Chapter 2 Existing Conditions

CHAPTER 2 EXISTING CONDITIONS

2.1 NATURAL CONDITIONS

2.1.1 TOPOGRAPHY AND GEOLOGY

The Study Area for water source development is identical to the upper basin of the Choluteca River and located in a mountainous area with the altitude between 900 m and 2,200 m. The area is divided into the sub-basins of the Choluteca River, *i.e.* the Guacerique River basin, the Grande River basin, the Sabacuante River basin, the Chiquito River basin, and basins of small creeks in La Tigra Mountains. *Figure 1.1* shows the schematic topography of the area.

On the other hand, the Study Area for water supply is Tegucigalpa urban area, as shown in *Figure 1.1*. The urban area has been developed from the confluence of the above five river systems and now expanding in all directions. The elevation of the urban area is between 900 m and 1,400 m.

Geology in and around the Study Area is roughly divided into Padre Miguel Group, Matagalpa Formation in Tertiary Period, and Valle de Angeles Group in Cretaceous Period. Basalt lavas cover Padre Miguel Group and Matagalpa Formation in early Quaternary period. Basement rocks are covered by terrace deposit, talus deposit, and river deposit Quaternary period with limited amount. *Figure 2.1* shows the geological map of the area.

2.1.2 HYDROLOGY

(1) General

The annual rainfall amount in the area varies between 800 mm and 1,500 mm and the area average makes 1,000 mm/year. *Figure 2.2* shows the isohyetal map of the area. According to the figure, rainfall amount is as large as 1,200 mm to 1,400 mm in the basin of the Guacerique River, the Grande River and La Tigra Mountains. On the other hand, rainfall amount in the area of southeast; the basins of the Sabacuante River and the Las Canoas River are as small as 850 mm. The annual pan evaporation is 1,400 mm.

Figure 2.3 shows the hydrogeological map of the Study Area. There are two types of hydrogeological units that are expected to be an aquifer in the Study Area as follows.

- Granular aquifer: the aquifer with intergranular flow in the Quaternary deposit of river deposit and terrace deposit. They are local aquifers and have moderate productivity of groundwater.
- Fissure aquifer: the aquifer in the fractured zones of basement rocks of Quaternary basalt, Padre Miguel Group volcanics, Matagalpa volcanics, and Valle de Angeles Group. They are local aquifers and have poor to moderate productivity of groundwater.

Above two types of aquifer are distributed scarcely in the Study Area.

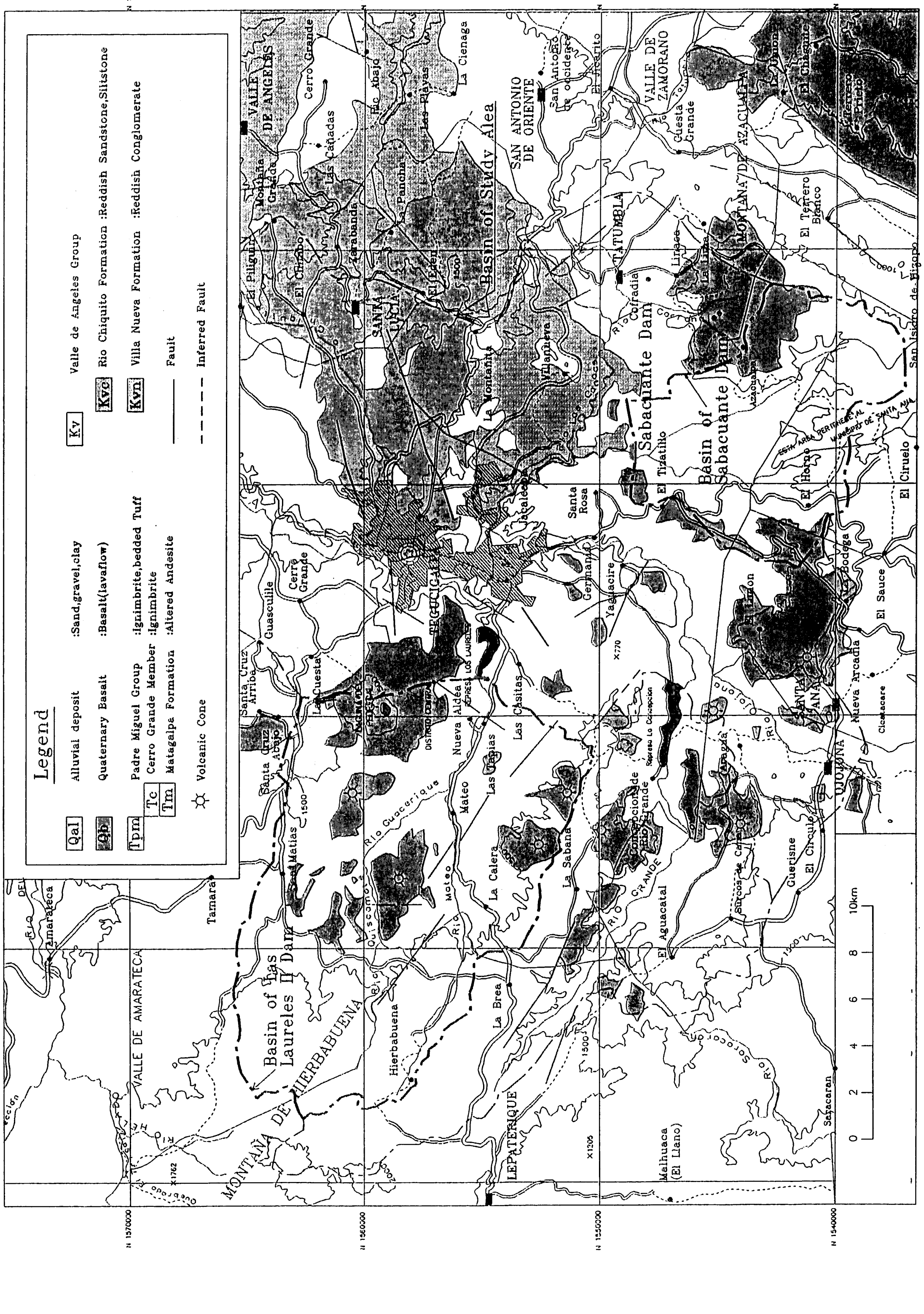

Figure 2.1	**Geological Map**

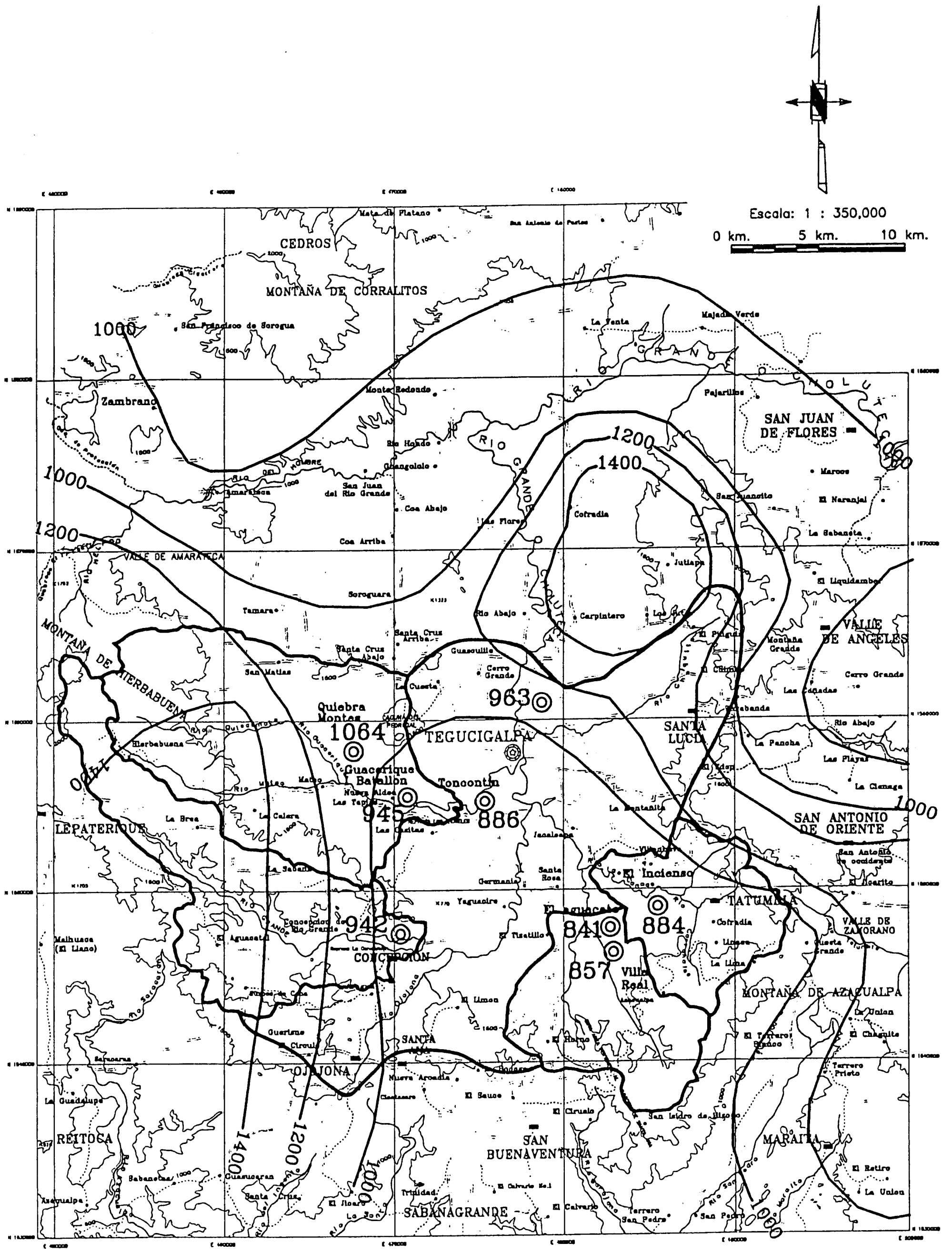

Figure 2.2	**Isohyetal Map**

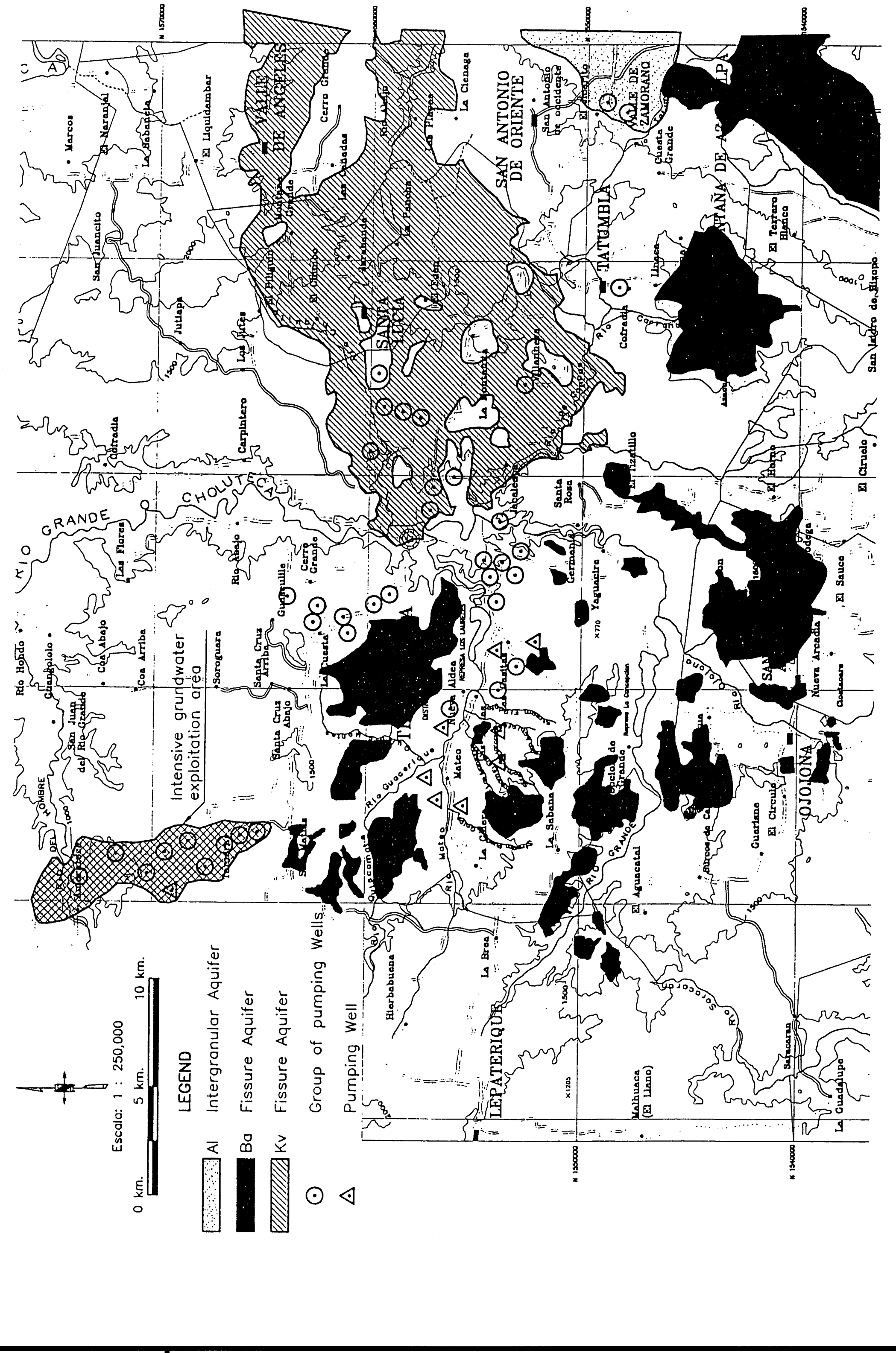

Figure 2.3	Hydrogeological Map

(2) Water Sources Potential in the Area

Water source potential in the area is indicated by isohyetal map and water source potential map. The average annual rainfall amount is about 1,000 mm and the amount of water falls in the basin is around 900 million m^3/year.

Figure 2.4 shows the surface water resources potential for each sub-basin in the area. Stream flow discharge record was analyzed and the average annual discharge and the lowest annual discharge in 10 years were shown in the figure. *Figure 2.4* shows comparatively large potential in the Guacerique River basin and the Grande River basin. The potential in the Sabacuante River and the Las Canoas River basin are smaller. The runoff ration is estimated as 20%, comparing the isohyetal map and the water potential map. Therefore, it is estimated that the total annual surface water available is around 180 million m^3.

The quality of surface water as water source is investigated periodically by SANAA. The result shows that the Guacerique River basin is the most deteriorated among all basins with the values of total/fecal coliforms and orthophosphates exceeding the standard value. The sources of contamination are estimated to be housing developments and the military base in the basin.

The groundwater aquifer in the area is found in two formations. One is permeable materials such as sand and gravel found in Quaternary deposits. Another is fractured zone of the basement volcanic rocks. Both formations are distributed scarcely in the Study Area and the amount of groundwater utilized is very limited. Consequently extensive development of groundwater is not expected.

2.2 SOCIOECONOMIC CONDITIONS

2.2.1 POPULATION

(1) Total Urban Population

The latest authorized population data is the National Census of Population and Household conducted by the General Directorate of Statistics and Census (DGEC) in 1988. The census concluded that the urban population of Tegucigalpa in 1988 was 576,661. Due to lack of a proper resident registration system in Honduras, the present population is only given as estimated values. Since the last Census in 1988, various population projections have been done in consideration of the results of the Census 1988. However, there is a big difference among them and any of them has few solid justification.

The present study estimated the existing population based on number of households given by the pre-census 2000, which DGEC prepared for the Census 2000, and average size of household given by the Permanent Multiple Purpose Questionnaire Survey of Families (EPHPM) conducted by DGEC in March 1999. The details of the population estimation are explained in the next chapter of this report.

As a result, the present urban population of Tegucigalpa in 2000 is estimated at 932,228.

(2) Breakdown by Social Class

The urban area of Tegucigalpa consists of several hundreds of neighborhoods called “barrio” and “colonia”. A neighborhood can be treated as an aggregation of households of a certain social class. Presently SANAA uses a classification of neighborhoods by their sizes of premise of houses and by road conditions inside neighborhood, as shown in *Table 2.1*.

