14. フィージビリティスタディ その2

14.1 はじめに

ここでは、本編の冒頭で述べたように、第一期と第二期を合わせたプロジェクトのフィージビリティを検討する。

14.2 水道計画

本編で述べてきたように目標年次（１９９３年）における給水区域は2,１００ha、給水人口は５５,０３０人、日最大水需要量は１３,２３０m³/日である。

水道計画の概要については図3.１4.１と図3.１4.２に、計画施設は表3.１4.１に示した。また図3.１4.３に建設計画、表3.１4.２に概算事業費、図3.１4.３に投資計画を示す。

14.3 財政評価

14.3.1 財源および借入金利

本スタディでは、ＬＷＵＡの指示に従い投資額の２０％を政府補助とし、８０％を政府ローンとする条件を用いる。年毎の投資額及び返済額を表３に示す。この検討は、政府機関であるＬＷＵＡが国内、国外からの資金を得て、水道区がＬＷＵＡから資金を得られるという前提で進める。

また、年利は９％で、６年間（建設期間）は元金据置で返済期限は据置期間を含めて３０年間である。事業費の５６.９％が外貨分で、残りは内貨分となっている。外貨については、フィリピン政府はＯＥＣＦ、世界銀行、アジア開発銀行などの融資機関に借款を求めることになろう。

14.3.2 分析結果

前述の仮定、条件に基づいた財政分析の結果、第一期と第二期を合わせたプロジェクトは財政面でフィージブルであることがわかった。

なお、本件では政府補助金２０％という条件で計算を行った。補助金率を一段階下げて１５％とした場合の財政分析結果は累積残高 — Cumulative Net Income — が赤字になる年が発生し、フィージビリティは成立しない。 — 本編末尾分析資料参照。

14.3.3 水道料金

収入計算において家事用水道料金は、水道区の平均世帯収入の５％以下で設定した。

14.4 事業便益の計測

14.4.1 給水人口、給水区域の増加

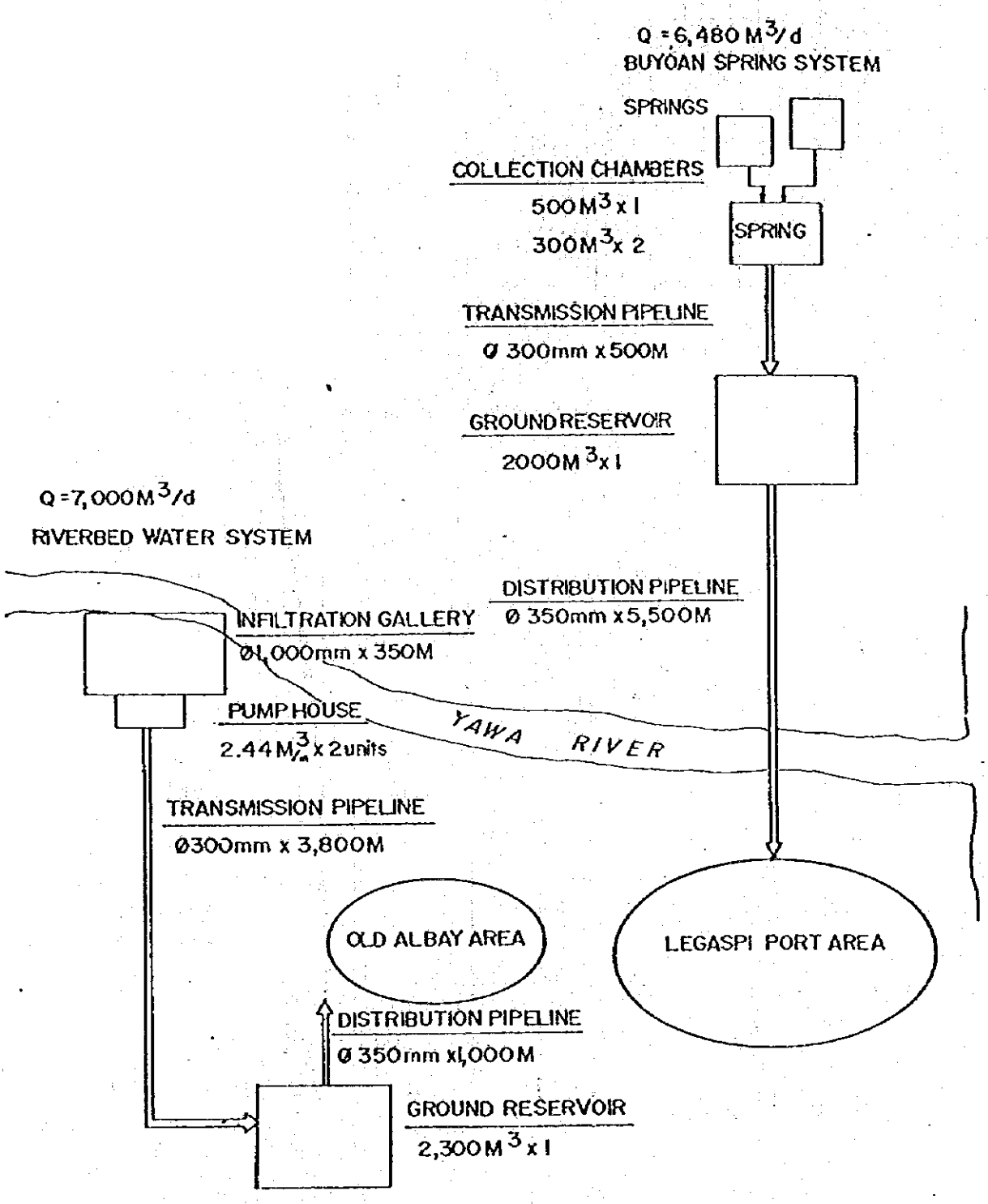
目標年次の給水人口は５５,０３０人で現在に較べて１９５％の増である。

給水区域は現在７９０haで目標年次に2,１００haに増加する。

14.4.2 内部収益率

内部収益率（ＩＥＲＲ）を計算した結果、以下に示すように本プロジェクトは経済的に妥当である。

1) 換算係数を用いない場合：１６％
2) 換算ケースＡの場合　　：１５％
3) 換算ケースＢの場合　　：１８％
4) 換算ケースＣの場合　　：１４％



水道計画概念図（第一期＋第二期）

Fig 3.14.1 Proposed Water Supply System

(Target Year : 1993)

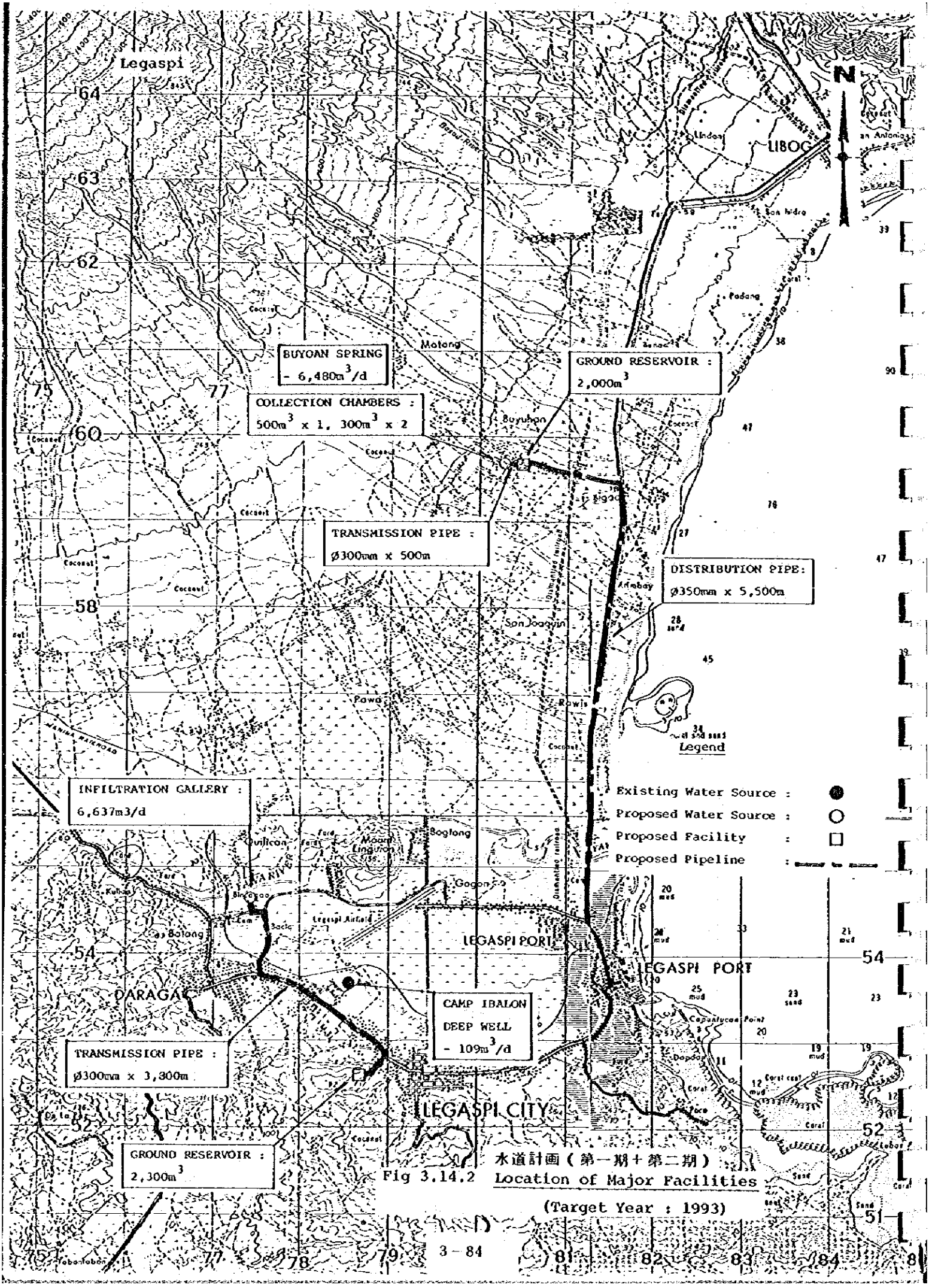


Fig 3.14.2 水道計画（第一期＋第二期）
Location of Major Facilities
(Target Year : 1993)

計画施設一覧（第一期＋第二期）

Table 3.14.1 Facilities required

(Target Year : 1993)

1) Buyoan Spring System (6,480 m^3/day)

a. Construction of Collection Chamber:
Made of reinforced concrete
Capacity and Number: 500 m^3 x 1 unit; and
300 m^3 x 2 units

b. Installation of Transmission Pipeline:
(From the Buyoan Spring (Collection Chamber) to the ground reservoir)
Diameter and Length : ϕ 300 mm x 500 m

c. Construction of Ground Reservoir:
Made of reinforced concrete
Capacity: 2,000 m^3
Number of basin: 1 basin

d. Installation of Distribution Pipeline:
(From the reservoir to the entrance of Legaspi Port)
Diameter and length : ϕ350 mm x 5,500 m

2) Riverbed Water System on the Yawa River (7,000 m^3/day)

a. Construction of Infiltration Gallery:
Material : Reinforced concrete pipe
Diameter and Length : ϕ 1,000 mm x 350 m

b. Intake Pump and Pump House:
Type of pump : Turbine pump
Capacity : 2.44 m^3/min x 60 m x 55 kw
Number of units: 2 units

c. Installation of Transmission Pipeline:
(From the infiltration gallery to the ground reservoir)
Diameter and Length: ϕ300 mm x 3,300 m

d. Construction of Ground Reservoir:
Made of reinforced concrete
Capacity: 2,300 m^3
Number of basin: 1 basin

e. Installation of Distribution Pipeline:
(From the reservoir to the entrance of Old Albay)
Diameter and Length: ϕ350 mm x 1,000 m

- to be continued-

3) Reinforcement and Expansion of Distribution Pipelines:

a. ϕ300 mm x 1,500 m
b. ϕ200 mm x 700 m
c. ϕ150 mm x 1,530 m
d. ϕ100 mm x 3,420 m
e. ϕ 75 mm x 14,300 m
f. ϕ 50 mm x 8,280 m

