L. MIAGAO, ILOILO

L. MIAGAO, ILOILO

I. STUDY AREA AND HYDROGEOLOGICAL ANALYSIS

1. Description of the Study Area

1.1 Physical Description

1.1.1 Geographical Location and Area

Miagao lies between 10°36'44" N latitude, 122°06'39" S and 122°17'30" E longitude. Bounded on the northeast by Igburas, on the east by Guimbal, on the west by San Joaquin and on the northwest Sibalom, Antique, it is 40 km west of the City of Iloilo. It has a total land area of 15,722.04 ha. covering 119 barangays. Location map is shown in FIGURE L-1.

1.1.2 Climate

Miagao has two pronounced season; dry from November to April and wet during the rest of the year. The maximum temperature stands at 32.2°C and the minimum at 22.9°C.

1.1.3 Terrain/Topography

The topography of the municipality is generally mountainous. With its five slope classification ranging from 0%-35% and above, about 60% of the municipality's total land area of 157.2204 square kilometer has a slope ranging from 15.1% to 35% and above.

1.1.4 Soil

There are five major soil types with Sta. Rita clay as the most dominant in the plain areas and undifferentiated Alimodian soil in the hills.

1.1.5 Administrative Composition and Land Use

The municipality is headed by the Mayor and Vice Mayor with eight (8) members of the Sangguniang Bayan as the local legislative body. Under the municipality are the barangays, the smallest political subdivision, which are headed by Barangay Captains/Chairmen with the Sangguniang Barangay as the lawmaking body. All these local officials are selected by the people through popular election.

Municipalities are classified according to the annual revenues from taxes. This classification serves as a major indication of the socio-economic situation of the population in the municipalities. The municipality of Miagao belongs to the 3rd class.

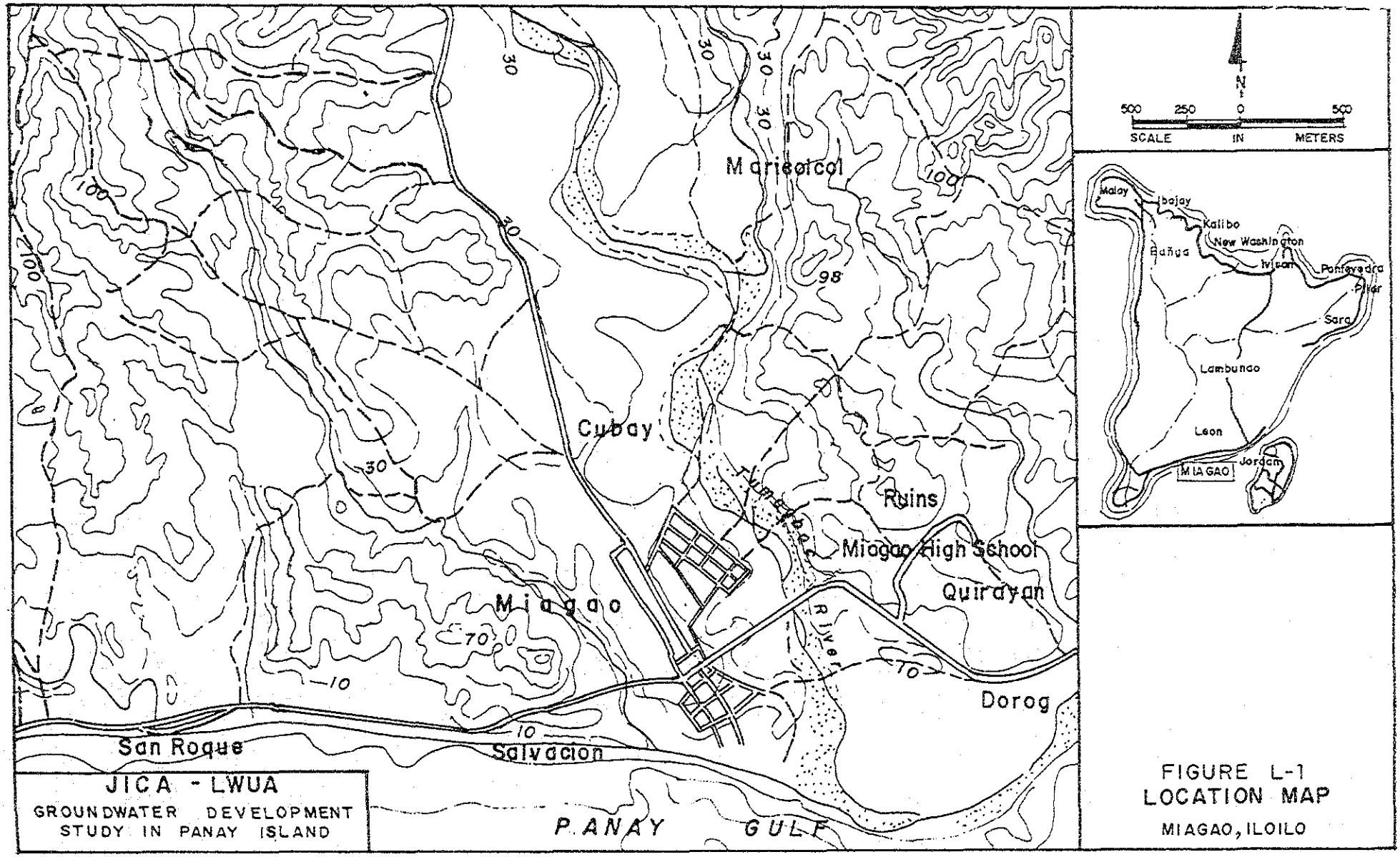


FIGURE L-1
LOCATION MAP
MIAGAO, ILOILO

Miagao is composed of the following 119 barangays:

1. Agdum
2. Aguianan
3. Alimodias
4. Awang
5. Aya-oy
6. Bacauas
7. Bacolod
8. Bagumbayan
9. Banbanan
10. Banga
11. Bangladan
12. Banayao
13. Banaclayan
14. Basisi
15. Baybay Norte (Poblacion)
16. Baybay Sur
17. Belen
18. Bolho (Poblacion)
19. Bolacawe
20. Buenavista Norte
21. Buenavista Sur
22. Bugtong Lumangan
23. Bugtong Naulid
24. Cabalaunan
25. Cabangcalan
26. Cabunutan
27. Caboldolan
28. Cagbang
29. Caitib
30. Calagtangan
31. Calampitao
32. Cavite
33. Cawayanan
34. Cubay
35. Cubay Ubos
36. Dalije
37. Dawilisan
38. Dawog
39. Diday
40. Dingle
41. Dwog
42. Funtilla
43. Fundacion
44. Gines
45. Guibongan
46. Igbita
47. Igbugo
48. Igcabidio
49. Igcabito-on
50. Igcatambos
51. Igdalaquit
61. Kirayan Norte
62. Kirayan Sur
63. Kirayan Tacas
64. La Consolacion
65. Lacadon
66. Lanutan
67. Lamayan
68. Mabayan
69. Maduyo
70. Malagyan
71. Mambatad
72. Maninila
73. Maricolcol
74. Maningyan
75. Mat-y (Poblacion)
76. Matalagon
77. Naclub
78. Nam-O Sur
79. Nam-O Norte
80. Narat-an
81. Narorogan
82. Naulid
83. Olango
84. Ongyod
85. Onap
86. Oyungan
87. Palaca
88. Paro-on
89. Potrido
90. Pudpud
91. Pungtod Monteclaro
92. Pungtod Naulid
93. Sag-on
94. San Fernando
95. San Jose
96. San Rafael
97. Sapa-Miagao
98. Sariag
99. Sibucad
100. Taal
101. Tabunacan
102. Tacas
103. Tambong
104. Tan-agan
105. Tatoy
106. Ticdalan
107. Tig-amaga
108. Tig-apog-apog
109. Tigbagacay
110. Tiglawa
111. Tigmalapad

52. Igdulaca
53. Igpajo
54. Igpangdas
55. Igpuro
56. Igpuro-Bariri
57. Igsoligue
58. Igtuba
59. Ilog-Ilog
60. Indag-an
112. Tigmarabo
113. Toog
114. Tugwa-ao
115. Tumagboc
116. Ubos Ilawod (Poblacion)
117. Ubos Ilaya (Poblacion)
118. Valencia
119. Wayang

The town is basically agricultural with 55% of the total land area (86.47 sq.km.), being utilized for agricultural purposes. Forest areas accounted for 28%, open grassland, 7%, residential areas, 5%, institutional areas, 3% and commercial areas, 2%.

1.1.6 Transportation

Land transportation is the primary means of commutation in the municipality. Prevalent modes of transportation include public utility vehicles (buses, jeepneys and tricycles) and private vehicles.

1.1.7 Infrastructure

The road network of the municipality consists of 105.106 km of road with about 48% classified as barangay roads, 30% provincial roads, 14% national roads and 8% municipal roads. Most of these roads (76%) are unpaved or of gravel and earth.

ILECO I is the only source of power servicing only 55% of the 119 barangays of the municipality.

1.2 Population and Living Conditions

1.2.1 Population Trend from the Past

From 1970 to 1975, the population of Miagao grew at an average annual growth rate of 1.8% which increased to 2.5% from 1975 to 1980.

With a total population and household of 45,816 persons and 7,741 respectively in 1980, average family size was six.

The average population density was 345 persons per square kilometer while the male-female ratio was almost 1:1.

From the population distribution, it can be noted that the municipality is predominantly rural with 85.6% of it population residing in the 112 rural barangays and only 14.4% in the 7 urban barangays.

TABLE L-1 Population and Number of Households by Barangay, Miagao, Iloilo 1980

Barangay	Population	No. of Households
Agdum	290	63
Aguinan	332	71
Alimodias	515	84
Awang	163	27
Aya-oy	283	56
Bacauas	515	96
Bacolod	315	56
Bagumbayan	353	64
Banbanan	418	63
Banga	198	38
Bangladan	296	44
Banayao	465	76
Banaclayan	202	32
Basisi	181	33
Baybay Norte (Poblacion)	1,256	205
Baybay Sur	1,065	175
Belen	145	23
Bolho (Poblacion)	303	57
Bolocawe	240	42
Buenavista Norte	348	58
Buenavista Sur	201	32
Bugtong Lumangan	214	32
Bugtong Naulid	125	24
Cabalaunan	185	32
Cabangcalan	181	31
Cabunutan	208	35
Caboldolan	79	13
Cagbang	209	40
Caitib	576	89
Calagtangan	318	58
Calampitao	313	49
Cavite	160	35
Cawayanan	210	35
Cubay	524	94
Cubay Ubos	132	26
Dalije	1,307	222
Dawilisan	810	144
Dawog	542	94
Diday	662	110
Dingle	235	39
Dwog	764	125
Funtilla	145	27
Fundacion	138	27
Guibongan	587	97
Igbita	334	52
Igbugo	268	47

TABLE L-1 Population and Number of Households by Barangay, Miagao, Iloilo 1980 (Cont'd)

Barangay	Population	No. of Households
Igcabidio	304	55
Igcabito-on	367	63
Igcatambos	295	50
Igdalaquit	180	27
Igdulaca	472	77
Igpajo	229	35
Igpangdas	243	41
Igpuro	270	42
Igpuro-Bariri	216	37
Igsoligue	388	72
Igtuba	374	65
Ilog-Ilog	206	36
Indag-an	550	104
Kirayan Norte	713	125
Kirayan Sur	719	116
Kirayan Tacas	550	94
La Consolacion	338	54
Lacadon	414	69
Lanutan	329	64
Lamayan	279	55
Mabayan	178	30
Maduyo	97	17
Malagyan	406	64
Mambatad	516	90
Maninila	562	104
Maricolcol	241	38
Maningyan	404	62
Mat-y (Poblacion)	1,487	214
Matalagon	150	25
Naclub	747	121
Nam-O Sur	150	26
Nam-O Norte	264	51
Narat-an	292	48
Narorogan	213	41
Naulid	359	61
Olango	311	58
Ongyod	149	23
Onap	239	42
Oyungan	1,100	183
Palaca	1,443	243
Paro-on	238	43
Potrido	309	54
Pudpud	541	88
Pungtod Monteclaro	216	40
Pungtod Naulid	116	22
Sag-on	291	43
San Fernando	339	61
San Jose	545	108

TABLE L-1 Population and Number of Households by Barangay, Miagao, Iloilo 1980 (Cont'd)

Barangay	Population	No. of Households
San Rafael	790	125
Sapa-Miagao	362	66
Sariag	504	81
Sibucad	271	53
Taal	126	23
Tabunacan	327	50
Tacas (Poblacion)	878	110
Tambong	151	26
Tan-agan	456	73
Tatoy	356	51
Ticdalan	265	45
Tig-amaga	210	32
Tig-apog-apog	249	42
Tigbagacay	184	38
Tiglawa	155	27
Tigmalapad	320	46
Tigmarabo	430	80
Toog	88	18
Tugwa-ao	180	33
Tumagboc	321	57
Ubos Ilawod (Poblacion)	798	134
Ubos Ilaya (Poblacion)	820	138
Valencia	271	49
Wayang	237	36
TOTAL	45,816	7,741

1.2.2 Age Distribution

Majority (69.5%) of Miagao's population in 1980 were aged 10-64, the age bracket comprising the productive or working age group. The proportion of persons belonging to the younger age bracket (0-9) was 24% while that of the older group (65 and above) was only 6.5%.

1.2.3 Morbidity/Mortality

Pneumonia, P.T.B. and chronic nephritis were among the leading causes of mortality while pneumonia, bronchitis an prematurity were the leading causes of infant mortality. Major morbidity causes, on the other hand, include bronchitis, rhinitis and influenza.

Malnutrition is prevalent in the area as 86.8% of preschool children are suffering from varying degrees of malnutrition. Of the 6,231 children weighed under the Operation

Timbang conducted in 1980, 54.9% suffered from first degree malnutrition, 42% second degree and 3.1%, third degree. However, from 1982-1983, there was a marked reduction of malnutrition incidence in the municipality.

1.2.4 Sanitation

As of 1980, about 70% of the total households have excrete waste disposal system of which 27.5% used flush or water sealed toilets and 42%, the antipolo system.

1.2.5 Public Services

The municipality has three privately-owned emergency clinics, two rural health units, 14 barangay health stations and a Maternal and Child Care Clinic. The telecommunication facilities include two telegram stations, two radio telecommunication and one private cargo and messengerial service station.

1.3 Economy and Industry

1.3.1 Agriculture

Agriculture is the predominant activity in Miagao as about 55% of its land area are devoted to agricultural production. Rice and corn are the two major crops grown. In 1980, there were a total of 525 ha. of irrigated areas and 3,808 ha. of rainfed areas cultivated to rice with a total production of 56,875 cavans and 177,056 cavans of palay, respectively. Average yield was 46.5 cavans per hectare for rainfed areas and 108 cavans per hectare for irrigated areas.

Corn production, on the other hand, reached 581.06 tons. Secondary crops grown include coconuts (346.39 ha.), peanuts (162.3 ha.), mango (104 ha.), coffee (20 ha.) and cacao (20 ha.).

Total number of farms was 4,959 in 1980 covering an aggregate area 7,314 ha.. Average farm size was 1.47 ha..

Livestock and poultry raising are usually raised on a backyard scale and for home consumption. However, on a commercial scale, there were 5 poultry and one swine projects operating in Miagao. Swine production reached 8,949 heads in 1983; cattle, 5,491; carabao, 5,962; chicken, 106,714; ducks, 5,419; and goats, 3,963.

1.3.2 Other Industries

Consisting of 526 firms in 1980, commercial establishments engaged in wholesale and retail trade and manufacturing predominate in the municipality accounting for 40% and 30% of

the total establishments respectively. Other establishments operating in Miagao include agriculture, fishery and forestry, electric, gas and water, transportation and storage, retail estate and business services and community social and personal services.

Loom weaving and bamboo craft were the more common cottage industries in the area.

1.3.3 Municipal Revenue

The average revenue generated by the municipality from 1978-1981 amounted to ₱571,172.

2. Analysis of Potential Water Source

2.1 Topography and Geology

The municipality of Miagao is situated near the mouth of the Tumagbac River. The Poblacion is located on the terrace, facing to the Panay Gulf in southern part. The municipality is mainly mountainous.

The geology of the study area comprises the lower Tarao Formation of Tertiary, Terrace deposits and Alluvial deposits. Geological map is shown in FIGURE L-2.

Tarao Formation (Pliocene to Miocene, Tertiary)

This unit is the basement rock in the study area and consists mainly of brownish medium-grained sandstone, with occasionally shale. Generally, the strike and the dip are N50 E and 30 to 45 SE, respectively.

Terrace Deposits (Diluvium, Quaternary)

This unit is spread on both sides of the Tumagbac River in several stages. The thickness is between 10 m to 20, and consists mainly of gravels which originates from tertiary sedimentary rocks.

Alluvial Deposits (Quaternary)

This unit is distributed along the Tumagbac River and consists of clay, sand and gravel. The thickness is approximately less than 10 m.

2.2 Existing Water Source

Surface Water

The municipal waterworks derives water from the Tumagbac River with a drainage area of 66 sq.km by means of infiltration gallery. One (1) km upstream to the intake site of the municipal waterworks, another intake facility of infiltration gallery is now (as of April 1988) under construction for the exclusive use of the University of the Philippines in the Visayas (UPV).

The operation of the UPV would mean an increase in population (student), construction of boarding house/dormitories, commercial establishments, etc. Therefore, the water supply of municipality will be greatly affected in the consumption of water.

Flow rate measurement of the Tumagbac River was carried out 100 m upstream of the infiltration gallery. Since the river flow spreads out into several small streams, measurement was per-

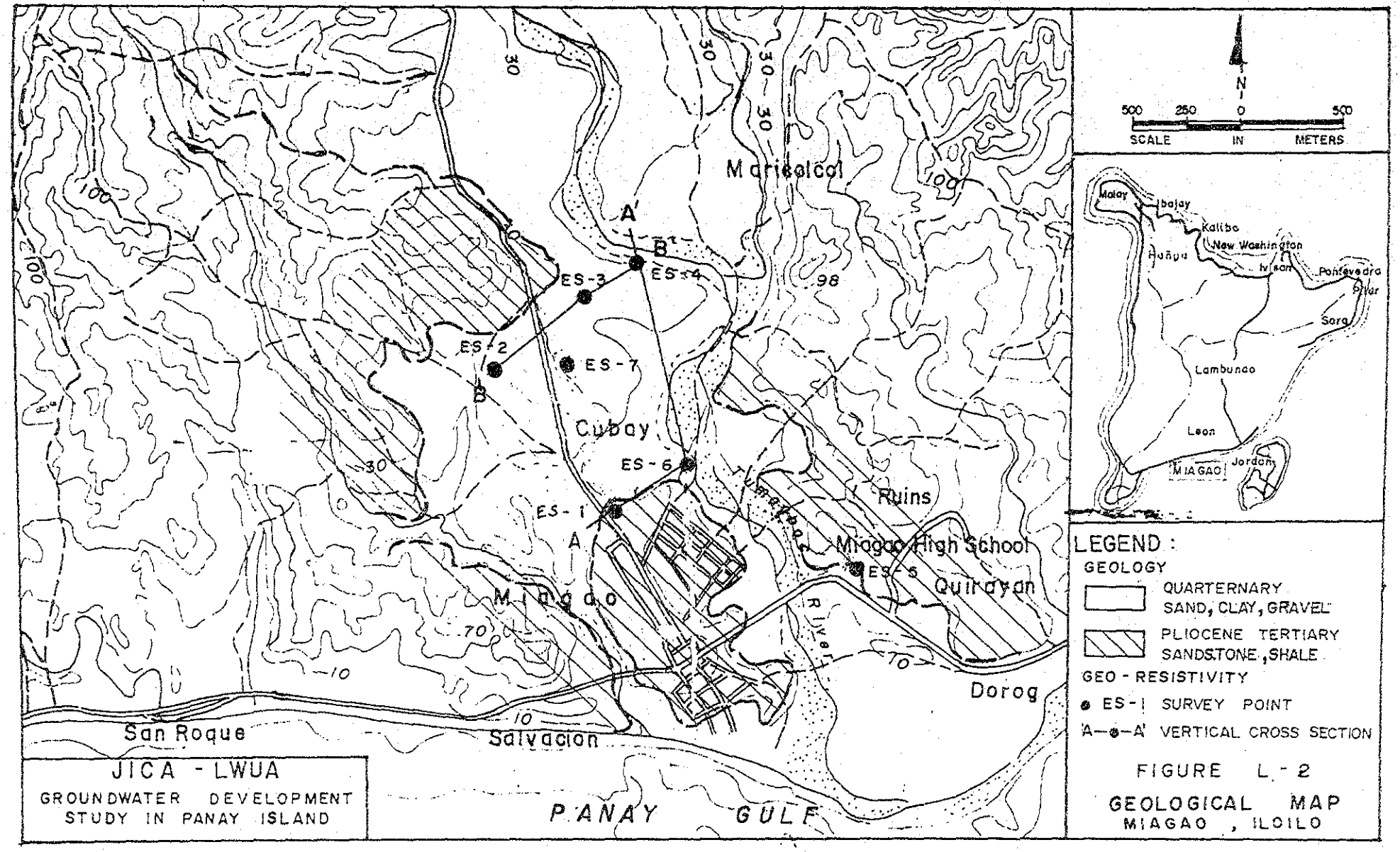


FIGURE L - 2

GEOLOGICAL MAP
MIAGAO , ILOILO

formed on two major streams with a certain depth and/or a certain flow velocity using a flow velocity measurement equipment.

The results are summarized as follows:

i) A total area of river flow cross section was measured to be about 0.13 sq.m in dry season and 6.25 sq.m in rainy season.

ii) A total flow amount was calculated at about 4,900 cu.m/day in dry season and 264,000 in rainy season.

iii) Therefore, the average flow velocity is about 0.44 m/sec in dry season and 0.49 m/sec in rainy season.

Wells

The residents derive groundwater from the Terrace deposits. The static water level of the wells are rather low, and the quantity barely meets the minimum requirements.

A well inventory survey was conducted at 6 wells in the town proper, as shown in FIGURE L-3. However, two of these were not measured for depth and static water level due to the manner of pump setting. Prior to the site survey, data collection was conducted at the District Engineer's Office of DPWH in Iloilo City and several well data including lithologic log were gathered. Actual measurement on those wells, however, ended in failure due to a welded cap and the manner of pump setting. The results of measurement are presented in TABLE L-2.

