

9. Implementation Plan

9.1 Water Source Development

The water source development for the proposed water supply system should be firstly carried out since the existing water sources can supply only a part of the demand in Bangwat and Municipality systems. The theoretical water demand was calculated in Chapter 4; however, this prediction was made on the assumption that the raw water is fully available through the period of the prediction. Therefore, such demand should be called the "Potential Demand". The amount of water to be supplied is, however, not as much as these figures because of a lack of water sources.

In this Chapter, the "Possible Water Supply Amount" is determined with a consideration on the raw water development schedule, in which the priority in the dam construction is also studied from the view point of the economical implementation of the water supply development.

The methodology of the study is described with following steps:

- (1) To allocate the potential water demand by zone;
- (2) To calculate the possible raw water intake capacity from the available sources in every year;
- (3) To calculate the possible water supply amount on the basis of the available raw water sources;
- (4) To make an economic comparison of possible alternatives; and

- (1) Allocation of the potential water demand by zone

This allocation is as presented in the Section 8-2-1.

- (2) Possible raw water intake capacity

An amount of the raw water intake will depend on the existence of the dams. Since the dam construction project requires a huge investment for both the construction and the land acquisition, it is not realistic to expect to construct all of the proposed dams at once.

In preparing the alternatives for the dam construction schedule, the following factors are considered:

- a. It is assumed that at most the three dams will be constructed in the first stage while other dams will be constructed later.
- b. The construction of the Khlong Lo Yung Dam is inevitable for the water supply for Zone 7 and Thai Muang area, but will be difficult to be implemented soonest because of the objection of the local people. Therefore, this dam is planned to be constructed in the second phase.
- c. Khlong Katha and Khao Che Tra dams will be constructed in the first phase since these dams are needed for commencing the water supply for Zones 1, 2, 3, 4, 8, and 9, as well as supplement the water demand of the municipality.
- d. Bang Niew dam should be constructed before Khao Che Tra dam, since it is lower in the elevation so that the treatment plant

will be located near the Bang Nieo dam.

Considering these conditions, three alternatives for dam construction are proposed for comparison study as shown in Table 9-1-1.

Table 9-1-1 Alternative for the Dam Construction Schedule

| Phase | Alternative 1 | Alternative 2 | Alternative 3 |
|-----------------------------|--|---|---|
| First Phase (1990-1993) | Bang Tho Sung Khlong Katha Bang Nieo Dam | Khlong Katha Bang Nieo Dam Khao Che Tra | Khlong Katha Bang Nieo Dam |
| Second Phase (1991-1994) | Khlong Lo Yung | Khlong Lo Yung | Khlong Lo Yung |
| Third Phase | Khao Che Tra (2002-2005) | Bang Tho Sung (2006-2009) | Khao Che Tra (2002-2005) Bang Tho Sung (2006-2009) |

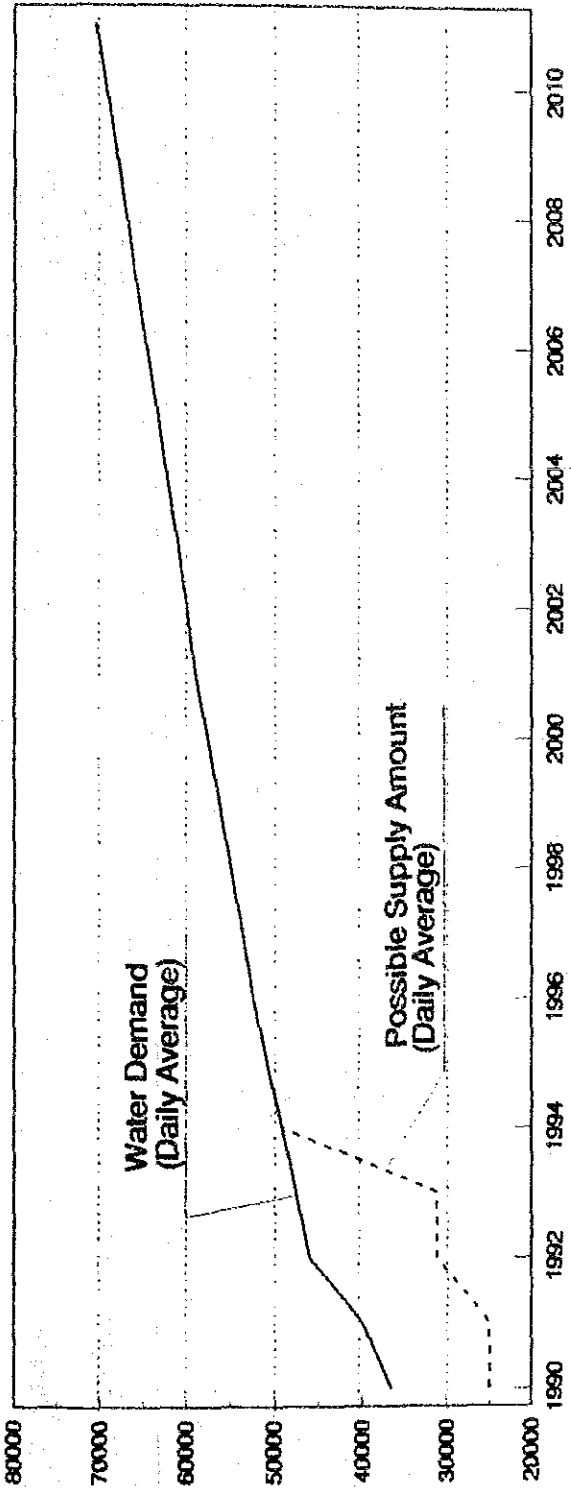
Note : In the Alternatives 2 and 3, a temporary raw water intake from the Khlong Bang Yai by a pumping station will be operated until the Bang Tho Sung Dam has been completed.

(3) Possible water supply amount

On the basis of the alternatives of the dam construction, possible water supply amounts are calculated by served zone on the daily average basis. A total supply amount is determined by summarizing the supply amount of each zone.

The Figures 9-1-1 to 9-1-3 show the potential water demand and possible supply amount as well as the dam construction schedule. The detailed calculations are shown in Appendix A9-1.

The amounts to be supplied from each dam are shown in Figures 9-1-4 to 9-1-6.



| | |
|----------------|---------------------|
| Khlong Ban Yai | Design/Construction |
| Bang Tho Sung | Design/Construction |
| Khlong Katha | Design/Construction |
| Bang Nieo Dam | Design/Construction |
| Khao Che Tra | Design/Construction |
| Khlong Lo Yung | Design/Construction |


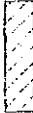
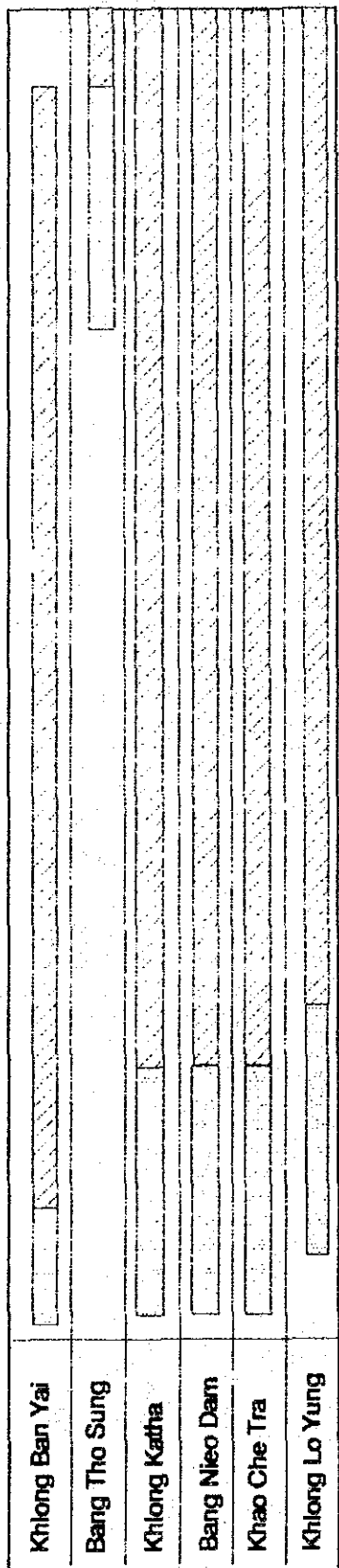
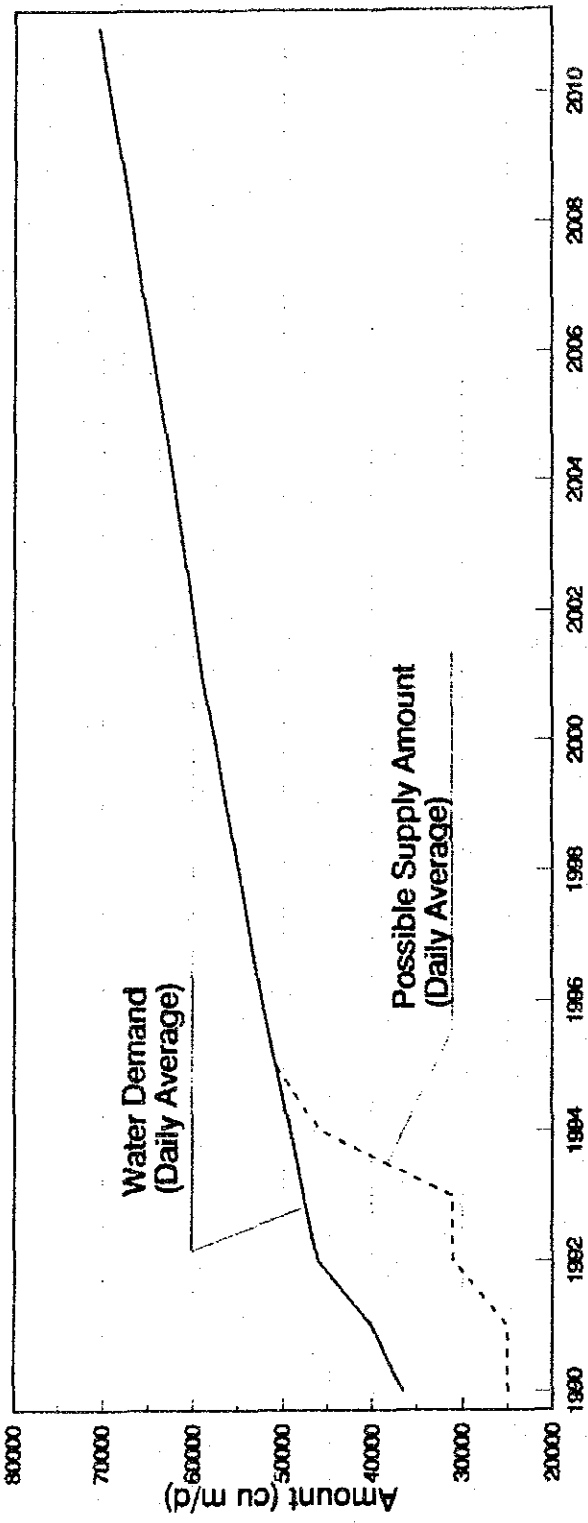
 Design/Construction
 Operation

FIGURE 9-1-1-1
Water Source Development Plan
(Alternative 1)




 Design/Construction
 Operation

FIGURE 9-1-2
Water Source Development Plan
 (Alternative 2)

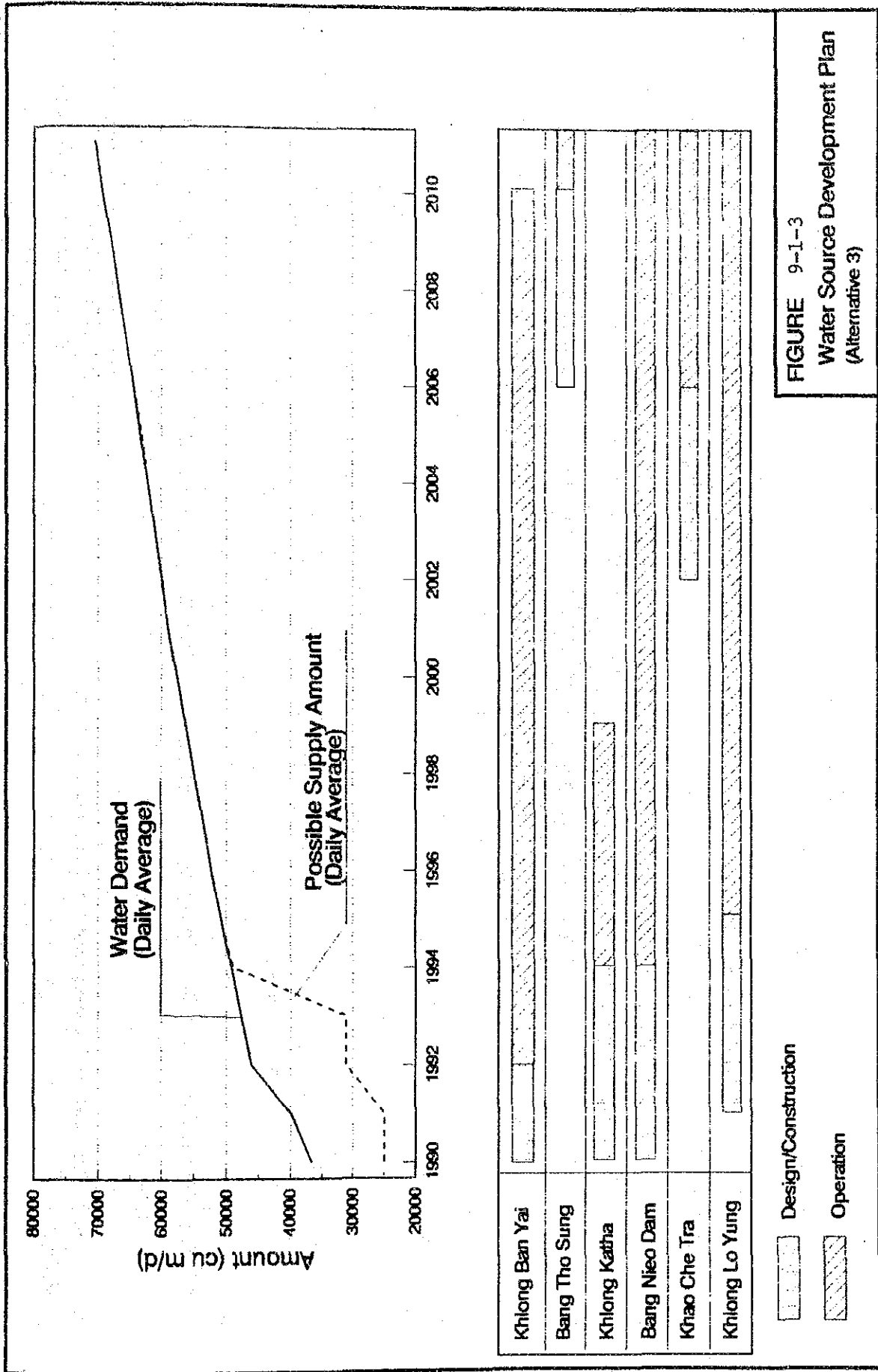


FIGURE 9-1-3
Water Source Development Plan
 (Alternative 3)

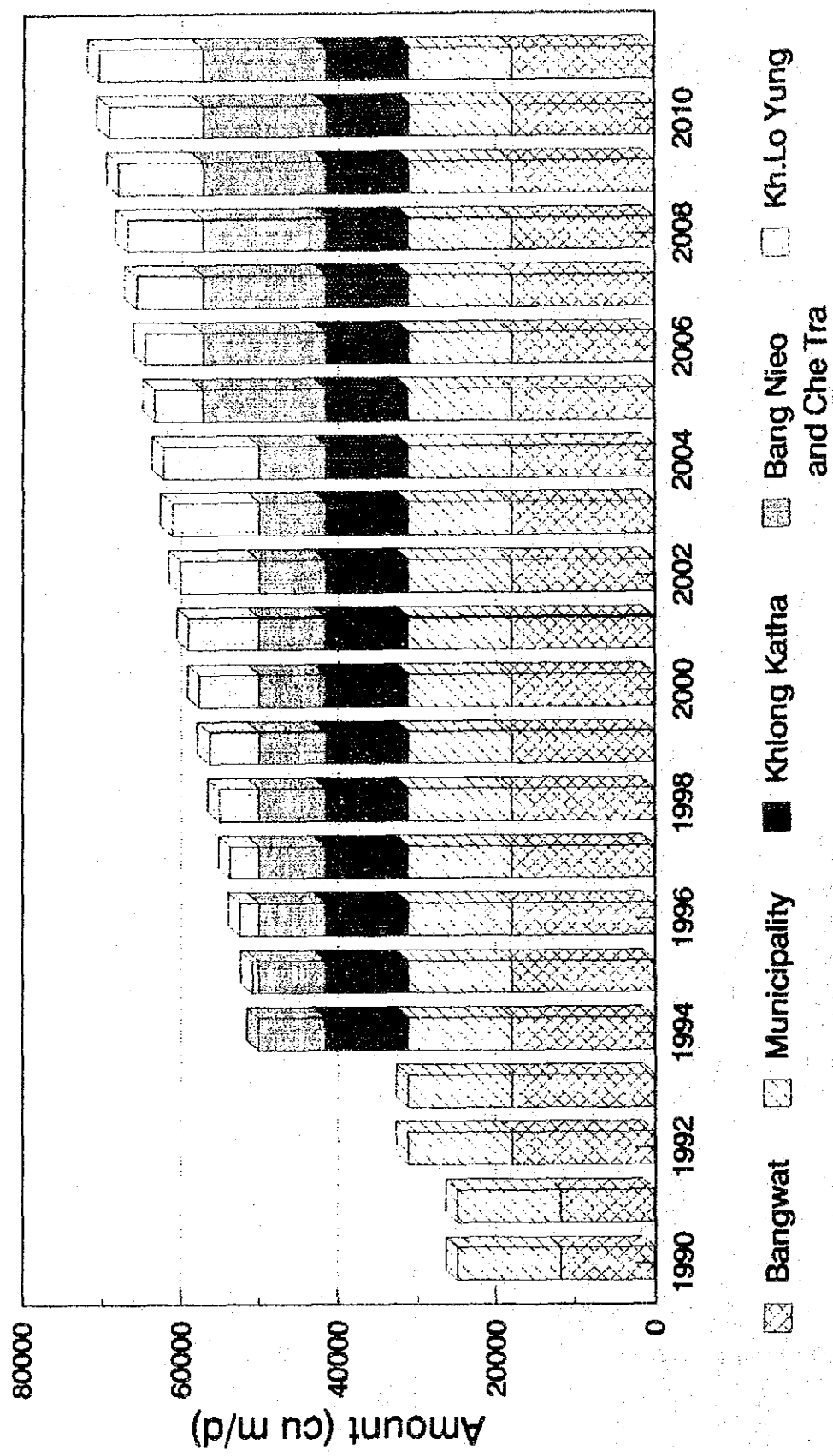


FIGURE 9-1-4
Supply Amount by Source
(Alternative 1)

Note : Supply amounts are expressed in Daily Average Demand

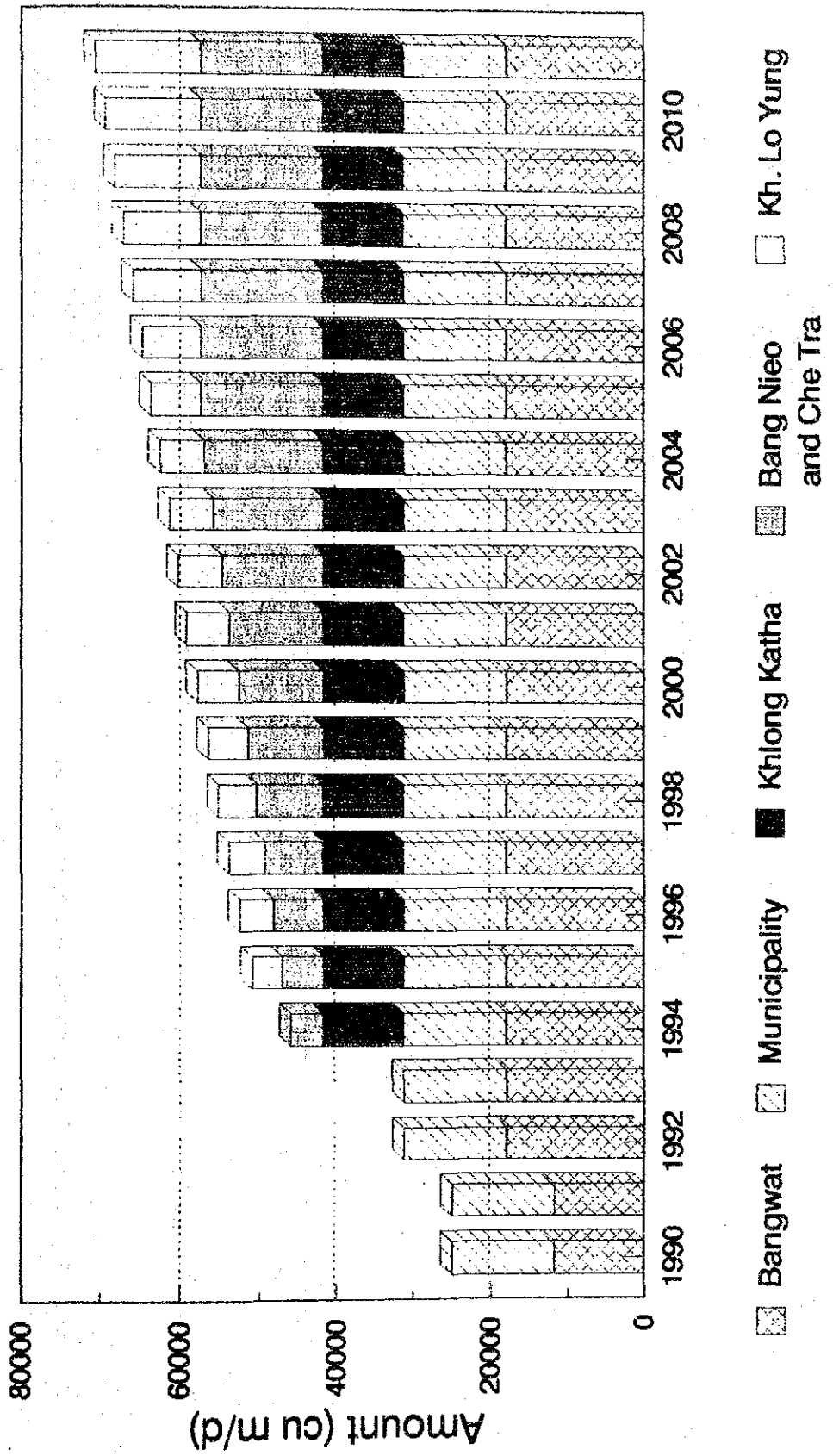


FIGURE 9-1-5
Supply Amount by Source
(Alternative 2)

Note : Supply amounts are expressed in Daily Average Demand.

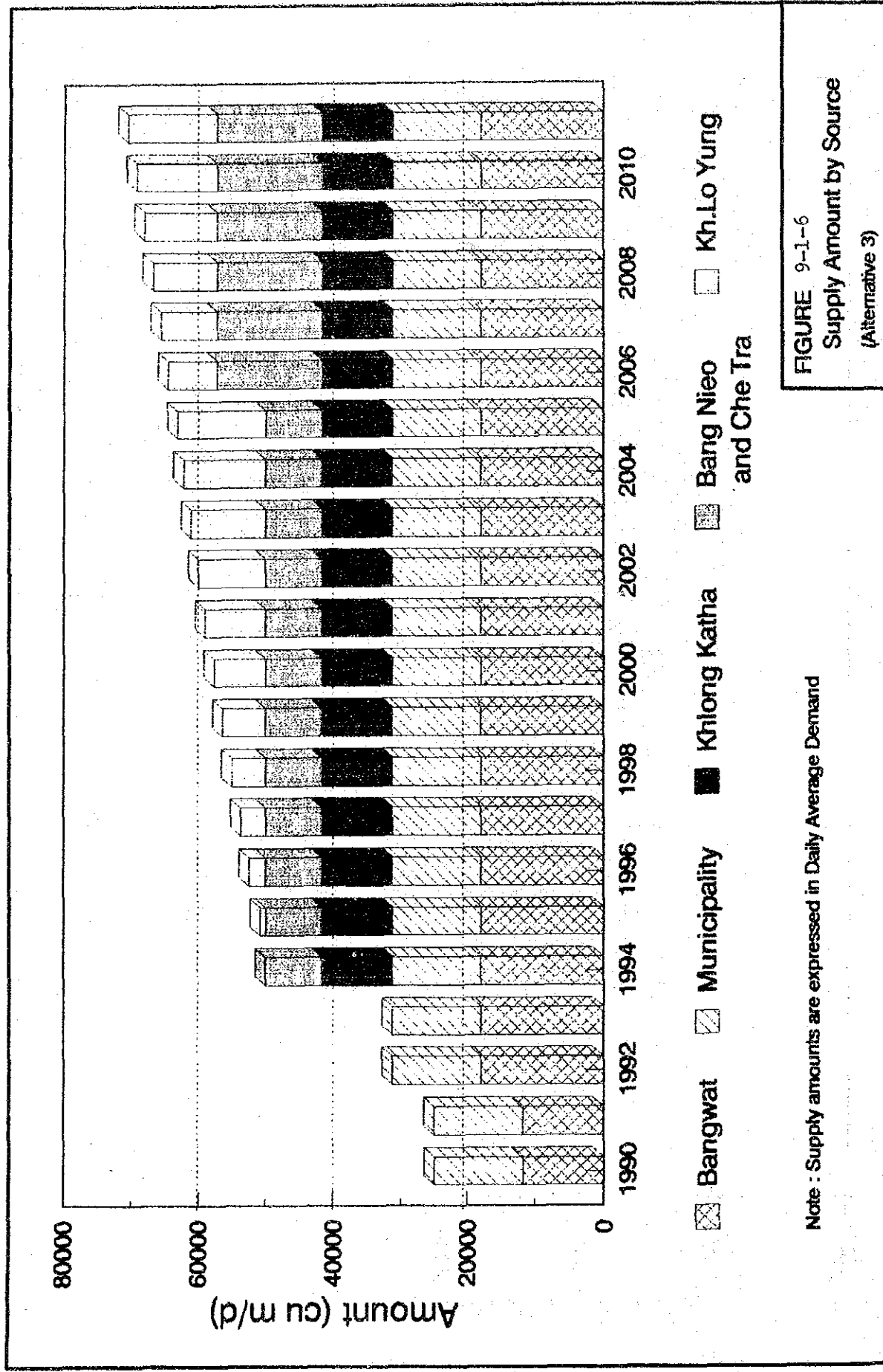


FIGURE 9-1-6
Supply Amount by Source
 (Alternative 3)

Note : Supply amounts are expressed in Daily Average Demand

(4) Economic comparison of the alternatives

The proposed alternatives were compared from the view point of the economical advantage. In the comparison, the following conditions are considered:

- a. The operation cost consisting of the energy and chemical costs are counted. The construction and land costs of the proposed dams are also counted on the scheduled year. Other costs, such as the construction cost of the water supply facilities, and manning cost, are not included since they are considered to be same for all alternatives.
- b. Comparison was made by calculating the average unit operation cost per volume of supplied water for the period from 1990 to 2011. This unit cost is calculated in Net Present Value (NPV) with a discount rate of 9 percent. The calculation is presented as follows:

$$\text{Average Unit Cost} = \frac{\sum \text{NPV (Cost for 1990-2011)}}{\sum \text{NPV (Supply Amount for 1990-2011)}} \\ \text{(Baht/cu m)}$$

The result of the calculation is shown in the Table 9-1-2.

