CHAPTER 6
WATER RESOURCES

CHAPTER 6 WATER RESOURCES

6.1 GENERAL

The Dagupan City Waterworks System obtains its raw water from 15 deep wells all located within the service area.

The rest of the barangays which are not served by the existing system depend on shallow and medium-deepwells drilled by the Ministry of Public Works and Highways (hereinafter referred to as MPWH) for their daily water needs. Likewise, a number of commercial establishments and individual households have their own private shallow wells fitted with manual pumps or dugwells with "pulley-rope and bucket."

The possible additional water sources for future use are groundwater utilizing through deepwells, and surface water from Agno River.

6.2 METEOROLOGY

6.2.1 Rainfall and Temperature

Dagupan City is classified under the first type of climate characterized by two pronounced seasons: the dry season lasting from November to May, and the rainy season starting from June and ends in October.

The average annual rainfall is 2,230 mm, while the peak monthly precipitation reaches an average of 565 mm. The typhoon season starts in May and lasts up to November.

Slight variation in temperature is observed throughout the year with an annual average of 28°C. The month of May is the warmest with an average of 29.7°C.

The monthly average rainfall and temperature are summarized in TABLE 6.2.1, while the isohyetal map of the Central Luzon area showing the rainfall distribution in Dagupan City and the surrounding municipalities is presented in FIGURE 6.2.1.

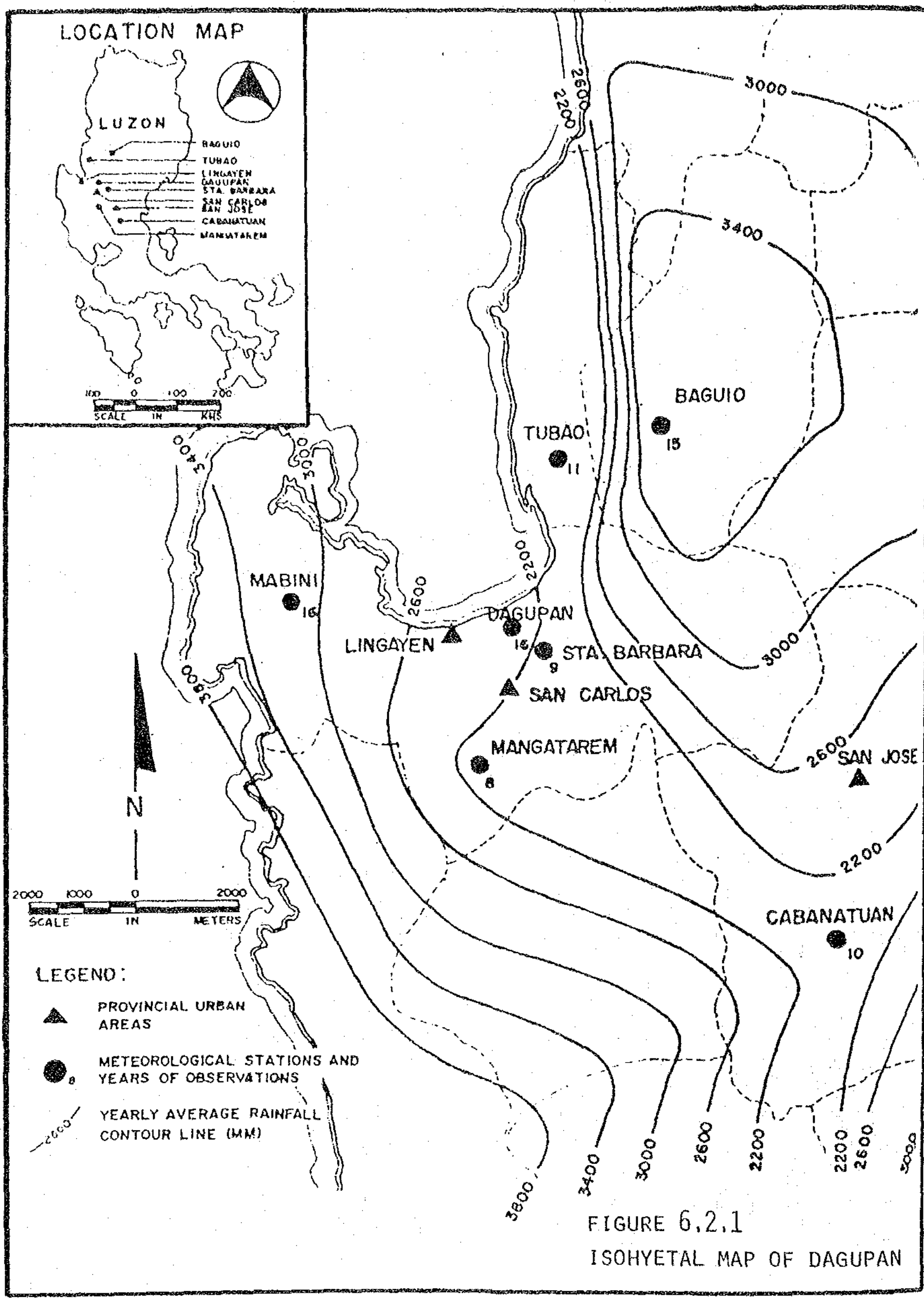


FIGURE 6.2.1
ISOHYETAL MAP OF DAGUPAN

TABLE 6.2.1 DAGUPAN CITY CLIMATOLOGICAL DATA

Month	Average Rainfall (mm)	Average Temperature (°C)
January	8.1	26.4
February	8.1	26.8
March	21.5	28.4
April	71.7	29.6
May	228.8	29.7
June	352.9	28.6
July	417.0	28.1
August	564.8	27.8
September	337.6	28.0
October	134.3	28.2
November	56.1	27.4
December	19.8	26.6
Yearly Average	2,320.2	28.0

Source: PAGASA
Note: Average for 23 years of record 1952 - 1975

6.2.2 Evapotranspiration

The value of the annual evapotranspiration was computed using the Turc's formula as shown below.

$$E \doteq \frac{P}{\sqrt{0.9 + \frac{P^2}{L^2}}}$$

where: E = effective evapotranspiration in mm/year
P = average yearly precipitation in mm
T = average temperature in °C
$L = 300 + 25T + 0.05T^3$

The evapotranspiration value was speculated at 1,565 mm/year so that 665 mm/year is available for runoff and groundwater infiltration.

6.3 GEOMORPHOLOGY

Dagupan City lies on the western part of the vast Central Luzon plains. The topography within the City and immediate vicinities is basically flat with elevations not exceeding 5 m above MSL.

The alluvial plain is often subject to flooding during high rainfall periods. The main physiographic feature is represented by Calmay River that flows from south to north discharging its load to Lingayen Gulf.

Vegetation is evenly distributed over the area and most of the lands are planted with rice and diversified crops.

6.4 GEOLOGY

Dagupan City which faces the Lingayen Gulf is located at the down stream end of a hydrogeological system that covers the northern part of Central Luzon plain. The system is situated north of the San Jose-Tarlac groundwater divide. Based on the Bureau of Mines' studies, the geology of the system is characterized by the flanks of the northern part of the Central Luzon plain, considered as the main recharging areas of the confined aquifer consisting of the following stratigraphic sequences.

Eastern Flank

a) Cretaceous - Paleogene (KPg): Undifferentiated graywackes and metamorphosed shales with spilite basic flows and pyroclastics.

b) Oligocene - Middle Miocene (N1): Transgressive marine sequence outcropping along the foot of the mountains and consists of interbedded conglomerates, sandstones, shales and limestones, associated with basic to intermediate lava flows and pyroclastics.

c) Upper Miocene - Pliocene (N2): Marine clastics, overlain by pyroclastics and tuffaceous sedimentary rocks, this unit, of limited extension, rims the western foothills of the Sierra Madre Mountains.

d) Foothill recent deposits: Alluvial fans and talus debris forming a practically continuous, gently slopping belt of generally high permeability.

Western Flank

a) Cretaceous - Paleogene (UC): Undifferentiated plutonic rocks consisting of prevailing diabases, gabbro and peridotites, associated with weathered argillaceous tuffs and pyroclastics. This unit outcrops around the area 8 km west of San Carlos; undifferentiated submarine flows, probably of the same age, mainly consisting of spilites and basalts, which are found to the west and northwest of Tarlac.

b) Oligocene - Middle Miocene (N1): Same as b) in the eastern flank, this unit is found at the foot of the mountains to the west of Tarlac.

c) Upper Miocene - Pliocene (N2): Same as c) in the eastern flank, this unit forms wide outcrops to the west and southwest of Tarlac.

d) Pliocene - Pleistocene (N3 + Q1): Marine deposits (molasse) that are found near Tarlac and extend toward NNW.

e) Foothill recent deposits: Prevailing talus debris of some modest alluvial fans that form a belt along the foot of the mountains particularly in the northern part of the western flank.

Alluvial Formation

A limited geological information is found around the area, as follows:

- Marine sediments are predominant with silt, clay, sand, and gravel silt and clay,
- Lateral successions of the lithology are rather poor, and
- The layer tend to be clayey with depth.

Upper Miocene - Pliocene (N2): Marine clastics which are found at short distance to the east and south of San Carlos is underlaid over the area with unconformity and abutting on the foot of both flanks. The thickness of the formation is not known.

6.5 SURFACE WATER

Several river bodies traverse Dagupan City, most of which have insufficient flow and poor quality and therefore not advisable for water supply purposes. Agno and Sinocalan Rivers are the only perennial water sources of major interest that are within the proximity of Dagupan area.

(1) Agno River

Agno River originates from Mount Pulog approximately 45 km north-east of Baguio City. It flows in a north-south direction and enters the wide Central Luzon plain taking a northeast-southwest direction. It finally discharges its raw water load to the Lingayen Gulf.

In August 1954, the Bureau of Public Works (now, MPWH) established a gauging station at barangay Dorongan, Urbiztondo, Pangasinan that drains an area of 5,134 sq.km. Only 7 complete years of records (from 1963 to 1969) are available as shown in TABLE 6.5.1. The river has a recorded minimum flow ranging from 2,454,000 cu.m/day (April 1965) to 65,000 cu.m/day (March 1976) which is sufficient enough to support the long term water demand of DAWASA.

TABLE 6.5.1 SURFACE WATER MINIMUM FLOW DATA, AGNO RIVER

Year	Month	Minimum Discharge (thousand cu.m/day)
1963	April	968
1964	April	881
1965	April	2,454
1966	March	760
1967	March	65
1968	April	808
1969	April	1,300

Source: Dorongan Gauging Station, Urbiztondo, Pangasinan
Latitude : 15°49'23"
Longitude: 120°19'30"

The feasibility study initiated by LWUA for the improvement of the water supply system of San Carlos City has established the most suitable location for the construction of a diversion structure. This area is situated in the Municipality of Bayambang, some 17 km southeast of San Carlos City where no tide influence is recorded and where the morphological conditions are suitable for the construction of intake and storage facilities.

(2) Sinocalan River

Sinocalan River is another major body of water traversing southeast of Dagupan City. It originates from the eastern mountain flanks and enters the Calasiao area taking a northwest direction and discharges into the Lingayen Gulf. It drains an area of approximately 18 sq.km and has a recorded minimum flow of 16,000 cu.m/day (April 1977).

The recorded flow of Sinocalan River for the years from 1960 to 1977 is presented in TABLE 6.5.2.

TABLE 6.5.2 SURFACE WATER MINIMUM FLOW DATA, SINOCALAN RIVER

Year	Month	Minimum Discharge (thousand cu.m/day)
1960	February	355
1961	February	389
1962	January	384
1963	April	320
1964	April	213
1965	December	282
1966	March	168
1967	March	285
1968	April	254
1969	March	149
1970	February	216
1971	March	149
1972	February	126
1973	April	36
1974	April	88
1975	February	130
1976	March	26
1977	April	16

Source: Poblacion Norte Gauging Station, Sta. Barbara, Pangasinan
Latitude : 16°00'00" Longitude: 120°28'20"

6.6 GROUNDWATER

At present, the DAWASA solely utilizes the groundwater reserve. The combined production of all the DAWASA wells is estimated at 9,640 cu.m/day. The wells collect water from the alluvial sediments not exceeding 200 m below ground surface.

Most of the city water consumers not connected to the system depend on the groundwater sources through shallow and medium deep wells. These wells collect water from shallow aquifers. Some of the deteriorations of the water quality and aquifer characteristics maybe attributed by the over-exploitation of groundwater resulting to the lowering of the piezometric level and inducing the entry of salt water into the aquifer.

6.6.1 Water Point Inventory

A water point inventory was developed within Dagupan City and its neighboring municipalities in order to assess the present groundwater conditions. The inventory included water level, temperature and conductivity measurements on some of the existing wells located in the investigation area.

Wells

Majority of the wells in Dagupan City was drilled beyond 50 m below ground surface and derive water from confined and semi-confined aquifers.

The data for the wells drilled by the MPWH, the National Irrigation Administration (hereinafter referred to as NIA) and private well drillers are presented in APPENDIX 6.6.1.1. Their locations are shown in FIGUREs 6.6.1 and 6.6.2.

A total of 37 well lithologic logs are available and are presented in APPENDIX 6.6.1.2.

