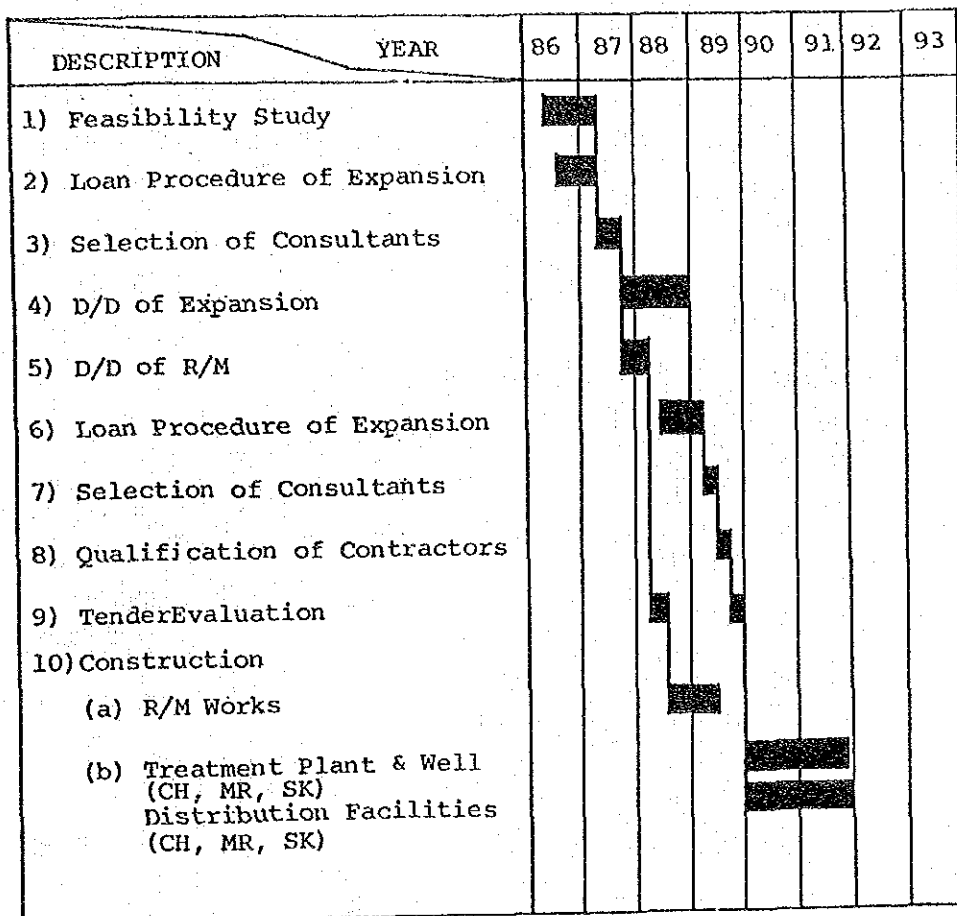
Note: Hang Dong Sanitary District has its own water supply system not belonging to PWA.

LEGEND

- : EXISTING PIPELINE
- : PROPOSED PIPELINE
- : EXISTING FACILITY
- : PROPOSED FACILITY
- : SERVICE AREA IN 2000



FIGURE
ES. 2 WATER SUPPLY SYSTEM IN 2000
JAPAN INTERNATIONAL COOPERATION AGENCY



NOTE : D/D Detailed Design
 R/M Rehabilitation and Modification
 CH Chiangmai
 MR Mae Rim
 SK San Kamphaeng

FIGURE	IMPLEMENTATION SCHEDULE
ES.3	
JAPAN INTERNATIONAL COOPERATION AGENCY	

Table-ES.4 ESTIMATED PROJECT COSTS FOR STAGE I IMPLEMENTATION

	(x 1,000 Baht)
A. Rehabilitation and Modification	22,400
Chiangmai	22,000
Mae Rim	200
San Kamphaeng	200
B. Expansion	202,400
Land Acquisition	1,800
Chiangmai	176,100
Mae Rim	18,200
San Kamphaeng	6,300
C. Engineering Services	24,700
D. Administration Cost	2,500
E. Physical Contingencies	17,600
F. Price Contingencies	39,900
Total	309,500

The tentative financing plan, summarized in Table-ES.5, assumes loans from a foreign financial institution such as OECF totaling 247,600 thousand Baht, or 80 % of capital expenditure, and local loans totaling 61,900 thousand Baht, or 20 % of capital expenditure. The total fund requirement through the project period is projected to amount to 705,000 thousand Baht on a cash-flow basis (inclusive of debt service) of which 56.1 % will be covered by internal cash generation and the rest(43.9 %) will be financed with foreign and local loans, and with no internal financial help of PWA.

Table-ES.5 TENTATIVE FINANCING PLAN FOR STAGE I IMPLEMENTATION
 [CHIANGMAI WATERWORKS] x 1,000 Baht

Item	Before Depreciation	% of Total
1. Sources of Funds		
Internal Cash Generation	395,500	56.1%
Outside Sources:		
- Foreign Financial Institution such as OECF	247,600	35.1%
- Local Financial Institution	61,900	8.8%
Total	705,000	100.0%
2. Application of Funds		
Capital Expenditure	309,500	43.9%
Debt Service	395,500	56.1%
Total	705,000	100.0%

The above financial conditions, together with the Financial Internal Rate of Return and the Economic Internal Rate of Return as high as 10.8 % and 16.6 % respectively demonstrate the financial and economic justification of the project.

