6.6.3 Aquifer

With reference to the geology, existing well lithologic logs and field investigations, an aquifer maybe identified in the recent alluvial deposits of the Magat River in the study area as can be seen from FIGURE 6.4.2 which represents the geological cross-sections traversing the Bayombong-Solano study area.

The deep confined aquifer which is composed of the impervious substratum with low permeability may not be advisable for exploitation.

<u>Hydrostratigraphy</u>

A total of 24 well lithologic logs is available for the reconstruction of the hydrogeological stratigraphy in the study area. The assessment is limited only on the shallow aquifer geometry since no well was drilled beyond 50 m below ground surface, except LWUA-JICA well No. 40. The absence of exploratory wells at selected areas with a primary objective of studying geological structure has disallowed accurate analysis in this study. However, the data collected maybe deemed sufficient to support shallow aquifer investigation, since the underlying strata is known to be composed of impermeable rock units which may not be advisable for groundwater exploitation. A geologic cross-section is exhibited in FIGURE 6.4.2.

The stratigraphical presentation is summarized below based on the well correlation sections as shown in FIGUREs 6.6.2 to 6.6.4.

- Cretaceous to Paleogene extrusives form the impermeable layer underlying most of the area. Groundwater maybe stored between fissures but its availability may not be quantified.

- For the source of the Borobbob Spring, the upstream portion serves as the spring's catchment area equivalent to approximately one square kilometer. Forest preservation is being taken care of by the Provincial Waterworks Office.

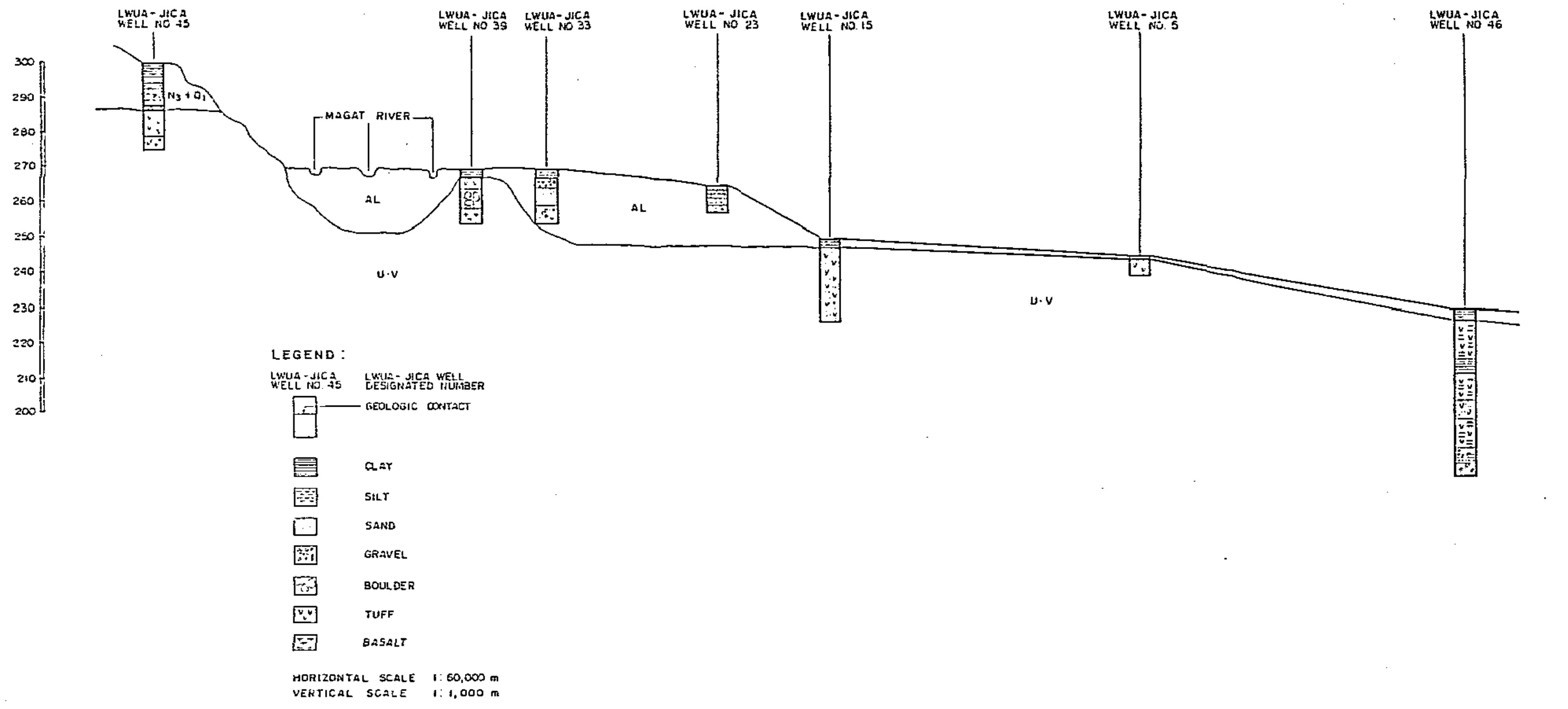


FIGURE 6.6.2
WELL CORRELATION SECTION A-A'
BAYOMBONG - SOLANO

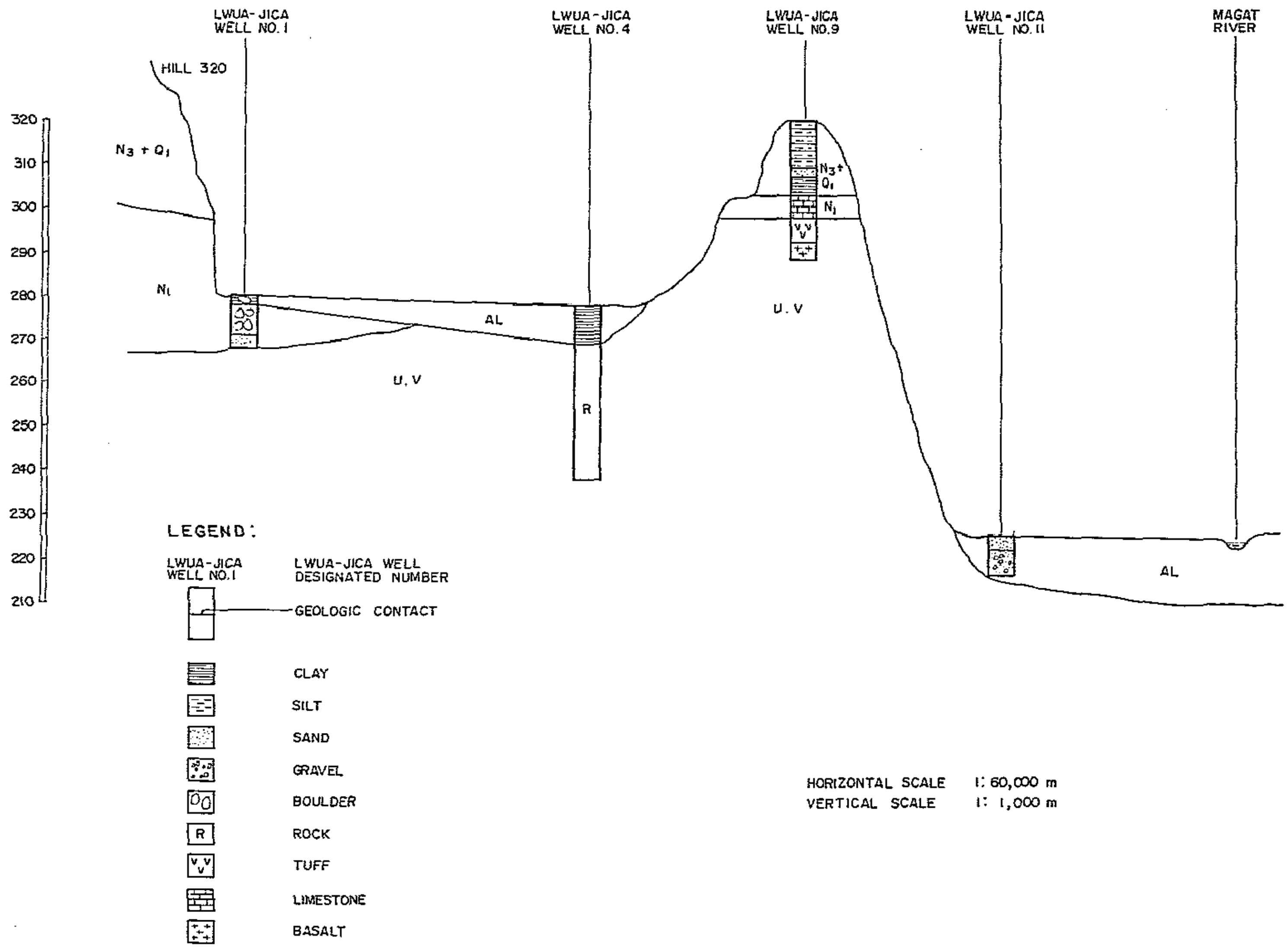


FIGURE 6.6.3
WELL CORRELATION SECTION B - B'
BAYOMBONG - SOLANO

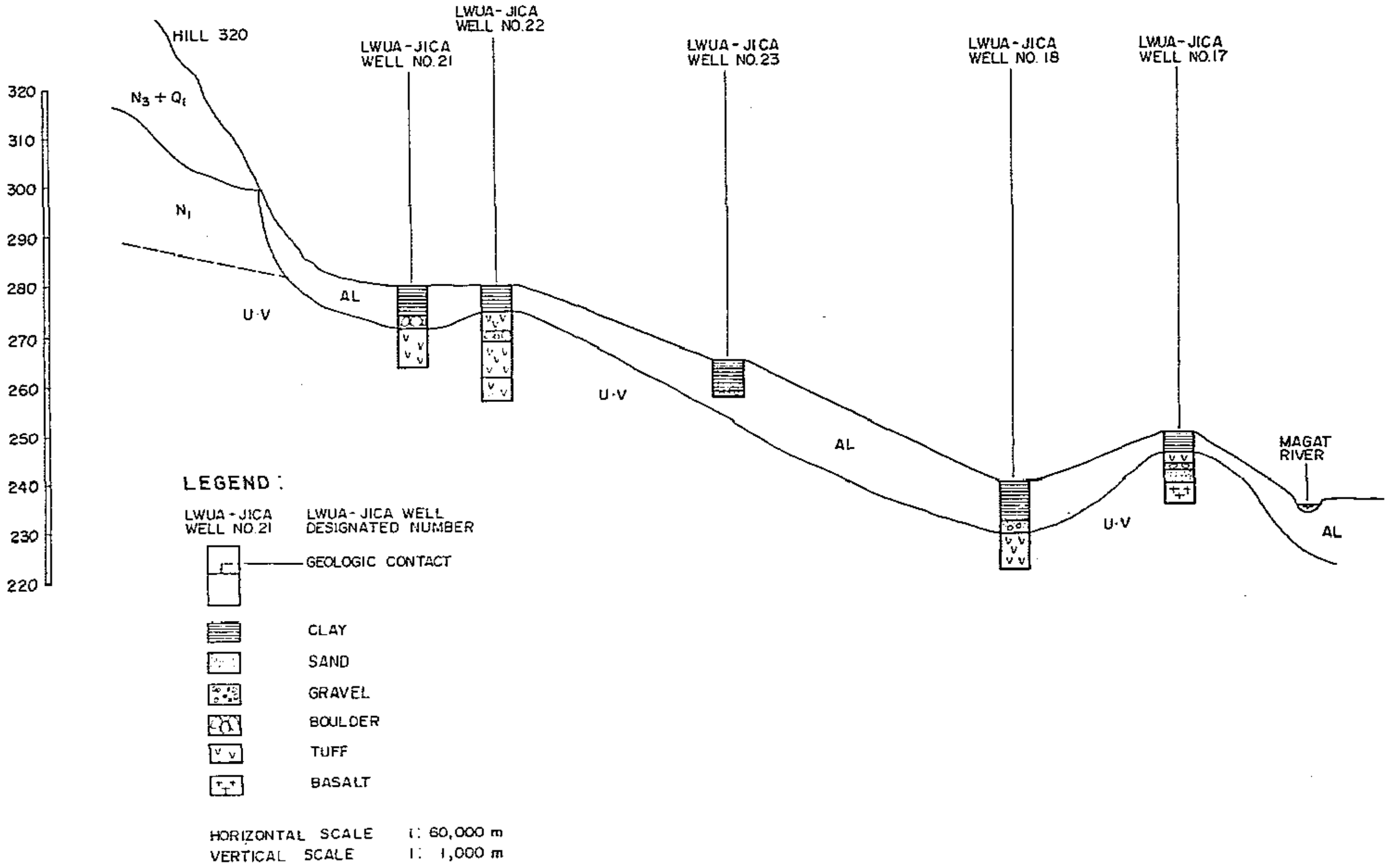


FIGURE 6.6.4
WELL CORRELATION SECTION C – C'
BAYOMBONG - SOLANO

- Alluvial deposits comprising superficial clay, silt, sand and gravel are the main shallow groundwater reservoir. The thickness of the phreatic aquifer ranges from 1 to 25 meters. The lateral and vertical sequences are rather poor. Recharge comes mainly from the Magat River and from the foot of the western mountain ranges. A wider area of the phreatic aquifer is recharged through the western mountain slopes, while the surface water body contributes only to the groundwater underflow along a narrow strip on the river banks. The extended waterfront of both recharge areas is separated by the 450 micro-Siemens/cm contour line drawn between the Magat River and the national road. Electric conductivity survey of river water was performed along the course of the Magat River and measurements revealed values ranging from 210 to 340 micro-Siemens/cm. However, conductivity values gathered from shallow wells drilled within the study area exhibited an average value of 600 micro-Siemens/cm, indicating separate sources of water contributing bodies. Thus, the 450 micro-Siemens/cm was established as the dividing front which serves as the limit of recharge.

The recent river bank sediments are deposited on a narrow strip along the Magat River. The sediment composition include clay, silt, sand, gravel and boulder. The underflow of the river body contributes mainly to the recharge of the surrounding phreatic aquifer. To obtain this water will necessitate construction of shallow water intake structure in the form of infiltration well, horizontal water collector or infiltration gallery.

Piezometric Conditions

A contour map of the piezometric water level is presented in FIGURE 6.6.5 based on the static water level measurements done on shallow wells. Because of the absence of past water table data from the time when the well was constructed until the recent study, the piezometric movement of groundwater cannot be made with accuracy.

Nonetheless, the piezometric contour map exhibits deductive hydraulic gradient along the direction of the Magat River with an average slope of 0.0033. The Magat River flowing gradient observed at the same area considered is 0.0036.

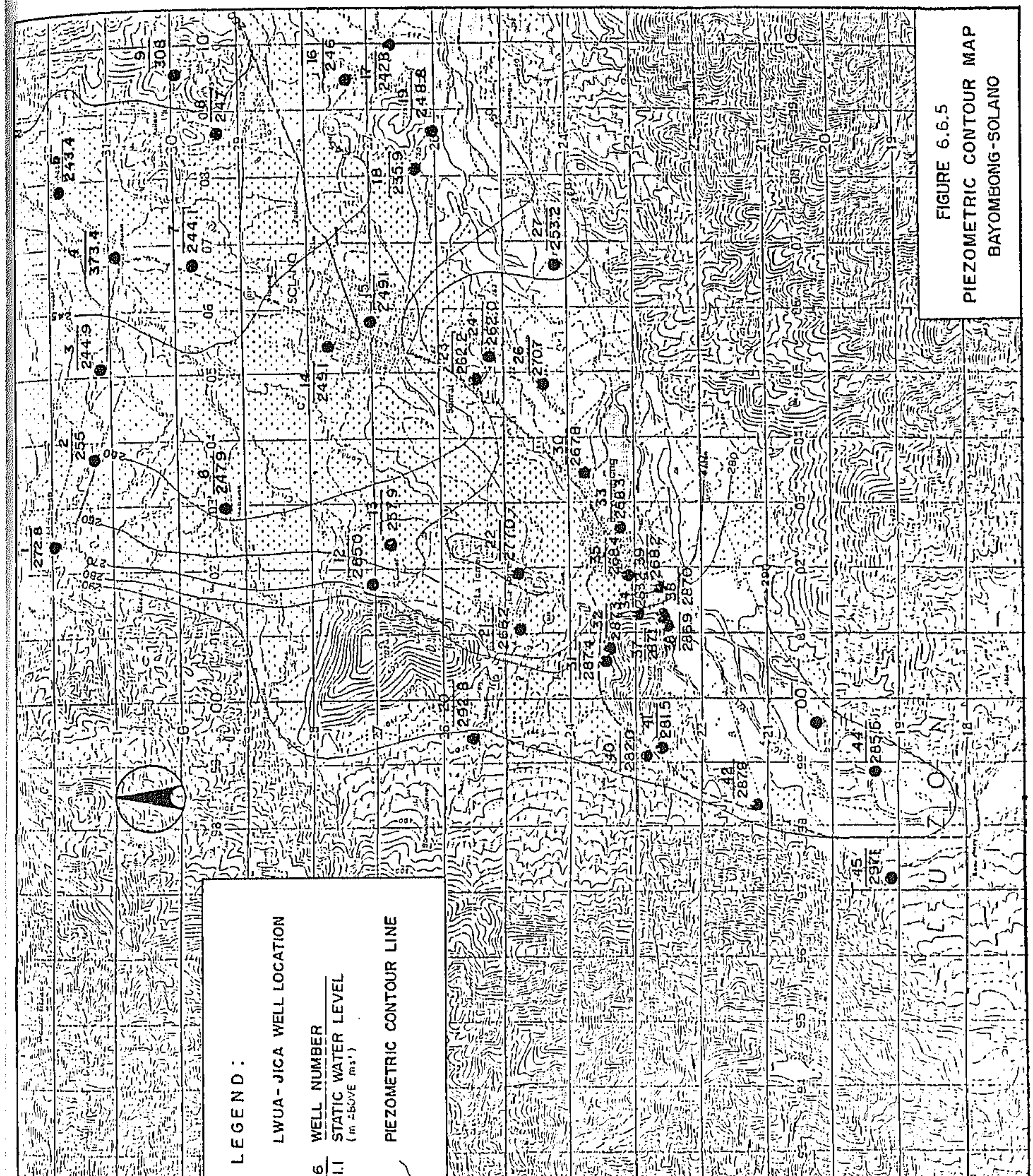


FIGURE 6.6.5
PIEZOMETRIC CONTOUR MAP
BAYOMBONG-SOLANO

The increasing pattern of the isopiestic lines maybe related to the surrounding hills where the hydraulic gradient is expected to be two to three times steeper compared to the downstream side. No discontinuity maybe observed on the map.

6.6.4 Groundwater Evaluation

The evaluation of the groundwater resources cannot be made with an acceptable degree of accuracy because of insufficient data to determine a reliable water balance.

Groundwater in the Alluvial Deposits

The alluvial aquifer in Bayombong-Solano study area is recharged by direct and indirect infiltration, from precipitation and from underflow of the Magat River, respectively. Neither current total recharge of the aquifer nor future additional recharge induced by pumping can be quantified with the available data. However, groundwater availability can be tentatively estimated using the Darcy's law of flow.

$$\frac{Q}{km} = T \times G \times 1000 \text{ m/km}$$

where, Q = groundwater underflow (cu.m/sec)

T = aquifer transmissivity (average permeability 10^{-5} m/sec, thickness of aquifer 5 - 10 m)

G = gradient of the peizometric surface (0.0033)

therefore:

$$\frac{Q}{km} = 14.3 - 28.5 \text{ cu.m/day/km}$$

Thus, the fictive continuous flow across a section of 1 km is equivalent to 0.17 - 0.33 lps (14.3 - 28.5 cu.m/day) which reflects very poor groundwater reserve.

Groundwater in the Recent River Bank Deposit

The following hydrogeological parameters may be applied to the recent river bank deposit.

- Coefficient of the permeability (k): 10^{-2} m/sec
- Average thickness of the deposit : 15 m
- Gradient of the groundwater head along the bank : 0.0036
- Minimum surface flow recorded : 1.5 cu.m/sec
- Average width of the river including bank at the upstream of Bayombong : 1,500 m

Then, the groundwater flow can be tentatively estimated using the Darcy's law of flow:

$$Q/1.5 \text{ km} = T \times G \times 1500 \text{ m}/1.5 \text{ km}$$
$$\fallingdotseq 70{,}000 \text{ cu.m/day}/1.5 \text{ km}$$

The fictive continuous groundwater flow across 1.5 km section of the recent river bank deposits is equivalent to 70,000 cu.m/day. On the other hand, 129,600 cu.m/day of river flow has been recorded as a minimum amount of flow for last 12 years. Hence, one third (1/3) of total flow can be utilized as groundwater on the assumption of the construction of intake structure along the side of the River.

6.7 WATER QUALITY

The following facts are obtained from the water quality examination.

a) Water samples collected at the reservoir inlet (Sample No. 1), service connection at Bayombong town proper (No. 2), and service connection in Solano town proper (No. 3) met physical, chemical and bacteriological quality set forth in the National Standards for Drinking Water of the Philippines.

b) All the water samples at both sides of the Magat River, except Sample No. 11 collected from a shallow well at Vista Hill, show slightly alkaline conditions based on the analysis of hardness and pH. The sum of Ca^{2+} and Mg^{2+} is predominant among cations. This result corresponds to the geological characteristics (lime stone formation) in the mountain side where the Borobbob Spring is located. This fact also corresponds to the result of high "C" value estimation that the slight alkaline conditions of water enables the water pipes to last longer.

c) Water samples collected from the shallow well in the flood plain of the Magat River and from the Magat River itself indicate that the proposed intake facility for future water source may not necessitate any specific treatment of water.

A detailed study of water quality is presented in APPENDIX 6.7.1.

6.8 RECOMMENDED SOURCES

As it has been discussed in the previous sections, the possible and dependable water sources in the subject area are limited to the Borobbob Spring and the Magat River.

In this connection, the maximum utilization of the Borobbob Spring shall be given first priority for planning the future water supply system. The expansion and improvement of intake facility at the Borobbob Spring together with the installation of an additional transmission line enables a total utilization of spring discharge from 6,100 cu.m/day to 11,000 cu.m/day corresponding to the meteorological conditions of respective seasons through the year. Therefore, before the water demand exceeds the minimum discharge of 6,100 cu.m/day, the back-up water source shall be developed to cope up with the said seasonal fluctuation of spring discharge.

