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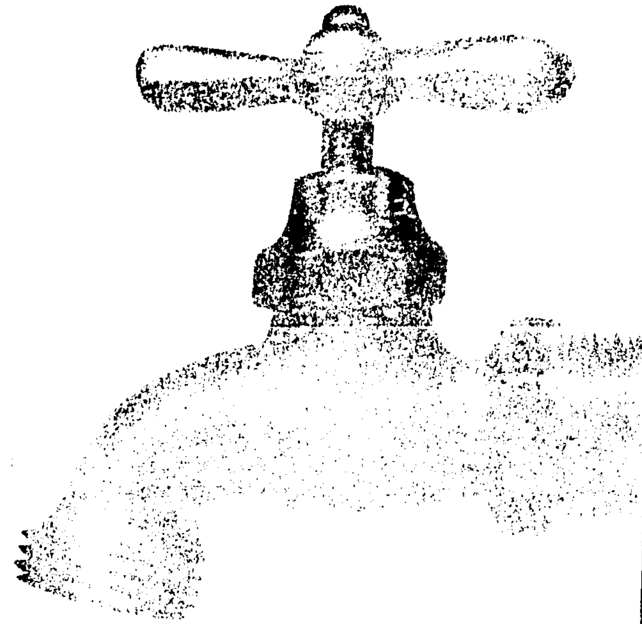

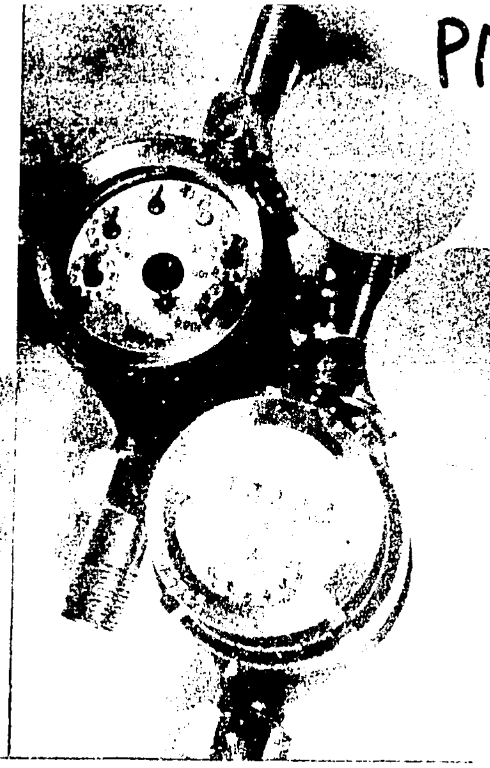

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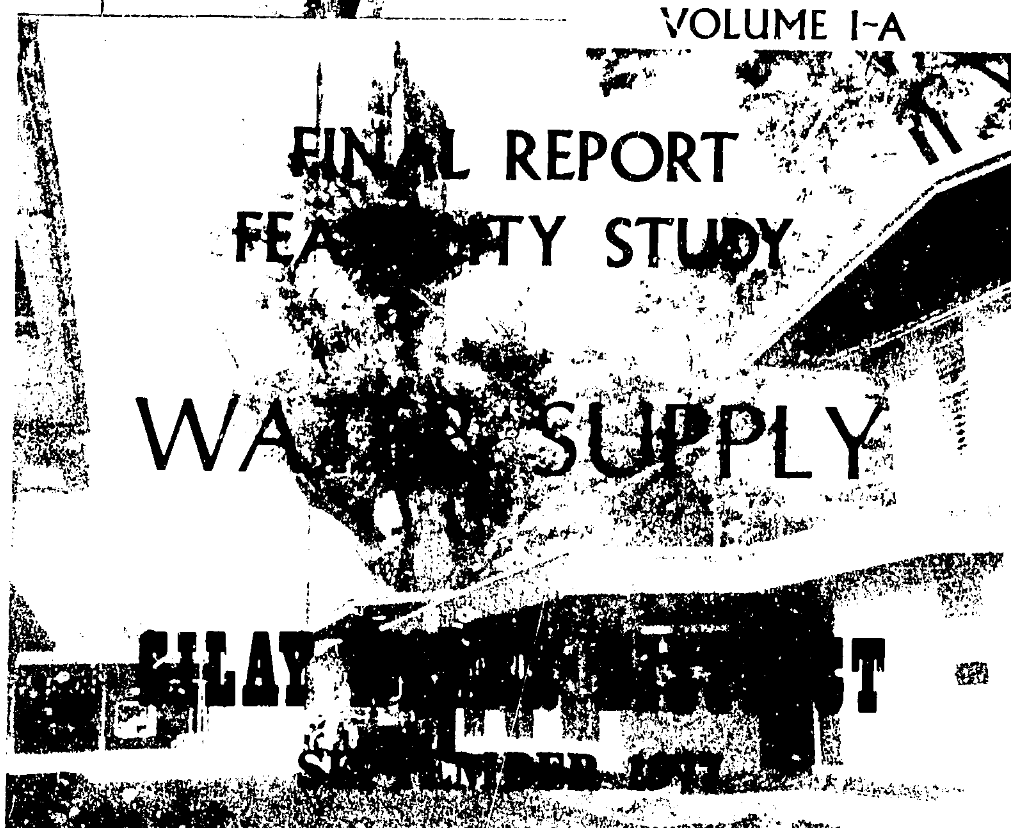
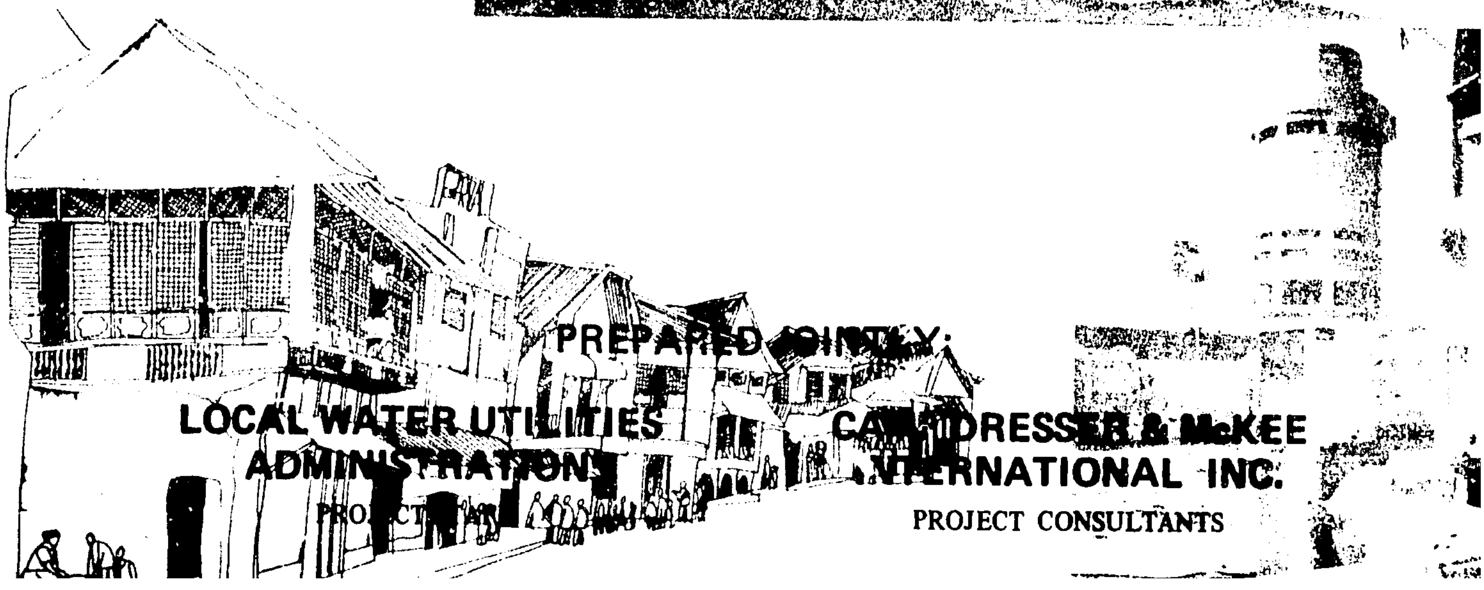


FINAL REPORT
FEASIBILITY STUDY

WATER SUPPLY

SILAY WATER DISTRICT

SEPTEMBER 197[illegible]



PREPARED JOINTLY:

LOCAL WATER UTILITIES ADMINISTRATION
PROJECT OWNER

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CHAPTER IX

DESCRIPTION AND COST OF THE RECOMMENDED PROGRAM

A. GENERAL

This chapter describes the immediate improvement program, and the first and second stages of the long-term construction program. In addition, the capital and operation and maintenance costs of the recommended program, concepts concerning sewerage and drainage, comments regarding the management of water resources and a statement regarding the environmental impact of this project are included. Appendices F, G, N and O, Volume II, are discussions of Design Criteria, Basis of Cost Estimates, Construction Methods and Materials, and Outline Specifications, respectively. The recommended construction program consists of the following 5 implementation steps:

1. Immediate Improvement Program (1978-79)
2. Stage I Phase A of the Long-Term Construction Program (1980-85)
3. Stage I Phase B of the Long-Term Construction Program (1986-90)
4. Stage II Phase A of the Long-Term Construction Program (1991-95)
5. Stage II Phase B of the Long-Term Construction Program (1996-2000)

Source

The current sources of water supply to Silay are wells no. 1, 2 and 4 located within the poblacion. These wells currently produce approximately 20, 22 and 21 lps, respectively, or a total of 5,000 cumd (24-hour operation). From the discussion of alternatives in Chapter VIII, future water supply will involve increased exploitation of the aquifer underlying Silay. A total of 12 wells (including the test well constructed during the course of this study) will be required to meet projected water supply demand to the year 2000 based on the provision of sufficient well capacity to supply 133 percent of anticipated maximum-day demand. The Silay Water District will also be required to secure water rights with the National Water Resources Council.

Storage

Silay currently has 570 cum of elevated storage. This total volume consists of a 190-cum elevated storage tank located near the site of existing well no. 4, and a 380-cum elevated storage tank near the site of existing well no. 1. Because the relatively low overflow elevation of the 190-cum storage tank is hydraulically incompatible with other recommended facilities, this tank will be abandoned early in the construction program. The recommended volume of storage capacity (as discussed in Chapter VIII) is equivalent to 6 percent of projected maximum-day demand. It is recommended that total additional storage volume required by the year 2000 be divided between 2 sites, as discussed in subsequent sections of this chapter.

Distribution System

The existing distribution system of the SIL-WD serves portions of the poblacion and barrios Rizal and Mambulac. Seventy-five percent of existing piping were installed between 1930 and 1955. Additional areas within the poblacion and barrios Rizal and Mambulac, and some new area in Barrio Guinhalaran, will receive service by 1980, with further additions by 1990. By the year 2000 these communities, as well as Barrio Lantad, will receive virtually complete water service coverage.

A total of approximately 27.7 km of 100-250 mm pipelines will be constructed by 1990, including 3.6 km of pipelines to replace existing pipelines that are undersized or in poor condition. An additional 12.5 km of pipelines will be constructed by the year 2000. These do not include new internal network pipelines that will be constructed during the study period. Figure IX-1 (appended) shows the overall recommended construction program by construction phase.

Internal network, service connections and fire hydrants will be installed in a program parallel to distribution system growth.

Administrative and Other Service Facilities

In addition to the source, storage and distribution facilities required for the production and transportation of water to consumers, it will be necessary to provide other facilities to improve the administrative, operation, maintenance and quality control capabilities of the water district. An administration building will be constructed during the immediate improvement program. A plumbing shop will be provided during Phase I-A. Because of the proximity of the SIL-WD to Bacolod City, a much larger water district, it has been assumed that the latter will share its laboratory and meter repair facilities with the SIL-WD.

B. IMMEDIATE IMPROVEMENT PROGRAM (1978-79)

While the findings and recommendations of this report are being reviewed, pending their approval by the SIL-WD, LWUA and financial agencies, certain steps may be taken to facilitate immediate improvements in the SIL-WD water supply system. These "high-impact" improvements will provide improved service to existing consumers and additional service to a limited number of new connections, before the implementation of the long-term construction program.

The existing operating wells within the SIL-WD can produce about 5,000 cumd for an estimated served population of 5,900. This amounts to a daily production rate of about 850 lpcd. Although two of the 3 existing wells are more than 25 years old, the existing source capacity is deemed adequate to meet projected system demand beyond 1980. It is recommended that the test well constructed during the course of this study be furnished with a pump house, pumping equipment and other equipment required to make the facility operational. Although not required on a priority basis, the additional well will provide standby capacity and provide sufficient water to overcome excessive leakage while the leak detection program is being conducted.

Disinfection facilities, including chlorination buildings, chlorinators, scales, booster pumps and other required appurtenances, will be provided at each of the 3 existing operating wells and at the proposed additional well. These facilities will provide an initial dosage of 2.0 mg/l to maintain a minimum chlorine residual of 0.1 mg/l at all points within the distribution system.

The provision of better pressure distribution throughout the SIL-WD system on a 24-hour basis will tend to worsen the current level of system leakage and wastage. It is therefore essential that an intensive program of leakage and wastage surveys and associated system repairs be undertaken during the immediate improvement program.

New distribution pipelines will be constructed within the SIL-WD service area. These pipelines are listed in Table IX-1 and shown in Figure IX-2. The majority of these pipelines will provide water supply to areas previously unserved, such as Seaview, Elena and Employee Subdivisions and Barrio Guinhalaran. The remaining pipelines will provide system loops or improve service to sections of the currently served area. The total of approximately 9.5 km of recommended pipelines consists of 200 meters of 250-mm pipelines, 2,960 meters of 200-mm pipelines, 2,175 meters of 150-mm pipelines and 4,160 meters of 100-mm pipelines.

All the existing 908* service connections will be provided with meters during the immediate improvement program. In addition, 35 percent (318) of these connections will be repaired or replaced.

---

*As of October 1976.

TABLE IX-1

DISTRIBUTION PIPELINES
IMMEDIATE IMPROVEMENT PROGRAM

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
125	Rizal St. South of Freedom Blvd.	250	190
148	To well at Node 66	250	10
			200
120	Freedom Blvd. East of Rizal St.	200	150
122	Freedom Blvd. East of Rizal St.	200	75
123	Freedom Blvd. East of Rizal St.	200	175
127	Rizal St. South of Freedom Blvd.	200	130
130	Rizal St. South of Freedom Blvd.	200	310
131	Rizal St. South of Freedom Blvd.	200	125
133	Rizal St. South of Freedom Blvd.	200	245
134	Rizal St. South of Freedom Blvd.	200	405
135	Rizal St. South of Freedom Blvd.	200	250
136	Bo. Guinhalaran	200	310
140	Along Matagoy Creek	200	140
141	Freedom Blvd. East of Rizal St.	200	225
142	Freedom Blvd. East of Rizal St.	200	190
143	Freedom Blvd. East of Rizal St.	200	230
			2,960
101	From Freedom Blvd. to 5 de Noviembre St.	150	250
104	From Freedom Blvd. to 5 de Noviembre St.	150	210
105	Rizal St.	150	570
108	From Freedom Blvd. to Abad St.	150	75
110	From Freedom Blvd. to Abad St.	150	75
111	From Freedom Blvd. to Abad St.	150	185
144	Bonifacio St.	150	240
147	Pipe Interconnection at Rizal and Burgos St.	150	10
500 *	Hofilena Subdivision	150	560
			2,175
100	McKinley St. in Bo. Mambulao	100	230
102	Bo. Mambulao	100	90
103	McKinley St. in Bo. Mambulao	100	130
106	Abad St.	100	300
107	Lopez St.	100	300
109	Abad St.	100	250
112	Elena Development	100	380
113	Elena Development	100	90
114	Elena Development	100	90
115	Elena Development	100	320

* Not used in computer analysis

TABLE IX-i (Continued)

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
116	Elena Development	100	290
117	Elena Development	100	105
121	From Freedom Blvd. to Abad St.	100	270
124	Elena Development	100	70
126	Hofilena Subdivision	100	170
128	Hofilena Subdivision	100	160
129	Hofilena Subdivision	100	150
132	Hofilena Subdivision	100	375
137	Bo. Guinhalaran	100	370
145	Pipe Interconnection at Plaridel St. and Zamora St.	100	10
146	Pipe Interconnection at Rizal St. and Zamora St.	100	10
			4,160 m
		Total	9,495 m

About 400 new connections will be provided within the present service area and an additional 1,132 connections will be provided within the 1980 service area extension.

The operational capabilities of the SIL-WD will be significantly improved by the construction of a new administrative building, complete with office space for administration, billing and record keeping, and a small library. This building will be furnished with desks, filing cabinets, typewriters, addressograph and validating machines. A vehicle, production meters for the three currently operating wells, and other minor distribution system appurtenances will be provided.

Table IX-2 presents the breakdown of costs (at 1978 price levels) for the immediate improvement program. The total project cost of ₱5.18 million consists of ₱2.65 million in foreign exchange and ₱2.53 million in local currency.

C. FIRST STAGE OF THE LONG-TERM CONSTRUCTION PROGRAM (1980-90)

As a result of alternative studies, a scheme for development of source, storage and distribution facilities has been selected as the recommended program. This selected scheme has been described in Chapter VIII. In this scheme, the entire SIL-WD service area, up to the year 2000, will be served by groundwater abstracted from the underlying aquifer by wells near the service area. The water produced will be transported to consumers via pipelines to be constructed along the alignments of existing and proposed roadways.

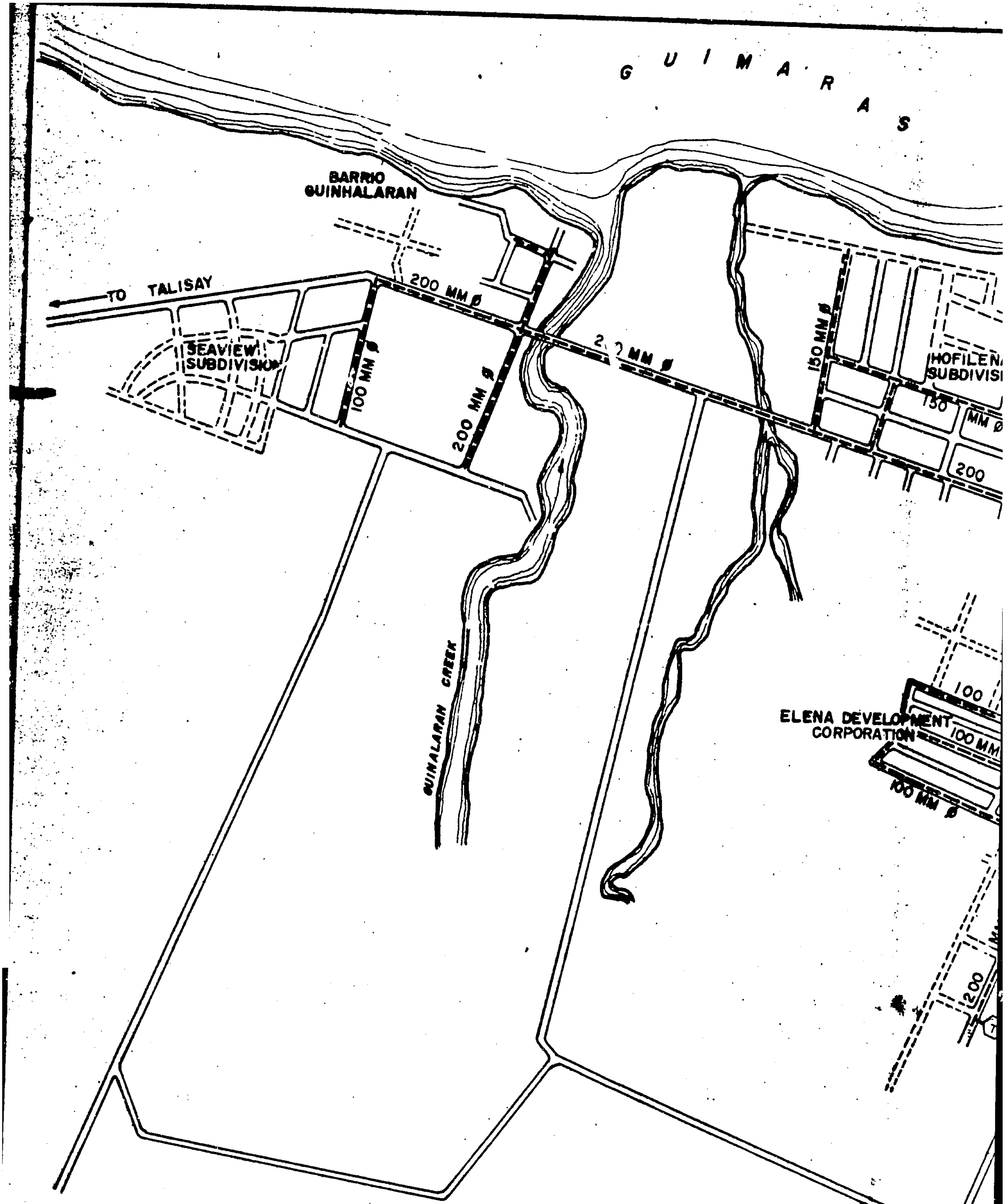
The first stage of the recommended construction program, including source development, storage, treatment and distribution facilities, will be implemented in 2 construction phases with durations of 6 years and 5 years, respectively.

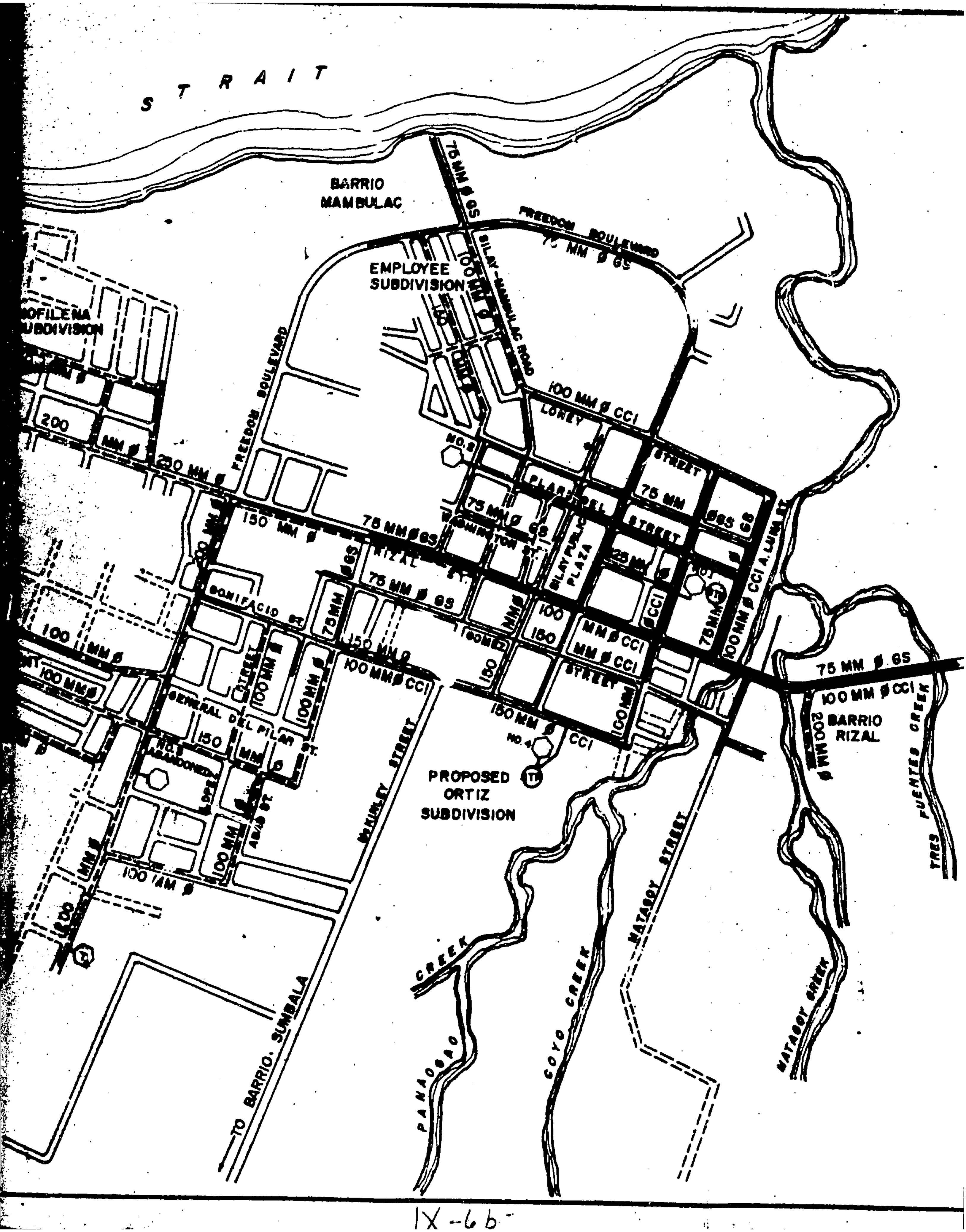
Existing facilities are incorporated into the recommended scheme to the greatest extent practical, although the 3 existing wells are assumed to be abandoned by 1986, and about 1,700 meters of existing pipelines will be replaced during Phase I-A.

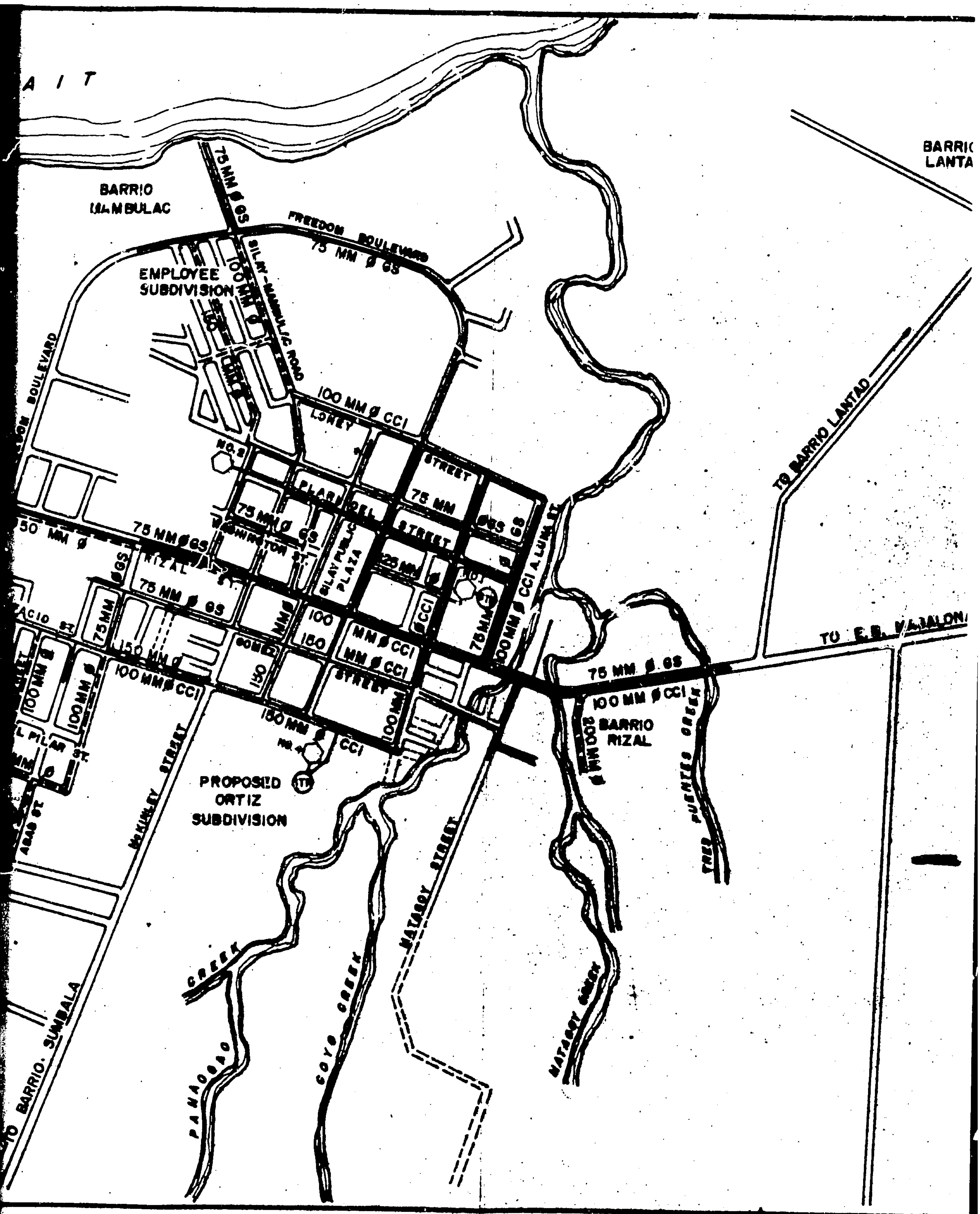
CONSTRUCTION PHASE I-A (1980-85)

Source Facilities

Current capacity of existing wells in Silay is estimated to be approximately 5,000 cumd. The test well drilled for aquifer stratigraphic and production information during the period of study will be completed and furnished with pumping equipment during the immediate improvement program. It is anticipated that this well will


G U I M A R A S
BARRIO
GUINHALARAN
TO TALISAY
200 MM Ø
SEAVIEW
SUBDIVISION
100 MM Ø
200 MM Ø
MM Ø
150 MM Ø
HOFILEN
SUBDIVISI
150
MM Ø
200
GUINHALARAN CREEK
100
ELENA DEVELOPMENT
CORPORATION
100 MM
100 MM Ø
200


STRAIT
BARRIO MAMBULAC
75 MM Ø GS
FREEDOM BOULEVARD
EMPLOYEE SUBDIVISION
SILAY-MAMBULAC ROAD
100 MM Ø CCI
LOPEZ STREET
NO. 2
PLARIDEL STREET
75 MM
75 MM Ø GS
WASHINGTON ST.
RIZAL ST.
SILAY PUBLIC PLAZA
A. LUNA ST.
BONIFACIO ST.
150 MM Ø
100 MM Ø CCI
GENERAL DEL PILAR ST.
NO. 3 ABANDONED
ABAD ST.
200 MM Ø
250 MM Ø
FREEDOM BOULEVARD
FILENA SUBDIVISION
MCKINLEY STREET
NO. 4
PROPOSED ORTIZ SUBDIVISION
BARRIO RIZAL
FUENTES CREEK
TRES
200 MM
MATASOY STREET
MATASOY CREEK
COYO CREEK
PANAOGAO CREEK
TO BARRIO SUMBALA
100 MM Ø


BARRIO
LANTA
TO BARRIO LANTAD
TO E.B. MAGALONA
BARRIO RIZAL
FREEDOM BOULEVARD
75 MM Ø GS
SILAY-GUIMBALAON ROAD
EMPLOYEE SUBDIVISION
100 MM Ø CCI
LONEY STREET
NO. 2
75 MM Ø GS
WASHINGTON ST.
RIZAL ST.
SILAY PUBLIC PLAZA
125 MM
DEL PILAR ST.
ABAD ST.
McKINLEY STREET
MATAGOY STREET
PROPOSED ORTIZ SUBDIVISION
NO. 4
100 MM Ø CCI
150 MM Ø CCI
200 MM Ø
75 MM Ø GS
100 MM Ø CCI
A. LUNA ST.
PANAOGAO CREEK
COYO CREEK
MATAGOY CREEK
TRES PUENTES CREEK
TO BARRIO SUMBALA
50 MM Ø

IX-6C

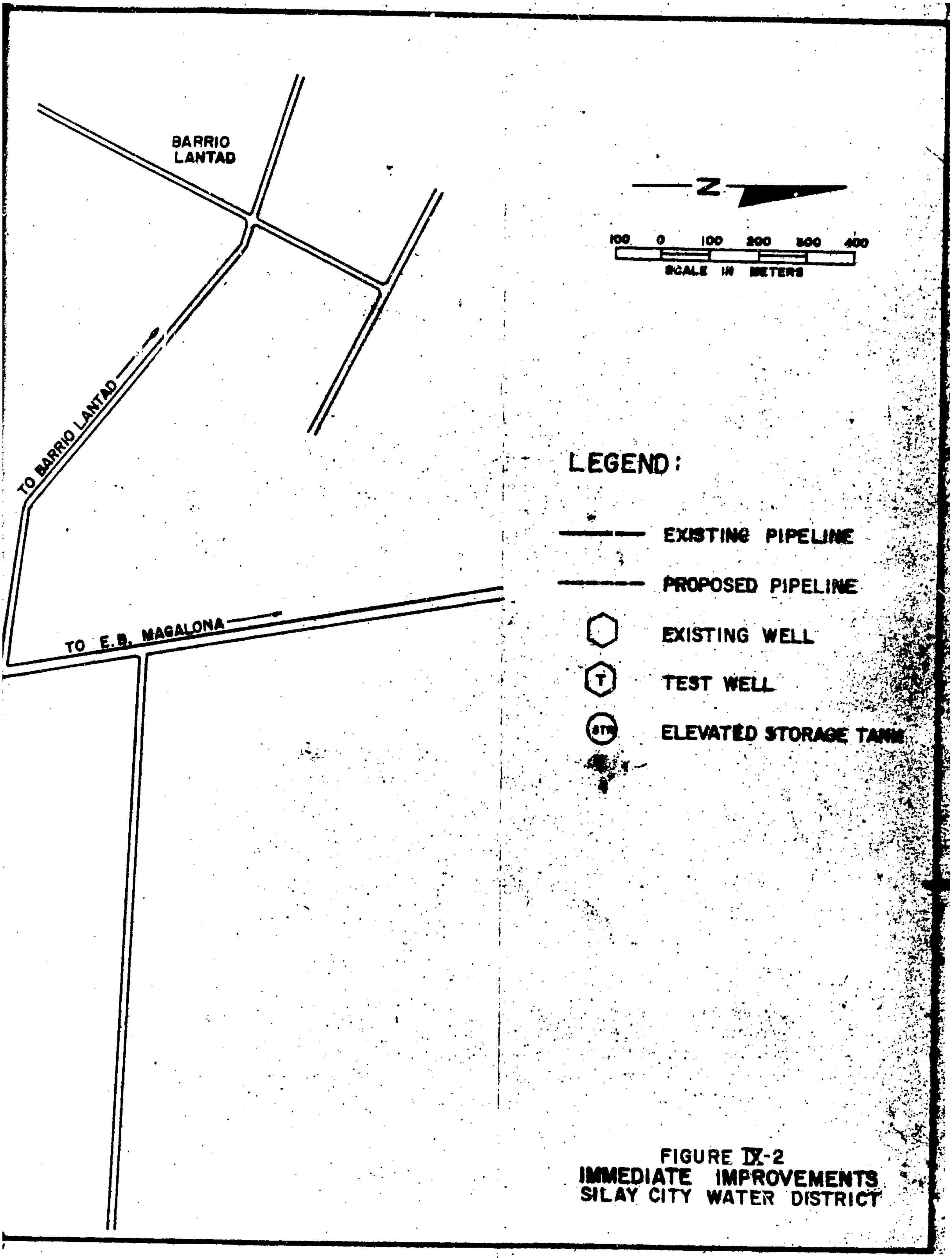


FIGURE IX-2
IMMEDIATE IMPROVEMENTS
SILAY CITY WATER DISTRICT

TABLE IX-2

COST SUMMARY
IMMEDIATE IMPROVEMENT PROGRAM

Item	Cost (₱) Local	Foreign[1]	Total
Source Facilities			
(Pump Station complete and chlorination facilities for test well)			
Materials and Equipment	26,200	161,300	
Civil and Structural	54,800	-	
	81,000	161,300	242,300
Distribution Pipelines			
(200 m x 250 mm)			
Materials and Equipment	11,600	44,000	
Civil and Structural	24,200	-	
(2,960 m x 200 mm)			
Materials and Equipment	94,700	373,000	
Civil and Structural	251,600		
(2,175 m x 150 mm)			
Materials and Equipment	47,600	188,400	
Civil and Structural	158,000	-	
(4,160 m x 100 mm)			
Materials and Equipment	16,600	166,400	
Civil and Structural	220,500	-	
(Valves)			
Materials and Equipment	16,900	44,200	
Civil and Structural	15,300	-	
	857,000	816,000	1,673,000
Sub-total[2]			
Materials and Equipment	213,600	977,300	1,190,900
Civil and Structural	724,400	-	724,400
	938,000	977,300	1,915,300

---

[1] Calculated at US$1.00 to ₱7.00

[2] Contingencies and engineering costs are 15 percent and 10 percent, respectively, for these items.

TABLE IX-2 (Continued)

Item	Cost (₱) Local	Foreign	Total
Service Connections			
(Convert 908 existing connections to metered connections)			
Materials and Equipment	-	176,200	
Civil and Structural	32,600		
(Replace 318 existing connections)			
Materials and Equipment	7,600	92,200	
Civil and Structural	92,500	-	
(Install 1,532 new connections)			
Materials and Equipment	36,800	741,500	
Civil and Structural	501,000	-	
	670,500	1,009,900	1,680,400
Administrative and Miscellaneous			
(Administrative Building and Equipment)			
Materials and Equipment	18,000	43,000	
Civil and Structural	363,000	-	
(Vehicle)			
Materials and Equipment	30,000	30,000	
Civil and Structural	-	-	
	411,000	73,000	484,000
Sub-total[3/]			
Materials and Equipment	92,400	1,082,900	1,175,300
Civil and Structural	989,100	-	989,100
	1,081,500	1,082,900	2,164,400
Leakage Survey and Repairs			
Materials and Equipment	4,000	6,000	
Civil and Structural	21,000	90,000	
	25,000	96,000	121,000

[3/] Contingencies and engineering costs are 10 percent and 5 percent, respectively, for these items.

TABLE IX-2 (Continued)

Item	Cost (₱) Local	Foreign	Total
Miscellaneous Items			
Materials and Equipment	5,000	17,000	
Civil and Structural	1,500	-	
	6,500	17,000	23,500
Sub-total [4/]			
Materials and Equipment	9,000	23,000	32,000
Civil and Structural	22,500	90,000	112,500
	31,500	113,000	144,500
Total Construction Cost			
Materials and Equipment	315,000	2,083,200	2,398,200
Civil and Structural	1,736,000	90,000	1,826,000
	2,051,000	2,173,200	4,224,200
Contingencies			
@ 15 percent	140,700	146,600	287,300
@ 10 percent	108,200	108,300	216,500
	2,299,900	2,428,100	4,728,000
Engineering [5/]			
@ 10 percent	77,100	143,200	220,300
@ 5 percent	41,600	77,400	119,000
	2,418,600	2,648,700	5,067,300
Land [6/]	115,000	-	115,000
TOTAL PROJECT COST	2,533,600	2,648,700	5,182,300

4/ No engineering and contingency costs are included for these items.

5/ Engineering costs consist of 65 percent foreign exchange, based on recent projects of this type.

6/ Includes land costs for administration building and plumbing shop.

produce about 2,700 cumd to provide a total source capacity of 7,700 cumd within the SIL-WD. This will be adequate to meet projected system demands, based on source production equal to 133 percent of maximum-day demand (as discussed in Chapter VIII) until 1982. (See Figure IX-3.)

During Phase I-A (1982) two additional wells will be constructed and existing well no. 2 will be abandoned due to its age and anticipated declining productivity. The resultant additional 5,400-cumd source capacity will increase the total source capacity to 11,200 cumd. This will satisfy projected water demands until 1986, at which time additional source development will be required. The proposed wells will be located at nodes no. 91 and 94 (see Figure IX-4).

The wells to be constructed will be 200 meters deep and will consist primarily of 250-mm diameter casing and screen. They will be provided with pumping equipment, valves, piping, meters and ancillary equipment.

Of the wells to be constructed during Phase I-A and subsequent phases, a sufficient number will be provided with dual (diesel/electric) drives to meet projected average-day system demand. The other wells will be provided with electric prime movers. Each well will be provided with a chlorination facility, complete with an isolated structure containing a chlorinator, chlorine gas cylinders, booster pump, scales and all associated valves, meters and piping.

Storage Facilities

As indicated by the alternative studies in Chapter VIII, the most economical combination of source and storage facilities to satisfy peak demands requires that a volume equal to about 6 percent of maximum-day requirements be provided in the form of storage tanks.

The existing 190-cum storage tank located adjacent to existing well no. 4 has an overflow elevation too low to be hydraulically compatible with the other elements of the recommended program. This tank will therefore be abandoned during Phase I-A. The existing 380-cum storage tank located adjacent to well no. 1 will be adequate until 1982.

In 1982, an elevated storage tank will be constructed at node 6 (see Figures IX-4 and IX-5), near the intersection of Rizal Street and Freedom Boulevard. This storage tank will have an overflow elevation of 23.4 meters, and a usable volume of 500 cum. At this time there will be a total of 880 cum useful elevated storage within the SIL-WD. This will be adequate to meet peak water supply demand within the distribution system until 1991.

The location of the additional storage tank on a second site was determined to be more hydraulically efficient than would be the case with all storage capacity located at a single site. This evaluation was made during the computer analyses of the distribution system.

Distribution Pipelines

Pipelines proposed for installation during the immediate improvement program extend service to new areas in Barrios Guinhalaran, Mambulac and Rizal and in the direction of the proposed new well east of the Elena Development with virtually no additional pipelines within the poblacion. During Phase I-A it is recommended that about 1,740 meters of existing pipelines within the poblacion be replaced with new 100-250 mm pipes. It is also recommended that about 9,620 meters of 100-250 mm diameter pipelines be constructed to improve service in existing service areas; to extend service to new areas; and to provide transmission capacity to additional wells constructed during this phase. The proposed Phase I-A pipelines are listed in Table IX-3 and are shown in Figures IX-4, IX-5 and IX-1 (appended).

Pipeline replacements within the poblacion include construction of a pipeline from the storage tank near existing well no. 1, along Plaridel and Zulueta Streets; a pipeline from the storage tank and pump station located at existing well no. 4: an extension of the pipeline previously constructed along Bonifacio Street to Freedom Boulevard; reinforcement of the pipeline along Rizal Street, from Burgos Street to the vicinity of Barrio Lantad Road: and reinforcement of the pipeline along Matagoy Street leading to Barrio Rizal.

New pipelines to be constructed during Phase I-A include an extension along Rizal Street near Seaview Subdivision; a new pipeline east of Seaview Subdivision; service area extension east of the Elena Development and the poblacion; pipelines from the well at node no. 91 in Barrio Rizal; an additional pipeline to Barrio Mambulac (along Freedom Boulevard); a pipeline to provide service to Barrio Lantad; and a pipeline along Rizal Street to the well at node no. 94.

The pipelines to be constructed during Phase I-A include 345 meters of 250-mm pipelines; 6,745 meters of 200-mm pipelines; 2,930 meters of 150-mm pipelines and 1,340 meters of 100-mm pipelines, or a total of approximately 11,360 meters of pipelines with diameters from 100 to 250 mm. All required valves and fittings will be included.

TABLE IX-3

DISTRIBUTION PIPELINES—PHASE I-A

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
	Reinforcement/Replacement Pipes		
459	Rizal Street to Matagoy Creek	250	125
462	Rizal Street to Matagoy Creek	250	200
			325
435	From Well at Node No. 31	200	70
438	From Well at Node No. 31	200	5
447	From Burgos St. Storage Tank	200	50
448	From Burgos St. Storage Tank	200	10
465	Rizal St. to Bo. Lantad Rd.	200	280
477	From Burgos St. Storage Tank	200	10
			425
405	Bonifacio St.	150	170
406	Bonifacio St.	150	80
408	Bonifacio St.	150	70
446	From Zamora St. to Burgos St.	150	175
463	Matagoy St.	150	115
464	Matagoy St.	150	90
			700
473	McKinley St.	100	190
474	Plaridel St.	100	100
			290
		Sub-total	1,740
	Additional Pipes		
220	To Well at Node No. 94	250	10
240	To Rizal St. Storage Tank	250	10
			20
205	Bo. Lantad Rd.	200	340
206	From Tres Fuentes Creek to Bo. Lantad Rd.	200	130
207	From Bo. Lantad Road East of Bo. Lantad	200	300
208	From Rd. East of Bo. Lantad to North Bo. Lantad Rd.	200	335
140	Along Matagoy Creek	200	360
211	Along Matagoy Creek	200	325
212	McKinley St. South of Bonifacio St.	200	550
214	McKinley St. South of Bonifacio St.	200	250
215	Freedom Blvd. South of Well at Node No. 66	200	415
216	East of Elena Development	200	420

TABLE IX-3 (Continued)

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
221	East of Elena Development	200	350
223	Seaview Subdivision	200	160
234	Freedom Blvd. West of Rizal St.	200	600
238	Freedom Blvd. (Bo. Mambulac)	200	130
241	Burgos St. to Storage Tank	200	105
242	McKinley St. South of Bonifacio St.	200	500
244	East of Seaview Subdivision	200	580
245	East of Seaview Subdivision	200	470
			6,320
204	Bo. Lantad Rd.	150	760
218	East of Elena Development	150	250
219	East of Elena Development	150	570
224	Seaview Subdivision	150	105
227	Seaview Subdivision (Rizal St.)	150	425
229	Pipe Interconnection at Bonifacio and A. Luna St.	150	10
231	Pipe Interconnection at Bonifacio and Zamora St.	150	10
237	Freedom Blvd. (Bo. Mambulac)	150	90
239	Pipe Interconnection near Tres Fuentes Creek	150	10
			2,230
201	Bo. Lantad Rd.	100	290
213	From Abad St. to McKinley St.	100	260
217	East of Elena Development	100	310
226	Seaview Subdivision	100	150
228	Pipe Interconnection at Plaridel St. and Burgos St.	100	10
230	Pipe Interconnection at Rizal South of Public Plaza	100	10
232	Pipe Interconnection at Bonifacio St. and Abad St.	100	10
233	Pipe Interconnection at Bonifacio and Burgos St.	100	10
			1,050
			9,620
		Total	11,360

Internal Network

Existing distribution system piping and internal network piping, together with the pipelines installed during the immediate improvement program, provide service to 182 hectares within the SIL-WD service area by 1980. The remainder of the 1980 service area will be provided with internal network piping · 1985. In addition, 50 percent of the additional area to rec ve service by 1990 will be provided with internal network piping by 1985.

Thus, by 1985, the final year of construction Phase I-A, a total of 340 hectares within the SIL-WD service area (37 percent of the year 2000 net service area or 75 percent of the 1990 net service area) will be provided with equivalent internal network system piping. This consists of 182 hectares covered by existing pipes in 1980; 92 hectares covered by distribution pipelines installed during Phase I-A; and 67 hectares of internal network piping installed during Phase I-A. The details of the proposed internal network system are present d in Annex IX-C.

Service Connections

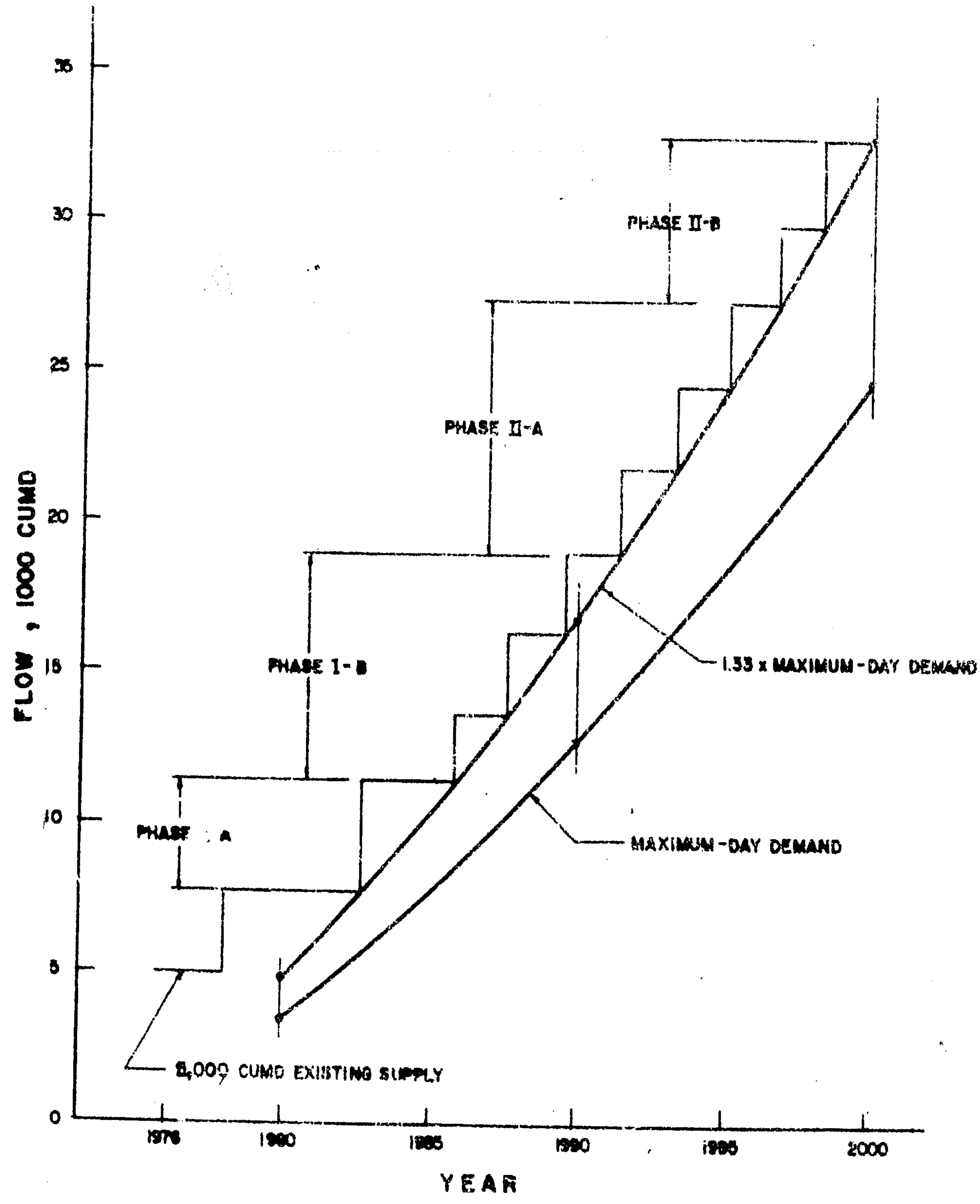
During Phase I-A about 35 percent (318) of the existing 908 service connections will be replaced or repaired. Together with the 318 other service connections replaced or repaired during the immediate improvement program, total major repair or replacement will cover 70 percent of the existing connections by the year 1985. Because of the percentage of existing pipelines installed before 1951 and the poor quality of installation practices and materials used, it has been assumed that the existing service connections to be repaired and replaced provide sub-standard service.