Several key actions are necessary if the project is to succeed.

1. Financing for project implementation must be confirmed. This confirmation includes the checking of a possibility of obtaining Government subsidies for project capital investment, which are now being suspended temporarily for Government budgetary reasons. Such subsidies will ease the financial conditions of waterworks in making capital investment.

2. Changes in structure of PWA's water tariff, as recommended in the Main Report, are needed together with periodic increases in tariffs (to cover the effects of price escalation).
3. Arrangements should be made with RID to secure in the dry seasons the necessary volumes of raw water from the Ping River and the irrigation canal, both of which are under the control of RID.
4. Suitable land site should be secured at the earliest time possible for the Ban Tho intake facilities which are proposed to be constructed in the Stage I.
5. A leakage team should be formed in the waterworks to pursue a program of reducing water leakage in accordance with the Framework prepared by JICA Team.
6. PWA should campaign the enlightenment of the residents in San Sai, Saraphi and Hang Dong on the necessity of potable piped water and the benefits of PWA service, as to pave a way for the planned Stage II implementation in these districts.

The project is technically feasible and provides the least cost solution for providing water supply as needed in the project area through the year 2000. The project is also significant to improve the existing facilities which are deteriorating. Implementation of the project will significantly improve the water supply and other environmental situation and health of the people in Chiangmai.

**UBON RATCHATHANI
AND
WARIN CHAMRAP**

UBON RATCHATHANI
AND
WARIN CHAMRAP

A. Introduction

This report summarizes the results of a comprehensive master plan and feasibility study conducted by a study team of the Japan International Cooperation Agency (JICA), which are presented in this volume of the Report entitled "DEVELOPMENT PLAN AND FEASIBILITY STUDY ON PROVINCIAL WATER SUPPLY PROJECTS IN THE KINGDOM OF THAILAND, UBON RATCHATHANI AND WARIN CHAMRAP".

Ubon Ratchathani and Warin Chamrap located approximately 500 km northeast of Bangkok, are neighboring municipalities which almost constitute one township served by a single water-supply system operated by Ubon-Warin Waterworks. The project area covers, other than these two municipalities, their adjacent districts including Ubon Sanitary District and five villages where no water supply services are provided and 74 % of the residents there are willing to be connected to PWA system.

The combined population of the study area is projected to increase from 152,000 in 1985 to 196,400 by 2010, the target year of the current project.

The current project purports to mitigate such immediate requirements, as well as to improve the service ratio in the long-run from 40 % at present to 75 % in 2010.

In view of the uncertainties in the future development of the study area as well as of the internal administrative reasons of PWA, project implementation is planned to be divided into two stages, i.e., Stage I up to the year 2000 and Stage II through 2010.

The existing facilities are suffering from deterioration which is reducing operation efficiency and increasing the unaccounted-for ratio. To cope with this situation, the Development Plan proposes an immediate improvement program to rehabilitate the existing system, together with immediate modification works to promptly increase the production-supply capacity of the

existing facilities. These immediate actions are required to be carried out prior to the Stage I expansion program, or as a part of its initial phase.

B. Strategies to the Targets

Water consumption will be increased to two and half times as large as the present level in the coming 13 years, from 12,400 cu m/day in 1985 to 31,100 cu m/day in 2000, and further to 48,700 cu m/day in 2010. Domestic demand will increase reflecting both population growth and per-capita consumption increase (from 142 lpcd in 1985 to 177 lpcd in 2000), and public demand is projected to expand at a slightly higher rate than the domestic one.

Strategic plans are illustrated in Fig-ES.1 and the estimated costs - therefor are summarized in Table-ES.1.

Table-ES.1 TOTAL COST FOR MASTER PLAN

Unit:1,000 Baht

Item	Stage I			Stage II	Total
	Rehabili. and Modifi.	Expansion	Sub- Total	(2000-2010) Expansion	Stages I and II
Land and Facilities	13,400	145,900	159,300	139,100	298,400
Engineering Services	1,500	15,800	17,300	14,700	32,000
Administration Cost	100	1,600	1,700	1,500	3,200
Physical Contingencies	1,100	11,400	12,500	10,900	23,400
Price Contingencies	2,000	26,400	28,400	87,300	115,700
Total	18,100	201,100	219,200	253,500	472,700