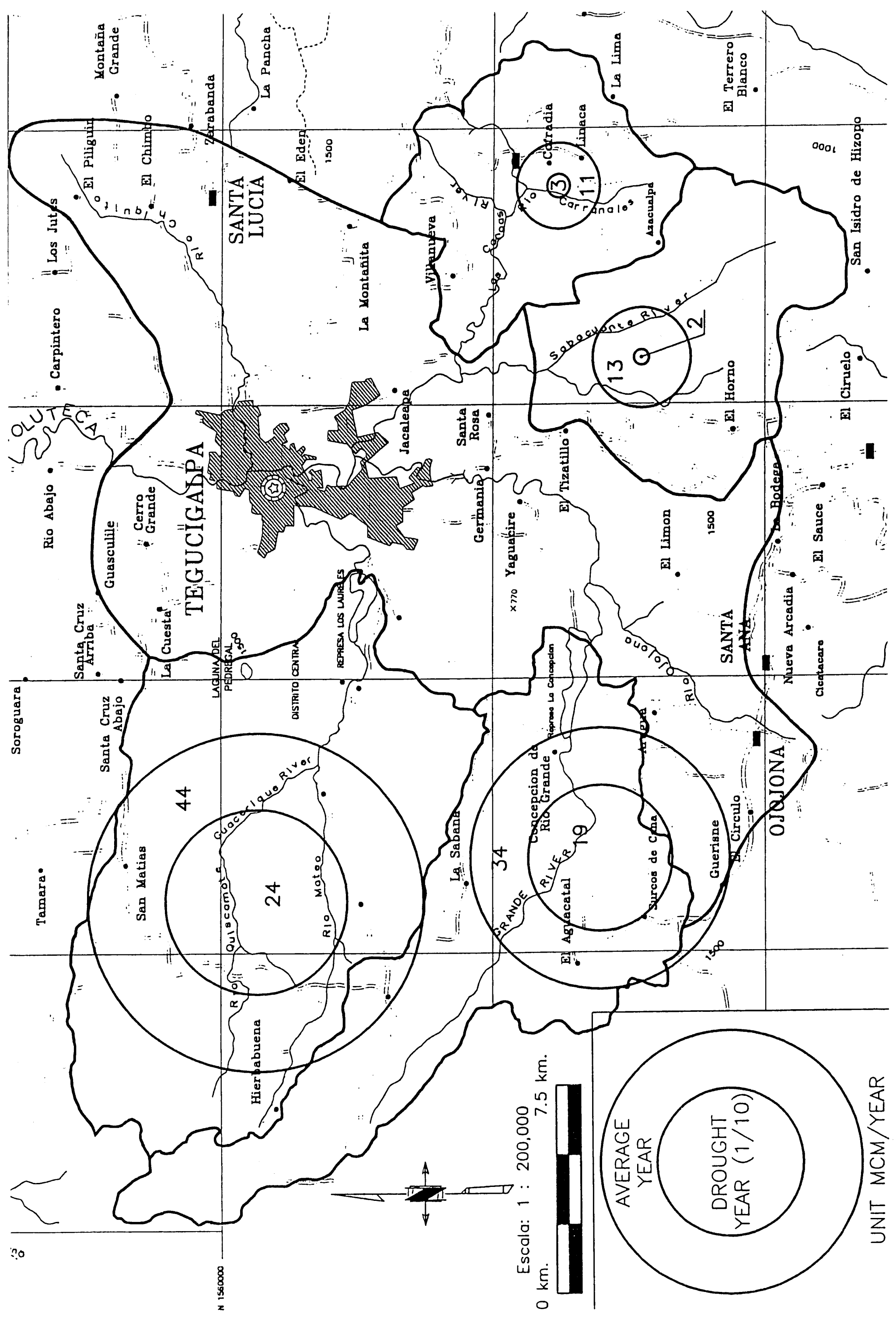

Figure 2.4	Surface Water Resource Potential

Table 2.1 Classification of Neighborhood by SANAA

Social class	Water supply method	Premise of each house (m^2)	Roads in neighborhood	
			Conditions	Width (m)
S (Superior)	Pipeline	More than 500	Paved with side walk	More than 8
A (High)	Pipeline	Less than 300	Paved with side walk	7~8
M (Middle)	Pipeline	Less than 120	Paved	7~8
C (Central area)	Pipeline	Less than 75	Paved	2~4
B (Low)	Pipeline	Less than 75	Paved	2~4
P (Programmed urbanization)	Pipeline	Less than 75	Paved	2~4
T (Developing community)	Pipeline or well	Less than 75	Unpaved	2~4

Source: SANAA, April 2000

Table 2.2 shows a breakdown of the present urban population by social class.

Table 2.2 Breakdown of Present Population by Social Class

Social class	Population in 2000 (persons)	Ratio (%)
S class	13,994	1.5%
A class	28,121	3.0%
M class	76,374	8.2%
C class	19,770	2.1%
B class	69,973	7.5%
P class	198,322	21.3%
T class	525,735	56.4%
Total	932,288	100.0%

2.2.2 ECONOMY

Honduras is one of the poorest countries in the Central America. Gross domestic product (GDP) per capita has been stagnant at around USD 650 during 1990s. *Table 2.3* shows gross domestic product of Honduras.

Table 2.3 National Gross Domestic Product

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
GDP (million USD)	3,091	3,191	3,371	3,581	3,534	3,678	3,811	4,004	4,122	4,044
Per capita GDP (USD)	633.5	634.7	650.7	671.1	643.3	650.6	655.3	669.5	670.5	640.3

Source: Inter-American Development Bank web page, http://www.iadb.org

Honduras obliges to rely on external debts in order to develop the country. *Table 2.4* shows the situation concerning external debts.

Table 2.4 External Debts

Year	1990	1991	1992	1993	1994	1995	1996	1997
Total debts	3,634	3,321	3,559	3,984	4,368	4,514	4,477	4,640
Bilateral public loan	1,401	1,089	1,163	1,307	1,470	1,455	1,412	1,368
Multilateral public loan	1,581	1,658	1,801	1,952	2,062	2,153	2,109	2,303
Total debt service	506	307	377	361	433	553	564	505
Debt service for bilateral loan	16	55	68	73	82	135	69	106
Debt service for multilateral loan	278	186	229	214	262	262	336	219
Total debt service ratio (%)	49.0	30.3	36.2	29.7	31.6	31.9	29.4	23.2

Source: Inter-American Development Bank web page, http://www.iadb.org (Unit: million USD)

The share of multilateral public loans to total debts has gradually increased and reached around 50% in 1997. Total debt service almost always exceeded 10% of GDP during 1990 to 1997 and oppressed national economy.

The national economy highly depends on the agricultural sector. Though a share of manufacturing industry sector to GDP is getting bigger, food products still occupied nearly 80 % of exports in 1998. From the viewpoint of nationwide labor force, an agriculture sector shared more than 50% in 1990, however, the share dropped to 37% in 1995. *Table 2.5* shows nationwide labor force by sector.

Table 2.5 Labor Force by Sector in Honduras

(Unit : %)

Year	1990	1991	1992	1993	1994
Agriculture	42.4	39.7	37.7	35.3	37.5
Industry	20.0	20.7	20.4	23.1	24.3
Service	37.5	39.6	41.9	41.6	38.2
Unemployment rate*	7.8	7.4	6.0	7.0	4.0

Source: Honduras Indicators of Labor Market, DGEC, 1996
* Inter-American Development Bank web page, http://www.iadb.org

Table 2.6 shows labor force by sector in Tegucigalpa. In the capital city majority of labor force is occupied by the service sector and the share of agricultural sector is merely 1 %.

Table 2.6 Labor Force by Sector in Tegucigalpa

(Unit : %)

Year	1990	1991	1992	1993	1994
Agriculture	0.6	0.8	0.9	0.8	1.0
Industry	29.6	29.3	27.8	29.7	33.4
Service	69.8	70.0	71.3	69.5	65.5

Source: Honduras Indicators of Labor Market, DGEC, 1996

Like in many Latin American countries, severe inflation is one of the big economic problems in Honduras. *Table 2.7* shows annual growth rate of consumer price index (CPI).

Table 2.7 Consumer Price Index

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Annual growth rate of CPI (%)	23.3	34.0	8.7	10.8	21.7	29.5	23.8	20.2	13.7	11.6
CPI (Year 1990 = 100)	100	134	146	161	196	254	315	379	430	480

Source: Inter-American Development Bank web page, http://www.iadb.org

Average annual inflation rate during 1990s was 19.0% a year.

2.2.3 DEVELOPING COMMUNITY

Due to lack of proper urban development plan and effective legislation system in Tegucigalpa, most of immigrants tend to settle down outside the existing neighborhoods and to form developing communities. In many cases developing communities were constructed in unfavorable and risky areas such as steep hillsides or vulnerable riversides without official permission. Moreover, some developing communities were constructed by invading private lands without owners' permission.

These situations make it very difficult to provide public services to these areas. In fact, there are not few developing communities without SANAA water supply service through distribution network in spite of SANAA's efforts to extend water supply service to there.

Based on population estimation in the Study, the existing population in developing communities reaches 525,735 persons, or 56.4% of the total urban population.

2.3 WATER SUPPLY SERVICE

2.3.1 SERVICE AREA AND SUPPLY METHODS

The existing service areas of SANAA water distribution network are shown in *Figure 2.5*. Outside the SANAA service areas, there are many neighborhoods where water is supplied by wells or tank lorries. *Figure 2.5* also shows these neighborhoods. SANAA operates a water filling station for tank lorries near Los Filtros distribution tanks, however, many private tank lorries obtain water from their own wells.

2.3.2 SERVED POPULATION

Based on the estimated present population by neighborhood and the abovementioned delineation of service areas, the present service population by supply method was estimated. *Table 2.8* shows the present service population by supply method.

Table 2.8 Present Service Population by Supply Method in 2000

Water supply method	Population		Neighborhood	
	Number	Ratio (%)	Number	Ratio (%)
By pipeline	852,271	91.4	505	87.0
By tank lorry	66,706	7.2	58	10.0
By well	13,311	1.4	16	3.0
Total	932,288	100.0	579	100.0

2.3.3 CONSUMPTION

(1) Consumption by Water Use

The Study estimates the existing water consumption based on the water sales records of SANAA. Because the share of non-measured customer is not small, the assumed water consumption for non-measured customers should be verified. For this purpose, accounted-for water rates for non-measured and measured customers are compared as shown in *Table 2.9*.

Table 2.9 Accounted-for Water Rate for Measured and Non-measured Customers

Water Use	Average accounted-for water (m^3/month)		Average number of custmers (no. of invoice)		Unit accounted-for water rate (m^3/month/invoice)	
	Measured	Non-measured	Measured	Non-measured	Measured	Non-measured
Domestic use	1,643,717	995,832	50,535	32,775	32.5	30.4
Commercial use	311,345	34,246	3,525	454	88.3	75.4
Industrial use	81,380	6,125	512	59	158.9	103.8
Public use	136,728	246,035	338	454	404.5	541.9
Public tap	125,519	128,514	44	44	2,852.7	2,920.8

Source: Sales data from Nov.1999 to Mar. 2000, SANAA Commercial Department, April 2000

The result of this comparison shows that the assumed unit accounted-for water rates for non-measured customers is realistic. Thus, it is concluded that the accounted-for water rates of sales records can be regarded as actual water consumption rates.

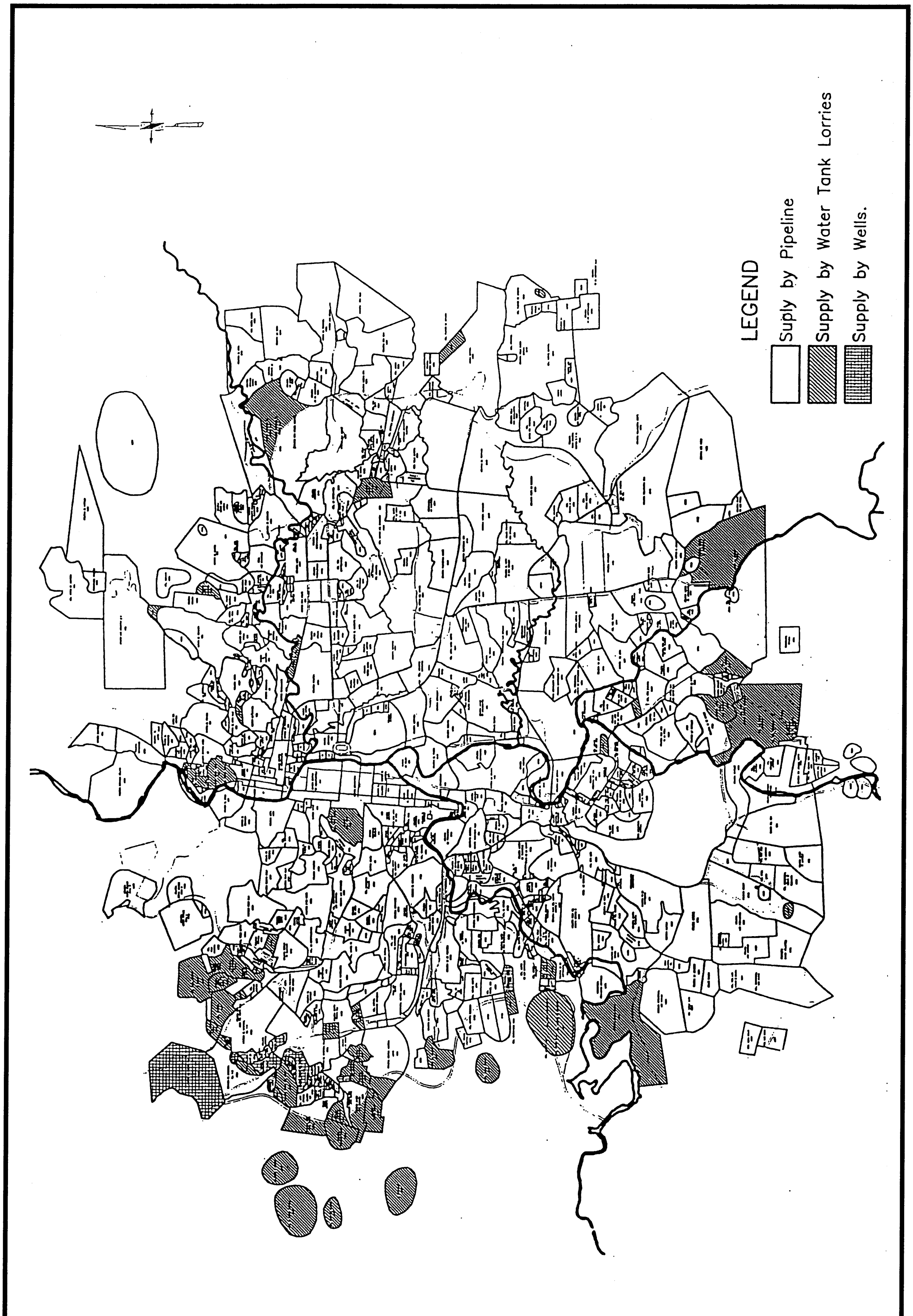

Figure 2.5	**Existing Water Supply Service Area**

Table 2.10 shows the existing water composition by water use.

Table 2.10 Existing Average Monthly Water Consumption by Water Use

Water Use	Average monthly consumption (m^3/month)	Protion (%)
Domestic use (including public tap)	2,893,582	78.0 %
Commercial use	345,591	9.3 %
Industrial use	87,505	2.4 %
Public use	382,762	10.3 %
Total	3,709,440	100.0 %

Source: Sales data from Nov.1999 to Mar. 2000, SANAA Commercial Department, April 2000

(2) Unit Water Consumption for Domestic Use

Annual total accounted-for water supplied by pipe in 1999 was 44,171,000 m^3/year, and accounted-for water for the domestic use is estimated at 34,453,380 m^3/year based on composition of water use shown in *Table 2.10*. With assumption that this amount is valid as the domestic consumption in 2000, unit water consumption for domestic use is estimated at 111 l/c/d.

2.3.4 WATER UTILIZATION

The existing water utilization was analyzed by water utilization survey conducted in the Study. In the water utilization survey the whole water users are categorized as follows.

- Domestic users of SANAA
- Non-domestic users of SANAA (commercial, industrial, public, and agricultural users)
- Nonusers of SANAA (people without piped water supply service)

Questionnaires were prepared and an interview method was applied for each of the above categories. Field survey was conducted during May 27 to June 10, 2000. Collected samples were carefully reviewed and inappropriate samples were rejected. As a result, the number of available samples was as shown in *Table 2.11*.

Table 2.11 Availability of Collected Samples

User Category	Class	Cellected Sample	Available Sample	Availability
Domestic User	Class S	40	36	90.0 %
	Class A	80	62	77.5 %
	Class M	120	111	92.5 %
	Class B	40	37	92.5 %
	Class C	40	39	97.5 %
	Class P	200	184	92.0 %
	Class T	160	147	91.9 %
Non-domestic user		90	82	91.1 %
Nonuser		120	118	98.3 %

(1) Domestic User

Table 2.12 shows the duration of water supply service and possession of storage tank.

Table 2.12 Domestic Service Duration and Possession of Storage Tank

Class	Average supply duration per day (hrs)		Average supply days per week (days)		Posession of Storage Tank	Capacity of Storage Tank*
	Dry	Rainy	Dry	Rainy		
S	7.3	8.8	6.6	6.7	86 %	8.5 days
A	11.2	11.7	6.6	6.8	65 %	4.7 days
M	11.7	12.4	6.8	6.9	32 %	8.3 days
B	9.8	9.9	6.7	6.7	14 %	2.8 days
C	16.5	16.9	6.8	6.8	13 %	4.2 days
P	7.7	9.9	6.5	6.8	20 %	6.5 days
T	7.1	7.4	4.5	4.6	6 %	4.0 days

*) Average of samples which possess a storage tank.

The result shows that almost everyday people can receive water supply service, however daily rationing is significant, normally only 7 hours to 12 hours people can receive water. Because the majority of people do not have water storage tank, this rationing may have significant negative effects on people's daily life.

Table 2.13 shows drinking water source and monthly expense for bottle water.