As shown in the Table 9-1-2, Alternative 3 shows the lowest unit cost which means the highest economic advantage, although the operation cost of the pumping station is highest. This is because the construction of the Bang Tho Sung dam will be scheduled later. By this comparison, Alternative 3 is recommended for the dam construction priority.

Detailed calculations are presented in Appendix A-9-1.

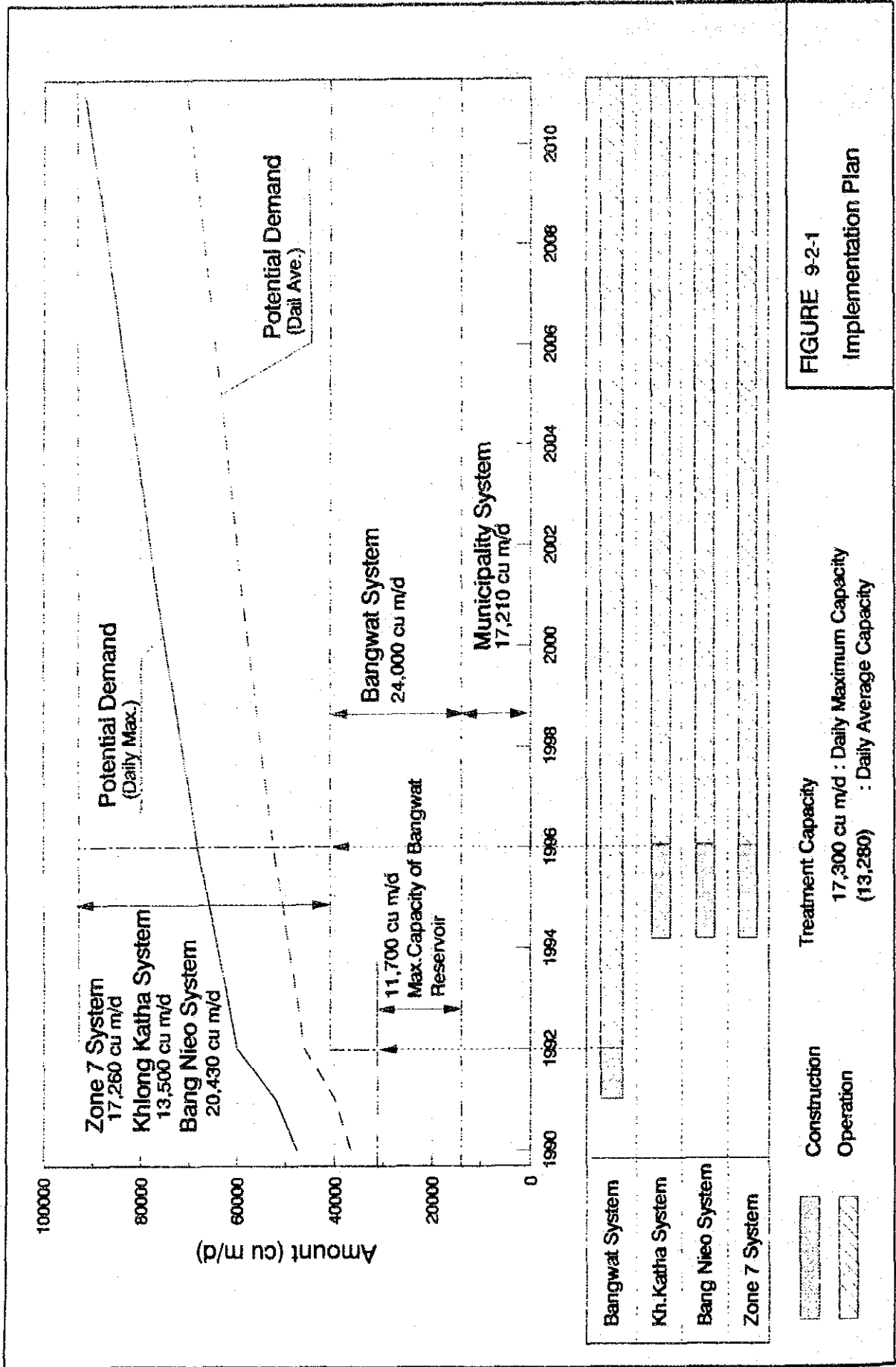
Table 9-1-2 Economic Comparison of Alternatives

| Year | Alternative 1 | | | Alternative 2 | | | Alternative 3 | | |
|-------------------------|------------------------------|-------------------------|----------------------------|------------------------------|-------------------------|----------------------------|------------------------------|-------------------------|----------------------------|
| | Supply Amount (cu m/d) | Dam Cost (B 1000) | Energy Cost (B 1000) | Supply Amount (cu m/d) | Dam Cost (B 1000) | Energy Cost (B 1000) | Supply Amount (cu m/d) | Dam Cost (B 1000) | Energy Cost (B 1000) |
| Unit Cost (Baht cu m) = | | | 15.041 | | | 14.184 | | | 12.995 |
| | | | | | | | | | |
| | | Total Cost | | Total Cost | | Total Cost | | | |
| NPV | 447,846 | | 2,458,643 | 445,153 | | 2,304,602 | 447,846 | | 2,124,274 |
| Total | 1,199,327 | | 3,764,555 | 1,195,183 | | 3,796,590 | 1,199,327 | | 3,795,982 |
| | | 3,604,836 | 159,719 | | 3,604,836 | 191,753 | | 3,604,836 | 191,146 |
| 1990 | 24,938 | | 3,152 | 24,938 | | 3,152 | 24,938 | | 3,152 |
| 1991 | 24,938 | | 4,165 | 24,938 | | 4,165 | 24,938 | | 4,165 |
| 1992 | 31,162 | 799,725 | 5,418 | 31,162 | 684,519 | 5,418 | 31,162 | 495,697 | 5,418 |
| 1993 | 31,162 | 1,613,595 | 5,433 | 31,162 | 1,498,389 | 5,433 | 31,162 | 1,309,567 | 5,433 |
| 1994 | 50,019 | 813,870 | 6,119 | 45,875 | 813,870 | 7,874 | 50,019 | 813,870 | 7,874 |
| 1995 | 50,821 | | 6,348 | 50,821 | | 8,089 | 50,821 | | 8,089 |
| 1996 | 52,437 | | 6,498 | 52,437 | | 8,397 | 52,437 | | 8,397 |
| 1997 | 53,710 | | 6,813 | 53,710 | | 8,708 | 53,710 | | 8,708 |
| 1998 | 55,004 | | 7,133 | 55,004 | | 9,025 | 55,004 | | 9,025 |
| 1999 | 56,322 | | 7,458 | 56,322 | | 9,346 | 56,322 | | 9,346 |
| 2000 | 57,662 | | 7,575 | 57,662 | | 9,576 | 57,662 | | 9,576 |
| 2001 | 59,026 | | 7,883 | 59,026 | | 9,890 | 59,026 | | 9,890 |
| 2002 | 60,076 | | 8,104 | 60,076 | | 10,115 | 60,076 | | 10,115 |
| 2003 | 61,161 | 188,823 | 8,208 | 61,161 | | 10,288 | 61,161 | | 10,288 |
| 2004 | 62,281 | 188,823 | 8,431 | 62,281 | | 10,518 | 62,281 | 188,823 | 10,518 |
| 2005 | 63,436 | | 8,167 | 63,436 | | 10,726 | 63,436 | 188,823 | 10,119 |
| 2006 | 64,626 | | 8,246 | 64,626 | | 10,292 | 64,626 | | 10,292 |
| 2007 | 65,747 | | 8,477 | 65,747 | | 10,528 | 65,747 | | 10,528 |
| 2008 | 66,897 | | 8,714 | 66,897 | 304,029 | 10,772 | 66,897 | 304,029 | 10,772 |
| 2009 | 68,079 | | 8,958 | 68,079 | 304,029 | 11,023 | 68,079 | 304,029 | 11,023 |
| 2010 | 69,291 | | 9,089 | 69,291 | | 9,089 | 69,291 | | 9,089 |
| 2011 | 70,533 | | 9,332 | 70,533 | | 9,332 | 70,533 | | 9,332 |

Note : Construction and manning costs are considered to be same for all cases.

9.2 Implementation Plan

The implementation of the water supply system is established on the basis of the recommended dam construction schedule, and is shown in Figure 9-2-1.



10. ORGANIZATION OF WATERWORKS

The organization of the waterworks is proposed with consideration on the components and size of the proposed water supply system. The construction of sections is based on the existing organization chart of the waterworks. Some additional sections are proposed for the operation of the proposed water treatment plants and a raw water pumping station. The proposed organization consists of the administration, the water production, the operation of the raw water pumping station at Khlong Lo Yung, and the service section as shown in Figure 10-1.

The major tasks and number of staff of each section are described as follows:

(1) Administration Section

This section will be responsible for the administrative and financial issues of the waterworks. The works to be done will include the preparation of the general administration for the waterworks' staff, meter reading and preparation of bills, collection of water charge, and management of the documents and records.

For the number of staff, a number of the existing system is considered as a basis and increased by 80 percent of the increase of water demand. For a number of meter reader is, however assumed to be three persons per each treatment system.

(2) Water Production Section

This section will be responsible for the operation and maintenance of each water treatment plant and raw water intake for the plant. Inspection of the transmission pipelines will be performed by this section. The maintenance of distribution pipeline under each system will be taken care by this section.

It is assumed that staff will consist of one chief and six staffs for each treatment plant.

(3) Raw Water Pumping Station Section

This section will be responsible for the operation and maintenance of the raw water pumping station at Khlong Lo Yung.

It is assumed that one chief and two staffs will be manned at the pumping station.

(4) Service Section

This section will be responsible for setting and repair of house connection.

A number of staff is assumed to increase by five persons as treatment systems will be expanded.

Table 10-1 shows numbers of staff.

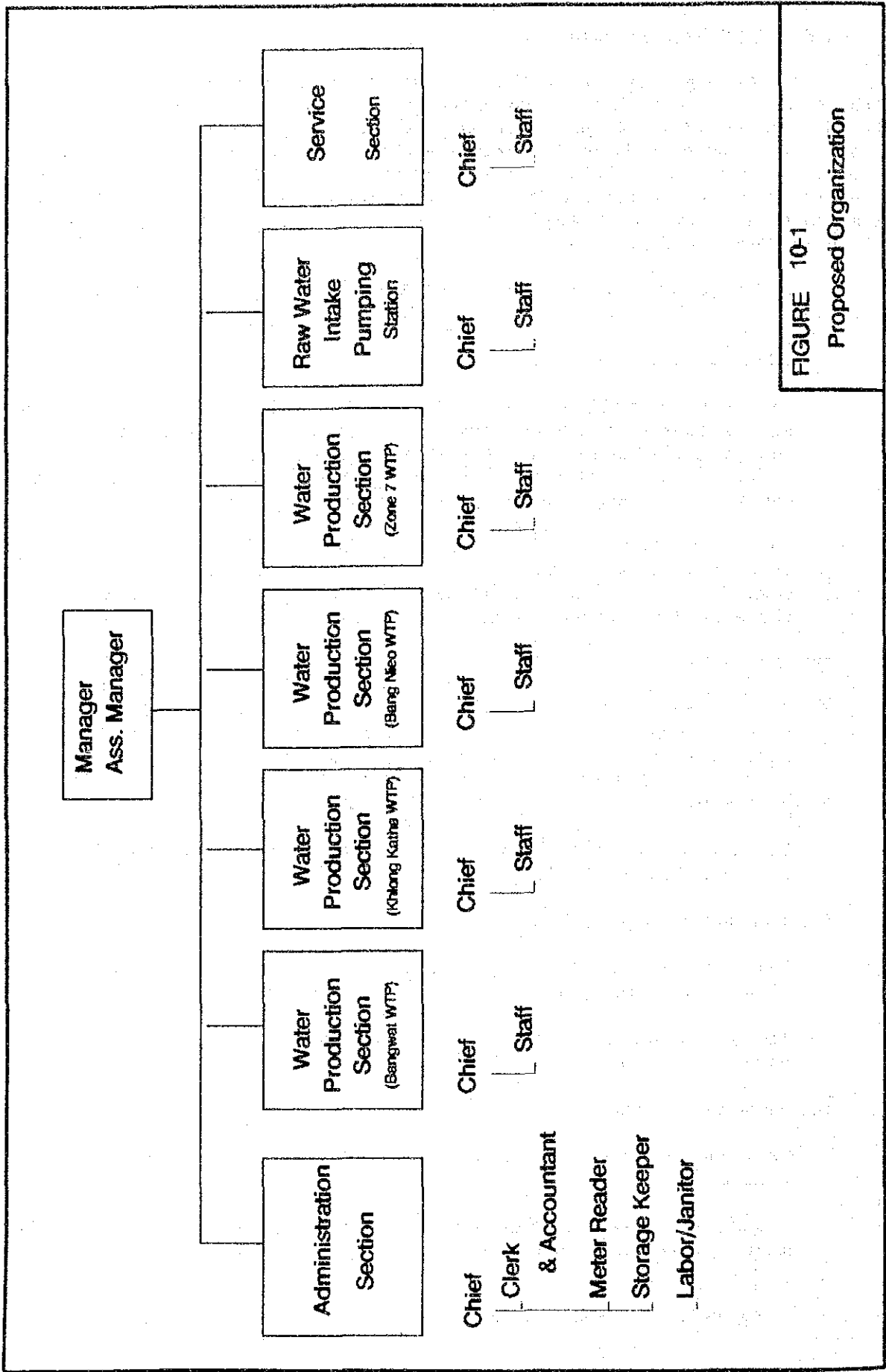


FIGURE 10-1
Proposed Organization

Table 10-1 Proposed Number of Staff

| Year | Manager | Administrative | Labor | Water Production | Chief Staff | Chief Staff | Chief Staff | Chief Staff | Chief Staff | Chief Staff | Service | | | |
|------|---------|----------------|----------------|------------------|--------------|---------------|--------------|------------------|--------------|--------------|--------------|---|---|----|
| | :Total | :Clerk | :Storage Meter | :Kath WTP | :Bangwat WTP | :Bang Nee WTP | :Zone 7 WTP | :Kh. LoYang Pump | | | Section | | | |
| | | :Keeper | :Reader | :etc. | :Chief Staff | :Chief Staff | :Chief Staff | :Chief Staff | :Chief Staff | :Chief Staff | :Chief Staff | | | |
| 1990 | 24 | 1 | 3 | 2 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1991 | 24 | 1 | 3 | 2 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1992 | 24 | 1 | 3 | 2 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1993 | 24 | 1 | 3 | 2 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1994 | 24 | 1 | 3 | 2 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1995 | 25 | 1 | 3 | 3 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1996 | 26 | 1 | 4 | 3 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1997 | 26 | 1 | 4 | 3 | 3 | 1 | 1 | 1 | 6 | 0 | 0 | 0 | 1 | 5 |
| 1998 | 51 | 1 | 4 | 3 | 9 | 1 | 1 | 1 | 6 | 1 | 6 | 0 | 0 | 10 |
| 1999 | 51 | 1 | 4 | 3 | 9 | 1 | 1 | 1 | 6 | 1 | 6 | 0 | 0 | 10 |
| 2000 | 51 | 1 | 4 | 3 | 9 | 1 | 1 | 1 | 6 | 1 | 6 | 0 | 0 | 10 |
| 2001 | 51 | 1 | 4 | 3 | 9 | 1 | 1 | 1 | 6 | 1 | 6 | 0 | 0 | 10 |
| 2002 | 51 | 1 | 4 | 3 | 9 | 1 | 1 | 1 | 6 | 1 | 6 | 0 | 0 | 10 |
| 2003 | 71 | 1 | 4 | 4 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2004 | 72 | 1 | 5 | 4 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2005 | 72 | 1 | 5 | 4 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2006 | 72 | 1 | 5 | 4 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2007 | 72 | 1 | 5 | 4 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2008 | 73 | 1 | 5 | 5 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2009 | 74 | 1 | 6 | 5 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2010 | 74 | 1 | 6 | 5 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |
| 2011 | 74 | 1 | 6 | 5 | 12 | 2 | 2 | 1 | 6 | 1 | 6 | 1 | 2 | 15 |

11. Project Cost Estimates

11.1 Construction Cost

The construction cost of the proposed water supply system was calculated for each component of facility. Table 11-1 shows a summary of the construction cost based on the 1989 price.

Table 11-1 Summary of the Construction Cost
(unit : Baht 1000)

| Item | Dimension | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) | Remark |
|------------------------------------|--|---------------------------|-------------------------------------|-----------------------------------|--------|
| A. Raw Water Development | | | | | |
| A-1. Construction Cost | | | | | |
| 1. | Bang Tho Sung Dam | 514,307 | 334,660 | 179,647 | |
| 2. | Khlong Katha Dam | 459,544 | 297,317 | 162,227 | |
| 3. | Bang Nieo Dam and Che Tra Dams | 440,745 | 275,527 | 165,218 | |
| 4. | Khlong Lo Yung Dam | 474,757 | 310,100 | 164,657 | |
| Total of A-1. | | 1,889,354 | 1,217,604 | 671,750 | |
| A-2. Land Cost | | | | | |
| 1. | Bang Tho Sung Dam | 93,750 | 0 | 93,750 | |
| 2. | Khlong Katha Dam | 125,000 | 0 | 125,000 | |
| 3. | Bang Nieo Dam and Che Tra Dams | 343,750 | 0 | 343,750 | |
| 4. | Khlong Lo Yung Dam | 375,000 | 0 | 375,000 | |
| Total of A-2. | | 937,500 | 0 | 937,500 | |
| Total of A. | | 2,826,854 | 1,217,604 | 1,609,250 | |
| B. Water Supply Development | | | | | |
| B-1. Construction Cost | | | | | |
| 1. | Bangwat System - Immediate Improvement | 104,142 | 63,065 | 41,078 | |
| 2. | Bangwat System | 36,320 | 29,056 | 7,264 | |
| 3. | Khlong Katha System | 83,774 | 44,809 | 38,965 | |
| 4. | Bang Neow Dam System | 321,010 | 221,873 | 99,137 | |
| 5. | Zone 7 System | 284,193 | 193,706 | 90,487 | |
| Total of B-1. | | 829,439 | 552,508 | 276,931 | |
| B-2. Land Cost | | | | | |
| 1. | Bangwat System - Immediate Improvement | 7,031 | 0 | 7,031 | |
| 2. | Bangwat System | 0 | 0 | 0 | |
| 3. | Khlong Katha System | 7,500 | 0 | 7,500 | |
| 4. | Bang Neow Dam System | 11,250 | 0 | 11,250 | |
| 5. | Zone 7 System | 94 | 0 | 94 | |
| Total of B-2. | | 25,875 | 0 | 25,875 | |
| Total of B. | | 855,314 | 552,508 | 302,806 | |
| Grand Total of A. B. | | 3,682,168 | 1,770,112 | 1,912,056 | |

Table 11-2 Construction Cost for Bangwat Immediate Improvement
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|--|-----------|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| A. Temporary Water Source Development | | | | | |
| a. Temporary Pumping Station | | | | | |
| Intake Weir Structure | | | 200 | 60 | 140 |
| Pump House (50 m ²) | | | 225 | 68 | 158 |
| Pump Unit (300 mm, 150 kw, 3 units) | | 1,000,000 | 3,000 | 2,400 | 600 |
| Electrical Works (50 % of Pump) | | | 1,500 | 1,200 | 300 |
| Miscellaneous (10 % of above) | | | 493 | 373 | 120 |
| Sub-total of a. | | | 5,418 | 4,100 | 1,317 |
| b. Raw Water Transmission Pipe | | | | | |
| SP 700 mm, L= 5,000 m | | 6,610 | 33,050 | 26,440 | 6,610 |
| Land Acquisition for Pumping Station | | | | | |
| | 500 sq m | 1,250 | 625 | 0 | 625 |
| Total of A. | | | 39,093 | 30,540 | 8,552 |
| B. Beach Water Supply Improvement | | | | | |
| a. High Level Reservoir | | | | | |
| Volume 900 cu m | | | 2,250 | 675 | 1,575 |
| b. Distribution Reservoir for Patong | | | | | |
| Volume 3,800 cu m | | | 7,980 | 2,394 | 5,586 |
| c. Distribution Reservoir for Karon and Katha | | | | | |
| Volume 1,200 cu m | | | 3,000 | 900 | 2,100 |
| d. Transmission Pipeline from Patong to Karon | | | | | |
| SP 300 mm, L= 8,000 m | | 2,940 | 23,520 | 18,816 | 4,704 |
| SP 200 mm, L= 1,200 m | | 1,770 | 2,124 | 1,699 | 425 |
| e. Distribution Pipeline | | | | | |
| (i) Patong (Zone 10) | | | | | |
| Replacement | | | | | |
| AC 200 mm, 1,390 m | | 890 | 1,237 | 371 | 866 |
| AC 250 mm, 360 m | | 1,180 | 425 | 127 | 297 |
| AC 300 mm, 5,715 m | | 1,620 | 9,258 | 2,777 | 6,481 |
| New Construction | | | | | |
| AC 150 mm, 800 m | | 610 | 488 | 146 | 342 |
| AC 200 mm, 1,940 m | | 890 | 1,727 | 518 | 1,209 |
| SP 400 mm, 150 m | | 4,150 | 623 | 187 | 436 |
| (ii) Karon and Katha (Zone 11) | | | | | |
| New Construction | | | | | |
| AC 150 mm, 800 m | | 610 | 488 | 146 | 342 |
| AC 200 mm, 9,550 m | | 890 | 8,500 | 2,550 | 5,950 |
| AC 300 mm, 1,600 m | | 1,620 | 2,592 | 778 | 1,814 |
| (iii) Kathu (Zone 6) | | | | | |
| AC 150 mm, 2,400 m | | 610 | 1,464 | 439 | 1,025 |
| Sub-total of a. to e. | | | 65,675 | 32,524 | 33,150 |

Table 11-2 Construction Cost for Bangwat Immediate Improvement (Cont'd)
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|---------------------------------------|------------|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| f. Land Acquisition | | | | | |
| High Level Reservoir, | 1,300 sq m | (*) | 0 | 0 | 0 |
| Dist. Reservoir (Patong) | 1,300 sq m | 3,125 | 4,063 | 0 | 4,063 |
| Dist. Reservoir (Karon) | 750 sq m | 3,125 | 2,344 | 0 | 2,344 |
| Sub-total of f. | | | 6,406 | 0 | 6,406 |
| Total of B | | | 72,081 | 32,524 | 39,557 |
| Total of Immediate Improvement | | | | | |
| Construction Cost | | | 104,142 | 63,065 | 41,078 |
| Land Cost | | | 7,031 | 0 | 7,031 |
| Total | | | 111,174 | 63,065 | 48,109 |

(*) : Land for the High Level Reservoir is cost-free because of the government property.

