17.1.4 Cash Flow Statement

1) Cash Flow

Table 17-1-15 shows the projected cash flow from 1990 to 2020. Estimate condition of each items to be counted in cash flow are as follows.

a. Cash Inflow

- Government contribution

  capital contribution for interest payment of domestic loan.

- Loan

  Local and foreign loan disbursement is estimated based on the Alternative 4 financing plan.

- Water sales, connection charge and service charge.

  Detailed estimation is shown in Table 17-1-11, 17-1-13 and 17-1-14.

- Other income

  This income is including sales of materials, fine penalties and other, and estimated 2 percent of total water sales of each year.

b. Cash Outflow

- Project expenditure

  It is according to capital disbursement schedule for Implementation plan.

- Amortization

  Alternative 4 financing plan is adopted in the debt service calculation.

- Operation & maintenance

  Details are shown in chapter 11.

- Connection expenses

  50 percent of Connection Fee.

- Share of Head Office.

As clearly shown in this table, from 2003, the net cash flow ended in a defect.

After 1994, net annual revenue surpluses are forecasted not enough cover throughout the phase II construction period and operation and expenditures in the maintenance period, amortization cost and operating expenses.

Table 17-1-15 Projected Cash Flow at 1989 Price (Cont'd)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cash Inflow																
Government contribution																
Capital contribution	0	0	0	676	750	833	1,090	1,210	1,343	1,490	1,654	1,836	2,038	344	382	424
Laon	0	0	4,433	10,743	52,239	13,543	0	0	0	0	0	0	0	0	0	
Local loan	0	0	770	1,452	9,079	2,769	0	0	0	0	0	0	0	0	0	79
Foreign loan	0	0	3,663	9,291	43,160	10,774	0	0	0	0	0	0	0	0	0	413
Operating Revenue	9,342	9,640	10,222	10,612	11,062	11,513	11,965	12,376	12,846	13,320	13,831	14,313	14,955	15,564	16,182	16,837
Water Sales	8,928	9,216	9,588	9,948	10,368	10,788	11,208	11,628	12,072	12,516	12,996	13,440	13,968	14,532	15,108	15,720
Connection Fee	208	212	412	433	453	472	494	473	489	507	526	552	653	682	710	737
Service Charge	27	28	30	32	34	37	39	42	44	47	49	52	55	59	62	66
Ohter Income	179	184	192	199	207	216	224	233	241	250	260	269	279	291	302	314
Total Inflow	9,342	9,640	14,654	22,031	64,051	25,888	13,055	13,586	14,189	14,810	15,485	16,149	16,993	15,908	16,564	17,753
Cash Outflow																
Project expenditures																
Local portion	0	0	2,638	5,691	31,105	8,769	0	0	0	0	0	0	0	0	0	281
Foreign portion	0	0	2,564	6,504	30,212	7,542	0	0	0	0	0	0	0	0	0	289
Amortization																
Principal	0	0	0	0	0	305	338	375	744	826	917	1,096	3,053	3,250	3,451	2,805
Interest	0	0	184	594	2,758	3,354	3,279	3,197	3,105	2,985	2,852	2,704	2,541	2,289	1,931	2,067
Operating Expenses	4,878	6,019	6,314	6,636	6,867	8,495	10,011	10,348	10,718	11,256	11,670	12,207	12,884	14,372	15,111	15,950
O & M Cost	2,513	3,602	3,733	3,982	4,131	5,678	7,111	7,385	7,671	8,123	8,446	8,893	9,429	10,806	11,431	12,151
Connection Expenses	104	106	206	217	227	236	247	237	245	254	263	276	327	341	355	369
Share of Head Office	2,261	2,311	2,375	2,437	2,509	2,581	2,653	2,726	2,802	2,879	2,961	3,038	3,128	3,225	3,325	3,430
Total Outflow	4,878	6,019	11,700	19,425	70,942	28,465	13,628	13,920	14,567	15,067	15,439	16,007	18,478	19,911	20,493	21,392
Net Cash flow	4,464	3,621	2,954	2,606	-6,891	-2,577	-573	-334	-377	-256	46	142	-1,484	-4,003	-3,929	-3,639
Accumulated	4,464	8,085	11,039	13,646	6,755	4,178	3,605	3,271	2,894	2,638	2,684	2,826	1,342	-2,662	-6,590	-10,229

Table 17-1-15 Projected Cash Flow at 1989 Price (Cont'd) (Unit: Baht x 1000)

