Following equipments will be purchased for the program:

- Leak detector
- Electric sound detector, and
- Pipe locator

A leakage control program as described in Appendix 11 is proposed for implementation.

12.3 Expansion Works

12.3.1 General

The proposed major facilities for the Stage I Expansion Works are summarized in this section. The planned water supply system for 2000 is shown in the general plan of Fig-12.3 and schematically outlined in Fig-12.4.

The projected year 2000's water demand of 10,900 cu m/d will be satisfied by production of the following treatment plant and deep wells:

Phophraya Treatment Plant	4,800 cu m/d
Dab Fafhun Deep Well	2,000 cu m/d
Kannasut Deep Well No.1	2,100 cu m/d
Proposed (Kannasut) Deep Well No.2	2,100 cu m/d
T o t a l	11,000 cu m/d

12.3.2 Outline of Proposed Water Supply Facilities

The major facilities proposed for the Stage I are tabulated in Table-12.2, and the details are to be referred to Appendix 8.

1) Proposed Deep Well (Kannasut) No.2

The proposed deep well for the Stage I project is developed about 1 km apart from the Kannasut Deep Well No.1 which was constructed as a part of

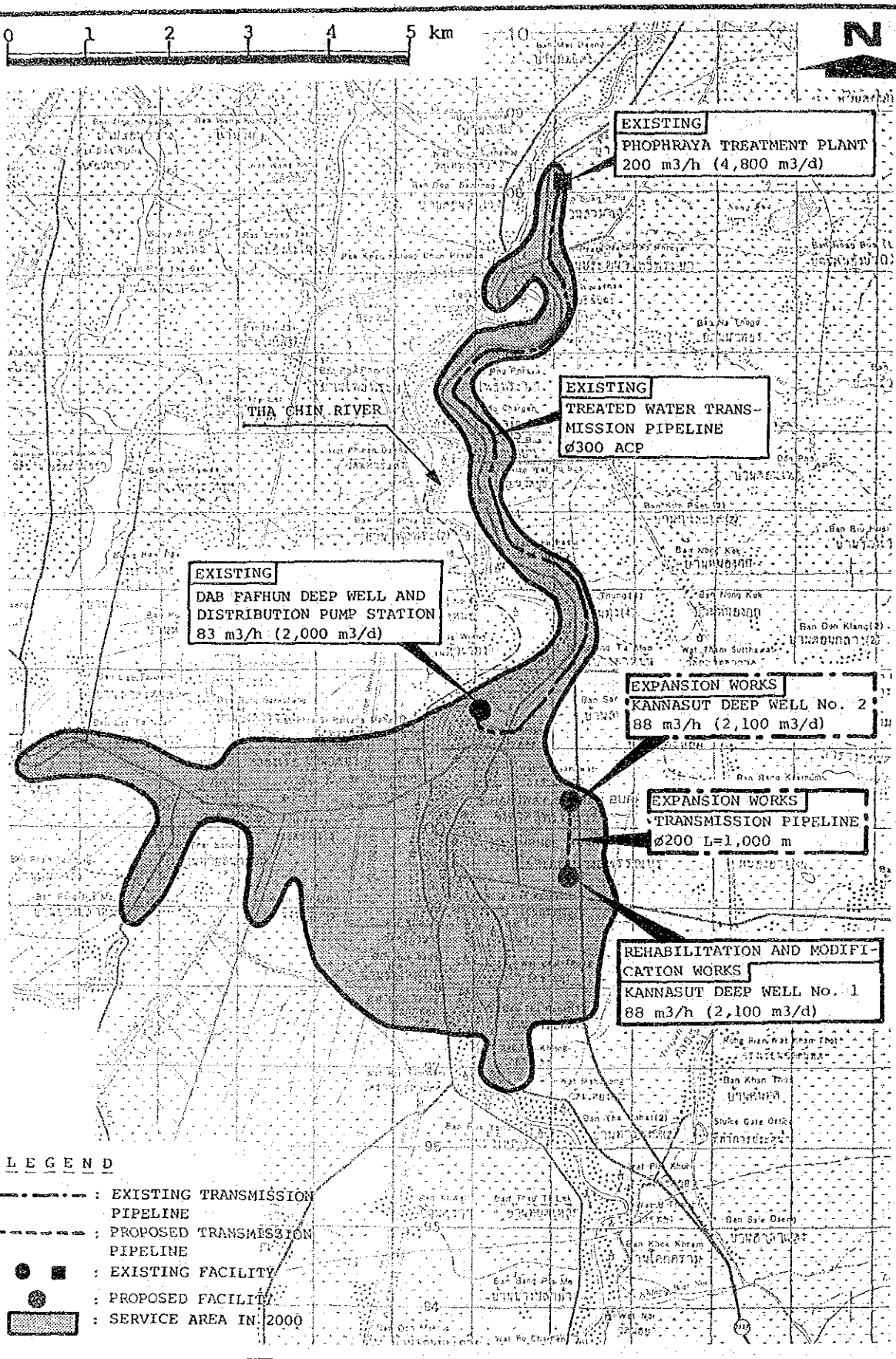
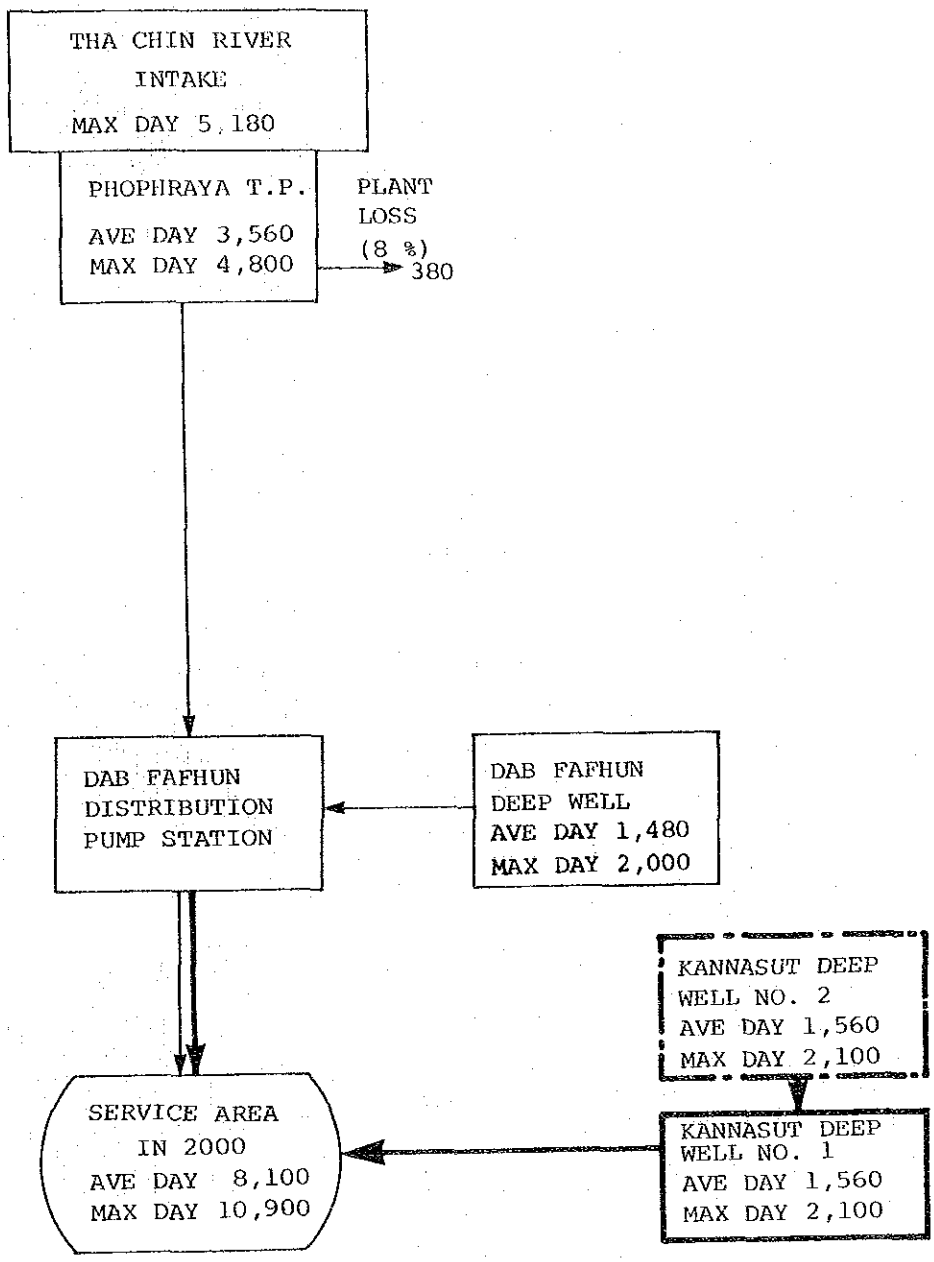


FIGURE 12.3 WATER SUPPLY SYSTEM IN 2000

JAPAN INTERNATIONAL COOPERATION AGENCY



L E G E N D

: EXISTING FACILITIES
: PROPOSED FACILITIES (REHABILITATION AND MODIFICATION WORKS)
: PROPOSED FACILITIES (EXPANSION WORKS)

Unit : cu m/day

FIGURE	OUTLINE OF WATER SUPPLY SYSTEM IN 2000
12.4	

JAPAN INTERNATIONAL COOPERATION AGENCY

the rehabilitation and modification works. The location of the well has been selected, considering the prevention of interference of the two wells and convenience of operation and maintenance.

A clear water transmission pipeline with 200 mm diameter of 1,000 m length will be installed from the proposed deep well to the Kannasut Deep Well No.1 and a flow meter will be equipped.

Layout of the proposed deep well and pipeline which will be connected to Kannasut Deep Well No.1, is shown in the foregoing Fig-12.1.

Table-12.2 EXPANSION WORKS

Item	No.	Unit	Remarks
1. Deep Well			
1) Well construction	1	well	Q 2,100 cu m/d, 150 m depth
2) Well pump equipment	1	unit	Q 1.5 cu m/min x H 35 m
3) Land acquisition	400	sq m	
2. Clear Water Transmission Pipeline			
1) Dia. 200 mm	1,000	m	
3. Distribution Facilities			
1) Distribution pump	1	pump	Q 2.1 cu m/min x H 35 m at Kannasut well No.1
2) Distribution pipelines			
Dia. 200 mm	4,150	m	
Dia. 150 mm	12,100	m	
Dia. 100 mm	16,950	m	

2) Distribution Pipelines

The distribution system in the proposed Stage I Expansion Works includes installation of about 33 km distribution mains in total, as shown in Fig-12.5.

Based on the computer-aided distribution network analysis, distribution pipelines are sized to serve the peak hour flows with sufficient service pressures.

Service connections will be installed by the Waterworks personnel as a part of routine task, when new applications are filed. More than 1,000 connections are planned to be installed by 2000.

12.4 Operation and Management Plan

To secure supply of sufficient amount of safe water to customers, the following procedures should be regarded by the Suphanburi Waterworks Office and the treatment plant/distribution pump station.