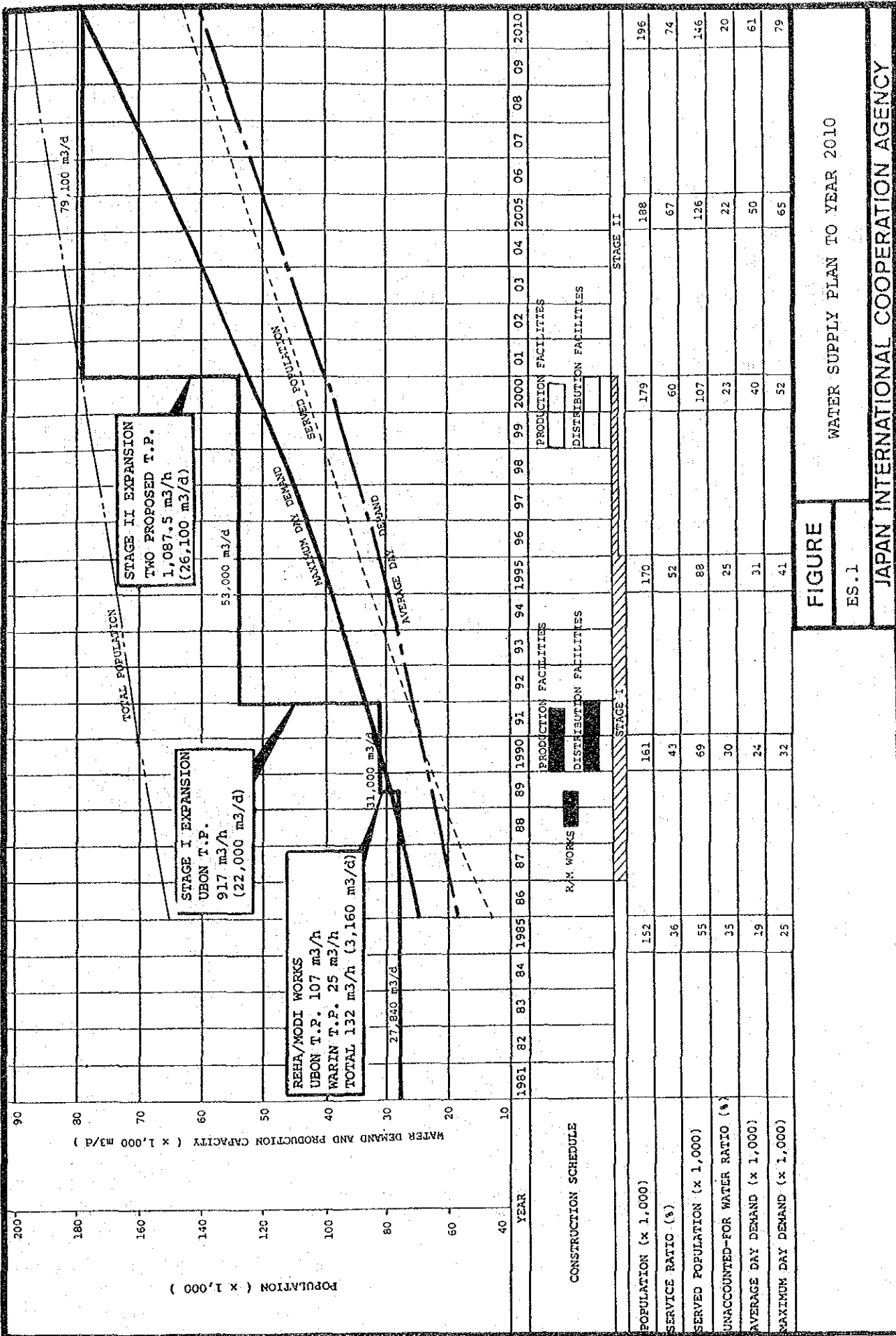
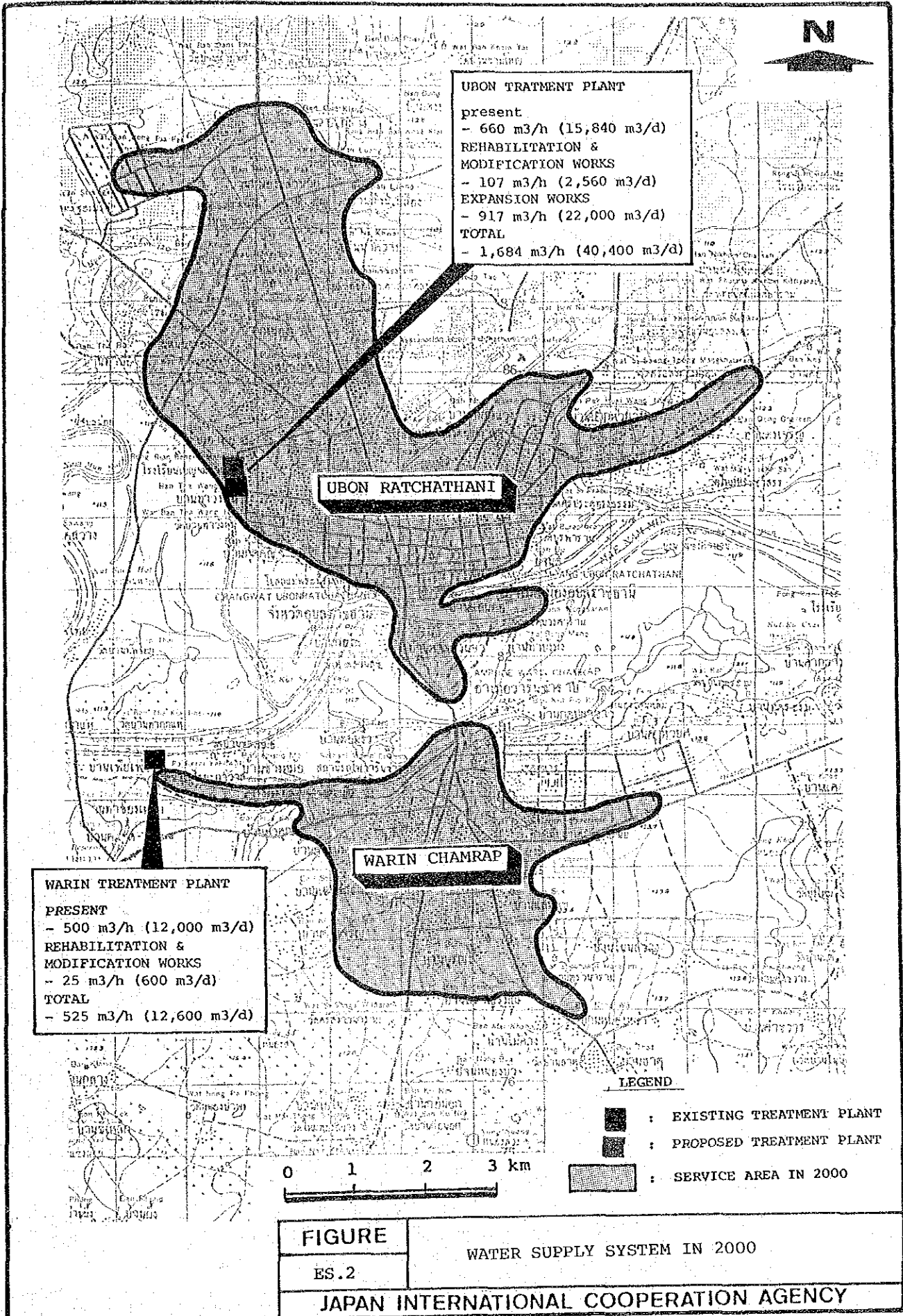