Beyond 11,000 cu.m/day of spring discharge, the excess of water demand shall be obtained from the Magat River in the form of underflow water to avoid further water treatment. The method of water intake is recommended to be the infiltration gallery or radial well, both of which intake the underflow water by same hydraulic principle. The necessary intake amount in the year 2010 can be satisfied by either intake method.

The location of the said intake structure is recommended to be situated in the river bank off 500 m away to the southeast from the foot of the Vista Hill as shown in FIGURE 6.6.1.

The water treatment considered is chlorination for short term development. Future treatment will be determined through the water quality monitoring prior to the expansion of the water source facility in the Phase II implementation.

CHAPTER 7
ANALYSIS AND EVALUATION OF ALTERNATIVES

CHAPTER 7 ANALYSIS AND EVALUATION OF ALTERNATIVES

7.1 GENERAL

The possible water supply alternatives are identified and evaluated in this chapter in order to develop the best water supply system for the target year of 2010. Each alternative was developed and evaluated based on the information obtained through field surveys on the water supply source/facilities and potential water sources, and the results of the hydrogeological studies.

The future water supply system may be determined based on the capacity and location of the water sources. The alternative study of water sources was primarily conducted using the recommendations in Chapter 6 - Water Resources.

In the analysis and evaluation of alternatives, the major considerations were the cost of construction, the cost of operation and maintenance of the water supply facilities.

Considering the above-mentioned principal concepts of the alternative study, the following particular approaches are taken up:

- Alternative study of water sources is first carried out for two cases that whether or not the potential water production of the Borobbob Spring shall be fully utilized.

- Required storage capacity of reservoir is subsequently studied for three cases considering the maximum utilization of the existing reservoir. Since each alternative plan will form different configuration of water sources and distribution facilities, the alternative study was carried out considering the overall water supply facilities.

- Alternative study of phased distribution network development was performed for the plan of distribution system as determined in the forgoing alternative study (See APPENDIX 7.1.1).

- Masoc/La Torre area was studied separately from the above-mentioned approaches in view of water distribution method due to the locational conditions of this service area.

7.2 FACTORS TO BE CONSIDERED FOR ALTERNATIVE STUDY

In evaluating alternatives, considered were: water demand for each design year, recommended water sources, design criteria for distribution system, storage requirements and locations, and other parameters relevant to the existing and proposed systems.

7.2.1 Planning Stages

In studying alternatives, planning stages are considered both for the long term and short term development of water supply system as shown below:

Construction Phase	Design Period
Phase I	1986 - 1995
Phase II	1996 - 2010

The long term development shall be completed during the Phase II period, while the short term development by the year 1995.

The Phase I project is further divided into two stages; Stage 1 for 1990 and Stage 2 for 1995 taking into account of practical construction period for the required facilities, especially for internal network and service connections.

7.2.2 Water Demand in Each Design Year

The future water demand as projected in Chapter 5 covering barangays to be served in the respective target years, is presented in TABLE 7.2.1.

TABLE 7.2.1 DEMAND PROJECTION BY BARANGAY (DAILY AVERAGE/MAXIMUM)

(Unit: cu.m/day)

Municipality	Barangay	Design Year		
		1990	1995	2010
Bayombong	District I	400	1,000	1,850
	District II	190	470	870
	District III	390	520	970
	District IV	310	500	920
	La Torre	170	280	530
	Masoc	170	210	450
	Bonfal East	40	220	420
	Bonfal Proper	80	350	680
	Bonfal West	50	270	510
	Sub-Total	1,800	3,820	7,200
Solano	Osmeña	250	560	1,120
	Quezon	180	550	1,100
	Quirino	290	890	1,670
	Roxas	250	780	1,570
	Pob. North	160	270	490
	Pob. South	150	300	470
	Sub-Total	1,280	3,350	6,420
Daily Average Demand		3,080	7,170	13,620
Daily Maximum Demand		4,000	9,000	17,000

7.2.3 Water Sources Considered

Based on the study of existing and potential water sources in Chapter 6, the following source alternatives are established.

(1) Surface/Underflow Water

The Magat River will be the source of surface water or underflow water. The minimum flow of surface water is about 130,000 cu.m/day at 10 years probability, while that of the underflow water is considered to be available at about one third (1/3) of the total water flow. In this connection, the daily maximum water demand in the year 2010 can still be taken from these water sources.

From the viewpoint of water intake method and water quality, the utilization of underflow water is recommended based on the following considerations:

Surface Water

- o Construction of intake facility will be costly owing to the wide spread of water course.
- o Water treatment facility will be required because of the high turbidity of the water.
- o Suspension of the use of the water intake facility during storms due to high turbidity.

Underflow Water

- o Stable water quality with low turbidity is available since the water is filtered in the river bed.
- o Stable amount of water from the intake is available even during the minimum flow conditions.
- o Water treatment facility is not required in principle.

Although a more detailed investigation will be required in a timely, a radial well may be used as the intake facility to ensure lower construction costs.

The following are the assumptions on the radial well at this planning stage and details are presented in APPENDIX 7.2.1.

Proposed Radial Well	Design Parameter
Well depth	10 m
Diameter - concrete caisson	5 m (I.D.)
- radial collector	10 m
Estimated discharge capacity	12,100 cu.m/day
Influence area	250 m (radius)

The water right will have to be allotted among agencies/local governments concerned in the future when the project will be implemented.

(2) Spring

The existing Borobbob Spring, with current intake amount of 4,770 cu.m/day, is to be utilized through the year 2010.

However, the potential water production of this spring varies from 6,100 cu.m/day as the minimum through the year to 11,000 cu.m/day during the rainy season. Thus, at least 1,330 cu.m/day through the year and 6,230 cu.m/day of water during the rainy season is available for further utilization.

7.2.4 Distribution System

The study of the distribution system includes the various alternative pipeline configurations and routing to arrive at the cheapest possible distribution system that can provide adequate water pressure in the proposed service area.

(1) Pressure Zone

The ground elevation of the proposed service area for the year 2010 varies from 255 m in Solano town proper to 300 m in Masoc/La Torre area. Because of its location, Masoc/La Torre area is considered to form one pressure zone and the rest of the proposed service area's distribution system will be studied.

(2) System Pressure

In accordance with the LWUA Methodology Manual, the design water pressure in the main pipes with a diameter of more than 150 mm as indicated below will be achieved in the year 2010 (Phase II) for the hourly maximum flow:

- o Max. static water pressure : 7.0 kg/sq.cm
- o Min. dynamic water pressure : 0.7 kg/sq.cm for the residential area; 1.4 kg/sq.cm for the commercial/industrial area.

During the Phase I period, a minor modification to the above-mentioned requirements may be adopted considering of the cost constraints as the intermediate measure of system improvement.

"C" value (Hazen Williams' Formula) being adopted in the said manual is also given below:

ϕ100 mm to ϕ200 mm : C = 110
ϕ250 mm to ϕ500 mm : C = 120
ϕ600 mm and over : C = 130

(3) Fire Protection

Full fire protection with adequate water pressure will be insured during the Phase II period. During the Phase I period, the existing fire hydrants will be utilized. The criteria to locate fire hydrants set forth in the LWUA Methodology Manual is summarized as follows:

	Residential Area	Commercial/ Industrial Area
Diameter of Fire Hydrants	100 mm	150 mm
Spacing	180 m	135 m
Hydrant Density	0.3 pc/ha	0.6 pc/ha

The number of fire hydrants can be determined either by spacing or by hydrant density criteria.

To verify the appropriateness of distribution system, a 22 1/sec of fire fighting water from each of two adjacent fire hydrants in the residential area as required in the LWUA Methodology Manual will be checked by the computer-aided network analysis.

(4) Storage Facilities

In coming up with the most cost-effective storage facilities, water demand and storage volume will have to be ascertained. In compliance with the LWUA Methodology Manual, the optimum configuration of the storage facilities will be selected from among the following three alternative schemes:

- Daily maximum supply and maximum storage,
- Intermediate supply and storage (150% of the daily maximum supply), and
- Peak hour supply and minimum storage.

The location of storage facilities will also be studied in relation to the location of major demand areas and necessary diameter of distribution pipes.

(5) Distribution Network

The most optimum distribution network will be determined from the view point of the least cost construction by means of the computer-aided network analysis by taking into account the afore-mentioned criteria of distribution system.

(6) Equipment/Materials and Unit Costs

The unit costs of water supply equipment and materials were inquired both in Manila and respective study area during the field survey.

The survey results revealed that almost all the equipment and materials are imported or partially manufactured in Manila area and distributed to local areas. These market prices which were mainly pipes and fittings, were compared with the LWUA Methodology Manual at the 1986 price level and it is concluded that the said Manual be referred to estimate the project cost.

With regard to pipe materials, PVC pipe for diameters up to 150 mm and steel pipe for diameters of 200 mm and above are utilized in this study based on the cost comparison. (See APPENDIX 7.2.2 for details)

7.3 ALTERNATIVE STUDY OF WATER SUPPLY SYSTEM

7.3.1 Water Source and Transmission

(1) Development of Alternatives

Even if the total production of the Borobbob Spring is fully utilized, it will still not be sufficient for the year 2010. Water production shall be supplemented utilizing the underflow water in the Magat River.

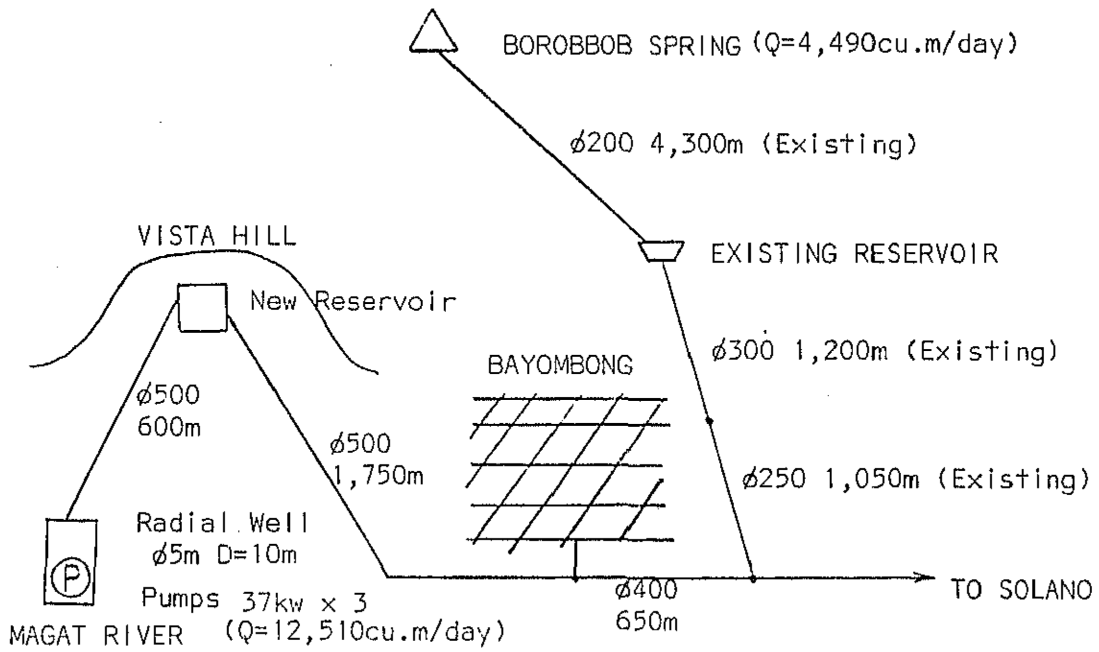
Water source alternatives are therefore to determine whether or not the further utilization of the Borobbob Spring is economical. In developing alternative plans, it is assumed that the water from the Magat River be pumped up to the ground reservoir to be constructed on the Vista Hill for distribution by gravity. The description of alternative plans is as follows and the schematic diagram is shown in FIGURE 7.3.1.

Alternative S-1 : No increase in the intake amount from the Borobbob Spring

- o The existing transmission line from the Borobbob Spring to the existing reservoir has a diameter of 200 mm with a total length of 4,300 m with 80.8 m of the difference of ground elevations. When a planned "C" value of 110 is applied to this pipeline, it has a capacity to convey 4,490 cu.m/day of water. Although an average of 4,770 cu.m/day was determined through the field survey, the estimated 4,490 cu.m/day is adopted for the planning purpose.

- o Based on the above premise, it is estimated that approximately 12,510 cu.m/day (17,000 cu.m/day - 4,490 cu.m/day) which is the daily maximum water demand in the year 2010 shall be obtained from the Magat River. To cope with this water demand, two units of radial wells (5 m I.D. and 10 m depth) with pumping facilities will be required.

ALTERNATIVE S-1



ALTERNATIVE S-2

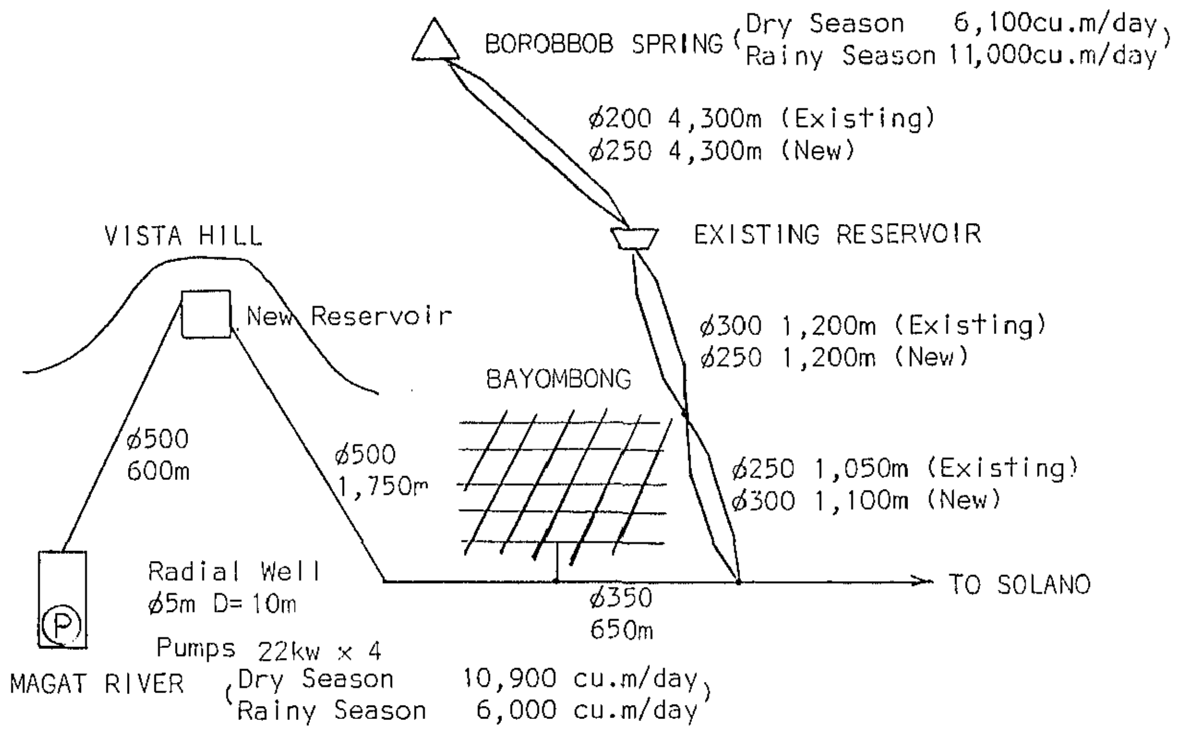


FIGURE 7.3.1
WATER SOURCE ALTERNATIVES

Alternative S-2 : Maximum utilization of the Borobbob Spring

- o Through the improvement and expansion of the intake box of the Borobbob Spring, the entire spring discharge (6,100 cu.m/day through the year and 11,000 cu.m/day in rainy season) will be conveyed to the existing reservoir.

- o Additional pipe requirement will be ø250 mm transmission line for 4,300 m length from the Borobbob Spring to the existing reservoir and distribution main (ø300 mm for 1,100 m and ø250 mm for 1,200 m) from the existing reservoir to Bayombong town proper.

- o To supplement the water production of the Borobbob Spring, 6,000 cu.m/day (rainy season) to 10,900 cu.m/day (dry season) shall be obtained from the Magat River as follows:

  Dry season 17,000 - 6,100 = 10,900 cu.m/day (5 months)
  Rainy season 17,000 - 11,000 = 6,000 cu.m/day (7 months)

  The required water source facilities are two units of radial wells (5 m I.D. and 10 m Depth) with pumping equipment.

(2) Cost Comparison

The construction cost together with operation and maintenance costs for 15 years period are estimated at the 1986 price level excluding common facilities, i.e., power sub-station, distribution reservoir and distribution network, as shown in TABLE 7.3.1.

Based on the above cost comparison, Alternative S-2 is selected as the most optimum plan for water source development.

TABLE 7.3.1 COST COMPARISON OF WATER SOURCE ALTERNATIVES

Required Facilities	Quantity	Unit Cost	Cost (₱x1,000)
Alternative S-1			
1. Water Source		(₱x1,000)	
Radial Well (5 m I.D., 10 m Depth)	1 unit	1,240	1,240
Pump House (H=30m, Q=145 l/s)	1 unit	948	948
Pumps (37 kw)	2+1 units (1 for standby)	442	1,326
Sub-Total			3,514
2. Transmission Line			
Radial Well - Vista Hill		(Peso/m)	
- Bayombong : ϕ500 mm	2,350 m	1,330	3,126
ϕ400 mm	650 m	970	631
Sub-Total			3,757
3. Operation and Maintenance		(Peso/MM)	
Salary (4 persons)	15 years	920	662
		(Peso/KWH)	
Energy (30mm x 9,111 cu.m/day)	6,854 MWH	2.11	14,462
Maintenance (10% of Construction Cost)	-	-	727
Sub-Total			15,851
TOTAL			23,122
Alternative S-2			
1. Water Source		(₱x1,000)	
Spring Box Rehabilitation	1 unit	40	40
Radial Well (5 m I.D., 10 m Depth)	1 unit	1,240	1,240
Pump House (H=30m, Q=126 l/s)	1 unit	860	860
Pumps (22 kw)	3+1 units (1 for standby)	358	1,432
Sub-Total			3,572
2. Transmission Line		(Peso/m)	
Spring - Reservoir; ϕ250mm	4,300 m	630	2,709
Reservoir - Bayombong; ϕ300 mm	1,100 m	750	825
ϕ250 mm	1,200 m	630	756
Radial Well - Vista Hill			
- Bayombong; ϕ500 mm	2,350 m	1,330	3,126
ϕ350 mm	650 m	900	585
Sub-Total			8,001
3. Operation and Maintenance		(Peso/MM)	
Salary (4 persons)	15 years	920	662
Energy (30m x 750/cu.m/day x 5 months)	2,351 MWH	(Peso/KWH) 2.11	4,961
(30m x 260/cu.m/day x 7 months)	1,141 MWH	2.11	2,408
Maintenance (10% of Construction Cost)	-	-	1,157
Sub-Total			9,188
TOTAL			20,761

7.3.2 Distribution System

(1) Development of Alternatives

The Masoc/La Torre service area is situated at higher ground elevation and is geographically isolated from the other service areas. The alternative study for the distribution system is therefore made for two of service area groupings.

<u>Bayombong town proper, Bonfal area and Solano town proper</u>

Three alternatives in optimizing the supply rate and storage volume are considered. In developing alternative plans and in comparing their costs, several assumptions are taken into account as follows:

- o Water from the Magat River will be pumped directly to the reservoir where sufficient contact time for chlorination is attained.
- o Chlorinators will be installed at the reservoirs.
- o Data on heads of pumps are based on the computer-aided hydraulic simulation.
- o All items common to all alternatives are not included in the comparative study.

Major concepts of three alternatives are:

Alternative D-1	:	Daily maximum supply and maximum storage
Alternative D-2	:	Intermediate supply and storage
Alternative D-3	:	Peak hour supply and minimum storage

For the first two alternatives, the required operational storage has been determined according to the LWUA Methodology Manual as described in the previous section. In addition to this, an emergency storage equal to two hours of the daily maximum water demand is considered common to all three alternatives. No extra operational storage is required for Alternative 3 as the peak hour water demand will be met by the water sources.

Along with the above-mentioned concepts, five alternative plans for the distribution system with different storage capacities are developed to meet the water demand in the year 2010. Detailed descriptions of the five alternatives are given below and the schematic diagrams are presented FIGURE 7.3.2. In the selection of major pipeline routes, the existing and planned road conditions are fully taken into account including the route with the shortest length and the route that passes the major demand areas in the proposed service area.

Alternative D-1-(1)

- A total of 3,970 cu.m storage requirement will be secured by the use of the existing reservoir (1,900 cu.m) and the construction of additional new reservoir (2,100 cu.m) on the Vista Hill.

- Additional water sources will be secured by the improvement and expansion of intake box at the Borobbob Spring and the construction of a radial well (5 m I.D., 10 m depth) in the upstream of the Magat River. A total of 17,000 cu.m/day on the daily maximum basis will be secured as follows:

Water Sources	Dry Season	Rainy Season
Borobbob Spring	6,100 cu.m/day	11,000 cu.m/day
Radial Well (Magat River)	10,900 "	6,000 "

Alternative D-1-(2)

- A total of 3,970 cu.m storage requirement will be secured by the use of existing reservoir (1,000 cu.m) and the construction of additional new reservoir (2,100 cu.m) near Bonfal area which will serve for Bonfal area and Solano town proper.

- The required storage capacity of the new reservoir is determined as a balance between the total storage requirement (3,970 cu.m) and the storage capacity of existing reservoir (1,900 cu.m) since the proposed service area forms one integrated distribution system as inter-connected by the existing distribution main. On the other hand, when the water demand in Bonfal area and Solano town proper is solely managed by the new reservoir, the required storage capacity will be 2,440 cu.m.

- Water source development plan is same as Alternative D-1-(1).