About 3,065 new service connections will be installed between 1981 and 1985, at a rate of 610 connections per year. Hence, by 1985, the SIL-WD will have a total of 5,505 connections. The detailed schedule of service connection installation is presented in Annex IX-C.

Fire Hydrants

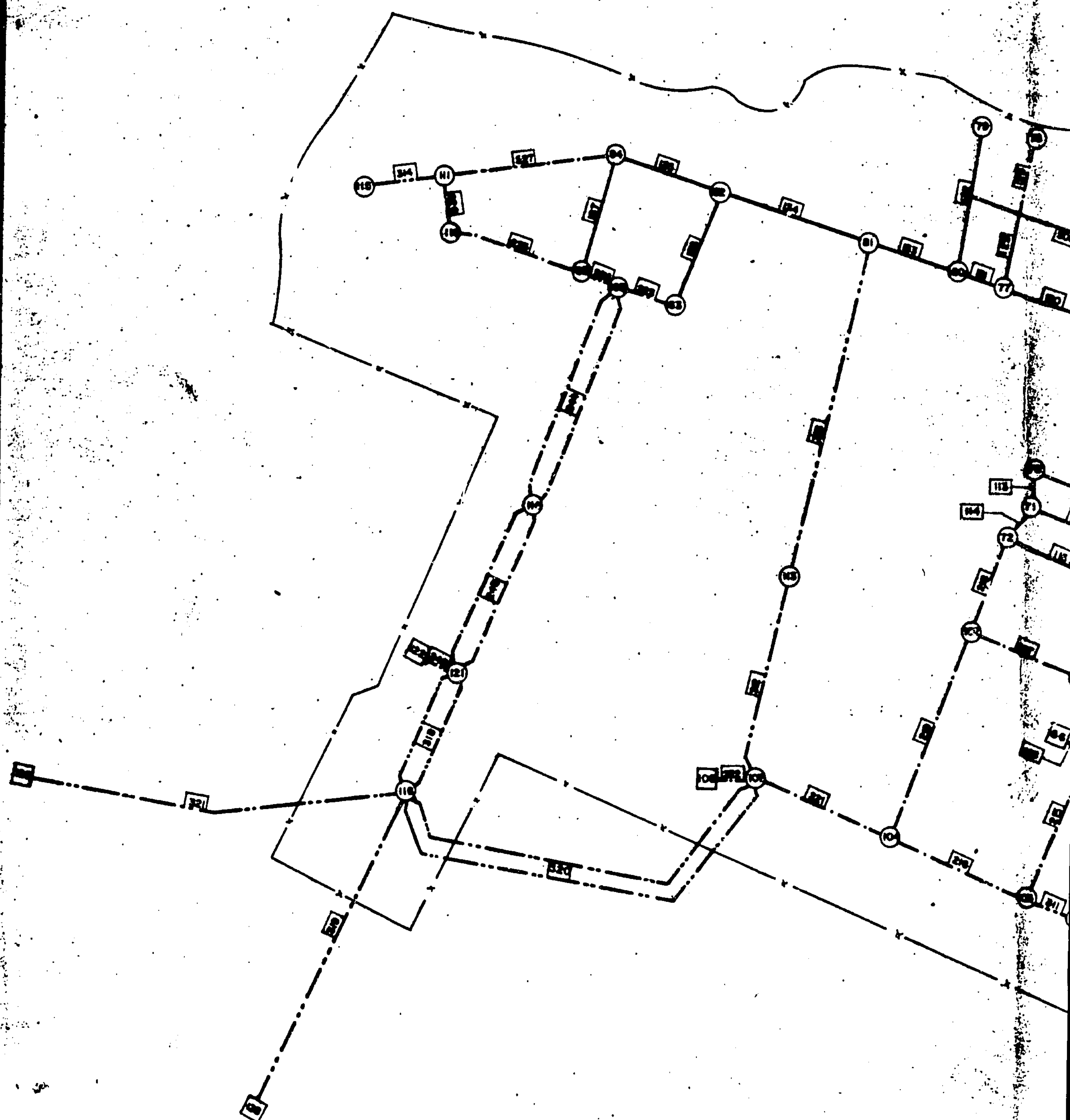
The SIL-WD has 45 fire hydrants installed within the distribution system. However, field surveys indicate that only 78 percent (35) of the existing hydrants are serviceable and capable of providing fire protection service to about 28 hectares of the present service area, if system pressures are raised to within acceptable limits.

Additional 289 hectares within the service area will be provided with fire protection service in Phase I-A by installing fire



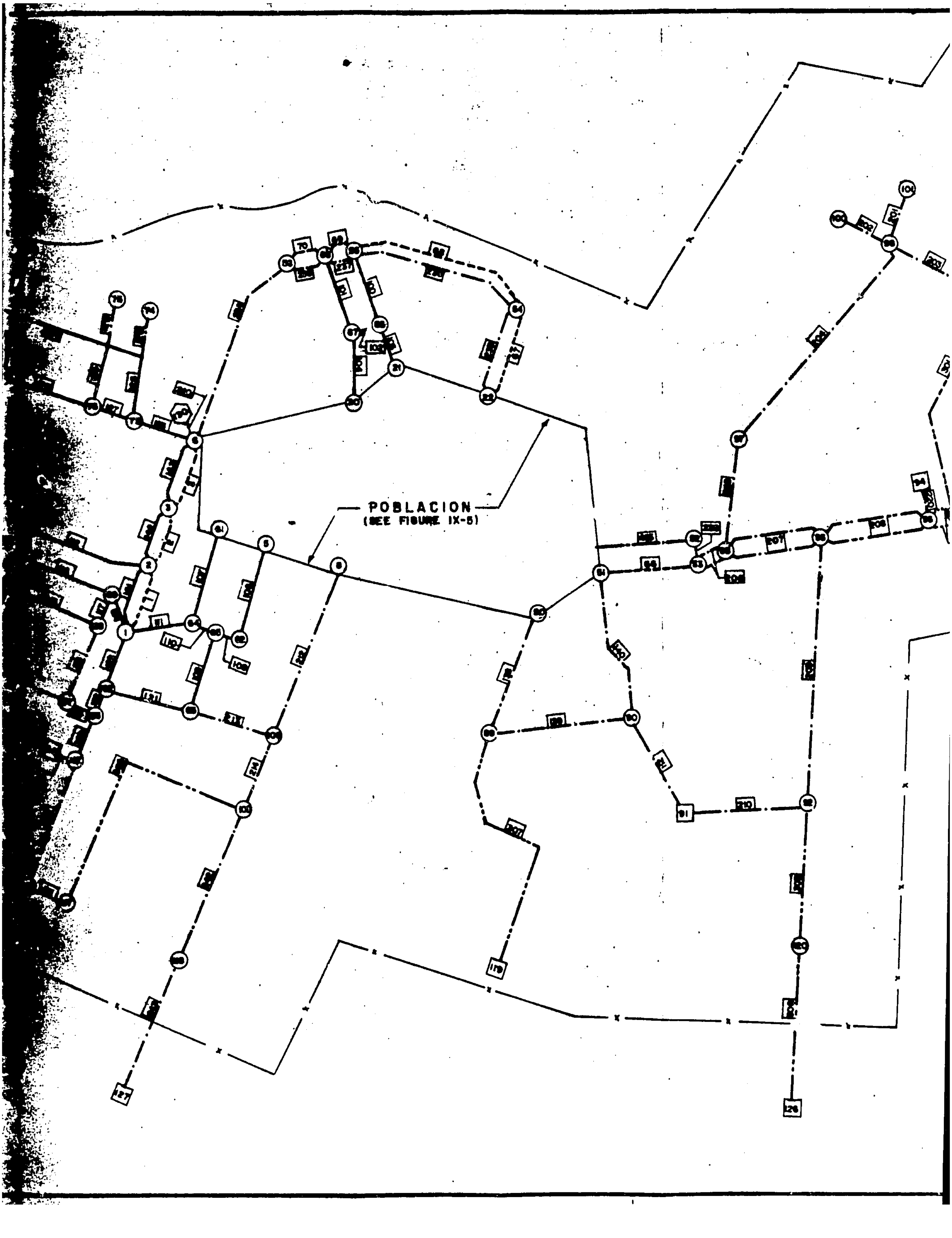
FEASIBILITY STUDY FOR WATER SUPPLY OF SECOND TEN URBAN AREAS LWUA-CDM

FIGURE IX-3
WATER SUPPLY / DEMAND CURVE
SILAY CITY WATER DISTRICT



FEASIBILITY STUDY FOR WATER SUPPLY OF SECOND TEN URBAN AREAS

LWUA-CDM



POBLACION
(SEE FIGURE IX-5)

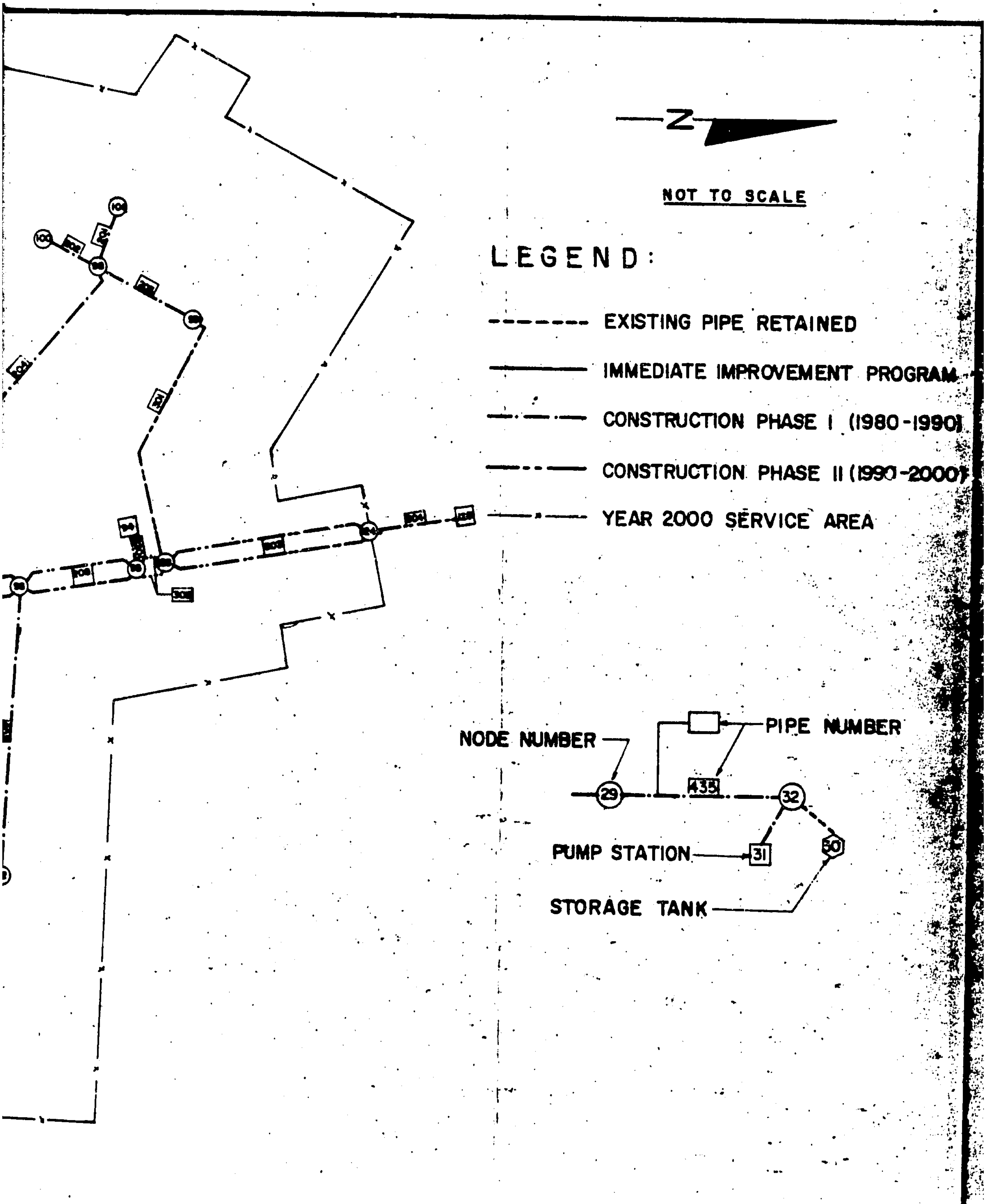


FIGURE IX-4
SCHEMATIC PLAN OF DISTRIBUTION SYSTEM
SILAY CITY WATER DISTRICT

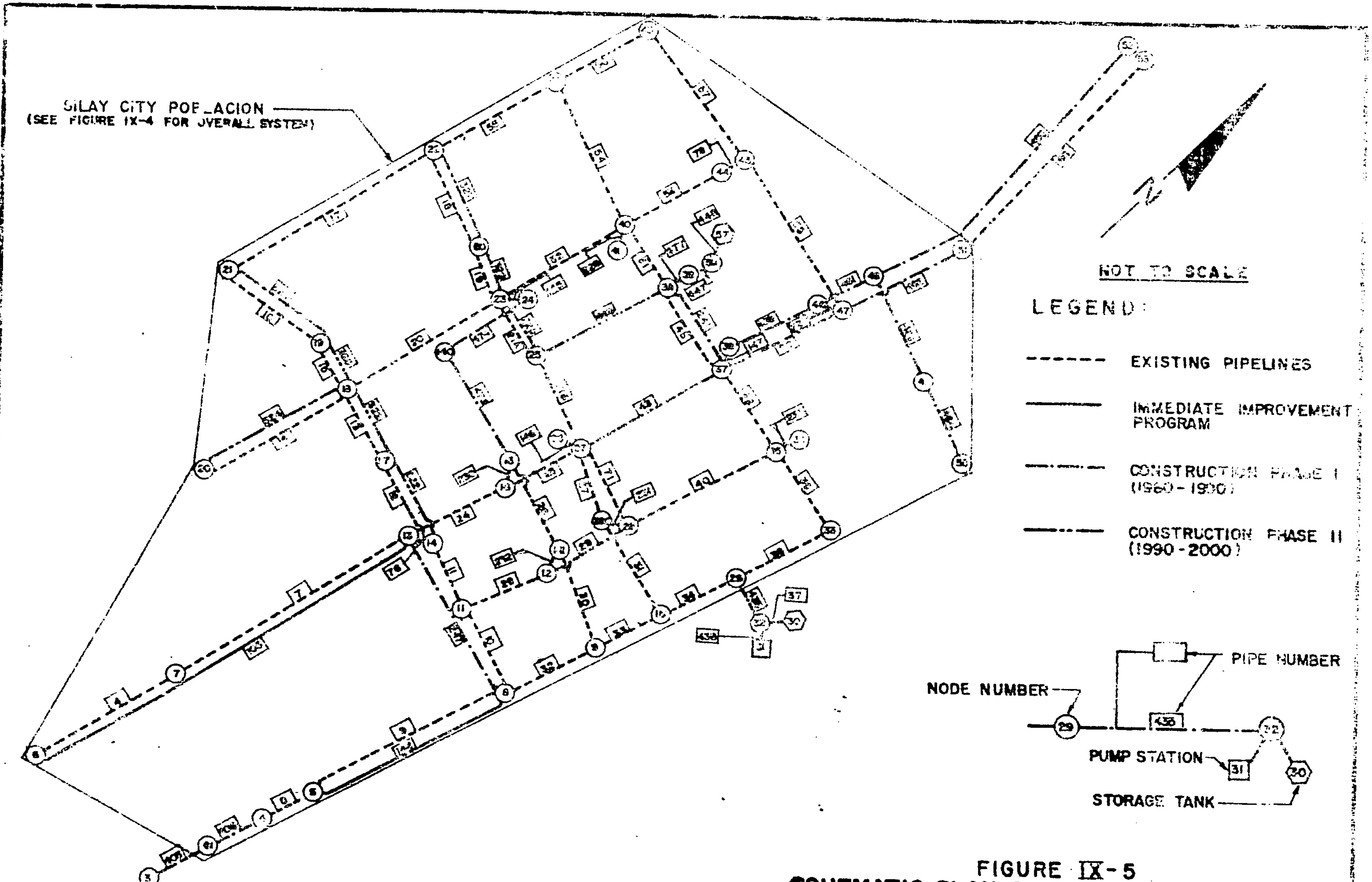


FIGURE IX - 5
SCHEMATIC PLAN OF DISTRIBUTION SYSTEM
(POBLACION)
SILAY CITY WATER DISTRICT

hydrants. By 1985, fire hydrant service will have been provided to 34 percent (317 hectares) of the projected year 2000 service area. Of the 317 hectares to receive hydrant service, about 100 hectares within the Poblacion, Barrios Rizal, Guinhalaran and Mambulac will receive a higher level of hydrant service due to higher property values and high population densities within these communities. A detailed schedule of fire hydrant installation is presented in Annex IX-C

Plumbing Shop

During Phase I-A a plumbing shop will be constructed and equipped with all tools required for the installation of water meters and service connections, as well as for repair and installation works within the distribution system.

Cost Summary - Phase I-A

The cost summary for proposed construction during Phase I-A is presented in Table IX-4. Based on 1978 price levels, the total project cost for this phase is ₱11.49 million, with a foreign exchange component (FEC) of ₱5.29 million which includes direct and indirect import items. Table IX-4 also shows a cost breakdown based on materials and equipment procurement and required civil and structural works. Materials and equipment considered in this breakdown include pipes, valves, pumps, water meters, fire hydrants and chlorinators.

CONSTRUCTION PHASE I-B (1986-90)

Source Facilities

As system demands approach the available source capacity in 1986, additional wells will be constructed. Two wells will be constructed in 1986 to provide 5,400 cumd additional source capacity. Existing wells no. 1 and 4 will be abandoned at this time because of anticipated declining productivity. Total source capacity within the SIL-WD will hence increase to 13,100 cumd, sufficient to satisfy system demand until 1988. The proposed additional wells will be constructed at nodes no. 108 and 31 (see Figures IX-4 and IX-5).

In 1988 and 1990, 2 additional wells will be required. These will be constructed at nodes 127 and 122, respectively (see Figure IX-4), and will each produce about 2,700 cumd. Thus, the total source production capacity will be 18,500 cumd by 1990. This will be sufficient to satisfy system water demand until 1991-92 at which time additional wells will be required to be able to meet the projected water supply demand.

All wells constructed during Phase I-B will be equipped with required structures and pumping, metering, piping and disinfection equipment.

TABLE IX-4

COST SUMMARY - PHASE I-A

Item	Cost (₱) Local	Foreign[7]	Total
Source Facilities			
(2 wells complete with equipment and chlorination facilities)			
Materials and Equipment	52,400	537,600	
Civil and Structural	754,600	-	
	807,000	537,600	1,344,600
Storage Facilities			
(500 cum elevated storage tank at Node No. 6)			
Materials and Equipment	732,600	52,300	
Civil and Structural	313,900	209,300	
	1,046,500	261,600	1,308,100
Distribution Pipelines			
(345 m x 250 mm)			
Materials and Equipment	20,000	75,900	
Civil and Structural	41,700	-	
(6,750 m x 200 mm)			
Materials and Equipment	216,000	850,500	
Civil and Structural	573,800	-	
(2,930 m x 150 mm)			
Materials and Equipment	64,500	254,900	
Civil and Structural	213,900	-	
(1,340 m x 100 mm)			
Materials and Equipment	5,400	53,600	
Civil and Structural	71,000	-	
(Valves)			
Materials and Equipment	12,500	37,900	
Civil and Structural	12,700	-	
	1,231,500	1,272,800	2,504,300
Sub-total[8]			
Materials and Equipment	1,103,400	1,862,700	2,966,100
Civil and Structural	1,981,600	209,300	2,190,900
	3,085,000	2,072,000	5,157,000

[7] Calculated at US$1.00 to ₱7.00.

[8] Contingencies and engineering costs are 15 percent and 10 percent, respectively, for these items.

TABLE IX-4 (Continued)

Item	Cost (₱) Local	Foreign	Total
Internal Network (67.4 ha)			
Materials and Equipment	36,100	282,700	
Civil and Structural	356,900	-	
	393,000	282,700	675,700
Service Connections (318 replacements and 3,065 new connections)			
Materials and Equipment	81,200	1,575,700	
Civil and Structural	1,094,800	-	
	1,176,000	1,575,700	2,751,700
Fire Hydrants			
Materials and Equipment	78,300	267,800	
Civil and Structural	115,300	-	
	193,600	267,800	461,400
Plumbing Shop and Tools			
Materials and Equipment	2,000	26,000	
Civil and Structural	363,000	-	
	365,000	26,000	391,000
Sub-total[9]			
Materials and Equipment	197,600	2,152,200	2,349,800
Civil and Structural	1,930,000	-	1,930,000
	2,127,600	2,152,200	4,279,800
Total Construction Cost			
Materials and Equipment	1,301,000	4,014,900	5,315,900
Civil and Structural	3,911,600	209,300	4,120,900
	5,212,600	4,224,200	9,436,800
Contingencies			
@ 15 Percent	462,800	310,800	773,600
@ 10 Percent	212,800	215,200	428,000
	5,888,200	4,750,200	10,638,400

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[9] Contingencies and engineering costs are 10 percent and 5 percent, respectively, for these items.

TABLE IX-4 (Continued)

Item	Cost (P) Local	Foreign	Total
Engineering[10]			
@ 10 Percent	207,600	385,500	593,100
@ 5 Percent	82,400	153,000	235,400
Sub-total	6,178,200	5,288,700	11,466,900
Land	24,600	-	24,600
TOTAL PROJECT COST	6,202,800	5,288,700	11,491,500

10/ Engineering costs consist of 65 percent foreign exchange, based on recent projects of this type.

Distribution Pipelines

During Phase I-B 1,880 meters will be constructed to reinforce previously installed pipelines, and 5,480 meters of additional pipelines will be constructed. Proposed Phase I-B pipelines are listed in Table IX-5 and shown in Figures IX-4, IX-5 and IX-1 (appended).

Proposed reinforcement pipelines include a portion of Freedom Boulevard near the well at node no. 66, a portion of Rizal Street east of Barrio Lantad and the pipeline east of Seaview Subdivision to the well at node no. 122.

New pipelines in Phase I-B will provide additional service in barrios Lantad, Rizal, Mambulac and Seaview Subdivision. Pipeline connections will also be made to wells constructed during this phase (at nodes no. 122 and 127).

The pipelines to be constructed during Phase I-B include 50 meters of 250-mm pipelines; 4,190 meters of 200-mm pipelines; 1,730 meters of 150-mm pipelines; and 1,440 meters of 100-mm pipelines, totalling 7,410 meters of pipelines with diameters from 100 to 250 mm. All required fittings and valves will be provided.

Internal Network

During Phase I-B an additional 113 hectares of equivalent internal network will be installed. This will consist of 19 hectares covered by distribution system pipelines and 94 hectares of internal network piping, all installed during this phase. Hence, by 1990, 49 percent of the year 2000 net service area will receive internal network piping.

Service Connections

During Phase I-B about 3,065 additional service connections will be installed within the SIL-WD service area, at a rate of 610 connections per year. By 1990 there will be a total of 8,570 service connections within the water district.

Fire Hydrants

During construction Phase I-B, about 137 hectares within the SIL-WD service area will be provided with fire protection service by fire hydrant installation. This additional area will bring the total area covered by fire hydrants to 454* hectares by 1990 (49 percent of the year 2000 service area served by internal network piping). About 20 additional hectares within the poblacion will receive higher level of fire hydrant service, with the remainder of the area to receive normal residential-type service.

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*Includes 28 hectares presently served by the existing system's fire hydrants.

TABLE IX-5

DISTRIBUTION PIPELINES - PHASE I [illegible]

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
	Reinforcement Pipes		
120	Freedom Blvd. East of Elena Development	200	150
122	Freedom Blvd. East of Elena Development	200	75
123	Freedom Blvd. East of Elena Development	200	175
206	Rizal St. East of Bo. Lantad	200	130
207	Rizal St. East of Bo. Lantad	200	300
244	East of Seaview Subdivision	200	580
245	East of Seaview Subdivision	200	470
		Sub-Total	1,880 m
	Additional Pipes		
246	To Well at Node No. 122	250	50
			50 m
138	Matagoy St.	200	370
210	From Matagoy Creek Road East of Bo. Lantad	200	320
209	On Road East of Bo. Lantad	200	800
222	To Well at Node No. 108	200	130
243	To Well at Node No. 127	200	450
247	McKinley St. East of Rizal St.	200	240
			2,310 m
119	Elena Development	150	100
139	From Matagoy St. to Maragoy Creek	150	450
203	Bo. Lantad	150	320
235	Freedom Blvd. West of Loney St.	150	290
236	Freedom Blvd. West of Loney St.	150	570
			1,730 m
118	Elena Development	100	250
126	Hofilena Subdivision	100	160
128	Hofilena Subdivision	100	185
129	Hofilena Subdivision	100	245
202	Bo. Lantad	100	250
225	Seaview Subdivision	100	350
			1,440
		Sub-Total	5,530 m
		Total	7,410

Cost Summary - Phase I-B

The cost summary for proposed construction during Phase I-B is presented in Table IX-6. Based on 1978 price levels, the total project cost for this phase is ₱9.69 million, with a foreign exchange component of ₱4.81 million.

D. SECOND STAGE OF THE LONG-TERM CONSTRUCTION PROGRAM (1991-2000)

The second stage of the recommended program includes provision of additional source, storage and distribution facilities and expansion of internal network, service connections and fire protection facilities. These works will be implemented in 2 construction phases.

CONSTRUCTION PHASE II-A (1991-95)

Source Facilities

As previously stated, wells installed during Phase I-B will provide sufficient total production capacity to meet system water demand until 1991. To provide adequate source capacity to meet system demand beyond 1995, 3 wells will be constructed during Phase II-A. These wells will each produce an estimated 2,700 cumd, and will be constructed at nodes no. 119, 128 and 129, in 1991, 1993 and 1995, respectively. The additional 8,100 cumd source capacity provided during this construction phase will increase the total capacity to 26,600 cumd for the SIL-WD, which will be sufficient to meet system demand until 1996-97 (see Figure IX-3).

Storage Facilities

In order to provide sufficient elevated storage capacity to meet system peak demand in the year 2000, an additional 700 cum of storage capacity will be required. It is recommended that a 200-cum storage tank be constructed in 1993 at node no. 57 (the site of of existing well no. 1). During the same year another elevated storage tank of 500 cum capacity will be constructed at node no. 6, the site of the tank constructed during Phase I-A.

At the time of construction of these storage tanks, the storage volume required beyond the year 2000 should be investigated to ensure that the most economical long-term construction program is implemented.

TABLE IX-6

COST SUMMARY – PHASE I-B

Item	Cost (₱) Local	Foreign[11]	Total
Source Facilities (4 wells complete with equipment and chlorination facilities)			
Materials and Equipment	104,800	1,075,200	
Civil and Structural	1,509,200	–	
	1,614,000	1,075,200	2,689,200
Distribution Pipelines			
(50 m x 250 mm)			
Materials and Equipment	2,900	11,000	
Civil and Structural	6,000	–	
(4,190 m x 200 mm)			
Materials and Equipment	134,100	527,900	
Civil and Structural	356,200	–	
(1,730 m 150 mm)			
Materials and Equipment	38,100	150,600	
Civil and Structural	126,200	–	
(1,440 m x 100 mm)			
Materials and Equipment	5,800	57,600	
Civil and Structural	76,300	–	
(Valves)			
Materials and Equipment	6,200	19,500	
Civil and Structural	6,400	–	
	758,200	766,600	1,524,800
Sub-total[12]			
Materials and Equipment	291,900	1,841,800	2,133,700
Civil and Structural	2,080,300	–	2,080,300
	2,372,200	1,841,800	4,214,000

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[11] Calculated at US$1.00 = ₱7.00

[12] Contingencies and engineering costs are 15 percent and 10 percent, respectively, for these items.

	Cost (₱)		
	Local	Foreign	Total
Internal Network (93.6 hectares)			
Materials and Equipment	50,200	392,600	
Civil and Structural	495,600	-	
	545,800	392,600	938,400
Service Connections (3,065 connections)			
Materials and Equipment	73,600	1,483,500	
Civil and Structural	1,002,300	-	
	1,075,900	1,483,500	2,559,400
Fire Hydrants			
Materials and Equipment	46,600	159,000	
Civil and Structural	68,300	-	
	114,900	159,000	273,900
Sub-total[13]			
Materials and Equipment	170,400	2,035,100	2,205,500
Civil and Structural	1,566,200	-	1,566,200
	1,736,600	2,035,100	3,771,700
Total Construction Cost			
Materials and Equipment	462,300	3,876,900	4,339,200
Civil and Structural	3,646,500	-	3,646,500
	4,108,800	3,876,900	7,985,700
Contingencies @ 15 percent	355,800	276,300	632,100
@ 10 percent	173,700	203,500	377,200
Sub-total	4,638,300	4,356,700	8,995,000
Engineering[14] @ 10 percent	169,600	315,000	484,600
@ 5 percent	72,600	134,800	207,400
	4,880,500	4,806,500	9,687,000
Land	1,200	-	1,200
TOTAL PROJECT COST	4,881,700	4,806,500	9,688,200

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[13] Contingencies and engineering costs are 10 percent and 5 percent, respectively, for these items.

[14] Engineering costs consist of 65 percent foreign exchange, based on recent projects of this type.

Distribution Pipelines

During Phase II-A, a total of 7,270 meters of pipelines will be constructed. These include 670 meters of 250-mm pipelines, 5,360 meters of 200-mm pipelines, 250 meters of 150-mm pipelines and 990 meters of 100-mm pipelines. The proposed Phase II-A pipelines are listed in Table IX-7 and shown in Figures IX-4 and IX-1 (appended).

New service areas will be served by some of the proposed Phase II-A pipelines. These are additional areas near barrios Rizal, Lantad and Guinhalaran; additional area east of Elena Development; and additional area east of Rizal Street between Barrio Guinhalaran and Elena Development.

In addition, pipelines will be constructed from the Phase II-A wells, including those at nodes no. 119, 122 and 128.

TABLE IX-7

DISTRIBUTION PIPELINES-PHASE II-A

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
319	East of Seaview Subdivision to Well at Node No. 128	250	670 m
302	Rizal St. at North Bo. Lantad Road	200	60
321	To Well at Node No. 129	200	1,310
305	Road East of Bo. Lantad	200	425
307	Matagoy St. to Well at Node No. 119	200	685
312	Rd. East of Rizal St. South of Elena Subdivision	200	540
313	Road East of Rizal St. South of Elena Subdivision	200	870
318	East of Seaview Subdivision to Well at Node No. 128	200	320
320	To Well at Node No. 108	200	1,150
			5,360 m
314	Seaview Subdivision (Rizal St.)	150	250 m
309	Road East of Elena Development	100	850
311	Road East of Elena Development	100	140
			990 m
	Total		7,270 m

Internal Network

During Phase II-A additional 237 hectares of equivalent internal network will be installed. This will consist of 45 hectares covered by distribution system pipelines and 192 hectares of internal network piping, all installed during this phase. About 74 percent of the year 2000 net service area will receive equivalent internal network piping by 1995.

Service Connections

During Phase II-A 3,900 additional service connections will be installed within the area served by the SIL-WD, at a rate of about 780 connections per year. Hence, by the year 1995, there will be a total of 12,470 service connections within the SIL-WD service area.

Fire Hydrants

During construction Phase II-A, 237 hectares within the SIL-WD service area will be provided with fire protection service by fire hydrant installation. This additional area will bring the total area covered by fire hydrants to about 691 hectares by 1995 (74 percent of the year 2000 service area served by internal network piping).

Cost Summary - Phase II-A

A cost summary for proposed construction during Phase II-A is presented in Table IX-8, based on 1978 price levels. The total project cost for this phase is ₱13.52 million, with a foreign exchange component of ₱6.17 million.

CONSTRUCTION PHASE II-B (1996-2000)

Source Facilities

During this final phase of the recommended construction program, 2 additional wells will be required. It is recommended that these wells be constructed at nodes no. 126 and 125 (see Figure IX-4) in 1997 and 1998, respectively. Each of the wells will have a capacity of 2,700 cumd, and will be provided with structures, pumping, metering, piping and disinfection facilities as required. The additional 5,400 cumd capacity provided during Phase II-B will increase the total source capacity to 32,000 cumd - sufficient to satisfy system demand until the year 2000.

TABLE IX-8

COST SUMMARY - PHASE II-A

Item	Cost (₱) Local	Foreign[15]	Total
Source Facilities			
(3 wells complete with equipment and chlorination facilities)			
Materials and Equipment	78,600	806,400	
Civil and Structural	1,131,900	-	
	1,210,500	806,400	2,016,900
Storage Facilities			
(200 cum elevated storage tank at Node No. 57)			
Materials and Equipment	355,700	25,400	
Civil and Structural	152,500	101,600	
(500 cum elevated storage tank at Node No. 6)			
Materials and Equipment	732,600	52,300	
Civil and Structural	313,900	209,300	
	1,554,700	388,600	1,943,300
Distribution Pipelines			
(5,360 m x 200 mm)			
Materials and Equipment	171,600	675,400	
Civil and Structural	455,600	-	
(250 m x 150 mm)			
Materials and Equipment	5,500	21,800	
Civil and Structural	18,200	-	
(990 m x 100 mm)			
Materials and Equipment	4,000	39,600	
Civil and Structural	52,500	-	
(670 m x 250 mm)			
Materials and Equipment	38,900	147,400	
Civil and Structural	81,100	-	
(Valves)			
Materials and Equipment	7,700	23,600	
Civil and Structural	7,900	-	
	843,000	907,800	1,750,800

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[15] Calculated at US$1.00 = ₱7.00

TABLE IX-8 (continued)

Item	Local	Foreign	Total
Sub-total[16]			
Materials and Equipment	1,394,600	1,791,900	3,186,500
Civil and Structural	2,213,600	310,900	2,524,500
	3,608,200	2,102,800	5,711,000
Internal Network (192.1 hectares)			
Materials and Equipment	103,000	805,700	
Civil and Structural	1,017,200	-	—
	1,120,200	805,700	1,925,900
Service Connections (3,900 new connections)			
Materials and Equipment	93,600	1,887,600	
Civil and Structural	1,275,300	-	—
	1,368,900	1,887,600	3,256,500
Fire Hydrants (237 hectares)			
Materials and Equipment	45,700	156,100	
Civil and Structural	67,100	-	—
	112,800	156,100	268,900
Sub-total[17]			
Materials and Equipment	242,300	2,849,400	3,091,700
Civil and Structural	2,359,600	-	2,359,600
	2,601,900	2,849,400	5,451,300
Total Construction Cost			
Materials and Equipment	1,636,900	4,641,300	6,278,200
Civil and Structural	4,573,200	310,900	4,8[illegible]4,100
	6,210,100	4,952,200	11,162,300

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[16] Contingencies and engineering costs are 15 percent and 10 percent, respectively, for these items.

[17] Contingencies and engineering costs are 10 percent and 5 percent, respectively, for these items.

TABLE IX-8 (continued)

Item		Cost (₱) Local	Foreign	Total
Contingencies				
@ 15 percent		541,200	315,400	856,600
@ 10 percent		260,200	284,900	545,100
	Sub-total	7,011,500	5,552,500	12,564,000
Engineering[18]				
@ 10 percent		229,900	426,900	656,800
@ 5 percent		104,900	194,900	299,800
	Sub-total	7,346,300	6,174,300	13,520,600
Land		900	-	900
TOTAL PROJECT COST		7,347,200	6,174,300	13,521,500

[18] Engineering costs consist of 65 percent foreign exchange, based on recent projects of this type.

Although under the recommended program, sufficient source capacity will be provided to satisfy projected demands until the year 2000, consideration should be given to demand beyond this year during Phase II-B to provide the most economical program of source development.

Distribution Pipelines

The majority of pipelines to be installed during Phase II-B are reinforcements to existing pipelines and other pipelines installed during the recommended construction program. These include reinforcements along Freedom Boulevard, Plaridel and McKinley Streets, within the poblacion, a portion of Rizal Street east of Barrio Lantad, and the pipeline from node no. 116 to the well at node no. 108.

Additional pipelines, extending beyond the anticipated year 2000 service area, will be required to transmit flows from the Phase II-B wells to demand centers within the service area. These pipelines extend to wells located at nodes no. 125 (northeast of Barrio Lantad), 126 (northeast of Barrio Rizal) and 129 (southeast of Barrio Guinhalaran).

The recommended Phase II-B pipelines are listed in Table IX-9 and shown in Figures IX-4, IX-5 and IX-1 (appended).

Internal Network

During Phase II-B, an additional 237 hectares of internal network piping will be installed. This will provide equivalent internal network system service to a total of 928 hectares within the SIL-WD service area or 100 percent of the year 2000 net service area.

Service Connections

About 3,900 additional service connections will be installed during this phase, at a rate of approximately 780 connections per year. Hence, by the year 2000, a total of 16,370 connections will have been installed within the SIL-WD service area.

Fire Hydrants

During construction Phase II-B, about 237 hectares within the SIL-WD service area will be provided with fire protection service by fire hydrant installation. This additional coverage increases the total area covered by fire hydrants to 928 hectares by the year 2000 (100 percent of the year 2000 service area served by internal network piping).

TABLE IX-9

DISTRIBUTION PIPELINES - PHASE II-B

Pipe Number	Location/Description	Pipe Diameter (mm)	Pipe Length (m)
	Reinforcement Pipes		
208	Rizal St. East of Bo. Lantad	200	335
302	Rizal St. at North Bo. Lantad Rd.	200	60
303	Rizal St. at North Bo. Lantad Road	200	580
318	East of Seaview Subdivision to Well at Node No. 128	200	320
320	To Well at Node No. 108	200	1,150
			2,445 m
322	McKinley St. West of Rizal St.	150	100
323	McKinley St. West of Rizal St.	150	100
324	Plaridel St.	150	190
325	McKinley St. West of Rizal St.	150	60
326	McKinley St. West of Rizal St.	150	130
327	Freedom Blvd. West of Rizal St.	150	130
328	Freedom Blvd. West of Rizal St.	150	65
329	Freedom Blvd. West of Rizal St.	150	85
			860 m
	Additional Pipes		
301	North Bo. Lantad Road	200	620
303	Rizal St., North of North Bo. Lantad Rd.	200	480
			1,100 m
304	To Well at Node No. 125	250	360
306	To Well at Node No. 126	250	500
			860 m
		Total	5,265 m

Cost Summary Phase II-B

A cost summary for construction during Phase II-B is presented in Table IX-10. Based on 1978 price levels, the total project cost of this phase is ₱10.28 million, with a foreign exchange component of ₱5.21 million.

E. CAPITAL COST SUMMARY

The capital costs for each phase of the recommended construction program, including the immediate improvement program, are summarized in Table IX-11. The total project costs presented in this table include engineering, contingencies and land costs. All construction cost estimates are based on 1978 price levels. The foreign exchange component of the total project cost includes the costs of direct and indirect import items.

F. ANNUAL OPERATION AND MAINTENANCE COSTS

Annual operation and maintenance costs include personnel, power, fuel, chemicals, maintenance, office supplies and other miscellaneous expenses which are necessary to sustain the overall water supply system. The total annual budgeted cost of the existing system was ₱285,300 in 1976. Following implementation of the immediate improvements and the long-term construction program, the annual cost will increase due to the additional costs for personnel, chemicals, fuel and maintenance.

The annual operating and maintenance costs are estimated to be ₱0.5 million, ₱1.3 million and ₱2.2 million in 1980, 1990 and 2000, respectively. The breakdown of these costs is presented in Table IX-12. All costs shown are based on projected 1978 price levels.

TABLE IX-10

COST SUMMARY PHASE II-B

Item	Cost (₱) Local	Cost (₱) Foreign[19]	Cost (₱) Total
Source Facilities			
(2 wells complete with equipment and chlorination facilities)			
Materials and Equipment	52,400	537,600	
Civil and Structural	754,600	-	
	807,000	537,600	1,344,600
Distribution Pipelines			
(860 m x 250 mm)			
Materials and Equipment	49,900	189,200	
Civil and Structural	104,100	-	
(3,545 m x 200 mm)			
Materials and Equipment	113,500	446,700	
Civil and Structural	301,300	-	
(860 m x 150 mm)			
Materials and Equipment	18,900	74,800	
Civil and Structural	62,800	-	
(Valves)			
Materials and Equipment	5,100	17,700	
Civil and Structural	5,700	-	
	661,300	728,400	1,389,700
Sub-total[20]			
Materials and Equipment	239,800	1,266,000	1,505,800
Civil and Structural	1,228,500	-	1,228,500
	1,468,300	1,266,000	2,734,300
Internal Network			
(237 Ha)			
Materials and Equipment	127,200	995,200	1,122,400
Civil and Structural	1,256,500	-	1,256,500
	1,383,700	995,200	2,378,900
Service Connections			
(3,900 new connections)			
Materials and Equipment	93,600	1,887,000	1,980,600
Civil and Structural	1,275,300	-	1,275,300
	1,368,900	1,887,000	3,255,900

[19] Calculated at US$1.00 to ₱7.00.

[20] Contingencies and engineering costs are 15 percent and 10 percent, respectively, for these items.

TABLE IX-10 (continued)

Item	Cost (₱) Local	Foreign	Total
Fire Hydrants (237.3 hectares)			
Materials and Equipment	45,800	156,300	
Civil and Structural	67,100	-	
	112,900	156,300	269,200
Sub-total[21]			
Materials and Equipment	266,600	3,038,500	3,305,100
Civil and Structural	2,598,900	-	2,598,900
	2,865,500	3,038,500	5,904,000
Total Construction Cost			
Materials and Equipment	506,400	4,304,500	4,810,900
Civil and Structural	3,827,400	-	3,827,400
	4,333,800	4,304,500	8,638,300
Contingencies			
@ 15 percent	220,200	189,900	410,100
@ 10 percent	286,600	303,800	590,400
Sub-total	4,840,600	4,798,200	9,638,800
Engineering[22]			
@ 10 percent	110,000	204,400	314,400
@ 5 percent	113,600	211,100	324,700
Sub-total	5,064,200	5,213,700	10,277,900
Land	600	-	600
TOTAL PROJECT COST	5,064,800	5,213,700	10,278,500

21/ Contingencies and engineering costs are 10 percent and 5 percent, respectively, for these items.

22/ Engineering costs consist of 65 percent foreign exchange, based on recent projects of this type.

TABLE IX-11

CAPITAL COST SUMMARY

Construction Phase	Construction Period	Construction Cost (₱)	Project Cost (₱) Local	Foreign	Total
Immediate Improvement Program	1978-79	4,224,200	2,533,600	2,648,700	5,182,300
I-A	1980-85	9,436,800	6,202,800	5,288,700	11,491,500
I-B	1986-90	7,985,700	4,881,700	4,806,500	9,688,200
II-A	1991-95	11,162,300	7,347,200	6,174,300	13,521,500
II-B	1996-2000	8,638,300	5,064,800	5,213,700	10,278,500
		41,447,300	26,030,100	24,131,900	50,162,000

TABLE IX-12

ESTIMATED OPERATION AND MAINTENANCE COSTS[23]

Year	Administration and Personnel	Power and Fuel[24]	Chemicals[25]	Maintenance[26]	Miscellaneous	Total
1976	186,600	43,600	1,900	29,000	24,200	285,300
1980	253,000	128,500	14,100	67,900	35,400	498,900
1985	389,900	272,200	27,800	136,400	57,100	883,400
1990	513,400	416,000	41,500	205,300	91,900	1,268,100
1995	673,600	605,000	59,600	294,000	148,000	1,780,200
2000	757,600	794,100	77,800	370,900	238,400	2,238,800

23/ Calculated at 1978 price levels.

24/ Includes diesel fuel for pump operation (@ ₱1.31/l and other miscellaneous fuel and electricity items.

25/ Includes chlorine (@ ₱5.0/kg).

26/ Maintenance for pipelines, structures and other civil items is calculated at ¼ percent per annum on total construction cost. Maintenance for mechanical equipment is calculated at 2 percent per annum.

G. SEWERAGE/DRAINAGE CONCEPTS

Existing Drainage System

The existing drainage system in Silay consists of a central conduit consisting of 1,000, 1,200 and 1,500 mm diameter reinforced concrete pipes. These extend along Rizal Street from Freedom Boulevard to Matigay Creek and are fed by a network of 600 mm diameter reinforced concrete pipes laid along the streets of the core city surrounding the public plaza. These relatively large conduits are in turn fed by an extensive system of smaller unlined open street canals constructed along streets peripheral to the core city. All water drained by this system is carried northward to a disposal point on Matigay Creek which subsequently joins Matagoy Creek, forming Bas. Creek which flows about ? km before emptying into Guimaras Strait. The southeastern and western portions of the municipality are drained exclusively by small unlined earthen canals which transport storm water to Guimaras Strait via Cabug Creek and small natural drainage c[illegible]ls near Barrio Nambulao. Existing drainage facilities are shown in Fi[illegible]e IX-6.

The larger conduits along Rizal Street were constructed in 1968-70 by the municipal engineering department to contain the flows transported by the older existing system of drainage pipes and canals. Although the core city area of Silay is relatively well developed with respect to drainage facilities, additional required works have not been done because of the inability of the municipality to generate funds. The municipality maintains the drainage facilities within an existing inadequate road maintenance budget.

The smaller unlined street canals are essentially earthen trenches varying in width from 0.5 to 1.0 meter, with depths varying from 0.25 to 0.50 meter. Although the flow from some street canals is directed to the larger network of drainage conduits, frequently, the outlying canals simply overflow into adjacent low-lying areas, especially during periods of heavy rainfall.

The existing drainage facilities were constructed for the collection and disposal of storm water runoff. Most of the street canals are dry during non-rainy periods. During rainy periods, surface runoff as well as some miscellaneous solid waste, is carried by the street canals, with minimal domestic sewage contributing to the total flow.

Field observations of the drainage system in Silay are as follows:

1. The major disposal area for storm water runoff is Guimaras Strait, via various small natural waterways such as Matigay, Matagoy and Cabug Creeks.

2. Domestic wastewater is discharged into septic tanks and pit privies. Some roof drainage is transported to these faci-

lities, with occasional flooding during rainy periods. Although direct discharge of domestic wastewater to storm water facilities is not [illegible], it is likely that an appreciable amount of domestic wastewater travels overland to drainage facilities or low-lying areas during rainy periods.

3. The public market, located along P. Burgos Street, is drained directly [illegible] to the Rizal Street drainage pipe via a short section of 600-mm pipe. The slaughterhouse serving the municipality is located in Barrio Guinhalaran, south of the poblacion, and is drained by local street canals directly into Guimaras Strait.

4. The municipality maintains the existing drainage system with funds allocated for road maintenance.

5. At present, there is only one known commercial producer of unusual wastewater, a poultry farm located near the intersection of Freedom Boulevard and Rizal Street. There are no other known industries producing significant wastewaters.

6. Approximately 14-18 metric tons/day of solid wastes is collected by the municipality, and hauled to a dump site located in low-lying areas south of the poblacion, near Cabug Creek. These wastes are subsequently burned.

7. Minor clogging of drainage conduits is caused by deposition of locally eroded soils and the dumping of solid waste materials into the drainage canals.

8. No significant flood problems have been experienced in Silay. Several areas are periodically flooded for several hours, but drain readily after the cessation of rainfall.

Relationship with Infrastructure and Other Engineering and Economic Factors

The provision of sewerage and drainage facilities within the SIL-WD has a significant impact on water supply and other infrastructure components. Similarly, economics (public's ability-to-pay) and the status of public health affect directly the feasibility of providing sewerage and drainage facilities.

In view of the relatively minor storm water drainage problems being experienced in the SIL-WD area, it appears that drainage facilities do not warrant high priority in Silay's list of infrastructure components. Before decisions can be made concerning the implementation of sewerage and/or drainage programs, additional technical and economic data must be collected and evaluated.