Table 11-3 Construction Cost for Bangwat System
 (other than Immediate Improvement)
 (Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|---|-----------|------------------------|------------------------------|--|--------------------------------------|
| A. Water Source Development | | | | | |
| Bang Tho Sung Dam | | | 514,307 | 334,660 | 179,647 |
| Land Acquisition, 0.3 km ² (300,000 m ²) | | 312.5 | 93,750 | 0 | 93,750 |
| Total of A. | | | 608,058 | 334,660 | 273,397 |
| B. Water Supply Development | | | | | |
| Raw Water Pipe | | | | | |
| SP 500 mm, L = 8,000 m | | 4,540 | 36,320 | 29,056 | 7,264 |
| Total of B. | | | 36,320 | 29,056 | 7,264 |

Table 11-4 Construction Cost for Khlong Katha System
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|---|----------------------|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| A. Water Source Development | | | | | |
| Khlong Katha Dam | | | 459,544 | 297,317 | 162,227 |
| Land Acquisition, 0.4 km ² (400,000 m ²) | | 312.5 | 125,000 | 0 | 125,000 |
| Total of A. | | | 584,544 | 297,317 | 287,227 |
| B. Water Supply Development | | | | | |
| 1. Raw Water Pipe | | | | | |
| SP 400 mm, L = 200 m | | 3,770 | 754 | 603 | 151 |
| 2. Treatment Plant: T3 | | | | | |
| Daily Average Demand | 10,380 cu m/d | | | | |
| Daily Maximum Demand | 13,494 cu m/d | | | | |
| Maximum Capacity | 13,900 cu m/d | | | | |
| Treatment Plant Facility | | | | | |
| Receiving Well | 20 cu m | | 20 | 8 | 12 |
| Sedimentation Basin | 580 cu m/h | | 11,600 | 4,640 | 6,960 |
| Sand Filter | 580 cu m/h | | 6,960 | 2,784 | 4,176 |
| Clear Water Reservoir | 4,800 cu m | | 11,520 | 4,608 | 6,912 |
| Pumping House | 100 sq m | | 450 | 180 | 270 |
| Chemical House | 100 sq m | | 400 | 160 | 240 |
| Administrarion Bldg | 200 sq m | | 1,000 | 400 | 600 |
| Operators Houses | 200 sq m | | 1,000 | 400 | 600 |
| Mechanical Works | | (B/unit) | | | |
| Chemical Equip | Mixer, Tank, 2 units | 640,000 | 1,280 | 1,024 | 256 |
| Chlorinator | 2 kg/h x 2 sets | 360,000 | 720 | 576 | 144 |
| Pumps | 4.5 cu m/m, 4 units | 500,000 | 2,000 | 1,600 | 400 |
| Miscellaneous | 20 % of above | | 800 | 640 | 160 |
| Electrical Works | 70% of Mech. Works | | 3,360 | 2,688 | 672 |
| Miscellaneous | 20 % of above | | 8,222 | 4,111 | 4,111 |
| Sub-total of 2. | | | 49,332 | 23,819 | 25,513 |
| 3. Distribution Pipeline (Zones 3 & 4) | | | | | |
| AC 150 mm, L-12,400 m | | 610 | 7,564 | 2,269 | 5,295 |
| AC 200 mm, L- 3,600 m | | 890 | 3,204 | 961 | 2,243 |
| AC 250 mm, L- 2,000 m | | 1,180 | 2,360 | 708 | 1,652 |
| SP 500 mm, L- 4,000 m | | 5,140 | 20,560 | 16,448 | 4,112 |
| Sub-total of 3. | | | 33,688 | 20,386 | 13,302 |
| 4. Land Acquisition | | | | | |
| Treatment Plant | 24,000 sq m | 312.5 | 7,500 | 0 | 7,500 |
| Total of Water Supply Development Project | | | | | |
| Construction Cost | | | 83,774 | 44,809 | 38,965 |
| Land Cost | | | 7,500 | 0 | 7,500 |
| Total | | | 91,274 | 44,809 | 46,465 |

Table 11-5 Construction Cost for Bang Nieo Dam System
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|---|----------------------|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| A. Water Source Development | | | | | |
| Bang Nieo Dam | | | 250,599 | 156,571 | 94,028 |
| Land Acquisition, 0.5 km ² (500,000 m ²) | | 312.5 | 156,250 | 0 | 156,250 |
| Che Tra Dam | | | 190,146 | 118,956 | 71,190 |
| Land Acquisition, 0.6 km ² (600,000 m ²) | | 312.5 | 187,500 | 0 | 187,500 |
| Construction Cost | | | 440,745 | 275,527 | 165,218 |
| Land Cost | | | 343,750 | 0 | 343,750 |
| Total of A. | | | 784,495 | 275,527 | 508,968 |
| B. Water Supply Development | | | | | |
| 1. Raw Water Pipe | | | | | |
| SP 500 mm, L = 200 m | | 5,140 | 1,028 | 822 | 206 |
| 2. Treatment Plant: T4 | | | | | |
| Daily Average Demand | 15,714 cu m/d | | | | |
| Daily Maximum Demand | 20,428 cu m/d | | | | |
| Maximum Capacity | 21,000 cu m/d | | | | |
| Treatment Plant Facility | | | | | |
| Receiving Well | 20 cu m | | 20 | 8 | 12 |
| Sedimentation Basin | 875 cu m/h | | 20,125 | 8,050 | 12,075 |
| Sand Filter | 875 cu m/h | | 11,375 | 4,550 | 6,825 |
| Clear Water Reservoir | 7,000 cu m | | 16,800 | 6,720 | 10,080 |
| Pumping House | 100 sq m | | 450 | 180 | 270 |
| Chemical House | 100 sq m | | 400 | 160 | 240 |
| Administration Bldg | 200 sq m | | 1,000 | 400 | 600 |
| Operators Houses | 200 sq m | | 1,000 | 400 | 600 |
| Mechanical Works (B/unit) | | | | | |
| Chemical Equip | Mixer, Tank, 2 units | 640,000 | 1,280 | 1,024 | 256 |
| Chlorinator | 2 kg/h x 2 sets | 360,000 | 720 | 576 | 144 |
| Pumps | 6.8 cu m/m, 4 units | 600,000 | 2,400 | 1,920 | 480 |
| Miscellaneous | 20 % of above | | 880 | 704 | 176 |
| Electrical Works | 70% of Mech. Works | | 3,696 | 2,957 | 739 |
| Miscellaneous | 20 % of above | | 12,029 | 6,015 | 6,015 |
| Sub-total of 2. | | | 72,175 | 33,663 | 38,512 |

Table 11-5 Construction Cost for Bang Nieo Dam System (Cont'd)
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|--|-------------|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| 3. Distribution Pipeline | | | | | |
| (Zone 1 & 2) | | | | | |
| AC 100 mm, L= | 6,950 m | 450 | 3,128 | 938 | 2,189 |
| AC 150 mm, L= | 2,340 m | 630 | 1,474 | 442 | 1,032 |
| AC 200 mm, L= | 2,750 m | 920 | 2,530 | 759 | 1,771 |
| SP 400 mm, L= | 27,050 m | 4,270 | 115,504 | 92,403 | 23,101 |
| SP 600 mm, L= | 10,950 m | 6,710 | 73,475 | 58,780 | 14,695 |
| SP 700 mm, L= | 4,680 m | 7,930 | 37,112 | 29,690 | 7,422 |
| (Zone 8) | | | | | |
| AC 150 mm, L= | 2,000 m | 630 | 1,260 | 378 | 882 |
| AC 200 mm, L= | 2,400 m | 920 | 2,208 | 662 | 1,546 |
| AC 300 mm, L= | 5,110 m | 1,680 | 8,585 | 2,575 | 6,009 |
| (Zone 9) | | | | | |
| AC 150 mm, L= | 2,850 m | 630 | 1,796 | 539 | 1,257 |
| AC 200 mm, L= | 800 m | 920 | 736 | 221 | 515 |
| Sub-total of 3. | | | 247,806 | 187,387 | 60,419 |
| 4. Land Acquisition | | | | | |
| Treatment Plant | 36,000 sq m | 312.5 | 11,250 | 0 | 11,250 |
| Total of Water Supply Development | | | | | |
| Construction Cost | | | 321,010 | 221,873 | 99,137 |
| Land Cost | | | 11,250 | 0 | 11,250 |
| Total | | | 332,260 | 221,873 | 110,387 |

Table 11-6 Construction Cost for Zone 7 System
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|--|---|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| A. Water Source Development | | | | | |
| Khlong Lo Yung Dam | | | 474,757 | 310,100 | 164,657 |
| Land Acquisition | 1.2 Km ² (1,200,000 m ²) | 312.5 | 375,000 | 0 | 375,000 |
| Total of A. | | | 849,758 | 310,100 | 539,658 |
| B. Water Supply Development | | | | | |
| 1. Raw Water Pumping Station | | | | | |
| Pump House, | 50 m ² | | 225 | 68 | 158 |
| Pump Unit (5.7 cu m/min, 4 units) | | 500,000 | 2,000 | 1,600 | 400 |
| Electrical Work (50 % of Pump) | | | 1,000 | 800 | 200 |
| Miscellaneous (10 % of above) | | | 323 | 247 | 76 |
| Sub-total of 1. | | | 3,548 | 2,714 | 833 |
| 2. Raw Water Transmission Pipe | | | | | |
| SP 600 mm, L = 34 km | | 5,600 | 190,400 | 152,320 | 38,080 |
| 3. Treatment Plant: T5 | | | | | |
| Daily Average Demand | | 13,295 cu m/d | | | |
| Daily Maximum Demand | | 17,284 cu m/d | | | |
| Maximum Capacity | | 17,800 cu m/d | | | |
| Treatment Plant Facility | | | | | |
| Receiving Well | 20 cu m | | 20 | 8 | 12 |
| Sedimentation Basin | 740 cu m/h | | 17,020 | 6,808 | 10,212 |
| Sand Filter | 740 cu m/h | | 11,100 | 4,440 | 6,660 |
| Clear Water Reservoir | 6,000 cu m | | 14,400 | 5,760 | 8,640 |
| Pumping House | 100 sq m | | 450 | 180 | 270 |
| Chemical House | 100 sq m | | 400 | 160 | 240 |
| Administrarion Bldg | 200 sq m | | 1,000 | 400 | 600 |
| Operators Houses | 200 sq m | | 1,000 | 400 | 600 |
| Mechanical Works | | (B/unit) | | | |
| Chemical Equip | Mixer, Tank, 2 units | 640,000 | 1,280 | 1,024 | 256 |
| Chlorinator | 2 kg/h x 3 sets | 360,000 | 1,080 | 864 | 216 |
| Pumps | 5.8 cu m/m, 4 units | 600,000 | 2,400 | 1,920 | 480 |
| Miscellaneous | 20 % of above | | 952 | 762 | 190 |
| Electrical Works | 70% of Mech. Works | | 3,998 | 3,199 | 800 |
| Miscellaneous | 20 % of above | | 11,020 | 5,510 | 5,510 |
| Sub-total of 3. | | | 66,120 | 31,434 | 34,686 |
| 4. Distribution Pipeline (Zone 7) | | | | | |
| AC 150 mm, L= 6,600 m | | 610 | 4,026 | 1,208 | 2,818 |
| AC 200 mm, L= 7,650 m | | 890 | 6,809 | 2,043 | 4,766 |
| AC 300 mm, L= 4,000 m | | 1,620 | 6,480 | 1,944 | 4,536 |
| AC 400 mm, L= 2,450 m | | 2,780 | 6,811 | 2,043 | 4,768 |
| Sub-total of 4. | | | 24,126 | 7,238 | 16,888 |

Table 11-6 Construction Cost for Zone 7 System (Cont'd)
(Unit : Baht 1000)

| Item | Dimension | Unit Cost (Baht) | Total Cost (Baht 1000) | Foreign Cur. Portion (Baht 1000) | Local Cur. Portion (Baht 1000) |
|--|--------------------|---------------------|---------------------------|-------------------------------------|-----------------------------------|
| 5. Land Acquisition | | | | | |
| Pump House, in Khlong Lo Yung | 300 m ² | 312.5 | 94 | 0 | 94 |
| Treatment Plant | 28,000 sq m | 0 | 0 | 0 | 0 |
| Sub-total of 5. | | | 94 | 0 | 94 |
| Total of Water Supply Development Project | | | | | |
| Construction Cost | | | 284,193 | 193,706 | 90,487 |
| Land Cost | | | 94 | 0 | 94 |
| Total | | | 284,287 | 193,706 | 90,581 |

11.2 Operation and Maintenance Cost

Operation and maintenance cost is calculated from the water demand in each year, and consists of energy, chemical, manning, repair, and replacement costs.

The energy and chemical costs are calculated in the alternative comparison of the implementation plan as presented in Chapter 9.

Manning cost is based on the prediction of the staff number of waterworks.

Replacement of the mechanical and electrical equipment is considered to be made 20 years after the installation so that they are not included in the period of the development plan.

Total operation and maintenance cost is tabulated in Table 11-7.

Table 11-7 Summary of Operation and Maintenance Cost
(unit : Baht 1000)

| Year | O P E R A T I O N C O S T | | | | | Sub-Total |
|------|---------------------------|---------------|--------------|-------------|-------------|-----------|
| | Energy Cost | Chemical Cost | Manning Cost | Repair Cost | Replacement | |
| 1990 | 3,152 | 497 | 2,077 | 14 | | 5,738 |
| 1991 | 4,165 | 497 | 2,180 | 14 | | 6,855 |
| 1992 | 5,418 | 621 | 2,289 | 14 | | 8,341 |
| 1993 | 5,433 | 621 | 2,404 | 14 | | 8,471 |
| 1994 | 7,874 | 996 | 2,524 | 14 | | 11,408 |
| 1995 | 8,089 | 1,012 | 2,761 | 14 | | 11,876 |
| 1996 | 8,397 | 1,045 | 5,450 | 14 | | 14,905 |
| 1997 | 8,708 | 1,070 | 5,722 | 65 | | 15,565 |
| 1998 | 9,025 | 1,096 | 7,414 | 65 | | 17,600 |
| 1999 | 9,346 | 1,122 | 7,785 | 65 | | 18,318 |
| 2000 | 9,576 | 1,149 | 8,174 | 65 | | 18,964 |
| 2001 | 9,890 | 1,176 | 8,583 | 65 | | 19,713 |
| 2002 | 10,115 | 1,197 | 9,012 | 65 | | 20,389 |
| 2003 | 10,288 | 1,218 | 11,584 | 65 | | 23,155 |
| 2004 | 10,518 | 1,241 | 12,334 | 103 | | 24,196 |
| 2005 | 10,726 | 1,261 | 12,951 | 103 | | 25,041 |
| 2006 | 10,292 | 1,287 | 13,599 | 103 | | 25,281 |
| 2007 | 10,528 | 1,310 | 14,279 | 103 | | 26,220 |
| 2008 | 10,772 | 1,333 | 15,201 | 103 | | 27,409 |
| 2009 | 11,023 | 1,356 | 16,180 | 103 | | 28,661 |
| 2010 | 9,089 | 1,380 | 16,989 | 103 | | 27,560 |
| 2011 | 9,332 | 1,405 | 17,838 | 103 | | 28,678 |

12. ANNUAL DISBURSEMENT SCHEDULE

The annual disbursement schedule is prepared on the basis of the construction schedule and the cost estimates as shown in the Chapter 9, and 10, respectively.

Table 12-1 shows an annual disbursement by item.

Table 12 - 1 Annual Disbursement Schedule
Unit (Baht 1000)

| Year | CONSTRUCTION COST | | | | | | | | | | : Engineering Cost | : Operation: | Land | Grand | |
|----------|-------------------|-------------|-------------|--------------|-----------|-------------|-----------|----------|--------------|----------|--------------------|--------------|-------------|-------|---------|
| | : Bangwat | : Kh. Katha | : Bang Nueo | : Kh. LoYung | : Contin- | : Sub-Total | : Design | : Super- | : Sub-Total: | : Cost | | | | | : Total |
| : Im-imp | : Develop't | | | | gency | | | vision | | | | | | | |
| : Total | : 104,142 | : 36,320 | : 83,774 | : 321,010 | : 284,193 | : 82,944 | : 912,393 | : 54,743 | : 18,248 | : 72,991 | : 414,345 | : 25,875 | : 1,425,594 | | |
| : 1990 | : 52,071 | : 0 | : 0 | : 0 | : 5,207 | : 57,278 | : 2,737 | : 912 | : 3,650 | : 5,738 | : 7,031 | : 73,697 | | | |
| : 1991 | : 52,071 | : 0 | : 0 | : 0 | : 5,207 | : 57,278 | : 0 | : 912 | : 912 | : 6,855 | : 18,844 | : 83,890 | | | |
| : 1992 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 24,634 | : 0 | : 24,634 | : 8,341 | : 0 | : 32,976 | | | |
| : 1993 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 27,371 | : 0 | : 27,371 | : 8,471 | : 0 | : 35,843 | | | |
| : 1994 | : 9,080 | : 20,944 | : 80,252 | : 71,048 | : 18,132 | : 199,457 | : 0 | : 3,650 | : 3,650 | : 11,408 | : 0 | : 214,514 | | | |
| : 1995 | : 18,160 | : 41,887 | : 160,505 | : 142,097 | : 36,285 | : 398,913 | : 0 | : 8,211 | : 8,211 | : 11,876 | : 0 | : 419,001 | | | |
| : 1996 | : 9,080 | : 20,944 | : 80,252 | : 71,048 | : 18,132 | : 199,457 | : 0 | : 4,562 | : 4,562 | : 14,905 | : 0 | : 218,924 | | | |
| : 1997 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 15,565 | : 0 | : 15,565 | | | |
| : 1998 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 17,600 | : 0 | : 17,600 | | | |
| : 1999 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 18,318 | : 0 | : 18,318 | | | |
| : 2000 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 18,964 | : 0 | : 18,964 | | | |
| : 2001 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 19,713 | : 0 | : 19,713 | | | |
| : 2002 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 20,389 | : 0 | : 20,389 | | | |
| : 2003 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 23,155 | : 0 | : 23,155 | | | |
| : 2004 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 24,196 | : 0 | : 24,196 | | | |
| : 2005 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 25,041 | : 0 | : 25,041 | | | |
| : 2006 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 25,281 | : 0 | : 25,281 | | | |
| : 2007 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 26,220 | : 0 | : 26,220 | | | |
| : 2008 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 27,409 | : 0 | : 27,409 | | | |
| : 2009 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 28,661 | : 0 | : 28,661 | | | |
| : 2010 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 27,560 | : 0 | : 27,560 | | | |
| : 2011 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 0 | : 28,678 | : 0 | : 28,678 | | | |

- Not 1. Contingency = 10 % of the total of gross construction cost
- 2. Engineering Cost (Design) = 6 % of the total construction cost
- 3. Engineering Cost (Supervision) = 2 % of the total construction cost

Part 3
FEASIBILITY STUDY

Part 3 FEASIBILITY STUDY

13. FUNDAMENTALS FOR FEASIBILITY STUDY

As described in Chapter 8, the proposed water supply system is divided in several sub-systems such as: (1) Bangwat System, (2) Khlong Katha System, (3) Bang Nieo Dam System, and (4) Zone 7 System. Aside from this, the Municipality waterworks is called the Municipality System.

The implementation of the water supply system is, however depending on the progress of the dam construction project which will be undertaken by the Royal Irrigation Department (RID) and is beyond the control of PWA. The only sub-system presently taken care by PWA itself is the Bangwat System. This system will be able to operate in full capacity by providing a temporary raw water intake from the Khlong Ban Yai. The operation of the pumping station is, therefore incorporated in the total system.

The Immediate Improvement Project to achieve a stable water supply in Patong, Karon, and Katha beaches is also proposed as a component of the project.

For the other sub-systems, the construction schedule was prepared on the basis of the assumed dam construction schedule as presented in Chapter 9.

There is a possibility for supplying water in some areas by developing temporary water sources such as existing streams or mining pits. This measure, however needs further continuous investigation works for determining capacities of such sources, and for planning processes of treating and delivering water. Not only a technical aspect, a land acquisition or permission of land owners is one of the biggest problems in the Phuket Island for use of mining pits.

Therefore, the detailed evaluation on such a temporary measure is not made in this feasibility study because of a lack of data as of now, a long duration required for the investigation works, and the uncertain situation for the possibility of use of mining pits.

14. Preliminary Design

14.1 Rehabilitation/Modification Plan

The Immediate Improvement Project for improving Bangwat System is proposed as a modification of the existing system, the detailed facility plan of which is presented in Chapter 8.

The objectives of the Immediate Improvement Project are:

- (i) To supplement the lack of the capacity of Bangwat Reservoir
- (ii) To improve the high pressure problem in Patong beach.
- (iii) To reduce the operation cost of clear water and booster pumping system by use of the high level and distribution reservoirs.
- (iv) To extend the water supply to Karon and Katha beaches without an additional pumping station.
- (v) To extend the water supply in Kathu area

14.2 Expansion Works

14.2.1 Facility Construction Plan

Implementation of the proposed water supply system is scheduled in accordance with the detailed processes as shown in Chapter 15.

The distribution pipelines will be completed at the same time of the completion of the treatment plants.

14.2.2 Phasing for the Implementation

The project implementation is divided into two stages as follows:

- (i) Immediate Improvement Project
- (ii) Main Project

The project components of each phase are summarized as shown in Table 14.1.

Table 14.1 Project Component in Each Phase

1. Immediate Improvement Project (1990-1991)

- A. Temporary Water Source Development
 - A-1. Construction of a Pumping Station at Khlong Bang Yai
 - B. Improvement of Beach Area Water Supply
 - B-1. Construction of a high level reservoir
 - B-2. Construction of service reservoirs
 - B-3. Construction of transmission pipe from the high level reservoir to Karon beach
 - B-4. Replacement of distribution pipes in Patong beach
 - B-5. Construction of distribution pipes in Patong, Karon, and Katha beaches
 - B-6. Construction of additional distribution pipes in Kathu area
-

2. Main Project (1994-1996)

A. Khlong Katha System

Preceding dam project : Khlong Katha Dam

- A-1. Construction of a raw water pipe
- A-2. Construction of a treatment plant
- A-3. Construction of a distribution pipe

B. Bang Niew Dam System

Preceding dam project : Bang Niew Dam
(Khao Che Tra Dam is to be completed in 2006)

- B-1. Construction of a raw water pipe
- B-2. Construction of a treatment plant
- B-3. Construction of a distribution pipe

C. Zone 7 System

Preceding dam project : Khlong Lo Yung Dam

- C-1. Construction of a raw water pumping station
 - C-2. Construction of a raw water pipe
 - C-3. Construction of a treatment plant
 - C-4. Construction of a distribution pipe
-

15. IMPLEMENTATION PLAN

The implementation plan is established for the three stages of the process: (i) the pre-construction stage, (ii) the construction stage, and (iii) the operation stage. The necessary processes for each stage are summarized as follows:

(i) Pre-construction stage:

- a. Land acquisition
- b. Preparation of the PWA's own budget
- c. Loan application
- d. Selection of the consultants for the detailed design
- e. Preparation of the detailed design
- f. Pre-qualification of the contractors
- g. Tendering
- h. Contract award

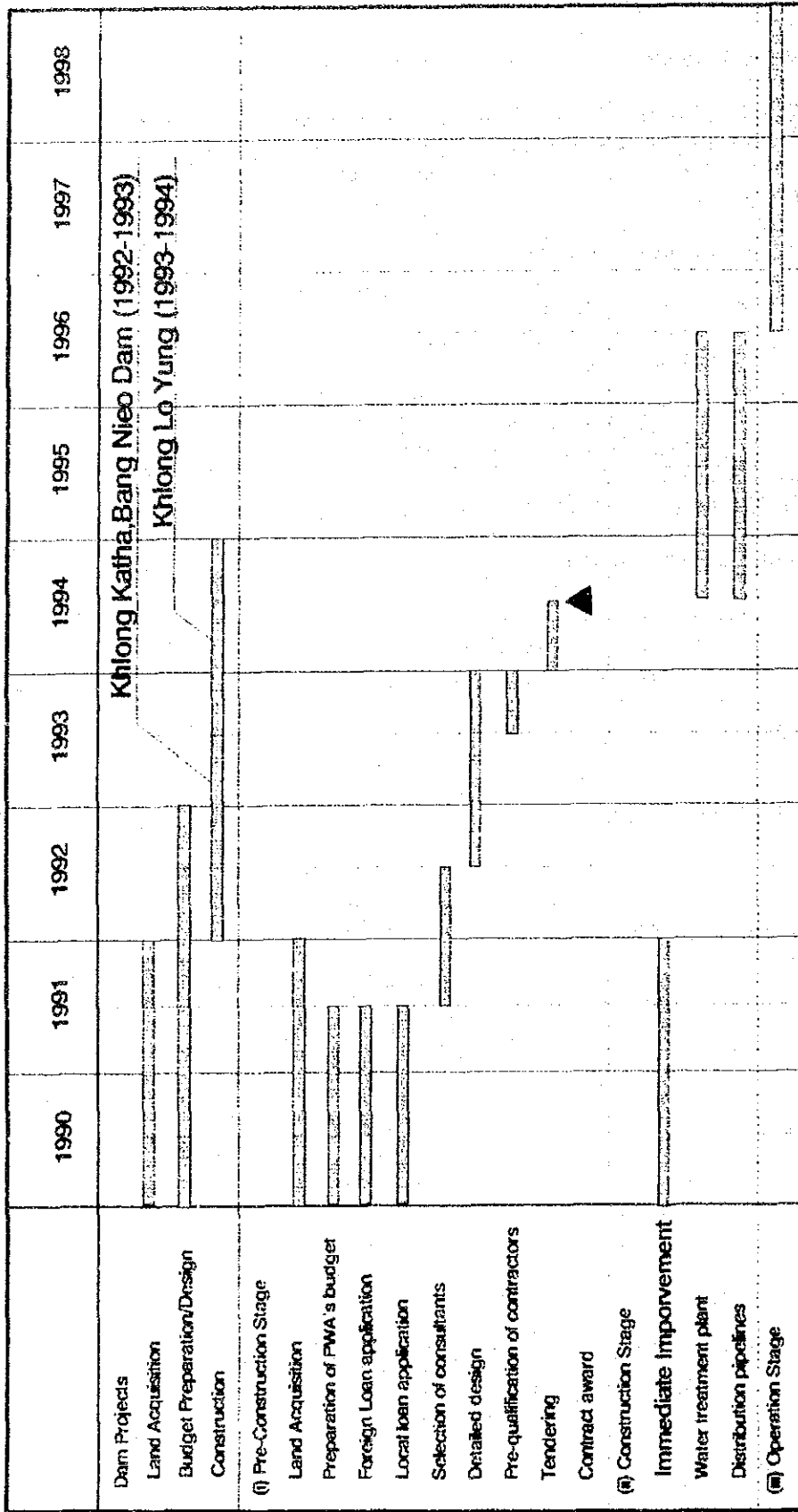
(ii) Construction stage

- a. Immediate Improvement
- b. Water treatment plant
- c. Distribution pipelines

(iii) Operation

The total implementation schedule is as shown in Figure 15-1.

Figure 15 - 1 Implementing Schedule for Phase 1



Note: Immediate Improvement Project is to be carried out by PWA itself.

16. Project Cost Estimates

The project cost is estimated and allocated as shown in Table 16-1 for each phase on the basis of the cost estimates of each component of the project.