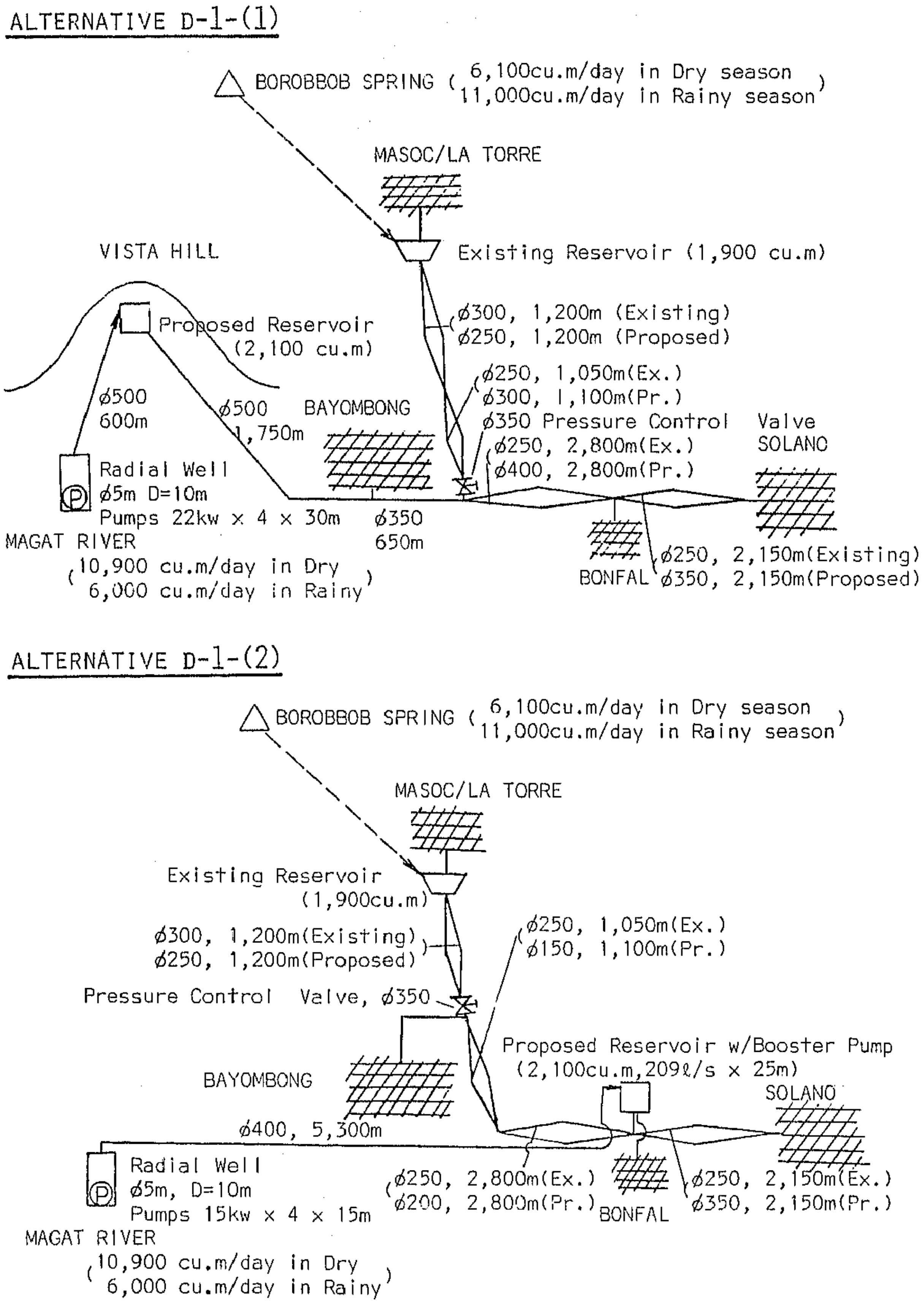
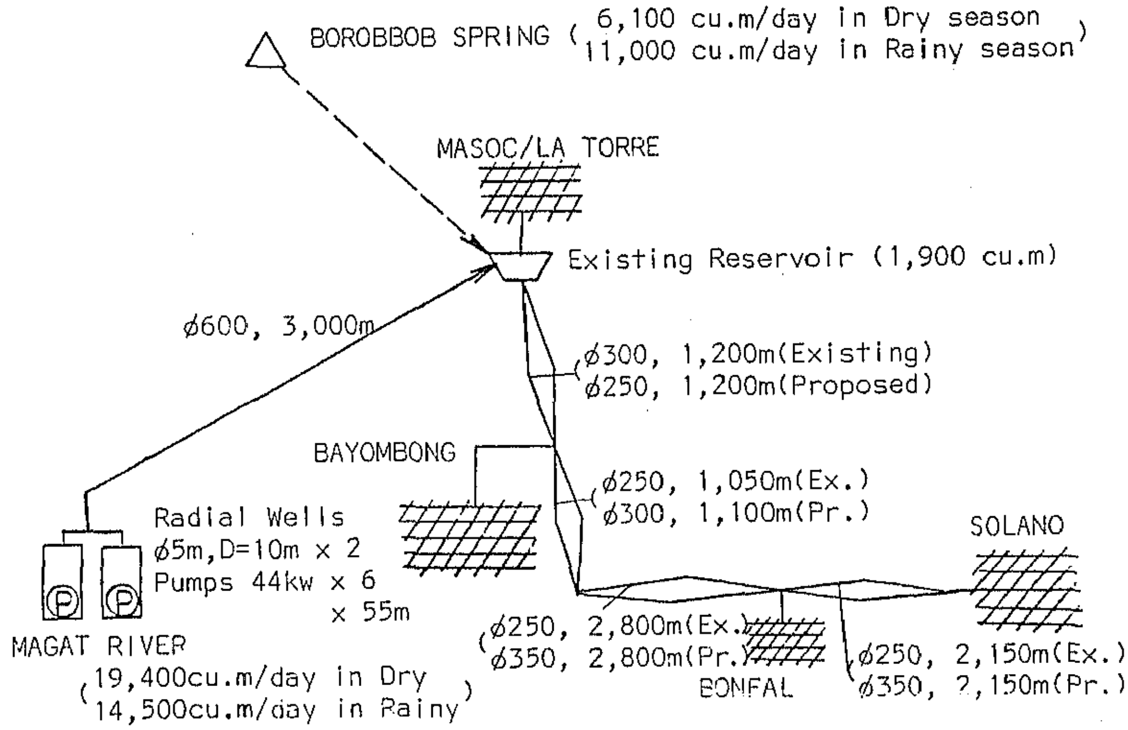


FIGURE 7.3.2(A)

ALTERNATIVE DISTRIBUTION SYSTEMS

ALTERNATIVE D-2-(1)



ALTERNATIVE D-2-(2)

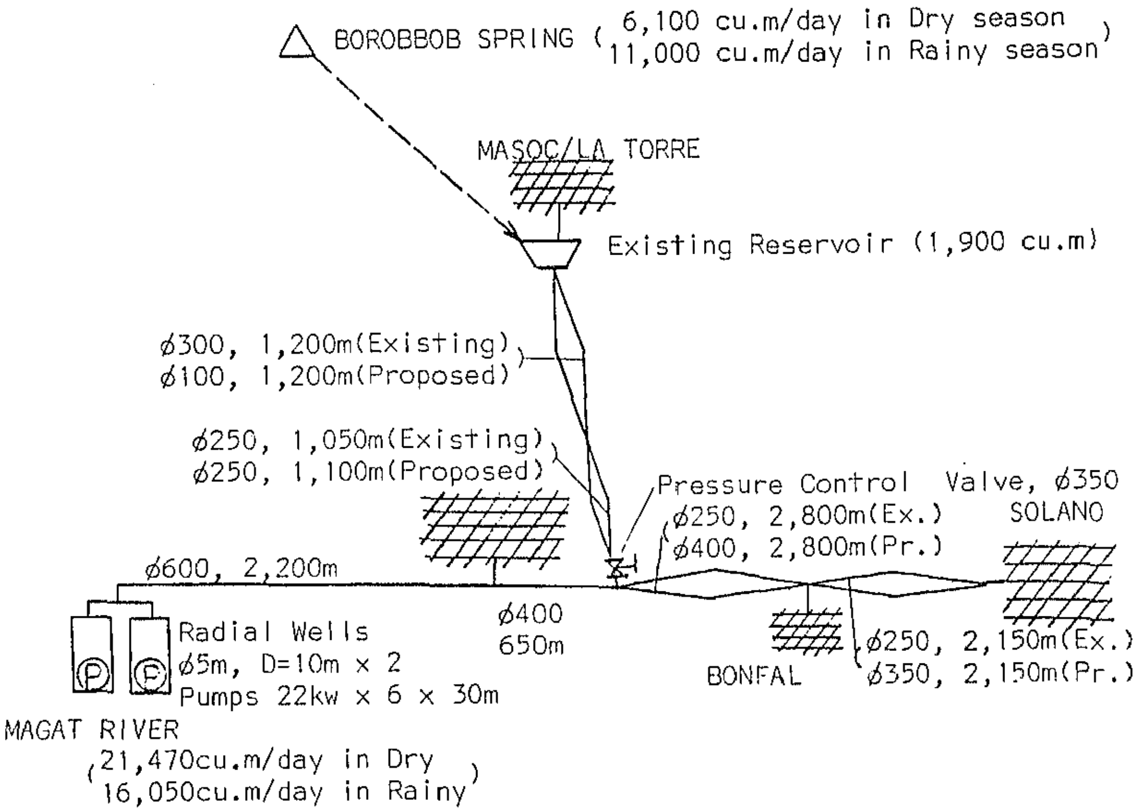


FIGURE 7.3.2(B)

ALTERNATIVE DISTRIBUTION SYSTEMS

Alternative D-2-(1)

- o Additional new reservoir is not considered, except for the use of existing one (1,900 cu.m).

- o Additional water sources will be secured by the improvement and expansion of intake box at the Borobbob Spring and the construction of two radial wells with increased capacity (5 m I.D., 10 m depth) in the upstream of the Magat River. A total of 25,500 cu.m/day (150% of the daily maximum water demand) will be transmitted to the existing reservoir as follows:

Water Sources	Dry Season	Rainy Season
Borobbob Spring	6,100 cu.m/day	11,000 cu.m/day
Radial Well (Magat River)	19,400 "	14,500 "

Alternative D-2-(2)

- o Only the existing reservoir will be used as same as Alternative D-2-(1).

- o Additional water sources will be secured by the same manner as Alternative D-2-(1). However, the spring water will be distributed via the existing reservoir (6,000 cu.m/day in dry season and 11,000 cu.m/day in rainy season), while the river water will be directly distributed to the service area from radial wells on the peak hour water demand basis (21,470 cu.m/day in dry season and 16,050 cu.m/day in rainy season).

Alternative D-3

- o Only the existing reservoir will be used as the emergency storage.

- o Additional water sources will be secured by the same manner as Alternative D-2-(1)/(2). The spring water will also be distributed via the existing reservoir as described in Alternative D-2-(2) (6,100 cu.m/day in dry season and 11,000 cu.m/day in rainy season), while the river water will be directly distributed to the service area from radial wells on the peak hour water demand basis (22,100 cu.m/day in dry season and 17,200 cu.m/day in rainy season).

Among the above-mentioned five alternatives, the system configuration of Alternative D-3 is more or less same as that of Alternative D-2-(2), though the former case requires larger capacity of pumps than the latter one to cope with the peak hour water demand. In this regard, it is apparent that Alternative D-3 costs higher than Alternative D-2-(2) and therefore, Alternative D-3 is excluded from the cost comparison of alternatives.

Major system configuration of the remaining four alternatives are presented in TABLE 7.3.2 to TABLE 7.3.5.

TABLE 7.3.2 REQUIRED FACILITIES OF DISTRIBUTION SYSTEM ALTERNATIVE D-1-(1)

Required Facilities	Dimension	Quantity
1. Water Source		
Radial Well	5 m I.D. x 10 m depth	1 unit
Pump House	(H=30 m, Q=126 l/sec)	1 unit
Pumps	22 kw	4 units (1 for standby)
Power Sub-Station	100 KVA	1 unit
2. Reservoir/Treatment		
Reservoir (Vista Hill)	2,100 cu.m	1 unit
Chlorinator (constant flow)	22 kg/day	2 units
Access Road (gravel base + asphalt pavement)	3.5 m Width	400 m
3. Transmission/Distribution Main		
Magat River - Reservoir (Vista Hill)	ϕ500 mm	600 m
Water Hammer Protection	Surge Tank	3 units
	Air Valve + Strainer	3 units
Distribution Main		
Pipe	ϕ500 mm	1,750 m
	ϕ400 mm	2,800 m
	ϕ350 mm	2,800 m
	ϕ300 mm	1,100 m
	ϕ250 mm	1,200 m
Valve	ϕ400 mm	1 pc.
	ϕ350 mm	2 pcs.
	ϕ300 mm	1 pc.
	ϕ250 mm	2 pcs.
Flow Meter	ϕ400 mm	1 pc.
	ϕ350 mm	1 pc.
Pressure Control Valve	ϕ350 mm	1 pc.

TABLE 7.3.3 REQUIRED FACILITIES OF DISTRIBUTION SYSTEM ALTERNATIVE D-1-(2)

Required Facilities	Dimension	Quantity
1. Water Source		
Radial Well	5 m I.D. x 10 m depth	1 unit
Pump House	(H=15 m, Q=126 l/sec)	1 unit
Pumps	15 kw	4 units (1 for standby)
Power Sub-Station	75 KVA	1 unit
2. Reservoir/Treatment		
Reservoir (Vista Hill)	2,100 cu.m	1 unit
Chlorinator (constant flow)	22 kg/day	2 units
Booster Pump Station	H=25 m, Q=209 l/s	1 unit
Power Sub-Station	150 KVA	1 unit
3. Transmission/Distribution Main		
Magat River - Reservoir (Bonfal)	ϕ400 mm	5,300 m
Distribution Main		
Pipe	ϕ450 mm	100 m
	ϕ350 mm	2,150 m
	ϕ250 mm	1,200 m
	ϕ200 mm	2,800 m
	ϕ150 mm	1,100 m
Valve	ϕ350 mm	1 pc.
	ϕ250 mm	2 pcs.
	ϕ200 mm	1 pc.
	ϕ150 mm	1 pc.
Flow Meter	ϕ400 mm	1 pc.
	ϕ350 mm	1 pc.
Pressure Control Valve	ϕ350 mm	1 pc.

TABLE 7.3.4 REQUIRED FACILITIES OF DISTRIBUTION SYSTEM ALTERNATIVE D-2-(1)

Required Facilities	Dimension	Quantity
1. Water Source		
Radial Well	5 m I.D. x 10 m depth	2 units
Pump House	(H=55 m, Q=112 l/sec)	2 units
Pumps	44 kw	6 units
		(1 for standby)
Power Sub-Station	300 KVA	1 unit
2. Reservoir/Treatment		
Chlorinator (constant flow)	45 kg/day	1 unit
3. Transmission/Distribution Main		
Magat River - Existing Reservoir	ϕ600 mm	3,000 m
Water Hammer Protection	Surge Tank	3 units
	Air Valve + Strainer	3 units
Distribution Main		
Pipe	ϕ400 mm	1,200 m
	ϕ350 mm	4,950 m
	ϕ300 mm	1,100 m
Valve	ϕ350 mm	2 pcs.
	ϕ300 mm	1 pc.
	ϕ250 mm	2 pcs.
Flow Meter	ϕ400 mm	1 pc.
	ϕ250 mm	1 pc.

TABLE 7.3.5 REQUIRED FACILITIES OF DISTRIBUTION SYSTEM ALTERNATIVE D-2-(2)

Required Facilities	Dimension	Quantity
1. Water Source		
Radial Well	5 m I.D. x 10 m depth	2 units
Pump House	(H=30 m, Q=124 l/sec)	2 units
Pumps	22 kw	6 units (1 for standby)
Power Sub-Station	150 KVA	1 unit
2. Reservoir/Treatment		
Chlorinator (constant flow)	22 kg/day	2 units
3. Transmission/Distribution Main		
Magat River - Bayombong	ϕ600 mm	2,200 m
Distribution Main		
Pipe	ϕ400 mm	3,450 m
	ϕ350 mm	2,150 m
	ϕ250 mm	1,100 m
	ϕ100 mm	1,200 m
Valve	ϕ400 mm	2 pcs.
	ϕ350 mm	1 pc.
	ϕ250 mm	3 pcs.
Pressure Control Valve	ϕ350 mm	1 pc.
Flow Meter	ϕ400 mm	1 pc.
	ϕ300 mm	1 pc.

Masoc/La Torre area

For the supply to Masoc/La Torre area, the following premises are established prior to the development of alternative plans:

- Water shall be distributed via the reservoir in order to attain more than 20 minutes of contact time for chlorination.
- Storage volume of the reservoir is considered equivalent to the emergency storage only since the water source for this service area is the Borobbob Spring which will provide continuous supply.

Based on the above premises, three alternative plans are developed as follows:

Alternative ML-1

- o Water will be branched near the Masoc Elementary School at about 310 m from the ground elevation of the transmission line conveying the water from the Borobbob Spring to the existing reservoir.
- o An additional reservoir will be constructed near the Masoc Elementary School to receive the branched water.
- o Masoc/La Torre area will be solely served by the new reservoir through the new distribution lines.

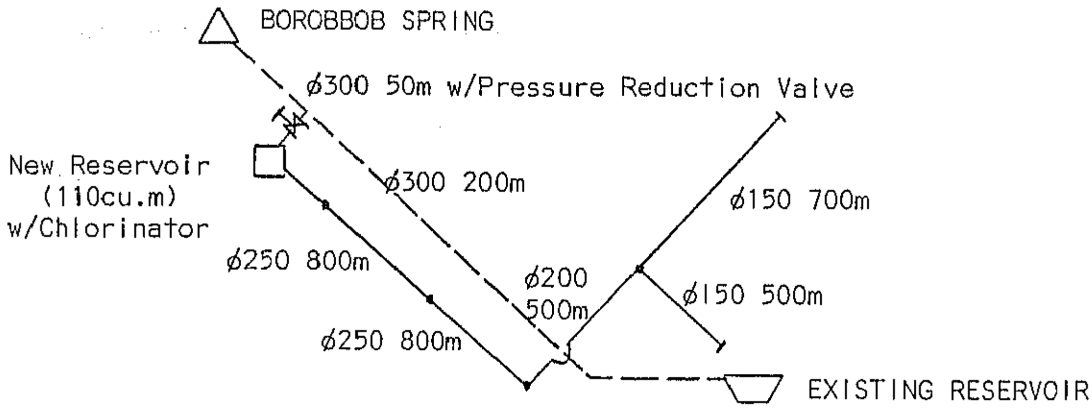
Alternative ML-2

- o Water source and additional reservoir are same as Alternative ML-1, however these facilities will serve only Masoc area through new distribution lines.
- o La Torre area will be served by the existing reservoir through new distribution lines.
- o New distribution lines of Masoc and La Torre areas will be inter-connected.

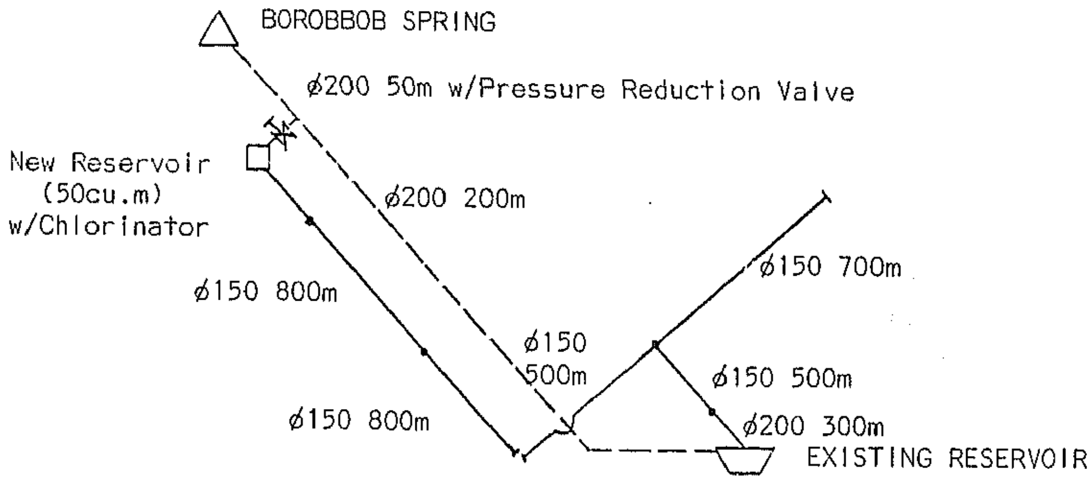
Alternative ML-3

- o Masoc/La Torre area will be served by the existing reservoir through new distribution lines.

ALTERNATIVE ML-1



ALTERNATIVE ML-2



ALTERNATIVE ML-3

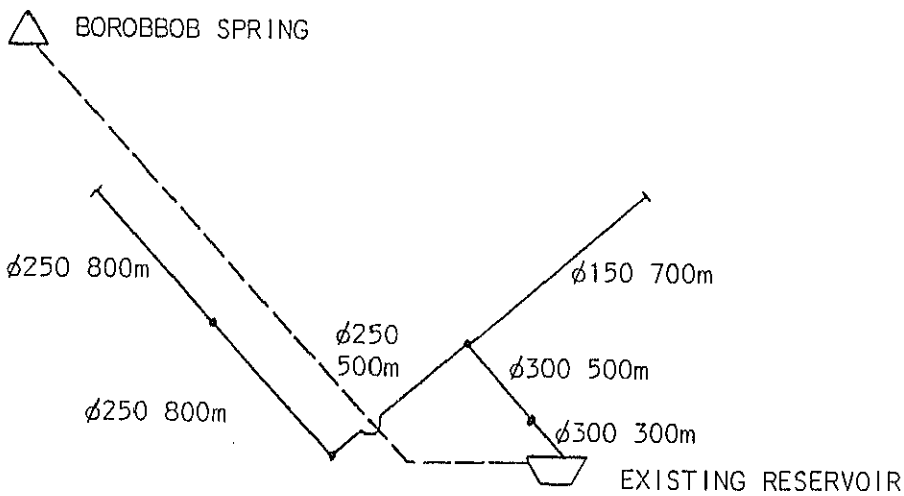


FIGURE 7.3.3 ALTERNATIVE DISTRIBUTION SYSTEMS FOR MASOC / LA TORRE AREA

The pipe diameters of the distribution network of each alternative are determined based on the computer-aided hydraulic simulation. Schematic diagrams and system configurations of these alternatives are shown in FIGURE 7.3.3 and TABLE 7.3.6, respectively.