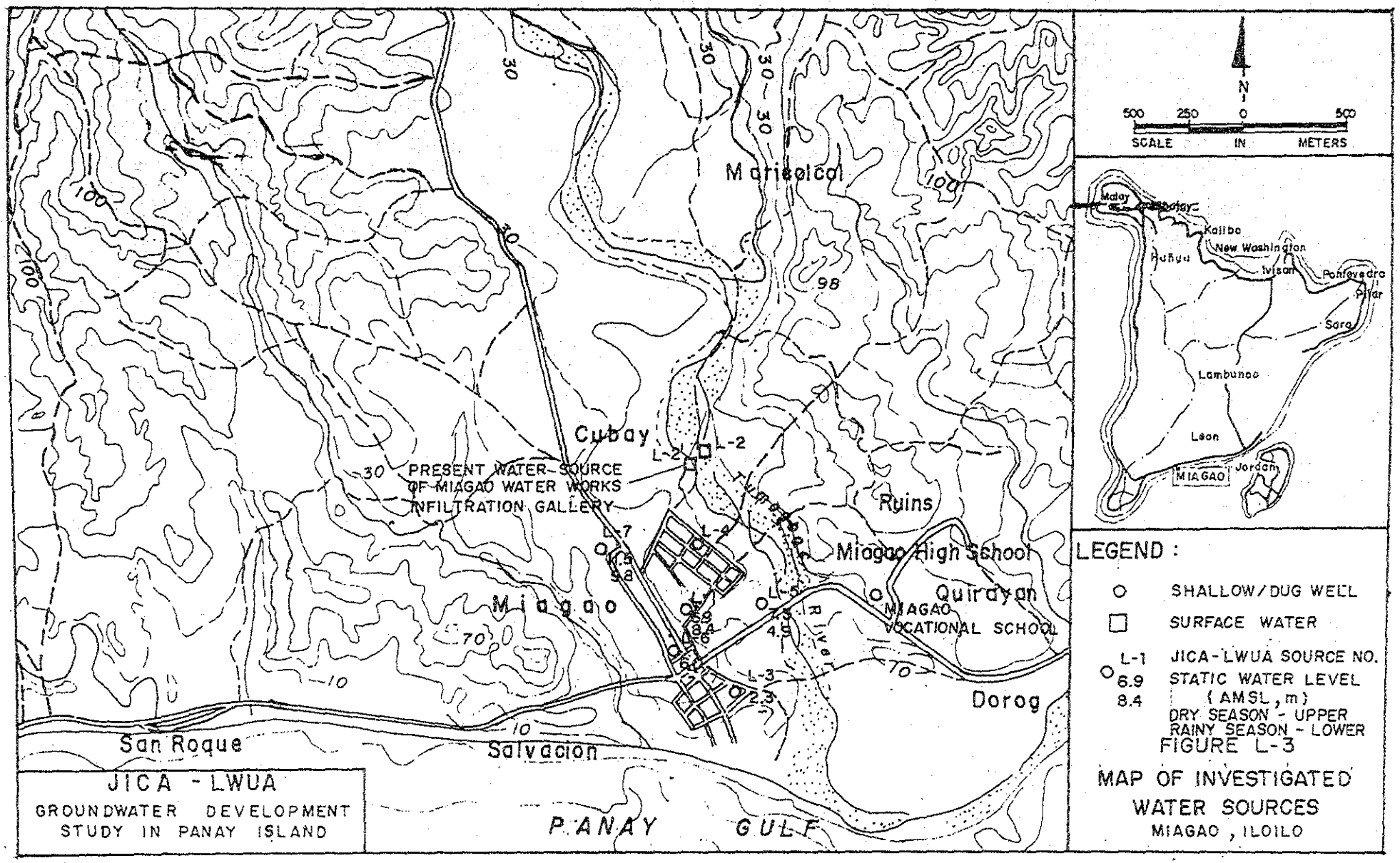


FIGURE L-3

MAP OF INVESTIGATED WATER SOURCES

MIAGAO, ILOILO

TABLE L-2 Well Data Summary

JICA-LWUA Source Number	Well Depth (M)	Ground Level (MAMSL)	Static Water Level: Dry Season (April 14) MBGL	Dry Season (April 14) MAMSL	Rainy Season (October 3) MBGL	Rainy Season (October 3) MAMSL
L-1 Dug Well at Central Elem. School	4.66	10.7	-3.75	6.9	-2.34	8.4
L-3 DPWH Well in Public Market	(29.27)**	12.3	(-10.00)	2.3	-	-
L-4 Shallow Well at River Side	8.48	8.2	0.63	8.8*	0.62	8.8
L-5 Shallow Well at River Side	4.42	7.7	-0.40	7.3	-2.75	4.9
L-6 DPWH Well at Bgy. Tacas	(23.80)	23.1	(-17.10)	6.0	-	-
L-7 DPWH Well at Bgy. Mat-y	(24.50)	25.8	(-14.30)	11.5	-15.96	9.8

* Due to existence of check valve.
** Figures in parenthesis was referred to well data at DEO of DPWH.

Survey results are summarized as follows:

i) There are wells with a depth of about 30 m in the town proper. However, the aquifer that was penetrated retains free groundwater.

ii) Groundwater table declines from the northwestward to the southeastward directions.

iii) In accordance with the steep ground slope of the plateau, the groundwater table declines rapidly to the direction of the sea.

iv) At the low land of the town proper along the Tumagbac River, the groundwater table is about 6.5 m above mean sea level.

On the other side of the town proper, there is a deep well which was constructed by DPWH in 1983 at playground of Southern Iloilo Polytechnic College. The diameter and the depth are ø140 mm and 76 m, respectively. But soon after the completion of construction, it was abandoned due to the salt water intrusion as well as offensive odor. This cause is seemed that the drilling point is near the coast.

2.3 Survey for Potential Water Source

2.3.1 Evaluation of Georesistivity Survey

The topography of Miagao is composed of flood plain with several units of terrace and the Tumagbac River with basement of Tarao Formation.

The purpose of the georesistivity survey was to investigate the possible presence of aquifers in the basement rock and in the terrace and alluvial deposits including the assessment of the thickness of these deposits. A total of seven survey points are indicated in FIGURE L-2.

Field activities are summarized below:

Date	:	April 13 to 14, 1988
No. of Survey Points	:	Seven (7) points
Type of Survey	:	Vertical Sounding
Configuration	:	Wenner Method
Sounding Depth	:	100 to 150 meters

The results of the ρ-a curve analysis is given in TABLE L-3 and leads to the development of resistivity sections as shown in FIGURE L-4 and L-5.

The interpretations and assessments obtained as of the present are the following:

1) The terrace has a thickness of about 0.4 to 8 meters showing resistivity ranging from 8 to 42 ohm.m which generally represents clayey to silty and sandy facies. However, sandy facies is considered to be poor.

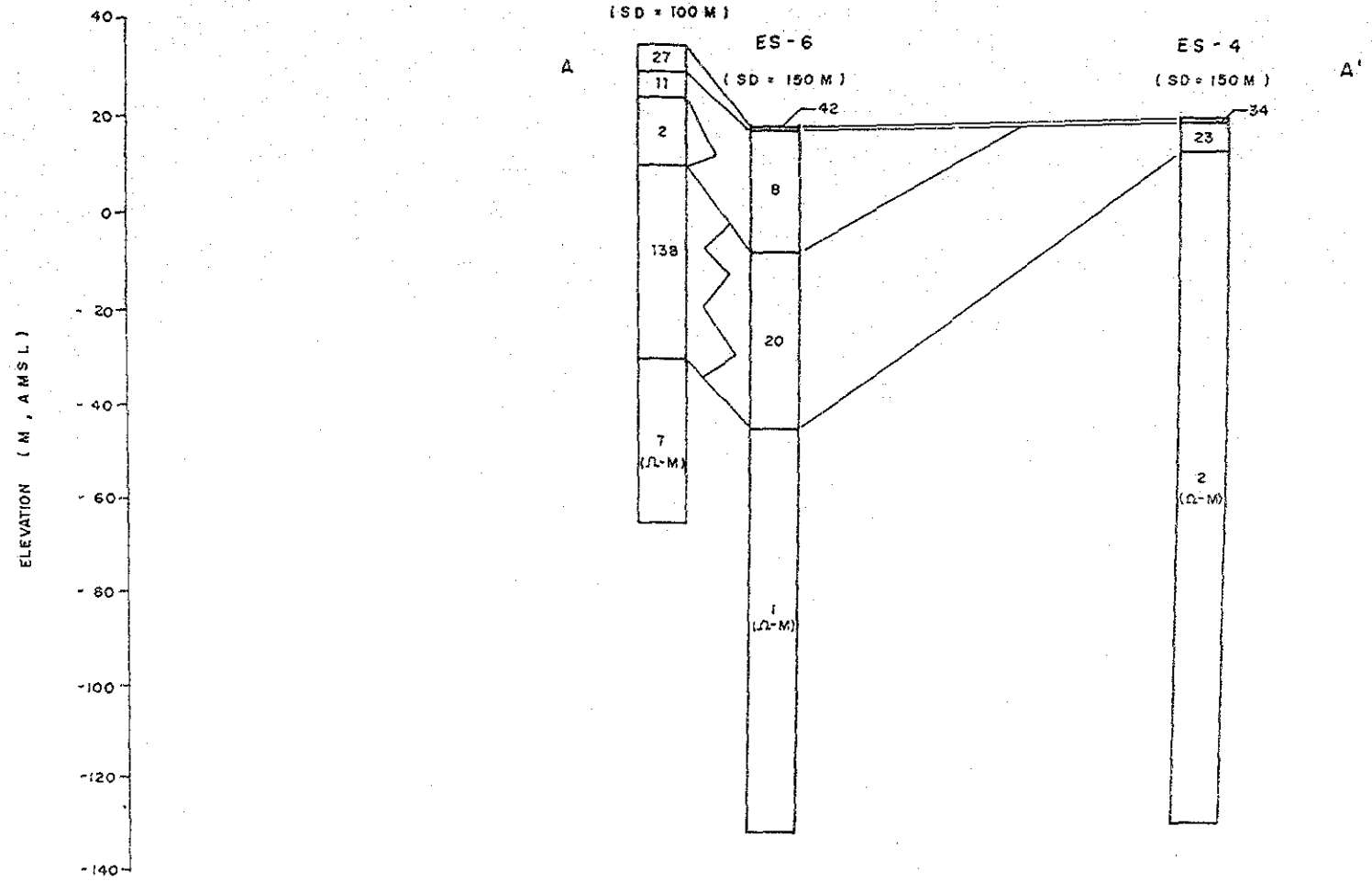
2) Alluvial deposit has a thickness of about 7 meters with resistivity of 23 ohm.m which is considered to be silty facies.

3) Basement generally shows from 1 to 20 ohm.m of resistivity and is considered to be silty facies. Survey point ES-1 shows resistivity of 138 ohm.m at a depth from 25 to 65 mbgl (40 meters in thickness) thereby proving it to be sandy facies supportive of a possible aquifer.

TABLE L-3 DEDUCTED VALUES OF GEORESISTIVITY READING INTERPRETATION

MIAGAO, ILOILO

SURVEY POINT	ELEVATION (M,AMSL)	TOPOGRAPHY	RESISTIVITY LAYER 1		2		3		4		5	
			ohm.m	m	ohm.m	m	ohm.m	m	ohm.m	m	ohm.m	m
ES-1	35	higher terrace	27	5.4	11	11	2	25	138	65	7	
ES-2	28	higher terrace	9	1.0	4	2.2	13	7	10	20	1	
ES-3	25	middle terrace	8	2.2	24	8	8	48	2			
ES-4	20	flood plain	34	1.1	23	7	2					
ES-5	20	middle terrace	9	1.1	4	7	2					
ES-6	18	lower terrace	42	0.4	8	16	6	26	20	63	1	
ES-7	26	higher terrace	5	1.3	7	7	14	55	2			



SCALE H = 1 : 10,000
V = 1 : 1,000

FIGURE L-4

GEORESISTIVITY SECTION A - A'

MIAGAO , ILOILO , PANAY ISLAND

JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND

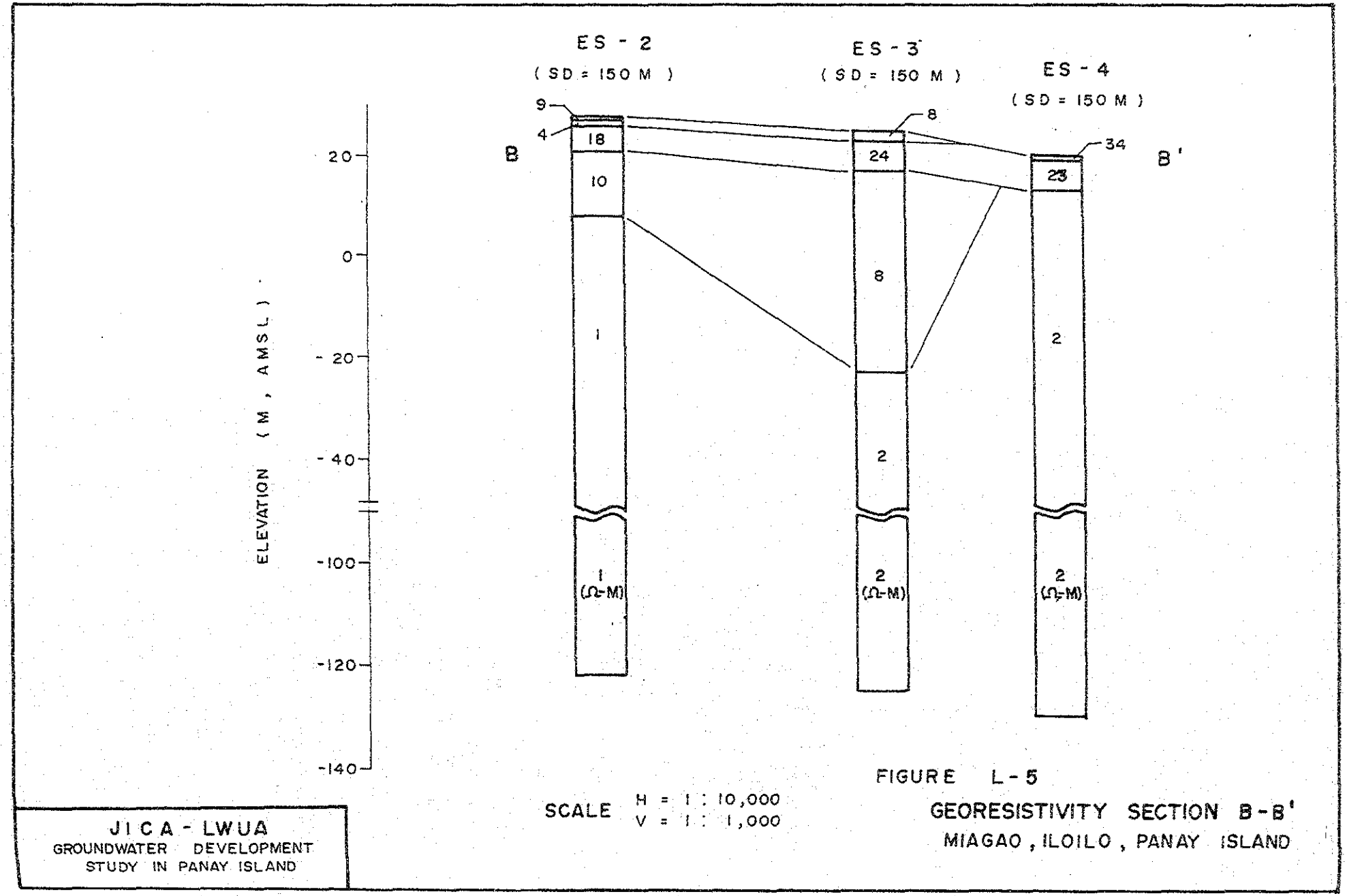


FIGURE L - 5

GEORESISTIVITY SECTION B - B'

MIAGAO , ILOILO , PANAY ISLAND

2.3.2 Observation/Test Well Drilling

Based on the result of georesistivity survey, the location of the observation well was decided near No. 1 Point (cf. FIGURE L-2).

Observation Well No. 1
Date : 10 to 31 March, 1989
Depth : 182.5 m

The analysis of No. 1 ρ-a curve showed the existing of sand or gravel between 25 m and 80 m under ground level. But as the well data are shown in FIGURE L-6, the strata are predominant silt and no layers consisting of sand and gravel. So the observation well failed to find the aquifer unfortunately.

2.4 Water Quality Analysis

Seven (7) water sources were examined in the field survey and two water samples were collected from the pumping station of the existing water supply system for laboratory analysis. Survey points are pinpointed in FIGURE L-3 and analysis results are shown in TABLE L-4.

TABLE L-4 Water Quality Analysis Results

Sample	WT (°C)	pH (-)	EC (μS/cm)	T-Fe (ppm)	Mn (ppm)	NH_4-N (ppm)
Dry Season						
L-1 Dug Well, Central Elem. School	29.8	7.2	2,030	0.2	nil	0.3
L-2 Tumagbac River	34.5	8.9	500	nil	nil	0.3
L-2 Riverbed Water	30.8	7.8	610	0.2	nil	0.3
L-3 Public Well, Public Market	31.0	7.8	1,430	0.5	nil	1.8

TABLE L-4 Water Quality Analysis Results (Cont'd)

Sample	WT (°C)	pH (-)	EC (μS/cm)	T-Fe (ppm)	Mn (ppm)	NH_4-N (ppm)
Rainy Season						
L-1 Dug Well, Central Elem. School	29.2	7.6	1,350	nil	-	nil
L-2 Tumagbac River	27.2	8.4	450	nil	-	nil
L-2' Riberbed Water	28.0	7.8	500	nil	-	nil
L-4 Shallow Well at River Side	28.5	8.0	1,080	-	-	-
L-5 Shallow Well at River Side	28.3	7.4	1,150	nil	-	nil
L-6 DPWH Well at Bgy. Tacas	28.1	8.2	1,000	-	-	-
- DPWH Well Next to L-6	28.6	8.0	550	nil	-	1.6

The surface and riverbed water of the Tumagbac River have low concentrations of dissolved solids in comparison to groundwater, and water in this particular study area is characterized by high pH as alkaline condition.

Following are the results of laboratory analysis for water samples collected from riverbed of Tumagbac River which is being used as the source for existing water supply system.

Samples	Tumagbac Riverbed Water	
Date of Sampling	5.20.88	10.03.88
Turbidity (FTU)	2	0.4
Color (UNIT)	nil	5 (apparent)
TDS (mg/l)	345	350
pH (-)	7.0	7.5
EC (μS/cm)	540	585
Alkalinity as $CaCO_3$ (mg/l)	256	210
Hardness as $CaCO_3$ (mg/l)	285	239

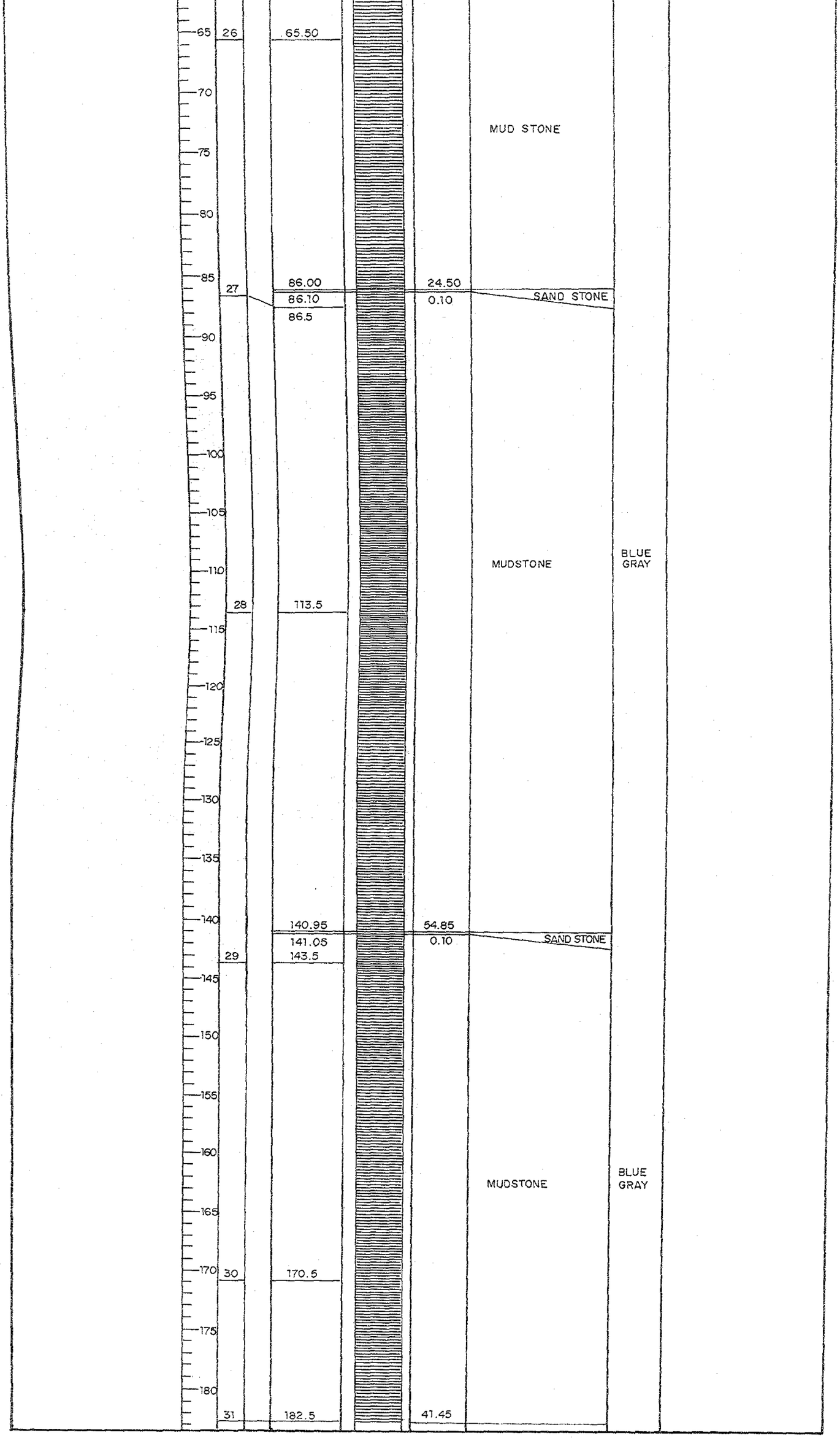
FIG.L-6 OBSERVATION WELL DATA SCALE :

LOCATION : MIAGAO, ILOILO

WELL NO. : 1 DEPTH : 182.5 m. DIAMETER : Ø 110mm CASING PIPE : Ø 50mm PVC

DATE : 10 TO 31 MARCH, 1989 TOTAL : 22

SCALE	DATE D.	DATE M.	DEPTH	GEOLOGICAL MAP	STRATA M. THKS.	GEOLOGICAL NAME	COLOUR
			m				
			3.95		3.95	(Quaternary) CLAY STICKY	
			4.5		0.55	CLAY & COBBLE	YELLOW
5	18	MAR	6.00			(Quaternary) CLAY STICKY	
			8.00		3.50		
10						(Quaternary) CLAY SOFT STICKY	BLUE GRAY
15			18.65		10.65		
20	21		20.00			SAND, GRAVEL ORGANIC SILT MIX CLAY	BLUE BLACK
			24.20		5.55		
25			24.60		0.40	SAND SILT	
					1.60	SAND GRAVEL OGANIC SILT MIX	
30			26.20				
35	22		35.50			FORMATION MUD-STONE MINUTE WHITE SAND MIX STICKY	WHITE YELLOW
40							
45							
50	25		50.50				
			54.50		28.30		
55			55.70		1.20	SAND STONE	
						MUDSTONE	GREEN BLUE
60			60.50		4.80		
			61.50		1.00	SAND STONE	
65	26		65.50				
70						MUD STONE	
75							
80							
85			86.00		24.50		
	27		86.10		0.10	SAND STONE	
			86.5				
90							
95							
100							


65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
170
175
180
26
65.50
MUD STONE
27
86.00
86.10
86.5
24.50
0.10
SAND STONE
MUDSTONE
BLUE GRAY
28
113.5
140.95
141.05
143.5
54.85
0.10
SAND STONE
29
MUDSTONE
BLUE GRAY
30
170.5
31
182.5
41.45

Samples	Tumagbac Riverbed Water	
Major Cations (meq/l)		
Sodium	1.4	0.9
Potassium	0.2	0.2
Calcium	3.3	2.6
Magnesium	2.4	2.2
Total	7.3	5.9
Major Anions (meq/l)		
Carbonate	0	0
Bicarbonate	5.11	4.2
Chloride	0.90	0.7
Sulfate	0.99	0.9
Total	7.00	5.8

Both water samples showed lower pH values than field analysis result. This is presumed to be caused by loss of gaseous constituents during transportation/preservation and/or analytical error. With regard to the geochemical characteristic, this water sources is classified to the typical Carbonate-Hardness Type.