Table 2.13 Drinking Water Source and Bottle Water Expense

Class	Raw tap water	Boiled tap water	Bottle water	Filtered tap water	Reply ratio to bottle water expense	Average expense for bottle water* (Lps/month)
S	5.6 %	19.4 %	41.7 %	33.3 %	38.9 %	204.6
A	0.0 %	25.8 %	58.1 %	16.1 %	58.1 %	189.0
M	5.5 %	31.2 %	54.1 %	9.2 %	53.2 %	148.8
B	24.3 %	29.7 %	45.9 %	0.0 %	43.2 %	112.0
C	5.1 %	61.5 %	33.3 %	0.0 %	25.6 %	186.2
P	12.1 %	34.6 %	53.3 %	0.0 %	49.5 %	136.9
T	64.5 %	26.2 %	9.2 %	0.0 %	10.2 %	130.8
Average	38.1 %	31.5 %	28.5 %	1.9 %	27.3 %	-

*) Average of samples which answered bottle water expenditure.

Except the classes C and T, bottle water is the main drinking water source. However, as a whole city, raw tap water is the largest drinking water source, and the second is boiled tap water.

The cost for bottle water for the class T is unbelievably heavy burden for the household finance.

Tables 2.14 to 2.16 show how domestic users evaluate the water supply service by SANAA.

Table 2.14 Evaluation of Water Pressure

Class	Satisfied		Accepatble		Not acceptable	
	Dry	Rainy	Dry	Rainy	Dry	Rainy
S	27.8%	69.4%	52.8%	19.4%	19.4%	11.1%
A	16.1%	29.0%	66.1%	61.3%	17.7%	9.7%
M	22.5%	48.6%	70.3%	50.5%	7.2%	0.9%
B	18.9%	21.6%	62.2%	64.9%	18.9%	13.5%
C	15.4%	23.1%	71.8%	74.4%	12.8%	2.6%
P	14.7%	69.0%	56.5%	28.8%	28.8%	2.2%
T	27.2%	55.8%	44.9%	40.1%	27.9%	4.1%
Average	22.4%	54.1%	53.3%	42.2%	24.3%	3.8%

Table 2.15 Evaluation of Color of Water

Class	Satisfied		Accepatble		Not acceptable	
	Dry	Rainy	Dry	Rainy	Dry	Rainy
S	25.0%	13.9%	52.8%	47.2%	22.2%	38.9%
A	1.6%	0.0%	87.1%	62.9%	11.3%	37.1%
M	15.3%	5.4%	75.7%	56.8%	9.0%	37.8%
B	0.0%	0.0%	97.3%	64.9%	2.7%	35.1%
C	0.0%	0.0%	100 %	74.4%	0.0%	25.6%
P	37.5%	7.1%	48.9%	53.3%	13.6%	39.7%
T	25.9%	7.5%	63.9%	55.8%	10.2%	36.7%
Average	24.1%	6.3%	65.8%	57.1%	10.1%	36.6%

Table 2.16 Evaluation of Taste of Water

Class	Satisfied		Accepatble		Not acceptable	
	Dry	Rainy	Dry	Rainy	Dry	Rainy
S	22.2%	11.1%	44.4%	38.9%	33.3%	50.0%
A	4.8%	1.6%	83.9%	66.1%	11.3%	32.3%
M	8.1%	5.4%	82.0%	52.3%	9.9%	42.3%
B	0.0%	0.0%	97.3%	70.3%	2.7%	29.7%
C	0.0%	0.0%	100 %	79.5%	0.0%	20.5%
P	26.1%	6.5%	57.1%	42.4%	16.8%	51.1%
T	22.4%	6.1%	68.7%	54.4%	8.8%	39.5%
Average	19.0%	5.4%	70.5%	54.0%	10.4%	40.6%

Table 2.14 shows that during dry season only 22.4 % is satisfied and 24.3 % feels "not acceptable". It tells that a water shortage during dry season is very severe.

Tables 2.15 and 2.16 show that during rainy season nearly 40 % feels that color and taste of water are not acceptable. During dry season the situation might be far better. During dry season nearly 20 % replies "satisfied" and only 10 % replies "not acceptable".

(2) Non-domestic User

Table 2.17 shows the duration of water supply service and possession of storage tank. The service duration is 13.0 hours during dry season and 15.4 hours during rainy season. Possession ratio of water storage tank is 73.2 %. Average capacity of water tank is 7.2 days.

Table 2.17 Non-domestic Service Duration and Possession of Storage Tank

Average supply duration per day (hrs)		Average supply days per week (days)		Posession of Storage
Dry season	Rainy season	Dry season	Rainy season	Tank
13.0	15.4	6.2	6.7	73.2 %

The effect of water shortage on the sales was asked in the questionnaires for non-domestic users. 45.1 % and 35.4 % reply there is negative effect of water shortage on sales during dry season and rainy season, respectively. In term of type of industry, agriculture, hotel, and others are severely affected but manufacturer, supermarket, and restaurant are less affected. Average magnitude of the effect is 53.2% during dry season and 47.7% during rainy season.

Table 2.18 shows how non-domestic users evaluate the water supply service by SANAA.

Table 2.18 Evaluation of Water Pressure and Quality

	Satisfied		Accepatble		Not acceptable	
	Dry	Rainy	Dry	Rainy	Dry	Rainy
Water pressure	40.2%	65.9%	39.0%	22.0%	20.7%	12.2%
Color	40.2%	11.0%	47.6%	31.7%	12.2%	57.3%
Taste	26.8%	7.3%	42.7%	34.1%	30.5%	58.5%

Similar to the domestic user survey, non-domestic users feel that during rainy season water pressure is better but water quality is worse.

(3) Nonuser

Water sources of SANAA nonusers are as follows.

- Water tanker 5.1 %
- Private water vender 28.0 %
- Community system 66.1 %
- Others 0.8 %

Community system is a small-scale water supply system operated by the community organization ("patronato" in Spanish). SANAA often provides technical assistance to community systems and in some cases SANAA sells water to community system.

Sources of drinking water are as follows.

- Boiled well water 11.0 %
- Raw well water 13.6 %
- Boiled water tanker water 41.5 %
- Raw water tanker water 28.8 %
- Bottle water 5.1 %

Table 2.19 shows how nonusers evaluate the quantity and quality of available water for them.

Table 2.19 Evaluation of Water Quantity and Quality

	Satisfied		Accepatble		Not acceptable	
	Dry	Rainy	Dry	Rainy	Dry	Rainy
Quantity	38.1%	46.6%	47.5%	48.3%	14.4%	5.1%
Color	15.3%	5.1%	79.7%	83.1%	5.1%	11.9%
Taste	13.6%	5.1%	53.4%	55.9%	33.1%	39.0%

During rainy season more water is available but water quality is worse.

2.4 WATER SUPPLY SYSTEM OPERATED BY SANAA

2.4.1 BACKGROUND

At the beginning of 1990s the supply system of Tegucigalpa provided service to a population around 610,000 inhabitants. It consisted of the following two (2) subsystems.

- Picacho subsystem, the oldest water supply system in Tegucigalpa, collected water from the sources in La Tigra Mountains. Gravity system aqueducts conducted the collected water to the distribution tanks called Picacho and then distributed to the city also by gravity. At that time there was no treatment plant.
- Los Laureles subsystem, which was put into service in 1975, collected water from Los Laureles reservoir and treated water in Los Laureles water treatment plant (WTP). Los Laureles system was constructed to supply water to low areas by gravity and to intermediate

areas through pumping station. Furthermore, the system supplemented water supply in certain high areas during the dry season when the Picacho system could not supply enough water.

Besides these main supply systems, other small subsystems existed as follows.

- Miraflores WTP which collected water from the Las Canoas and the Sabacuante Rivers.
- Loarque WTP which collected water from the Grande River.
- Water supply by wells

The production and demand level in 1990 is shown in *Table 2.20*.

Table 2.20 Demand and Production in 1990

	Average	Dry season	Rainy season
Total production :	1,000	840	1,170
- By Picacho subsystem	400	300	500
- By Los Laureles subsystem	500	450	550
- By Miraflores WTP	40	30	60
- By Loarque WTP	20	20	20
- By wells	40	40	40
Demand	1,230	1,350	1,100
Deficit	230 (18%)	510 (37%)	0 (0%)

Source: SANAA (Unit: l/s)

As shown in *Table 2.20*, in 1990 an average water shortage was 230 l/s which was 18% of average demand, and the shortage increased in dry season up to 37%.

At that time, the main problems were as follows.

- New water sources was necessary to cover the evolution of water demand.
- Conduction facilities of Picacho subsystem were depleted and the productivity of the system decreased. Also proper water treatment was required to guarantee the potability of water.
- Insufficient design of distribution tanks. Many of them were roofless and had insufficient capacity.
- Poor design of distribution network caused very complicated operation, a non continuous service submitted to distribution schedules, and high loss indexes.

To solve these problems SANAA launched the following two (2) important projects with the support of the Inter-American Development Bank (IDB) and foreign cooperation agencies.

- The IDB/799 Project financed by IDB. The project was almost to renew the existing system, to restructure it and to expand it towards the new urban areas so that the distribution facilities were in capacity to cover the demand when new resources were incorporated. The project reached a final design level during 1987 to 1989.
- A master plan and feasibility study for Tegucigalpa water supply system (1988 Master Plan) aimed to select the new resource to be incorporated. It was concluded that at Concepcion on the Grande River a new dam which could provide 1.2 m^3/s, or could double the production rate at that time, be constructed. Concepcion dam construction project was financed by Italy for the dam and conduction lines and by France for the treatment plant and primary distribution line.

The construction of Concepcion dam began at the end of the 1989 and finished in 1992, and its filling lasted in 1993. Concepcion WTP, conduction lines and primary lines were constructed meanwhile. Concepcion subsystem started its operation in 1993. However, because the distribution facilities were not sufficient to use the production capacity of Concepcion, Concepcion subsystem was operated with a reduced capacity.

Indeed the IDB/799 program that should have been carried out on the period 1989 to 1993 was delayed by several setbacks including the followings.

- SANAA could not comply with the IDB loan conditions.
- Several times tendering process was not successful and cancelled.

In fact, the effective start of the IDB/799 was the end of 1993. Also in the execution stage the project faced new difficulties due to the necessity to adapt the program to the new situation due to Concepcion subsystem. Modifications had to be carried along, to redefine priorities, which produced delays in the progress of the works. During 1993 to 1995, the project execution continued in a slow and messed-up way. Later on, after planning adjustments and with a new supervision team, the project began to be developed in a more organized way. At the beginning of 1998, several important works were finished such as Kennedy III distribution tank, Picacho WTP, and most of the distribution networks.

2.4.2 OUTLINE OF THE EXISTING SYSTEM

The existing water supply system consists of three (3) major subsystems, Picacho subsystem, Los Laureles subsystem, and Concepcion subsystem. Los Laureles and Concepcion subsystems are of water intake from reservoirs constructed in the Guacerique River and the Grande River respectively, while Picacho subsystem is of water intake from several streams. A maximum water intake capacity for each system varies between the dry and rainy seasons and it is more significant in Picacho subsystem that does not have a storage capacity.

There is another small subsystem, Miraflores subsystem that has been suspending its operation due to heavy damages of facilities by Hurricane Mitch. Miraflores subsystem is of water intake from the Sabacuante River and the Las Canoas River.

Each subsystem has an own water treatment plant, thus there are four (4) water treatment plants, however, Miraflores WTP is now out of operation due to severe damages by Hurricane Mitch in 1998. Miraflores WTP is currently under repair work.

Distribution system is rather complex reflecting Tegucigalpa’s geography with many small uphills and downhills combined with rapid and unplanned development of the urban areas. There are about 50 distribution reservoirs in the system and each has its own distribution area. Basically the existing distribution system is based on an idea to allocate water from each water treatment plant to distribution reservoirs by a gravity flow. Concepcion is located at an intermediate elevation and has the biggest supply capacity, therefore its water is covering most parts of the city. Water from Picacho WTP, which is the highest water treatment plant, covers higher areas. Water from Los Laureles WTP, which is the lowest water treatment plant, mainly covers lower parts of the city. However, due to a shortage of water from Picacho WTP, water from Concepcion WTP and even from Los Laureles WTP is pumped up to the reservoirs designed to be covered by Picacho WTP.

There are also areas where water is not supplied through pipes but supplied by tank lorries. It is noted that some areas with pipe water supply are subsidiarily supplied by tank lorries when the water shortage is critical.

A general layout of the existing water supply system is shown in *Figure 2.6*.

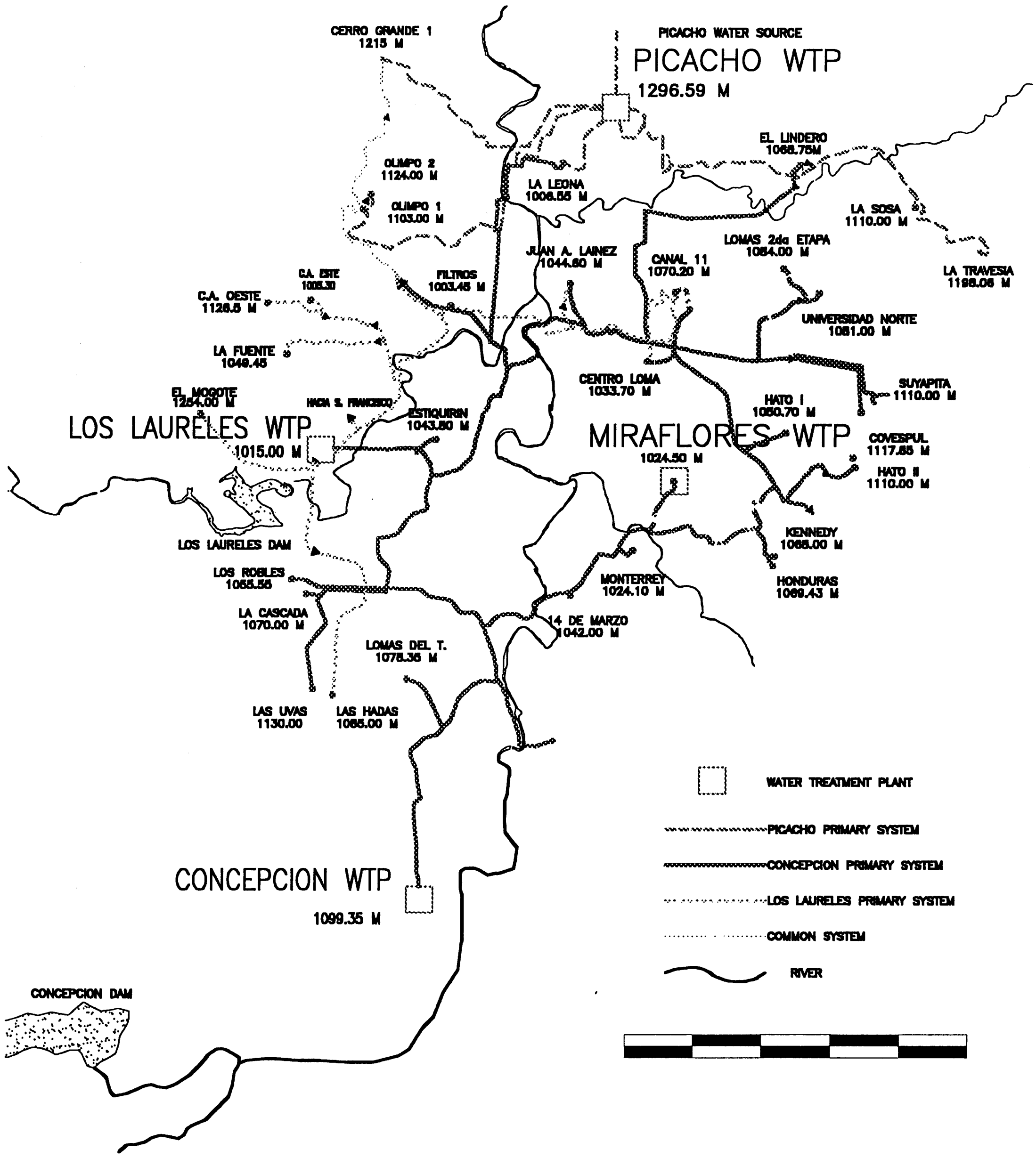

Figure 2.6	General Layout of Existing Water Supply System

2.4.3 WATER SOURCES AND CONDUCTION FACILITIES

(1) Water Sources

There are four (4) water sources used by SANAA at present, as shown in *Table 2.21*.

Table 2.21 Water Sources Used by SANAA

Name of subsystem	Water souce	Type of water source facility
Picacho	Creeks in La Tigra Mountains	Intake weirs
Los Laureles	Guacerique River	Dam
Concepcion	Grande River	Dam
Miraflores	Sabacuante River and Las Canoas River	Intake weir

Source: SANAA, 2000

It is necessary to evaluate the present yield capacity of the above sources in order to make a water source development master plan. Water yield capacity of each source was evaluated for the driest month in 10 years. The result is shown in *Table 2.22*. The capacity evaluated is the 99 % reliable yield capacity.

Table 2.22 Present Yield Capacity for the Driest Month in 10 Years

Subsystem	Present yield capacity (l/s)
Picacho	200 (350*)
Los Laureles	540
Concepcion	1,000
Miraflores	0
Total	1,740 (1,890*)

*: With yield capacity of San Juancito

(2) Water Intake Facilities

Picacho subsystem takes water from small weirs constructed in several streams, which does not have a storage capacity. There are four (4) main sources, namely San Juancito, Jutiapa, Chimbo and Carrizal. Among them, in San Junacito, which is the biggest water source, Hurricane Mitch destroyed most of intake weirs and conduction pipelines to Picacho WTP.