- Treatment Plant/Distribution Pump Station

  (1) To gauge and control water flow in the system for required volume of water to meet the demand,

  (2) To control water quality by dosing chemicals correctly after jar test results,

  (3) To maintain the plant and pump station in orderly conditions,

- Waterworks Office

  (4) To control the whole supply system by collecting information from the operation room of treatment plant and pump station regularly and giving instruction immediately, and

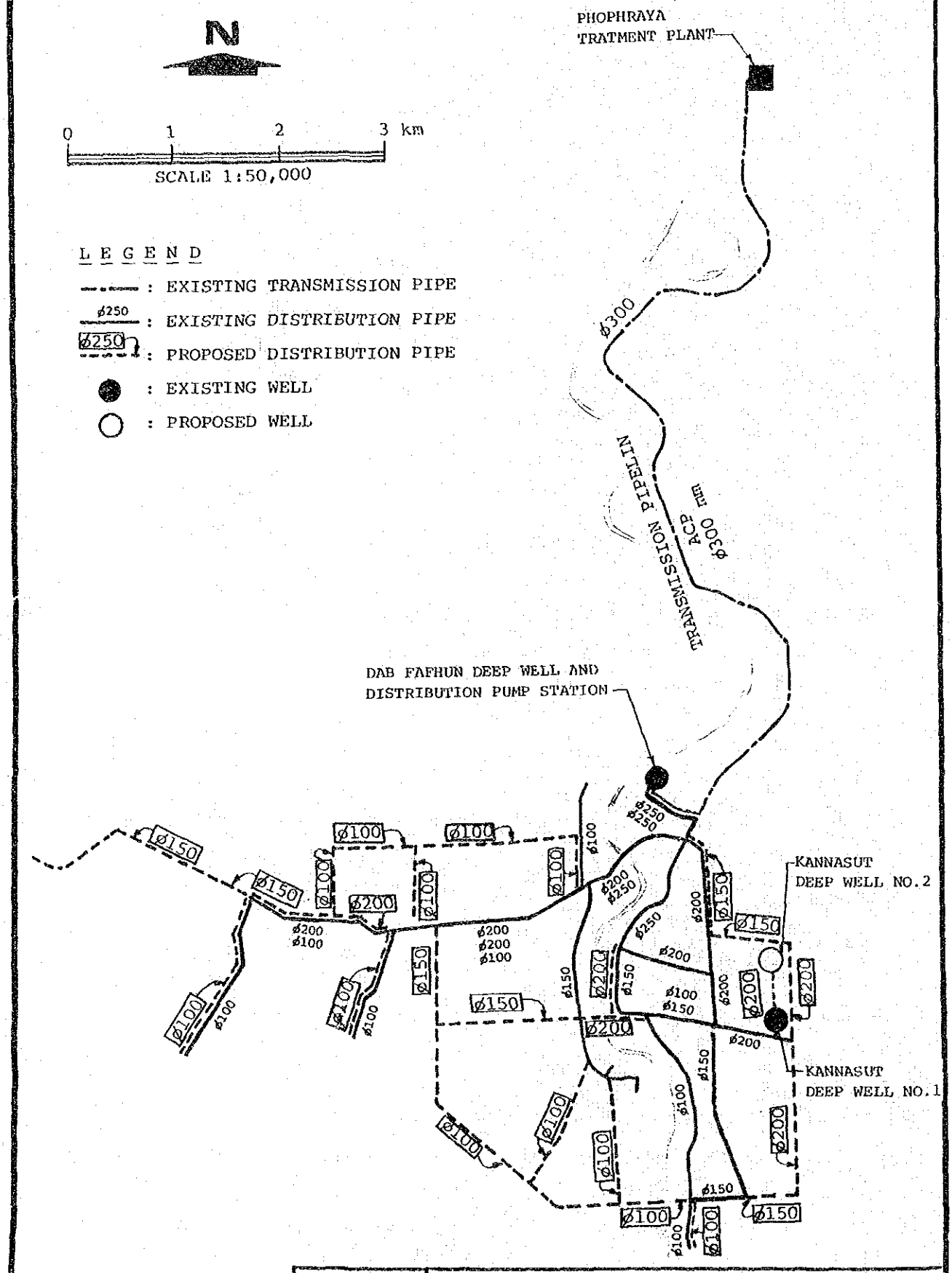


FIGURE	PROPOSED DISTRIBUTION PIPELINES IN 2000
12.5	

JAPAN INTERNATIONAL COOPERATION AGENCY

(5) To organize the leakage survey team in the Waterworks for reducing water leakage,

(6) To economize the operation cost by coordinating the production of treatment plant and deep wells and the distribution therefrom.

In realizing the above mentioned matters and to prepare for the increasing water demand, the number of personnel shall be increased, as shown in Table-12.3. The effect on the operation and maintenance cost is estimated in Chapter 13.

Related to the above (6), the water production cost per cubic meter of the treatment plant is about 30 % higher than that of the deep well. This should be taken into consideration in future operation of the system, especially when priority is to be given either of the two sources.

Table-12.3 STAFF REQUIREMENT FOR SUPHANBURI WATERWORKS

Description	Grade	1986	1990	1995	2000
1) Manager	8	1	1	1	1
2) Water Production Section					
- Chief	7	1	1	1	1
- Mechanic	5	0	0	1	1
- Production Staff	4	8	8	10	10
- Janitor	3	0	0	1	1
- Electrician	3	0	0	1	1
4) Service Section					
- Chief	7	1	1	1	1
- Technician	6	0	0	1	1
- Servicing Staff	5	6	6	8	8
- Skilled Labor	6	0	0	1	1
- Driver	3	0	0	1	1
5) Administration Section					
- Chief	7	1	1	1	1
- Clerk	6	1	1	2	2
- Finance & A/C	6	5	5	7	7
- Storage Keeper	4	1	1	2	2
- Bill Collector	5	3	3	4	4
- Meter Reader	4	2	2	3	3
- Security Staff	4	2	2	2	2
T O T A L		32	32	48	48

CHAPTER 13 PROJECT IMPLEMENTATION AND COST ESTIMATES

CHAPTER 13 PROJECT IMPLEMENTATION AND COST ESTIMATES

In this chapter, availability of labor, material, equipment and machinery necessitated for construction is studied.

Related to it, the procurement procedures of PWA is reviewed and the principal matters of financing the project is discussed.

Following the above, the implementation schedule is proposed and the cost estimation is presented.

13.1 Labor, Material, Equipment and Machinery

13.1.1 Labor

A good number of qualified workers can be mobilized in the project area, enough to meet the civil and architectural needs for the implementation of the project. The mobilization may be facilitated by the climate of the labor market of the project area where supply generally exceeds demand.

The qualification of levels of skill in various trades has not been institutionalized and each laborer differs in skill. General contractors are trying to maintain the level of workmanship, by employing skilled workers on a permanent basis and/or sub-contracting the part of work to contractors which are specialized in particular fields.

13.1.2 Materials

1) Standards of Construction Materials

The following two standards are adopted and practiced by PWA:

General Construction Standard
Pipe and Fitting Standard

The pipe and fitting standards have been based mainly on the standards of the American Water Works Association (AWWA). Regarding matters unspecified

therein and/or un-specified details, PWA makes its own specifications.

On the part of manufacturers, materials based on their own standards, as well as on AWWA, JWWA, B.S. (British Standards) and DIN (German Standards) have been prepared and supplied to PWA.

2) Construction Materials

Materials used in construction by waterworks are roughly divided into a) general construction materials and b) waterworks related construction materials.

a) General Construction Materials

Natural products like natural gravel, sand, clay and timber are available in the area, although crush/sieved stone is gradually taking the place of natural gravel for concrete aggregate.

Such local products as steel bars, cement, bricks, concrete precast products, ready mixed concrete, window sashes, doors and furniture are easily available.

As for scaffolding and staging, steel materials have taken the place of wooden ones since the beginning of 1980s. Staging of bamboo and wooden plates is still popular in the countryside.

Wooden forms are popular in the construction field.

b) Waterworks Related Construction Materials

Machines specifically used in water treatment, like chemicals dosing pumps, chlorinator and others are mostly imported.

Asbestos cement pipes up to 600 mm in diameter are available. Cast iron valves and pipe fittings are made by a few local factories. One of the largest is capable of making

1,500 mm sized valves.

A few makers are manufacturing service meters by importing major components and assembling them in domestically made casings.

Two to three firms are producing alum, and PWA is now being supplied by a national enterprise. Chlorine gas is produced by an unknown number of companies which have sufficient supply capacity.

13.1.3 Equipment and Machinery

Small construction machinery like concrete pushcarts, concrete mixers, drainage pumps for civil works, etc., and motors and engines for them have been manufactured locally. Large construction machinery for general and special uses are imported. Both of the local and foreign made, after-sale service is taken care by the local agents.

Lease service of construction machinery has been undertaken by about ten firms. Almost all kinds of construction machinery can be available on a rental base. Rental conditions are flexible.

Machinery for general uses are owned by large contractors and some of them have their own repair workshops and motor pools.

13.2 Procurement and Financing

13.2.1 Procurement Procedures of PWA

Procurement of goods and construction works is generally made on a contract basis. Except for small scale and urgently necessary goods or works, PWA depends on open tendering rather than direct appointment.

The following criteria have been set on the level of order agencies:

Individual Waterworks	: less than 50,000 Baht
PWA Regional Office	: from 50,000 to 500,000 Baht
PWA Head Office	: more than 500,000 Baht

The below procedures are taken from planning to tendering and awarding contracts:

Planning is made by Planning Division of Corporate Planning Department. On the basis of the plan, Project Preparation Division of Engineering Department prepares detail designs and plans of goods procurement.

Costs of goods procurement and construction works are estimated jointly by Project Preparation Division and Cost Estimation Division and tendering is made based on such estimated costs.

Tendering is managed by two committees of PWA. One committee is responsible for checking the consistency with the specified conditions and opening the proposed tender prices. Tendering Committee is responsible, then, for evaluating the proposed tenders and finalizing them.

Both committees are formed by the PWA directors and higher ranked senior staff. After decision making, the contract is officially finalized between PWA and the contractor/supplier.

Generally adopted is open tendering. In case of big projects, prequalification is applied prior to open tendering. Tendering by the specified bidders and awarding by direct-appointment is seldom practiced except special cases.

Announcement of open tenders is made public in Bidding News, weekly editions of the Thai Construction Association publication, Construction Business News (monthly publication), other Thai papers, and English ones in case of international tendering.

When the method of announcement is conditioned with the loan/grant

agreement, the terms and conditions of the loan will be followed.

The present procedures of procurement of PWA are well routinized and applying them to the project will be reasonable and justifiable.

13.2.2 Project Financing

Implementation of the project assumes that the fund will be made available from foreign financial sources such as the OECF Loans. Therefore, if the fund is provided by other types of leading agencies on the terms and conditions different from said loans, the schedule may be adjusted so as to meet these terms and conditions.

The Stage I Works consist of two components, the Rehabilitation and Modification Works to be undertaken at the early phase of the Stage, and to be followed by the Expansion Works which constitute major component of the Stage I Works.

The Stage I Works are planned to be financed by the following two kinds of loans. The First loan which consists of the following components:

a) Engineering service loan for detailed design for the whole Stage I Works

b) Project loan for the Rehabilitation and Modification Works

c) Engineering service loan for the construction supervision services for the above Rehabilitation and Modification Works

The Second loan which consists of the followings:

a) Project loan for the construction of Stage I Expansion Works

b) Engineering service loan for construction supervision services for the above works

Implementation delineates the time schedule for the above loan procedure, together with detailed design and construction to be followed.