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cash Inflow															
Government contribution															
Capital contribution	5	5	6	6	7	8	9	10	11	12					
Laon															
Local loan															
Foreign loan															
Operating Revenue	17,513	18,124	18,828	19,563	20,327	21,095	21,095	21,095	21,095	21,095	21,095	21,095	21,095	21,095	21,095
Water Sales	16,332	16,968	17,628	18,324	19,044	19,740	19,740	19,740	19,740	19,740	19,740	19,740	19,740	19,740	19,740
Connection Fee	784	743	770	792	817	870	870	870	870	870	870	870	870	870	870
Service Charge	70	74	77	81	85	90	90	90	90	90	90	90	90	90	90
Onter Income	327	339	353	366	381	395	395	395	395	395	395	395	395	395	395
Total Inflow	17,518	18,129	18,834	19,569	20,334	21,103	21,104	21,105	21,106	21,107	21,095	21,095	21,095	21,095	21,095
Cash Outflow															
Project expenditures															
Local portion															
Foreign portion															
Amortization															
Principal	2,948	3,103	2,412	2,498	2,590	2,466	3,138	3,196	3,292	3,292	3,496	3,605	3,511	3,606	3,703
Interest	1,924	1,769	1,602	1,515	1,424	1,328	1,251	1,154	1,057	957	853	745	632	537	440
Operating Expenses	16,977	17,805	19,058	20,281	21,072	22,175	22,175	22,175	22,175	22,175	22,175	22,175	22,175	22,175	22,175
O & M Cost	13,050	13,788	14,915	16,007	16,661	17,618	17,618	17,618	17,618	17,618	17,618	17,618	17,618	17,618	17,618
Connection Expenses	392	372	385	396	409	435	435	435	435	435	435	435	435	435	435
Share of Head Office	3,535	3,645	3,758	3,878	4,002	4,122	4,122	4,122	4,122	4,122	4,122	4,122	4,122	4,122	4,122
Total Outflow	21,849	22,677	23,072	24,294	25,086	25,969	26,564	26,525	26,524	26,424	26,524	26,525	26,318	26,318	26,318
Net Cash flow	-4,331	-4,547	-4,238	-4,725	-4,752	-4,866	-5,460	-5,420	-5,418	-5,317	-5,429	-5,430	-5,223	-5,223	-5,223
Accumulated	-14,560	-19,108	-23,346	-28,070	-32,822	-37,688	-43,149	-48,569	-53,987	-59,304	-64,733	-70,164	-75,387	-80,610	-85,833

The result of this cash flow statement reveals that the annual net cash flow will not continuously raise profit surpluses throughout after 1994. The cumulative deficit will be 32,822 thousand Baht in 2010 and 85,833 thousand Balt in 2020, respectively.

As a sensitivity analysis, cash flow statement are also made on the assumption that the water tariff including connection and service charges will be increased every three years at the rate of five percent per annum adjusting for inflation of five percent per year. The result of this study reveals, as shown in Appendix A17-1-6, that the annual net cash flow, also will not continuously raise profit surpluses throughout after 1994 except year of 2000 and 2001.

The cumulative deficit amount will be 76,213 thousand Baht in 2011 and 185,000 thousand Baht in 2020, respectively.

2) Share of Head and Regional Office Overhead Expenses

PWA is administratively, technically, economically and financially independent from the central government. Therefore, in order that total financial independence can be achieved by the PWA in the future, administrative expenses of its head and regional office, such as inventories, personal expenses and consignment fee shall be charged to the revenue of each waterworks.

In view of the above, it is recommended that the share allocation of administrative expenses shall be calculated based on number of waterworks and gross revenue of each waterworks.

Table 17-1-16 shows share of Head and Regional Office Overhead Expenses in 1986 and 1987.

Table 17-1-16 Share of Head and Regional Office Overhead Expenses
Su Ngai Golok (Regional Office No. 5)

YEAR 1986		
1. HEAD Office Expenses		
a) Per Waterworks Portion (1/3)	Baht	468,688
b) WW/PWA-Total Consumption Portion (2/3)	Baht	1,099,594
2. Regional Office Expenses		
a) Per Waterworks Portion (1/3)	Baht	212,281
b) WW/Region-Total Consumption Portion (2/3)	Baht	367,006
TOTAL SHARE OF HEAD AND REGIONAL OFFICE OVERHEAD EXPESES	Baht	2,147,570

YEAR 1987		
1. HEAD Office Expenses		
a) Per Waterworks Portion (1/3)	Baht	517,498
b) WW/PWA-Total Consumption Portion (2/3)	Baht	1,210,764
2. Regional Office Expenses		
a) Per Waterworks Portion (1/3)	Baht	207,358
b) WW/Region-Total Consumption Portion (2/3)	Baht	365,087
TOTAL SHARE OF HEAD AND REGIONAL OFFICE OVERHEAD EXPESES	Baht	2,300,707

3) Unit Cost of Water

As shown in Table 17-1-17, the unit cost after debt service which will register 7.70 Baht per cu m in 2011 or equal to 80 percent of the average unit water cost from year 1990 to 2011 and almost fourth level of present water tariff structure of PWA. And average unit water cost from 1990 to 2020 is projected to stand at 8.54 Baht or sixth level of present water tariff.