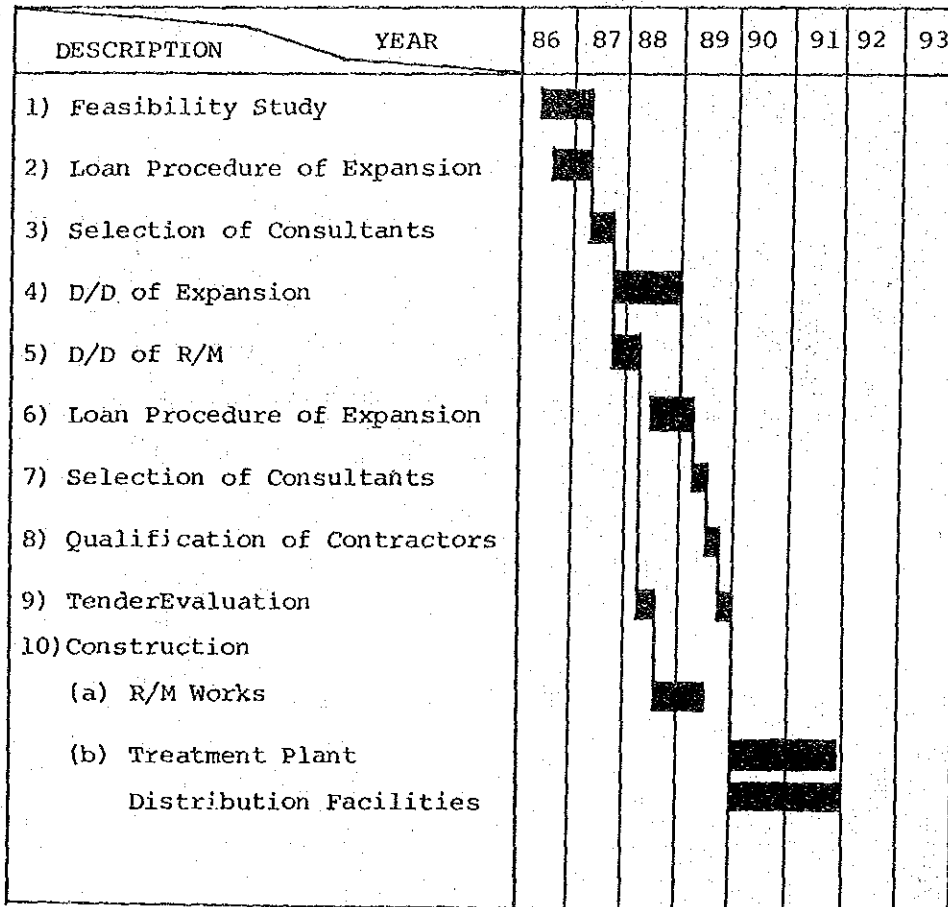
FIGURE
ES.1
WATER SUPPLY PLAN TO YEAR 2010
JAPAN INTERNATIONAL COOPERATION AGENCY

C. Proposed Water Supply, 1987-2000

The proposed water supply system for Stage I will cover the service area shown in Fig-ES.2. The rehabilitation and modification will provide needed improvement of existing facilities. The Stage I Expansion is designed to meet projected maximum day demand of 52,400 cu m/d, to serve 107,400 people by 2000, and to expand the service area to 3,900 ha. Additional 53 km distribution pipelines will be installed, with approximately 7,300 service connections. Implementation is proposed to proceed as Fig-ES.3.

The proposed project and its costs are summarized in Table-ES.2. The estimated capital investment cost of the project, totaling 219,200 thousand Baht at current prices allowing for price increases of 3.3 percent per annum is realistic, based on preliminary designs plus an allowance of 7 % for physical contingencies.