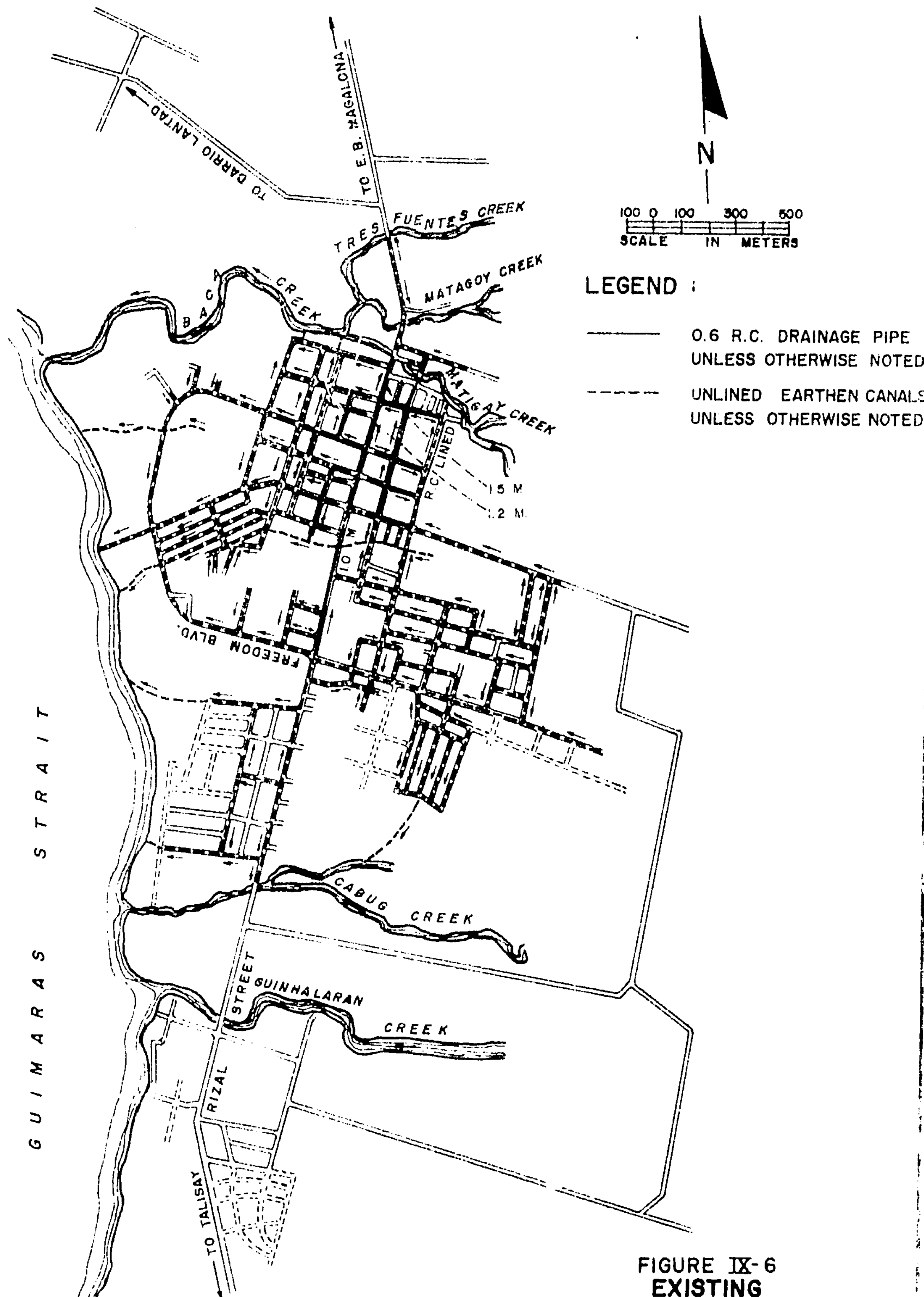

FIGURE IX-6
EXISTING SEWERAGE / DRAINAGE FACILITIES
SCHEMATIC
SILAY WATER DISTRICT

Information from the Department of Health indicates that in 1976, 23 percent of Silay households had water-borne toilet facilities, 16 percent had closed-pit type toilets and 61 percent had no toilet facilities. It is unlikely that such a low percentage of "modern" facilities can economically justify a near-future sewerage program.

The rationale for the provision of wastewater facilities has traditionally been based on aesthetics and public health benefits. At present, there is an obvious water supply problem in the SIL-WD. As the water supply problem is resolved, wastewater volumes will increase. Related aesthetic and public health standards will improve in time, increasing the urgency for solution of the wastewater problem.

Projected Wastewater Volumes

Wastewater flows in the SIL-WD were projected for the years 1990, 2005 and 2025. These estimates are shown in Table IX-13.

The service area considered for the wastewater projections was the core area to receive water supply by 1980. This area is the most densely populated area in the water district, and is the area where public health and nuisance problems associated with wastewater will be greatest.

The wastewater volume which could be collected was determined by estimating the percentage of water supply connections (domestic and commercial/industrial/institutional) with sewer connections during the design period from 1990 to 2025. It was assumed that all water supply connections would have sewer connections by 2025, and that in 1990, 30 percent of domestic and 50 percent of commercial/industrial/institutional water supply connections would have sewer connections. It was assumed that there would be no unusually large water-consuming connections during the design period, and that 90 percent of water consumed would therefore be returned to the sewers. An allowance was made for groundwater infiltration into the sewers, based on projected percentage of physical area with sewers and an infiltration rate of 0.15 lps/hectare. The number of sewer connections required during the design period was then checked to ensure that the annual rate of sewer connections was realistically within the capabilities of the water district.

TABLE IX-13

AVERAGE DAILY WASTEWATER FLOWS
SILAY CITY WATER DISTRICT

Served Area	Design Year	Wastewater Flows (cumd)			
		Domestic	Commercial/ Industrial/ Institutional	Infiltration Allowance	Total
Poblacion	1990	566	151	797	1,514
	2005	2,072	587	1,148	3,807
	2025	7,895	1,974	1,594	11,463
Barrio Rizal	1990	165	44	292	501
	2005	605	171	420	1,196
	2025	2,306	576	583	3,465
Barrio Mambulac	1990	208	55	603	866
	2005	761	216	868	1,845
	2025	2,899	725	1,205	4,829
Barrio Guinhalaran	1990	133	35	266	434
	2005	487	138	382	1,007
	2025	1,857	464	531	2,852
Total	1990	1,072	285	1,958	3,315
	2005	3,925	1,112	2,818	7,855
	2025	14,957	3,739	3,913	22,609

Alternatives Available

The cost of sewerage/drainage facilities for the SIL-WD area is expected to be significant.

The provision of a financially self-sufficient sewerage/drainage system is seldom achieved even in developed countries. It is likely that the SIL-WD is no exception to this rule.

Feasible alternatives for sewerage in SIL-WD area appear to be as follows:

(1) individual (septic tanks) or unified public collection system;

(2) combined or separate sewerage/drainage systems;

(3) various degrees of centralized community sewage treatment;

(4) disposal system (river, land, or bay disposal) for treated sewage.

The question of whether the SIL-WD should construct a combined or a separate sewerage/drainage system depends on economic circumstances.

An alternative to the combined system which must be investigated in detail during the sewerage feasibility study is the provision of open canals (peripheral drains).

Alternative treatment and disposal methods for intercepted wastewater may consist of:

(1) Screening of gross solids, high-rate lagoons and effluent discharge into Guimaras Strait.

(2) Some form of treatment such as conventional primary and/or high rate secondary treatment may be applied. Treated wastes may be used potentially for agricultural irrigation.

Recommendations

As soon as the first phase of the water supply program is underway, a comprehensive sewerage/drainage feasibility study should be undertaken. This study must address the issue of combined versus separate sewers. It should also update the population and water demand projections of this water supply study.

Once the decision has been made to use either the combined or separate system, the water district must embark as promptly as possible on a street sewering and house connection program.

A plumbing code should be developed by the SIL-WD to coordinate plumbing requirements for water, wastewater and surface runoff facilities. This code becomes very important and meaningful particularly if a separate system of sewers is adopted.

In the meantime, a house-to-house survey should be conducted to inventory existing wastewater and toilet facilities. As-built drawings of storm drains and peripheral canals must be compiled and accurately recorded in preparation for the sewerage/drainage feasibility study.

For residences and establishments that currently lack waste disposal facilities and are financially unable to provide the modern flush toilet with septic tank, the Department of Health (Division of Environmental Sanitation) has developed an inexpensive water-seal toilet.

Permanent rights-of-way should be acquired for the main routes that will be used for drainage/sewerage canals.

Dumping solid wastes into waterways, canals and manholes, should be strictly prohibited. Solid wastes not only pollute the water, but are also very unsightly and serve as habitats for flies, rodents and parasites. The proper handling of solid wastes should be studied and planned carefully.

H. MANAGEMENT OF WATER RESOURCES

In order to make the best use of water resources available for present and future demands of the SIL-WD, certain technical and management steps must be considered. These considerations are primarily related to the collection of data concerning the chemical quality and amount of water produced by the district, and a data storage and retrieval system which would be made readily accessible to those organizations dealing with the subject. These are discussed further in Appendices M and P, Volume II of this report.

I. UPDATING THE WATER SUPPLY MASTER PLAN

To be a meaningful working document, this water supply master plan must be periodically updated. Changes related to technological developments, social goals, land use concepts, unforeseen population growth or movement, etc., must be reviewed for possible long-range impact on the programs recommended in this report. An outline of the steps required for such periodic updating is presented in Appendix Q, Volume II.

J. ENVIRONMENTAL CONSIDERATIONS

Appendix R, Volume II discusses some of the ways the construction program may affect the environment of the study area. Some of the natural resources affected by the program are irreplaceable, requiring due consideration before actual construction.

ANNEX IX--C

DISTRIBUTION SYSTEM GROWTH

ANNEX IX-C

DISTRIBUTION SYSTEM GROWTH

General

It is necessary to project the growth of the distribution system in order to estimate the required expenditures for internal network piping, service connections and fire hydrant requirements. The projection of distribution system growth is based on (1) an apportionment of the served population among individual sections within the service area, (2) the projected number of persons served by each connection, and (3) the individual areas of projected served sections within the service area. The details of these items are discussed below.

Served Population

The projections of served population presented in Chapter VI are presented in Annex Table IX-C-1, according to individual community served and respective service areas in 1976, 1980, 1990 and 2000.

ANNEX TABLE IX-C-1

SERVED POPULATION PROJECTIONS
SILAY CITY WATER DISTRICT

Community Served	1976 Service Area	1980 Service Area	1990 Service Area	2000 Service Area
Silay Poblacion	4,424	8,250	21,890	35,730
Bo. Rizal	878	2,410	7,510	16,660
Bo. Mambulac	598	3,030	12,730	20,770
Bo. Guinhalaran	-	1,940	8,500	19,800
Bo. Lantad	-	-	4,240	10,200
Served Population	5,900	15,630	54,870	103,160
Total Service Area Population	21,280	41,440	84,610	130,770
Percent Population Served	28	38	65	79

Number of Persons per Connection

Based on the pilot area survey made within the present SIL-WD service area, the average number of persons served per service connection is 6.5. It is anticipated that this number will slightly decrease during the study period. It has been assumed that the effects of future increased living standards and family planning will be offset by the effects of future inward migration. Hence, the estimates of average population served per connection are 6.4 for 1980 and 1990 and 6.3 for 2000.

Total Served Area for Individual Communities

The total areas of the individual served communities were projected on the basis of field studies and locations with potential consumers of the SIL-WD water supply. These projections are presented in Annex Table IX-C-2.

ANNEX TABLE IX-C-2

TOTAL SERVICE AREA
SILAY WATER DISTRICT
(in hectares)

Community Served	1976 Service Area	1980 Service Area	1990 Service Area	2000 Service Area
Silay Poblacion	69	123	215	272
Bo. Rizal	14	45	104	200
Bo. Mambulac	21	93	104	107
Bo. Guinhalaran	-	41	94	256
Bo. Lantad	-	-	89	197
	104	302	606	1,032

Area Served by Internal Network

In order to project the net area to be served by internal network piping, the gross served areas presented in Annex Table IX-C-2 were modified, taking into account the percentage of population served throughout the study period (65 percent and 79 percent of the service area population in 1990 and 2000, respectively) and the actual area served by installed piping by 1980 (182 hectares). Thus, the modified served areas correspond to 182.0, 454.5 and 928.8 hectares in 1980, 1990 and 2000, respectively (60, 75 and 90 percent of the total service area).

It has also been assumed that distribution system pipelines passing through the service areas will provide service to the areas within 50 meters on each side of the pipelines. The resultant net areas to receive internal network are given in Annex Table IX-C-3.

Number of Service Connections

The number of service connections was projected by dividing the served population (see Annex Table IX-C-1) by the average number of persons per connection. The estimated number of service connections for each community within the service area is presented in Annex Table IX-C-4.

During the leakage survey, which will be conducted as part of the immediate improvement program, it is expected that some existing service connections will be identified as major sources of leakage. It is projected that major repair or replacement will include 35 percent of existing service connections by 1980, and an additional 35 percent during Phase I-A. This schedule of repair and replacement is based on findings that about 75 percent of existing connections were installed before 1951 and that materials and installation methods previously used were substandard.

Areas to Receive Fire Protection

All areas to receive water supply service by the year 2000 will also receive fire protection service by this time. Normal residential-type fire hydrant service will be provided, except in those areas where high property values or high population densities are expected. Portions of the poblacion, barrios Rizal, Guinhalaran and Mambulac will receive a higher level of fire protection service. The schedule for fire hydrant installation is listed in Annex Table IX-C-5.

ANNEX TABLE IX-C-3

NET AREA SERVED BY INTERNAL NETWORK SYSTEM
(in hectares)

Community Served	Phase I-A (1981-85)	Phase I-B (1986-90)	Phase II-A (1991-1995)	Phase II-B (1996-2000)	Total
Silay Poblacion (110.7)*	31.4	19.1	41.8	41.8	244.8
Bo. Rizal (27.1)*	10.1	11.4	39.4	51.0	139.0
Bo. Mambulac (19.5)*	16.4	26.5	2.8	9.2	74.4
Bo. Guinhalaran (24.7)*	-	8.2	64.6	80.0	177.5
Bo. Lantad	9.5	28.4	43.5	55.3	136.7
Net Area Served By Internal Network (182.0)	67.4	93.6	192.1	237.3	772.4
Area Served by Distribution Pipes	92.1	19.4	44.9	-	156.4
Total Cumulative Area Served	341.5	454.5**	691.5	928.8***	928.8

*Figures in parentheses indicate areas served by 1980. The total 182.0 hectares represents 60 percent of the 1980 service area. The remaining 120.0 hectares of the 1980 service area will be served by 1985.

**Represents 75 percent of total 1990 service area.

***Represents 90 percent of total 2000 service area.

ANNEX TABLE IX-C-4

SCHEDULE FOR SERVICE CONNECTION INSTALLATION

Community Served	Immediate Improvements (1978-80)	Phase I-A (1981-85)	Phase I-B (1986-90)	Phase II-A (1991-95)	Phase II-B (1996-2000)
Silay Poblacion (681)*	609	1,065	1,065	1,125	1,125
Bo. Rizal (135)*	245	395	395	735	735
Bo. Mambulac (92)*	378	760	760	655	655
Bo. Guinhalaran	300	515	515	905	905
Bo. Lantad	--	330	330	480	480
Total (908)*	1,532	3,065	3,065	3,900	3,900
Cumulative Total	2,440	5,505	8,570	12,470	16,370

*Figures in parenthesis indicate existing service connections.

ANNEX TABLE IX-C-5

SCHEDULE FOR FIRE HYDRANT INSTALLATION

Community Served	Phase I-A (1981-85)	Phase I-B (1986-90)	Phase II-A (1991-95)	Phase II-B (1996-2000)	Total
Silay Poblacion	71.1(61.2)*	31.0(20.0)*	57.3	57.3	244.7**(81.2)*
Bo. Rizal	57.3(14.0)*	27.9	47.2	47.5	179.9 (14.0)*
Bo. Mambulac	30.8(13.0)*	15.0	25.4	25.3	96.5 (13.0)*
Bo. Guinhalaran	73.4(11.4)*	35.8	60.5	60.6	230.4 (11.4)*
Bo. Lantad	56.6	27.6	46.6	46.6	177.3
TOTAL	289.2(99.6)*	137.3(20.0)*	237.0	237.3	
CUMULATIVE TOTAL**	317.2(99.6)*	454.5(119.6)*	691.5	928.8	928.8

*Figures in parentheses indicate areas to receive high-level hydrant service.
**Includes 28.0 hectares presently served by fire hydrants.

Discussions herein on fire protection assume that adequate distribution mains will be provided and that hydrants are required to obtain the available fire flow.

Distribution System Computer Printouts

The following computer printouts (see Annex Tables IX-C-6 and IX-C-7) indicate the estimated hydraulic conditions within the SIL-WD distribution system in the year 2000. The peak-hour and minimum-flow conditions are included as representative of the design conditions at that time. The critical conditions considered for some pipelines are not necessarily the peak or minimum conditions, but the majority of the proposed pipelines are carrying capacity flows during peak-hour conditions.

The format of computer printouts is discussed in Chapter XII of the Methodology Manual. Pipeline numbers from 0 to 100, shown on the computer printouts, represent existing pipelines. If an existing pipeline is replaced, the 0 to 100 series pipes are replaced by 400 series pipes. The pipelines with numbers between 101 and 199 are recommended for installation during the immediate improvement program. The 200 series pipelines are intended to satisfy 1990 design conditions and the 300 series pipelines, to satisfy year 2000 design conditions.

Some of the pipelines in the recommended construction program may appear to be in a construction phase not indicated by appropriate pipe numbers. This may result from other conditions governing the staging of recommended facilities. An example might be a 300 series pipeline included within the Phase I-B (1986-90) construction program. The 300 series indicates a pipeline required for year 2000 service, to be installed after 1990. A well required before 1990 might be located along the 300 series pipeline, and would require installation of the pipeline before 1990.

ANNEX TABLE IX-C-6

COMPUTER PRINTOUT
YEAR 2000 PEAK HOUR
SILAY CITY WATER DISTRICT

```
SILAY 2000 PEAK HOUR


INPUT AND OUTPUT IN                      LPS
NO OF NODES                              134
NO OF PIPES                              191
MAX NO OF ITERATIONS                      20
PEAKING FACTOR                       1.75000
ALLOW P-DROP FR/STATIC - PCT          30.0
STATIC HGL FOR P-DROP CALC            25.0
MAX UNBAL - LPS                      0.05000
MAX ALLOW VEL -MPS                     3.000
MIN ALLOW VEL - MPS                    0.400
MAX ALLOW HL -  M/1000 M               10.00
MIN ALLOW HL -  M/1000 M                0.30
MAX ALLOW PRESS - ATM                  7.000
MIN ALLOW PRESS - ATM                  0.700
NO OF HEADS TO BE READ                     1
NO OF UNKNOWN CONSUMPTIONS                 1
SUM OF FIXED DEMANDS                   37.57
BANDWIDTH                                 17
ITER   1 UNBAL     27.23 LPS
ITER   2 UNBAL     16.13 LPS
ITER   3 UNBAL      7.10 LPS
ITER   4 UNBAL      1.90 LPS
ITER   5 UNBAL      0.88 LPS
ITER   6 UNBAL      0.55 LPS
ITER   7 UNBAL      0.26 LPS
ITER   8 UNBAL      0.09 LPS
ITER   9 UNBAL      0.02 LPS

SOLUTION NO. 1 REACHED IN    9 ITERATIONS
      0.0166 GPM UNBALANCE
```

BEST AVAILABLE DOCUMENT

ANNEX TABLE IX-C-6 (continued)

PIPE NO	NODES FROM	TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	CK	--HEADLOSS--- MT	MT/1000	CK
1	1	2	150	225.	80	0.203E-01	3.45	0.19	LO	0.20	0.89	
2	2	3	150	190.	80	0.172E-01	2.07	0.12	LO	0.07	0.35	
3	3	5	150	230.	80	0.208E-01	1.32	0.07	LO	0.03	0.15	LO
4	6	7	100	235.	70	0.196E 00	1.31	0.17	LO	0.32	1.38	
405	61	3	150	170.	100	0.102E-01	2.56	0.15	LO	0.06	0.34	
406	4	61	150	80.	100	0.478E-02	3.11	0.18	LO	0.04	0.49	
7	12	7	100	335.	70	0.279E 00	1.73	0.22	LO	0.77	2.31	
408	5	4	150	70.	100	0.419E-02	5.38	0.30	LO	0.09	1.35	
9	8	5	150	240.	80	0.217E-01	4.63	0.26	LO	0.37	1.54	
10	11	8	150	125.	80	0.113E-01	2.21	0.12	LO	0.05	0.39	
11	11	14	150	115.	80	0.104E-01	5.71	0.33	LO	0.35	3.07	
12	14	17	150	100.	80	0.904E-02	4.95	0.28	LO	0.17	1.75	
13	17	18	150	100.	80	0.904E-02	3.61	0.20	LO	0.10	0.97	
14	18	20	150	190.	80	0.172E-01	4.08	0.23	LO	0.23	1.22	
15	18	19	100	50.	70	0.500E-01	1.38	0.18	LO	0.09	1.52	
16	19	21	100	130.	70	0.103E 00	1.04	0.13	LO	0.12	0.90	
17	22	21	100	290.	70	0.242E 00	1.21	0.15	LO	0.34	1.18	
18	60	22	100	130.	70	0.103E 00	2.83	0.36	LO	0.75	5.74	
19	22	60	100	65.	70	0.542E-01	3.16	0.40		0.46	7.02	
20	23	18	150	230.	80	0.208E-01	9.47	0.54		1.34	5.81	
21	25	23	100	95.	70	0.709E-01	3.31	0.42		0.65	7.65	
21	27	25	100	105.	70	0.875E-01	1.95	0.25	LO	0.30	2.86	
24	16	13	100	120.	70	0.100E 00	3.40	0.43		0.97	8.05	
25	17	16	100	100.	70	0.834E-01	3.60	0.46		0.89	8.93	
26	141	15	150	110.	80	0.994E-02	1.76	0.10	LO	0.03	0.26	LO
27	280	27	150	110.	80	0.994E-02	2.27	0.13	LO	0.05	0.41	
28	12	11	150	115.	80	0.104E-01	10.46	0.59		0.80	6.98	
29	29	12	150	100.	80	0.904E-02	12.02	0.68		0.90	9.04	
30	9	141	150	120.	80	0.108E-01	1.16	0.07	LO	0.01	0.12	LO
31	10	280	150	130.	80	0.118E-01	4.79	0.27	LO	0.21	1.65	
32	9	8	150	110.	80	0.994E-02	11.12	0.63		0.86	7.82	
33	10	9	150	100.	80	0.904E-02	13.43	0.76		1.11	11.10	HI
34	29	10	150	105.	80	0.949E-02	20.73	1.17		2.60	24.79	HI
435	32	29	200	70.	110	0.864E-03	31.50	1.00		0.51	7.35	
36	29	33	150	100.	80	0.904E-02	9.62	0.54		0.60	5.98	
37	30	32	100	5.	80	0.326E-02	0.0	0.0	LO	0.0	0.0	LO
438	31	32	200	5.	110	0.617E-04	31.50	1.00		0.04	7.35	
39	33	35	150	135.	80	0.122E-01	6.18	0.46		0.60	4.43	
40	35	23	150	190.	80	0.172E-01	11.66	0.66		1.62	8.54	
42	37	35	150	105.	70	0.122E-01	4.80	0.28	LO	0.23	2.19	
43	37	27	100	180.	70	0.150E 00	3.93	0.50		1.90	10.53	HI
45	37	39	150	105.	70	0.122E-01	7.33	0.41		0.49	4.63	
446	39	25	150	175.	100	0.105E-01	15.68	0.89		1.71	9.78	
447	38	59	200	50.	110	0.617E-03	0.0	0.0	LO	0.0	0.0	LO
448	57	59	200	10.	110	0.123E-03	0.0	0.0	LO	0.0	0.0	LO
51	39	40	150	80.	70	0.926E-02	14.94	0.85		1.38	17.30	HI
52	40	23	150	170.	30	0.154E-01	9.42	0.53		0.98	5.75	
53	40	44	100	130.	70	0.108E 00	0.22	0.03	LO	0.01	0.05	LO
54	40	42	100	190.	70	0.158E 00	3.15	0.40		1.32	6.97	
55	42	22	100	155.	70	0.129E 00	2.78	0.35	LO	0.86	5.52	

ANNEX TABLE IX-C-6 (continued)

PIPE NO	NODES FROM	NODES TO	DIA MM	L METRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	--CK	--HEADLOSS--- MT	MT/1000	CK
56	42	42	100	130.	70	0.108E 00	0.12	0.02	LO	0.00	0.02	LO
57	45	43	100	180.	70	0.150E 00	3.25	0.41		1.33	7.40	
58	47	45	100	185.	70	0.154E 00	5.52	0.70		3.65	19.71	HI
459	46	36	200	125.	110	0.154E-02	37.87	1.21		1.29	10.33	HI
60	47	37	100	125.	70	0.104E 00	4.64	0.59		1.79	14.29	HI
461	48	46	200	80.	110	0.318E-03	33.19	1.06		0.65	8.09	
462	51	47	150	200.	100	0.120E-01	16.06	0.91		2.04	10.22	HI
463	45	48	150	115.	100	0.688E-02	12.67	0.72		0.76	6.59	
466	50	49	150	90.	100	0.338E-02	15.04	0.85		0.81	9.05	
465	52	48	200	400.	110	0.494E-02	22.70	0.73		1.61	4.04	
66	53	51	100	290.	70	0.242E 00	0.89	0.11	LO	0.20	0.67	
67	52	54	75	290.	70	0.982E 00	1.35	0.30	LO	1.70	5.88	
68	54	55	75	570.	70	0.193E 01	0.03	0.01	LO	0.00	0.00	LO
69	18	55	75	90.	70	0.305E 00	0.67	0.15	LO	0.14	1.60	
70	56	39	75	130.	70	0.440E 00	0.18	0.04	LO	0.02	0.14	LO
71	23	27	100	110.	70	0.917E-01	0.67	0.09	LO	0.04	0.40	
473	15	140	100	190.	100	0.819E-01	0.60	0.08	LO	0.04	0.20	LO
474	140	24	100	100.	100	0.431E-01	0.60	0.08	LO	0.02	0.20	LO
76	13	17	100	10.	70	0.334E-02	4.85	0.62		0.16	15.59	HI
477	35	33	200	10.	110	0.123E-03	0.61	0.02	LO	0.00	0.00	LO
78	45	44	100	10.	70	0.834E-02	1.65	0.19	LO	0.02	1.68	
100	46	55	100	230.	100	0.991E-01	2.51	0.32	LO	0.55	2.37	
101	37	83	150	250.	100	0.150E-01	6.17	0.35	LO	0.43	1.74	
102	37	86	100	90.	100	0.388E-01	0.93	0.12	LO	0.03	0.38	
103	21	36	100	130.	100	0.560E-01	4.26	0.54		0.82	6.31	
104	20	37	150	210.	100	0.126E-01	9.18	0.52		0.76	3.63	
105	13	6	150	470.	100	0.281E-01	4.47	0.25	LO	0.45	0.96	
106	5	62	100	300.	100	0.129E 00	1.45	0.18	LO	0.26	0.85	
107	61	64	100	300.	100	0.129E 00	0.55	0.07	LO	0.04	0.14	LO
108	65	63	150	75.	100	0.449E-02	2.96	0.17	LO	0.03	0.45	
109	63	60	100	250.	100	0.108E 00	0.25	0.04	LO	0.01	0.04	LO
110	64	65	150	75.	100	0.449E-02	3.56	0.20	LO	0.05	0.63	
111	1	64	150	185.	100	0.111E-01	5.38	0.30	LO	0.25	1.35	
112	2	70	100	180.	100	0.164E 00	1.87	0.24	LO	0.52	1.37	
113	71	70	100	90.	100	0.318E-01	1.77	0.23	LO	0.11	1.24	
114	72	71	100	90.	100	0.383E-01	1.82	0.23	LO	0.12	1.31	
115	69	72	100	320.	100	0.138E 00	1.30	0.17	LO	0.22	0.70	
116	69	71	100	290.	100	0.125E 00	1.75	0.22	LO	0.35	1.21	
117	65	63	100	105.	100	0.452E-01	0.44	0.06	LO	0.01	0.09	LO
118	67	68	100	250.	100	0.108E 00	2.11	0.27	LO	0.43	1.71	
119	102	67	150	100.	100	0.593E-02	7.70	0.44		0.26	2.62	
120	112	193	250	150.	110	0.625E-03	37.03	0.75		0.50	3.34	
121	192	63	100	270.	100	0.116E 00	2.33	0.30	LO	0.56	2.06	
122	193	192	250	75.	110	0.312E-03	28.33	0.58		0.15	2.04	
123	172	1	250	175.	110	0.729E-03	24.39	0.50		0.27	1.54	
124	1	69	100	70.	100	0.302E-01	3.18	0.41		0.26	3.68	
125	6	73	250	190.	110	0.791E-03	20.68	0.42		0.22	1.14	
126	73	74	100	330.	100	0.142E 00	5.14	0.66		2.95	8.95	
127	72	75	200	130.	110	0.151E-02	12.31	0.31	LO	0.17	1.29	
128	76	75	100	345.	100	0.149E 00	5.34	0.63		3.30	9.58	

ANNEX TABLE IX-C-6 (continued)

PIPE NO	NODES FROM	NODES TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	--CK	--HEADLOSS--- MT	MT/1000	CK
129	77	78	100	395.	100	0.170E 00	3.32	0.42		1.57	3.99	
130	76	77	200	310.	110	0.333E-02	2.07	0.07	LO	0.01	0.05	LO
131	80	77	200	125.	110	0.154E-02	5.78	0.18	LO	0.04	0.32	
132	80	79	100	375.	100	0.162E 00	4.97	0.63		3.15	8.39	
133	81	80	200	245.	110	0.303E-02	12.89	0.41		0.34	1.41	
134	82	81	200	405.	110	0.500E-02	3.74	0.12	LO	0.06	0.14	LO
135	82	84	200	250.	110	0.309E-02	12.01	0.38	LO	0.31	1.23	
136	83	82	200	310.	110	0.383E-02	20.91	0.67		1.07	3.44	
137	85	34	100	370.	100	0.159E 00	3.19	0.41		1.37	3.69	
138	35	50	200	370.	110	0.457E-02	19.34	0.62		1.10	2.98	
139	90	89	150	450.	100	0.269E-01	2.31	0.13	LO	0.13	0.28	LO
140	90	51	200	460.	110	0.568E-02	19.52	0.62		1.39	3.03	
141	1	2	200	225.	110	0.278E-02	10.06	0.32	LO	0.20	0.89	
142	2	3	200	190.	110	0.235E-02	6.05	0.19	LO	0.07	0.35	
143	3	6	200	230.	110	0.284E-02	3.87	0.12	LO	0.03	0.15	LO
144	8	5	150	240.	100	0.144E-01	5.79	0.33	LO	0.37	1.54	
145	23	24	100	10.	100	0.431E-02	0.04	0.00	LO	0.00	0.00	LO
146	27	26	100	10.	100	0.431E-02	0.66	0.08	LO	0.00	0.20	LO
147	36	37	150	10.	100	0.593E-03	37.11	2.10		0.48	48.22	HI
148	76	112	250	10.	110	0.417E-04	31.50	0.64		0.02	2.48	
201	98	101	100	290.	100	0.125E 00	5.39	0.69		2.83	9.75	
202	98	100	100	250.	100	0.108E 00	4.67	0.59		1.87	7.49	
203	99	98	150	320.	100	0.191E-01	10.16	0.57		1.40	4.38	
204	97	98	150	760.	100	0.455E-01	3.96	0.22	LO	0.58	0.77	
205	95	97	200	340.	110	0.429E-02	11.14	0.35	LO	0.36	1.07	
206	95	52	250	130.	110	0.541E-03	29.82	0.61		0.29	2.24	
207	93	95	250	300.	110	0.125E-02	44.57	0.91		1.41	4.71	
208	96	93	250	235.	110	0.140E-02	35.32	0.72		1.03	3.06	
209	92	93	200	300.	110	0.938E-02	13.71	0.44		1.26	1.57	
210	91	92	200	360.	110	0.445E-02	4.15	0.13	LO	0.06	0.17	LO
211	91	90	200	325.	110	0.401E-02	27.35	0.87		1.84	5.66	
212	106	8	200	550.	110	0.679E-02	8.53	0.27	LO	0.36	0.65	
213	106	63	100	260.	100	0.112E 00	3.16	0.40		0.94	3.63	
214	105	106	200	250.	110	0.309E-02	14.95	0.48		0.46	1.85	
215	103	112	200	415.	110	0.512E-02	7.89	0.25	LO	0.23	0.57	
216	104	103	200	420.	110	0.519E-02	15.89	0.51		0.87	2.07	
217	67	102	100	310.	100	0.134E 00	1.87	0.24	LO	0.42	1.37	
218	102	72	150	250.	100	0.150E-01	4.36	0.25	LO	0.23	0.91	
219	104	102	150	570.	100	0.341E-01	9.70	0.55		2.29	4.02	
220	94	96	250	10.	110	0.417E-04	31.50	0.64		0.02	2.48	
221	107	104	200	350.	110	0.432E-02	33.28	1.06		2.85	8.13	
222	108	107	200	130.	110	0.161E-02	31.50	1.00		0.96	7.35	
223	109	83	200	165.	110	0.204E-02	26.48	0.84		0.88	5.33	
224	105	95	150	105.	100	0.628E-02	14.49	0.82		0.89	8.45	
225	65	110	100	350.	100	0.151E 00	5.08	0.65		3.06	8.75	
226	110	111	100	150.	100	0.646E-01	2.04	0.26	LO	0.24	1.61	
227	84	111	150	425.	100	0.254E-01	10.39	0.59		1.94	4.56	
228	40	41	100	10.	100	0.431E-02	1.36	0.17	LO	0.01	0.77	
229	47	46	150	10.	100	0.598E-03	5.06	0.29	LO	0.01	1.21	
230	15	16	100	10.	100	0.431E-02	0.14	0.02	LO	0.00	0.01	LO

ANNEX TABLE IX-C-6 (continued)

PIPE NO	NODES FROM	TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	CK	--HEADLOSS--- MT	MT/1000	CK
231	280	28	150	10.	100	0.598E-03	1.77	0.10	LO	0.00	0.17	LO
232	12	141	100	10.	100	0.431E-02	1.09	0.14	LO	0.01	0.51	
233	35	34	100	10.	100	0.431E-02	0.16	0.02	LO	0.00	0.01	LO
234	6	56	200	500.	110	0.741E-02	16.89	0.54		1.39	2.32	
235	22	54	150	290.	100	0.173E-01	11.91	0.67		1.70	5.88	
236	54	55	150	570.	100	0.341E-01	0.26	0.01	LO	0.00	0.00	LO
237	68	55	150	90.	100	0.533E-02	5.91	0.33	LO	0.14	1.60	
238	56	83	200	130.	110	0.161E-02	3.71	0.12	LO	0.02	0.14	LO
239	52	53	150	10.	100	0.598E-03	4.83	0.27	LO	0.01	1.10	
240	120	6	250	10.	110	0.417E-04	37.57	0.77		0.03	3.44	
241	37	39	200	105.	110	0.130E-02	24.54	0.78		0.49	4.63	
242	118	105	200	500.	110	0.617E-02	23.63	0.75		2.17	4.33	
243	127	118	200	450.	110	0.556E-02	31.50	1.00		3.31	7.35	
244	114	109	250	580.	110	0.242E-02	46.76	0.95		2.99	5.15	
245	121	114	250	470.	110	0.196E-02	53.53	1.09		3.11	6.02	
246	122	121	250	50.	110	0.208E-03	31.50	0.64		0.12	2.48	
247	8	13	200	240.	110	0.296E-02	8.27	0.26	LO	0.15	0.62	
301	123	99	200	730.	110	0.901E-02	18.46	0.59		1.99	2.73	
302	123	96	250	60.	110	0.250E-03	6.39	0.13	LO	0.01	0.13	LO
303	124	123	250	580.	110	0.242E-02	29.17	0.57		1.17	2.02	
304	125	124	250	360.	110	0.150E-02	31.50	0.64		0.89	2.48	
305	120	92	200	425.	110	0.525E-02	23.31	0.74		1.79	4.21	
306	126	120	250	500.	110	0.208E-02	31.50	0.64		1.24	2.48	
307	119	84	200	685.	110	0.846E-02	23.31	0.74		2.88	4.21	
309	115	117	100	950.	100	0.366E 00	0.33	0.04	LO	0.05	0.06	LO
311	103	117	100	140.	100	0.603E-01	1.23	0.16	LO	0.09	0.63	
312	127	113	200	540.	110	0.667E-02	25.65	0.82		2.71	5.02	
313	113	81	200	870.	110	0.107E-01	18.88	0.60		2.48	2.85	
314	111	115	150	250.	100	0.150E-01	6.77	0.38	LO	0.52	2.07	
318	116	121	250	320.	110	0.133E-02	22.03	0.45		0.41	1.28	
319	128	116	250	670.	110	0.279E-02	31.50	0.64		1.66	2.48	
320	116	107	250	1150.	110	0.479E-02	34.20	0.70		3.32	2.89	
321	129	116	200	1100.	110	0.136E-01	31.50	1.00		8.08	7.35	
322	14	17	150	100.	100	0.598E-02	6.19	0.35	LO	0.17	1.75	
323	17	18	150	100.	100	0.598E-02	4.51	0.26	LO	0.10	0.97	
324	18	20	150	190.	100	0.114E-01	5.10	0.29	LO	0.23	1.22	
325	18	19	150	60.	100	0.359E-02	5.75	0.33	LO	0.09	1.52	
326	19	21	150	130.	100	0.777E-02	4.32	0.24	LO	0.12	0.90	
327	60	22	150	130.	100	0.777E-02	11.76	0.67		0.75	5.74	
328	23	60	150	65.	100	0.389E-02	13.11	0.74		0.46	7.02	
329	25	23	150	85.	100	0.508E-02	13.74	0.78		0.65	7.65	

ANNEX TABLE TABLE IX-C-6 (continued)

NODE	GROUND ELEV	FLOW	HGL ELEV	HEAD MTRS	PRESSURE ATM---CK	PRESSURE PCT DROP---CK
1	6.5	-2.34	29.270	22.77	2.20	-1.18
2	5.0	-3.50	29.070	24.07	2.33	-0.28
3	4.0	-5.49	29.000	25.00	2.42	-0.00
4	5.0	-2.27	29.100	24.10	2.33	-0.41
5	5.0	-3.59	29.190	24.19	2.34	-0.80
6	2.0	-8.35	28.570	26.57	2.[illegible]1	0.13
7	3.5	-3.04	28.640	25.14	2.43	1.41
8	6.0	-3.17	29.560	23.56	2.28	-2.45
9	6.0	-1.15	30.420	24.42	2.36	-6.19
10	6.0	-2.50	31.530	25.53	2.47	-11.02
11	5.5	-1.54	29.610	24.11	2.33	-2.60
12	5.5	-0.47	30.410	24.91	2.41	-6.02
13	5.0	-0.61	29.410	24.41	2.36	-1.73
14	5.0	-0.44	29.260	24.26	2.35	-1.08
15	5.5	-0.96	30.380	24.88	2.41	-5.88
16	5.5	-0.33	30.380	24.88	2.41	-5.98
17	4.5	-3.01	29.080	24.58	2.38	-0.34
18	4.0	-1.28	28.990	24.99	2.42	0.05
19	3.5	-1.77	28.900	25.40	2.46	0.41
20	3.0	0.0	28.750	25.75	2.49	0.95
21	2.0	-2.31	28.780	26.78	2.59	0.82
22	2.0	-2.90	29.120	27.12	2.63	-0.44
23	5.0	-0.68	30.320	25.32	2.45	-5.51
24	5.0	-0.70	30.320	25.32	2.45	-5.51
25	5.0	-0.58	30.970	25.97	2.51	-8.22
26	5.5	-0.66	31.270	25.77	2.49	-9.67
27	5.5	-0.66	31.270	25.77	2.50	-9.68
28	6.0	-0.73	31.320	25.32	2.45	-10.08
29	6.0	-1.15	34.140	28.14	2.72	-22.33
30	6.5	0.0	34.650	28.15	2.73	-25.11
31	6.5	31.50	34.690	28.19	2.73	-25.28
32	6.5	0.0	34.650	28.15	2.73	-25.11
33	6.5	-1.43	33.540	27.04	2.62	-20.17
34	6.0	-0.15	32.940	26.94	2.61	-17.13
35	6.0	-1.26	32.940	26.94	2.61	-17.13
36	6.0	-0.75	33.650	27.65	2.68	-20.23
37	6.0	-1.05	33.170	27.17	2.63	-18.13
38	5.5	-0.61	32.680	27.18	2.63	-15.68
39	5.5	-0.65	32.680	27.18	2.63	-15.68
40	5.0	-0.70	31.300	26.30	2.55	-9.58
41	5.0	-1.36	31.290	26.29	2.55	-9.55
42	3.0	-0.49	29.980	26.98	2.61	-3.75
43	3.5	-3.13	29.980	26.48	2.56	-3.84
44	5.0	-1.63	31.290	26.29	2.55	-9.56
45	5.0	-0.80	31.310	26.31	2.55	-9.63
46	6.0	-0.38	34.940	28.94	2.80	-25.84
47	6.0	-0.84	34.960	28.96	2.80	-25.90
48	6.0	-2.27	35.590	29.59	2.86	-28.66
49	6.0	-2.36	36.350	30.35	2.94	-31.96
50	6.0	-4.30	37.160	31.16	3.02	-35.59

ANNEX TABLE IX-C-6 (continued)

NODE	GROUND ELEV	FLOW	HGL ELEV	HEAD MTRS	--------PRESSURE-------- ATM---CK	PCT DROP---CK
51	6.0	-4.36	37.000	31.00	3.00	-34.78
52	6.0	-2.20	37.210	31.21	3.02	-35.68
53	6.0	-3.94	37.190	31.19	3.02	-35.03
54	1.0	-12.97	27.420	26.42	2.56	5.66
55	0.5	-9.33	27.410	26.91	2.61	5.57
56	0.5	-13.00	27.580	27.08	2.62	5.00
57	29.0	0.0	32.680	3.68	0.36	LO**********
59	5.0	0.0	32.080	27.13	2.63	-15.68
60	4.0	-1.63	29.870	25.87	2.50	-3.47
61	5.0	0.0	29.060	24.06	2.33	-0.24
62	6.0	-4.41	28.940	22.94	2.22	0.28
63	6.0	-5.21	28.930	22.93	2.22	0.09
64	6.0	-2.36	29.020	23.02	2.23	-0.07
65	6.0	-0.88	28.970	22.97	2.22	0.13
66	6.0	31.50	30.210	24.21	2.34	-5.28
67	5.5	-3.73	29.430	23.93	2.32	-1.82
68	5.5	-1.24	29.090	23.59	2.27	0.01
69	5.0	-1.00	29.010	24.01	2.32	-0.03
70	3.5	-3.64	28.540	25.04	2.42	1.79
71	3.5	-1.80	28.660	25.16	2.44	1.35
72	4.0	-3.83	28.770	24.77	2.40	0.90
73	2.0	-3.22	28.750	26.75	2.59	0.93
74	0.5	-5.14	25.800	25.30	2.45	11.24
75	0.5	-5.34	25.280	24.78	2.40	13.06
76	2.0	-4.90	28.580	26.58	2.57	1.55
77	2.0	-4.53	28.570	26.57	2.57	1.60
78	0.5	-3.32	26.990	26.49	2.56	7.04
79	0.5	-4.97	25.460	24.96	2.42	12.42
80	2.0	-2.13	28.610	26.61	2.53	1.46
81	1.5	-9.73	28.950	27.45	2.60	0.18
82	1.5	-5.16	29.010	27.51	2.65	-0.03
83	2.5	-5.56	30.080	27.58	2.67	-4.06
84	1.0	-4.81	28.700	27.70	2.68	1.07
85	2.5	-6.21	30.070	27.57	2.67	-4.03
86	1.5	-2.68	27.960	26.46	2.56	3.79
87	1.5	-2.08	27.990	26.49	2.56	3.67
88	0.5	-3.48	27.560	27.06	2.62	5.06
89	8.0	-6.28	38.270	30.27	2.93	-44.12
90	8.0	-5.51	38.390	30.39	2.94	-44.73
91	9.0	31.50	40.230	31.23	3.02	-56.16
92	6.0	-13.75	40.170	34.17	3.31	-48.56
93	6.5	-4.46	38.910	32.41	3.14	-44.05
94	6.5	31.50	39.960	33.46	3.24	-48.72
95	6.0	-3.60	37.500	31.50	3.05	-36.94
96	7.0	-2.57	39.940	32.94	3.19	-49.71
97	5.0	-7.17	37.130	32.13	3.11	-33.39
98	2.5	-4.06	36.550	34.05	3.30	-28.49
99	3.0	-8.29	37.950	34.95	3.38	-34.43
100	1.5	-4.67	34.680	33.18	3.21	-20.65
101	2.0	-5.39	33.720	31.72	3.07	-17.47

ANNEX TABLE IX-C-6 (continued)

NODE	GROUND ELEV	FLOW	HGL ELEV	HEAD MTRS	PRESSURE ATM---CK	PRESSURE PCT DROP---CK
102	5.0	-7.21	29.000	24.00	2.32	-0.01
103	7.0	-6.77	30.430	23.43	2.27	-6.48
104	6.0	-7.66	31.290	25.29	2.45	-9.98
105	7.0	-8.40	30.380	23.38	2.26	-6.29
106	7.0	-3.25	29.920	22.92	2.22	-4.19
107	5.5	-6.77	34.140	28.64	2.77	-21.88
108	5.5	31.50	35.100	29.60	2.87	-25.94
109	2.5	-5.79	30.950	28.45	2.75	-7.37
110	2.0	-3.04	27.000	25.00	2.42	7.39
111	1.5	-5.66	26.760	25.26	2.45	8.14
112	6.0	-2.36	30.190	24.19	2.34	-5.17
113	4.5	-6.77	31.430	26.93	2.61	-9.91
114	4.0	-6.77	33.940	29.94	2.90	-19.77
115	1.5	-5.77	26.250	24.75	2.40	10.01
116	5.5	-6.77	37.460	31.96	3.09	-36.00
117	7.0	-1.56	30.340	23.34	2.26	-6.08
118	9.0	-7.82	32.550	23.55	2.28	-17.75
119	10.0	23.31	41.150	31.15	3.02	-63.94
120	10.0	-8.19	41.960	31.96	3.09	-68.20
121	5.5	0.0	37.050	31.55	3.05	-34.26
122	5.5	31.50	37.180	31.68	3.07	-34.79
123	7.0	-3.32	39.940	32.94	3.19	-49.75
124	8.0	-3.32	41.110	33.11	3.21	-57.69
125	8.0	31.50	42.010	34.01	3.29	-61.94
126	10.0	31.50	43.200	33.20	3.21	-74.72
127	10.0	31.50	35.860	25.86	2.50	-36.09
128	10.0	31.50	39.120	29.12	2.82	-53.27
129	5.5	31.50	45.540	40.04	3.88	-70.40
130	0.5	37.570	29.00	28.50	2.76	0.00
140	4.5	0.0	30.340	25.84	2.50	-5.48
141	5.5	-0.49	30.410	24.91	2.41	-6.00
192	6.0	-1.61	29.540	23.54	2.28	-2.33
193	6.0	-1.00	29.690	23.69	2.29	-2.99
290	6.0	-0.75	31.320	25.32	2.45	-10.09

ANNEX TABLE IX-C-7

COMPUTER PRINTOUT
YEAR 2000 MINIMUM FLOW
SILAY CITY WATER DISTRICT

SILAY CITY MINIMUM FLOW CONDITION

INPUT AND OUTPUT IN	L[illegible]
NO OF NODES	1[illegible]4
NO OF PIPES	1[illegible]1
MAX NO OF ITERATIONS	[illegible]
DAMPING FACTOR	0.[illegible]
ALLOW P-HEAD FR/STATIC - PCT	[illegible]
STATIC PRESS FOR P-STEP CALC	[illegible]
MAX UNBAL - LPS	0.[illegible]
MAX ALLOW VEL - MPS	[illegible]
MIN ALLOW VEL - MPS	0.[illegible]
MAX ALLOW HL - M/1000 M	10.[illegible]
MIN ALLOW HL - M/1000 M	0.[illegible]
MAX ALLOW PRESS - ATM	7.[illegible]
MIN ALLOW PRESS - ATM	0.700
NO OF FIXED HGL HEAD	[illegible]
NO OF UNKNOWN WITH CONSUMPTIONS	[illegible]
SUM OF FIXED DEMANDS	-[illegible].7[illegible]
BANDWIDTH	[illegible]

ITER 1	UNBAL	17.47 LPS
ITER 2	UNBAL	[illegible].0[illegible] LPS
ITER 3	UNBAL	[illegible].2[illegible] LPS
ITER 4	UNBAL	[illegible].97 LPS
ITER 5	UNBAL	0.[illegible] LPS
ITER 6	UNBAL	0.20 LPS
ITER 7	UNBAL	0.0[illegible] LPS

SOLUTION NO. 1 REACHED IN 7 ITERATIONS
0.0[illegible] GPM UNBALANCE

BEST AVAILABLE DOCUMENT

ANNEX TABLE IX-C-7 (continued)