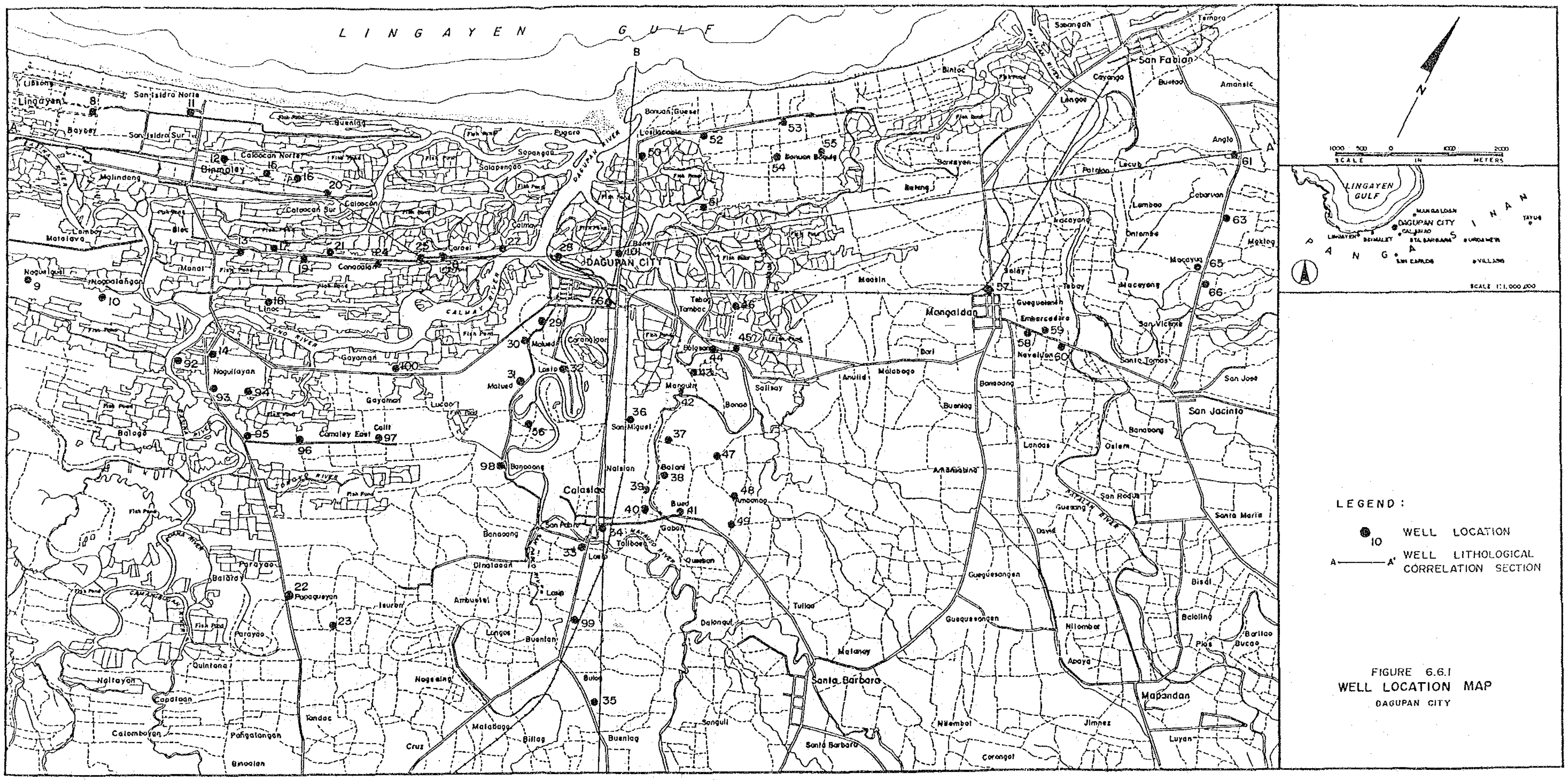


FIGURE 6.6.1
WELL LOCATION MAP
DAGUPAN CITY

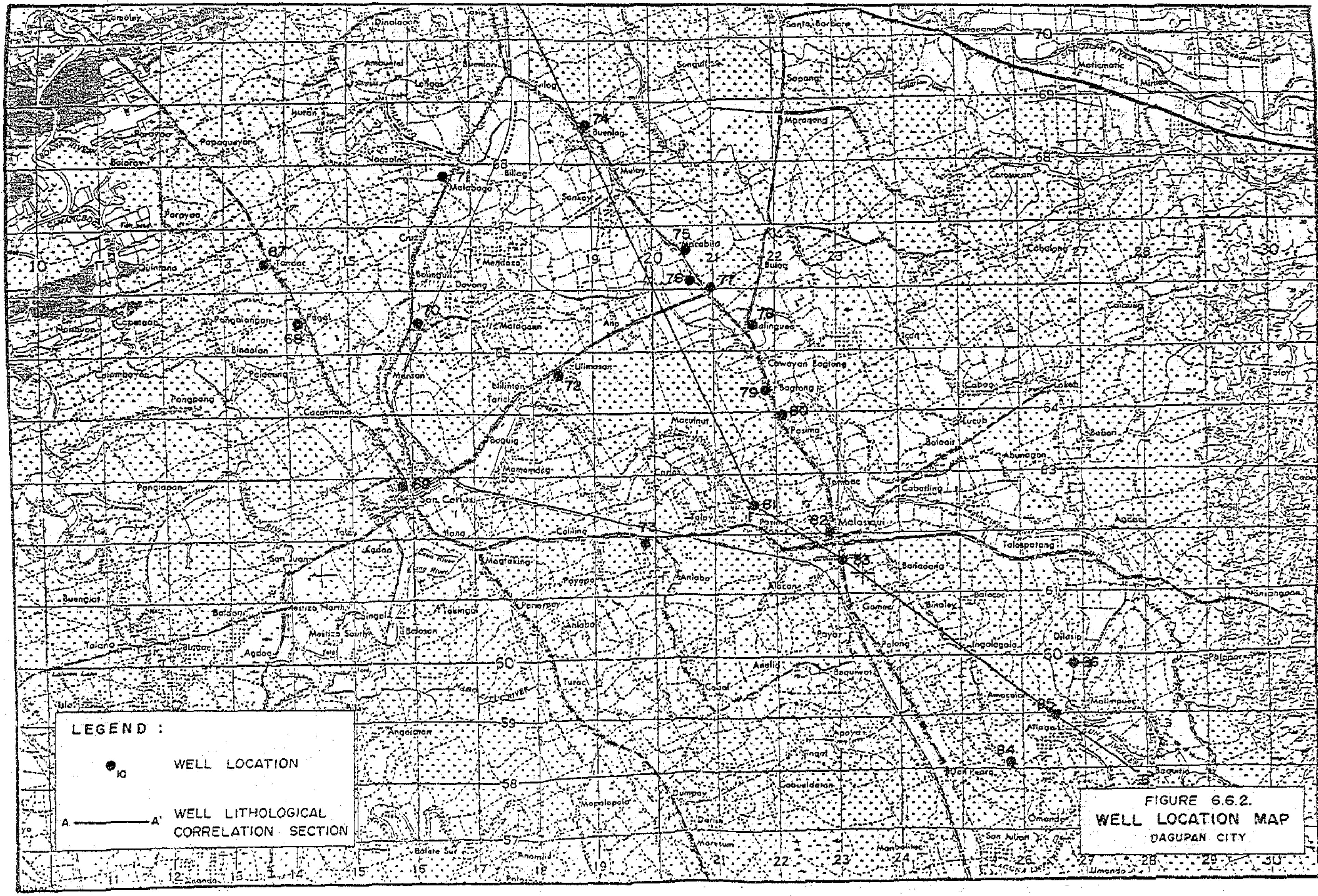


FIGURE 6.6.2.
WELL LOCATION MAP
DAGUPAN CITY

The MPWH wells range from 40 to 260 m in depth and have casing diameters of 100 to 250 mm. The computed specific capacities reflected on the pumping test data vary from 0.02 to 2.65 lps/m. An unfavorable well performance maybe attributed to poor well design and construction since these wells produce water from an open hole below the casing or from a short length of slotted pipes. Some wells have encountered the alluvial sediments of clay, silt, sand, gravel and subordinate tuffaceous clay layers as cited from the driller's lithologic descriptions. The deeper sandy and gravelly intercalations deposited in between clay and silt layers, if properly exploited, may sustain an possibility to produce a certain amount of groundwater.

The NIA wells which were located in the Municipalities of San Fabian, Sta. Barbara, Malasique and Binmaley, and were drilled to varying depths of 118 to 374 m and cased with ϕ400/200 mm telescopic pipes. The wells which were intended for irrigation purposes have been deriving groundwater from sand, gravel and gravelly silt formations at depths of 60 to 155 m below ground surface. The pumping test records showed specific capacity values in the range of 3.7 to 7.7 lps/m with equivalent aquifer transmissivities of 300 to 1800 sq.m/day indicating wells with good production capabilities. The wells with good capacity of production are located rather in the hydrogeological upstream area so that a deep aquifer is still kept with enough sufficient continuing pressure.

6.6.2 Aquifers

Based on the geology, well lithological logs, and the result of georesistivity survey, shallow and deep aquifers have been identified in the study area as can be seen in the electrostratigraphic sections (Details are presented in APPENDIX 6.6.2.1)

The intermediate layer, L-3, which overlies the basement formation is presumed to comprise dominant clay and silt layers with low permeability.

Thin deposits of sand and gravel maybe presumed to exist between layers of clay and silt in the formation defined in L-4. The aquifer appears to be lenticular shape with medium to low permeability.

The basement formation may offer good water production capability, however, detailed analysis of this formation is beyond the scope of this study.

(1) Hydrostratigraphy

The study area comprises the fluvial deposits, Upper Quarternary and Upper Miocene to Pliocene marine sediments.

The study of the groundwater in this report is limited only on fluvial and Quarternary marine sediments which are sub-divided into layers. The lateral and vertical sequences of the formations are presented in FIGUREs 6.6.2.2 to 6.6.2.3 of APPENDIX 6.6.2.1 and the extent of the cross-section is exhibited in FIGURE 6.6.3. A general view of the study area is summarized below.

Layer 1

This is considered to be superficial layer with geoelectric resistivity responses ranging from 3 to 3,000 ohm-m. The values of 3 to 10 ohm-m may correspond to clay and sand sediments saturated with fresh or brackish water.

Those values exceeding 50 ohm-m maybe correlated to partly cemented sand and gravel deposits. The thickness of the layer varies from 1 to 15 m. The layer seen in the cross-section H-H' along the coastal belt presents a typical semi-confined groundwater aquifers. The layer is capable of producing 0.25 to 0.41 l/sec through ∅25 mm pipes at depths of 3 to 5 m below ground surface. The relatively resistive layer ranging from 1,000 to 3,000 ohm-m encountered along the coast is considered to be an isolated sand dune with cemented sand.

Layer 2

This layer comprising the fluvial sediments of clay, silt, sand and gravel with geo-resistivity values ranging from 0.5 to 1.5 ohm-m is intruded with saline water. Its maximum thickness is approximately 70 m and the extent of its intrusions into inland is seen in the cross-sections D-D' and I-I'.

This layer is recharged through river bed, leaking salty ponds and rainwater infiltration to the ground. Layer 2 comprises relatively high permeable fluvial sediments at the downstream end of the northern Central Luzon plain hydrogeological system. Uncontrolled groundwater exploitation in the upstream of this system will lead to more deteriorated conditions, i.e., deeper and further inland.

Layer 3

This is the intermediate layer with geoelectric resistivity responses ranging from 2 to 11 ohm-m. It is composed of clay, silt and subordinate sandy and gravelly intercalations.

This sequence overlies the basement formation with unconformity in the depths of approximately 300 to 350 m below ground surface, especially in northwest areas of Dagupan City. The predominating sediments of Layer 4, as described below, intercalates with sediments of Layer 3 in areas east to southeast of Dagupan City. This condition can be best explained in the cross-sections B-B', C-C', D-D', I-I', and J-J'. The upper part of this layer, where the saline layer (Layer 2) is facing, will be invaded by the saline water in case the piezometric potential of the layer becomes less compared to the saline layer's potential.

Layer 4

This large lens-shaped layer with georesistivity values ranging from 11 to 20 ohm-m is composed mainly of alternating sequences of silty/clayey sand and sandy silt/clay with partly gravel interbeds. The west to northwest end of the lens-shaped layer interfaces with Layer 3 as shown in cross-section C-C'. The sequence has an average thickness of approximately 200 m. Confined aquifers with relatively good water-producing capabilities exist in between silty/clayey sand and gravel intercalations as proven by some of the lithological logs available from wells drilled in the study area. Majority of the DAWASA wells obtain groundwater from this formation, however, the aquifer characteristics cannot be determined because only fragmented data at the time of well construction are available.

FIGURE 6.6.3
GEORESISTIVITY SURVEY LOCATION AND ELECTROSTRATIGRAPHIC SECTIONS
DAGUPAN CITY

Layer 5

This layer is considered as the basement formation which widely outcrops in the west and southwest of Tarlac province. The basement formation of Upper Miocene to Pliocene in geologic age comprising of marine clastic sediments of poorly cemented sandstone, siltstone and poorly sorted conglomerate can be observed immediately east and south of San Carlos City (13 and 20 km, respectively). The formation probably forms the substratum of the Quarternary and extends to east and west as far as the mountain foothills where it is gravity-faulted. The basement formation is probably recharged through debris and alluvial fans composed of unconsolidated sediments covering the upper layer of the sequence. The layer has geoelectric resistivity responses in the range of 30 to 70 ohm-m. The uppermost part of the formation lies approximately 300 to 350 m below ground surface in areas north to northwest of Dagupan City. In other areas, its upper elevation could not be determined because the sharp depression of the formation has been created.

(2) Physical Characteristics

Based on the discussion on the hydrostratigraphy (Section 6.6.2.1), the following nature of the aquifer is summarized below:

Shallow Aquifer

L-1 (superficial layer), L-2 (upper saline layer) and upper portion of L-3 of which it is deposited down to 70 m below ground surface and overlying L-4 are grouped into shallow aquifer and characterized as follows:

- The aquifer is generally phreatic and partly confined to semiconfined.
- L-2 (upper saline layer) has invaded the northwestern part of Dagupan City.
- With an average well diameter of 150 mm drilled to a depth of 70 m, the aquifer can offer specific capacity and transmissivity values of 1.5 lps/m and 150 sq.m/day, respectively.

Deep Aquifer

The lower portion of L-3 (70 m below ground surface) and L-4 are classified as deep aquifer which have the following natures:

- The aquifer is being exploited by DAWASA wells with depths ranging from 113 to 195 m and casing diameters ranging from 114 to 250 mm at an average discharge rate of 6 l/sec (approximately 500 cu.m/day).
- As discussed in the section of water quality, some of the wells tapped to deep aquifer has been affected by the salt water intrusion.

6.6.3 Piezometric Conditions

Based on the water level measurements done during the field survey, a piezometric map has been drawn to define the groundwater flow and direction. However, the difficulty in measuring the water levels in most of the wells which are sealed and abandoned and the lack of well design to establish the different aquifers being exploited have rendered it improbable to reconstruct a more precise piezometric map. The piezometric contour map is shown in FIGURE 6.6.4.

The characteristics of the map maybe summarized as follows:

a) The BPW records have shown that when the wells were constructed, some of them were free-flowing or their piezometric level were near the ground surface. Because of massive upstream withdrawal, a constant decline of water level and decrease of reservoir pressure had been noticed.

b) The map shows a typical presentation of converging flow with gradual sloping pattern of northwest ward direction to Lingayen Gulf at an average gradient of 0.001.

c) The negative value of isopiestic contour lines is indicative of saline water intruding into the shallow aquifer as a result of excessive groundwater withdrawal in the upstream of Dagupan City.

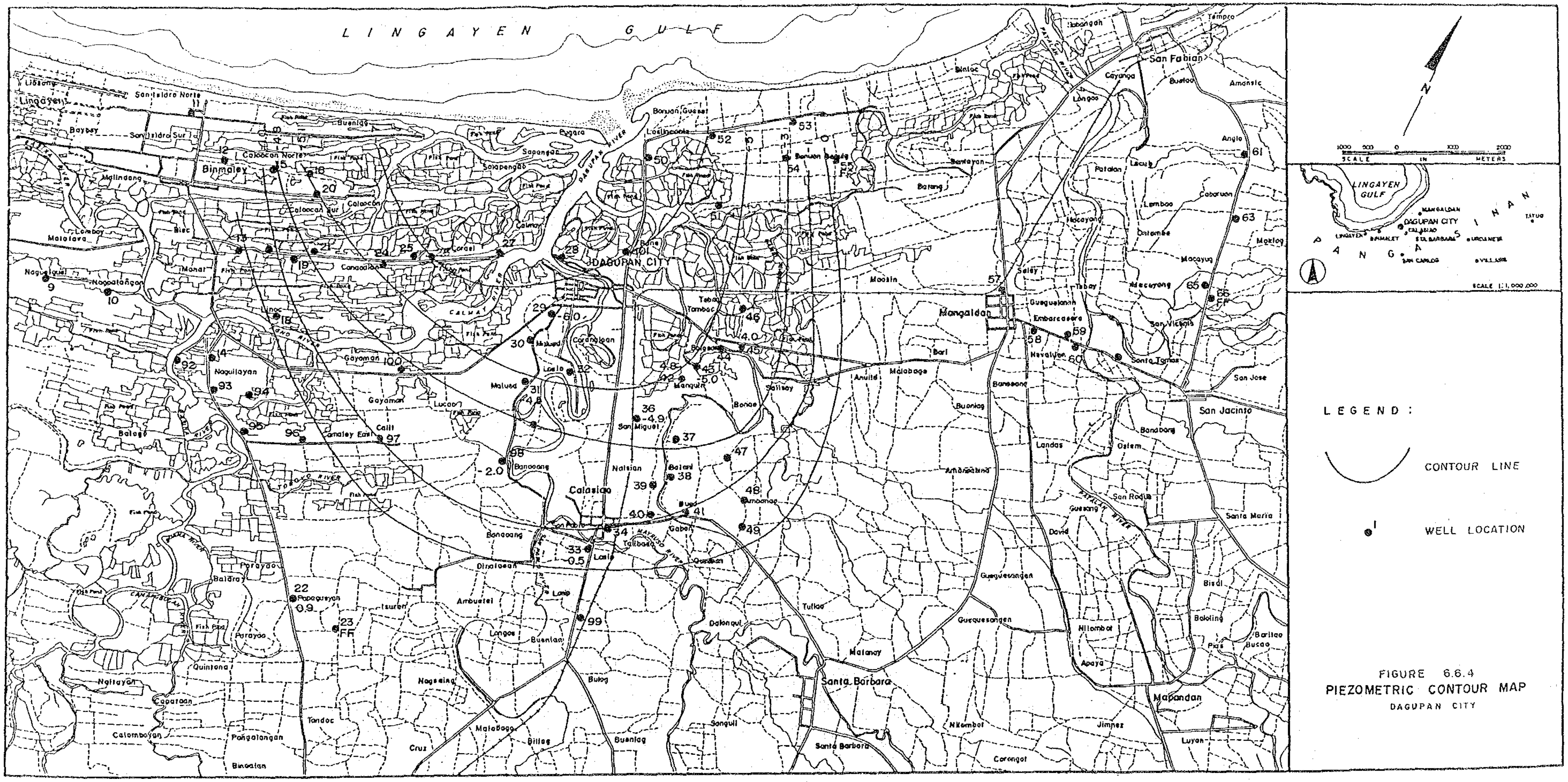


FIGURE 6.6.4
PIEZOMETRIC CONTOUR MAP
DAGUPAN CITY

d) Most of the wells located east of Dagupan City at a distance of 10 km or farther have shown no abrupt lowerings in water level.

6.6.4 Test Well

The test well drilling in Dagupan City was intended to explore aquifer not influenced by salt water intrusion. In this connection, the target depth of the test well was set at 300 m to allow for a 100 m deep exploration from a depth of 200 m which is the maximum depth of the existing deep wells.

In addition, the following objectives were also given to the test well drilling:

- Establish the hydrogeological stratigraphy including the lithological and geoelectric logs,
- Examine the hydraulic parameters for exploitation of groundwater, and
- Design the most suitable production well for the short term development.

The test well drilling site was determined at barangay Bacayao Norte which was the only available location within the area recommended based on the georesistivity survey and well inventory study (see FIGURE 6.6.4 Piezometric Contour Map).

The drilling work was commenced on August 6, 1986. When the pilot hole was drilled up to 292 m depth on August 21, the bore hole had collapsed. Although intensive recovering work was extended up to 242 m, the drilling equipment suffered a breakdown on September 25. After repair of the said equipment, the bore hole was redrilled up to 200 m from October 13 to 14. On October 16, drilling work was finally given up due to inclined casing pipe caused by continuous rainfall.

Through the above-mentioned drilling activities, cutting samples were collected from respective depths. Followings are the geological composition of the test well development from the evaluation of cutting samples:

Depth (m)	Description
0 - 10	Sandy silt/clay with some shells and a trace of pebbles. (Layer 1)
10 - 45	Homogeneous silt/clay (Layer 3)
45 - 60	Sandy silt with some pebbles. (Layer 4)
60 - 75	Clay
75 - 125	Gravelly silt/clay
125 - 270	Silt/clay with a little sand. (Layer 4)
over 270	Silt

Comparison of these samples with the previously obtained hydrogeological information indicated that the outline of the geological formation and hydrostratigraphy in the subject area are more or less the same as determined in the foregoing section; Hydrostratigraphy.

6.6.5 Groundwater Evaluation

As discussed in the previous section of aquifer and piezometric conditions, the gradual lowering of the piezometric head of not only the deep aquifer but also the shallow aquifer shows that the hydrogeological system around the area is no longer in equilibrium as a result of overexploitation in the hydrogeological upstream and Dagupan City.