Table 16-1 Project Cost Estimates by Phase
(Unit : Baht 1000)

| Item | Immediate Improvement Project | | | Main Project | | |
|---|-------------------------------|--------|--------|--------------|--------|-------|
| | Total | (F/C) | (L/C) | Total | (F/C) | (L/C) |
| 1. Bangwat System - Immediate Improvement | | | | | | |
| A. Temporary Water Source Development | | | | | | |
| a. Temporary Pumping Station | 5,418 | 4,100 | 1,317 | | | |
| b. Raw Water Transmission Pipe | | | | | | |
| SP 700 mm, L= 5,000 m | 33,050 | 26,440 | 6,610 | | | |
| B. Beach Water Supply Improvement | | | | | | |
| a. High Level Reservoir | | | | | | |
| Volume 900 cu m | 2,250 | 675 | 1,575 | | | |
| b. Distribution Reservoir for Patong | | | | | | |
| Volume 3,800 cu m | 7,980 | 2,394 | 5,586 | | | |
| c. Distribution Reservoir for Karon and Katha | | | | | | |
| Volume 1,200 cu m | 3,000 | 900 | 2,100 | | | |
| d. Transmission Pipeline from Patong to Karon | | | | | | |
| SP 300 mm, L= 8,000 m | 23,520 | 18,816 | 4,704 | | | |
| SP 200 mm, L= 1,200 m | 2,124 | 1,699 | 425 | | | |
| e. Distribution Pipeline | | | | | | |
| (i) Patong (Zone 10) | | | | | | |
| Replacement | | | | | | |
| AC 200 mm, 1,390 m | 1,237 | 371 | 866 | | | |
| AC 250 mm, 360 m | 425 | 127 | 297 | | | |
| AC 300 mm, 5,715 m | 9,258 | 2,777 | 6,481 | | | |
| New Construction | | | | | | |
| AC 150 mm, 800 m | 488 | 146 | 342 | | | |
| AC 200 mm, 1,940 m | 1,727 | 518 | 1,209 | | | |
| SP 400 mm, 150 m | 623 | 187 | 436 | | | |
| (ii) Karon and Katha (Zone 11) | | | | | | |
| New Construction | | | | | | |
| AC 150 mm, 800 m | 488 | 146 | 342 | | | |
| AC 200 mm, 9,550 m | 8,500 | 2,550 | 5,950 | | | |
| AC 300 mm, 1,600 m | 2,592 | 778 | 1,814 | | | |
| (iii) Kathu (Zone 6) | | | | | | |
| AC 150 mm, 2,400 m | 1,464 | 439 | 1,025 | | | |
| Sub-Total of 1. | 104,142 | 63,065 | 41,078 | | | |
| 2. Bangwat System - Other than the Immediate Improvement | | | | | | |
| Raw Water Pipe (To be constructed after Bang Tho Sung Dam) | | | | | | |
| SP 500 mm, L = 8,000 m | | | | 36,320 | 29,056 | 7,264 |
| Sub-Total of 2. | | | | 36,320 | 29,056 | 7,264 |

Table 16-1 Project Cost Estimates by Phase (Cont'd)
(Unit : Baht 1000)

| Item | Immediate Improvement Project | | | Main Project | | | | | |
|---|-------------------------------|-------|-------|--------------|---------|--------|---------|---------|---------|
| | Total | (F/C) | (L/C) | Total | (F/C) | (L/C) | | | |
| 3. Khlong Katha System | | | | | | | | | |
| A. Raw Water Pipe | | | | | | | | | |
| SP 400 mm, L = 200 m | | | | 754 | 603 | 151 | | | |
| B. Treatment Plant (T3) | | | | | | | | | |
| | | | | 49,332 | 23,819 | 25,513 | | | |
| C. Distribution Pipeline (Zones 3 & 4) | | | | | | | | | |
| AC 150 mm, L=12,400 m | | | | 7,564 | 2,269 | 5,295 | | | |
| AC 200 mm, L= 3,600 m | | | | 3,204 | 961 | 2,243 | | | |
| AC 250 mm, L= 2,000 m | | | | 2,360 | 708 | 1,652 | | | |
| SP 500 mm, L= 4,000 m | | | | 20,560 | 16,448 | 4,112 | | | |
| Sub-Total of 3. | | | | 83,774 | 44,809 | 38,965 | | | |
| 4. Bang Niao Dam System | | | | | | | | | |
| A. Raw Water Pipe | | | | | | | | | |
| SP 500 mm, L = 200 m | | | | 1,028 | 822 | 206 | | | |
| B. Treatment Plant (T4) | | | | | | | | | |
| | | | | 72,175 | 33,663 | 38,512 | | | |
| C. Distribution Pipeline (Zone 1 & 2) | | | | | | | | | |
| AC 100 mm, L= 6,950 m | | | | 3,128 | 938 | 2,189 | | | |
| AC 150 mm, L= 2,340 m | | | | 1,474 | 442 | 1,032 | | | |
| AC 200 mm, L= 2,750 m | | | | 2,530 | 759 | 1,771 | | | |
| SP 400 mm, L=27,050 m | | | | 115,504 | 92,403 | 23,101 | | | |
| SP 600 mm, L=10,950 m | | | | 73,475 | 58,780 | 14,695 | | | |
| SP 700 mm, L= 4,680 m | | | | 37,112 | 29,690 | 7,422 | | | |
| (Zone 8) | | | | | | | | | |
| AC 150 mm, L= 2,000 m | | | | 1,260 | 378 | 882 | | | |
| AC 200 mm, L= 2,400 m | | | | 2,208 | 662 | 1,546 | | | |
| AC 300 mm, L= 5,110 m | | | | 8,585 | 2,575 | 6,009 | | | |
| (Zone 9) | | | | | | | | | |
| AC 150 mm, L= 2,850 m | | | | 1,796 | 539 | 1,257 | | | |
| AC 200 mm, L= 800 m | | | | 736 | 221 | 515 | | | |
| Sub-Total of 4. | | | | 321,010 | 221,873 | 99,137 | | | |
| 5. Zone 7 System | | | | | | | | | |
| A. Raw Water Pumping Station | | | | | | | | | |
| | | | | 3,548 | 2,714 | 833 | | | |
| B. Raw Water Transmission Pipe | | | | | | | | | |
| SP 600 mm, L = 34 km | | | | 190,400 | 152,320 | 38,080 | | | |
| C. Treatment Plant (T5) | | | | | | | | | |
| | | | | 66,120 | 31,434 | 34,686 | | | |
| D. Distribution Pipeline (Zone 7) | | | | | | | | | |
| AC 150 mm, L= 6,600 m | | | | 4,026 | 1,208 | 2,818 | | | |
| AC 200 mm, L= 7,650 m | | | | 6,809 | 2,043 | 4,766 | | | |
| AC 300 mm, L= 4,000 m | | | | 6,480 | 1,944 | 4,536 | | | |
| AC 400 mm, L= 2,450 m | | | | 6,811 | 2,043 | 4,768 | | | |
| Sub-Total of 5. | | | | 284,193 | 193,706 | 90,487 | | | |
| Total | | | | 104,142 | 63,065 | 41,078 | 725,297 | 489,444 | 235,853 |

17. FINANCIAL AND ECONOMIC STUDY

17.1 Financial Study

The financial plan for the proposed water supply system is studied to enable the waterworks to take necessary steps for the viable implementation of the project with due consideration on the existing financial practices, potential finding sources to meet the estimated capital costs for the construction and recurrent costs for the operation.

17.1.1 Funding Arrangements

The funds are required largely in two categories for the construction capital and recurrent costs for yearly operating and maintenance of the systems, including debt service, depreciation and other miscellaneous expenses.

1) Cost Estimates

The required costs break down and the implementation-disbursement schedule into annual disbursement for the construction stage are presented in Table 17-1-1. The implementation plan of this program is separated into two stages. Phase I is constructed from 1990 to 1992 and Phase II is planned to be implemented from 1993 to 1996.

The capital disbursement for the construction is graphically indicated in Figure 17-1-1.

2) Funds for Construction Costs

Out of the total capital costs, the foreign currency portion is financed by the international lending agency which the local currency portion is financed by the government subsidies, PWA's own equity or loan.

Such international loans are normally provided to finance the foreign currency portion of the project costs; however, in certain cases, a part of local currency portion is also financed by international loan when such is desirable.

If the funding capability of the executing agency is not sufficient, the subsidy from the central government to the possible extent may be desirable and more soft loans with low interest and longer period of repayment should be sought.

a. Loan from International Lending Agencies

The international loans are broadly grouped in two categories such as multilateral and bilateral loans. The multilateral loans are regarded as loans from the World Bank and Asian Development Bank. The interest of such loans are presently ranging from 6-8 percent per annum and repayment period is normally 20 years with a grace period of 5 years. The bilateral loans are exemplified by the loan from West Germany, U.S.A. or Japan with very concessionaire terms, for example, low interest rates of 2-3 percent per annum and long maturity periods (up to 30 years) including an extended grace period up to 10 years.

Table 17-1-1 Implementation/Disbursement Schedule at 1989 Price

(Unit : Baht x 1000)

| Year | Construction Cost | | | Design | | | Engineering Cost | | | Supervision | | | Land Cost | | | Sub-Total | | | Contingency | | | Grand Total | | | |
|-------|-------------------|---------|---------|--------|--------|--------|------------------|-------|--------|-------------|---------|---------|-----------|--------|--------|-----------|---------|---------|-------------|------|-------|-------------|------|-------|--|
| | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total | |
| Total | 489,443 | 339,996 | 829,439 | 36,464 | 18,278 | 54,742 | 12,156 | 6,091 | 18,247 | 25,875 | 538,063 | 390,240 | 928,303 | 48,944 | 33,999 | 82,943 | 587,007 | 424,239 | 1,011,246 | | | | | | |
| 1990 | 0 | 52,071 | 52,071 | 1,823 | 914 | 2,737 | 608 | 304 | 912 | 7,031 | 2,431 | 60,320 | 62,751 | 0 | 5,207 | 5,207 | 2,431 | 65,527 | 67,958 | | | | | | |
| 1991 | 0 | 52,071 | 52,071 | 0 | 0 | 0 | 608 | 304 | 912 | 18,844 | 608 | 71,219 | 71,827 | 0 | 5,207 | 5,207 | 608 | 76,426 | 77,034 | | | | | | |
| 1992 | 0 | 0 | 0 | 16,409 | 8,225 | 24,634 | 0 | 0 | 0 | 0 | 16,409 | 8,225 | 24,634 | 0 | 0 | 0 | 16,409 | 8,225 | 24,634 | | | | | | |
| 1993 | 0 | 0 | 0 | 18,232 | 9,139 | 27,371 | 0 | 0 | 0 | 0 | 18,232 | 9,139 | 27,371 | 0 | 0 | 0 | 18,232 | 9,139 | 27,371 | | | | | | |
| 1994 | 122,360 | 58,964 | 181,324 | 0 | 0 | 0 | 2,431 | 1,219 | 3,650 | 0 | 124,791 | 60,183 | 184,974 | 12,236 | 5,896 | 18,132 | 137,027 | 66,079 | 203,106 | | | | | | |
| 1995 | 244,723 | 117,926 | 362,649 | 0 | 0 | 0 | 5,470 | 2,741 | 8,211 | 0 | 250,193 | 120,667 | 370,860 | 24,472 | 11,793 | 36,265 | 274,665 | 132,460 | 407,125 | | | | | | |
| 1996 | 122,360 | 58,964 | 181,324 | 0 | 0 | 0 | 3,039 | 1,523 | 4,562 | 0 | 125,399 | 60,487 | 185,886 | 12,236 | 5,896 | 18,132 | 137,635 | 66,383 | 204,018 | | | | | | |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | |

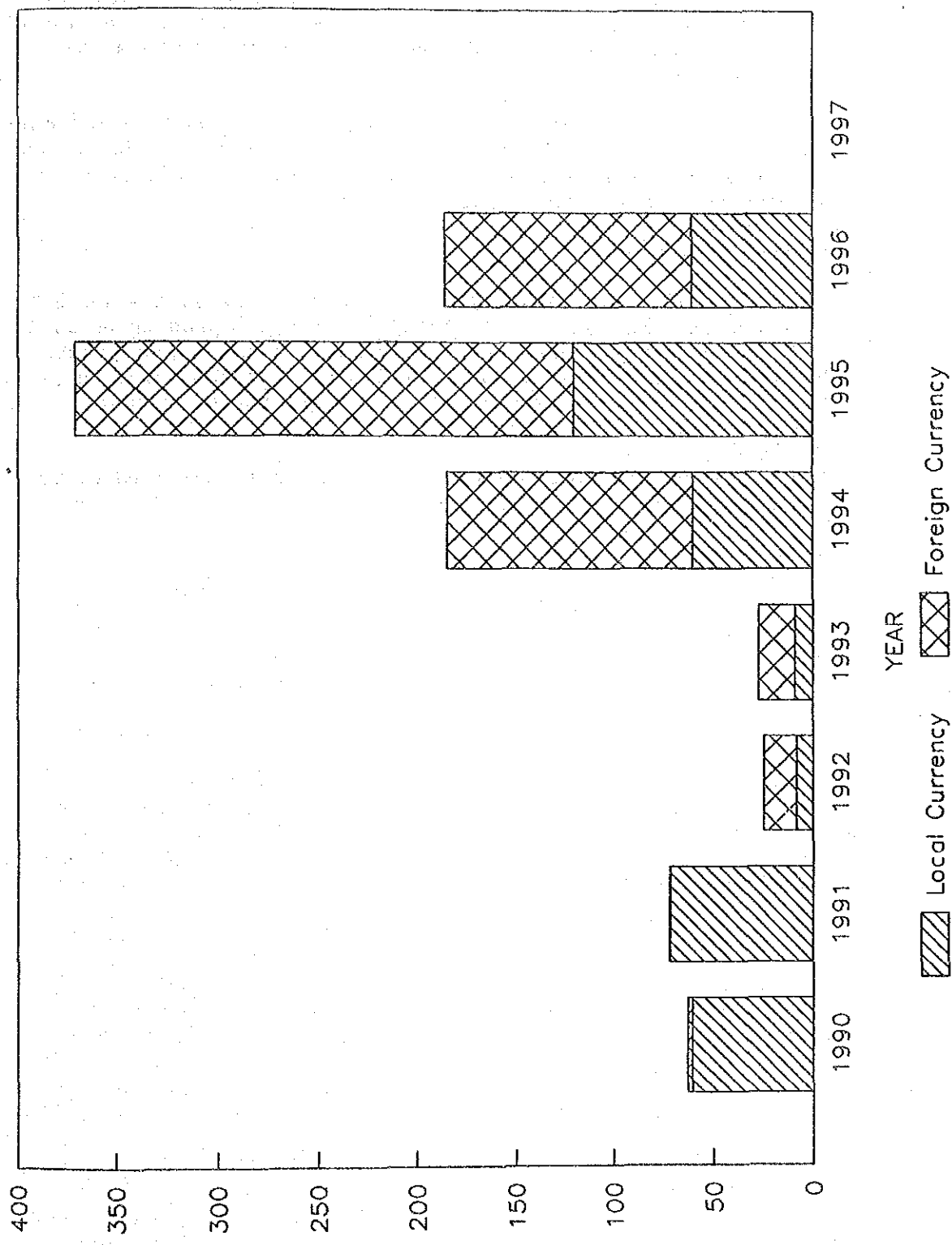
Note: 1. Contingency = 10 % of the total of gross construction cost

2. Engineering Cost (Design) = 6 % of the total construction cost

3. Engineering Cost (Supervision) = 2 % of the total construction cost

4. F.C.: Foreign Currency

5. L.C.: Local Currency



BAH T x 1,000,000

FIGURE 17-1-1
CAPITAL DISBURSEMENT

b. Government Subsidy

The subsidy from the central government is allocated to the local municipalities in Thailand for the construction project to develop public utilities such as irrigation and drainage system, sewerage system, feeder roads and other infrastructure development projects.

The water supply development project as proposed to enhance community benefits such as public health and economic development is necessary to be encouraged by the government initiative with allocation of meaningful amount of subsidy.

c. Loan from Domestic Banks

The local currency portion of the capital costs are normally financed by domestic banks, wholly or partly depending on availability of other sources of capital as subsidy. PWA presently borrows the fund from the Krung Thai Bank. In amortization period, PWA pays only interest part and capital repayments are in charge of the national government.

Table 17-1-2 shows loan conditions of international lending agencies.

Table 17-1-2 Loan Conditions

| Agency | Interest Rate | Duration (Grace Period) Year | Charge |
|-----------|---------------|---------------------------------|--|
| IBRD | 7.74% | 15-20 (3-5) | Front-end Fee: ----- Commitment Charge: 0.75% |
| IDA | 0% | 40 (10) or 35 (10) | Service Charge: 0.75% Commitment charge: ----- |
| IDB | 8.1% | 15-25 (4-6) | Commitment Charge: 0.75% Inspection Fee 1% of loan amount |
| ADB | 6.37% | 10-30 (2-7) | Commitment Charge: 0.75% |
| * OECS | 2.74% | 28.8 (9.6) | ----- |

* Average condition of 1988.

3) Funds for Recurrent Costs

The funds are normally required after the construction of the system to meet the annual costs including operation and maintenance costs, and debt service payment if any loan is provided. There are established practices in the developed countries that such recurrent costs are met by the users of the system who receive the benefits through the collection of water tariff.

17.1.2 Alternative Financing Plan

The financial plans are developed based on the capital disbursement schedule and funding arrangements. The funding arrangements are considered among others one of the most decisive factor for the financial viability of the project. The funding arrangement which will not impose unbearable burden upon the water works is most desirable subject, however, to the availability of sufficient fund or the loan of lenient condition.

The following five alternatives for the funding arrangement are considered to assess the financial impact on the waterworks as well as individual consumer and thereby to select adequate funding arrangement.

Alternative 1 : Total project costs is financed by the international lending agencies (ADB or IBRD).

Alternative 2 : The foreign currency portion equivalent to 538,063 thousand Baht is financed by bilateral

loan and local currency portion of 390,240 thousand Baht is financed by the international lending agencies.

- Alternative 3 : The foreign currency portion equivalent to 538,063 thousand Baht is financed by bilateral loan and local currency portion of 390,240 thousand Baht is financed by equal contribution of local loan and PWA's own equity allocation.
- Alternative 4 : The total of foreign currency portion and a part of local currency portion equivalent to 230,599 thousand Baht (approximately 83 percent of the total project cost) is financed by bilateral loan and 159,641 thousand Baht is financed by equal contribution of local loan and PWA's own equity allocation.
- Alternative 5 : The total of foreign currency portion and a part of local currency portion equivalent to 230,599 thousand Baht (approximately 83 percent of the total project cost) is financed by bilateral loan and remaining portion of 159,641 thousand Baht is financed by local loan.

In the alternative plans above, the conditions of the loan are assumed as follows.

- IBRD or ADB: 20 year repayment period including 5 year grace period with 7 percent interest per annum.
- Bilateral Loan: 30 year repayment period including 10 year grace period with 2.7 percent interest per annum.
- Local Loan: 13 year repayment period including 3 year grace period with 11 percent interest per annum and in amortization period, PWA pays only interest part and principal repayments are depended on national government contribution.

Such government funding contribution can also be justified by the prospective increase of socio-economic benefits to be derived from the proposed project as manifested in economic project analysis.

Summarized fund arrangements for each alternative plan are shown in Table 17-1-3.

Table 17-1-3 Funds Arrangements
Unit : Baht x 1,000

| Funds Plan | Source of Fund | | | |
|---------------|--------------------|----------------|------------|------------------|
| | International Loan | Bilateral Loan | Local Loan | PWA's own Equity |
| Alternative 1 | 928,303 | | | |
| Alternative 2 | 390,240 | 538,063 | | |
| Alternative 3 | | 538,063 | 195,120 | 195,120 |
| Alternative 4 | | 768,662 | 79,820.5 | 79,820.5 |
| Alternative 5 | | 768,662 | 159,641 | |

The sources of capital costs and subsequent recurrent costs including debt services and operation and maintenance costs are indicated in alternative funding plans in Table 17-1-4 and the funding burden to be imposed on PWA in each alternative is highlighted in Figure 17-1-2.

As clearly shown in this figure, the Alternatives 3 and 4 appear more agreeable since required funds from PWA in successive years are less than other alternatives. Although there is no significant difference in graphic indication between Alternatives 3 and 4, Alternative 4 imposes less initial funding burden on PWA during construction stage.

Alternative 4 is, therefore assumed as a recommendable funding arrangement. The further financing analysis are made based on this alternative to identify the various factors necessary for making the project financially viable.

Tables 17-1-5 to 17-1-7 show the detail debt service for Alternative 4 financing plan and Table 17-8 shows summarized project cost and funding allocation of Alternative 4.

Appendix A17-1-1 to A17-1-5 shows details of debt services for each alternative plans.

Table 17-1-4 Capital and Annual Costs Cash Outlay

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|----------------------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Alternative 1 | | | | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | | | | |
| Foreign loan | 62,751 | 71,827 | 24,634 | 27,371 | 184,974 | 370,860 | 185,886 | | | | | | | | | | |
| Local loan | | | | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | | | | |
| O/M costs | 5,739 | 6,855 | 8,341 | 8,471 | 11,408 | 11,876 | 14,905 | 15,565 | 17,600 | 18,318 | 18,964 | 19,713 | 20,389 | 23,155 | 24,196 | 25,041 | 25,281 |
| Debt Service | 4,393 | 9,420 | 11,145 | 13,061 | 26,909 | 66,755 | 79,767 | 101,923 | 101,923 | 101,923 | 101,923 | 101,923 | 101,923 | 101,923 | 101,923 | 101,923 | 101,923 |
| Total | 10,132 | 16,275 | 19,486 | 21,532 | 37,417 | 78,631 | 94,672 | 95,332 | 119,523 | 120,241 | 120,887 | 121,636 | 122,312 | 125,078 | 126,119 | 126,964 | 127,204 |
| Alternative 2 | | | | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | | | | |
| Foreign loan(1) | 2,431 | 608 | 16,409 | 18,232 | 124,791 | 250,193 | 125,399 | | | | | | | | | | |
| Foreign loan(2) | 60,320 | 71,219 | 8,225 | 9,139 | 60,183 | 120,667 | 60,487 | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | | | | |
| O/M costs | 5,739 | 6,855 | 8,341 | 8,471 | 11,408 | 11,876 | 14,905 | 15,565 | 17,600 | 18,318 | 18,964 | 19,713 | 20,389 | 23,155 | 24,196 | 25,041 | 25,281 |
| Debt Service | 4,288 | 9,290 | 10,309 | 11,441 | 19,023 | 42,545 | 50,165 | 57,374 | 57,374 | 57,374 | 57,374 | 57,374 | 57,374 | 57,374 | 57,374 | 57,374 | 57,374 |
| Total | 10,027 | 16,145 | 18,650 | 19,912 | 30,431 | 54,421 | 65,070 | 65,730 | 74,974 | 75,692 | 76,338 | 77,087 | 77,761 | 78,417 | 79,088 | 79,762 | 80,435 |
| Alternative 3 | | | | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | | | | |
| Foreign loan | 60,320 | 71,219 | 8,225 | 9,139 | 60,183 | 120,667 | 60,487 | | | | | | | | | | |
| Local loan | 2,431 | 608 | 16,409 | 18,232 | 124,791 | 250,193 | 125,399 | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | | | | |
| O/M costs | 5,739 | 6,855 | 8,341 | 8,471 | 11,408 | 11,876 | 14,905 | 15,565 | 17,600 | 18,318 | 18,964 | 19,713 | 20,389 | 23,155 | 24,196 | 25,041 | 25,281 |
| Debt Service | 3,383 | 7,317 | 8,212 | 13,386 | 20,065 | 33,457 | 45,851 | 45,851 | 45,851 | 47,659 | 48,302 | 48,302 | 48,302 | 48,302 | 48,302 | 48,302 | 48,302 |
| Total | 69,442 | 85,391 | 24,778 | 30,996 | 91,636 | 166,000 | 121,243 | 61,416 | 63,451 | 65,977 | 66,266 | 66,015 | 66,691 | 67,591 | 68,632 | 69,177 | 69,587 |
| Alternative 4 | | | | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | | | | |
| Foreign loan | 29,639 | 35,479 | 597 | 663 | 3,351 | 6,721 | 3,373 | | | | | | | | | | |
| Local loan | 0 | 0 | 0 | 3,930 | 4,362 | 4,842 | 6,016 | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | | | | |
| O/M costs | 3,473 | 869 | 23,441 | 26,046 | 178,273 | 357,419 | 179,141 | | | | | | | | | | |
| Debt Service | 29,639 | 35,479 | 0 | 26,046 | 178,273 | 357,419 | 179,141 | | | | | | | | | | |
| Total | 29,639 | 35,479 | 597 | 663 | 3,351 | 6,721 | 3,373 | 6,678 | 7,413 | 8,430 | 9,357 | 10,387 | 11,529 | 1,639 | 1,819 | 2,019 | 419 |
| Alternative 5 | | | | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | | | | |
| Foreign loan | 0 | 0 | 0 | 7,860 | 8,724 | 9,684 | 12,033 | | | | | | | | | | |
| Local loan | 3,473 | 869 | 23,441 | 26,046 | 178,273 | 357,419 | 179,141 | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | | | | |
| O/M costs | 5,739 | 6,855 | 8,341 | 8,471 | 11,408 | 11,876 | 14,905 | 15,565 | 17,600 | 18,318 | 18,964 | 19,713 | 20,389 | 23,155 | 24,196 | 25,041 | 25,281 |
| Debt Service | 3,354 | 7,280 | 7,979 | 12,685 | 17,867 | 28,256 | 34,106 | 34,106 | 34,106 | 34,308 | 34,797 | 34,797 | 34,797 | 34,797 | 34,797 | 34,797 | 34,797 |
| Total | 38,732 | 49,614 | 16,917 | 21,819 | 32,626 | 46,853 | 52,384 | 49,671 | 51,706 | 52,626 | 52,761 | 53,510 | 54,186 | 54,794 | 55,435 | 56,076 | 56,717 |
| Alternative 5 | | | | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | | | | |
| Foreign loan | 0 | 0 | 0 | 7,860 | 8,724 | 9,684 | 12,033 | | | | | | | | | | |
| Local loan | 3,473 | 869 | 23,441 | 26,046 | 178,273 | 357,419 | 179,141 | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | | | | |
| O/M costs | 5,739 | 6,855 | 8,341 | 8,471 | 11,408 | 11,876 | 14,905 | 15,565 | 17,600 | 18,318 | 18,964 | 19,713 | 20,389 | 23,155 | 24,196 | 25,041 | 25,281 |
| Debt Service | 6,614 | 14,443 | 15,207 | 23,916 | 29,466 | 40,595 | 47,458 | 47,458 | 47,458 | 47,861 | 48,351 | 48,351 | 48,351 | 48,351 | 48,351 | 48,351 | 48,351 |
| Total | 12,353 | 21,298 | 23,548 | 32,387 | 40,874 | 52,471 | 62,363 | 63,023 | 65,058 | 66,179 | 66,315 | 66,064 | 66,740 | 67,189 | 67,638 | 68,087 | 68,536 |

Table 17-1-4 Capital and Annual Costs Cash Outlay (Cont'd) (Unit : Baht x 1000)

| Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|----------------------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Alternative 1 | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | |
| Foreign loan | | | | | | | | | | | | | | |
| Local loan | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | |
| O/M costs | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Debt Service | 101,923 | 101,923 | 101,923 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 | 61,128 |
| Total | 128,143 | 129,332 | 130,584 | 88,688 | 89,806 | 89,806 | 89,806 | 89,806 | 89,806 | 89,806 | 89,806 | 89,806 | 89,806 | 89,806 |
| Alternative 2 | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | |
| Foreign loan(1) | | | | | | | | | | | | | | |
| Foreign loan(2) | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | |
| O/M costs | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Debt Service | 78,017 | 78,017 | 78,017 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 | 55,060 |
| Total | 104,237 | 105,426 | 106,678 | 82,620 | 83,738 | 83,738 | 83,738 | 83,738 | 83,738 | 83,738 | 83,738 | 83,738 | 83,738 | 83,738 |
| Alternative 3 | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | |
| Foreign loan | | | | | | | | | | | | | | |
| Local loan | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | |
| O/M costs | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Debt Service | 40,306 | 40,306 | 40,306 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 |
| Total | 66,526 | 67,715 | 68,967 | 62,731 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 |
| Alternative 4 | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | |
| Foreign loan | | | | | | | | | | | | | | |
| Local loan | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | |
| O/M costs | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Debt Service | 40,306 | 40,306 | 40,306 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 | 35,171 |
| Total | 66,526 | 67,715 | 68,967 | 62,731 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 | 63,849 |
| Alternative 5 | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | |
| Foreign loan | | | | | | | | | | | | | | |
| Local loan | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | |
| O/M costs | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Debt Service | 50,816 | 50,816 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 |
| Total | 77,036 | 78,225 | 78,905 | 77,804 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 |
| Alternative 6 | | | | | | | | | | | | | | |
| Capital Costs | | | | | | | | | | | | | | |
| PWA's Equity | | | | | | | | | | | | | | |
| Subsidy | | | | | | | | | | | | | | |
| Foreign loan | | | | | | | | | | | | | | |
| Local loan | | | | | | | | | | | | | | |
| Recurrent Costs | | | | | | | | | | | | | | |
| O/M costs | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Debt Service | 51,389 | 51,389 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 | 50,244 |
| Total | 77,609 | 78,798 | 78,905 | 77,804 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 | 78,922 |