The following is the schedule covering (1) the Rehabilitation and Modification and (2) Stage I Expansion:

Rehabilitation and Modification Works	: July 1988 - June 1989 (1 year)
Expansion Works	: January 1991 - December 1991 (1 year)

13.3 Implementation Schedule

As the construction of the water supply system is one of the important public works, it is imperative that a reliable construction work be ensured within the shortest period practical. In view of these, the construction works under the Stage I should adopt the common construction methods widely practiced in Thailand, so that the steady construction works are easily undertaken and the period can be shortened.

The timing of the implementation of Stage I Works which are composed of Rehabilitation and Modification Works and Expansion Works for Suphanburi and Phophraya are set as follows:

The timing of executing the rehabilitation/modification is flexible, although earlier execution is preferable. The works are planned to be completed in 1989 prior to the commencement of the expansion works.

The expansion works to meet the demand in 2000 are scheduled to be completed at end of 1991.

The design period for the rehabilitation/modification works is estimated at about 4 month, judging from the work volume.

As the facilities included in the expansion works are diversified in nature, the design period of 15 months is planned.

Loan application for the project will be made in two steps presumably.

The first step loan is planned to cover the engineering service, design of both of the rehabilitation/modification and expansion works and supervision of the former, and the implementation of rehabilitation/modification.

The second step loan is for the implementation of the expansion works, inclusive of supervision by consultants.

The construction period planned for the rehabilitation/modification works is estimated on 1 year, including safety margin.

As for the expansion works, the planned 1 year is rather tight, when the involved works are considered. A detailed execution plan will be needed in the later stage.

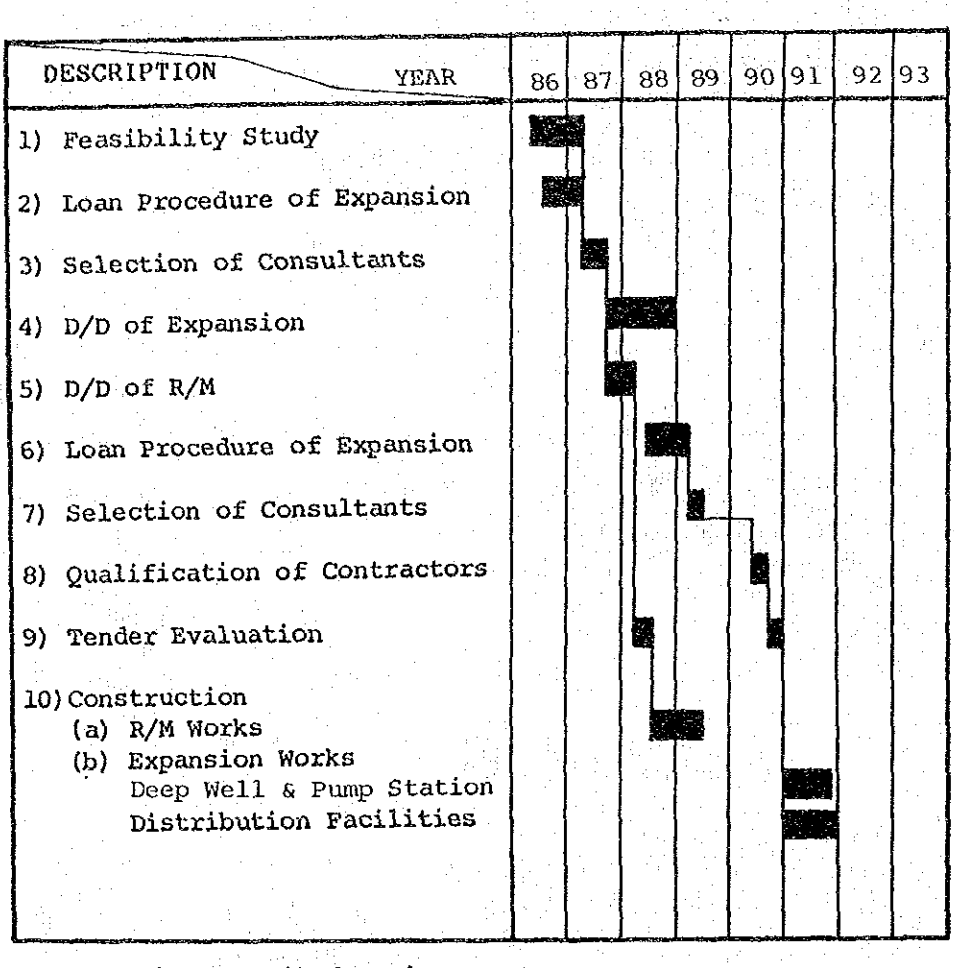
The above mentioned conditions were taken into account in preparing the implementation schedule, shown in Fig-13.1.

13.4 Cost Estimates and Disbursement Schedule

13.4.1 Cost Estimates for Rehabilitation and Modification Works

The methods of cost estimation and cost-allocation of foreign/local currency, described in detail in Appendix 9 were applied herewith.

Table-13.1 shows the summary of the estimated cost of rehabilitation and modification works resulted by the estimation and allocation.



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

FIGURE	IMPLEMENTATION SCHEDULE
13.1	

JAPAN INTERNATIONAL COOPERATION AGENCY

Table-13.1 ESTIMATED COST OF REHABILITATION AND MODIFICATION WORKS

(Unit : 1,000 ฿)

Item	F/C	L/C	Total
1. Land Acquisition	-	2,000	2,000
2. Phophraya Treatment Plant	1,551	799	2,350
3. Clear Water Transmission Pipeline	390	260	650
4. Dab Fafhun Deep Well and Distribution Pump Station	1,575	525	2,100
5. Kannasut Deep Well (No.1) and Pump Station	7,500	2,500	10,000
6. Distribution Pipeline	4,800	3,200	8,000
Total	15,816	9,284	25,100

13.4.2 Cost Estimates for Expansion Works

Table-13.2 shows the summary of the estimated cost of expansion works resulted by the estimation and allocation, and the details are referred to Appendix 9.

Table-13.2 ESTIMATED COST OF EXPANSION WORKS

(Unit : 1,000 ฿)

Item	F/C	L/C	Total
1. Land Acquisition	-	200	200
2. Kannasut Deep Well	1,650	550	2,200
3. Clear Water Transmission Pipeline	600	400	1,000
4. Distribution Facilities	10,830	7,170	18,000
1) Distribution Pump	150	50	200
2) Pipelines	10,680	7,120	17,800
Total	13,080	8,320	21,400

13.4.3 Cost Estimates for Operation and Maintenance

Operation and maintenance cost is classified as stated below, the items are:

1) Personnel Cost

The personnel cost is estimated as follows:

Organization and staff arrangement will continue to keep the present form, even if managerial practice and efficiency in functioning may need improvement in future.

Corresponding to increased supply of water resulting from the rehabilitation/modification and expansion works, work volume of operation/maintenance/service will increase accordingly.

Every section in the waterworks, to meet increased work volume, will have to be staffed by additional personnel gradually. The number of personnel from 1986 to 2000 was assumed considering the work volume.

Personnel cost are calculated on the basis of the number of personnel classified by position and function multiplied by the salary grades of the PWA, according to their functions and positions as shown in Table-12.3. In case one grade is divided into several salary levels, the medium level is used as a base of calculation. The basic level of personnel expenses is assumed to increase at 7 % per annum, inclusive of price escalations, following the pattern in recent years.

2) Electricity and Fuel Cost

The electricity rate is divided into two portions. The first one, fixed on the basis of the total electric equipments' rated capacity (@ ฿95/kW), is paid monthly. The second one is charged on the basis of actual consumption measured by periodical meter readings (@ ฿1.36/kWA).

In this report, estimation is made by a simplified method, on the following assumptions:

Electricity:

(a) The present electricity cost consisting of the both portions mentioned above and fuel cost of each waterworks is

converted to unit cost (per cubic meter of produced water).

(b) Unit cost will be subject to price escalation of 3.3 % per annum

(c) Annual electricity cost is calculated from the planned yearly water production volume multiplied by unit cost.

(d) In case the treatment plant and well(s) in the area are not in full operation, the priority of operation is given to the well(s) with cheaper unit electricity cost, so that the combined total electricity cost may be minimized.

Fuel:

Fuel cost is assumed to increase in the same proportion with electricity charges.

3) Chemical Cost

Considering the future water quality and planned treatment process, chemical dosage was forecast in the previous chapter, on an average basis.

Unit cost of chemicals per cubic meter of produced water is calculated on the basis of the present average price and the quoted chemical dosage. The unit prices employed herein are as follows:

Alum	฿ 3.8/kg
Lime	฿ 1.5/kg
Chlorine	฿12.0/kg

The unit cost is assumed to increase at 3.3 % per annum from 1986 to 2000.

Chemicals cost in a particular year is calculated based on the planned water volume and unit cost for the year.

4) Connection Work Cost

Connection cost is an expense to connect service pipe to consumers' service meters from the distribution pipe.

The number of connections is estimated from the served population and average number of household members per family in a respective year.

Average unit connection cost is estimated on the basis of the accounting records of the actual expenses spent for connection works, with escalation at 3.3 % per annum from 1986 to 2000.

Connection cost in a respective year is calculated on the basis of yearly increase in the connection number and the above average unit cost per connection work.

5) Other Cost

This item includes costs for repair works, office expenses and other miscellaneous costs. Data in 1985 show that these costs amount to about 8 % of total expenditure including personnel, power and other costs stated in the preceding sections.

For better maintenance of the facilities, particularly to keep the unaccounted ratio at a lowest possible level, repair costs and material costs are expected to increase. The ratio of other expenses to the total cost is, therefore, projected to increase gradually. Estimation of this item was therefore made along this line.

6) Operation and Maintenance Summarized

All of the operation and maintenance costs estimated in the preceding sections are summarized and tabulated as shown below in Table-13.3.

Table-13.3 OPERATION AND MAINTENANCE COST

(Unit : 1,000 ฿)

Item	1986	1990	1995	2000
Personnel Cost	2,255	2,952	6,036	8,465
Electricity & Fuel Cost	1,738	2,398	2,499	3,728
Chemical Cost	317	426	577	810
Connection Cost	210	234	156	141
Other	419	557	859	1,218
Total	4,939	6,567	10,127	14,362

13.4.4 Disbursement Schedule

The project will be commenced in 1987 and completed in 1991. Disbursement by each year will be made as stated in Table-13.4, which is based on the Implementation Schedule.

The cost described in the Table of the Schedule is denoted in 1986 price.