4) Other Equipment

a. Service Meter:
ϕ 13 mm x 10,200 pieces

b. Bulk Meter:
ϕ350 mm x 2 pieces
ϕ300 mm x 2 pieces
ϕ100 mm x 1 piece

c. Valve:
72 pieces (ϕ300 mm - ϕ 75 mm)

d. Fire Hydrant:
80 pieces

e. Chlorinator:
2 sets

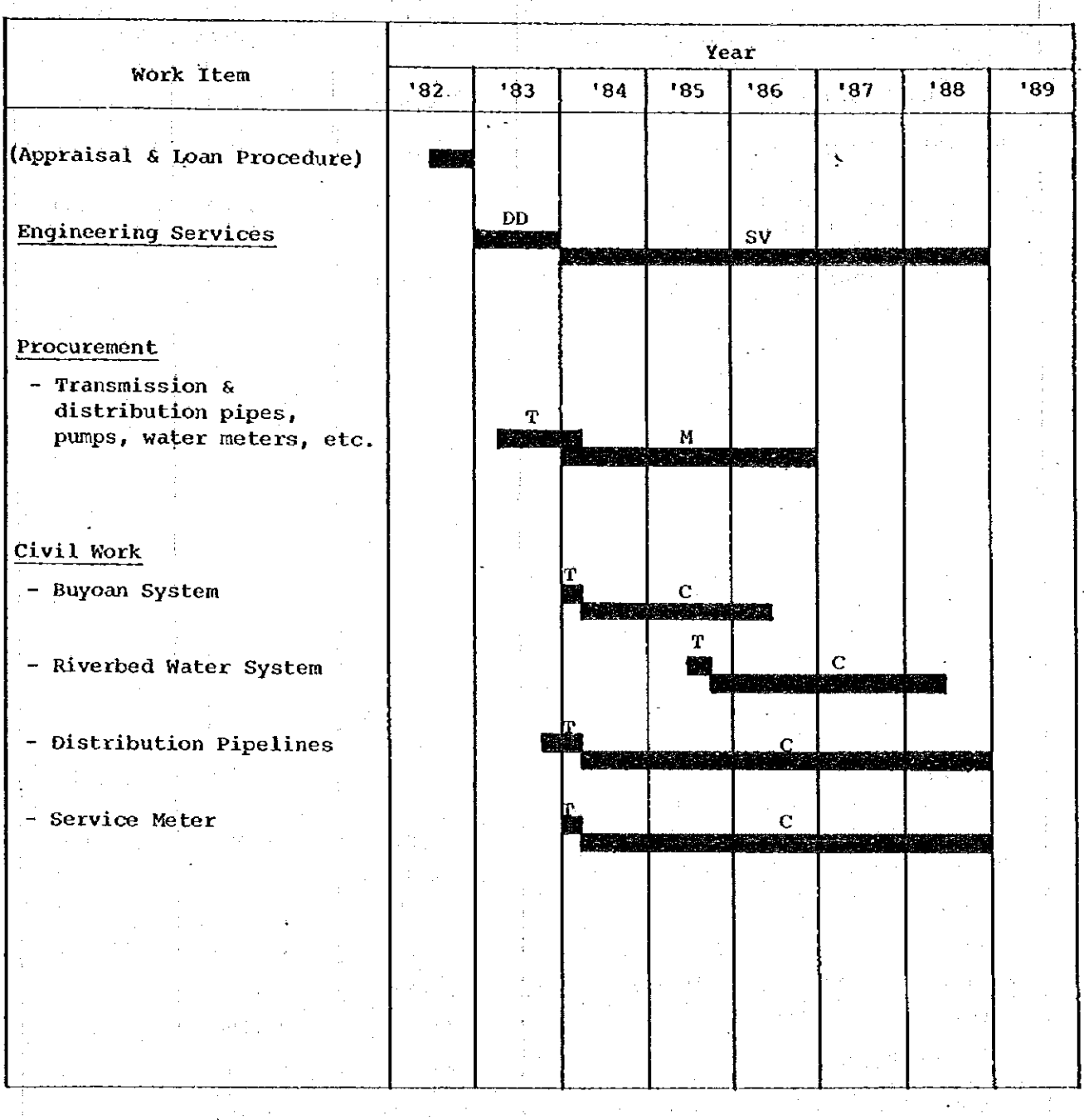
f. Vehicle:
3 units

Legaspi
(I + II)

実施工程（第一期＋第二期）

Fig 3.14.3 Construction Schedule

(Target Year : 1993)



Note: DD = Detailed Design
SV = Supervision of Construction
T = Tendering Procedure (Advertisement/Tendering/Evaluation/Award)
M = Manufacturing & Shipping
C = Construction/Installation

事業費（第一期＋第二期）

Legaspi Table 3.14.2 Project Cost (Target Year : 1993) (I+II)

Note: - Unit = One Thousand Pesos = '000 Pesos
- Prices as of 1st July 1981
- Foreign Exchange Rate: US $ 1.00 = Peso 7.80

Work Items	Cost		
	Total Cost	Foreign Currency Component	Local Currency Component
A. Buyoan System	8,413	4,133	4,280
B. Riverbed Water System	9,670	4,903	4,767
C. Reinforcement/Expansion of Distribution Pipelines	4,663	3,124	1,539
D. Other Equipment	7,880	5,939	1,941
Sub Total	30,626	18,099	12,527
Detailed Design Cost (10.5%)	3,216	1,901	1,315
Supervision Cost (3.5 %)	1,072	634	438
Land Cost	143	-	143
Total	35,057	20,634	14,423
Physical Contingency (10 %)	3,506	2,064	1,442
Total	38,563	22,698	15,865
Price Contingency	28,839	15,659	13,180
Grand Total (Project Cost)	67,402	38,357	29,045
	(Equivalent to US$8.64 M)	(Equivalent to US$4.92 M)	(Equivalent to US$3.72 M)

年度別投資計画（第一期＋第二期）

Table 3.14.3 Disbursement Schedule

(Target Year : 1993)

NOTE:
- F/C = Foreign Currency Component
- L/C = Local Currency Component
- Unit: One Thousand Pesos = '000 Pesos
- Prices: As of 1st July 1981
- Foreign Exchange Rate: US$1.00 = Pesos 7.80

(Thousand Pesos)

Description	Cost			Yearly Disbursement											
	Total Cost	Breakdown		1983		1984		1985		1986		1987		1988	
		F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
A. Buyoan System															
a) Collection Chamber (500 m³ x 1, 300 m³ x 2)	1,780	445	1,335			445	1,335								
b) Transmission (ø300 mm x 500 m)	488	327	161			327	161								
c) Ground Reservoir (2,000 m³ x 1)	1,800	450	1,350					225	675	225	675				
d) Distribution (ø350 mm x 5,500 m)	4,345	2,911	1,434			1,941	717	970	717						
B. Riverbed Water System															
a) Infiltration Gallery (ø1,000 mm x 350 m)	1,400	350	1,050							175	525	175	525		
b) Pump House (2.44 m³/min x 60 m x 2)	1,700	1,020	680							816	340	204	340		
c) Transmission (ø300 mm x 3,800 m)	3,710	2,486	1,224					622	244	1,864	490		490		
d) Ground Reservoir (2,300 m³ x 1)	2,070	518	1,552									173	552	345	1,000
e) Distribution (ø350 mm x 1,000 m)	790	529	261							529	130		131		
C. Reinforcement/Expansion of Distribution															
a) ø300 mm x 1,500 m	975	653	322			400	193			253			129		
b) ø200 mm x 700 m	273	183	90			183	90								
c) ø150 mm x 1,530 m	421	282	139			141	70			141	69				
d) ø100 mm x 3,420 m	616	413	203			68	34	139	70	206	34		65		
e) ø 75 mm x 14,300 m	1,716	1,150	566			230	113	230	113	690	113		113		114
f) ø 50 mm x 8,280 m	662	443	219			89	44	89	44	265	44		44		43

(to be continued)

NOTE: - F/C = Foreign Currency Component
- F/C = Local Currency Component
- Unit: One Thousand Pesos = '000 Pesos
- Prices: As of 1st July 1981
- Foreign Exchange Rate: US$1.00 = Pesos 7.80

NOTE: Price Escalation Rate (Price Contingency)
Present - 1984: 15% Annual both for F/C and L/C
1985 - 1989: 12% Annual both for F/C and L/C
1990 - : 10% Annual both for F/C and L/C

(Thousand Pesos)

Description	Cost			Yearly Disbursement											
	Total Cost	Breakdown		1983		1984		1985		1986		1987		1988	
		F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C	F/C	L/C
D. Other Equipment															
a) Service Meter (ø13 mm x 10,208)	6,635	5,109	1,526			3,065	306	2,044	306		306		306		302
b) Bulk Meter (ø350 mm x 2, ø200 mm x 2, ø100 mm x 1)	47	38	9					38	9						
c) Valve (72)	432	315	117			79	30	79	30	157			30		27
d) Fire Hydrant (80)	536	354	182			89	45	89	50	176			50		37
e) Chlorinatort (2)	20	18	2					18	1						1
f) Vehicle (3)	210	105	105			70	70	35	35						
Sub-Total	30,626	18,099	12,527			7,127	3,208	4,578	2,294	5,497	2,726	552	2,775	345	1,524
Detailed Design Cost (10.5%)	3,216	1,901	1,315	1,901	1,315										
Supervision Cost (3.5%)	1,072	634	438			128	88	126	87	126	87	126	87	128	89
Land Cost	143		143				48		30		30		35		
Total	35,057	20,634	14,423	1,901	1,315	7,255	3,344	4,704	2,411	5,623	2,843	678	2,897	473	1,613
Physical Contingency (10%)	3,506	2,064	1,442	190	132	726	334	471	241	562	284	68	290	47	161
Total	38,563	22,698	15,865	2,091	1,447	7,981	3,678	5,175	2,652	6,185	3,127	746	3,187	520	1,774
Price Contingency	28,839	15,659	13,180	674	467	4,157	1,916	3,640	1,865	5,615	2,838	848	3,623	725	2,471
Grand Total (Project Cost)	67,402	38,357	29,045	2,765	1,914	12,138	5,594	8,815	4,517	11,800	5,965	1,594	6,810	1,245	4,245

財　政　評　価　分　析　表

（第一期＋第二期）

Legaspi

I + II

FINANCIAL TABLE 1

LEGASPI WATER SUPPLY PROJECT

PORJECT COSTS BY YEAR OF CONSTRUCTION

(P1,000's)

Project Components By Major Elements	Costs as of 7-1-81 By Construction Year						
	Total	1983	1984	1985	1986	1987	1988
1. Collection Chambers	1,780	-	1,780	-	-	-	-
2. Reservoirs	3,870			900	900	725	1,345
3. Pumps	1,700	-		-	1,156	544	
4. Transmission	4,198		488	866	2,354	490	-
5. Distribution	9,798	-	4,313	2,372	2,474	482	157
6. I/G	1,400	-	-		700	700	-
7. Meters	6,682		3,371	2,397	306	306	302
8. Hydrants	536	-	134	139	176	50	37
9. Chlorinators	20	-	-	19	-	-	1
10. Vehicles	210		140	70	-	-	-
11. Engineering	3,216	3,216	-	-	-	-	-
12. Lands	143		48	30	30	35	
13. Physical Cont.	3,506	322	1,060	712	846	358	208
14. Valves	432	-	109	109	157	30	27
15. Supervision	1,072	-	216	213	213	213	217
16.							
17.							
18.							
TOTAL, 7-1-81	38,563	3,538	11,659	7,827	9,312	3,933	2,294
ESCALATION FACTORS		1.322500	1.520875	1.703380	1.907785	2.136719	2.393126
ESCALATED COSTS	67,402	4,679	17,732	13,332	17,765	8,404	5,490

FINANCIAL TABLE 2

LEGASPI WATER SUPPLY PROJECT I + II

OPERATION AND MAINTENANCE COSTS

(₱1,000's)

Year	Fixed, 7-1-81 Costs				Escalated Costs	
	Power	Chemicals	Others	Total	Factor 1/	Amount
1981	22	34	140	196	1.000000	196
1982	22	34	159	215	1.150000	247
1983	22	34	179	235	1.322500	311
1984	22	35	198	255	1.520875	388
1985	-	68	217	285	1.703380	485
1986	-	73	275	348	1.907785	664
1987	-	78	343	421	2.136719	899
1988	37	91	401	529	2.393126	1,266
1989	87	108	459	654	2.680301	1,753
1990	145	127	527	799	2.948331	2,356
1991	210	149	594	953	3.243164	3,091
1992	284	174	652	1,110	3.567480	3,960
1993	369	202	710	1,281	3.924228	5,027
1994	369	202	710	1,281	4.316657	5,530
1995	369	202	710	1,281	4.748316	6,083
1996	369	202	710	1,281	5.223148	6,691
1997	369	202	710	1,281	5.745463	7,360
1998	369	202	710	1,281	6.320009	8,096

1/ Escalation currently 15 percent per year to 1984 (1981 = 1.00), 12 percent per year between 1985 and 1989 and 10 percent per year in 1990 and afterwards.

Legaspi

I + II

FINANCIAL TABLE 3

LEGASPI WATER SUPPLY PROJECT

LOAN DISBURSEMENTS AND DEBT SERVICE

(₱1,000's)

Year	Disbursement 1/		Loans Outstanding		Interest Payments 4/		Principal Payments 3/	Total Debt Service
	Grant 20%	Loan 80%	Beginning	Ending	First Year 2/	Later Years		
1981								
1982								
1983	936	3,743		3,911				
1984	3,546	14,186	3,911	19,087				
1985	2,666	10,666	19,087	31,950				
1986	3,553	14,212	31,950	49,676				
1987	1,681	6,723	49,676	61,172				
1988	1,098	4,392	61,172	71,266				
1989			71,266	71,103		6,414	163	6,577
1990			71,103	70,308		6,399	795	7,194
1991			70,308	68,977		6,328	1,331	7,659
1992			68,977	66,907		6,208	2,070	8,278
1993			66,907	64,358		6,022	2,549	8,571
1994			64,358	61,389		5,792	2,969	8,761
1995			61,389	58,420		5,525	2,969	8,494
1996			58,420	55,451		5,258	2,969	8,227
1997			55,451	52,482		4,991	2,969	7,960
1998			52,482	49,513		4,723	2,969	7,692

1/ From Financial Table 1.