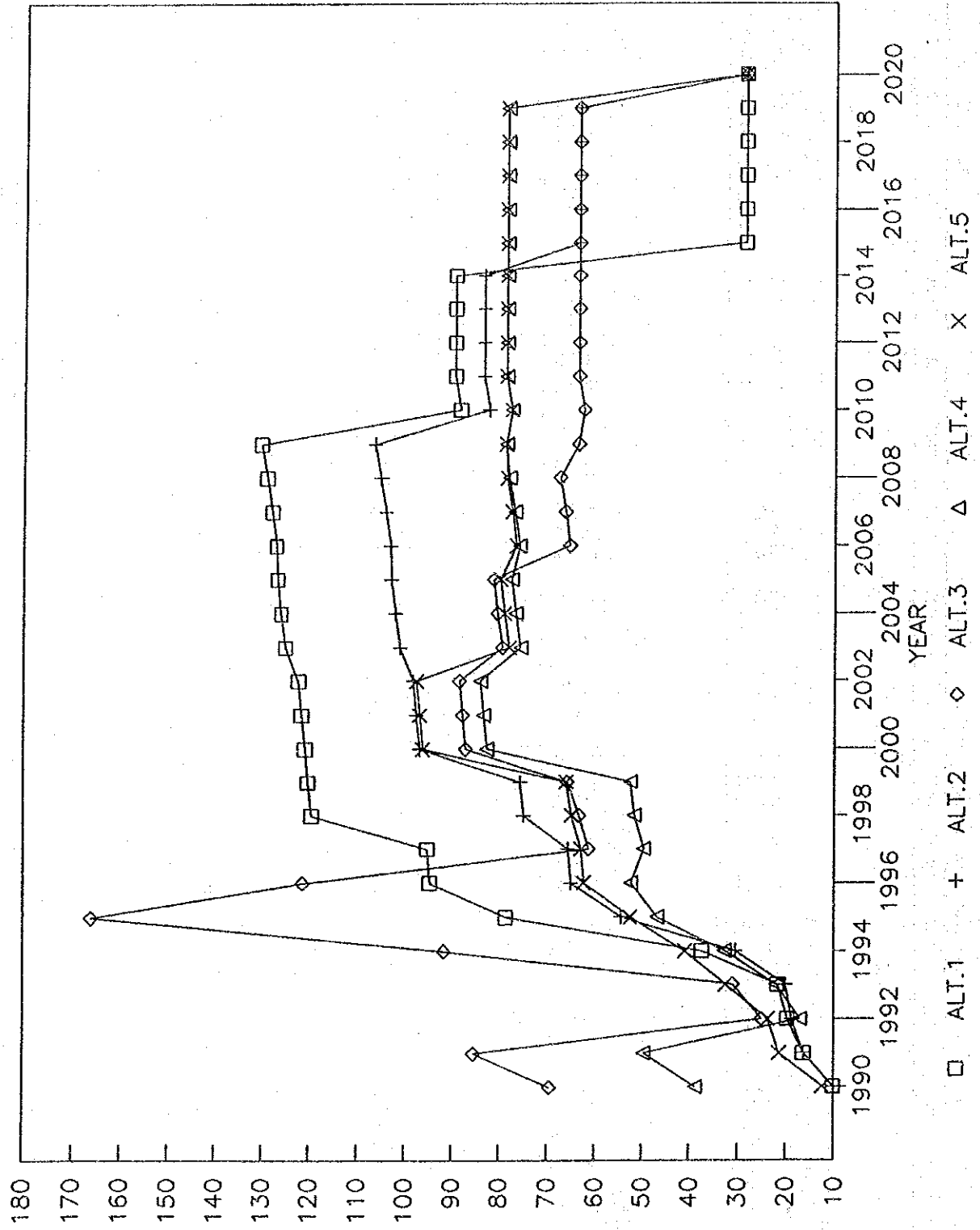


FIGURE 17-1-2
PUNDING BURDEN

BAHT x 1,000,000

Table 17-1-5 Debt Services (Alternative 4)
for Foreign Portion

(Unit : Baht x 1000)

| Year | Capital | Interest | Total Annual Repayment | Balance of Capital |
|--------------|----------------|----------------|---------------------------|-----------------------|
| 1990 | 0 | 94 | 94 | 3,473 |
| 1991 | 0 | 117 | 117 | 4,342 |
| 1992 | 0 | 750 | 750 | 27,783 |
| 1993 | 0 | 1,453 | 1,453 | 53,829 |
| 1994 | 0 | 6,267 | 6,267 | 232,102 |
| 1995 | 0 | 15,917 | 15,917 | 589,521 |
| 1996 | 0 | 20,754 | 20,754 | 768,662 |
| 1997 | 0 | 20,754 | 20,754 | 768,662 |
| 1998 | 0 | 20,754 | 20,754 | 768,662 |
| 1999 | 0 | 20,754 | 20,754 | 768,662 |
| 2000 | 29,490 | 20,754 | 50,244 | 768,662 |
| 2001 | 30,286 | 19,958 | 50,244 | 739,172 |
| 2002 | 31,104 | 19,140 | 50,244 | 708,886 |
| 2003 | 31,944 | 18,300 | 50,244 | 677,782 |
| 2004 | 32,806 | 17,438 | 50,244 | 645,838 |
| 2005 | 33,692 | 16,552 | 50,244 | 613,032 |
| 2006 | 34,602 | 15,642 | 50,244 | 579,340 |
| 2007 | 35,536 | 14,708 | 50,244 | 544,739 |
| 2008 | 36,495 | 13,748 | 50,244 | 509,203 |
| 2009 | 37,481 | 12,763 | 50,244 | 472,708 |
| 2010 | 38,493 | 11,751 | 50,244 | 435,227 |
| 2011 | 39,532 | 10,712 | 50,244 | 396,734 |
| 2012 | 40,599 | 9,644 | 50,244 | 357,202 |
| 2013 | 41,696 | 8,548 | 50,244 | 316,603 |
| 2014 | 42,821 | 7,423 | 50,244 | 274,907 |
| 2015 | 43,977 | 6,266 | 50,244 | 232,086 |
| 2016 | 45,165 | 5,079 | 50,244 | 188,109 |
| 2017 | 46,384 | 3,859 | 50,244 | 142,944 |
| 2018 | 47,637 | 2,607 | 50,244 | 96,560 |
| 2019 | 48,923 | 1,321 | 50,244 | 48,923 |
| Total | 768,662 | 343,828 | 1,112,490 | |

Table 17-1-6 Debt Services (Alternative 4)
for Local Portion

(Unit : Baht x 1000)

| Year | Capital | Interest | Total Annual Repayment | Balance of Capital |
|--------------|---------------|---------------|---------------------------|-----------------------|
| 1990 | 0 | 3,260 | 3,260 | 29,639 |
| 1991 | 0 | 7,163 | 7,163 | 65,118 |
| 1992 | 0 | 7,229 | 7,229 | 65,715 |
| 1993 | 3,930 | 7,301 | 11,231 | 66,377 |
| 1994 | 4,362 | 7,238 | 11,600 | 65,798 |
| 1995 | 4,842 | 7,497 | 12,339 | 68,156 |
| 1996 | 6,016 | 7,336 | 13,352 | 66,687 |
| 1997 | 6,678 | 6,674 | 13,352 | 60,670 |
| 1998 | 7,413 | 5,939 | 13,352 | 53,992 |
| 1999 | 8,430 | 5,124 | 13,554 | 46,579 |
| 2000 | 9,357 | 4,196 | 13,554 | 38,149 |
| 2001 | 10,387 | 3,167 | 13,554 | 28,792 |
| 2002 | 11,529 | 2,025 | 13,554 | 18,405 |
| 2003 | 1,639 | 756 | 2,395 | 6,876 |
| 2004 | 1,819 | 576 | 2,395 | 5,238 |
| 2005 | 2,019 | 376 | 2,395 | 3,419 |
| 2006 | 419 | 154 | 573 | 1,399 |
| 2007 | 465 | 108 | 573 | 981 |
| 2008 | 516 | 57 | 573 | 516 |
| Total | 79,820 | 76,176 | 155,996 | |

Table 17-1-7 Debt Services (Alternative 4)

(Unit : Baht x 1000)

| Year | Capital | Interest | Total Annual Repayment | Balance of Capital |
|--------------|----------------|----------------|---------------------------|-----------------------|
| 1990 | 0 | 3,354 | 3,354 | 33,112 |
| 1991 | 0 | 7,280 | 7,280 | 69,460 |
| 1992 | 0 | 7,979 | 7,979 | 93,498 |
| 1993 | 3,930 | 8,755 | 12,685 | 120,206 |
| 1994 | 4,362 | 13,504 | 17,867 | 297,900 |
| 1995 | 4,842 | 23,414 | 28,256 | 657,677 |
| 1996 | 6,016 | 28,089 | 34,106 | 835,349 |
| 1997 | 6,678 | 27,428 | 34,106 | 829,332 |
| 1998 | 7,413 | 26,693 | 34,106 | 822,654 |
| 1999 | 8,430 | 25,878 | 34,308 | 815,241 |
| 2000 | 38,847 | 24,950 | 63,797 | 806,811 |
| 2001 | 40,673 | 23,125 | 63,797 | 767,964 |
| 2002 | 42,633 | 21,165 | 63,797 | 727,291 |
| 2003 | 33,582 | 19,057 | 52,639 | 684,659 |
| 2004 | 34,625 | 18,014 | 52,639 | 651,076 |
| 2005 | 35,711 | 16,928 | 52,639 | 616,451 |
| 2006 | 35,020 | 15,796 | 50,816 | 580,740 |
| 2007 | 36,001 | 14,816 | 50,816 | 545,719 |
| 2008 | 37,011 | 13,805 | 50,816 | 509,719 |
| 2009 | 37,481 | 12,763 | 50,244 | 472,708 |
| 2010 | 38,493 | 11,751 | 50,244 | 435,227 |
| 2011 | 39,532 | 10,712 | 50,244 | 396,734 |
| 2012 | 40,599 | 9,644 | 50,244 | 357,202 |
| 2013 | 41,696 | 8,548 | 50,244 | 316,603 |
| 2014 | 42,821 | 7,423 | 50,244 | 274,907 |
| 2015 | 43,977 | 6,266 | 50,244 | 232,086 |
| 2016 | 45,165 | 5,079 | 50,244 | 188,109 |
| 2017 | 46,384 | 3,859 | 50,244 | 142,944 |
| 2018 | 47,637 | 2,607 | 50,244 | 96,560 |
| 2019 | 48,923 | 1,321 | 50,244 | 48,923 |
| Total | 848,483 | 420,003 | 1,268,486 | |

Table 17-1-8 Project Cost, Disbursement Schedule
and Funding Allocation of Alternative 4

a. Project Cost and Disbursement Schedule

(Unit : Baht x 1,000)

| Year | Foreign Portion | Local Portion | Total |
|-------|--------------------|------------------|---------|
| 1990 | 2,431 | 60,320 | 62,751 |
| 1991 | 608 | 71,219 | 71,827 |
| 1992 | 16,409 | 8,225 | 24,634 |
| 1993 | 18,232 | 9,139 | 27,371 |
| 1994 | 124,791 | 60,183 | 184,974 |
| 1995 | 250,193 | 120,667 | 370,860 |
| 1996 | 125,399 | 60,487 | 185,886 |
| Total | 538,063 | 390,240 | 928,303 |

b. Funding Allocation

(Unit : Baht x 1,000)

| Year | Bilateral Loan | Local Loan | PWA's Equity | Total |
|-------|-------------------|---------------|-----------------|---------|
| 1990 | 3,473 | 29,639 | 29,639 | 62,751 |
| 1991 | 869 | 35,479 | 35,479 | 71,827 |
| 1992 | 23,441 | 596.5 | 596.5 | 24,634 |
| 1993 | 26,046 | 662.5 | 662.5 | 27,371 |
| 1994 | 178,273 | 3,350.5 | 3,350.5 | 184,974 |
| 1995 | 357,419 | 6,720.5 | 6,720.5 | 370,860 |
| 1996 | 179,141 | 3,372.5 | 3,372.5 | 185,886 |
| Total | 768,662 | 79,820.5 | 79,820.5 | 928,303 |

17.1.3 Revenue Plan

1) Water Sales

The revenue is required to be raised by waterworks to meet the annual cash requirement after the construction of the systems. Such annual cash requirements normally include the operation and maintenance costs as well as debt service if a certain loan is made to finance the capital costs.

a. PWA Water Tariff Schedule

Water tariffs are collected by reading water meters with the exception of negligible direct sale fees. PWA has three major sources of tariff revenue: namely, water sales, service charges and connection fees. Revenue from these tariffs contribute 95 percent to the total revenue of PWA. All the waterworks have the same income structure as this. PWA also applies the same water tariff structure to all waterworks. Table 17-1-9 shows the current levels of water tariff structure.

Table 17-1-9 Present Water Tariff Structure

| Consumption (cu m / mo) | Tariff (Baht / cu m) |
|-----------------------------|--------------------------|
| 0 - 10 | 3.75 |
| 11 - 20 | 4.50 |
| 21 - 30 | 6.50 |
| 31 - 50 | 7.50 |
| 51 - 80 | 8.00 |
| 81 - 100 | 8.50 |
| 101 - 300 | 9.00 |
| 300 - 1,000 | 9.25 |
| 1,100 - 2,000 | 9.50 |
| 2,001 - 3,000 | 9.75 |
| 3,001 and above | 10.00 |

Connection Fees and Service Charges:

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

Present Connection Fees:

The minimum connection fee is set at 2,050 Baht for 1/2" diameter pipe with a length of 10 meters. The additional fee can be added substantially to the total cost of a connection - for example a new 1/2" connection with a length of 30 meters from the main pipe which 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 charges for the labor and material costs.

Present connection charge and estimated connection fees are shown in Tables 17-1-10 and 17-1-11, respectively.

Table 17-1-10 Present Connection Charge

| Size of Connection | Basis Connection Fee (for connection less than 10 meters from main pipe) (Baht / conn.) |
|--------------------|--|
| 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 |

Note: Basic connection fee is applied to the connection less than 10 m from the main pipe

Table 17-1-11 Connection Fee

| Size of Conn. (inch) | 0.5 | 0.75 | 1 | 1.5 | 2 | 2.5 | 3 | 4 | 6 | Conn. Charge |
|------------------------------|--------------|-------|-------|-------|-------|--------|--------|--------|--------|-----------------|
| Conn. charge (Bath/conn.) | 2,050 | 2,750 | 3,750 | 6,690 | 9,575 | 13,075 | 15,495 | 21,455 | 30,025 | |
| Year | No. of Conn. | | | | | | | | | (Bath x 1000) |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 785 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1,632 |
| 1992 | 477 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1,001 |
| 1993 | 476 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 999 |
| 1994 | 453 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 952 |
| 1995 | 478 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1,003 |
| 1996 | 480 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 0 | 1,020 |
| 1997 | 440 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 1,094 |
| 1998 | 1,497 | 0 | 0 | 0 | 20 | 0 | 6 | 0 | 0 | 3,353 |
| 1999 | 491 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 1,198 |
| 2000 | 492 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 1,200 |
| 2001 | 493 | 0 | 3 | 0 | 20 | 0 | 0 | 0 | 0 | 1,213 |
| 2002 | 709 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 1,607 |
| 2003 | 1,786 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 3,815 |
| 2004 | 694 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 1,576 |
| 2005 | 724 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 1,637 |
| 2006 | 728 | 0 | 3 | 0 | 14 | 0 | 0 | 0 | 0 | 1,638 |
| 2007 | 698 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,431 |
| 2008 | 700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,435 |
| 2009 | 676 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,386 |
| 2010 | 707 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,449 |
| 2011 | 706 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1,459 |

Note : 0.5 inch ; Domestic & Commercial

1 inch ; Government & School

2 inch ; Hospital & tourism

3 inch ; Industrial

Service charges are levied on consumers according to the size of their connection, and increase rapidly for larger connections. The service charge is levied monthly and is fixed, regardless of the level of water consumption during a given month. Present service charges are shown in Table 17-1-12 below.

Table 17-1-12 Present Service Charge

| 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 |

Service charges are estimated by multiplying the number of connections by the service charge per connection as shown in Table 17-1-13.

Table 17-1-13 Service Charge

| Size of Conn. (inch) | 0.5 | 0.75 | 1 | 1.5 | 2 | 2.5 | 3 | 4 & above | Total Service Charge |
|-------------------------------|--------------|------|----|-----|-----|-----|-----|--------------|-------------------------|
| Conn. charge (Bath/month.) | 10 | 15 | 30 | 60 | 100 | 120 | 160 | 200 | |
| Year | No. of Conn. | | | | | | | | (Bath x 1000) |
| 1990 | 1,997 | 0 | 52 | 0 | 130 | 0 | 0 | 0 | 414 |
| 1991 | 2,782 | 0 | 53 | 0 | 132 | 0 | 0 | 0 | 511 |
| 1992 | 3,259 | 0 | 54 | 0 | 134 | 0 | 0 | 0 | 571 |
| 1993 | 3,735 | 0 | 55 | 0 | 136 | 0 | 0 | 0 | 631 |
| 1994 | 4,188 | 0 | 56 | 0 | 138 | 0 | 0 | 0 | 688 |
| 1995 | 4,666 | 0 | 57 | 0 | 140 | 0 | 0 | 0 | 748 |
| 1996 | 5,146 | 0 | 59 | 0 | 143 | 0 | 0 | 0 | 810 |
| 1997 | 5,586 | 0 | 59 | 0 | 163 | 0 | 0 | 0 | 887 |
| 1998 | 7,083 | 0 | 59 | 0 | 183 | 0 | 6 | 0 | 1,102 |
| 1999 | 7,574 | 0 | 59 | 0 | 203 | 0 | 6 | 0 | 1,185 |
| 2000 | 8,066 | 0 | 59 | 0 | 223 | 0 | 6 | 0 | 1,268 |
| 2001 | 8,559 | 0 | 62 | 0 | 243 | 0 | 6 | 0 | 1,353 |
| 2002 | 9,268 | 0 | 62 | 0 | 259 | 0 | 6 | 0 | 1,457 |
| 2003 | 11,054 | 0 | 62 | 0 | 275 | 0 | 6 | 0 | 1,690 |
| 2004 | 11,748 | 0 | 62 | 0 | 291 | 0 | 6 | 0 | 1,793 |
| 2005 | 12,472 | 0 | 62 | 0 | 307 | 0 | 6 | 0 | 1,899 |
| 2006 | 13,200 | 0 | 65 | 0 | 321 | 0 | 6 | 0 | 2,004 |
| 2007 | 13,898 | 0 | 65 | 0 | 321 | 0 | 6 | 0 | 2,088 |
| 2008 | 14,598 | 0 | 65 | 0 | 321 | 0 | 6 | 0 | 2,172 |
| 2009 | 15,274 | 0 | 65 | 0 | 321 | 0 | 6 | 0 | 2,253 |
| 2010 | 15,981 | 0 | 65 | 0 | 321 | 0 | 6 | 0 | 2,338 |
| 2011 | 16,687 | 0 | 68 | 0 | 321 | 0 | 6 | 0 | 2,424 |

b. Project Water Sales Revenue

Water Sales of the waterworks are estimated as tabulated in Table 17-1-14 with the following conditions adopted in the forecasting.

Table 17-1-14 Water Sales

| Item/Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| (1) Domestic | | | | | | | | | | | |
| Water Sales (cu.m/d) | 1,361 | 1,815 | 1,856 | 1,898 | 2,853 | 3,612 | 3,797 | 3,919 | 3,828 | 3,954 | 4,081 |
| Water Sales (cu.m/month) | 40,830 | 54,450 | 55,680 | 56,940 | 85,590 | 108,360 | 113,910 | 117,570 | 114,840 | 118,620 | 122,430 |
| No. of Connections | 439 | 706 | 1,135 | 1,564 | 1,993 | 2,422 | 2,852 | 3,243 | 3,634 | 4,025 | 4,416 |
| Water Cons./Conn. | 92.97 | 77.12 | 49.06 | 36.41 | 42.95 | 44.74 | 39.94 | 36.25 | 31.60 | 29.47 | 27.72 |
| Water Sales(\$1,000Baht) | 284 | 362 | 330 | 306 | 488 | 625 | 633 | 630 | 580 | 580 | 586 |
| (2) Governmental/Institutional | | | | | | | | | | | |
| Water Sales (cu.m/d) | 360 | 481 | 492 | 503 | 755 | 956 | 1,006 | 1,037 | 1,014 | 1,047 | 1,081 |
| Water Sales (cu.m/month) | 10,800 | 14,430 | 14,760 | 15,090 | 22,650 | 28,680 | 30,180 | 31,110 | 30,420 | 31,410 | 32,430 |
| No. of Connections | 54 | 55 | 56 | 57 | 58 | 59 | 62 | 62 | 62 | 62 | 62 |
| Water Cons./Conn. | | | | | | | | | | | |
| Water Sales(\$1,000Baht) | 88 | 121 | 123 | 126 | 196 | 253 | 264 | 273 | 267 | 276 | 285 |
| (3) Commercial | | | | | | | | | | | |
| Water Sales (cu.m/d) | 1,246 | 1,661 | 1,639 | 1,737 | 2,611 | 3,306 | 3,475 | 3,587 | 3,504 | 3,619 | 3,735 |
| Water Sales (cu.m/month) | 37,380 | 49,830 | 50,970 | 52,110 | 78,330 | 99,180 | 104,250 | 107,610 | 105,120 | 108,570 | 112,050 |
| No. of Connections | 1,558 | 2,076 | 2,124 | 2,171 | 3,264 | 4,133 | 4,344 | 4,484 | 4,380 | 4,524 | 4,669 |
| Water Cons./Conn. | 23.99 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 |
| Water Sales(\$1,000Baht) | 169 | 225 | 230 | 236 | 354 | 448 | 471 | 487 | 475 | 491 | 507 |
| (4) Industrial | | | | | | | | | | | |
| Water Sales (cu.m/d) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,000 | 1,000 | 1,000 |
| Water Sales (cu.m/month) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30,000 | 30,000 | 30,000 |
| No. of Connections | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Water Cons./Conn. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5,000.00 | 5,000.00 | 5,000.00 |
| Water Sales(\$1,000Baht) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 290 | 289 | 289 |
| (5) Tourism | | | | | | | | | | | |
| Water Sales (cu.m/d) | 3,367 | 4,491 | 4,592 | 4,697 | 7,059 | 8,937 | 9,395 | 9,697 | 9,472 | 9,783 | 10,098 |
| Water Sales (cu.m/month) | 101,010 | 134,730 | 137,760 | 140,910 | 211,770 | 268,110 | 281,830 | 290,910 | 284,160 | 293,490 | 302,940 |
| No. of Connections | 128 | 130 | 132 | 134 | 136 | 138 | 140 | 160 | 180 | 200 | 220 |
| Water Cons./Conn. | 788.95 | 1,036.38 | 1,043.64 | 1,051.57 | 1,557.13 | 1,942.83 | 2,013.21 | 1,818.19 | 1,578.67 | 1,467.45 | 1,377.00 |
| Water Sales(\$1,000Baht) | 900 | 1,213 | 1,240 | 1,269 | 1,941 | 2,476 | 2,606 | 2,581 | 2,606 | 2,685 | 2,764 |
| Total (\$1,000 Baht) | 17,292 | 23,052 | 23,076 | 23,244 | 35,748 | 45,624 | 47,688 | 48,652 | 50,616 | 51,852 | 53,172 |

Table 17-1-14 (Cont'd)

(1) Domestic

| Item/Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Water Sales (cu.m/d) | 4,210 | 4,272 | 4,336 | 4,380 | 4,450 | 4,523 | 4,590 | 4,658 | 4,705 | 4,778 | 4,854 |
| Water Sales (cu.m/month) | 126,300 | 128,160 | 130,080 | 131,400 | 133,500 | 135,690 | 137,700 | 139,740 | 141,150 | 143,340 | 145,620 |
| No. of Connections | 4,805 | 5,449 | 6,093 | 6,737 | 7,381 | 8,025 | 8,647 | 9,269 | 9,891 | 10,513 | 11,133 |
| Water Cons./Conn. | 26.29 | 23.52 | 21.35 | 19.50 | 18.09 | 16.91 | 15.92 | 15.08 | 14.27 | 13.63 | 13.08 |
| Water Sales(*1,000Baht) | 593 | 574 | 556 | 541 | 546 | 551 | 555 | 559 | 561 | 566 | 572 |

(2) Governmental/Institutional

| Item/Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Water Sales (cu.m/d) | 1,115 | 1,132 | 1,149 | 1,160 | 1,176 | 1,199 | 1,215 | 1,233 | 1,247 | 1,266 | 1,286 |
| Water Sales (cu.m/month) | 33,450 | 33,960 | 34,470 | 34,800 | 35,340 | 35,970 | 36,450 | 36,990 | 37,410 | 37,980 | 38,580 |
| No. of Connections | 65 | 65 | 65 | 65 | 65 | 68 | 68 | 68 | 68 | 68 | 71 |
| Water Cons./Conn. | 295 | 299 | 304 | 307 | 312 | 318 | 321 | 328 | 331 | 336 | 342 |
| Water Sales(*1,000Baht) | | | | | | | | | | | |

(3) Commercial

| Item/Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Water Sales (cu.m/d) | 3,854 | 3,910 | 3,969 | 4,009 | 4,073 | 4,140 | 4,201 | 4,263 | 4,306 | 4,374 | 4,443 |
| Water Sales (cu.m/month) | 115,620 | 117,300 | 119,070 | 120,270 | 122,190 | 124,200 | 126,030 | 127,890 | 129,180 | 131,220 | 133,290 |
| No. of Connections | 4,818 | 4,888 | 4,961 | 5,011 | 5,091 | 5,175 | 5,251 | 5,329 | 5,383 | 5,468 | 5,554 |
| Water Cons./Conn. | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 | 24.00 |
| Water Sales(*1,000Baht) | 523 | 530 | 538 | 544 | 552 | 561 | 570 | 578 | 584 | 593 | 603 |

(4) Industrial

| Item/Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Water Sales (cu.m/d) | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 | 1,000 |
| Water Sales (cu.m/month) | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 | 30,000 |
| No. of Connections | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| Water Cons./Conn. | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 | 5,000.00 |
| Water Sales(*1,000Baht) | 289 | 289 | 289 | 289 | 289 | 289 | 289 | 289 | 289 | 289 | 289 |

(5) Tourism

| Item/Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Water Sales (cu.m/d) | 10,418 | 10,571 | 10,730 | 10,838 | 11,012 | 11,193 | 11,356 | 11,525 | 11,642 | 11,824 | 12,011 |
| Water Sales (cu.m/month) | 312,540 | 317,130 | 321,900 | 325,140 | 330,360 | 335,790 | 340,680 | 345,750 | 349,260 | 354,720 | 360,330 |
| No. of Connections | 240 | 256 | 272 | 288 | 304 | 318 | 318 | 318 | 318 | 318 | 318 |
| Water Cons./Conn. | 1,302.25 | 1,238.79 | 1,183.46 | 1,128.96 | 1,086.71 | 1,055.94 | 1,071.32 | 1,087.26 | 1,098.30 | 1,115.47 | 1,133.11 |
| Water Sales(*1,000Baht) | 2,845 | 2,880 | 2,917 | 2,940 | 2,981 | 3,025 | 3,072 | 3,120 | 3,153 | 3,205 | 3,259 |

| | | | | | | | | | | | |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Total (*1,000 Baht) | 54,540 | 54,864 | 55,248 | 55,452 | 56,160 | 56,928 | 57,684 | 58,488 | 59,016 | 59,868 | 60,780 |
|---------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|

- i) Water tariffs will remain unchanged until 2020.
- ii) Water sales are estimated by use for domestic, commercial, institutional, industrial and other use as predicted in each year.
- iii) Water sales are calculated from the monthly average water consumption multiplied by water tariff.