The employed exchange rate is : US $1.00 = ฿26.12

Table-13.4 PROJECT COST AND DISBURSEMENT SCHEDULE

Unit : x 1,000 Baht

ITEM	Total Cost	BREAK DOWN				1987				1988				1989				1990				1991			
		FC	LC			FC	LC			FC	LC			FC	LC			FC	LC			FC	LC		
			Material Cost	Labor Cost			Material Cost	Labor Cost			Material Cost	Labor Cost			Material Cost	Labor Cost			Material Cost	Labor Cost			Material Cost	Labor Cost	
				Skilled	Unskilled			Skilled	Unskilled			Skilled	Unskilled			Skilled	Unskilled			Skilled	Unskilled			Skilled	Unskilled
A. Rehab. & Modification																									
1. Land Acquisition	2,000	0	2,000	0	0	0	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Phophraya T.P.	2,350	1,551	282	282	235	0	0	0	0	628	113	113	94	931	169	169	141	0	0	0	0	0	0	0	0
3. Clear Water Transmission Pipeline	650	390	65	91	104	0	0	0	0	156	26	36	42	234	39	55	62	0	0	0	0	0	0	0	0
4. Dab Fafhun Deep Well and D.P. Station	2,100	1,575	210	147	168	0	0	0	0	630	84	59	67	945	126	88	101	0	0	0	0	0	0	0	0
5. Kannasut D. Well No.1 and P. Station	10,000	7,500	1,000	700	800	0	0	0	0	3,000	400	280	320	4,500	600	420	480	0	0	0	0	0	0	0	0
6. Distribution Pipeline	8,000	4,800	800	1,120	1,280	0	0	0	0	1,920	320	448	512	2,880	480	672	768	0	0	0	0	0	0	0	0
- Total of A -	25,100	15,816	4,357	2,340	2,587	0	2,000	0	0	6,326	943	936	1,035	9,490	1,414	1,404	1,552	0	0	0	0	0	0		
B. Expansion																									
1. Land Acquisition	200	0	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	0	0	0	0	0	0
2. Kannasut D. Well No.2	2,200	1,650	220	154	176	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,650	220	154	176
3. Transmission Pipeline	1,000	600	100	140	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	100	140	160
4. Dist. Facilities	18,000	10,830	1,800	2,506	2,864	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,830	1,800	2,506	2,864
a. Dist. Pump	200	150	20	14	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	20	14	16
b. Pipelines	17,800	10,680	1,780	2,492	2,848	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,680	1,780	2,492	2,848
- Total of B -	21,400	13,080	2,320	2,800	3,200	0	0	0	0	0	0	0	0	0	0	0	0	0	200	0	0	13,080	2,120	2,800	3,200
- Total of A+B -	46,500	28,896	6,677	5,140	5,787	0	2,000	0	0	6,326	943	936	1,035	9,490	1,414	1,404	1,552	0	200	0	0	13,080	2,120	2,800	3,200
C. Engineering Services																									
1. Detail Design	2,300	1,380	0	920	0	276	0	184	0	1,104	0	736	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Field Survey and Soil Investigation	300	180	0	120	0	180	0	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Supervision	2,300	1,380	0	920	0	0	0	0	0	345	0	230	0	345	0	230	0	0	0	0	0	690	0	460	0
- Total of C -	4,900	2,940	0	1,960	0	456	0	304	0	1,449	0	966	0	345	0	230	0	0	0	0	0	690	0	460	0
- Total of A+B+C -	51,400	31,836	6,677	7,100	5,787	456	2,000	304	0	7,775	943	1,902	1,035	9,835	1,414	1,634	1,552	0	200	0	0	13,770	2,120	3,260	3,200
D. Administration Cost	514	318	67	71	58	5	20	3	0	78	9	19	10	98	14	16	16	0	2	0	0	138	21	33	32
- Total of A+B+C+D -	51,914	32,154	6,744	7,171	5,845	461	2,020	307	0	7,853	952	1,921	1,045	9,933	1,428	1,650	1,568	0	202	0	0	13,908	2,141	3,293	3,232
E. Physical Contingencies 7%	3,634	2,251	472	502	409	32	141	21	0	550	67	134	73	695	100	116	110	0	14	0	0	974	150	230	226
- Total of A+B+C+D+E - (Project Cost at 1986 Price)	55,548	34,405	7,216	7,673	6,254	493	2,161	329	0	8,403	1,019	2,055	1,118	10,628	1,528	1,766	1,677	0	216	0	0	14,881	2,291	3,523	3,458
F. Price Contingencies, 3.3% per annum	6,827	4,290	730	950	856	16	71	11	0	564	68	138	75	1,087	156	181	172	0	30	0	0	2,623	404	621	610
- Total of A+B+C+D+E+F - (Total Project Cost)	62,375	38,695	7,946	8,623	7,110	509	2,233	339	0	8,967	1,087	2,193	1,193	11,716	1,685	1,947	1,849	0	246	0	0	17,504	2,695	4,144	4,068
G. Total of Year						3,081				13,441				17,196				246				28,411			

Note: 1) Figures of items A to E are expressed at 1986 prices.
2) Figures of items F and G are expressed at current prices.

CHAPTER 14 FINANCIAL AND ECONOMIC ANALYSIS

CHAPTER 14 FINANCIAL AND ECONOMIC ANALYSIS

14.1 FINANCIAL ANALYSIS

14.1.1 Financing For Proposed Project

This chapter verifies the financial feasibility of the proposed project for Suphanburi Waterworks on the assumptions that capital investment will be disbursed and financed as shown in Table-14.1.

1) The above disbursements will be grouped into two phases, (1) rehabilitation and modification and (2) expansion.

2) The foreign portions and part of local portions will be financed by a foreign financial institution such as OECF (Overseas Economic Cooperation Fund of Japan) and the terms and conditions of loans will be the same as the prevailing ones, i.e.,

a.	Interest Rate	:	3.5% per annum
b.	Maturity	:	25 years, with a grace period of 7 years

3) The part of local portions which will be financed with foreign loans is calculated to meet the recent practices of the loans.

4) The rest of local portions, i.e., 20% of the total project cost, will be financed by the Krung Thai Bank Ltd. The terms and conditions of loans will be the same as the prevailing ones, i.e.,

a.	Interest Rate	:	13.0% per annum
b.	Maturity	:	10 years, with a grace period of 3 years

5) Analysis is made to verify that debt service and the increase in operation and maintenance expenses resulting from the implementation of the proposed project, as forecast in Section 14.1.4 following, can be absorbed by an increase in revenue, mainly due to the recent revisions in the water tariff schedule.

Table-14.1 PROJECT COST, DISBURSEMENT SCHEDULE AND SOURCES OF FUND (SUPHANBURI WATERWORKS)

a. PROJECT COST AND DISBURSEMENT SCHEDULE (x 1,000 BAHT)

YEAR	FOREIGN PORTION	LOCAL PORTION	TOTAL
1987	509	2,572	3,081
1988	8,967	4,474	13,441
1989	11,716	5,480	17,196
1990	0	246	246
1991	17,504	10,907	28,411
TOTAL	38,696	23,679	62,375

b. SOURCES OF FUND (x 1,000 BAHT)

YEAR	OECF LOAN	LOCAL LOAN	TOTAL
1987	2,465	616	3,081
1988	10,753	2,688	13,441
1989	13,757	3,439	17,196
1990	197	49	246
1991	22,729	5,682	28,411
TOTAL	49,900	12,475	62,375

Note: Disbursement amounts are forecast at current prices.

14.1.2 Approach to Financial Analysis

Like other waterworks of PWA, the Suphanburi Waterworks will be wholly under the control of PWA Head Office in budgetary and financial aspects. All the revenues of these waterworks are, as a rule, transferred to PWA Head Office and all the necessary expenses of the waterworks inclusive of those for their administration, operation and maintenance are allocated by the PWA Head Office annually. The financing of their capital investment, if any, including the implementation of the project under this study, is also planned and executed at the responsibility and on the accounts of PWA Head Office.

In view of the above, this report verifies the financial feasibility by the following methods, instead of the analysis of income statements and balance sheets, which is only meaningful for entities that have full or semi-autonomy in their financial management.

Method I : Cash Flow Analysis

In this analysis, the following are projected:

(a) Revenue collection from the waterworks.
(b) Operation and Maintenance expenses allocation to the waterworks from PWA Head Office.
(c) Share of Head and Regional Office Overhead Expenses.
(d) Debt service relating to the waterworks.
(e) Net cash flow surplus
(f) Unit cost of water after debt service but before depreciation

and check if the amount of item I.(a) above can cover the necessary amounts for items I.(b), I.(c) and I.(d).

Method II : Fixed Assets, Unit Cost after Depreciation and Rate of Return Analysis

The following items are projected:

(a) Fixed Assets in Operation.

(b) Depreciation of Fixed Assets.

(c) Total Cost after Depreciation and Interest.

(d) Unit Cost after Depreciation and Interest.

(e) Rate of Return = Surplus after Depreciation and Interest / Fixed Assets in Operation.

and with these figures, the rate of return from the operation of the waterworks is projected. This rate of return will provide one of the criteria for the financial feasibility of the project and also give an assessment of the suitability of the proposed water tariff schedule.

Method III : Financial Internal Rate of Return analysis (FIRR)

A discount rate at which the net present worth revenue of the project equals zero will be calculated as a factor to verify the financial feasibility of the project.

14.1.3 Financial Performance of the Waterworks

Table-14.2 following shows the combined annual revenues and expenditures of Suphanburi Waterworks on a cash-flow basis for 1984 and 1985. Reflecting the recent up-ward revision of the water tariff schedule executed from 1984 to 1985, the revenues of the waterworks mainly consisting of water sales increased remarkably to improve the revenue-expenditure ratio drastically from 0.91 in 1984, or a deficit equal to 9 % of the annual revenue, to 1.52 % in 1985, or a surplus of 52 % over the annual expenditure.

14.1.4 Cash-Flow Analysis

The Cash-Flow Analysis is summarized in Table-14.3 following. The items comprised in the table and the assumptions used for forecasting their future estimates are given below.

Table-14.2 REVENUE AND EXPENDITURE OF SUPHANBURI WATERWORKS (BAHT) (FOR PAST TWO YEARS)

	1984	1985
Water Production (x1,000 m3)	2,169	2,223
Water Sales (x 1,000 m3)	1,263	1,286
No. of Connections	4,320	4,500
REVENUE:		
Water Sales	3,671,244	6,234,795
Service Charge	582,310	599,005
Connection Fee	434,132	695,287
Others	47,052	26,764
Total	4,734,738	7,555,851
EXPENDITURE:		
Personnel Expenses	2,078,922	2,315,038
Chemicals	277,864	289,396
Material & Maintenance	75,653	262,297
Oil & Fuel	30,140	56,477
Office Supplies	17,268	9,242
Hire & Service	187,136	114,194
Electricity	2,351,511	1,678,771
Connection Cost	168,685	199,527
Others	26,279	34,858
Total	5,213,458	4,959,800
REVENUE/EXPENDITURE	0.91	1.52

Table-14.3 CASH FLOW PROJECTED (x 1,000 Baht) AT CURRENT PRICE (SUPHANBURI WATERWORKS)