3. Conclusion and Recommendation

The observation well drilled to 182.5 m under ground level. Unfortunately, the aquifer which enough to the water supply system was not existing at near poblacion.

There is a bigger possibility to derive groundwater through deep wells in the inland area upstream of the Tumagbac River Sandstone dominates hence.

On the other hand, water resource originated from the Tumagbac River is also dependable. Though the flow amount of the surface water is rather small and it will be affected by the water intake of the UPV, certain amount of riverbed water will be expected.

For further investigation regarding groundwater development potential, an automatic water level recorder was installed at the Well No. L-7 last October 4, 1988.

II. CONCEPTUAL WATER SUPPLY SYSTEM

1. Existing Water Supply Conditions

1.1 Water Use Condition

The municipality of Miagao has an existing water supply system constructed by the now defunct National Waterworks and Sewerage Authority (NAWASA) sometime in late 1930. From then on, improvement/expansion of the system was undertaken by the municipal government with the assistance of the Ministry of Public Works. Presently, the waterworks system, which serves only the Poblacion area is being managed/operated by the municipal government since no Water District has been formed in Miagao.

The system derives water from the Tumagbac River through a perforated collector pipe, which is installed in the river-bed. Presently, the system serves 310 households in the Poblacion by individual connections. The estimated served population is approximately 1,900.

In addition to the waterworks system, 6 dug wells and 200 pumpequipped wells are serving as supplementary sources of water supply for the urban area. In the rural areas consisting of 112 barangays, 200 dug wells, 920 pumped wells and 200 spring are utilized as sources of domestic water supply.

Presently, the construction of the school building and the utilities of the UPV is in its final stage (as of May 1988) in a newly developed lot adjacent to the north-western edge of the urban area.

For its source of water supply, the UPV also depends on infiltrated water from Tumagbac River by means of perforated collector pipes laid in the river-bed. The intake site of UPV is only a kilometer upstream of the intake site of the municipal waterworks.

When the UPV will start operation, probably this year (1988), it is expected that water supply of the municipality will be greatly affected since the UPV's source of supply is barely a kilometer upstream of the intake site of the municipal waterworks system. As per the UPV projection, their maximum day consumption would be 2,932 cu.m/day in 1992.

Besides, the operation of the UPV would mean an increase in population (students), construction of boarding houses/dormitories, commercial establishments, etc. In this connection, additional source of water supply for the municipality is, therefore, a pressing necessity.

Since the existing piped water supply system is operated only 5 to 6 hours a day, consumers are suffering from lack of supply amount and inadequacy in maintaining sanitary conditions. Continuous water

supply throughout a day and expansion of piped water supply are indeed desired by people residing in urban area of the municipality.

1.2 Existing Water Supply System and Problems Encountered

(a) Intake Facilities

A 49 m perforated concrete pipe is laid across the river with a slight slant towards the collection wells (2 m in width, 2.5 m in length, 10 m in height) from which water is pumped to the reservoir.

(b) Distribution Reservoir

There are two (2) reservoirs in the study area. One is an elevated concrete tank 13 m above ground level and has capacity of 90 cu.m and the other is a domed ground-concrete reservoir with a diameter of 10 m and a capacity of 450 cu.m. Both are located in Barangay Mat-y, 1 kilometer away apart from the municipal hall.

Due to the lack of capacity of these storage, deteriorated distribution pipelines and to save on power expenditure, maximum hours of supply is limited to 7 hours daily (from 6 a.m. to 1 p.m.). Disinfection is only provided during rainy season.

(c) Distribution Pipeline

Cast iron (CI) pipes and galvanized iron (GI) pipes are used. According to the explanation of the Municipal Planning and Development Coordinator, the maximum diameter of distribution pipe presumably would be 100 mm. Unfortunately, no general map of the water supply system, or any illustration of facilities were obtained.

2. Water Demand Projection

2.1 Criteria

Due to intermittent supply of drinking water and absence of appropriate water supply record, the per capita unit water consumption is not available. In this regard, the present per capita unit water consumption is assumed to be 100 lpcd, which is within the range of commonly adopted figure as described in the LWUA Methodology Manual.

Design unit water consumption by consumer type is thereby estimated in accordance with the said Manual, as follows:

- Domestic per capita unit water consumption is estimated at 112 lpcd in the year 1995 with an annual increase ratio of 2% from

1988 to 1990 and 1.5% from 1990 to 1995 against 100 lpcd in 1988.

- Commercial unit water consumption is estimated at 1.4 cu.m/connection/day with its connection density ratio of 1.2 per 100 inhabitants.

- Institutional unit water consumption in 1995 is estimated at 5.2 cu.m/connection/day with its connection density ratio of 1.0 per 2,000 inhabitants in the service area.

The existing water supply system was constructed in 1930's and expansion/improvement of the original system took place in accordance with the increase of water demand. In this regard, a thorough improvement of the major facilities are not prerequisite.

Taking into account these conditions, the unaccounted-for water is assumed to be 40% to the total distributed amount which is the LWUA standard ratio for old and new combined pipelines.

2.2 Areas to be Served

The target year for water supply planning is set for the year 1995 for the purpose of intermediate water supply development/improvement.

With regard to the planned service area in the said target year, priority shall be given to the densely populated area for improvement/expansion of water supply services being rendered by superannuated existing water supply facilities. Likewise, seven barangays in the Poblacion, namely Baybay Norte, Baybay Sur, Bolho, Mat-y, Tacas, Ubos Ilawod and Ubos Ilaya are designated as the planned service area. Inclusion of other barangays shall be considered upon accomplishment of the intermediate improvement.

2.3 Population Projection

The National Economic Development Authority (NEDA) has projected the municipal population in each year from 1981 to 2000 based on population census it conducted in 1980. The municipal government, on the other hand, does not have any population data for the target year for this water supply planning.

Owing to the above-mentioned situation, the NEDA population projection is adopted as principal data.

Percentage share of the barangay population to the municipal population in 1995 is assumed to be the same as that of the 1980 census result. The result of population projection is shown in TABLE L-5.

TABLE L-5 Population Projection of Service Area

Year	Municipality	Service Area (Poblacion)							
		Baybay Norte	Baybay Sur	Bolho	Mat-y	Tacas	Ubos Ilawod	Ubos Ilaya	Total
1980	45,816	1,256	1,065	303	1,487	878	798	820	6,607
1985	51,524	1,410	1,200	340	1,670	990	900	920	7,430
1990	56,942	1,560	1,320	380	1,850	1,090	990	1,020	8,210
1995	62,434	1,710	1,450	410	2,030	1,200	1,090	1,120	9,010

With regard to the water supply service ratio, the municipal government is presently serving for about 310 connections or equivalent to approximately 1,900 persons. This has about 20 to 25% of the population coverage in the subject area.

For the planning purpose, the water supply service ratio is considered to be 80% of the service area population in 1995.

Average number of persons per household is assumed to be 5.00 in 1995 according to the standard figure adopted by NEDA.

2.4 Water Demand Projection

The future water consumption in 1995 is estimated based on the afore-mentioned planned service population and design unit water consumption by consumer type.

The estimated number of connection and future water consumption are shown in TABLE L-6.

TABLE L-6 Water Consumption in 1995

Service Area	Poblacion							
	Baybay Norte	Baybay Sur	Bolho	Mat-y	Tacas	Ubos Ilawod	Ubos Ilaya	Total
Served Population	1,370	1,160	330	1,620	960	870	900	7,210
No. of Connections								
Domestic	274	232	66	324	192	174	180	1,442
Commercial	16	14	4	19	12	10	11	86
Institutional*	1	1	1	1	1	1	1	7
Total	291	247	71	344	205	185	192	1,535
Water Consumption (cy.m/day)								
Domestic	153	130	37	181	108	97	101	807
Commercial	17	20	6	27	17	14	15	116
Institutional	5	5	5	5	5	5	5	35
Total	175	155	48	213	130	116	121	958
Unaccounted-for-Water	117	103	32	142	87	77	81	639
Total	292	258	80	355	217	193	202	1,597

* At least one connection is considered for each barangay as the elementary school

The ratio of the daily maximum water demand to the daily average water demand is determined in relation to the planned service population based on the LWUA Methodology Manual as shown in TABLE L-7.

TABLE L-7 Demand Variation Factor for Daily Maximum Water Demand

Service Population	Ratio (Daily Max./Daily Ave.)
Less than 30,000	1.30 : 1
30,000 to 200,000	1.25 : 1
Over 20,000	1.20 : 1

The estimated daily maximum water demand is shown in TABLE L-8.

TABLE L-8 Daily Maximum Water Demand

Service Area	Water Demand (cu.m/day)
Baybay Norte	380
Baybay Sur	340
Bolho	100
Mat-y	460
Tacas	280
Ubos Ilawod	250
Ubos Ilaya	260
Total	2,070

The peak hour water demand is estimated in proportion to the daily maximum water demand and service population in accordance with the LWUA Methodology Manual as shown below:

$$C = (\text{Peak Hour Demand} \times 24)/(\text{Daily Maximum Demand})$$

$$= 2.2 - 0.3 \times \log (\text{Service Population}/1{,}000)$$

The ratio of peak hour demand in the year 1995 is calculated at 1.94 and the peak hour water demand is estimated at 4,020 cu.m/day.

3. Proposed Water Supply Facilities

3.1 Basic Approach for Water Supply Improvement

3.1.1 Conditions and Constraints

The conceptual plan for water supply improvement is focused on major water supply facilities, such as water source, main transmission and distribution pipelines, and reservoir. Branch lines, service connections and fire hydrants are likewise excluded from conceptual planning. However, following conditions are taken into account as much as possible:

(1) Low cost in construction, operation and maintenance,
(2) Seasonal fluctuation of source capacity will not seriously affect stable water supply,
(3) Water source will be located within the administrative boundary of respective municipality.

3.1.2 Water Source Development

Infiltration water of Tumagbac River is water sources for water supply facilities of poblacion area and its surrounding area, where drinking water is available by dug wells.

University of the Philippines in the Visayas (UPV) being under construction, plans to introduce infiltration water of Tumagbac River, for water supply in the university while new intake point will be located at 1.0 km upstream from the existing intake point, and it will cause a serious effect on existing water sources.

Therefore, hydrogeological survey and test well survey were performed for groundwater development under at this investigation and it revealed that development of new groundwater sources is quite difficult.

So, to cape with increasing water demand, infiltration water and surface water of Tumagbac river shall be utilized as water source for Miagao District.

3.2 Plan for Improvement of Water Supply Facilities

3.2.1 Water Source Facility

To increase the capacity of the existing intake facility, installation of new intake pipes and rehabilitation of intake pump facility will be carried out.

New intake pipe (ø400 mm x L 40 m, 4 units) will be installed towards the upstream of the river and connected to existing intake pipe (ø 1000 mm x L 50 m).

New pumping facilities will be installed to increase the capacity of existing intake pumping station. Capacity of pump facility will meet with daily maximum water demand.

Horizontal centrifugal pump:
ø 125 mm x 1.1 cu.m/min x 45.0 mH x 30 kW,
3 unit (1 unit for spare)

Chlorination facility for calcium Hypochlorite injection will be also newly constructed.

3.2.2 Transmission Facility

Transmission main, from intake pumping station to reservoir will be reconstructed in bigger diameter because of its small diameter (ø 74 mm) and deterioration.

ø 200 mm, l=700 m

3.2.3 Distribution Facility

There are two existing reservoirs one is an elevated tank, with capacity of 90 cu.m. located 13 m above ground level, and another is domed ground reservoir, with capacity of 450 cu.m.

Because of the low water level of ground reservoir (approximately +25 m), it must cover Baybay Horte, Baybaysur, Bolho and elevated tank will serve Maty, Tacas, Ubas Ilawod, Ubas Ilaya. The capacity of elevated tank is equivalent to 7% of daily maximum water demand of served area and it is enough for operation storage, however, it's not enough for emergency and fire fighting storage.

Therefore, 1 unit of new tank with RC, capacity 90 cu.m, same type of existing one, will be constructed.

The existing distribution pipe, constructed many years ago had been deteriorated, consequently, replacement of distribution pipe and expansion of served area will be performed.

ø 200 mm pipe 1,200 m
ø 150 mm pipe 1,900 m

3.2.4 Required Water Supply Facilities

Location of major water supply facilities is shown in FIGURE L-7 flow diagram of facilities in FIGURE L-8 and detail of distribution pipeline in proposed service area in FIGURE L-9.

Size and quantity of required facilities are listed below:

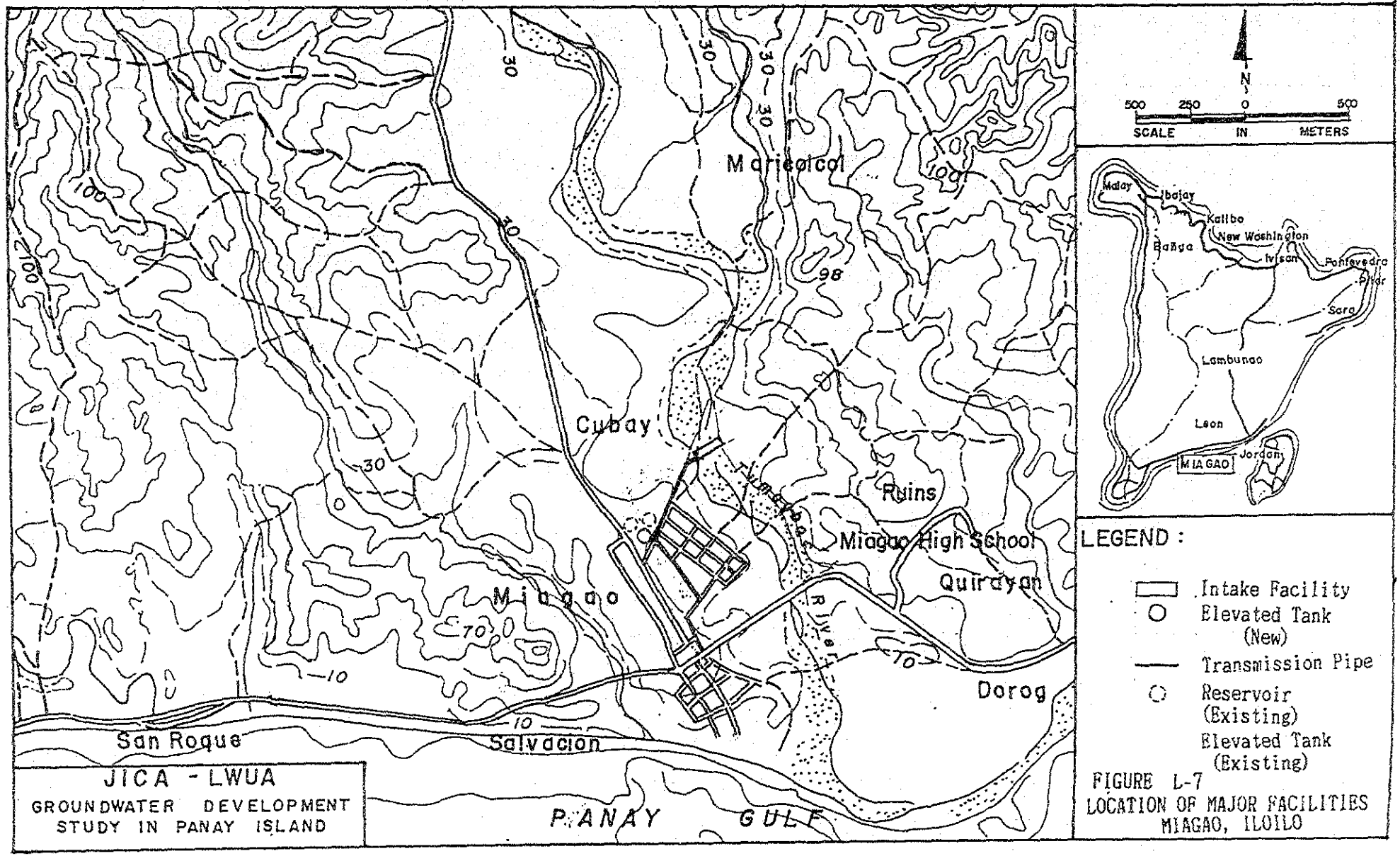
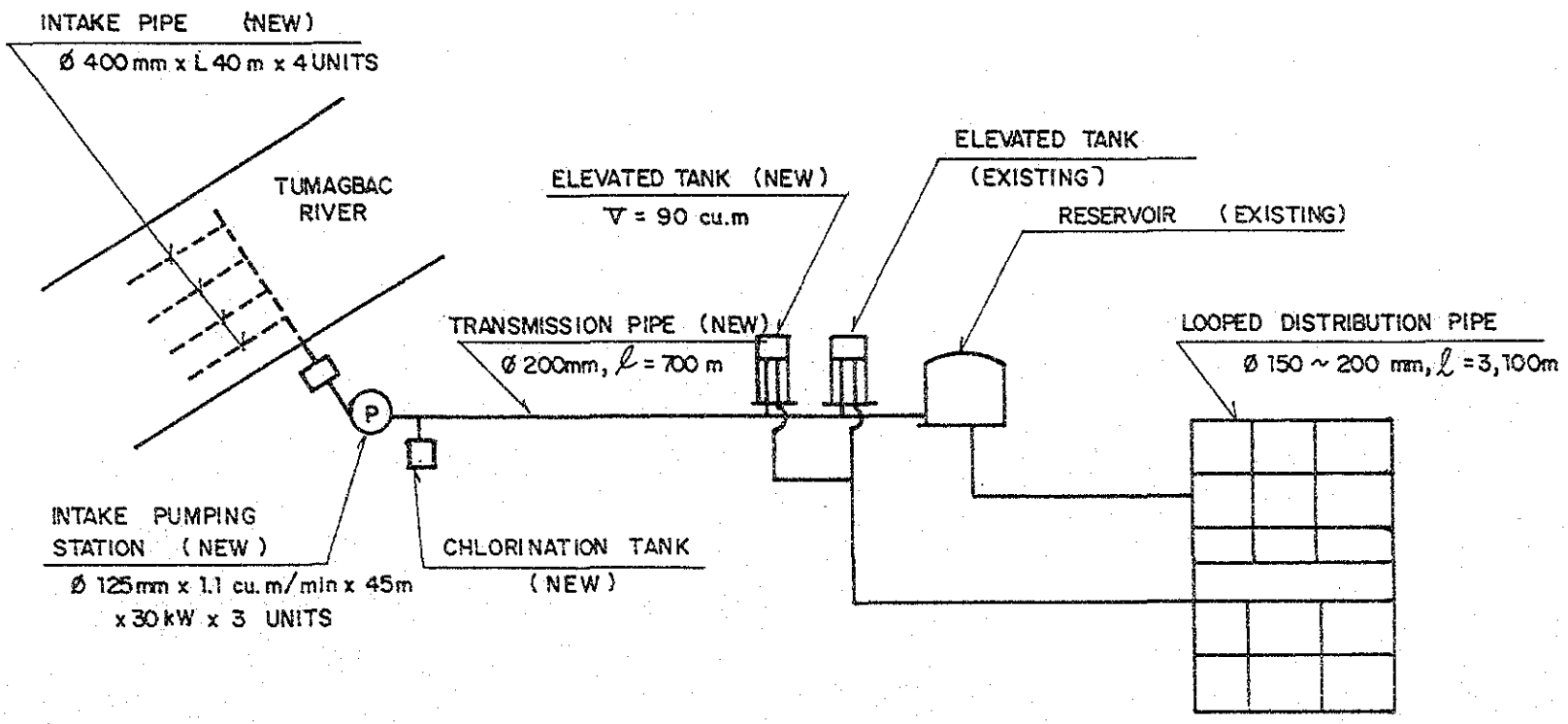