Los Laureles and Concepcion subsystems take water from reservoirs which were constructed exclusively for water supply use. In the both reservoirs, each water intake facility is located at the bottom of a dam body, which can take water only from bottom of the reservoir. This sometimes causes water quality problems related manganese and iron, since bottom water tends to be rich with those elements because of anaerobic conditions. There is a plan to install a new water intake facility to take water from surface of Los Laureles reservoir.

Miraflores subsystem takes water from small weirs constructed in the Sabacuante River and the Las Canoas River, although Hurricane Mitch destroyed these weirs.

(3) Conduction Facilities

Basically all the subsystems adopt gravity flow from water sources to water treatment plants. However, Los Laureles subsystem occasionally needs to pump up water when a water level of the reservoir lowers the design minimum water level.

Lengths and sizes of the conduction lines are shown in *Table 2.23* and their locations are shown in *Figures 2.7 and 2.8*.

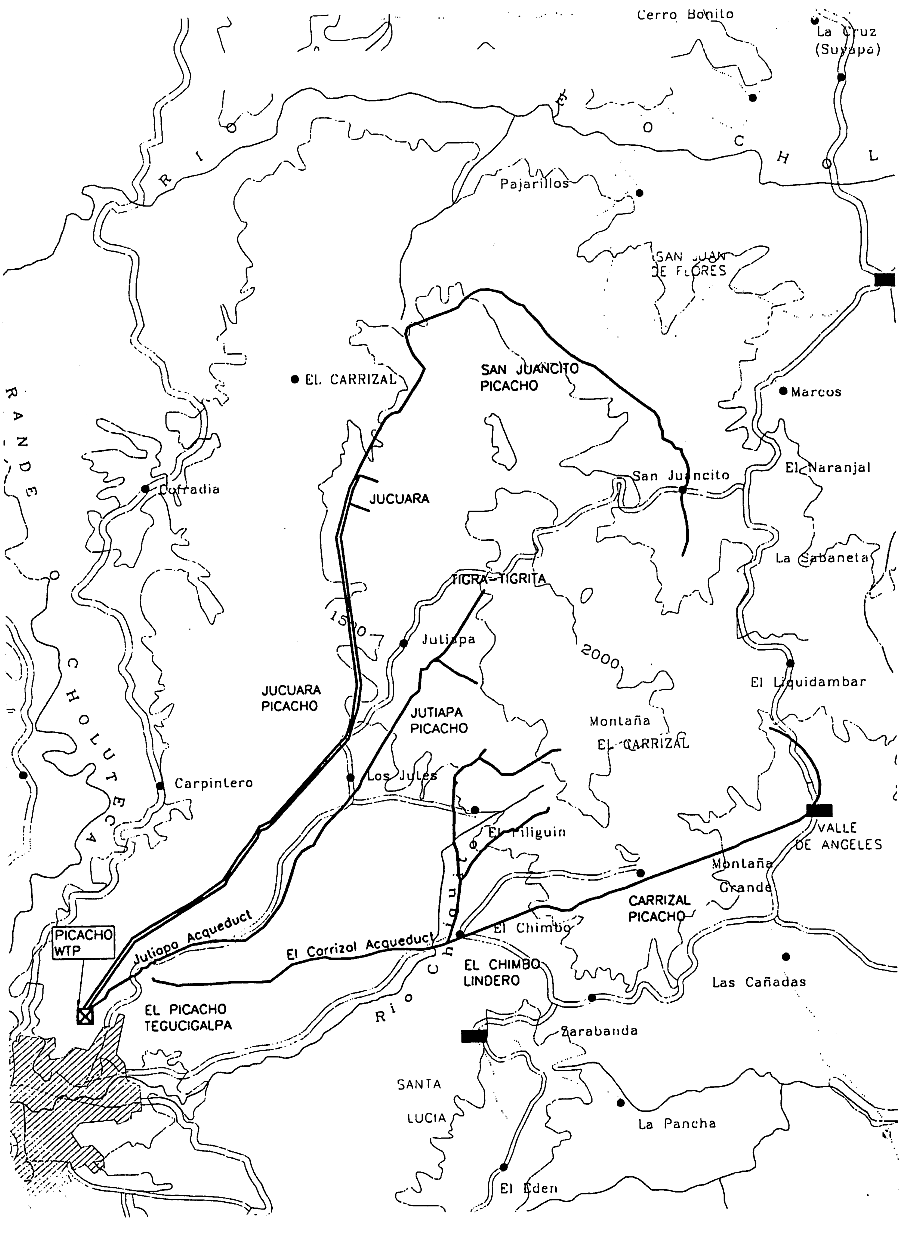

Figure 2.7	Existing Picacho Conduction Lines

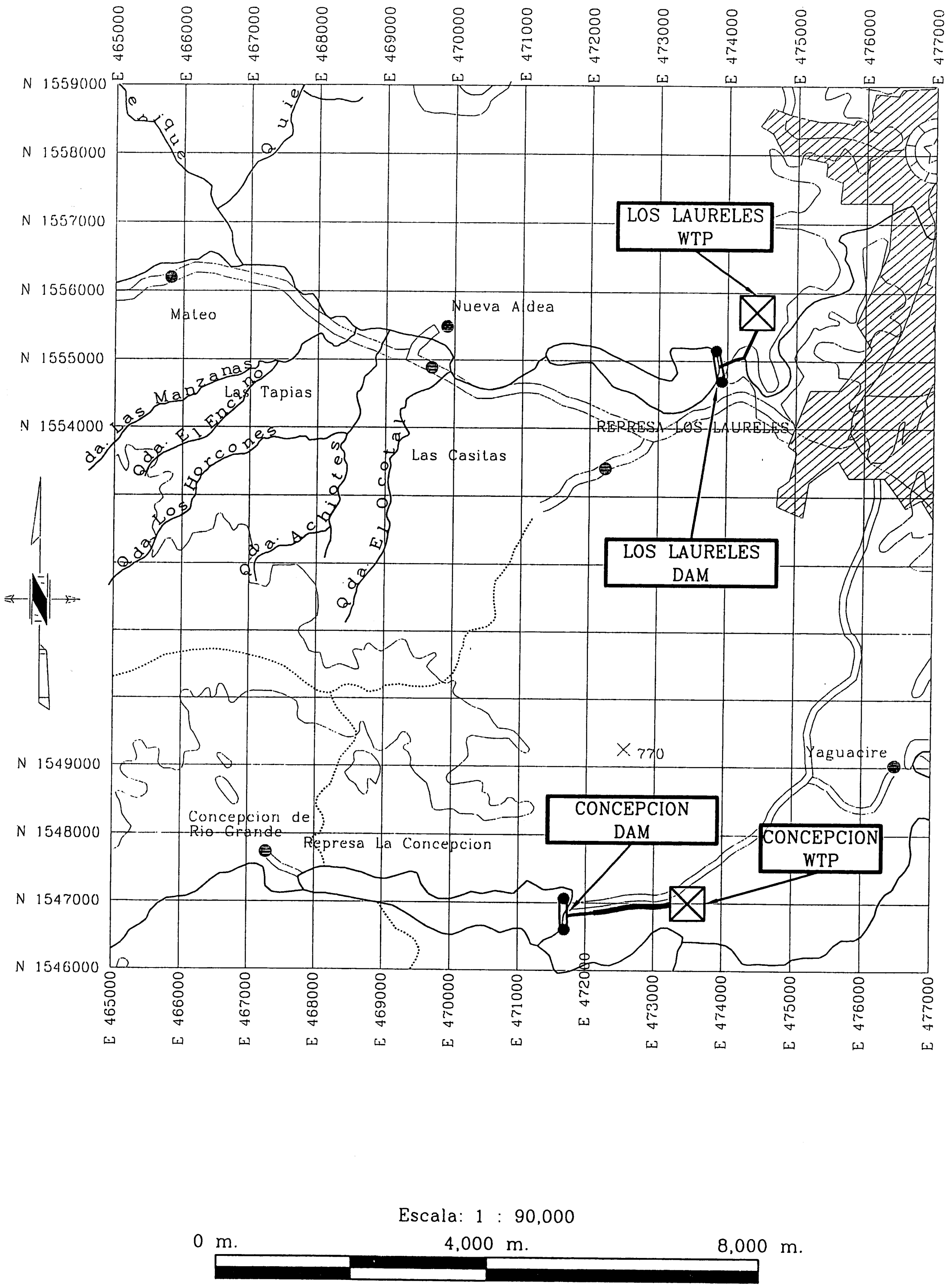

Figure 2.8	Existing Los Laureles and Concepcion Conduction Lines

Table 2.23 Existing Conduction Facilities

Subsystem	Intake lines	Design capacity (m^3/d)	Main Pipeline	
			Diameter (mm)	Length (approx-km)
Picacho	San Juancito	77,800 (900 l/s)	100 - 550	40
	Jutiapa		100 - 250	14
	Chimbo & Carrizal		100 - 450	26
Los Laureles		57,900 (670 l/s)	1,000	0.8
Concepcion		129,600 (1,500 l/s)	1,500	1.8
Miraflores*	Las Canoas	8,640 (100 l/s)	500	5
	Sabacuante		500	19

Source: SANAA, 2000; *: Estimated by the Study

As mentioned above, in Picacho subsystem, not only intake weirs but also conduction lines were severely damaged by Hurricane Mitch. It is said that the conduction capacity has been decreased by 50%.

2.4.4 WATER TREATMENT PLANT

Picacho WTP is located on the top of the Picacho hill. This treatment plant is located at the highest elevation with 1,296 m among the treatment plants in the existing system, supplying water mainly higher areas. General layout of Picacho WTP is shown in *Figure 2.9*.

Los Laureles WTP is located about 800 m downstream Los Laureles dam, treating water from Los Laureles reservoir. This plant is located at the lowest elevation with 1,015 m among the treatment plants of the existing system.

Concepcion WTP is located about 1.8 km downstream Concepcion dam at elevation of 1,099 m. It has a biggest treatment capacity among the treatment plants in the existing system. General layout of Concepcion WTP is shown in *Figure 2.10*.

Miraflores WTP is located in Colonia Miraflores at elevation of 1,024 m. Miraflores WTP is currently out of operation, however, clear water reservoir is operated as a distribution reservoir with receiving water from Concepcion WTP.

(1) Water Treatment Capacity

Design water treatment capacity of the existing plants is shown in *Table 2.24*. While actual production rates, which are shown in the same table, lower the design capacities, this does not mean that actual treatment capacities are smaller than the designed because the actual production rates depending on the capacities of the water sources. By analyzing daily production rates at each plant, it was confirmed that Concepcion and Los Laureles WTPs have a treatment capacity at the designed rates.

Table 2.24 Design Water Treatment Capacity

Treatment plant	Design intake capacity (m^3/day)	Actual average daily intake in 1999 (m^3/day)
Picacho WTP	77,760 (900 l/s)	26,203 (303 l/s)
Los Laureles WTP	57,900 (670 l/s)	51,762 (599 l/s)
Concepcion WTP	103,700 (1,200 l/s)	101,321 (1,173 l/s)
Miraflores WTP	2,600 (30 l/s)	Out of operation

Source: SANAA, 2000

Total water production in 1999 was 62,577,000 m^3/year.

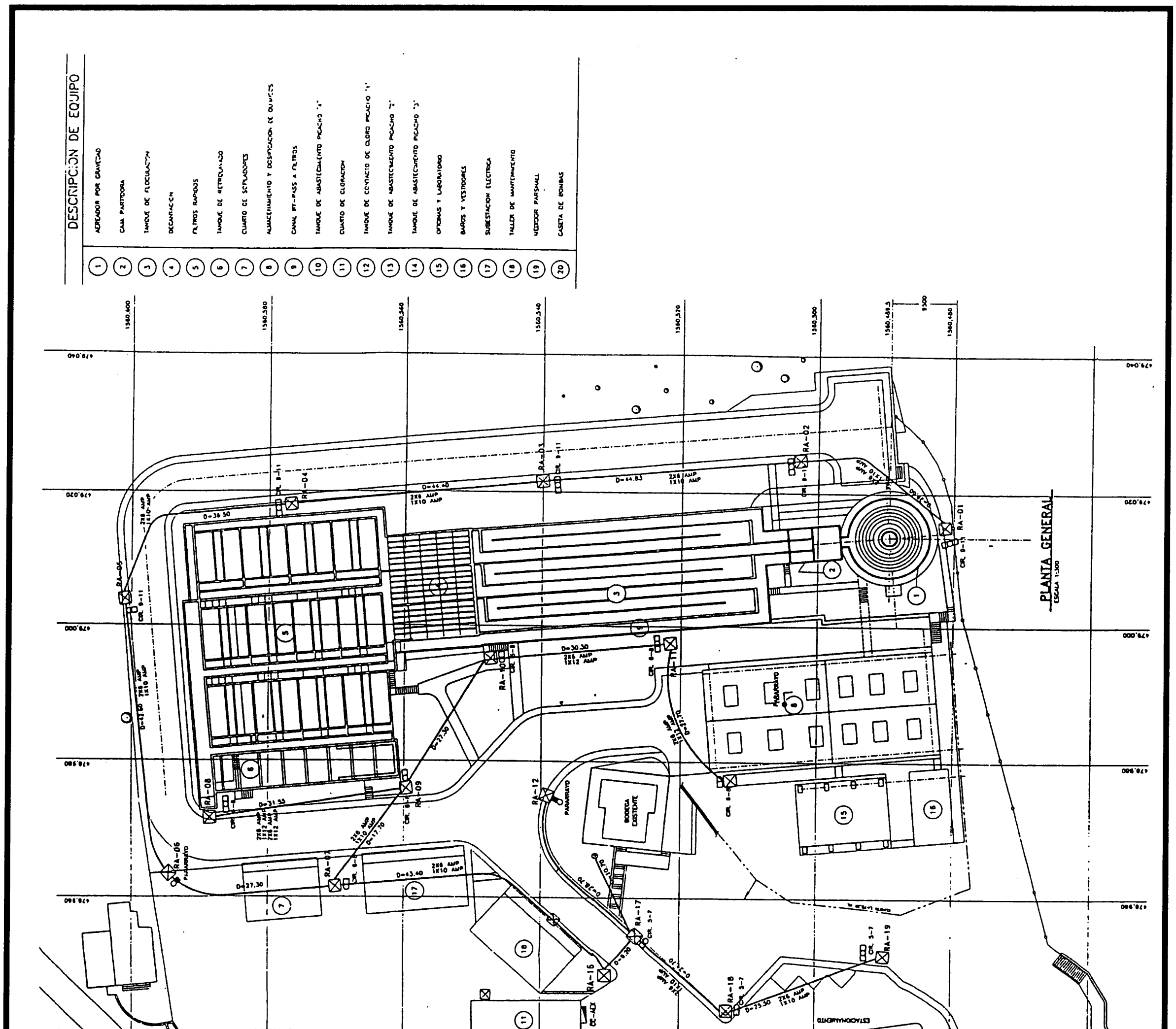

Figure 2.9	**General Layout of Existing Picacho WTP**

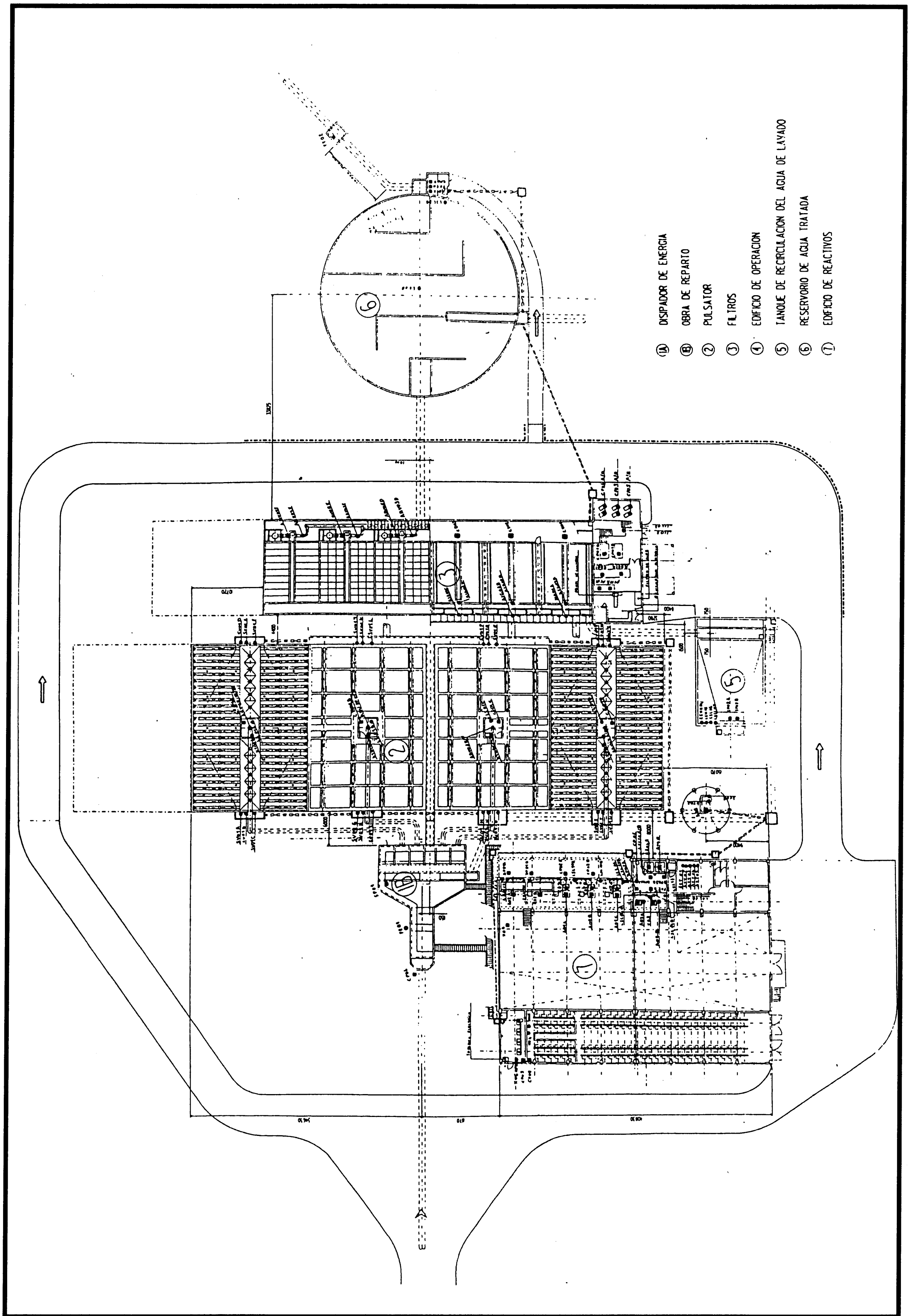

Figure 2.10	General Layout of Existing Concepcion WTP

(2) Treatment Process

The quality of raw water is generally acceptable as the source of drinking water, however, the concentration of iron and manganese is rather high. Especially manganese concentration in raw water of Concepcion WTP occasionally exceeds an acceptable level.