Description	Text Ref.	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
(A) Water Production (x1000 m3)		1,837	1,968	2,034	2,097	2,157	2,207	2,307	2,403	2,443	2,482	2,566	2,648	2,736	2,859	2,939
(B) Unaccounted for Water (%)		40	39	37	36	34	32	30	29	27	25	25	24	24	23	23
(C) Water Sales (x1000 m3)		1,095	1,205	1,278	1,351	1,424	1,497	1,606	1,716	1,789	1,862	1,935	2,008	2,081	2,190	2,263
(D) No. of Connections		4,689	4,837	5,068	5,233	5,418	5,545	5,819	5,937	6,036	6,141	6,250	6,303	6,399	6,466	6,547
(E) Average Water Tariff (Baht/m3)**		6.61	6.61	6.61	7.29	7.29	7.29	8.03	8.03	8.03	8.85	8.85	8.85	9.76	9.76	9.76
1. Operating Revenue:																
1.1 Water Sales		7,238	7,962	8,444	9,840	10,372	10,904	12,899	13,778	14,365	16,480	17,127	17,773	20,304	21,372	22,085
1.2 Connection Fees		730	572	892	703	788	541	1,286	554	465	543	564	274	547	382	462
1.3 Service Charges		624	644	675	768	795	814	941	960	976	1,095	1,114	1,124	1,258	1,271	1,287
1.4 Other Revenue		39	42	46	52	55	56	69	70	72	83	86	88	101	105	109
Total 1.		8,632	9,219	10,057	11,362	12,009	12,314	15,195	15,362	15,878	18,201	18,891	19,259	22,210	23,131	23,942
2. Expenses:																
2.1 Operation & Maintenance																
- Personnel Cost		2,255	2,374	2,541	2,718	2,952	4,166	4,627	5,139	5,498	6,036	6,458	6,910	7,394	7,912	8,465
- Electricity & Fuel Cost		1,738	1,964	2,116	2,231	2,398	2,524	2,092	2,277	2,386	2,499	2,673	2,915	3,131	3,407	3,728
- Chemical Cost		317	353	379	398	426	448	486	526	551	577	614	662	703	755	810
- Connection Cost		210	169	273	202	234	166	369	164	142	156	167	84	157	113	141
- Other Cost		419	450	492	514	557	677	702	751	795	859	918	979	1,055	1,129	1,218
Sub-total 2.1		4,938	5,311	5,800	6,063	6,566	7,980	8,276	8,857	9,372	10,126	10,831	11,550	12,440	13,316	14,362
2.2 Share of Head & Regional Office Overhead Expenses		1,547	1,653	1,803	2,037	2,153	2,208	2,724	2,754	2,846	3,263	3,387	3,452	3,982	4,147	4,292
2.3 Debt Service		0	83	529	1,356	2,791	3,439	4,081	4,774	6,041	5,757	5,473	5,499	5,296	5,093	4,070
Total 2.		6,485	7,047	8,132	9,456	11,509	13,627	15,081	16,385	18,260	19,147	19,691	20,502	21,718	22,555	22,724
3. Net Cash Flow Surplus:																
3.1 Annual		2,146	2,172	1,925	1,906	500	-1,312	114	-1,023	-2,382	-945	-800	-1,243	492	576	1,218
3.2 Cumulative		2,146	4,319	6,244	8,150	8,650	7,338	7,452	6,429	4,047	3,102	2,302	1,058	1,551	2,127	3,345
4. Unit Cost of Water after Debt Service (Baht/m3)*		4.97	5.05	5.34	6.06	6.98	8.06	7.97	8.57	9.24	9.31	9.23	9.42	9.54	9.52	9.26

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

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

1) Operating Revenue

The Operating Revenue is classified as follows :

Water Sales

Water Sales are estimated in the table as:
products of Projected Water Sales Volumes (shown as item (C) in the table) multiplied by the Average Water Tariff (shown as item (E)).

a. Average Water Tariff

The average water tariff for 1986 shown in the table is calculated as the average of the water tariffs collected by the waterworks during the six months ending March 1986.

In view of the past performance and the political and social climate of Thailand where frequent revision of public charges is difficult, this report forecasts cash flow on the assumption that the water tariffs will be increased every three years at the rate of 3.3% per annum. As shown in Appendix 10, Table-10.2 and -10.3, sensitivity studies were made in this report to forecast cash flows on the assumptions that (1) water tariffs will be increased every year at the rate of 3.3 % (Table-10.2) and (2) water tariffs will remain unchanged up to the target year 2000 (Table-10.3). Also for the purpose of constant price analysis such as FIRR, EIRR and AIC calculations, a cash flow table at 1986 constant prices is shown in Appendix 10, Table-10.1.

b. PWA Water Tariff Schedule

Water tariffs are collected by water meters, with the exception of negligible direct sale fees. Shown below is the existing water tariff schedule, compared with the one which was in force prior to the revision in 1984.

Table-14.4 WATER TARIFF SCHEDULE

Consumption (cubic meters/ month)	Existing Tariff (B/cubic meter)	Previous Tariff (B/cubic meter)
1-10	3.75	2.00
11-20	4.50	2.50
21-50	6.00	3.00
51-80	7.00	4.00
81-100	7.50	4.50
101-300	8.00	5.00
301 and above	8.50	5.50

Connection Fees and Service Charges

These fees and charges are of the nature which cover actual expenses to be borne by the users for connection work. PWA accounts these fees and charges as revenue sources and they actually form a significant part of its revenue.

In this study, these fees and charges are forecast on the basis of future demand projection with charge rates to be revised every three years at the rate of 3.3 % per annum as in the case of water tariffs. As a sensitivity study, forecasts are made on the assumptions of (1) every year upward revision of 3.3 % and (2) no changes in charge rates, as given in Appendix 10, Tables-10.2 and -10.3.

Connection fees

Connection fees are estimated in the table as:
products of annual increases in the number of connections multiplied by the 1985 average fee per connection work, with price adjustments.

Existing PWA Connection Fees:

The minimum connection fee is set at 2,050 Baht for 1/2" ϕ pipe with a length of 10 meters. Based on the records for the past three years, average connection fees for households are assumed at 3,566 Baht and for those for industrial and other large scale consumers at 6,985 Baht. The additional fee can add substantially to the total cost of a connection - for example a new 1/2" connection 30 meters from the main pipe could cost over double that for an equivalent connection 10 meters from the main. The additional fees are not charged according to a fixed scale, but instead are levied by PWA on an ad hoc basis, using standard unit costs for the labor and material required.

Table-14.5 Existing Connection Fees

Size of Connection	Basic Connection Fee (for connections less than 10 meters from main pipe) - Baht/connection -
1/2"	2,050
3/4"	2,750
1"	3,750
1 1/2"	6,690
2"	9,575
2 1/2"	13,075
3"	15,495
4"	21,455
6"	30,025

Service Charges

Service charges are estimated in the table as:
a product of the number of connections multiplied by the 1985 average charge per connection, with price adjustments.

Existing PWA Service Charges:

Service charges are levied on consumers according to the size of their connection, as shown Table-14.6 below.

Table-14.6 Service Charges

Size of Connection	Monthly Service Charge (Baht)
1/2"	10
3/4"	15
1"	30
1 1/2"	60
2"	100
2 1/2"	120
3"	160
4" and above	200

Other Revenue

This item is estimated in the table as:
a portion equal to the ratio of the other revenue to the 1985 combined total of water sales, connection fees and service charges, with price adjustments.

2) Expenses

With the expansion of water supply facilities, water production is planned under the current project to be increased approximately 2 times more than the present level. With production expanded, the scale of operation and maintenance and other expenses are expected to increase. This report forecasts expenses in the following manner.

Operation & Maintenance

This item is shown in the table classified as follows:

a. Personnel Cost
b. Electricity & Fuel Cost
c. Chemical Cost
d. Connection Cost
e. Other Cost

The method of estimation employed in forecasting operation and maintenance expenses are delineated in Chapter 13.

As shown in table-14.2, the Revenue and Expenditure Account of Suphanburi Waterworks lists only operation and maintenance expenses as expenditure items and do not reflect the following items which are important in financial feasibility analysis:

(1) the overhead expenses of the Head Office and Regional Office No. 2 which controls Suphanburi Waterworks.
(2) depreciation of the fixed assets of the waterworks,
(3) debt service expenses payable by Head Office, if any, in relation to the capital investment in the waterworks.

The cash flow table of this study lists them as follows.

Share of Head & Regional Office Overhead Expenses

The formula shown in Table-14.7 is the existing accounting method applied to the allocation of Head and Regional Office overhead expenses to be shared by Suphanburi Waterworks.

As discussed in Section 14.3, this formula is considered unfair to small sized waterworks or those waterworks whose earning position is not favorable.

Table-14.7 SHARE ALLOCATION OF HEAD AND REGIONAL OFFICE EXPENSES
(SUPHANBURI WATERWORKS)

1985 Cost Share Allocation

1. Head Office Expenses

a) Per Waterworks Portion (1/3)

Baht 159,272,735 x (1/3) / (No. of Waterworks in PWA) = Baht 285,435

b) WW/PWA-Total Consumption Portion (2/3)

Baht 159,272,735 x (2/3) x (WW% of PWA Total) = Baht 686,184

2. Regional Office Expenses

a) Per Waterworks Portion (1/3)

Baht 8,102,335 x (1/3) / (No. of Waterworks in Region)= Baht 117,425

b) WW/Region-Total Consumption Portion (2/3)

Baht 8,102,335 x (2/3) x (WW% of Regional Total) = Baht 265,469

TOTAL SHARE OF HEAD AND REGIONAL OFFICE
OVERHEAD EXPENSES = Baht 1,354,514

The formula is, as you see in Table-14.7, divided into two portions:

(1) The portion applicable to one-third of Head and Regional Office overhead expenses. The share of this portion is allocated to each waterworks at 402,860 Baht, equal in amount regardless of their sizes of water sales and earning positions. This amount equaled to 8.1 % of the operation and maintenance expenses of Suphanburi waterworks, but the corresponding figure for a large-sized waterworks such as Chiangmai Waterworks was only 2.3 %, indicating unfairness of the formula of allocating these overhead expenses.

(2) The portion applicable to the rest two-thirds. The share of this portion is calculated by sales scales of waterworks, regardless of their earning positions. This makes the share practically uncollectable when respective waterworks make deficits or fail to make surpluses enough to pay share amounts.

In view of the above, it is recommended that the allocation of shares be made in one lot without partitioning it into two portions and the calculation of shares be based on net surpluses of waterworks rather than their sales scales, as illustrated by a trial formula suggested in Appendix 10, Table-10.4.

The recommended formula may support cross-subsidies among waterworks, with those earning more to pay more and those earning less or making losses to pay less or nothing. Under the new formula, therefore, waterworks with large earnings will have to be allocated larger shares than under the existing PWA formula. Suphanburi Waterworks would have paid 652 thousand Baht in 1985, or 48.1 % of the share calculated by the existing formula. A large scale waterworks such as Chiangmai, on the other hand, would be required to pay 11,291 thousand Baht, or 9.4 % more than the share under the existing formula.

This report tries to forecast future share allocations by the existing formula, but also tries to make forecasts, as a sensitivity study, by the new formula suggested above, with price

escalation of 3.3 % per year in both cases.

Debt Service

Debt service payment as forecast in Table-14.8 is considered as a factor which usually restricts the cash flow of an entity which has gone through a large scale of capital investment. With such foreign assistance as OECF loans to finance the total foreign currency portion and part of the local currency portion, as referred to in Section 14.1.1, financing of the project will be substantially improved.

3) Net Cash Flow Surplus

Annual and 3.2 Cumulative

As shown in Table-14.3, the cumulative cash flow surpluses throughout the project period are projected to cover (1) operation and maintenance expenses, (2) the waterworks' share of Head and Regional Office overhead expenses calculated either by the existing PWA formula or by a new formula suggested above, and (3) PWA's debt service arising from the proposed project, though yearly balances for 1991 and 1993-1977 will record minor deficits.