TABLE 7.3.6 CONFIGURATION OF DISTRIBUTION SYSTEM ALTERNATIVES FOR MASOC/LA TORRE AREA

Required Facilities		Alt. ML-1	Alt. ML-2	Alt. ML-3
Reservoir		110 cu.m	50 cu.m	-
Chlorinator (constant flow)		22 kg/day	22 kg/day	-
Distribution Line				
Pipe :	ϕ300 mm	200 m	-	800 m
	ϕ250 mm	1,600 m	-	2,100 m
	ϕ200 mm	500 m	1,300 m	-
	ϕ150 mm	1,250 m	2,500 m	700 m
	ϕ100 mm	-	50 m	-
Valve:	ϕ300 mm	1 pc.	-	3 pcs.
	ϕ250 mm	5 pcs.	-	7 pcs.
	ϕ200 mm	2 pcs.	4 pcs.	-
	ϕ150 mm	4 pcs.	8 pcs.	2 pcs.
Pressure Control Valve		ϕ150 mm, 1 pc.	ϕ100 mm, 1 pc.	-

(2) Cost Comparison

The cost comparison of the distribution system alternatives includes the cost for operation and maintenance for a 15 year period at the 1986 price level. The unit costs adopted for the cost estimates are based on the LWUA Methodology Manual.

Bayombong town proper, Bonfal area and Solano town proper

A summary of cost comparison of four alternatives is given in TABLE 7.3.7 and its detailed breakdown is shown in TABLE 7.3.8 to TABLE 7.3.11.

TABLE 7.3.7 COST COMPARISON OF ALTERNATIVE DISTRIBUTION SYSTEMS

Unit : ₱ x 1,000

Facilities	Alt. D-1-(1)	Alt. D-1-(2)	Alt. D-2-(1)	Alt. D-2-(2)
Construction Cost				
Water Source	6,037	5,786	9,966	8,908
Reservoir/Treatment	3,433	8,929	119	196
Transmission/ Distribution	11,593	10,732	12,339	10,824
Sub-Total	21,063	25,447	22,424	19,928
Operation & Maintenance Cost	10,469	13,365	16,412	10,024
TOTAL	31,532	38,812	38,836	29,952

Based on the above cost comparison, Alternative D-2-(2) is selected as the most optimum configuration of the distribution system in the subject service area.

TABLE 7.3.8 COST ESTIMATES OF ALTERNATIVE D-1-(1)

Required Facilities	Quantity	Unit Cost (₱)	Cost (₱x1,000)
Construction Cost			
1. Water Source			
Radial Well	1 unit	1,240,000	1,240
Pump House	1 unit	860,000	860
Pumps (22 kw)	4 units	358,000	1,432
Power Sub-Station (100 KVA)	1 unit	2,505,000	2,505
Sub-Total			6,037
2. Reservoir/Treatment			
Reservoir	2,100 cu.m	-	2,661
Chlorinator (22 kg/day)	2 units	98,100	196
Access Road (3.5 m Width)	400 m	1,440	576
Sub-Total			3,433
3. Transmission/Distribution Main			
Magat River - Reservoir (ϕ600 mm)	600 m	1,330	798
Surge Tank	3 units	150,000	450
Air Valve + Strainer	3 units	40,000	120
Distribution Main			
Pipe : ϕ500 mm	1,750 m	1,330	2,327
ϕ400 mm	2,800 m	970	2,716
ϕ350 mm	2,800 m	900	2,520
ϕ300 mm	1,100 m	760	836
ϕ250 mm	1,200 m	630	756
Valve ϕ400 mm	1 pc.	95,200	95
ϕ350 mm	2 pcs.	74,400	149
ϕ300 mm	1 pc.	34,800	35
ϕ250 mm	2 pcs.	11,200	22
Flow Meter			
ϕ400 mm	1 pc.	215,000	215
ϕ350 mm	1 pc.	164,000	164
Pressure Control Valve, ϕ350 mm	1 pc.	390,000	390
Sub-Total			11,593
TOTAL			21,063
Operation & Maintenance Cost (15 years)			
Salary (2 persons x 3 facilities)	15 years	920/MM	994
Energy : Dry Season	2,351 MWH	2.11/KWH	4,961
Rainy Season	1,141 MWH	"	2,408
Maintenance	10% of Construction Cost	-	2,106
TOTAL			10,469
GRAND TOTAL			31,532

TABLE 7.3.9 COST ESTIMATES OF ALTERNATIVE D-1-(2)

Required Facilities	Quantity	Unit Cost (₱)	Cost (₱x1,000)
Construction Cost			
1. Water Source			
Radial Well	1 unit	1,240,000	1,240
Pump House	1 unit	860,000	860
Pumps (15 kw)	4 units	314,000	1,256
Power Sub-Station (75 KVA)	1 unit	2,430,000	2,430
Sub-Total			5,786
2. Reservoir/Treatment			
Reservoir	2,100 cu.m	-	2,661
Chlorinator (22 kg/day)	2 units	98,100	196
Booster Pump Station	1 unit	3,492,000	3,492
Power Sub-Station (150 KVA)	1 unit	2,580,000	2,580
Sub-Total			8,929
3. Transmission/Distribution Main			
Magat River - Reservoir (ϕ400 mm)	5,300 m	970	5,141
Distribution Main			
Pipe : ϕ450 mm	100 m	1,160	116
ϕ350 mm	2,150 m	900	1,935
ϕ250 mm	1,200 m	630	756
ϕ200 mm	2,800 m	520	1,456
ϕ150 mm	1,100 m	410	451
Valve ϕ350 mm	1 pc.	74,400	74
ϕ250 mm	2 pcs.	11,200	22
ϕ200 mm	1 pc.	6,700	7
ϕ150 mm	1 pc.	5,300	5
Flow Meter			
ϕ400 mm	1 pc.	215,000	215
ϕ350 mm	1 pc.	164,000	164
Pressure Control Valve, ϕ350 mm	1 pc.	390,000	390
Sub-Total			10,732
TOTAL			25,447
Operation & Maintenance Cost (15 years)			
Salary (2 persons x 3 facilities)	15 years	920/MM	994
Energy : Dry Season			
- Well	1,176 MWH	2.11/KWH	2,481
- Booster Pump	1,959 MWH	"	4,133
Rainy Season			
- Well	571 MWH	"	1,205
- Booster Pump	951 MWH	"	2,007
Maintenance	10% of Construction Cost	-	2,545
TOTAL			13,365
GRAND TOTAL			38,812

TABLE 7.3.10 COST ESTIMATES OF ALTERNATIVE D-2-(1)

Required Facilities	Quantity	Unit Cost (₱)	Cost (₱x1,000)
Construction Cost			
1. Water Source			
Radial Well	2 units	1,240,000	2,480
Pump House	2 units	923,000	1,846
Pumps (44 kw)	6 units	470,000	2,820
Power Sub-Station (300 KVA)	1 unit	2,820,000	2,820
Sub-Total			9,966
2. Reservoir/Treatment			
Chlorinator (45 kg/day)	1 unit	119,100	119
Sub-Total			119
3. Transmission/Distribution Main			
Magat River - Reservoir (ϕ600 mm)	3,000 m	1,600	4,800
Surge Tank	3 units	150,000	450
Air Valve + Strainer	3 units	40,000	120
Distribution Main			
Pipe : ϕ400 mm	1,200 m	970	1,164
ϕ350 mm	4,950 m	900	4,455
ϕ300 mm	1,100 m	760	836
Valve ϕ350 mm	2 pcs.	74,400	149
ϕ300 mm	1 pc.	34,800	35
ϕ250 mm	2 pcs.	11,200	22
Flow Meter			
ϕ400 mm	1 pc.	215,000	215
ϕ250 mm	1 pc.	93,000	93
Sub-Total			12,339
TOTAL			22,424
Operation & Maintenance Cost (15 years)			
Salary (2 persons x 3 facilities)	15 years	920/MM	662
Energy : Dry Season	4,310 MWH	2.11/KWH	9,094
Rainy Season	2,092 MWH	"	4,414
Maintenance	10% of Construction Cost	-	2,245
TOTAL			16,412
GRAND TOTAL			38,836

TABLE 7.3.11 COST ESTIMATES OF ALTERNATIVE D-2-(2)

Required Facilities	Quantity	Unit Cost (₱)	Cost (₱x1,000)
Construction Cost			
1. Water Source			
Radial Well	2 units	1,240,000	2,480
Pump House	2 units	850,000	1,700
Pumps (22 kw)	6 units	358,000	2,148
Power Sub-Station (150 KVA)	1 unit	2,580,000	2,580
Sub-Total			8,908
2. Reservoir/Treatment			
Chlorinator (22 kg/day)	2 units	98,100	196
Sub-Total			196
3. Transmission/Distribution Main			
Magat River - Bayombong (ϕ600mm)	2,200 m	1,600	3,520
Distribution Main			
Pipe : ϕ400 mm	3,450 m	970	3,347
ϕ350 mm	2,150 m	900	1,935
ϕ250 mm	1,100 m	630	693
ϕ100 mm	1,200 m	250	300
Valve ϕ400 mm	2 pcs.	95,200	190
ϕ350 mm	1 pc.	74,400	74
ϕ250 mm	3 pcs.	11,200	34
Pressure Control Valve, ϕ350 mm	1 pc.	390,000	390
Flow Meter			
ϕ400 mm	1 pc.	126,000	126
ϕ250 mm	1 pc.	215,000	215
Sub-Total			10,824
TOTAL			19,928
Operation & Maintenance Cost (15 years)			
Salary (2 persons x 2 facilities)	15 years	920/MM	662
Energy : Dry Season	2,351 MWH	2.11/KWH	4,961
Rainy Season	1,141 MWH	"	2,408
Maintenance	10% of Construction Cost	-	1,993
TOTAL			10,024
GRAND TOTAL			29,952

Masoc/La Torre area

The cost comparison of three alternatives is shown in TABLE 7.3.12. Aside from the cost advantage of Alternative ML-3 against other alternatives, Alternative ML-3 has a potential advantage on its system configuration for the absence of any mechanical and electrical equipment in this specific system greatly lessens daily tasks of operation and maintenance and increases the advantage from the integrated system operation at the existing reservoir. Likewise, Alternative ML-3 is selected as the most optimum distribution system for Masoc/La Torre area.

TABLE 7.3.12 COST COMPARISON OF ALTERNATIVE DISTRIBUTION SYSTEMS
(MASOC/LA TORRE AREA)

Facilities	Unit Cost (₱)	Alternative ML-1		Alternative ML-2		Alternative ML-3	
		Q'ty	Cost (₱x1,000)	Q'ty	Cost (₱x1,000)	Q'ty	Cost (₱x1,000)
Construction Cost							
o Reservoir	-	110 cu.m	268	50 cu.m	162	-	-
o Chlorinator (22 kg/day)	98,100	1 unit	98	1 unit	98	-	-
o Distribution Main							
Pipe: ϕ300 mm	750	200 m	150	-	-	800 m	600
ϕ250 mm	630	1,600 m	1,008	-	-	2,100 m	1,323
ϕ200 mm	520	500 m	260	1,300 m	676	-	-
ϕ150 mm	410	1,250 m	513	2,500 m	1,025	700 m	287
ϕ100 mm	250	-	-	50 m	13		
Valve: ϕ300 mm	34,800	1 pc.	35	-	-	3 pcs.	104
ϕ250 mm	11,200	5 pcs.	11	-	-	7 pcs.	78
ϕ200 mm	6,700	2 pcs.	7	4 pcs.	27	-	-
ϕ150 mm	5,300	4 pcs.	5	8 pcs.	42	2 pcs.	11
Sub-Total			1,989		1,783		2,403
o Pressure Control Valve							
ϕ150 mm	137,000	1 pc.	137	-	-	-	-
ϕ100 mm	89,000	-	-	1 pc.	89	-	-
TOTAL			2,492		2,132		2,403
Operation & Maintenance Cost (15 years)							
o Salary (2 persons)	920/MM	15 years	331	15 years	331		-
o Maintenance	10% of Construction Cost		268		215		240
TOTAL			599		546		240
GRAND TOTAL			3,091		2,678		2,643

7.3.3 Phasing of Distribution Network Development

(1) Development of Alternatives

From the view point of economical and flexible implementation of distribution network, two alternative phasing plans (single and parallel pipeline alignments) are developed as follows:

Alternative D-2-(2)-A : Single Pipeline Alignment

- o The most optimum network configuration to allow the peak hour water flow in the year 2010 is first determined by means of the computer-aided hydraulic simulation which was made in the previous section.

- o Distribution pipes to be required in the Phase I service area are then identified from the above-mentioned network configuration.

- o The Phase II distribution network will be completed by installing additional pipes for the area to be served in this period.

Alternative D-2-(2)-A : Parallel Pipeline Alignment

- o Based on the optimum route of distribution pipes as determined in the previous section, the least cost network configuration, which is mainly pipe sizes, is determined to satisfy a minimum of 0.7 kg/sq.cm of water pressure under the peak hour water flow of the Phase I water demand.

- o For the Phase II water demand, additional pipes wherever necessary for augmenting the distribution capacity to cope with all the criteria set forth in the LWUA Methodology Manual are determined. Likewise, several pipeline routes will form a parallel pipeline alignment.

The configuration of alternative distribution network by construction phases are summarized in TABLE 7.3.13. Details of the computer-aided network simulation are given in APPENDIX 7.3.1.

TABLE 7.3.13 CONFIGURATION OF ALTERNATIVE DISTRIBUTION NETWORKS

Materials	Alt. D-2-(2)-A			Alt. D-2-(2)-B		
	Phase I	Phase II	Total	Phase I	Phase II	Total
<u>Pipe (m)</u>						
ϕ 150 mm	4,000	500	4,500	4,000	850	4,850
ϕ 200 mm	1,155	0	1,155	3,605	0	3,605
ϕ 250 mm	3,205	500	3,705	3,855	1,300	5,155
ϕ 300 mm	800	0	800	2,800	0	2,800
ϕ 350 mm	10	1,750	1,760	710	5,200	5,910
ϕ 400 mm	3,450	0	3,450	0	700	700
ϕ 450 mm	0	0	0	1,000	1,000	2,000
ϕ 500 mm	1,200	0	1,200	500	0	500
ϕ 600 mm	1,000	0	1,000	0	0	0
Total	14,820	2,750	17,570	16,470	9,050	25,520
<u>Valves (pcs.)</u>						
ϕ 150 mm	13	2	15	13	3	16
ϕ 200 mm	5	0	5	9	0	9
ϕ 250 mm	9	2	11	10	5	15
ϕ 300 mm	3	0	3	1	0	1
ϕ 350 mm	1	2	3	2	4	6
ϕ 400 mm	2	0	2	0	1	1
ϕ 450 mm	0	0	0	1	1	2
ϕ 500 mm	2	0	2	1	0	1
ϕ 600 mm	1	0	1	0	0	0
Total	36	6	42	37	14	51

(2) Cost Comparison

Construction costs of each alternative are estimated including valves to be installed.

For cost comparison purpose, the construction year of the distribution network is set in 1990 for Phase I and 1998 for Phase II. The discount rate applied to each phase is 12% per annum. For reference, 10% and 15% of discount rate are also considered.

A summary of cost comparison is presented in TABLE 7.3.14.

TABLE 7.3.14 COST COMPARISON OF ALTERNATIVE DISTRIBUTION NETWORK (NET PRESENT WORTH)

Unit : ₱ x 1,000

Distribution Network	Discount Rate 10%	12%	15%
Alternative D-2-(2)-A			
Phase I: (ϕ150 - ϕ600 mm)			
Pipeline: 14,820 m	7,103	6,806	6,290
Valve : 36 pcs.	724	694	641
Sub Total	7,827	7,500	6,931
Phase II: (ϕ150 - ϕ350 mm)			
Pipeline: 2,750 m	506	433	336
Valve : 6 pcs.	44	38	29
Sub Total	550	471	365
TOTAL	8,377	7,971	7,296
Alternative D-2-(2)-B			
Phase I: (ϕ150 - ϕ500 mm)			
Pipeline: 16,470 m	6,554	6,279	5,863
Valve : 37 pcs.	451	432	399
Sub Total	7,004	6,711	6,202
Phase II: (ϕ150 - ϕ450 mm)			
Pipeline: 9,050 m	1,857	1,588	1,233
Valve : 14 pcs.	143	122	95
Sub Total	2,000	1,710	1,327
TOTAL	9,004	8,421	7,529

According to the above cost comparison, the difference of the net present worth of comparable costs is about 5% under 12% of discount rate. Therefore, further comparison is made by adopting the cost escalation rate; 12% per annum from 1986 to 1989 and 10% per annum for the later project period. The escalated net present worth cost comparisons are shown in TABLE 7.3.15.

TABLE 7.3.15 ESCALATED PROJECT COST OF ALTERNATIVE DISTRIBUTION NETWORK

Unit : ₱ x 1,000

Distribution Network	Discount Rate 10%	12%	15%
Alternative D-2-(2)-A			
Phase I	12,316	11,801	10,906
Phase II	1,855	1,589	1,231
TOTAL	14,171	13,390	12,137
Alternative D-2-(2)-B			
Phase I	11,021	10,560	9,759
Phase II	6,746	5,768	4,476
TOTAL	17,767	16,328	14,235

Based on the above cost comparison, it is concluded that Alternative D-2-(2)-A (single pipeline alignment) is the most optimum plan for phasing the development of distribution network.

CHAPTER 8
RECOMMENDED PLAN

CHAPTER 8 RECOMMENDED PLAN

8.1 GENERAL

This chapter presents the recommended plan for the short term and long term development of the BSWS based on the results of forgoing alternative studies.

The recommended plan consists of two construction phases; Phase I (1986-1995) and Phase II (1996-2010). Phase I period is further divided into two stages; Stage 1 (1986-1990) and Stage 2 (1991-1995) considering the scope of immediate improvements and capital cost requirements.

The proposed implementation program includes the development of water sources and the construction of conveyance, transmission, treatment and disinfection, storage and distribution facilities. The repair and rehabilitation of existing water supply facilities are also considered in the Phase I activities.

This Chapter also presents capital and annual project costs of the recommended implementation schemes.

Some deviations from the technical standards being adopted in the LWUA Methodology Manual have been applied in the Phase I period due to cost considerations. These deviations are: staging of some waterworks facilities to provide lower initial construction costs; provision of lower system pressure, and the postponement of the construction of the administration building to Phase II. All costs presented in this chapter are based on 1986 price level.

8.2 RECOMMENDED WATER SUPPLY SYSTEM

8.2.1 Layout of the Water Supply System

The general layout of the recommended water supply system for BSWS is shown in FIGURE 8.2.1 and its schematic layout is shown in FIGURE 8.2.2.

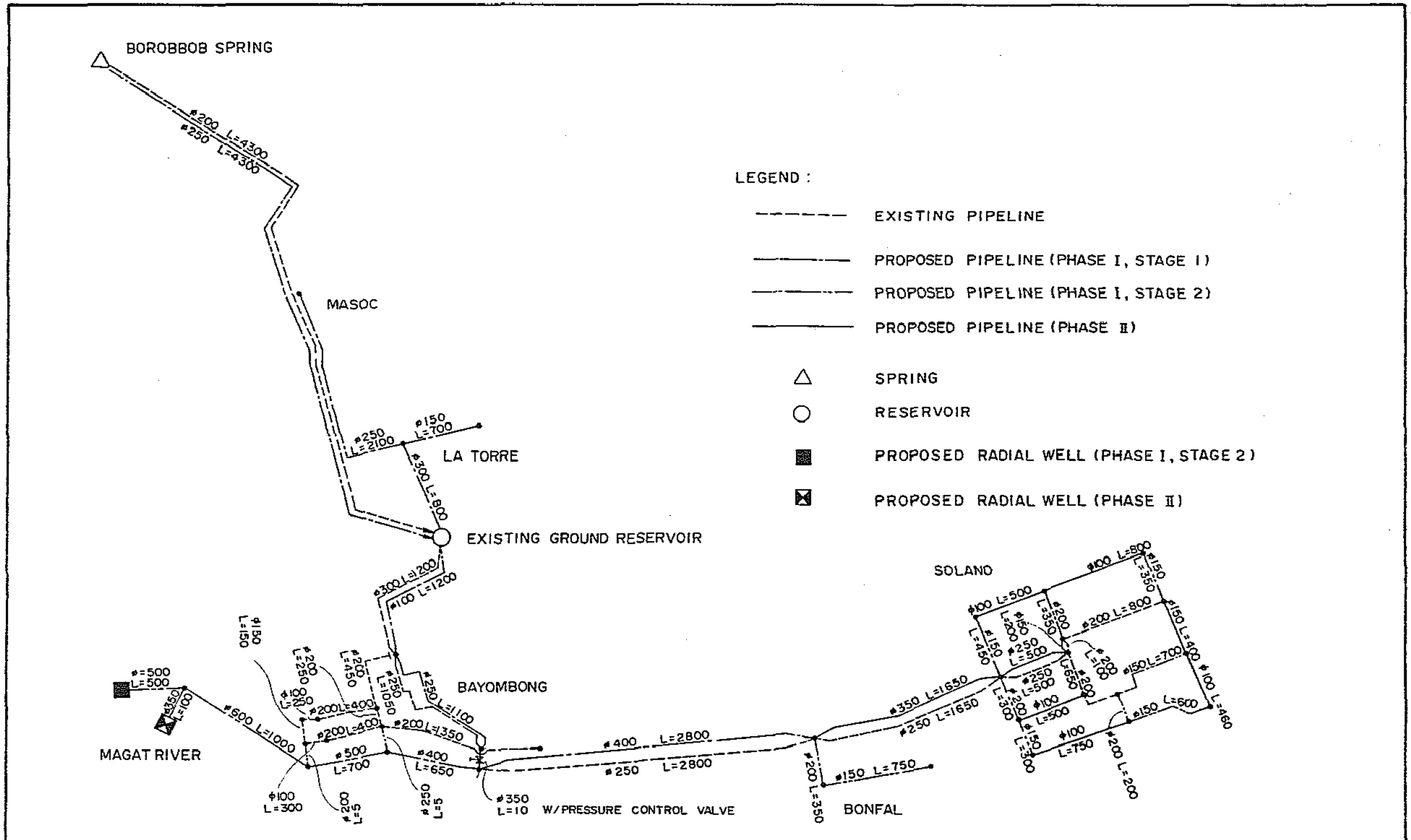


FIGURE 8.2.2
SCHEMATIC LAYOUT OF
WATER SUPPLY SYSTEM

The description of the required facilities by project phase is given in TABLE 8.2.1 and a summary of the major facilities is also given in TABLE 8.2.2.