In the PWA's water tariff system, water charge is levied on consumers according to metered water consumption after every month. Charging method is to levy a progressive method for the amount metered. Prior to the increases, charges were levied on a sliding scale. Thus, for example, a consumer using 25 cu m of water in a month would pay 3.75 Baht per cu m for the first 10 cu m, 4.50 Baht per cu m for the next 10 cu m and 6.50 Baht per cu m only for the last 5 cu m above 20 cu m, so that a total payment will be 115 Baht.

17.1.4 Cash Flow Statement

1) Cash Flow

Table 17-1-15 shows the projected cash flow from 1990 to 2020. Estimate condition of each items to be counted in cash flow are as follows.

a. Cash Inflow

- Government contribution

capital contribution for interest payment of domestic loan.

- Loan

Local and foreign loan disbursement is estimated based on the Alternative 4 financing plan.

- Water sales, connection charge and service charge.

Detailed estimation is shown in Tables 17-1-11, 17-1-13 and 17-1-14.

- Other income

This income is including sales of materials, fine penalties and other, and estimated 2 percent of total water sales of each year.

- Income from Phuket municipality

PWA agreed with Phuket municipality about water rate to be supplied from waterworks at four Baht per cu.m.

b. Cash Outflow

- Project expenditure

It is according to capital disbursement schedule for Implementation plan.

- Amortization

Alternative 4 financing plan is adopted in the debt service calculation.

- Operation & maintenance

Details are shown in chapter 11.

- Connection expenses

50 percent of Connection Fee.

- Share of Head Office

Table 17-1-15 Projected Cash Flow at 1989 Price

| Year | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 |
|-----------------------------|---------|---------|---------|---------|---------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Cash Inflow | | | | | | | | | | | | | | | | |
| Government Contribution | 0 | 0 | 0 | 3,930 | 4,362 | 4,842 | 6,016 | 6,678 | 7,413 | 8,430 | 9,357 | 10,387 | 11,529 | 1,639 | 1,819 | 2,019 |
| Capital Contribution | 33,112 | 36,348 | 24,038 | 26,709 | 181,624 | 384,140 | 182,514 | | | | | | | | | |
| Lease | 28,639 | 35,479 | 597 | 663 | 3,351 | 6,721 | 3,373 | | | | | | | | | |
| Local Loan | 3,473 | 869 | 23,441 | 26,046 | 178,273 | 357,419 | 179,141 | | | | | | | | | |
| Foreign Loan | 18,052 | 25,656 | 25,110 | 25,339 | 38,103 | 48,287 | 50,472 | 51,810 | 56,083 | 55,272 | 56,703 | 58,197 | 59,025 | 61,858 | 59,930 | 60,819 |
| Operating Revenue | 17,292 | 23,052 | 23,076 | 23,244 | 35,748 | 45,624 | 47,688 | 48,852 | 50,616 | 51,852 | 53,172 | 54,540 | 54,864 | 55,248 | 55,452 | 56,160 |
| Water Sales | 0 | 1,632 | 1,001 | 999 | 952 | 1,003 | 1,020 | 1,094 | 3,353 | 1,198 | 1,200 | 1,213 | 1,607 | 3,815 | 1,576 | 1,637 |
| Connection Fee | 414 | 511 | 571 | 631 | 688 | 748 | 810 | 887 | 1,102 | 1,185 | 1,268 | 1,353 | 1,457 | 1,690 | 1,793 | 1,899 |
| Service Charge | 346 | 461 | 462 | 465 | 715 | 912 | 954 | 977 | 1,012 | 1,037 | 1,063 | 1,091 | 1,097 | 1,105 | 1,109 | 1,123 |
| Other Income | 2,164 | 0 | 7,379 | 7,188 | 26,587 | 21,477 | 22,434 | 23,436 | 24,458 | 25,499 | 26,560 | 27,641 | 28,860 | 30,102 | 31,370 | 32,456 |
| Income From Municipality | 53,328 | 62,004 | 56,526 | 63,165 | 250,675 | 438,746 | 261,435 | 81,924 | 87,954 | 89,201 | 92,620 | 96,225 | 99,414 | 93,599 | 93,119 | 95,294 |
| Total Inflow | | | | | | | | | | | | | | | | |
| Cash Outflow | | | | | | | | | | | | | | | | |
| Project Expenditures | | | | | | | | | | | | | | | | |
| Local Portion | 60,320 | 71,219 | 8,225 | 9,139 | 60,183 | 120,667 | 60,487 | | | | | | | | | |
| Foreign Portion | 2,431 | 608 | 16,408 | 18,232 | 124,791 | 250,193 | 125,399 | | | | | | | | | |
| Amortization | | | | | | | | | | | | | | | | |
| Principal | 0 | 0 | 0 | 3,930 | 4,362 | 4,842 | 6,016 | 6,678 | 7,413 | 8,430 | 9,357 | 10,387 | 11,529 | 1,639 | 1,819 | 2,019 |
| Interest | 3,354 | 7,280 | 7,979 | 8,755 | 13,504 | 23,414 | 28,089 | 27,428 | 26,693 | 25,878 | 24,950 | 23,125 | 21,165 | 19,057 | 18,014 | 16,928 |
| Operating Expenses | 9,585 | 12,533 | 13,708 | 13,866 | 18,984 | 21,220 | 24,621 | 25,523 | 28,999 | 28,857 | 29,737 | 30,734 | 31,664 | 35,602 | 35,559 | 36,560 |
| O & M Cost | 5,739 | 6,856 | 8,341 | 8,471 | 11,408 | 11,876 | 14,905 | 15,565 | 17,600 | 18,318 | 18,964 | 19,713 | 20,389 | 23,155 | 24,196 | 25,041 |
| Connection Expenses | 0 | 816 | 501 | 500 | 476 | 502 | 510 | 547 | 1,677 | 599 | 600 | 607 | 804 | 1,908 | 788 | 819 |
| Share of Head Office | 3,846 | 4,861 | 4,866 | 4,895 | 7,100 | 8,842 | 9,206 | 9,411 | 9,722 | 9,940 | 10,173 | 10,414 | 10,471 | 10,539 | 10,575 | 10,700 |
| Payment to RID | 854 | 930 | 854 | 854 | 2,231 | 2,289 | 2,407 | 2,500 | 2,595 | 2,691 | 2,789 | 2,888 | 2,965 | 3,044 | 3,126 | 3,200 |
| Total Outflow | 76,544 | 92,570 | 47,175 | 54,776 | 224,055 | 422,625 | 247,019 | 62,129 | 65,700 | 65,856 | 66,323 | 67,420 | 68,427 | 69,427 | 70,427 | 71,427 |
| Net Cash Flow | -23,216 | -30,566 | 9,352 | 8,390 | 26,620 | 16,121 | 14,416 | 19,795 | 22,255 | 23,345 | -3,703 | -1,195 | 988 | 2,314 | 1,795 | 2,896 |
| Accumulated | -23,216 | -53,782 | -44,431 | -36,041 | -9,420 | 6,701 | 21,117 | 40,913 | 63,167 | 86,512 | 82,810 | 81,615 | 82,603 | 84,917 | 86,712 | 89,608 |

Table 17-1-15 Projected Cash Flow at 1989 Price (Cont'd)

(Unit: Baht x 1000)

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|--------------------------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Cash Inflow | | | | | | | | | | | | | | | |
| Government Contribution | | | | | | | | | | | | | | | |
| Capital Contribution | 419 | 465 | 516 | | | | | | | | | | | | |
| Laon | | | | | | | | | | | | | | | |
| Local Loan | | | | | | | | | | | | | | | |
| Foreign Loan | | | | | | | | | | | | | | | |
| Operating Revenue | 61,709 | 62,357 | 63,265 | 63,835 | 64,852 | 65,879 | 65,879 | 65,879 | 65,879 | 65,879 | 65,879 | 65,879 | 65,879 | 65,879 | 65,879 |
| Water Sales | 56,928 | 57,684 | 58,488 | 59,016 | 59,868 | 60,780 | 60,780 | 60,780 | 60,780 | 60,780 | 60,780 | 60,780 | 60,780 | 60,780 | 60,780 |
| Connection Fee | 1,638 | 1,431 | 1,435 | 1,386 | 1,449 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 |
| Service Charge | 2,004 | 2,088 | 2,172 | 2,253 | 2,338 | 2,424 | 2,424 | 2,424 | 2,424 | 2,424 | 2,424 | 2,424 | 2,424 | 2,424 | 2,424 |
| Other Income | 1,139 | 1,154 | 1,170 | 1,180 | 1,197 | 1,216 | 1,216 | 1,216 | 1,216 | 1,216 | 1,216 | 1,216 | 1,216 | 1,216 | 1,216 |
| Income From Municipality | 32,035 | 31,675 | 31,292 | 30,889 | 30,219 | 40,587 | 40,587 | 40,587 | 40,587 | 40,587 | 40,587 | 40,587 | 40,587 | 40,587 | 40,587 |
| Total Inflow | 94,163 | 94,497 | 95,073 | 94,724 | 104,071 | 106,466 | 106,466 | 106,466 | 106,466 | 106,466 | 106,466 | 106,466 | 106,466 | 106,466 | 106,466 |
| Cash Outflow | | | | | | | | | | | | | | | |
| Project Expenditures | | | | | | | | | | | | | | | |
| Local Portion | | | | | | | | | | | | | | | |
| Foreign Portion | | | | | | | | | | | | | | | |
| Amortization | | | | | | | | | | | | | | | |
| Principal | 35,020 | 36,001 | 37,011 | 37,481 | 38,493 | 39,532 | 40,599 | 41,696 | 42,821 | 43,977 | 45,165 | 46,384 | 47,637 | 48,923 | |
| Interest | 15,796 | 14,816 | 13,805 | 12,763 | 11,751 | 10,712 | 9,644 | 8,548 | 7,423 | 6,266 | 5,079 | 3,859 | 2,607 | 1,321 | |
| Operating Expenses | 36,935 | 37,905 | 39,237 | 40,558 | 39,639 | 40,922 | 40,922 | 40,922 | 40,922 | 40,922 | 40,922 | 40,922 | 40,922 | 40,922 | 40,922 |
| O & M Cost | 25,281 | 26,220 | 27,409 | 28,661 | 27,560 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 | 28,678 |
| Connection Expenses | 819 | 716 | 718 | 693 | 725 | 730 | 730 | 730 | 730 | 730 | 730 | 730 | 730 | 730 | 730 |
| Share of Head Office | 10,835 | 10,969 | 11,110 | 11,204 | 11,354 | 11,514 | 11,514 | 11,514 | 11,514 | 11,514 | 11,514 | 11,514 | 11,514 | 11,514 | 11,514 |
| Payment to RID | 3,297 | 3,379 | 3,463 | 3,549 | 4,092 | 4,183 | 4,183 | 4,183 | 4,183 | 4,183 | 4,183 | 4,183 | 4,183 | 4,183 | 4,183 |
| Total Outflow | 91,048 | 92,101 | 93,516 | 94,351 | 93,975 | 95,349 | 95,348 | 95,349 | 95,349 | 95,348 | 95,349 | 95,348 | 95,349 | 95,349 | 95,349 |
| Net Cash Flow | 3,115 | 2,396 | 1,557 | 373 | 10,097 | 11,117 | 11,118 | 11,117 | 11,117 | 11,118 | 11,117 | 11,118 | 11,117 | 11,117 | 11,117 |
| Accumulated | 92,723 | 95,119 | 96,676 | 97,069 | 107,146 | 118,263 | 129,381 | 140,499 | 151,616 | 162,734 | 173,851 | 184,969 | 196,086 | 207,203 | 268,564 |

• Payment to RID

PWA shall pay 20 stang per cu.m. for water taken from dam facilities.

As clearly shown in this table, from 1990 to 1991, and from 2000 to 2000, the net cash flow ended in a defect.

It seems clear from "Alternative 4 financing plan" that these deficits are covered with PWA's own equity finance.

After 2001, net annual revenue surpluses are forecasted large enough to cover throughout operation and maintenance period, amortization cost and operating expenses.

The result of this cash flow statement reveals that the annual net cash flow will continuously raise profit surpluses throughout after 2001, with cumulative surplus increasing to 118,263 thousand Baht in 2011 and 268,564 thousand Baht in 2020. This accumulated surplus is almost three times as large as the gross operating revenue of the year 2011.

This result may demonstrate the simple financial feasibility of this project.

As a sensitivity analysis, cash flow statement are also made on the assumption that the water tariff including connection and service charges will be increased every three years at the rate of five percent per annum adjusting for inflation of five percent per year. The result of this study reveals, as shown in Appendix, A 17-1-6, that the annual net cash flow will continuously raise profit surpluses throughout after 1994 except year of 2000 and 2001.

The cumulative surplus amount will be 839,094 thousand Baht in 2011 and 2,264,318 thousand Baht in 2020, respectively.

2) Share of Head and Regional Office Overhead Expenses

PWA is administratively, technically, economically and financially independent from the central government. Therefore, in order that total financial independence can be achieved by the PWA in the future, administrative expenses of its head and regional office, such as inventories, personal expenses and consignment fee shall be charged to the revenue of each waterworks.

In view of the above, it is recommended that the share allocation of administrative expenses shall be calculated based on number of waterworks and gross revenue of each waterworks.

Table 17-1-16 shows share of Head and Regional Office Overhead Expenses in 1986 and 1987.

Table 17-1-16 Share of Head and Regional Office Overhead Expenses
Phuket (Regional Office No. 4)

| | |
|--|----------------|
| YEAR 1986 | |
| 1. HEAD Office Expenses | |
| a) Per Waterworks Portion (1/3) | Baht — |
| b) WW/PWA-Total Consumption Portion (2/3) | Baht — |
| 2. Regional Office Expenses | |
| a) Per Waterworks Portion (1/3) | Baht — |
| b) WW/Region-Total Consumption Portion (2/3) | Baht — |
| TOTAL SHARE OF HEAD AND REGIONAL OFFICE OVERHEAD EXPESSES | |
| | Baht — |
| YEAR 1987 | |
| 1. Head Office Expenses | |
| a) Per Waterworks Portion (1/3) | Baht 517,498 |
| b) WW/PWA-Total Consumption Portion (2/3) | Baht 134,063 |
| 2. Regional Office Expenses | |
| a) Per Waterworks Portion (1/3) | Baht 278,962 |
| b) WW/Region-Total Consumption Portion (2/3) | Baht 72,552 |
| TOTAL SHARE OF HEAD AND REGIONAL OFFICE OVERHEAD EXPESSES | |
| | Baht 1,003,075 |

3) Unit Cost of Water

As shown in Table 17-1-17, the unit cost after debt service which will register 2.40 Baht per cu m in 2011 and 2020 or equal to 78 percent of the average unit water cost from year 1990 to 2011 and almost minimum level of present water tariff structure of PWA. An average unit water cost from 1990 to 2011 is 4.50 Baht per cu.m.

The unit cost after depreciation is shown in Appendix A12-1-7.

Table 17-1-17 Unit Cost of Water

(Unit :Baht x 1000)

| year | Water Consum. (cu.m/day) | Capital Invest. | Operating Expenses | Payment to RID | Total Expenses | Unit Water Cost (Baht/cu.m) |
|------|-----------------------------|-----------------|--------------------|----------------|----------------|--------------------------------|
| 1990 | 7,818 | 62,751 | 9,585 | 854 | 73,190 | 25.65 |
| 1991 | 8,449 | 71,827 | 12,533 | 930 | 85,290 | 27.66 |
| 1992 | 13,694 | 24,634 | 13,708 | 854 | 39,196 | 7.84 |
| 1993 | 13,760 | 27,371 | 13,866 | 854 | 42,091 | 8.38 |
| 1994 | 31,491 | 184,974 | 18,984 | 2,231 | 206,189 | 17.94 |
| 1995 | 31,525 | 370,860 | 21,220 | 2,289 | 394,369 | 34.27 |
| 1996 | 33,042 | 185,886 | 24,621 | 2,407 | 212,914 | 17.65 |
| 1997 | 34,296 | 0 | 25,523 | 2,500 | 28,023 | 2.24 |
| 1998 | 35,573 | 0 | 28,999 | 2,595 | 31,594 | 2.43 |
| 1999 | 36,871 | 0 | 28,857 | 2,691 | 31,548 | 2.34 |
| 2000 | 38,192 | 0 | 29,737 | 2,789 | 32,526 | 2.33 |
| 2001 | 39,533 | 0 | 30,734 | 2,888 | 33,622 | 2.33 |
| 2002 | 40,656 | 0 | 31,664 | 2,965 | 34,629 | 2.33 |
| 2003 | 41,806 | 0 | 35,602 | 3,044 | 38,646 | 2.53 |
| 2004 | 42,878 | 0 | 35,559 | 3,126 | 38,685 | 2.47 |
| 2005 | 43,949 | 0 | 36,560 | 3,200 | 39,760 | 2.48 |
| 2006 | 44,001 | 0 | 36,935 | 3,297 | 40,232 | 2.51 |
| 2007 | 44,062 | 0 | 37,905 | 3,379 | 41,284 | 2.57 |
| 2008 | 44,117 | 0 | 39,237 | 3,463 | 42,700 | 2.65 |
| 2009 | 44,062 | 0 | 40,558 | 3,549 | 44,107 | 2.74 |
| 2010 | 50,108 | 0 | 39,639 | 4,092 | 43,731 | 2.39 |
| 2011 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2012 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2013 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2014 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2015 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2016 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2017 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2018 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2019 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |
| 2020 | 51,397 | 0 | 40,922 | 4,183 | 45,105 | 2.40 |

Average Unit Water Cost (1990-2020) : 4.50

4) Average Water Rate

In view of revenue aspects, average water tariff is calculated based on water sales and is shown in Table 17-1-18.

5) Depreciation

At the end of the project, it may reasonably be expected to exist some residual (or terminal) value. That is, the capital asset will not have been used up in the course of the project period, and there will be a "residual asset". In this financial study, project period is established for 31 years from 1990 to 2020. The residual value is, therefor added to the benefit stream in the last year 2020.

Table 17-1-19 shows the depreciation of the project fixed assets of each water supply system.

For calculating, following conditions are adopted.

Depreciation method : Straight - line method

Final Salvage value : 10 percent of investment Cost

Durable years :

1. Bangwat System - Immediated Improvement
: 30 years
2. Bangwat System - New Development
: 30 years
3. Khlong Katha System
: 37 years
4. Bang Nieo Dam System
: 33 years
5. Zone 7 System
: 32 years

Durable years of facilities was calculated by weighted average of each component. As shown in the Table 17-1-19, total salvage value in the year 2011 and 2020 are 958,827 thousand Baht and 261,833 thousand Baht, respectively.

Table 17-1-18 Average Water Tariff

| Year | Water Consumption (cu.m/d) | Water Sales (1000 Baht /year) | Average Water Tariff (Baht/cu.m) |
|------|----------------------------|-------------------------------|----------------------------------|
| 1990 | 6,334 | 17,292 | 7.48 |
| 1991 | 8,448 | 23,052 | 7.48 |
| 1992 | 8,639 | 23,076 | 7.32 |
| 1993 | 8,833 | 23,244 | 7.21 |
| 1994 | 8,928 | 23,112 | 7.09 |
| 1995 | 9,128 | 23,424 | 7.03 |
| 1996 | 9,332 | 23,736 | 6.97 |
| 1997 | 9,531 | 24,060 | 6.92 |
| 1998 | 15,030 | 39,804 | 7.26 |
| 1999 | 15,436 | 40,608 | 7.21 |
| 2000 | 15,849 | 41,436 | 7.16 |
| 2001 | 16,271 | 42,264 | 7.12 |
| 2002 | 16,537 | 42,792 | 7.09 |
| 2003 | 21,184 | 55,248 | 7.15 |
| 2004 | 21,387 | 55,452 | 7.10 |
| 2005 | 21,713 | 56,160 | 7.09 |
| 2006 | 22,055 | 56,928 | 7.07 |
| 2007 | 22,362 | 57,684 | 7.07 |
| 2008 | 22,679 | 58,488 | 7.07 |
| 2009 | 22,900 | 59,018 | 7.06 |
| 2010 | 23,242 | 59,868 | 7.06 |
| 2011 | 23,594 | 60,780 | 7.06 |
| 2012 | 23,594 | 60,780 | 7.06 |
| 2013 | 23,594 | 60,780 | 7.06 |
| 2014 | 23,594 | 60,780 | 7.06 |
| 2015 | 23,594 | 60,780 | 7.06 |
| 2016 | 23,594 | 60,780 | 7.06 |
| 2017 | 23,594 | 60,780 | 7.06 |
| 2018 | 23,594 | 60,780 | 7.06 |
| 2019 | 23,594 | 60,780 | 7.06 |
| 2020 | 23,594 | 60,780 | 7.06 |

Table 17-1-19 Depreciation

(Unit: Baht x 1000)

| YEAR | Bangwat Imm-imp | Bangwat Development | Khlong Katha | Bang Niso | Zone 7 | Yearly Total | Accum. Total | Salvage Value |
|------|--------------------|------------------------|-----------------|--------------|--------|-----------------|-----------------|------------------|
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52,071 |
| 1992 | 3,124 | 0 | 0 | 0 | 0 | 3,124 | 3,124 | 101,018 |
| 1993 | 3,124 | 0 | 0 | 0 | 0 | 3,124 | 6,249 | 97,893 |
| 1994 | 3,124 | 0 | 0 | 0 | 0 | 3,124 | 9,373 | 94,769 |
| 1995 | 3,124 | 0 | 0 | 0 | 0 | 3,124 | 12,497 | 272,969 |
| 1996 | 3,124 | 0 | 0 | 0 | 0 | 3,124 | 15,621 | 632,494 |
| 1997 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 38,621 | 790,818 |
| 1998 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 61,620 | 767,819 |
| 1999 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 84,619 | 744,820 |
| 2000 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 107,619 | 721,820 |
| 2001 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 130,618 | 698,821 |
| 2002 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 153,617 | 675,822 |
| 2003 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 176,617 | 652,822 |
| 2004 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 199,616 | 629,823 |
| 2005 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 222,615 | 606,824 |
| 2006 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 245,615 | 583,824 |
| 2007 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 268,614 | 560,825 |
| 2008 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 291,613 | 537,826 |
| 2009 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 314,613 | 514,826 |
| 2010 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 337,612 | 491,827 |
| 2011 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 360,612 | 468,827 |
| 2012 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 383,611 | 445,828 |
| 2013 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 406,610 | 422,829 |
| 2014 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 429,610 | 399,829 |
| 2015 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 452,609 | 376,830 |
| 2016 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 475,608 | 353,831 |
| 2017 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 498,608 | 330,831 |
| 2018 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 521,607 | 307,832 |
| 2019 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 544,606 | 284,833 |
| 2020 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 567,606 | 261,833 |
| 2021 | 3,124 | 1,090 | 2,038 | 8,755 | 7,993 | 22,999 | 590,605 | 238,834 |
| 2022 | 0 | 1,090 | 2,038 | 8,755 | 7,993 | 19,875 | 610,480 | 218,959 |
| 2023 | 0 | 1,090 | 2,038 | 8,755 | 7,993 | 19,875 | 630,355 | 199,084 |
| 2024 | 0 | 1,090 | 2,038 | 8,755 | 7,993 | 19,875 | 650,230 | 179,209 |
| 2025 | 0 | 1,090 | 2,038 | 8,755 | 7,993 | 19,875 | 670,105 | 159,334 |
| 2026 | 0 | 1,090 | 2,038 | 8,755 | 7,993 | 19,875 | 689,980 | 139,459 |
| 2027 | 0 | 0 | 2,038 | 8,755 | 7,993 | 18,785 | 708,766 | 120,673 |
| 2028 | 0 | 0 | 2,038 | 8,755 | 7,993 | 18,785 | 727,551 | 101,888 |
| 2029 | 0 | 0 | 2,038 | 8,755 | 0 | 10,793 | 738,344 | 91,095 |
| 2030 | 0 | 0 | 2,038 | 0 | 0 | 2,038 | 740,382 | 89,057 |
| 2031 | 0 | 0 | 2,038 | 0 | 0 | 2,038 | 742,420 | 87,019 |
| 2032 | 0 | 0 | 2,038 | 0 | 0 | 2,038 | 744,457 | 84,982 |
| 2033 | 0 | 0 | 2,038 | 0 | 0 | 2,038 | 746,495 | 82,944 |
| 2034 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |
| 2035 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |
| 2036 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |
| 2037 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |
| 2038 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |
| 2039 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |
| 2040 | 0 | 0 | 0 | 0 | 0 | 0 | 746,495 | 82,944 |

17.1.5 Financial Analysis

In this analysis the viability of project shall be measured by the following financial feasibility criteria:

FIRR

$B/C > 1$

$NPV > 0$

where;

FIRR - Financial internal rate of return

B - present value of benefits

C - present value of costs

B/C - ratio of benefits to costs

NPV - net present value or $B - C$

In the calculation of the Financial Internal Rate of Return (FIRR), the following two indicators are normally used to evaluate the financial profitability of the project.

(1) Internal Rate of Return on Investment (IRROI)

The term, IRROI, indicates the internal rate of return on total capital investment, and assesses the profitability of the project as a whole and the ability to recover funds invested in the project.

The IRROI is calculated based on the assumption that the total capital investment is covered by its own capital. Therefore, the financial conditions such as the loan conditions on borrowed capital, changes on the ratio of equity to total capital requirement and others have no effect on the IRROI. Accordingly, the IRROI indicates the profitability of the project itself.

(2) Internal Rate of Return of Equity (IRROE)

The term, IRROE, indicates the internal rate of return on equity, and assesses the profitability only with respect to equity and the ability to recover funds invested in the project as equity. Here, the IRROE is calculated on the basis of such financial conditions proper to the project as the loan conditions on borrowed capital and amount of capital owned.

In this study, the FIRR was calculated using the both method.

The rate of return was computed based on the present value of cash inflow and outflows.

A $B/C > 1$, or an $NPV > 0$ at nine percent discount rate, indicates that the project is feasible, i.e. financial benefits exceed financial costs

at the prevailing opportunity cost of capital, hence, the project is viable for implementation, Tables 17-1-20 and 17-1-21 represent the tabulation and calculation of Financial Benefit and Cost for the project. As clear in these tables, the FIRROE is estimated to be 12.67 percent, NPV is 31,208 thousand Baht and B.C. Ratio is 1.01 respectively.