All the existing treatment plants, *i.e.* Picacho, Concepcion, Los Laureles, and Miraflores WTPs employ almost the same treatment process, however, Miraflores WTP is out of operation. *Figure 2.11* shows a flow sheet of the treatment process of Picacho WTP and *Figure 2.12* shows that of Los Laureles and Concepcion WTPs. They employ a cascaded aeration process at the beginning of the treatment to recover oxidized condition that induces precipitation of iron and oxidation of odorants. Coagulation process is accelerated by aluminum sulfate and high polymer auxiliary agent, while auxiliary agent is not added at Picacho WTP. In Concepcion WTP, potassium permanganate ($KMnO_4$) is occasionally added to oxidize manganese ion contained in raw water together with coagulants.

In the sedimentation process, two (2) types of sedimentation acceleration are employed. Picacho WTP has sedimentation basins equipped with plate settlers and Los Laureles and Concepcion WTPs have sedimentation basins equipped with pulsators. However, the pulsators are presently out of work in the both treatment plants.

Filtration process employs ordinary rapid sand filtration with air backwashing. Back washing water and drain from the sedimentation process are discharged to nearby rivers except Picacho WTP that has a sludge drying beds. Disinfect ion process employs liquid chlorine dosing to maintain the residual chlorine concentration above 0.1 mg/l at the users' hydrants.

(3) Quality of Treated Water

The quality of treated water is considered acceptable according to the following example of results of water quality analysis shown in *Table 2.25*. However, the results of the aforementioned water utilization survey indicate that treated water occasionally has aesthetic problems especially in rainy season probably because of both high turbidity of raw water during rainy season and the abovementioned problems of sedimentation process.

Table 2.25 Example of Water Quality Analysis

Parameters	Unit	Standard	Picacho WTP		Los Laureles WTP		Concepcion WTP	
			Raw	Treated	Raw	Treated	Raw	Treated
Turbidity	NTU	5	2.9	1.1	30.9	1.9	67.9	0.9
True Color	Pt-color unit	15	14.4	4.5	96.4	7.8	167.9	2.6
pH	-	6.5-8.5	6.8	6.9	6.8	6.9	6.8	6.8
Conductivity	μs/cm	400	64.3	76.0	107.3	138.6	42.6	92.3
Alkalinity (total)	mg/l	-	19.0	19.3	46.5	35.2	18.0	19.6
Hardness (as $CaCO_3$)	mg/l	400	74.2	78.8	80.7	99.0	35.0	59.1
Chlorine (Cl2)	mg/l	-	-	2.8	-	2.7	-	2.4
Iron (Fe)	mg/l	0.3	-	-	-	-	-	-
Manganese (Mn)	mg/l	0.5	-	-	-	-	-	-

Source: Water quality analysis by SANAA, average of January, 2000.

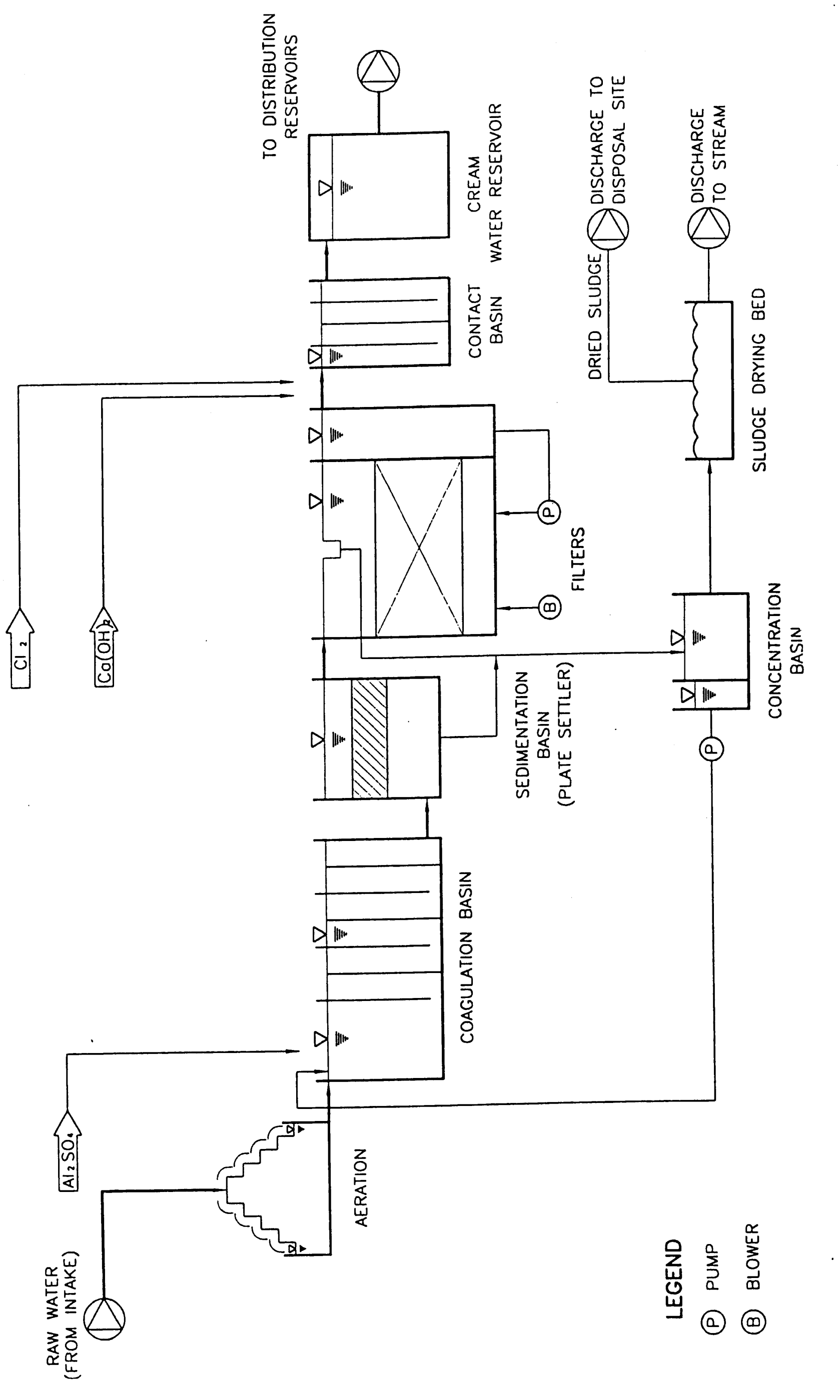

Figure 2.11	Process Flow Sheet of Picacho WTP

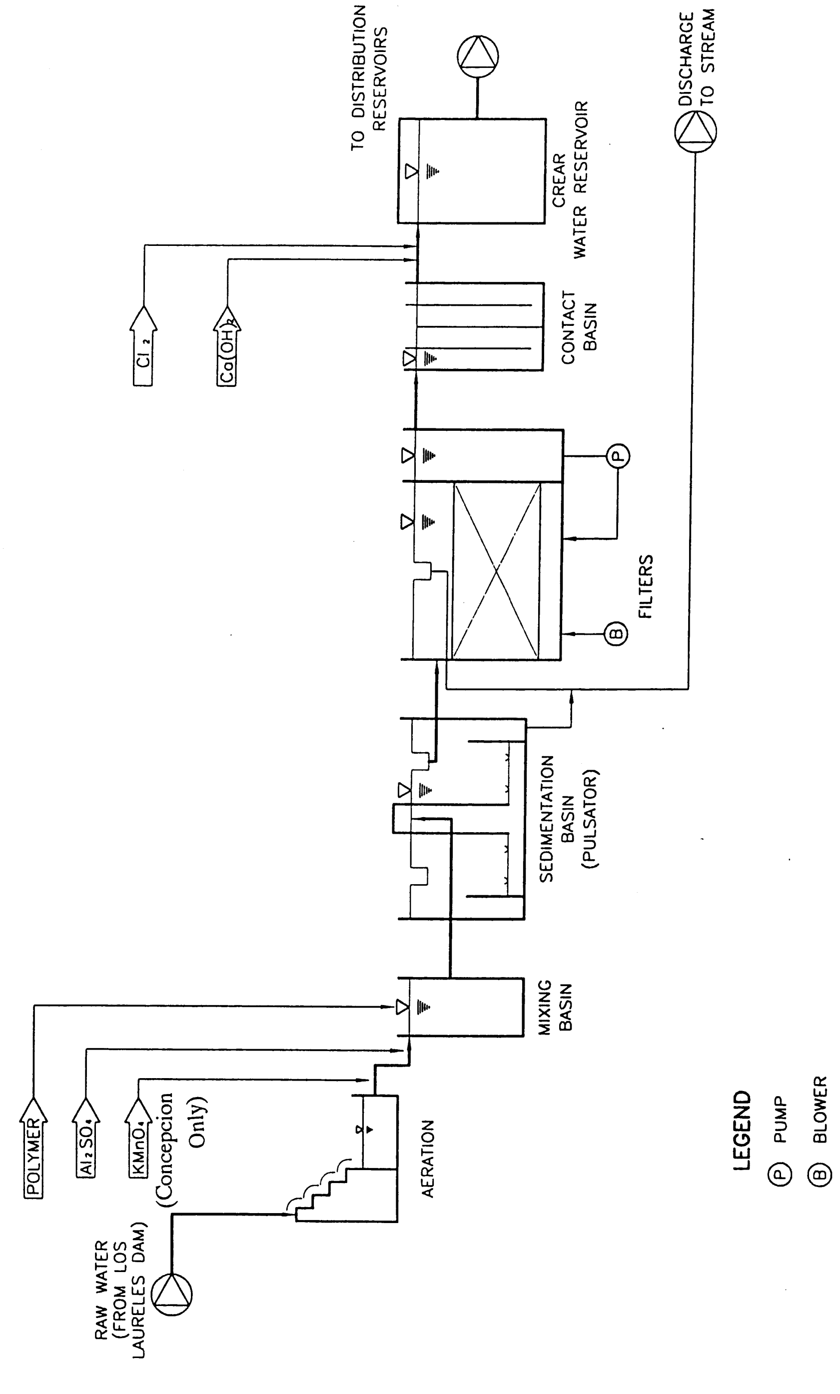

Figure 2.12	Process Flow Sheet of Los Laureles and Concepcion WTPs

2.4.5 TRANSMISSION AND DISTRIBUTION SYSTEM

(1) Outline

The transmission system transmits water from the water treatment plants to distribution reservoirs. Due to geography of the city, several higher places require two-step serial pumping for transmission.

Each water treatment plant has a transmission system which conveys water to distribution reservoirs assigned to each treatment plant. Several distribution reservoirs receive water from more than two treatment plants, but there is no interconnection between transmission pipelines. Therefore, it is considered that there are three (3) independent transmission systems.

Basically, distribution reservoirs are allocated to the water treatment plants by their elevation. In principle, Picacho transmission system covers higher areas, Los Laureles transmission system covers lower areas and Concepcion transmission system covers intermediate elevation areas, however, there are many exceptions. Several distribution reservoirs in higher areas receive water from Los Laureles WTP by pumping up, and several distribution reservoirs in lower areas receive water from Concepcion WTP using pressure release valves.

(2) Transmission Pipeline

General layout of the transmission pipelines and distribution reservoirs is shown in *Figure 2.13*. Flow diagram of the existing transmission system is shown in *Figure 2.14*.

(3) Pumping Stations

SANAA operates 24 pumping stations for transmission, as shown in *Table 2.26*.

Table 2.26 Existing Pumping Stations for Transmission

Name	Elevation of pump pit (m)	Specification of pumps		
		Number	Motor (HP)	Q (l/s)
Canteras	987.00	4	250	128.9
Centro America 1	991.00	2	150	94.6
		1	75	47.3
Centro America 2 Este	1,055.00	2	60	47.3
Centro America 2 Oeste	1,055.00	2	75	47.3
Cerro Grande 1	1,102.85	2	75	44.2
Cerro Grande 2	1,167.07	2	60	44.2
Covespul	1,107.45	2		
Estiquirin	999.60	2	150	157.7
Hato	1,045.00	2	60	34.7
Honduras	1,073.00	2	5	1.5
Juan A Lainez	985.00	2	125	94.6
Los Pinos	1,065.00	2		
La Fuente		2	30	12.6
Loma Linda Canal 11	988.10	1	150	88.3
		1	100	56.8
Loma Linda Centro Loma	988.10	2	40	37.9
Los Robles - Los Robles Reservoir	996.50	3	25	
Los Robles - Las Hadas Reservoir	996.50	2	50	21.9
Mogote	1,010.00	4	400	67.0
Nueva Suyapa	1,039.50	2	130	24.9
San Francisco		2	75	37.9
San Francisco 19 Setiembre		1		
Suyapita	1,039.50	2	150	112.3
Suyapita 2		2		
Universidad	1,044.72	2	60	47.3
Villa Nueva	1,045.00	3	30	22.1