PIPE NO	NODES FROM	TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	CK	--HEADLOSS--- MT	MT/1000	CK
1	1	2	150	225.	80	0.203E-01	4.54	0.26	LO	0.34	1.49	
2	2	3	150	190.	80	0.172E-01	4.70	0.27	LO	0.30	1.59	
3	3	6	150	230.	80	0.208E-01	5.19	0.29	LO	0.44	1.91	
4	7	6	100	235.	70	0.196E 00	0.62	0.08	LO	0.08	0.34	
405	61	3	150	170.	100	0.102E-01	2.89	0.15	LO	0.07	0.43	
406	4	61	150	80.	100	0.478E-02	1.18	0.07	LO	0.01	0.08	LO
7	13	7	100	335.	70	0.279E 00	1.14	0.14	LO	0.36	1.06	
408	5	4	150	70.	100	0.419E-02	1.57	0.09	LO	0.01	0.14	LO
9	8	5	150	240.	80	0.217E-01	0.29	0.02	LO	0.00	0.01	LO
10	11	8	150	125.	80	0.113E-01	0.96	0.05	LO	0.01	0.08	LO
11	11	14	150	115.	80	0.104E-01	4.29	0.24	LO	0.15	1.34	
12	14	17	150	100.	80	0.904E-02	3.03	0.17	LO	0.07	0.71	
13	17	18	150	100.	80	0.904E-02	2.81	0.16	LO	0.06	0.61	
14	16	20	150	190.	80	0.172E-01	1.42	0.08	LO	0.03	0.17	LO
15	18	19	100	60.	70	0.500E-01	0.48	0.06	LO	0.01	0.21	LO
16	19	21	100	130.	70	0.108E 00	0.42	0.05	LO	0.02	0.17	LO
17	21	22	100	290.	70	0.242E 00	0.35	0.05	LO	0.04	0.12	LO
18	60	22	100	130.	70	0.108E 00	0.60	0.08	LO	0.04	0.32	
19	23	60	100	65.	70	0.542E-01	0.65	0.08	LO	0.02	0.38	
20	18	23	150	230.	80	0.208E-01	0.42	0.02	LO	0.00	0.02	LO
21	25	23	100	85.	70	0.709E-01	0.31	0.04	LO	0.01	0.10	LO
21	27	25	100	105.	70	0.876E-01	2.77	0.35	LO	0.58	5.50	
24	16	13	100	120.	70	0.100E 00	1.75	0.22	LO	0.28	2.36	
25	27	16	100	100.	70	0.834E-01	1.20	0.15	LO	0.12	1.17	
26	141	15	150	110.	80	0.994E-02	2.78	0.16	LO	0.07	0.60	
27	280	27	150	110.	80	0.994E-02	4.47	0.25	LO	0.16	1.45	
28	12	11	150	115.	80	0.104E-01	5.51	0.31	LO	0.25	2.13	
29	28	12	150	100.	80	0.904E-02	5.38	0.30	LO	0.20	2.04	
30	9	141	150	120.	80	0.108E-01	3.09	0.17	LO	0.09	0.75	
31	10	280	150	130.	80	0.118E-01	7.80	0.44		0.53	4.06	
32	9	8	150	110.	80	0.994E-02	6.77	0.38	LO	0.34	3.12	
33	10	9	150	100.	80	0.904E-02	10.05	0.57		0.65	6.49	
34	29	10	150	105.	80	0.949E-02	18.29	1.03		2.06	19.66	HI
435	32	29	200	70.	110	0.864E-03	31.50	1.00		0.51	7.35	
36	29	33	150	100.	80	0.904E-02	13.01	0.74		1.05	10.47	HI
37	30	32	100	5.	80	0.326E-02	0.0	0.0	LO	0.0	0.0	LO
438	31	32	200	5.	110	0.617E-04	31.50	1.00		0.04	7.35	
39	33	35	150	135.	80	0.122E-01	12.77	0.72		1.36	10.10	HI
40	35	28	150	190.	80	0.172E-01	3.62	0.20	LO	0.19	0.98	
42	35	37	150	105.	70	0.122E-01	6.90	0.50		0.70	6.64	
43	27	37	100	180.	70	0.150E 00	1.60	0.20	LO	0.36	1.98	
45	37	39	150	105.	70	0.122E-01	4.91	0.23	LO	0.23	2.21	
446	25	39	150	175.	100	0.105E-01	1.06	0.06	LO	0.01	0.07	LO
447	38	59	200	50.	110	0.617E-03	22.35	0.71		0.19	3.89	
448	59	57	200	10.	110	0.123E-03	22.35	0.71		0.04	3.89	
51	40	39	150	80.	70	0.926E-02	0.13	0.01	LO	0.00	0.00	LO
52	22	40	150	170.	80	0.154E-01	0.44	0.02	LO	0.00	0.02	LO
53	44	40	100	130.	70	0.108E 00	0.49	0.06	LO	0.03	0.22	LO
54	40	42	100	190.	70	0.158E 00	0.43	0.05	LO	0.03	0.18	LO
55	42	22	100	155.	70	0.129E 00	0.45	0.05	LO	0.03	0.19	LO

ANNEX TABLE IX-C-7 (continued)

PIPE NO	NODES FROM	TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	--CK	--HEADLOSS--- MT	MT/1000	C
56	43	42	100	130.	70	0.108E 00	0.10	0.01	LO	0.00	0.01	
57	45	43	100	180.	70	0.150E 00	0.64	0.08	LO	0.07	0.36	
58	47	45	100	185.	70	0.154E 00	1.55	0.20	LO	0.35	1.88	
459	46	36	200	125.	110	0.154E-02	9.96	0.32	LO	0.11	0.87	
60	47	37	100	125.	70	0.104E 00	1.22	0.15	LO	0.15	1.20	
461	48	46	200	80.	110	0.988E-03	9.97	0.32	LO	0.07	0.87	
462	51	47	150	200.	100	0.120E-01	2.97	0.17	LO	0.09	0.45	
463	48	49	150	115.	100	0.688E-02	1.83	0.10	LO	0.02	0.18	L
464	49	50	150	90.	100	0.533E-02	1.42	0.08	LO	0.01	0.11	L
465	52	48	200	400.	110	0.494E-02	12.19	0.39	LO	0.51	1.27	
66	53	51	100	290.	70	0.242E 00	1.45	0.19	LO	0.48	1.67	
67	22	54	75	290.	70	0.982E 00	0.34	0.08	LO	0.13	0.47	
68	54	55	75	570.	70	0.193E 01	0.12	0.03	LO	0.04	0.06	L
69	55	88	75	90.	70	0.305E 00	0.06	0.01	LO	0.00	0.02	L
70	88	56	75	130.	70	0.440E 00	0.13	0.03	LO	0.01	0.07	L
71	28	27	100	110.	70	0.917E-01	1.32	0.17	LO	0.15	1.40	
473	15	140	100	190.	100	0.819E-01	2.01	0.26	LO	0.30	1.57	
474	140	24	100	100.	100	0.431E-01	2.01	0.26	LO	0.16	1.57	
76	13	14	100	10.	70	0.834E-02	2.61	0.33	LO	0.05	4.53	
477	39	38	200	10.	110	0.123E-03	22.45	0.71		0.04	3.93	
78	45	44	100	10.	70	0.834E-02	0.77	0.10	LO	0.01	0.52	
100	86	55	100	230.	100	0.991E-01	1.00	0.13	LO	0.10	0.43	
101	87	88	150	250.	100	0.150E-01	2.81	0.16	LO	0.10	0.40	
102	87	86	100	90.	100	0.388E-01	0.04	0.01	LO	0.00	0.00	L
103	21	86	100	130.	100	0.560E-01	1.42	0.18	LO	0.11	0.82	
104	20	87	150	210.	100	0.126E-01	3.20	0.18	LO	0.11	0.52	
105	13	6	150	470.	100	0.281E-01	4.39	0.25	LO	0.44	0.93	
106	62	5	100	300.	100	0.129E 00	1.53	0.19	LO	0.28	0.95	
107	64	61	100	300.	100	0.129E 00	1.71	0.22	LO	0.35	1.17	
108	65	62	150	75.	100	0.449E-02	2.28	0.13	LO	0.02	0.28	L
109	65	63	100	250.	100	0.100E 00	0.38	0.05	LO	0.02	0.07	L
110	64	65	150	75.	100	0.449E-02	2.81	0.16	LO	0.03	0.41	
111	1	64	150	185.	100	0.111E-01	4.93	0.28	LO	0.21	1.15	
112	70	2	100	380.	100	0.164E 00	1.21	0.15	LO	0.23	0.61	
113	71	70	100	90.	100	0.388E-01	1.84	0.23	LO	0.12	1.33	
114	72	71	100	90.	100	0.388E-01	1.86	0.24	LO	0.12	1.36	
115	72	68	100	320.	100	0.138E 00	0.33	0.04	LO	0.02	0.06	L
116	69	71	100	290.	100	0.125E 00	0.29	0.04	LO	0.01	0.04	L
117	68	69	100	105.	100	0.452E-01	1.46	0.19	LO	0.09	0.67	
118	67	68	100	250.	100	0.108E 00	1.34	0.17	LO	0.19	0.74	
119	193	67	150	100.	100	0.598E-02	2.65	0.15	LO	0.04	0.36	
120	112	193	250	150.	110	0.625E-03	27.45	0.56		0.29	1.92	
121	192	63	100	270.	100	0.116E 00	2.17	0.28	LO	0.49	1.61	
122	193	192	250	75.	110	0.312E-03	24.62	0.50		0.12	1.57	
123	192	1	250	175.	110	0.729E-03	22 .3	0.45		0.23	1.29	
124	69	1	100	70.	100	0.302E-01	1.00	0.13	LO	0.03	0.43	
125	73	6	250	190.	110	0.791E-03	7.91	0.16	LO	0.04	0.19	L
126	73	74	100	330.	100	0.142E 00	0.88	0.11	LO	0.11	0.34	
127	76	73	200	130.	110	0.161E-02	9.34	0.30	LO	0.10	0.77	
128	76	75	100	345.	100	0.149E 00	0.91	0.12	LO	0.13	0.37	

ANNEX TABLE IX-C-7 (continued)

PIPE NO	NODES FROM	NODES TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	VEL MPS	VEL CK	HEADLOSS MT	HEADLOSS MT/1000	HEADLOSS CK
129	77	78	100	395.	100	0.170E 00	0.57	0.07	LO	0.06	0.15	LO
130	77	76	200	310.	110	0.383E-02	11.09	0.35	LO	0.35	1.06	
131	80	77	200	125.	110	0.154E-02	12.44	0.40	LO	0.16	1.32	
132	80	79	100	375.	100	0.162E 00	0.85	0.11	LO	0.12	0.32	
133	81	80	200	245.	110	0.303E-02	13.65	0.43		0.38	1.56	
134	82	81	200	405.	110	0.500E-02	8.47	0.27	LO	0.26	0.64	
135	82	84	200	250.	110	0.309E-02	0.47	0.01	LO	0.00	0.00	LO
136	83	82	200	310.	110	0.383E-02	9.82	0.31	LO	0.26	0.85	
137	85	84	100	370.	100	0.159E 00	1.52	0.19	LO	0.35	0.93	
138	50	89	200	370.	110	0.457E-02	0.63	0.02	LO	0.00	0.01	LO
139	90	89	150	450.	100	0.269E-01	1.80	0.10	LO	0.08	0.18	LO
140	90	91	200	460.	110	0.568E-02	2.27	0.07	LO	0.03	0.06	LO
141	1	2	200	225.	110	0.273E-02	13.30	0.42		0.34	1.49	
142	2	3	200	190.	110	0.235E-02	13.76	0.44		0.30	1.59	
143	3	6	200	230.	110	0.284E-02	15.21	0.48		0.44	1.91	
144	8	5	150	240.	100	0.144E-01	0.36	0.02	LO	0.00	0.01	LO
145	24	23	100	10.	100	0.431E-02	1.39	0.24	LO	0.01	1.40	
146	27	26	100	10.	100	0.431E-02	0.11	0.01	LO	0.00	0.01	LO
147	36	37	150	10.	100	0.598E-03	9.83	0.55		0.04	4.12	
148	66	112	250	10.	110	0.417E-04	31.50	0.64		0.02	2.48	
201	98	101	100	290.	100	0.125E 00	0.92	0.12	LO	0.11	0.37	
202	98	100	100	250.	100	0.106E 00	0.80	0.10	LO	0.07	0.29	LO
203	99	98	150	320.	100	0.191E-01	4.35	0.25	LO	0.29	0.91	
204	98	97	150	760.	100	0.455E-01	1.93	0.11	LO	0.15	0.20	LO
205	97	95	200	340.	110	0.420E-02	0.70	0.02	LO	0.00	0.01	LO
206	95	52	250	130.	110	0.541E-03	14.69	0.30	LO	0.08	0.60	
207	93	95	250	300.	110	0.125E-02	14.61	0.30	LO	0.18	0.60	
208	96	93	250	335.	110	0.140E-02	24.15	0.49		0.51	1.52	
209	93	92	200	800.	110	0.988E-02	8.77	0.23	LO	0.55	0.69	
210	92	91	200	360.	110	0.445E-02	5.01	0.16	LO	0.09	0.24	LO
211	91	90	200	325.	110	0.401E-02	5.01	0.16	LO	0.08	0.24	LO
212	6	106	200	550.	110	0.679E-02	0.04	0.00	LO	0.00	0.00	LO
213	63	106	100	260.	100	0.112E 00	1.65	0.21	LO	0.28	1.09	
214	106	105	200	250.	110	0.309E-02	1.13	0.04	LO	0.00	0.02	LO
215	112	103	200	415.	110	0.512E-02	3.65	0.12	LO	0.06	0.14	LO
216	103	104	200	420.	110	0.519E-02	0.57	0.02	LO	0.00	0.00	LO
217	67	102	100	310.	100	0.134E 00	0.67	0.09	LO	0.06	0.21	LO
218	102	72	150	250.	100	0.150E-01	2.85	0.16	LO	0.10	0.42	
219	104	102	150	570.	100	0.341E-01	3.41	0.19	LO	0.33	0.58	
220	94	96	250	10.	110	0.417E-04	31.50	0.64		0.02	2.48	
221	107	104	200	350.	110	0.432E-02	4.15	0.13	LO	0.06	0.17	LO
222	107	108	200	130.	110	0.161E-02	0.0	0.0	LO	0.0	0.0	LO
223	109	83	200	165.	110	0.204E-02	10.77	0.34	LO	0.17	1.01	
224	109	85	150	105.	100	0.628E-02	4.08	0.23	LO	0.08	0.81	
225	85	110	100	350.	100	0.151E 00	1.49	0.19	LO	0.32	0.91	
226	110	111	100	150.	100	0.646E-01	0.97	0.12	LO	0.06	0.41	
227	84	111	150	425.	100	0.254E-01	1.16	0.07	LO	0.03	0.08	LO
228	40	41	100	10.	100	0.431E-02	0.23	0.03	LO	0.00	0.03	LO
229	47	46	150	10.	100	0.598E-03	0.05	0.00	LO	0.00	0.00	LO
230	15	16	100	10.	100	0.431E-02	0.61	0.03	LO	0.00	0.17	LO

ANNEX TABLE IX-C-7 (continued)

PIPE NO	NODES FROM	NODES TO	DIA MM	L MTRS	H-W C	K-VALUE	FLOW	--VEL-- MPS	CK	--HEADLOSS--- MT	MT/1000	CK
231	280	26	150	10.	100	0.598E-03	3.20	0.13	LO	0.01	0.52	
232	141	12	100	10.	100	0.431E-02	0.22	0.03	LO	0.00	0.03	LO
233	35	34	100	10.	100	0.431E-02	0.05	0.00	LO	0.00	0.00	LO
234	56	6	200	600.	110	0.741E-02	0.52	0.02	LO	0.00	0.00	LO
235	22	54	150	290.	100	0.175E-01	3.03	0.17	LO	0.13	0.47	
236	54	55	150	570.	100	0.341E-01	1.03	0.06	LO	0.04	0.06	LO
237	55	88	150	90.	100	0.538E-02	0.48	0.03	LO	0.00	0.02	LO
238	83	56	200	130.	110	0.161E-02	2.62	0.08	LO	0.01	0.07	LO
239	52	53	150	10.	100	0.598E-03	2.13	0.12	LO	0.00	0.24	LO
240	6	130	250	10.	110	0.417E-04	32.41	0.66		0.03	2.61	
241	37	39	200	105.	110	0.130E-02	16.46	0.52		0.23	2.21	
242	105	118	200	500.	110	0.617E-02	1.34	0.04	LO	0.01	0.02	LO
243	118	127	200	450.	110	0.556E-02	0.0	0.0	LO	0.0	0.0	LO
244	114	109	250	580.	110	0.242E-02	15.84	0.52	LO	0.40	0.69	
245	121	114	250	470.	110	0.196E-02	17.00	0.35	LO	0.37	0.79	
246	122	121	250	50.	110	0.208E-03	31.50	0.64		0.12	2.48	
247	8	13	200	240.	110	0.296E-02	6.49	0.21	LO	0.09	0.39	
301	123	99	200	730.	110	0.901E-02	5.77	0.18	LO	0.23	0.32	
302	56	123	250	60.	110	0.250E-03	6.91	0.14	LO	0.01	0.15	LO
303	123	124	250	580.	110	0.242E-02	0.57	0.01	LO	0.00	0.00	LO
304	124	125	250	360.	110	0.150E-02	0.0	0.0	LO	0.0	0.0	LO
305	92	120	200	425.	110	0.325E-02	1.40	0.04	LO	0.01	0.02	LO
306	120	126	250	500.	110	0.208E-02	0.0	0.0	LO	0.0	0.0	LO
307	89	119	200	685.	110	0.846E-02	1.40	0.04	LO	0.02	0.02	LO
309	117	105	100	850.	100	0.366E 00	1.65	0.21	LO	0.92	1.09	
311	103	117	100	140.	100	0.603E-01	1.92	0.24	LO	0.20	1.44	
312	107	113	200	540.	110	0.667E-02	8.02	0.25	LO	0.32	0.58	
313	113	81	200	870.	110	0.107E-01	6.86	0.22	LO	0.38	0.44	
314	111	115	150	250.	100	0.150E-01	1.16	0.07	LO	0.02	0.08	LO
318	121	116	250	320.	110	0.133E-02	14.50	0.30	LO	0.19	0.59	
319	116	128	250	670.	110	0.279E-02	0.0	0.0	LO	0.0	0.0	LO
320	116	107	250	1150.	110	0.[illegible]79E-02	13.34	0.27	LO	0.58	0.50	
321	116	129	200	1100.	110	0.136E-01	0.0	0.0	LO	0.0	0.0	LO
322	14	17	150	100.	100	0.598E-02	3.79	0.21	LO	0.07	0.71	
323	17	18	150	100.	100	0.598E-02	3.51	0.20	LO	0.06	0.61	
324	18	20	150	190.	100	0.114E-01	1.78	0.10	LO	0.03	0.17	LO
325	18	19	150	60.	100	0.359E-02	1.99	0.11	LO	0.01	0.21	LO
326	19	21	150	130.	100	0.777E-02	1.75	0.10	LO	0.02	0.17	LO
327	60	22	150	130.	100	0.777E-02	2.47	0.14	LO	0.04	0.32	
328	23	60	150	65.	100	0.389E-02	2.70	0.15	LO	0.02	0.58	
329	25	23	150	85.	100	0.508E-02	1.29	0.07	LO	0.01	0.10	LO

ANNEX TABLE IX-C-7 (continued)

NODE	GROUND ELEV	FLOW	HGL ELEV	HEAD MTRS	-------PRESSURE------- ATM---CK	PCT DROP---CK
1	6.5	-0.40	30.10U	23.60	2.28	-4.90
2	5.0	-0.60	29.77U	24.77	2.40	-3.19
3	4.0	-0.94	29.47U	25.47	2.47	-1.86
4	5.0	-0.39	29.54U	24.54	2.38	-2.27
5	5.0	-0.61	29.55U	24.55	2.38	-2.31
6	2.0	-1.43	29.03U	27.03	2.62	-0.10
7	3.5	-0.52	29.11U	25.61	2.48	-0.42
8	6.0	-0.54	29.56U	23.56	2.28	-2.42
9	6.0	-0.20	29.90U	23.90	2.31	-3.91
10	6.0	-0.43	30.55U	24.55	2.38	-6.73
11	5.5	-0.26	29.57U	24.07	2.33	-2.41
12	5.5	-0.08	29.81U	24.31	2.35	-3.45
13	5.0	-0.10	29.46U	24.46	2.37	-1.92
14	5.0	-0.07	29.41U	24.41	2.36	-1.72
15	5.5	-0.16	29.75U	24.25	2.35	-3.17
16	5.5	-0.06	29.74U	24.24	2.35	-3.17
17	4.5	-0.52	29.34U	24.84	2.40	-1.39
18	4.0	-0.22	29.28U	25.28	2.45	-1.12
19	3.5	-0.30	29.27U	25.77	2.49	-1.05
20	3.0	0.0	29.25U	26.25	2.54	-0.95
21	2.0	-0.40	29.25U	27.25	2.64	-0.91
22	2.0	-0.50	29.21U	27.21	2.63	-0.78
23	5.0	-0.12	29.28U	24.28	2.35	-1.15
24	5.0	-0.12	29.29U	24.29	2.35	-1.21
25	5.0	-0.10	29.28U	24.28	2.35	-1.19
26	5.5	-0.11	29.86U	24.36	2.36	-3.67
27	5.5	-0.11	29.86U	24.36	2.36	-3.67
28	6.0	-0.13	30.02U	24.02	2.32	-4.42
29	6.0	-0.20	32.61U	26.61	2.58	-15.71
30	6.5	0.0	33.13U	26.63	2.58	-18.34
31	6.5	31.50	33.16U	26.66	2.58	-18.50
32	6.5	0.0	33.13U	26.63	2.58	-18.34
33	6.5	-0.25	31.57U	25.07	2.43	-11.40
34	6.0	-0.03	30.20U	24.20	2.34	-5.22
35	6.0	-0.22	30.20U	24.20	2.34	-5.22
36	6.0	-0.13	29.55U	23.55	2.28	-2.37
37	6.0	-0.18	29.50U	23.50	2.28	-2.19
38	5.5	-0.10	29.23U	23.73	2.30	-0.99
39	5.5	-0.11	29.27U	23.77	2.30	-1.16
40	5.0	-0.13	29.27U	24.27	2.35	-1.14
41	5.0	-0.23	29.27U	24.27	2.35	-1.14
42	3.0	-0.08	29.24U	26.24	2.54	-0.92
43	3.5	-0.54	29.24U	25.74	2.49	-0.95
44	5.0	-0.29	29.30U	24.30	2.35	-1.26
45	5.0	-0.14	29.31U	24.31	2.35	-1.28
46	6.0	-0.07	29.65U	23.65	2.29	-2.85
47	6.0	-0.14	29.65U	23.65	2.29	-2.65
48	6.0	-0.39	29.72U	23.72	2.30	-3.15
49	6.0	-0.40	29.70U	23.70	2.29	-3.06
50	6.0	-0.74	29.69U	23.69	2.29	-3.01

ANNEX TABLE IX-C-7 (continued)

NODE	GROUND ELEV	FLOW	HGL ELEV	HEAD MTRS	-------PRESSURE------- ATM---CK	PCT DROP---CK
51	6.0	-0.75	29.74U	23.74	2.30	-3.24
52	6.0	-0.38	30.23U	24.23	2.35	-5.35
53	6.0	-0.67	30.23U	24.23	2.35	-5.34
54	1.0	-2.22	29.08U	28.08	2.72	-0.27
55	0.5	-1.61	29.04U	28.54	2.76	-0.14
56	0.5	-2.23	29.03U	28.53	2.76	-0.10
57	5.5	-22.35U	29.00	23.50	2.27	0.00
59	5.5	0.0	29.04U	23.54	2.28	-0.16
60	4.0	-0.29	29.25U	25.25	2.44	-1.01
61	5.0	0.0	29.54U	24.54	2.38	-2.24
62	6.0	-0.76	29.84U	23.84	2.31	-3.64
63	6.0	-0.89	29.84U	23.84	2.31	-3.65
64	6.0	-0.40	29.89U	23.89	2.31	-3.86
65	6.0	-0.15	29.86U	23.86	2.31	-3.73
66	6.0	31.50	30.76U	24.76	2.40	-7.65
67	5.5	-0.64	30.41U	24.91	2.41	-6.00
68	5.5	-0.21	30.22U	24.72	2.39	-5.21
69	5.0	-0.17	30.13U	25.13	2.43	-4.72
70	3.5	-0.62	30.00U	26.50	2.57	-3.92
71	3.5	-0.31	30.12U	26.62	2.58	-4.39
72	4.0	-0.66	30.24U	26.24	2.54	-4.97
73	2.0	-0.55	29.06U	27.06	2.62	-0.23
74	0.5	-0.88	28.95U	28.45	2.75	0.18
75	0.5	-0.91	29.04U	28.54	2.76	-0.13
76	2.0	-0.84	29.16U	27.16	2.63	-0.60
77	2.0	-0.78	29.49U	27.49	2.66	-1.83
78	0.5	-0.57	29.43U	28.93	2.80	-1.52
79	0.5	-0.85	29.54U	29.04	2.81	-1.88
80	2.0	-0.37	29.66U	27.66	2.68	-2.43
81	1.5	-1.67	30.04U	28.54	2.76	-3.78
82	1.5	-0.38	30.30U	28.80	2.79	-4.73
83	2.5	-0.95	30.56U	28.06	2.72	-5.90
84	1.0	-0.82	30.30U	29.30	2.84	-4.65
85	2.5	-1.06	30.65U	28.15	2.72	-6.21
86	1.5	-0.46	29.14U	27.64	2.68	-0.51
87	1.5	-0.36	29.14U	27.64	2.68	-0.50
88	0.5	-0.60	29.04U	28.54	2.76	-0.13
89	8.0	-1.08	29.69U	21.69	2.10	-3.29
90	8.0	-0.94	29.77U	21.77	2.11	-3.67
91	9.0	0.0	29.85U	20.85	2.02	-4.25
92	6.0	-2.36	29.94U	23.94	2.32	-4.08
93	6.5	-0.76	30.49U	23.99	2.32	-6.62
94	6.5	31.50	31.02U	24.52	2.37	-8.98
95	6.0	-0.62	30.31U	24.31	2.35	-5.69
96	7.0	-0.44	31.00U	24.00	2.32	-9.07
97	5.0	-1.23	30.31U	25.31	2.45	-5.46
98	2.5	-0.70	30.46U	27.96	2.71	-5.53
99	3.0	-1.42	30.76U	27.76	2.69	-6.75
100	1.5	-0.80	30.39U	28.89	2.80	-5.07
101	2.0	-0.92	30.36U	28.36	2.75	-5.02

ANNEX TABLE IX-C-7 (continued)

NODE	GROUND ELEV	FLOW	HGL ELEV	HEAD MTRS	-------PRESSURE------- ATM---CK	PCT DROP---CK
102	5.0	-1.24	30.35U	25.35	2.45	-5.60
103	7.0	-1.16	30.68U	23.68	2.29	-7.62
104	6.0	-1.32	30.68U	24.68	2.39	-7.28
105	7.0	-1.44	29.55U	22.55	2.18	-7.28
106	7.0	-0.56	29.56U	22.56	2.18	-2.51
107	5.5	-1.16	30.74U	22.56	2.18	-2.53
108	5.5	0.0	30.74U	25.24	2.44	-7.39
109	2.5	-0.99	30.73U	25.24	2.44	-7.39
110	2.0	-0.52	30.33U	28.23	2.73	-6.53
111	1.5	-0.97	30.27U	28.33	2.74	-4.92
112	6.0	-0.40	30.73U	28.77	2.78	-4.61
113	4.5	-1.16	30.42U	24.73	2.39	-7.54
114	4.0	-1.16	31.13U	25.92	2.51	-5.80
115	1.5	-1.16	30.25U	27.13	2.63	-8.53
116	5.5	-1.16	31.32U	28.75	2.78	-4.54
117	7.0	-0.27	30.48U	25.82	2.50	-9.86
118	9.0	-1.34	29.54U	23.48	2.27	-6.71
119	10.0	-1.40	29.68U	20.54	1.99	-2.71
120	10.0	-1.40	29.93U	19.68	1.90	-3.55
121	5.5	0.0	31.51U	19.93	1.93	-4.88
122	5.5	31.50	31.63U	26.01	2.52	-10.66
123	7.0	-0.57	30.99U	26.13	2.53	-11.19
124	8.0	-0.57	30.99U	23.99	2.32	-9.03
125	8.0	0.0	30.99U	22.99	2.23	-9.46
126	10.0	0.0	29.93U	22.99	2.23	-9.46
127	10.0	0.0	29.54U	19.93	1.93	-4.88
128	10.0	0.0	31.32U	19.54	1.89	-2.85
129	5.5	0.0	31.32U	21.32	2.06	-12.19
130	0.5	-32.41U	29.00	25.82	2.50	-9.86
140	4.5	0.0	29.45U	28.50	2.76	0.00
141	5.5	-0.08	29.81U	24.95	2.42	-1.83
192	6.0	-0.28	30.33U	24.31	2.35	-3.46
193	6.0	-0.17	30.45U	24.33	2.36	-5.77
280	6.0	-0.13	30.02U	24.45	2.37	-6.29
				24.02	2.33	-4.44

CHAPTER X FINANCIAL FEASIBILITY ANALYSIS

A. GENERAL

The financial feasibility analysis herein establishes a detailed set of guidelines that the water district management may use in making crucial decisions during the next few years. The technical aspects and project cost of the recommended plan have been presented in Chapter IX. Its economic justification follows in Chapter XI. In this chapter, a plan is developed to indicate how and when funds will be used to operate and maintain the system, implement the program, establish reserve funds, and retire indebtedness.

Water rates have been developed on the basis that the system will be financially self-supporting. Capital funds for the recommended plan will be derived by borrowing from international lending agencies and LWUA. The water rates that have been developed appear to be within the ability-to-pay of the average householder in the water district. The financial analysis includes those revenues and disbursement for the proposed construction program from 1978-1990 (Immediate Improvements Phase I-A and Phase I-B). All revenues and disbursements shown between 1990 and 2000 are those directly attributable to continued service and expenses occurring from facilities constructed between 1978 and 1990.

B. THE EXISTING SYSTEM

Personnel

As of March 1976, the SIL-WD plantilla consisted of 27 personnel with key positions already filled up. Recent developments have been directed towards updating its personnel rules and regulations and the adoption of LWUA guidelines in the area of personnel management.

Water Rates

As of September 1976, the system had a total of 908 service connections, of which 248 were metered and 660 were flat rate. New water rates were implemented on 1 March, 1977. The new rate structure charges ₱14.50 for flat rate and ₱12.50 plus ₱0.50 for every cubic meter in excess of 10 cum for metered connection. Commercial and industrial users are charged twice these rates.

Financial Statement

For the year 1976, SIL-WD had an average monthly operation and maintenance expense of roughly ₱20,000.00 while average monthly gross income lags behind considerably at approximately ₱8,500.00. Bigger losses are expected if allowances are made for depreciation. In addition to its revenues from water sales, the district has also been receiving subsidy from the city government. As of January 1, 1977, the subsidy was in the amount of ₱7,000 per month for 9 months.

The financial position is expected to improve with the continued subsidy, the implementation of increased water rates and the installation of the commercial practices system.

Historic financial records have not been based on organized accounting system. Therefore, data on the past finances of the present system is inadequate to form sound bases for future projections. It is necessary to make certain assumptions for the financial feasibility analysis. These are discussed later in this chapter. Validity of these assumptions will be tested as the project is implemented.

C. DEVELOPMENT COSTS

The cost estimates of the facilities needed to improve and expand water services of the water district over the development planning period are presented in Chapter IX. Cost estimates of the facilities are based on the projected July 1978 unit prices.

Project Costs

Project costs of facilities recommended for implementation in Phase I-A are summarized on an annual basis in Annex Table X-C-1. Engineering services for design and construction supervision are broken down. It has been assumed that 70 percent of the engineering services applies to surveys and design and 30 percent to construction supervision. Design costs are shown in the year preceding construction. Contingencies (15/10 percent) are distributed uniformly during the construction period. Foreign exchange component of total project cost includes cost of direct and indirect import items, as well as a portion of the engineering costs.

Escalation of Costs

To account for the effects of inflation, capital cost estimates are escalated. This has been done year by year on an item by item basis using escalation factors computed from assumed inflationary trends and applied to the basic current cost data as shown in Annex Table X-C-2. The escalation factors used are based on an average annual rate of inflation of 10 percent per year from 1978 through 1980, 8 percent from 1981 to 1985, and 6 percent per year thereafter. On the other hand, annual costs and family income are escalated at a rate of 8 percent all throughout the 23-year study period. These escalation factors have been assumed to apply equally to the local and foreign exchange costs.

D. OPERATION AND MAINTENANCE COSTS

This cost category covers cash expenses required to keep the system operating and adequately maintained. It assures the continued maintenance of the water district's revenue-producing capacity and protection of its investment. Included in this cost category are: personnel, power, chemicals, maintenance, rental, and other miscellaneous expenses which are necessary to run the overall water system.

Most items increase in accordance with the quantity of water produced; the number of customers served; and the extent to which the physical plant will be operated and maintained.

The operating costs of the existing and future systems are presented in Chapter IX.

E. FINANCING POLICIES COVERING LOCAL WATER DISTRICT DEVELOPMENT

The following are the major potential sources of funds which can be utilized by the SII-WD:

Operating Source

To the extent that revenues from the operations of the local water district exceed annual cash requirements for all other purposes, funds can be devoted to financing development costs. As a practical matter, it is highly desirable to finance a significant proportion of development costs in this manner in order to reduce the amount that must be borrowed and the associated debt service costs.

Non-Operating Sources

Non-operating sources of funds for development include 3 basic groups:

1. Loans - funds may be borrowed by the water district for development. One of LWUA's primary functions is lending funds for development to water districts. From the water district's point of view, LWUA is the primary, if not the only realistic source of funds. LWUA borrows both foreign currencies and pesos at varying terms and relends needed funds to water district according to the composite terms needed to support the blend of debt service terms LWUA itself must meet. At present, LWUA's terms include:

	Immediate Improvements Loan	Phase I-A and I-B Loan
Interest -	9 percent per annum to be computed at $\frac{3}{4}$ percent per month. Interest due on the local component is paid annually. Interest on foreign exchange is capitalized during construction.	9 percent per annum to be computed monthly at $\frac{3}{4}$ percent per month from the year following the date of disbursement.

	Immediate Improvements Loan	Phase I-A and I-B Loan
	Total loan outstanding at the end of construction period earns another full year interest before repayment.	
Duration -	30-year loan, disbursement assumed made at mid-year, thus will earn interest for 6 months.	30-year loan from the date of initial disbursement.
Principal -	Amortized equally for 30 years to start one year after constructions.	No principal payments due during construction period (construction periods of Stage I - Phases A and B are explained in Chapter IX). Principal repayment periods is 30 years less the duration of the disbursement period.

2. Charges and Assessments - consist of payments made by new customers and benefiting property owners for the costs of specific portions of the facilities being developed. Typically, such charges are made for the costs of new construction and water meters and for all or a portion of the costs of new distribution system extensions. LWUA guidelines suggest that new customers may pay for connections and water meters, but currently do not include an assessment for distribution system costs. For purposes of this analysis, new customers were assumed to be paying for the new connections and water meters on a revolving fund basis. These sources are referred to as "contributions in aid of construction" in accounting terminology and have the effect of reducing the amounts to be borrowed. Since many new customers will not be in a position to pay connection fees (or benefit assessment charges) in cash, it will be necessary to provide financing assistance. Present practice is to allow such payments to be made at a flat monthly rate of ₱5.00 over a period of 10 years.

3. Grants or Credits - LWUA has access to loan funds on concessionary terms and is thus able to relend funds at rates that are below market rates. This in itself is a 'credit' available to the local water district borrower. In some countries, the national government makes outright grants to local water districts in recognition of the overall national benefit of having safe and reliable water systems. Another approach is for the government to advance a portion of the funds needed during the early years of development at little or no interest to assist the local utility in building its financial capacity. This is another form of 'credit' as referred to above. Later, as the revenue base expands and development expenditures decline, the local utility refunds such advances as permitted by its cash position. At the present time, however, the local water district is expected to

undertake its development programs with no equity participation by government or assistance other than the LWUA loans.

Reserve Requirements

Since reserve requirements are tied directly to obtaining development loans from LWUA, they are considered as funds required to support capital development. After total revenue requirements are determined, LWUA guidelines suggest that 10 percent be set aside for reserve funds. For purposes of this study, a lower percentage will be used, starting at 3 percent progressively increasing to 10 percent.

F. FUNDS FOR CAPITAL DEVELOPMENT

Once the basic data requirements are met and the financing policies outlined, funds required to cover development costs are then determined. The most important document in this regard is the breakdown of project costs as escalated and shown in Annex Table X-C-2.

Depreciable Assets/Depreciation Expenses

Capital assets acquired each year become subject to depreciation in their first full year of service. Thus a pipeline completed in 1978 becomes "depreciable" in 1979. If it has a 50-year life, depreciation continues for 50 years and it is assumed to be retired in the 51st year. The cost of large facilities that require several years to construct is carried as "work-in-process" until completed.

Annex Table X-F-1 shows the water district's assets and depreciable value forecasts, the initial purpose of which is to show the appropriate "depreciable" values for use in calculating replacement costs and annual depreciation expenses. At the same time, year-end book values of assets are shown as well as the value of work-in-process.

Based on the schedule of assets, annual depreciation expenses were calculated and are shown in Annex Table X-F-2.

Revolving Fund for Connections

To assist new customers in financing service connection charges, it is necessary to provide working capital for a revolving fund. It is proposed that LWUA's present policy which provides for the costs to be payable at ₱5.00/month over a 10-year period be increased to ₱6.83 by 1978 to cover the increased unit price of meters. Net inflow funds will be required over a period of 10 years to build sufficient income to support the annual costs of connections. At some future point, income exceeds annual expenditures and the revolving fund can be used to refund the earlier advances of working capital.

Annex Table X-F-3 indicates the working capital requirements. In this table, the two key assumptions are:

1. The monthly installment payments are based on actual costs of constructing service connections and meters; thus, the monthly payments by customers connected to the system in 1981 would be greater than by those who would be connected to the system in 1978 to account for the escalation of construction costs.

2. Sixty (60) percent of all new customers would utilize the installment method of financing connection charges.

Revenue Unit Forecast

The present LWUA rate policy incorporates the use of "revenue units" (RU) in determining the basic cost per cubic meter of water to domestic consumers. Commercial and industrial customers are charged twice the unit price for domestic use and wholesale water distributors are charged thrice the basic price. As defined, a "revenue unit" is an arbitrary unit of measure into which discharges from pipes of various sizes are reduced to a 3/8-inch connection by the use of conversion factors.

Thus, the discharge of a 3/8-inch connection (actually a ½-inch connection, but regulated by a water meter to give the discharge of a 3/8-inch connection) is multiplied by 1.0; that of a ½-inch by 2.5; that of a ¾-inch by 4; that of a 1-inch by 8; and so forth, to get the total RUs delivered.

Two charges are levied on metered connections - the service charge and the commodity charge. The service charge is the fixed charge which covers the first 10 cum of water. It varies according to the size of the connection. The commodity charge is payment for water consumed after the first 10 cum. The unit price is uniform for every size and type of connection.

Annex Tables X-F-4a and X-F-4b give the revenue unit forecast.

G. ANALYSIS OF WATER RATES

Ability-To-Pay Issue

Presidential Decree No. 198 stipulates that water districts must be financially self-sufficient. In the past, most water systems have not been able to generate sufficient revenues to cover even just the operation and maintenance expenses due to various factors, including poor pricing schemes, defective collection system and inadequate consumer promotion. The major reason for insufficient revenues, however, is that certain consumers being served by the water district have such low incomes and hence, are not in a financial position to pay the full costs of the system. Therefore, before a water system is improved and expanded, the ability-to-pay of the population targeted to be served must first be ascertained.

Since water districts are not expected to be extended government subsidy, this has significantly simplified the analysis of the factors affecting ability-to-pay. The factors that affect ability-to-pay are the annual income of families covered by the water district and the percentage of their income allocated to water supply.

In March 1975, an informal survey was conducted among Water District General Managers to help gather data needed for the ability-to-pay studies. Questionnaires were distributed to 15 water districts covering provincial areas that differed in size, location and economic conditions.

The answers given by the general managers of the 15 water districts are summarized as follows:

1) Though 10 of the water districts were revenue-producing prior to the change in management of the water districts, 13 imposed increased water rates upon takeover.

2) Water consumers generally accepted the increase after some explanations justifying it. Only five received formal complaints about the increased rates while eight received formal complaints about the poor quality of water supply.

3) Ten had difficulty in the collection of water bills primarily due to dissatisfaction of consumers to the water service.

4) Assuming that capital and service improvements were made, the general managers indicated they could increase their rates by as low as 25 percent and as high as 447 percent for the average and below average households.

A formal survey was conducted in April and May, 1975 in the city of Lipa and the municipality of Tanauan. These pilot areas were selected because (a) they are at present experiencing water supply problems, (b) the income level of their families is similar to that of the national income figure, and (c) they are near Manila, only about 2 hours away by bus.

The survey covered 556 families, classified into 4 income groups. Approximately 28 percent came from the low-income class (below ₱220/month); 55 percent from the middle-income group (₱221-750); 12 percent from the upper middle income class (₱751-₱1,500); and 5 percent from the high-income group (above ₱1,500).

The table below presents the highlights and pertinent findings of the survey:

ESTIMATED ABILITY-TO-PAY BY INCOME GROUPING

					Weighted Average
Income Group	₱220	₱221-750	₱751-1,500	Above ₱1,500	
% Distribution	28%	55%	12%	5%	
Probable Ability-to-Pay on Basis of Improved Service[1]	₱13.50	₱24.50	₱37.00	₱67.50	₱25.00/mo
Estimated Average Income	₱220	₱660	₱1,000	₱2,700	₱680/household
Ability-to-Pay Divided by Average Income	6.1%	3.7%	3.7%	2.5%	3.7%

The foregoing table indicates that the low-income group may be able to pay a maximum of ₱13.50 a month for water (about 6.1 percent of their average income). In the extreme end, the high-income group may be able to pay a maximum of ₱67.50 a month for water (only 2.5 percent of their average income). This disparity in the percentage of income allocated to water by the 2 income groups may well be the best argument of those advocating a socialized price structure.

The probable maximum ability-to-pay of the pilot area average household is about ₱25.00 per month.

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[1] This figure includes appropriate allowances for the respondents understating their income or willingness to pay and the increase in amount they are willing to pay as a result of improved services.

Family Income

In the Survey of Households Bulletin Series No. 34, published July 1973 by the NCSO, Manila (page 3, Table 5), the following data are given:

	Total Families	Total Urban	Manila and Suburbs	Other Urban Areas	Rural
Median Family Annual Income, Pesos	₱2,454	₱3,972	₱5,202	₱3,650	₱1,954
Size of Sample, Families	6,347	1,913	525	1,388	4,434

The above data are for the 12-month period May 1970 to April 1971, more or less. The figure for "other urban areas". ₱3,650 median family annual income, may approximate, or may be a little less, than the median family income at the areas served with piped water. As the figures cited above show, in general, people in urban areas tend to be financially better off than people in rural areas. The term "urban areas" includes all urban areas in the country, in general, most urban area of the city or municipality. The inhabitants of the central urban areas are expected to be somewhat wealthier than the other areas of the city or municipality.

By July 1976, the annual income for "other urban areas" cited above, escalated at 10 percent per year, would be about ₱6,200/year.

The report, "The Filipino Family, Community, and Nation" by Emma Porio, Frank Lynch and Mary R. Hollnsteiner published by the Institute of Philippine Culture of Ateneo de Manila University in April 1975, cites in Table A9, page 99 the results of a survey in April 1974. The families surveyed were distributed among 15 urban areas, and included 373 families in Metro Manila. Excluding the families in Metro Manila, mean monthly income of the remaining 1,599 families was ₱572, or ₱6,864 per year. Escalating this income at an annual rate of 10 percent, by 1 July 1976, it would be an income of about ₱8,510 per year. These 14 urban areas are among the more urbanized in the country. They included, for instance, only 3 municipalities, the other eleven being classified as cities. The median population of the 14 urban areas in the 1970 census was about 70,000.

Based on these data, the mean family income of the people residing in the water service areas of the communities whose water systems are proposed to be improved might be, by 1 July 1976, somewhat between the ₱6,200 per year (developed from the 1970/71 data of the NCSO) and the ₱8,510 per year (developed from the data of Porio, Lynch and Hollnsteiner). For lack of other data, the average water-using family may have an income of about ₱7,900 during 1976 (or ₱660 per month, which is close to the Lipa household survey). This is equivalent to an annual income of $1,000 for a family of six or seven.

Initial Rate Determination

Severla trials were made to come up woth "revenue unit" (RU) prices that can be used for a period of several years. It is good practice for the water district to adjust prices every 3 years or so, instead of annually.

Based on the trials made, the water rates established are as follows:

Period	Water Rate (₱/RU)
1978-1980	0.80
1981-1983	1.20
1984-1986	1.50
1987-1991*	1.70
1992-1996*	1.80
1997-2000*	2.00

The first step of ₱0.80/RU was selected as an intermediate rate, in anticipation of the second step (₱1.20/RU) which is indicative of the required cost to make the system financially viable. The rate of ₱1.20/RU in 1982 cost levels is equivalent to ₱0.82 in 1978 prices (based on 10 percent discount rate). Likewise ₱1.50/RU in 1985 is equivalent to ₱0.77 in 1978 prices.

Feasibility of Charges

The question of feasibility is a matter of analyzing whether or not the customers of the water district are able to pay the required charges both now and in the future in order to obtain safe and reliable water services. Inasmuch as the proposed water rates represent the "mean", determination has been made for that group of households whose income (₱700/mo) also represents the "mean". Probable use of water by this group was claculated at 24 cum per month.[2/] For present purposes, the study covers consumers with 1/2-inch connections inasmuch as they comprise the bulk of the domestic/government consumers. Working back, the 1979 rate of ₱0.70 per revenue unit will yield a monthly service charge of ₱17.50. The commodity

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*The rates from 1990 to 2000 cover only expenses of debt service and operation and maintenance costs incurred for facilities constructed up to 1990. Water rates from 1990 - 2000 would be higher if the SIL-WD continued to construct additional facilities from 1990 to 2000.

[2/] Probable use of water by income groups:

Income Grouping	Below Average	Average	Upper Middle	High	Weighted Mean
Probable Water Use (cum/mo)	16	24	32	44	23.7

charge for a 24-cum consumption is ₱9.80 (0.70 x 14). For newly connected customers who avail of the 10-year installment plan, monthly expenditure for water will increase by ₱6.83 to account for the service connection charge. Since both water and household incomes increase each year, the impact of the installment charge on the expenditure pattern of the household will decline over the 10-year period of payment. The estimated impact of the increased rates and connection charges on household patterns is shown below for the mid-point of each rate block.

	1979	1982	1985	1989	1994	1998
Escalated income of household earning ₱700/mo in 1976 (8% per year)	880	1,110	1,400	1,900	2,800	3,520
Expenditure for 24 cum water consumption-service charge (first 10 cum)	20.00	30.00	37.50	42.50	45.00	50.00
Commodity charge (Rate/RU x 14 cum)	11.20	16.80	21.00	23.80	25.20	28.00
Income allocation to water for existing consumers (%)	3.5	4.2	4.2	3.5	2.5	2.2
Connection charge for New customers (₱6.83/mo in 1978)	7.51	9.63	12.13	15.31	20.48	25.85
Income allocation to water for new customers	4.4	5.1	5.0	4.3	3.2	2.9

Since the mid-point of the period was selected for comparison, it should be noted that the proportions shown would be slightly higher in the year preceding the mid-point and lower in the succeeding year of each rate block.

In the example shown above, the proportions of the household income required for water services (except in 1982 and 1985 which are the crucial years) are considered within the limit of the ability-to-pay studies done in Lipa City where willingness to pay fees for improved services was found to be about 3.7 percent of the household income.

In the final analysis, if any significant improvement is to be achieved in the scope and quality of public water service and if the requirement for commercially viable and financially self-supporting water districts is to be maintained, all groups of water customers will have to pay substantially higher charges for water services than they have paid in the past.

Socialized Water Rates

A policy guideline in the structuring of water rate charges is that they must be reasonable and realistic. Since water is a prime commodity both for the poor and the rich, the socialized rate may be determined such that a greater financial burden is carried by those who can afford (but not to the point that it becomes oppressive to them).

In the preceding sections, specific rates established meet the cash requirements for an improved system and at the same time fall within the average consumer's ability-to-pay. Under this scheme, the cost for the first 10 cum consumed is ₱20.00 and the subsequent consumption, ₱0.80/cum. Thus the monthly rates for the following water consumption will be:

Usage (cum/mo)	Cost/month (₱)*
16	24.80
18	26.40
20	28.00
22	29.60
24	31.20
30	36.00
32	37.60
44	47.20

The estimated impact on the average income household (assumed to have a monthly 1976 income of ₱660) and the below average income household (assumed to have an adjusted monthly 1976 income of ₱300) is as follows:

Income Level	Projected 1979 Monthly Income	Monthly Usage of Water	Cost of Water/mo	Percent of Income Allocated to Water
Below Average	₱380	16 cum	₱24.80	6.5
Average	830	24 cum	31.20	3.8

*For ½-inch connection domestic classification.