The unit cost after depreciation is shown in Appendix A12-1-7.

Table 17-1-17 Unit Cost of Water

(Unit :Baht x 1000)

year	Water Consumption (cu.m/day)	Capital Investemen	Operating Expenses	Head Share	Total Expenses	Unit Water Cost (Baht/cu.m)
1990	3,653	0	2,617	2,261	7,139	5.35
1991	3,782	0	3,708	2,311	8,330	6.03
1992	3,970	5,202	3,939	2,375	13,891	9.59
1993	4,166	12,195	4,199	2,437	21,268	13.99
1994	4,372	61,317	4,358	2,509	70,693	44.30
1995	4,586	16,311	5,914	2,581	27,387	16.36
1996	4,810	0	7,358	2,653	12,664	7.21
1997	5,027	0	7,622	2,726	13,074	7.13
1998	5,252	0	7,916	2,802	13,520	7.05
1999	5,487	0	8,377	2,879	14,135	7.06
2000	5,732	0	8,709	2,961	14,631	6.99
2001	5,986	0	9,169	3,038	15,245	6.98
2002	6,271	0	9,756	3,128	16,012	7.00
2003	6,568	0	11,147	3,225	17,597	7.34
2004	6,879	0	11,786	3,325	18,436	7.34
2005	7,203	570	12,520	3,430	19,950	7.59
2006	7,541	0	13,442	3,535	20,512	7.45
2007	7,879	0	14,160	3,645	21,450	7.46
2008	8,229	0	15,300	3,758	22,816	7.60
2009	8,593	0	16,403	3,878	24,159	7.70
2010	8,971	0	17,070	4,002	25,074	7.66
2011	9,361	0	18,053	4,122	26,297	7.70
2012	9,361	0	18,053	4,122	26,297	7.70
2013	9,361	0	18,053	4,122	26,297	7.70
2014	9,361	0	18,053	4,122	26,297	7.70
2015	9,361	0	18,053	4,122	26,297	7.70
2016	9,361	0	18,053	4,122	26,297	7.70
2017	9,361	0	18,053	4,122	26,297	7.70
2018	9,361	0	18,053	4,122	26,297	7.70
2019	9,361	0	18,053	4,122	26,297	7.70
2020	9,361	0	18,053	4,122	26,297	7.70
Average Unit Water Cost (1990-2020) :						8.54

4) Average Water Rate

In view of revenue aspects, average water tariff is calculated based on water sales and is shown in Table 17-1-18.

5) Depreciation

At the end of the project, it may reasonably be expected to exist some residual (or terminal) value. That is, the capital asset will not have been used up in the course of the project period, and there will be a "residual asset". In this financial study, project period is established for 31 years from 1990 to 2020. The residual value is, therefor added to the benefit stream in the last year 2020.

Table 17-1-19 shows th depreciation of the project fixed assets of water supply system, such as intake facility, treatment plant and mechanical & electrical equipment.

For calculating, following conditions are adopted.

Depreciation method : Straight - line method
Final Salvage value : 10 percent of investment Cost

Durable years :

1. Raw Water Intake : 27 years
2. Treatment Plant : 30 years
3. Transmisiion Pipeline : 30 years
4. Distribution Pipeline : 28 years

Durable years of facilities was calculated by weighted average of each component. As shown in the Table, total salvage value in the year 2011 and 2020 are 41,728 thousand Baht and 18,281 thousand Baht, respectively.

Table 17-1-18 Average Water Tariff

Year	Water Consumption (cu.m/d)	Water Sales (1000 Baht /year)	Average Water Tariff (Baht/cu.m)
1990	3,653	8,928	6.70
1991	3,782	9,216	6.68
1992	3,970	9,588	6.62
1993	4,166	9,948	6.54
1994	4,372	10,368	6.50
1995	4,586	10,788	6.44
1996	4,810	11,208	6.38
1997	5,027	11,628	6.34
1998	5,252	12,072	6.30
1999	5,487	12,516	6.25
2000	5,732	12,996	6.21
2001	5,986	13,440	6.15
2002	6,271	13,968	6.10
2003	6,568	14,532	6.06
2004	6,879	15,108	6.02
2005	7,203	15,720	5.98
2006	7,541	16,332	5.93
2007	7,879	16,968	5.90
2008	8,229	17,628	5.87
2009	8,593	18,324	5.84
2010	8,971	19,044	5.82
2011	9,361	19,740	5.78
2012	9,361	19,740	5.78
2013	9,361	19,740	5.78
2014	9,361	19,740	5.78
2015	9,361	19,740	5.78
2016	9,361	19,740	5.78
2017	9,361	19,740	5.78
2018	9,361	19,740	5.78
2019	9,361	19,740	5.78
2020	9,361	19,740	5.78

Table 17-1-19 Depreciation

(Unit: Baht x 1000)