FIGURE L-7
LOCATION OF MAJOR FACILITIES
MIAGAO, ILOILO



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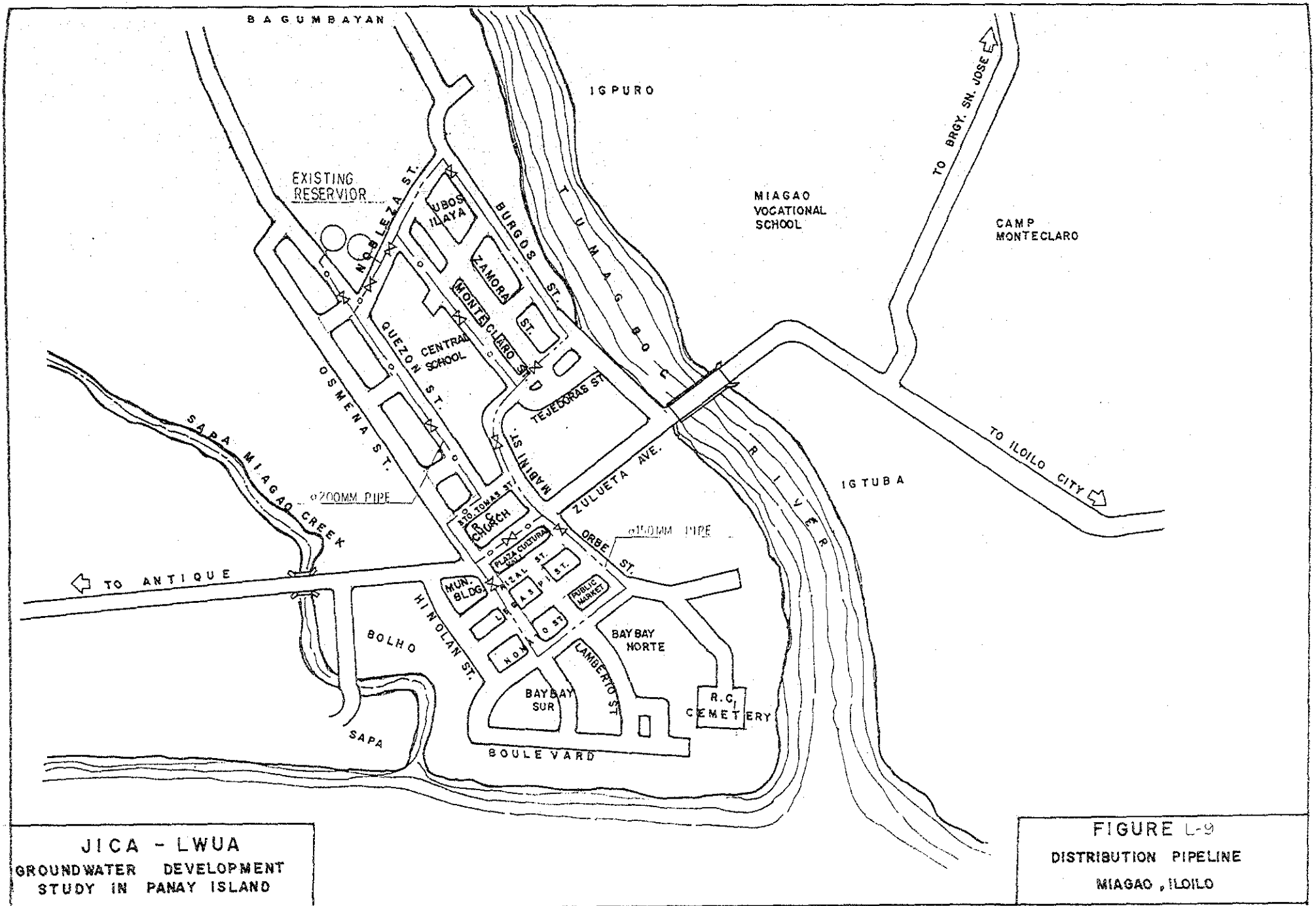
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND

FIGURE L-8
FLOW DIAGRAM
MIAGAO, ILOILO



JICA - LWUA
GROUNDWATER DEVELOPMENT STUDY IN PANAY ISLAND

FIGURE L-9
DISTRIBUTION PIPELINE
MIAGAO, ILOILO

(1) Water Source Facility

Installation of intake pipe:
ø400 mm x 40 m, 4 lines

Intake pump facilities:
Horizontal centrifugal pump
ø 125 mm x 1.1 cu.m/min x 45 m x 30 kW, 3 units

Chlorination tank

(2) Transmission Facility

Transmission main from intake pumping station to reservoir:
ø200 mm, l=700 m

(3) Distribution Facility

Elevated tank: RC, 90 cu.m

Installation of distribution pipe:
ø 150 mm pipe, 1,900 m
ø 200 mm pipe, 1,200 m

3.3 Rough Cost Estimate of Major Water Supply Facilities

3.3.1 Unit Construction Cost

Unit construction cost of required facilities is based on the "In-Place Cost of Waterworks Materials" (as of January 1989) of LWUA. Any unit cost not shown in this list is referred to "Unit Price Manual - Water Supply Feasibility Studies" (July 1983) upon consideration of price escalation that 15% per annum upto 1987 and 7% per annum from 1987 as adopted by LWUA.

All construction costs are estimated in Philippine Pesos and the total cost is only converted into U.S. Dollars and Japanese Yen based on the following exchange rate as of September 1989.

U.S. $1.00 = Yen 145.70 = Peso 20.78

Unit costs used in rough cost estimate are attached in Appendix-5.

3.3.2 Rough Cost Estimate

Facility	Cost (Thousand Peso)
Water Source	
Intake pipe	
(ø 400 mm x 40m, 4 units)	326.4
Pumping (1.1 cu.m/min x 45 m)	1,647.7
Chlorination tank	14.5
Transmission Line	
(ø 200 mm, 700 m)	150.0
Distribution Facility	
Elevated tank (90 cu.m, 1 unit)	730.8
Distribution main	
(ø 150 mm pipe 1,900 m)	1,026.0
(ø 200 mm pipe 1,200 m)	756.0
(ø 150 mm valve 5 pcs.)	28.5
(ø 200 mm valve 6 pcs.)	51.0
Total	4,730.9

Total construction cost for improvement of major water supply facilities is estimated at approximately 4.73 million Pesos (33.2 million Yen or 0.23 million U.S. Dollar).

M. JORDAN, ILOILO

M. JORDAN, ILOILO

I. STUDY AREA AND HYDROGEOLOGICAL ANALYSIS

1. Description of the Study Area

1.1 Physical Description

1.1.1 Geographical Location and Area

The municipality of Jordan is centrally located in the island of Guimaras. Bounded on the northeast by Buenavista, on the southwest by Nueva Valencia, on the northwest by Iloilo Strait and on the southwest by Guimaras Strait, it is approximately 1.5 nautical miles from Iloilo. It has a total land area of 30,440 ha. covering 32 barangays. Location map is shown in Figure M-1.

1.1.2 Climate

Jordan's climate is relatively cold. The maximum temperature stands at 28.2°c and the minimum at 24.97°C. It has 2 pronounced seasons; dry from November to early May and wet during the rest of the year.

1.1.3 Terrain/Topography

The topography of Jordan is characterized by moderately undulating and rolling to very steeply sloping and rolling land in many directions. Almost 62% of its land area has a slope ranging from 8-40% with only 11.10% having broad areas of level to nearly level lands. The steeply sloping areas are faced along the sea coast facing Iloilo while lowlands are concentrated in the southwestern side along the coast of Guimaras Strait. Land elevation ranges from zero to 300 m. above sea level.

1.1.4 Soil

There are 5 types of soil identified in the municipality; Guimaras gravely loam, hydrosol, faraon clay, San Rafael loam and beach sand with Guimaras gravelly loam, as the most common soil type accounting for 60% of the total land area.

1.1.5 Administrative Composition and Land Use

The municipality is headed by the Mayor and Vice Mayor with eight (8) members of the Sangguniang Bayan as the local legislative body. Under the municipality are the barangays, the smallest political subdivision, which are headed by Barangay Captains/Chairmen with the Sangguniang Barangay as the lawmaking body. All these local officials are selected by the people

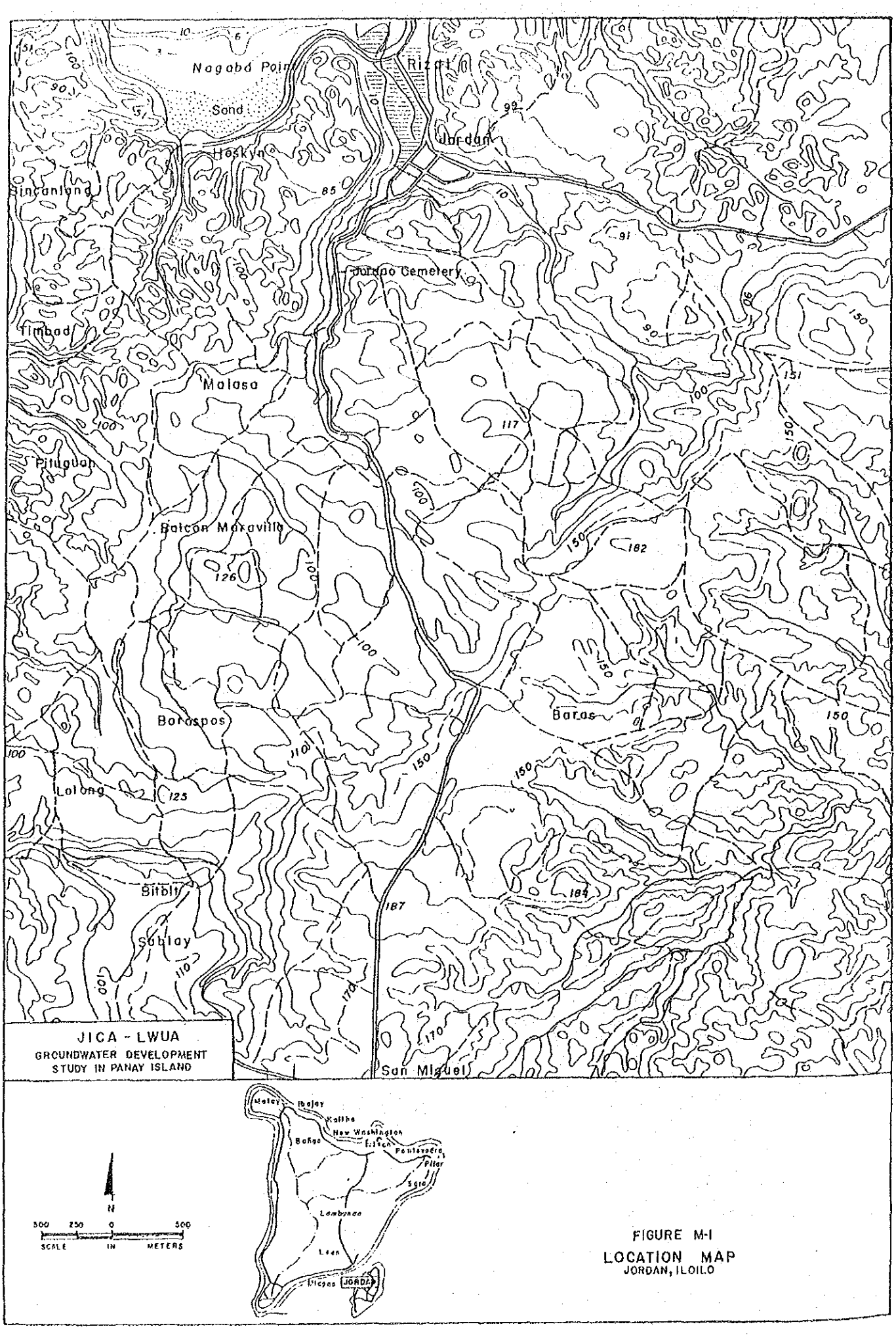


FIGURE M-I
LOCATION MAP
JORDAN, ILOILO

through popular election.

Municipalities are classified according to the annual revenues from taxes. This classification serves as a major indication of the socio-economic situation of the population in the municipalities. The municipality of Jordan belongs to the 3rd class.

Jordan is composed of the following 33 barangays:

1. Aguilar
2. Alaguisoc
3. Alegria
4. Ayangan
5. Balcoon Maravilla
6. Balcon Mellisa
7. Bubog
8. Bugnay
9. Buljangan
10. Cabano
11. Constancia
12. Dasal
13. Espinosa
14. Hoskyn
15. Igcawayan
16. Inampologan
17. Lawi
18. Maabay
19. Millan
20. Marabuan
21. Poblacion
22. Ravina
23. Rizal
24. Sabang
25. San Isidro
26. San Miguel
27. Sebario
28. Sebaste
29. Sapal
30. Sinapsapan
31. Sta. Teresa
32. Tamborong
33. Tanglad

Jordan's topography is highly suitable for intensive lowland agricultural production. Of the total land area of 30,440 ha., about 60% are devoted to agricultural production, 5%, forestland, 29% classified as pasture/open grasslands and 3% swamps and fishpond.

1.1.6 Transportation

Transportation system in Jordan is of two types, land and water transportation. within the municipality, prevalent modes of transportation are jeepneys (totaling to 48), privately owned and for hire motorcycles (39), motorized tricycles (18), private cars and jeepneys. On the other hand, from Iloilo to the municipality, principal means of transportation are ferry-boats (totaling to 5) and pumpboats (48).

1.1.7 Infrastructure

The road network in Jordan consists of 241,362 km. of road with about 23.4% classified as national roads, 15.5% provincial roads, 0.4% municipal roads and 60.6% barangay roads. Most of these roads (92.5%) are of gravel and earth surfacing. Concrete roads accounted for only 0.6% while asphalted roads, 11.40%.

Of the 33 barangays of Jordan, only six were energized servicing 10.4% of the total number of household as of 1980 by GUIMELCO. The type of lighting most commonly used was kerosene.

1.2 Population and Living Conditions

1.2.1 Population Trend from the Past

Jordan's population grew from 27,016 in 1970 to 32,474 in 1975 to 36,014 in 1980 posting an average annual growth rate of 3.75% from 1970-1975 and 2.09% form 1975- 1980. Male population predominated over the female population with the males accounting for 51% of the total population.

In 1980, there were a total of 6,017 households with an average family size of six. Population density was only 114 persons per square kilometer, majority (81.1%) of whom reside in the rural areas and only 18.9% stay in the urban barangays.

TABLE M-1 Population and Number of Households by Barangay, Jordan, Iloilo 1980

Barangay	Population	No. of Households
Aguilar	1,069	187
Alaguisoc	882	149
Alegria	950	172
Ayangan	792	127
Balcon Maravilla	1,122	191
Balcon Mellisa	694	116
Bubog	447	73
Bugnay	806	146
Buljangan	538	97
Cabano	1,714	278
Constancia	1,654	28
Dasal	915	144
Espinosa	1,154	177
Hoskyn	1,434	227
Igcawayan	718	118
Inampologan	450	79
Lawi	1,296	211
Maabay	1,161	190
Millan	994	172
Marabuan	1,476	250
Poblacion	2,245	396
Ravina	724	114
Rizal	1,898	301
Sabang	944	158
San Isidro	1,034	163
San Miguel	1,227	212
Sebario	823	139
Sebaste	978	171
Sapal	728	125
Sinapsapan	1,624	259
Sta. Teresa	2,589	432
Tamborong	524	91
Tanglad	410	72
TOTAL	36,014	6,017

1.2.2 Age Distribution

The municipality's population has a young age structure with 60% of its population belonging to the 0-24 age group. The dependent population (those 0-14 years old) accounted for 49.7% while the productive or working population (those 15-64 years old) accounted for 50.30%.

1.2.3 Morbidity/Mortality

In 1984, the leading causes of morbidity include URTI, bronchitis and dia-enteritis while major mortality causes were cardiovascular DHS, internal hemorrhage and PTB.

Malnutrition is prevalent in the area as 76.6% of preschool children are suffering from varying degrees of malnutrition. Of the 10,798 children weighed under the Operation Timbang, 45.6% are suffering from first degree malnutrition, 27.8% from second degree and 3.2% from third degree malnutrition.

1.2.4 Sanitation

There are no drainage and disposal system in the municipality. Almost all households dispose their waste by dumping and burning.

Regarding toilet facilities, the more common types used were sanitary pit privy (30.1%), antipolo open pit privy (18.6%), water sealed (16.6%), open pit (11%) and others (20%).

1.2.5 Public Services

Health services are provided by the Rural Health Unit (comprising of one rural health center, 8 barangay health stations and botica sa barangays.) and a general hospital located in San Miguel (with a 25-bed capacity).

The RHU is manned by 1 rural health physician, 1 dentist, 1 rural health nurse, 7 rural health midwives and 1 sanitary inspector. Augmenting these personnel are 19 barangay health workers, 24 barangay nutrition scholars, etc. The hospital's personnel, on the other hand, include 3 doctors, 6 nurses, 1 pharmacist, 1 medical technologist, one aide and 5 attendants.

At present, there are 40 schools in Jordan consisting of 13 primary schools, 22 elementary schools and 5 secondary schools. Each barangay has its own school either primary or elementary although Maabay and Ravina have both.

Serving the communication needs of the population is one post office in the Poblacion. Telegraphic messages and other services are provided by private firms in Iloilo City.

1.3 Economy and Industry

1.3.1 Agriculture

Jordan is primarily an agricultural municipality with 60% of its total area cultivated for agricultural production and employs majority of its labor force.

Rice is the most important crop grown as 42.2% of the total agricultural areas are devoted to rice production. Irrigated area are devoted to rice production. Irrigated areas which cover 149 ha. have an average yield of 58.29 cavans per ha.. Rainfed riceland covers 4,176 ha. with an average production of 54.85 cavans/hectare while upland rice covering 7,749 ha. has an average yield of 14.90 cavans/hectare.

Coconut and corn are the other major crops with 3,373 ha. and 1,234 ha. devoted to cultivation, respectively. Average yield is 7,800 nuts/hectare/year for coconut and 16 cavans/hectare for corn. Orchard production is gradually emerging as an important agricultural activity in Jordan. Mango, cashew nuts, avocado, citrus are presently planted to 2,098.11 ha..

As of 1980, total number of farms in Jordan was 3,391 covering an aggregate area of 13,623 ha.. Average farm size was 4.02 ha..

Approximately more than 90% of the households raised backyard livestock and poultry. The most common animals raised were chicken, ducks, swine, carabao, cattle and goat.

1.3.2 Other Industries

Of the 302 commercial establishments in Jordan, the most common business activities are sari-sari store accounting for 46% of the total firms, buy and sell (18.2%), rice retailer (11.3%) and carinderia (7.9%).

Typical traditional activities which utilize local raw materials like bamboo and fiber craft, i.e., boat making, charcoal making and copra production are the main features of industrial activities in Jordan.

1.3.3 Municipal Revenue

From 1980 to 1984, Jordan which is a third class municipality showed apparent increases in revenue especially in the collection of real property taxes, business taxes, residence taxes, etc. Revenue generated by the municipality increased from P1,112,207 in 1980 to P1,422,200 in 1984.

2. Analysis of Potential Water Source

2.1 Topography and Geology

The topography of Jordan is characterized by moderately undulating and rolling to very steeply sloping and rolling land in many directions. The sloping areas are situated along the sea coast facing Iloilo, while low lands are concentrated in the southwestern side along the coast of Guimaras Strait. Land elevation ranges from 0 m to 300 m above sea level.

In the northern part of the study area, cliffs consisting of limestone of tertiary face Iloilo Strait. In the inland area, the thickness of the limestone gradually decreases and pyroclastic rocks, such as tudd, are distributed widely. Alluvial deposit is observed in the narrow plain along small rivers such as the Jordan River. Geological map is shown in FIGURE M-2.

Limestone (Miocene, Tertiary)

This limestone is distributed in the northern part of the study area including the poblacion. This unit consists of reef limestone and forms the cliff. In Buenavista, northern part of the study area, this unit is highly karstified. Many springs gushing out from cracks of this rock are observed

Pyroclastic Rock (Palaeocene to Oligocene, Tertiary)

This unit, whic consists of tuff, is the basement rock and is widely found in the study area. The above mentioned limestone lies on this rock.

Alluvial Deposits (Quaternary)

This unit is mainly resedimented materials such as sand and clay transported from inland by the river water into low-land. This is found in flood plain and swamp.

2.2 *Existing Water Source*

Spring

The water source of the Jordan Water Distric consists of several springs with low yields. The water supply system of JWD covers about 500 households in the two barangays, e.g., Poblacion and Rizal. This system, however, can serve water only for a few hours a day during the dry season due to the very low yield.

In Barangay Hoskyn, which is adjacent to the Poblacion, a Level II water supply is likewise in operation. The system is supplied by water drawn from another spring called Ipil Spring.

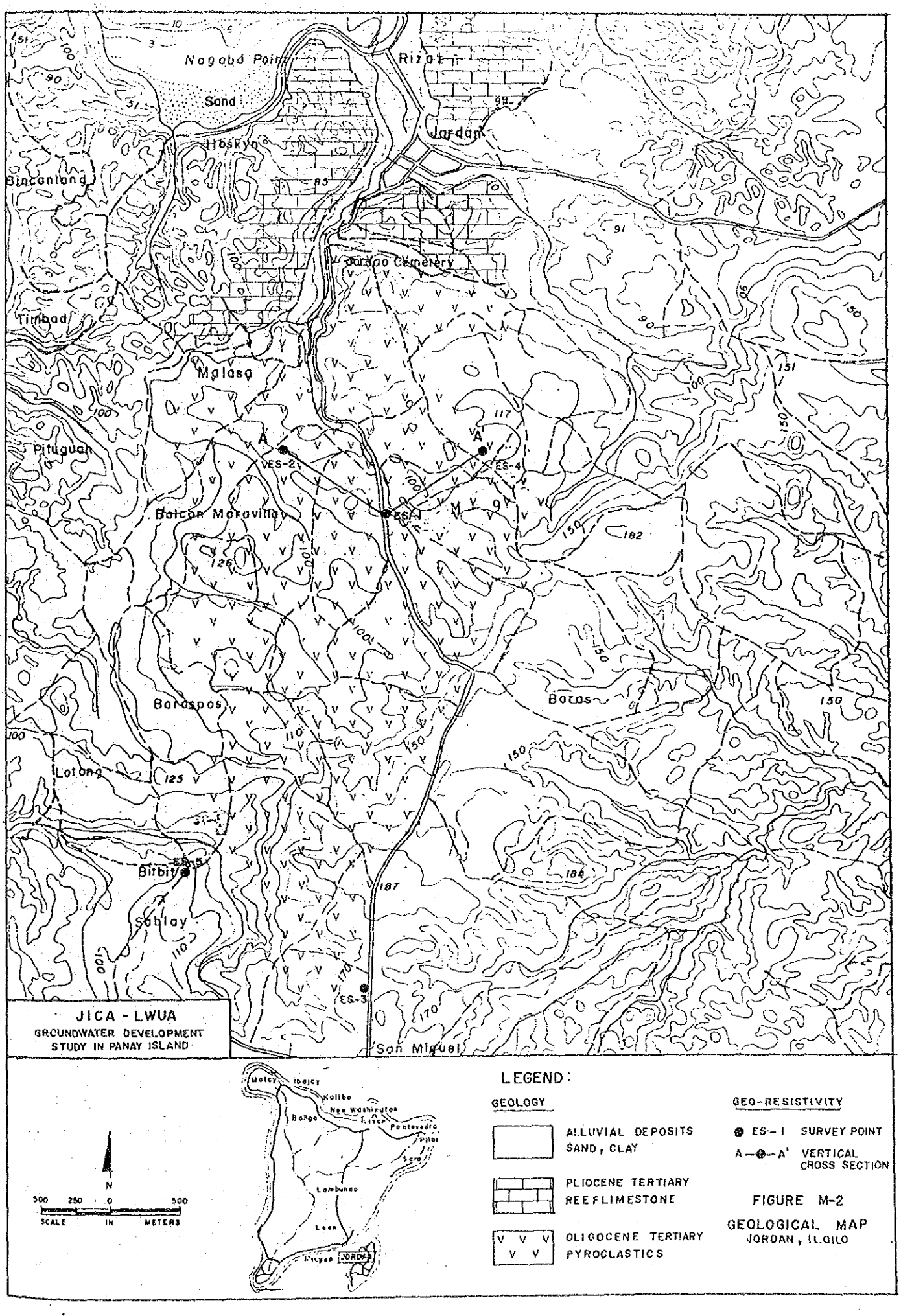


FIGURE M-2

GEOLOGICAL MAP
JORDAN, ILOILO

Since the water supply system could not satisfy the requirement of the town proper, the residents principally depend on shallow wells, open dug wells and creek water. In the inland area, the people depend on creeks, several springs, water vendors, privately owned shallow/dug wells and rainwater for their water needs.