As a sensitivity analysis, cash flow forecasts are also made on the assumption that, instead of the OECF loan, a foreign loan whose lending rate is 8.5 % per annum is applied to finance 80 % of the total project investment. The result of this study reveals, as shown in Appendix 10, Tables-10.9 and -10.10, that the annual revenue-expenditure balance will turn to deficits from 1990, with the cumulative balance also turning to deficits from 1993. This indicates a necessity of internal finance within the PWA system to cover such deficits, in case the project be financed by such foreign loans.

Table-14.8 DEBT SERVICE PROJECTED (SUPHANBURI WATERWORKS)

Year	FOREIGN CURRENCY PORTION (in 1,000 Baht) Interest : 3.5% per annum*									LOCAL CURRENCY PORTION (in 1,000 Baht) Interest : 13.0 % per annum									TOTAL DEBT SERVICE
	Rehabil. and Modif.	Stage I Expan.	Loans Outstanding Beginning	Loans Outstanding Ending	Interest Payments 1st year	Interest Payments Later year	Principal Repayment Rehab. & Mod.	Principal Repayment Expnasion	Debt Service Sub-total	Rehabil. and Modif.	Stage I Expan.	Loans Outstanding Beginning	Loans Outstanding Ending	Interest Payments 1st year	Interest Payments Later year	Principal Repayment Rehab. & Mod.	Principal Repayment Expnasion	Debt Service Sub-total	
1987	2,465	0	0	2,465	43	0	0	0	43	616	0	0	616	40	0	0	0	40	83
1988	10,753	0	2,465	13,218	188	86	0	0	274	2,688	0	616	3,304	175	80	0	0	255	529
1989	13,757	0	13,218	26,975	241	463	0	0	703	3,439	0	3,304	6,743	224	430	0	0	653	1,356
1990		197	26,975	27,172	3	944	0	0	948		49	6,743	5,829	3	877	963	0	1,843	2,791
1991		22,729	27,172	49,901	398	951	0	0	1,349		5,682	5,829	10,547	369	758	963	0	2,090	3,439
1992			49,901	49,901		1,747	0	0	1,747			10,547	9,584		1,371	963	0	2,334	4,081
1993			49,901	49,901		1,747	0	0	1,747			9,584	7,802		1,246	963	819	3,028	4,774
1994			49,901	48,402		1,747	1,499	0	3,245			7,802	6,020		1,014	963	819	2,796	6,041
1995			48,402	46,904		1,694	1,499	0	3,193			6,020	4,238		783	963	819	2,565	5,757
1996			46,904	45,405		1,642	1,499	0	3,140			4,238	2,456		551	963	819	2,333	5,473
1997			45,405	42,633		1,589	1,499	1,274	4,361			2,456	1,637		319		819	1,138	5,499
1998			42,633	39,861		1,492	1,499	1,274	4,264			1,637	819		213		819	1,032	5,296
1999			39,861	37,088		1,395	1,499	1,274	4,167			819	0		106		819	925	5,093
2000			37,088	34,316		1,298	1,499	1,274	4,070										4,070
2001			34,316	31,544		1,201	1,499	1,274	3,973										3,973
2002			31,544	28,772		1,104	1,499	1,274	3,876										3,876
2003			28,772	25,999		1,007	1,499	1,274	3,779										3,779
2004			25,999	23,227		910	1,499	1,274	3,682										3,682
2005			23,227	20,455		813	1,499	1,274	3,585										3,585
2006			20,455	17,682		716	1,499	1,274	3,488										3,488
2007			17,682	14,910		619	1,499	1,274	3,391										3,391
2008			14,910	12,138		522	1,499	1,274	3,294										3,294
2009			12,138	9,366		425	1,499	1,274	3,197										3,197
2010			9,366	6,593		328	1,499	1,274	3,100										3,100
2011			6,593	3,821		231	1,499	1,274	3,003										3,003
2012			3,821	2,547		134		1,274	1,407										1,407
2013			2,547	1,274		89		1,274	1,363										1,363
2014			1,274	0		45		1,274	1,318										1,318

4) Unit Cost of Water after Debt Service

This Unit Cost on a cash flow basis may be compared with the unit cost after depreciation and interest on a income flow basis shown in Table-14.9. As shown in Table-14.3, the unit cost after debt service on a cash flow basis which will register 4.97 Baht/m3 in 1986 or equal to 75.2 % of the then prevailing average water tariff(6.61 Baht), is projected to stand at 9.26 Baht in 2000 or 95.6 % of the comparable water tariff (9.76 Baht).

14.1.5 Fixed Assets, Unit Cost after Depreciation and Rate of Return Analysis

1) Fixed Assets

Fixed Assets (excluding land) in this analysis are expressed in the following terms:

(a) Accumulative Fixed Assets = Accumulative Fixed Assets of previous year + completion amount of construction work, transferred from "Work in Progress".

(b) Accumulative Depreciation = Accumulative Depreciation of previous year + depreciation of current year. Depreciation is applied by a straight line method, with durability of fixed assets assumed to be 30 years.

(c) Net Fixed Assets = (a) - (b) above.

(d) Work in Progress = Accumulative capital investment - accumulative capital construction completed (No price escalation applied - during construction).

(e) TOTAL (Total fixed assets excluding land) = (c) + (d) above.

(f) Total Cost before Depreciation and Interest = Operation and Maintenance Cost (see Table-10.2 of Appendix 10) + Share of Head & Regional Office Overhead Expenses (see same Table).

Table-14.9 FIXED ASSETS, UNIT COST AFTER DEPRECIATION AND RATE OF RETURN

(SUPHANBURI WATERWORKS) x 1,000 BAHT

YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fixed Assets														
Accumulative Fixed Assets	14,687	15,171	18,747	32,751	50,922	52,847	82,723	85,453	88,273	91,186	94,195	97,303	100,514	103,831
Less Accumulative Depreciation	6,252	6,964	7,819	9,169	11,169	13,299	16,495	19,888	23,486	27,301	31,342	35,619	40,145	44,931
Net Fixed Assets in Operation	8,435	8,207	10,928	23,582	39,754	39,548	66,228	65,565	64,786	63,885	62,853	61,684	60,369	58,900
Work in Progress	3,075	16,460	30,476	17,335	28,376	28,132	0	0	0	0	0	0	0	0
TOTAL	11,510	24,667	41,404	40,917	68,130	67,680	66,228	65,565	64,786	63,885	62,853	61,684	60,369	58,900
Total Cost before Depreciation and Interest	7,018	7,724	8,100	8,789	10,336	11,000	11,701	12,409	13,389	14,329	15,234	16,422	17,599	18,942
Total Cost after Depreciation but before Interest		8,436	8,955	10,139	12,336	13,130	14,898	15,802	16,988	18,144	19,275	20,699	22,125	23,728
Total Cost after Depreciation and Interest		8,965	10,311	11,967	14,812	16,248	17,890	18,563	19,465	20,336	21,183	22,404	23,626	25,026
Unit Cost of Water (Baht/cm3) after Depreciation and Interest*		7.01	7.63	8.40	9.89	10.12	10.43	10.38	10.45	10.51	10.55	10.77	10.79	11.06
Average Rate Base		8,321	9,568	17,255	31,668	39,651	52,888	65,896	65,176	64,335	63,369	62,268	61,026	59,634
Surplus after Depreciation and Interest		1,767	1,051	439	-1,671	-1,053	-2,021	-1,620	-1,263	-822	-633	-195	267	523
Rate of Return after Completion of Construction						-3%	-4%	-2%	-2%	-1%	-1%	0%	0%	1%

Note: * [{(Total Cost after Depreciation and Debt Service) of this Table} x {(1.1 Water Sales)/(1. Operating Revenue) of Cash Flow Table}]/[{(C) Water Sales (x 1000 m3)} of Cash Flow Table]

As shown in Table-14.9, Net Fixed Assets in Operation which is projected to stand at 8,435 thousand Baht in 1987, or 97.7 % of then Total Revenue (8,632 thousand Baht, see Table-10.2 of Appendix 10) will register 66,228 thousand Baht in 1993, the year after completion of construction, or 4.2 times as large as then Total Revenue (15,869 thousand Baht, see the same Table), but will reduce to 58,900 thousand Baht in 2000, or 2.3 times of then Total Revenue (25,549 thousand Baht, see the same Table), in reflection of both accumulative depreciation and increases in revenue resulting from the expansion of production facilities. The improvement of the above revenue - fixed assets ratio is reflected in the rate of return mentioned below.

2) Cost after Depreciation and Interest

This analysis show production cost in the following terms:

(g) Total Cost after Depreciation but before Interest = (f) + depreciation for current year (accumulative depreciation for current year - that for previous year).

(h) Total Cost after Depreciation and Interest = (g) + interest payable for current year (see Table-14.8).

(i) Unit Cost of Water after Depreciation and Interest = (h) / Water Sales (x 1,000 m3) (see (C) of Table-10.2 of Appendix 10).

The figures of Total Cost after Depreciation and Interest on a income flow basis shown in Table-14.9 are found almost equal to those of Total Cost after Debt Service on a cash flow basis shown in Table-10.2 of Appendix 10.

	1993	1998
Total Cost after Depreciation and Interest (Table-14.9, x 1,000 Baht)	17,890	22,404
Total Cost after Debt Service (Table-10.2 of Appendix 10, x 1,000 Baht)	16,476	21,718

This is due partly to the low interest rate (3.5 % per annum) of the foreign loan applicable to this project.

The figures of Unit Cost after Depreciation and Interest are compared with those of Unit Cost after Debt Service as follows:

		1993	1998
i)	After Depreciation and Interest	10.43 Baht	11.06 Baht
ii)	After Debt Service	8.61 Baht	9.54 Baht

This comparison reflects the trends that depreciation decreases yearly, while annual debt service reaches its peak in 1997 and 1998 (see Table-14.8).

3) Rate of Return after Completion of Construction

This item is calculated in this analysis as follows:

(j) Average Rate Base = (Fixed Assets in Operation for current year + Fixed Assets in Operation for previous year) / 2.

(k) Surplus after Depreciation and Interest = Total Revenue (see Table-10.2 of Appendix 10) - (h).

(l) Rate of Return after Completion of Construction = (k) / (j).

The Rate of return which is forecast to register -3 % in 1992 will improve to 1 % in 2000 after dropping to -4 % in 1993. This indicates the possibility that the earning position will turn favorable, though gradually.