Under such hydrogeological condition, a general evaluation of the groundwater resources can be made using Darcy's law of flow:

$$\frac{Q}{km} = T \times G \times 1{,}000 \text{ m/km}$$

where: Q = groundwater underflow (cu.m/day)
T = aquifer transmissivity (cu.m/day/m)
G = gradient of the piezometric surface

therefore,

$$Q/km = 190 \times 0.0014 \times 1{,}000 = 266 \text{ cu.m/day/km}$$

Thus, the underground water flow across a section of 1 km can be 266 cu.m/day/km which is equivalent to a fictive continuous flow of about 3 lps. This value is rather small compared with the data obtained from this study. However, the order of magnitude of groundwater flow in this area is more or less realistic under the present equilibrium conditions. Based on the above evaluation, 9,000 cu.m/day of groundwater cannot be exploited within the jurisdiction of Dagupan City.

6.7 WATER QUALITY

A total of 19 water samples were taken from surface water (Mayruso River) and groundwater (wells and spring), Physical and chemical analyses of these samples were performed to evaluate the water quality with respect to potability and treatment requirements. (Refer to APPENDIX 6.7.1)

6.7.1 Surface Water

The results of the physical and chemical analyses of the water sample taken from Mayruso River indicate that the water exceeds the permissible limit of turbidity set forth in the Philippine National Standards for Drinking Water (NSDW). This condition usually prevails during the rainy period when the river water is loaded with suspended solids.

If the Mayruso River is utilized as a supplement to the existing sources, raw water must be subjected to a complete treatment process to ensure year-round reliability.

6.7.2 Groundwater

Water samples from the present water supply sources of Dagupan City were taken for physical and chemical analysis. The results indicate that samples obtained from Pumping Station Nos. 6, 10, 12 and 14 exceeded the permissible limits of Total Dissolved Solids (TDS), pH, calcium and chloride.

The high chloride and conductivity values from samples of Pumping Station Nos. 6, 10 and 14 were in the range of 400 to 930 mg/l and 1800 to 2700 micro-Siemens/cm, respectively indicating that the shallow aquifer is contaminated with saline water. This phenomenon was previously confirmed by the georesistivity measurements as outlined in the section "Aqifers" (refer to APPENDIX 6.6.2.1). The drop of the natural water table below sea level has created an unstable dynamic condition which subsequently upset the physical equilibrium of the fresh-salt water interface. This maybe the reason for the presence of brackish/salty water in northwestern portion of Dagupan City extending up to the northern part of San Carlos City.

6.8 RECOMMENDED WATER SOURCES

6.8.1 Study of Alternative Water Sources

(1) Development of Alternatives

The groundwater resources in the subject area are limited and threatened by gradual deterioration due to the increasing exploitation in the upstream of the hydrogeological systems. This condition has led to the salt water intrusion further inland.

Under the above condition, alternative sources to meet the water demand of 30,600 cu.m/day in the year 2010 are identified as follows:

Alternative 1

Exploitation of deeper aquifer

Alternative 2

Control and possible elimination of salt water intrusion by:

a) Reduction of exploitation or planning a balanced utilization of groundwater for different uses, i.e., agricultural, industrial and domestic.

b) Construction of spreaded basin or recharge well which will provide an artificial fresh water recharge to the salt water intruded aquifer.

c) Development of a fresh water ridge adjacent to or parallel to the coastal line.

d) Construction of an artificial sub-surface barrier.

Alternative 3

Utilization of river water, i.e., Agno River in the southeast portion of the City and river water in the northeast portion of the City.

(2) Discussion of Alternatives

Among the above-listed alternatives, the possibility of tapping the Layer-4 (deep aquifer) within the administrative jurisdiction of the City without contributing to damage potentials of groundwater exploitation is quite low. An intensive exploitation of groundwater within the limited well field will further deteriorate fresh groundwater potential. Thus, Alternative 1 is not recommended for the long term development.

As to Alternative 2, only scheme "a" has been proven to be both technically and financially effective. However, such approach is not applicable for this specific project since it will require a regional master plan for the proper management of both ground and surface water resources of the Northern Luzon Basin. The concept of the development of fresh water ridge has been proven to be technically applicable, but financially not feasible. In general, the practical applicability of these four schemes mentioned in Alternative 2 are not yet properly established and therefore not recommended for the case of Dagupan City.

Alternative 3 has a disadvantage of the construction of long transmission pipeline because of its required length (for example, in the case of Agno River, about 26 km along the national road from the possible intake point in Bayambang Municipality to Dagupan City). The San Carlos City Water District made a plan for utilization of the water from Agno River as its future water source.

Considering the above-mentioned alternatives and the results of the field investigations, the utilization of the river water may be the only solution for the long term water supply. It is, however, noteworthy to recommend that the comprehensive regional water source development study be taken up prior to commence the Phase II project to seek for a rationalized and cost-effective development through the joint effort of Water Districts/ municipalities concerned.

6.8.2 Recommended Water Sources

The required amount of water of 30,600 cu.m/day is possible to be reserved either by tapping surface water or underflow of Agno River. Prior to implement the long term development plan, the allocation of water right toward the year 2010 and the possibility of sharing water intake and its relevant facilities with the municipalities concerned has to be established in order to lower the project cost and to maximize the utilization of the limited amount of water resources.

As to the short term development, the additional water requirement is estimated at about 9,000 cu.m/day in the year 1995. Although the presence of salt water intrusion limits the groundwater exploitation, the results obtained from georesistivity survey and well inventory study revealed that the Calasiao area just outside of the Dagupan City may offer a reasonable hydraulic parameters enough to sustain the said amount of water demand.

The well design is considered to have a total depth of about 250 m with a diameter of not less than 150 mm to exploit at least 600 cu.m/day from each well. The proposed well field for the short term development is presented in FIGURE 6.8.1.

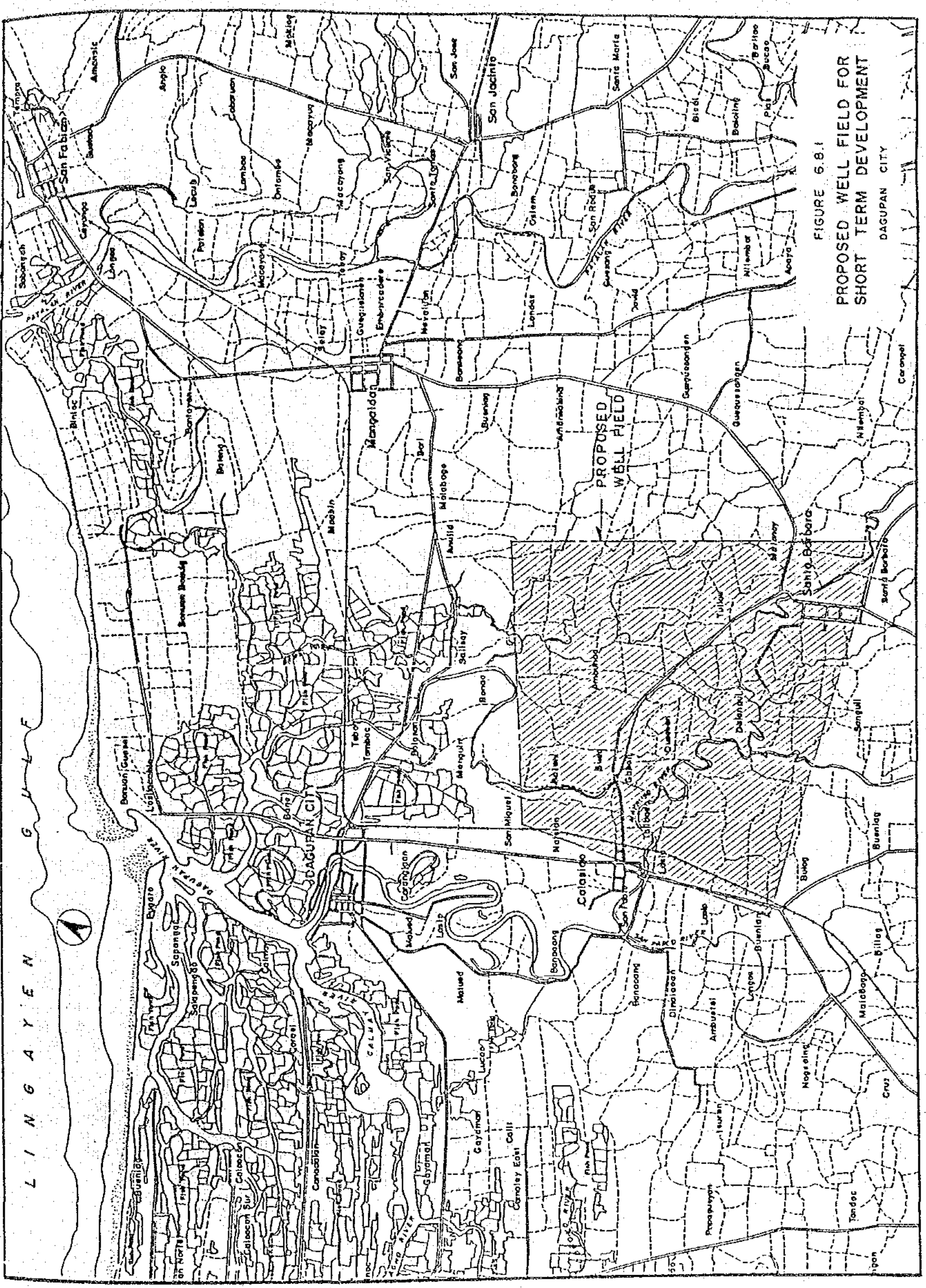


FIGURE 6.8.1
PROPOSED WELL FIELD FOR SHORT TERM DEVELOPMENT
DAGUPAN CITY

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 existing water supply sources/facilities and potential water sources, and on the results of the geoelectric sounding and the well inventory study.

The future city 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 including necessary transmission facility for two cases that whether the future water source will be only the Agno River or the combination of the Agno River and the groundwater from deep wells.

- Required storage capacity of reservoir is subsequently studied for three cases in relation to the need to develop additional water sources.

- Alternative distribution network is studied with reference to the most economical plan of phased development based on the result of foregoing alternative study (See APPENDIX 7.1.1).

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 DAILY AVERAGE AND MAXIMUM DEMAND

Unit: cu.m/day

Barangay	1990	1995	2010
Bacayao Norte	-	320	810
Bacayao Sur	-	-	380
Barangay 1	450	530	730
Barangay 2 & 3	690	690	980
Barangay 4	1,200	1,190	1,840
Bolosan	-	-	1,140
Caranglaan	640	1,000	2,070
Herrero	660	920	1,820
Lasip Chico	-	-	240
Lasip Grande	220	360	820
Lucao	610	1,000	2,380
Malued	670	1,030	2,120
Mayambo	600	760	840
Pantal	1,440	2,250	3,680
Poblacion Oeste	600	590	770
Pogo Chico	560	870	1,610
Pogo Grande	170	240	360
Salisay	-	-	350
Tambac	-	-	380
Tapuac	640	650	770
Tebeng	-	-	390
Daily Average Demand	9,150	12,400	24,480
Daily Maximum Demand	11,500	15,500	30,600

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) Realignment of Existing Deep Wells

As determined from the field investigations, 5 out of the 15 existing deep wells do not produce potable water. Of these, 3 have high chloride content, and the rest, undesirable color.

In this regard, it is best to abandon these wells so that the water from these wells will not flow into the distribution network. At the same time salt water intrusion at the remaining 10 wells will be decelerated.

A list of the existing wells, including those that are to be abandoned, is shown in TABLE 7.2.2.

TABLE 7.2.2 LIST OF EXISTING WELLS FOR REALIGNMENT

Well No.	Pump Capacity (cu.m/day)	Realignment
1	550	To be used
2	1,490	ditto
3	1,820	ditto
4	1,510	ditto
5	460	ditto
6	460	To be abandoned
7	740	To be used
8	460	ditto
9	600	ditto
10	600	To be abandoned
11	430	To be used
12	430	To be abandoned
13	Abandoned	-
14	580	To be abandoned
15	670	To be used
16	960	To be abandoned
Total	11,760	8,730

After realignment of the existing wells, the potential water production of the remaining 10 deep wells on a daily basis will be 8,730 cu.m/day. However, with the present practice of operating the pump 18 hours per day, the actual water production may be about 6,600 cu.ma/day (75% of the total potential production).

(2) Surface Water/Underflow Water

The Agno River was concluded to be the best potential source of water for long term development to supplement the present groundwater sources. The intake point at the Agno River is identified to be at Bayambang area, about 26 km inland from Dagupan City. This is in terms of its accessibility by road for construction of transmission pipeline. Although more detailed investigation will be required later, it can be said that a radial well may be used as the intake facility because of its low cost construction. (See APPENDIX 7.2.1 for details)

The following are the assumptions on the radial well at this planning stage:

Proposed Radial Well	Design Parameter	
Well depth	17.5	m
Diameter - concrete caisson	6	m
- radial collector	31	m
Estimated discharge	6,010	cu.m/day
Influence area	400	m (radius)

The allotment of water right among agencies/local governments concerned is the future requirements to put into practice the project.

(3) Groundwater

The life span of the existing 10 wells may be up to the end of the Phase I period because of the deterioration of the water quality of these wells from salt water intrusion.

To supplement the said present water production, a well field near Calasiao area, just outside of the city boundary, is identified to be suitable for about 9,000 cu.m/day. A proposed design parameter of deep wells to be constructed in the said area is as follows:

Proposed Deep Well	Design Parameter
Well depth	250 m
Casing diameter	150 mm
Estimated discharge	600 cu.m/day
Influence area	250 m (radius)

A total of 15 deep wells will be required to be constructed in the proposed well field.

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 1.5 m to 3.7 m above MSL. In this regard, only one pressure zone is considered for Dagupan City through the year 2010.

(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 the cost constraints as the intermediate measure of system improvement.

"C" value (Hazen William formula) being adopted in the said manual is also given below:

ø100 mm to ø200 mm : C = 110
ø250 mm to ø500 mm : C = 120
ø600 mm and over : C = 130

(3) Fire Protection

Full fire protection with adequate water pressure will be insured during the Phase II period. The criteria on the location of fire hydrants as 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 l/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 construction cost 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

Two alternative plans for water source and transmission were developed based on the available water sources. In each alternative, the existing 10 deep wells, whose total water production is about 6,600 cu.m/day, are considered to be dependable for the Phase I period, but may be abandoned in the Phase II period.

Alternative S-1

Phase I : Construction of 15 additional new deep wells with a total water production of about 9,000 cu.m/day in the Calasiao area.

Phase II : Utilization of underflow water of Agno River with a total water production of about 21,600 cu.m/day at the Bayambang area.

Alternative S-2

Phase I/II : Utilization of underflow water of Agno River both for Phase I and II; 21,600 cu.m/day for Phase I and 30,600 cu.m/day for Phase II.

In the utilization of the Agno River, there is no alternative routing of transmission line since the proposed pipeline route along the national road is the best one.

As to water treatment, the slow sand filtration process will be made use of. The location of this treatment facility is to be within the city boundary as is the site of water source facilities. This would make the operation/maintenance of the facilities much easier.

A schematic system diagram of these alternatives is shown in FIGURE 7.3.1 and outline of facilities is shown in TABLE 7.3.1.

TABLE 7.3.1 MAJOR FACILITIES OF ALTERNATIVES FOR WATER SOURCE AND TRANSMISSION

Facilities	Alternative S-1	Alternative S-2
Water Source	Deep Well (ø150 mm, 250m^{D}) 15 units Radial Well (ø6 m) 4 units	Radial Well (ø6 m) 5 units
Transmission Line	ø600 mm - 26,000 m ø350 mm - 4,000 m ø150 mm - 4,500 m	ø800 mm - 26,000 m
Water Treatment	Slow Sand Filter (4,320 sq.m)	Slow Sand Filter (6,300 sq.m)

(2) Cost Comparison

A cost comparison of these alternatives (1986 price level) is given in TABLE 7.3.2.

Comparing the cost of two alternatives, Alternative S-1 is more favorable than Alternative S-2. Besides a lower cost in construction and operation/maintenance, Alternative S-1 has a potential advantage as it can supply the increased demand of water.

Thus, for water source development and transmission, Alternative S-1 is recommended for the target year of 2010.