Three springs located in the hilly area were observed. These springs, which are not yet developed for the water supply system, are located 3.5 km, 4.5 km and 8 km from the Poblacion, respectively.

The yields of springs are as follows:

TABLE M-2 Yields of Springs

Name	Dry Season	Rainy Season
Barang Spring (Rizal) in Guimaras Bulk Sugar Sugar Installation, Tapped to JWD (partly)	Not Measured	220 cu.m/day
Teodoro Spring (Rizal) in abandoned Teodoro Cement Factory. Tapped to JWD (partly)	N.A. (dry up)	N.A.
Cueva Spring (Rizal) Near T.C.F. Tapped to JWD	N.A. (little)	N.A.
Aguilay Spring (Poblacion) Behind the municipal office. Tapped to JWD	N.A. (quite little)	N.A. (little)
Biri Spring (Poblacion) Back of Poblacion. Tapped to adjacent area, privately-owned	N.A. (dry up)	N.A.
Singalong Spring (Hoskyn) Near Poblacion. Tapped to RWSA.	N.A. (little)	more than 56.4 cu.m/day
Ipil Spring (Hoskyn) Near municipal office. Tapped to JWD	N.A.	more than 35 cu.m/day
M-5 Spring (Balcon Maravilla) Inland area. 3.5 km far from municipal office	N.A. Not flowing	1721 cu.m/day free flowing

TABLE M-2 Yields of Springs (Cont'd)

Name	Dry Season	Rainy Season
M-2 Spring (Balcon Maravilla) Inland area. 4.5 km far from municipal office	50 cu.m/day	3230 cu.m/day
Balading Spring (San Miguel) Inland area.	Not measured	4929 cu.m/day (at downstream)
Cabadjangan Spring (Hoskyn) Along the coast. 2 km far from Town Proper. Tapped to adjacent area.	N.A.	N.A. 112 cu.m/day (another spring)

Thus, the spring in the study area, has a low yield in dry season. There is a fairly big spring in Buenavista about 11 km far from the Poblacion. It originates from a limestone cavern facing the Iloilo Straight. Hundreds of tons of water are brought from here by barges and sold in Iloilo City for the use of ships and marine products processing. However, there is no road from Jordan along the coast due to the steep cliff, and, utilization of this spring as a source of supply for Jordan seems to be not feasible at present.

Wells

Shallow wells are also used in the narrow plain area along the small river and inland areas, but their yields are quite insufficient.

Well inventory survey was conducted on 3 wells/spring, (as shown in FIGURE M-3) one of which is located in the Poblacion and two in the inland area. Because of the topographical feature of the area, very meager sources could be found on the plateau located behind the town proper.

Survey results are presented in TABLE M-3.

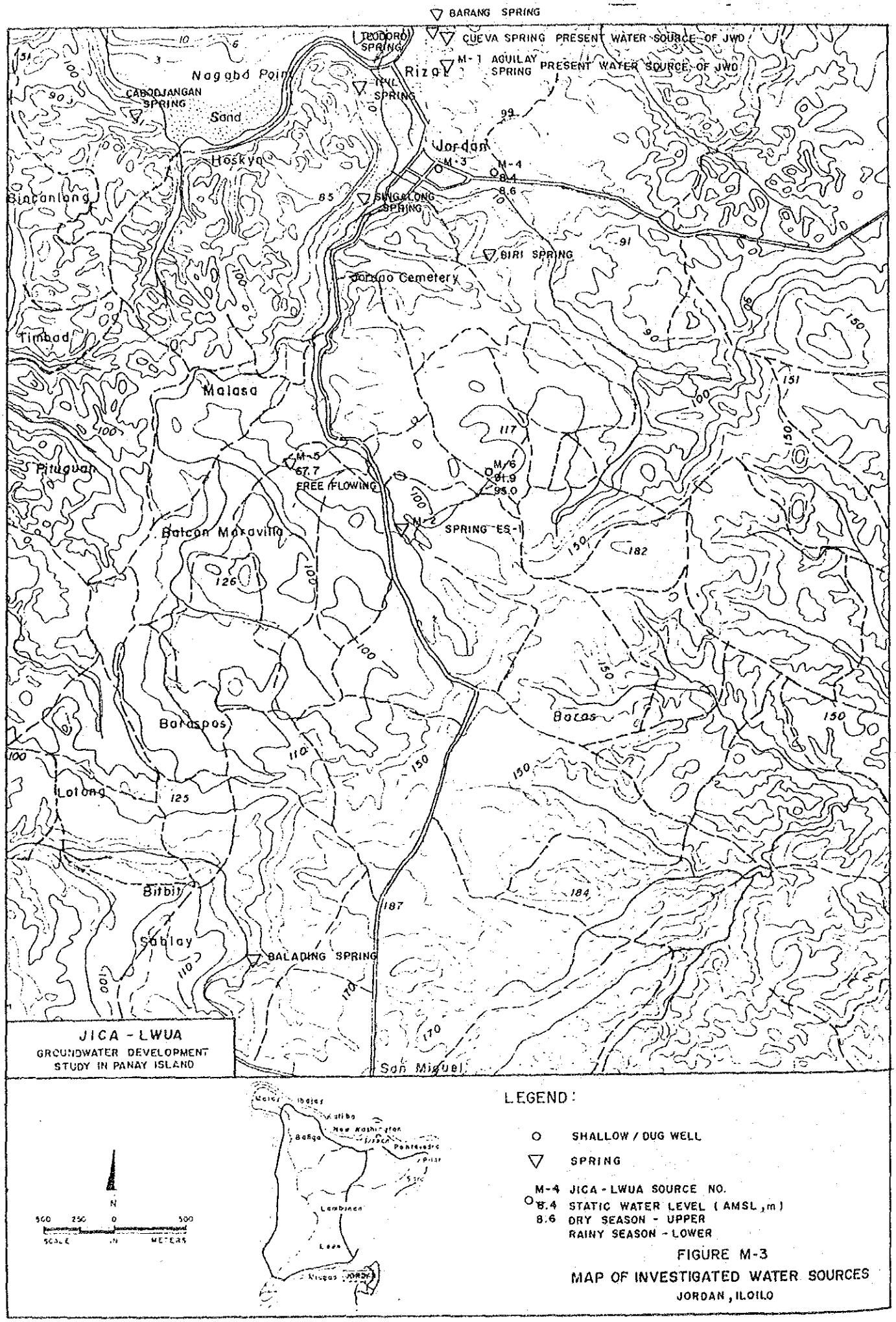


FIGURE M-3

MAP OF INVESTIGATED WATER SOURCES

JORDAN , ILOILO

TABLE M-3 Well Data Summary

JICA-LWUA Source Number	Well Depth (M)	Ground Level (MAMSL)	Static Water Level			
			Dry Season		Rainy Season	
			(MBGL)	(MAMSL)*	(MBGL)	(MAMSL)
M-4 Dug Well, Poblacion	1.19	8.5	-0.10	8.4	0.14	8.6
M-5 Spring ES-2	3.40	70.0	-2.30	67.7	Free Flowing	
M-6 Dug Well ES-4	3.49	95.0	-3.10	91.9	0.0	95.0

* Estimate based on the 1/50,000 topographical map and supplemental topographical survey

The results are summarized as follows:

i) There are no deep wells in the area, except one well in Teodoro Cement Factory. However, technical data of it is not available.

ii) Free groundwater table exists at slightly deep level below the ground level in dry season. However, it rises up to ground surface in rainy season.

iii) The specific capacity of shallow/dug wells appear to be very low.

2.3 Survey for Potential Water Source

2.3.1 Evaluation of Georesistity Survey Result

The geology in Jordan consists mainly of limestone and pyroclastic rock. Mountainous topography is dominant. The georesistivity survey was undertaken in an area far away from the poblacion because the topography within the poblacion does not lend itself to georesistivity survey.

The georesistity survey aims to explore the possible presence of aquifers in pyroclastic rock and limestone. Survey points are indicated on FIGURE M-2.

Survey activities are summarized below:

Date : April 15, 1988
No. of Survey Points : Five (5) points

Type of Survey : Vertical Sounding
Configuration : Wenner Method
Sounding Depth : 150 meters

The results of the ρ-a curve analysis is presented in TABLE M-4 and the georesistivity section subsequently developed is shown in FIGURE M-4.

The following interpretations and assessment are available as of the present.

1) Due to the absence of reliable geologic logs, the difficulty of correlating the resistivity layer and geological unit was encountered. Therefore, the interpretation was arrived at considering the geological characteristics observed at shallow wells and springs.

2) Limestone shows resistivity values of more than 90 ohm.m when located above the groundwater table.

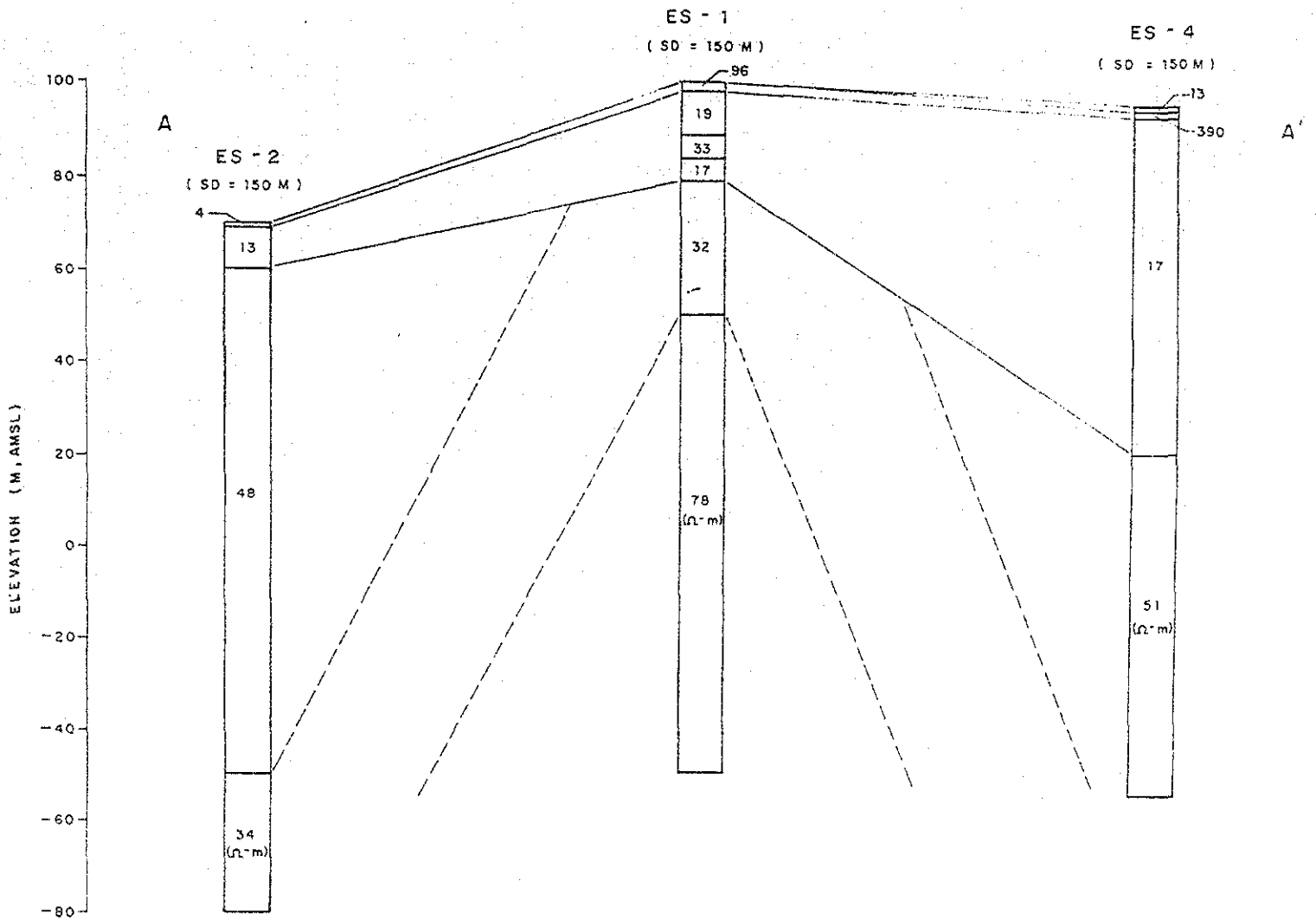
3) Pyroclastic rock below groundwater table shows resistivity values of less than 20 ohm.m.

4) As a whole, survey points and their surrounding area other than ES-5 indicated very poor but possible presence of groundwater.

TABLE M-4 VALUES OF GEORESISTIVITY READING INTERPRETATION

JORDAN, ILOILO

SURVEY POINT	ELEVATION (M,AMSL)	TOPOGRAPHY	RESISTIVITY LAYER 1		2		3		4		5		6	
			ohm.m	m	ohm.m	m	ohm.m	m	ohm.m	m	ohm.m	m	ohm.m	m
ES-1	100	gentle slope	94	1.9	19	11	33	16	17	21	32	46	18	
ES-2	70	mountain foot	4	0.6	13	10	48	100	34					
ES-3	180	hill top	220	0.8	550	7.5	160	20	650	30	88			
ES-4	95	alluvial plain	13	0.8	390	2.3	17	76	51					
ES-5	100	alluvial plain	24	2.2	16	11	9	22	17					



SCALE H = 1 : 10,000
V = 1 : 1,000

FIGURE M-4
GEORESISTIVITY SECTION A-A'
JORDAN , ILOILO , GUIMARAS

JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND

2.3.2 Other Water Source

(1) Boro-Boro Spring

When the Study Team conducted the reconnaissance survey for the existing and potential water source in Jordan, Guimaras Island, the Study Team got an information that there is a big spring which supplies a considerable quantity of water for industrial use and for ship allegedly. The Team visited the spring on April 16, 1988.

The name of the spring is Boro-Boro Spring, and it is located between Dapdap Point and Cauang, on the western cost of the municipality of Buenavista which is adjacent to the municipality of Jordan. (FIGURE M-5)

There is no road along the coast leads to this spring from the barangay Rizal, Jordan, since the most part of the coast in this area is a sheer cliff of lime rock, approximately 70 to 80 meters in height.

The spring is accessible from the barangay Rizal, Jordan through a 17km sub-provincial road, passing through the Buenavista poblacion, going to barangay Dagsa-an, from where foot-travel across a lime rock hill towards Boro-Boro Spring.

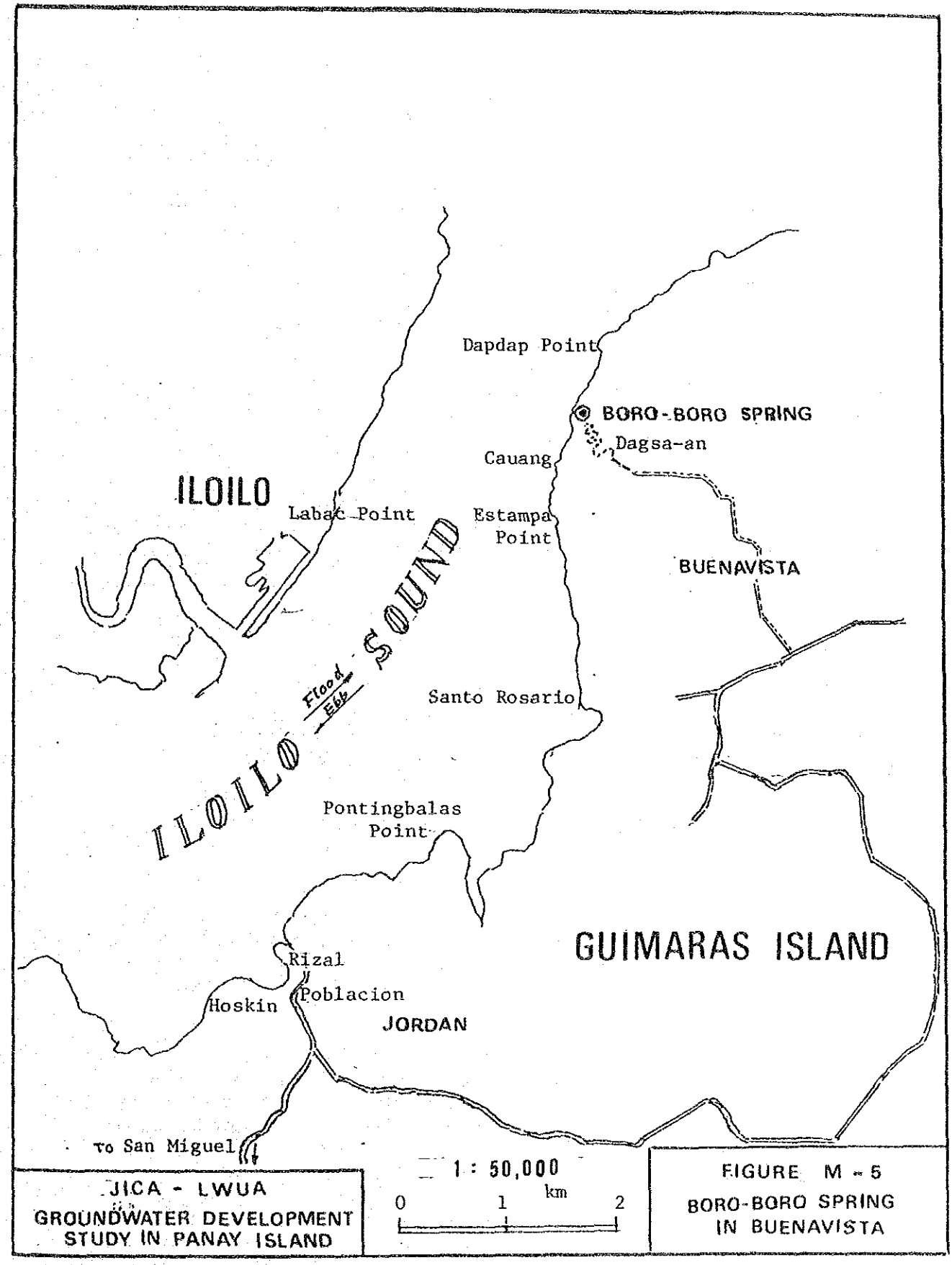
The water springs from a big cavern which faces toward the Iloilo Strait. In front of the mouth of the cavern a concrete wall is provided to block sea water intrusion.

The spring is owned by a private company, Iloilo Water Service Corporation. Since water from the spring is overflowing to the sea and there is no provision of measuring device, the yield of the spring is not ascertained.

The spring water is used for drinking purposes especially for the use of ship, ice making and washing. Alleged customers are Negros Navigation Shipping Co., Aboitiz Shipping, Iloilo Haulers, Inc., Iloilo Shipping Port, William Lines, Trans-Asia Pacific, National Power Corp. Barges 3 & 4, and Fortuna Ice Plant.

The spring water is transported to Iloilo daily by barge, and the average volume of water transported is allegedly 150 cu.m. This has been done since 1970.

Although the exact yield of the spring is unknown now, water available from this spring is deemed more than sufficient to meet the requirement for Iloilo Water Service Corporation, therefore, there will be a possibility to use this spring as a supplemental source for Jordan Water District, especially in drought season.


Dapdap Point
BORO-BORO SPRING
Dagsa-an
Cauang
ILOILO
Labac Point
Estampa Point
BUENAVISTA
ILOILO SOUND
Flood
Ebb
Santo Rosario
Pontingbalas Point
GUIMARAS ISLAND
Rizal
Poblacion
Hoskin
JORDAN
To San Miguel
1 : 50,000
0 1 2 km
JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND
FIGURE M - 5
BORO-BORO SPRING
IN BUENAVISTA

The idea is as follows;

To construct a reservoir with an appropriate capacity at the wharf area in barangay Rizal, Jordan, and transport water from Boro-Boro Spring to the said reservoir by barge when the need arises. The consideration to be taken is as follows:

1) Negotiations with the owner of the spring (Iloilo Water Service Corporation)

   The owner of the spring will be undoubtedly very hesitant or reluctant with such a negotiation, because he will surely be afraid of an adverse effect to his business.

2) Negotiations with the municipal authority of Buenavista

   Because the spring locates in the administrative area of Buenavista, yet Buenavista has not been benefited due to the inconvenient location of the spring.

3) Funding and financial state of Jordan Water District

   To construct a reservoir at the wharf area of barangay Rizal and to transport water from the spring to the reservoir requires a certain amount of budget. Can Jordan Water District bear such a expenses?

(2) Research and Development of "Water Gallery" for San Miguel Area

The barangay San Miguel where the capitol of sub-province of Guimaras, the District Engineer's Office, DPWH and Guimaras Hospital are located has never enjoyed since this area was developed. These government offices were located at this area mainly because of the land acquisition, the most of which were donated by a charitable land owner.

San Miguel area is situated on a wide open plateau of which elevation is approximately 150 m above sea level, 8.5 km from the Poblacion, and makes a remarkable contrast to Rizal-Poblacion area where there is less space to accommodate those government offices. The only problem in San Miguel is "water". Rain water is even used for water source.

On the occasion of the visit to this area in January 1989, the well engineer of the Study Team observed that the groundwater level in San Miguel area (in the premises of Guimaras Hospital) was only 1 m below the ground level, even it was

amidst of dry season.

This is presumably because that the rain water is maintained in underground layer for much longer time after precipitation due to a favorable geological structure condition for the preservation of groundwater.

Considering this, it will be recommended to research into utilization of the above-mentioned groundwater preserved in a shallow layer, and to take a developmental action as a trial.