(1) Source Facility

The existing intake box at the Borobbob Spring will be improved and expanded and the additional transmission pipeline from the intake box to the existing reservoir will be constructed during the Phase I period for the maximum utilization of the existing water source. Each unit of radial well will be constructed at the Magat River in Phase I and II to meet the increasing water demand (See FIGURE 8.2.3).

(2) Transmission Facility

Additional new transmission line will be constructed from the intake box of the Borobbob Spring to the existing reservoir during the Stage 1 of Phase I.

(3) Treatment Facility

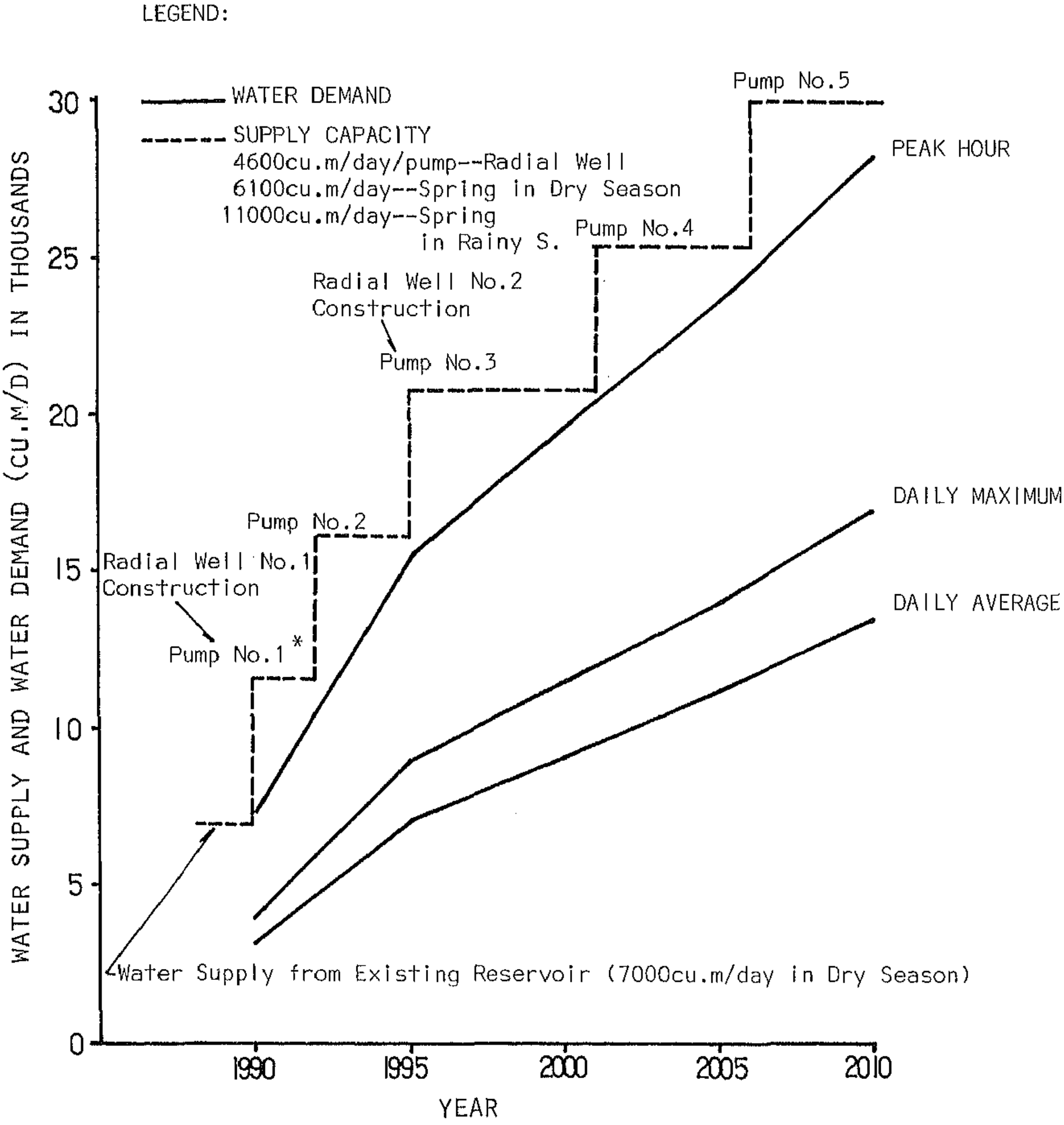
Chlorination equipment will be installed at the existing reservoir. Another unit will be installed at the transmission main from the radial well during the Phase I period.

The cost to install the neutralization equipment for the chlorination equipment is excluded in this planning stage and its need will be determined in the Phase II implementation.

The requirement of treatment facilities for the water from radial well will be subject to further water quality monitoring before the expansion of service areas in the Phase II implementation.

(4) Distribution Facility

The additional distribution main from the existing reservoir to Bonfal area via Bayombong town proper will be constructed during the Stage I of Phase I. This distribution main will be extended up to Solano town proper in the Phase II period.



* Note: One standby pump will be installed simultaneously.

FIGURE 8.2.3

WATER SUPPLY VS. DEMAND CURVE OF RECOMMENDED PLAN

The distribution pipeline from the radial well at the Magat River will be constructed and connected to the distribution network in Bayombong town proper and further linked to the distribution main to Bonfal and Solano town proper areas during the Stage 2 of Phase I.

The main pipeline of the distribution network in Masoc/La Torre area will be constructed in the Stage 1 of Phase I.

The internal network of the distribution system in the proposed service area will be constructed through the Phase II.

The existing distribution lines (ø100 mm) in the town propers of Bayombong and Solano are utilized to form a part of the proposed internal network.

(5) Service Connections

As it has been observed during the field survey, all the existing service connections are not equipped with water meters and have leakages because of inappropriate plumbing work and protections.

Resultant from these situation, the implementation of leakage detection survey and repair/replacement of damaged service connections will be carried out in the early stage of the Project in order to increase the accounted-for water. The installation of water meters at new service connections and the provision of preventive maintenance program are another prerequisites for the sound operation of future water supply system.

TABLE 8.2.1 DESCRIPTION OF REQUIRED FACILITIES

Phase	Facility	Major Facilities Required
Phase I Stage I	Source	o The Borobbob Spring will be improved/expanded to utilize 6,100 cu.m/day in dry season and 11,000 cu.m/day in rainy season.
	Treatment	o The existing chlorination box at the existing reservoir will be replaced with new constant flow chlorinator (22 kg/day, constant dosage).
	Transmission	o New pipeline form the spring to the existing reservoir (ϕ 250 x 4,300 mm).
	Distribution	o New pipeline from the existing reservoir to Bonfal area via Bayombong town proper (ϕ100 x 1,200 m, ϕ250 x 1,100m, ϕ400 x 2,800 m, ϕ350 x 10 m w/Pressure Control Valve). o Distribution main in the Masoc/La Torre area, (ϕ300 x 800 m, ϕ250 x 2,100m, ϕ150 x 700 m). o Flow meters at the existing reservoir (ϕ250 x 1, ϕ300 x 1) o Internal network and service connection in each sub-service area. o Water meters will be installed at the all service connection. o Leakage protection works for service connections and pipelines will be conducted after the leakage detection service.
	Others	o Operation center will be constructed at backside of capital compound and used for materials storage facility during the construction period. o 2 vehicles will be purchased.

TABLE 8.2.1 DESCRIPTION OF REQUIRED FACILITIES (cont'd)

Phase	Facility	Major Facilities Required
Phase I Stage 2	Source	o One unit of radial well (ø5 m, Depth 10 m) with ultimate capacity of 12,600 cu.m/day at the Magat River o Installation of Pumps at the radial well. (22 KW, H = 25 m, 3 units including 1 unit for stand-by)
	Treatment	o Constant flow chlorinator at the distribution line from the radial well (22 kg/day)
	Distribution	o New pipeline from the radial well to Bayombong town proper (ø500 x 500 m, ø600 x 1,000 m, ø500 x 700 m, ø400 x 650 m) o Distribution main in the Bayombong town proper, Bonfal, Solano town proper. (ø150 x 3,300 m, ø200 x 1,155 m, ø250 x 5 m, ø400 x 650 m, ø500 x 1,100 m , ø600 x 1,000 m) o Internal network and service connection in each sub-service area. o Flow meter at the radial well (ø400 x 1)
	Others	o 1 vehicle will be purchased.
Phase II	Source	o Additional one radial well (ø5 m, Depth 10 m) at the Magat River o Pump installation (22 kw, H=25 m, 3 units)
	Distribution	o Main from new radial well to previously constructed main (ø350, 100 m). o New main from Bonfal area to Solano town proper (ø350 x 1,650 m, ø250 x 500 m). o Internal network and service connection in each sub-service area.
	Electricity	o Power substation (150 KVA)
	Others	o Administration building construction o 1 vehicle will be purchased. o Replacement of pumps, chlorinators, flow meters, water meters, equipments of operation center and vehicles purchased during the Phase I.

TABLE 8.2.2 SUMMARY OF MAJOR FACILITIES REQUIRED BY PHASE

Item \ Phase	Phase I Stage 1	Phase I Stage 2	Phase II*	Total	Remarks
1. Source Facility					
(1) Spring intake improvement /expansion					
1) Intake box expansion /roofing	1 lot	-	-	1 lot	
2) Drain pipe/valve (ϕ250)	1 set	-	-	1 set	
(2) River bed water intake					
1) Radial well (ϕ5 m, 10 m^D)	-	1 unit	1 unit	2 units	
2) Power substation (150 kVA)	-	-	1 unit	1 unit	
3) Pump 22 kw, 25 m^H)	-	3 units	3 units	6 units	w/one standby
2. Transmission Facility					
(1) Spring-Reservoir (ϕ250)	4,300 m	-	-	4,300 m	
(2) Valve (ϕ250)	2 sets	-	-	2 sets	
3. Treatment Facility					
(1) Chlorinator Adjustable constant flow 22 kg/day	1 set	1 set	-	2 sets	
4. Distribution Facility					
(1) Main pipe (ϕ100 to ϕ600)	8,710 m	7,310 m	2,750 m	18,770 m	
(2) Valve (ϕ100 - ϕ600)	16 sets	21 sets	6 sets	43 sets	
(3) Pressure control valve (ϕ350)	1 set	-	-	1 set	
(4) Internal network (ϕ75/ϕ100)	20,350 m	12,550 m	7,550 m	40,450 m	
(5) Service connections (1/2", 3/4")	1,694 units	4,618 units	6,804 units	13,116 units	Excluding existing 1,309
(6) Water meter (1/2")	1,309 sets	-	-	1,309 sets	
(7) Flow meter (ϕ250 to ϕ400)	2 sets	1 set	-	3 sets	
(8) Fire protection (Hydrant) (ϕ150, ϕ100)	-	-	185 sets	185 sets	
5. Adm. Bldg./Operation Center	Operation Center	-	Adm. Bldg.	2 Bldgs.	
6. Vehicle	2	1	1	4	

* Excluding replacement of equipment

8.2.2 Implementation Program

In accordance with the facility requirements as described in the previous section, the project implementation program is developed as shown in FIGURE 8.2.4.

8.2.3 Project Cost

The project cost is estimated based on the implementation program using the current market price of equipment and materials and the LWUA Methodology Manual at 1986 price level.

A summary of estimated project cost is shown in TABLE 8.2.3 and the detailed break down is given in APPENDIX 8.2.1.

TABLE 8.2.3 SUMMARY OF PROJECT COST

(Unit : Thousand Pesos)

Facility	Phase I		Phase II
	Stage 1	Stage 2	
1) Spring Facilities	44	0	0
2) Radial Well Facilities	0	3,134	3,134
3) Power Substation	0	0	2,580
4) Transmission Facilities	2,731	0	0
5) Disinfection Facilities	98	98	0
6) Distribution Facilities	12,562	9,867	6,202
7) Service Connection	2,222	3,748	5,518
8) Land Acquisition	158	0	0
9) Admin. Bldg. & Ope. Ctr.	1,090	0	1,320
10) Vehicle & Stored Material	814	496	505
11) Replacement of Equipments	-	-	7,425
Sub-Total	19,719	17,343	26,684
Physical Contingency (8%)	1,578	1,387	2,135
Total	21,297	18,730	28,819
Leakage Detection	321	-	-
Engineering Charge			
D/D (10% of Total)	4,003	-	2,882
C/S (4% of Total)	852	749	1,153
GRAND TOTAL	26,473	19,479	32,854

FIGURE 8.2.4 IMPLEMENTATION PROGRAM

Description		Phase I Stage 1			Phase I Stage 2					Phase II		
	'87	'88	'89	'90	'91	'92	'93	'94	'95	2000	2005	2010
Appraisal & Loan Procedure	—											
Engineering Service												
- Detailed Design		—								—		
- Construction Supervision		—	—	—	—	—	—	—	—	—	—	—
- Leakage Detection		446	446	446								
Source Facility												
- Spring Intake Box Rehabilitation		—										
- Radial Well ø5m, D=10m					1					1		
- Radial Well Pumping Facility					2		1			1	1	1
- Power Sub-Station										150KVA		
Treatment Facilities												
- Disinfection Facilities 22kg/day			1		1							
Distribution Facility												
- Distribution Main Pipeline												
ø100 - ø600, 16,020m			3,600	5,110	7,310							
ø150 - ø350, 2,750m										2,750	- - -	
- Internal Network												
ø 75 - ø100, 32,900m			10,175	10,175	2,510	2,510	2,510	2,510	2,510			
ø 75 - ø100, 7,550m										- - -	7,550	- - -
- Service Connection												
ø1/2"x 6,293, ø3/4"x 19		0/5	843/2	842/2	921/2	922/2	922/2	922/2	921/2			
ø1/2"x 6,791, ø3/4"x 13										—	6,791/13	—
- Rehabilitation												
o Water Meter ø1/2" 1,309		1,309										
o Service Connection ø1/2" 669		223	223	223								
o Laterals			—	—								
- Flow Meter												
ø250 x 1, ø300 x 1			—									
ø400 x 1					—							
- Fire Protection												
Hydrant ø100, ø150 185										185	- - -	
Others												
- Operation Center			—									
- Administration Building										—		
- Land Acquisition		—										
- Vehicle	1 *	1 *		1 *						1 *		
- Replacement of Equipments Installed in Phase I										- - -	- - -	- - -

Legend: —— : Continuous Work; - - - : Intermittent Work; * : Procurement

Operation and Maintenance Cost for each Stage and Phase are summarized as follows;

Phase I	Stage 1	(1990)	: 1,107 thousand pesos per annum
	Stage 2	(1995)	: 2,073 thousand pesos per annum
Phase II		(2010)	: 3,756 thousand pesos per annum

CHAPTER 9
FINANCIAL FEASIBILITY ANALYSIS

CHAPTER 9 FINANCIAL FEASIBILITY ANALYSIS

9.1 GENERAL

The selected technical alternative for the realization of water supply for the Short Term Development Plan has been shown in Chapter 8. Such a plan must however be verified from a financial point of view. The financial feasibility of the project was analyzed and a financial plan for allocation of available funds, based on LWUA's guideline, was developed in this chapter.

The analysis of the financial viability of the project covers the revenues which mainly come from water sales, the development costs, the operating and maintenance costs, debt service on the loans, etc. during the first 10 years from the start of the construction of the water system. The Financial Internal Rate of Return is also calculated.

The proposed water rates should be fair, reasonable, and realistic based on the ability of the consumers to pay. In order to achieve this, a socialized rate structure will be adopted.

9.2 EXISTING SYSTEM

9.2.1 Rate Structure

As of July 1986, BSWS has 1,345 unmetered connections. The following rate structure has been effective since the latter half of 1960's in the waterworks system.

(1) Water Rates

The following flat rates are applied because all the faucets are unmetered.

Domestic	₱ 5.00-10.00/month
Industrial	₱34.00/month
Commercial	₱53.00/month

(2) Connection Service Fees :

A new customer pays the entire service connection fees.

9.2.2 Revenue and Expenditure

The annual revenue and expenditure of the waterworks system in the last five years are shown below.

Year	Revenue	Expenditure	Net Revenue (Deficit)
1981	₱144,590	₱120,587 1/	₱24,003
1982	140,943	106,154 1/	34,789
1983	137,621	130,584 1/	7,037
1984	142,371	159,616	(17,245)
1985	151,626	148,592	3,034

In 1985, the waterworks revenue and expenditure were 1.1 % of the Province's total revenue and expenditure, respectively.

The waterworks borrowed a long-term loan of ₱800,000 from the Central Government and a repayment of ₱27,747 annually over a period of forty years started in 1974. However, the repayment stopped in 1984 and 1985 because of the increase in personnel and operation and maintenance expenses.

A breakdown of the expenditure of the waterworks is shown in TABLE 9.2.1. Also the corresponding breakdown in percentage follows is shown below :

	1982	1983	1984
Personal Services	59.4%	61.6%	54.3%
Maintenance & Operation Expenses	14.5	17.1	45.7
Loan Repayment	26.1	21.3	0
Total Expenditure	100.0	100.0	100.0

1/ including loan repayment

Note that in 1984 the supplies and material cost, appearing under the maintenance and operating expenses, accounted for 44% of the total expenditure. Such may have been the cause that the loan repayment could not carried out.

TABLE 9.2.1 EXPENDITURE OF BSWS

	1982	1983	1984
1. Personal Services			
Salaries and Wages	₱51,464	₱63,716	₱75,704
Insurance 2/	3,739	4,317	4,495
Living Allowance & Medicare	2,569	5,999	745
Home Development Fund	1,005	1,162	1,221
Bonus	4,289	5,310	5,227
Sub-Total	₱63,066	₱80,504	₱86,592
2. Maintenance and Other Operating Expenses			
Traveling & Communication	₱ 794	₱ 1,276	₱ 529
Repair & Maintenance	280	2,564	150
Supplies and Materials	13,657	18,000	69,976
Electricity	Nil	Nil	Nil
Other Services	610	493	2,369
Loan Repayment	27,747	27,747	0
Sub-Total	₱43,088	₱50,080	₱73,024
Total Expenditure	₱106,154	₱130,584	₱159,616

9.3 MARKET SURVEY

The market survey for the study area in the municipalities of Bayombong-Solano was conducted from May 25 to June 9, 1986 with LWUA's cooperation using the simplified market survey method. The number of respondents totaled 5,808 and the estimated coverage ratio in the study area is 41%.

2/ Life insurance, Retirement insurance and State insurance

The details of the market survey results is shown in Appendix 9.3.1.

From the market survey, the income distribution of the respondents is determined as follows:

Income Bracket3/	Bayombong		Solano		Total	
	Ave. Pesos	Number	Ave. Pesos	Number	Ave. Pesos	Number
₱900 and below	618	802	637	927	628	1,729
₱901 to ₱1500	1,233	737	1,215	899	1,223	1,636
₱1,501 to ₱2,500	2,040	396	2,089	445	2,066	841
₱2,501 to ₱4,500	3,339	321	3,363	319	3,351	640
₱4,501 and above	7,108	133	6,834	151	6,962	284

From the result of the market survey, the respondent's willingness to connect is summarized as follows :

Answer	Bayombong	Solano
Yes	57 %	50 %
No	18	32
Undecided	3	5
With own connection	22	13

Note : With respect to type of users, residential users account for 93% in Bayombong and 89% in Solano, respectively.

It is observed from the results of the survey that the over the half of respondents representing all income brackets are willing to connect to the waterworks system.

Judging from the above, it seems that the majority of the residents in the study area are willing to connect to the new system when the expansion of the water supply system is completed in Bayombong-Solano.

3/ Residential, excluding no-income and no-answer

9.4 PROJECT COST AND FINANCING

9.4.1 Project Implementation Schedule and Project Period

As described in Chapter 8, in the project schedule of this study, it is assumed that :

- Design will be completed in 1988
- Construction will be started in 1989 and completed by 1995.

The financial analysis covers a 10-year period which includes the construction period, however, a 20 year period is adopted for the calculation of FIRR.

9.4.2 Financial Conditions

The major potential sources of funds for the Water District are the operating sources and the non-operating sources.

The operating sources are the excess of revenue over expenses. The LWUA's guideline suggests that the District should make a contribution of 10% to the project cost as equity on the project. However, when the waterworks cannot provide the said equity due to its current tight financial situation, it is suggested that the government will provide a grant to the District to make up for the equity. In this study, 5% of the project cost is set as the equity.

The non-operating sources include loans. In this study, to realize a water rate structure, it is recommended that the LWUA introduce a soft loan into the project in addition to the regular loan. The loan funds from LWUA will be utilized to finance the balance of the project cost plus capitalized interest. Presently, LWUA's terms include:

(1) Regular loan

Interest :	First ₱2 million :	10% per annum
	Next ₱5 million :	12% per annum
	Above ₱7 million :	14% per annum

Duration	:	Thirty-year loan; disbursements are assumed to be made at mid-year, and the maximum disbursement period is four years.
Principal	:	Principal repayment is thirty years with one year grace period.

(2) Soft loan

Interest	:	10% per annum Interest is not charged for the first 5 years, starting on the 6th year, with the district to start paying interest on the 6th year. In cases where the project is not completed within 5 years, interest will be capitalized from the 5th year up to the time of completion.
Principal	:	Principal Repayment is 20 years starting on the 11th year after the start of disbursement.

9.4.3 Project Cost

On the basis of the cost estimate developed in Chapter 8, the project cost for the District in the Short Term Development Plan is estimated at ₱86.06 million and its breakdown is shown in TABLE 9.4.1.