Since FIRROE exceeds the opportunity cost of capital of nine percent and interest rate of international lending agencies.

B/C and NPV also exceed financial feasibility criteria, the project is considered financial feasible. The undertaking of the project is therefore suggested itself to proceed positively on condition to repay the interest for borrowed capital.

Table 17-1-20 Financial Benefit and Cost (on investment)

(Unit :Baht x 1000)

| year | Operatin Income | Govern. Subsidy | Total Income | Capital Invest. | Operating Expenses | Total Expenses | Net Income | Net Present Value | | | |
|---------------|--------------------|--------------------|-----------------|--------------------|-----------------------|-------------------|---------------|-------------------|---------|---------------|--|
| | | | | | | | | Benefit | Cost | Net Income | |
| 1990 | 0 | 0 | 0 | 62,751 | 0 | 62,751 | -62,751 | 0 | 62,751 | -62,751 | |
| 1991 | 0 | 0 | 0 | 71,827 | 0 | 71,827 | -71,827 | 0 | 65,896 | -65,896 | |
| 1992 | 13,164 | 0 | 13,164 | 24,634 | 1,490 | 26,124 | -12,960 | 11,080 | 21,988 | -10,908 | |
| 1993 | 13,144 | 3,930 | 17,074 | 27,371 | 1,490 | 28,861 | -11,787 | 13,184 | 22,286 | -9,102 | |
| 1994 | 45,297 | 4,362 | 49,659 | 184,974 | 1,490 | 186,464 | -136,805 | 35,180 | 132,096 | -96,916 | |
| 1995 | 50,260 | 4,842 | 55,102 | 370,860 | 1,490 | 372,350 | -317,248 | 35,813 | 242,002 | -206,189 | |
| 1996 | 53,323 | 6,016 | 59,339 | 185,886 | 1,490 | 187,376 | -128,037 | 35,382 | 111,726 | -76,344 | |
| 1997 | 56,683 | 6,678 | 63,361 | 0 | 13,806 | 13,806 | 49,555 | 34,661 | 7,552 | 27,108 | |
| 1998 | 61,978 | 7,413 | 69,391 | 0 | 17,282 | 17,282 | 52,110 | 34,825 | 8,673 | 26,152 | |
| 1999 | 62,208 | 8,430 | 70,638 | 0 | 17,140 | 17,140 | 53,498 | 32,524 | 7,892 | 24,632 | |
| 2000 | 64,700 | 9,357 | 74,057 | 0 | 18,020 | 18,020 | 56,037 | 31,282 | 7,612 | 23,671 | |
| 2001 | 67,275 | 10,387 | 77,662 | 0 | 19,017 | 19,017 | 58,646 | 30,097 | 7,370 | 22,727 | |
| 2002 | 69,322 | 11,529 | 80,851 | 0 | 19,947 | 19,947 | 60,905 | 28,745 | 7,092 | 21,654 | |
| 2003 | 73,397 | 1,639 | 75,036 | 0 | 23,885 | 23,885 | 51,152 | 24,475 | 7,791 | 16,685 | |
| 2004 | 72,737 | 1,819 | 74,556 | 0 | 23,842 | 23,842 | 50,714 | 22,311 | 7,135 | 15,176 | |
| 2005 | 74,712 | 2,019 | 76,731 | 0 | 24,843 | 24,843 | 51,889 | 21,066 | 6,820 | 14,245 | |
| 2006 | 77,125 | 419 | 77,544 | 0 | 25,218 | 25,218 | 52,326 | 19,531 | 6,352 | 13,179 | |
| 2007 | 79,047 | 465 | 79,512 | 0 | 26,188 | 26,188 | 53,325 | 18,373 | 6,051 | 12,322 | |
| 2008 | 81,255 | 516 | 81,771 | 0 | 27,520 | 27,520 | 54,252 | 17,335 | 5,834 | 11,501 | |
| 2009 | 83,146 | 0 | 83,146 | 0 | 28,841 | 28,841 | 54,305 | 16,171 | 5,609 | 10,562 | |
| 2010 | 85,508 | 0 | 85,508 | 0 | 27,922 | 27,922 | 57,587 | 15,257 | 4,982 | 10,275 | |
| 2011 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 14,390 | 4,781 | 9,609 | |
| 2012 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 13,201 | 4,386 | 8,815 | |
| 2013 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 12,111 | 4,024 | 8,088 | |
| 2014 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 11,111 | 3,692 | 7,420 | |
| 2015 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 10,194 | 3,387 | 6,807 | |
| 2016 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 9,352 | 3,107 | 6,245 | |
| 2017 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 8,580 | 2,851 | 5,729 | |
| 2018 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 7,872 | 2,615 | 5,256 | |
| 2019 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 58,699 | 7,222 | 2,399 | 4,822 | |
| 2020 | 87,903 | 0 | 87,903 | 0 | 29,205 | 29,205 | 320,532 | 6,625 | 2,201 | 24,159 | |
| Salvage Value | | | | | | (-261,833) | | | | | |
| | | | | | | | | 577,949 | 788,951 | -191,268 | |
| | | | | | | | | 0.73 | FIRR is | 5.24% | |

Table 17-1-21 Financial Benefit and Cost (on equity)

(Unit :Baht x 1000)

| year | Operating Loan | Operating Income | Govern. Subsidy | Total Income | Capital Invest. | Operating Expenses | Debt Services | Total Expenses | Net Income | Net Present Value | | |
|------|-------------------|---------------------|--------------------|-----------------|--------------------|-----------------------|------------------|-------------------|---------------|-------------------|---------|---------------|
| | | | | | | | | | | Benefit | Cost | Net Income |
| 1990 | 33,112 | 0 | 0 | 33,112 | 62,751 | 0 | 3,354 | 66,105 | -32,993 | 33,112 | 66,105 | -32,993 |
| 1991 | 36,348 | 0 | 0 | 36,348 | 71,827 | 0 | 7,280 | 79,107 | -42,759 | 33,347 | 72,575 | -39,228 |
| 1992 | 24,038 | 13,164 | 0 | 37,202 | 24,634 | 1,490 | 7,979 | 34,103 | 3,099 | 31,312 | 28,704 | 2,608 |
| 1993 | 26,709 | 13,144 | 3,930 | 43,783 | 27,371 | 1,490 | 12,685 | 41,546 | 2,237 | 33,808 | 32,081 | 1,727 |
| 1994 | 181,624 | 45,297 | 4,362 | 231,283 | 184,974 | 1,490 | 17,867 | 204,331 | 26,952 | 163,846 | 144,753 | 19,093 |
| 1995 | 364,140 | 50,260 | 4,842 | 419,242 | 370,860 | 1,490 | 28,256 | 400,606 | 18,636 | 272,478 | 260,366 | 12,112 |
| 1996 | 182,514 | 53,323 | 6,016 | 241,853 | 185,886 | 1,490 | 34,106 | 221,482 | 20,371 | 144,209 | 132,062 | 12,146 |
| 1997 | | 56,683 | 6,678 | 63,361 | 0 | 13,806 | 34,106 | 47,912 | 15,449 | 34,661 | 26,210 | 8,451 |
| 1998 | | 61,978 | 7,413 | 69,391 | 0 | 17,282 | 34,106 | 51,388 | 18,004 | 34,825 | 25,790 | 9,035 |
| 1999 | | 62,208 | 8,430 | 70,638 | 0 | 17,140 | 34,308 | 51,448 | 19,190 | 32,524 | 23,688 | 8,836 |
| 2000 | | 64,700 | 9,357 | 74,057 | 0 | 18,020 | 63,797 | 81,817 | -7,760 | 31,282 | 34,560 | -3,278 |
| 2001 | | 67,275 | 10,387 | 77,662 | 0 | 19,017 | 63,797 | 82,814 | -5,152 | 30,097 | 32,093 | -1,996 |
| 2002 | | 69,322 | 11,529 | 80,851 | 0 | 19,947 | 63,797 | 83,744 | -2,893 | 28,745 | 29,774 | -1,028 |
| 2003 | | 73,397 | 1,639 | 75,036 | 0 | 23,885 | 52,639 | 76,524 | -1,488 | 24,475 | 24,960 | -485 |
| 2004 | | 72,737 | 1,819 | 74,556 | 0 | 23,842 | 52,639 | 76,481 | -1,925 | 22,311 | 22,887 | -576 |
| 2005 | | 74,712 | 2,019 | 76,731 | 0 | 24,843 | 52,639 | 77,482 | -751 | 21,066 | 21,272 | -206 |
| 2006 | | 77,125 | 419 | 77,544 | 0 | 25,218 | 50,816 | 76,034 | 1,510 | 19,531 | 19,151 | 380 |
| 2007 | | 79,047 | 465 | 79,512 | 0 | 26,188 | 50,816 | 77,004 | 2,509 | 18,373 | 17,793 | 580 |
| 2008 | | 81,255 | 516 | 81,771 | 0 | 27,520 | 50,816 | 78,336 | 3,436 | 17,335 | 16,607 | 728 |
| 2009 | | 83,146 | 0 | 83,146 | 0 | 28,841 | 50,244 | 79,085 | 4,061 | 16,171 | 15,381 | 790 |
| 2010 | | 85,508 | 0 | 85,508 | 0 | 27,922 | 50,244 | 78,166 | 7,343 | 15,257 | 13,947 | 1,310 |
| 2011 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 14,390 | 13,006 | 1,384 |
| 2012 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 13,201 | 11,932 | 1,270 |
| 2013 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 12,111 | 10,947 | 1,165 |
| 2014 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 11,111 | 10,043 | 1,069 |
| 2015 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 10,194 | 9,213 | 980 |
| 2016 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 9,352 | 8,453 | 899 |
| 2017 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 8,580 | 7,755 | 825 |
| 2018 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 7,872 | 7,114 | 757 |
| 2019 | | 87,903 | 0 | 87,903 | 0 | 29,205 | 50,244 | 79,449 | 8,455 | 7,222 | 6,527 | 695 |
| 2020 | | 87,903 | 0 | 87,903 | 0 | 29,205 | | 29,205 | 320,532 | 6,625 | 2,201 | 24,159 |

Salvage Value

(-261,833)

1,159,423 1,147,950 31,208

NPV is 1.01 FIRR is 12.67%

17.2 Economic Study

This section shows a evaluation of the anticipated economic benefits to be derived from the project and economic cost.

Evaluation is concentrated mainly on such benefits, among others, as public health, improvement of living environment and economic contribution to the community. Regarding the economic evaluation of the project, a most preferable approach may be quantification of the economic benefits and costs. But in many cases, there are many unquantifiable factors in the infrastructure development project, such as this water supply project; however, in this study, quantifiable benefits and cost is counted for analysis as much as possible. And intangible factors are also considered.

The first step in the economic analysis is to adjust financial prices to economic values by eliminating direct transfer payments. Direct transfer payments are payments that represent not the use of real sources but only the transfer of claims to real resources from one party in the same economic society to another. In this projects, the most large transfer payments are direct government subsidies and credit transactions that include loans, receipts, repayments of principal and interest payments. All these entries should be taken out before the financial accounts are adjusted to reflect economic values.

17.2.1 Economic Benefits of the Project

The main economic benefit which will be brought about by the implementation of the project as proposed in this study are summarized as follows.

Direct Benefits :

- Increase in the area and population to be served
- Continuous supply of safe water

Indirect Benefits :

- Increase of employment opportunity
- Improvement of health condition
- Increase in consumer satisfaction
- Increase in land values
- Increase in income in some productive sectors

1) Beneficial Value of Water

It is assumed that all residents in the served area would be willing to obtain water in sufficient quantities at a given price. In general, public charges such as water tariff are established lower than real its value by political reason. Taking the benefits for "consumer's satisfaction" into consideration, it is assumed that the economic value of water is 20 percent higher than the average rate per volume of water used in the financial analysis.

According to the result of questionnaire survey in Phuket area, 53.7 percent of residents are willing to pay for water charge in the up-to-50 Baht bracket, 36.6 percent in the 51-100 Baht bracket. Respondents, who didn't use the water supply system of PWA or municipal, wanted the water charge less than 200 Baht.

In the meantime, it clears from water sales forecasting that average monthly water charge per connection for domestic is 51.38 Baht at 2011. This figure shows that water charge is about two percent of average monthly income of respondent, in 1988. If this water charge increase by 20 percent, monthly water charge of 62 Baht is considered within the willingness-to-pay of consumers.

Table 17-2-1 shows economic water value of the project.

Table 17-2-1 Economic Water Value

(Unit : Baht x 1000)

| Year | Domes. | Govern. | Comme. | Indus. | Tourism | Phuket Munici. | Total |
|------|--------|---------|--------|--------|---------|-------------------|---------|
| 1990 | 4,090 | 1,267 | 2,434 | 0 | 12,960 | 2,597 | 23,347 |
| 1991 | 5,213 | 1,742 | 3,240 | 0 | 17,467 | 0 | 27,662 |
| 1992 | 4,752 | 1,771 | 3,312 | 0 | 17,856 | 8,855 | 36,546 |
| 1993 | 4,406 | 1,814 | 3,398 | 0 | 18,274 | 8,626 | 36,518 |
| 1994 | 7,027 | 2,822 | 5,098 | 0 | 27,950 | 31,904 | 74,802 |
| 1995 | 9,000 | 3,643 | 6,451 | 0 | 35,654 | 25,772 | 80,521 |
| 1996 | 9,115 | 3,802 | 6,782 | 0 | 37,526 | 26,921 | 84,146 |
| 1997 | 9,072 | 3,931 | 7,013 | 0 | 38,606 | 28,123 | 86,746 |
| 1998 | 8,352 | 3,845 | 6,840 | 4,176 | 37,526 | 29,350 | 90,089 |
| 1999 | 8,352 | 3,974 | 7,070 | 4,162 | 38,664 | 30,599 | 92,821 |
| 2000 | 8,438 | 4,104 | 7,301 | 4,162 | 39,802 | 31,872 | 95,678 |
| 2001 | 8,539 | 4,248 | 7,531 | 4,162 | 40,968 | 33,169 | 98,617 |
| 2002 | 8,266 | 4,306 | 7,632 | 4,162 | 41,472 | 34,632 | 100,469 |
| 2003 | 8,006 | 4,378 | 7,747 | 4,162 | 42,005 | 36,122 | 102,420 |
| 2004 | 7,790 | 4,421 | 7,834 | 4,162 | 42,336 | 37,644 | 104,186 |
| 2005 | 7,862 | 4,493 | 7,949 | 4,162 | 42,926 | 38,947 | 106,339 |
| 2006 | 7,934 | 4,579 | 8,078 | 4,162 | 43,560 | 38,442 | 106,756 |
| 2007 | 7,992 | 4,622 | 8,208 | 4,162 | 44,237 | 38,010 | 107,231 |
| 2008 | 8,050 | 4,723 | 8,323 | 4,162 | 44,928 | 37,550 | 107,736 |
| 2009 | 8,078 | 4,766 | 8,410 | 4,162 | 45,403 | 37,067 | 107,886 |
| 2010 | 8,150 | 4,838 | 8,539 | 4,162 | 46,152 | 47,063 | 118,904 |
| 2011 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2012 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2013 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2014 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2015 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2016 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2017 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2018 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2019 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |
| 2020 | 8,237 | 4,925 | 8,683 | 4,162 | 46,930 | 48,704 | 121,640 |

2) Benefit Pertinent to Health

Benefit pertaining to health which is the one of the purposes of installing a water supply system, involves both the community concerned and the individuals in the area. The anticipated benefits concerning health, viewed from public and individual standpoints, are detailed in the following.

(1) Benefits from Public Health Standpoint

Health benefit to accrue to the community from the water supply system has two aspects, namely, 1) the preventive effect brought forth by the water supply system reduces the burden on the local and central governments for the disease preventive activities and patient treatment facilities, and 2) the elimination of opportunities of contact with infected matters reduces epidemic cases on the part of the individuals.

Regarding the first item above, Budgetary and physical provisions of the governments will be lightened with respect to chemical disinfection for prevention of epidemics, hospitals together with necessary personnel and equipment and materials. Regarding the second items, details will be presented in the next subsection.

(2) Individual Health Benefits

The provision of the proposed water supply system results in health benefits to the individual people in the service area, such as reduction in the risk and incidence of water borne diseases, consequent elongation of life span, reduced expenditure on medical care, reduction in income loss through absence from work, and others.

Table 17-2-2 shows age-cause-specific distribution of patients and Medical Cost per capita in 1981.

Table 17-2-2 Age-Cause-Specific Distribution & Medical Cost Per Capita

| Age | Type of Disease | | | | | Total |
|--------------------------------|-----------------|-----------|-------------|---------------------------|----------|-------|
| | Infective | Digestive | Respiratory | Delivery and Obstetric | Others | |
| 0 | 0.114 | 0.017 | 0.135 | 0.276 | 0.458 | 1.0 |
| 1-4 | 0.045 | 0.016 | 0.181 | 0.0 | 0.758 | 1.0 |
| 5-14 | 0.010 | 0.061 | 0.066 | 0.001 | 0.862 | 1.0 |
| 15-24 | 0.001 | 0.010 | 0.002 | 0.044 | 0.933 | 1.0 |
| 25-44 | 0.001 | 0.020 | 0.004 | 0.034 | 0.941 | 1.0 |
| 45-64 | 0.005 | 0.040 | 0.027 | 0.0002 | 0.928 | 1.0 |
| 65+ | 0.001 | 0.034 | 0.044 | 0.0 | 0.011 | 1.0 |
| Outpatient cost/ patient | 74.33 | 101.83 | 66.88 | 66.23 | 78.04 | |
| Inpatient cost/ patient | 1,424.90 | 1,464.66 | 684.27 | 552.02 | 1,417.46 | |

Source: HOMES RESEARCH REPORT by Faculty of Economics, Thammasat University, National Economic and Social Development Board, and Asian Development Bank.

According to historical consumer price increase, it is estimated that outpatient cost per patient is 100 Baht and inpatient cost per patient is 2,000 Baht regarding Infective in 1989.

The following assumptions are made to calculate the saving of medical care cost by the installation of the water supply system .

- a. The average number of water-borne disease occurred per 1,000 persons is to be 32.0 in the Study Area on the basis of the recorded incidences rate in the year 1987, which described in SECTION 1.2.4.
- b. About 50 percent of the above cases is attributable to the in-provision of the adequate water supply system.
- c. Hospitalization for treating these cases is on the average for two weeks, and amounts spent for medical care is about 300 Baht per day per patient.
- d. About 30 percent of the population is actually economically active. The final figure for the cost of time lost due to illness was derived by taking the economically active portion of those afflicted by water-borne diseases by minimum daily salary of 67 Baht and 15 days based on the assumption that workers earning 67 Baht per day (67 Baht is the minimum salary rate of a laborer in southern part of Thailand) are unable to work for an average of 15 day described in the above clause.

The cost of the medical expenses was derived by multiplying the morbidity rate by the served population and the average expenditure for medical expenses of 300 Baht.

The sum of the two economic costs related to health benefits was adjusted by 50 percent to account for the fact that not all water-borne diseases are caused by a poor water supply system but may also be due to poor personal hygiene or lack of sewerage facilities.

The economic values derived from health benefits is shown in Table 17-2-3.

These benefits are more quantifiable in due assumptions which are based on various available data. Hence, an estimate of such benefit in the monetary terms was exhausted possible means.

3) Contribution to Local Economy

The construction of the water supply system contributes substantially to the local economy in several ways.

In the first place, land value in the area will be appreciated, and in accordance with such an increase in land value, related properties will also rise in value. On the other hand, the construction of the system furnishes employment opportunities to the local people and purchases local products of materials and equipment. Some of the above benefits are quantifiable while others are not.

Table 17-2-3 Health Benefits

(Unit : Baht x 1000)

| Year | Served Population | Cost of Time Loss (A) | Medical Expenses (B) | Total Economic Loss | Reduction Due to Project |
|------|-------------------|-----------------------|----------------------|---------------------|--------------------------|
| 1990 | 9,558 | 92.2 | 1,376.4 | 1,468.6 | 734 |
| 1991 | 10,536 | 101.7 | 1,517.2 | 1,618.8 | 809 |
| 1992 | 14,706 | 141.9 | 2,117.7 | 2,259.5 | 1,130 |
| 1993 | 15,408 | 148.7 | 2,218.8 | 2,367.4 | 1,184 |
| 1994 | 15,965 | 154.0 | 2,299.0 | 2,453.0 | 1,226 |
| 1995 | 16,642 | 160.6 | 2,396.4 | 2,557.0 | 1,279 |
| 1996 | 17,306 | 167.0 | 2,492.1 | 2,659.0 | 1,330 |
| 1997 | 17,897 | 172.7 | 2,577.2 | 2,749.8 | 1,375 |
| 1998 | 39,694 | 383.0 | 5,715.9 | 6,098.9 | 3,049 |
| 1999 | 40,778 | 393.4 | 5,872.0 | 6,265.5 | 3,133 |
| 2000 | 41,839 | 403.7 | 6,024.8 | 6,428.5 | 3,214 |
| 2001 | 42,878 | 413.7 | 6,174.4 | 6,588.1 | 3,294 |
| 2002 | 44,659 | 430.9 | 6,430.9 | 6,861.8 | 3,431 |
| 2003 | 60,780 | 586.4 | 8,752.3 | 9,338.7 | 4,669 |
| 2004 | 64,277 | 620.1 | 9,255.9 | 9,876.0 | 4,938 |
| 2005 | 67,848 | 654.6 | 9,770.1 | 10,424.7 | 5,212 |
| 2006 | 70,017 | 675.5 | 10,082.4 | 10,758.0 | 5,379 |
| 2007 | 71,826 | 693.0 | 10,342.9 | 11,035.9 | 5,518 |
| 2008 | 73,588 | 710.0 | 10,596.7 | 11,306.6 | 5,653 |
| 2009 | 75,110 | 724.7 | 10,815.8 | 11,540.5 | 5,770 |
| 2010 | 86,013 | 829.9 | 12,385.9 | 13,215.7 | 6,608 |
| 2011 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2012 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2013 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2014 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2015 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2016 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2017 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2018 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2019 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |
| 2020 | 89,771 | 866.1 | 12,927.0 | 13,793.1 | 6,897 |

NOTE : (A) $30 \% \times 1.13/1000 \times \text{S.P.} \times 67 \text{ Baht} \times 15 \text{ Days}$
 (B) $1.13/1000 \times \text{S.P.} \times 300 \text{ Baht} \times 15 \text{ Days}$

(1) Value Added to Land

Investment in water supply facilities, and also in other public utilities such as sewerage, electricity and road improvement, have the effect of raising the intrinsic value of the parcels of land served by those facilities. The value added per unit of land tends to equal or exceed pro rate share of the investment involved.

In the present project area, this benefit is considered especially significant. The value of the benefit will be measured by the additional prices buyers are willing to pay for properties on which physical improvements have been made. It is because the buyers appreciate the possible intensive use of land, not to mention the improved quality of amenity in the area.

Projected service area is shown in Table 17-2-4, which are calculated based on the assumption that both sides of pipeline with 200 m width are covered by water supply system.

Table 17-2-4 Served Land Area

| <u>Zone</u> | <u>Area(sq.km)</u> |
|----------------------|--------------------|
| Bangwat System | 4.941 |
| Khlong Katha System | 4.400 |
| Bang Nieo Dam System | 11.576 |
| Zone 7 System | 4.140 |
| Total | 25.057 |

In the meantime, land prices are adopted following unit cost:

- Baht 2,000,000 /Rai = Baht 1,250/sq m in flat area in the Island.
- Baht 5,000,000 /Rai = Baht 3,125/sq m in hill side area in the each the Island.
- Baht 500,000 /Rai = Baht 313/sq m in rubber plantation in the hill side area in and out side the Island.
- Baht 300,000 /Rai = Baht 188/sq m in hill side area in and out side the Island.

On the basis of proportionate shares of estimated infrastructure investments in public utilities about five percent of total increase in land values and increase during seven years after completion of each water supply systems have been attributed to the availability of water supply system. This benefit is developed in Table 17-2-5.