A "water gallery" illustrated in FIGURE M-6 is one of the idea to get such groundwater in a effective manner. Dimensions of each well as well as its arrangement are shown in the schematic drawing. The essential point of this "water gallery" is the replacement of the soil in the site with much permeable materials, such as coarse sand and gravels as illustrated in the drawing.

The expected yield depends the permeability of the soil in this area. Therefore, prior to design a water gallery, a pumping test (continuous and step-drawdown test) should be conducted.

When this water gallery is expected to be successful, this method will be applied to each governmental office separately. Since the water gallery is a system to collect groundwater in shallow layer from the ground surface, much consideration should be taken for protection of contamination from the ground surface. Therefore, a certain area surrounding a water gallery should be reserved prohibiting of construction of housing and other buildings. Also, special attention should be paid for toilet facilities in the vicinity.

2.4 Water Quality Analysis

A total of 18 existing water sources were examined during the field survey. Survey points are indicated on FIGURE M-3 and analysis results are shown in TABLE M-5. Two (2) water samples from existing springs were collected for laboratory analysis.

TABLE M-5 Water Quality Analysis Results

Sample		WT (°C)	pH (-)	EC (μS/cm)	T-Fe (ppm)	Mn (ppm)	NH_4-N (ppm)
Dry Season							
M-1	Aguilay Spring	27.8	7.0	630	nil	nil	nil
M-2	Spring No. 1	28.7	7.0	450	1.0	nil	0.5

TABLE M-5 Water Quality Analysis Results (Cont'd)

Sample		WT (°C)	pH (-)	EC (μS/cm)	T-Fe (ppm)	Mn (ppm)	NH_4-N (ppm)
M-3	Public Well, No. 3273-18 Central Elem. School	29.4	7.0	840	5.0	nil	0.5
M-4	Dug Well	28.7	7.1	620	0.3	nil	0.3
Rainy Season							
M-1	Aguilay Spring	27.4	7.2	610	nil	-	nil
M-2	Spring No. 1	28.2	7.4	400	Tr.	-	nil
M-3	Public Well, No. 3273-18, Central Elem. School	28.8	7.2	740	5.0	-	2.6
M-4	Dug Well	27.5	7.2	600	0.5	-	nil
M-5	Spring	28.3	7.2	510	-	-	-
M-6	Dug Well	28.4	7.5	355	Tr.	-	-
-	Teodoro Spring	28.0	7.4	472	-	-	-
-	Cueva Spring	27.5	7.5	510	-	-	-
-	Cabadjangan Spring, Bgy. Hoskyn	27.5	7.2	382	nil	-	nil
-	Creek beside Cabadjangan Spring	27.0	7.2	550	nil	-	nil
-	Ipil Spring	27.7	7.1	480	-	-	-
-	San Miguel Hospital						
	Dug Well No. 1	27.3	6.4	205	nil	-	nil
	Dug Well NO. 2	27.2	6.0	180	nil	-	nil

TABLE M-5 Water Quality Analysis Results (Cont'd)

Sample	WT (°C)	pH (-)	EC (μS/cm)	T-Fe (ppm)	Mn (ppm)	NH_4-N (ppm)
- Balading Spring	27.8	4.7	120	-	-	-
- Creek at Balading Spring	28.1	4.9	55	-	-	-
- Singalong Spring	27.5	7.0	550	-	-	-
- Biri Spring	27.5	7.3	430	-	-	-

The quality of the water sources examined in the field survey has a similarity in character and content and is generally found to be favorable for drinking purposes. However, the presence of ammonium nitrogen gives an indication of possible water source contamination by wastewater.

Following are the results of laboratory analysis for two existing water sources.

Sample	Spring No.1 (M-2)	Guimaras Bulk Sugar Installation (Barang Spr.)
Date of Sampling	5.21.88	10.06.88
Turbidity (FTU)	1	22
Color (UNIT)	nil	40 (apparent)
TDS (mg/l)	352	280
pH (-)	7.5	7.3
EC (μS/cm)	550	510
Alkalinity as $CaCO_3$ (mg/l)	256	220
Hardness as $CaCO_3$ (mg/l)	300	239
Major Cations (meq/l)		
Sodium	0.05	0.2
Potassium	0.01	0.01
Calcium	4.90	4.4
Magnesium	1.10	0.4
Total	6.06	5.0

Sample	Spring No.1 (M-2)	Guimaras Bulk Sugar (Cont'd) Installation (Barang Spr.)
Major Anions (meq/l)		
Carbonate	0	0
Bicarbonate	5.11	4.4
Chloride	0.8	4.4
Sulfate	0.09	0.1
Total	6.00	5.0

The laboratory analysis indicates that these springs have typical Carbonate-Hardness Type of geochemical characteristic and chemical constituents are within acceptable range for drinking purpose. High turbidity and apparent color in spring water of Guimaras Bulk Sugar Installation are considered to be caused by presence of clay particles.

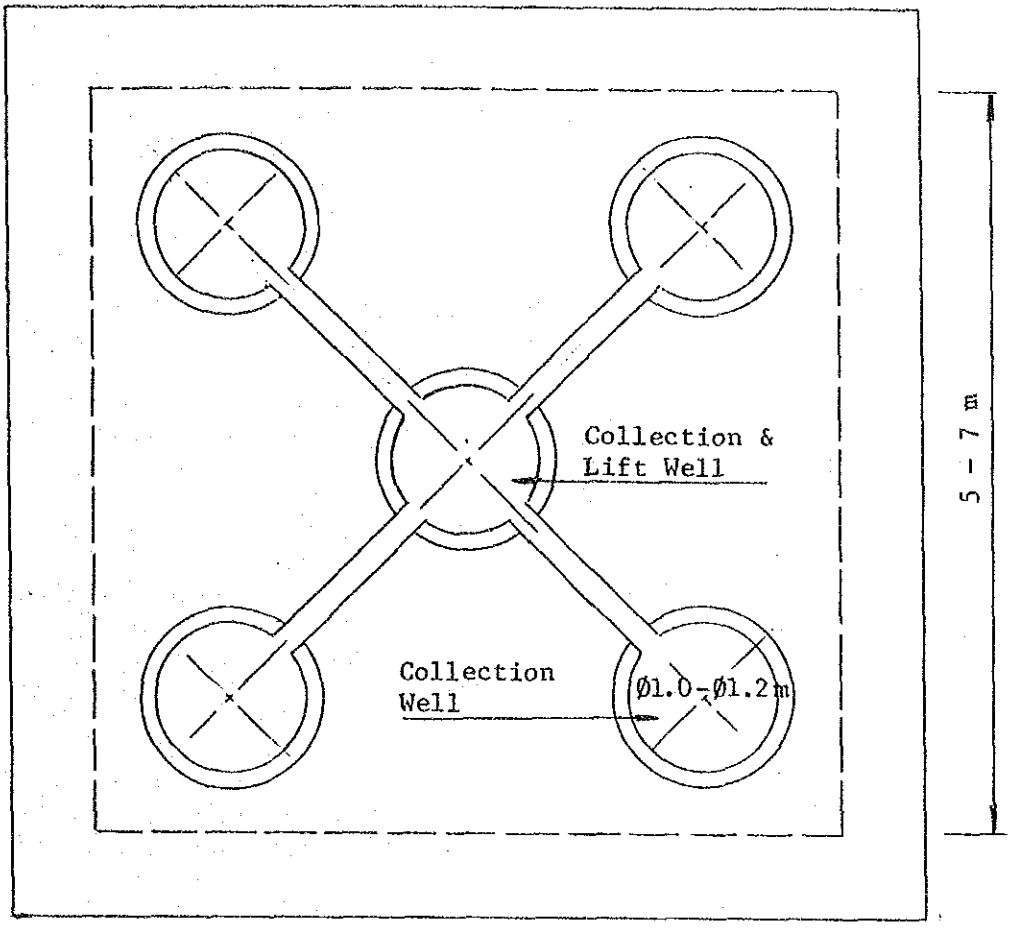
3. Conclusion and Recommendation

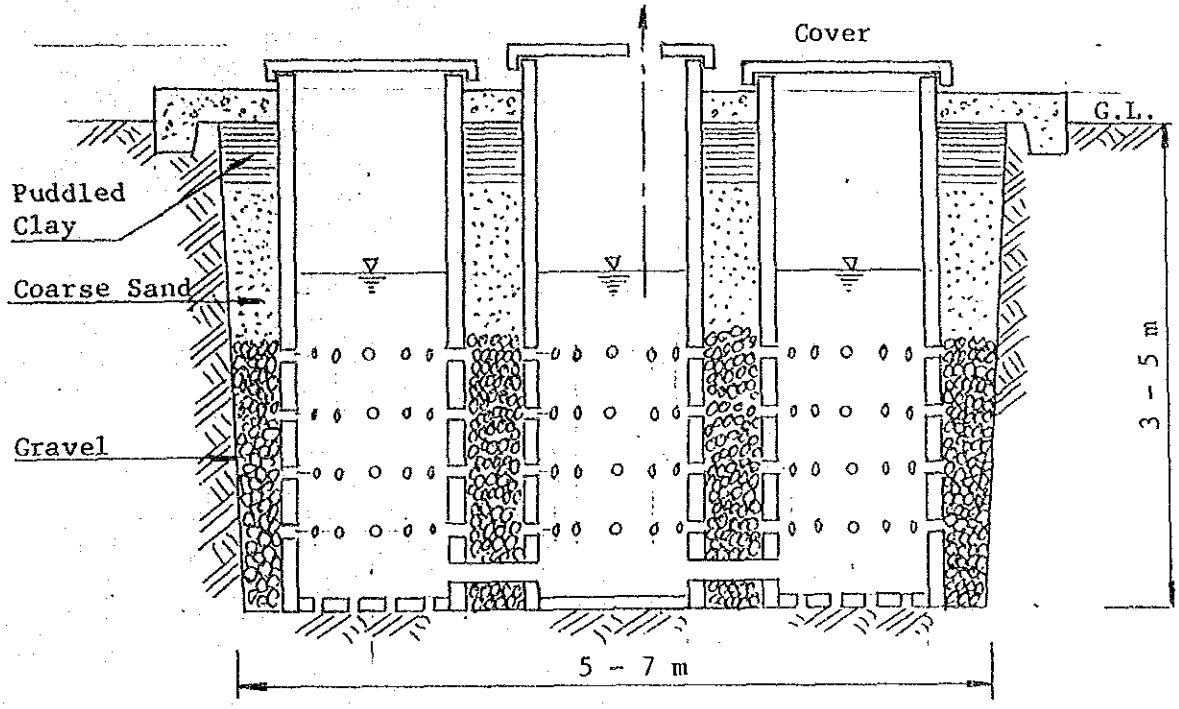
The development of the groundwater by deep well appears to be impractical because the pyroclastic rocks are impermeable.

The groundwater in the study area consists mostly of springs from the cracks of the limestone formation. Therefore, the quantity of spring water is not stable throughout the year.

The most possible way to get additional water source for the Jordan Water District (JWD) is to utilize the existing spring at the maximum. Especially, M-2 Spring is not possible water source to be developed, for which water can be flown down to Town Proper by gravity. In addition, the Barang Spring, owned by the Guimaras Bulk Sugar Installation, is also possible source for the JWD. Though the water of the spring is already tapped partly, its utmost utilization will be effective. However, a water treatment facilities will be necessary due to high turbidity with white color and some iron content.

An effective way to ensure water source with sufficient yield is to get the water from the limestone cavern facing the Iloilo Strait or the spring at the Guimaras Bulk Sugar Installation. However, proper arrangements with respect to of the water right is essential, because the above-mentioned water source is located in a privately-owned lot.





JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND

FIGURE M - 6
WATER GALLERY

II. CONCEPTUAL WATER SUPPLY SYSTEM

1. Existing Water Supply Conditions

1.1 Water Use Condition

Six barangays of the Municipality of Jordan are presently served by water systems, coverage of which is limited to those areas where houses are clustered in a specific locality. The Poblacion Rizal water system is administered by the municipal government with a clientele of 545 households representing 80% of the total number of households in the two barangays.

Other barangays which enjoy the services of piped water supply systems are Hoskyn, Morobuan, Aguilar and Lawi. The coverage is however, limited to the houses in their respective barangay centers. Each system's coverage ratio to the total number of households are: Hoskyn, 64%; Morobuan, 71%; Aguilar, 44%; and Lawi, 70%. These systems are administered and maintained by the barangay government themselves.

The people not served by the system derive their water supply from springs, artesian wells, pump wells and open shallow wells. Rivers and streams are likewise utilized for washing and bathing, though they are few and far from population centers. In Barangay San Miguel, which is the capitol of the sub-province of Guimaras, the District Engineer's Office, DPWH and Guimaras Hospital, are located, rainwater is even used for water source. For instance, Guimaras Hospital is equipped with a concrete-made rainwater storage tank the capacity of which is approximately 140 cu.m. All the rain- water totaling on the roof of the hospital buildings are being collected into this storage tank which is situated on the premises of the hospital. The shallow wells barely supply the demand for hospital use.

Because of high elevation (approximately 150 m above sea level), groundwater level is very deep, making it very difficult for deep wells to obtain and supply sufficient quantity of water to the people in the area.

A water district has been formed (in 1984) but it is not yet operational pending proper documentation.

As a whole, the present water supply conditions are insufficient and unstable due to limited amount and seasonal change of spring yield. Therefore, new water source development and upgrading of distribution facilities are indeed important.

1.2 Existing Water Supply System and Problems Encountered

No precise and detailed drawings of the existing water supply systems were obtained. Barang Spring, which is located in the prem-

ises of Guimaras Bulk Sugar, Inc.; Cueva Spring; Ipil Spring; and a spring behind the municipal compound, are the main sources to supply the Poblacion-Rizal waterworks system. The spring water behind the municipal compound is pumped up to a 15 cu.m capacity distribution reservoir, then flows down to the supply area by means of gravity. In the Poblacion, since water distribution is made possible solely by means of gravity, the system's expansion is limited to houses located in the relatively low areas. Also, since water supply from springs decrease during summer, the system cannot provide adequate water during that period.

Existing transmission and distribution pipelines have been laid from 1966 to 1969. They are all made of GI pipe, sized 1-1/2" to 3", and the total length is approximately 3 km.

2. Water Demand Projection

2.1 Criteria

The supply amount of the existing water supply system could not be determined due to the absence of flow meter. In this regard, the present per capita unit water consumption is assumed to be 90 lpcd taking into account the locality and standard of living, and this assumption is within the range of commonly adopted figure as described in the LWUA Methodology Manual.

Design unit water consumption by consumer type is thereby estimated in accordance with the said Manual, as follows:

- Domestic per capita unit water consumption is estimated at 100 lpcd in the year 1995 with an annual increase ratio of 2% from 1988 to 1990 and 1.5% from 1990 to 1995 against 90 lpcd in 1988.

- Commercial unit water consumption is estimated at 1.4 cu.m/connection/day with its connection density ratio of 1.2 per 100 inhabitants.

- Institutional unit water consumption in 1995 is estimated at 5.2 cu.m/connection/day with its connection density ratio of 1.0 per 2,000 inhabitants in the service area.

The existing water supply system was constructed in 1966 to 1969 and partial improvement/expansion took place as the service connections increased year by year. In this regard, the ratio of unaccounted-for water is assumed to be 40% of the total distributed amount, which is the LWUA standard ratio for old and new combined pipelines.

2.2 Areas to be Served

The target year for water supply planning is set for the year 1995 for the purpose of intermediate water supply development/improvement.

With regard to the planned service area in the said target year, priority shall be given to the densely populated area with the immediate improvement of water supply conditions under the aged existing water supply facilities. The present service area, which covers Poblacion and barangays Hoskyn and Rizal, is likewise designated as the planned service area. Inclusion of unserved barangay to the water supply service area shall be considered upon accomplishment of the intermediate improvement.

2.3 Population Projection

The National Economic Development Authority (NEDA) has projected the municipal population in each calendar year from 1981 to 2000 based on population census it conducted in 1980. The municipal government, on the other hand, does not have such projected data for the target year.

Owing to this data limitation, the NEDA population projection is adopted as principal data.

Percentage share of barangay population to the municipal population is assumed to be the same as that of the 1980 census result. The result of population projection is shown in TABLE M-6.

TABLE M-6 Population Projection of Service Area

Year	Municipality	Service Area			
		Poblacion	Hoskyn	Rizal	Total
1980	36,014	2,245	1,434	1,898	5,577
1985	40,470	2,520	1,610	1,130	6,260
1990	44,690	2,790	1,780	2,360	6,930
1995	48,340	3,010	1,920	2,550	7,480

With regard to the water supply service ratio, the municipal government is presently serving a clientele of 545 households, which is equivalent to about 80% of the present service area or about 50% of the planned service area. Considering the principal objective of this intermediate improvement, the water supply service ratio is assumed to be 80% of the planned service area population.

Average number of persons per household is assumed to be 5.00 in 1995 based on the standard figure adopted by NEDA.

2.4 Water Demand Projection

The future water consumption in 1995 is estimated based on the aforementioned planned service population and design unit water consumption by consumer type.

The estimated number of connection and future water consumption are shown in TABLE M-7.

TABLE M-7 Water Consumption in 1995

Service Area	Poblacion	Hoskyn	Rizal	Total
Served Population	2,410	1,540	2,040	5,990
No. of Connection				
Domestic	482	308	408	1,198
Commercial	29	18	24	71
Institutional	1	1	1	3
Total	512	327	433	1,272
Water Consumption (cu.m/day)				
Domestic	241	154	204	599
Commercial	41	25	34	100
Institutional	5	5	5	15
Total	287	184	243	714
Unaccounted-for Water	191	123	162	476
TOTAL	478	307	405	1,190

The ratio of the daily maximum water demand to the daily average water demand is determined in relation to the planned service population based on the LWUA Methodology Manual as shown in TABLE M-8.

TABLE M-8 Demand Variation Factor for Daily Maximum Water Demand

Service Population	Ratio (Daily Max./Daily Ave.)
Less than 30,000	1.30 : 1
30,000 to 200,000	1.25 : 1
Over 20,000	1.20 : 1

The estimated daily maximum water demand is shown in TABLE M-9.

TABLE M-9 Daily Maximum Water Demand

Service Area	Water Demand (cu.m/day)
Poblacion	620
Hoskyn	400
Rizal	530
Total	1,550

The peak hour water demand is estimated in pro- portion to the daily maximum water demand and service population in accordance with the LWUA Methodology Manual as shown below:

C = (Peak Hour Demand x 24)/(Daily Maximum Demand)

= 2.2 -0.3 x log (Service Population/1,000)

The ratio of peak hour demand in the year 1995 is calculated at 1.97 and the peak hour water demand is estimated at 3,050 cu.m/day.

3. Proposed Water Supply Facilities

3.1 Basic Approach for Water Supply Improvement

3.1.1 Conditions and Constraints

The conceptual plan for water supply improvement is focused on major water supply facilities, such as water source, main transmission and distribution pipelines, and reservoir. Branch lines, service connections and fire hydrants are likewise excluded from conceptual planning. However, following conditions are taken into account as much as possible:

(1) Low cost in construction, operation and maintenance,
(2) Seasonal fluctuation of source capacity will not seriously affect stable water supply,
(3) Water source will be located within the administrative boundary of respective municipality.

3.1.2 Water Source Development

Although water supply facilities managed by Jordan Water District supplies two districts, (pobulacion and Rizal), in dry season serious water shortage often occurs due to the lack of water production of the springs which they depend on.

Through field survey and hydrogeological survey carried out in this project, some springs were found at mountainous area, in spite of the capacities are small. Among them, Biri spring and Balading spring have relatively large capacities and they are 96 l/min, 60 l/min respectively.

But Balading spring was regarded as inadequate for drinking water because of its high pH value and high iron content, and it is also located in mountainous area, about 8 km far from poblacion.

Though most of the wells in this area are small scale shallow wells and large capacities can not be expected, one deep well (Teodoro Deep Well : Depth 81 m) situated in the site of lime factory which can be utilized as effective water source.

Therefore, for the water source for Jordan, small scale springs, scattered in mountainous area and hill at the back of Rizal, shall be fully utilized and the spring water will be gathered and delivered to each district, namely, poblacion, Rizal and Hoskyn.

Spring water obtained from mountainous area will be gathered in reservoir located in Poblacion and served mainly in poblacion area.

Water obtained from springs at hill of Rizal and deep wells will be delivered mainly to Rizal area through existing reservoir.

Ipil spring will be fully utilized for Hoskyn area. Existing spring at Hotel in Hoskyn can be considered as an additional source. Transmission and distribution pipes will be replaced due to small diameter.

In spite of the completion of these scheme, daily maximum water demand can not be fulfilled and another water source development will be needed. In this project, feasibility for another water source development seems suspicions, therefore the scope of this project must be limited to the sources deemed feasible.

3.2 Plan for Improvement of Water Supply Facilities

3.2.1 Water Source Facility

Barang Spring

Intake box of spring will be reconstructed and spring water can be fully utilized.

Sand filter and pump facility will be installed and spring water will be pumped to reservoir.

Sand filter: W 6.5m x B 6.5m x D 2.5m
Pump : ø 50 mm x 0.2 cu.m/min x 40.0 m x 3.7 kW, 1 unit

Teodoro Deep Well

Intake pump facility and elevated tank will be constructed.

Submersible water pump for deep well:
ø 50 mm x 0.15 cu.m/min x 60.0 m x 3.7 kW, 1 unit
Elevated tank: RC, W 3.0 m x B 3.0 m x H 3.0 m

Biri Spring

Intake dam and intake pipe will be installed.

Intake dam : W 15.0 m x H 2.0 m
Intake pipe : ø 300 mm pipe, l = 25 m

M-2 Spring

Existing intake weir will be improved and intake box will be built.

M-5 Spring

Intake box will be constructed and intake pipe will be installed.

Aguilay Spring

Pump facility will be renewed and spring water, mixed with cueva spring water, will be pumped to reservoir.

Ipil Spring

Intake box will be reconstructed and pump facility and elevated tank will be installed.

Cabadiangan Spring

Pump facility and elevated tank (V=30 cu.m) will be installed.

Spring behind the hotel (Hoskyn area)

Intake box will be built.

3.2.2 Transmission Facility

Following items will be constructed:

(1) Transmission mains

From M-2 spring to the junction point with M-5 spring:
ø 100 mm pipe, l= 1,500 m

From M-5 spring to the junction point with M-2 spring:
ø 100 mm pipe, l = 500 m

From new junction box of M-2, M-5 spring to Jordan reservoir: ø 150 mm pipe, l = 2,000 m

From Biri spring to Jordan reservoir:
ø 100 mm pipe, l = 1,000 m

From Barang spring to Rizal reservoir :
ø 100 mm pipe, l = 1,000 m

From Cuera spring to Aquilay spring:
ø 100 mm pipe, l = 1,000 m

From Teodoro deep well to new reservoir:
ø 100 mm pipe, l = 1,000 m

From Jordan reservoir to Rizal reservoir:
ø 150 mm pipe, l = 1,500 m

From Aguilay spring to new reservoir:
ø 100 mm pipe, l = 200 m

(2) Junction box

New junction box will be constructed at the junction point of M-2, M-5 spring:
W 3.0 m x L 5.0 m x H 3.5 m

3.2.3 Distribution Facility

Following reservoir will be newly built.