Source: SANAA, 2000

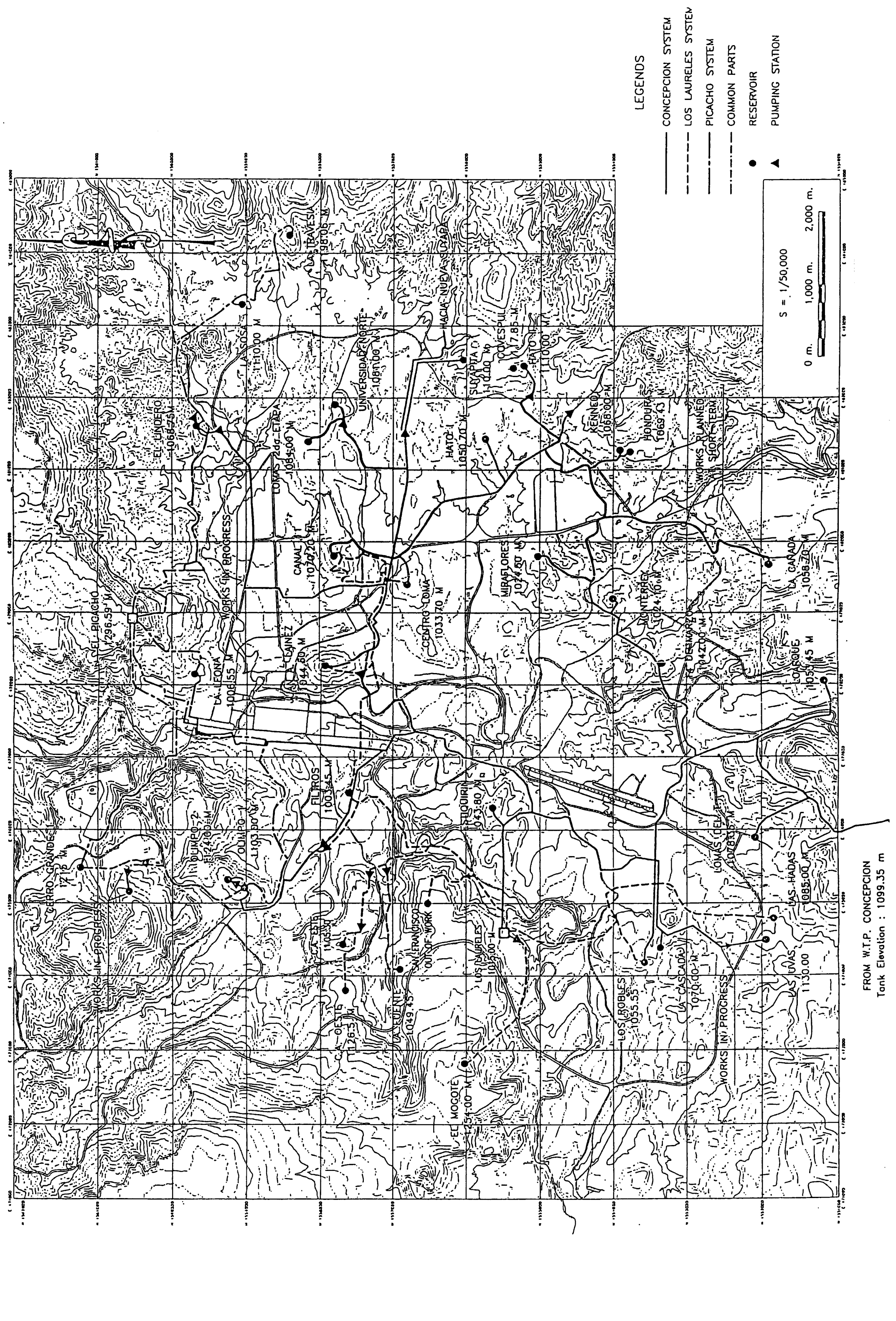

Figure 2.13	Existing Transmission Lines and Distribution Reservoirs

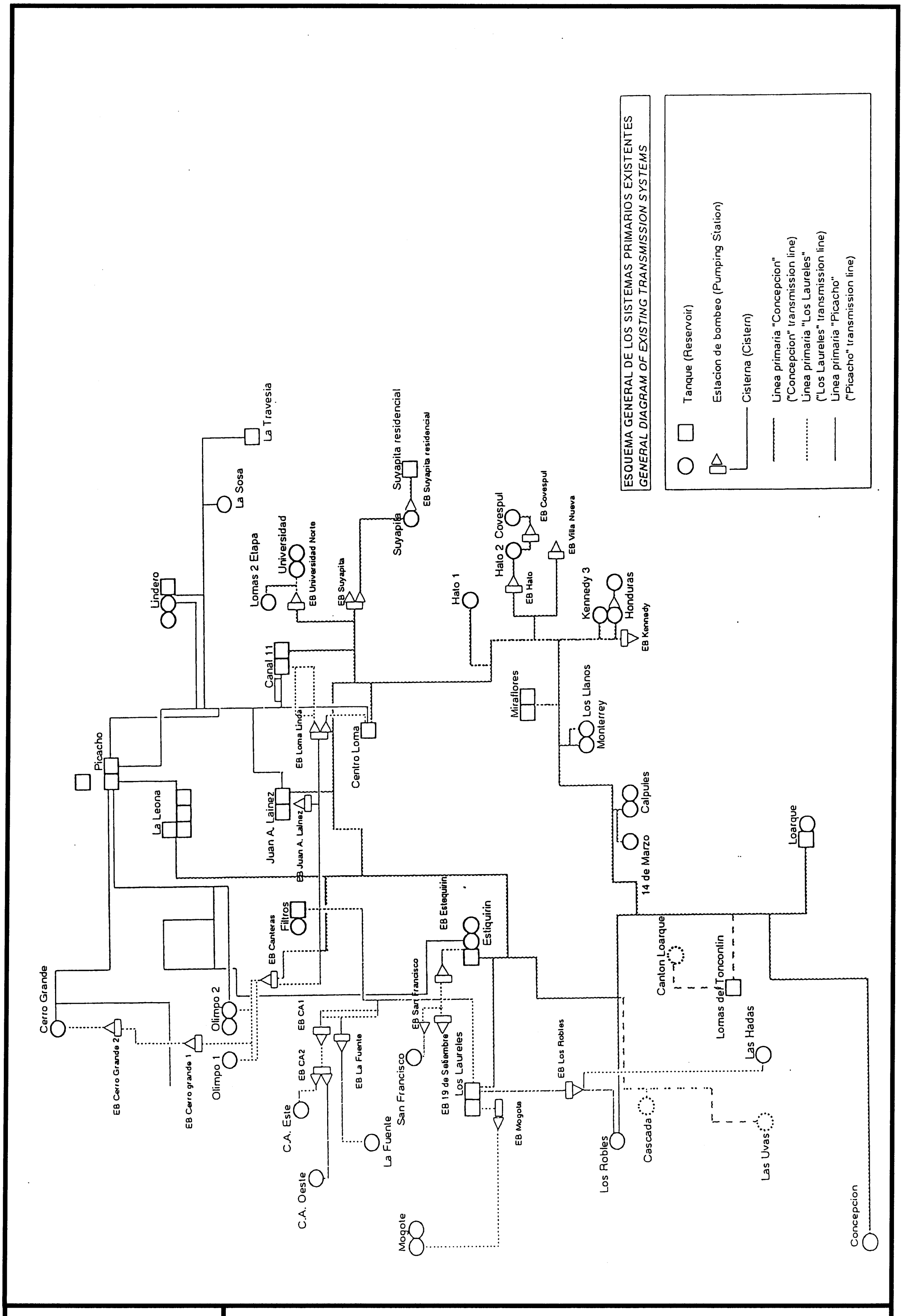

Figure 2.14	Flow Diagram of Existing Transmission System

(4) Distribution Reservoir

Currently there are 46 reservoirs. Among them 35 reservoirs are operated by SANAA and others are operated by private developers. Only the reservoirs operated by SANAA receive water from transmission pipelines and the others receive water from one of the reservoirs operated by SANAA. List of the reservoirs operated by SANAA is shown in *Table 2.27*.

(5) Distribution Pipeline

Present water distribution is not continuous due to a shortage of water. Water is rationed to each neighborhood from one distribution reservoir by switching over valves at certain intervals, usually 10 to 15 hours a day. Therefore, many users have a water tank in their houses to stock water.

Pipe materials consist of ductile cast iron, PVC, asbestos, and steel. Materials of new lines mostly consist of ductile cast iron and PVC.

(6) Water Leakage

It has been widely believed that the present distribution system has a big water leakage problem. However, due to lack of proper water metering little quantitative information is available. Only quantitative information available is SANAA's estimation based on daily minimum flows. It counts 40% to 45% but could contain not only leakage but also unaccounted-for water (unknown use water) such as filling a storage tank.

Present study conducted a leakage study to estimate leakage amount and to investigate the actual conditions of leakage. According to the study results, unaccounted-for water estimated from the minimum flow varies 24% to 43% in eight (8) surveyed areas.

More direct estimation of leakage by comparison between inflow water and water consumption were made in three (3) survey areas. Water consumption rates in the selected survey areas were estimated based on water consumption amounts measured by reading water meters of selected houses. Although it is more preferable to measure every house in the survey areas, only the houses equipped with water meter were selected to be measured, since not every house has a water meter in Tegucigalpa. As a result, the leakage was estimated 29 to 34%.

Other information related to the leakage is comparisons between water production rates and revenue water. Based on the SANAA sales record and production records, non-revenue rate is calculated at 32.9% as shown in *Table 2.28*. Apparently there are much not charged water, therefore the balance between the production rates and revenue water could give a larger estimation than the actual leakage. Even though, it must be still useful because it can give an overall idea while the actual flow measurements above mentioned only give a partial information of the total system.

Table 2.28 Actual Accounted-for Water and Production

Year	Accounted-for water (m^3/year)	Production (m^3/year)	Non-revenue rate (%)
1998	35,661	56,972	37.4
1999	44,542	62,577	28.8
Total	80,203	119,549	32.9

Source: SANAA, 2000

Table 2.27 List of Existing Distribution Reservoirs

Name of Distribution Reservoir	Eleveation of LWL (m)	Capacity (m^3)	Depth (m)	Shape	Material
14 de Marzo	1,041.60	820	3.7	Circular	Bricks
Calpules 1 Alto	1,046.50	95	4.2	Circular	Steel
Calpules 2 Bajo	1,042.25	261	5.4	Circular	Steel
Canal 11	1,070.20	1,735	3.05	Rectangular	Concrete
Centro Lomas 1	1,034.35	923	2.85	Rectangular	Concrete
Centroamerica. Oeste	1,126.50	1,342	2.8	Circular	Bricks
Centroamerica Oeste Zona 2	1,129.80			Circular	Bricks
Cerro Grande 1	1,215.40	2,124	4	Circular	Concrete
Concepcion	1,099.35	2,520	3.65	Circular	Concrete
Covespul	1,117.85	55	4.35	Circular	Steel
Hato de Enmedio 1	1,050.70	885	5.85	Circular	Steel
Hato de Enmedio 2	1,110.00	888	5.85	Circular	Steel
Mogote 1	1,254.25	744	3.7	Circular	Concrete
Mogote 2	1,250.00	733	8	Circular	Steel
Estiquirin 1	1,044.25	969	3	Rectangular	Masonry
Estiquirin 2	1,044.80	3,254	4.65	Circular	Concrete
Estiquirin 3	1,044.80	3,883	5.35	Circular	Concrete
Los Filtros 1	1,007.65	161	2.45	Rectangular	Masonry
Los Filtros 2	1,003.45	3,497	4.85	Circular	Concrete
Honduras Residencial Bajo	1,069.43	757	3.5	Circular	Bricks
Honduras Residencial Alto	1,080.00	57	3	Circular	Concrete
Juan A. Lainez 1	1,044.90	604	1.95	Rectangular	Bricks
Juan A. Lainez 2	1,044.90	1,167	4.2	Rectangular	Bricks
Kennedy 3	1,068.00	5,000	6	Circular	Concrete
La Fuente	1,049.45	539	7	Circular	Steel
La Leona 1	1,006.10	1,477	2.5	Rectangular	Masonry
La Leona 2	1,006.05	1,294	2.75	Rectangular	Masonry
La Leona 3	1,006.55	1,100	2.9	Rectangular	Masonry
La Leona 4	1,006.65	2,103	2.4	Rectangular	Masonry
Las Hadas	1,085.00	416	7	Circular	Steel
Lindero 1	1,069.15	622	2.9	Rectangular	Masonry
Lindero 2	1,069.50	369	2.5	Circular	Concrete
Lindero 3	1,068.75	639	3.1	Circular	Concrete
Loarque 2	1,057.00	157	4.1	Circular	Concrete
Lomas 2 Etapa	1,084.00	643		Circular	Concrete
Lomas del Toncontin	1,078.37	435	3	Rectangular	Bricks
Los Robles	1,055.55	594	3.5	Circular	Concrete
Miraflores 1	1,025.65	735	2.3	Rectangular	Concrete
Miraflores 2	1,025.75	719	2.25	Rectangular	Concrete
Monterrey	1,024.10	329	2.2	Circular	Concrete
Monterrey Los Llanos	1,028.30	35	3	Circular	Steel
Olimpo 1	1,103.00	1,767	10	Circular	Steel
Olimpo 2 Nuevo	1,121.00	846	6	Circular	Steel
Olimpo 2 Viejo	1,124.40	851	5.86	Circular	Steel
Centroamerica Este	1,105.30	1,010	2.3	Circular	Bricks
La Sosa	1,110.35	726	2.95	Circular	Bricks
Suyapita	1,110.00	1,897	3.6	Circular	Concrete
La Travesia 1	1,198.06	620	5.9	Rectangular	Concrete
La Travesia 2	1,198.06	620	5.9	Rectangular	Concrete
Universidad Norte 1	1,081.00	209	5.1	Circular	Steel
Universidad Norte 2	1,093.00	72	3.5	Circular	Steel
Los Laureles 1	1,015.20	3,593	3.85	Rectangular	Concrete
Los Laureles 2	1,015.20	3,593	3.85	Rectangular	Concrete
Picacho 1 Contacto de Cloro	1,297.99	1,697	2.6	Rectangular	Concrete
Picacho 2	1,296.59	1,650	3.35	Rectangular	Concrete
Picacho 3	1,296.59	1,627	3.35	Rectangular	Concrete

Source: SANAA, 2000

From this information, the study assumed the present system has 40% of unaccounted-for water and 30 % of leakage water.

Leakage sound detection in the leakage study found 26 invisible leakages in 46.5 km of surveyed pipe length. It was estimated that there existed 1,118 leakages in the whole system by applying this ratio to whole length of distribution pipelines of 2,000 km. On the other hand, SANAA conducts 5,000 to 6,000 leakage repairs every year. This means that leakages happen one after another in the system.

According to the SANAA leakage repair records, major causes of leakage are aging of pipe, improper installation works and other unknown reasons and there is no significant difference of leakage occurrence among the area. However, most leakages occur in pipes with less than 8 inch diameter.

2.4.6 WATER SUPPLY BY TANK LORRY

SANAA operates a water filling station for tank lorries at Los Filtros. All tank lorries operated by SANAA and a part of tank lorries operated by private companies load water at Los Filtros station. Water sales of Los Filtros station in recent four (4) years is shown *Table 2.29*. The private tank lorry shares about 90% of a total water sales of Los Filtros water filling station.

Table 2.29 Water Sales Records of Los Filtros Water Filling Station

Year	SANAA tank lorry	Private tank lorry	Total
1996	0	218,418	218,418
1997	35,214	378,433	413,647
1998	39,024	337,921	376,945
1999	41,987	329,458	371,445

Source: SANAA, March 2000 (unit : m^3/year)

It should be noted that many private tank lorries obtain water from private wells. There is no data concerning an amount of water supply by such tank lorries. Presently SANAA can not control such private tank lorries neither in quality nor in quantity.

2.4.7 ON-GOING PROJECTS

Hurricane Mitch in October 1998 severely damaged the water supply system in Tegucigalpa, especially Picacho subsystem.

Regarding the extremely serious situation, SANAA carried out an emergency plan in order to overcome the most critical situations and to re-establish the service in most of the city in a relatively short time. The areas supplied by Concepcion and Los Laureles WTPs could quickly recover the almost normal service conditions, while the areas supplied by Picacho subsystem have been applied severe rationing, which will continue until the middle of 2000.

During the emergency and later reconstruction stages, the international financial agencies and several countries offers supports to rehabilitate the damaged facilities, to start preventive measurements, and to meet the current and future. The major on-going projects are as follows.

- **IDB/799 Project**: When Hurricane Mitch happened, the project IDB/799 was not finished. A part of the pending funds was reassigned to cover certain repair and reconstruction necessities.
- **IDB/1029 Project**: IDB assigned new funds for reconstruction works: conduction lines,

distribution lines, pumping stations and other improvements.
Amount of the project: USD 10 million (90% by IDB and 10% by local funds)

- **World Bank Project**: The World Bank financed reconstruction works, mainly of conduction lines and primary distribution lines.
  Amount of the Project : USD 5 million
- **French Government Project**: consisting on the reconstruction of 20 km of San Juancito aqueduct of ductile cast iron pipe, diameters from 400 mm to 600 mm.
  Amount of the Project : USD 8 million
- **Grant Aid Project by Japanese Government**: consisting on the rehabilitation of the distribution system, including the construction of new tanks, the rehabilitation of main and secondary distribution lines. The basic design has been made and its execution has been programmed for the period 2001–2004.
  Amount of the Project : Japanese Yen 3.4 billion
- **European Community Project**: Water Supply System Rehabilitation and Expansion Component. Installation of the necessary infrastructure to carry the water to the poor neighborhoods located in the northwest part of the city. It includes the construction of conduction and pumping lines and two tanks with capacity of 1890 m^3 and 850 m^3. The project is still at preliminary level. Probable execution: 2001 - 2002.
  Amount: EURO: 2.7 million

2.4.8 EXISTING PROBLEMS

From the viewpoint of service level, major problems are as follows.

- Many developing communities can not receive water through pipe.
- Water supply service is rationed. Moreover, unplanned water failure is not rare.
- Tap water has aesthetic problems.
- Potability of water supplied by tank lorry is not assured.

From the viewpoint of water supply system, major problems are as follows.

- Operation of transmission system is not efficient. Currently several distribution reservoirs in higher areas receive water from Los Laureles WTP by pumping up, and those in lower areas receive water from Concepcion WTP using pressure release valves. It is necessary to review operation of transmission system more efficiently based on topography.
- Vertical intervals within some service areas are too large, which cause excess pressure on distribution pipes. It is necessary to review delineation of service area of each distribution reservoir.
- Operation of distribution system is complicated due to rationed water supply.
- Treated water of water treatment plants occasionally has aesthetic problems during rainy season.
- Many private tank lorries are out of SANAA’s control.

2.5 SANITARY SYSTEM

2.5.1 OUTLINE

A sanitary sewer system, collection and disposal of domestic wastewater, covers most part of Tegucigalpa urban area, except areas where water is not supplied through distribution pipelines, but supplied by tank lorries

The sanitary sewer is composed of one main and 35 sub-collectors, collecting and carrying wastewater by gravity flow and discharging it to the Choluteca River in the city area, without any treatment. The system is theoretically of a separated system, in which wastewater is collected to sewer pipes and storm water is discharged through open ditches along side roads, it is very common, however, that storm water is discharged to the sewer pipes in the rainy seasons.

In the areas where no sanitary sewer is available, houses have a pit latrine and domestic wastewater is spread over the roads and gardens. Since the water consumption rate in the areas are very low, 20 to 30 l/day/capita, and those areas are developing along steep slopes, unhygienic conditions are not observed significantly in those areas. However, as the master plan would propose the expansion of water distribution networks to those areas, the water consumption rate is expected to increase considerably, resulting in increase of wastewater discharge. Therefore, it would be required that expansion of water distribution network be accompanied with expansion of sewer network.

In addition, several areas that were developed by private developers or non governmental organizations and are located out side the present sewer network have their own sewer system mostly equipped with septic tanks before the final disposal to nearby rivers or streams.

2.5.2 PRESENT SEWER SYSTEM

Present sewer system covers about 500 thousand people and a coverage counts about 50% of the total population. Amount of collected wastewater is estimated at around 100 thousand m^3/day from a water consumption rate. Collecting system adopts a separated system, while actually the system works as a combined system by sewers receiving storm water at many places.