	Phase I					Phase II			
	Intake	Treatment Plant 1	Treatment Plant 2	Trans. Pipeline	Distri. Pipeline	Raw Water Intake	Yearly Total	Accum. Total	Salvage Value
Asset Price	4,320	25,015	10,928	17,400	26,787	570			
Year									
1990	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	129	0	129	129	9,280
1995	0	0	0	365	732	0	1,097	1,226	66,899
1996	125	750	328	522	861	0	2,586	3,813	80,066
1997	125	750	328	522	861	0	2,586	6,399	77,480
1998	125	750	328	522	861	0	2,586	8,985	74,894
1999	125	750	328	522	861	0	2,586	11,571	72,308
2000	125	750	328	522	861	0	2,586	14,158	69,721
2001	125	750	328	522	861	0	2,586	16,744	67,135
2002	125	750	328	522	861	0	2,586	19,330	64,549
2003	125	750	328	522	861	0	2,586	21,917	61,962
2004	125	750	328	522	861	0	2,586	24,503	59,376
2005	125	750	328	522	861	0	2,586	27,089	57,360
2006	125	750	328	522	861	19	2,605	29,694	54,755
2007	125	750	328	522	861	19	2,605	32,300	52,149
2008	125	750	328	522	861	19	2,605	34,905	49,544
2009	125	750	328	522	861	19	2,605	37,510	46,939
2010	125	750	328	522	861	19	2,605	40,115	44,334
2011	125	750	328	522	861	19	2,605	42,721	41,728
2012	125	750	328	522	861	19	2,605	45,326	39,123
2013	125	750	328	522	861	19	2,605	47,931	36,518
2014	125	750	328	522	861	19	2,605	50,537	33,912
2015	125	750	328	522	861	19	2,605	53,142	31,307
2016	125	750	328	522	861	19	2,605	55,747	28,702
2017	125	750	328	522	861	19	2,605	58,352	26,097
2018	125	750	328	522	861	19	2,605	60,958	23,491
2019	125	750	328	522	861	19	2,605	63,563	20,886
2020	125	750	328	522	861	19	2,605	66,168	18,281
2021	125	750	328	522	861	19	2,605	68,773	15,676
2022	125	750	328	522	861	19	2,605	71,379	13,070
2023	0	750	328	522	861	19	2,480	73,859	10,590
2024	0	750	328	522	732	19	2,351	76,210	8,239
2025	0	750	328	157	129	19	1,383	77,593	6,856
2026	0	0	0	0	0	19	19	77,612	6,837
2027	0	0	0	0	0	19	19	77,631	6,818
2028	0	0	0	0	0	19	19	77,650	6,799
2029	0	0	0	0	0	19	19	77,669	6,780
2030	0	0	0	0	0	19	19	77,688	6,761
2031	0	0	0	0	0	19	19	77,707	6,742
2032	0	0	0	0	0	19	19	77,726	6,723
2033	0	0	0	0	0	0	0	77,726	6,723
2034	0	0	0	0	0	0	0	77,726	6,723
2035	0	0	0	0	0	0	0	77,726	6,723
2036	0	0	0	0	0	0	0	77,726	6,723
2037	0	0	0	0	0	0	0	77,726	6,723
2038	0	0	0	0	0	0	0	77,726	6,723
2039	0	0	0	0	0	0	0	77,726	6,723
2040	0	0	0	0	0	0	0	77,726	6,723

17.1.5 Financial Analysis

To determine the viability of the project, all costs and benefits shall be transformed to their present values at nine percent discount rate. This is the rate assumed to represent the pertinent opportunity cost of capital. A low discount rate, however, is considered justified since the project shall benefit the rural consumers whose annual incomes are generally lower than urban consumers.

In this analysis the viability of project shall be measured by the following financial feasibility criteria:

$B/C > 1$

$NPV > 0$

where;

B - present value of benefits

C - present value of costs

B/C - ratio of benefits to costs

NPV - net present value or B - C

A $B/C > 1$, or an $NPV > 0$ at nine percent discount rate, indicates that the project is feasible, i.e. financial benefits exceed financial costs at the prevailing opportunity cost of capital, fence, the project is viable for implementation, Table 17-1-20 represents the tabulation and calculation of Financial Benefit and Cost for the project. As clear in this table, NPV is -77,663 thousand Baht and B.C. Ratio is 0.31 respectively.

These figures are less than financial feasibility criteria but it is to be noted in this connection that these figures refer only to incremental earnings of the newly invested capital and if the formerly invested capital are combined, the project is considered financially more feasible than the case of without this project. As a sensitivity study, Financial Benefit and Cost which include sunk cost and benefit from such investment are calculated in Table 17-1-21. In this case, NPV is -14,183 thousand Baht and B.C. ratio is 0.94. The undertaking of the project is therefore suggested that more soft condition loan or government subsidy are required to proceed the project and achieve the financial self-standing of waterworks.