2/ Disbursements assumed to be equally spread during year. Charge with 50 per cent of annual interest in first year.

3/ Principal payments are made in equal yearly instalments.

4/ Interest is capitalized during construction.

FINANCIAL TABLE 4

LEGASPI WATER SUPPLY PROJECT

CASH REQUIREMENTS PER REVENUE UNIT

(₱1,000's)

Year	Debt Service	O & M	Total Costs	Estimated Reserves 1/	Cost With Reserves	Revenue Units 2/	Cost Per Revenue Unit 3/
1981		196	196		196	845	0.23
1982		247	247		247	871	0.28
1983		311	311		311	924	0.34
1984		388	388		388	951	0.41
1985		485	485		485	1,756	0.28
1986		664	664		664	1,987	0.33
1987		899	899		899	2,268	0.40
1988		1,266	1,266		1,266	2,597	0.49
1989	6,577	1,753	8,330	417	8,747	3,003	2.91
1990	7,194	2,356	9,550	478	10,028	3,493	2.87
1991	7,659	3,091	10,750	1,075	11,825	4,073	2.90
1992	8,278	3,960	12,238	1,224	13,462	4,709	2.86
1993	8,571	5,027	13,598	1,360	14,598	5,422	2.69
1994	8,761	5,530	14,291	1,429	15,720	5,422	2.90
1995	8,494	6,083	14,577	1,458	16,035	5,422	2.96
1996	8,227	6,691	14,918	1,492	16,410	5,422	3.03
1997	7,960	7,360	15,320	1,532	16,852	5,422	3.11
1998	7,692	8,096	15,788	1,579	17,367	5,422	3.20

1/ Reserve estimate equal to 10 per cent of total costs. (5 per cent for the first two years)

2/ Revenue units from Tables 9A, 9B and 9C.

3/ Revenue units divided into costs with reserves.

FINANCIAL TABLE 5 - A

LEGASPI WATER SUPPLY PROJECT

ABILITY TO PAY FOR WATER

1	2	3	4	5	6	7	8
Year	Ave. Monthly Family Income 1/	Available 5%	Average Family Size	Household Water Use		Revenue Units Per Month 2/	Max. Ability Per Rev. Unit
				lpcd	Cubic Meters/ Month		
1981	620.00	31.00	5.70	55	9	25	1.24
1982	713.00	35.65	5.69	55	9	25	1.43
1983	819.95	41.01	5.68	55	9	25	1.64
1984	942.94	47.15	5.67	55	9	25	1.89
1985	1,056.09	52.80	5.66	70	12	27	1.96
1986	1,182.82	59.14	5.65	70	12	27	2.19
1987	1,324.76	66.24	5.64	115	20	37	1.79
1988	1,483.73	74.19	5.63	115	20	37	2.01
1989	1,661.78	83.09	5.62	116	20	37	2.25
1990	1,827.96	91.40	5.61	117	20	37	2.47
1991	2,010.75	100.54	5.60	119	20	37	2.72
1992	2,211.83	110.92	5.59	120	20	37	3.00
1993	2,433.01	121.65	5.58	120	20	37	3.29

1/ Average monthly income escalated by 15 per cent per year to 1984, 12 per cent per year between 1985 and 1989, and 10 per cent in 1990 and afterwards.

2/ Assumed 1/2" service.

FINANCIAL TABLE 5 - B

LEGASPI WATER SUPPLY PROJECT

ABILITY TO PAY FOR WATER

I + II

Year	Ave. Monthly Family Income 1/	Available 5%	Average Family Size	Household Water Use		Revenue Units Per Month 2/	Max. Ability Per Rev. Unit
				lpcd	Cubic Meters/ Month		
1994	2,676.31	133.82	5.57	120	20	37	3.62
1995	2,943.94	147.20	5.56	120	20	37	3.98
1996	3,238.33	161.92	5.55	120	20	37	4.38
1997	3,562.16	178.11	5.54	120	20	37	4.81
1998	3,918.38	195.92	5.53	120	20	37	5.30

1/ Average monthly income escalated by 15 percent year to 1984, 12 percent per year between 1985 and 1989, and 10 percent in 1990 and afterwards.

2/ Assumed 1/2" service.

FINANCIAL TABLE 6 - A

LEGASPI WATER SUPPLY PROJECT
ILLUSTRATIVE CASH FLOW TABLE
₱1,000's EXCEPT CHARGES PER UNIT

I + II

Year	Revenue Units 1/	Charges Per Unit	Gross Revenues	Net Revenue 2/		Basic Costs 3/	Required Reserves 4/	Total Costs 5/	Net Income	
				%	Amount				Annual	Cumulative
1981	845	0.60	507	95	482	196		196	286	286
1982	871	0.60	523	95	497	247		247	250	536
1983	924	0.95	877	95	834	311		311	523	1,059
1984	951	1.50	1,427	96	1,369	388		388	981	2,040
1985	1,756	1.50	2,634	96	2,529	485		485	2,044	4,084
1986	1,987	1.70	3,378	97	3,277	664		664	2,613	6,697
1987	2,268	1.70	3,856	97	3,740	899		899	2,841	9,538
1988	2,597	2.00	5,194	97	5,038	1,266		1,266	3,772	13,310
1989	3,003	2.00	6,006	97	5,826	8,330	300	8,630	-2,804	10,506
1990	3,493	2.45	8,558	98	8,387	9,550	428	9,978	-1,591	8,915
1991	4,073	2.45	9,979	98	9,779	10,750	998	11,748	-1,969	6,946
1992	4,709	2.70	12,714	98	12,460	12,238	1,271	13,509	-1,049	5,897
1993	5,422	2.70	14,639	98	14,346	13,598	1,464	15,062	-716	5,181

1/ From Tables 9A, 9B and 9C.
2/ Gross revenues from water sales reduced by bad debt allowance.
3/ Total of project debt service, operation and maintenance costs.
4/ Ten percent of gross water sales, after completion of construction. (5 percent for the first two years)
5/ Includes the costs of replacing the first complement of project components with seven years of life expectancy.

FINANCIAL TABLE 6 - B

LEGASPI WATER SUPPLY PROJECT

ILLUSTRATIVE CASH FLOW TABLE

₱1,000's EXCEPT CHARGES PER UNIT

I + II

Year	Revenue Units 1/	Charges Per Unit	Gross Revenues	Net Revenues 2/		Basic Costs 3/	Required Reserves 4/	Total Costs 5/	Net Income	
				%	Amount				Annual	Cumulative
1994	5,422	2.9	15,724	98	15,409	14,291	1,572	15,863	-454	4,727
1995	5,422	2.9	15,724	98	15,409	14,577	1,572	16,149	-740	3,987
1996	5,422	2.9	15,724	98	15,409	14,918	1,572	16,490	-1,081	2,906
1997	5,422	3.2	17,350	98	17,003	15,320	1,735	17,055	-52	2,854
1998	5,422	3.2	17,350	98	17,003	15,788	1,735	17,523	-520	2,334

1/ From Tables 9A, 9B and 9C.

2/ Gross revenues from water sales reduced by bad debt allowance.

3/ Total of project debt service, operation and maintenance costs.

4/ Ten percent of gross water sales, after completion of construction.

5/ Includes costs of replacing the dirst complement of project components with seven years of life expectancy.

FINANCIAL TABLE 7

LEGASPI WATER SUPPLY PROJECT

ILLUSTRATIVE RATE SCHEDULE

DOMESTIC AND GOVERNMENTAL SERVICE CONNECTIONS, 1/2"

Year	First 10 m^3 1/	Charge for Each Added m^3 2/			Charge 3/ per Revenue Unit
		11-20	21-45	over 45	
1981	15.00	0.72	0.84	1.02	0.60
1982	15.00	0.72	0.84	1.02	0.60
1983	23.75	1.14	1.33	1.62	0.95
1984	37.50	1.80	2.10	2.55	1.50
1985	37.50	1.80	2.10	2.55	1.50
1986	42.50	2.04	2.38	2.89	1.70
1987	42.50	2.04	2.38	2.89	1.70
1988	50.00	2.40	2.80	3.40	2.00
1989	50.00	2.40	2.80	3.40	2.00
1990	61.25	2.94	3.43	4.17	2.45
1991	61.25	2.94	3.43	4.17	2.45
1992	67.50	3.24	3.78	4.59	2.70
1993	67.50	3.24	3.78	4.59	2.70

Note: 1/ To obtain charge per m^3 for the first 10 m^3 classified by connection size, multiply R.U. charge shown in 3/ above by the following connection size factors.

Domestic : 1.0 for 3/8"; 2.5 for 1/2"; 4.0 for 3/4"; 8 for 1"
Commerical: 5.0 for 1/2"; 8.0 for 3/4"; 16.0 for 1"; 40.0 for 1 1/2"

2/ To obtain charge for each added m^3, multiply R.U. charges shown in 3/ by the following block factors.

Domestic : 1.2 for 11-20 m^3; 1.4 for 21-45 m^3; 1.7 for over 45 m^3
Commercial: 2.4 for 21-45 m^3; 2.8 for 45-100 m^3; 2.4 for over 100 m^3

FINANCIAL TABLE 8

LEGASPI WATER SUPPLY PROJECT
GROWTH IN POPULATION, SERVICE CONNECTIONS
AND IN DELIVERED AND PROCURED WATER

1	2	3	4	5	6	7	8
Year	Ave. Number Service Connections	Number For Service	Persons Served	Daily Use lpcd 1/	Annual Water Supply (1,000 M^3)		
					Delivered	% Unacct.	Produced
1981	1,367	13.6	18,600	69	466	45	759
1982	1,411	13.6	19,200	69	483	43	778
1983	1,570	13.0	20,400	69	515	40	803
1984	1,716	12.1	20,900	69	526	40	836
1985	1,974	11.0	22,100	127	1,025	40	1,710
1986	2,322	10.0	23,300	135	1,151	37	1,798
1987	2,698	9.1	24,520	144	1,288	34	1,899
1988	3,298	8.5	28,100	144	1,479	32	2,034
1989	4,103	7.9	32,400	145	1,717	30	2,193
1990	5,178	7.2	37,200	147	1,997	28	2,342
1991	6,623	6.4	42,600	149	2,324	26	2,490
1992	8,628	5.6	48,500	150	2,664	25	2,631
1993	11,575	4.6	55,030	150	3,017	25	2,777

1/ Liters per capita per day.

Legaspi

FINANCIAL TABLE 9A

I + II

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF REVENUE UNITS

A) AVERAGE NUMBER OF CONCESSIONAIRES

Year	Residential and Government					Commercial and Industrial					Total
	3/8"	1/2"	3/4"	1"	S-Total	1/2"	3/4"	1"	1 1/2"	S-Total	
1981	363	836	11	1	1,211	133	14	7	2	156	1,367
1982	363	836	11	1	1,211	133	14	7	2	156	1,367
1983	392	902	12	1	1,307	133	14	7	2	156	1,463
1984	428	985	13	1	1,427	141	15	7	2	165	1,592
1985	500	1,150	15	2	1,667	175	18	10	2	205	1,872
1986	587	1,350	18	2	1,957	260	27	15	3	305	2,262
1987	676	1,555	20	2	2,253	380	40	22	3	445	2,698
1988	852	1,960	26	2	2,840	391	41	23	3	458	3,298
1989	1,090	2,506	33	3	3,632	402	42	24	3	471	4,103
1990	1,408	3,239	42	5	4,694	413	44	24	3	484	5,178
1991	1,838	4,227	55	6	6,126	424	45	25	3	497	6,623
1992	2,435	5,601	73	9	8,118	436	46	25	3	510	8,628
1993	3,315	7,625	99	11	11,050	448	47	26	3	525	11,575

B) SERVICE REVENUE UNITS PER CUBIC METER

Year	Residential and Government					Commercial and Industrial					Total
	1.00	2.50	4.0	8.0	S-total	5.0	8.0	16.0	40.0	S-Total	
1981	363	2,090	44	8	2,505	665	112	112	80	969	3,474
1982	363	2,090	44	8	2,505	665	112	112	80	969	3,474
1983	392	2,255	48	8	2,703	665	112	112	80	969	3,672
1984	428	2,463	52	8	2,951	705	120	112	80	1,017	3,968
1985	500	2,875	60	16	3,451	875	144	160	80	1,259	4,710
1986	587	3,375	72	16	4,050	1,300	216	240	120	1,876	5,926
1987	676	3,888	80	16	4,660	1,900	320	352	120	2,692	7,352
1988	852	4,900	104	16	5,872	1,955	328	368	120	2,771	8,643
1989	1,090	6,265	132	24	7,511	2,010	336	384	120	2,850	10,361
1990	1,408	8,098	168	40	9,714	2,065	352	384	120	2,921	12,635
1991	1,838	10,568	220	48	12,674	2,120	360	400	120	3,000	15,674
1992	2,435	14,003	292	72	16,802	2,180	368	400	120	3,068	19,870
1993	3,315	19,063	396	88	22,862	2,240	376	416	120	3,152	26,014