- New reservoir for Jordan district will be constructed on the hill at the south of poblacion area. Capacity will be equivalent to 15% of daily maximum water demand of poblacion area.

  RC, W 6.0 m x L 6.0 m x D 3.0 m, 108 cu.m
  Elevation : + 30.0 m

- New reservoir for Rizal district will be constructed on the hill behind municipal compound.

  RC, W 5.0 mx L 5.0 m x D 3.0 m, 75 cu.m
  Elevation : +20.0 m

Following distribution pipes will be installed:

ø 150 mm pipe, l= 3,450 m
ø 100 mm pipe, l= 1,750 m

3.2.4 Required Water Supply Facilities

Layout of major water supply facilities is shown in FIGURE M-7, flow diagram of facilities in FIGUREd M-8, 9, 10 and etail of distribution pipeline in proposed service area in FIGURE M-11.

Size and quantity of required facilities are listed below:

(1) Water Source Facility

Following facilities will be constructed and installed for each springs and wells.

- Barang Spring

Intake box
Sand filter : W 6.5 m x B 6.5 m x D 2.5 m
Pump: ø 50 mm x 0.2 cu.m/min x 40.0 mH x 3.7 kW, 1 unit

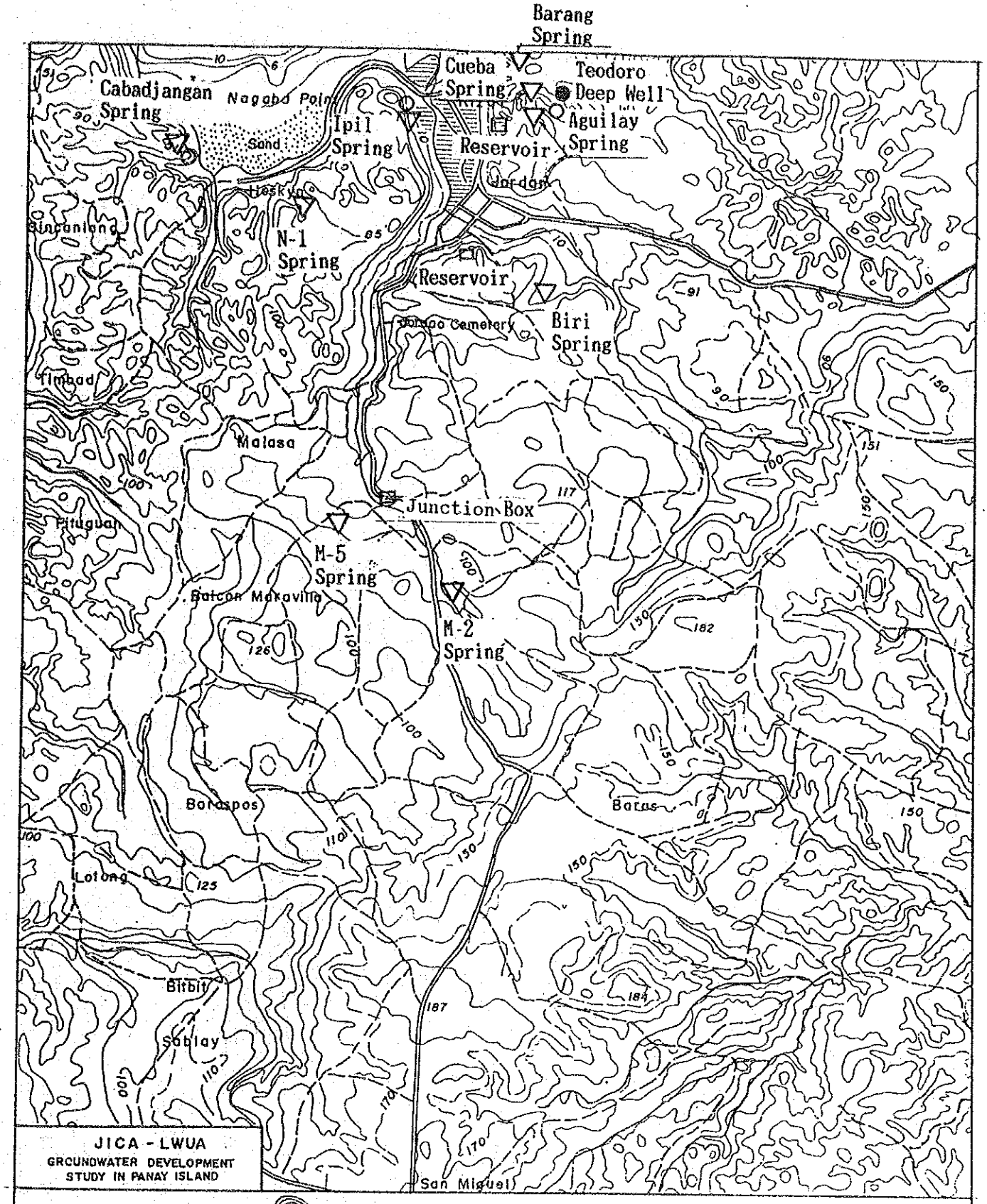
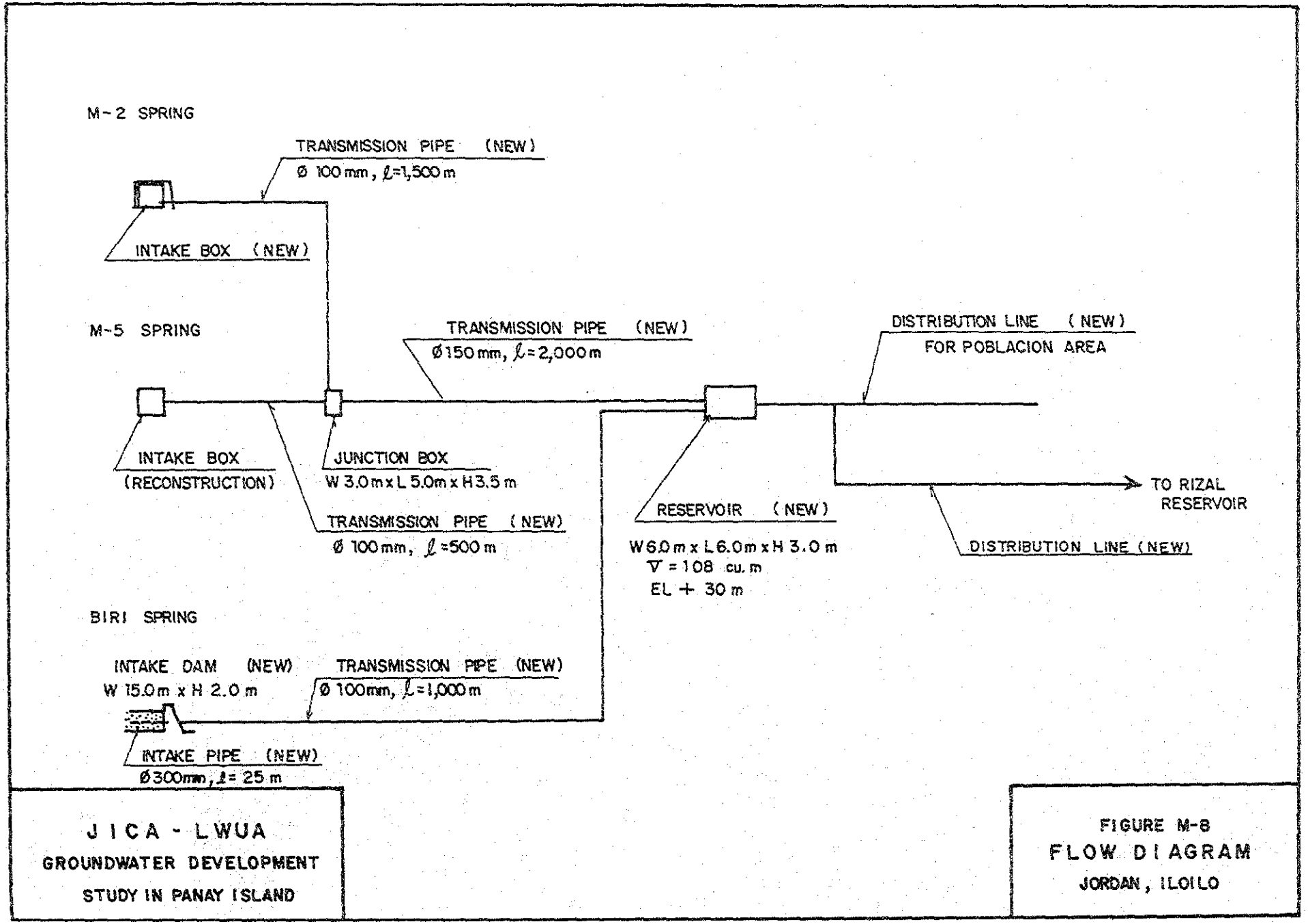
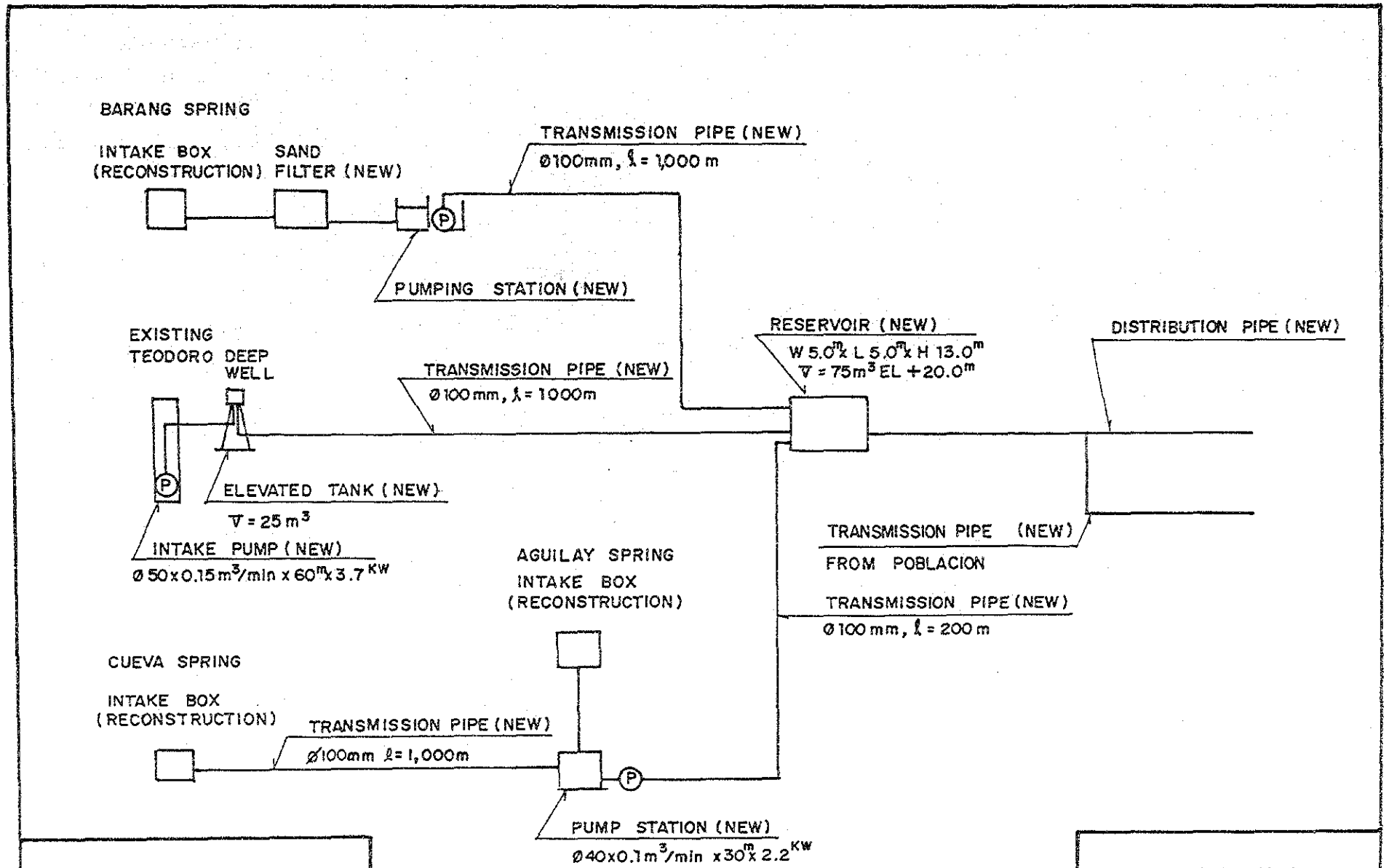
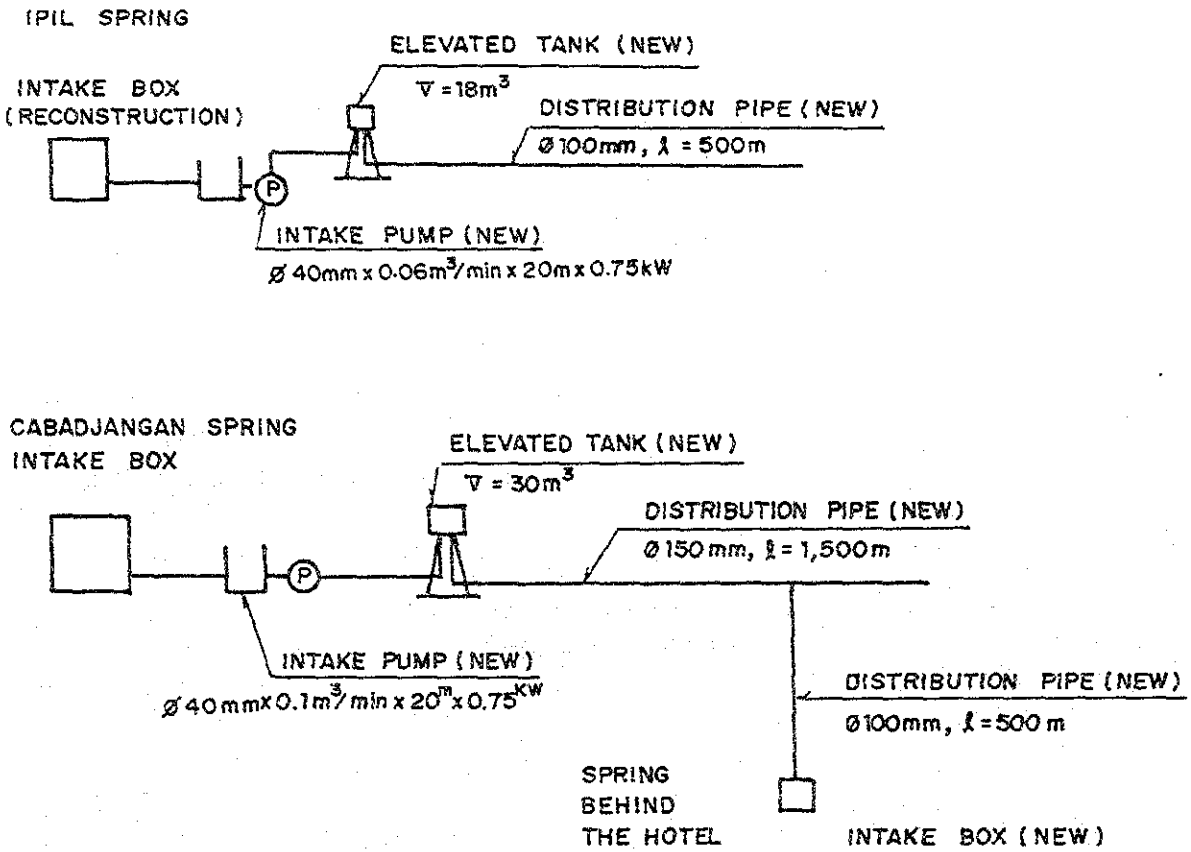


FIGURE M-7
LOCATION OF MAJOR FACILITIES
JORDAN, ILOILO

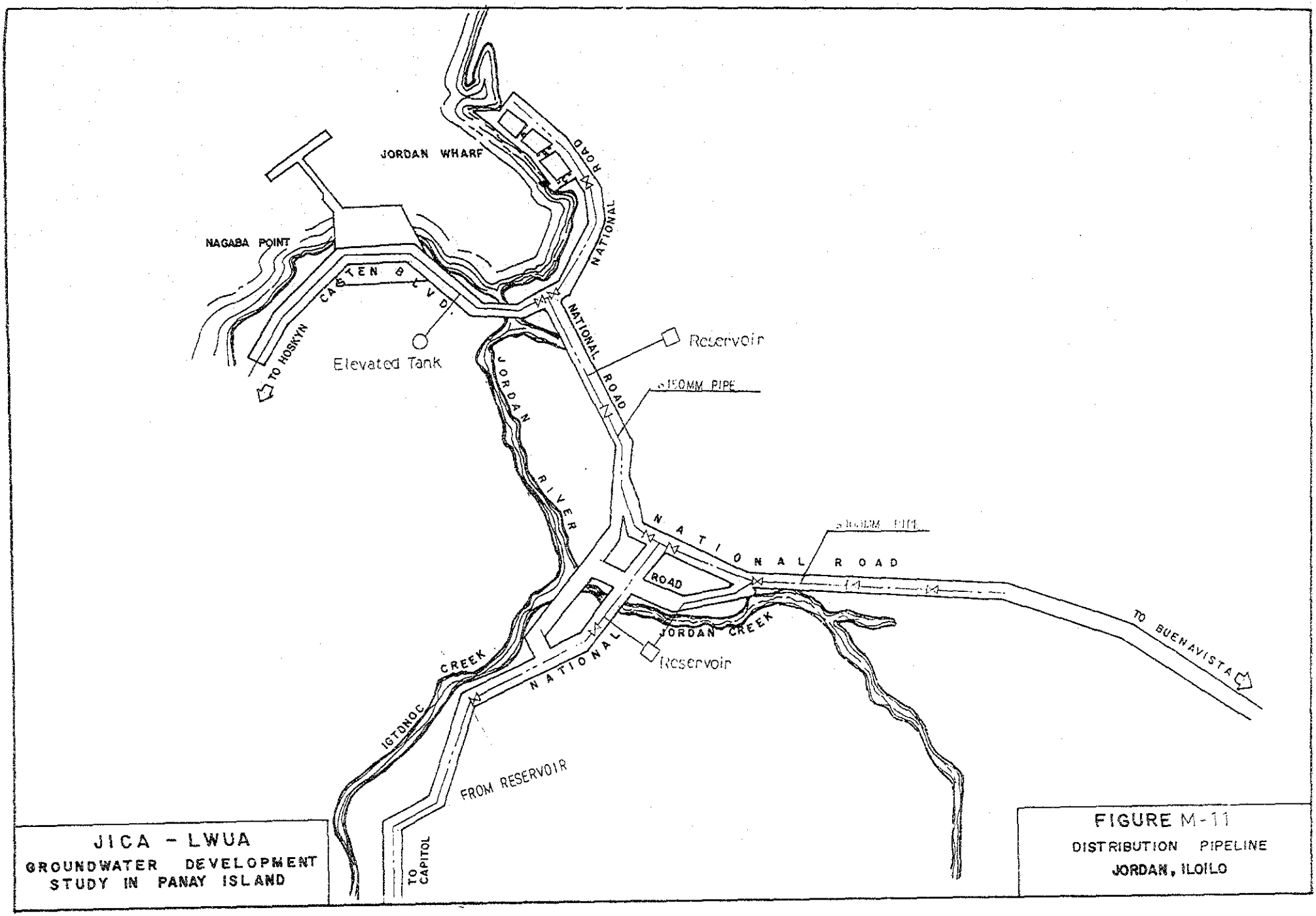

M-2 SPRING
TRANSMISSION PIPE (NEW)
Ø 100 mm, ℓ=1,500 m
INTAKE BOX (NEW)
M-5 SPRING
TRANSMISSION PIPE (NEW)
Ø150 mm, ℓ=2,000 m
DISTRIBUTION LINE (NEW)
FOR POBLACION AREA
INTAKE BOX
(RECONSTRUCTION)
JUNCTION BOX
W 3.0 m x L 5.0 m x H 3.5 m
TRANSMISSION PIPE (NEW)
Ø 100 mm, ℓ=500 m
RESERVOIR (NEW)
W 6.0 m x L 6.0 m x H 3.0 m
∇ = 108 cu. m
EL + 30 m
TO RIZAL RESERVOIR
DISTRIBUTION LINE (NEW)
BIRI SPRING
INTAKE DAM (NEW)
W 15.0 m x H 2.0 m
TRANSMISSION PIPE (NEW)
Ø 100mm, ℓ=1,000 m
INTAKE PIPE (NEW)
Ø300mm, ℓ= 25 m
JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND
FIGURE M-8
FLOW DIAGRAM
JORDAN, ILOILO


BARANG SPRING
INTAKE BOX (RECONSTRUCTION)
SAND FILTER (NEW)
TRANSMISSION PIPE (NEW)
Ø100mm, ℓ = 1,000 m
PUMPING STATION (NEW)
EXISTING TEODORO DEEP WELL
TRANSMISSION PIPE (NEW)
Ø100 mm, ℓ = 1000m
RESERVOIR (NEW)
W 5.0m x L 5.0m x H 13.0m
V = 75m³ EL +20.0m
DISTRIBUTION PIPE (NEW)
ELEVATED TANK (NEW)
V = 25 m³
INTAKE PUMP (NEW)
Ø 50x0.15m³/min x 60m x 3.7 KW
TRANSMISSION PIPE (NEW)
FROM POBLACION
AGUILAY SPRING
INTAKE BOX
(RECONSTRUCTION)
TRANSMISSION PIPE (NEW)
Ø100 mm, ℓ = 200 m
CUEVA SPRING
INTAKE BOX
(RECONSTRUCTION)
TRANSMISSION PIPE (NEW)
Ø100mm ℓ= 1,000m
PUMP STATION (NEW)
Ø40x0.1m³/min x30m x 2.2 KW
JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND
FIGURE M-9
FLOW DIAGRAM
JORDAN, ILOILO



JICA - LWUA
GROUNDWATER DEVELOPMENT
STUDY IN PANAY ISLAND

FIGURE M-10
FLOW DIAGRAM
JORDAN, ILOILO



JICA - LWUA
GROUNDWATER DEVELOPMENT STUDY IN PANAY ISLAND

FIGURE M-11
DISTRIBUTION PIPELINE
JORDAN, ILOILO

- Teodoro Deep Well

  Pump: ø 50 x 0.15 cu.m/min x 60.0 mH x 3.7 kW, 1 unit
  Elevated tank : RC, W 3.0 m x B 3.0 m x H 3.0 m

- Biri Spring

  Intake dam: W 15.0 m x H 2.0 m
  Intake pipe: ø 300 mm pipe, 25 m

- M-2 Spring

  Intake weir
  Intake box

- M-5 Spring

  Intake box

- Aguilay Spring

  Intake box
  Pump facility

- Ipil Spring

  Intake box
  Pump facility
  Elevated tank

- Cabadjaangan Spring

  Pump facility
  Elevated tank : V= 30 cu.m

- Spring behind the hotel at Hoskyn

  Intake box

(2) Transmission Facility

Following items will be constructed.