Table 17-1-20 Financial Benefit and Cost

(Unit :Baht x 1000)

year	Govern. Subsidy	Operating Income	Total Income	Capital Invest.	Operating Expenses	Total Expenses	Net Income	Present Value Benefit	Present Value Cost	Present Value Net Income
1990	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	5,202	0	5,202	-5,202	0	4,378	-4,378
1993	0	0	0	12,195	0	12,195	-12,195	0	9,417	-9,417
1994	0	0	0	61,317	0	61,317	-61,317	0	43,439	-43,439
1995	676	0	676	16,311	0	16,311	-15,635	439	10,601	-10,162
1996	750	452	1,202	0	1,516	1,516	-314	717	904	-187
1997	833	863	1,696	0	1,853	1,853	-157	928	1,014	-86
1998	1,090	1,333	2,423	0	2,223	2,223	200	1,216	1,116	100
1999	1,210	1,807	3,017	0	2,761	2,761	256	1,389	1,271	118
2000	1,343	2,318	3,661	0	3,175	3,175	486	1,546	1,341	205
2001	1,490	2,800	4,290	0	3,712	3,712	578	1,663	1,439	224
2002	1,654	3,442	5,096	0	4,389	4,389	707	1,812	1,560	251
2003	1,836	4,051	5,887	0	5,877	5,877	10	1,920	1,917	3
2004	2,038	4,669	6,707	0	6,616	6,616	91	2,007	1,980	27
2005	344	5,324	5,668	570	7,455	8,025	-2,357	1,556	2,203	-647
2006	382	6,000	6,382	0	8,482	8,482	-2,100	1,607	2,136	-529
2007	424	6,611	7,035	0	9,310	9,310	-2,275	1,626	2,151	-526
2008	5	7,315	7,320	0	10,563	10,563	-3,243	1,552	2,239	-687
2009	5	8,050	8,055	0	11,786	11,786	-3,731	1,567	2,292	-726
2010	6	8,814	8,820	0	12,577	12,577	-3,757	1,574	2,244	-670
2011	6	9,582	9,588	0	13,680	13,680	-4,092	1,570	2,239	-670
2012	7	9,582	9,589	0	13,680	13,680	-4,091	1,440	2,054	-614
2013	8	9,582	9,590	0	13,680	13,680	-4,090	1,321	1,885	-564
2014	9	9,582	9,591	0	13,680	13,680	-4,089	1,212	1,729	-517
2015	10	9,582	9,592	0	13,680	13,680	-4,088	1,112	1,586	-474
2016	11	9,582	9,593	0	22,175	22,175	-12,582	1,021	2,359	-1,339
2017	12	9,582	9,594	0	22,175	22,175	-12,581	936	2,164	-1,228
2018	0	9,582	9,582	0	22,175	22,175	-12,593	858	1,986	-1,128
2019	0	9,582	9,582	0	22,175	22,175	-12,593	787	1,822	-1,035
2020	0	9,582	9,582	0	22,175	3,894	5,688	722	293	429
Salvage Value						(-18,281)				
						NPV =		34,098	111,762	-77,663
						B/C =	0.31			

Table 17-1-21 Financial Benefit and Cost

(Unit :Baht x 1000)