The preceding table shows that the financial burden to the below average income group is heavy.

A socialized pricing alternative has been developed to relieve the low income groups of the high financial cost of water with the following rate structure:

first 16 cum/mo at	₱0.90/cum
from 17-24 cum/mo at	1.95/cum
from 25 or more cum/mo at	2.75/cum

The resulting monthly rates for the various water usages will be:

Usage (cum)	Cost/month (₱)
16	14.40
18	18.30
20	22.20
22	26.10
24	30.00
30	46.50
32	52.00
44	85.00

The corresponding impact on the various income levels is as follows:

Income Level	Projected 1979 Monthly Income	Monthly Usage of Water	Cost of Water/mo	Percent of Income Allocated to Water
Below Average	₱ 380	16 cum	₱14.40	3.8
Average	830	24 cum	30.00	3.6
Upper Middle	1,260	32 cum	52.00	4.1
High	2,910	44 cum	85.00	2.9

The preceding table shows that across the income profile of the community, the monthly costs range from 2.9 - 4.1 percent of household income.

Revenue Forecasts

Estimated future levels of income from water sales are shown in Annex Table X-B-1.

H. FINANCIAL SUMMARY

Several trials have been conducted in developing the forecasts of financial statements of the SIL-WD. These statements are based on the following major assumptions:

1. Reserve Fund: 3 percent of sales for 1978-1990; 6 percent for 1991-1995; and 10 percent for 1996-2000.
2. Uncollectibles: 2 percent of gross revenue requirements for the first year of a new rate application, and 1 percent for the second and third years.
3. Accounts Receivable: equivalent to 3 months of sales.
4. Accounts Payable: equivalent to 2 months of operating expenses.

External Borrowing Required

Annex Table X-H-1 shows a summary of the external borrowing required and the annual debt servicing of the loans. Two separate analyses were made for the immediate improvement loan and the Phases I-A and I-B loans to comply with prevailing LWUA terms.

Borrowing will start in 1978 and continue through 1990. The immediate improvement loan (1978-1981) will amount to ₱6.437 million. The Phase I-A loan will cover the 8-year period 1978-85 inclusive and will amount to ₱14.631 million. The Phase I-B loan will cover the 5-year period 1986-90 inclusive and will be about ₱15.181 million.

The immediate improvement loan of ₱6.437 million consists of ₱5.590 million in escalated capital expenditures (see Table X-C-2) and ₱0.847 million capitalized interest. The Phase I loan of ₱14.631 million in 1978 and ₱15.181 million in 1986 include escalated capital expenditures (see Table X-C-2) less revenues from the service connection revolving fund (see Table X-F-3).

Projections of Financial Statements

Annex Table X-H-2 shows the net income (loss) on a yearly basis. Net loss is forecasted in 1980 and 1983.

Net income cumulative would show positive values in fifteen of the 23-year study period.

Other related data such as water production, water sales, unaccounted-for-water and rate of return based on net fixed asset in operation are also presented in the table.

Cash Flow Statements

The cash flow statement provides an indication of the adequacy of working capital. It is not generally sufficient to cover cash outlays with revenues because of the tendency of cash receipts to lag behind cash outlays. In general, an expanding organization with an active capital development program and increasing level of activities will require similarly increasing quantities of working capital.

Annex Table X-H-3 presents the annual projected "Sources and Application of Funds." Potential net decreases are expected in the year 1978, 1983, 1997 and 2000. By 2000, positive net cumulative cash balance will be ₱22.478 million even if "cash at the beginning of 1978" has been assumed equal to zero.

Other Financial Statements

Appendix Table X-H-4 presents the "Projected Balance Sheet" which shows the projected fixed and current assets, liabilities and equity of the water district from 1976 to 2000.

Rate of Return

Discount rate of return on total investments (Annex Table X-H-5) measures the true efficiency of mobilizing investments on the project from a broader perspective. Taken from a different perspective, it measures the effective utilization of total investments employed in the project. It shows what the compounded growth of investment within the project cycle would be based on the interplay of cash outflows and the resulting inflows from such investment.

Net asset salvage value of ₱4.370 million is added to net cash inflow in the year 2000. This is done based on the assumption that the project will terminate in the last projection year. Hence, assets are to be liquidated and all liabilities are to be paid from the proceeds of the assets.

Several trials were made in finding the rate of interest that equated the present value of the cash inflows to the unrecovered investments. In the SIL-WD, the rate of return, with the assumptions made, is estimated to be 9.14 percent.

I. FINANCIAL RECOMMENDATIONS

1. The water district should establish a revolving fund to assist new customers in financing service connection charges.
2. The proposed water rates (for domestic consumers) to effect self-sufficiency are as follows:

Period	Water Rate(₱/RU)
1978-1980	0.80
1981-1983	1.20
1984-1986	1.50
1987-1991	1.70
1992-1996 *	1.80
1997-2000 *	2.00

It is recommended, however, that in the implementation of these rates, the water districts follow the socialized pricing approach which will generate the same amount of income to meet its requirements.

3. The recommended plan for the first construction phase (Phase I-A) of SIL-WD is financially feasible. Borrowing for that period would be ₱14.631 million.

External borrowing would still be necessary for the Phase I-B period.

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*These rates are recommended to cover expenses incurred by implementing and operating facilities included in the Immediate Improvement Program and Phases I-A and I-B only.

ANNEX X-C

DEVELOPMENT COSTS

ANNEX TABLE X-C-1

PROJECT COST OF RECOMMENDED PROGRAM
SILAY WATER DISTRICT
WITHOUT ESCALATION
(₱ x 1000)

Item			1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Total
Source Facilities	a) Equipment		7	19			382			52	382		191		191	1,224
	b) Wells		21	61			1,211			165	1,210		605		605	3,878
Storage Facilities			26	79			1,550									1,655
Distribution Pipelines			51	151	989	989	988			123	903	903				5,097
Internal Network			7	19	-	151	151	151	151	186	210	210	210	210	208	1,864
Fire Hydrants			5	13		103	103	103	103	114	61	61	61	61	61	849
Service Connection	a) Pipes		20	58	-	457	457	457	457	529	414	414	414	414	414	4,505
	b) Meters		7	20	-	157	157	157	157	186	157	157	151	157	159	1,628
Plumbing Shop	a) Equipment		-	1		31										32
	b) Structure		4	10		406										420
Immediate Improvements	a) Source Facilities	1. Equipment	204													204
		2. Structure	102													102
	b) Distribution Pipelines		1,125	991												2,116
	c) Administration Building	1. Equipment	2	69												71
		2. Structure	14	405												419
	d) Vehicles		-	69												69
	e) Service Connection	1. Pipes	459	417	417											1,293
		2. Meters	230	209	209											648
	f) Leakage Survey and Repair	1. Labor	56	55												111
		2. Equipment	5	5												10
	g) Miscellaneous Items		24													24
Feasibility Studies 1/			52		212											264
Sub-total 2/			2,421	2,651	1,827	2,294	4,999	868	868	1,355	3,337	1,745	1,638	842	1,638	26,483
Land			115		25						1					141
Total Project Cost 3/			2,536	2,651	1,852	2,294	4,999	868	868	1,355	3,338	1,745	1,638	842	1,638	26,624

1/ Computed at approximately 1% of the total project cost.

2/ Includes design (first year of each major segment of development), supervision of construction and contingencies spread uniformly during the period of construction.

3/ Does not include interest during construction. For calculated interest see Table X-H-1.

ANNEX TABLE X-C-2

PROJECT COST OF RECOMMENDED PROGRAM
SILAY CITY WATER DISTRICT
WITH ESCALATION
(₱ x 1000)

Item	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Total
Escalation Factor	1.000	1.000	1.210	1.307	1.412	1.525	1.647	1.779	1.886	1.999	2.119	2.246	2.381	
Source Facilities														
a) Equipment	7	21			539			93	720		405		455	2,240
b) Wells	21	67			1,710			294	2,282		1,282		1,441	7,097
Storage Facilities	26	86			2,189									2,301
Distribution Pipelines	51	166	1,197	1,293	1,395			219	1,703	1,805				7,829
Internal Network	7	21		197	213	230	249	331	396	420	445	472	495	3,476
Fire Hydrants	5	14	-	135	145	157	170	203	115	122	129	137	145	1,477
Service Connection														
a) Pipes	20	64		597	645	697	753	941	731	828	877	930	[illegible]	8,119
b) Meters	7	22		205	222	239	259	331	296	314	333	353	379	2,960
Plumbing Shop														
a) Equipment	-	1		41										42
b) Structure	4	11		531										546
Immediate Improvements														
a) Source Facilities														
1) Equipment	204													204
2) Structure	102													102
b) Distribution Pipelines	1,125	1,090												2,215
c) Administration Building														
1) Equipment	2	76												78
2) Structure	14	446												460
d) Vehicle	-	76												76
e) Service Connection														
1) Piper	459	459	505											1,423
2) Meters	230	230	253											713
f) Leakage Survey & Repairs														
1) Labor	56	61												117
2) Equipment	5	6												11
g) Miscellaneous Items	24													24
Feasibility Studies	52		257											309
Sub-Total	2,421	2,917	2,212	2,999	7,058	1,323	1,431	2,412	6,293	3,489	3,471	1,892	3,901	41,819
Land	115		30						2					147
Total Project Cost	2,536	2,917	2,242	2,999	7,058	1,323	1,431	2,412	6,295	3,489	3,471	1,892	3,901	41,966

ANNEX X-F

FUNDS FOR CAPITAL DEVELOPMENT

ANNEX TABLE X-P-1

ASSET AND DEPRECIABLE VALUE FORECAST
SILAY WATER DISTRICT
(P x 1000)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
I. ASSETS ADDED BY YEAR END																							
Source Facilities a) Equipment	7	21			539			93	720		405		455										
b) Wells	21	67			1710			294	2282		1282		1441										
Storage Facilities	26	86			2169																		
Distribution Pipelines	51	166	1197	1293	1395			219	1703	1805													
Internal Network	7	21	-	197	213	230	249	331	396	420	445	472	495										
Fire Hydrants	5	14	-	135	145	157	170	203	115	122	129	137	145										
Service Connection a) Pipes	20	64	-	597	645	697	753	941	781	828	877	930	986										
b) Meters	7	22	-	205	222	239	259	331	296	314	333	353	379										
Plumbing Shop a) Equipment		1	-	41																			
b) Structure	4	11	-	531																			
Immediate Improvements a) Source Facilities																							
1. Equipment	204																						
2. Structure	102																						
b) Distribution Pipelines	1125	1090																					
c) Administration Building																							
1. Equipment	2	76																					
2. Structure	14	446																					
d) Vehicle	-	76																					
e) Service Connection																							
1. Pipes	459	459	505																				
2. Meters	230	230	253																				
f) Leakage Survey and Repairs																							
1. Labor	56	61																					
2. Equipment	5	6																					
g) Miscellaneous Items	24																						
Feasibility Studies	52		257																				
Replacements a) Source Facilities - Equipment																579				1368			
b) Service Connections - Meters																590	628	666	530	562	596	632	678
c) Plumbing Shop - Equipment																			105				
d) Administration Building - Equipment																	207						
e) Vehicles									130							195							294
f) Leakage Survey and Repairs - Equipment																14	15						
g) Miscellaneous Items																68							
Total Assets Added By Year-End	2421	2917	2212	2999	7058	1323	1431	2412	6423	3489	3471	1892	3901	-	-	1447	850	666	635	1930	596	632	972
II. DEPRECIABLE VALUES																							
A. 50 Years Service Life																							
Existing Facilities	3185	3185	3057	3010	2963	1685	1620	1571	1571	1461	1461	1461	1351	1351	1351	1351	1351	1351	1351	1351	1351	1351	1351
Storage Facilities	-	26	112	112	112	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301	2301
Distribution Pipelines	-	1176	2432	3629	4922	6317	6317	6317	6536	8239	10044	10044	10044	10044	10044	10044	10044	10044	10044	10044	10044	10044	10044
Internal Network	-	7	28	28	225	438	668	917	1248	1644	2064	2509	2981	3476	3476	3476	3476	3476	3476	3476	3476	3476	3476
Fire Hydrants	-	5	19	19	154	299	456	626	829	944	1066	1195	1332	1477	1477	1477	1477	1477	1477	1477	1477	1477	1477
Service Connection - Pipes		479	1002	1507	2104	2749	3446	4199	5140	5921	6749	7626	8556	9542	9542	9542	9542	9542	9542	9542	9542	9542	9542
Plumbing Shop - Structure	-	4	15	15	546	546	546	546	546	546	546	546	546	546	546	546	546	546	546	546	546	546	546
Administration Building - Structure	-	14	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460
Leakage Survey and Repairs - Labor		56	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117	117
Total 50 Years Life	3185	4952	7242	8897	11603	14912	15931	17054	18748	21633	24808	26259	27688	29314	29314	29314	29314	29314	29314	29314	29314	29314	29314

ANNEX TABLE X-F-1 (CONTINUED)

ASSET AND DEPRECIABLE VALUE FORECAST
SILAY WATER DISTRICT
(P x 1000)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
B. 30 Years Service Life											
Feasibility Studies	–	52	52	309	309	309	309	309	309	309	309
Total 30 Years Life	–	52	[illegible]	309	309	309	309	309	309	309	[illegible]
C. 25 Years Service Life											
Existing Facilities	149	149	149	149	149	–	–	–	–	–	
Source Facilities – Structure	–	102	102	102	102	102	102	102	102	102	102
Source Facilities – Wells	–	21	88	88	88	1798	1798	1798	2092	4374	4374
Total 25 Years Life	149	272	339	339	339	1900	1900	1900	2194	4476	4476
D. 15 Years Service Life											
Existing Facilities	114	114	–	–	–	–	–	–	–	–	–
Source Facilities – Equipment		211	232	232	232	771	771	771	864	1584	1584
Service Connection – Meters	–	237	489	742	9[illegible]7	1169	1408	1667	1998	2294	2608
Plumbing Shop – Equipment	–	–	1	1	42	42	42	42	42	42	42
Administration Building – Equipment	–	2	78	78	78	[illegible]	78	78	78	78	[illegible]
Leakage Survey and Repairs – Equipment	–	5	11	11	11	11	11	11	11	11	11
Miscellaneous Items	–	24	24	24	24	24	24	24	24	24	24
Total 15 Years Life	114	593	[illegible]35	[illegible]	1334	2095	2334	2593	3017	40[illegible]	4347
E. 7 Years Service Life											
Vehicle	–	–	76	76	76	76	76	76	76	130	130
Total 7 Years Life	–	–	76	76	76	76	76	76	76	130	130
TOTAL DEPRECIABLE VALUES	3448	5369	8544	10709	13661	19292	20550	21932	24344	30581	34070
TOTAL BOOK VALUE OF ASSETS OTHER THAN LAND	5869	8786	1075[illegible]	13708	20719	20615	21[illegible]	24344	30767	34070	37541
LAND	115	115	145	145	145	145	145	145	147	147	147
TOTAL BOOK VALUE OF ALL CAPITAL ASSET	[illegible]984	8901	10901	13853	2[illegible]64	20760	22126	24459	30914	34217	37688

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
B. 30 Years Service Life												
Feasibility Studies	309	309	309	3[illegible]	309	309	309	309	309	309	309	309
Total 30 Years Life	[illegible]	309	309	309	[illegible]	309	309	309	309	309	309	309
C. 25 Years Service Life												
Existing Facilities												
Source Facilities – Structure	102	102	102	[illegible]	102	102	102	102	102	102	[illegible]2	[illegible]2
Source Facilities – Wells	5656	5656	7097	7[illegible]	[illegible]097	7097	7097	7097	709[illegible]	[illegible]097	7097	7097
Total 25 Years Life	5758	5758	7199	[illegible]199	7199	7199	7199	7199	7199	7199	7199	7199
D. 15 Years Service Life												
Existing Facilities	–	–	–	–	–	–	–	–	–	–	–	–
Source Facilities – Equipment	1989	1989	2444	2444	2444	2812	2791	2791	2791	3620	3620	3620
Service Connection – Meters	2941	3294	3[illegible]73	36[illegible]	[illegible]73	4026	4402	4[illegible]5	5140	5480	5837	6210
Plumbing Shop – Equipment	42	42	42	44	42	42	41	41	1[illegible]	105	105	105
Administration Building – Equipment	78	78	76	78	78	76	207	[illegible]7	[illegible]	207	207	207
Leakage Survey and Repairs – Equipment	11	11	11	11	1	[illegible]	29	29	29	29	29	29
Miscellaneous Items	24	24	[illegible]	[illegible]	2[illegible]	68	68	68	68	68	68	68
Total 15 Years Life	5085	5438	6272	6272	[illegible]	7044	[illegible]538	[illegible]	8340	95[illegible]9	[illegible]66	10239
E. 7 Years Service Life												
Vehicle	130	130	130	130	130	196	196	196	196	196	196	196
Total 7 Years Life	130	130	130	130	130	196	196	196	196	196	[illegible]96	[illegible]96
TOTAL DEPRECIABLE VALUES	3[illegible]	39323	43224	43224	43[illegible]24	4406[illegible]	44[illegible]56	44969	45[illegible]58	46527	46884	47[illegible]
TOTAL BOOK VALUE OF ASSETS OTHER THAN LAND	[illegible]133	43224	43224	43224	44[illegible]	44912	45222	45504	47288	47123	47516	48229
LAND	147	147	147	147	147	147	147	147	147	147	147	147
TOTAL BOOK VALUE OF ALL CAPITAL ASSET	39580	43371	43[illegible]	43371	44818	45059	[illegible]369	4575[illegible]	47[illegible]5	47270	47563	[illegible]376

ANNEX TABLE X-F-2

SCHEDULE OF DEPRECIATION EXPENSES
SILAY WATER DISTRICT
(₱ x 1000)

Year	Service Life Category					Total Annual Depreciation Expenses	Accumulated Depreciation Prior Year	Book Value of Assets Retired During the Year					Net Accumulated Depreciation Year End
	50 Years	30 Years	25 Years	15 Years	7 Years			50 Years	25 Years	15 Years	7 Years	Total	
1978	64	-	6	8	-	78	2,215						2,293
1979	99	2	11	40	-	152	2,293						2,445
1980	145	2	14	56	11	228	2,445	128		114		242	2,431
1981	178	10	14	73	11	286	2,431	47				47	2,670
1982	232	10	14	89	11	356	2,670	47				47	2,979
1983	298	10	76	140	11	535	2,979	1,278	149			1,427	2,087
1984	319	10	76	156	11	572	2,087	65				65	2,594
1985	341	10	76	173	11	611	2,594	49				49	3,156
1986	375	10	88	201	11	685	3,156					-	3,841
1987	433	10	179	269	19	910	3,841	110			76	186	4,565
1988	496	10	179	290	19	994	4,565						5,559
1989	525	10	230	339	19	1,123	5,559						6,682
1990	554	10	230	363	19	1,176	6,682	110				110	7,748
1991	586	10	288	418	19	1,321	7,748						9,069
1992	586	10	288	418	19	1,321	9,069						10,390
1993	586	10	288	418	19	1,321	10,390						11,711
1994	586	10	288	470	28	1,382	11,711			479	130	609	12,484
1995	586	10	288	503	28	1,415	12,484			356		356	13,543
1996	586	10	288	530	28	1,442	13,543			253		253	14,732
1997	586	10	288	556	28	1,468	14,732			246		246	15,954
1998	586	10	288	634	28	1,546	15,954			761		761	16,739
1999	586	10	288	658	28	1,570	16,739			239		239	18,070
2000	586	10	288	683	28	1,595	18,070			259		259	19,406

ANNEX TABLE X-F-3

WORKING CAPITAL REQUIREMENTS
FOR REVOLVING FUND FOR NEW CONNECTIONS
SILAY CITY WATER DISTRICT

Year	Number of New Connections	Number of Installment Plan Added	Number of Installment Plan Paid	Total Paying Monthly Installment (Cumulative)	Monthly Installment Plan, ₱ (Escalated)	Increment Added 4/	Increment Deducted 5/	Lump Sum Payments 6/ (Escalated)	Installment Payments (Cumulative)	Total Payments	Annual Construction Cost 7/	Working Capital Required	Cumulative Capital Requirement
						₱ x 1000							
1978	510	306	0	306	6.83	25	0	129	13	142	323	181	181
1979	511	307		613	7.51	26		142	39	181	355	174	355
1980	511	307		920	8.26	30		156	68	224	391	16	522
1981	613	368		1,288	8.92	39		203	103	306	507	201	723
1982	613	368		1,656	9.63	43		219	144	363	548	185	908
1983	613	368		2,024	10.40	46		237	188	425	592	167	1,075
1984	613	368		2,392	11.23	50		256	236	492	639	147	1,222
1985	613	368		2,760	12.13	54		276	288	564	690	126	1,348
1986	613	368		3,128	12.86	57		293	344	637	732	95	1,443
1987	613	368		3,496	13.63	60		310	402	712	775	64	1,507
1988	613	368	153	3,711	14.45	64	13	329	451	780	822	42	1,549
1989	613	368	307	3,772	15.31	68	27	348	490	838	871	33	1,582
1990	613	368	307	3,833	16.23	72	29	369	531	900	923	23	1,605
1991	0	0	338	3,495	17.20	0	35	0	532	532	0	(532)	1,073
1992			368	3,127	18.23		41		491	491		(491)	582
1993			368	2,759	19.32		45		446	446		(446)	136
1994			368	2,391	20.48		48		398	398		(398)	(262)
1995			368	2,023	21.71		52		346	346		(346)	(608)
1996			368	1,655	23.01		56		290	290		(290)	(898)
1997			368	1,287	24.39		59		231	231		(231)	(1,129)
1998			368	919	25.85		62		169	169		(169)	(1,298)
1999			368	551	27.40		66		103	103		(103)	(1,401)
2000			368	183	29.04		70		33	33		(33)	(1,434)

4/ Accumulated installment payments are calculated on the basis of 100 percent incremental additions during previous years and 50 percent of the last year.
5/ Based on the assumption that installment plan will be paid back in ten years.
6/ Assumed to be 40 percent of construction cost.
7/ Amount to be shouldered by the customers which is : 2/3 of pipes + meters.

ANNEX TABLE X-F-4a

STRATIFICATION OF SERVICE CONNECTION
SILAY CITY WATER DISTRICT

Year	Domestic/Government 1/2"	3/4"	1"	Sub-Total	Commercial/Industrial 1/2"	3/4"	1"	Sub-Total	Total
1978	1,186	50	12	1,248	128	27	15	170	1,4[illegible]
1980	2,040	86	21	2,1[illegible]	220	47	26	293	2,440
1985	4,602	194	48	4,8[illegible]	496	106	59	661	5,505
1990	7,165	302	75	7,542	771	164	93	1,028	8,570

ANNEX TABLE X-F-4b

REVENUE UNIT FORECAST 8/

Year	Domestic / Government 1/2" (2.5)	3/4" (4.0)	1" (8.0)	Sub-Total	Commercial / Industrial 1/2" (5.0)	3/4" (8.0)	1" (16.0)	Sub-Total	Grand Total 9/	Service Charge (RUs) 10/	Estimated Consumption (cum/year) Domestic	Commercial	Commodity Charge (RUs) Domestic 11/	Commercial 12/	Total Revenue Units
1978	2,965	200	96	3,261	640	216	240	1,096	4,357	522,840	327,040	42,705	177,280	44,610	[illegible]44,730
1980	5,100	344	168	5,612	1,100	376	415	1,892	7,504	900,480	598,965	79,935	341,325	[illegible]9,550	1,[illegible]31,355
1985	11,505	776	384	12,665	2,480	848	944	4,272	16,937	2,032,440	1,208,150	171,185	626,870	183,73[illegible]	2,[illegible]43,040
1990	17,913	1,208	600	19,721	3,855	1,312	1,486	6,655	26,376	3,165,120	2,403,160	380,695	1,498,120	514,67[illegible]	5,[illegible]77,910

8/ Computation of revenue units based on LWUA guidelines on structuring water rates.
9/ Grand total of number of connections multiplied by their respective conversion factors for computing revenue units (in RUs).
10/ Multiply grand total by 120 (derived from 10 cum/month, the minimum amount covered by the service charge 12 months/year) in RUs.
11/ Domestic consumption - (120 x number of domestic connections) x use factor. Use factor for domestic/institutional classification is 1.
12/ Commercial consumption - (120 x number of commercial connections) x use factor. Use factor for commercial classification is 2.

ANNEX X-G

ANALYSIS OF WATER RATES

ANNEX TABLE X-G-1

REVENUE FORECASTS
SILAY CITY WATER DISTRICT

Year	Rate/RU ₱	Estimated Number of RUS (Yearly in 000s)	Income from Sales	₱ x 1000 (Bad Debt)	Other Income 13/	Total Net Income
1978	0.80	745	596	12	12	596
1979	0.80	1,038	830	8	17	839
1980	0.80	1,331	1,065	11	21	1,075
1981	1.20	1,633	1,960	39	39	1,960
1982	1.20	1,936	2,323	23	46	2,346
1983	1.20	2,238	2,686	27	54	2,713
1984	1.50	2,541	3,812	76	76	3,812
1985	1.50	2,843	4,205	43	85	4,307
1986	1.50	3,310	4,965	50	99	5,014
1987	1.70	3,777	6,421	128	128	6,421
1988	1.70	4,244	7,215	72	144	7,287
1989	1.70	4,711	8,009	80	160	8,089
1990	1.70	5,178	8,803	88	176	8,891
1991	1.70	↓	8,803	88	176	8,891
1992	1.80	↓	9,320	186	186	9,320
1993	1.80	↓	9,320	93	186	9,413
1994	1.80	↓	9,320	93	186	9,413
1995	1.80	↓	9,320	93	186	9,413
1996	1.80	↓	9,320	93	186	9,413
1997	2.00	↓	10,356	207	207	10,356
1998	2.00	↓	10,356	104	207	10,459
1999	2.00	↓	10,356	104	207	10,459
2000	2.00	5,178	10,356	104	207	10,459

13/ Other income (derived from meter replacement charges, contingency fees of new connections, service fees, etc.) is about 2% of sales.

ANNEX X-H

FINANCIAL SUMMARY

ANNEX TABLE X-H-1

DEBT SERVICE SCHEDULE OF TOTAL PROJECT LOAN*
SILAY CITY WATER DISTRICT
(₱ x 1000)

Year	Outstanding Loan End of Year: Immediate Improvement	Phase I-A and I-B	Total	Capital Repayments: Immediate Improvement	Phase I-A and I-B	Total	Interest Payments: Immediate Improvement	Phase I-A and I-B	Total	Total Debt Service
1978	2,449	6	2,455	-	-	-	46	-	46	46
1979	5,075	298	5,373	-	-	-	148	1	149	149
1980	6,110	1,558	7,668	-	-	-	214	27	241	241
1981	6,437	4,251	10,688	-	-	-	223	140	363	363
1982	6,389	10,946	17,335	48	-	48	579	383	962	1,010
1983	6,337	11,844	18,181	52	-	52	575	985	1,560	1,612
1984	6,280	12,783	19,063	57	-	57	570	1,066	1,636	1,693
1985	6,218	14,631	20,849	62	-	62	565	1,150	1,715	1,777
1986	6,151	20,179	26,330	67	110	177	560	1,317	1,877	2,054
1987	6,078	22,846	28,924	73	110	183	554	1,816	2,370	2,553
1988	5,998	25,427	31,425	80	110	190	547	2,056	2,603	2,793
1989	5,911	26,317	32,228	87	164	251	540	2,288	2,828	3,079
1990	5,816	29,154	34,970	95	164	259	532	2,369	2,901	3,160
1991	5,712	28,876	34,588	104	278	382	523	2,624	3,147	3,529
1992	5,599	28,487	34,086	113	389	502	514	2,599	3,113	3,615
1993	5,476	28,098	33,574	123	389	512	504	2,564	3,068	3,580
1994	5,342	27,542	32,884	134	556	690	493	2,529	3,022	3,712
1995	5,196	26,986	32,182	146	556	702	481	2,479	2,960	3,662
1996	5,037	26,322	31,359	159	664	823	468	2,429	2,897	3,720
1997	4,863	25,544	30,407	174	778	952	453	2,369	2,822	3,774
1998	4,674	24,766	29,440	189	778	967	438	2,299	2,737	3,704
1999	4,468	23,874	28,342	206	892	1,098	421	2,229	2,650	3,748
2000	4,243	22,871	27,114	225	1,003	1,228	402	2,149	2,551	3,779

*Immediate Improvement, Phase I-A and Phase I-B only.

ANNEX TABLE X-H-2

PROJECTED INCOME STATEMENT
SILAY WATER DISTRICT
(P x 1000)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Water Production Per Year (1,000 x cum)	925 →		1130 →					2085 →				
Water Sales Per Year (1,000 x cum)	370 →		679 →					1379 →				
Unaccounted-for-water (%)	60 →		40 →					34 →				
Connections: - Metered	1418 →		2440 →					5505 →				
Consumption (lpcd)	130 →		105 →					113 →				
OPERATING REVENUE												
Water Sales	596	830	1065	1960	2323	2686	3812	4265	4965	6421	7215	8009
Less: Uncollectibles	12	8	11	39	23	27	76	43	50	128	72	80
Other Revenue	12	17	21	39	46	54	76	85	99	128	144	160
Total Revenue	596	839	1075	1960	2346	2713	3812	4307	5014	6421	7287	8089
OPERATING EXPENSES												
Administration and Personnel	220	[illegible]	296	353	405	556	612	667	791	923	997	1111
Power and Fuel	72	108	150	178	253	316	387	465	557	660	774	908
Chemicals	6	11	17	21	27	33	40	48	56	67	78	90
Maintenance	48	74	79	115	156	204	218	233	250	318	395	[illegible]
Miscellaneous	81	91	102	114	129	145	165	186	212	241	276	315
Depreciation	78	152	228	286	356	535	572	611	685	910	924	1123
Total Operating Expenses	505	591	872	1087	1326	1739	1994	2210	2551	3119	3514	3922
Operating Income	91	148	203	873	1020	924	1818	2097	2463	3302	3777	4167
Plus: Interest on Reserves	1	4	8	14	23	34	48	65	84	108	1	169
Net Income Before Interest	92	152	211	887	1043	958	1866	2162	2547	3410	3910	4336
Interest on Debt	46	149	241	363	[illegible]	1560	1636	1715	1877	2370	2603	2828
Net Income (Loss)	46	3	(30)	524	[illegible]	(602)	230	447	670	1040	1307	1508
Cumulative Net Income (Loss)	46	49	19	543	624	22	252	699	1369	2409	3716	5224
Appropriation to Reserves	18	25	32	59	70	81	114	128	149	193	216	240
Average Net Fixed Assets in Operation	2493	5226	7845	10510	15381	19126	19950	21280	25050	29210	31738	33361
Rate of Return (%)	3.65	2.83	2.59	8.31	6.63	4.83	9.11	9.85	9.83	11.30	11.89	12.49

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Water Production Per Year (1,000 x cum)	3865 →										3865
Water Sales Per Year (1,000 x cum)	2784 →										2784
Unaccounted-for-water (%)	28 →										28
Connections: - Metered	8570 →										8570
Consumption (lpcd)	120 →										120
OPERATING REVENUE											
Water Sales	8803	8803	9320	9320	9320	9320	9320	10356	10356	10356	10356
Less: Uncollectibles	88	88	186	93	93	93	93	207	104	104	104
Other Revenue	176	176	186	186	186	186	186	207	207	207	207
Total Revenue	8891	8891	9320	9413	9413	9413	9413	10356	10459	10459	10459
OPERATING EXPENSES											
Administration and Personnel	1394	1396	1509	1627	1761	1900	2054	2218	2392	2582	2793
Power and Fuel	1043	1132	1223	1319	1427	1539	1664	1797	1939	2092	2263
Chemicals	105	113	122	132	142	154	166	179	193	209	226
Maintenance	517	556	604	651	704	760	821	887	957	1033	1117
Miscellaneous	[illegible]	391	422	455	493	531	574	620	569	722	781
Depreciation	1176	1321	1321	1321	1382	1415	1442	1468	1546	1570	1595
Total Operating Expenses	4502	4909	5201	5505	5909	[illegible]	6721	7159	7596	8208	8775
Operating Income	4389	3982	4119	3908	3504	[illegible]	2692	3187	2763	2251	1684
Plus: Interest on Reserves	204	259	335	413	491	569	674	812	957	1102	1247
Net Income Before Interest	4593	4241	4454	4321	3995	3683	3366	3999	3720	3353	2931
Interest on Debt	2901	3147	3113	3068	3022	2960	2897	2822	2737	2650	2551
Net Income (Loss)	1692	1094	1341	1253	973	723	469	1177	983	703	380
Cumulative Net Income (Loss)	6916	8010	9351	10604	11577	[illegible]	12769	13946	14929	15632	16012
Appropriation to Reserves	264	528	559	559	559	559	932	1036	1036	1036	[illegible]
Average Net Fixed Assets in Operation	35108	35810	34489	33891	33688	33048	32270	32097	31853	30909	30129
Rate of Return (%)	12.50	11.12	11.94	11.53	10.40	9.42	8.34	9.93	8.57	7.26	5.59

ANNEX TABLE X-H-3

PROJECTED SOURCES AND APPLICATIONS OF FUNDS
[illegible] WATER DISTRICT
(P x 1000)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
SOURCES OF FUNDS											
Net Income Before Interest	92	152	211	887	1043	958	1866	2162	2547	3410	3910
Add: Depreciation	78	152	228	286	356	535	572	611	685	910	994
Total Internal Cash Generation	170	304	439	1173	1399	1493	2438	2773	3232	4320	4904
Long-Term Borrowing	2455	2918	2295	3020	6695	898	939	1848	5658	2777	2691
Capital Contributions	142	181	224	306	363	425	492	564	637	712	780
Total External Cash Generation	2597	3099	2519	3326	7058	1323	1431	2412	6295	3489	3471
Total Sources of Funds	2767	3403	2958	4499	8457	2816	3869	5185	9527	7809	8375
APPLICATIONS OF FUNDS											
Capital Expenditures	2536	2917	2242	2999	7058	1323	1431	2412	6295	3489	3471
Capitalized Interest	61	182	277	327							
Debt Service: Interest	46	149	241	[illegible]	962	1560	1636	1715	1877	2370	2603
Principal	–	–	–	–	48	52	57	62	177	183	190
Sub-total Debt Service	46	149	241	363	1010	1612	1693	1777	2054	2553	2793
Replacements									130		
Increase in Working Capital	285	65	64	206	91	68	263	181	68	312	187
Total Applications of Funds	2928	3313	2824	3895	8159	3003	3392	4370	8547	6354	6451
INCREASE (DECREASE) IN CASH BALANCE	(161)	90	134	604	298	(18[illegible])	477	815	980	1455	1924
CASH BALANCE BEGINNING OF YEAR	0	(161)	(71)	63	667	965	778	1255	2070	3050	4505
CASH BALANCE END OF YEAR	(161)	(71)	63	667	965	778	1255	2070	3050	4505	6429
DEBT-SERVICE RATIO*	3.70	2.[illegible]	1.82	3.23	1.39	0.93	1.44	1.56	1.57	1.69	1.76
RATIO OF INTERNALLY GENERATED CASH LESS DEBT SERVICE TO CAPITAL EXPENDITURE (%)	4.77	5.00	7.86	24.35	5.51	–	52.06	58.08	18.33	50.64	60.82

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
SOURCES OF FUNDS												
Net Income Before Interest	4336	4593	4261	4454	4321	3995	[illegible]83	3156	3999	3720	3352	[illegible]
Add: Depreciation	1123	1176	1321	1321	1321	1182	1215	1442	1468	1546	157[illegible]	1595
Total Internal Cash Generation	5459	5769	[illegible]	5775	[illegible]	5177	[illegible]	4598	5467	[illegible]	492[illegible]	[illegible]
Long-Term Borrowing	1054	1201										
Capital Contributions	838	900	530	491	446	398	346	290	231	159	103	33
Total External Cash Generation	1892	1901	537	491	446	398	346	290	231	159	103	33
Total Sources of Funds	7351	9670	60[illegible]4	6266	6063	5775	5[illegible]	5098	5698	5435	5024	4559
APPLICATIONS OF FUNDS												
Capital Expenditures	[illegible]	[illegible]										
Capitalized Interest												
Debt Service: Interest	2828	2901	3147	3113	3068	3022	2960	2897	2822	2737	2650	2551
Principal	251	259	382	502	512	690	702	823	952	96[illegible]	1098	1228
Sub-total Debt Service	3079	3160	3529	3615	3580	3712	3662	3[illegible]0	3774	3704	3748	3779
Replacements					1447	850	666	635	1930	536	632	[illegible]72
Increase in Working Capital	178	142	(496)	58	174	(43)	(42)	(107)	175	(33)	(63)	(31)
Total Applications of Funds	5149	7203	3033	3673	5201	4519	4286	4248	5879	4267	4317	[illegible]
INCREASE (DECREASE) IN CASH BALANCE	2202	2467	3061	2593	887	1256	115[illegible]	850	(181)	11[illegible]	709	(121)
CASH BALANCE BEGINNING OF YEAR	6429	8631	11098	14159	16752	17639	18895	20053	20903	20722	21890	22599
CASH BALANCE END OF YEAR	8631	11098	14159	16752	17639	18895	20053	20903	20722	21890	22599	22478
DEBT-SERVICE RATIO*	1.77	1.83	1.[illegible]	1.60	1.58	1.45	1.[illegible]	1.29	1.45	1.42	1.31	1.20
RATIO OF INTERNALLY GENERATED CASH LESS DEBT SERVICE TO CAPITAL EXPENDITURE (%)	125.79	66.85										

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*Ratio of internally generated cash to debt service.

ANNEX TABLE X-H-4

PROJECTED BALANCE SHEET
SILAY WATER DISTRICT
(₱ x 1000)

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
ASSETS												
Fixed Assets:												
Gross Value of Fixed Assets	6045	9144	11421	14700	21711	21607	22973	25336	31761	35064	38535	40427
Less: Accumulated Depreciation	2293	2445	2431	2670	2979	2087	2594	3156	3841	4565	5559	6682
	3752	6699	8990	12030	18732	19520	20379	22180	27920	30499	32976	33745
Current Assets:												
Cash	(161)	(71)	63	667	965	778	1255	2070	3050	4505	6429	8631
Accounts Receivable	149	208	266	490	581	672	953	1066	1241	1605	1804	2002
Provision for Bad Debts	(3)	(2)	(3)	(10)	(6)	(7)	(19)	(11)	(12)	(32)	(18)	(20)
Inventories	210	234	258	274	298	323	350	440	378	403	429	458
Total Current Assets	195	369	584	1421	1838	1766	2539	3565	4657	6481	8644	11071
Total Assets	3947	7068	9574	13451	20570	21286	22918	25745	32577	36980	41620	44816
EQUITY AND LIABILITIES												
Current Liabilities:												
Accounts Payable	71	90	107	134	162	209	237	267	311	368	420	467
Current Maturities of Long-Term Debt	–	–	–	48	52	57	62	177	183	190	251	259
Total Current Liabilities	71	90	107	182	214	266	299	444	494	558	671	726
Long-Term Debts (Current Maturities)	2455	5373	7668	10640	17283	18124	19001	20672	26147	28734	31174	31969
Equity:												
Government Contribution	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233
Capital Contribution	142	323	547	853	1216	1641	2133	2697	3334	4046	4826	5664
Reserves	18	43	75	134	204	285	399	527	676	869	1085	1325
Unappropriated Retained Earnings	28	6	(56)	409	420	(263)	(147)	172	673	1640	2631	3899
Total Equity	14[illegible]	1605	1799	2629	3073	2896	3618	4629	5936	7660	9775	12121
Total Equity and Liabilities	3947	7068	9574	13451	20570	21286	22918	25745	32577	36980	41620	44816

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
ASSETS											
Fixed Assets:											
Gross Value of Fixed Assets	44218	44218	44218	45665	45906	46216	46598	48282	48117	48510	49223
Less: Accumulated Depreciation	7748	9069	10390	11711	12484	13543	14732	15954	16739	18070	19406
	36470	35149	33828	33954	33422	32673	31866	32328	31378	30440	29817
Current Assets:											
Cash	11098	14159	16752	17639	18895	20053	20903	20722	21890	22599	20478
Accounts Receivable	2201	2201	2330	2330	2330	2330	2330	2589	2589	2589	2589
Provision for Bad Debts	(22)	(22)	(47)	(23)	(23)	(23)	(23)	(52)	(26)	(26)	(26)
Inventories	490	38	41	241	[illegible]	273	232	247	263	281	301
Total Current Assets	13767	16376	19076	20187	21458	22633	23442	23506	24716	25443	25342
Total Assets	50237	51525	52904	54141	54880	55306	55308	55834	56094	55883	55159
EQUITY AND LIABILITIES											
Current Liabilities:											
Accounts Payable	554	598	647	697	755	814	880	950	1025	1106	1197
Current Maturities of Long-Term Debt	382	502	512	690	702	823	952	967	1098	1228	1361
Total Current Liabilities	936	1100	1159	1387	1457	1637	1832	1917	2123	2334	2558
Long-Term Debts (Current Maturities)	34588	34086	33574	32884	32182	31359	30407	29440	28342	27114	25753
Equity:											
Government Contribution	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233	1233
Capital Contribution	6564	7096	7587	8033	8431	8777	9067	9298	9467	[illegible]	9603
Reserves	1589	2117	2676	3235	3794	4353	5285	6321	7357	8393	9429
Unappropriated Retained Earnings	5327	5893	6675	7369	7783	7947	7484	7625	7572	7239	6583
Total Equity	14713	16339	18171	19870	21241	22310	23069	24477	25629	26435	26848
Total Equity and Liabilities	50237	51525	52904	54141	54880	55306	55308	55834	56094	55883	55159

ANNEX TABLE X-H-5

RATE OF RETURN ON TOTAL INVESTMENT (DISCOUNTED CASH FLOW METHOD) SILAY CITY WATER DISTRICT (₱ x 1000)

Year	Debt Service	Net Increase In Cash	Total Cash Inflow	Investments	Net Cash Inflow	1st Present Factor	Trial Value: 5% Value	2nd Present Factor	Trial Value: 10% Value
1976									
1977									
1978	46	(161)	(115)	2,597	(2,712)	1.000	[illegible]	1.000	(2,712)
1979	149	90	239	3,099	(2,860)	.952	(2,723)	.909	(2,600)
1980	241	134	375	2,519	(2,144)	.907	(1,945)	.826	(1,771)
1981	363	604	967	3,326	(2,359)	.864	(2,038)	.751	(1,772)
1982	1,010	298	1,308	7,058	(5,750)	.823	(4,732)	.683	(3,927
1983	1,612	(187)	1,425	1,323	102	.784	80	.621	63
1984	1,693	477	2,170	1,431	739	.746	551	.564	417
1985	1,777	815	2,592	2,412	180	.711	128	.513	92
1986	2,054	980	3,034	6,425	(3,391)	.677	(2,296)	.467	(1,584)
1987	2,553	1,455	4,008	3,489	519	.645	335	.424	220
1988	2,793	1,924	4,717	3,471	1,246	.614	765	.386	481
1989	3,079	2,202	5,281	1,892	3,389	.585	1,983	.350	1,186
1990	3,160	2,467	5,627	3,901	1,726	.557	961	.319	551
1991	3,529	3,061	6,590	–	6,590	.530	3,493	.290	1,911
1992	3,615	2,593	6,208	–	6,208	.505	3,135	.263	1,633
1993	3,580	887	4,467	1.447	3,020	.481	1,453	.239	1,453
1994	3,712	1,256	4,968	[illegible]	4,118	.458	1,886	.218	898
1995	3,662	1,158	4,820		4,154	.436	1,811	.198	822
1996	3,720	850	4,570		3,935	.416	1,637	.180	708
1997	3,774	(181)	3,593	1,9[illegible]	1,663	.396	659	.164	273
1998	3,704	1,168	4,872	596	4,276	.377	1,612	.149	637
1999	3,748	709	4,457	632	3,825	.359	1,373	.135	516
2000	3,779	(121)	3,658	972	7,056 14/	.342	2,412	.123	868
							+7,828		-1,637

Rate of Return = 9.14%

14/ Includes net asset value of ₱4,370

Total Assets	-	₱ 55,159
Total Liabilities	-	(28,311)
Cash	-	(22,478)
Net Asset Value	-	₱ 4,370

CHAPTER XI ECONOMIC FEASIBILITY ANALYSIS

A. WATER AND THE ECONOMY

Introduction

Water is a basic requirement in any country's economic development and no economic activity can take place without it. However, this basic function diminishes in relative importance as a higher level of economic development is attained by a country. In most instances, the availability of water alone will not spur economic growth for there are other significant factors that influence development, such as peace and order, political stability, rate of taxation and availability of infrastructure facilities. Hence, a water supply project must be considered as only one part of a regional development program. It must be viewed within the context of the overall government program.

Considering that the Philippines is still a developing country, water supply plays a fairly important role in the national or regional economy. Traditionally, water has been made available to the consuming public at very nominal rates. There is a tendency for the consumers to use water wastefully. As a consequence, the regard given to it is far below its true importance.

To the water consumer, the value of water is measured by its contribution to the satisfaction of the family group which uses the water. His perspective includes himself and his household and all the health, well being and productivity aspects of family life. To the businessman, water is valued for all it does to improve business. From the national viewpoint, the benefits to the water user, both householder and businessman, are only a part of the total.

Major Uses of Water Supply

<u>Domestic.</u> Water for domestic use is usually given top priority because water is essential to life and, up to a point, essential to general well-being. Estimation of the beneficial value of water for domestic purposes is best viewed in terms of average willingness to pay for water rather than do without it. It will be noted that the willingness to pay is higher than the price charged insofar as most users are concerned.

<u>Industrial Use.</u> Water is used by industry primarily as a factor of production. In some instances, it goes into the production process as an input. This is the case for the soft drinks industry. One method of determining the value of water to industry is to analyze the

cost of alternative industrial processes which produce the same product but use less water. This is not, however, always possible and may be unduly laborious.

Other Uses. Crop irrigation is one of the major uses of water. The value of water used for irrigation purposes can be estimated by an elaborate calculation of "with" and "without" project conditions. All other costs are assumed to be paid and water becomes the residual claimant under "without" and "with" project conditions. Detailed analysis of the area to be irrigated is required.

Another important use is hydropower generation. Water used for this purpose may be valued by comparison with the lowest-cost alternative of providing electric power. Lastly, bodies of water serve a basic role in many recreational activities. Ordinarily, water quality is not adversely affected by recreational use. Water value in this case depends on a number of factors such as accessibility, setting, beauty and quality.

In the Philippines, the National Water Resources Council establishes the water priorities, in pursuance of the policies laid down by its charter, Presidential Decree No. 424. In general, the system of priorities for the development, conservation and utilization of the country's water resources reflects the current usage of water and is responsive to the changing demand for water. Another presidential decree (Presidential Decree No. 198) has declared that the creation, operation, maintenance and expansion of water supply and wastewater disposal systems are a national policy of high priority.

B. METHODOLOGY

Recommended and Next-Best System

One approach in determining the economic feasibility of a water supply project involves a comparison of the benefits and costs of the recommended system and those of the next best system. In this method, the capital expenditure costs and the operating and maintenance costs for both alternative systems are transformed to an equivalent annual cost basis during the projection period. The comparison will show which of the alternative systems will generate the same level of benefits at less cost.

Benefit-Cost Ratio

A second approach in determining the economic feasibility of water supply project involves the following steps:

1. The identification of the economic benefits and costs that can be attributed to the establishment, operation and maintenance of an improved water supply system;

2. The determination of the possible bases for quantifying these benefits and costs; and

3. The comparison of the present value of the benefits likely to be generated and the present value of the costs.

The results of the economic analysis are then expressed as a single ratio called the benefit-cost ratio. The project is considered feasible if the ratio is equal to or greater than 1:1.

Internal Rate of Return

Another method involves the calculation of the economic internal rate of return of the proposed project. The total amount of the benefits as well as of the costs is determined throughout the projection period. By trial and error, the interest rate at which the present worth of the benefits is equal to the present worth of the cost is then calculated. The project is considered desirable if its internal economic rate of return is higher than the minimum rate generally acceptable in such projects, which is usually the opportunity cost of capital.

Method(s) Adopted

Both the second and third methods were employed in determining this project's economic feasibility. These two were considered more appropriate than the first method because in this case, the recommended plan has already been selected from several alternatives on the basis of present worth cost comparisons (as discussed in Chapters VIII and IX).

Calculation of Benefit and Cost Streams

The economic studies cover only Stage I of the proposed water supply program, which extends from 1978 to 1990. Benefits, however, were projected up to 2000. This is because the benefits from the facilities to be constructed up to 1990 would continue to accrue beyond their construction period.

The construction costs included in the analysis are those which will be incurred up to 1990, except replacement costs and the operation and maintenance costs which were projected up to 2000. This is due to the fact that proper maintenance of the facilities will have to be undertaken regularly for as long as benefits are desired to be realized from the system.

Estimates of benefits and costs were based on 1978 prices. In recognition of inflationary pressures, all benefits were escalated by 10 percent from 1978 to 1980, by 8 percent from 1981 to 1985 and by 6 percent from 1986 to 1990. All project costs were also escalated in the same manner, with the exception of operation and maintenance costs which were escalated uniformly by 8 percent all throughout the study period. In both cases, however, the escalation factor for 1990 was held constant up to 2000. This is because only Stage I of the proposed project is being considered in the economic analysis; hence, only partial inflation has been adopted.