A trunk main, called Rio Choluteca collector, runs through the town starting from Loarque along the Choluteca River collecting wastewater from 10 main collectors each of which receives several sub-collectors. Rio Choluteca collector discharges wastewater to the Choluteca River at Miramesi with no treatment. Size of Rio Choluteca collector varies from 450 mm to 1200 mm with a total length of about 10 km. A total length of the trunk main and other 10 collectors are about 55 km.

General layout of sub-collectors is shown in *Figure 2.15* and a flow diagram of the collectors is shown *Figure 2.16*.

2.5.3 PRESENT PROBLEMS

There seems to be two (2) major problems; the development of wastewater collection system and wastewater treatment system.

For the wastewater collection system, the improvement of the present system is required in terms of the expansion of network to cover the existing urban area and rehabilitation of the existing sewer.

Obviously, discharging wastewater without treatment is one of the biggest problems to be addressed as early as possible from an environmental viewpoint. Not to speak of the rainy season, the dilution capacity of the Choluteca River is very limited in the dry season and pollution of the Choluteca River is supposed to be serious.

1 SUB COLECTOR AGUA DULCE
2 SUB COLECTOR QUBRADA GRANDE DEL SUR
3 COLECTOR CHOLUTECA
4 SUB COLECTOR LAS MAJADAS
5 SUB COLECTOR VICTOR F. ARDON
6 SUB COLECTOR KENNEDY
7 SUB COLECTOR SAN JOSE
8 SUB COLECTOR MIRAFLORES
9 SUB COLECTOR AGUA SALADA
10 SUB COLECTOR EL BOCON
11 SUB COLECTOR LA SOLEDAD
12 SUB COLECTOR HATO DE ENMEDIO
13 SUB COLECTOR HATO DE ENMEDIO A
14 SUB COLECTOR LAS COLINAS
15 SUB COLECTOR EL HOGAR
16 SUB COLECTOR CENTRO AMERICA OESTE
17 SUB COLECTOR EL PRADO
18 SUB COLECTOR QUEBRADA GRANDE DEL NORTE
19 SUB COLECTOR LA TRINIDAD
20 SUB COLECTOR SANTA BARBARA
21 SUB COLECTOR CIUDAD NUEVA
22 SUB COLECTOR GUACERIQUE
23 SUB COLECTOR EL ALAMO
24 SUB COLECTOR MAYANGLE
25 SUB COLECTOR CAMAGUARA
26 SUB COLECTOR ESTADOS UNIDOS
27 SUB COLECTOR LA OREJONA
28 SUB COLECTOR QUEBRADA SECA
29 SUB COLECTOR LA SOSA
30 SUB COLECTOR RIO CHIQUITO
31 SUB COLECTOR EL SAPO
32 SUB COLECTOR LAS JOYAS
33 SUB COLECTOR CERRO GRANDE
34 SUB COLECTOR EL RINCON
35 SUB COLECTOR EL REPARTO
36 ALCANTARILLADO (EN CONSTRUCCION) COLONIA ARTURO QUEZADA.

TRAMO OBSTRUIDO O DESTRUIDO
SECTION OBSTRUCT ON DESTROY

Figure 2.15	General Layout of Existing Sewerage System

ESQUEMA DE ALCANTARILLADO ACTUAL

EXISTING SEWERAGE SYSTEM

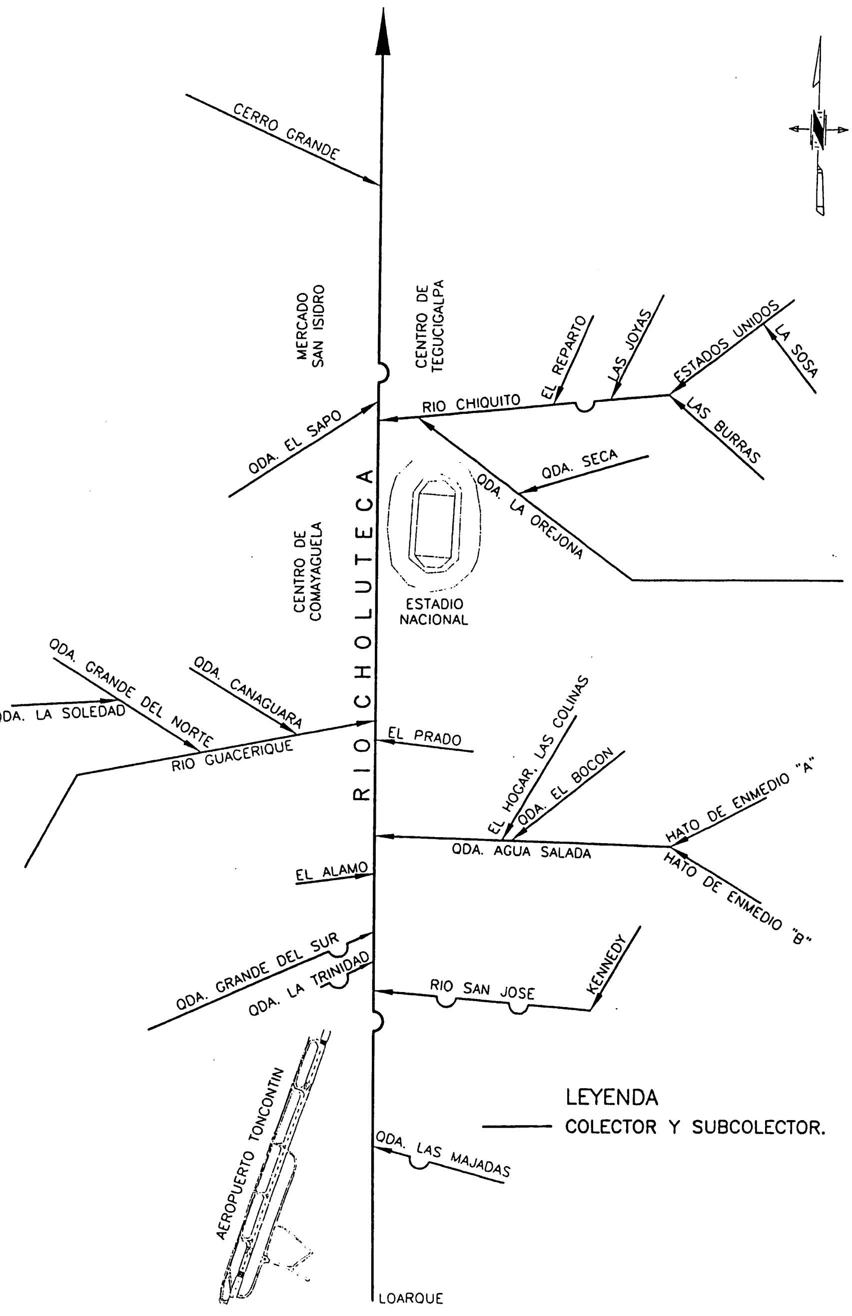

Figure 2.16	Flow Diagram of Existing Sewerage System

2.6 RELEVANT LAWS AND REGULATIONS

2.6.1 GENERAL

The following relevant laws and regulations were collected and reviewed.

- General law concerning exploitation of national waters
- SANAA constitution law
- General law concerning environmental protection
- Law on municipalities
- Law on public works and national infrastructure promotion and development

Through the review of these laws, the following issues were studied.

- Rules on water rights
- Necessary approvals and permissions for the water supply services
- Possible legal measures for water source protection
- Procedure of environmental impact assessments (EIA)
- Objectives, competence, and legal framework of SANAA
- Rules on privatization of public service sectors
- Rules on concession

In addition to these current laws and regulations, two (2) very important laws are submitted to and currently discussed in the National Congress. One is the frame law for water supply and sewerage sector, and the other is the general law on water. Since these laws may have huge impacts on the future of the water service sector, they were intensively reviewed. The main findings are as follows.

2.6.2 FRAME LAW FOR WATER SUPPLY AND SEWERAGE SECTOR

During 1990's institutional reform of water supply and sewerage sector as a whole sector has been intensively discussed among Honduran side and international institutions such as the World Bank and IDB. Especially IDB has taken strong initiative to orient the discussion towards decentralization of the sector and clear separation of three functions of the sector, *i.e.* strategic planning, regulation, and service delivery. The IDB's basic strategies for these policies can be summarized as follows:

- Transfer the water supply and sewerage systems of SANAA to municipalities.
- Privatize delivery function of the water supply and sewerage service through concession.
- Assign strategic planning function to the state government organization.
- Create independent regulatory body.

To realize the abovementioned strategies, IDB provided technical assistance to draft the Frame Law for Water Supply and Sewerage Sector (in Spanish "Ley Marco del Sector Agua Potable y Alcantarillado Sanitario). However, this frame law project has stuck in the course of the legislative procedure for more than three (3) years until recently.

During this period IDB and the World Bank tried hard to realize the Frame Law by means of making it one of the loan conditions to submit the Frame Law to the Congress. In fact, IDB and the World Bank cancelled a sector adjustment operation of USD 65 million by reason of the slippage of the frame law project. Furthermore, currently IDB proposes an operation of USD 29 million for potable water and sanitation investment on condition of submission of "a potable water and sanitation law with satisfactory provision for regulation" to the Congress.

Recently the modified version of the Frame Law was submitted to the Congress in February 2000. The important concepts in the Frame Law are as follows:

- The Secretariat of Public Health is responsible for strategic planning of the sector.
- The National Potable Water and Sewerage Commission shall be created under the Secretariat of Public Health. The commission will be in charge of regulation and control of the service delivery. The commission is also responsible for preparation of tariff calculation method, and supervision of tariff proposals.
- In the urban areas, the municipalities shall deliver the water supply and sewerage services. SANAA's systems in the urban areas shall be transferred from SANAA to the corresponding municipalities within three (3) years. During transition period SANAA will continue to operate the systems. When any of the municipalities are not ready to over take the systems after the transition period, SANAA operates the system on contract basis with the municipalities.
- SANAA is in charge of delivery of the services in the rural areas.
- Municipalities can deliver the potable water and sewerage services directly through its own organization or through establishment of municipal corporations, or indirectly through concession to private companies. Even if municipalities deliver the services directly through its own organization, potable water and sewerage accounts should be kept separately.
- In case the service delivered by a private company based on concession contract, the private company shall take the technical and the operation risks but not the commercial risk, which shall be taken by the municipality.

As well, quite a large space is taken up for explaining basic principles of tariff regime. Important principles for tariff setting are as follows:

- The tariff system should be based on consumption measurement so as to promote a rational and efficient water use.
- The tariff will cover all the service cost including a margin for the benefit for the provider and investment cost for system expansion.
- To follow the principle of service equality and generality, subsidy for investment may be necessary.
- A cross subsidy between user categories will be introduced, if it is justified from the social equality.
- Tariff calculation method should be uniform all over the country but different coefficient will be applied to reflect the socioeconomic situation of different regions.

Now there is discussion between the Honduran government and IDB about the eligibility of the submitted Frame Law as a condition of IDB operation. IDB criticizes that the National Potable Water and Sewerage Commission under the Secretariat of Public Health is not enough independent as a regulatory body, and the Honduran government defends against this criticism.

2.6.3 GENERAL LAW OF WATER

The current general law on exploitation of national waters was enacted in 1927. Since then more than 70 years has passed and the conditions related to water administration has totally changed. Now it is widely recognized the necessity to establish new legal frame for water administration, and a draft of the general law of water was prepared. The draft was reviewed by relevant ministries and institutions including SANAA, and it was submitted to the National

Congress on February 2000. The major policies of the draft are as follows:

- To integrate the necessary competence of water administration, the water authority will be created.
- Watershed will be the water administrative unit.
- The water authority will have a right to impose water charge to primary users of raw water.
- Water authority will have enough power to protect water sources.

The general law of water will facilitate future water source protection and will contribute to efficient and powerful water administration. In this regard the general law of water is highly appreciated.

2.7 ORGANIZATION OF SANAA

2.7.1 OBJECTIVES AND COMPETENCE OF SANAA

SANAA was established by the government decree No.91/61 in order to integrate competence in the field of water supply and sewerage into one centralized organization. The decree prescribes that all the facilities and services related to the water supply and sewerage in the country should be transferred to SANAA. The same decree attribute the necessary faculties for water supply and sewerage services to SANAA, which include study and planning of hydraulic resource, construction and operation and maintenance of facilities related to water supply and sewerage services, formulation and revision of regulations, and setting and revision of tariff. However, in reality, this aim has been distorted mainly due to political reasons. In spite of the stipulation of the decree No.91/61, SANAA has never been in position to revise tariff structure, as it intended.

2.7.2 ORGANIZATION STRUCTURE

In 1994 SANAA started an important reform program. The management worked out new policies and visions to reform SANAA. In 1995 the Honduran government, the World Bank, IDB, and SANAA held a seminar to discuss these policies and visions, and they reached to the following consents:

- Decentralize SANAA into seven (7) regional divisions. The regional divisions have certain autonomy in planing, operation and financial aspects.
- Municipalization of SANAA system will be proceeded in gradual and orderly manner, with careful consideration to regional conditions.
- To realize municipalization of SANAA system in Tegucigalpa, fund for severance allowance should be provided.

Among the above consents, decentralization of SANAA into seven (7) regional divisions was achieved in 1995. To correspond this restructure, four (4) central divisions for planning, technical, development, and financial were established as normative divisions. *Figure 2.17* shows the present organization of SANAA.

The Metropolitan Division is responsible for the water supply and sewerage services in Tegucigalpa. *Figure 2.18* shows the organization structure of the Metropolitan Division of SANAA. Currently the Financial and Planning Divisions under the headquarters of SANAA perform financial, commercial, and planning functions related to the Metropolitan Division.