year	Loan	Govern. Subsidy	Operating Income	Total Income	Capital Invest.	Operating Expenses	Debt Service	Total Expenses	Net Income	Present Value Benefit	Present Value Cost	Present Value Net Income
1990	0	0	9,342	9,342	0	4,878	0	4,878	4,464	9,342	4,878	4,464
1991	0	0	9,640	9,640	0	6,019	0	6,019	3,621	8,844	5,522	3,322
1992	4,433	0	10,222	14,655	5,202	6,314	184	11,700	2,955	12,334	9,848	2,487
1993	10,743	0	10,612	21,355	12,195	6,636	594	19,425	1,930	16,490	15,000	1,490
1994	52,239	0	11,062	63,301	61,317	6,867	2,758	70,942	-7,642	44,844	50,257	-5,413
1995	13,543	676	11,513	25,732	16,311	8,495	4,029	28,835	-3,104	16,724	18,741	-2,017
1996	0	750	11,965	12,715	0	10,011	4,029	14,040	-1,325	7,582	8,372	-790
1997	0	833	12,376	13,209	0	10,348	4,029	14,377	-1,168	7,226	7,865	-639
1998	0	1,090	12,846	13,936	0	10,718	4,195	14,913	-977	6,994	7,484	-490
1999	0	1,210	13,320	14,530	0	11,256	4,195	15,451	-921	6,690	7,114	-424
2000	0	1,343	13,831	15,174	0	11,670	4,195	15,865	-691	6,410	6,702	-292
2001	0	1,490	14,313	15,803	0	12,207	4,195	16,402	-599	6,124	6,356	-232
2002	0	1,654	14,955	16,609	0	12,884	6,761	19,645	-3,036	5,905	6,984	-1,079
2003	0	1,836	15,564	17,400	0	14,372	6,761	21,133	-3,733	5,676	6,893	-1,218
2004	0	2,038	16,182	18,220	0	15,111	6,761	21,872	-3,652	5,452	6,545	-1,093
2005	0	344	16,837	17,181	570	15,950	4,862	21,382	-4,201	4,717	5,870	-1,153
2006	0	382	17,513	17,895	0	16,977	4,862	21,839	-3,944	4,507	5,501	-993
2007	0	424	18,124	18,548	0	17,805	4,862	22,667	-4,119	4,286	5,238	-952
2008	0	5	18,828	18,833	0	19,058	4,397	23,455	-4,622	3,992	4,972	-980
2009	0	5	19,563	19,568	0	20,281	4,397	24,678	-5,110	3,806	4,800	-994
2010	0	6	20,327	20,333	0	21,072	4,397	25,469	-5,136	3,628	4,544	-916
2011	0	6	21,095	21,101	0	22,175	4,397	26,572	-5,471	3,454	4,350	-896
2012	0	7	21,095	21,102	0	22,175	4,397	26,572	-5,470	3,169	3,991	-821
2013	0	8	21,095	21,103	0	22,175	4,397	26,572	-5,469	2,908	3,661	-754
2014	0	9	21,095	21,104	0	22,175	4,397	26,572	-5,468	2,668	3,359	-691
2015	0	10	21,095	21,105	0	22,175	4,412	26,587	-5,482	2,448	3,083	-636
2016	0	11	21,095	21,106	0	22,175	4,412	26,587	-5,481	2,246	2,829	-583
2017	0	12	21,095	21,107	0	22,175	4,412	26,587	-5,480	2,060	2,595	-535
2018	0	0	21,095	21,095	0	22,175	4,399	26,574	-5,479	1,889	2,380	-491
2019	0	0	21,095	21,095	0	22,175	4,399	26,574	-5,479	1,733	2,183	-450
2020	0	0	21,095	21,095	0	22,175	4,399	26,574	-5,479	1,590	2,003	-413
Salvage Value								(-18,281)				
								NPV =		215,736	229,919	-14,183
								B/C =	0.94			

17.2 Economic Study

This section shows a evaluation of the anticipated economic benefits to be derived from the project and economic cost.

Evaluation is concentrated mainly on such benefits, among others , as public health, improvement of living environment and economic contribution to the community. Regarding the economic evaluation of the project, a most preferable approach may be quantification of the economic benefits and costs. But in may cases, there are many unquantifiable factors in the infrastructure development project, such as this water supply project; however, in this study, quantifiable benefits and cost is counted for analysis as much as possible. And intangible factors are also considered.

The first step in the economic analysis is to adjust financial prices to economic values by eliminating direct transfer payments. Direct transfer payments are payments that represent not the use of real sources but only the transfer of claims to real resources from one party in the same economic society to another. In this projects, the most large transfer payments are direct government subsidies and credit transactions that include loans, receipts, repayments of principal and interest payments. All these entries should be taken out before the financial accounts are adjusted to reflect economic values.

17.2.1 Economic Benefits of the Project

The main economic benefit which will be brought about by the implementation of the project as proposed in this study are summarized as follows.

Direct Benefits :

- Increase in the area and population to be served
- Continuous supply of safe water

Indirect Benefits :

- Increase of employment opportunity
- Improvement of health condition
- Increase in consumer satisfaction
- Increase in land values
- Increase in income in some productive sectors

1) Beneficial Value of Water

It is assumed that all residents is the served area would be willing to obtain water in sufficient quantities at a given price. In general, public charges such as water tariff are established lower than real its value by political reason. Taking the benefits for "consumer's satisfaction" into consideration, it is assumed that the economic value of water is 20 percent higher than the average rate per volume of water used in the financial analysis.

According to the result of questionnaire survey in Su Ngai Golok area, 38.4 percent of residents are willing to pay for water charge in the up-to-50 Baht bracket, 23.1 percent in the 51-100 Baht bracket. The remaining 38.5 percent didn't give clear answer.

In the meantime, it clears from water sales forecasting that average monthly water charge per connection is 106.55 Baht at 2011. This figure shows that water charge is about three percent of average monthly income of respondent, in 1988. If this water charge increase by 20 percent, monthly water charge of 130 Baht is considered within the willingness-to-pay of consumers.

Table 17-2-1 shows economic water value of the project.