C. QUANTIFIABLE BENEFITS

The economic benefits that will be derived from the proposed water supply improvement program for the water district may be classified into quantifiable and non-quantifiable. Quantifiable benefits are those which can be expressed in monetary terms. On the other hand, non-quantifiable benefits are intangible but real, and are extremely difficult to express in monetary terms.

Benefits resulting from the proposed project were evaluated on an incremental basis, i.e., on a "with" or "without" principle. Hence, the benefit figures reflect only those that will accrue to the service area as a result of the improvement of the water supply system. They exclude the benefits arising from the present system.

The quantifiable benefits that are discussed in the following sections are: increase in land values, improved health conditions, reduction in fire damage, and beneficial value.

Increase in Land Values

The implementation of the water supply project will result in an increase in the land values of the service area. However, it must be pointed out that the increase in land values cannot be attributed solely to the water supply project. Any difference between the acquisition cost and the present market value of a piece of land evolves from a series of market and public forces which exist whether or not the water supply project is undertaken. Such forces include the general pace of industrialization, construction activity, inflation, land speculation, taxation, public land acquisition and selling. More particularly, such a difference could be the result of a general estimation of productivity due to infrastructure investments which include a water supply project.

The portion of land values attributable to the provision of an improved public water supply system was estimated in the household survey in Lipa City (May 1975) to be about 22.6 percent of the market value of a piece of land. It is reasonable to assume that this figure represents the incremental value of a piece of land, given access to water supply. In a specific instance, a residential lot about 400 sqm has the following market values:

Without Water	400 sqm x ₱50	=	₱20,000	
With Water	400 sqm x ₱65	=	₱26,000	
		Ratio	=	1.3 or 30% increase

In this particular case, the incremental cost of ₱6,000 closely represents the market value of a private well (complete with pumps, electric controls, etc.) to serve the premises.

On the basis of this information, it may be conservative to assume that 20 percent of the value of land served by the water distribution system could be attributed to the water supply project.

Assumptions made for this analysis are explained in Annex XI-C. Annex Table XI-C-1 shows the computations of this benefit, which amounts to a present worth of ₱ 22.7 million.

Health Benefits

The establishment of a water supply system in a community will necessarily bring about health benefits to the population. Undoubtedly, the provision of safe, potable water to the population is a prerequisite for the maintenance of minimum health standards. These health benefits are ordinarily manifested in the following:

1. A significant reduction in the incidence of water-borne diseases such as cholera, dysentery, gastro-enteritis, and typhoid/paratyphoid. As a result, there will be a decrease in the amount of time lost by income earners who are afflicted with such diseases.

2. A subsequent reduction in premature deaths due to the lower incidence of water-borne diseases.

3. A corresponding reduction in medical expenses for the same reason.

Calculation for the health benefits and associated assumptions used are presented in Annex XI-C. Annex XI-C-2 shows the health benefits on a yearly basis, with a total present worth of ₱914,362.

Reduction in Fire Damage

With the installation of suitable fire hydrants especially in the high-value as well as the residential districts in the service area as part of the proposed project, savings due to reduced fire damages will result from the availability of an adequate amount of water and increased water pressure for fire-fighting purposes. Calculations relative to this benefit are explained in Annex XI-C and shown in detail in Annex Table XI-C-3. The present value of this benefit amounts to ₱8.3 million.

No attempt was made to quantify the inconvenience to the people rendered homeless and the value of human lives lost due to fire.

Beneficial Value of Water

This benefit (sometimes called "consumer satisfaction") is quantified by the additional revenue generated by the water district as a result of an improved water supply project. In the case of a community which previously did not have any piped water system, the "consumer satisfaction" benefit may be measured by the full amount of the economic value of the accounted-for-water.

For a community where the proposed project involves merely the expansion and improvement of the existing system, this benefit may be measured by the economic value of the incremental water production directly resulting from the improvement of the system.

For this benefit, the concept of consumers surplus was adopted. This concept takes into account not only what households and commercial establishments are actually paying for water but also how much more the consumers are willing to pay for this essential commodity. Calculations for the beneficial value of water are shown in Annex XI-C and Annex Table XI-C-4. The present value of this benefit amounts to ₱19.8 million.

D. NON-QUANTIFIABLE BENEFITS

The non-quantifiable benefits arising from a water supply project are generally as important as the quantifiable benefits. However, they do not easily lend themselves to valuation. The approach taken herein is to acknowledge their existence and importance. No attempt has been made to quantify or include them in the benefit-cost calculations.

The proposed water supply project will set off a chain of events beyond its construction period. Those activities include among others the inducement to industry to establish plants in the service area due to availability of dependable water supply. Without such supply, new industrial and commercial establishments would be forced to develop their own supply system or relocate elsewhere. The overall cost of providing separate water systems is normally large and represents a deterrent to invest in the area and consequently to industrial development.

Because of the employment generated by the project, hired laborers are able to spend their wages for purchasing goods at the local stores. Hence, each peso they spend is generated back into the income stream of the local economy. In the operation and maintenance of the project, the water district would find it advantageous to purchase required supplies locally and engage local service.

E. ECONOMIC COSTS

General

The total cost of the proposed water supply system is the sum of all expenditures required to realize project objectives and benefits.

Costs have been divided into the following:

1. Project Costs
2. Replacement Costs
3. Operating and Maintenance Costs

In general, economic costs are easier to identify and quantify than benefits. This is because most of the costs are incurred in real, monetary terms to pay for either goods or services while benefits are usually intangible.

Project Costs

Project costs include the construction cost of the proposed facilities such as pipes, meters and equipment, as well as, engineering services and contingencies, and land cost. The cost of the feasibility studies has also been included.

Annex Table XI-F-1 shows the construction costs of the proposed water supply project for the water district. They are listed by component as to type of expenditure in 1978 prices. They are further broken down into foreign and domestic components.

The cost of unskilled labor is shown separately from the domestic component of the project. From the balance of the domestic cost, 5 percent was assumed to be in the form of hidden taxes.

Adjustment on Project Costs

In the determination of the project costs, adjustments were made for those items which are not properly valued by the price mechanism. A price other than the market price (called the shadow price) was imputed to these items. In this way, most of the effects of price discrepancies which could be identified, whether primary or secondary, were incorporated directly into the project analysis and imputed as direct costs to project investment. The 'shadow prices' used in this analysis are those employed by international lending institutions and the Planning and Project Development Office (PPDO) of the Department of Public Works, Transportation and Communication.

One of the items where 'shadow pricing' was applied is the price of unskilled labor (otherwise known as common labor). In a perfectly competitive market, the price of labor is determined by the marginal value of its product. In this case, therefore, the price of labor is equal to the value of the output which an extra laborer hired would produce. However, this is not applicable in an economy such as that of the Philippines where there is a surplus of labor. Since there is widespread disguised unemployment in such an economy, unskilled labor is normally valued below the actual wage rate likely to be paid. In this study, the opportunity cost of unskilled labor or its potential in other employment was valued at one half of its estimated cost in the project. The net effect is to reduce the cost of unskilled labor by 50 percent, thereby reducing the summation of project cost.

Skilled labor, on the other hand, was valued at its going rate. It was assumed that if skilled labor were not employed in the service area, it would probably migrate elsewhere to obtain employment or better wage.

Adjustments were also made with respect to cost of project facilities which use up the limited foreign exchange reserves. Foreign exchange used to import project components was valued at 1.2 times their actual peso cost. This effectively increased foreign exchange cost by 20 percent, thereby affecting project cost in a similar manner. This was done to reflect the opportunity cost or alternative value of foreign exchange. Domestic components, on the other hand, were priced at their actual cost.

Interest was likewise not included since this is considered a financial instead of an economic cost.

Annex Table XI-E-1 shows the conversion of financial costs to economic costs through shadow pricing and other adjustments. The present value (see Table XI-E-4) of total economic project cost for SIL-WD amounts to ₱22.0 million.

Replacement Costs

Based on the criteria used in the financial studies, vehicles have a life expectancy of 7 years while meters are expected to be replaced every 15 years. Other items which have a service life of 15 years are the equipment of the source facilities, plumbing shop and administration building, as well as those for leakage survey and repair and miscellaneous items. All wells and their structures were assumed to be serviceable for 25 years. The feasibility studies were assumed to be valid for 30 years. All other facilities in the system are expected to last for 50 years.

During the 23-year period from 1978 to 2000, therefore, vehicles, meters, equipment with a service life of 15 years and the miscellaneous items will have to be replaced. Annex Table XI-E-2 shows the replacement schedule and costs of vehicles, meters, equipment and miscellaneous items. The present value of total replacement costs (see Table XI-E-4) for SIL-WD amounts to ₱631,900.

Salvage Value

Annex Table XI-E-3 shows the salvage value in 2001 of all the capital equipment to be used in the project. The percentage of salvage value was based on the remaining service life of the facilities in 2001. For SIL-WD, the present worth of the salvage value (see Table XI-E-4) is ₱2.3 million.

Operating and Maintenance Cost

Operating and maintenance costs refer to the costs associated with the maintenance, operation and management of the project. Otherwise known as annual costs, they include personnel, power, chemicals, and other miscellaneous maintenance expenses such as fuel and lubrication, repairs, communication needs and office rental. Only the operating and maintenance costs of the proposed project (i.e., excluding those of the present system) were considered in this study.

Annex Table XI-E-4 presents the incremental annual recurring costs associated with running and operating the water district up to 2000. The present value of these costs amounts to ₱8.6 million.

Calculation for Economic Costs

The economic cost may be expressed as the adjusted (shadow priced) project cost plus replacement cost plus operating/maintenance cost less salvage value. Annex Table XI-E-4 shows the computation of total economic costs for SIL-WD, amounting to ₱29 million.

F. BENEFIT-COST ANALYSIS

The summary of the quantifiable economic benefits and economic costs for SIL-WD is shown below. They are expressed in their present values (discounted at 12 percent) after the 1978 prices have been escalated.

SUMMARY OF BENEFITS AND COSTS
(in million pesos)

Benefits		Costs	
Increase in Land Values	₱ 22.708	Project Costs	₱22.039
Health	0.914	(+)	
Reduction in Fire Damage	8.328	Replacement Cost	0.632
Beneficial Value	19.769	(+)	
	51.719	Operating and Maintenance Cost	8.581
		Sub-Total	₱31.252
		(-)	
		Salvage Value	2.268
			₱28.984

Benefit Cost Ratio - 1.78:1

The preceding table shows that the quantifiable benefits exceed the economic costs associated with the improvement of the water supply system in SIL-WD. Under the principle of benefit-cost ratio, the project is, therefore, considered economically feasible.

The actual benefits of the proposed project may be really greater than what the benefit-cost ratio represents because the non-quantifiable benefits have not been incorporated into the analysis for obvious reasons.

G. INTERNAL ECONOMIC RATE OF RETURN

The internal economic rate of return (IERR) is the rate at which the present value of the quantifiable benefits is equal to the present value of the economic costs of the proposed project. It is generally held that for a project to be feasible and desirable, its IERR should be higher than the prevailing opportunity cost of capital. In this particular study, the opportunity cost of capital is 12 percent.

For S/L-WD, the IERR is 80.5 percent as shown in Annex Table XI-G-1. On the basis of the above stated principle of IERR, the proposed project appears to be economically feasible and justified.

ANNEX XI-C

QUANTIFIABLE BENEFITS

ANNEX XI-C

QUANTIFIABLE BENEFITS

Portion of Land Values Attributable to Water Supply Project

Annex Table XI-C-1 shows the present values of the portion of land values attributable to the proposed water supply project, based on the following assumptions:

1. In accordance with the staging program of the construction of facilities, the 1980 service area of 302 hectares was projected to increase in the following manner; by 22 hectares from 1980 to 1981; by 23 hectares from 1981 to 1982; by 25 hectares from 1982 to 1983; by 27 hectares from 1983 to 1984; by 29 hectares from 1984 to 1985; by 31 hectares from 1985 to 1986; by 33 hectares from 1986 to 1987; by 35 hectares from 1987 to 1988; by 38 hectares from 1988 to 1989; and by 41 hectares from 1989 to 1990.

2. Land use was assumed to be 86 percent residential and 14 percent commercial/institutional/industrial throughout the projected period. This classification was based on the water demand projections in 1980 by consumer category, as shown in Chapter VI.

3. The 1977 costs of land based on estimated market values in Silay City are:

Residential	:	₱20 per sqm
Industrial/Commercial/Institutional	:	₱35 " "

These costs were assumed to be constant over the projection period.

4. The portion of the total cost of land specifically attributable to the provision of water supply was assumed to be 20 percent of the cost of land. This land value benefit was escalated by 8 percent from 1980 to 1985 and by 6 percent from 1985 to 1990.

5. A discount factor of 12 percent was used to obtain the present values of the benefits. This is believed to be the opportunity cost of capital and is commonly used for public investment projects like water supply development.

For SIL-WD, the land value benefit in its present worth amounts to ₱22.7 million.

ANNEX TABLE XI-C-1

PORTION OF INCREASED LAND VALUES ATTRIBUTABLE TO PROJECT
SILAY WATER DISTRICT

Year	Land Use (sqm)		Cost of Land (₱ x 1000)		Total Cost of Land (₱ x 1000)	20 Percent Benefit Due to Project (₱ x 1000)	Escalation Factor	Escalated Benefit (₱ x 1000)	Discount Factor at 12%	Present Value of Benefit (₱ x 1000)
	Residential	Commercial Institutional/ Industrial	Residential	Commercial Institutional/ Industrial						
1980	2,657,600	362,400	₱53,152.0	₱12,684.0	₱65,836.0	₱13,167.2	1.210	₱15,932.3	.797	₱12,698.7
1981	193,600	26,400	3,872.0	924.0	4,796.0	959.2	1.307	1,253.7	.712	892.6
1982	202,400	27,600	4,048.0	966.0	5,014.0	1,002.8	1.412	1,416.0	.636	900.5
1983	220,000	30,000	4,400.0	1,050.0	5,450.0	1,090.0	1.525	1,662.3	.567	942.5
1984	237,600	32,400	4,752.0	1,134.0	5,886.0	1,177.2	1.647	1,938.8	.507	983.0
1985	255,200	34,800	5,104.0	1,218.0	6,322.0	1,264.4	1.779	2,24[illegible]	.452	1,016.7
1986	272,800	37,200	5,456.0	1,302.0	6,758.0	1,351.6	1.886	2,549.[illegible]	.404	1,029.8
1987	290,400	39,600	5,808.0	1,386.0	7,194.0	1,438.8	1.999	2,876.2	.361	1,038.3
1988	308,000	42,000	6,160.0	1,470.0	7,630.0	1,526.0	2.119	3,233.6	.322	1,041.2
1989	334,400	45,600	6,688.0	1,596.0	8,284.0	1,656.8	2.246	3,721.2	.288	1,071.7
1990	360,800	49,200	7,216.0	1,722.0	8,938.0	1,787.6	2.381	4,256.3	.257	1,093.9
	5,332,800	727,200	₱106,656.0	₱25,452.0	₱132,108.0	₱26,421.6		₱41,088.9		₱22,708.3

Health Benefits

To determine the amount of benefit arising from the reduction of income lost of those afflicted with water-borne diseases, pertinent statistics on morbidity rate were gathered from the Department of Health. From 1964 to 1974, an average of 598.4 out of every 100,000 population in Silay City were afflicted with primary water-borne diseases every year, regardless of age, sex, and income class. The same rate was assumed for the service area in the absence of specific data. The morbidity rate in the service area was assumed to remain constant during the 21-year projection period.

Since not all of those afflicted with said diseases are wage-earners, an adjustment was made accordingly. Based on the 1970 Census on Population and Housing of the National Census and Statistics Office, 38 percent of the municipality's population was economically active.[1] It was assumed, therefore, that only 38 percent of 598.4 per 100,000 who were afflicted with primary water-borne diseases were economically active. Hence, this is the only segment of the population who would suffer a reduction in income due to said diseases. Furthermore, these afflicted wage-earners were assumed to be earning ₱8 a day and unable to work for 15 days on the average because of their illness. The final figure corresponding to the economic cost of time lost due to water-borne diseases was thereby arrived at by multiplying the number of people afflicted with water-borne diseases by 38 percent, by ₱8 a day and then by 15 days.

Another health benefit that could be associated with the establishment of a safe public water supply system is the reduction of the economic cost of the premature death of those afflicted with water-borne diseases in the service area. Obviously, the reduction of the life span of the population caused by said diseases is an economic loss to the community.

This economic loss due to premature death was determined by multiplying the number of people who die because of water-borne diseases (assuming that a water supply improvement program were not undertaken) by 38 percent and then by ₱11,629. The projected number of such deaths was based on the average of the 10-year mortality rate for primary water-borne diseases in the province of Negros Occidental as gathered from the Department of Health. These figures indicated that 93.4 persons died of the 598.4 per 100,000 who

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[1] Economically active population includes those who are 10 years old and over, whether employed or unemployed, excluding retired persons, students and housewives.

were afflicted with water borne diseases. This mortality rate was assumed to be constant over the projection period. The 38 percent corresponds to the portion of the service area population who are income earners. The ₱11,629 represents the monetary value of each death. This was derived from the estimated income to be earned by the average wage-earner over a period of five years discounted at 12 percent plus 20 percent associated economic costs (summation of ₱200 a month x 12 months x discount factor + 20 percent associated costs).

The third health benefit that can be derived from the improvement of the water supply in the service area is the reduction of the medical expenses of person afflicted with water-borne diseases. According to the Lipa City pilot survey on "Ability To Pay",2/ an afflicted persons spends ₱113.00 annually on the average for medical expenses which include hospitalization, medicine and doctors' fee. Based on this finding, the total medical expenses incurred due to water-borne diseases were arrived at by multiplying ₱113.00 by the number of people afflicted with such diseases in the service area.

The sum of all three economic costs related to health benefits had to undergo three final adjustments to arrive at more meaningful figures. First, 40 percent of the total economic loss due to water-borne diseases was taken as the health benefit directly resulting from the water supply improvement program. This reduction was made to account for the fact that not all water-borne diseases are caused by a poor water system and may also be due to less than ideal personal hygiene or lack of sewerage facilities. Second, the 40 percent health benefit was escalated by 8 percent from 1980 to 1985, by 6 percent from 1985 to 1990, after which the escalation factor was held constant up to 2000. Third, the escalated health benefit was discounted to its present worth at 12 percent. Annex Table XI-C-2 shows the calculations associated with the health benefits for SIL-WD. The total present value of said benefits after the adjustments amounts to ₱914,362.

Reduction in Fire Damage

The proposed water supply improvement program will result in increased water pressure and reliable supply for domestic as well as for fire-fighting purposes. At present, it is estimated that approximately 10 percent of the total poblacion of Silay City is covered by the existing effective fire hydrant service. With the

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2/Refer to Methodology Manual, Chapter 20 for "Ability to Pay" studies.

ANNEX TABLE XI-C-2

HEALTH BENEFITS
SILAY WATER DISTRICT

Year	Served Population	Cost of Time Lost Due To Illness (1)	Economic Loss Due to Premature Death (2)	Cost of Medical Expenses (3)	Total Economic Loss Due to Illness/Premature Deaths	40 Percent Reduction due to Project (Benefit)	Escalation Factor	Escalated Reduction Due to Project (Benefit)	Discount Factor at 12 Percent	Present Value of Health Benefit
1980	15,630	₱ 4,265	₱ 64,373	₱10,569	₱ 79,206	₱ 31,683	1.210	₱ 38,336	.797	₱ 30,554
1981	17,721	4,636	72,984	11,983	89,803	35,921	1.307	46,949	.712	34,428
1982	20,093	5,483	82,754	13,587	101,824	40,729	1.412	57,510	.636	36,576
1983	22,781	6,216	93,824	15,404	115,444	46,178	1.525	70,421	.567	39,929
1984	25,829	7,048	106,377	17,465	130,890	52,356	1.647	86,231	.507	43,719
1985	29,2[illegible]	7,991	120,611	19,802	148,404	59,362	1.779	105,605	.452	47,733
1986	33,[illegible]4	9,060	136,752	22,452	168,264	67,306	1.886	126,938	.404	51,283
1987	37,546	10,272	155,346	25,456	190,774	76,310	1.999	152,543	.361	55,068
1988	42,683	11,647	175,791	28,862	216,300	86,520	2.119	183,336	.322	59,034
1989	48,395	13,205	199,316	32,724	245,245	98,098	2.246	220,329	.288	63,455
1990	54,870	14,972	225,984	37,103	278,059	111,223	2.381	264,823	.237	68,060
1991									.229	60,644
1992									.205	54,289
1993									.183	48,463
1994									.163	43,166
1995									.146	38,664
1996									.130	34,427
1997									.116	30,719
1998									.104	27,542
1999									.093	24,629
2000	54,870	14,972	225,984	37,103	278,059	111,223	2.381	264,823	.083	21,980
								₱4,001,251		₱914,362

Total Population : 69,200
Economically Active : 26,395 or 38%

Morbidity Rate: 598.4
Mortality Rate: 93.2

(1) 38% x $\frac{598.4}{100,000}$ x S.P. x ₱8 x ₱15

(2) 38% x $\frac{93.2}{100,000}$ x S.P. x ₱11,62[illegible]

(3) $\frac{598.4}{100,000}$ x. S.P. x ₱113

implementation of the program which will involve the installation of new fire hydrants, the extent of fire protection coverage will be expanded. Hence, a reduction in fire damage is expected in the service area.

This reduction was assumed to be 0.75 percent of the combined assessed values of all structures in the service area. For Silay City, the average assessed value of each structure was assumed to be ₱18,800[3/]. The number of structures was derived from the projected population to be served by the system, assuming that each household has an average of 6.1 members[4/].

The fire protection benefit was based on the assumed overall reduction in fire damage, but correlated with the schedule of fire hydrant installation in the service area. Percentage of fire protection starts at 10 percent in 1980, gradually increasing to 100 percent in 1990 in accordance with the extent of the service area to be covered by the fire hydrants.

The net reduction in fire damage was escalated by 8 percent from 1980 to 1985, by 6 percent from 1985 to 1990, after which the escalation factor was held constant up to 2000. It was then discounted at 12 percent. The present value of the fire protection benefit, as shown in Annex Table XI-C-3 amounts to ₱6.3 million.

Beneficial Value of Water

Since water is essential to human life, all members of the served population in the service area presumably would be willing to obtain it in sufficient quantities at some given price. With the proposed improvement of the system's facilities, the volume of water production is expected to increase considerably to serve the needs of the growing population. This will bring about additional revenues to the water district, especially since a price increase of water may be justified in view of the improved service.

In general, water rates charged by the water district do not reflect the true value of water. Moreover, it is recognized that households and commercial users are really willing to pay more than what they are actually being charged for water consumed. From the economic viewpoint, therefore, there is a consumers' surplus. This consumers' surplus refers to the additional amount consumers are willing to pay over and above what they are paying for water. For

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[3/] In the absence of assessed value records on Silay City, the figure on Gapan was used.

[4/] Based on the 1970 Census on Housing in Negros Occidental province.

ANNEX TABLE XI-C-3

REDUCTION IN FIRE DAMAGE
SILAY WATER DISTRICT

Year	Number of Structures[5]	Total Value at ₱18,800 each[6] (₱ x 1000)	Overall Reduction in Fire Damage (.0075) ₱ x 1000	Percentage of Fire Protection	Net Reduction in Fire Damage (Benefit) (₱ x 1000)	Escalation Factor[7]	Escalated Value of Net Reduction	Discount Factor at 12%	Present Value of Net Benefit (₱ x 1000)
1980	2,562	₱ 48,165.6	₱ 361.2	10%	₱ 36.1	1.210	₱ 43.7	.797	₱ 34.8
1981	2,905	54,614.0	409.6	15	61.4	1.307	80.3	.712	57.2
1982	3,294	61,927.2	464.5	22	102.2	1.412	144.3	.636	91.8
1983	3,735	70,218.0	526.6	32	168.5	1.525	257.0	.567	145.7
1984	4,234	79,599.2	597.0	48	286.6	1.647	472.0	.507	239.3
1985	4,801	90,258.8	676.9	71	480.6	1.779	855.0	.452	386.5
1986	5,443	102,328.4	767.5	76	583.3	1.886	1,100.1	.404	444.4
1987	6,171	116,014.8	870.1	81	704.8	1.999	1,408.9	.361	508.6
1988	6,997	131,543.6	986.6	87	858.3	2.119	1,818.8	.322	585.6
1989	7,934	149,159.2	1,118.7	93	1,040.4	2.246	2,336.7	.288	673.0
1990	8,995	169,106.0	1,268.3	100	1,268.3	2.381	3,019.8	.257	776.1
1991								.229	691.5
1992								.205	619.1
1993								.183	552.6
1994								.163	492.2
1995								.146	440.9
1996								.130	392.6
1997								.116	350.3
1998								.104	314.1
1999								.093	280.8
2000	8,995	169,106.0	1,268.3	100	1,268.3	2.381	3,019.8	.083	250.6
							₱41,734.6		₱8,327.7

[5] Derived from the served population projections in Chapter VI, assuming that there are 6.1 members per household according to the 1970 Census on Housing in Negros Occidental.

[6] Based on the assessed value records in Gapan, in the absence of similar data on Silay City.

[7] Escalated annually by 10 percent from 1978 to 1980, by 8 percent from 1980 to 1985 and by 6 percent from 1985 to 1990, after which the escalation factor was held constant up to 2000.

purposes of this study, this additional value has been estimated to be 50 percent higher than domestic water rates and 25 percent higher than commercial/industrial/institutional water rates[8].

In the determination of this benefit, the following steps were taken:

1. Only the incremental volume of accounted-for-water was considered; hence, the 1977 accounted-for-water amounting to 291,999* cum was deducted from total accounted-for-water projections in Chapter VI. The water demand projections in Chapter VI, expressed in liters per capita per day, were converted to cubic meters per year.

2. Classification of accounted-for-water into domestic and others (commercial/institutional/industrial) was based likewise on Chapter VI.

3. The price per cubic meter of water for domestic use was derived by de-escalating the rate per revenue unit of water in Chapter X, Annex Table X-G-1. The rate of water for other uses (commercial/institutional/industrial) was assumed to be twice that for domestic use. The rates were then adjusted upwards to reflect consumers' surplus: 50 percent higher for domestic water and 25 percent higher for others.

4. The net economic revenues were obtained by subtracting the assumed 1977 revenues of SIL-WD of ₱78,000 from total economic revenues. The net economic revenues may be considered as benefits of the proposed project since revenues of the existing system have been duly excluded.

5. The net economic revenues were then escalated by 10 percent from 1978 to 1980, by 8 percent from 1980 to 1985, by 6 percent from 1985 to 1990, after which the escalation factor was held constant up to 2000. Finally, the escalated values were discounted at 12 percent to obtain their present values.

For SIL-WD, the beneficial value of water amounts to a present value of ₱19.8 million, as shown in Annex Table XI-C-4.

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[8] Refer to Procedures for the Economic and Financial Analysis of Water Projects, LWUA, May 1976.

* Based on Chapter IV, accounted-for-water in 1976 was 220,416 cum/yr. In 1980, projected accounted-for-water, is 678,889 cum/yr, with a growth rate of 32.476 percent per year. Hence, accounted-for-water for 1977:

220,416 (1.32476) = 291,999 cum/yr.

ANNEX TABLE XI-C-4

BENEFICIAL VALUE OF WATER
SILAY WATER DISTRICT

Year	Incremental Accounted-For-Water (cum/year)[9]	cum per year Domestic (88%)	cum per year Others (12%)	Price Per cum[10] Domestic	Price Per cum Others	Economic Value Per cum[11] Domestic	Economic Value Per cum Others	Economic Water Revenues Domestic	Economic Water Revenues Others	Total Economic Revenue	Escalation Factor[12]	Escalated Economic Revenue	Discount Factor at 12 Percent	Present Value of Economic Revenue (₱ x 1000)
1977	291,999													
1978	94,832	83,452	11,380	.80	1.60	1.20	2.00	100.1	22.8	122.9	1.000	122.9	1.000	122.9
1979	220,461	194,006	26,455	.74	1.48	1.11	1.85	215.3	48.9	264.2	1.100	290.6	.893	259.5
1980	386,890	340,463	46,427	.68	1.36	1.02	1.70	347.3	78.9	426.2	1.210	515.7	.797	411.0
1981	466,102	410,170	55,932	.95	1.90	1.43	2.38	586.5	133.1	719.6	1.307	940.5	.712	669.6
1982	561,531	494,147	67,384	.88	1.76	1.32	2.20	652.3	148.2	800.5	1.412	1,130.3	.636	718.9
1983	676,498	595,318	81,180	.82	1.64	1.23	2.05	732.2	166.4	898.6	1.525	1,370.4	.567	777.0
1984	815,004	717,204	97,800	.94	1.88	1.41	2.35	1,011.3	229.8	1,241.1	1.647	2,044.1	.507	1,036.4
1985	981,868	864,0[illegible]4	117,824	.88	1.76	1.32	2.20	1,140.5	259.2	1,399.7	1.779	2,490.1	.452	1,125.5
1986	1,182,894	1,040,947	141,947	.81	1.62	1.22	2.03	1,270.0	288.[illegible]	1,558.2	1.886	2,938.8	.404	1,187.3
1987	1,425,080	1,254,070	171,010	.85	1.70	1.28	2.13	1,605.2	364.[illegible]	1,969.5	1.999	3,937.0	.361	1,421.3
1988	1,716,850	1,510,828	206,022	.79	1.58	1.19	1.98	1,797.9	407.9	2,205.8	2.119	4,674.1	.322	1,505.1
1989	2,068,356	1,820,153	248,203	.73	1.46	1.10	1.83	2,002.2	454.2	2,456.4	2.246	5,517.1	.288	1,588.9
1990	2,491,830	2,192,810	299,020	.67	1.34	1.01	1.68	2,214.7	502.4	2,717.1	2.381	6,469.4	.257	1,662.6
1991				.63	1.26	.95	1.58	2,083.2	472.5	2,555.7		6,085.1	.229	1,393.5
1992				.61	1.22	.92	1.53	2,017.4	457.5	2,474.9		5,892.7	.205	1,208.0
1993				.57	1.14	.86	1.43	1,885.8	427.6	2,313.4		5,508.2	.183	1,008.0
1994				.52	1.04	.78	1.30	1,710.4	388.7	2,099.1		4,998.0	.163	814.7
1995				.49	.98	.74	1.23	1,622.7	367.8	1,990.5		4,739.4	.146	692.0
1996				.45	.90	.68	1.13	1,491.1	337.9	1,829.0		4,354.9	.130	566.1
1997				.46	.92	.69	1.15	1,513.0	343.9	1,856.9		4,421.3	.116	512.9
1998				.43	.86	.65	1.08	1,425.4	322.9	1,748.2		4,162.5	.104	432.9
1999				.40	.80	.60	1.00	1,315.7	299.0	1,614.7		3,844.6	.093	357.5
2000	2,491,830	2,192,810	299,020	.37	.74	.56	.93	1,228.0	278.1	1,506.1	2.381	3,586.0	.083	297.6
												80,033.7		19,769.2

[9] The 1977 volume of 291,999 cum per year of accounted-for-water was deducted from the water demand projections throughout the study period to obtain the incremental volume.

[10] The price per cum of water for domestic use was derived by de-escalating the rate per revenue unit of water in Table X-G-1, Chapter X; the rate of water for other uses (commercial, institutional and industrial) was assumed to be twice that for domestic use.

[11] Assumed to be 50 percent higher than domestic rates and 25 percent higher than rate for 'others'.

[12] Escalated annually by 10 percent from 1978 to 1980, by 8 percent from 1980 to 1985, by 6 percent from 1985 to 1990, after which the escalation factor was held constant up to 2000.

ANNEX XI-E

ECONOMIC COSTS

ANNEX TABLE XI-E-1

CONVERSION OF FINANCIAL COST TO ECONOMIC COST
SILAY WATER DISTRICT

	Financial Project Cost	Foreign Exchange Component	Domestic Component	Unskilled Labor	Balance of Domestic Component[13]	Taxes[14] (5%)	Others (95%)	Shadow Pricing: Foreign Exchange Component x 1.2	Shadow Pricing: Unskilled Labor x .5	Shadow Pricing: Others x 1.0	Economic Project Cost[15]	Economic Construction Cost[16]
Source Facilities												
a) Equipment	1,224,000	1,197,064	26,936	7,935	19,001	950	18,051	1,436,477	3,968	18,051	1,458,496	1,152,961
b) Structure	3,878,000	959,168	2,918,832	859,855	2,058,977	102,949	1,956,028	1,151,002	429,928	1,956,028	3,536,958	2,796,01[illegible]
Storage Facilities	1,655,000	398,620	1,256,380	360,985	895,395	44,770	850,625	478,344	180,493	850,625	1,509,462	1,193,250
Distribution Pipelines	5,097,000	2,646,485	2,450,515	1,137,810	1,312,705	65,625	1,247,070	3,175,782	568,905	1,247,070	4,991,757	3,946,053
Internal Network	1,864,000	800,534	1,063,466	442,750	[illegible]0,716	31,036	589,680	960,641	221,37[illegible]	589,680	1,771,6[illegible]	1,53[illegible]
Fire Hydrants	849,000	489,206	359,794	101,090	2[illegible],704	12,935	245,769	587,047	50,5[illegible]	245,7[illegible]	8[illegible],361	764,815
Service Connections												
a) Pipes	4,505,000	2,198,679	2,306,321	1,375,835	930,486	46,524	883,962	2,638,415	687,918	883,962	4,210,295	3,645,276
b) Meters	1,628,000	1,356,313	271,687	162,075	109,612	5,481	104,131	1,627,576	81,038	104,131	1,812,745	1,565,476
Plumbing Shop												
a) Equipment	32,000	29,601	2,399	351	2,048	102	1,946	35,521	17[illegible]	1,946	37,642	32,590
b) Structure	420,000	12,977	407,023	59,599	347,424	17,371	330,053	15,572	29,799	330,053	375,424	325,043
Immediate Improvements												
a) Source Facilities												
1. Equipment	204,000	197,552	6,448	2,643	3,8[illegible]	191	3,614	237,062	1,321	3,[illegible]	241,997	191,300
2. Structure	10[illegible],000	6,055	95,945	39,332	56,6[illegible]	2,831	53,782	7,[illegible]	19,666	53,[illegible]	80,71[illegible]	63,806
b) Distribution Facilities	2,116,000	1,063,457	1,052,543	513,360	539,183	26,9[illegible]9	512,224	1,276,14[illegible]	256,680	512,224	2,045,05[illegible]	1,616,642
c) Administration Building												
1. Equipment	71,000	49,481	21,519	3,154	18,365	918	17,447	59,377	1,577	1[illegible]	78,401	61,977
2. Structure	419,000	12,977	406,023	59,521	346,502	17,325	329,177	15,572	29,760	329,177	374,509	296,055
d) Vehicles	69,000	35,145	33,855	-	33,855	1,693	32,162	42,174	-	32,162	74,336	58,764
e) Service Connections												
1. Pipes	1,293,000	633,300	659,700	411,231	248,469	12,423	236,046	759,960	205,615	236,046	1,201,621	949,895
2. Meters	648,000	537,664	110,336	68,779	41,557	2,078	39,479	645,197	34,389	39,479	719,065	565,434
f) Leakage Survey and Repair												
1. Labor	111,000	90,000	21,000	8,820	12,180	609	11,571	108,000	4,410	11,571	123,981	123,981
2. Equipment	10,000	6,000	4,000	1,680	2,320	116	2,204	7,200	840	2,204	10,244	10,244
g) Miscellaneous Items	24,000	17,000	7,000	500	6,500	325	6,175	20,400	250	6,175	26,825	26,825
Feasibility Studies	264,000	147,840	116,160	-	116,160	5,808	110,352	177,408	-	10,352	287,760	287,760
Sub-Total	26,483,000	12,885,118	13,597,882	5,617,305	7,980,577	399,029	7,581,548	15,462,142	2,808,652	7,581,548	25,852,341	21,215,100
Land	141,000	-	141,000	-	141,000	7,050	133,950	-	-	133,950	133,950	133,950
Total Project Cost	26,624,000	12,885,118	13,738,882	5,617,305	8,121,577	406,079	7,715,498	15,462,142	2,808,652	7,715,498	25,986,291	21,349,050

[13] Domestic cost component less unskilled labor cost.
[14] Computed at 5 percent of domestic cost component after unskilled labor cost was deducted from it.
[15] Obtained by adding foreign exchange cost, unskilled labor and cost of 'others' after they have been adjusted through shadow pricing.
[16] Derived by subtracting contingencies and engineering services from the economic project cost.

ANNEX TABLE XI-E-2

REPLACEMENT COST
SILAY WATER DISTRICT
1978 PRICES
(₱ x 1000)

Year	Vehicles	Meters	Equipment	Miscellaneous Items	Total
1978					
1979					
1980					
1981					
1982					
1983					
1984					
1985					
1986	₱ 29.8				₱ 29.8
1987	29.0				29.0
1988					
1989					
1990					
1991					
1992					
1993					
1994	29.8	₱ 209.6	₱205.1	₱ 5.3	₱ 449.8
1995	29.0	203.3	84.8		317.1
1996		183.6		21.5	205.10
1997		150.7	31.6		182.3
1998		150.7	359.7		510.4
1999		150.7			150.7
2000		150.7			150.7
Total	₱117.6	₱1,199.3	₱681.2	₱ 26.8	₱2,024.9

ANNEX TABLE XI-E-3

SALVAGE VALUE IN 2001
SILAY WATER DISTRICT
1978 PRICES
(₱ x 1000)

Year	50 Years Economic Value		50 Years Salvage Value	30 Years Economic Value		30 Years Salvage Value	25 Years Economic Value		25 Years Salvage Value	15 Years Economic Value		15 Years Salvage Value	7 Years Economic Value		7 Years Salvage Value	Infinite Economic Value		Infinite Salvage Value	Total [17]
1978	₱ 1,359.9	56%	₱ 761.5	₱ 56.7	27%	₱ 15.3	₱ 77.8	12%	₱ 9.3							₱110.2	100%	₱110.2	₱ 896.3
1979	1,672.2	58	969.9				44.7	16	7.2										977.1
1980	1,072.3	60	643.4	231.1	33	76.3										23.7	100		743.4
1981	1,664.8	62	1,032.2																1,032.2
1982	2,453.5	64	1,576.6				872.4	28	244.3										1,820.9
1983	505.0	66	336.1																356.1
1984	585.0	68	397.8																397.8
1985	781.0	70	546.[illegible]				120.2	40	48.1										594.8
1986	1,262.2	72	908.8				872.3	44	383.8	₱ 510.4	7%	₱ 35.7							1,328.3
1987	1,262.2	74	934.0							150.7	13	19.6							953.6
1988	563.2	76	428.5				436.2	52	226.8	330.6	20	66.1							721.4
1989	563.8	78	439.8							150.7	27	40.7							480.5
1990	559.2	80	447.4				436.2	60	261.7	335.3	33	110.7							819.8
1991																			-
1992																			-
1993																			-
1994										420.0	60	252.0	₱29.8	14%	₱ 4.2				256.2
1995										288.1	67	193.0	29.0	29	8.4				201.4
1996										205.1	73	149.7							149.7
1997										182.3	80	145.8							145.8
1998										510.4	87	444.1							444.1
1999										150.7	93	140.2							140.2
2000										379.5	100	379.5							379.5
	₱14,394.5		₱9,472.7	₱287.8		₱ 91.6	₱2,859.8		₱1,181.2	₱3,613.8		₱1,977.1	₱58.8		₱12.6	₱133.9		₱133.9	₱12,869.1

Total Economic Value: ₱21,349.0
Total Salvage Value : ₱12,869.1

[17] Salvage values for each year represent the salvage value of the item in year 2001.

ANNEX TABLE XI-E-4

SUMMARY OF ECONOMIC COSTS
SILAY WATER DISTRICT
(₱ x 1000)

Year	Project Cost	Replacement Cost	Salvage Value 18/	O and M Costs	Total Costs	Escalation Factor For Other Costs 19/	Escalation Factor For O and M Costs 20/	Escalated Project Cost	Escalated Replacement Cost	Escalated O and M Cost	Escalated Total Costs	Discount Factor at 12 Percent	Present Value of Project Cost	Present Value of Replacement Cost	Present Value of O and M Costs	Present Value of Total Costs
1978	₱ 2,531.2		896.3	71.0	2,602.2	1.000	1.000	2,531.2		71.0	2,602.2	1.000	2,531.2		71.0	2,602.2
1979	2,543.[illegible]		977.1	143.4	2.687.[illegible]	1.100	1.080	2,798.0		154.9	2,952.9	.893	2,498.6		138.[illegible]	2,636.9
1980	1,865.1		743.4	194.6	2,059.7	1.210	1.166	2,256.8		226.9	2,483.7	.797	1.798.7		180.8	1,979.5
1981	2,217.4		1,032.2	280.2	2,497.6	1.307	1.260	2,898.[illegible]		353.1	3,251.2	.712	2,063.5		251.4	2,314.9
1982	4,784.5		1,820.9	356.7	5,141.2	1.412	1.360	6,755.7		485.1	7,240.8	.636	4,296.6		308.5	4,6[illegible]
1983	849.6		386.1	497.0	1,346.6	1.525	1.469	1,295.6		730.1	2,025.7	.567	734.6		414.0	1,[illegible]8.6
1984	849.6		397.1	537.7	1,387.3	1.647	1.587	1,399.3		853.3	2,252.6	.507	709.5		432.6	1,142.1
1985	1,334.8		594.8	579.1	1,913.9	1.779	1.714	2,374.6		992.6	3,367.2	.452	1,073.3		448.7	1,522.0
1986	3,267.3	29.8	1,326.3	652.6	3,9[illegible].7	1.886	1.851	6,162.1	56.2	1,208.0	7,426.3	.404	2,489.5	22.7	488.0	3,000.2
1987	1,708.8	29.0	953.6	748.3	2,486.1	1.999	1.999	[illegible],415.9	55.0	1,495.9	4,969.8	.361	1,233.1	20.9	540.0	1,794.0
1988	1,604.5		721.4	810.4	2,414.9	2.119	2.159	3,399.9		1,749.7	5,149.6	.322	1,094.8		563.4	1,658.2
1989	825.2		480.5	888.2	1,713.4	2.241	2.332	1,853.4		2,071.3	3,924.7	.288	533.8		596.5	1,[illegible]30.3
1990	1,604.6		819.8	963.8	2,568.4	2.381	2.518	3,820.6		2,426.8	6,247.4	.257	981.9		623.7	1,605.6
1991					963.8						2,426.8	.229			555.7	555.7
1992					963.8						2,426.8	.205			497.[illegible]	497.5
1993					963.8						2,426.8	.183			444.1	444.1
1994		449.8	256.2		1,413.6				1,071.0		3,427.8	.163		174.6	395.6	570.2
1995		317.1	201.4		1,280.9				755.0		3,181.8	.146		110.2	354.3	464.5
1996		205.1	149.7		1,165.9				488.3		2,915.[illegible]	.130		63.5	315.5	379.0
1997		182.3	145.8		1,146.1				434.1		2,860.	.116		50.4	2[illegible]1.5	331.9
1998		510.4	444.1		1,474.2				1,215.3		3,642.1	.104		126.4	252.4	378.8
1999		150.7	140.2	↓	1,114.5	↓	↓		358.8	↓	2,785.6	.093		33.4	225.7	259.1
2000		150.7	379.5	963.8	1,114.5	2.381	2.518		358.8	2,426.8	2,785.6	.083		29.8	201.4	231.2
	₱25,986.2	₱2,024.9		16,361.0	44.374.1			40,961.2	4,795.5	37,086.7	82,843.4		22,039.1	631.9	8,580.6	31,251.6
Salvage Value			₱12,869.1		-12,869.1	2.381					-30,641.3	.074				-2,267.5
					31,503.0						52,202.1					28,98[illegible].1

18/ The annual salvage values were not escalated individually since they represent values for 2001; hence, only their sum was escalated by the factor used for project and replacement costs.

19/ Project cost and replacement cost were escalated annually by 10 percent from 978 to 1980, by 8 percent from 1980 to 1985, by 6 percent from 1985 to 1990, after which the escalation factor was held constant up to 2000.

20/ Operating and maintenance costs were escalated annually by 8 percent from 1978 to 1990, after which the escalation factor was held constant up to 2000.

ANNEX XI-G

INTERNAL ECONOMIC RATE OF RETURN

ANNEX TABLE XI-G-1

INTERNAL RATE OF RETURN
SILAY WATER DISTRICT
(₱ x 1000)

Year	Escalated Value		Discount Factor at 80 percent	Present Value at 80 percent		Discount Factor at 85 percent	Present Value at 85 percent	
	Benefits	Costs		Benefits	Costs		Benefits	Costs
1978	122.9	2,602.2	1.000	122.9	2,602.2	1.000	122.9	2,602.2
1979	290.6	2,952.9	.556	161.6	1,641.8	.541	157.2	1,597.5
1980	16,530.0	2,483.7	.309	5,107.8	767.5	.292	4,826.8	725.2
1981	2,321.5	3,251.2	.171	397.0	556.0	.158	366.8	513.7
1982	2,748.1	7,240.8	.095	261.1	687.9	.085	233.6	615.5
1983	3,360.1	2,025.7	.053	178.1	107.4	.046	154.6	93.2
1984	4,541.1	2,252.6	.029	131.7	65.3	.025	113.5	56.3
1985	5,700.1	3,367.2	.016	91.2	53.9	.013	74.1	43.8
1986	6,714.9	7,426.3	.009	60.4	66.8	.007	47.0	52.0
1987	8,374.5	4,969.8	.005	41.9	24.9	.004	33.5	19.9
1988	9,909.8	5,149.6	.003	29.7	15.4	.002	19.8	10.3
1989	11,795.7	3,924.7	.002	23.6	7.9	.001	11.8	3.9
1990	14,010.3	6,247.4	.001	14.0	6.2	.001	14.0	6.2
1991	9,369.7	2,426.8	0	0	0	0	0	0
1992	9,177.3	2,426.8						
1993	8,792.8	2,426.8						
1994	8,282.6	3,497.8						
1995	8,024.0	3,181.8						
1996	7,639.5	2,915.1						
1997	7,705.9	2,860.9						
1998	7,447.1	2,642.1						
1999	7,129.2	2,785.6						
2000	6,870.6	2,785.6	0	0	0	0	0	0
	166,858.3			6,621.0			6,175.6	
		82,843.4			6,339.7			6,603.2
Salvage Value		- 30,641.3			- 0.0			0.0
		52,202.1			6,603.2			6,339.7
	3.2			1.00				

Present Value 80% = 17.8
Present Value 85% = (164.1)
181.9

$$\text{IERR} = .80 + \frac{.05\,(17.8)}{181.9}$$

= 80.5%

M E T H O D O L O G Y

M E M O R A N D A

Methodology Memorandum No. 1

To : L. V. Gutierrez, Jr.

From : A. de Vera

Date : 4 January 1977

Subject: Pilot Area Survey

A. Need

In estimating water accountability, data on the ratio of borrowers to primary users, average persons per household, and per capita consumption are necessary. Information on capacity and willingness-to-pay would greatly aid financial analysis. In all cases, these data are not readily available in the Philippines. The only way to get these data would be to actually perform a house-to-house survey within the served areas of the water district (WD). Considering time and financial constraints, a pilot area survey would be the best approach. This is merely surveying a representative area within the WD and projecting the data obtained for the entire served area of the WD.

B. Methodology

1. Choose a pilot area within the WD. Desirable requirements for the area are as follows:

   a. adequate line pressures, preferably with 24-hour service;
   b. metered connections;
   c. presence of domestic as well as commercial connections. Ratio of commercial to domestic connections for the area must not exceed that for the entire WD;
   d. representative income levels of the concessionaires.

2. Devise a one-page questionnaire so that it:

   a. is easily understood by WD personnel (who will serve as interviewers);
   b. provides relevant information;
   c. provides a means of cross-checking some answers given by respondents;
   d. would make tabular analysis easy.

   A sample questionnaire is attached.

3. Get assistance from the WD personnel in the house-to-house survey. It is suggested that they do the actual interview because of their familiarity with local customs and dialects. However, before allowing the WD enumerators to proceed on their own, it is necessary that:

   a. the enumerators be given a thorough briefing on the importance of the survey, as well as the purpose of each item in the questionnaire.
   b. the enumerators be accompanied to the first few houses, and given additional pointers or feedback before they proceed on their own.

4. Conduct a house-to-house survey of all households within the pilot area. A map at this point indicating the existing houses (with their code numbers) would be necessary. The following would be helpful during the survey:

   a. brief the respondents about the purpose of the survey before asking questions. It is very important that they be receptive to the interviewers. Otherwise data given could be misleading.
   b. in asking for estimates of consumption, avoid using technical terms, i.e., liters, gallons, etc. Use local containers like pails, drums or whatever they use. Note the capacity of the container in the questionnaire.