NOTE : D/D Detailed Design
 R/M Rehabilitation and Modification

FIGURE	IMPLEMENTATION SCHEDULE
ES.3	
JAPAN INTERNATIONAL COOPERATION AGENCY	

Table-ES.2 ESTIMATED PROJECT COSTS FOR STAGE I IMPLEMENTATION
(x 1,000 Baht)

A. Rehabilitation and Modification	13,400
Land Acquisition	-
Ubon Treatment Plant	5,800
Warin Treatment Plant	3,400
Distribution Facilities	4,200
B. Expansion	145,900
Land Acquisition	2,900
Ubon No.4 Treatment Plant	89,100
Warin Treatment Plant	5,600
Distribution Facilities	48,300
C. Engineering Services	17,300
D. Administration Cost	1,700
E. Physical Contingencies	12,500
F. Price Contingencies	28,400
Total	219,200

The tentative financing plan, summarized in Table-ES.3, assumes loans from a foreign financial institution such as OECF totaling 175,400 thousand Baht, or 80 % of capital expenditure, and local loans totaling 43,800 thousand Baht, or 20 % of capital expenditure. The total fund requirement through the project period is projected to amount to 399,100 thousand Baht, on a cash-flow basis, of which 45.1 % will be covered by internal cash generation and the rest (54.9 %) will be financed with foreign and local loans, and with no internal financial help of PWA.

Table-ES.3 TENTATIVE FINANCING PLAN FOR STAGE I IMPLEMENTATION
 [UBON-WARIN WATERWORKS] x 1,000 Baht

Item	Before Depreciation	% of Total
1. Sources of Funds		
Internal Cash Generation	179,900	45.1%
Outside Sources:		
- Foreign Financial Institution such as OECF	175,400	43.9%
- Local Financial Institution	43,800	11.0%
Total	399,100	100.0%
2. Application of Funds		
Capital Expenditure	219,200	54.9%
Debt Service	179,900	45.1%
Total	399,100	100.0%

This financial situation, together with the Financial Internal Rate of Return of 8.8 % and the Economic Internal Rate of Return of 14.4 %, demonstrates financial and economic justification of the project, in view of the terms of finance applicable to the project and the prevailing cost of capital in Thailand.

Several key actions are necessary if the project is to succeed.

1. Financing for project implementation must be confirmed. This confirmation includes the checking of a possibility of obtaining Government subsidies for project capital investment, which is now being suspended temporarily for Government budgetary reasons. Such subsidy will reduce the capital cost of the project.

2. Changes in structure of PWA's water tariff, as recommended in the Main Report, are needed, together with periodic increases in tariffs (to cover the effects of price escalation).
3. PWA should secure the land proposed as a site for the treatment plant which is located next to the Ubon Treatment Plant and make necessary arrangements for the use of land, including evacuation of resident houses and relocation of the raw water pipe there now being used by the Air Force.
4. A leakage team should be formed in the waterworks to pursue a program of reducing water leakage in accordance with the Framework prepared by JICA Team.

The project is technically feasible and provides the least cost solution for providing water supply as needed in the project area through the year 2000. The project is also significant to improve the existing facilities which are deteriorating. Implementation of the project will significantly improve the water supply and other environmental situation and health of the people in Ubon and Warin.

SUPHANBURI

SUPHANBURI

A. Introduction

This report summarizes the results of a comprehensive master plan and feasibility study conducted by a study team of the Japan International Cooperation Agency (JICA), which are presented in this volume of the Report entitled "DEVELOPMENT PLAN AND FEASIBILITY STUDY ON PROVINCIAL WATER SUPPLY PROJECTS IN THE KINGDOM OF THAILAND, SUPHANBURI".

The study area covers Suphanburi Municipality and its neighboring Sanitary District, Phophraya, both located approximately 100 km northwest of Bangkok. Suphanburi is an administrative, educational and commercial center serving agricultural districts surrounding the municipality.

The combined population of Suphanburi and Phophraya is projected to increase from 28,600 in 1985 to 37,600 by 2010, the target year of the current project.

The service ratio of the area is comparatively high to register 79 % in 1985, but this is due chiefly to the hydrogeological features of the area, where potable water is unavailable from shallow wells. Despite the high rate of service ratio, the necessity to expand water supply in this area is urgent, as the unserved residents are forced to depend upon unsanitary rain and river water or to purchase unreasonable expensive water from vendors.

The current project purports to mitigate such immediate requirements, as well as to improve the service ratio in the long-run from 79 % at present to 94 % in 2010.

In view of the uncertainties in the future development of Suphanburi and Phophraya as well as of the internal administrative reasons of PWA, project implementation is planned to be divided into two stages, i.e., Stage I up to the year 2000 and Stage II through 2010.

It is also to be noted that the unaccounted-for water ratio is increasing rapidly these years, with the water supply facilities deteriorating. Because of the increasing unaccounted-for ratio, recent expansion in production has not resulted in purported increase in supply.

In view of the above, the Development Plan proposes an immediate improvement program to rehabilitate the existing system, together with immediate modification works to increase the production-supply capacity of the existing facilities. These immediate actions are required to be carried out prior to the Stage I expansion program, or as part of its initial phase.

B. Strategies to the Targets

As a step to achieve the service ratio of 94 % in 2010, a ratio of 92 % will be targeted for the year 2000, probably one of the highest ratio among PWA Waterworks. For this purpose the share of public, commercial, industrial and other large-scale consumers are required to be increased.

The field survey and the questionnaire survey conducted in January 1986 revealed that the unstableness of water supply due to the deterioration of the production-supply facilities was pointed out as one of the main reasons why large-scale consumers evaded the use of PWA water. This unstableness of supply together with high priced water tariffs were iterated by large-scale consumers as the points to be rectified in PWA water-supply service.