Table 17-2-1 Eonomic Water Value

(Unit : Baht x 1000)

Year	Domestic	Govern.	Comme.	Indus.	Tourism	Others	Total
1990	3,211	2,347	374	72	3,672	1,037	10,714
1991	3,398	2,376	389	72	3,744	1,080	11,059
1992	3,658	2,419	403	72	3,802	1,152	11,506
1993	3,946	2,434	403	72	3,859	1,224	11,938
1994	4,234	2,477	403	86	3,931	1,310	12,442
1995	4,550	2,506	418	86	3,989	1,397	12,946
1996	4,882	2,549	418	86	4,046	1,469	13,450
1997	5,213	2,592	418	101	4,075	1,555	13,954
1998	5,573	2,635	432	101	4,104	1,642	14,486
1999	5,947	2,650	432	101	4,147	1,742	15,019
2000	6,336	2,693	432	115	4,176	1,843	15,595
2001	6,754	2,707	432	115	4,190	1,930	16,128
2002	7,200	2,750	432	130	4,205	2,045	16,762
2003	7,690	2,794	432	130	4,219	2,174	17,438
2004	8,179	2,837	432	144	4,234	2,304	18,130
2005	8,712	2,880	432	144	4,248	2,448	18,864
2006	9,259	2,938	446	158	4,248	2,549	19,598
2007	9,821	2,981	446	173	4,248	2,693	20,362
2008	10,411	3,024	446	173	4,262	2,837	21,154
2009	11,016	3,082	446	187	4,262	2,995	21,989
2010	11,650	3,125	446	202	4,277	3,154	22,853
2011	12,298	3,182	446	202	4,277	3,211	23,616
2012	12,298	3,182	446	202	4,277	3,211	23,616
2013	12,298	3,182	446	202	4,277	3,211	23,616
2014	12,298	3,182	446	202	4,277	3,211	23,616
2015	12,298	3,182	446	202	4,277	3,211	23,616
2016	12,298	3,182	446	202	4,277	3,211	23,616
2017	12,298	3,182	446	202	4,277	3,211	23,616
2018	12,298	3,182	446	202	4,277	3,211	23,616
2019	12,298	3,182	446	202	4,277	3,211	23,616
2020	12,298	3,182	446	202	4,277	3,211	23,616

2) Benefit Pertinent to Health

Benefit pertaining to health which is the one of the purposes of installing a water supply system, involves both the community concerned and the individuals in the area. The anticipated benefits concerning health, viewed from public and individual standpoints, are detailed in the following.

(1) Benefits from Public Health Standpoint

Health benefit to accrue to the community from the water supply system has two aspects, namely, 1) the preventive effect brought forth by the water supply system reduces the burden on the local and central governments for the disease preventive activities and patient treatment facilities, and 2) the elimination of opportunities of contact with infected matters reduces epidemic cases on the part of the individuals.

Regarding the first item above, Budgetary and physical provisions of the governments will be lightened with respect to chemical disinfection for prevention of epidemics, hospitals together with necessary personnel and equipment and materials. Regarding the second items, details will be presented in the next subsection.

(2) Individual Health Benefits

The provision of the proposed water supply system results in health benefits to the individual people in the service area, such as reduction in the risk and incidence of water borne diseases, consequent elongation of life span, reduced expenditure on medical care, reduction in income loss through absence from work, and others.

Table 17-2-2 shows age-cause-specific distribution of patients and Medical Cost per capita in 1981.

Table 17-2-2 Age-Cause-Specific Distribution & Medical Cost Per Capita

Age	Type of Disease					
	Infective	Digestive	Respiratory	Delivery and Obstetric	Others	Total
0	0.114	0.017	0.135	0.276	0.458	1.0
1-4	0.045	0.016	0.181	0.0	0.758	1.0
5-14	0.010	0.061	0.066	0.001	0.862	1.0
15-24	0.001	0.010	0.002	0.044	0.933	1.0
25-44	0.001	0.020	0.004	0.034	0.941	1.0
45-64	0.005	0.040	0.027	0.0002	0.928	1.0
65+	0.001	0.034	0.044	0.0	0.011	1.0
Outpatient cost/ patient	74.33	101.83	66.88	66.23	78.04	
Inpatient cost/ patient	1,424.90	1,464.66	684.27	552.02	1,417.46	

Source: HOMES RESEARCH REPORT by Faculty of Economics, Thammasat University, National Economic and Social Development Board, and Asian Development Bank.

According to historical consumer price increase, it is estimated that outpatient cost per patient is 100 Baht and inpatient cost per patient is 2,000 Baht regarding Infective in 1989.

The following assumptions are made to calculate the saving of medical care cost by the installation of the water supply system .

a. The average number of water-borne disease occurred per 1,000 persons is to be 25.5 in the Study Area on the basis of the recorded incidences rate in the year 1987, which described in SECTION 1.2.4.

b. About 50 percent of the above cases is attributable to the in-provision of the adequate water supply system.

c. Hospitalization for treating these cases is on the average for two weeks, and amounts spent for medical care is about 300 Baht per day per patient.

d. About 30 percent of the population is actually economically active. The final figure for the cost of time lost due to illness was derived by taking the economically active portion of those afflicted by water-borne diseases by minimum daily salary of 67 Baht and 15 days based on the assumption that workers earning 67 Baht per day (67 Baht is the minimum salary rate of a laborer in southern part of Thailand) are unable to work for an average of 15 day described in the above clause.