The proposed financing scheme for the project is as follows :

Project Cost		₱86.06	million
Equity	5%	4.30	"
LWUA Regular Loan	50%	43.03	"
LWUA Soft Loan	45%	38.73	"
Capitalized Interest		₱10.49	"
Total Project Cost		₱96.55	million

TABLE 9.4.1 BREAKDOWN OF PROJECT COST

(Unit : 1,000 Pesos)

Year	1988	1989	1990	1991	1992	1993	1994	1995	Total
Construction Cost	1,107	10,603	8,009	11,555	1,356	1,721	1,356	1.355	37.062
Physical Contingencies	89	848	641	924	108	138	108	108	2,965
- Sub Total -	1,196	11,451	8,650	12,479	1,464	1,859	1,464	1.463	40,027
Price Contingencies	386	5,965	6,479	12,621	1,923	3,085	3,015	3,685	37,159
- Estimated Construction Cost -	1,581	17,416	15,128	25,101	3,387	4,944	4,480	5,148	77,185
Engineering Charge	5,294	0	0	0	0	0	0	0	5,294
Leakage Detection(L/D)	107	107	107	0	0	0	0	0	321
Price Escaration for L/D	35	56	80	0	0	0	0	0	170
Construction Supervision	63	697	605	1,004	135	198	179	206	3.087
Total Project Cost	7,080	18.275	15,921	26,105	3,522	5,142	4,659	5.354	86,058

Note) Construction Cost : Based on 1986 Price
Inflation Rate : 15% p.a.
Physical Contingencies : 8% of Construction Cost
Engineering Charge : (10% of Construction Cost & Physical Contingencies) + (Price Escalation)
Construction Supervision : 4% of Estimated Construction Cost

The computation of capitalized interest and the subsequent debt service obligations of the District are presented in TABLE 9.4.2. The long term borrowing from 1988-95 amounts to ₱92.25 million.

9.4.4 Operating and Maintenance Cost

The operating and maintenance costs shown in TABLE 9.4.3, described in detail in Chapter 8, include all annual expenses necessary in operating the system and maintaining its revenue producing capacity. In the financial projections, the operating and maintenance costs are assumed to increase according to the increase in the capacity of the system with expected inflationary effect as shown in TABLE 9.4.4.

9.4.5 Escalation of Costs

To account for the effects of inflation, the investment costs and the annual operating and maintenance costs are escalated by 15% compounded per annum.

9.4.6 Reserve Requirements

The reserve requirements are tied directly to the acquisition of development loans from LWUA. These are considered as funds necessary to support capital development. LWUA guidelines suggest that 10% of direct water sales be set aside as reserve funds. In this analysis, the allocation for reserves is assumed to be 5% from 1994 to 1995 and 10% from 1996 onward.

9.5 REVENUE ANALYSIS AND WATER RATES

9.5.1 Derivation of Revenue Units

LWUA recommends the adoption of the optional method which is a combination of the revenue unit and the quantity block methods.

TABLE 9.4.2 PROJECTED DEBT SERVICE SCHEDULE

Disbursement Amount		₱81.76 million	
Regular Loan		43.03 "	
Soft Loan		38.73 "	
Capitalized Interest			
Regular Loan		10.49 "	
Soft Loan		0 "	
Total Loan		₱92.25 million	
Financed Interest			
Regular Loan	First	₱2 million	10% per annum
	Next	₱5 million	12% per annum
	Above	₱7 million	14% per annum
Soft Loan			10% per annum

(Unit : ₱ million)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. Regular Loan										
Disbursement	7.08	18.28	15.92	17.53	-	-	-	-	-	-
Capitalized Interest	0	0.81	3.48	6.20	-	-	-	-	-	-
Operational Interest	-	-	-	-	7.31	7.31	7.29	7.27	7.24	7.21
Principal Repayment	-	-	-	-	0	0.16	0.19	0.21	0.24	0.27
Debt Services	0	0	0	0	7.31	7.48	7.48	7.48	7.48	7.48
2. Soft Loan										
Disbursement	-	-	-	24.35	2.52	4.14	3.66	4.05	-	-
Capitalized Interest	-	-	-	-	-	-	-	-	-	-
Operational Interest	-	-	-	-	-	-	-	-	3.87	3.87
Principal Repayment	-	-	-	-	-	-	-	-	0	0
Debt Services	0	0	0	0	0	0	0	0	3.87	3.87
Total Debt Services	0	0	0	0	7.31	7.48	7.48	7.48	11.35	11.35
Debt at End of Year	7.08	26.17	45.57	77.88	80.40	84.38	87.85	91.69	91.45	91.18

TABLE 9.4.3 PROJECTED OPERATION AND MAINTENANCE COST

(Unescalated)

(Unit : ₱1,000)

Year	Total O&M Cost	Administrative Expenses	Energy	Chemicals	Maintenance	Miscellaneous
1988	607	298	0	0	114	195
1989	871	386	0	32	178	275
1990	1,107	475	0	35	242	355
1991	1,287	488	0	44	312	443
1992	1,484	501	16	53	383	531
1993	1,681	515	32	63	453	618
1994	1,877	528	47	72	524	706
1995	2,073	541	63	81	594	794
1996	2,073	541	63	81	594	794
1997	2,073	541	63	81	594	794
1998	2,073	541	63	81	594	794

TABLE 9.4.4 PROJECTED OPERATION AND MAINTENANCE COST

(Escalated)

(Unit : ₱1,000)

Year	Total O&M Cost	Administrative Expenses	Energy	Chemicals	Maintenance	Miscellaneous
1988	803	394	0	0	151	258
1989	1,325	587	0	49	271	418
1990	1,936	831	0	61	423	621
1991	2,589	982	0	88	628	891
1992	3,433	1,159	37	123	886	1,228
1993	4,472	1,370	85	168	1,205	1,644
1994	5,742	1,615	144	220	1,603	2,160
1995	7,293	1,903	222	285	2,090	2,793
1996	8,387	2,188	255	328	2,404	3,212
1997	9,645	2,517	294	377	2,764	3,694
1998	11,092	2,894	338	433	3,179	4,248

The number of revenue units have been computed using the optional method. Under this method the minimum charge varies depending on the size of the connection.[4/] In addition, factors are applied to successive quantity blocks of water consumed per month.

These factors increase as the level of consumption increases since they are set to attain a socialized tariff structure where users with low consumption pay a low average rate while users with high level of consumption pay higher average rate. This scheme will also encourage the poor population to connect to the system.

The factors used for the minimum charge (Service Charge Revenue Units or SCRUs), and commodity charges for different sizes and types of service connections and total equivalent volume are shown in TABLE 9.5.1 and TABLE 9.5.2, respectively.

9.5.2 Water Rate Structure

It is assumed that the following socialized rate structure for domestic/institutional users with 1/2 inch connections is employed in this analysis :

Quantity Block	Factor
First 10 cu.m/month	1.00
11-20 cu.m/month	1.30
21-35 cu.m/month	1.80
Above 35 cu.m/month	2.40

For commercial/industrial users, the use factors are double.

4/ The use factors for the first 10 cu.m which depend on the size of connections are as follows :

3/8" = 1.0	3/4" = 4.0
1/2" = 2.5	1" = 8.0

TABLE 9.5.1 SERVICE CONNECTIONS AND SERVICE CHARGE REVENUE UNITS

STRATIFICATION OF SERVICE CONNECTIONS (BSWS)

Year	Total Service Connections	Connection Size (inch) Domestic/Government 1/2	3/4	1	Sub-TTL	Commercial/Industrial 1/2	3/4	1	Sub-TTL
1988	1.321	1,306	5		1,311	10	0		10
1989	2,159	2,067	7		2,074	85	0		85
1990	3,003	2,834	9		2,843	160	0		160
1991	3,926	3,701	11		3,712	214	0		214
1992	4.850	4,569	13		4,582	268	0		268
1993	5,774	5,436	15		5.451	323	0		323
1994	6.698	6,304	17		6,321	377	0		377
1995	7.621	7,171	19		7,190	431	0		431

COMPUTATION OF SERVICE CHARGE REVENUE UNITS (BSWS)

Year	Total SCRUS (1,000)	Domestic/Government X 2.5	X 4.0	X 8.0	Sub-Total	X .12	Commercial/Industrial X 5.0	X 8.0	X 16.0	Sub-Total	X .12
1988	400	3,265	20	0	3,285	394	50	0	0	50	6
1989	674	5.168	28	0	5,196	623	425	0	0	425	51
1990	951	7,085	36	0	7.121	855	800	0	0	800	96
1991	1,244	9,253	44	0	9.297	1.116	1,070	0	0	1,070	128
1992	1.538	11.423	52	0	11.475	1,377	1,340	0	0	1,340	161
1993	1,832	13,590	60	0	13.650	1.838	1.615	0	0	1.615	194
1994	2,126	15,760	68	0	15.828	1,899	1,885	0	0	1.885	226
1995	2,419	17.928	76	0	18,004	2.160	2,155	0	0	2,155	259

TABLE 9.5.2 EQUIVALENT VOLUME OF WATER SOLD

(Unit : X 1,000)

1988	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		406	157	50	75	124	
Factor			0	1.30	1.80	2.40	
E.v.	394		-	65	134	298	892
Commercial/Ind.		44	1	5	9	29	
Factor			0	2.60	3.60	4.80	
E.v.	6		-	12	34	138	190
Total E.V.							1,081

1989	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		502	249	51	76	127	
Factor			0	1.30	1.80	2.40	
E.v.	623		-	66	137	304	1,130
Commercial/Ind.		60	10	5	11	33	
Factor			0	2.60	3.60	4.80	
E.v.	51		-	14	39	160	265
Total E.V.							1,395

1990	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		597	341	51	77	128	
Factor			0	1.30	1.80	2.40	
E.v.	855		-	67	138	307	1,366
Commercial/Ind.		76	19	6	12	38	
Factor			0	2.60	3.60	4.80	
E.v.	96		-	16	45	183	340
Total E.V.							1.706

TABLE 9.5.2 (Cont'd)

(Unit : X 1,000)

1991	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		800	445	71	106	177	
Factor			0	1.30	1.80	2.40	
E.v.	1,116		-	92	191	425	1,825
Commercial/Ind.		105	26	9	17	53	
Factor			0	2.60	3.60	4.80	
E.v.	128		-	23	63	255	469
Total E.V.							2,294

1992	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		1,003	550	91	136	227	
Factor			0	1.30	1.80	2.40	
E.v.	1,377		-	118	245	544	2,283
Commercial/Ind.		134	32	11	22	68	
Factor			0	2.60	3.60	4.80	
E.v.	161		-	29	81	328	598
Total E.V.							2,881

1993	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		1,206	654	110	166	276	
Factor			0	1.30	1.80	2.40	
E.v.	1,638		-	143	298	662	2,742
Commercial/Ind.		162	39	14	27	83	
Factor			0	2.60	3.60	4.80	
E.v.	194		-	35	98	396	723
Total E.V.							3,465

TABLE 9.5.2 (Cont'd)

(Unit : X 1,000)

1994	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		1,409	759	130	195	325	
Factor			0	1.30	1.80	2.40	
E.v.	1,899		-	169	351	781	3,200
Commercial/Ind.		191	45	16	32	98	
Factor			0	2.60	3.60	4.80	
E.v.	226		-	42	115	469	852
Total E.V.							4,052

1995	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.30)	21-35 m3 (1.80)	Above 35 m3 (2.40)	Total Equivalent Volume
Domestic/Gov.		1,613	863	150	225	375	
Factor			0	1.30	1.80	2.40	
E.v.	2,160		-	195	405	900	3,661
Commercial/Ind.		220	52	19	37	113	
Factor			0	2.60	3.60	4.80	
E.v.	259		-	48	133	541	981
Total E.V.							4,642

9.5.3 Feasibility of Charges

The feasibility of charges can be determined by subjecting the required water rates for 1/2 inch connections to the following requirements:

1. Minimum charge (for the first 10 cu.m) must not exceed 5% of the average family income of the low income group.
2. Increase must be limited to 60% of the existing rates in the previous year.

The proposed water rates necessary to achieve financial viability are within the ability-to-pay of the customers. From the projected revenue forecast shown in TABLE 9.5.3, the following water charges for the initial 10 cu.m do not exceed 5% of the average income of the low income class, and anticipated increases are within the 60% limit throughout the study period.

However, when another LWUA's regular loan is applied to the project instead of the LWUA's soft loan which is employed here, the minimum charge should be increased in a few years before starting the debt services payment for this LWUA regular loan. This makes it difficult to satisfy the above requirements in the years from 1991 to 1997.

Period	Mimimum Charge	Monthly Family Income	Percentage of Income Allocated to Water	Percentage Increase
1988	₱25.0	₱ 823	3.0	-
1989	37.5	943	4.0	50
1990	50.0	1,079	4.6	33
1991	60.0	1,231	4.9	20
1992	65.0	1,403	4.6	8
1993	80.0	1,599	5.0	23
1994	85.0	1,823	4.7	6
1995	85.0	2,078	4.1	0

TABLE 9.5.3 PROJECTED REVENUE FORECAST

(Unit : 1,000 Pesos)

Year	Total Expenses	Rate Unit	Total Equivalent Volume	Total Sales	Bad Debts (3%)	Net Sales	Surplus	Cumulative Surplus
1988	803	1.0	1,081	1,081	32	1,049	246	246
1989	1,325	1.5	1,395	2,092	63	2,029	704	950
1990	1,936	2.0	1,706	3,412	102	3,310	1,374	2,324
1991	2,589	2.4	2,294	5,505	165	5,340	2,751	5,075
1992	10,746	2.6	2,881	7,492	225	7,267	-3,479	1,595
1993	11,949	3.2	3,465	11,087	333	10,755	-1,194	401
1994	13,219	3.4	4,052	13,778	413	13,365	146	547
1995	14,770	3.4	4,642	15,783	473	15,309	539	1,086

9.6 FINANCIAL SUMMARY

The financial analysis was based on the forecasts of the following financial statements:

1. Income Statement (TABLE 9.6.1)
2. Cash Flow Statement (TABLE 9.6.2)
3. Balance Sheet (TABLE 9.6.3).

The following assumptions were used for the financial projections:

1. Revenue-Tariff levels were based on the following objectives:
   a) Revenue generation should be adequate to meet the minimum financial internal rate of return of 12-14%.
   b) The District should be able to meet its cash requirements and after project completion, to undertake a reasonable amount of investment to continue expansion and improvement of the system.

2. Reserve Fund ; 10% of direct water sales.

3. Cash ; 1 month of administrative expenses.

4. Accounts Receivable ; 2 months of direct water sales.

5. Bad Debts ; 3% of direct water sales.

6. Inventories ; 2 months of expenses of chemicals.

7. Depreciation ; 2.5% of average gross value of fixed assets.

8. Accounts Payable ; 2 months of direct operating and maintenance costs.

9. Customer's Deposits ; ₱50.00 per service connection.

10. Other Operating Revenues ; 3% of direct water sales.

TABLE 9.6.1 PROJECTED INCOME STATEMENT

(Unit : 1,000 Pesos)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
No. of Service Connections	1,321	2,159	3,003	3,926	4,850	5,774	6,698	7,621	7,621	7,621	7,621
Production (m3 x 1,000)	900	1,022	1,121	1,460	1,777	2,073	2,353	2,619	2,619	2,619	2,619
Unaccounted for Water (%)	50	45	40	38	36	34	32	30	30	30	30
Consumption (m3 x 1,000)	450	562	673	905	1,137	1,368	1,600	1,833	1,833	1,833	1,833
Equivalent Volume (x 1,000)	1,081	1,395	1,706	2,294	2,881	3,465	4,052	4,642	4,642	4,642	4,642
Rate Unit	1.0	1.5	2.0	2.4	2.6	3.2	3.4	3.4	4.2	4.8	4.8
Water Sales	1,081	2,092	3,412	5,505	7,492	11,087	13,778	15,783	19,496	22,282	22,282
Other Revenues	32	63	102	165	225	333	413	473	585	668	668
- Total Revenues -	1,114	2,155	3,515	5,670	7,716	11,420	14,192	16,256	20,081	22,950	22,950
Direct Cost	803	1,325	1,936	2,589	3,433	4,472	5,742	7,293	8,387	9,645	11,092
Administrative Expenses	394	587	831	982	1,159	1,370	1,615	1,903	2,188	2,517	2,894
Power & Fuel	0	0	0	0	37	85	144	222	255	294	338
Chemicals	0	49	61	88	123	168	220	285	328	377	433
Maintenance & Repair	151	271	423	628	886	1,205	1,603	2,090	2,404	2,764	3,179
Miscellaneous	258	418	621	891	1,228	1,644	2,160	2,793	3,212	3,694	4,248
Bad Debts	32	63	102	165	225	333	413	473	585	668	668
- Total Costs -	835	1,388	2,038	2,754	3,658	4,805	6,155	7,766	8,972	10,313	11,760
Income Before Depreciation	278	767	1,476	2,916	4,059	6,615	8,036	8,490	11,110	12,637	11,190
Depreciation	177	654	1,139	1,947	2,035	2,163	2,280	2,414	2,414	2,414	2,414
Income Before Interest	101	113	337	969	2,024	4,452	5,756	6,076	8,696	10,223	8,776
Interest	0	0	0	0	7,313	7,313	7,292	7,267	11,112	11,079	11,043
Net Income	101	113	337	969	-5,289	-2,861	-1,536	-1,191	-2,416	-856	-2,267

TABLE 9.6.2 PROJECTED CASH FLOW STATEMENT

(Unit : 1,000 Pesos)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Sources of Funds											
Income Before Depreciation	278	767	1,476	2,916	4,059	6,615	8,036	8,490	11,110	12,637	11,190
LWUA Loan	7,080	19,086	19,404	32,305	2,522	4,142	3,659	4,051	0	0	0
Equity	0	0	0	0	1,000	1,000	1,000	1,303	0	0	0
Grant	0	0	0	0	0	0	0	0	0	0	0
-Total Sources of Funds-	7,358	19,853	20,880	35,221	7,581	11,757	12,695	13,844	11,110	12,637	11,190
Applications of Funds											
Investment in Project	7,080	18,275	15,921	26,105	3,522	5,142	4,659	5,354	0	0	0
Capitalized Interest	0	811	3,483	6,200	0	0	0	0	0	0	0
[Total Investment]	7,080	19,086	19,404	32,305	3,522	5,142	4,659	5,354	0	0	0
Interest (Regular Loan)	0	0	0	0	7,313	7,313	7,292	7,267	7,239	7,206	7,170
Interest (Soft Loan)	0	0	0	0	0	0	0	0	3,873	3,873	3,873
< Total Operational Interest >	0	0	0	0	7.313	7,313	7,292	7,267	11,112	11,079	11,043
Principal (Regular Loan)	0	0	0	0	0	164	185	210	238	271	307
Principal (Soft Loan)	0	0	0	0	0	0	0	0	0	0	0
< Total Principal Repayment >	0	0	0	0	0	164	185	210	238	271	307
[Total Debt Services]	0	0	0	0	7,313	7,477	7,477	7,477	11,350	11,350	11,350
Working Capital Increase	13	10	2	86	52	158	740	54	1,323	340	-200
Cash & Other Current Assets	33	49	69	82	97	114	135	159	182	210	241
Accounts Receivable	180	349	569	917	1,249	1,848	2,296	2,630	3,249	3,714	3,714
Inventories	0	8	10	15	21	28	37	48	55	63	72
Reserves	0	0	0	0	0	0	689	789	1,950	2,228	2,228
Accounts Payable	134	221	323	432	572	745	957	1,216	1,398	1,607	1,849
Customers' Deposit	66	162	300	471	631	924	1,139	1,296	1,600	1,829	1,829
-Total Applications of funds-	7,093	19,096	19,406	32,391	10,887	12,777	12,876	12,885	12,673	11,690	11,150
Cash Surplus	265	757	1,474	2,830	-3,306	-1,020	-181	959	-1,564	947	40
Cumulative Cash Surplus	265	1,022	2,496	5,326	2,020	1,000	819	1,778	215	1,161	1,202
Cash Flow	265	757	1,474	2,830	-4,306	-2,020	-1,181	-344	-1,564	947	40

TABLE 9.6.3 PROJECTED BALANCE SHEET

(Unit : 1,000 Pesos)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Fixed Asset	7,080	26,166	45,570	77,875	81,397	86,539	91,198	96,552	96,552	96,552	96,552
Depreciation	177	831	1,970	3,917	5,952	8,116	10,396	12,809	15,223	17,637	20,051
Net Fixed Asset	6,903	25,335	43,600	73,958	75,445	78,423	80,802	83,743	81,329	78,915	76,501
Current Asset	478	1,428	3,144	6,340	3,385	2,990	3,976	5,404	5,651	7,376	7,457
-Total Assets-	7,381	26,763	46,744	80,298	78,830	81,413	84,778	89,147	86,980	86,291	83,958
Capital Equity	0	0	0	0	1,000	2,000	3,000	4,303	4,303	4,303	4,303
Government Grant	0	0	0	0	0	0	0	0	0	0	0
Operational Surplus	101	214	551	1,520	-3,769	-6,631	-8,166	-9,357	-11,774	-12,630	-14,897
Total Equity	101	214	551	1,520	-2,769	-4,631	-5,166	-5,054	-7,471	-8,327	-10,594
Long Term Debt	7,080	26.166	45,570	77,875	80,397	84,375	87,849	91,690	91,452	91,181	90,874
Current Liabilities	200	383	623	903	1,203	1,669	2,096	2,511	2,998	3,437	3,678
-Total Equity and Liabilities-	7,381	26,763	46,744	80,298	78,830	81,413	84,778	89,147	86,980	86,291	83,958

11. Debt services for the long-term loan from the Central Government is not considered in this study since it will not significantly affect the District's operations.

9.7 FINANCIAL INTERNAL RATE OF RETURN (FIRR)

The Financial Internal Rate of Return is a major consideration affecting capital investment decisions. It measures the effective utilization of the total investment and also the equity employed in the project and shows the compounded growth of investments within the project period.