It is projected that the share of large-scale consumers will gradually increase with improvement in services, as shown in Table-ES.1, i.e., from 36 % of the total consumers in 1985 to 41 % in 2000 and to 43 % in 2010. Such improvement in the share of large-scale consumers will doubtless contribute to the betterment of the waterworks' rate of return, as the average water-tariff level will be improved.

Table-ES.1 PROJECTED WATER DEMAND FOR SUPHANBURI WATERWORKS

<u>Item</u>	<u>1985</u>	<u>2000</u>	<u>2010</u>
1. Total Population	28,600	34,000	37,600
Suphanburi	24,300	29,100	32,300
Phophraya	4,300	4,900	5,300
2. Population Served	22,600	31,300	35,300
Suphanburi	19,200	26,800	30,300
Phophraya	3,400	4,500	5,000
3. Water Sales : (m ³ /day)	2,880	6,200	8,630
a) Domestic	1,840	3,660	4,940
Suphanburi	1,570	3,130	4,240
Phophraya	270	530	700
b) Public and Other Large-Scales	1,040	2,540	3,690
Suphanburi	1,000	2,330	3,340
Phophraya	40	210	350
4. Water Production (m ³ /day)	4,970	8,050	10,800
5. Unaccounted-for as % of Production	42	23	20

The use of groundwater as raw water source should be encouraged from the viewpoint of cost-consciousness. This not only reduces chemical and electricity cost but also cut down personnel expenses drastically. The number of personnel is projected to increase from 32 in 1986 only to 48 in 2000, while water sales will increase from 1,095 thousand cu m to 2,263 thousand cu m during the project period.

The domestic per-capita consumption is also projected to increase almost linearly from 82 lpcd in 1985 to 117 lpcd in 2000, and further to 140 lpcd in 2010.

Strategic plans are illustrated in Fig-ES.1 and the estimated costs therefor are summarized in Table-ES.2.