C. <u>Data</u>

The following data may be obtained from the survey:

1. Pilot area density
2. Average persons/household
3. Borrowers from connected households and percentage of households dependent on the WD
4. Potential concessionaires
5. Consumption estimates
6. Income levels and the respective rates showing willingness to pay for improved service
7. Water accountability

________ WATER DISTRICT
PILOT AREA QUESTIONNAIRE

DATE ____________
TIME ____________

INTERVIEWEE ____________ ADDRESS ____________

TYPE OF DWELLING ____________ CONSTRUCTION MATERIAL ____________

WD CONCESSIONAIRE

1. NO. OF OCCUPANTS: ________

2. CLASSIFICATION:

☐ Domestic
☐ Commercial
☐ Institutional
☐ Industrial
☐ ________

3. SIZE OF CONNECTION:

☐ ½" ☐ 1" ☐ 2"
☐ ¾" ☐ 1½" ☐ ____

4. TYPE OF CONNECTION:

☐ metered: meter functioning
☐ metered: meter damaged
☐ flat rate (unmetered)

5. APPURTENANCES (Connected to System)

☐ with hand pump
☐ with electric motor pump
HRS used/day ________
Pump rated HP ________
GPM ________
____

6. OTHER SOURCE ASIDE FROM WD:

Own	Other HH
☐ wells	☐ wells
☐ springs	☐ springs
☐ rainwater	☐ rainwater
☐ ________	☐ ________

NON-WD CONCESSIONAIRE

1. NO. OF OCCUPANTS: ____

2. SOURCE OF SUPPLY:

☐ own private well
☐ rainwater
☐ spring
☐ public faucet
☐ WD concessionaire
HH Code No. ____
☐ public well
☐ others' private well
☐ ________

3. CONSUMPTION:

☐ free
☐ paying
volume used per day ________
Paying ₱ ________
for ________.

REMARKS:

FOR ALL HOUSEHOLDS

1. WD-WATER AVAILABLE:
No. of hours ________
Time ________

2. FAUCETS:
☐ 1 ☐ 3 ☐ 5
☐ 2 ☐ 4 ☐ ____

3. SHOWERS:
☐ 1 ☐ 2 ☐ 3 ☐ ____

4. FLUSH WATER CLOSET:
☐ 1 ☐ 2 ☐ 3 ☐ ____

5. MANUAL WATER CLOSET:
☐ 1 ☐ 2 ☐ 3 ☐ ____

6. ☐ w/septic tank ☐ w/o septic tank

7. AVERAGE MONTHLY:

	Consumption	Billing/Payment
WD:	____	____
wells:	____	____
others:	____	____

8. USER:
☐ w/ borrowers
☐ w/o borrowers
Total no. of HH borrowers ________
Total no. of HH borrowers' occupants ________

9. How much would you be willing to pay if water service were improved?
________/month.

(TO BE FILLED UP AT THE WD OFFICE)

1. HOUSEHOLD CODE NO. ________

2. INCOME:

☐ below average (₱220 below)
☐ average (₱221 - 750)
☐ upper middle (₱751 - 1,500)
☐ high (₱1,500 above)

3. WD CONCESSIONAIRE:

☐ registered
☐ unregistered

4. PAYMENTS:

☐ up-to-date
☐ delinquent

____
ENUMERATOR

____
POSITION

Methodology Memorandum No. 2

To : L. V. Gutierrez, Jr.

From : A. de Vera

Date : 31 January 1977

Subject: Estimating Water Accountability

A. Need

To be able to determine future water demand per capita, need for leak detection and survey program, and the level of development possible for reducing wastage and leakage, the following information must first be available.

1. Ratio of accounted-for and unaccounted-for-water.

2. Ratio of wastage and leakage in relation to total production.

3. Domestic consumption per capita.

Although there are various methods for estimating water accountability, the selection of a method depends on the purpose for which it is to be used and the level of accuracy desired. Accounted-for-water as used herein refers to the revenue-producing water for the water district. It is the sum of the billed metered consumption and inferred water consumption at flat-rate connections.

B. Methodology

1. Pilot Area Survey

a. Objective - To be able to estimate total accounted-for and unaccounted-for-water. Accuracy will depend on the reliability of the consumption figures as obtained in the pilot area survey.[1/]

b. Data Necessary - Monthly production; number of metered and unmetered connections; water rate schedule; pilot area data; and total monthly metered consumption.

[1/] Refer to Methodology Memorandum No. 1.

c. Steps

1) Obtain total number of households dependent on water system. To do this, first obtain ratio of households dependent on the system to total households in the pilot area and apply ratio to the whole service area. Compute for number of primary and secondary users.

2) Compute for inferred flat-rate use per month.

3) Compute total accounted-for-water by adding average monthly metered consumption and total inferred flat-rate use per month.

4) Unaccounted-for-water is total production less accounted-for-water. It is also the total of potentially billable water plus wastage, leakage and other uses.

5) Potentially billable water is the sum of:

   - Usage of borrowers from flat-rate primary users;
   - Unbilled flat-rate use
   - Wastage of flat-rate users

2. Weighted Average of First 10-City Survey

a. Objective - In a water system with all functions billed as flat-rate, computing for water accountability is impossible without resorting to detailed surveys. However, this method implies that the figures obtained during the first 10-area survey (CDM - 1975) approximate those of other water districts. Accuracy, however, is not determined.

b. Data Necessary - Total monthly production and figures obtained during the First 10-Area Survey of CDM.

c. Steps

Multiply monthly production by:

.31 to get accounted-for-water
.11 to get underestimated flat-rate use
.26 to get wastage
.25 to get leakage
.07 for others

3. Field Study Method

a. Objective - To be able to determine within ± 5 percent accuracy water accountability figures. This method, however, is time-consuming and very expensive.

b. Data Necessary - All data received shall be generated in the field. The number of concessionaires and the water rate schedule are basic requirements.

c. Steps

1) For each section of transmission and distribution line in the water system, appropriate measuring devices shall be installed in order to determine the amount of water flowing in and out, water used by the concessionaires, and water leakage.

2) Desk-top analysis is then necessary to determine water accountability.

METHODOLOGY MEMORANDUM NO. 3

To : L. V. Gutierrez, Jr.

From : P. del Rosario

Date : 8 February 1977

Subject: Classification of Water Districts According to Future Water Requirements

A. Introduction

The purpose of this methodology manual is to classify water districts (WD) so that future water requirements may be estimated. The factors to be considered in classifying WD's are economic and social development in the district's boundaries, probable sources of additional water supply and the people's ability-to-pay for improved water service.

The group with the probable highest per capita consumption is labelled Group I; and the group with the probable lowest water consumption, Group V. Affluent and highly urbanized water districts may fall under Group I, while less developed and small water districts, under Group V.

B. Methodology

The initial service area of the WD will most likely include the central urban area or core city (poblacion). To classify it according to future water demands, the WD and its central urban area are judged according to 5 grouping criteria - 1975 urban income, 1975 standard of living, 1975 business index, 1980 cost of water, and served population in 1980. For each criterion, a number of points, from 0 to 20, are allotted to each water district. The total number of points under the 5 criteria determines the classification of the WD.

Table MM 3-1 lists the 5 criteria by which the WD can be classified, and the points allotted to rankings in each criterion.

The grouping of the WD's based on the range of total points under the 5 criteria is as follows:

TABLE MM 3-1

WATER DISTRICT GROUPING CRITERIA

1975 Urban Income		1975 Standard of Living				1975 Business Index		1980 Cost of Water		1980 Served Population	
Income Taxes Paid by Urban Residents (P)	Points 20	% of Households with Refrigerators in Urban Area	Points 10	% of Households with Flush Toilets in Urban Area	Points 10	% of Commercial Establishments in Urban Area	Points 20	Source of Additional Water Supply	Points 20	Population Served in Urban Area	Points 20
more than 30,000,000	20	more than 30	10	more than 60	10	more than 6.6	[illegible]	Spring, gravity type	20	more than 150,000	20
10,000,001-30,000,000	18	25.1 - 30	9	50.1 - 60	9	4.6 - 6.6	16			100,001 - 150,000	18
5,000,001-10,000,000	16	20.1 - 25	8	40.1 - 50	8	3.1 - 4.5	11				
1,000,001- 5,000,000	14	15.1 - 20	7	30.1 - 40	7	1.7 - 3.0	7	Spring with booster pump	17	80,001 - 100,000	16
500,001- 1,000,000	12	10.1 - 15	6	20.1 - 30	6	1.0 - 1.6	4	Infiltration with short transmission line/well points	14	65,001 - 80,000	14
100,001- 500,000	10	5 - 10	5	10 - 20	5	less than 1	2			52,001 - 65,000	12
50,001- 100,000	8	less than 5	4	less than 10	4			Infiltration with long transmission line/wells	11	41,001 - 52,000	10
20,001- 50,000	6									31,001 - 41,000	9
8,001- 20,000	4							Surface water without reservoir	7	22,001 - 31,000	8
4,001- 8,000	2							Surface water with reservoir	5	15,001 - 22,000	7
4,000 or less	1									10,001 - 15,000	6
										less than 10,000	5

Group	Total Points
I	70 and above
II	60 - 69
III	50 - 59
IV	40 - 49
V	39 and below

In allotting points under each criterion, readily available data are taken from the latest NCSO report (1970 or 1975 census). These data are: total population in the city or municipality; total households; number of urban households; number of commercial establishments; number of industrial establishments; number of households with refrigerators; and number of households using flush water-sealed toilets. The data on total income taxes paid in the city/municipality in 1975 were obtained from the BIR office. Data on the probable sources of additional water supply were taken from the recent preliminary hydro-survey conducted by LWUA and the WD.

The following is a procedure for assigning points to a WD on the basis of the 5 criteria.

1. 1975 Urban Income

Urban income is based on the total income taxes paid by individuals and business entities and the percentage of urban households with respect to total households in the city/municipality. If the 1975 data are not available, the percentage of urban households is projected to 1975 by applying an increase of 0.1 to 0.4 percent per year. In projecting the percentage of urban households, growth characteristics and urban development must be considered. The projected percentage is multiplied by 1975 total income. Table MM 3-1 shows the breakdown of the annual income with points ranging from 1 to 20.

2. 1975 Standard of Living

The standard of living is measured by the number of households in the urban area with refrigerators and those with flush water-sealed toilets.

The percentage of urban households with refrigerators with respect to total urban households is projected to 1975, if the 1975 census is not available. An increase of 1 to 4 percent per annum is applied, depending upon the recent economic and social development in the city/municipality. The same procedure is applied to the percentage of urban households using flush water-sealed toilets. Table MM 3-1 shows the percentages of households with refrigerators and those with flush toilets with respect to total urban households, with points ranging from 4 to 10.

3. 1975 Business Index

The business index is measured by the percentage of commercial establishments with respect to total urban households in 1975. One industrial establishment (data from NCSO census) is assumed to be equivalent to 10 commercial establishments (except when the 1975 census is available). An increase of 1 to 20 establishments per year is applied, depending on the recent business activities and urban development in the city/municipality. The number of urban households in 1975 is obtained by multiplying the 1975 total households (total population ÷ average of 7 persons/household) by the 1975 percentage of urban households as derived in the methodology for 1975 urban income. The 1975 sum of commercial establishments divided by the number of 1975 urban households is the business index of the city/municipality. Table MM 3-1 shows the various levels of business index, with corresponding points ranging from 2 to 20.

4. 1980 Cost of Water

The cost of water is inferred from the probable source of additional water supply by 1980. The probable source of additional water supply is weighted according to its apparent economic viability. A spring source that is located within the 1980 service area and can flow by gravity is considered the most economical. Surface water requiring complete water treatment with impounding reservoir is the most expensive. Infiltration galleries with short or long transmission lines, wells, or spring source requiring booster pump, are considered to have weights between the most and least expensive (see Table MM 3-1).

5. Served Population in 1980

The served population in 1980 is projected by delineating the future service areas of the WD and projecting the population of the city/municipality and of the service areas. The 1980 served population is determined as a portion of the service area population. In projecting the population served and the future service areas, economic growth and urban development, availability of water supply and capability of the water district to provide service must be considered.

C. Expected Water Demand By Class of WD

The experience of the LWUA-CDM staff, especially during the First Ten Urban Areas Project in the Philippines, has been used to assign values of expected water demand to the 5 classes of water districts. These expected water demands are shown in Table MM 3-2.

D. Example of Water District Classification

This method of classifying a water district is illustrated, with the Silay City Water District as an example. Available data for Silay City are taken from the NCSO and BIR reports, and from the preliminary hydro-survey by LWUA and the SIL-WD. The following data were obtained:

Total income taxes paid in the city - ₱20,049,139 (1974-1975)

Total population in the city - 103,493 (1975)

Total number of households in the city - 10,915 (1970)

Total number of households in the urban area - 3,693 (1970)

Total number of commercial establishments in the city - 36 (1970)

Total number of industrial establishments in the city - 1 (1970)

Total urban households with refrigerators - 266 (1970)

Total urban households using flush water-sealed toilets - 807 (1970)

Probable source of additional water supply - wells (1980)

Population in the service area - 21,280 (1980)

To determine the specific weights of the above data for each grouping criterion, the methodology developed is applied as follows:

TABLE MM 3-2

WATER DEMAND OF WATER DISTRICT GROUPINGS

Classification	Year 1980	Year 1990	Year 2000
Group I			
Domestic use, lpcd	140	155	175
Commercial/Industrial/Institutional			
% of domestic	17	21	25
Equivalent, lpcd	24	33	35
Accounted-for-water, lpcd	164	188	210
Unaccounted-for-water			
% of production	40	28	20
Equivalent, lpcd	109	73	52
Total production required, lpcd	273	261	262
Group II			
Domestic use, lpcd	120	135	150
Commercial/Industrial/Institutional			
% of domestic	15	17	20
Equivalent, lpcd	18	23	30
Accounted-for-water, lpcd	138	158	180
Unaccounted-for-water			
% of production	40	28	20
Equivalent, lpcd	92	62	45
Total production required, lpcd	230	220	225
Group III			
Domestic use, lpcd	105	120	135
Commercial/Industrial/Institutional			
% of domestic	13	16	18
Equivalent, lpcd	14	19	24
Accounted-for-water, lpcd	119	139	159
Unaccounted-for-water			
% of production	40	28	20
Equivalent, lpcd	79	54	40
Total production required, lpcd	198	193	199

TABLE MM 3-2 (Continued)

WATER DEMAND OF WATER DISTRICT GROUPINGS

Classification	Year 1980	Year 1990	Year 2000
Group IV			
Domestic use, lpcd	95	110	125
Commercial/Industrial/Institutional			
% of domestic	12	14	16
Equivalent, lpcd	12	15	20
Accounted-for-water, lpcd	107	125	145
Unaccounted-for-water			
% of production	40	28	20
Equivalent, lpcd	71	49	36
Total production required, lpcd	178	174	181
Group V			
Domestic use, lpcd	90	100	110
Commercial/Industrial/Institutional			
% of domestic	10	13	15
Equivalent, lpcd	9	13	17
Accounted-for-water, lpcd	99	113	127
Unaccounted-for-water			
% of production	40	28	20
Equivalent, lpcd	66	44	32
Total production required, lpcd	165	157	159

1. 1975 Urban Income

In 1970, the urban households accounted for 33.8 percent of the total households in the city. But due to recent developments in the local economy and subdivision housing projects in the urban sector of the city, the number of urban households was projected to increase to 35 percent in 1975. The product of the total 1974-1975 income taxes and the 1975 percentage of urban households represents the urban income taxes which amount to about ₱7.017 million. Table MM 3-1 gives this a weight of 16 points.

2. 1975 Standard of Living

This is measured by:

a. 1975 urban households using refrigerators

In 1970, 7.2 percent of the urban households had refrigerators. Due to economic and housing developments, the percentage was estimated to increase to about 12 percent in 1975. Table MM 3-1 gives this a weight of 6 points.

b. 1975 urban households using flush water-sealed toilet facilities

In 1970, the households with toilet facilities represented 21.9 percent of urban households. Due to the recent housing developments in the urban area, the households with toilet facilities were projected to be about 32 percent in 1975. Table MM 3-1 gives this a weight of 7 points.

3. 1975 Business Index

It is assumed that one industrial establishment is equivalent to 10 commercial establishments. Based on the 1970 census, the number of commercial establishments (equivalent industrial establishments included) was 46 (36 + 10). These establishments were expected to have increased to 96 (at 10 establishments per year) in 1975. Total urban households increased from 3,693 in 1970 to about 5,180 in 1975 (1975 population of 103,493 ÷ average 7 persons/household). Hence, the business index in 1975 was 1.9 percent (commercial establishments divided by the number of urban households in 1975). Table MM 3-1 gives this a weight of 7 points.

4. 1980 Cost of Water

Based on the hydro-survey of LWUA-CDM and SIL-WD, deepwells appear to be the most probable economical source of additional supply. Table MM 3-1 gives a weight of 11 points for this source.

5. 1980 Served Population

By 1980, the served population is expected to be about 15,630[1] as projected from the 1975 NCSO Census of Population and Housing. Table MM 3-1 gives this a weight of 7 points.

Therefore, the SIL-WD has a total of 54 points under the 5 criteria, indicating that it belongs to Group III. The water demands of this group from 1980 to year 2000 are listed in Table MM 3-2.

Table MM 3-3 classifies 16 water districts in the Philippines according to the 5 grouping criteria.

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[1] See Chapter VI, Table VI-3, of the Silay City Feasibility Study Report.

TABLE MM 3-3

SUMMARY OF CITIES/MUNICIPALITIES SUBJECTED TO THE WATER DISTRICT GROUPING CRITERIA

City/Municipality	1975 Urban Income (Points)	1975 Standard of Living: Urban Households with Refrigerators (Points)	1975 Standard of Living: Urban Households with Flush Toilets (Points)	1975 Business Index (Points)	1980 Cost of Water Source of Supply (Points)	1980 Served Population (Points)	Total Points	Group
Bislig, Surigao del Sur	14	6	7	11	14	7	59	3
Urdaneta, Pangasinan	6	7	9	11	11	6	50	3
Calamba, Laguna	14	9	10	7	17	6	63	2
Gapan, Nueva Ecija	6	8	9	7	11	6	47	4
Silay City	16	6	7	7	11	7	54	3
Cebu City	20	10	10	7	5	20	72	1
Davao City	16	9	9	16	11	10	71	1
Bacolod City	20	9	9	7	11	18	74	1
Zamboanga City	14	7	9	7	7	16	62	2
Digos, Davao del Sur	12	6	9	7	11	5	50	3
Bacacay, Albay	1	5	9	11	20	5	51	3
Bangued, Abra	1	6	8	7	20	6	48	4
Dalaguete, Cebu	1	5	8	4	11	5	34	5
Baybay, Leyte	10	9	8	16	9	6	58	3
Roxas City	10	9	8	16	7	6	56	3
Cotabato City	12	9	8	11	11	7	58	3
Olongapo City	18	9	10	20	11			1
Subic	4	5	6	16	11	5	47	4
San Fernando (Pampanga)	14	6	7	20	11	7	65	2
Tarlac	12	8	8	16	11	8	63	2
Cabanatuan City	12	8	10	11	11	9	61	2
Lipa City	8	8	10	16	11	7	60	2
Lucena-Pagbilao-Tayabas	14	6	8	7	17	12	64	2
Daet	10	5	4	4	20	10	53	3

Methodology Memorandum No. 4

To : L. V. Gutierrez, Jr.

From : E. Jacildo

Date : 20 January 1977

Subject: Probability Analysis of Stream Flows by Gumbel

A. Need

In evaluating the surface water sources for water supply purposes, the analyst has to focus his interest on statistical frequency of extreme low flows. Since the exact sequence of streamflow for future years can not be predicted, he also has to consider the probable variations in flows in order to develop a design on the basis of calculated risk.

In 1941, E. J. Gumbel devised a probability method by which recurring flows can be computed for design requirements. Under this method, the hydrologic data are analyzed as an "extreme value" distribution and the sets of hydrologic data are plotted as straight lines. Gumbel's method has been found advantageous to use.

B. Basic Data

The hydrologic data are found in Surface Water Supply Bulletins published by the Water Resources Division of the Bureau of Public Works (BPW). Data are presented in the following sequence:

1. Name of river basin
2. Name of stream
3. Location of gaging station in latitude and longitude
4. Drainage area in square kilometers
5. Records available: months and year
6. Gage elevation
7. Extremes; magnitude and dates of maximum and minimum flows
8. Remarks
9. Revisions
10. Presentation of daily discharge for one year

It should be noted that Surface Water Supply Bulletins after 1967 have not been published; they are on file at the BPW Water Resources Division.

C. Methodology

Below are the steps in Gumbel's probability analysis of streamflows.

Table MM4-1

1. Tabulate the monthly flows (mean, minimum or maximum, whatever is desired).
2. Take note of any changes in the yearly records as stated under "Remarks" or "Revisions" of the Bulletin. Write them under remarks in Table MM4-1.

Table MM4-2

1. Arrange all monthly flows in ascending order, i.e., from lowest to highest. Any flow that occurs more than once should be listed.
2. Rank the arranged flows under "m".
3. Take the logarithm of Q.
4. Solve for the probability flow by the formula

$$\frac{m}{n+1} \times 100$$

   where, m is the rank of a particular flow
   n is the total number of recorded flows.
5. Solve for the return period by the formula

$$\frac{n+1}{m}.$$

Figure MM4-1

1. Plot log Q as ordinate against probability as abscissa. Figure MM4-1 is Gumbel's special probability paper.
2. Draw a straight line (month line) passing through the points marked in step C-1. If not all the points fall on the line, adjust the line such that it passes on the average path of the points. Any return period which falls on the line is in month's term. The line may be extended in order to reach periods not covered by it.
3. Take the antilogarithms of the values of return periods in months as projected on the log Q scale (ordinate). The antilogs are the recurring flows in cubic meters per day.

TABLE MM4-1

MEAN-DAY DISCHARGE PER MONTH

Basin: Pampanga (San Vicente)
Station: Peñaranda River
Location: lat. 15°18'46"; long. 120°56'30"
Drainage Area: 575 sqkm

Gage Elevation: 11,050 m
Units: cumd x 1,000

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Minimum-Day Discharge/ Year	Remarks
1965	-	2,283	753	351	372	1,313	-	-	-	3,239	5,156	4,358		
1966	-	2,915	-	-	8,941	1,595	2,682	4,215	5,425	1,413	9,801	5,380		
1967	4,922	857	1,189	547	873	425	1,012	6,614	4,415	5,707	5,896	125		
1968	66	77	120	540	96	-	-	-	-	-	-	117		
1969	141	32	336	689	664	301	3,203	2,394	2,248	1,175	1,785	2,190		
1970	1,989	814	279	17	17	3,561	2,928	1,628	9,590	11,726	9,689	6,915		
1971	3,123	642	732	294	1,499	4,567	4,021	1,824	1,377	11,161	5,229	15,007		
1972	5,992	4,873	406	1,461	767	415	18,347	15,977	6,306	216	4,701	2,896		
1973	697	823	82	108	95	686	2,525	2,650	4,405	14,582	4,149	2,124		
1974	1,405	1,332	2,191	471	621	3,781	3,497	10,761	10,014	12,567	16,317	13,693		

TABLE MM4-2

MEANFLOW (PEÑARANDA RIVER, SAN VICENTE)
GAPAN WATER DISTRICT

m	Q cumd x 10^3	Log Q	Probability $(\frac{m}{n+1} \times 100)$	Return Period (Months) $(\frac{n+1}{m})$
1	17	4.230	0.93	108.00
2	17	4.230	1.85	54.00
3	32	4.505	2.78	36.00
4	66	4.820	3.70	27.00
5	77	4.886	4.63	21.60
6	82	4.914	5.56	18.00
7	95	4.978	6.48	15.43
8	96	4.982	7.41	13.50
9	108	5.033	8.33	12.00
10	117	5.068	9.26	10.80
11	120	5.079	10.18	9.82
12	125	5.097	11.11	9.00
13	141	5.149	12.04	8.31
14	216	5.334	12.96	7.71
15	279	5.446	13.89	7.20
16	294	5.468	14.82	6.75
17	301	5.478	15.74	6.35
18	336	5.526	16.67	6.00
19	351	5.545	17.59	5.68
20	372	5.570	18.52	5.40
21	406	5.608	19.44	5.14
22	415	5.618	20.37	4.91
23	425	5.628	21.30	4.70
24	471	5.673	22.22	4.50
25	540	5.732	23.15	4.32
26	547	5.738	24.07	4.15
27	621	5.793	25.00	4.00
28	642	5.808	25.93	3.86
29	664	5.822	26,85	3.72
30	686	5.836	27.78	3.60
31	689	5.838	28.70	3.48
32	697	5.843	29.63	3.38
33	732	5.864	30.56	3.27
34	753	5.877	31.48	3.18
35	767	5.885	32.41	3.08
36	814	5.911	33.33	3.00
37	823	5.915	34.26	2.92
38	857	5.933	35.18	2.84

TABLE MM4-2 (continued)

MEANFLOW (PEÑARANDA RIVER, SAN VICENTE)
GAPAN WATER DISTRICT

m	Q cumd x 10^3	Log Q	Probability $(\frac{m}{n+1} \times 100)$	Return Period (Months) $(\frac{n+1}{m})$
39	873	5.941	36.11	2.77
40	1,012	6.005	37.04	2.70
41	1,175	6.070	37.96	2.63
42	1,189	6.075	38.889	2.57
43	1,313	6.118	39.815	2.51
44	1,332	6.124	40.741	2.45
45	1,377	6.139	41.667	2.40
46	1,405	6.148	42.592	2.35
47	1,413	6.150	43.518	2.30
48	1,461	6.165	44.444	2.25
49	1,499	6.176	45.370	2.20
50	1,595	6.203	46.296	2.16
51	1,628	6.212	47.222	2.12
52	1,785	6.252	48.148	2.08
53	1,824	6.261	49.074	2.04
54	1,989	6.299	50.000	2.00
55	2,124	6.327	50.926	1.96
56	2,190	6.340	51.852	1.93
57	2,191	6.341	52.778	1.89
58	2,248	6.352	53.704	1.86
59	2,283	6.358	54.630	1.83
60	2,394	6.379	55.555	1.80
61	2,525	6.402	56.481	1.77
62	2,650	6.423	57.407	1.74
63	2,680	6.428	58.333	1.71
64	2,896	6.462	59.259	1.69
65	2,915	6.465	60.185	1.66
66	2,928	6.466	61.111	1.64
67	3,123	6.494	62.037	1.61
68	3,203	6.506	62.963	1.59
69	3,209	6.510	63.889	1.56
70	3,497	6.544	64.815	1.54
71	3,561	6.552	65.741	1.52
72	3,781	6.578	66.667	1.50
73	4,021	6.604	67.592	1.48
74	4,149	6.618	68.518	1.46
75	4,215	6.625	69.444	1.44
76	4,358	6.639	70.370	1.42

TABLE MM4-2 (continued)

MEANFLOW (PEÑARANDA RIVER, SAN VICENTE)
GAPAN WATER DISTRICT

m	Q cumd x 10^3	Log Q	Probability $(\frac{m}{n+1} \times 100)$	Return Period (Months) $(\frac{n+1}{m})$
77	4,405	6.644	71.296	1.40
78	4,415	6.645	72.222	1.38
79	4,567	6.660	73.148	1.37
80	4.701	6.672	74.074	1.35
81	4,873	6.688	75.000	1.33
82	4,922	6.697	75.926	1.32
83	5,156	6.712	76.852	1.30
84	5,229	6.718	77.778	1.28
85	5,380	6.731	78.704	1.27
86	5,425	6.734	79.630	1.26
87	5,707	6.756	80.556	1.24
88	5,896	6.770	81.481	1.23
89	5,992	6.778	82.407	1.21
90	6,306	6.800	83.333	1.20
91	6,614	6.820	84.259	1.19
92	6,915	6.840	85.185	1.17
93	8,941	6.951	86.111	1.16
94	9,590	6.982	87.037	1.15
95	9,689	6.986	87.963	1.14
96	9,801	6.991	88.889	1.12
97	10,014	7.001	89.815	1.11
98	10,761	7.032	90.741	1.10
99	11,161	7.048	91.667	1.09
100	11,726	7.069	92.592	1.08
101	12,567	7.099	93.518	1.07
102	13,693	7.136	94.444	1.06
103	14,582	7.164	95.370	1.05
104	15,007	7.176	96.296	1.04
105	15,977	7.203	97.222	1.03
106	16,317	7.213	98.148	1.02
107	18,347	7.264	99.074	1.01

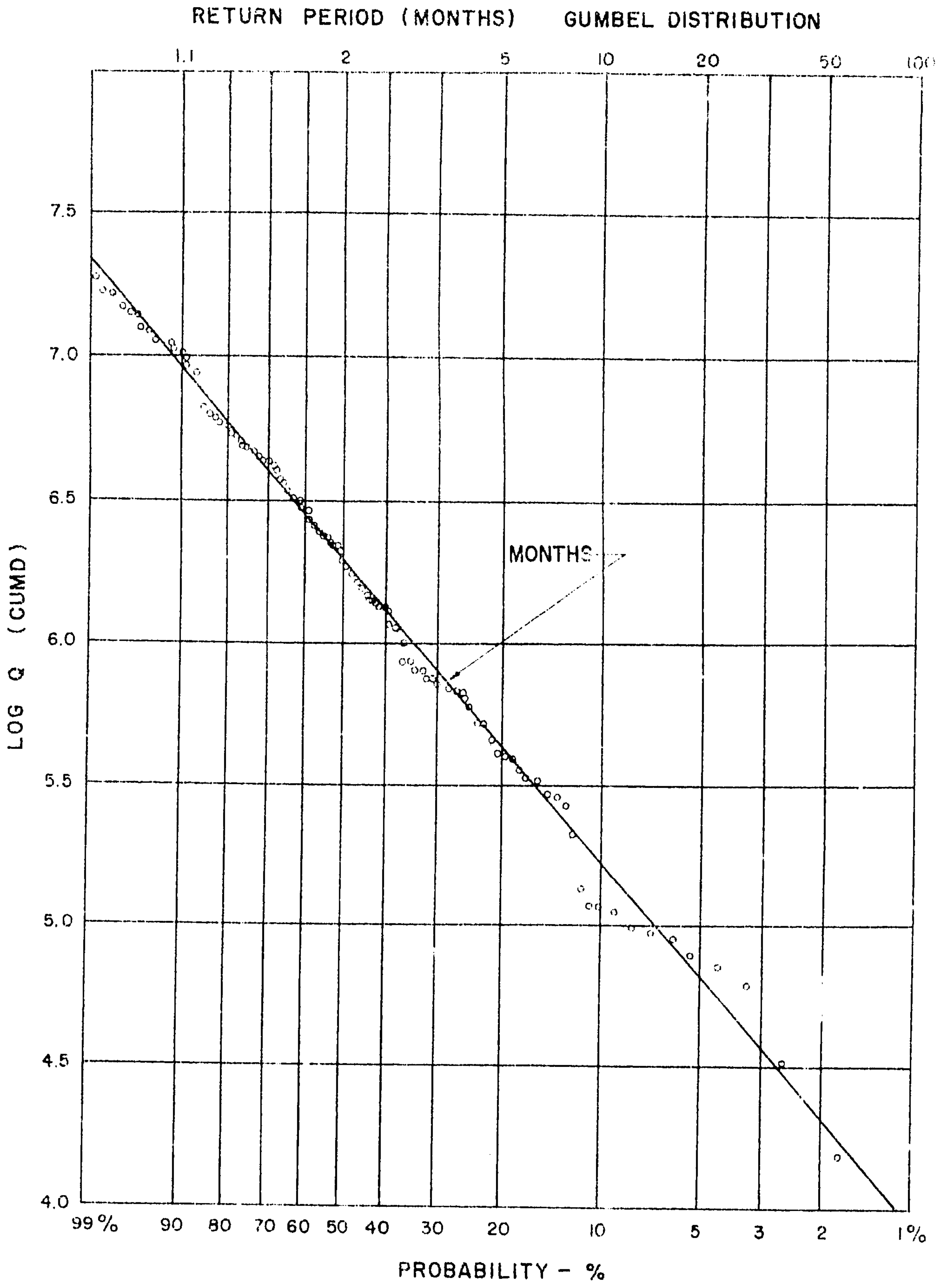


FIGURE MM4-1
MONTHLY MEANFLOW
(PENARANDA RIVER, SAN VICENTE)
GAPAN WATER DISTRICT

Methodology Memorandum No. 5

To : L. V. Gutierrez, Jr.

From : J. B. Arbuthnot/B. R. Conklin

Date : 16 May 1977

Subject: Quantity of Storage Versus Rate of Supply

A. General

The demand for water in a water system is not uniform, therefore, the system must be designed to supply water at varying rates of demand.

One common method of supplying water at varying rates is to provide a specific amount of source pumping capacity and supply the difference between demand and pumping capacity from a water storage facility.

The most economical amount of pumping capacity and storage volume is selected based on cost studies of alternative combinations of facilities that would meet a community's needs. Some of the factors that should be considered in these cost studies and some basic guidelines for selecting properly sized facilities are presented in this memorandum.

B. Discussion

The amount of water a community needs at any particular instant is primarily dependent on the following factors:

1. The number of people within the community
2. The number of water-consuming facilities within the average home (faucets, toilets, showers, automatic washing appliances, etc.)
3. The habits of people (what times people eat, shower, sleep, etc.)

In general, daily usage of water follows a pattern with two peak usage periods during the day and low usage late at night. Figure MM5-1 shows a typical variation measured in a section of the Cebu City distribution system.

The relationship of the peak usage on an average day can be determined statistically for a given community. The statistical peak is an average of each person's peak usage and has two important properties:

1. The statistical peak is a function of the number of people in the community. The fewer people, the higher the peak may be because each person's peak usage could more easily affect the total flow.

2. The statistical peak should be recognized as a mathematical average, and on some days the peak usage could be much higher or lower than the statistical peak.

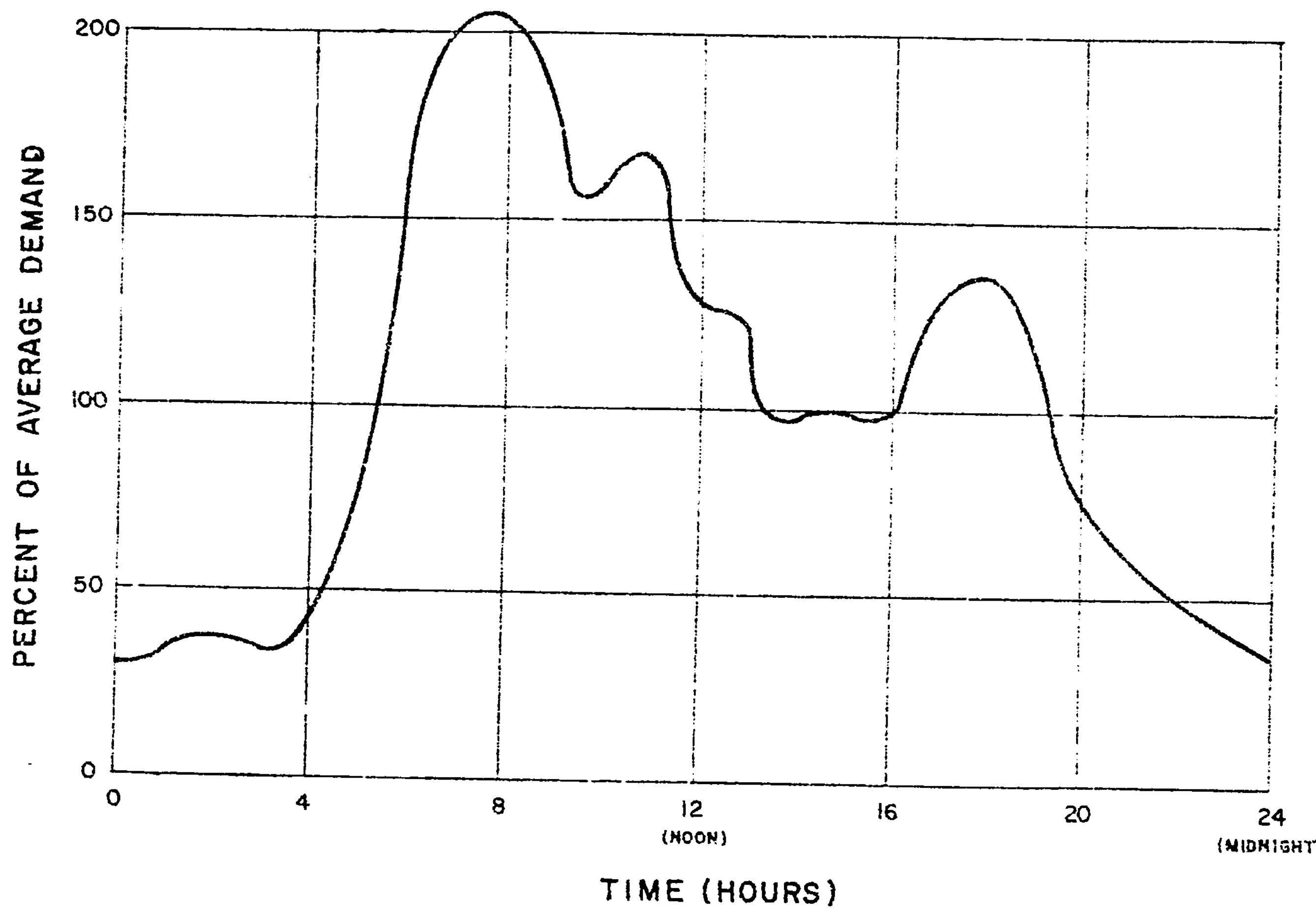
The common engineering practice for water systems is to supply water from a source at maximum-day rates either by pumping or gravity. Maximum-day demand is the maximum quantity of water used during an entire day in a single year. Water usage can be at or near maximum-day demand for a period of weeks during summer months. Source capacity must equal maximum-day demand because it would be impractical to store sufficient water to supply maximum-day demand rates for more than a few days.

The difference in demand between the peak-hour demands and the supply (which is equal to maximum-day demands) occurs during a period of short duration where demand exceeds supply. Stored water is used to meet this short period of excess demand and is called operational storage. It should be noted at this time that there are three categories of storage:

1. Operational storage - used to meet hourly fluctuations in demand.

2. Emergency storage - used to meet demands in case of breakdowns in source facilities; typically equal to a full day's demand.

3. Fire storage - used to meet the required volume of water used to extinguish the worst fire expected in the community.



FEASIBILITY STUDY FOR WATER SUPPLY OF SECOND TEN URBAN AREAS LWUA-CDM

FIGURE MM5-1
DAILY USAGE PATTERN

Storage requirements for the last two categories have been largely neglected in these studies because of the excessive cost involved to provide the storage.

C. Methodology

The engineer must determine the amount of storage and source capacity to meet the demands in a specific community. A set of curves that relate the peak hourly usage to the number of people in a community has been developed by CDM and others.[1] Practice has shown that a volume of about 15 to 20 percent of the maximum-day usage is required as operational storage if source facilities can supply maximum-day demands. Combining the "peaking curves" with the operational storage requirement, a second set of curves relating the quantity of storage to the number of people, at different rates of source supply, has been developed (see Figure MM5-2).

Up to this point, the only option that has been discussed is to supply peak-hour demands from storage facilities. In many cases, the cost of storage facilities is so high that it may be more economical to provide additional source capacity and reduce the quantity of storage. This is especially true where storage is provided in elevated structures that are very costly, since they are built to withstand earthquakes. The curves in Figure MM5-2 have been used in this study to determine the requirements for storage at various supply rates in order to prepare cost comparisons of alternative supply and storage combinations.

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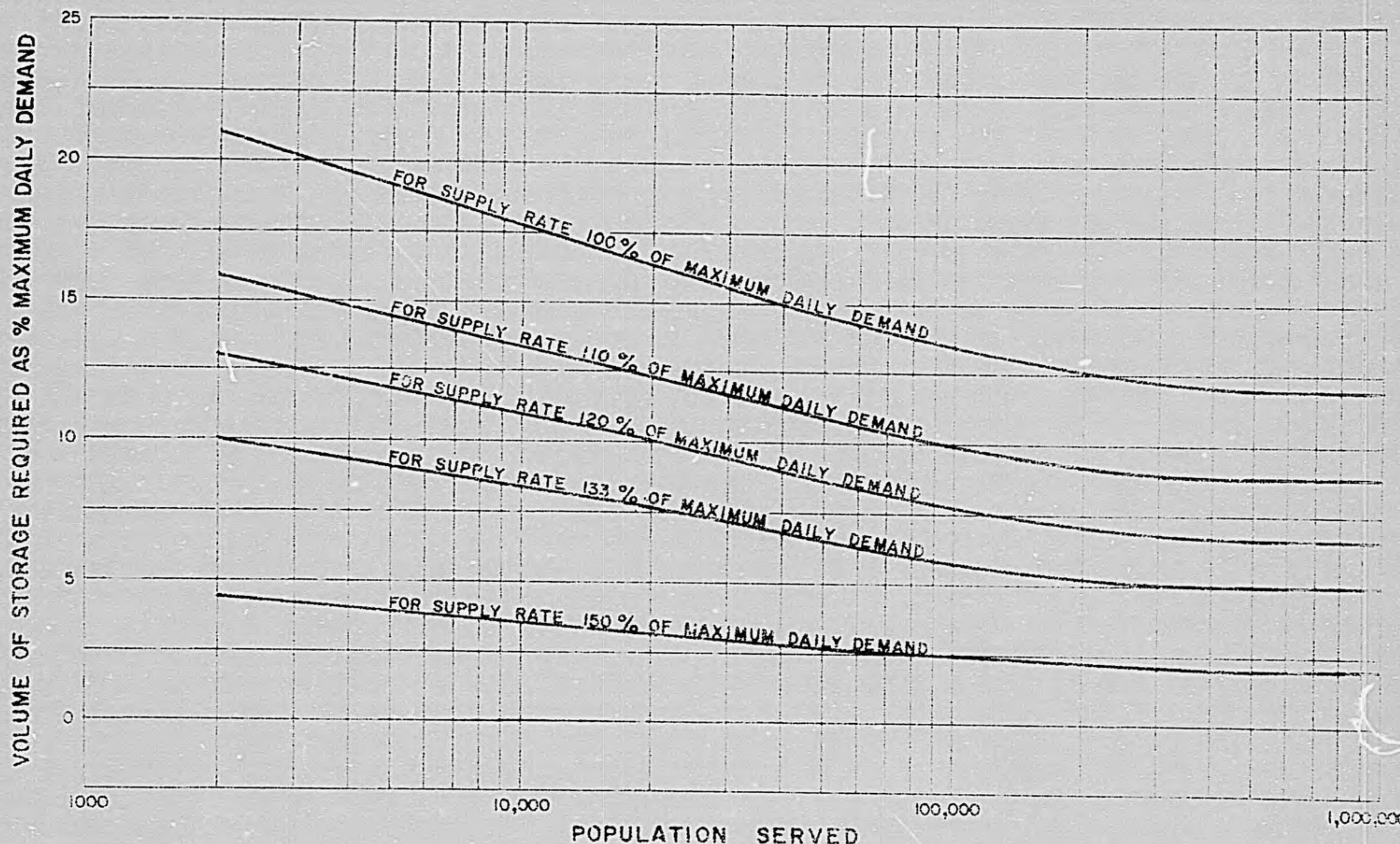
[1] ASCE Manual of Practice No. 37.



FEASIBILITY STUDY FOR WATER SUPPLY OF SECOND TEN URBAN AREAS LWUA-CDM

FIGURE MM 5-2
STORAGE REQUIRED TO MEET DAILY PEAK WATER DEMAND

Methodology Memorandum No. 6

To : L. V. Gutierrez, Jr.

From : J. Arbuthnot; B. Conklin

Date : 22 March 1977

Subject: Economical Sizing of Pumped Waterlines

A. General

This memorandum develops an expression for the most economic size of a pipeline for pumped water systems based on two cost factors: cost of pipe-in-place and cost of pumping (energy). The larger the pipe the greater the cost of construction. Also, the larger the pipe the lesser the cost of energy required to pump water through the pipe. The most economic pipe sizes would be where the incremental cost of pumping is equal to the incremental cost of pipe construction.

In most situations, the above cost factors are the most important factors in determining the economical size of transmission mains. Even when these are not the only important factors, it is still advantageous to know what is the most economic size of pipe with regard to these two factors.

B. General Relationship

The total annual cost of a pipe line is equal to the sum of its construction cost (expressed on an amortized annual basis) plus its annual pumping cost.

$$C_t = C_c + C_p \quad 1/$$

To determine the most economic pipe diameter both the factors on the right hand side of the equation were expressed in terms of the diameter of the pipe. The equation was then differentiated with respect to the diameter, and solved for the diameter for which the resulting expression was equal to zero. 2/

1/ Total Annual Cost = Annual Construction Cost + Annual Pumping Cost.

2/ $\frac{d(C_t)}{dx} = \frac{d(C_c)}{dx} + \frac{d(C_p)}{dx} = 0$, where X = pipe diameter

C. Annual Construction Cost

The construction cost of the pipe was taken from Table G-4 of Appendix G, Basis of Cost Estimates, in Volume II of the final report. Costs were adjusted by adding a value for necessary valves and by escalating these by 10 percent per year for 2 years to obtain July 1978 construction costs. These costs were then increased by 15 percent for contingencies and then by 10 percent for engineering. The following equation was derived and represents the adjusted construction costs in Table G-4 in terms of the diameter.

$$C = 2845 \, (\text{Dia.})^{1.292} \quad \text{---- Equation 1}$$

C is the installed cost of pipe in pesos per meter, and Dia, the diameter of the pipe in meters.

The amortized annual cost of construction is the cost of construction multiplied by the capital recovery factor (as influenced by the economic life of the pipe and discount factor). The general equation is:

$$\text{Annual Cost of Construction} = \text{CRF} \times 2845 (\text{Dia.})^{1.292} \quad \text{---- Equation 2}$$

where CRF is the capital recovery factor; for n = 50 years, discount rate = 12%, CRF is equal to 0.12042.

D. Annual Pumping Cost

The annual cost of pumping energy may be expressed in terms of the amount of water pumped, the energy required to overcome the frictional loss in the pipe, the price of electrical energy and the efficiency of the pumping machinery. The general equation may be written as:

$$\text{Annual Cost of Pumping Energy} = \frac{\text{Mass/Year} \times g \times Hf \times ₱/\text{kwh}}{\text{efficiency} \times 3.6 \times 10^6} \quad \text{---- Equation 3}$$

where mass/Year is the amount of water pumped in kilograms; g, the gravitational constant; Hf, the energy lost by friction of flow in the pipe expressed in meters; ₱/kwh, the cost of energy in pesos per kilowatt hour; and 3.6×10^6, the number of newton-meters per kilowatt hour.

The friction loss of energy in the pipe may be expressed in terms of the diameter utilizing the Hazen-Williams (H&W) equation,

$$Hf = \frac{L \times MLD^{1.852}}{361.27 \, C^{1.852} \, D^{4.87}} \quad \text{---- Equation 4}$$

where L is the length of pipe in meters; MLD, the flow of water in million liters per day; C, the Hazen & Williams roughness coefficient; and Dia, the diameter of the pipe in meters.

E. Minimum Cost Diameter

The expression for minimum cost diameter may be obtained by inserting the expression for HF in the equation for the cost of pumping energy, combining this with the expression for the annual cost of construction, differentiating, setting the resulting expression equal to zero and solving for the diameter:

$$\text{Minimum Cost Diameter} = \frac{MLD^{0.4628} \times (\text{pesos/kwh})^{0.1623}}{2.391\ (\text{efficiency})^{0.1623}\ C^{0.3005}\ (A/P,\ 12\%,\ n)^{0.1623}}$$

using a C value of 120 and a capital recovery factor of 0.12042, the following equation is obtained:

$$\text{Minimum Cost Diameter} = \frac{MLD^{0.4628} (\text{pesos/kwh})^{0.1623}}{7.149\ (\text{efficiency})^{0.1623}} \quad \text{- - - - Equation 5}$$

The above equation is expressed graphically in Figure MM 6-1.

F. Limitations of the Analysis

How reliable is the preceding relationship (Equation 5), between water carried and economic pipe diameter? The derivation is rigorous but the relation is no more exact than are the simplifying assumptions upon which the derivation was based:

1. Construction Cost Relationship

The construction cost relation (Equation 1) has a standard deviation of just under 10 percent. This means that two-thirds of the time the formula will represent the adjusted costs tabulated, within 10 percent. The largest difference observed was 20 percent. Even so, economic conditions and the cost of pipe may change in time. Probably, a new table of pipe costs has to be made every 2 or 3 years, and the formulas, along with Figure MM 6-1, adjusted accordingly.

2. Other Assumptions

Other assumptions are:

C = 120 (Hazen & Williams coefficient)
i = 12% (Discount rate)
n = 50 years (Economical life of pipe)

The derivation also assumes that for the changes in pumping head, using various pipe sizes for a design flow, the total construction cost of the pumping station remains constant. This assumption is reasonable since the difference in cost between one pump selection and another for different heads at the same flow would not alter the cost of the complete station by significant amount. Generally, the installed motor horsepower would also be the same since the motors come in standard sizes and one size may be used for a number of different pump selections at a given flow.

The relative rate of inflation for pipeline construction is assumed equal to that of power costs.

3. Flow Quantities are Based on Constant Flow

The derivation of the most economic pipe diameter is based on a constant rate of flow within the pipe. This is probably the most general and therefore the least accurate of any of the assumptions.