FINANCIAL TABLE 9B1

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF REVENUE UNITS

DOMESTIC

Year	Delivered Water (x1000 cum)	Service Connections (x 0.12)	Net	11 - 20 cum		21 - 45 cum		over 45 cum		Total CRU's
				cum	x 1.2	cum	x 1.4	cum	x 1.7	
1981	415	145	270	145	174	125	175	-	-	349
1982	430	145	285	145	174	140	196	-	-	370
1983	458	157	301	157	188	144	202	-	-	390
1984	468	171	297	171	205	126	176	-	-	381
1985	912	200	712	200	240	512	717	12	20	977
1986	1,024	235	789	235	282	554	776	-	-	1,058
1987	1,146	270	876	270	324	606	848	-	-	1,172
1988	1,316	341	975	341	409	634	888	-	-	1,297
1989	1,528	436	1,092	436	523	656	918	-	-	1,441
1990	1,777	563	1,214	563	676	651	911	-	-	1,587
1991	2,068	735	1,333	735	882	598	837	-	-	1,719
1992	2,371	974	1,397	974	1,169	423	592	-	-	1,761
1993	2,685	1,326	1,359	1,326	1,591	33	46	-	-	1,637

FINANCIAL TABLE 9B2

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF WATER REVENUES UNITS

I + II

COMMERCIAL

Year	Delivered Water (x1000 cum)	Service Connections (x 0.12)	Net	11 - 45 cum		46 - 100 cum		Over 100 cum		Total CRU's
				cum	x 2.4	cum	x 2.8	cum	x 3.4	
1981	51	18	33	33	79	-	-	-	-	79
1982	53	18	35	35	84	-	-	-	-	84
1983	57	18	39	39	94	-	-	-	-	94
1984	58	19	39	39	94	-	-	-	-	94
1985	113	24	89	86	206	3	8	-	-	214
1986	127	36	91	91	218	-	-	-	-	218
1987	142	53	89	89	214	-	-	-	-	214
1988	163	54	109	109	262	-	-	-	-	262
1989	189	56	133	133	319	-	-	-	-	319
1990	220	58	162	162	389	-	-	-	-	389
1991	256	59	197	197	473	-	-	-	-	473
1992	293	61	232	214	514	18	50	-	-	564
1993	332	63	269	221	530	48	134	-	-	664

FINANCIAL TABLE 9C

SUMMARY OF REVENUE UNITS

Year	Residential and Governmental				Commercial and Industrial				Total All
	Service			Total R & C	Service			Total C & I	
	RU/Serv. Connection	Multiplied by 0.12	Commodity Rev. Units		RU/Serv. Connection	Multiplied by 0.12	Commodity Rev. Units		
1981	2,505	301	349	650	969	116	79	195	845
1982	2,505	301	370	671	969	116	84	200	871
1983	2,703	324	390	714	969	116	94	210	924
1984	2,951	354	381	735	1,017	122	94	216	951
1985	3,451	414	977	1,391	1,259	151	214	365	1,756
1986	4,050	486	1,058	1,544	1,876	225	218	443	1,987
1987	4,660	559	1,172	1,731	2,692	323	214	537	2,268
1988	5,872	705	1,297	2,002	2,771	333	262	595	2,597
1989	7,511	901	1,441	2,342	2,850	342	319	661	3,003
1990	9,714	1,166	1,587	2,753	2,921	351	389	740	3,493
1991	12,674	1,521	1,719	3,240	3,000	360	473	833	4,073
1992	16,802	2,016	1,761	3,777	3,068	368	564	932	4,709
1993	22,862	2,743	1,637	4,380	3,152	378	664	1,042	5,422

Legaspi I + II

経　済　評　価　分　析　表

（第一期＋第二期）

I + II

ECONOMIC TABLE 1

LEGASPI WATER SUPPLY PROJECT

SUMMARY OF PROJECT COST

Costs as of July 1, 1981 in 1,000 Pesos

Components	Total Cost	Foreign Currency Portion	Local Currency Portion
1. Collection Chambers	1,780	445	1,335
2. Reservoirs	3,870	968	2,902
3. Pumps	1,700	1,020	680
4. Transmission	4,198	2,813	1,385
5. Distribution	9,798	6,564	3,234
6. I/G	1,400	350	1,050
7. Meters	6,682	5,147	1,535
8. Hydrants	536	354	182
9. Chlorinators	20	18	2
10. Vehicles	210	105	105
11. Engineering	3,216	1,901	1,315
12. Lands	143	-	143
13. Valves	432	315	117
14. Supervision	1,072	634	438
15.			
16.			
17.			

Source: From Cost Estimates

ECONOMIC TABLE 2

LEGASPI WATER SUPPLY PROJECT

ANNUAL DEMAND AND GROSS PRODUCTION IN 1,000 M^3

1	2	3	4	5	6	7	8	9
Year	Average Connections	Persons Per Service Connection	Population Served	Average Water Use		Net Increase in Delivered Volume	Unacounted Percentage	Annual Production
				Liters/ Capita Per Day	Water Delivered Annually			
1981	1,367	13.6	18,600	62	418	-	45	759
1982	1,367	13.6	18,600	63	418	-	45	778
1983	1,463	12.7	18,600	65	442	-	45	803
1984	1,592	12.1	19,200	66	460	18	45	836
1985	1,872	11.0	20,800	135	1,026	584	40	1,710
1986	2,262	10.0	22,600	137	1,133	691	37	1,798
1987	2,698	9.1	24,250	140	1,253	811	34	1,899
1988	3,298	8.5	28,100	135	1,383	941	32	2,034
1989	4,103	7.9	32,400	130	1,535	1,093	30	2,193
1990	5,178	7.2	37,200	124	1,686	1,244	28	2,342
1991	6,623	6.4	42,600	119	1,843	1,401	26	2,490
1992	8,628	5.6	48,500	112	1,973	1,531	25	2,631
1993	11,575	4.6	55,030	104	2,083	1,641	25	2,777

ECONOMIC TABLE 3-A

LEGASPI WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

Costs as of July 1, 1981 in 1,000 Pesos

Component	Foreign Costs	Local Costs	Common Labor Costs	Residual Local Cost	Converted Value			
					Foreign x 1.25	Labor x 0.5	Residual x 0.95	Total
1. Collection Chamber	445	1,335	868	467	556	434	444	1,434
2. Reservoir	968	2,902	1,886	1,016	1,210	943	965	3,118
3. Pumps	1,020	680	340	340	1,275	170	323	1,768
4. Transmission	2,813	1,385	346	1,039	3,516	173	987	4,676
5. Distribution	6,564	3,234	1,294	1,940	8,205	647	1,843	10,695
6. I/G	350	1,050	525	525	438	263	499	1,200
7. Meters	5,147	1,535	307	1,228	6,434	154	1,167	7,755
8. Hydrants	354	182	73	109	443	37	104	584
9. Chlorinators	18	2	-	2	23	-	2	25
10. Vehicles	105	105	-	105	131	-	100	231
11. Engineering	1,901	1,315	-	1,315	2,376	-	1,249	3,625
12. Lands	-	143	-	143	-	-	136	136
13. Valves	315	117	23	94	394	12	89	495
14. Supervision	634	438	-	438	793	-	416	1,209
15.								
16.								
17.								

ECONOMIC TABLE 3-B

LEGASPI WATER SUPPLY PROJECT
CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST
Costs as of July 1, 1981 in 1,000 Pesos

Component	Foreign Costs	Local Costs	Common Labor Costs	Residual Local Cost	Converted Value			
					Foreign x 1.0	Labor x 0.5	Residual x 0.95	Total
1. Collection Chamber	445	1,335	868	467	445	434	444	1,323
2. Reservoir	968	2,902	1,886	1,016	968	943	965	2,875
3. Pumps	1,020	680	340	340	1,020	170	323	1,513
4. Transmission	2,813	1,385	346	1,039	2,813	173	987	3,973
5. Distribution	6,564	3,234	1,294	1,940	6,564	647	1,843	9,054
6. I/G	350	1,050	525	525	350	263	499	1,112
7. Meters	5,147	1,535	307	1,228	5,147	154	1,167	6,468
8. Hydrants	354	182	73	109	354	17	104	495
9. Chlorinators	18	2	-	2	18	-	2	20
10. Vehicles	105	105	-	105	105	-	100	205
11. Engineering	1,901	1,315	-	1,315	1,901	-	1,249	3,150
12. Lands	-	143	-	143	-	-	136	136
13. Valves	315	117	23	94	315	12	89	416
14. Supervision	634	438	-	438	634	-	416	1,050
15.								
16.								
17.								

ECONOMIC TABLE 3-C

LEGASPI WATER SUPPLY PROJECT

CONVERSION OF CONSTRUCTION COST TO ECONOMIC COST

Costs as of July 1, 1981 in 1,000 Pesos

Component	Foreign Costs	Local Costs	Common Labor Costs	Residual Local Cost	Converted Value			
					Foreign x 1.25	Labor x 1.0	Residual x 1.0	Total
1. Collection Chamber	445	1,335	868	467	556	868	467	1,891
2. Reservoir	968	2,902	1,886	1,016	1,210	1,886	1,016	4,112
3. Pumps	1,020	680	340	340	1,275	340	340	1,955
4. Transmission	2,813	1,385	346	1,039	3,516	346	1,039	4,901
5. Distribution	6,564	3,234	1,294	1,940	8,205	1,294	1,940	11,439
6. I/G	350	1,050	525	525	438	525	525	1,488
7. Meters	5,147	1,535	307	1,228	6,434	307	1,228	7,969
8. Hydrants	354	182	73	109	443	73	109	625
9. Chlorinators	18	2	-	2	23	-	2	25
10. Vehicles	105	105	-	105	131	-	105	236
11. Engineering	1,901	1,315	-	1,315	2,376	-	1,315	3,691
12. Lands	-	143	-	143	-	-	143	143
13. Valves	315	117	23	94	394	23	94	511
14. Supervision	634	438	-	438	793	-	438	1,231
15.								
16.								
17.								

ECONOMIC TABLE 4-0

LEGASPI WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

I + II

Value without CONVERSION

Components	Total	1983	1984	1985	1986	1987	1988
1. Collection Chamber	1,780	-	1,780	-	-	-	-
2. Reservoirs	3,870	-	-	900	900	725	1,345
3. Pumps	1,700	-	-	-	1,156	544	-
4. Transmission	4,198	-	488	866	2,354	490	-
5. Distribution	9,798	-	4,313	2,372	2,474	482	157
6. I/G	1,400	-	-	-	700	700	-
7. Meters	6,682	-	3,371	2,397	306	306	302
8. Hydrants	536	-	134	139	176	50	37
9. Chlorinators	20	-	-	19	-	-	1
10. Vehicles	210	-	140	70	-	-	-
11. Engineering	3,216	3,216	-	-	-	-	-
12. Land	143	-	48	30	30	35	-
13. Valves	432	-	109	109	157	30	27
14. Supervision	1,072	-	216	213	213	213	217
15.							
16.							
17.							
18.							
Total	35,057	3,216	10,599	7,115	8,466	3,575	2,086

Legaspi

I + II

ECONOMIC TABLE 4-A

LEGASPI WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

Value with CONVERSION A

Components	Total	1983	1984	1985	1986	1987	1988
1. Collection Chamber	1,434	-	1,434	-	-	-	-
2. Reservoirs	3,118	-	-	725	725	584	1,084
3. Pumps	1,768	-	-	-	1,202	566	-
4. Transmission	4,676	-	544	964	2,622	546	-
5. Distribution	10,695	-	4,708	2,589	2,701	526	171
6. I/G	1,200	-	-	-	600	600	-
7. Meters	7,755	-	3,912	2,782	355	355	351
8. Hydrants	584	-	146	151	192	55	40
9. Chlorination	25	-	-	24	-	-	1
10. Vehicles	231	-	154	77	-	-	-
11. Engineering	3,625	3,625	-	-	-	-	-
12. Land	136	-	46	29	29	32	-
13. Valves	495	-	125	125	180	34	31
14. Supervision	1,209	-	244	240	240	240	245
15.							
16.							
17.							
18.							
Total	36,951	3,625	11,313	7,706	8,846	3,538	1,923

ECONOMIC TABLE 4-B

I + II

LEGASPI WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

Value with CONVERSION B

Components	Total	1983	1984	1985	1986	1987	1988
1. Collection Chambers	1,323	-	1,323	-	-	-	-
2. Reservoirs	2,875	-	-	661	661	518	1,035
3. Pumps	1,513	-	-	1,029	484	-	-
4. Transmission	3,973	-	477	795	2,225	476	-
5. Distribution	9,054	-	3,984	2,173	2,264	453	180
6. I/G	1,112	-	-	-	556	556	-
7. Meters	6,468	-	3,234	2,328	323	323	260
8. Hydrants	495	-	124	129	163	45	34
9. Chlorinators	20	-	-	19	-	-	1
10. Vehicles	205	-	137	68	-	-	-
11. Engineering	3,150	3,150	-	-	-	-	-
12. Land	136	-	46	29	29	32	-
13. Valves	416	-	104	104	150	29	29
14. Supervision	1,050	-	211	209	209	209	212
15.							
16.							
17.							
18.							
Total	31,790	3,150	9,640	7,544	7,064	2,641	1,751