14.1.6 Financial Internal Rate of Return

Table-14.10 represents the tabulation and calculation of the Financial Internal Rate of Return for Suphanburi Waterworks on an incremental basis resulting from investment in the expansion project of the waterworks, utilizing a discount rate that equates costs with benefits, which produces a figure of 3.3 %. Even with the new formula suggested for share allocation of Head & Regional Office overhead expenses applied, however the Financial Internal Rate of Return for the project is still substantially improved to register 4.0 %, a little higher than the lending rate to be

Table-14.10 FINANCIAL INTERNAL RATE OF RETURN (FIRR) TABLE 6-14

(SUPHANBURI WATERWORKS) x 1,000 BAHT 0.03 0.04

YEAR	TOTAL WATER REVENUE	CAPITAL INVESTMENT COST	OPERATING COSTS & H.R.O.*	1986 PRICE NET REVENUE	NET BENEFITS DISCOUNTED AT 6 %	NET BENEFITS DISCOUNTED AT 7 %
1987	0	2,983	0	-2,983	-2,896	-2,868
1988	0	12,596	0	-12,596	-11,873	-11,645
1989	1,676	15,600	593	-14,517	-13,285	-12,905
1990	2,263	216	862	1,185	1,053	1,013
1991	2,540	24,154	1,678	-23,291	-20,091	-19,144
1992	3,874		1,776	2,098	1,757	1,658
1993	4,012		1,861	2,151	1,749	1,635
1994	4,436		1,949	2,487	1,964	1,817
1995	4,958		2,175	2,783	2,133	1,955
1996	5,473		2,359	3,114	2,317	2,104
1997	5,747		2,478	3,269	2,362	2,124
1998	6,412		2,753	3,659	2,566	2,285
1999	7,035		2,973	4,062	2,766	2,440
2000	7,585		3,254	4,331	2,863	2,501
2001	7,585		3,254	4,331	2,780	2,405
2002	7,585		3,254	4,331	2,699	2,312
2003	7,585		3,254	4,331	2,620	2,223
2004	7,585		3,254	4,331	2,544	2,138
2005	7,585		3,254	4,331	2,470	2,056
2006	7,585		3,254	4,331	2,398	1,977
Salvage		-25,070		25,070	13,880	7,685
TOTALS	101,523	30,478	44,235	26,810	2,778	-6,234

Note: * Share Allocation of Head and Regional Office Overhead Expenses (calculated by the existing PWA formula).

FIRR= 3+(4-3)x2,778/(2,778+6,234)
= 3.31%

applied by foreign financial institutions.

14.1.7 Financial Feasibility

The results of the analysis mentioned above throughout Section 14.1 reveal that the Internal Rate of Return of the capital investment for the project on an incremental basis is not enough to cover debt service expenses arising from the project investment. On a compound basis which includes cash generations from existing capital assets as well, however, the revenue of the waterworks will be able to cover all expenses inclusive of the debt service expenses incurring from project investment, as shown in Table-14.3 which registers no operating deficits during the project period in terms of cumulative surpluses. This indicates financial feasibility of the project to the extent that the capital investment for this waterworks will cause no adverse effects on the financial management of PWA on a cash flow basis.

14.1.8 Summary of Sensitivity Study Results

The results of sensitivity studies are summarized, for your reference, as follows:

1) Cashflow analysis (in terms of accumulative surplus in 2000)

Unit: 1,000 Baht

a. Main Report (see Table-14.3) 3,345
   Tariff change: every three years
   Share allocation PWA method
   Foreign loan: interest rate at 3.5 % p.a.

b. Sensitivity Study A (Share allocation: PWA formula)
   a) Tariff change: every year (Appendix 10, Table-10.2) 9,959
   b) Tariff change: no change (Appendix 10, Table-10.3) -36,186

c. Sensitivity Study B (Share allocation: new formula)
   a) Tariff change: every year (Appendix 10, Table-10.6) 32,716
   b) Tariff Change: every 3 years (App. 10, Table-10.7) 25,256
   c) Tariff change: no change (App. 10, Table-10.8) -18,753

d. Sensitivity Study C (Foreign loan: at 8.5 % p.a., and tariff change: every 3 years) (App.10, Table-10.10) -21,894

2) Fixed Assets, Unit Cost after Depreciation and Rate of Return Analysis

a. Main Report (see Table-14.9)

Unit cost of water in 2000	11.06 Baht
Annual surplus in 2000	523 thousand Baht
Rate of return in 2000	1 %

b. Sensitivity Study (share allocation: new formula, see Table-10.11 of APP.10)

Unit cost of water in 2000	10.01 Baht
Annual surplus in 2000	2,898 thousand Baht
Rate of return in 2000	5 %

3) Financial Internal Rate of Return

a. Main Report (share allocation: PWA formula, see Table-14.10) 3.31 %

b. Sensitivity Study (share allocation: new formula, see Table-10.12 of App.10) 3.95 %

14.2 ECONOMIC ANALYSIS

This analysis purports the economic justification of the project by comparing the net creation of benefits to the net increase in costs.

In this analysis, benefits and costs are considered from the national interest standpoint. Costs are converted to economic costs to reflect alternative uses of resources by the nation, and benefits include effects of the projects upon water users and upon the community in which the improvement occurs.

Benefits and costs in this analysis are valued in the present national value of money, currently at approximately 10%, for the purpose of discounting benefits and costs.

In this analysis, economic justification is considered to be proved if benefits exceed costs at the present national value.

14.2.1 Economic Benefits

The main socio-economic benefits which will be brought about by the implementation of the Suphanburi Water Supply Expansion Project as proposed in the current feasibility study are summarized as follows.

1) Water Volume Benefits

The increases to be brought about by the project in total water production, served population and per capita and total water consumption are summarized in Chapter 2. Also water pressures will be substantially increased and the existing chronic water shortages will be eliminated.

2) Water Quality Effects

The questionnaire market survey which the study team conducted in January, 1986 revealed that the majority of Suphanburi residents are not satisfied with the present quality of water supplied, as shown in Appendix 5.

3) Fire Loss Reduction

Table-14.11 show that the damages in Suphanburi caused by fire losses in the past three years amounted to considerable amounts.

As the water supply service will dramatically improve and expand the fire fighting capabilities of the area, this will protect property values especially in the central business districts where a major conflagration has the greatest potential. With reduced fire loss, personal injury and loss of human lives will be markedly reduced.

4) Effects on Health, Sanitation and Aesthetics

Table-14.12 following shows that Suphanburi is still not free from water-borne diseases such as Typhoid, Dysentery, Diarrhea and Food Poisoning.

Table-14.11 FIRE LOSSES
IN
SUPHANBURI

YEAR	NUMBER		AMOUNT OF DAMAGE (BAHT)
	IN MUNICIPALITY	OUT OF MUNICIPALITY	
1981	10	5	5,380,000
1982	5	5	-
1983	7	8	-
1984	13	2	4,008,500
1985	8	10	26,818,000 (rice-mill burant)

SOURCE: SUPHANBUARI FIRE STATION, JULY 1986

Table-14.12 MORBIDITIES AND MORTALITIES
BY
WATERBORNE DISEASES
IN
SUPHANBURI AND PHOPHRAYA

1) SUPHANBURI

Year	Diarrhoea		Dysentery		Thyphoid		Cholera		Food Poisoing	
	Morbid	Mortal	Morbid	Mortal	Morbid	Mortal	Morbid	Mortal	Morbid	Mortal
1982	732	-	41	-	54	-	-	-	126	-
1983	784	-	36	-	74	-	-	-	117	-
1984	905	-	65	-	25	-	-	-	81	-
1985	955	-	112	1	11	-	-	-	95	-

Source : Suphanburi Provincial Public Health Office, July 1986

2) PHOPHRAYA

Year	Diarrhoea		Dysentery		Thyphoid		Cholera		Food Poisoing	
	Morbid	Mortal	Morbid	Mortal	Morbid	Mortal	Morbid	Mortal	Morbid	Mortal
1982	80	16	-	-	-	-	-	-	17	-
1983	34	5	-	-	-	-	-	-	1	-
1984	100	17	-	-	-	-	-	-	2	-
1985	82	7	-	-	-	-	-	-	-	-

Source : Phophraya Public Health Office, July 1986

The current project upon implementation will be a positive step in reducing such water-borne diseases. Improvement of sanitation and beautification will also contribute to further development of these areas.

5) Increase in Property Values

With the improvement of the sanitary environment and fire protection, property values throughout the city, particularly in the areas where water supply will be improved or extended by the project, will show an increase.

6) Direct and Indirect Impacts on Local and National Economies

Direct employment of people and procurement of materials during the planning, construction and operational periods of the project will produce excellent economic repercussions on the regional economies, which will in turn impact the national economy as a whole.

14.2.2 Economic Costs

This analysis considered (1) project costs, (2) replacement costs, and (3) operating and maintenance costs. These economic costs are based on the values used in the Financial Analysis adjusted to convert them into economic costs.

1) Project Costs

In determining project costs, this analysis used adjustments for two items only, where the market price mechanism does not function properly. The adjusted prices or so-called "shadow prices" used in this analysis are those employed by OECF and international lending institutions.

a. Prices of Skilled and Unskilled Labor

In this study, the opportunity cost of unskilled labor or its potential in other employment is valued at 0.38 of its estimated cost for the project.

Skilled labor, on the other hand, is valued at a factor of 0.73.

b. Foreign Exchange

In view of the comparatively free foreign exchange practices in Thailand, no shadow prices are applied in this analysis.

c. Interest and Hidden Taxes

Interest is not included since this is a financial rather than economic cost. Local hidden taxes, subsidies and duties, which we assumed to amount 20.9% of local costs, are also removed as they consist only of inter-sectorial transfers of funds from the view point of national economy.

2) Operation and Maintenance Cost

This study considers the operation and maintenance costs pertaining to the proposed project only, excluding those of the present system. The operation and maintenance costs are so-called "annual costs" which include personnel, electricity & fuel, chemical, connection, and other miscellaneous expenses.

3) Replacement Cost and Salvage Value

This analysis also considers the present value of all those facilities, equipment and other items included in the Project with a service life of less than 30 years to be replaced during the 30 years period from 1987 to 2006.

The replacement costs or costs incurred in order to replace mechanical equipment and others that have exceeded their life expectancy are considered part of the economic cost. They are however not shown in the EIRR Table as most of these mechanical equipment having a service life of 15 years will be required to be replaced after 2006, the terminal year of the Table.

The economic cost of the project is expressed as :

"Adjusted (shadow priced) project cost" + "Operating and maintenance cost" + "Replacement cost" - "Salvage Value". The percentage of salvage value is measured on the basis of the remaining service life of the facilities invested in the proposed project in the year of 2006.

14.2.3 Economic Justification

To verify a synthetic measure of the economic justification of the projects, the following two analyses are given in this study.

1) Cost Benefit Ratio

As shown Table-14.13, the ratios of present-value economic benefits to economic cost of the proposed projects for Suphanburi calculated in the methods previously outlined are 1.33 at 1986 price and 0.73 at present value discounted at 10 % per annum. This does not satisfies the criteria of 1 : 1 for economic viability of the project, but it is to be noted in this connection that the rate in practice may be well above the criterion of 1 : 1, if non-quantifiable indirect benefits are not incorporated into this analysis.

2) Economic Internal Rate of Return

The economic internal rate of return (EIRR) of the project is the rate at which the present value of the quantifiable benefits equals the present value of the economic cost of the proposed project.

This study uses as the measure of economic benefits the total revenue of the waterworks which is considered to be the lowest economic benefits of water supply.

Table-14.14 shows economic internal rates of return (EIRR) at 9.40 %, a little lower than, 10% which is considered as the prevailing opportunity cost of capital in Thailand. It is also to be noted in this connection that non-quantifiable benefits are not considered in this study.