The rate of return was computed based on the present value of cash inflows and outflows. As shown in TABLE 9.7.1, the rate of return, with the assumptions made, is estimated to be 13.5%. (See APPENDIX 9.7.1)

9.8 FINANCIAL RECOMMENDATION

The recommended project for the Short Term Development Plan is financially feasible. The proposed water rates for 1/2 inch connections of domestic users to achieve financial self-sufficiency are :

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱25.0	₱3.3	₱4.5	₱6.0
1989	1.5	37.5	4.9	6.8	9.0
1990	2.0	50.0	6.5	9.0	12.0
1991	2.4	60.0	7.8	10.8	14.4
1992	2.6	65.0	8.5	11.7	15.6
1993	3.2	80.0	10.4	14.4	19.2
1994	3.4	85.0	11.1	15.3	20.4
1995	3.4	85.0	11.1	15.3	20.4
1996	4.2	105.0	13.7	18.9	25.2
1997	4.8	120.0	15.6	21.6	28.8

TABLE 9.7.1 FINANCIAL INTERNAL RATE OF RETURN

(Unit : ₱1,000)

Year	Rate/Unit (₱)	Income before Depreciation	LWUA Loan	Total Investment	Total Debt Services	Working Capital Increase	Net Cash Inflow	Present Value
1988	1.0	278	7,080	7,080	0	13	265	265
1989	1.5	767	19,086	19,086	0	10	757	667
1990	2.0	1,476	19,404	19,404	0	2	1,474	1,145
1991	2.4	2,916	32,305	32,305	0	86	2,830	1,938
1992	2.6	4,059	2,522	3,522	7,313	52	-4,306	-2,599
1993	3.2	6,615	4,142	5,142	7,477	158	-2,020	-1,075
1994	3.4	8,036	3,659	4,659	7,477	740	-1,181	-554
1995	3.4	8,490	4,051	5,354	7,477	54	-344	-142
1996	4.2	11,110			11,350	1,323	-1,564	-570
1997	4.8	12,637			11,350	340	947	304
1998	4.8	11,190			11,350	-200	40	11
1999	5.5	12,776			11,350	369	1,056	264
2000	5.5	10,862			11,350	-265	-223	-49
2001	6.6	13,768			12,026	638	1,104	214
2002	6.6	11,238			12,026	-350	-438	-75
2003	8.0	14,827			12,026	797	2,004	302
2004	8.0	11,480			12,026	-463	-83	-11
2005	9.5	14,595			12,026	753	1,816	213
2006	9.5	10,169			12,026	-613	-1,244	-128
2007	10.8	11,114			12,026	409	-1,321	-120

FIRR = 13.5

As shown above, rapid and continuous increases of Rate/Unit are inevitable in this project during the first 10 years, due to the lower level of the existing water rate structure and also an expected tight financial situation of the District. However, after 1997 annual moderate increase in the percentage of the water rate is expected.

For detail, please reher to APPENDIX 9.8.1.

CHAPTER 10
ECONOMIC FEASIBILITY ANALYSIS

CHAPTER 10 ECONOMIC FEASIBILITY ANALYSIS

10.1 GENERAL

The objective of the project is to uplift the social welfare of the community. Therefore, an evaluation of the effectiveness of the project, in terms of socio-economic factors not considered in the financial analysis is made in this economic analysis.

It may not be possible to evaluate all the costs and the benefits of a project because some of them are not quantifiable or the technical methods to evaluate them quantitatively are not available. It is for this reason that only quantifiable benefits and costs will be included in the analysis.

The comparison between the costs and benefits shall allow an assessment of the economic feasibility of the project.

10.2 METHOD OF ANALYSIS

To evaluate economic feasibility of the project, the Economic Internal Rate of Return (EIRR) should be assessed through the calculations on the economic benefits and costs anticipated from the implementation of the project.

The project is considered economically feasible if the EIRR is higher than the opportunity cost of capital, or the rate of return that can be obtained from the best alternative use of the available capital. For public investment programs such as water supply projects, the opportunity cost of capital is from 12% to 15%.

10.3 ECONOMIC BENEFITS OF THE PROJECT

The implementation of the project will provide the following direct and indirect benefits:

Direct Benefits:

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

Indirect Benefit:

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

The quantifiable benefit considered in the economic feasibility analysis is the beneficial value of water (consumer's satisfaction).

Beneficial Value of Water

It is assumed that all residents of the served area would be willing to obtain water in sufficient quantities at a given price. In general, water prices charged by the Water District are lower than the real value of water. Taking the benefits for "consumer's satisfaction" into consideration, it is assumed that the economic value of water is 20% higher than the de-escalated average rate per cu.m of water used in the Financial Analysis.

The economic value of water is shown in TABLE 10.3.1.

TABLE 10.3.1 INCREASE IN CONSUMER STATISFACTION

Year	Incremental Accounted-For Water[1/] (1,000 cu.m/Year)	Price Per cu.m[2/]	Economic Value Per cu.m[3/]	Economic Water Revenues (₱1,000)
1988	-134	2.48	2.98	-399
1989	-22	3.42	4.10	-90
1990	89	4.16	4.99	444
1991	321	4.46	5.35	1,718
1992	553	4.31	5.17	2,860
1993	784	4.74	5.69	4,459
1994	1,016	4.49	5.39	5,474
1995	1,249	4.01	4.81	6,010
1996	1,249	4.42	5.30	6,625
1997	1,249	4.52	5.42	6,775
1998	1,249	4.03	4.84	6,040
1999	1,249	4.12	4.94	6,175
2000	1,249	3.68	4.42	5,516
2001	1,249	3.95	4.74	5,920
2002	1,249	3.52	4.22	5,276
2003	1,249	3.81	4.57	5,710
2004	1,249	3.40	4.08	5,096
2005	1,249	3.61	4.33	5,411
2006	1,249	3.22	3.86	4,826
2007	1,249	3.27	3.92	4,901

1/ The volume of accounted-for water of 584 thousand cu.m in 1986 is deducted from the projected water consumptions throughout the study period to obtain incremental volume.

2/ The price per cu.m was based on the de-escalated average rate/cu.m in the financial analysis.

3/ The economic value was assumed to be 1.2 times the price per cu.m of water.

10.4 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 converted into the economic costs using factors for shadow pricing. The factors for shadow pricing applicable to the study are as follows:

- Foreign exchange component: 1.3
- Unskilled labor premium : 0.5
- Others : 1.0

All taxes should be excluded in the economic study. It is assumed that the cost for the balance of domestic component includes hidden taxes for 5% of the amount.

10.4.1 Project Cost

By using the shadow pricing factors, the economic project cost is ₱51.64 million which was obtained based on the project cost used in the Financial Feasibility Analysis as shown in TABLE 10.4.1.

10.4.2 Salvage Value

TABLE 10.4.2 presents the salvage value of all the capital equipment in the project in 2007. The percentage of the salvage value was based on the remaining service life of the facilities in 2007.

10.4.3 Operating and Maintenance Costs

In the economic analysis, operating and maintenance costs of personnel, power, chemicals, and maintenance are considered. Likewise, this cost category is converted to economic costs by the shadow pricing factors. TABLE 10.4.3 shows the economic operating and maintenance cost.

TABLE 10.4.1 ECONOMIC PROJECT COST

(Unit : ₱1,000)

	Financial Project Cost	Foreign Exchange Component	Domestic Component	Unskilled Labor	Balance of Domestic Component	Taxes (5%)	Others (95%)	SHADOW PRICING Foreign Exchange Component x 1.3	SHADOW PRICING Unskilled Labor x 0.5	SHADOW PRICING Others x 1.0	Total Economic Cost
Civil Works											
Spring Facilities	32	12	20	5	15	1	14	16	3	14	33
Radial Well Facilities	1,813	682	1,131	172	959	48	911	887	86	911	1,884
Electric Sub-station	0	0	0	0	0	0	0	0	0	0	0
Transmission Facilities	1,251	488	763	110	653	33	620	634	55	620	1,309
Disinfection Facilities	77	10	67	6	61	3	58	13	3	58	74
Distribution Facilities	9,578	3,570	6,008	893	5,115	256	4,859	4,641	446	4,859	9,946
Service Connection	655	59	596	173	423	21	402	77	87	402	566
Land Acquisition	158	0	158	0	158	8	150	0	0	150	150
Admin. Bldg. & Ope. Ctr.	545	98	447	54	393	19	374	127	27	374	528
Vehicle & Stored Material	0	0	0	0	0	0	0	0	0	0	0
Sub-Total of Civil Works	14,109	4,919	9,190	1,413	7,777	389	7,388	6,395	707	7,388	14,490
Equipment											
Spring Facilities	11	9	2	0	2	0	2	12	0	2	14
Radial Well Facilities	1,322	1,138	184	0	184	9	175	1,479	0	175	1,654
Electric Sub-station	0	0	0	0	0	0	0	0	0	0	0
Transmission Facilities	1,480	855	625	0	625	31	594	1,112	0	594	1,706
Disinfection Facilities	119	90	29	0	29	1	28	117	0	28	145
Distribution Facilities	12,850	8,164	4,686	0	4,686	234	4,452	10,613	0	4,452	15,065
Service Connection	5,315	5,081	234	0	234	12	222	6,605	0	222	6,827
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0
Admin. Bldg. & Ope. Ctr.	545	392	153	0	153	8	145	510	0	145	655
Vehicle & Stored Material	1,311	795	516	0	516	26	490	1,033	0	490	1,523
Sub-Total of Equipment	22,953	16,524	6,429	0	6,429	321	6,108	21,481	0	6,108	27,589
Total of C.W. & Equipment	37,062	21,443	15,619	1,413	14,206	710	13,496	27,876	707	13,496	42,079
Physical Contingencies4/	2,965	1,715	1,250	113	1,136	57	1,079	2,230	57	1,080	3,367
Engineering Services5/	5,189	3,002	2,187	198	1,989	99	1,889	3,903	99	1,889	5,891
Leakage Detection	321	0	321	0	321	16	305	0	0	305	305
Project Cost	45,537	26,160	19,377	1,724	17,652	882	16,769	34,009	863	16,770	51,642

4/ 8% of Total Cost of Civil Work Equipment
5/ 12% of Total Cost of Civil Work Equipment as Engineering Charge and Construction Supervision

TABLE 10.4.2 SALVAGE VALUE IN YEAR 2007

(Unit : ₱1,000)

Year	Economic Value	Remaining Life in 2007 6/	Salvage Value
1988	6,098	50.0 %	3,049
1989	13,431	52.5	7,051
1990	10,146	55.0	5,580
1991	14,637	57.5	8,416
1992	1,717	60.0	1,030
1993	2,180	62.5	1,363
1994	1,717	65.0	1,116
1995	1,716	67.5	1,158
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			28,763

6/ The average economic life of all items is assumed to be 40 years.

TABLE 10.4.3 INCREMENTAL ECONOMIC OPERATION & MAINTENANCE COST

(Unit : ₱1,000)

Year	Financial O & M Cost	Foreign Exchange Component	Domestic Component	Taxes (5%)	Others (95%)	SHADOW PRICING Foreign Exchange Component x 1.3	SHADOW PRICING Others x 1.0	Economic O & M Cost	Net Economic O & M Cost
1987	160	22	138	7	131	29	131	160	-
1988	607	93	514	26	488	121	488	609	449
1989	871	146	725	36	689	190	689	879	719
1990	1,107	191	916	46	870	248	870	1,118	958
1991	1,287	240	1,047	52	995	312	995	1,307	1,147
1992	1,484	298	1,186	59	1,127	387	1,127	1,514	1,354
1993	1,681	356	1,325	66	1,259	463	1,259	1,722	1,562
1994	1,877	415	1,462	73	1,389	540	1,389	1,929	1,769
1995	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
1996	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
1997	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
1998	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
1999	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2000	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2001	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2002	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2003	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2004	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2005	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2006	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975
2007	2,073	472	1,601	80	1,521	614	1,521	2,135	1,975

10.5 INTERNAL ECONOMIC RATE OF RETURN (IERR)

EIRR is determined based on economic costs and benefits of the projects. TABLE 10.5.1 shows the computation of the EIRR. The EIRR is 4.3%. Although this rate falls below the opportunity cost of capital of 12%, the project is considered financially feasible as described in CHAPTER 9. The safe water supply is indispensable to the inhabitants from the viewpoint of social welfare and the implementation of the project will produce a number of unquantifiable benefits. An undertaking of the project is suggested itself to proceed positively.

TABLE 10.5.1 ECONOMIC INTERNAL RATE OF RETURN

(Unit : 1,000 Pesos)

Year	Total Economic Benefits	Total Economic Costs	Net Benefits	Present Value
1988	-399	6,547	-6,946	-6,946.0
1989	-90	14,150	-14,240	-13,656.1
1990	444	11,104	-10,660	-9,803.7
1991	1,718	15,784	-14,066	-12,405.6
1992	2,860	3,071	-211	-178.5
1993	4,459	3,742	717	581.6
1994	5,474	3,486	1,988	1,546.4
1995	6,010	3,691	2,319	1,729.8
1996	6,625	1,975	4,650	3,326.4
1997	6,775	1,975	4,800	3,292.9
1998	6,040	1,975	4,065	2,674.3
1999	6,175	1,975	4,200	2,649.8
2000	5,516	1,975	3,541	2,142.4
2001	5,920	1,975	3,945	2,289.0
2002	5,276	1,975	3,301	1,836.8
2003	5,710	1,975	3,735	1,993.1
2004	5,096	1,975	3,121	1,597.1
2005	5,411	1,975	3,436	1,686.2
2006	4,826	1,975	2,851	1,341.8
2007	4,901	-26,788	31,689	14,302.1

EIRR (%)= 4.28

CHAPTER 11
ORGANIZATION AND MANAGEMENT

CHAPTER 11 ORGANIZATION AND MANAGEMENT

11.1 PRESENT ORGANIZATION STRUCTURE

The BSWS is owned, operated and managed by the Provincial Government of Nueva Vizcaya. It is headed by a Provincial Waterworks Supervisor who under the direction of the Provincial Governor, directs, administers and manages the operation of the BSWS.

The Sangguniang Panlalawigan is the policy making body while the Provincial Governor is the chief appointing officer of the system.

Presently, 11 personnel are manning the system. Three are assigned in the billing and collection section, two in the operation and maintenance and four in the general services section. (See FIGURE 11.1.1 for the present organization structure of the system).

A number of ordinances have been passed relating mostly to the increases in water fees, extension of the service area and other improvement works of the BSWS.

11.2 PROPOSED ORGANIZATION STRUCTURE

11.2.1 Introduction

The proposed organization structure for the BSWS is the water district structure. The JICA Study Team believes that with the water district organization structure, the water system can look forward to dedicated policy makers providing continuity of policy and its consistent enforcement; to financial independence and business-like management; to capable, qualified and regularly trained personnel, and to freedom from political interference in its operations, particularly on hiring and water rates setting.

The JICA Study Team, however, proposes some changes on both the staffing guidelines, as well as the organization chart, without shaking the basic water district structure.

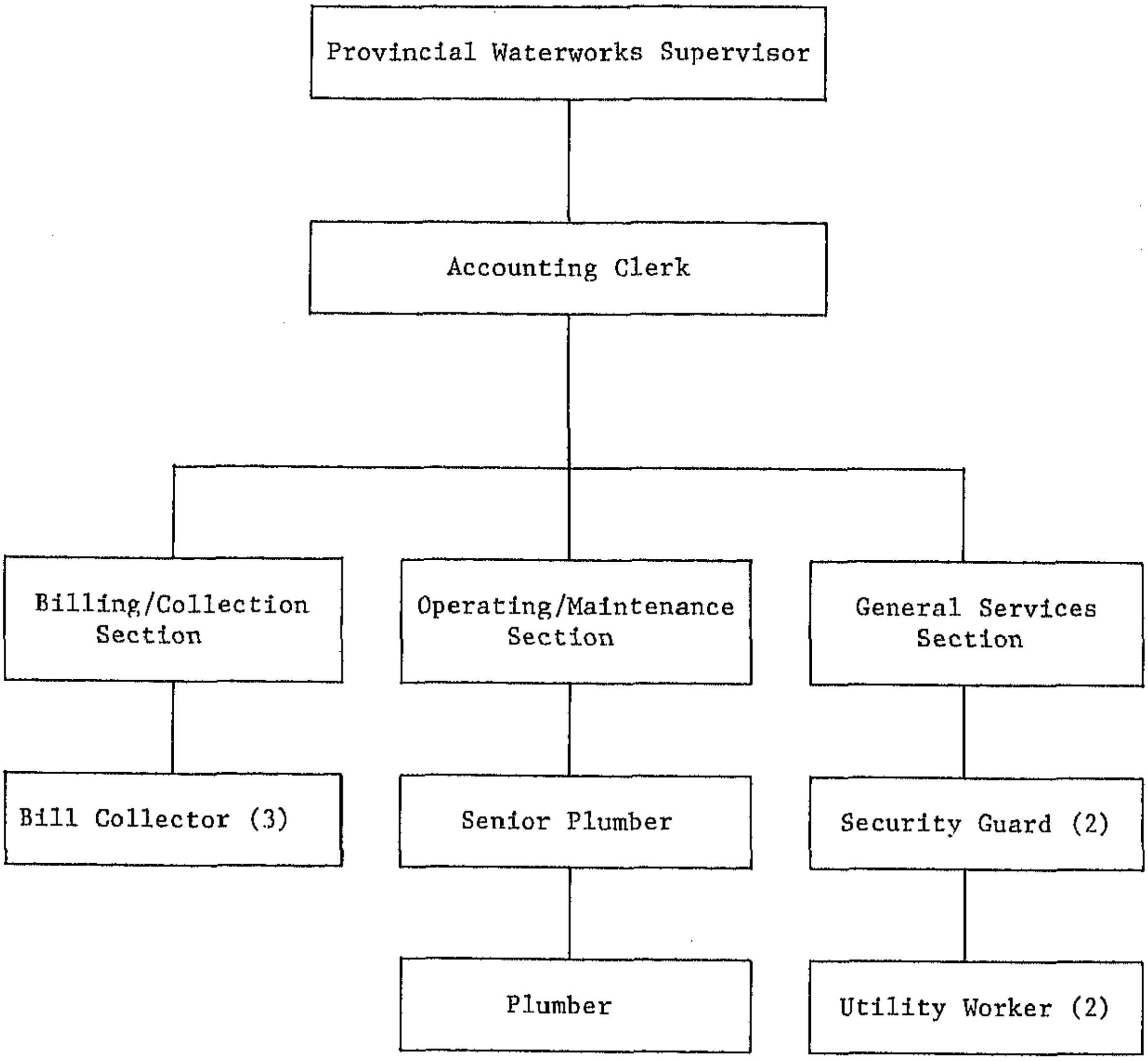


FIGURE 11.1.1 ORGANIZATION STRUCTURE OF BAYOMBONG SOLANO WATERWORKS SYSTEM

11.2.2 Examination of the LWUA Methodology Manual

The number of water district employees depends primarily on the total number of service connections. Based on this concept, the LWUA Methodology Manual proposes the following staff requirement for a water district.

Personnel	No. of Connections				
	2,000	5,000	10,000	15,000	20,000
General Manager	1	1	1	1	1
Administrative Staff	7	14	20	22	23
Technical Staff	16	35	59	75	92
Commercial Staff	12	25	40	52	64
- meter readers, bill collectors, inspectors	(6)	(14)	(25)	(32)	(42)
- other employees	(6)	(11)	(15)	(20)	(22)
Total Staff	36	75	120	150	180
No. of Staff/1,000 Connections	18	15	12	10	9

Note: The above data do not include personnel for construction of new connections, etc. which are considered to be part of development cost. These development expenses entail additional staff which is assumed to be 15 personnel per 1,000 additional service connection.

Moreover, the above figures are related to a water supply system without treatment plant. If such plant were necessary, additional 10 to 15 employees for each treatment plant with a capacity ranging from 10,000 to 50,000 cu.m/day may be considered.

Above-indicated table shows the staff requirement corresponding up to 20,000 connections. Therefore, we cannot use this table to compute the number of personnel both for Angeles City Water District and Dagupan City Water District in 1995 and 2010, since they will apparently be beyond the extent of the table.

It is possible, not to mention, that it can be estimate the number of personnel exceeding 20,000, on the basis of some assumption of personnel number per 1,000 connections. But it seems to be slightly forcible.

Therefore, the JICA Study Team checked the formula derived from the result of a statistical analysis of the number of personnel in relation to the number of connections for 38 existing water districts for the years 1979, 1980 and 1982.

The guideline proposes two staffing levels. The first level has been proposed for the period 1986-1995; the second for the period 1996-2010.

The upper staffing level for the period 1996-2010 was computed from the formula:

$$\log(\text{no. of employees}) = \log(\text{no. of connections}) \times 0.8311 - 1.2113$$

The lower level, which was assumed for the earlier period from 1986-1996, allows a 30 percent reduction in staff below the calculated value.

Using the above-mentioned formula, the number of personnel for the BSWS, if formed into a water district, could be computed as follows:

Design Year	No. of Employees
1995	72
2010	175

See FIGURE 11.2.1 for the proposed water district staff using the LWUA Methodology Manual.

It is true that the formula presented by the LWUA as a guideline in this study is based on the result of a statistical analysis of the existing water districts. But no evaluation has been indicated whether the figures which were derived from the formula are appropriate or not.