Legaspi

I + II

ECONOMIC TABLE 4-C

LEGASPI WATER SUPPLY PROJECT

ECONOMIC COSTS DISTRIBUTED TO YEARS

₱ x 1,000

Value with CONVERSION C

Components	Total	1983	1984	1985	1986	1987	1988
1. Collection Chamber	1,891	-	1,891	-	-	-	-
2. Reservoir	4,112	-	-	956	956	771	1,429
3. Pumps	1,955	-	-	-	1,329	626	-
4. Transmission	4,901	-	570	1,011	2,748	572	-
5. Distribution	11,439	-	5,036	2,769	2,888	563	183
6. I/G	1,488	-	-	-	744	744	-
7. Meters	7,969	-	4,020	2,859	365	365	360
8. Hydrants	625	-	156	162	205	59	43
9. Chlorinators	25	-	-	24	-	-	1
10. Vehicles	236	-	157	79	-	-	-
11. Engineering	3,691	3,691	-	-	-	-	-
12. Land	143	-	48	30	30	35	-
13. Valves	511	-	129	128	186	36	32
14. Supervision	1,231	-	248	245	245	244	249
15.							
16.							
17.							
18.							
Total	40,217	3,691	12,255	8,263	9,696	4,015	2,297

ECONOMIC TABLE 5

I + II

LEGASPI WATER SUPPLY PROJECT
OPERATION AND MAINTENANCE EXPENSES
Costs as of July 1, 1981 in 1,000 Pesos

Year	Power	Chemicals	Others	Total	Net Costs
1981	22	34	140	196	-
1982	22	34	159	215	-
1983	22	34	179	235	20
1984	22	35	198	255	40
1985	-	68	217	285	70
1986	-	73	275	348	133
1987	-	78	343	421	206
1988	37	91	401	529	314
1989	87	108	459	654	439
1990	145	127	527	799	584
1991	210	149	594	953	738
1992	284	174	652	1,110	895
1993	369	202	710	1,281	1,066

Base Year = 1983

Legaspi

ECONOMIC TABLE 6-0

I + II

LEGASPI WATER SUPPLY PROJECT
LIFE EXPECTANCY AND REPLACEMENT SCHEDULES
₱ x 1,000

Value without CONVERSION

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Collection Chamber			1,780		1,780
2. Reservoir			3,870		3,870
3. Pumps		1,700			1,700
4. Transmission			4,198		4,198
5. Distribution			9,798		9,798
6. I/G			1,400		1,400
7. Meters		6,682			6,682
8. Hydrants			536		536
9. Chlorinators	20				20
10. Vehicles	210				210
11. Land				143	143
12. Valves			432		432

7 Year Items	Years of Installation					Years of Replacement				
1. Chlorinators	1985	1988				1992	1995	1999	2002	2006
						2009				
2. Vehicles	1985					1991	1992	1998	1999	2005
						2006	2012			

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1986	1987				2001	2002			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003

ECONOMIC TABLE 6-A

LEGASPI WATER SUPPLY PROJECT
LIFE EXPECTANCY AND REPLACEMENT SCHEDULES
₱ x 1,000

Value with CONVERSION A

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Collection Chamber			1,434		1,434
2. Reservoir			3,118		3,118
3. Pumps		1,768			1,768
4. Transmission			4,676		4,676
5. Distribution			10,695		10,695
6. I/G			1,200		1,200
7. Meters		7,755			7,755
8. Hydrants			584		584
9. Chlorinators	25				25
10. Vehicles	231				231
11. Land				136	136
12. Valve			495		495

7 Year Items	Years of Installation					Years of Replacement				
1. Chlorinators	1985	1988				1992	1995	1999	2002	2006
						2009				
2. Vehicles	1984	1985				1991	1992	1998	1999	2005
						2006	2012			

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1986	1987				2001	2002			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003

Legaspi

ECONOMIC TABLE 6-B

I + II

LEGASPI WATER SUPPLY PROJECT
LIFE EXPECTANCY AND REPLACEMENT SCHEDULES
₱ x 1,000

Value with CONVERSION B

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Collection Chamber			1,323		1,323
2. Reservoir			2,875		2,875
3. Pumps		1,513			1,513
4. Transmission			3,973		3,973
5. Distribution			9,054		9,054
6. I/G			1,112		1,112
7. Meters		6,468			6,468
8. Hydrants			495		495
9. Chlorinators	20				20
10. Vehicles	205				205
11. Land				136	136
12. Valves			416		416

7 Year Items	Years of Installation					Years of Replacement				
1. Chlorinators	1985	1988				1992	1995	1999	2002	2006
						2009				
2. Vehicles	1984	1985				1991	1992	1998	1999	2005
						2006	2012			

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1986	1987				2001	2002			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003

ECONOMIC TABLE 6-C

LEGASPI WATER SUPPLY PROJECT

LIFE EXPECTANCY AND REPLACEMENT SCHEDULES

₱ x 1,000

Value with CONVERSION C

Components	Life Expectancy of Components				
	7 Years	15 Years	50 Years	Infinite	Total
1. Collection Chambers			1,891		1,891
2. Reservoir			4,112		4,112
3. Pumps		1,955			1,955
4. Transmission			4,901		4,901
5. Distribution			11,439		11,439
6. I/G			1,488		1,488
7. Meters		7,969			7,969
8. Hydrants			625		625
9. Chlorinators	25				25
10. Vehicles	236				236
11. Land				143	143
12. Valves			511		511

7 Year Items	Years of Installation					Years of Replacement				
1. Chlorinators	1985	1988				1992	1995	1999	2002	2006
						2009				
2. Vehicles	1984	1985				1991	1992	1998	1999	2005
						2006	2012			

15 Year Items	Years of Installation					Years of Replacement				
1. Pumps	1986	1987				2001	2002			
2. Meters	1984	1985	1986	1987	1988	1999	2000	2001	2002	2003

I + II

ECONOMIC TABLE 7-0

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF SALVAGE VALUES

₱ x 1,000

Value without CONVERSION

Components	Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased			
1984	48)		
1985	30)		
1986	30) 143	75%	107
1987	35)		
50 Year Life, Year Constructed			
1 1984	6,824	42%	2,866
2 1985	4,386	44%	1,930
3 1986	6,761	46%	3,110
4 1987	2,477	48%	1,189
5 1988	1,566	50%	783
6 1989			
15 Year Life, Year of Replacement			
1 1999	3,371	7%	236
2 2000	2,397	13%	312
3 2001	1,442	20%	288
4 2002	870	27%	235
5 2003	302	33%	100
7 Year Life, Years of Final Replacement			
1 2006	19	0%	0
2 2009	1	43%	0
3 2006	70	0%	0
4 2012	140	86%	120
Total			11,276

ECONOMIC TABLE 7-A I + II

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF SALVAGE VALUES

₱ x 1,000

Value with CONVERSION A

Components	Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased			
1984	46)		
1985	29)		
1986	29 } 136	75%	102
1987	32)		
50 Year Life, Year Constructed			
1 1984	6,957	42%	2,922
2 1985	4,554	44%	2,004
3 1986	7,020	46%	3,229
4 1987	2,345	48%	1,126
5 1988	1,326	50%	663
15 Year Life, Year of Replacement			
1 1999	3,912	7%	274
2 2000	2,782	13%	362
3 2001	1,557	20%	311
4 2002	921	27%	249
5 2003	351	33%	116
7 Year Life, Years of Final Replacement			
1 2006	24	0%	0
2 2009	1	43%	0
3 2006	77	0%	0
4 2012	154	86%	132
Total			11,490

Legaspi

I + II

ECONOMIC TABLE 7-B

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF SALVAGE VALUES

₱ x 1,000

Value with CONVERSION B

Components	Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased			
1984	46)		
1985	29)		
1986	29) 136	75%	102
1987	32)		
50 Year Life, Year Constructed			
1 1984	6,012	42%	2,525
2 1985	3,862	44%	1,699
3 1986	6,019	46%	2,769
4 1987	2,077	48%	997
5 1988	1,278	50%	639
15 Year Life, Year of Replacement			
1 1999	3,234	7%	226
2 2000	3,357	13%	436
3 2001	807	20%	161
4 2002	323	27%	87
5 2003	260	33%	86
7 Year Life, Years of Final Replacement			
1 2006	19	0%	0
2 2009	1	43%	0
3 2006	68	0%	0
4 2012	137	86%	118
Total			9,845

ECONOMIC TABLE 7-C

I + II

LEGASPI WATER SUPPLY PROJECT

CALCULATION OF SALVAGE VALUES

₱ x 1,000

Value with CONVERSION C

Components	Base Year Value	Percentage of Base Year Value	31st Year Salvage Base Year Values
Infinite Life, Year Purchased			
1984	48)		
1985	30) 143	75%	107
1986	30)		
1987	35)		
50 Year Life, Year Constructed			
1 1984	7,782	42%	3,268
2 1985	5,026	44%	2,211
3 1986	7,727	46%	3,554
4 1987	2,745	48%	1,318
5 1988	1,687	50%	844
15 Year Life, Year of Replacement			
1 1999	4,020	7%	281
2 2000	2,859	13%	372
3 2001	1,694	20%	339
4 2002	991	27%	268
5 2003	360	33%	119
7 Year Life, Years of Final Replacement			
1 2006	24	0%	0
2 2009	1	43%	0
3 2006	79	0%	0
4 2012	157	86%	135
Total			12,816

I + II

ECONOMIC TABLE 8-0

LEGASPI WATER SUPPLY PROJECT

SUMMARY OF ALL PROJECT COSTS

Costs as of July 1, 1981 in 1,000 Pesos

Value without CONVERSION

Year	Cost of Facilities	Net O & M	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	3,216	20		3,236		
1984	10,599	40		10,639		
1985	6,249	70		6,319		
1986	6,978	133		7,111		
1987	5,439	206		5,645		
1988	2,576	314		2,890		
1989		439		439		
1990		584		584		
1991		738	140	878		
1992		895	89	984		
1993		1,066		1,066		
1994		1,066		1,066		
1995		1,066	1	1,067		
1996		1,066		1,066		
1997		1,066		1,066		
1998		1,066	140	1,206		
1999		1,066	3,460	4,526		
2000		1,066	2,397	3,463		
2001		1,066	1,462	2,528		
2002		1,066	851	1,917		
2003		1,066	302	1,368		
2004		1,066		1,066		
2005		1,066	140	1,206		
2006		1,066	89	1,155		
2007		1,066		1,066		
2008		1,066		1,066		
2009		1,066	1	1,067		
2010		1,066		1,066		
2011		1,066		1,066		
2012		1,066	70	1,136		
Total	25,057	24,759	9,142	68,958	(11,276)	57,682

ECONOMIC TABLE 8-A

I + II

LEGASPI WATER SUPPLY PROJECT

SUMMARY OF ALL PROJECT COSTS

Costs as of July 1, 1981 in 1,000 Pesos

Value with CONVERSION A

Year	Cost of Facilities	Net O & M	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	3,625	20		3,645		
1984	11,313	40		11,353		
1985	6,742	70		6,812		
1986	7,188	133		7,321		
1987	5,614	206		5,820		
1988	2,469	314		2,783		
1989		439		439		
1990		584		584		
1991		738	154	892		
1992		895	101	996		
1993		1,066		1,066		
1994		1,066		1,066		
1995		1,066	1	1,067		
1996		1,066		1,066		
1997		1,066		1,066		
1998		1,066	154	1,220		
1999		1,066	4,013	5,079		
2000		1,066	2,782	3,848		
2001		1,066	1,557	2,623		
2002		1,066	922	1,988		
2003		1,066	351	1,417		
2004		1,066		1,066		
2005		1,066	154	1,220		
2006		1,066	101	1,167		
2007		1,066		1,066		
2008		1,066		1,066		
2009		1,066	1	1,067		
2010		1,066		1,066		
2011		1,066		1,066		
2012		1,066	154	1,220		
Total	36,951	24,759	10,445	72,155	(11,490)	60,665

Legaspi

I + II

ECONOMIC TABLE 8-B

LEGASPI WATER SUPPLY PROJECT

SUMMARY OF ALL PROJECT COSTS

Costs as of July 1, 1981 in 1,000 Pesos

Value with CONVERSION B

Year	Cost of Facilities	Net O & M	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	3,150	20		3,170		
1984	9,640	40		9,680		
1985	6,749	70		6,819		
1986	5,634	133		5,767		
1987	4,390	206		4,596		
1988	2,227	314		2,541		
1989		439		439		
1990		584		584		
1991		738	137	875		
1992		895	87	982		
1993		1,066		1,066		
1994		1,066		1,066		
1995		1,066	1	1,067		
1996		1,066		1,066		
1997		1,066		1,066		
1998		1,066	137	1,203		
1999		1,066	3,321	4,387		
2000		1,066	2,328	3,394		
2001		1,066	1,352	2,418		
2002		1,066	808	1,874		
2003		1,066	260	1,326		
2004		1,066		1,066		
2005		1,066	137	1,203		
2006		1,066	87	1,153		
2007		1,066		1,066		
2008		1,066		1,066		
2009		1,066	1	1,067		
2010		1,066		1,066		
2011		1,066		1,066		
2012		1,066	137	1,203		
Total	31,790	24,759	8,793	65,342	(9,845)	55,497