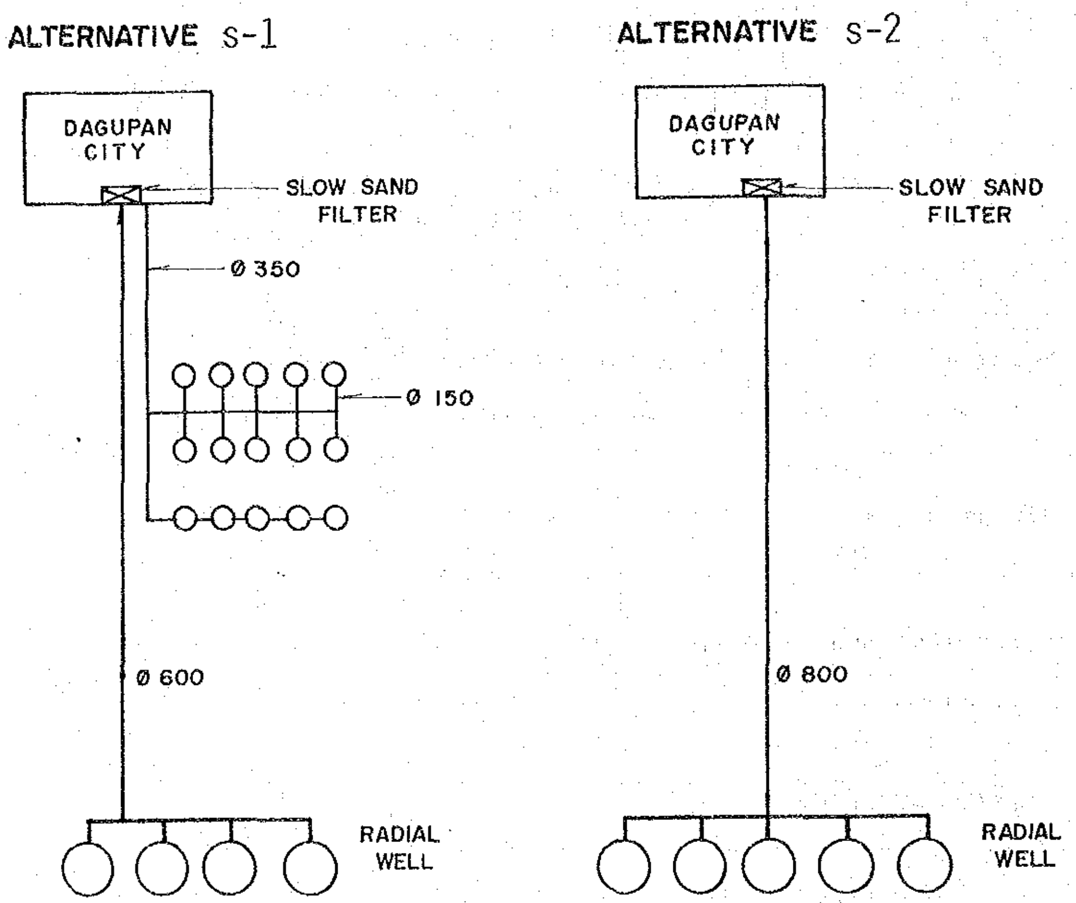


FIGURE 7.3.1 SYSTEM CONFIGURATION OF ALTERNATIVES

TABLE 7.3.2 COST COMPARISON OF WATER SOURCE ALTERNATIVES

Unit : ₱ x 1,000

Storage Volume	Unit Cost (₱)	Alternative S-1		Alternative S-2	
		Q'ty	Cost	Q'ty	Cost
1. Water Source					
Deep Well					
Well	640,000	15 units	9,600	-	-
Pump	450,000	15 units	6,750	-	-
Sub-Total			16,350		
Radial Well					
Well	1,760,000	4 units	7,040	5 units	8,800
Pump House	634,000	4 units	2,536	5 units	3,170
Pump	403,000	8 units	3,224	10 units	4,030
Sub-Total			12,800		16,000
TOTAL			29,150		16,000
2. Transmission Line					
∅800 mm	2,230/m	-	-	26,000 m	57,980
∅600 mm	1,600/m	26,000 m	41,600	-	-
∅350 mm	900/m	4,000 m	3,600	-	-
∅150 mm	410/m	4,500 m	1,845	-	-
TOTAL			47,045		57,980
3. Slow Sand Filter	-	4,320 sq.m	10,783	6,300 sq.m	14,136
4. Energy Consumption 15 years	0.5/KWH	34,040 MWH	17,020	38,346 MWH	19,173
5. Maintenance Cost 15 years (10% of construction cost)		1 lot	130,467	1 lot	132,174
GRAND TOTAL			234,465		239,463

7.3.2 Storage Facilities

(1) Development of Alternatives

In developing alternative plans for storage requirements, the following assumptions are adopted:

Phase I (1995)

- o Daily maximum supply and maximum storage capacity are considered.

Phase II (200)

- o Three alternatives as described in the previous section are taken up.
- o For cases of the intermediate supply and the peak hour supply, the demand variation is considered to be managed by the new deep well water sources since these sources are apparently cheaper than to increase the capacity of the water intake, the raw water conveyance and the treatment facilities.

The storage requirements of each alternative are estimated, as shown in TABLE 7.3.3.

TABLE 7.3.3 STORAGE REQUIREMENTS OF ALTERNATIVES

Design Year	Served Pop.	Daily Max. Demand (cu.m/day)	Storage Volume (cu.m) Emergency	Alt. R-1 Maximum Op'l	Alt. R-1 Maximum Total	Alt. R-2 Intermediate Op'l	Alt. R-2 Intermediate Total	Alt. R-3 Minimum Op'l	Alt. R-3 Minimum Total
1990	32,910	11,450	-	1,889	1,889	1,889	1,889	1,889	1,889
1995	48,840	15,480	-	2,399	2,399	2,399	2,399	2,399	2,399
2010	90,130	30,590	2,549	4,374	6,923	489	3,038	0	2,549

Based on the above storage requirements, the needs for additional water source facilities should be able to cope with the peak hour demand. Alternative R-2 necessitates additional 26 deep wells over Alternative R-1. The requirement for Alternative R-3 is more than that of Alternative R-2, but the required storage capacity of the reservoir for these two alternatives are similar as compared to Alternative R-1.

(2) Cost Comparison

According to the facility requirements of each alternative, it is apparent that Alternative R-3 costs higher than Alternative R-2. Thus, the cost comparison is made only between Alternatives R-1 and 2 on the basis of 1986 price level.

In the cost comparison, the following common facilities are excluded from the cost estimates.

a) Radial wells (4 units) and their raw water conveyance main up to the water treatment facility.
b) Slow sand filtration facility.
c) Distribution pumps to be installed at the reservoir and distribution pipelines.

A summary of cost comparison is shown in TABLE 7.3.4. Based on the above comparison of storage facilities, Alternative R-1 is recommended.

TABLE 7.3.4 COST COMPARISON OF ALTERNATIVE STORAGE CAPACITIES

Facility/Costs	Alternative R-1 (Max.)	Alternative R-2 (Intermediate)
Required Facilities		
Reservoir - Phase I	2,399 cu.m	2,399 cu.m
- Phase II	4,524 cu.m	639 cu.m
TOTAL	6,923 cu.m	3,038 cu.m
Water Sources	15 wells	41 wells
Construction Costs		
Reservoir - Phase I	₱ 2,897,000	₱ 2,897,000
- Phase II	₱ 4,346,000	₱ 1,244,000
Sub Total	₱ 7,243,000	₱ 4,141,000
Water Sources - Well	₱ 9,600,000	₱26,240,000
- Pump	₱ 6,750,000	₱18,450,000
Sub Total	₱ 16,350,000	₱44,690,000
TOTAL	₱ 23,593,000	₱48,831,000

(3) Location of Storage Facilities

With regard to the location of the distribution reservoir, the best construction site is at Barangay Caranglaan. Not only is land available, but the place is also the route of the conveyance/transmission pipelines from the water source facilities.

7.3.3 Distribution Network

(1) Development of Alternatives

The choice of alternative routes for the major distribution pipeline is limited because of roads and traffic conditions as well as the size and location of the major demand centers in the proposed service area.

Considering all these conditions, two alternative plans for the distribution network are developed: Alternative D-A consists of a single pipeline alignment and Alternative D-B forms a parallel pipeline alignment.

Alternative D-A

- The most optimum network configuration, allowing the peak hour water flow in the year 2010, was determined through the computer-aided network simulation. Criteria set forth in the LWUA Methodology Manual are satisfied in the Phase II period.

Alternative D-B

- Based on the optimum route for major distribution pipelines as established in Alternative D-A, the least cost network configuration satisfying a minimum of 0.7 kg/sq.cm. of water pressure under the peak hour water flow during the Phase I period was determined by means of computer simulation.

- For the Phase II stage, additional distribution pipes to form a parallel pipe alignment wherever necessary to satisfy all the criteria were subsequently determined.

Network configuration of these alternatives by pipe size are presented in TABLE 7.3.5. Details of the computer-aided network analysis are given in APPENDIX 7.3.1.

TABLE 7.3.5 CONFIGURATION OF ALTERNATIVE DISTRIBUTION NETWORKS

Materials	Alternative D-A			Alternative D-B		
	Phase I	Phase II	Total	Phase I	Phase II	Total
Pipe (m)						
ϕ 100 mm	290	500	790	1,130	290	1,420
ϕ 150 mm	0	4,160	4,160	1,910	6,150	8,060
ϕ 200 mm	1,780	1,030	2,810	880	2,500	3,380
ϕ 250 mm	550	6,450	7,000	2,790	9,580	12,370
ϕ 300 mm	3,650	0	3,650	400	440	840
ϕ 350 mm	840	0	840	660	360	1,020
ϕ 400 mm	360	0	360	290	590	880
ϕ 450 mm	300	0	300	1,710	1,360	3,070
ϕ 500 mm	290	0	290	0	350	350
ϕ 600 mm	1,360	0	1,360	0	0	0
ϕ 700 mm	350	0	350	0	0	0
Total	9,770	12,140	21,910	9,770	21,620	31,390
Valves (pcs.)						
ϕ 100 mm	1	2	3	4	1	5
ϕ 150 mm	0	14	14	6	21	27
ϕ 200 mm	6	3	9	3	8	11
ϕ 250 mm	2	22	24	9	32	41
ϕ 300 mm	12	0	12	1	1	2
ϕ 350 mm	3	0	3	2	1	3
ϕ 400 mm	1	0	1	1	2	3
ϕ 450 mm	1	0	1	6	5	11
ϕ 500 mm	1	0	1	0	1	1
ϕ 600 mm	5	0	5	0	0	0
ϕ 700 mm	1	0	1	0	0	0
Total	33	41	74	32	72	104

(2) Cost Comparison

Construction costs of each alternative were estimated including valves to be installed at every 300 m intervals.

For cost comparison purposes, the year of construction is set in 1990 for Phase I and 1998 for Phase II pipelines. Discount rate applied to each phase is 12% per annum. For reference, 10% and 15% discount rates are also applied.

A summary of cost comparison is presented in TABLE 7.3.6.

TABLE 7.3.6 COST COMPARISON OF ALTERNATIVE DISTRIBUTION NETWORK (NET PRESENT WORTH)

Unit : ₱ x 1,000

Distribution Network	Discount Rate 10%	12%	15%
Alternative D-A			
Phase I: (ø100 - ø700 mm)			
Pipeline: 9,770 m	5,476	5,246	4,848
Valve : 33 pcs.	1,638	1,570	1,450
Sub Total	7,114	6,816	6,298
Phase II: (ø100 - ø250 mm)			
Pipeline: 12,140 m	1,552	1,329	1,031
Valve : 41 pcs.	84	72	56
Sub Total	1,636	1,401	1,087
TOTAL	8,750	8,217	7,385
Alternative D-B			
Phase I: (ø100 - ø450 mm)			
Pipeline: 9,770 m	4,009	3,841	3,549
Valve : 32 pcs.	748	717	662
Sub Total	4,756	4,557	4,211
Phase II: (ø100 - ø500 mm)			
Pipeline: 21,620 m	3,188	2,728	2,118
Valve : 72 pcs.	394	337	261
Sub Total	3,582	3,065	2,379
TOTAL	8,339	7,622	6,590

At the discount rate of 12% per annum, Alternative D-B is only 7.8% cheaper than Alternative D-A. Therefore, further cost comparison is made considering the cost escalation at 12% per annum from 1986 to 1989 and 10% from 1990 to 1998, as shown in TABLE 7.3.7.

TABLE 7.3.7 ESCALATED PROJECT COST OF ALTERNATIVE DISTRIBUTION NETWORK

Unit : ₱ x 1,000

Distribution Network	Discount Rate		
	10%	12%	15%
Alternative D-A			
Phase I	11,194	10,725	9,910
Phase II	5,518	4,726	3,666
TOTAL	16,712	15,451	13,576
Alternative D-B			
Phase I	7,485	7,171	6,626
Phase II	12,082	10,338	8,024
TOTAL	19,567	17,509	14,650

Based on the above cost comparison, it is concluded that Alternative D-A (single pipeline alignment) is the most optimum plan for the phased 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 Dagupan City water supply system based on the results of the 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 Dagupan City is shown in FIGURE 8.2.1 and its schematic layout is also shown in FIGURE 8.2.2. 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.

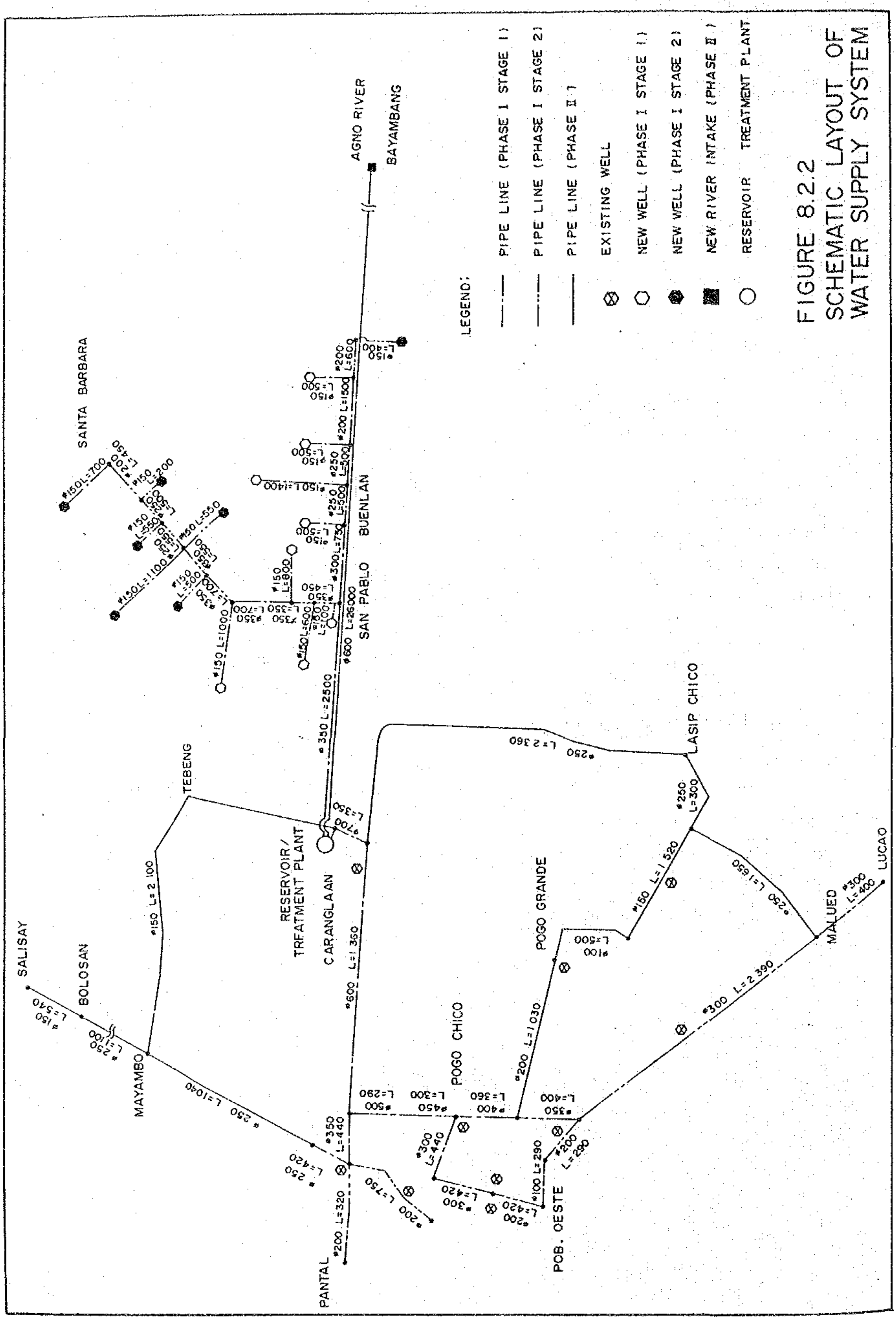


FIGURE 8.2.2 SCHEMATIC LAYOUT OF WATER SUPPLY SYSTEM

(1) Source Facility

The 10 existing deep wells with a total water production of 6,550 cu.m/day will be used in Phase I. Additional 15 deep wells with an average yield of 600 cu.m/day will be located in the Calasiao area during the Phase I period and will be utilized throughout the Phase II. The underflow water of the Agno River will be utilized through the 4 units of radial wells with a total production of 21,600 cu.m/day (See FIGURE 8.2.3).

(2) Transmission Facility

New transmission main will be constructed from respective water sources to the reservoir corresponding to the plan of water source development.

(3) Treatment Facility

During the Phase I period, a constant flow chlorinator will be installed at each of the 10 existing deep well pumping stations and at the ground reservoir to be constructed in Barangay Caranglaan.

In Phase II, a slow sand filtration plant will be constructed at the site of the ground reservoir to treat the water from the radial wells at the Agno River. And an additional chlorinator with a capacity of 45 kg/day constant dosage will be installed at the reservoir.

(4) Distribution Facility

The ground reservoir will be constructed at Caranglaan with a capacity of 2,400 cu.m in the Stage 1 of Phase I and expanded to about 7,000 cu.m during the Phase II period. The booster pump station with a capacity of about 10 cu.m/minute at 30 m head will be constructed at the reservoir in Stage 1 and its capacity will be increased to 14 cu.m/minutes in Stage 2 and to 20 cu.m/minute in Phase II period. Installation cost of the power generation facility for emergency use and the neutralization equipment for the disinfection facility are excluded in the cost estimates of this planning stage. The necessity of installing these facilities is the subject to be determined in Phase II period.

Main distribution pipeline from the reservoir to Pogo Chico will be constructed in the Stage 1 of Phase I. During the Stage 2 period, main pipelines to Lucao, Pob. Oeste and Pantal will be extended. Other main distribution pipeline will be constructed in the Phase II period. The existing distribution lines in the town proper will be utilized as a part of the internal network.