- Transmission mains
  ø 100 mm, 6,200 m
  ø 150 mm, 2,000 m

- Junction box
  W 3.0 m x L 5.0 m x H 3.5 m

(3) Distribution Facility

Reservoir
  Poblacion Area (108 cu.m)
  Rizar Area (75 cu.m)
Elevated Tank
  Hoskyn Area-1 (18 cu.m)
  Hoskyn Area-2 (30 cu.m)

Distribution pipe will be installed as follows.

ø 150 mm pipe, l= 3,450 m
ø 100 mm pipe, l= 1,750 m

3.3 Rough Cost Estimate of Major Water Supply Facilities

3.3.1 Unit Construction Cost

Unit construction cost of required facilities is based on the "In-Place Cost of Waterworks Materials" (as of January 1989) of LWUA. Any unit cost not shown in this list is referred to "Unit Price Manual - Water Supply Feasibility Studies" (July 1983) upon consideration of price escalation that 15% per annum upto 1987 and 7% per annum from 1987 as adopted by LWUA.

All construction costs are estimated in Philippine Pesos and the total cost is only converted into U.S. Dollars and Japanese Yen based on the following exchange rate as of September 1989.

U.S. $1.00 = Yen 145.70 = Peso 20.78

Unit costs used in rough cost estimate are attached in Appendix-5.

3.3.2 Rough Cost Estimate

Facility	Cost (Thousand Peso)
Water Source	
Barang Spring:	
Intake box (6.5 cu.m)	11.0
Sand filter (6.5 m x 6.5 m x 2.5 m)	203.9
Pump (0.2 cu.m/min x 40.0 mH, 1 unit)	400.0
Teodoro Deep Well:	
Pump (0.15 cu.m/min x 60.0 mH)	400.0
Elevated tank (27 cu.m)	208.8

Facility	Cost (Thousand Peso)
Biri Spring:	
Intake dam (1.5 m x 2.0 m)	101.4
Intake pipe (ø 300 mm, 25 m)	28.0
M-2 Spring:	
Intake weir	10.0
Intake box (6.5 cu.m)	11.0
M-5 Spring	
Intake box (6.5 cu.m)	11.0
Aguilay Spring	
Intake box (6.5 cu.m)	11.0
Pump (0.1 cu.m/min x 10.0 mH)	300.0
Ipil Spring	
Intake box (6.5 cu.m)	11.0
Pump (0.06 cu.m/min x 20.0 mH)	150.0
Elevated tank (18 cu.m)	139.2
Cabadjangan Spring	
Pump (0.1 cu.m/min x 20.0 mH)	300.0
Elevated tank	232.0
Spring behind the hotel at Hoskyn	
Intake box (0.5 cu.m)	11.0
Transmission Facility	
Transmission line	
(ø 100 mm, 6,200 m)	3,100.0
(ø 150 mm, 3,500 m)	2,205.0
Junction box (52.5 cu.m)	130.3
Distribution Facility	
Reservoir	
Poblacion Area (108 cu.m)	835.2
Rizar Area (75 cu.m)	580.0
Elevated tank	
Hoskyn Area-1 (18 cu.m)	139.0
Hoskyn Area-2 (30 cu.m)	232.0
Distribution Line	
(ø 100 mm pipe, 1,750 m)	472.5
(ø 150 mm pipe, 3,450 m)	1,863.0
(ø 100 mm valve, 6 pcs.)	27.0
(ø 150 mm valve, 12 pcs.)	68.4
Total	12,191.7

Total construction cost for improvement of major water supply facilities is estimated at approximately 11.2 million Pesos (78.9 million Yen or 0.54 million U.S. Dollar).

APPENDICES

APPENDIX-1

ACRONYMS AND ABBREVIATIONS

ORGANIZATIONS

AKELCO	:	Aklan Electric Cooperative, Inc.
BCGS	:	Bureau of Coast and Geodetic Survey
BMGS	:	Bureau of Mines and Geo-Science
BPW	:	Bureau of Public Works (now DPWH)
BWP	:	Barangay Water Program
CAA	:	Civil Aeronautics Administration
CAPELCO	:	Capiz Electric Cooperative, Inc.
DECS	:	Department of Education, Culture and Sports
DELMES	:	Don Eugenio Ladrido Memorial Elementary School Lambunao, Iloilo
DENR	:	Department of Environment and Natural Resources
DEO	:	District Engineer's Office, DPWH
DPWH	:	Department of Public Works and Highways
DOH	:	Department of Health
GOJ	:	Government of Japan
GOP	:	Govenment of the Republic of the Philippines
GUIMELCO	:	Guimaras Island Electric Cooperative, Inc.
ILELCO	:	Iloilo Electric Cooperative, Inc.
IWA	:	Ibajay Waterworks Association
JICA	:	Japan International Cooperation Agency
JWD	:	Jordan Water Distict
KWD	:	Kalibo Water District
LIST	:	Lambunao Institute of Science and Technology
LWUA	:	Local Water Utilities Administration
MIWD	:	Metro Iloilo Water District
MHS	:	Municipal High School
MNR	:	Ministry of Natural Resources
NACIAD	:	National Council on Integrated Area Development
NAWASA	:	National Waterworks and Sewerage Authority (now MWSS and LWUA)
NCSO	:	National Census and Statistics Office
NEDA	:	National Economic and Development Authority
NHA	:	National Housing Authority
NIA	:	National Irrigation Administration

NPC	:	National Power Corporation
NWRC	:	National Water Resources Council
PHO	:	Provincial Health Office
PSPC	:	Panay State Polytechnic College
PWD	:	Pilar Water District
RCWD	:	Roxas City Water District
RHU	:	Rural Health Unit
RWDC	:	Rural Waterworks Development Corporation
RWSA	:	Rural Waterworks and Sanitation Association
SEAFDEC	:	South-East Asian Fisheries Development Center
SIPC	:	Southern Iloilo Polytechnic College
UPV	:	The University of the Philippines in Visayas
USAID	:	United States Agency for International Development

TECHNICAL TERMS

MAMSL, mamsl	:	Meter Above Mean Sea Level
GI	:	Galvanized iron (pipe)
MBGL, mbgl	:	Meter Below Ground Level
PNSDW	:	Philippine National Standard for Drinking Water
PVC	:	Polyvynil chloride (pipe)

UNITS

cm	:	centimeter
cm/sec	:	centimeter per second
cu.m	:	cubic meter
cu.m/day	:	cubic meter per day
cu.m/month	:	cubic meter per month
FTU	:	formazin turbidity unit
ha	:	hectare
hr	:	hour
km	:	kilometer
kw	:	kilo watt
KWH	:	kilo watt hour
l/day or liter/day	:	liter per day

l/min or liter/min	:	liter per minute
l/sec or liter/sec	:	liter per second
lps	:	liter per second
lpcd	:	liter per capita per day
mH	:	meter in Height
µS/cm	:	micro siemens per centimeter
mm	:	millimeter
m	:	meter
m/second	:	meter per second
mm/year	:	millimeter per year
ohm-m	:	ohm meter
sq.cm.sec	:	square centimer per second
sq.km	:	square kilometer
sq.m	:	square meter

APPENDIX-2

LIST OF OFFICIALS AND PERSONS CONCERNED

LOCAL WATER UTILITIES ADMINISTRATIONS (LWUA)

Ricardo T. Quebral	:	Administrator
Porthos P. Alma Jose	:	Ex-Administrator
Vitaliano J. de la Vega	:	Deputy Administrator, Engineering Services
Alfredo B. Espino	:	Manager, Project Management Office
Jesus R. Gomez	:	Manager, Planning Department
Eriberto R. Calubaquib	:	Manager, Water Resources Division, Planning Department
Gerry Sullano	:	Manager, Project Identification Division, Planning Department
Roberto B. Binag	:	Manager, Water Systems Development Division, Planning Department
Salvador C. Ner	:	Prof. Engr. D, Water Resources Division, Planning Department
Cezar P. Cruzado	:	Hydrogeologist, Water Resources Division, Planning Department
Renito Navarro	:	Water Resources Division, Planning Department
Aristotle Doctor	:	Water Resources Division, Planning Department
Armando T. Fernandez	:	Manager, Construction Department
Edwin T. Ruiz	:	Manager, Wells Construction Division, Construction Department
Rolando A. Grospe	:	Asst. Manager, Wells Construction Division, Construction Department
Isagani S. Capalad	:	Prof. Engr. D, Wells Construction Division, Construction Department
Ver Bombeta	:	Drilling Engineer, Wells Construction Division, Construction Department
Franco C. Bula, Jr.	:	WDPO-D, Water District Formation Division, Regulatory Services
Vina Sebastian	:	Water District Formation Division, Regulatory Services

NATIONAL IRRIGATION ADMINISTRATION (NIA)

Domingo B. Dato-on	:	Manager, Operation Division, Regional Office, Iloilo
Sergio Agting	:	Senior Engr. B, Planning Section, Regional Office, Iloilo

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS (DPWH)

Flomina Tupaz	:	District Engr., 1st DEO, Iloilo
Rodolfo Canastillo	:	Asst. District Engr., 1st DEO, Iloilo
Emilio Rosada	:	Well Drilling Supervisor, 1st DEO Iloilo
Rodolfo Pollentes	:	District Engr., DEO, Guimaras
Modesto D. Intoy	:	District Engr., DEO, Aklan
Criselda R. Roldan	:	Civil Engr., DEO, Aklan

MALAY, AKLAN

Hon. Regelio Aguirre	:	Municipal Mayor
Sergio S. Prado	:	Vice Mayor

IBAJAY, AKLAN

Hon. Joeben Miraflores	:	Municipal Mayor
Josue Albar Siñel	:	President, Ibajay RWSA
Jesus P. Venus	:	System Superintendent

NEW WASHINGTON, AKLAN

Hon. Eriberto Venus	:	Municipal Mayor
Dodgie Pastrana	:	General Manager, New Washington Water District

KALIBO, AKLAN

Hon. Allen S. Quimpo	:	Municipal Mayor
Robert L. Cheng	:	Chairman, Board of Directors, Kalibo Water District
Avelino M. Domingo, Jr.	:	General Manager, Kalibo Water District

BANGA, AKLAN

Hon. Segrio T. Rigodon	:	Municipal Mayor

IVISAN, CAPIZ

Hon. Mely Yap	:	Municipal Mayor
Renato Quiachon Villareal	:	Vice Mayor
Romualdo U. Diestre	:	Municipal Treasurer

PONTEVEDRA, CAPIZ

Hon. Jose Avelino III	:	Municipal Mayor
Raguel Olandia	:	Planning and Development Coordinator
Manuel T. Icang	:	Member, Board of Directors, Pontevedra Water District

PILAR, CAPIZ

Hon. Porfirist Perez	:	Municipal Mayor
Roberto C. Alba	:	General Manager, Pilar Water District
Remo J. Benliro	:	Member, Sangunian Bayan

ROXAS CITY, CAPIZ

Hon. Juliano A. Alba	:	City Mayor
Ardisli A. Ambrosio	:	Asst. City Engr., CEO
Alberto Pestano	:	General Manager, Roxas City Water District

SARA, ILOILO

Hon, Neptali S. Salcedo	:	Municipal Mayor
Elmo S. Escrupulo	:	Manager, Municipal Waterworks

LAMBUNAO, ILOILO

Hon. Vicente L. Ramirez	:	Municipal Mayor
Hon. Raul Roncesvalles	:	Member, Sangguniang Bayan
Wilfredo G. Pilla	:	Municipal Planning and Development Coordinator

LEON, ILOILO

Hon. Ludovico C. Cabado	:	Municipal Mayor
Florencio C. Sajo, Jr.	:	Municipal Secretary
Salvador Villan	:	Municipal Planning and Development Coordinator
Brenda G. De Guzman	:	Personnel Officer Designate
Lorna C. Cadiz	:	Statistician, Office of the Mayor

MIAGAO, ILOILO

Hon. Erlinda N. Britanico	:	Municipal Mayor
Hon. Alfredo Monsale	:	Member, Sangguniang Bayan
Rafael Fabilo	:	Municipal Planning and Development Coordinator

JORDAN, SUB-PROVINCE GUIMARAS, ILOILO

Hon. Leo T. Espinosa	:	Municipal Mayor
Cresente Chavez	:	Ex-Mayor
Remy G. Tamson	:	General Manager, Jordan Water District
Glicerio Gaylan	:	Land Owner, Ipil Spring, Hoskyn

CONGRESSMAN

Hon. Alberto J. Lopez	:	Congressman, 2nd District, Province of Iloilo
Gerry B. Yucon	:	Secretary to Congressman Lopez

PROVINCIAL GOVERNMENT OF ILOILO

Augustus T. Bacabac	:	Secretary to the Governor
Alfredo de Guzman	:	Provincial Planning and Development Coordinator

SUB-PROVINCE OF GUIMARAS

Dr. Catalino Nava	:	Governor
Dr. Alfledo S. Javier	:	Guimaras Hospital
Dr. Gregorio Sancho	:	Asst. Provincial Health Officer, Guimaras Hospital

ILOILO CITY, ILOILO

Moises G. Molen, Jr.	:	General Manager, MIWD
Ernesto J. Caberoy	:	Personnel Officer, MIWD

OTHERS

Gerardo S. Solas	:	Superintendent, Southern Iloilo Polytechnic College, Miagao, Iloilo
Satoru Fukumoto	:	Asst. Manager, Aquaculture Dept., SEAFDEC, Iloilo
Dr. Yoshifumi Yashiro	:	Aquaculture Expert, SEAFDEC

APPENDIX-3 UNIT CONSTRUCTION COST

TABLE-1 Unit Construction Costs

Materials	Unit	In-Place Cost
Pipeline		
for 150 psi		
400 mm (steel)	LM	2,040
350 mm (steel)	LM	1,910
300 mm (steel)	LM	1,120
250 mm (steel)	LM	930
200 mm (steel)	LM	750
150 mm (PVC)	LM	630
100 mm (PVC)	LM	500
for 100 psi		
200 mm (steel)	LM	630
150 mm (PVC)	LM	540
100 mm (PVC)	LM	270
Butterfly Valve		
400 mm	pc.	60,000
350 mm	pc.	49,000
Gate Valve		
300 mm	pc.	15,000
250 mm	pc.	11,000
200 mm	pc.	8,500
150 mm	pc.	5,700
100 mm	pc.	4,500
Reservoirs		
Steel, Elevated	cu.m	5,500
Concrete, Elevated	cu.m	5,800
Concrete, Ground	cu.m	1,930

TABLE-2 Deep Well Construction Cost (Thousand Pesos)

Depth (m)	Casing Size (mm)		
	200	250	300
40	234	306	359
60	413	503	593
80	413	521	629
100	485	629	755
120	557	719	881
140	629	809	989
160	701	899	1,095
180	773	989	1,222
200	845	1,078	1,330

TABLE-3 Deep Well Pump Stations Costs (Thousand Pesos)

kW	Electric Motor Drive	Diesel Engine Drive
7	519	596
15	635	750
22	731	866
29	827	981
37	904	1,096
44	962	1,173
51	1,019	1,250

TABLE-4 Booster Pump Station

$C = (42.6 - 8.08 \log Q) \times H^{0.305} (\log Q - 0.7)^{(6/H-0.25)}$

where, C : Cost (thousand Pesos)
Q : Design Capacity (lps)
H : Total Dynamic Head (m)

TABLE-5 Gas Chlorinator

Water Flow Condition	Max. Chlorine Dosage (kg/day)	Unit Cost (Peso)
Constant	22	112,300
Constant	45	136,400
Variable	22	169,100
Variable	45	193,800

TABLE-6 Earth/Concrete Work

Item	Unit	Unit Cost (Peso)
Earthwork		
Rock Excavation	cu.m	170
Common Excavation	cu.m	70
Concrete Work		
Concrete 4,000 psi	cu.m	1,690
Concrete 3,000 psi	cu.m	1,380

APPENDIX 4

IMPLEMENTING ARRANGEMENT ON THE TECHNICAL COOPERATION FOR THE GROUNDWATER DEVELOPMENT STUDY IN PANAY ISLAND IN THE REPUBLIC OF THE PHILIPPINES

AGREED UPON BETWEEN

THE JAPAN INTERNATIONAL COOPERATION AGENCY

AND

THE LOCAL WATER UTILITIES ADMINISTRATION

Manila, December 9, 1987

Forthes P. Alma Jose
Administrator
Local Water Utilities
Administration

山下 生比古

Ikuhiko Yamashita
Leader, Japanese
Preliminary Survey Team
The Japan International
Cooperation Agency

I. INTRODUCTION

In response to the request of the Government of the Republic of the Philippines (hereinafter referred to as "GOP"), the Government of Japan (hereinafter referred to as "GOJ") has decided to conduct the Groundwater Development Study in Panay Island in the Republic of the Philippines (hereinafter referred to as "the Study") and exchanged the Notes Verbales with the GOP concerning the implementation of the Study.

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of GOJ, will undertake the Study in accordance with the relevant laws and regulations enforced in Japan. On the part of GOP, Local Water Utilities Administration (hereinafter referred to as "LWUA") shall act as the counterpart agency to the Japanese Study team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study. The present document constitutes the implementing arrangement between JICA and LWUA under the above mentioned Notes Verbales exchanged between the two governments.

II. OBJECTIVES OF THE STUDY

1. To evaluate the groundwater development potential for municipal water supply in Panay Island

2. To transfer technology to the Philippine counterpart personnel in the course of the Study.

III. THE STUDY AREA

The Study area will cover thirteen (13) municipalities in three (3) provinces of Panay Island. Four (4) municipalities will be selected for test well drilling and related investigation.

IV. SCOPE OF THE STUDY

Scope of the Study will include the following:

1. data collection and review
   - 1.1 socio-economy
   - 1.2 land use
   - 1.3 development plans
   - 1.4 physical conditions
     - a. topography
     - b. hydrology and meteorology
     - c. geology and hydrogeology

1.5 water supply and demand
1.6 water supply facilities
1.7 previous studies on groundwater

2. field survey
   2.1 reconnaisance
      a. topography
      b. hydrology and meteorology
      c. geology and hydrogeology
      d. existing water supply facilities
   2.2 electrical sounding
   2.3 water quality analysis for existing wells
   2.4 well inventory and groundwater level observation
   2.5 discharge measurement of surface water

3. analysis and evaluation of groundwater and recommendations
   3.1 hydrogeological analyis
   3.2 oroundwater development potential
   3.3 water demand forecast
   3.4 recommendations

4. test well drilling and related investigation for selected municipalities
   4.1 preparation of implementation program
   4.2 execution of observation holes
   4.3 execution of test well construction
   4.4 observation and analysis
      a. geological loggings
      b. pumping tests
      c. water quality analysis
      d. analysis of test wells

5. groundwater supply system
   5.1 conceptual water supply system
   5.2 rough cost estimate of the system

V. STUDY SCHEDULE

The Study will be conducted in accordance with the tentative schedule attached in ANNEX I.

VI. REPORTS

JICA will prepare and submit the following reports to LWUA in English.

1. Inception Report (10 copies)
   At the beginning of the field survey

2. Progress Report (10 copies)
   At the middle of the field survey

3. Interim Report (10 copies)
   At the end of the field survey

   LWUA will submit to JICA its comments within one month after the receipt of Interim Report

4. Draft Final Report (10 copies)

   LWUA will provide JICA its comments within one month after receipt of the Draft Final Report

5. Final Report (30 copies)

   Within two months after receipt of the comments on the Draft Final Report by LWUA.

VII. UNDERTAKING OF GOP

In accordance with the Notes Verbales exchanged between the GOJ and GOP, GOP shall accord privileges, immunities and other benefits to the Japanese Study Team and, through the authorities concerned, take necessary measures to facilitate smooth conduct of the study.

1. (1) GOP shall be responsible for dealing with claims which may be brought by the third parties against the members of the Japanese Study team and shall hold them harmless in respect of claims or liabilities arising in the course of or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims or liabilities arising from the gross negligence or willful misconduct of the above mentioned members.

   (2) GOP shall secure the safety of the Study team during the implementation of the Study.

2. LWUA shall at its own expense, provide the Study team with the following, in cooperation with other agencies concerned:

   (1) Available data and information related to the Study shown in IV.1

   (2) Counterpart personnel

   (3) Administrative and technical support staff

(4) Suitable office space in Manila including appropriate furnishings and sub-offices in Panay Island

(5) Credentials or identification cards to the members of the Study team

(6) Two service vehicles with drivers for entire duration of the Study

3. LWUA shall make necessary arrangements with other governmental and non-governmental organizations concerned for the following:

(1) To secure the safety of the members of the Japanese Study team

(2) To secure permit for the members of the Japanese Study team to enter, leave and sojourn in the Philippines for the duration of their assignments therein

(3) To exempt the members of the Japanese Study team from taxes, duties, fees and other charges on equipment, machinery and other materials brought into the Philippines for the conduct of the Study

(4) To exempt the members of the Japanese Study team from income tax and charges of any kind imposed on or in connection with any emolument or allowance paid to the members of the Japanese Study team for their services in connection with the implementation of the Study

(5) To provide the necessary facilities to the Japanese Study team for remittance as well as utilization of the funds introduced into the Philippines from Japan in connection with the implementation of the Study

(6) To secure permission for entry into private properties or other areas for the conduct of the Study

(7) To secure permission to take all data and documents related to the Study out of the Philippines to Japan by the Study team

(8) To provide medical services as needed and the expenses will be borne by the members of the Japanese Study team.

VIII. UNDERTAKING OF GOJ

In accordance with the Notes Verbales exchanged between GOJ and GOP, GOJ through JICA, shall take necessary measures for the implementation of the Study.

1. To dispatch, at its own expense, Study team to the Republic of the Philippines

2. To pursue technology transfer to the Philippine counterpart personnel in the course of the Study

IX. CONSULTATION

JICA and LWUA shall consult with each other in respect of any matter that may arise in the interpretation or implementation of this arrangement.

ANNEX I

TENTATIVE SCHEDULE