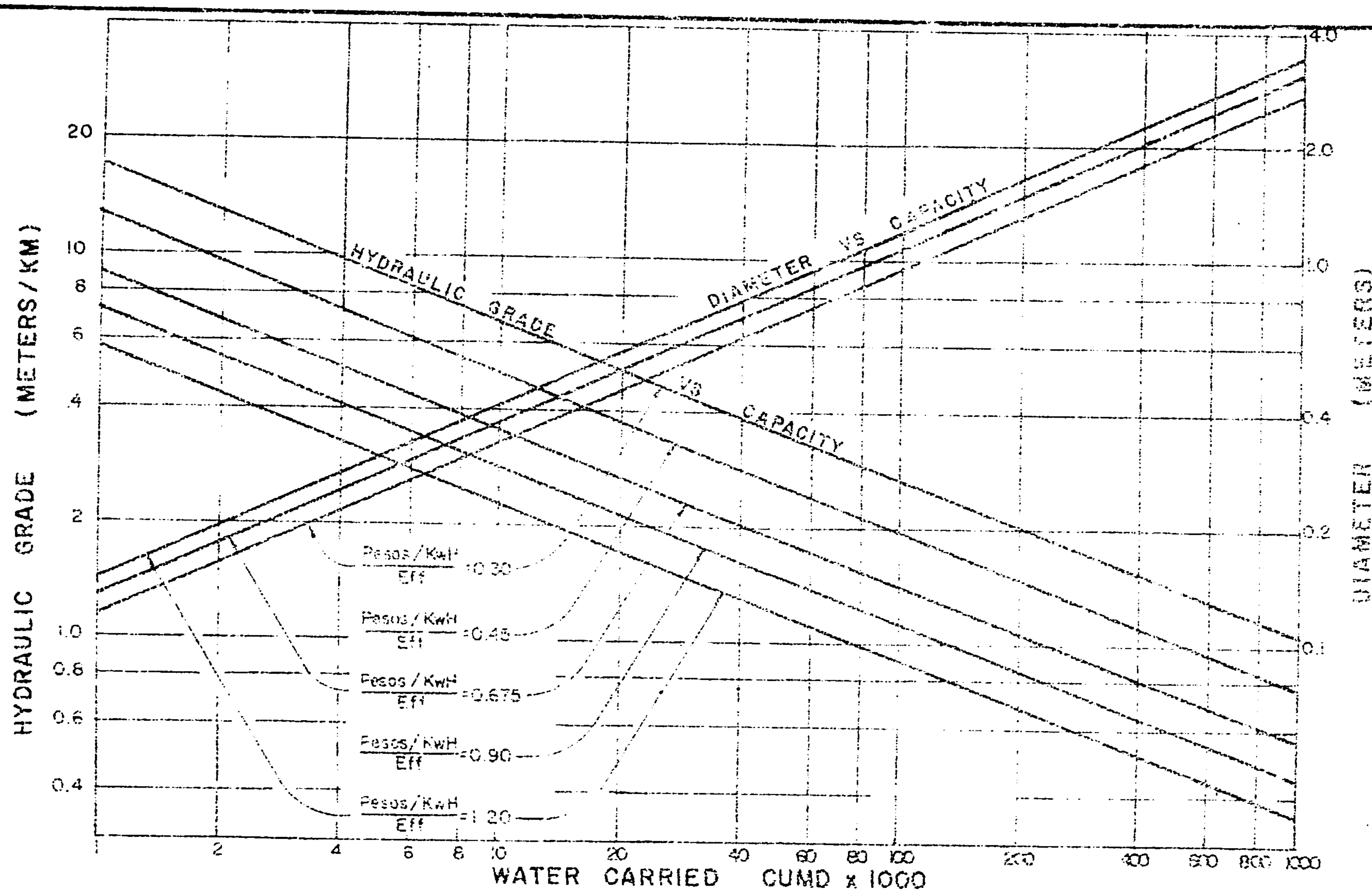
Normally a pipeline is designed for a specific flow condition; even under design conditions that flow may occur only part of the time. The flow in a transmission main could be expected to nearly equal the design flow for long period of time. However, in a distribution main, sized for peak-hour flows, the flow may not be equal to the design flow except for very short periods of time.

The variation in energy costs due to a fluctuating pumping rate through a pipeline can be calculated and applied to adjust the most economic pipe diameter determined from Figure MM 6-1. This so-called "energy variability factor" is discussed in the following section.

G. Energy Variability Factor

Figure MM 6-1 is based on selecting a pipeline where the flow will be constant throughout the year. In most cases, pipeline sizes are selected on a maximum expected rate of flow. If the flow through the pipeline is less than the design flow the pumping head (which directly affects energy costs) would decrease according to the 2.852 power of the flow (Q). Conversely, if flow greater than design flow rate is pumped through a pipeline, the energy cost would be increased by the 2.852 power.

The overall difference in energy costs over the day or year can be calculated by comparing the costs of pumping at a constant flow rate with the cost of pumping at the expected flow variation. This value is the so-called "energy variability factor" (EVF). The design flow for the pipe is used as the base flow and the actual flow to the design flow over the day is expressed as a percent.



Note : 1. CONSIDERS CONSTRUCTION AND PIPELINE FRICTION COSTS ONLY INCLUDING ENGINEERING AND CONTINGENCIES

2. AVERAGE C = 120 OVER 50 YEARS

3. ECONOMIC DISCOUNT RATE = 12 %

4. PIPE COST (MID 1978 PRICES) = $2845D^{1.25}$ PER METER, (D IN METERS)

LWUA - CDM

FIGURE MM6 - 1
MOST ECONOMIC WATER TRANSMISSION

The method used is to raise the difference between actual flow and the base flow (expressed as a percentage) to the 2.852 power. The ratio of the sum for the day of the actual flow to the design flow each raised to the 2.852 power is equal to the EVF. Figure MM 6-2 and Table MM 6-1 present two possible flow variations and the calculated energy variability factor for each.

The two flow patterns selected for Figure MM 6-2 are not commonly used design curves. Pattern 1 was selected to show that if a higher rate of flow than the design flow is pumped through the pipeline during a portion of the day, the EVF is greater than 1.0. Pattern 2 shows that if the actual flow rate is nearly equal to the design flow, the EVF would be nearly equal to 1.0.

An EVF of less than 1.0 would be a more common occurrence since the majority of pipelines are designed for some maximum future flow. The suggested EVF in a following section is an example of an EVF less than 1.0.

I. Application of EVF

The EVF can be used with Figure MM 6-1 in calculating the minimum cost pipe diameter. The EVF is inserted into the annual energy cost equation (equation 3) and then included in the differentiation, resulting in a revised equation as follows:

$$\text{Minimum Cost Diameter} = EVF^{0.1623} \frac{MLD^{0.4628}\ (Pesos/kwh)^{0.1623}}{7.149\ (efficiency)^{0.1623}} \quad \text{-- Equation 6}$$

The application of EVF requires 2 steps: first, design a minimum economic pipeline for some flow using Figure MM 6-1; and second, calculate the EVF for the actual flow variation and multiply the pipe size calculated in Step 1 by the EVF raised to the 0.1623 power.

J. Suggested EVF

The feasibility report on the Second Ten Provincial Urban Areas deals mainly with distribution pipelines; therefore, a suggested EVF that is applicable to distribution systems is presented herein.

The calculation of an EVF depends entirely on the flow data or assumed flow within a specific pipeline. The only accurate data produced during the feasibility studies are the diurnal flow variations measured in a portion of Cebu. The peak flow in the Cebu data was 2.06 which is greater than the design flows

TABLE MM 6-1

SAMPLE "EVF" FOR DIFFERENT FLOW PATTERNS

Hour	Flow Pattern No. 1		Flow Pattern No. 2	
	Percent of Average Day Demand	Energy Variation	Percent of Average Day Demand	Energy Variation
1	32	0.039	48	0.123
2	36	0.054	48	0.123
3	39	0.068	48	0.123
4	33	0.042	100	1.000
5	46	0.109	100	1.000
6	95	0.864	100	1.000
7	193	6.522	120	1.682
8	206	7.855	120	1.682
9	198	7.016	120	1.682
10	156	3.554	120	1.682
11	169	4.466	120	1.682
12	129	2.067	120	1.682
13	123	1.805	120	1.682
14	95	0.864	120	1.682
15	99	0.972	120	1.682
16	96	0.890	120	1.682
17	107	1.212	120	1.682
18	133	2.255	120	1.682
19	130	2.113	120	1.682
20	87	0.672	100	1.000
21	64	0.280	100	1.000
22	54	0.172	100	1.000
23	42	0.084	48	0.123
24	38	0.063	48	0.123
		44.038		28.481

$EVF_1 \frac{44.038}{24.000} = 1.83$ $EVF_2 \frac{28.481}{24.000} = 1.19$

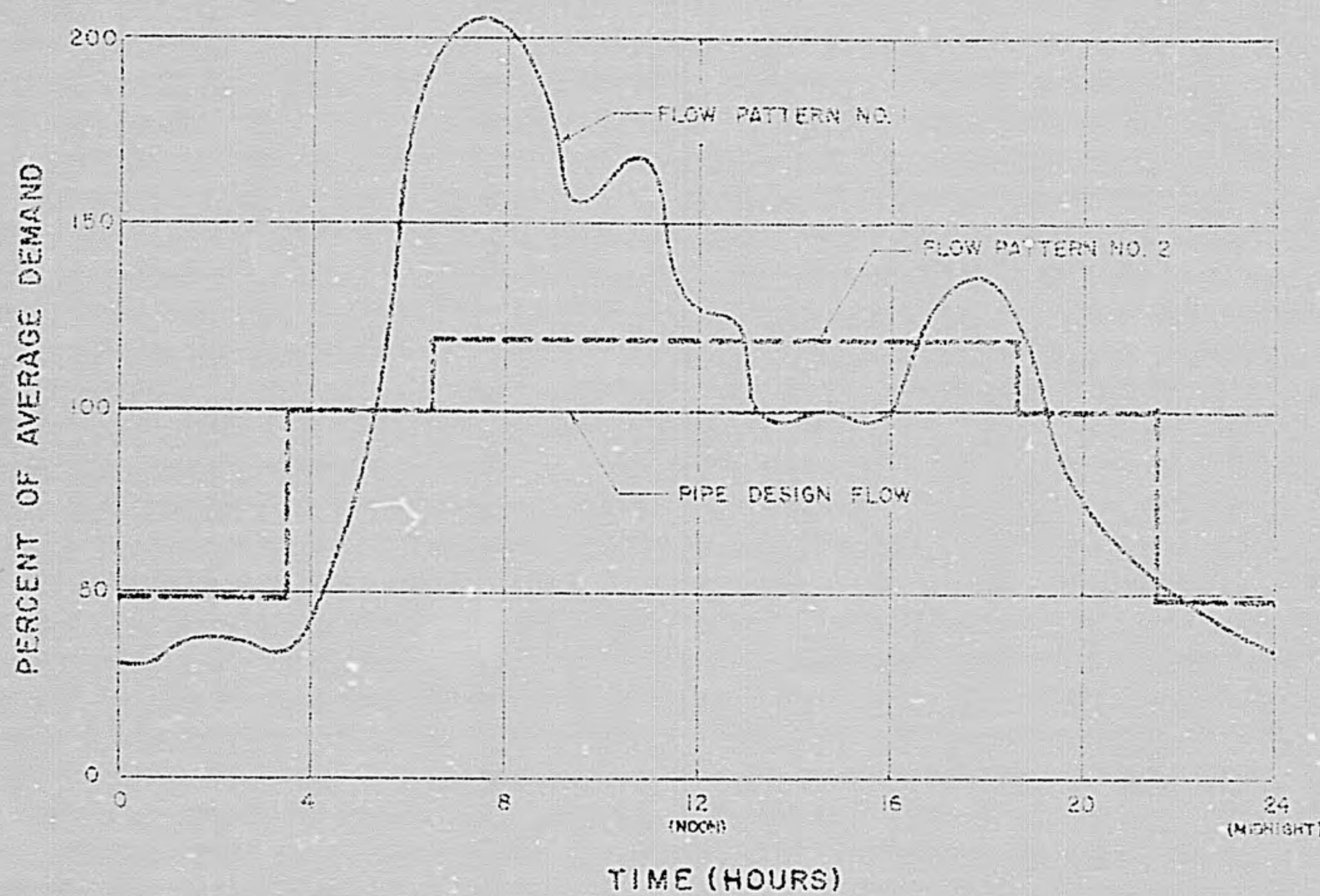


FIGURE MM6-2
SAMPLE FLOW PATTERNS

used for this study. Figure MM 6-3 presents an adjusted graph of diurnal flow using the shape of the Cebu curve but a maximum peak of 1.75. The EVF for this curve is equal to 0.32 (see Table MM 6-2) and when raised to the 0.1623 power, equals 0.83.

In practice, the EVF used for distribution systems in this study is only significant when the pipeline size is greater than 300 mm (significant means that EVF changes the recommended pipe size by a large incremental size).

K. Example

Problem: Select an economical distribution pipe size to convey a peak-hour flow of 20 MLD. The cost of power is 49 centavos per kilowatt hour, the pump efficiency is 81 percent, and the motor efficiency is equal to 90 percent.

Solution:

$$\frac{\text{Pesos/kwh}}{\text{Eff}} = \frac{.49}{.81 \times .90} = .672, \quad \text{say } .675$$

From Figure MM 6-1 using the flow of 20 MLD and Pesos/kwh/Eff = .675 select a pipe size of 500 mm.

For a flow variation in a distribution main, the EVF is equal to 0.32 and the EVF raised to the 0.1623 power is equal to 0.83. The most economical pipe size for the actual flow variation is equal to 0.83 x 500 m or 415 mm; so choose 400 mm pipe size.

TABLE MM 6-2

"EVF" FOR DISTRIBUTION SYSTEM

Hour	Percent of Average Day Demand	Percent of Design Flow 3/	Energy Variation 4/
1	35	20	0.010
2	40	23	0.015
3	39	22	0.013
4	37	21	0.012
5	73	42	0.084
6	134	77	0.475
7	164	94	0.838
8	175	100	1.000
9	174	99	0.972
10	163	93	0.813
11	162	93	0.813
12	134	77	0.475
13	118	67	0.317
14	94	54	0.172
15	94	54	0.172
16	94	54	0.172
17	105	60	0.233
18	129	74	0.424
19	123	70	0.362
20	96	55	0.182
21	72	41	0.079
22	58	33	0.042
73	47	27	0.024
24	40	23	0.015
			7.716

$$EVF = \frac{7.716}{24.000^*} = -.32 \qquad EVF^{0.1623} = 0.83$$

3/ Using 175 percent of average day as base flow for pipe design.
4/ Equals Percent Design Fl. . raised to the 2.852 power.
* Energy variation at con..ant flow

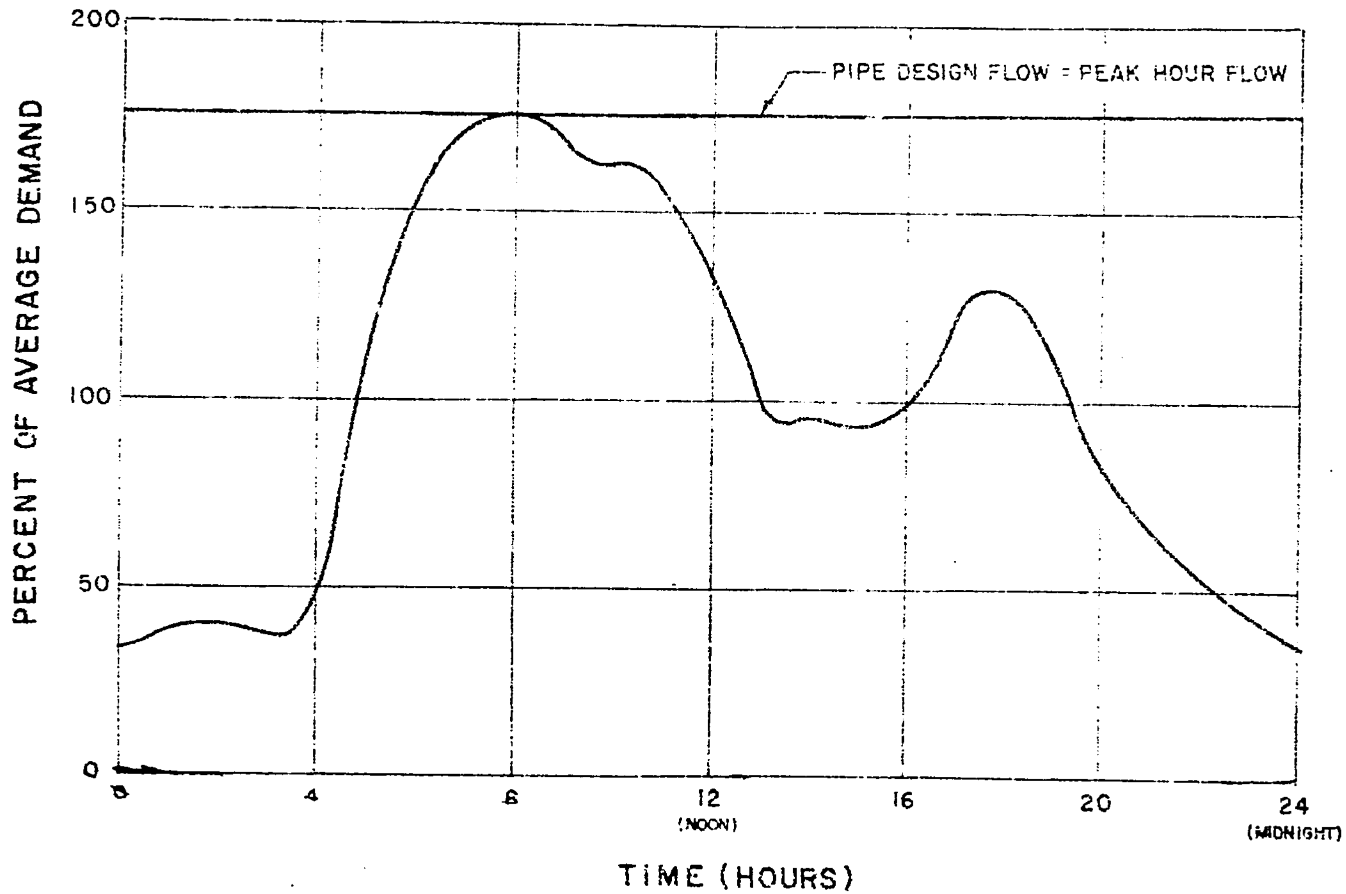
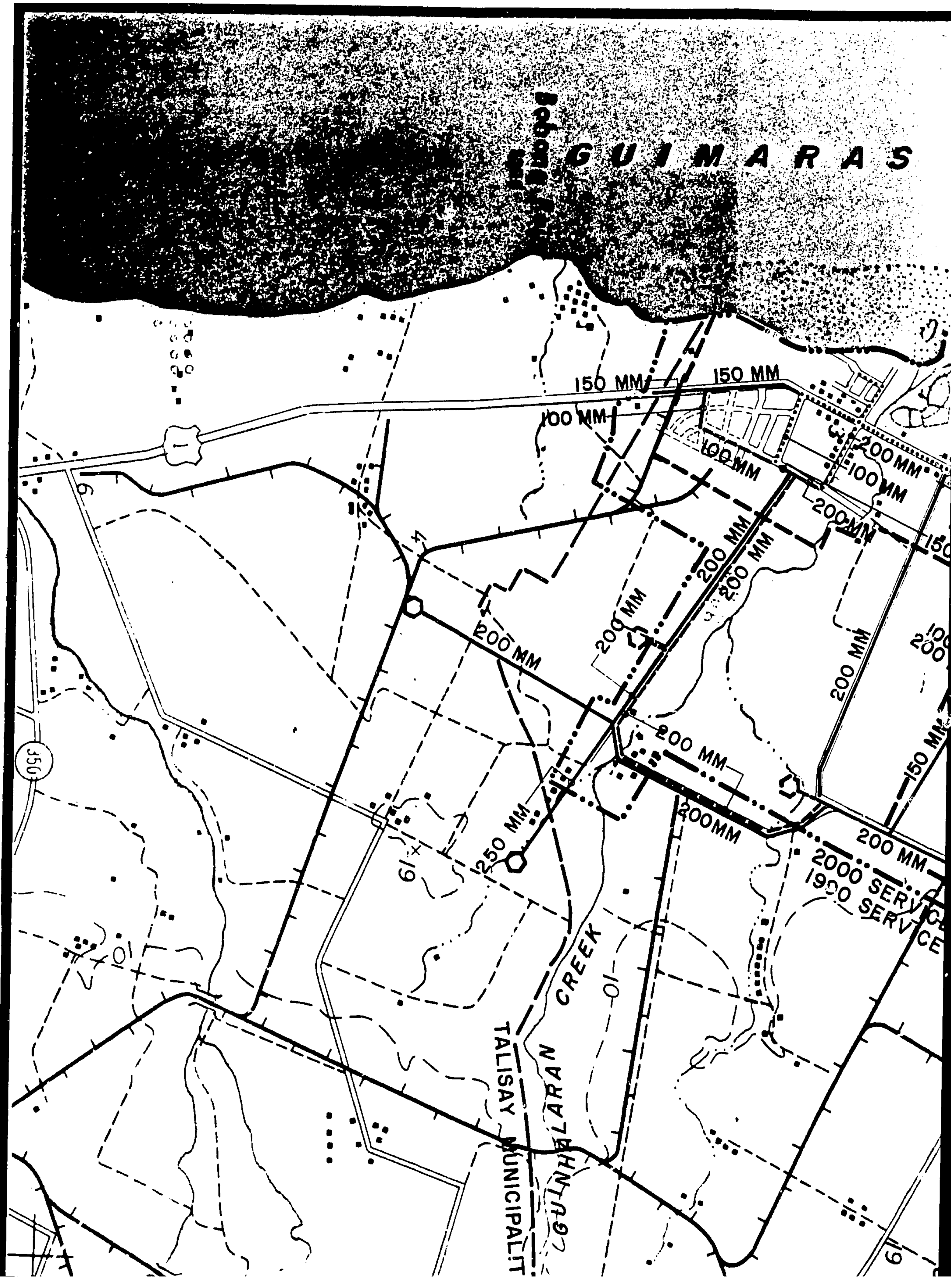
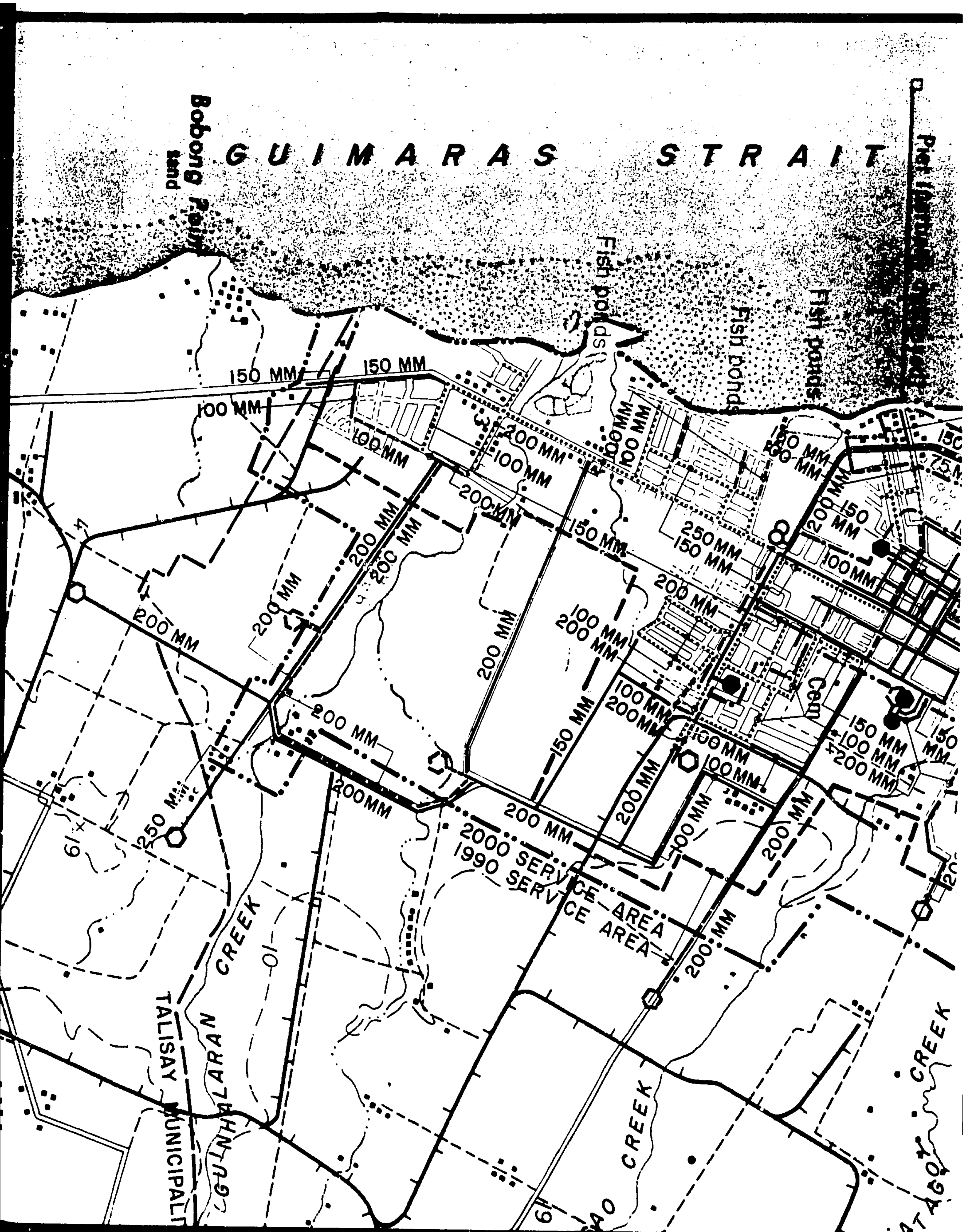
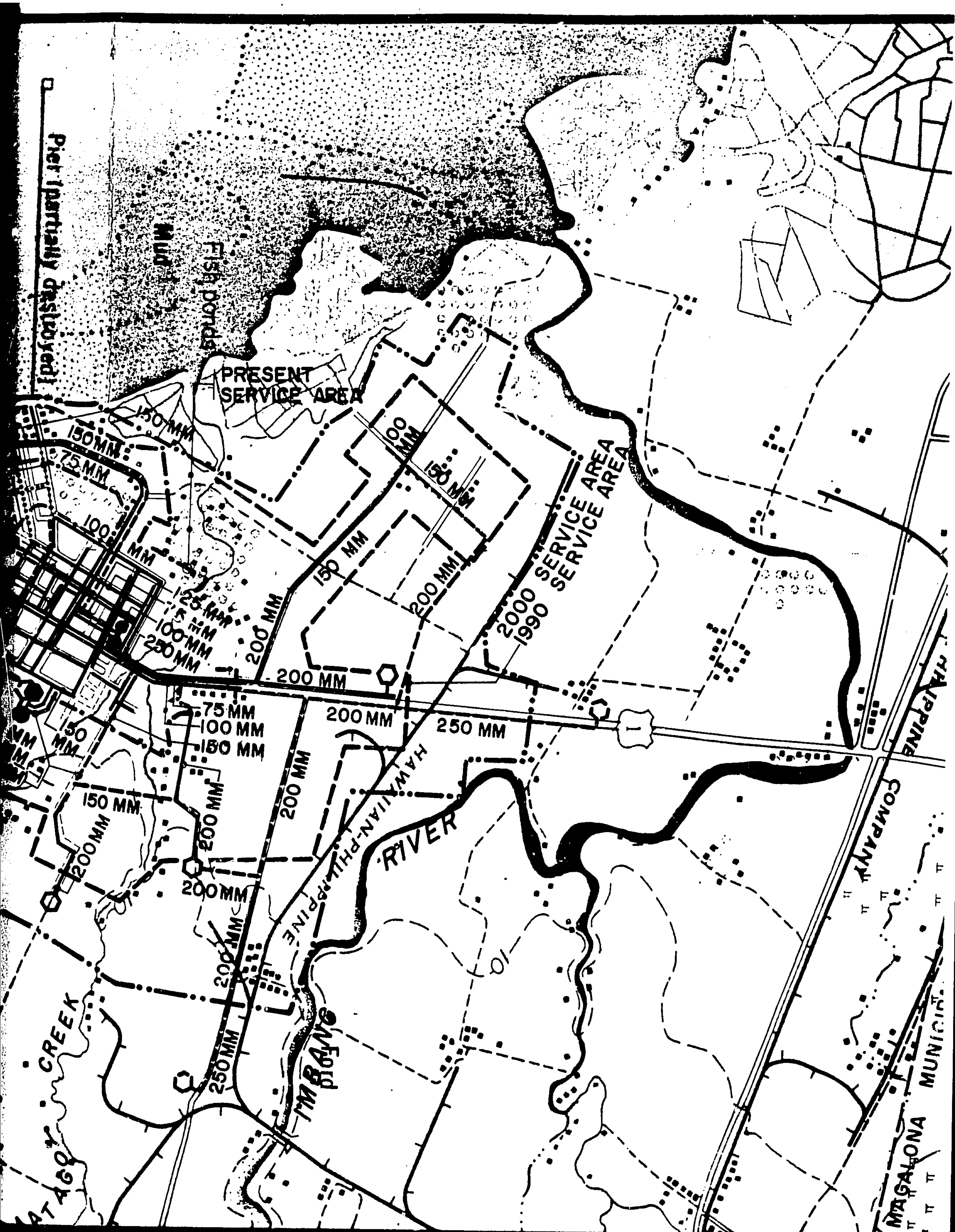


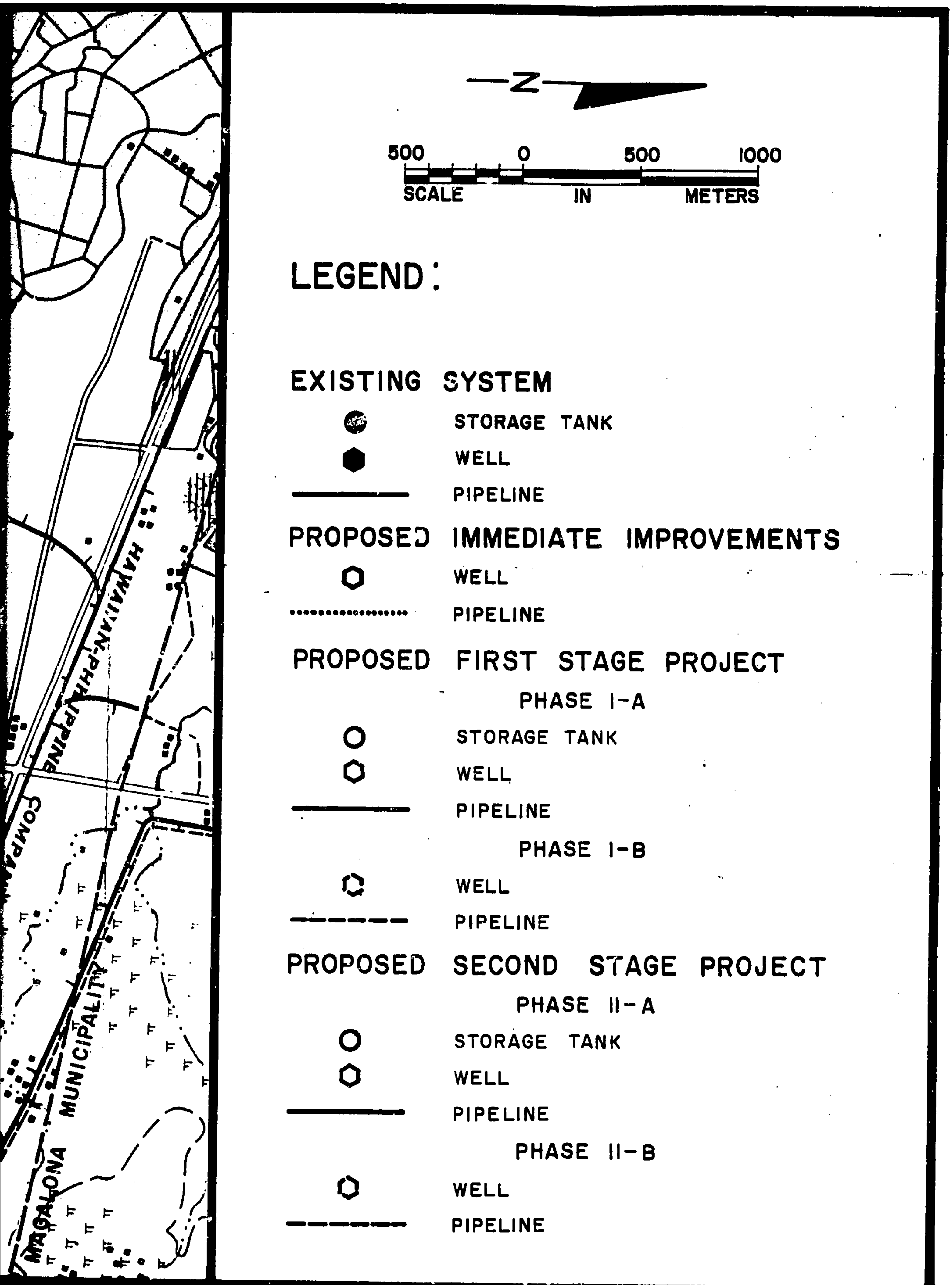
FIGURE MM6-3
TYPICAL FLOW VARIATION
FOR DISTRIBUTION MAINS

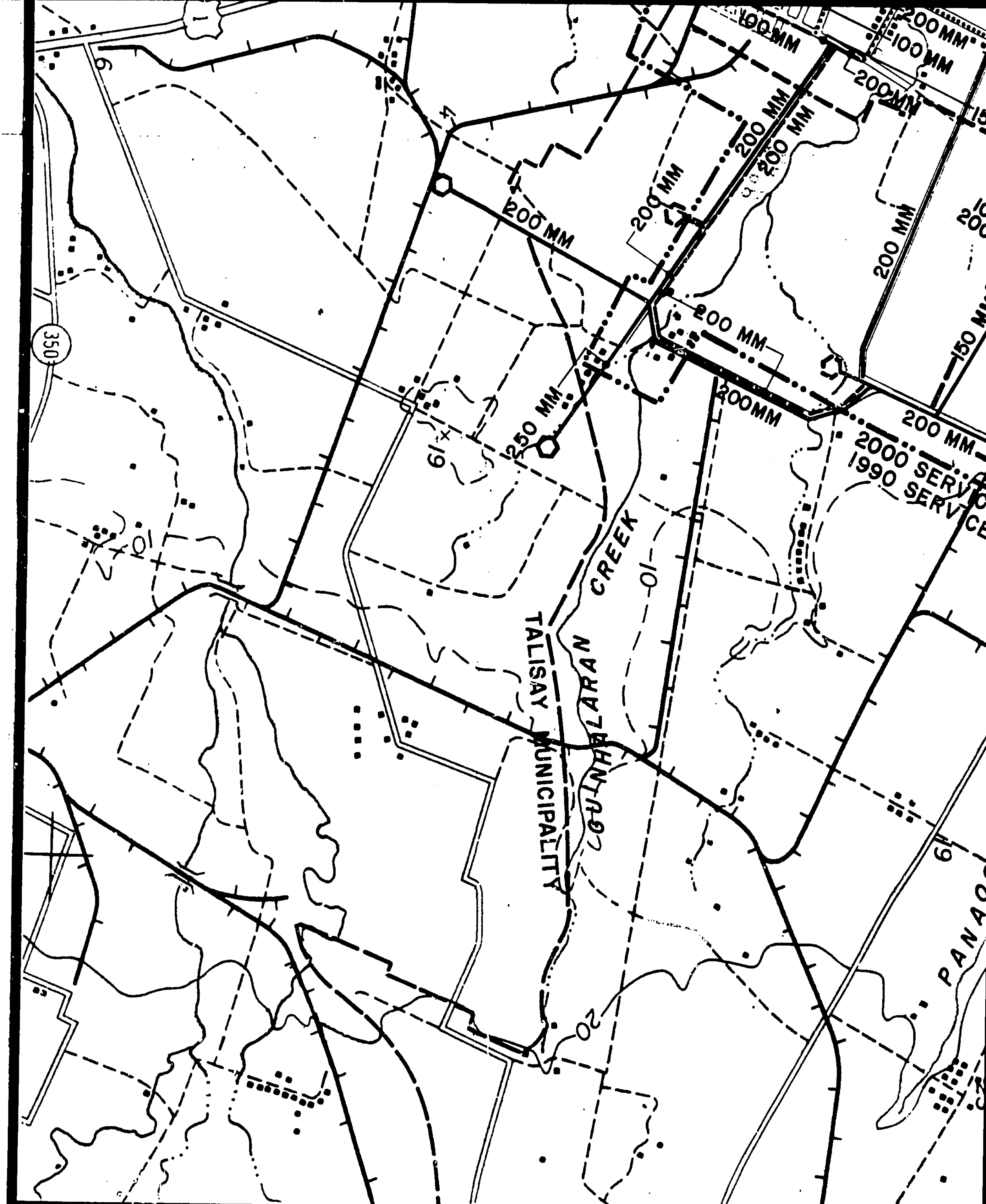

GUIMARAS
150 MM
150 MM
100 MM
100 MM
200 MM
100 MM
200 MM
200 MM
200 MM
200 MM
200 MM
200 MM
200 MM
200 MM
150 MM
200 MM
250 MM
200 MM
2000 SERVICE
1990 SERVICE
CREEK
GUINHALARAN
TALISAY MUNICIPALIT



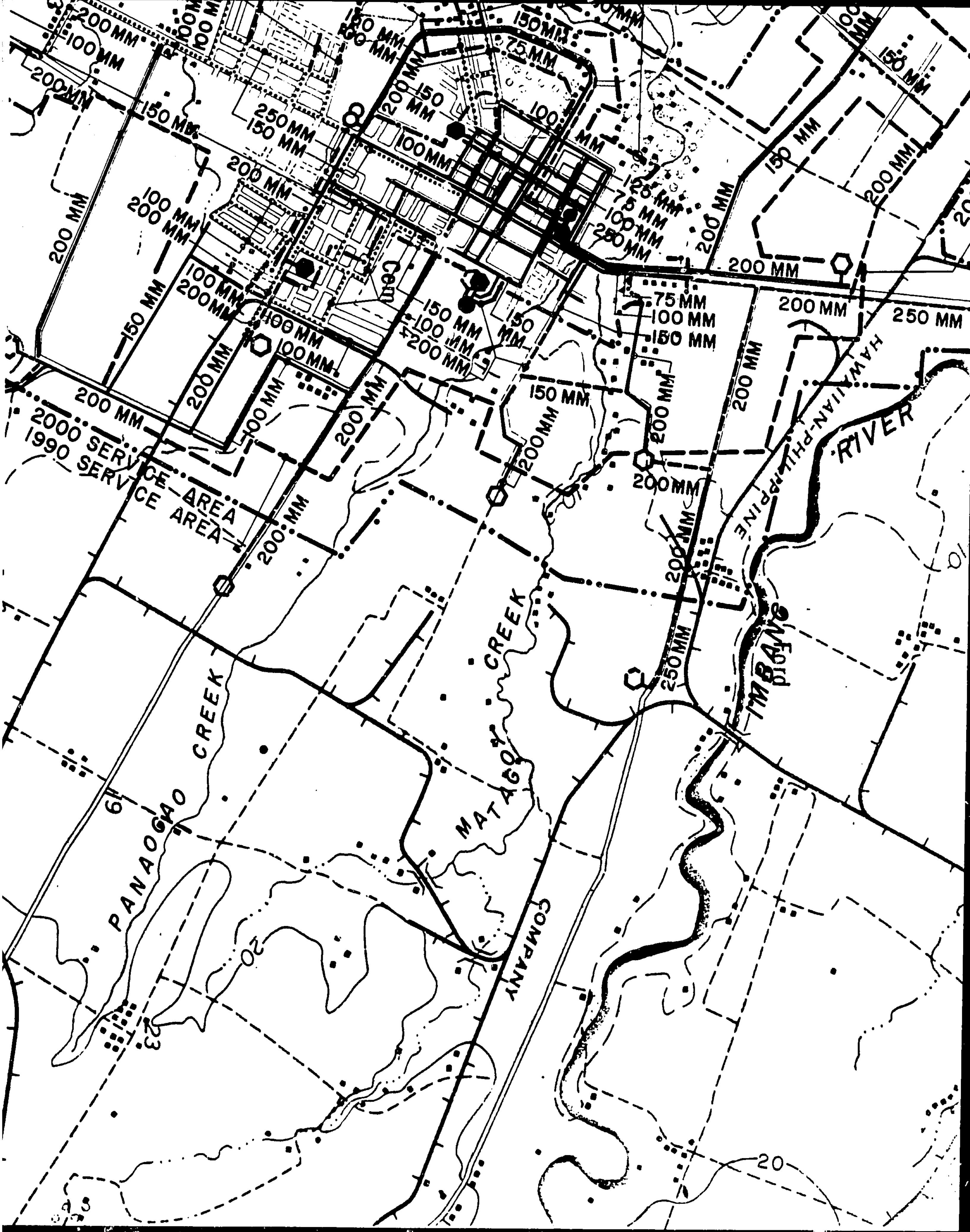
GUIMARAS STRAIT
Bobong Point
Fish ponds
Fish ponds
Fish ponds
150 MM
150 MM
100 MM
100 MM
200 MM
100 MM
200 MM
250 MM
150 MM
200 MM
150 MM
100 MM
Cem
2000 SERVICE AREA
1990 SERVICE AREA
250 MM
CREEK
TALISAY MUNICIPALITY
GUINHALARAN
CREEK
CREEK

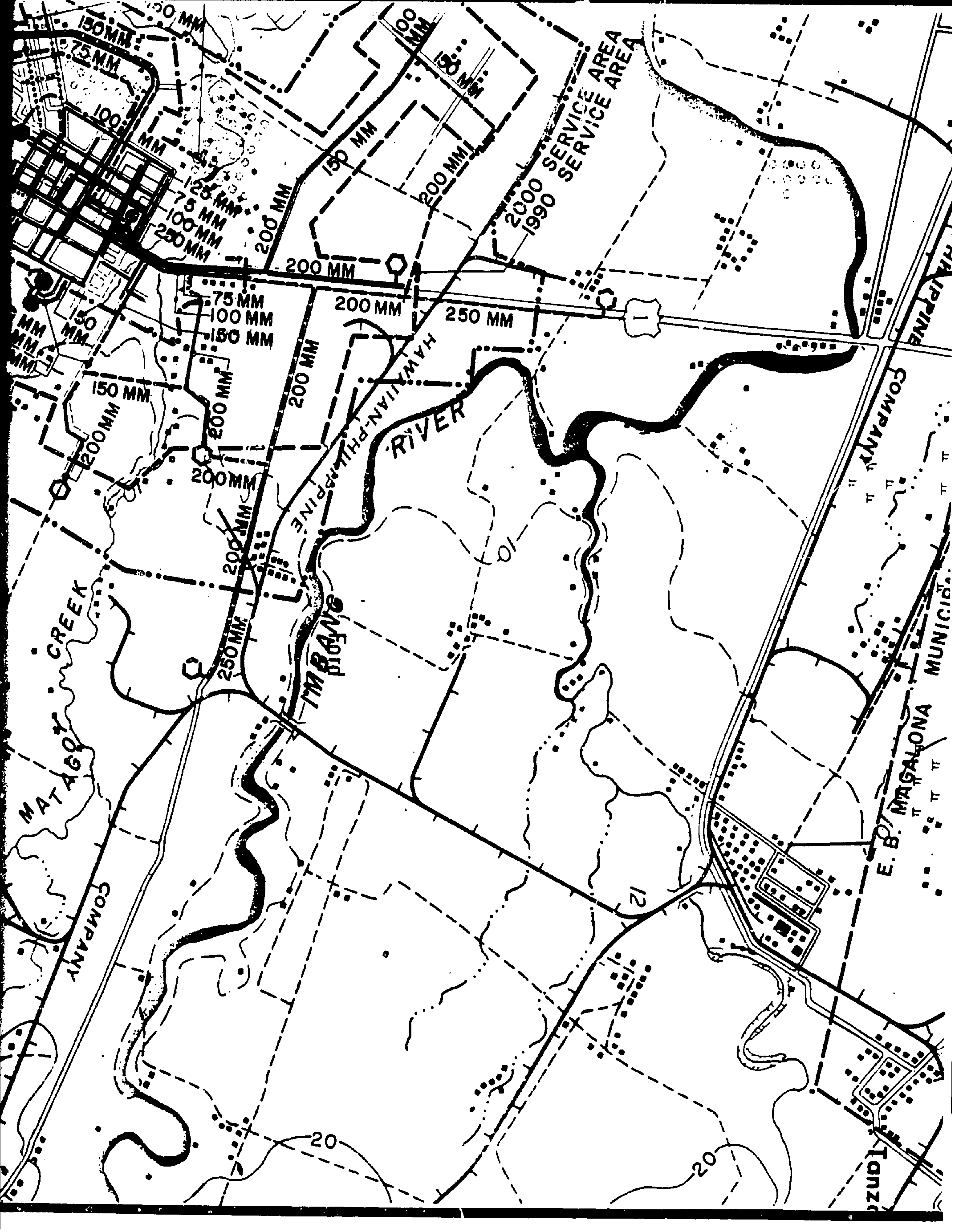

Pier (partially destroyed)
Mud
Fishponds
PRESENT SERVICE AREA
150 MM
150 MM
75 MM
100 MM
125 MM
100 MM
250 MM
200 MM
100 MM
150 MM
150 MM
200 MM
200 MM
200 MM
250 MM
75 MM
100 MM
150 MM
150 MM
200 MM
200 MM
200 MM
200 MM
200 MM
250 MM
2000 SERVICE AREA
1990 SERVICE AREA
HAWAIIAN-PHILIPPINE
RIVER
IMBANG
CREEK
COMPANY
MAGALONA
MUNICI


N
500
0
500
1000
SCALE IN METERS
LEGEND:
EXISTING SYSTEM
STORAGE TANK
WELL
PIPELINE
PROPOSED IMMEDIATE IMPROVEMENTS
WELL
PIPELINE
PROPOSED FIRST STAGE PROJECT
PHASE I-A
STORAGE TANK
WELL
PIPELINE
PHASE I-B
WELL
PIPELINE
PROPOSED SECOND STAGE PROJECT
PHASE II-A
STORAGE TANK
WELL
PIPELINE
PHASE II-B
WELL
PIPELINE
HAWAIIAN-PHILIPPINE
COMPANY
MAGALONA MUNICIPALITY

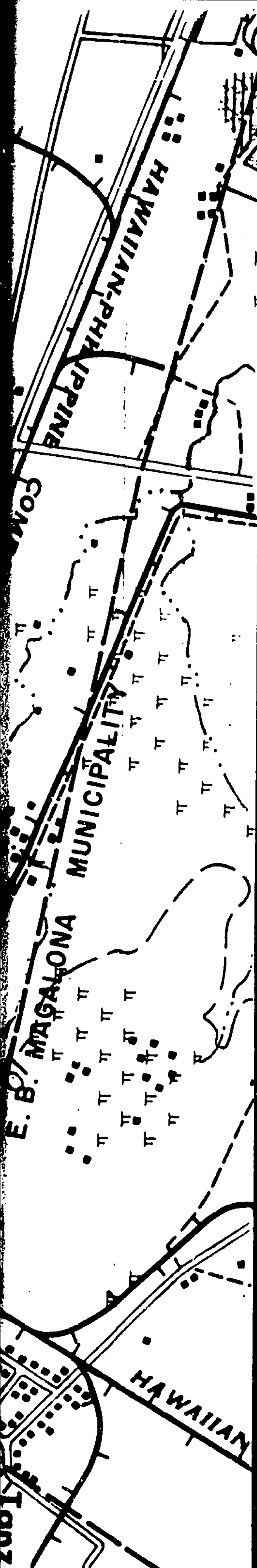


FEASIBILITY STUDY FOR WATER SUPPLY OF SECOND TEN URBAN AREAS **LWUA-CDM**


200 MM
100 MM
150 MM
75 MM
250 MM
125 MM
2000 SERVICE AREA
1990 SERVICE AREA
Cem
PANAOGAO CREEK
MATAGOY CREEK
COMPANY
HAWAIIAN-PHILIPPINE
IMBANG RIVER
20
23



150 MM
75 MM
100 MM
125 MM
75 MM
100 MM
250 MM
200 MM
150 MM
200 MM
200 MM
250 MM
75 MM
100 MM
150 MM
150 MM
200 MM
200 MM
200 MM
200 MM
200 MM
250 MM
2000 SERVICE AREA
1990 SERVICE AREA
HAWAIIAN-PHILIPPINE
RIVER
IMBANG
CREEK
COMPANY
COMPANY
E. B. MAGALONA
20
20



STORAGE TANK

WELL

PIPELINE

PROPOSED IMMEDIATE IMPROVEMENTS

WELL

PIPELINE

PROPOSED FIRST STAGE PROJECT

PHASE I-A

STORAGE TANK

WELL

PIPELINE

PHASE I-B

WELL

PIPELINE

PROPOSED SECOND STAGE PROJECT

PHASE II-A

STORAGE TANK

WELL

PIPELINE

PHASE II-B

WELL

PIPELINE

FIGURE IX-1

WATER SUPPLY SOURCE
TRANSMISSION AND DISTRIBUTION SYSTEM
MAP SHOWING

EXISTING FACILITIES

RECOMMENDED STAGE I FACILITIES

RECOMMENDED STAGE II FACILITIES

SILAY CITY WATER DISTRICT