(5) Service Connections

As it has been observed during the field survey of existing water supply facilities, there are considerable number of service connections with not-functioning water meters and unmetered service connections. Leakages from service connections were also confirmed as well.

Resultant from these situation, the implemenation of leakage detection survey and repair/replacement of damaged water meters and service connections are to 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.

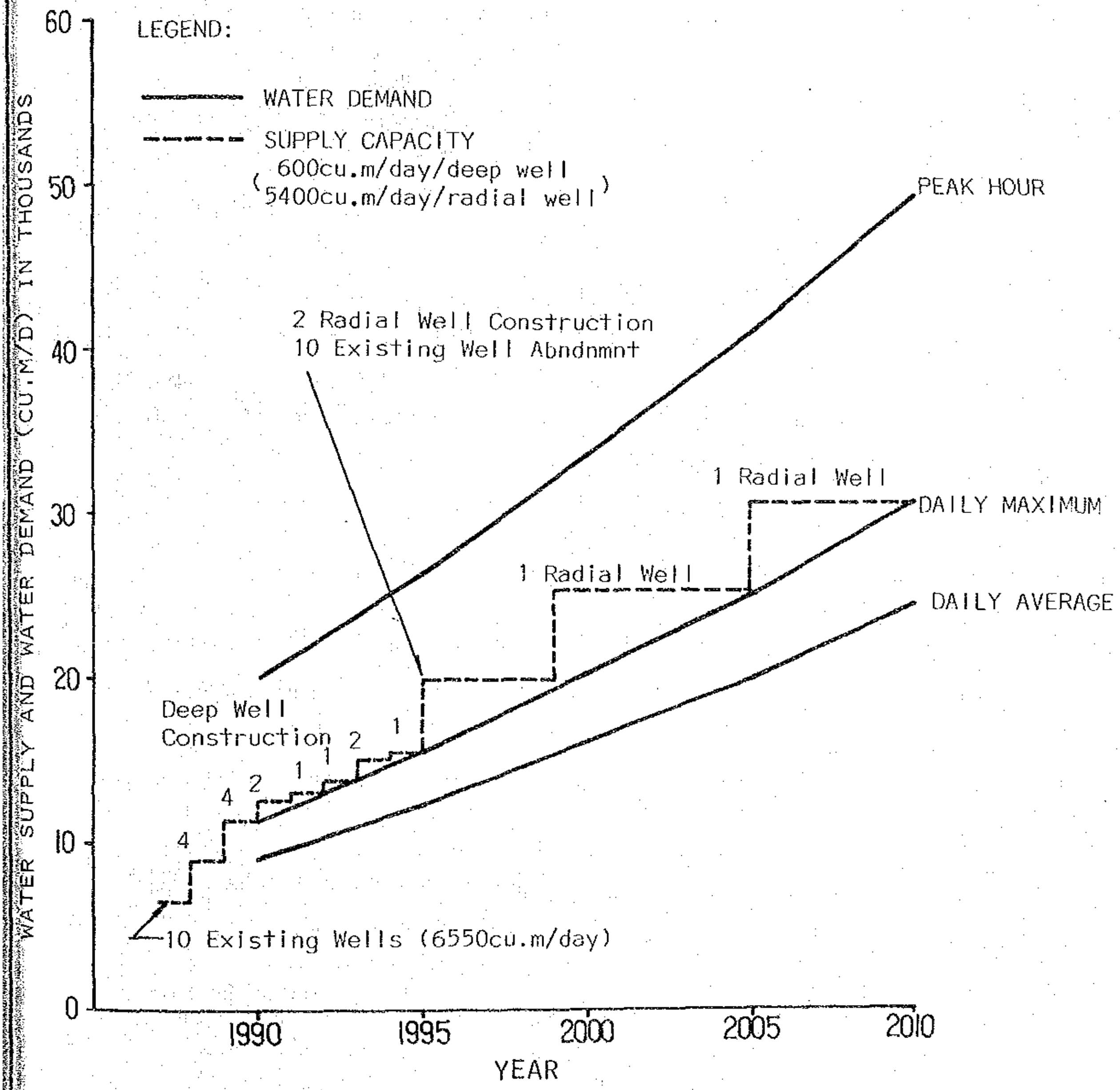


FIGURE 8.2.3

WATER SUPPLY VS. DEMAND CURVE OF RECOMMENDED PLAN

TABLE 8.2.1 DESCRIPTION OF REQUIRED FACILITIES BY PHASE

Phase	Facility	Major Facilities Required
Phase I Stage 1	Source	o 5 out of 15 existing wells will be abandoned due to salt water intrusion. Pumping facilities at the remaining 10 existing wells will be renewed. o A total of 8 wells will be constructed in the Calasiao Area. o Total water production: 6,550 cu.m/day from the existing 10 wells and 4,800 cu.m/day from the new 8 wells.
	Treatment	o 11 chlorination facilities at the 10 existing wells and the proposed reservoir. (22 kg/day, constant dosage)
	Transmission	o Pipeline between the proposed reservoir and the new wells (ϕ650-ϕ350, 12,650 m)
	Distribution	o Reservoir with booster pumping station at Caranglaan (V=2,400 cu.m, 9.7 cu.m/minute x 30 m head) o Main pipelines from the reservoir to the city's core area (ϕ300-ϕ700, 3,540m) o Internal network and service connection in the service area.
	Electricity	o Substation with a capacity of 200 KVA at the reservoir
	Others	o Construction of Operation Center o 2 vehicles will be purchased.

TABLE 8.2.1 DESCRIPTION OF REQUIRED FACILITIES BY PHASE (CONT'D)

Phase	Facility	Major Facilities Required
Phase I Stage 2	Source	o 7 additional wells in the Calasiao area (4,200 cu.m/day)
	Transmission	o Additional pipeline (ø150-ø350, 7,200m)
	Distribution	o Additional booster pump facilities at the proposed reservoir (4.3 cu.m/minute x 30 m head) o Extension of Main Pipeline (ø200-ø350, 5,940m)
	Others	o 1 vehicle will be purchased.
Phase II	Source	o 4 radial wells at the Agno River in Malasiqui, Mun. of Bayambang (ø6m x 16m depth, 21,600 cu.m/day) o 10 existing wells will be abandoned. o 8 pump installation with one stand-by at the radial wells
	Treatment	o Additional chlorination facility at the reservoir (45kg/day, Constant dosage)
	Electricity	o Expansion of substation at the reservoir (to 400 KVA)
	Transmission	o Pipeline between the reservoir and the radial wells at the Agno River (ø300 x 2,400m, ø600 x 26,000m)

TABLE 8.2.1 DESCRIPTION OF REQUIRED FACILITIES BY PHASE (CONT'D)

Phase	Facility	Major Facilities Required
Phase II	Distribution	o Expansion of reservoir (V=4,550 cu.m) including additional pump facility (20.2 cu.m/minute x 30 m head) o Extension of main distribution pipeline (ϕ150-ϕ250, 11,640m)
	Others	o Construction of the Administration Building o 3 vehicles will be purchased o Replacement of pumps, chlorinator, flow meters, water meters, equipments of operation center, and vehicles purchased during Phase I

TABLE 8.2.2 SUMMARY OF MAJOR FACILITIES REQUIRED BY PHASE

Item	Phase I Stage 1	Phase I Stage 2	Phase II*	Total
1. Source Facility				
(1) Deep well (ϕ150 x 250m)	8 units	7 units	-	15 units
(2) Radial well (ϕ6m, 16mD)	-	-	4 units	4 units
(3) Pumping facility				
Deep well pumping station (0.42 cu.m/min/pump)	8 sets	7 sets	-	15 sets
Deep well pump (0.45 cu.m/min/pump)	10 sets	-	-	10 sets
Radial well pump (29 KW, 55 m-head)	-	-	9 sets	9 sets
Radial well pump house	-	-	4 units	4 units
(4) Flow meter (ϕ100)	18 units	7 units	-	25 units
2. Transmission Facility				
Pipeline (ϕ150 - ϕ600)	12,650 m	7,200 m	28,400 m	48,250 m
3. Water Purification Plant				
Slow sand filtration (21,600 cu.m/day)	-	-	1 lot	1 lot
4. Distribution Facility				
(1) Reservoir (V=2,400 cu.m/4,550 cu.m)	1 unit	-	1 unit	2 units
(2) Booster pump station (30 m head)	1 unit (9.7 cu.m/min)	1 unit (4.3 cu.m/min)	1 unit (20.2 cu.m/min)	3 units
(3) Chlorination facility (constant flow 22/45 kg/day)	11 units	-	1 unit	12 units
(4) Electric sub-station	200 KVA	-	400 KVA	400 KVA
(5) Distribution pipes				
1) Main pipe (ϕ200 - ϕ600)	3,540 m	5,940 m	11,640 m	21,120 m
2) River crossing (D=1.5m, ϕ250 - ϕ450)	120 m	-	300 m	420 m
3) Valve (ϕ200 - ϕ700)	13 sets	25 sets	39 sets	77 sets
4) Internal network (ϕ100/ϕ150)	21,700 m	3,800 m	25,400 m	50,900 m
5) Service connection w/meter (1/2", 3/4")	2,296	3,818	8,956	15,070
6) Water meter (1/2", 3/4")	1,408	-	-	1,408
7) Fire protection (ϕ150 - ϕ75)	-	-	343	343
8) Flow Meter (ϕ400)	-	-	1 set	1 set
9) Administration & Operation building	1 bldg.	-	1 bldg.	2 bldg.
10) Vehicle	2	1	3	6

* 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 the 1986 price level.

A summary of estimated project cost is shown in TABLE 8.2.3 and the detailed breakdown 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) Source Facilities	11,690	7,805	13,203
2) Transmission Facilities	7,794	3,835	43,424
3) Purification Plant	0	0	9,544
4) Reservoir	2,898	0	4,362
5) Disinfection Facilities	1,079	0	119
6) Electric Sub-station	2,620	0	1,020
7) Distribution Facilities	15,684	6,287	22,177
8) Service Connection	4,020	3,095	7,261
9) Admin. Bldg. & Ope. Ctr.	1,380	0	1,610
10) Land Acquisition	132	0	1,320
11) Vehicle & Stored Material	1,103	547	1,798
12) Replacement of Equipment	-	-	14,562
Sub-Total	48,400	21,569	120,400
Physical Contingency (8%)	3,872	1,726	9,632
Total	52,272	23,295	130,032
Leakage Detection	1,020	-	-
Engineering Charge			
D/D (10% of Total)	7,557	-	13,003
C/S (4% of Total)	2,091	932	5,201
GRAND TOTAL	62,940	24,227	148,236

Operation and maintenance cost for each Stage and Phase are summarized as follows:

Phase I	Stage 1 (1990)	:	2,855 thousand pesos per annum
	Stage 2 (1995)	:	4,214 thousand pesos per annum
Phase II	(2010)	:	7,028 thousand pesos per annum

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		1,420	1,420	1,410								
Source Facility												
- Deep Well ϕ150 D=250m			4	4	2	1	1	2	1			
- Deep Well Pumping Station			4	4	2	1	1	2	1			
- Existing Well Rehabilitation			10									
- Radial Well ϕ6m D=16m										2 1	1	
- Radial Well Pumping Facilities												
Transmission Facility												
- Deep Well - Reservoir ϕ150-ϕ350, 19,850m			8,650	4,000	2,300	1,100	950	1,850	1,000			
- Agno River - Reservoir ϕ300 x 2,400m, ϕ600, 26,400m										26,800 800	800	
Treatment Facilities												
- Disinfection Facilities			11							1		
- Slow Sand Filtration Plant												
Distribution Facilities												
- Reservoir			2,400							4,550		
- Booster Pump Facilities												
- Power Sub-Station			200KVA							400KVA		
- Distribution Main Pipeline												
ϕ200-ϕ700, 9,480m			1,710	1,830	5,940							
ϕ150-ϕ250, 11,640m										11,640		
- Internal NetWork												
ϕ75-ϕ150, 25,490m			10,844	10,844	760.4	760.4	760.4	760.4	760.4			
ϕ75-ϕ250, 25,444m											25,444	
- Service Connection												
ϕ1/2"x 6,090, ϕ3/4"x 24			1,139/8	1,140/9	763/1	762/2	762/1	762/2	762/1			
ϕ1/2"x 8,940, ϕ3/4"x 16											8,940/16	
- Rehabilitation												
o Water Meter		1,392/16										
ϕ1/2"x 1,392, ϕ3/4"x 16												
o Service Connection 2,125		709	708	708								
o Laterals												
- Flow Meter ϕ400										1		
- Fire Protection (ϕ100, ϕ150 343)										343		
Others												
- Operation Center												
- Administration Building												
- Land Aquisition												
- Vehicle		1 *	1 *		1 *					1 *	1 *	1 *
- Replacement of Equipments Installed in Phase I												

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

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 system. The Financial Internal Rate of Return (FIRR) 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 March 1986, DAWASA has 4,250 metered connections and unmetered connections.

The water rates charged by DAWASA were adjusted as needed in order to improve the service of water supply system and to maintain its financial riability. The past adjustments in the water rates for metered connections are shown below.

Consumption Ranges	Water Rates	
	Nov. '73	Apr. '80
1-10 cu.m	₱5.00/month(min.)	₱10.00/month(min.)
11-20 cu.m	0.55/cu.m	1.10/cu.m
21-50 cu.m	0.55/cu.m	1.20/cu.m
51-100 cu.m	0.55/cu.m	1.20/cu.m
101-200 cu.m	0.55/cu.m	1.20/cu.m
Over 200 cu.m	0.55/cu.m	1.20/cu.m

The past water rates were applied to all customers without a distinction between residential and commercial user.

Now, following rate structure has been effective since 1984.

(1) Water Rates

There are two (2) types of water rates, i.e., flat rates and metered rates, as follows :

a) Flat Rates:

Ten (10) metered public faucets are applied a flat rate of ₱30.00/month, however, some additional fees are added to the flat rate based on the number of consumers of each public faucet. The other nineteen (19) unmetered public faucets are used free of charge.

b) Metered Rates:

Consumption Ranges	Residential	Commercial
1-10 cu.m	₱25.00/month (min.)	₱30.00/month (min.)
11-20 cu.m	2.75/cu.m	3.25/cu.m
21-50 cu.m	3.00/cu.m	3.50/cu.m
51-100 cu.m	4.00/cu.m	4.00/cu.m
101-200 cu.m	4.50/cu.m	4.50/cu.m
Over 200 cu.m	5.00/cu.m	5.00/cu.m

These rates are applicable to metered connections.

(2) Connection Service Fees

The applicant pays the following connection service fees.

a) Tapping Fees:

Size of Connection	Residential	Commercial
1/2"	₱120.00	₱200.00
3/4"	180.00	250.00
1"	220.00	320.00

b) Extension Fees:

Size of Connection	Residential	Commercial
1/2"	₱ 90.00	₱150.00
3/4"	120.00	200.00
1"	180.00	250.00

c) Inspection and Estimates Fees: ₱30.00

d) Meter Test Fees:

1/2"	₱15.00
3/4"	25.00
1"	40.00

e) Installation and Labor Fees: ₱80.00 (minimum)

f) Minimum advance to cover two (2) months consumption : ₱90.00

9.2.2 Revenue and Expenditure

The annual revenue and expenditure of the waterworks system in the last three years are shown below:

Year	Revenue	Expenditure (Capital Outlay)	Net Revenue
1983	₱1,803,121	₱1,392,709	₱ 410,411
		(49,890)	
1984	2,786,941	2,316,324	470,616
		(91,658)	
1985	4,495,278	2,528,177	1,967,101
		(0)	

It is observed that the increase in the water rate charged in September 1984 contributed to the increase in revenue in 1984 and 1985.

In 1985, the waterworks revenue was about 19% of the City's total revenue while its expenditure was about 10% of the City's total expenditure. This means that the waterworks system is a revenue earner for the City.

Regarding the revenue of the waterworks, its breakdown is shown in TABLE 9.2.1 below.

TABLE 9.2.1 BREAKDOWN OF REVENUE OF DAWASA

	1983	1984	1985
Water Sales	₱1,704,551	₱2,682,397	₱4,414,329
Connection Service Fee	98,570	104,544	80,949
Total	₱1,803,121	₱2,786,941	₱4,495,278

To reduce unaccounted-for water in the system of DAWASA, priority should be in providing meters for all connections, especially for the 29 unmetered public faucets. The present water rate must also be reviewed to come out with a more socialized scheme.

A breakdown of the expenditures is shown in TABLE 9.2.2. Also the corresponding breakdown in percentage is shown below :

	1983	1984	1985
Personal Services	42.8%	34.9%	35.9%
Maintenance & Operating Expenses	54.3	61.2	64.1
Capital Outlay	2.9	3.9	0
Total Expenditure	100.0%	100.0%	100.0%

Electricity cost, which is included in the maintenance and operating expense, has been ranked as the biggest cost item of the total expenditure in the waterworks at 47.7% in 1984 and 43.5% in 1985. Next are salaries and wages at 23.4% in 1984 and 25.0% in 1985.