ECONOMIC TABLE 8-C

I + II

LEGASPI WATER SUPPLY PROJECT

SUMMARY OF ALL PROJECT COSTS

Costs as of July 1, 1981 in 1,000 Pesos

Value with CONVERSION C

Year	Cost of Facilities	Net O & M	Replace-ment Costs	Total	Salvage	Net Cost
1982						
1983	3,691	20		3,711		
1984	12,255	40		12,295		
1985	7,252	70		7,322		
1986	7,959	133		8,092		
1987	6,191	206		6,397		
1988	2,869	314		3,183		
1989		439		439		
1990		584		584		
1991		738	157	895		
1992		895	103	998		
1993		1,066		1,066		
1994		1,066		1,066		
1995		1,066	1	1,067		
1996		1,066		1,066		
1997		1,066		1,066		
1998		1,066	157	1,223		
1999		1,066	4,123	5,189		
2000		1,066	2,859	3,925		
2001		1,066	1,694	2,760		
2002		1,066	992	2,058		
2003		1,066	360	1,426		
2004		1,066		1,066		
2005		1,066	157	1,223		
2006		1,066	103	1,169		
2007		1,066		1,066		
2008		1,066		1,066		
2009		1,066	1	1,067		
2010		1,066		1,066		
2011		1,066		1,066		
2012		1,066	157	1,223		
Total	40,217	24,759	10,864	75,840	(12,816)	63,024

ECONOMIC TABLE 9

I + II

LEGASPI WATER SUPPLY PROJECT

BENEFITS AT 1981 PRICES

(₱ x 1,000)

Year	Volume	Qualitative	Fire Loss Reduction	Total	National Interest Adjustment
1982					
1983					
1984	67	164	67	298	328
1985	2,161	327	89	2,577	2,835
1986	2,557	491	116	3,164	3,480
1987	3,001	491	148	3,640	4,004
1988	3,482	491	192	4,165	4,582
1989	4,044	491	252	4,787	5,266
1990	4,603	491	331	5,425	5,968
1991	5,184	491	437	6,112	6,723
1992	5,665	491	584	6,740	7,414
1993	6,072	491	801	7,364	8,100
1994	6,072	491	801	7,364	8,100
1995	6,072	491	801	7,364	8,100
1996	6,072	491	801	7,364	8,100
1997	6,072	491	801	7,364	8,100
1998	6,072	491	801	7,364	8,100
1999	6,072	491	801	7,364	8,100
2000	6,072	491	801	7,364	8,100
2001	6,072	491	801	7,364	8,100
2002	6,072	491	801	7,364	8,100
2003	6,072	491	801	7,364	8,100
2004	6,072	491	801	7,364	8,100
2005	6,072	491	801	7,364	8,100
2006	6,072	491	801	7,364	8,100
2007	6,072	491	801	7,364	8,100
2008	6,072	491	801	7,364	8,100
2009	6,072	491	801	7,364	8,100
2010	6,072	491	801	7,364	8,100
2011	6,072	491	801	7,364	8,100
2012	6,072	491	801	7,364	8,100
Total	152,204	13,748	18,236	184,188	202,600

ECONOMIC TABLE 10-0

LEGASPI WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN COMPUTATION

I + II

Cost Value without CONVERSION

Year	Total Cost	Total Benefit	Net Benefit	Present Net Benefit
1982				
1983	3,236	-	-3,236	-3,236
1984	10,639	328	-10,311	-8,859
1985	6,319	2,835	-3,484	-2,572
1986	7,111	3,480	-3,631	-2,303
1987	5,645	4,004	-1,641	-894
1988	2,890	4,582	1,692	792
1989	439	5,266	4,827	1,942
1990	584	5,968	5,384	1,861
1991	878	6,723	5,845	1,736
1992	984	7,414	6,430	1,640
1993	1,066	8,100	7,034	1,542
1994	1,066	8,100	7,034	1,325
1995	1,067	8,100	7,033	1,138
1996	1,066	8,100	7,034	978
1997	1,066	8,100	7,034	840
1998	1,206	8,100	6,894	707
1999	4,526	8,100	3,574	315
2000	3,463	8,100	4,637	351
2001	2,528	8,100	5,572	363
2002	1,917	8,100	6,183	346
2003	1,368	8,100	6,732	323
2004	1,066	8,100	7,034	290
2005	1,206	8,100	6,894	245
2006	1,155	8,100	6,945	212
2007	1,066	8,100	7,034	184
2008	1,066	8,100	7,034	158
2009	1,067	8,100	7,033	136
2010	1,066	8,100	7,034	117
2011	1,066	8,100	7,034	100
2012	1,136	8,100	18,240*	224*
Salvage(-)	11,276			
Total	57,682	202,600	144,918	1

Rate of Return = 0.16

Legaspi

I + II

ECONOMIC TABLE 10-A

LEGASPI WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION A

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	3,645	-	-3,645	-3,645
1984	11,353	328	-11,025	-9,555
1985	6,812	2,835	-3,977	-2,987
1986	7,321	3,480	-3,841	-2,500
1987	5,820	4,004	-1,816	-1,024
1988	2,783	4,582	1,799	879
1989	439	5,266	4,827	2,045
1990	584	5,968	5,384	1,977
1991	892	6,723	5,831	1,855
1992	996	7,414	6,418	1,770
1993	1,066	8,100	7,034	1,681
1994	1,066	8,100	7,034	1,457
1995	1,067	8,100	7,033	1,262
1996	1,066	8,100	7,034	1,094
1997	1,066	8,100	7,034	948
1998	1,220	8,100	6,880	804
1999	5,079	8,100	3,021	306
2000	3,848	8,100	4,252	373
2001	2,623	8,100	5,477	416
2002	1,988	8,100	6,112	403
2003	1,417	8,100	6,683	382
2004	1,066	8,100	7,034	348
2005	1,220	8,100	6,880	295
2006	1,167	8,100	6,933	258
2007	1,066	8,100	7,034	227
2008	1,066	8,100	7,034	196
2009	1,067	8,100	7,033	170
2010	1,066	8,100	7,034	147
2011	1,066	8,100	7,034	128
2012	1,220	8,100	18,370*	289*
Salvage(-)	11,490			
Total	60,665	202,600	141,935	-1

* Values include salvage.

Rate of Return = 0.15

ECONOMIC TABLE 10-B

LEGASPI WATER SUPPLY PROJECT

INTERNAL RATE OF RETURN COMPUTATION

I + II

Cost Value with CONVERSION B

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	3,170	-	-3,170	-3,170
1984	9,680	328	-9,352	-7,936
1985	6,819	2,835	-3,984	-2,869
1986	5,767	3,480	2,287	-1,398
1987	4,596	4,004	-592	-307
1988	2,541	4,582	2,041	898
1989	439	5,266	4,827	1,803
1990	584	5,968	5,384	1,707
1991	875	6,723	5,848	1,573
1992	982	7,414	6,432	1,468
1993	1,066	8,100	7,034	1,363
1994	1,066	8,100	7,034	1,156
1995	1,067	8,100	7,033	981
1996	1,066	8,100	7,034	833
1997	1,066	8,100	7,034	707
1998	1,203	8,100	6,897	588
1999	4,387	8,100	3,713	269
2000	3,394	8,100	4,706	289
2001	2,418	8,100	5,682	296
2002	1,874	8,100	6,226	275
2003	1,326	8,100	6,774	254
2004	1,066	8,100	7,034	224
2005	1,203	8,100	6,897	186
2006	1,153	8,100	6,947	159
2007	1,066	8,100	7,034	137
2008	1,066	8,100	7,034	116
2009	1,067	8,100	7,033	99
2010	1,066	8,100	7,034	84
2011	1,066	8,100	7,034	71
2012	1,203	8,100	16,742*	143*
Salvage(-)	9,845			
Total	55,497	202,600	147,103	-1

* Values include salvage.

Rate of Return = 0.18

Legaspi

I + II

ECONOMIC TABLE 10-C

LEGASPI WATER SUPPLY PROJECT
INTERNAL RATE OF RETURN COMPUTATION

Cost Value with CONVERSION C

Year	Total Cost	Total Benefit	Net Benefit	Present Benefit
1982				
1983	3,711	-	-3,711	-3,711
1984	12,295	328	-11,967	-10,480
1985	7,322	2,835	-4,487	-3,441
1986	8,092	3,480	-4,612	-3,098
1987	6,397	4,004	-2,393	-1,408
1988	3,183	4,582	1,399	721
1989	439	5,266	4,827	2,178
1990	584	5,968	5,384	2,127
1991	895	6,723	5,828	2,017
1992	998	7,414	6,416	1,944
1993	1,066	8,100	7,034	1,867
1994	1,066	8,100	7,034	1,635
1995	1,067	8,100	7,033	1,432
1996	1,066	8,100	7,034	1,254
1997	1,066	8,100	7,034	1,098
1998	1,223	8,100	6,877	940
1999	5,189	8,100	2,911	349
2000	3,925	8,100	4,175	438
2001	2,760	8,100	5,340	490
2002	2,058	8,100	6,042	486
2003	1,426	8,100	6,674	470
2004	1,066	8,100	7,034	434
2005	1,223	8,100	6,877	372
2006	1,169	8,100	6,931	328
2007	1,066	8,100	7,034	292
2008	1,066	8,100	7,034	255
2009	1,067	8,100	7,033	224
2010	1,066	8,100	7,034	196
2011	1,066	8,100	7,034	171
2012	1,223	8,100	19,693*	420*
Salvage(-)	12,816			
Total	63,024	202,600	139,576	0

* Values include salvage.

Rate of Return = 0.14

政府補助金率算定のための財政分析資料

〔政府補助金率を一段階低い１５％（対総投資額）とした場合の財政分析結果は非有意。〕

Legaspi

I + II

FINANCIAL TABLE 3

LEGASPI WATER SUPPLY PROJECT

LOAN DISBURSEMENTS AND DEBT SERVICE

(₱1,000's)

Year	Disbursement 1/		Loans Outstanding		Interest Payments 4/		Principal Payments 3/	Total Debt Service
	Grant 15%	Loan 85%	Beginning	Ending	First Year 2/	Later Years		
1981								
1982								
1983	702	3,977		4,155				
1984	2,660	15,072	4,155	20,279				
1985	2,000	11,332	20,279	33,945				
1986	2,665	15,100	33,945	52,779				
1987	1,261	7,143	52,779	64,993				
1988	824	4,666	64,993	75,717				
1989			75,717	75,544		6,815	173	6,988
1990			75,544	74,699		6,799	845	7,644
1991			74,699	73,285		6,723	1,414	8,137
1992			73,285	71,086		6,596	2,199	8,795
1993			71,086	68,378		6,398	2,708	9,106
1994			68,378	65,223		6,154	3,155	9,309
1995			65,223	62,068		5,870	3,155	9,025
1996			62,068	58,913		5,586	3,155	8,741
1997			58,913	55,758		5,302	3,155	8,457
1998			55,758	52,603		5,018	3,155	8,173

1/ From Financial Table 1.

2/ Disbursements assumed to be equally spread during year. Charge with 50 per cent of annual interest in first year.

3/ Principal payments are made in equal yearly instalments.

4/ Interest is capitalized during construction.

FINANCIAL TABLE 4

LEGASPI WATER SUPPLY PROJECT

CASH REQUIREMENTS PER REVENUE UNIT

(₱1,000's)

Year	Debt Service	O & M	Total Costs	Estimated Reserves 1/	Cost With Reserves	Revenue Units 2/	Cost Per Revenue Unit 3/
1981		196	196		196	845	0.23
1982		247	247		247	871	0.28
1983		311	311		311	924	0.34
1984		388	388		388	951	0.41
1985		485	485		485	1,756	0.28
1986		664	664		664	1,987	0.33
1987		899	899		899	2,268	0.40
1988		1,266	1,266		1,266	2,597	0.49
1989	6,988	1,753	8,741	437	9,178	3,003	3.06
1990	7,644	2,356	10,000	500	10,500	3,493	3.01
1991	8,137	3,091	11,228	1,123	12,351	4,073	3.03
1992	8,795	3,960	12,755	1,276	14,031	4,709	2.98
1993	9,106	5,027	14,133	1,413	15,546	5,422	2.87
1994	9,309	5,530	14,839	1,484	16,323	5,422	3.01
1995	9,025	6,083	15,108	1,511	16,619	5,422	3.07
1996	8,741	6,691	15,432	1,543	16,975	5,422	3.13
1997	8,457	7,360	15,817	1,582	17,399	5,422	3.21
1998	8,173	8,096	16,269	1,627	17,896	5,422	3.30

1/ Reserve estimate equal to 10 per cent of total costs. (5 per cent for the first two years)

2/ Revenue units from Tables 9A, 9B and 9C.