Table-ES.2 TOTAL COST FOR MASTER PLAN

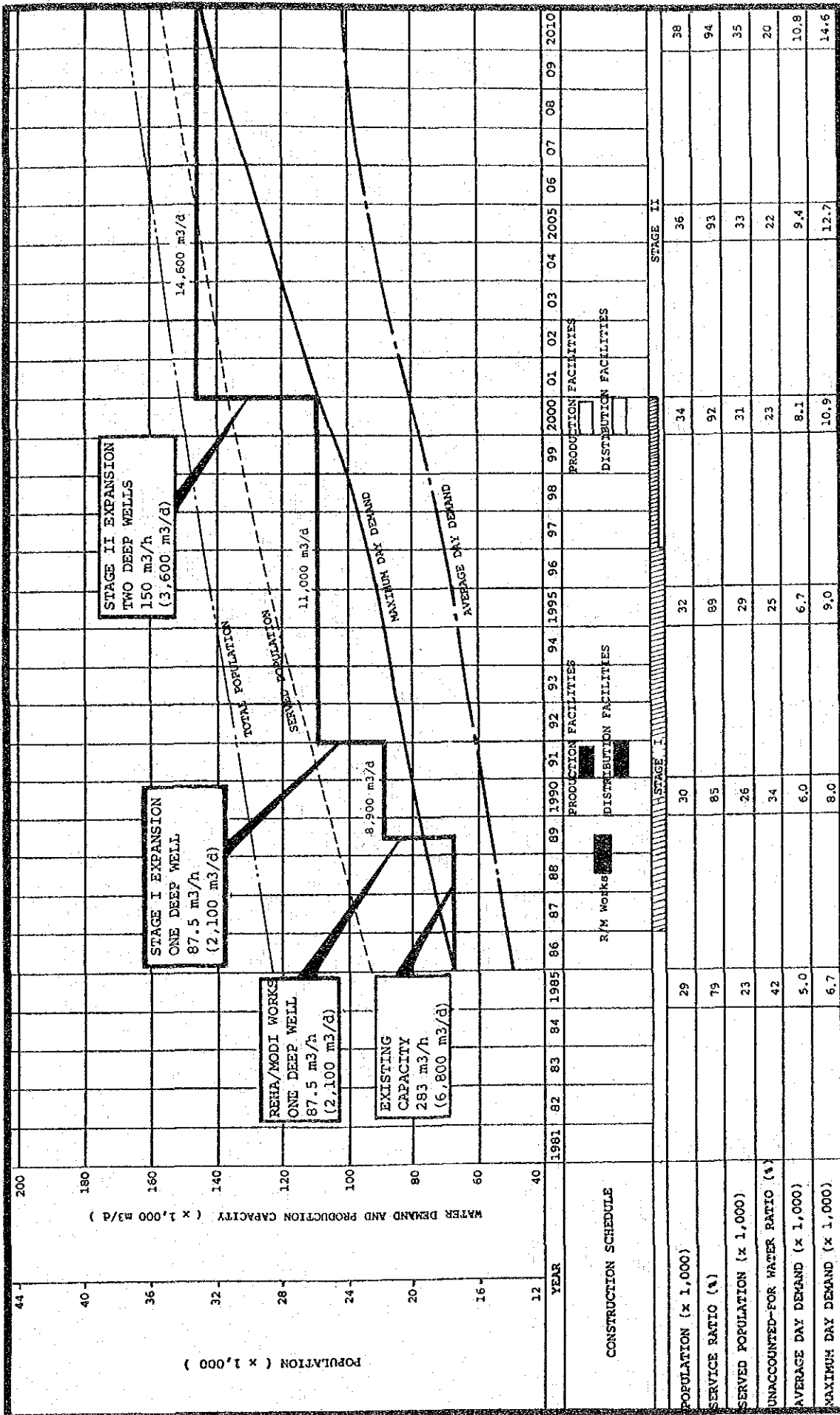
Unit:1,000 Baht

Item	Stage I		Stage II	Total
	Rehabili. and Modifi.	Expansion	(2000-2010) Expansion	Stages I and II
Land and Facilities	25,100	21,400	29,500	76,000
Engineering Service	2,600	2,300	3,000	7,900
Administration Cost	300	200	300	800
Physical Contingencies	1,900	1,700	2,300	5,900
Price Contingencies	2,600	4,300	18,400	25,300
Total	32,500	29,900	53,500	115,900

C. Proposed Water Supply, 1987-2000

The proposed water supply system for Stage I will cover the service area shown in Fig-ES.2. The rehabilitation and modification will provide needed improvement of existing facilities and to construct a 2,100 cu m/d deep well to meet the urgent water demand which is expected to intensity around 1988. The Stage I Expansion is designed to meet projected maximum day demand of 10,900 cu m/d, to serve 31,300 people by 2000, and to expand the service area to 2,300 ha. Additional 33 km distribution pipelines will be installed, with approximately 1,000 service connections. Implementation is proposed to proceed as Fig-ES.3.

The proposed project and its costs are summarized in Table-ES.3. The estimated cost of the project, totaling 62,400 thousand Baht at current prices allowing for price increases of 3.3 percent per annum is realistic, based on preliminary designs plus an allowance of 7 % for physical contingencies.