TABLE 9.2.2 EXPENDITURE OF DAWASA

	1983	1984	1985
1. Personal Services			
Salaries and Wages	₱476,876	₱541,804	₱603,296
Insurance1/	46,378	44,829	51,505
Living Allowance & Medicare	61,491	163,731	194,097
Home Development Fund	10,173	15,141	15,995
Bonus	-	41,985	41,584
Sub-Total	₱595,918	₱807,490	₱906,477
2. Maintenance and Other Operating Expenses			
Traveling & Communication	₱ 7,800	₱ 10,289	₱ 18,702
Maintenance of Gov't Facility	35,945	40,757	147,232
Supplies and Materials	179,367	231,203	0
Electricity	472,369	1,104,118	1,049,054
Repair of Equipment	59,188	28,531	45,707
Other Services	1,232	2,278	361,005
Sub-Total	₱755,901	₱1,417,176	₱1,621,700
3. Capital Outlay			
Equipment	₱ 8,090	₱91,658	0
Building & Structure	32,800	0	0
Sub-Total	₱40,890	₱91,658	0
Total Expenditure	₱1,392,709	₱2,316,324	₱2,528,177

1/ Life insurance, Retirement insurance and State insurance

9.3 MARKET SURVEY

The market survey for the study area in Dagupan City was conducted from May 21 to June 2, 1986 with LWUA's cooperation using the simplified market survey method. The number of respondents totaled 4,050 and the estimated coverage ratio in the study area is 35%.

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 Bracket 2/	Ave.Pesos	Number
₱900 and below	650	1,027
₱901 to ₱1500	1,224	1,227
₱1,501 to ₱2,500	2,121	674
₱2,501 to ₱4,500	3,501	458
₱4,501 and above	8,406	314

From the result of market survey, the respondents' willingness to connect and the user's types are summarized as follows :

Answer		Residential	Commercial	Industrial	Total
Yes	:	31.3 %	21.6 %	20.4 %	30.5 %
No	:	36.8	29.0	44.4	36.4
Undecided	:	0.8	0.7	0.0	0.8
With Own Conn.	:	31.1	48.7	35.2	32.3

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

Residential users account for 92% of the total respondents and willingness to connect on the part of the respondents is only 30% of the total, while unwillingness to connect is 36%. It is observed from the result of the market survey that one third of respondents, especially in the low income group, are not willing to connect to the waterworks system in Dagupan city.

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 reasonable 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, 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 ₱157.54 million and its breakdown is shown in TABLE 9.4.1.

The proposed financing scheme for the project is as follows :

Project Cost		₱157.54	million
Equity	5%	7.88	"
LWUA Regular Loan	50%	78.77	"
LWUA Soft Loan	45%	70.89	"
Capitalized Interest		₱17.74	"
Total Project Cost		₱175.28	million

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 ₱167.40 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.

TABLE 9.4.1 BREAKDOWN OF PROJECT COST

(Unit : 1.000 Pesos)

Year	1988	1989	1990	1991	1992	1993	1994	1995	Total
Construction Cost	1,550	33,022	13,828	10.315	2,394	2,453	3,991	2,416	69,969
Physical Contingencies	124	2,642	1,106	825	192	196	319	193	5,598
- Sub Total -	1,674	35,664	14,934	11,140	2,586	2,649	4,310	2,609	75.567
Price Contingencies	540	18,576	11,186	11,267	3,395	4,398	8,875	6,570	64,806
- Estimated Construction Cost -	2,214	54,240	26,120	22,407	5,980	7,047	13,185	9,179	140,373
Engineering Charge	9,994	0	0	0	0	0	0	0	9.994
Leakage Detection(L/D)	341	341	338	0	0	0	0	0	1.020
Price Escaration for L/D	110	178	253	0	0	0	0	0	541
Construction Supervision	89	2,170	1,045	896	239	282	527	367	5.615
Total Project Cost	12,747	56,928	27,756	23,303	6,220	7,329	13,713	9.546	157,542

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

TABLE 9.4.2 PROJECTED DEBT SERVICE SCHEDULE

Disbursement Amount		₱149.66 million		
Regular Loan		78.77 "		
Soft Loan		70.89 "		
Capitalized Interest				
Regular Loan		11.32 "		
Soft Loan		6.42 "		
Total Loan		₱167.40 million		
Financed Interest				
Regular Loan	First	₱2 million	10%	per annum
	Next	₱5 million	12%	"
	Above	₱7 million	14%	"
Soft Loan			10%	"

(Unit : ₱ million)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1. Regular Loan										
Disbursement	12.75	56.93	9.10	-	-	-	-	-	-	-
Capitalized Interest	0	1.60	9.80	-	-	-	-	-	-	-
Operational Interest	-	-	-	12.44	12.44	12.41	12.37	12.32	12.27	12.20
Principal Repayment	-	-	-	0	0.27	0.30	0.34	0.39	0.44	0.51
Debt Services	0	0	0	12.44	12.71	12.71	12.71	12.71	12.71	12.71
2. Soft Loan										
Disbursement	-	-	18.66	22.80	5.22	5.83	11.71	6.67	-	-
Capitalized Interest	-	-	-	-	-	-	-	6.42	-	-
Operational Interest	-	-	-	-	-	-	-	-	7.73	7.73
Principal Repayment	-	-	-	-	-	-	-	-	-	-
Debt Services	0	0	0	0	0	0	0	6.42	9.20	9.20
Total Debt Services	0	0	0	12.44	12.71	12.71	12.71	12.71	20.44	20.44
Debt at End of Year	12.75	71.28	108.84	131.64	136.59	142.12	153.49	166.19	165.75	165.24

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	2,179	1,038	330	0	337	474
1989	2,548	1,059	403	80	424	582
1990	2,855	1,080	484	90	511	690
1991	3,126	1,163	536	96	569	762
1992	3,399	1,246	589	103	627	834
1993	3,670	1,329	641	109	684	907
1994	3,943	1,412	694	116	742	979
1995	4,214	1,495	746	122	800	1,051
1996	4,214	1,495	746	122	800	1,051
1997	4,214	1,495	746	122	800	1,051
1998	4,214	1,495	746	122	800	1,051

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	2,882	1,373	436	0	446	627
1989	3,876	1,611	613	122	645	885
1990	4,994	1,889	847	157	894	1,207
1991	6,289	2,339	1,079	194	1,144	1,533
1992	7,861	2,882	1,362	238	1,449	1,930
1993	9,765	3,535	1,706	291	1,821	2,412
1994	12,060	4,319	2,122	354	2,271	2,994
1995	14,824	5,259	2,624	429	2,815	3,697
1996	17,048	6,048	3,018	493	3,237	4,252
1997	19,605	6,955	3,471	567	3,723	4,889
1998	22,546	7,998	3,991	652	4,281	5,623

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% after 1993 to 1994 and 10% from 1995 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.

The number of revenue units has been computed using the optional method. Under this method the minimum charge varies depending on the size of the connection.3/ 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.

3/ 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 (DAWASA)

Year	Total Service Connections	Connection Size (inch): Domestic/Government 1/2	3/4	1	Sub-TTL	Commercial/Industrial 1/2 4/	3/4	1	Sub-TTL
1988	4,250	3,100	26		3,126	1,124	0		1,124
1989	5,389	4,124	34		4,158	1,231	0		1,231
1990	6,531	5,149	43		5,192	1,339	0		1,339
1991	7,290	5,867	44		5,911	1,379	0		1,379
1992	8,049	6,585	46		6,631	1,418	0		1,418
1993	8,807	7,302	47		7,349	1,458	0		1,458
1994	9,566	8,020	49		8,069	1,497	0		1,497
1995	10,324	8,737	50		8,787	1,537	0		1,537

COMPUTATION OF SERVICE CHARGE REVENUE UNITS (DAWASA)

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	1,617	7,750	104	0	7,854	942	5,620	0	0	5,620	674
1989	1,992	10,310	136	0	10,446	1,254	6,155	0	0	6,155	739
1990	2,369	12,873	172	0	13,045	1,565	6,695	0	0	6,695	803
1991	2,609	14,668	176	0	14,844	1,781	6,895	0	0	6,895	827
1992	2,848	16,463	184	0	16,647	1,998	7,090	0	0	7,090	851
1993	3,088	18,255	188	0	18,443	2,213	7,290	0	0	7,290	875
1994	3,328	20,050	196	0	20,246	2,430	7,485	0	0	7,485	898
1995	3,567	21,843	200	0	22,043	2,645	7,685	0	0	7,685	922

4/ Some public faucets are included in the year from 1988 to 1994

TABLE 9.5.2 EQUIVALENT VOLUME OF WATER SOLD

(Unit : X 1,000)

1988	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		894	375	135	161	223	
Factor			0	1.35	1.85	2.60	
E.v.	942		-	182	298	580	2.002
Commercial/Ind.		472	135	24	51	263	
Factor			0	2.70	3.70	5.20	
E.v.	674		-	64	187	1,367	2.293
Total E.V.							4.295

1989	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		1.142	499	167	199	277	
Factor			0	1.35	1.85	2.60	
E.v.	1.254		-	226	369	719	2.567
Commercial/Ind.		528	148	27	57	297	
Factor			0	2.70	3.70	5.20	
E.v.	739		-	72	211	1,542	2.564
Total E.V.							5.131

1990	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		1.419	623	207	247	342	
Factor			0	1.35	1.85	2.60	
E.v.	1.565		-	279	456	890	3,191
Commercial/Ind.		586	161	30	64	332	
Factor			0	2.70	3.70	5.20	
E.v.	803		-	80	236	1,725	2.845
Total E.V.							6.036

TABLE 9.5.2 (Cont'd)

(Unit : X 1,000)

1991	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		1,611	709	234	280	388	
Factor			0	1.35	1.85	2.60	
E.v.	1,781		-	316	517	1,008	3,623
Commercial/Ind.		626	165	32	69	359	
Factor			0	2.70	3.70	5.20	
E.v.	827		-	87	256	1,868	3,038
Total E.V.							6,661

1992	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		1,803	796	262	312	433	
Factor			0	1.35	1.85	2.60	
E.v.	1,998		-	354	578	1,126	4,055
Commercial/Ind.		666	170	35	74	387	
Factor			0	2.70	3.70	5.20	
E.v.	851		-	94	275	2,011	3,231
Total E.V.							7,286

1993	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		1,994	882	289	345	478	
Factor			0	1.35	1.85	2.60	
E.v.	2,213		-	390	638	1,243	4,485
Commercial/Ind.		706	175	37	80	414	
Factor			0	2.70	3.70	5.20	
E.v.	875		-	100	295	2,154	3,424
Total E.V.							7,908

TABLE 9.5.2 (Cont'd)

(Unit : X 1,000)

1994	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		2,186	968	317	377	524	
Factor			0	1.35	1.85	2.60	
E.v.	2,430		-	427	698	1,361	4,817
Commercial/Ind.		745	180	40	85	441	
Factor			0	2.70	3.70	5.20	
E.v.	898		-	107	314	2,293	3,612
Total E.V.							8,529

1995	SCRUS	Consumption (m3)	First 10 m3	11-20 m3 (1.35)	21-35 m3 (1.85)	Above 35 m3 (2.60)	Total Equivalent Volume
Domestic/Gov.		2,378	1,054	344	410	569	
Factor			0	1.35	1.85	2.60	
E.v.	2,645		-	465	759	1,480	5,348
Commercial/Ind.		785	184	42	90	468	
Factor			0	2.70	3.70	5.20	
E.v.	922		-	114	333	2,436	3,805
Total E.V.							9,153

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	1.35
21-35 cu.m/month	1.85
Above 35 cu.m/month	2.60

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

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.

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	2,882	1.0	4,295	4,295	129	4,166	1,284	1,284
1989	3,876	1.5	5,131	7,696	231	7,465	3,589	4,873
1990	4,994	1.5	6,036	9,054	272	8,782	3,788	8,662
1991	18,733	2.0	6,661	13,322	400	12,922	-5,811	2,851
1992	20,571	2.0	7,286	18,943	568	18,375	-2,196	655
1993	22,475	3.0	7,908	23,725	712	23,014	539	1,193
1994	24,770	3.2	8,529	27,292	819	26,473	1,703	2,896
1995	27,534	3.2	9,153	29,291	879	28,412	878	3,774

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 of 1992 and 1993.

Period	Minimum Charge	Monthly Family Income	Percentage of Income Allocated to Water	Percentage Increase
1988	₱25.0	₱ 852	2.9	-
1989	37.5	976	3.8	50
1990	37.5	1,117	3.4	0
1991	50.0	1,274	3.9	33
1992	65.0	1,452	4.5	30
1993	75.0	1,655	4.5	15
1994	80.0	1,887	4.2	7
1995	80.0	2,151	3.7	0

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.

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	4,250	5,389	6,531	7,290	8,049	8,807	9,566	10,324	10,324	10,324	10,324
Production (m3 x 1,000)	2,732	3,036	3,342	3,608	3,795	4,091	4,310	4,519	4,519	4,519	4,519
Unaccounted for Water (%)	50	45	40	38	36	34	32	30	30	30	30
Consumption (m3 x 1,000)	1,366	1,670	2,005	2,237	2,469	2,700	2,931	3,163	3,163	3,163	3,163
Equivalent Volume (x 1,000)	4,295	5,131	6,036	6,661	7,286	7,908	8,529	9,153	9,153	9,153	9,153
Rate Unit	1.0	1.5	1.5	2.0	2.6	3.0	3.2	3.2	3.9	4.5	5.0
Water Sales	4,295	7,696	9,054	13,322	18,943	23,725	27,292	29,291	35,698	41,190	45,767
Other Revenues	129	231	272	400	568	712	819	879	1,071	1,236	1,373
- Total Revenues -	4,424	7,927	9,326	13,721	19,511	24,437	28,110	30,169	36,769	42,426	47,140
Direct Cost	2,882	3,876	4,994	6,289	7,861	9,765	12,060	14,824	17,048	19,605	22,546
Administrative Expenses	1,373	1,611	1,889	2,339	2,882	3,535	4,319	5,259	6,048	6,955	7,998
Power & Fuel	436	613	847	1,079	1,362	1,706	2,122	2,624	3,018	3,471	3,991
Chemicals	0	122	157	194	238	291	354	429	493	567	652
Maintenance & Repair	446	645	894	1,144	1,449	1,821	2,271	2,815	3,237	3,723	4,281
Miscellaneous	627	885	1,207	1,533	1,930	2,412	2,994	3,697	4,252	4,889	5,623
Bad Debts	129	231	272	400	568	712	819	879	1,071	1,236	1,373
- Total Costs -	3,011	4,107	5,266	6,689	8,429	10,477	12,879	15,703	18,119	20,841	23,919
Income Before Depreciation	1,413	3,820	4,060	7,033	11,082	13,960	15,232	14,467	18,650	21,585	23,221
Depreciation	319	1,782	2,721	3,303	3,459	3,642	3,985	4,384	4,384	4,384	4,384
Income Before Interest	1,094	2,038	1,339	3,729	7,623	10,318	11,247	10,083	14,266	17,201	18,837
Interest	0	0	0	12,444	12,444	12,408	12,366	12,319	19,998	19,937	19,868
Net Income	1,094	2,038	1,339	-8,715	-4,821	-2,090	-1,119	-2,236	-5,732	-2,736	-1,031

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	1.413	3.820	4.060	7.033	11.082	13.960	15,232	14,467	18.650	21,585	23.221
LWUA Loan	12,747	58.533	37,555	22,803	5.220	5.829	11,713	13.092	0	0	0
Equity	0	0	0	500	1,000	1,500	2,000	2.877	0	0	0
Grant	0	0	0	0	0	0	0	0	0	0	0
-Total Sources of Funds-	14.100	62.353	41.615	30.336	17.302	21,289	28.945	30.436	18.650	21.585	23.221
Applications of Funds											
Investment in Project	12.747	56.928	27.756	23.303	6,220	7,329	13.713	9.546	0	0	0
Capitalized Interest	0	1.605	9,799	0	0	0	0	6.423	0	0	0
[Total Investment]	12,747	58.533	37.555	23,303	6.220	7,329	13,713	15.969	0	0	0
Interest (Regular Loan)	0	0	0	12.444	12,444	12.408	12.366	12.319	12.266	12.205	12.136
Interest (Soft Loan)	0	0	0	0	0	0	0	0	7.732	7,732	7,732
< Total Operational Interest >	0	0	0	12.444	12.444	12.408	12,366	12,319	19.998	19,937	19.868
Principal (Regular Loan)	0	0	0	0	266	302	344	391	444	505	574
Principal (Soft Loan)	0	0	0	0	0	0	0	0	0	0	0
< Total Principal Repayment >	0	0	0	0	266	302	344	391	444	505	574
[Total Debt Services]	0	0	0	12,444	12,710	12,710	12.710	12,710	20.442	20.442	20.442
Working Capital Increase	137	250	-17	300	410	268	1,443	-58	2.518	817	573
Cash & Other Current Assets	114	134	157	195	240	295	360	438	504	580	667
Accounts Receivable	716	1,283	1.509	2,220	3.157	3.954	4,549	4.882	5,950	6.865	7.628
Inventories	0	20	26	32	40	49	59	72	82	95	109
Reserves	0	0	0	0	0	0	1.365	1.465	3.570	4.119	4.577
Accounts Payable	480	646	832	1,048	1.310	1,628	2.010	2,471	2.841	3.268	3.758
Customers' Deposit	213	404	490	729	1,046	1.321	1.531	1,652	2,013	2.323	2.581
-Total Applications of funds-	12.884	58.783	37.538	36,047	19.340	20,307	27,866	28.621	22.960	21.259	21.015
Cash Surplus	1,275	3,571	4,077	-5.711	-2.038	982	1,079	1,815	-4.310	326	2.205
Cumulative Cash Surplus	1.275	4.846	8.923	3,211	1.173	2.155	3,234	5.049	740	1.066	3.271
Cash Flow	1.275	3,571	4,077	-6.211	-3.038	-518	-921	-1,062	-4.310	326	2,205

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	12,747	71,280	108,835	132,138	138,358	145,687	159,400	175,369	175,369	175,369	175,369
Depreciation	319	2,101	4,822	8,125	11,584	15,226	19,211	23,595	27,980	32,364	36,748
Net Fixed Asset	12,428	69,179	104,013	124,013	126,774	130,461	140,189	151,774	147,389	143,005	138,621
Current Asset	2,106	6,283	10,615	5,659	4,610	6,453	9,566	11,905	10,845	12,724	16,251
-Total Assets-	14,534	75,463	114,629	129,672	131,384	136,914	149,755	163,679	158,235	155,729	154,872
Capital Equity	0	0	0	500	1,500	3,000	5,000	7,877	7,877	7,877	7,877
Government Grant	0	0	0	0	0	0	0	0	0	0	0
Operational Surplus	1,094	3,133	4,472	-4,243	-9,064	-11,154	-12,273	-14,510	-20,242	-22,978	-24,010
Total Equity	1,094	3,133	4,472	-3,743	-7,564	-8,154	-7,273	-6,633	-12,365	-15,101	-16,133
Long Term Debt	12,747	71,280	108,835	131,638	136,592	142,119	153,488	166,189	165,745	165,240	164,666
Current Liabilities	693	1,050	1,322	1,777	2,357	2,949	3,541	4,123	4,855	5,590	6,339
-Total Equity and Liabilities-	14,534	75,463	114,629	129,672	131,384	136,914	149,755	163,679	158,235	155,729	154,872

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

3. Cash ; 1 month of labor cost.

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.