3/ Revenue units divided into costs with reserves.

FINANCIAL TABLE 6 - A

LEGASPI WATER SUPPLY PROJECT
ILLUSTRATIVE CASH FLOW TABLE
₱1,000's EXCEPT CHARGES PER UNIT

Year	Revenue Units 1/	Charges Per Unit	Gross Revenues	Net Revenue 2/		Basic Costs 3/	Required Reserves 4/	Total Costs 5/	Net Income	
				%	Amount				Annual	Cumulative
1981	845	0.60	507	95	482	196		196	286	286
1982	871	0.60	523	95	497	247		247	250	536
1983	924	0.95	877	95	834	311		311	523	1,059
1984	951	1.50	1,427	96	1,369	388		388	981	2,040
1985	1,756	1.50	2,634	96	2,529	485		485	2,044	4,084
1986	1,987	1.70	3,378	97	3,277	664		664	2,613	6,697
1987	2,268	1.70	3,856	97	3,740	899		899	2,841	9,538
1988	2,597	2.00	5,194	97	5,038	1,266		1,266	3,772	13,310
1989	3,003	2.00	6,006	97	5,826	8,741	300	9,041	-3,215	10,095
1990	3,493	2.45	8,558	98	8,387	10,000	428	10,428	-2,041	8,054
1991	4,073	2.45	9,979	98	9,779	11,228	998	12,226	-2,447	5,607
1992	4,709	2.70	12,714	98	12,460	12,755	1,271	14,026	-1,566	4,041
1993	5,422	2.70	14,639	98	14,346	14,133	1,464	15,597	-1,251	2,790

1/ From Tables 9A, 9B and 9C.
2/ Gross revenues from water sales reduced by bad debt allowance.
3/ Total of project debt service, operation and maintenance costs.
4/ Ten percent of gross water sales, after completion of construction. (5 percent for the first two years)
5/ Includes the costs of replacing the first complement of project components with seven years of life expectancy.

FINANCIAL TABLE 6 - B

LEGASPI WATER SUPPLY PROJECT
ILLUSTRATIVE CASH FLOW TABLE
₱1,000's EXCEPT CHARGES PER UNIT

Year	Revenue Units 1/	Charges Per Unit	Gross Revenues	Net Revenues 2/		Basic Costs 3/	Required Reserves 4/	Total Costs 5/	Net Income	
				%	Amount				Annual	Cumulative
1994	5,422	2.9	15,724	98	15,409	14,839	1,572	16,411	-1,002	1,788
1995	5,422	2.9	15,724	98	15,409	15,108	1,572	16,680	-1,271	517
1996	5,422	2.9	15,724	98	15,409	15,432	1,572	17,004	-1,595	-1,078
1997	5,422	3.2	17,350	98	17,003	15,817	1,735	17,552	-549	-1,627
1998	5,422	3.2	17,350	98	17,003	16,269	1,735	18,004	-1,001	-2,628

1/ From Tables 9A, 9B and 9C.

2/ Gross revenues from water sales reduced by bad debt allowance.

3/ Total of project debt service, operation and maintenance costs.

4/ Ten percent of gross water sales, after completion of construction.

5/ Includes costs of replacing the dirst complement of project components with seven years of life expectancy.

資　　料

資料 1. 水質試験記録

本調査では既存水源および将来水源として可能性のあるものについて水質試験を行なう。試験結果を表 1.1 に、またフィリピン国の水質基準を表 1.2 に示す。湧水、深井戸ならびに伏流水の水質をまとめると以下の通りである。

1) 湧　　水

a　ほとんどの湧水水質は、消毒以外の処理施設を必要としない良質のものである。

b　通常、軟水水質であり非腐蝕性である。溶解性物質の濃度、硬度、塩分濃度はきわめて低い値を示している。

c　バニャデロ湧水の水質は、比較的硫酸分に富んでいる（600㎎/ℓ）。健康上また、パイプ保護のためには他の硫酸分の少ない湧水と混合して給水することが望まれる。

2) 深　井　戸

a　都市部にある深井戸の水質は色度、においとも高い値を示している。

b　家事用水としては好ましくない溶解性物質の濃度は高い。

c　家庭汚水からの汚染の心配はない。

3) 伏　流　水

河床に掘られた浅井戸および伏流水の水質は、概して良好である。現在、近隣の住民によって使用されており、家事用水としても処理する必要はないものと思われる。

水質分析表

Table 1 Water Quality of Existing Water Soueces in Legaspi City and Daraga

Items \ Source	Budiao Spring No. 1	Budiao Spring No. 2	Banadero Spring	Daraga Spring	Camp Ibalon Deep Well	Bogtong Spring	Salbacion Spring	Tinapian Spring	Lacag Spring	Buyoan Spring	Tinago Deep Well	Malabog Spring	Bicol Deep Well	Bitano Deep Well
Sampling date	10 Aug	10 Aug	10 Aug	11 Aug	11 Aug	11 Aug	19 Aug	14 Aug	17 Aug	11 Aug	11 Aug	11 Aug	11 Aug	11 Aug
Weather	fine	fine	fine	Clouded	Clouded	Clouded	fine	fine	fine	Clouded	Clouded	Clouded	Clouded	Clouded
Atom. Temperature (°C)	27	27	27	25	25	25	28	27	26	25	25	25	25	25
Water Temperature (°C)	25	25	26	26	27	26	26	23	24	24.5	29	26	36	27
Turbidity (mg/l)	0	0	0	0	0	0	0	0	8	0	5	0	0	20
Color (mg/l)	0	0	0	10	15	0	0	0	0	0	20	0	8	40
Conductivity(μS/cm)	350	380	1060	650	1000	1050		230		340	2600	320	1690	
Hardness (mg/l)	60	85	310	775	100	190	67.5	35	25	95	325	50	30	300
Calcium (mg/l)	12	16	96	20	32	64	13	8	6	22	90	12	8	64
Magnesium (mg/l)	7.3	8.5	17	6.7	4.9	7.3	9	3.6	2.4	9.7	24	5	2.4	34
Chloride (mg/l)	12	18	76	36	70	40	50	12	35	12	340	10	230	290
pH	7.2	7.1	7.2	6.9	6.8	7.4	7.0	6.6	6.9	6.8	7.6	6.6	6.5	7.6
Alkalinity (mg/l)	70	50	80	60	160	100	80	40	50	70	240	80	200	210
Sulfate (mg/l)	2	1	600	20	15	140	2.5	0	1	0	215	0	41	275
Ammonia-N (mg/l)	<0.3	<0.3	<0.3	0.3	2.5	<0.3	<0.3	<0.3	0.4	<0.3	1.0	<0.3	1.5	2.0
Iron (mg/l)	0.001	0.01	0.015	0.01	0.01	0.01	0.01	0.015	0.045	0.005	0.025	0.01	0.015	0.04
Manganese (mg/l)	0.05	nil	0.05	0.15	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.02	0.10	0.35
Odor[1/]	0	0	1	1	3	1	0	0	0	0	4	2	4	5
Total Bacteria (/ml)	negative	100	100	90	negative	20	50	50	more than 3000	negative	negative	negative	negative	negative
Coliform groups (/ml)	negative	negative	negative	50	negative	20	15	20	more than 1000	negative	negative	negative	negative	negative

フィリピン国飲料水質基準

Table 2 Water Quality Standard
Key Parameters of the Philippines
Standard for Drinking Water

Parameters[1/]	Permissible Level[2/]	Maximum Permissible[2/]
Coliform groups	No detecting in 100 ml	-
Total Bacteria	10/ml	-
Odor	Unobjectionable	-
Taste	Unobjectionable	-
Color	5 units	50 units
Turbidity	5 units	25 units
Total solids	500	1,500
pH	7.0 - 8.5	6.5 - 9.2
Total hardness	100	500
Calcium, as Ca	75	200
Magnesium, as Mg	50	150
Chloride, as Cl	200	600
Sulfate, as SO_4	200	400
Nitrate, as NO_3	-	30
Iron, as Fe	0.3	1.0
Manganese, as Mn	0.1	0.5

1/ The above table shows only main parameters of the Standard, which are considered essential for judging characteristics of drinking water quality.

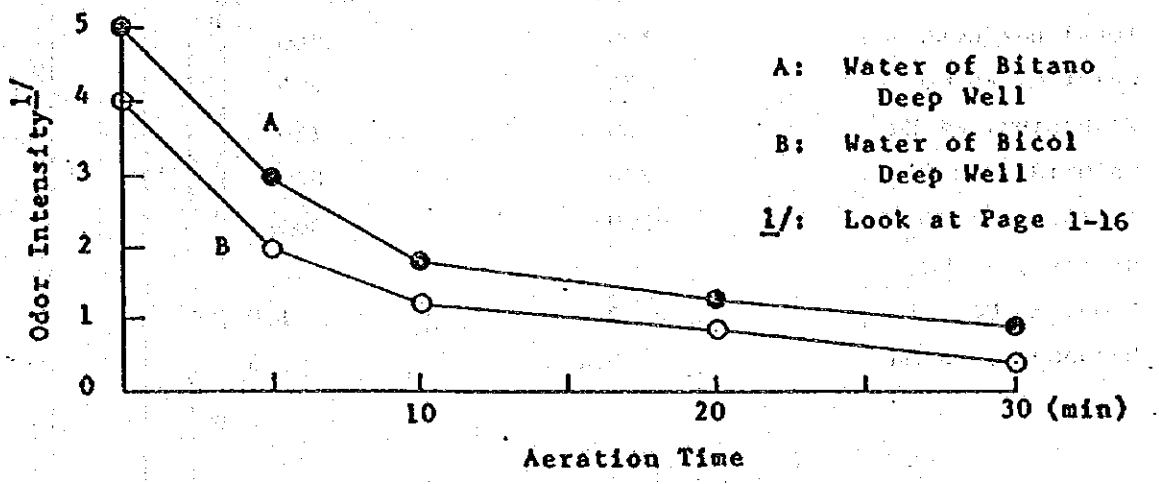
2/ All units are in mg/l, unless otherwise stated.

上記水源水質のうち特記すべき事項は、いくつかの湧水を除き、特に深井戸水は、水素硫化物の臭気および色度が高い値を示していることである。以下に臭気および色度について説明を加える。

1) 水素硫化物による臭気

第1編「水道の現況」の表1.3.1に示すように、調査地域の深井戸水は、特に強い臭気がある。これは、火山地域に一般的にみられる現象である。この硫化水素臭は、硫酸の還元によるものと思われる。一方、河川表流水、浅井戸およびいくつかの湧泉の臭気は零かあってもわずかである。

臭気を除去するために、現地でエアレーションテストを実施した。その結果、図1に示すように、短時間で臭気は減少した。



エアレーションによる臭気除去結果

Fig 1 Test Result of Odor Removed by Aeration

2) 色　　度

表1.3.1に示すように、調査地域のほとんどの深井戸水およびダラガ湧水は黄色を呈しており、その色度は、飲料水水質基準をはるかに超えている。色度の原因は、溶解性物質によるものと思われ、色度と溶解性物質の関連を調査した。