FIGURE

WATER SUPPLY PLAN TO YEAR 2010

ES.1

JAPAN INTERNATIONAL COOPERATION AGENCY

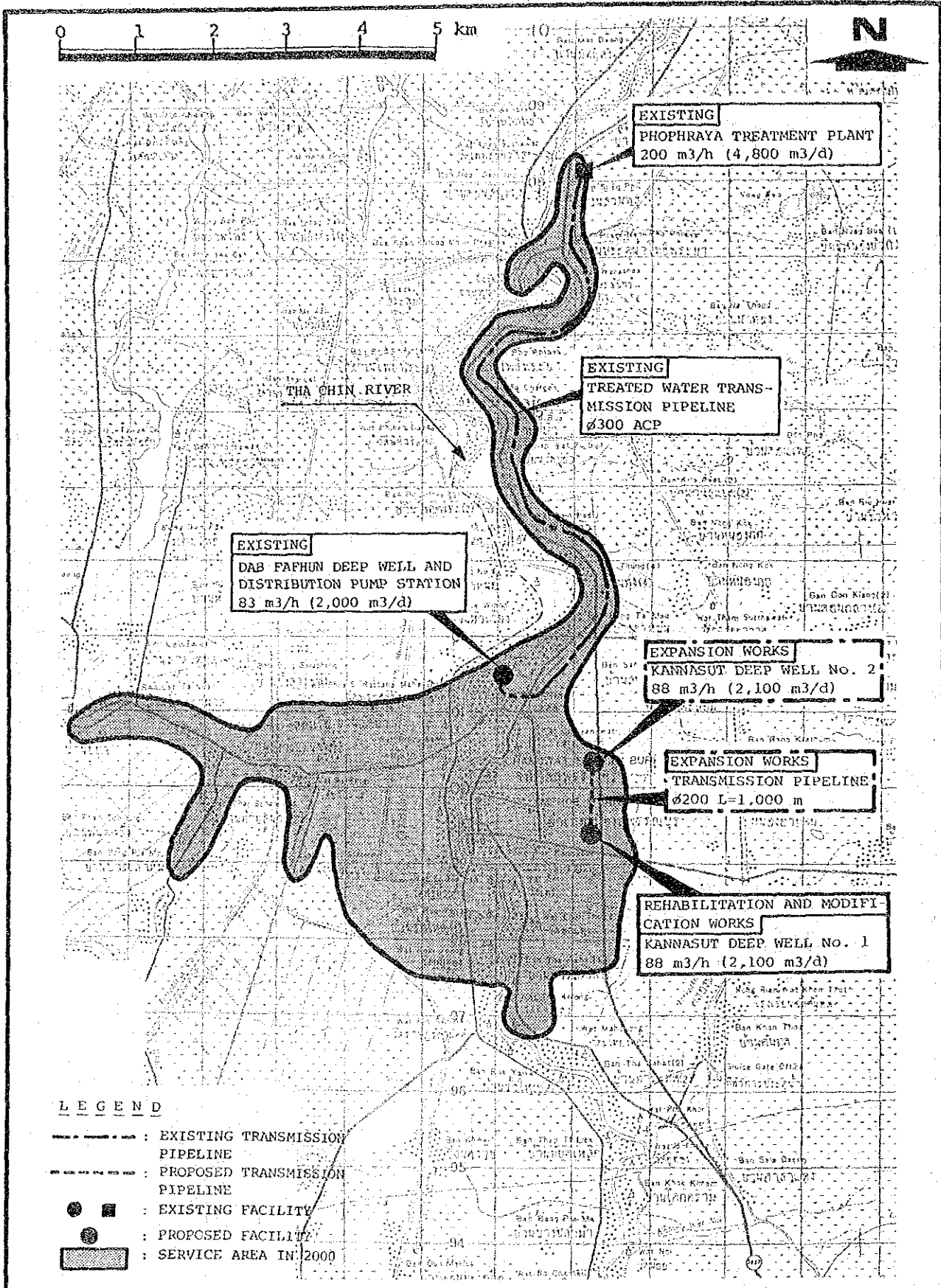


FIGURE	WATER SUPPLY SYSTEM IN 2000
ES.2	
JAPAN INTERNATIONAL COOPERATION AGENCY	

DESCRIPTION	YEAR							
	86	87	88	89	90	91	92	93
1) Feasibility Study	■	■						
2) Loan Procedure of Expansion	■							
3) Selection of Consultants		■						
4) D/D of Expansion		■	■					
5) D/D of R/M		■						
6) Loan Procedure of Expansion			■					
7) Selection of Consultants				■				
8) Qualification of Contractors				■	■			
9) Tender Evaluation			■			■		
10) Construction				■	■			
(a) R/M Works			■	■				
(b) Expansion Works						■	■	
Deep Well & Pump Station						■	■	
Distribution Facilities						■	■	

NOTE : D/D : Detailed Design
 R/M : Rehabilitation and Modification

FIGURE	IMPLEMENTATION SCHEDULE
ES.3	
JAPAN INTERNATIONAL COOPERATION AGENCY	

Table-ES.3 ESTIMATED PROJECT COSTS FOR STAGE I IMPLEMENTATION

	(x 1,000 Baht)
A. Rehabilitation and Modification	25,100
Land Acquisition	2,000
Phophraya Treatment Plant	2,350
Clear Water Transmission Pipeline	650
Dab Fafhun Deep Well and Distribution Pump Station	2,100
Kannasut Deep Well (No.1) and Pump Station	10,000
Distribution Pipeline	8,000
B. Expansion	21,400
Land Acquisition	200
Kannasut Deep Well (No.2)	2,200
Clear Water Transmission Pipeline	1,000
Distribution Facilities:	
- Distribution Pump	200
- Pipelines	17,800
C. Engineering Services	4,900
D. Administration Cost	500
E. Physical Contingencies	3,600
F. Price Contingencies	6,900
Total	62,400

The tentative financing plan, summarized in Table-ES.4, assumes loans from a foreign financial institutions totaling 49,900 thousand Baht, or 80 % of capital expenditure, and local loans totaling 12,500 thousand Baht, or 20 % of capital expenditure. The total fund requirement through the project

period is projected to amount to 116,700 thousand Baht on a cash-flow basis, of which 46.5 % will be covered by internal cash generation and the rest (53.5 %) will be financed with foreign and local loans, and with no internal financial help of PWA.

Table-ES.4 TENTATIVE FINANCING PLAN FOR STAGE I IMPLEMENTATION
[SUPHANBURI WATERWORKS] x 1,000 Baht

Item	Before Depreciation	% of Total
1. Sources of Funds		
Internal Cash Generation	54,300	46.5%
Outside Sources:		
- Foreign Financial Institution such as OECF	49,900	42.8%
- Local Financial Institution	12,500	10.7%
Total	116,700	100.0%
2. Application of Funds		
Capital Expenditure	62,400	53.5%
Debt Service	54,300	46.5%
Total	116,700	100.0%

The Financial Internal Rate of Return which is calculated as 3.3 % and the Economic Internal Rate of Return of 9.4 % are not considered so favorable. One of the reasons is that capital investment of this project has to be directed largely to the improvement of the deteriorated facilities.

Another consideration to be paid in this respect is the unfairness of the calculation formula of allocating Head and Regional Office Overhead expenses to waterworks, which is placing undue financial burdens on small-scale waterworks.

This report suggests a new trial formula of share calculation which may work more fair both to large and small sized waterworks.

If this trial formula is applied, FIRR and EIRR of the current project for Suphanburi Waterworks will register 4.0 % and 11.1 %, respectively.

Moreover, there are indications that all such data as unit cost and rate of return are showing improvement toward the target year 2000. It is well assumed that Suphanburi Waterworks will demonstrate more favorable indicators in the coming Stage II period.

Several key actions are necessary if the project is to succeed.

1. Financing for project implementation must be confirmed. This confirmation includes the checking of a possibility of obtaining Government subsidies for project capital investment, which is now being suspended temporarily for Government budgetary reasons. Such subsidy will ease the financial conditions of waterworks in making capital investment, particularly for such waterworks as Suphanburi whose earning positions should yet to be strengthened.
2. Changes in structure of PWA's water tariff, as recommended in the Main Report, are needed together with periodic increases in tariffs (to cover the effects of price escalation).
3. The formula of allocating Head and Regional Office overhead expenses to waterworks is recommended to be revised to be more fair particularly to small waterworks still poor in their rates of return.

4. Suitable land sites should be secured at the earliest time possible for the deep wells and distribution pumping station which are proposed to be constructed in Stage I.
5. A leakage survey team should be formed in the waterworks to pursue a program of reducing water leakage in accordance with the Framework prepared by JICA Team.

The project is technically feasible and provides the least cost solution for providing water supply as needed in the project area through the year 2000. The project is also significant to improve the existing facilities which are deteriorating. Implementation of the project will significantly improve the water supply and other environmental situation and health of the people in Suphanburi and Phophraya.