Table-14.13 ECONOMIC BENEFITS VS COSTS (INCREMENTAL)

[SUPHANBURI WATERWORKS] x 1,000 BAHT

YEAR	AT 1986 PRICE		DISCOUNTED AT 10% PER ANNUM	
	BENEFITS	COSTS	BENEFITS	COSTS
1987	0	2,442	0	2,220
1988	0	11,134	0	9,202
1989	1,676	14,143	1,259	10,626
1990	2,263	723	1,546	494
1991	2,540	21,653	1,577	13,445
1992	3,874	1,137	2,187	642
1993	4,012	1,191	2,059	611
1994	4,436	1,247	2,069	582
1995	4,958	1,392	2,103	590
1996	5,473	1,509	2,110	582
1997	5,747	1,586	2,014	556
1998	6,412	1,762	2,043	561
1999	7,035	1,903	2,038	551
2000	7,585	2,083	1,997	548
2001	7,585	2,083	1,816	499
2002	7,585	2,083	1,651	453
2003	7,585	2,083	1,501	412
2004	7,585	2,083	1,364	375
2005	7,585	2,083	1,240	341
2006	7,585	2,083	1,127	310
Salvage				0
TOTAL	101,523	76,401	31,702	43,599
	BENEFITS/COS = 1.329		BENEFITS/COS = 0.727	

Table-14.14 ECONOMIC INTERNAL RATE OF RETURN (EIRR)

[SUPHANBURI WATERWORKS] x 1,000 BAHT

YEAR	TOTAL ECONOMIC BENEFITS * AT 1986 PRICE	TOTAL CAPITAL INVESTMENT AT 1986 PRICE	OPERATING COSTS & H.R.O.** AT 1986 PRICE	NET BENEFITS AT 1986 PRICE	CONVERTED ECONOMIC VALUE				NET BENEFITS	
					TOTAL ECONOMIC BENEFITS	TOTAL CAPITAL INVESTMENT	OPERATING COSTS & H.R.O.*	NET BENEFITS	DISCOUNTED AT 9%	DISCOUNTED AT 10%
1987	0	2,983	0	-2,983	0	2,442	0	-2,442	-2,241	-2,220
1988	0	12,596	0	-12,596	0	11,134	0	-11,134	-9,371	-9,202
1989	2,040	15,600	474	-14,035	2,040	13,764	380	-12,104	-9,346	-9,094
1990	2,622	216	690	1,717	2,622	171	552	1,900	1,346	1,298
1991	3,205	24,154	1,342	-22,290	3,205	20,579	1,074	-18,448	-11,990	-11,455
1992	4,079		1,421	2,659	4,079		1,137	2,943	1,755	1,661
1993	4,954		1,489	3,465	4,954		1,191	3,763	2,058	1,931
1994	5,536		1,559	3,977	5,536		1,247	4,289	2,153	2,001
1995	6,119		1,740	4,379	6,119		1,392	4,727	2,176	2,005
1996	6,702		1,887	4,815	6,702		1,509	5,192	2,193	2,002
1997	7,285		1,983	5,302	7,285		1,586	5,699	2,208	1,997
1998	7,867		2,202	5,665	7,867		1,762	6,106	2,171	1,945
1999	8,741		2,379	6,363	8,741		1,903	6,839	2,231	1,981
2000	9,324		2,603	6,721	9,324		2,083	7,242	2,167	1,907
2001	9,324		2,603	6,721	9,324		2,083	7,242	1,988	1,734
2002	9,324		2,603	6,721	9,324		2,083	7,242	1,824	1,576
2003	9,324		2,603	6,721	9,324		2,083	7,242	1,673	1,433
2004	9,324		2,603	6,721	9,324		2,083	7,242	1,535	1,302
2005	9,324		2,603	6,721	9,324		2,083	7,242	1,408	1,184
2006	9,324		2,603	6,721	9,324		2,083	7,242	1,292	1,076
Salvage		-25,070		25,070		-21,683		21,683	3,869	3,223
TOTAL				58,554				69,703	1,100	-1,714

Note : * Average water tariff in 1986 used as benefits. (6.61 Baht)
** Share Allocation of Head and Regional Office Overhead Expenses.

EIRR = 9+(10-9)x1,100/(1,100+1,714)
= 9.391%

In view of the difficulty of quantifying the economic benefits delineated in Section 14.2.1 above, this study also tried to show as for reference the EIRR based on the Average Incremental Cost (AIC) which the World Bank and WHO recommend as a proxy for economic benefits or a long run marginal cost of water as shown in Appendix 10, Table-10.17. The EIRR based on the AIC is calculated at 10.06 %.

The above analysis demonstrates the economic feasibility of the project.

14.2.4 Summary of Sensitivity Study Results

The results of sensitivity studies are summarized ,for your references, as follows:

1) Main Report (share allocation: PWA formula)

   a. Economic Benefit vs Cost (see Table-14.13)

      i) at 1986 price 1.33 : 1

      ii) discounted at 10 % p.a. 0.73 : 1

   b. Average incremental cost (see Table-10.13 of App.10) 6.24 Baht

   c. Economic internal rate of return

      i) prevailing tariff as unit of benefit (Table-14.14) 9.39 %

      ii) AIC as unit of benefit (Table-10.17 of App.10) 10.82 %

2) Sensitivity Study (share allocation: new formula)

   a. Economic Benefit vs Costs (see Table-10.15 of APP.10)

      i) at 1986 price 2.09 : 1

      ii) discounted at 10 % p.a. 0.82 : 1

   b. Average incremental cost (see Table-10.14 of App.10) 6.27 Baht

c. Economic internal rate of return

i) prevailing tariff used as unit of benefit (see Table-10.16 of App.10)	10.06 %
ii) AIC used as unit of benefit (see Table-10.18 of App.10)	10.82 %

14.3 Considerations on Water Tariffs

14.3.1 General

As discussed below, this chapter makes the following suggestions for successful implementation of the project as well as effective post-implementation operation and maintenance of the improved water supply system proposed in this feasibility study.

1) periodical upward revisions, every three-year revisions for example, to cover price escalations.

2) consideration for lower tariff burdens for users of lower income brackets.

3) study of an appropriate level of connection charges and such other factors as cost of drilling a new well in connection with the willingness of potential new consumers in the project area.

4) consideration for alleviating the burden of share of PWA Head and Regional Office overhead expenses allocable to small-sized water-works.

14.3.2 Present Level of Water Tariffs

1) The average water tariff level

The average water tariff charged both to domestic and other consumers in Suphanburi for the six months starting October 1985, the first month after the recent across-the-board water tariff revision which took place from November 1984, was 6.61 Baht/m3.

As shown in Table-14.3, the water tariff level will be 13.6 % higher than the projected unit cost of water in 1987, and will exceed unit cost of water by 4.3 % in 2000.

2) Ability and Willingness to Pay

As shown in Table-14.15, the average household income per month of all households who replied to the questionnaire survey conducted in January 1986 is estimated at 3,225 Baht in Suphanburi. If the criteria of 3 % of average household income which OECF and other international lending institutions recommend as the maximum payable limit of water tariffs is applied, the limit of ability to pay by dwellers is, as shown in Table-14.16, estimated at the 12.1 Baht/m3. This maximum payable amount is found higher than the prevailing average water tariff level.

The average expressed willingness-to-pay amount of those households willing to connect is calculated, as shown in Table-14.16, at 6.5 Baht/m3, almost equal to the prevailing average water tariff. It is to be noted that the willing-to-pay amount stated in a questionnaire survey always reflects the psychology of purchasers to pay as little as possible.

The prevailing water tariff level is thus found appropriate to cover operation and maintenance expenses of the waterworks and also from the view point of the ability to pay of the dwellers in Suphanburi.

Of the total repliers, on the other hand, the share of those households belonging to the income brackets less than 2,000 Baht/month whose average income is assumed at around 1,300 Baht/month, as shown in Table-14.16, amounts to 44.7 %.

The maximum payable water rate for those households, which consist of 5.3 members according to the questionnaire survey and consume water at the rate of 84 lpcd, is estimated at around 2.93 Baht/m3. This is lower than the prevailing PWA water rate (4.5 Baht/m3) applicable to the corresponding water consumption by these low income consumers. This suggests a need of special consideration for lower water rates applicable to those households of low income brackets.

It was also found out during the course of questionnaire survey the prevailing high connection charges were serving to dampen the willingness of potential new consumers to connect. This was found true particularly when connection charges exceeded the cost of well drilling where water of comparatively good quality was available.

Table-14.15 MAXIMUM PAYABLE PRICE FOR WATER
IN
SUPHANBURI

The assumed maximum domestic payable price for water to be used for financial and economic analysis was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		84
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		5.29
(3) AVERAGE HOUSEHOLD INCOME PER MONTH		3,225
(A) LESS THAN 2,000 Baht	44.7%	
(B) 2,000 - 3,000 Baht	27.5%	
(C) 3,000 - 4,500 Baht	9.7%	
(D) 4,500 - 6,000 Baht	6.2%	
(E) 6,000 - 7,500 Baht	5.1%	
(F) 7,500 - 10,000 Baht	4.3%	
(G) 10,000 - 15,000 Baht	2.0%	
(H) 15,000 - 50,000 Baht	0.4%	
(I) OVER 50,000 Baht	0.1%	

(4) MAXIMUM PAYABLE PRICE FOR WATER PER M3
((3)x0.05)/((1)x(2)x30/1000)= 12.1 Baht/m3

Note: 5% of monthly Household income assumed to be the maximum payable amount for water charges. (according to the World Bank guideline.)

SOURCE : QUESTIONNAIRE SURVEY, JANUARY 1986

Table-14.16 WILLING-TO-PAY PRICE FOR WATER
IN
SUPHANBURI

The assumed willing-to-pay value of water to be used as a basis of measuring the economic value of water volume benefits was estimated by the following formula.

FORMULA:

(1) ASSUMED DOMESTIC PER CAPITA DEMAND (lpcd), JANUARY 1986		84
(2) ASSUMED NUMBER OF HOUSEHOLD MEMBERS, JANUARY 1986		5.29
(3) AVERAGE WILLING-TO-PAY AMOUNT PER MONTH		87.15
(A) Up to 50 Baht	53.9%	
(B) Up to 100 Baht	37.6%	
(C) Up to 200 Baht	7.3%	
(D) Up to 500 Baht	0.8%	
(E) Up to 1,000 Baht	0.4%	

(4) WILLING-TO -PAY PRICE PER M3
(3)/((1)x(2)x30/1000) = 6.5 Baht/m3

14.3.3 Future Water Tariff Considerations

As forecast in Section 14.1.4, the net cumulative cash flow surpluses are projected to produce positive figures up to 2000, if the tariffs are escalated same as price increases of 3.3 % per annum. It is however projected, as shown in Appendix 10, Table-10.3 that if the water tariff level is kept unchanged, the annual revenue-expenditure balance will turn to deficit from 1990 and the cumulative balance from 1993 and both will remain negative up to 2000. This suggests an advisability of raising the water tariffs to cover price escalations. Ideally speaking such revisions should be made as frequently as possible. In view of the past performance and the political and social climate of Thailand, this study recommends periodical revisions of water tariffs with three- to four-year intervals.

Constant regard is required to be paid to the relation between unit cost of water and the prevailing water tariff level. In this connection such accounting items as the share of PWA Head Office and Regional Office overhead expenses, debt service expenses and allocation of depreciation cost, as referred to in Section 14.1.4, are important factors in determining unit cost of water. Complaints are heard about the formula being used in allocating the share of PWA Head Office and Regional Office overhead expenses, which imposes unfairly heavy burdens on small sized waterworks, the reason being that per waterworks portions both of Head and Regional Office expenses (one third of their expenses) are allocated to each waterworks regardless of the production scales and earning positions of waterworks as discussed in 14.1.14, 2), 2.2. It is therefore suggested that consideration be paid to the alleviation of such burdens on small sized waterworks. In this connection, a tentative formula is suggested in Appendix 10, Table-10.4 as a hint to such consideration.