その結果、図2に示すように、色度に対するマンガンの相関係数が0.94と高いことが判明した。

3) 結　　論

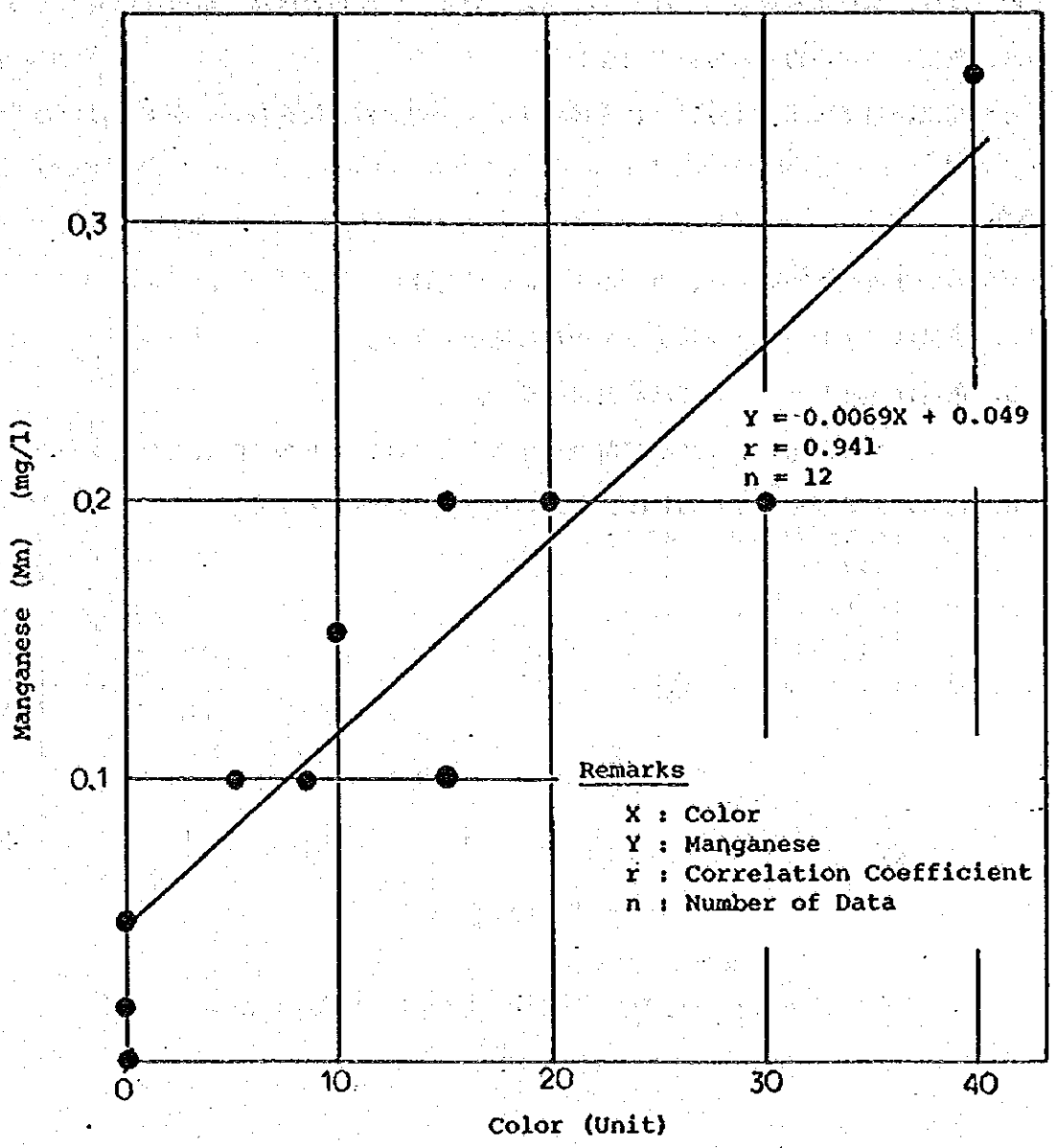
臭気および色度については、以下のように結論付けられる。

a. 臭気はエアレーションによって簡単に除去できる。

b. 色度はエアレーションでは除去できない。

c. マンガンを酸化によって不溶解性にするためには、10 mg/ℓ 以上の塩素が要求される。

d. 色度除去処理を行うためには、一連の浄水処理が必要となる。



色度とマンガンの相関関係

Fig 2 Correlation of Color and Manganese Concentration

資料2. 送水管の現況

アルバイ州水道の送水管は１９８１年６月の洪水により、ひどい損傷を受けたままとなっている。マヨン火山のふもとに布設されたパイプラインがとくにひどく、玉石、砂利、砂を含んだマヨン火山からの泥流により損傷を受けたものと思われる。パイプの破損状況を調べ、その改善方策を見い出す目的で現地調査を行なった。調査時点は洪水２ケ月後の１９８１年８月である。調査結果を以下にまとめる。

1. ブディアオ湧水系

a. 付図に示すA地点およびB地点の間で、管路の破損個所が多く見られた。目に付く破損個所は既に応急処置がとられており、現在通水している。

b. B地点では、満管では流れていない。

c. B地点およびその下流側では、パイプから直接ハンドポンプを使用して取水している需用家もいる。

d. B地点およびC地点のほぼ中央付近に、排気用のパイプが設置してあり、稼動中であった。

e. C地点の水圧は 0.5 kg/cm^2 であった。

f. A地点における湧水量の測定値は 7,６００ m^3/日程度であった。なお、過去のデータでは6,540 m^3/日が最小湧水量である。

g. パイプの通水能力は、流速係数　C＝９０を仮定して 3,９００ m^3/日と計算される。

上述の調査結果は、1) A地点およびB地点の間には、修理が行き届いていないパイプの破損個所が依然存在している、2)現在のパイプ中の流量はその通水能力に比べてはるかに少ない、3)湧水量は充分にあるが、たとえパイプが完全に修理されたとしても、湧水量全部を流せるだけのパイプの通水能力は現在のところない、の３点に集約される。

2. バニャデロ湧水系

現地調査時点においては、未だ、パイプの修理は行なわれていなかった。取水施設も同様に破損しており、実際の湧水量は確認されなかった。

口径、延長より、管路の通水能力はC＝９０を仮定して2,２００ m^3/日と計算された。なお、湧水量のデータは2,９４０ m^3/日である。

送水管路線図

Fig 1 Location Map of Transmission Pipelines

資料 3. ダラガ地区の水圧分布

ダラガ地区における水圧分布および時間変動を調べるために、図1および図2に示すように送水管上の4地点を選定し、水圧測定を行なった。

送水管が最初に分岐する地点をR－1点とし、分岐直後の2地点をそれぞれR－2点、R－3点と設定した。R－4点として、ダラガポブラシオン地区の末端で水圧が特に低いと予想される地点を選定した。R－4点に対しては、記録計をメイン管より4m下側にある給水栓にとりつけた。

図からも明らかなように、4地点の水圧はいずれも常時低い。最大水圧でも1 Kg/cm² 以下である。とくに午前6時～8時の間は、0.2 Kg/cm² と極端に下がることがわかる。

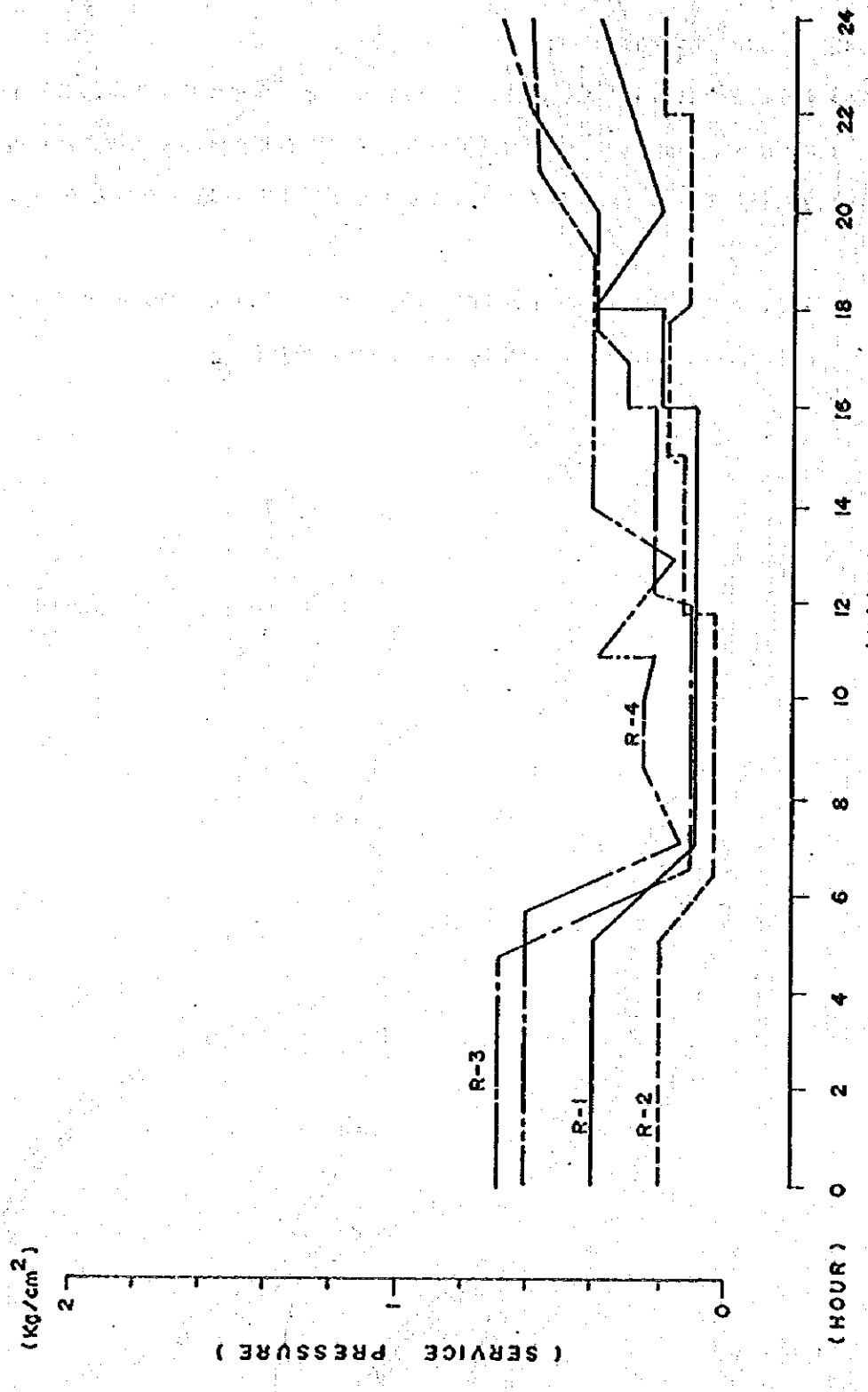
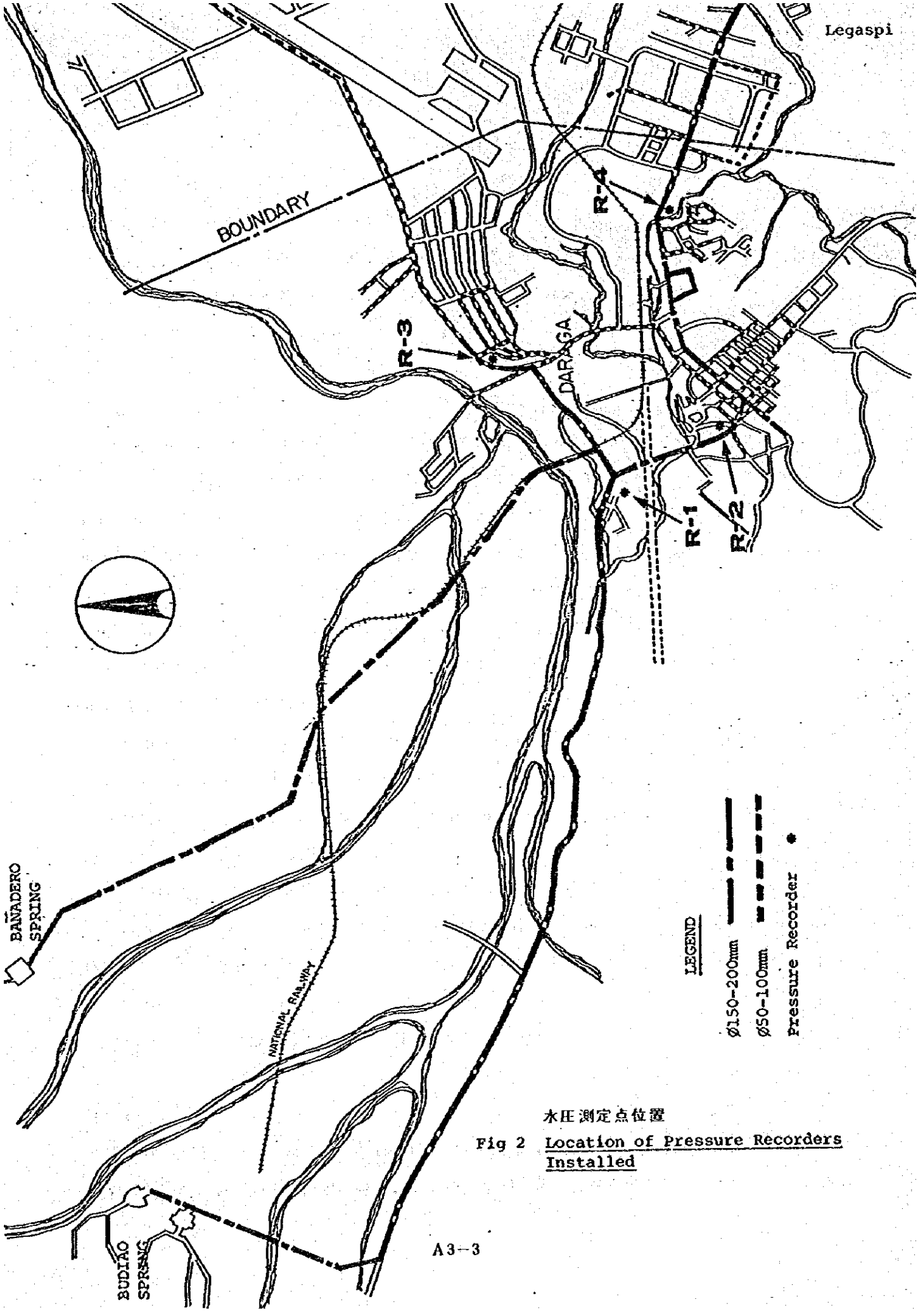


Fig 1 水圧測定結果
Variation of Water Pressure in Daraga
(Aug. 1981)



水圧測定点位置

Fig 2 Location of Pressure Recorders Installed