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 13.1%.

9.8 FINANCIAL RECOMMENDATION

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

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	1,413	12,747	12,747	0	137	1,275	1,275
1989	1.5	3,820	58,533	58,533	0	250	3,571	3,156
1990	1.5	4,060	37,555	37,555	0	-17	4,077	3,185
1991	2.0	7,033	22,803	23,303	12,444	300	-6,211	-4,289
1992	2.6	11,082	5,220	6,220	12,710	410	-3,038	-1,854
1993	3.0	13,960	5,829	7,329	12,710	268	-518	-279
1994	3.2	15,232	11,713	13,713	12,710	1,443	-921	-439
1995	3.2	14,467	13,092	15,969	12,710	-58	1,062	-448
1996	3.9	18,650			20,442	2,518	-4,310	-1,605
1997	4.5	21,585			20,442	817	326	107
1998	5.0	23,221			20,442	573	2,205	642
1999	5.0	19,839			20,442	-447	-156	-40
2000	6.0	25,103			21,792	1,410	1,901	432
2001	6.0	20,631			21,792	-592	-570	-114
2002	7.0	24,640			21,792	1,244	-1,604	285
2003	8.0	27,879			21,792	1,142	4,945	776
2004	8.0	21,077			21,792	-900	184	26
2005	9.0	22,407			21,792	890	-274	-34
2006	10.0	22,565			21,792	735	38	4
2007	10.0	12,220			21,792	-1,368	-8,204	-786

FIRR = 13.1

Period	Rate/ Unit	First 10cu.m	11-20cu.m	21-35cu.m	Above 35cu.m
1988	₱1.0	₱25.0	₱3.4	₱4.6	₱6.5
1989	1.5	37.5	5.1	6.9	9.8
1990	1.5	37.5	5.1	6.9	9.8
1991	2.0	50.0	6.8	9.3	13.0
1992	2.6	65.0	8.8	12.0	16.9
1993	3.0	75.0	10.1	13.9	19.5
1994	3.2	80.0	10.8	14.8	20.8
1995	3.2	80.0	10.8	14.8	20.8
1996	3.9	97.5	13.2	18.0	25.4
1997	4.5	112.5	15.2	20.8	29.3

As shown above, rapid increases of Rate/Unit are be inevitable in this project during the first four years, since the existing water rate structure is comparatively in a lower level. However, after 1993 a moderate increase in the percentage of the water rate is expected annually.

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 benefits of a project because some of them are not quantifiable or the technical methods to evaluate them quantitatively are not available. It is 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 benefits considered in the economic feasibility analysis are: increased land value, improved health conditions, and the beneficial value of water (consumer's satisfaction).

Except for the beneficial value of water, all other benefits are held constant after completion of the project.

10.3.1 Increase in Land Values

The water supply improvement project will contribute to an increase in land value of the service area. However, this increased value could be the result of a general increase of productivity due to improved infrastructure which includes a water supply project.

The portion of land values attributable to the water supply system in the service area was determined by comparing the market values of land served and not served by the water system. The average market value of residential land served by the water system is ₱120/sq.m, and commercial land is ₱600/sq.m, while the average market value of land residential unserved by the water system is ₱80/sq.m, and commercial land is ₱260/sq.m, respectively.

Generally, it is assumed that 20% of the incremental value of land could be attributed to the water supply project.

The present worth benefit of increase in land values from the project implementation is shown in TABLE 10.3.1.

10.3.2 Improved Health Conditions

The provision of safe, potable water to the population is a prerequisite to attain minimum health standards. However, quantification of health benefits is usually difficult although the direct relationship between safe water supply and improved health is obvious.

In quantifying health benefits, two factors were considered : the cost of time lost due to illness, and the cost of medical expenses.

In computing the cost of the time lost due to illness, not all persons afflicted with water-borne diseases are income-earners. It is assumed in this study that 30% of the population is actually economically active. The average morbidity rate from 1979 to 1983 in Dagupan city was 461 out of 10,000. The final figure for the cost of time lost due to illness was derived by taking the economically active portion of those afflicted by water-borne diseases multiplied by ₱57.00 and 15 days based on the assumption that workers earning ₱57.00/day3/ are unable to work for an average of 15 days per year.

The cost of medical expenses was derived by multiplying the morbidity rate by the served population and the average annual expenditure for medical expenses of ₱200.00.

The sum of the two economic costs related to health benefits was adjusted by 20% to account for the fact that not all water-borne diseases are caused by a poor water system but may also be due to poor personal hygiene or lack of sewerage facilities.

3/ ₱57.00 is assumed as the minimum wage for industrial and agricultural workers.

TABLE 10.3.1 PORTION OF LAND VALUES ATTRIBUTABLE TO PROJECT

Year	Land Use (1,000 sq.m)[1/]		Cost of Land (₱1,000)			
	Residential	Commercial/Industrial/Institutional	Residential (₱80/sq.m)	Commercial/Industrial/Institutional (₱260/sq.m)	Total Cost of Land	20 Percent Due to Project[2/]
1988						
1989						
1990						
1991	50	10	4,000	2,600	6,600	1,320
1992	60	0	4,800	0	4,800	960
1993	40	10	3,200	2,600	5,800	1,160
1994	60	0	4,800	0	4,800	960
1995	50	10	4,000	2,600	6,600	1,320
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						

1/ The service area of 711 ha from 1988 to 1990 is projected to increase annually by 6 ha in 1991 and 1992; by 5 ha in 1993 and by 6 ha in 1994 and 1995.

2/ Portion of land values specifically attributable to water supply project is 20%.

The total present values derived from health benefits is shown in TABLE 10.3.2.

TABLE 10.3.2 HEALTH BENEFITS

(Unit : ₱1,000)

Year	Served Population	Cost of Time Due to Illness 4/	Cost of Medical Expenses 5/	Total Economic Losses	20% Reduction Due to Project (Benefit)
1988	23,428	277	216	493	99
1989	27,978	331	258	589	118
1990	32,910	389	303	692	138
1991	36,100	427	333	760	152
1992	39,280	464	362	826	165
1993	42,470	502	392	894	179
1994	45,650	540	421	961	192
1995	48,840	578	450	1,028	206
1996	48,840	578	450	1,028	206
1997	48,840	578	450	1,028	206
1998	48,840	578	450	1,028	206
1999	48,840	578	450	1,028	206
2000	48,840	578	450	1,028	206
2001	48,840	578	450	1,028	206
2002	48,840	578	450	1,028	206
2003	48,840	578	450	1,028	206
2004	48,840	578	450	1,028	206
2005	48,840	578	450	1,028	206
2006	48,840	578	450	1,028	206
2007	48,840	578	450	1,028	206

4/ $30.0\% \times \frac{461}{10,000} \times SP \times$ ₱57 x 15 days

5/ $\frac{461}{10,000} \times SP \times$ ₱200

10.3.3 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 10.3.3.

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 ₱96.88 million which was obtained based on the project cost used in the Financial Feasibility Analysis as shown in TABLE 10.4.1.

TABLE 10.3.3 INCREASE IN CONSUMER STATISFACTION

Year	Incremental Accounted-For Water 6/ (1,000 cu.m/year)	Price Per cu.m 7/	Economic Value Per cu.m 8/	Economic Water Revenues (₱1,000)
1988	-133	3.24	3.89	-517
1989	171	4.24	5.09	870
1990	506	3.71	4.45	2,253
1991	738	4.37	5.24	3,870
1992	970	5.02	6.02	5,843
1993	1,201	5.14	6.17	7,408
1994	1,432	4.86	5.83	8,351
1995	1,664	4.31	5.17	8,606
1996	1,664	4.70	5.64	9,385
1997	1,664	4.84	5.81	9,665
1998	1,664	4.80	5.76	9,585
1999	1,664	4.28	5.14	8,546
2000	1,664	4.59	5.51	9,165
2001	1,664	4.10	4.92	8,187
2002	1,664	4.27	5.12	8,526
2003	1,664	4.36	5.23	8,706
2004	1,664	3.89	4.67	7,768
2005	1,664	3.91	4.69	7,807
2006	1,664	3.88	4.66	7,748
2007	1,664	3.46	4.15	6,909

6/ The volume of accounted-for water of 1.50 million cu.m in 1986 is deducted from the projected water consumptions throughout the study period to obtain incremental volume.

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

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

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											
Source Well Facilities	9,018	2,239	6,779	818	5,961	298	5,663	2,911	409	5,663	8,983
Transmission Facilities	5,349	2,093	3,256	465	2,791	140	2,651	2,721	232	2,651	5,604
Reservoir	2,638	754	1,884	203	1,681	84	1,597	980	102	1,597	2,679
Disinfection Facilities	421	54	367	32	335	17	318	70	16	318	404
Electric Sub-station	982	406	576	52	524	26	498	528	26	498	1,052
Distribution Facilities	8,981	2,829	6,152	1,030	5,122	256	4,866	3,678	515	4,866	9,059
Service Connection	781	71	710	207	503	25	478	92	103	478	673
Land Acquisition	132	0	132	0	132	6	126	0	0	126	126
Admin. Bldg. & Ope. Ctr.	690	124	566	69	497	25	472	161	35	472	668
Vehicle & Stored Material	0	0	0	0	0	0	0	0	0	0	0
Sub-Total of Civil Works	28,992	8,570	20,422	2,876	17,546	877	16,669	11,141	1,438	16,669	29,248
Equipment											
Source Well Facilities	10,477	7,818	2,659	0	2,659	133	2,526	10,163	0	2,526	12,689
Transmission Facilities	6,279	3,605	2,674	0	2,674	134	2,540	4,687	0	2,540	7,227
Reservoir	261	145	116	0	116	6	110	189	0	110	299
Disinfection Facilities	658	496	162	0	162	8	154	645	0	154	799
Electric Sub-station	1,638	1,376	262	0	262	13	249	1,789	0	249	2,038
Distribution Facilities	12,990	8,855	4,135	0	4,135	207	3,928	11,511	0	3,928	15,439
Service Connection	6,334	6,055	279	0	279	14	265	7,871	0	265	8,136
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0
Admin. Bldg. & Ope. Ctr.	690	497	193	0	193	10	183	646	0	183	829
Vehicle & Stroed Material	1,650	1,080	570	0	570	28	542	1,404	0	542	1,946
Sub-Total of Equipment	40,977	29,927	11,050	0	11,050	553	10,497	38,905	0	10,497	49,402
Total of C.W. & Equipment	69,969	38,497	31,472	2,876	28,596	1,430	27,166	50,046	1,438	27,166	78,650
Physical Contingencies9/	5,598	3,080	2,518	230	2,288	114	2,174	4,004	72	2,174	6,250
Engineering Services10/	9,796	5,390	4,406	403	4,003	200	3,803	7,006	201	3,803	11,010
Leakage Detection	1,020	0	1,020	0	1,020	51	969	0	0	969	969
Project Cost	86,383	46,967	39,416	3,509	35,907	1,795	34,112	61,056	1,711	34,112	96,879

9/ 8% of Total Cost of Civil Work & Equipment
10/ 14% of Total Cost of Civil Work & Equipment as Engineering Charge and Construction Supervision

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.

TABLE 10.4.2 SALVAGE VALUE IN YEAR 2007

(Unit : ₱1,000)

Year	Economic Value	Remaining Life in 2007 11/	Salvage Value
1988	10,759	50.0 %	5,379
1989	41,566	52.5	21,822
1990	17,405	55.0	9,573
1991	12,984	57.5	7,466
1992	3,014	60.0	1,808
1993	3,087	62.5	1,929
1994	5,023	65.0	3,265
1995	3,041	67.5	2,053
1996			
1997			
1998			
1999			
2000			
2001			
2002			
2003			
2004			
2005			
2006			
2007			53,295

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

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.

10.5 ECONOMIC INTERNAL RATE OF RETURN (EIRR)

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 6.0%. 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 10.4.3 INCREMENTAL ECONOMIC OPERATION & MAINTENANCE COST

(Unit : ₱1,000)

						SHADOW PRICING			
Year	Financial O & M Cost	Foreign Exchange Component	Domestic Component	Taxes (5%)	Others (95%)	Foreign Exchange Component x 1.3	Others x 1.0	Economic O & M Cost	Net Economic O & M Cost
1987	2,528	697	1,831	92	1,739	906	1,739	2,645	-
1988	2,179	408	1,771	89	1,682	530	1,682	2,212	-433
1989	2,548	528	2,020	101	1,919	686	1,919	2,605	-40
1990	2,855	629	2,226	111	2,115	818	2,115	2,933	288
1991	3,126	697	2,429	121	2,308	906	2,308	3,214	569
1992	3,399	764	2,635	132	2,503	993	2,503	3,496	851
1993	3,670	831	2,839	142	2,697	1,080	2,697	3,777	1,132
1994	3,943	899	3,044	152	2,892	1,169	2,892	4,061	1,416
1995	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
1996	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
1997	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
1998	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
1999	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2000	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2001	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2002	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2003	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2004	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2005	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2006	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697
2007	4,214	965	3,249	162	3,087	1,255	3,087	4,342	1,697

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	-418	10,326	-10,744	-10,744.0
1989	988	41,526	-40,538	-38,262.0
1990	2,391	17,693	-15,302	-13,632.0
1991	5,342	13,553	-8,211	-6,904.2
1992	6,968	3,865	3,103	2,462.6
1993	8,747	4,219	4,528	3,391.8
1994	9,503	6,439	3,064	2,166.3
1995	10,132	4,738	5,394	3,599.5
1996	9,591	1,697	7,894	4,972.1
1997	9,871	1,697	8,174	4,859.4
1998	9,791	1,697	8,094	4,541.6
1999	8,752	1,697	7,055	3,736.4
2000	9,371	1,697	7,674	3,836.0
2001	8,393	1,697	6,696	3,159.2
2002	8,732	1,697	7,035	3,132.8
2003	8,912	1,697	7,215	3,032.6
2004	7,974	1,697	6,277	2,490.2
2005	8,013	1,697	6,316	2,365.0
2006	7,954	1,697	6,257	2,211.3
2007	7,115	-51,598	58,713	19,585.2
			EIRR (%)=	5.95

CHAPTER 11
ORGANIZATION AND MANAGEMENT

CHAPTER 11 ORGANIZATION AND MANAGEMENT

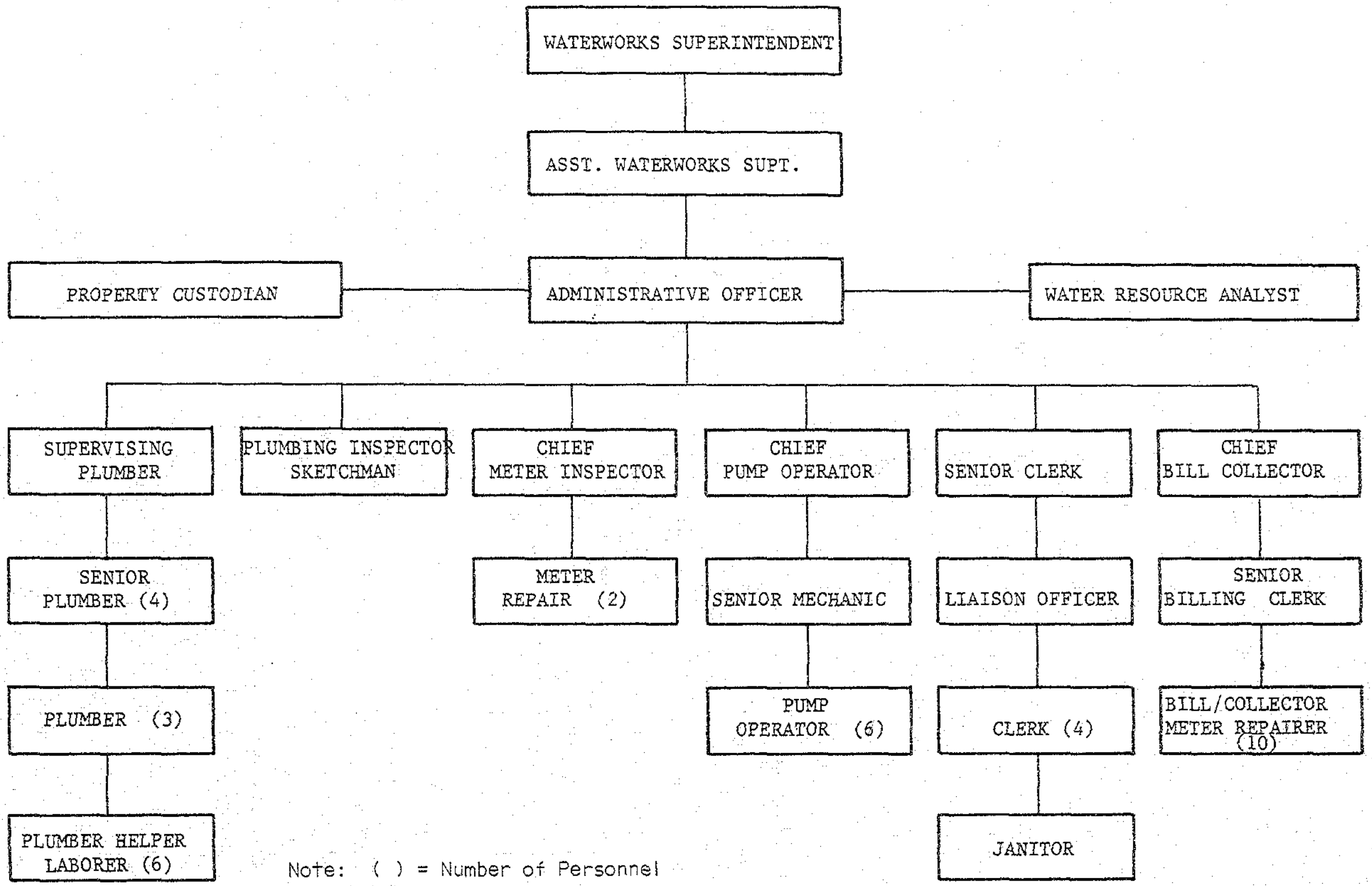
11.1 PRESENT ORGANIZATION STRUCTURE

The Dagupan City Waterworks System Administration (DAWASA) which is owned and operated by the city government of Dagupan was established in 1930.