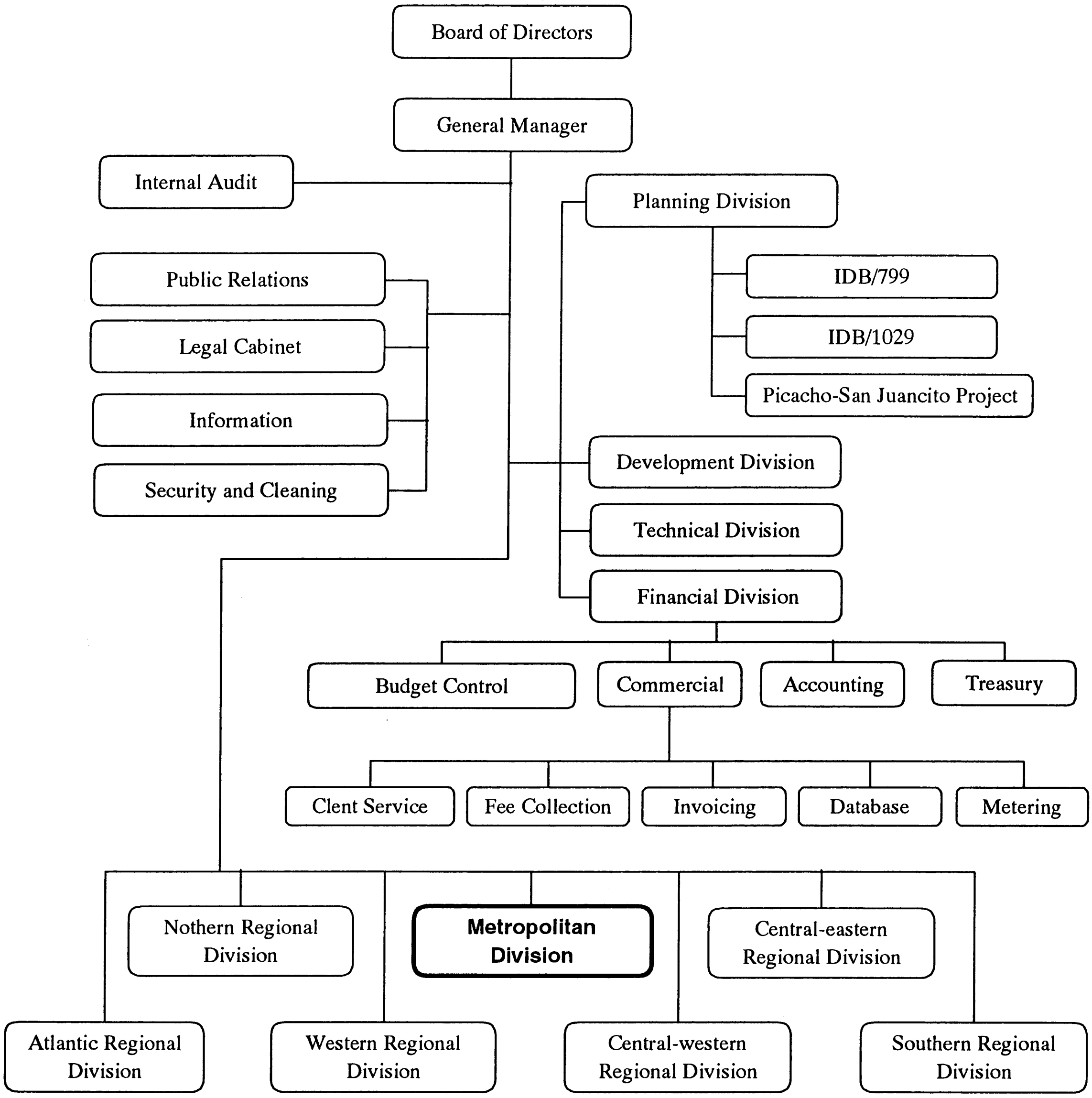

Figure 2.17	Existing Organization Chart of SANAA

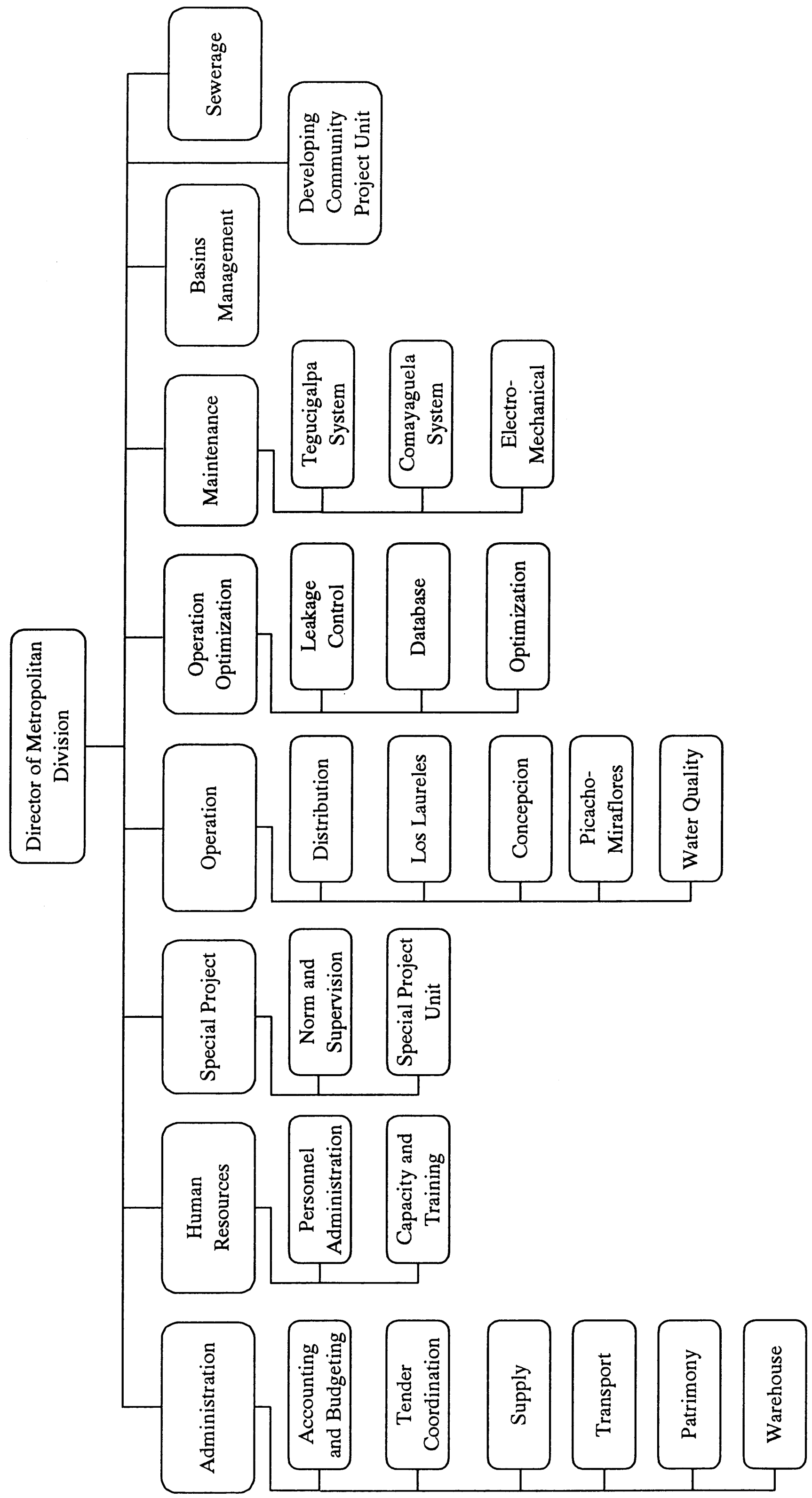

Figure 2.18	Existing Organization Chart of SANAA Metropolitan Division

It should be noted that among seven (7) regional divisions only the Metropolitan Division does not have commercial department. It means that the headquarters keep the competence to collect revenue from Tegucigalpa, which is the main revenue source of SANAA. It might have been a realistic solution to support financially weak regions, but it apparently breaches the decentralization principle.

2.7.3 NUMBER OF PERSONNEL

Before the reform program SANAA employed around 2,100 staffs, and the management at that time tried to reduce 30 % of total personnel. As of April 2000 SANAA employs 1,788 staffs which means 15 % reduction from 2,100 staffs.

Among 1,788 staffs, 832 staffs currently belong to the Metropolitan Division. However, in reality the Financial and Planning Divisions function as the financial, commercial, and planning departments of the Metropolitan Division. The virtual staff number of the Metropolitan Division is estimated at 1,078, which is 60% of whole SANAA staffs.

SANAA is often criticized for its excess personnel. In case of pipe water supply, the number of users per one staff is about 790 in Tegucigalpa and 725 in San Pedro Sula. The fact that the indicator in Tokyo is more than three (3) times higher than in Tegucigalpa might indicate there is excess personnel, however, the comparison should be careful because this indicator varies depends on many conditions such as available water source, degree of outsourcing, etc.

2.8 FINANCIAL PERFORMANCE OF SANAA

2.8.1 FINANCIAL CONDITIONS OF SANAA

Table 2.30 shows the profit and loss statements (P/L) of SANAA from 1996 to 1999.

Table 2.30 Profit and Loss Statements of SANAA

Items	1999*	1998	1997	1996
Water supply income	138	132	117	109
-Not metered rate	*39*	*39*	*37*	*33*
-Metered rate	*104*	*76*	*63*	*59*
-Mixed rate	*0*	*17*	*22*	*20*
-Adjust of error	*(11)*	*(11)*	*(8)*	*(6)*
-Other incomes	*6*	*10*	*3*	*3*
Sewage service income	23	25	20	21
Sale by water tanker	8	10	5	5
Financial income	3	2	4	4
Other incomes	2	2	3	0
Total Income	173	171	149	139
Water supply expense	117	90	64	46
Sewage service expense	2	1	2	2
Depreciation expense	12	12	12	15
Commercial expense	15	13	12	8
Administration expense	48	41	45	40
Financial expense	1	0	0	1
Total expenses	195	157	135	112
Profit (Loss)	**(22)**	**14**	**14**	**27**

*) Not yet audited. (Unit: Million Lps)

Source: SANAA Accounting Report

Water supply income accounts for 80 % of total income. Proportion of metered rate income becomes larger and larger, but the amount of non-metered rate income has not decreased.

According to the above P/L, SANAA could gain profit from 1996 to 1998 but run into a loss of Lps 22 million in 1999. However, SANAA is proceeding reevaluation of fixed assets so as to introduce inflation accounting in the fiscal year ended December 2000. Accordingly, SANAA reevaluates fixed assets from present USD 113 million to USD 357 million, and at the same time amount of capital will increase by the same value. As a result, depreciation cost will be increased around 3.4 times higher than the existing figure in the local currency, and the loss in 1999 will be reevaluated at Lps 46 million.

Table 2.31 shows the balance sheets of SANAA from 1996 to 1999. It is conspicuous that ratio of equity capital (ratio of capital to total of capital and liability) is very high at 93.5%. This financial criterion implies a financial stability of SANAA. However, in fact SANAA depends capital investments on the state government and this "subsidy" enables SANAA to run substantial no-debt management.

The balance sheet as of 1999 presents that cumulative loss is Lps 71 million. However, it should be noted that in the balance sheets no severance allowance reserves have been booked. It is estimated that proper booking of severance allowance reserve requires approximately Lps 147 million (or USD 10 million). Furthermore, SANAA thinks that Lps 8.5 million of account receivable as of December 1999 cannot be collected, because the defaulters have moved away and retracing is almost impossible. Then, the actual loss in 1999 is estimated at Lps 226.5 million.

Table 2.31 Balance Sheets of SANAA

Items	1999*	1998	1997	1996
Fixed Assets	1,552	1,596	1,540	1,402
Property and plant equipment	*646*	*619*	*NA*	*NA*
Construction in process	*906*	*976*	*NA*	*NA*
Diferred Assets	57	34	30	36
Deposit for guarantee	*13*	*10*	*NA*	*NA*
Depreciation cost	*12*	*6*	*NA*	*NA*
Investment for distribution	*32*	*19*	*NA*	*NA*
Current Assets	256	210	195	172
Cash in bank	*41*	*24*	*NA*	*NA*
Accounts receivable	*89*	*84*	*NA*	*NA*
Advance payment and loan for employees	*51*	*32*	*NA*	*NA*
Inventories	*75*	*71*	*NA*	*NA*
Long-term Accounts Receivable	37	25	17	9
Other Assets	12	2	2	4
Total Assets	**1,914**	**1,867**	**1,784**	**1,622**
Capital	1,790	1,789	1,679	1,499
Contribution	*966*	*787*	*753*	*726*
Contribution for projects	*894*	*1,046*	*988*	*847*
(Deficit)	*(49)*	*(59)*	*(77)*	*(101)*
Net profit (Loss)	*(22)*	*14*	*14*	*27*
Liability	124	78	105	123
Long-term account payable	*56*	*48*	*36*	*26*
Current liability	*68*	*29*	*69*	*97*
- Short-term loan	*1*	*1*	*NA*	*NA*
- Short-term account payable	*65*	*27*	*NA*	*NA*
- Other account payable	*2*	*1*	*NA*	*NA*
Other liabilities	*0*	*0*	*NA*	*NA*
Total Capital and Liabilities	**1,914**	**1,867**	**1,784**	**1,622**

*) Not yet audited. (Unit: Million Lps)

Source: SANAA Accounting Report

2.8.2 FINANCIAL CONDITIONS OF SANAA METROPOLITAN DIVISION

Table 2.32 shows the profit and loss statements (P/L) of SANAA Metropolitan Division in 1999, and share of the Metropolitan Division in the whole SANAA finance. The Metropolitan Division accounts 75 % of total income and 78 % of total expenses of SANAA.

Table 2.32 P/L of SANAA Metropolitan Division in 1999

Items	Whole SANAA	Metro. division	Share of Met.div.
Water supply income	138	95	69 %
-Not metered rate	*39*	*2*	*5 %*
-Metered rate	*104*	*98*	*94 %*
-Adjust of error	*(11)*	*(11)*	*100 %*
-Other incomes	*6*	*6*	*100 %*
Sewage service income	23	23	100 %
Sale by water tanker	8	6	75 %
Financial income	3	2	67 %
Other incomes	2	2	100 %
Total Income	173	129	75 %
Water supply expense	117	91	78 %
Sewage service expense	2	2	100 %
Depreciation expense	12	12	100 %
Commercial expense	15	12	80 %
Administration expense	48	35	73 %
Financial expense	1	0	0 %
Total expenses	195	152	78 %
Profit (Loss)	**(22)**	**(24)**	**109 %**

Source: SANAA Accounting Report (Unit: Million Lps)

Table 2.33 shows the breakdown of 1999 balance sheets of SANAA.

Table 2.33 Balance Sheets of SANAA Metropolitan Division in 1999

Items	Whole	Metro. Div.	Projects	Other 6 Divs.
Fixed Assets	1,552	522	731	299
Property and plant equipment	*646*	*371*	*12*	*262*
Construction in process	*906*	*151*	*718*	*37*
Diferred Assets	57	0	57	*0*
Deposit for guarantee	*13*	*0*	*13*	*0*
Depreciation cost	*12*	*0*	*12*	*0*
Investment for distribution	*32*	*0*	*32*	*0*
Current Assets	256	133	70	53
Cash in bank	*41*	*20*	*11*	*10*
Accounts receivable	*89*	*68*	*0*	*21*
Advance payment and loan for employees	*51*	*32*	*19*	*0*
Inventories	*75*	*14*	*40*	*21*
Long-term Accounts Receivable	37	19	6	12
Other Assets	12	0	12	0
Total Assets	**1,914**	**674**	**876**	**364**
Capital	1,790	626	830	334
Contribution	*966*	*625*	*0*	*341*
Contribution for projects	*894*	*64*	*830*	*0*
(Deficit)	*(49)*	*(40)*	*0*	*(9)*
Net profit (Loss)	*(22)*	*(24)*	*0*	*2*
Liability	124	48	46	30
Long-term account payable	*56*	*8*	*22*	*26*
Current liability	*68*	*40*	*24*	*4*
- Short-term loan	*1*	*1*	*0*	*0*
- Short-term account payable	*65*	*38*	*23*	*4*
- Other account payable	*2*	*1*	*1*	*0*
Total Capital and Liabilities	**1,914**	**674**	**876**	**364**

Source: SANAA Accounting Report (Unit: Million Lps)

The item "projects" on balance sheets presents all the costs born by on-going projects. After the completion of the projects, more than 80% of assets in "projects" will transferred to the Metropolitan Division. Therefore, the Metropolitan Division holds more than 70% of the total capital of SANAA.

2.8.3 TARIFF

Table 2.34 shows the current tariff of SANAA Metropolitan Division. One of the biggest financial problems of SANAA is very low tariff level. It is noted that when water consumption exceeds the range of minimum tariff, water charge is calculated by multiplying tariff of the right column by the whole consumption. For example, if a domestic user consumes 21 m^3/month, the water charge is Lps 21, instead of Lps 15 as common in many countries. This method is not fare. For example, the difference of charge between the user of 30 m^3/month and that of 31 m^3/month becomes Lps 7.2.

Table 2.34 Current Tariff of SANAA Metropolitan Division

Category	Consumption (m^3/month)	Minimum Tariff (Lps/month)	Tariff (Lps/m^3)
Domestic use	0-20	14.00	
	21-30		1.00
	31-40		1.20
	41-50		1.70
	51-60		1.85
	61-		3.95
Commercial use	0-20	46.80	
	21-30		2.55
	31-40		2.75
	41-50		2.95
	51-60		3.25
	61-		4.70
Industrial use	0-50	175.50	
	51-60		3.90
	61-		4.70
Public use	0-50	101.50	
	51-60		2.35
	61-		3.90
Public tap	0-180	75.60	
	181-		0.60

Source: SANAA

2.9 INSTITUTIONAL ISSUES

2.9.1 OUTLINE

The necessary functions of the whole water supply sector for the efficient and sufficient service are as follows.

- Analysis of existing condition
- Setting target
- Planning
- Financial analysis and setting tariff structure
- Implementation

The existing institutional problems as a whole sector are as follows.

- Lack of the national policy of the sector
- Lack of an urban development plan of Tegucigalpa

Other important problems, nonexistence of independent regulatory body and lack of proper tariff adjustment system, are closely related to the lack of the National policy of the sector. In same manner, the lack of an urban development plan as a higher ranked plan for water service planning results in difficulties in water source protection and inefficient supply system planning.

2.9.2 TARIFF PROBLEM

SANAA is regarded as the state institution with financial autonomy. On the other hand, the competence to set proper tariff has never been given to SANAA. During 1990s the tariff adjustment proposal of SANAA was approved only twice, in 1990 and 1995, and the increase level was far from enough to catch up inflation during the period. A study report prepared by the Honduran consultant ESA in 1998 pointed out that the last tariff adjustment increased the tariff level 100% but the inflation between August 1990 and September 1995 was 159%. Based on monthly consumer price index, the inflation between September 1995 and May 2000 exceeds 100 %. In brief, the present tariff in real price is less than 40 % of that in 1990.

Judging from the SANAA tariff proposal submitted to the National Supervising Commission for the Public Services (CNSSP) in September 1999, SANAA provided enough background information and explanation for the their proposal. This fact leads us to the conclusion that CNSSP has not approved SANAA's proposal only due to political reasons.

2.9.3 Labor Union Problem

The labor union of SANAA (SITRASANAAYS) consists of all employees of SANAA except for the member of managing board. The collective contract between SANAA management and the union is extremely favorable for the employees and it makes the reform of SANAA very difficult. The article 89 of the collective contract stipulates that the present collective contract will never loose its validity even if the form or name of SANAA will be changed.

This labor union problem is common to all the state autonomous institutions like the National Electricity Company (ENEE), the Honduras Telecommunication Company (HONDUTEL), the national universities, and the port authority. Privatization of these institutions is intensively discussed among the Honduran government and international financing organization like IDB and IMF. Among them the privatization of HONDUTEL is most advanced. Since it is apparent that with the strong labor union as it is no private investor will be interested in acquisition of HONDUTEL, the management of HONDUTEL is now trying to cancel the existing collective contract. In order to cancel the existing collective contract, the management of HONDUTEL proposes the following compensations.

- To provide the employees with four (4) to five (5) % of the company shares.
- To settle all the social benefit stipulated in the collective contract, such as severance allowance, paid holidays, etc.
- To pay Lps 7,000 as a special bonus.
- To pay special allowance to the leaders of the union, which is equivalent the salary for at least six (6) months.

It shows how difficult to cancel the existing collective contract. In SANAA's case, even the settlement of the social benefit might be almost impossible judging from the present financial condition. Therefore HONDUTEL model could not properly function in SANAA case.

2.9.4 Water Source Protection Problem

Theoretically, Honduran legislation considers the necessity of water source protection, and provides the way of protection. At least the Law of National Waters Exploitation, the Forest Law, and the General Law of Environment contain prescriptions to protect the basins of water sources.

In reality, SANAA confronts severe problems in water source protection. In spite of SANAA's declaration as a protected zone, Los Laureles reservoir is surrounded by several neighborhoods, and the Guacerique River Basin is endangered by large-scale housing development projects.