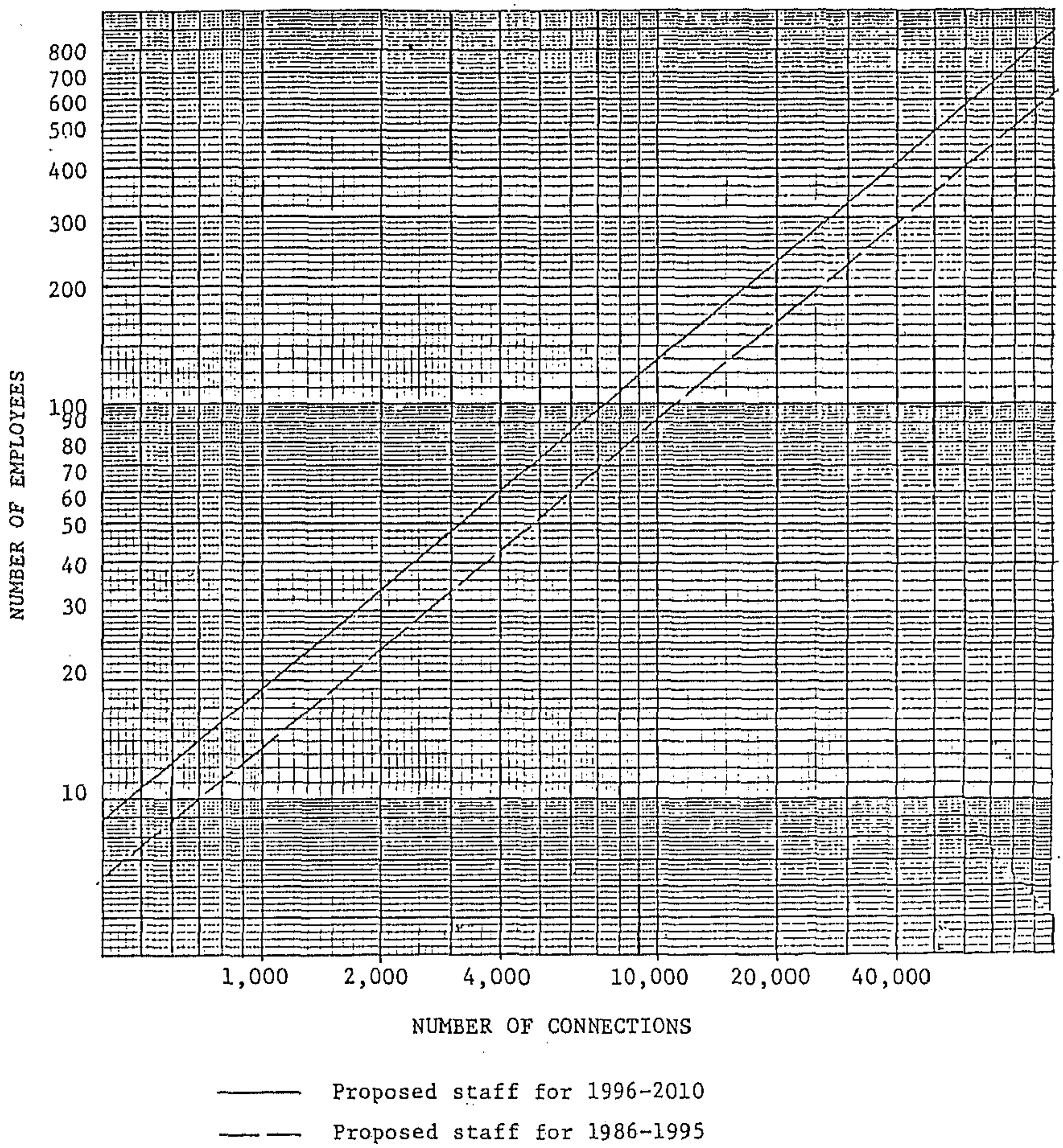


FIGURE 11.2.1 PROPOSED WATER DISTRICT STAFF BY LWUA METHODOLOGY MANUAL

Considering the actual scope and content of operation and management work, the number of personnel computed from the LWUA Methodology Manual, seems to be rather high, particularly for the year 2010.

In this study, therefore, a new proposal regarding the number of personnel based on the appropriate performance of individual work may be recommended.

11.2.3 Proposed Guideline of JICA Study Team

The task of management is to carry policy into effect with the fullest efficiency within the limits assigned; that is, to attain the maximum performance at the minimum cost. It is the duty of management to create conditions which will bring about the optimum use of all resources available to the water district.

Based on this concept, the JICA Study Team closely examined the present structure of the existing BSWS not only regarding to the number of personnel, but also the quality of the services to be provided to the consumers. Also considered as a reference were the statistical data regarding to the number of personnel and the organizational structures of the BSWS in a developed country.

The procedure which has been adopted in this study is, at first, to divide the organization of a water district into two main branches:

a) The administrative and commercial divisions, comprising what may be termed the business management (including matters concerning water charges) of the water district.

b) The engineering and technical division, embracing the design and construction of minor extension or improvement works utilizing internal reserve fund; and the operation renewal and maintenance of existing works.

Secondly, the number of personnel has been computed considering the present number of personnel of the BSWS and appropriate performance of individual assignment.

TABLE 11.2.1 shows the JICA Study Team's guideline on the personnel needed to man the proposed water district by scope and content of work.

It was decided by JICA Study Team, to assign no bill collector based on the assumption that the consumers will pay water charges directly to the water district or through their affiliated banks.

TABLE 11.2.2 shows the summary of the present (1986) and the proposed staffing pattern (1995 and 2010) for the BSWS.

11.2.4 Organization Structure

The organization structure proposed for the BSWS is basically the water district structure.

The water system/district will be headed by a five-man Board of Directors, as per PD 198, who will come from the various sectors of the community and will be appointed by the mayor or governor, as the case may be. It is this Board that will set all the policies of the water system/district.

The everyday affairs of the water system/district will be managed by the General Manager who will be appointed by the Board of Directors.

The two broad divisions of the system/district will be:

a) Administrative and Commercial Division

b) Technical Division

The proposed number of personnel for both divisions is:

	1995	2010
General Manager	1	1
Administrative and Commercial	23	32
Technical	25	25
Total	49	58

FIGURE 11.2.2 shows the proposed organization chart for the proposed Bayombong-Solano Water District.

TABLE 11.2.1 STAFFING GUIDELINE

DIVISION AND POSITION OF STAFF	NUMBER	CONTENTS OF WORKS, REMARKS
General Manager	1	Sec.23 of Provincial Water Utilities Act of 1973
ADMINISTRATIVE AND COMMERCIAL		
Asst. General Manager	1	
General Affairs Division		°Correspondence °Filing °Agendas °Establishment °Resister of Land, fixed assets °Tenancies °Statistics °General Information and Returns °Board Work, Contracts °Miscellaneous
Manager	1	
Staff	2 (< 20,000 connections) 4 (< 50,000 connections)	
Account Division		°Cash Receipts and Payments °Revenue Expenditure °Capital Expenditure °Borrowing Powers °Rates and Rating °Wages and Insurance °Recoverable Charges °Procurement of Equipment and Materials °Supplies °Miscellaneous Costs
Manager	1	
Staff	3 (< 10,000 connections) 5 (< 30,000 connections) 7 (< 50,000 connections)	
General Service Division		°Store-keeping °Transportation °Utilities
Manager	1	
Clerk	1	
Mechanics	1	
Staff	4 - 10	4 for less than 10,000 conn., 6 for less than 20,000 conn., 10 for more than 20,001 conn.

TABLE 11.2.1 STAFFING GUIDELINE (continued)

DIVISION AND POSITION OF STAFF	NUMBER	CONTENTS OF WORKS, REMARKS
Water Charges Division		°Assessments °Resister of Supplies °Guarantees °Meter Charges °Revision of Charges °Statistics °Water Survey °Meter Reading (Consumption, Complaints, Reports) °Collection of Water Charges
Manager	1	
Clerk	2 (<20,000 connections) 3 (<30,000 connections) 5 (<50,000 connections)	
Meter Reader	Proportional to the no.of conn.	° One (1) meter reader per 1,500 connections
TECHNICAL		
Asst. General Manager (Eng'r)	1	
Distribution Division		°Preservation of Water Sources, Prevention of Pollution °Afforestation (in case of spring source) °Operation and Maintenance
Manager (Eng'r)	1	
Mechanics	2	°Service Reservoirs
Electrician	1	°Transmission Mains/ Distribution Mains*
Pump Operators	2 for every 5 stations	°Pumping Stations * Hydrants and Valves * Waste Inspection * Extentions, Renewals, Cleaning and Repairs, Street Repairs
Reservoir Attendants	2	° Two (2) attendants per one reservoir
Pipeline Patrol	Prop'l to the Pipeline length	° One (1) staff per every five (5) kilometer for the first 60 km, then add one per every ten (10) kilometer
General Maintenance	3	° Painters, Blacksmith & c.

TABLE 11.2.1 STAFFING GUIDELINE (continued)

DIVISION AND POSITION OF STAFF	NUMBER	CONTENTS OF WORKS, REMARKS
Service Works Division		°Meter Fixing and Repairs
Manager	1	°Meter Fixing °Exchanging and Testing °Repairing °Plumbing °Laying and Maintenance of Service Pipes and Fittings °Plumbing Repairs °Testing of Fittings
Fitters	Proportional to the no.of conn.	° Two(2) fitters for the first 20,000 connections, then add one (1) fitter for every additional 10,000 connections
Meter Repairman	Proportional to the no.of conn.	° Two(2) repairers for the first 10,000 connections, then add one (1) repairer for every additional 10,000 connections
Plumbers	Proportional to the no.of conn.	° Two(2) plumbers for the first 20,000 connections, then add one (1) plumber for every additional 10,000 connections
Laborers	Proportional to the no.of conn.	° Two (2) laborers for the first 20,000 connections, then add one laborer forevery additional 10,000 connections

TABLE 11.2.2 SUMMARY OF PRESENT (1986) AND PROPOSED (1995 and 2010) STAFFING PATTERN (BAYOMBONG-SOLANO)

	1986	1995	2010
Population Served	10,414	36,000	62,900
No. of Connections	1,345	7,600	14,400
Supply Capacity (cu.m/day)	4,770	9,000	17,000
Length of T/D Main (m)	16,000	23,000	24,000
No. of Pump Stations	-	1	2
General Manager	-	1	1
ADMINISTRATIVE AND COMMERCIAL			
Assistant General manager	-	1	1
General Affairs	-	3	3
Accountancy	1	4	6
General Services	2	7	9
Water Charges			
Manager	-	1	1
Clerk	-	2	2
Meter Reader	-	5	10
Bill Collector	3	-	-
Sub-Total	3	8	13
Total	6	23	32
TECHNICAL			
Assistant General Manager	1	1	1
Distribution			
Manager	-	1	1
Mechanics	-	2	2
Electrician	-	1	1
Pump Operator	1	2	2
Reservoir Attendant	1	2	2
Patrol	-	4	4
General Maintenance	-	3	3
Sub-Total	2	15	15
Service Works			
Manager	-	1	1
Fitter	2	2	2
Meter Repairman	-	2	2
Plumber	-	2	2
Laborer	-	2	2
Sub-Total	2	9	9
Total	5	25	25
GRAND TOTAL	11	49	58

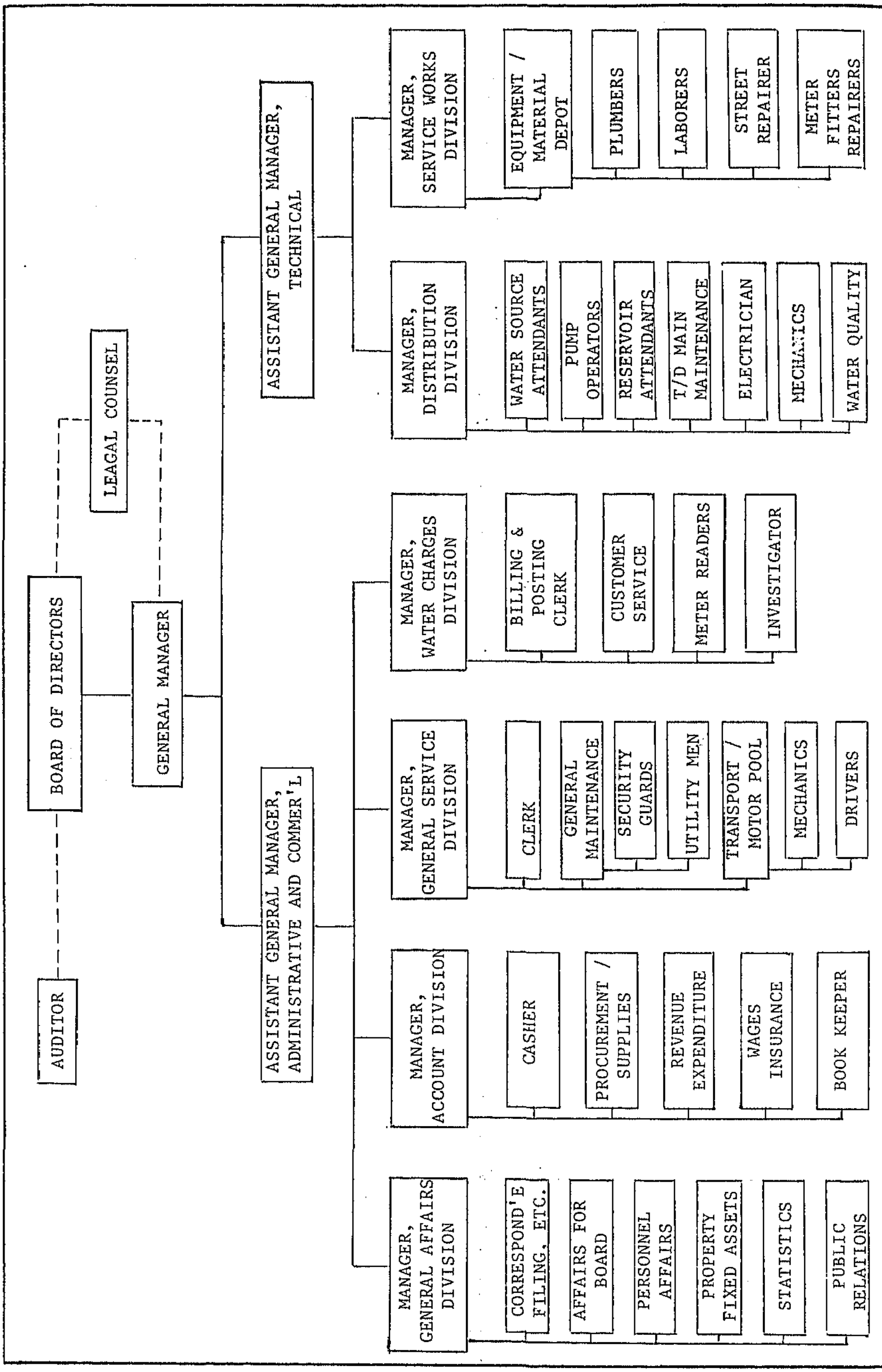


FIGURE 11.2.2 PROPOSED ORGANIZATION STRUCTURE

11.3 MANAGEMENT

11.3.1 Importance of Management

As stated in Section 11.2.3, the task of management is to carry policy into action with the fullest efficiency within the limits assigned; that is, to attain maximum performance at minimum cost. It is the duty of management to create conditions which will bring about the optimum use of all resources available to the water district. Thus the scope of management carries with it a lot of responsibilities.

The continuous and successful operation of a water district depends largely on the patronage of its consumers. The consumers would only patronize a water district if it can provide them safe water in sufficient quantities at all times at a cost within their reach. Patronage of consumers can be achieved through good management.

11.3.2 Functions and Duties of General Manager/Staff

FIGURE 11.2.2 shows the departmental organization in a medium-sized water district whose sources of supply are deep wells. (If its sources are surface water, the treatment plant staff should be added.)

Many of the functions indicated on the chart are common to the four proposed water districts respectively, although relatively small water districts (e.g., Bayombong-Solano Water District) may find it unnecessary to departmentalize during the early stage.

A carefully planned organization is essential to ensure that the needs of consumers throughout the area can be promptly appreciated and efficiently met. Thus, it is also desirable that every member of the organization not only understand and realize the significance and importance of his or her particular function but also properly discharge that particular function.

(1) The General Manager

Provincial Water Utilities Act of 1973 prescribes the Officers and Employees as follows:

> "SEC. 23. The General Manager. --- At the first meeting of the Board, or as soon as practicable, the Board shall appoint, by a majority vote, a general manager and shall define his duties and fix his compensation. Said officer shall serve at the pleasure of the Board. (As amended by Sec. 9, PD 768)
>
> SEC. 24. Duties. --- The duties of the General Manager and other officers shall be determined and specified from time to time by the Board. The General Manager, who shall not be a director, shall have full supervision and control of the maintenance and operation of water district facilities, with power and authority to appoint all personnel of the district: Provided, that the appointment of personnel in the supervisory level shall be subject to approval by the Board. (As amended by Sec. 10, PD 768)"

Thus, the duties fall, to a large extent, within the sphere of administration. The General Manager should therefore, have managerial ability, and a thorough knowledge of the administrative machine which he controls. Managerial ability implies the ability to select suitably trained or qualified staff, to delegate work and responsibility wisely, and to create and maintain a spirit of co-operative enthusiasm throughout the entire organization. The General Manager must be able to co-ordinate the efforts of the several different sections, and should keep in close touch with the more important matters being dealt with by each.

Since water industry is mainly concerned with the problems of the collection of water, its storage, treatment (at least chlorination), and distribution, it is most desirable that the General Manager is a chartered civil/sanitary engineer who also has managerial abilities on general, and especially, financial matters.

Presently, however, the four study areas are not yet managed as a water district, for these systems to start out rightly, it must be able to have a man of managerial competence and experience appointed as a General Manager.

Therefore, the first priority should rather be given to managerial ability rather than to be an engineer. In case any other non-technical person is appointed as the General Manager, the General Manager should be assisted by a chief engineer.

Although the General Manager is responsible for the day-to-day conduct of affairs of the water district, he should not become too immersed in details. He should exercise over-all supervision and control, thereby giving himself ample time to plan the improvement/development of the Water District carefully in anticipation of the consumer's needs, and to deal promptly with unforeseen situations of major importance as they arise.

(2) The Administrative machine

As indicated in the FIGURE 11.2.2, the proposed organization of the water district can be divided into two main branches:--- (1) the Administrative, and (2) the Technical.

These two branches are in contact at many points, and are so interdependent that a high degree of co-operation is essential to ensure coordination of effort, economy in working, and proper balance between income and expenditure. Each of these two main branches is, in turn, divided into a number of subsections.

As efficient administration cannot be achieved by staff in water-tight compartments, officers in charge of departments should not only possess a detailed knowledge of every aspect of the work of their respective departments, but should also take an interest in, and have a general knowledge of, the work of other departments.

In the organization depicted in functional form in FIGURE 11.2.2, it seems not necessary to mention the scope of the individual works one by one basis. Keynotes or recommendations are as follow:---

11.3.3 Problems Arising from the Transition of Administrations

Transition from the existing water supply organizations to the respective water districts will inevitably take time. Each water authority then should make necessary preparations for setting up respective water districts in various aspects --- legislative, budgetary, personnel and technical.

(1) Personnel

a) Appointment of qualified personnel to the key positions is indispensable for good management of a water district. Generally, it might be somewhat difficult to get well educated or qualified personnel in local cities and municipalities, especially in areas far from Metro Manila. However, there are other aspects that may make up for apparent lack of education or qualification. These are experience, the right attitude and the potential or capacity of a person to learn.

b) If the employees who belong to the existing water supply authorities will transfer to the proposed water districts there will be no displacement, since the number of employees of the existing water supply authorities are less than the proposed number of personnel required for water districts in the target years 1990 and 2010.

However, there may be problems on absorbing dead wood or unwanted employees. It may be best to terminate such employees services at the start of the water district operations so as not to complicate matters further.

c) It is recommended that the experience of the personnel who have worked for a long time for the relevant water authority and are well acquainted with that water supply system, managerially or technically, be made good use of.

d) In the procedures for recruitment, if necessary, any newly formed water district may fully utilize the LWUA's assistance to obtain desirable personnel, especially for managerial positions. It is expected, therefore, the LWUA can use its testing system to recommend the most appropriate candidate as required water district.

e) Attention should be given to procedures for the recruitment, proper use and retention of technical personnel including the establishment of career structures.

f) Training of personnel on all levels and categories is a vital aspect in relation to work performance, morale and retention of staff. It was disclosed through the study, that most of the staff of all the four water supply systems have not enjoyed the benefits of any kind of training at all. Before and after the formation of these systems into water districts, the LWUA should train the personnel from the board of directors and General Manager down to the plumber.

g) An information dissemination and public relations programs should be developed. The water districts serves the people and needs the support of the people, especially on payment of water bills or when the water rates are increased. It should therefore regularly inform and educate its public on the plans and programs of the water district and on the correct usage of water.

(2) Change of Charging System

a) At present, in the waterworks of Angeles City, Dagupan City and Cabuyao-Sta. Rosa-Biñan, the combined use of flat rate system and metered system is adopted, while in Bayombong-Solano only a flat rate system is adopted because all the faucets are unmetered.

In principle, the proposed four water districts should be operated and managed on the basis of 100% metering, in accordance with the Letter of Instruction No. 700, June 1, 1978, to insure correct charging of water actually consumed and discourage its wasteful use. One hundred percent (100%) metering is the basis of the water tariff structure and, in effect, is the basis for financial viability.

b) To install water meters (including replacement of the nonfunctioning/malfunctioning meters) to all the consumers takes time. Therefore, it is necessary to stipulate a provisional rate regulation of combined use of flat rate and metered system, fixing the target date by which 100% metering should be realized.

c) Since the life of water meters is about 8 years, the water district should have a plan to replace water meters installed at every customer once in 8 years basis and to guarantee the budget and manpower necessary for its execution.

11.3.4 *Problems Arising from Rapid Expansion of the Systems*

(1) Coordination During Construction Period

According to the demand projection in the target year for the Short Term Development, the size of the water supply systems will more than double compared to its present size.

Considering the rapid expansion of the water supply systems, there may be much inconvenience caused by the construction work. For instance, to minimize water interruption and traffic congestion caused by pipe laying work, it is necessary to develop close coordination and cooperation between the respective water district and the LWUA (Engineering Services) together with the local transportation authorities and inform the people to be affected by the expansion project.

(2) Office Accommodation for Increasing Personnel

Increase of personnel requires a larger office space. In this regard, the newly established water districts may talk with the related cities/municipalities respectively of utilization of the former office space of the respective water supply authorities until the water district could afford to move to a new office.

1.4 OTHER RECOMMENDATIONS

11.4.1 LWUA Assistance

Immediately upon their formation into water districts, it is recommended that the LWUA install an appropriate commercial practice system (CPS). Also, an effective and sustained training programs for both water district officials and personnel should be formulated and implemented as soon as possible. A rational public information and education program should also be undertaken by the new water districts.

The JICA Team also reminds that the LWUA maximizes its assistance to the proposed water district upon its formation. It is expected that partially the proposed water district will need the LWUA's assistance in all aspects of its operation and financial, technical and institutional. It is believed that this package of assistance will greatly enhance the water system's capability to provide an adequate and efficient water service to its consuming public.

11.4.2 Formation of Water Districts

Basically, the LWUA provides every necessary assistance once a waterworks system is formed into a water district. Yet, under the decree that created both the LWUA and the water district (PD 198, as amended), the formation of a water district is at the option of the local governments concerned.

There is actually a very positive trend towards the formation of water districts in the above-mentioned four study areas. Members of the Sangguniang Panlalawigan/Panlungsod have been taking an increasing interest in the importance of an improved water supply system. The JICA Team believes the LWUA can facilitate things by having a more aggressive program or campaign in water district formation itself; but should include effective information measures to promote formation through grass-roots and media based campaigns.