The system's policy making body is the Sangguniang Panlunsod while operation and maintenance is being managed by a waterworks superintendent who has direct supervision over the entire staff of the system. The city mayor, however, has the sole power to appoint officers and other personnel of the system.

A complement of 50 personnel compose DAWASA's staff. The system has an approved organization structure (See FIGURE 11.1.1). However, functional responsibilities and jurisdictions have not been fully defined and enforced in accordance with the said structure. Thus, it is a usual happenings that the personnel holding the position of clerks, bill collectors, meter readers and pump operators are actually executing the duties of plumbers, plumber helpers and laborers, or vice versa. This practice often proves detrimental to the efficient operation of the system because said personnel are performing jobs where they are not qualified or properly trained.

Another major constraint affecting the smooth operation of the system is inadequate financing. Although the system is supposed to be self-liquidating, its budget is dependent on the budget appropriation provided by the Sangguniang Panlungsod. Salary level remain low and DAWASA officials find it hard to attract qualified and well-trained persons required to augment the capability of its staff. Also, the system does not have an effective training program for the development of its available manpower. In general, the same factors are also causing the present system's low level of water service.



Note: ( ) = Number of Personnel

FIGURE 11.1.1 ORGANIZATION STRUCTURE OF DAGUPAN WATERWORKS SYSTEM

City Ordinance No. 5, series 1932 sets the rules and regulations governing the waterworks system and its operations. Basically, the ordinances is still in effect except for some amendments specifically with regard to water rates and fines.

11.2 PROPOSED ORGANIZATION STRUCTURE

11.2.1 Introduction

The proposed organization structure for the Dagupan City Waterworks System is the water district structure. The JICA Study Team believes that the water system with regard to the water district organization structure can be expected to be successful if policy makers keep the continuity of policy and consistent enforcement thereof, its financial independence and business-like management by to capable, qualified and protect regularly trained personnel and also freedom from political interference in its operation, particularly on hiring and water rates setting.

The JICA Study Team, however, proposes some changes on the staffing guidelines as well as the organization chart. The basic water district structure, now existing, shall remain the same.

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, LWUA's 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
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 Water District and Dagupan 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, 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 guidelines 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:

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

See FIGURE 11.2.1 for the number of personnel needed for the Dagupan City Water District, drawn by, using the LWUA Methodology Manual.

The lower level, which was assumed for the earlier period between 1986-1995, shows a 30% in staff below the calculated value.

Using the above mentioned formula, the number of personnel for Dagupan City Waterworks System, if formed into a water district, could be computed as follows:

Design Year	No. of Employees
1995	93
2010	224

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

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.

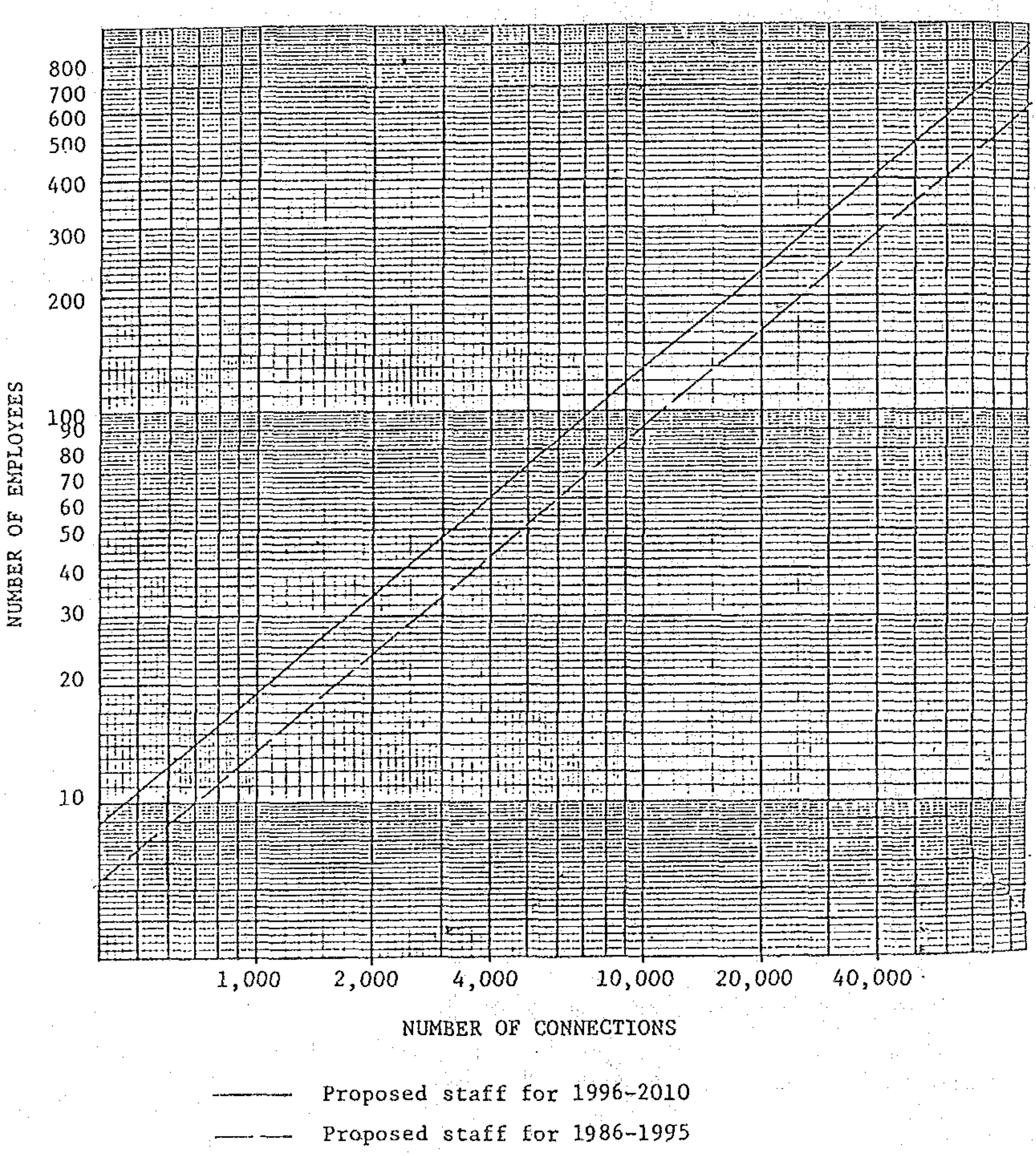


FIGURE 11.2.1 PROPOSED WATER DISTRICT STAFF BY LWUA METHODOLOGY MANUAL

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

11.2.3 Proposed Guidelines of the 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 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.

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

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 division, comprising whatever may it be termed the business management (including matters concerning water system changes) of the water district.

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

Secondly, the number of personnel has been computed taking into consideration the present number of personnel now in the DAWASA and the appropriate performance of individual work 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 Dagupan city.

11.2.4 Proposed Organization Structure

The organization structure proposed for the Dagupan City Waterworks System is basically the water district structure.

The water district will be headed by a five man Board of Directors, as per PD 198, whoes member 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 district.

The implementation of policy will be done by a General Manager who will be appointed by the Board of Directors.

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

1) Administrative and Commercial Division
2) Technical division

Later on, it would be necessary for the Dagupan City Water District to create the position of Assistant General Manager. As the commercial operation expands, it also be necessary and advisable to split the Administrative and commercial division into two divisions.

For the time being, however, the two division structure is recommended and the proposed number of personnel for both divisions are:

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		
Manager	1	°Meter Fixing and Repairs °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 (DAGUPAN CITY)

	1986	1995	2010
Population Served	23,430	48,800	90,100
No. of Connections	4,250	10,300	19,300
Supply Capacity (cu.m/d)	9,640	15,500	30,600
Length of T/D Pipeline (m)	25,000	55,000	146,000
No. of Pump Stations	15	25	19
General manager	1	1	1
ADMINISTRATIVE AND COMMERCIAL			
Assistant General manager	1	1	1
General Affairs	1	3	3
Accountancy	1	6	6
General Services	2	9	9
Water Charges			
Manager	-	1	1
Clerk	2	2	2
Meter Reader	5	7	13
Bill Collector	5	-	-
Sub-Total	12	10	16
Total	17	29	35
TECHNICAL			
Assistant General Manager	-	1	1
Distribution			
Manager	-	1	1
Mechanics	1	2	2
Electrician	-	1	1
Pump Operator	1	10	8
Reservoir Attendant	-	2	2
Patrol	-	12	22
General Maintenance	-	3	3
Sub-Total	2	31	39
Service Works			
Manager	-	1	1
Fitter	-	2	2
Meter Repairman	2	3	4
Plumber	11	2	2
Laborer	17	2	2
Sub-Total	30	10	11
Total	32	42	51
GRAND TOTAL	50	72	87

Position/Division	1995	2010
General Manager	1	1
Administrative and Commercial	29	35
Technical	42	51
Total	72	87

FIGURE 11.2.2 shows the proposed organization chart for the Dagupan City Waterworks System/Water District.

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.)

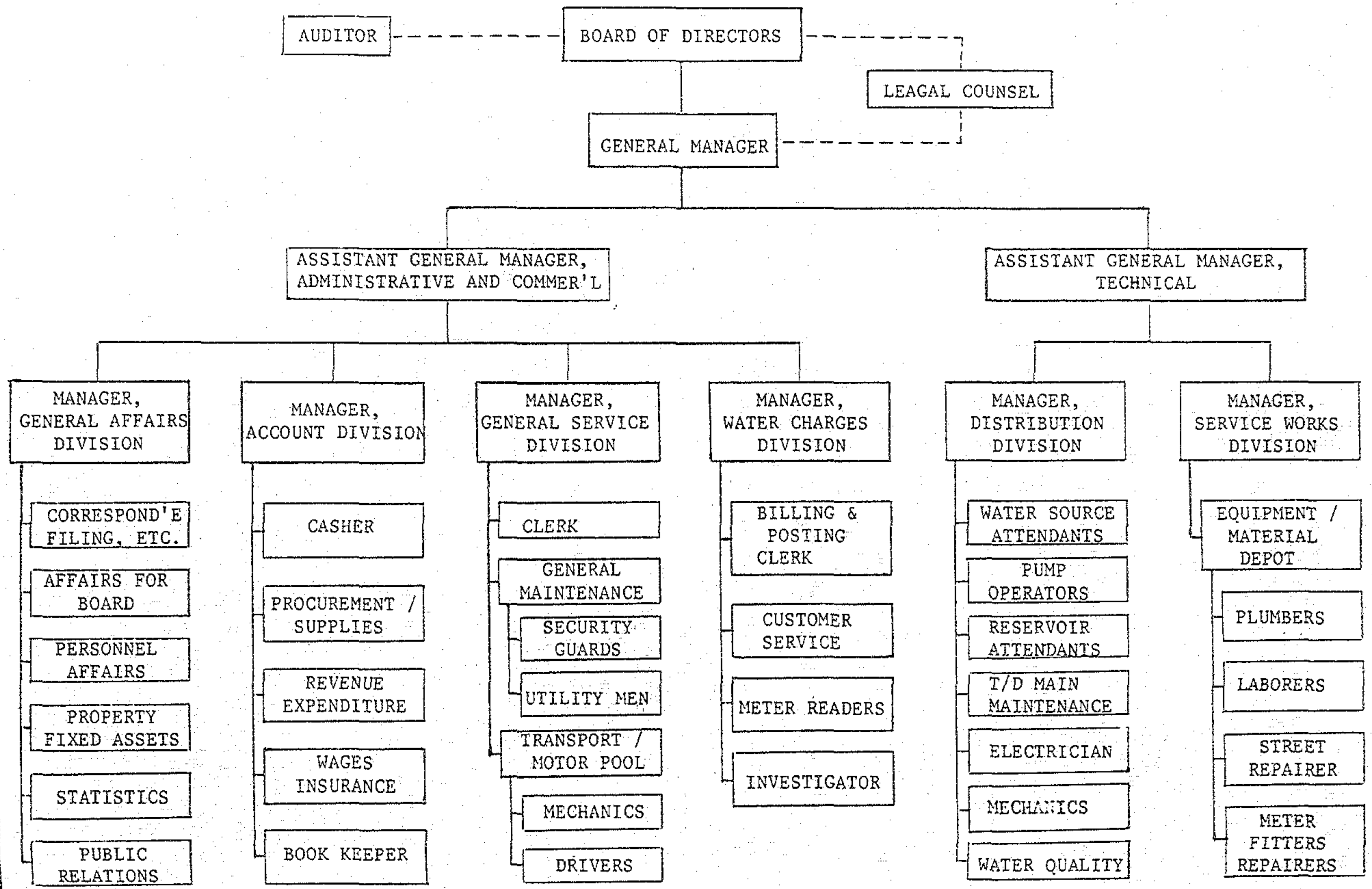


FIGURE 11.2.2 PROPOSED ORGANIZATION STRUCTURE

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 manageri-al 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 LWUA's assistance to obtain desirable personnel, especially for managerial positions. It is expected, therefore, 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, 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 LWUA (Engineering Services)

11.4 OTHER RECOMMENDATIONS

11.4.1 LWUA Assistance

Immediately, upon formation into water districts, it is recommended that the LWUA establish an appropriate commercial operation system (CPS). Also, an effective employment and sustained training programs for both WD 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 LWUA maximizes its assistance to the proposed WD upon its formation. It is expected that at initial stage the proposed WD will need LWUA's assistance in all aspects of its operations, i.e., 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 the consuming public.

11.4.2 Formation of Water Districts

Basically, LWUA is to provide every necessary assistance when a waterworks system is formed into a water district. However, under the decree that created both 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 that LWUA can facilitate matters by making a more agressive program or campaign for water district formation itself, and it should include effective information drive to promote formation through grassroots and media based campaigns.

11.4.3 Granting of Subsidy

It is also worth noting that for the effective management of two or more water districts, PD 198 provides for a "consolidation and joint operation" of these districts. It is believed that a merger or consolidation of the facilities or operations of two or more water districts can lower the cost of operating the system. This will lead to lowering the water rates charged to the consumers resulting to lessening the number of staff to run the system. If not, then the subsidy may be granted to water districts whose construction costs may be too high for such districts can afford. Subsidy is recommended especially when the resulting water rates are impracticably high. Provincial Water Utilities Act of 1973 (PD 198) gives a provision relating to "Government Assistance to Non-Viable Water District" in its Sec. 76.

According to the provision, such an aid or subsidy is limited "in such amount as LWUA may recommend, but not exceeding the cost of source development and main transmission line."

It seems necessary to make a guideline in order to realize releases of such fund, eliminating arbitrary reduction of amount. For example, a guideline shall be made subsidize for the development of water resources that will double the quantity of the existing water source or for systems where the raw conduit or transmission pipeline length exceeds 20 km may be effective.

11.4.4 Other Legislations

Due to the increase of population and progress of the human activities, the problem of sea water intrusion has gradually become a big problem in most of the populous coastal regions, i.e., Cebu, Sorsogon, Bulacan, Capiz, Pampanga, Pangasinan and Manila.

Dagupan as well as Lingayen, San Carlos and other nearby municipalities are located on the downstream end of the hydrogeological northern basin of the Central Luzon Plain, hence its present groundwater resources are the remainder after the abstraction of the groundwater by areas located hydrogeologically upstream.

Therefore, if the present groundwater exploitation is to be continued (or even be increased) in the rest of the basin, the groundwater resources will be able to meet the future needs only for a short period.

Considering the potential future development of surface water of the Agno River for water source to Dagupan City, the following should be studied:

a) Legislation of the necessary provision regarding to special funding for "bulk water supply system".

b) Legislation regarding subsidy for "costly water resources development".