(2) Intensified Land Use

When water supply systems become available, coupled with other public utilities in general, the land in the area can be more intensively used, as the present project is implemented. More people can be supported and more activities in industry, commerce and others can be conducted in the project area. This project will, therefore contribute to this area

Table 17-2-5 Economic Land Value Increase

(Unit : Baht x 1000)

| | Bangwat Imm-imp (1) | Bangwat Develop. (2) | Khlong Katha (3) | Bang Nieo (4) | Zone 7 (5) | Total Land Value | Increase Land Value | Benefit Due to Project |
|----------------------------|---------------------------|----------------------------|------------------------|---------------------|---------------|---------------------|------------------------|------------------------------|
| Land Price (Baht/sq. m) | 3,125 | | 313 | 188 | 3,125 | | | |
| 1990 | 30,881,250 | 0 | 2,754,400 | 4,352,576 | 25,875,000 | 68,804,226 | 0 | 0 |
| 1991 | 31,498,875 | 0 | 2,892,120 | 4,570,205 | 26,392,500 | 70,294,700 | 1,490,474 | 30,881 |
| 1992 | 32,128,853 | 0 | 3,036,726 | 4,798,715 | 26,920,350 | 71,825,644 | 1,530,944 | 31,499 |
| 1993 | 32,771,430 | 0 | 3,188,562 | 5,038,651 | 27,458,757 | 73,398,400 | 1,572,756 | 32,129 |
| 1994 | 33,426,858 | 0 | 3,347,990 | 5,290,583 | 28,007,932 | 75,014,364 | 1,615,964 | 32,771 |
| 1995 | 34,095,395 | 0 | 3,515,390 | 5,555,112 | 28,568,091 | 76,674,989 | 1,660,624 | 33,427 |
| 1996 | 34,777,303 | 0 | 3,691,159 | 5,832,868 | 29,139,453 | 78,381,783 | 1,706,795 | 34,095 |
| 1997 | 35,472,849 | 0 | 3,875,717 | 6,124,512 | 29,722,242 | 80,136,320 | 1,754,536 | 58,587 |
| 1998 | 36,182,306 | 0 | 4,069,503 | 6,430,737 | 30,316,686 | 81,940,233 | 1,803,913 | 25,001 |
| 1999 | 36,905,952 | 0 | 4,272,978 | 6,752,274 | 30,923,020 | 83,795,225 | 1,854,992 | 26,251 |
| 2000 | 37,644,071 | 0 | 4,486,627 | 7,089,888 | 31,541,481 | 85,703,067 | 1,907,842 | 27,563 |
| 2001 | 38,396,953 | 0 | 4,710,959 | 7,444,382 | 32,172,310 | 87,665,604 | 1,962,537 | 28,941 |
| 2002 | 39,164,892 | 0 | 4,946,507 | 7,816,601 | 32,815,756 | 89,684,756 | 2,019,152 | 62,561 |
| 2003 | 39,948,190 | 0 | 5,193,832 | 8,207,431 | 33,472,072 | 91,762,525 | 2,077,768 | 64,724 |
| 2004 | 40,747,154 | 0 | 5,453,524 | 8,617,803 | 34,141,513 | 93,900,993 | 2,138,468 | 33,472 |
| 2005 | 41,562,097 | 0 | 5,726,200 | 9,048,693 | 34,824,343 | 96,102,333 | 2,201,340 | 34,142 |
| 2006 | 42,393,339 | 0 | 6,012,510 | 9,501,128 | 35,520,830 | 98,368,806 | 2,266,473 | 34,824 |
| 2007 | 43,241,205 | 0 | 6,313,135 | 9,976,184 | 36,231,247 | 100,702,771 | 2,333,965 | 35,521 |
| 2008 | 44,106,029 | 0 | 6,628,792 | 10,474,993 | 36,955,872 | 103,106,686 | 2,403,915 | 36,231 |
| 2009 | 44,988,150 | 0 | 6,960,232 | 10,998,743 | 37,694,989 | 105,583,114 | 2,476,427 | 0 |
| 2010 | 45,887,913 | 0 | 7,308,243 | 11,548,680 | 38,448,889 | 108,134,725 | 2,551,612 | 0 |
| 2011 | 46,805,671 | 0 | 7,673,655 | 12,126,114 | 39,217,867 | 110,764,307 | 2,629,582 | 0 |
| 2012 | 47,741,785 | 0 | 8,057,338 | 12,732,420 | 40,002,224 | 113,474,766 | 2,710,459 | 0 |
| 2013 | 48,696,620 | 0 | 8,460,205 | 13,369,041 | 40,802,268 | 116,269,134 | 2,794,368 | 0 |
| 2014 | 49,670,553 | 0 | 8,883,215 | 14,037,493 | 41,618,314 | 119,150,575 | 2,881,440 | 0 |
| 2015 | 50,663,964 | 0 | 9,327,376 | 14,739,367 | 42,450,680 | 122,122,387 | 2,971,813 | 0 |
| 2016 | 51,677,243 | 0 | 9,793,745 | 15,476,336 | 43,299,694 | 125,188,017 | 3,065,630 | 0 |
| 2017 | 52,710,788 | 0 | 10,283,432 | 16,250,152 | 44,165,688 | 128,351,060 | 3,163,043 | 0 |
| 2018 | 53,765,004 | 0 | 10,797,604 | 17,062,660 | 45,049,001 | 131,615,269 | 3,264,209 | 0 |
| 2019 | 54,840,304 | 0 | 11,337,484 | 17,915,793 | 45,949,981 | 134,984,562 | 3,369,293 | 0 |
| 2020 | 55,937,110 | 0 | 11,904,358 | 18,811,583 | 46,868,981 | 138,463,032 | 3,478,470 | 0 |

Note : Annual increase rate of land value

(1) ; 2%

(3) ; 4%

(4) ; 4%

(5) ; 2%

which is expected to develop the important economic area of Thailand, but can't be immediately quantifiable its economic benefits.

(3) Public Revenue

Public tax revenue to the local and central government will be increased in two ways.

First, the appreciated land value will produce an increase in land tax revenue. On the other hand, buildings, such as for commerce, dwelling and others, will be graded up in quality and quantity, thus making possible an increase in property tax. This benefit cannot necessarily be quantified, but it can stitutes an important reliable tax source for the governments concerned.

(4) Employment and Local Products

During the construction period, the local economy will benefit through the employment of individuals for construction work and through the purchase of locally made materials and supplies. The amount of investment for the project is sizable. The project after completion will also provide permanent employment opportunities for the operation and maintenance of water supply systems.

These economic benefit of production for employment opportunity should be counted in economic cost analysis by using the shadow pricing factor.

Some of the economic benefits, presently regarded as unquantifiable, may become quantifiable in the future when scientific tools useful for such evaluation are devised. Even at this stage where those benefits cannot be measured in the monetary terms, the benefits justify, it is judged, the proposed investment in the present water supply project. And further, the evaluation justifies that the investment is to be made from the fund sources of public and private beneficiaries, namely, the central, local province governments and PWA and the people in the area involved.

Summary of Economic Benefit is shown in Table 17-2-6.

Benefits of the proposed project have so far been considered from the three viewpoints of health, land value and contribution to the local economy. Some of the benefits were quantified, but most of them were treated as unquantifiable. Therefore, the benefits of the latter category have been elaborated in works. The calculations of the quantifiable benefits show that the monetary values to be gained in the analysis period after the completion of the project area equal to 3,806 million Baht, converted to present worth, 54 million Baht.

Table 17-2-6 Summary of Economic Benefits

(Unit : Baht x 1000)

| Year | Economic : Water Value | Health Benefits : Cost of Time Loss | Total Medical Expenses | Economic : Benefit | Increase : Land Value | Total Economic Benefit |
|------|------------------------------|---|------------------------------|-----------------------|-----------------------------|------------------------------|
| 1990 | 23,347 | 92 | 1,376 | 734 | 0 | 24,081 |
| 1991 | 27,662 | 102 | 1,517 | 809 | 30,881 | 59,353 |
| 1992 | 36,546 | 142 | 2,118 | 1,130 | 31,499 | 69,175 |
| 1993 | 36,518 | 149 | 2,219 | 1,184 | 32,129 | 69,831 |
| 1994 | 74,802 | 154 | 2,299 | 1,226 | 32,771 | 108,799 |
| 1995 | 80,521 | 161 | 2,396 | 1,279 | 33,427 | 115,227 |
| 1996 | 84,146 | 167 | 2,492 | 1,330 | 34,095 | 119,571 |
| 1997 | 86,746 | 173 | 2,577 | 1,375 | 58,587 | 146,708 |
| 1998 | 90,089 | 383 | 5,716 | 3,049 | 25,001 | 118,139 |
| 1999 | 92,821 | 393 | 5,872 | 3,133 | 26,251 | 122,205 |
| 2000 | 95,678 | 404 | 6,025 | 3,214 | 27,563 | 126,455 |
| 2001 | 98,617 | 414 | 6,174 | 3,294 | 28,941 | 130,852 |
| 2002 | 100,469 | 431 | 6,431 | 3,431 | 62,561 | 166,461 |
| 2003 | 102,420 | 586 | 8,752 | 4,669 | 64,724 | 171,813 |
| 2004 | 104,186 | 620 | 9,256 | 4,938 | 33,472 | 142,596 |
| 2005 | 106,339 | 655 | 9,770 | 5,212 | 34,142 | 145,693 |
| 2006 | 106,756 | 676 | 10,082 | 5,379 | 34,824 | 146,959 |
| 2007 | 107,231 | 693 | 10,343 | 5,518 | 35,521 | 148,270 |
| 2008 | 107,736 | 710 | 10,597 | 5,653 | 36,231 | 149,620 |
| 2009 | 107,886 | 725 | 10,816 | 5,770 | 0 | 113,656 |
| 2010 | 118,904 | 830 | 12,386 | 6,608 | 0 | 125,512 |
| 2011 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2012 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2013 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2014 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2015 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2016 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2017 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2018 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2019 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |
| 2020 | 121,640 | 866 | 12,927 | 6,897 | 0 | 128,537 |

17.2.2 Economic Costs of the Project

The direct costs of the project should be transformed into economic costs. For this purpose, the project cost and operating and maintenance costs are considered in the study. These costs will be covered into the economic cost using factors of shadow pricing.

The financial project costs explained in Sub-section 12.1 was converted into economic costs by the following modification.

- 1) Import duties and domestic taxes are assumed to be 10 percent for foreign portion and five percent for the local portion of the project cost.
- 2) Shadow exchange rate factor of 1.00 was applied to the foreign currency component. A shadow pricing factor of 0.95 was applied to the local currency component. A premium factor of 0.5 was applied to unskilled labor portion, which is estimated about 10 percent of local currency portion of project cost. On the other 1.0 premium factor was applied to skilled lafor portion.

Economic Costs of the Project is shown in Table 17-2-7.

- 3) Economic cost of dam construction

Since dams construction project cost shall be bear by RID, in financial analysis, these expenses are not counted in financial cost. Only payment to RID for water from dam facilities shall be counted in operating expences.

In economic a analysis, however, dams construction cost shall be considered in economic project cost as annual economic depreciation cost.

Table 17-2-8 shows Economic Depreciation for Dam System. For calculat ing, following conditions are adopted.

Depreciation method : Straight - line method
Durable years : 50 years

Table 17-2-7 Economic Project Cost

(Unit : Baht x 1000)

| Year | Financial Project Cost | | | Tax | | | Economic Project Cost | | |
|-------|------------------------|---------|---------|--------|--------|--------|-----------------------|---------|---------|
| | F.C. | L.C. | Total | F.C. | L.C. | Total | F.C. | L.C. | Total |
| Total | 538,063 | 390,240 | 928,303 | 53,806 | 19,511 | 73,317 | 484,257 | 335,510 | 819,767 |
| 1990 | 2,431 | 60,320 | 62,751 | 243 | 3,016 | 3,259 | 2,188 | 51,860 | 54,048 |
| 1991 | 608 | 71,219 | 71,827 | 61 | 3,561 | 3,622 | 547 | 61,230 | 61,777 |
| 1992 | 16,409 | 8,225 | 24,634 | 1,641 | 411 | 2,052 | 14,768 | 7,072 | 21,840 |
| 1993 | 18,232 | 9,139 | 27,371 | 1,823 | 457 | 2,280 | 16,409 | 7,857 | 24,266 |
| 1994 | 124,791 | 60,183 | 184,974 | 12,479 | 3,009 | 15,488 | 112,312 | 51,742 | 164,054 |
| 1995 | 250,193 | 120,667 | 370,860 | 25,019 | 6,033 | 31,052 | 225,174 | 103,744 | 328,918 |
| 1996 | 125,399 | 60,487 | 185,886 | 12,540 | 3,024 | 15,564 | 112,859 | 52,004 | 164,863 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2001 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2002 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 17-2-8 Depreciation For Dam System

(Unit: Baht x 1000)

| | Bang Tho Sung | Khlong Katha | Bang Nioo | Che Tra | Khlong Lo Yung | Yearly Total | Accum. Total | Salvage Value |
|-----------------|------------------|-----------------|-----------|---------|-------------------|-----------------|-----------------|------------------|
| Economic | | | | | | | | |
| Dam Price | 455,646 | 407,060 | 221,754 | 168,266 | 420,654 | | | |
| Year | | | | | | | | |
| 1993 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1994 | 0 | 8,141 | 4,435 | 3,365 | 0 | 15,942 | 15,942 | 781,138 |
| 1995 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 40,296 | 1,177,438 |
| 1996 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 64,651 | 1,153,083 |
| 1997 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 89,006 | 1,128,728 |
| 1998 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 113,360 | 1,104,374 |
| 1999 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 137,715 | 1,080,019 |
| 2000 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 162,070 | 1,055,664 |
| 2001 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 186,424 | 1,031,310 |
| 2002 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 210,779 | 1,006,955 |
| 2003 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 235,134 | 982,600 |
| 2004 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 259,488 | 958,246 |
| 2005 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 283,843 | 933,891 |
| 2006 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 308,198 | 909,536 |
| 2007 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 332,552 | 885,182 |
| 2008 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 356,907 | 860,827 |
| 2009 | 0 | 8,141 | 4,435 | 3,365 | 8,413 | 24,355 | 381,262 | 836,472 |
| 2010 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 414,729 | 1,258,651 |
| 2011 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 448,197 | 1,225,183 |
| 2012 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 481,665 | 1,191,715 |
| 2013 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 515,132 | 1,158,248 |
| 2014 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 548,600 | 1,124,780 |
| 2015 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 582,067 | 1,091,313 |
| 2016 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 615,535 | 1,057,845 |
| 2017 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 649,003 | 1,024,377 |
| 2018 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 682,470 | 990,910 |
| 2019 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 715,938 | 957,442 |
| 2020 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 749,405 | 923,975 |
| 2021 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 782,873 | 890,507 |
| 2022 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 816,341 | 857,039 |
| 2023 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 849,808 | 823,572 |
| 2024 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 883,276 | 790,104 |
| 2025 | 9,113 | 8,141 | 4,435 | 3,365 | 8,413 | 33,468 | 916,743 | 756,637 |

17.2.3 Economic Analysis

To determine the viability of the project, all economic cost and benefits shall be transformed to their present value at nine percent discount rate. This is the rate assumed to represent the pertinent opportunity cost of capital. A low discount rate, however, is considered justified since the project shall benefit the rural consumers whose annual incomes are generally lower than urban consumers.

In this analysis the viability of project shall be measured by the following economic feasibility criteria:

EIRR

$B/C > 1$

$NPV > 0$

where;

EIRR - Economic internal rate of return

B - present value of benefits

C - present value of costs

B/C - ratio of benefits to costs

NPV - net present value or $B - C$

The rate of return was computed based on the present value of cash inflow and outflows.

A $B/C > 1$, or an $NPV > 0$ at nine percent discount rate, indicates that the project is feasible, i.e. economic benefits exceed economic costs at the prevailing opportunity cost of capital, hence, the project is viable for implementation. Table 17-2-9 represents the tabulation and calculation of Economic Benefit and Cost for the project. As clear in this table, the EIRR is estimated to be 7.44 percent, NPV is -69,406 thousand Baht and B.C. Ratio is 0.90 respectively.

EIRR does not exceed the opportunity cost of capital of nine percent but exceed interest rate of loan from international lending agencies. And it is to be noted in this connection that this figure refers only to economic water value. So if other economic benefits, which are described in this section, are combined, the project is considered economically feasible and a number of unquantifiable benefits will also be conceived from the implementation of the project. The undertaking of the project is suggested itself to be proceeded positively. As a sensitivity study, EIRR, which includes other economic benefit such as health benefit and land value increase, also calculated in Table 17-2-10.

Table 17-2-9 Economic Internal Rate of Return

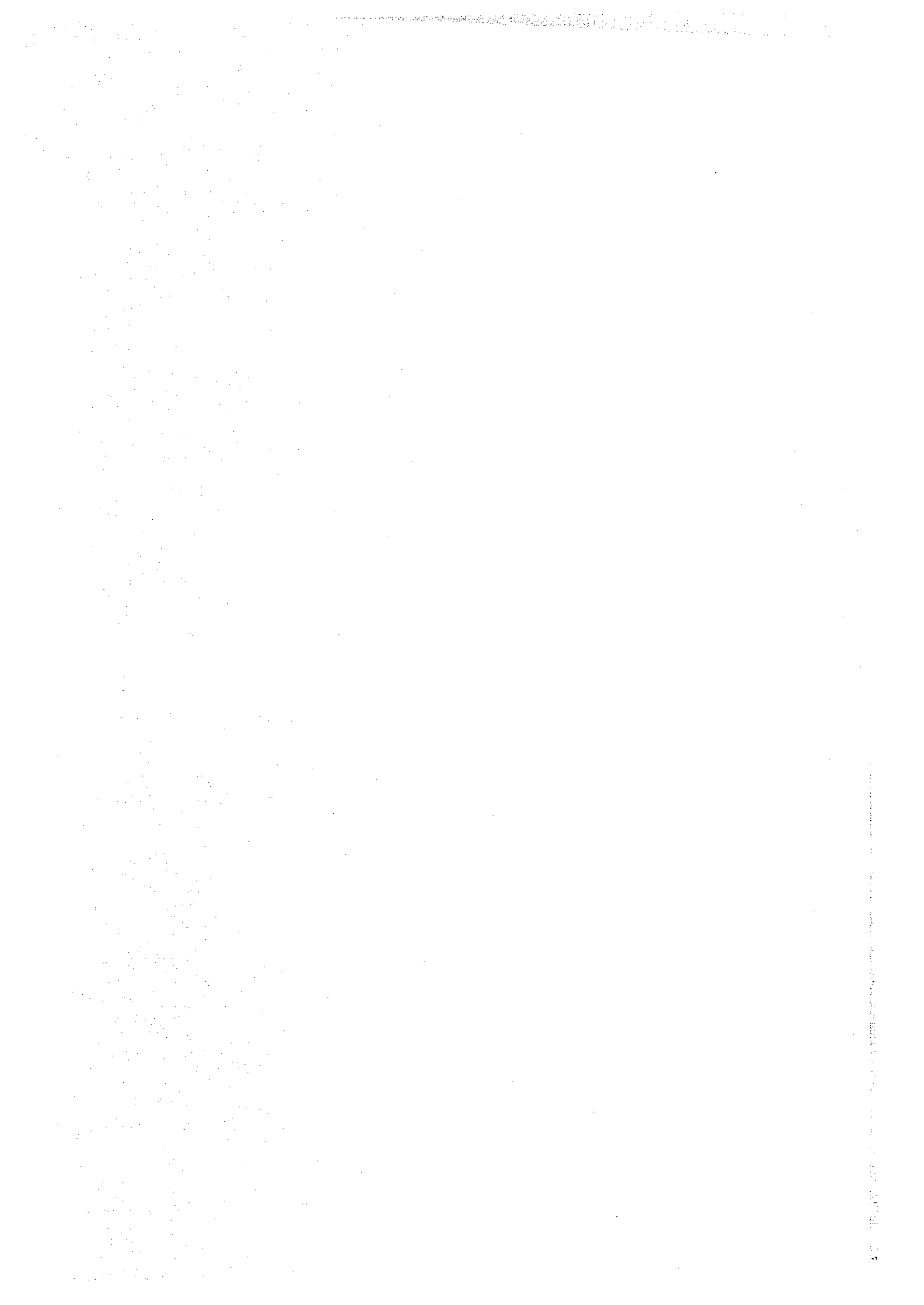
(Unit :Baht x 1000)

| year | Water Value | Total Income | Capital Invest. | Operating Expenses | Total Expenses | Net Income | Net Present Value | | |
|---------------|-------------|--------------|-----------------|--------------------|----------------|------------|-------------------|---------|------------|
| | | | | | | | Benefit | Cost | Net Income |
| 1990 | 0 | 0 | 54,048 | 0 | 54,048 | -54,048 | 0 | 54,048 | -54,048 |
| 1991 | 0 | 0 | 61,777 | 0 | 61,777 | -61,777 | 0 | 56,676 | -56,676 |
| 1992 | 15,796 | 15,796 | 21,840 | 1,416 | 23,256 | -7,460 | 13,295 | 19,574 | -6,279 |
| 1993 | 15,768 | 15,768 | 24,266 | 1,416 | 25,682 | -9,914 | 12,176 | 19,831 | -7,655 |
| 1994 | 54,052 | 54,052 | 164,054 | 1,416 | 165,470 | -111,418 | 38,292 | 117,223 | -78,931 |
| 1995 | 59,771 | 59,771 | 328,918 | 1,416 | 330,334 | -270,563 | 38,847 | 214,694 | -175,847 |
| 1996 | 63,396 | 63,396 | 164,863 | 1,416 | 166,279 | -102,883 | 37,801 | 99,146 | -61,345 |
| 1997 | 66,635 | 66,635 | 0 | 13,116 | 13,116 | 53,519 | 36,451 | 7,175 | 29,277 |
| 1998 | 71,365 | 71,365 | 0 | 16,417 | 16,417 | 54,948 | 35,816 | 8,239 | 27,576 |
| 1999 | 73,120 | 73,120 | 0 | 16,283 | 16,283 | 56,837 | 33,666 | 7,497 | 26,169 |
| 2000 | 76,078 | 76,078 | 0 | 17,119 | 17,119 | 58,959 | 32,136 | 7,231 | 24,905 |
| 2001 | 79,125 | 79,125 | 0 | 18,066 | 18,066 | 61,059 | 30,663 | 7,001 | 23,662 |
| 2002 | 81,298 | 81,298 | 0 | 18,949 | 18,949 | 62,349 | 28,904 | 6,737 | 22,167 |
| 2003 | 84,633 | 84,633 | 0 | 22,690 | 22,690 | 61,943 | 27,606 | 7,401 | 20,204 |
| 2004 | 85,404 | 85,404 | 0 | 22,650 | 22,650 | 62,754 | 25,557 | 6,778 | 18,779 |
| 2005 | 87,714 | 87,714 | 0 | 23,600 | 23,600 | 64,114 | 24,081 | 6,479 | 17,602 |
| 2006 | 90,590 | 90,590 | 0 | 23,957 | 23,957 | 66,633 | 22,817 | 6,034 | 16,783 |
| 2007 | 93,023 | 93,023 | 0 | 24,878 | 24,878 | 68,145 | 21,495 | 5,749 | 15,746 |
| 2008 | 95,651 | 95,651 | 0 | 26,144 | 26,144 | 69,507 | 20,277 | 5,542 | 14,735 |
| 2009 | 97,942 | 97,942 | 0 | 27,399 | 27,399 | 70,543 | 19,049 | 5,329 | 13,720 |
| 2010 | 100,712 | 100,712 | 0 | 26,525 | 26,525 | 74,187 | 17,970 | 4,733 | 13,237 |
| 2011 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 16,952 | 4,542 | 12,410 |
| 2012 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 15,552 | 4,167 | 11,386 |
| 2013 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 14,268 | 3,823 | 10,445 |
| 2014 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 13,090 | 3,507 | 9,583 |
| 2015 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 12,009 | 3,217 | 8,792 |
| 2016 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 11,018 | 2,952 | 8,066 |
| 2017 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 10,108 | 2,708 | 7,400 |
| 2018 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 9,273 | 2,484 | 6,789 |
| 2019 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 8,508 | 2,279 | 6,228 |
| 2020 | 103,556 | 103,556 | 0 | 27,744 | 27,744 | 75,812 | 7,805 | 2,091 | 5,714 |
| Salvage Value | | | (-248,741) | | | | | | |
| | | | | | | | 635,482 | 704,888 | -69,406 |
| NPV is | | 0.90 | | EIRR is | | 7.44% | | | |

Table 17-2-10 Economic Internal Rate of Return

(Unit :Baht x 1000)

| year | Water Value | Increase Land Value | Health Benefit | Total Income | Capital Invest. | Operating Expenses | Total Expenses | Net Income | Net Present Value | | | |
|---------------|-------------|---------------------|----------------|--------------|-----------------|--------------------|----------------|------------|-------------------|---------|------------|--------|
| | | | | | | | | | Benefit | Cost | Net Income | |
| 1990 | 0 | 0 | 0 | 0 | 54,048 | 0 | 54,048 | -54,048 | 0 | 54,048 | -54,048 | |
| 1991 | 0 | 0 | 0 | 0 | 61,777 | 0 | 61,777 | -61,777 | 0 | 56,676 | -56,676 | |
| 1992 | 15,796 | 1,130 | 31,499 | 48,425 | 21,840 | 1,416 | 23,256 | 25,169 | 40,758 | 19,574 | 21,184 | |
| 1993 | 15,768 | 1,184 | 32,129 | 49,081 | 24,266 | 1,416 | 25,682 | 23,400 | 37,900 | 19,831 | 18,069 | |
| 1994 | 54,052 | 1,226 | 32,771 | 88,049 | 164,054 | 1,416 | 165,470 | -77,421 | 62,376 | 117,223 | -54,847 | |
| 1995 | 59,771 | 1,279 | 33,427 | 94,477 | 328,918 | 1,416 | 330,334 | -235,857 | 61,403 | 214,694 | -153,291 | |
| 1996 | 63,396 | 1,330 | 34,095 | 98,821 | 164,863 | 1,416 | 166,279 | -67,458 | 58,924 | 99,146 | -46,223 | |
| 1997 | 66,635 | 1,375 | 58,587 | 126,597 | 0 | 13,116 | 13,116 | 113,481 | 69,253 | 7,175 | 62,078 | |
| 1998 | 71,365 | 3,049 | 25,001 | 99,415 | 0 | 16,417 | 16,417 | 82,998 | 49,893 | 8,239 | 41,654 | |
| 1999 | 73,120 | 3,133 | 26,251 | 102,504 | 0 | 16,283 | 16,283 | 86,221 | 47,196 | 7,497 | 39,698 | |
| 2000 | 76,078 | 3,214 | 27,563 | 106,855 | 0 | 17,119 | 17,119 | 89,736 | 45,137 | 7,231 | 37,905 | |
| 2001 | 79,125 | 3,294 | 28,941 | 111,360 | 0 | 18,066 | 18,066 | 93,294 | 43,156 | 7,001 | 36,155 | |
| 2002 | 81,298 | 3,431 | 62,561 | 147,290 | 0 | 18,949 | 18,949 | 128,341 | 52,367 | 6,737 | 45,630 | |
| 2003 | 84,633 | 4,669 | 64,724 | 154,026 | 0 | 22,690 | 22,690 | 131,336 | 50,240 | 7,401 | 42,839 | |
| 2004 | 85,404 | 4,938 | 33,472 | 123,814 | 0 | 22,650 | 22,650 | 101,164 | 37,051 | 6,778 | 30,273 | |
| 2005 | 87,714 | 5,212 | 34,142 | 127,068 | 0 | 23,600 | 23,600 | 103,468 | 34,885 | 6,479 | 28,406 | |
| 2006 | 90,590 | 5,379 | 34,824 | 130,793 | 0 | 23,957 | 23,957 | 106,836 | 32,943 | 6,034 | 26,909 | |
| 2007 | 93,023 | 5,518 | 35,521 | 134,062 | 0 | 24,878 | 24,878 | 109,184 | 30,978 | 5,749 | 25,229 | |
| 2008 | 95,651 | 5,653 | 36,231 | 137,535 | 0 | 26,144 | 26,144 | 111,391 | 29,156 | 5,542 | 23,614 | |
| 2009 | 97,942 | 5,770 | 0 | 103,712 | 0 | 27,399 | 27,399 | 76,313 | 20,171 | 5,329 | 14,842 | |
| 2010 | 100,712 | 6,608 | 0 | 107,320 | 0 | 26,525 | 26,525 | 80,795 | 19,149 | 4,733 | 14,416 | |
| 2011 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 18,081 | 4,542 | 13,539 | |
| 2012 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 16,588 | 4,167 | 12,421 | |
| 2013 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 15,218 | 3,823 | 11,396 | |
| 2014 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 13,962 | 3,507 | 10,455 | |
| 2015 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 12,809 | 3,217 | 9,592 | |
| 2016 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 11,751 | 2,952 | 8,800 | |
| 2017 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 10,781 | 2,708 | 8,073 | |
| 2018 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 9,891 | 2,484 | 7,406 | |
| 2019 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 9,074 | 2,279 | 6,795 | |
| 2020 | 103,556 | 6,897 | 0 | 110,453 | 0 | 27,744 | 27,744 | 82,709 | 8,325 | 2,091 | 6,234 | |
| Salvage Value | | | | | | | (-248,741) | | | | | |
| | | | | | | | | | 949,415 | 704,888 | 244,528 | |
| | | | | | | | | | NPV is | 1.35 | EIRR is | 15.52% |



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