The cost of the medical expenses was derived by multiplying the morbidity rate by the served population and the average expenditure for medical expenses of 300 Baht.

The sum of the two economic costs related to health benefits was adjusted by 50 percent to account for the fact that not all water-borne diseases are caused by a poor water supply system but may also be due to poor personal hygiene or lack of sewerage facilities.

The economic values derived from health benefits is shown in Table 17-2-3.

These benefits are more quantifiable in due assumptions which are based on various available data. Hence, an estimate of such benefit in the monetary terms was exhausted possible means.

3) Contribution to Local Economy

The construction of the water supply system contributes substantially to the local economy in several ways.

In the first place, land value in the area will be appreciated, and in accordance with such an increase in land value, related properties will also rise in value. On the other hand, the construction of the system furnishes employment opportunities to the local people and purchases local products of materials and equipment. Some of the above benefits are quantifiable while others are not.

(1) Value Added to Land

Investment in water supply facilities, and also in other public utilities such as sewerage, electricity and road improvement, have the effect of raising the intrinsic value of the parcels of land served by those facilities. The value added per unit of land tends to equal or exceed pro rate share of the investment involved.

In the present project area, this benefit is considered especially significant. The value of the benefit will be measured by the additional prices buyers are willing to pay for properties on which physical improvements have been made. It is because the buyers appreciate the possible intensive use of land, not to mention the improved quality of amenity in the area.

Table 17-2-3 Health Benefits

(Unit : Baht x 1000)

Year	Served Population	Cost of Time Loss (A)	Medical Expenses (B)	Total Economic Loss	Reduction Due to Project
1990	10,606	81.5	1,217.0	1,298.6	649
1991	11,113	85.4	1,275.2	1,360.7	680
1992	12,065	92.8	1,384.5	1,477.2	739
1993	13,065	100.4	1,499.2	1,599.7	800
1994	14,113	108.5	1,619.5	1,728.0	864
1995	15,210	116.9	1,745.3	1,862.3	931
1996	16,355	125.7	1,876.7	2,002.5	1,001
1997	17,454	134.2	2,002.8	2,137.0	1,069
1998	18,596	143.0	2,133.9	2,276.9	1,138
1999	19,782	152.1	2,270.0	2,422.1	1,211
2000	21,012	161.5	2,411.1	2,572.7	1,286
2001	22,286	171.3	2,557.3	2,728.7	1,364
2002	23,826	183.2	2,734.0	2,917.2	1,459
2003	25,435	195.6	2,918.7	3,114.2	1,557
2004	27,113	208.5	3,111.2	3,319.7	1,660
2005	28,859	221.9	3,311.6	3,533.4	1,767
2006	30,674	235.8	3,519.8	3,755.7	1,878
2007	32,436	249.4	3,722.0	3,971.4	1,986
2008	34,258	263.4	3,931.1	4,194.5	2,097
2009	36,139	277.8	4,147.0	4,424.8	2,212
2010	38,080	292.8	4,369.7	4,662.4	2,331
2011	40,081	308.2	4,599.3	4,907.4	2,454
2012	40,081	308.2	4,599.3	4,907.4	2,454
2013	40,081	308.2	4,599.3	4,907.4	2,454
2014	40,081	308.2	4,599.3	4,907.4	2,454
2015	40,081	308.2	4,599.3	4,907.4	2,454
2016	40,081	308.2	4,599.3	4,907.4	2,454
2017	40,081	308.2	4,599.3	4,907.4	2,454
2018	40,081	308.2	4,599.3	4,907.4	2,454
2019	40,081	308.2	4,599.3	4,907.4	2,454
2020	40,081	308.2	4,599.3	4,907.4	2,454

NOTE : (A) 30 % x 1.13/1000 x S.P. x 67 Baht x 15 Days
(B) 1.13/1000 x S.P. x 300 Baht x 15 Days

As shown in Chapter 1, the study are consists of the municipality and a neighboring area on the north in Tambon Pasemas of Amphor Su Ngai Golok as in Table 17-2-4.

Table 17-2-4 Land Area

Zone		Area(sq.km)
Zone 1	Low Density Residential Zone	5.77408
Zone 2	Medium Density Residential Zone	2.63808
Zone 3	High Density Resi./Commercial Zone	1.34208
Zone 4	Rural/Agricultural Zone	13.64552
Zone 5	Others	2.23024
Total		25.63

In the meantime, land prices are higher in the central commercial areas. In these area, typical official land prices are 2,000 Baht per sq.m upto 6,250 Baht per sq.m. The farther from the center and main roads areas are, the lower are the land prices. In these areas, typical official land prices do not exceed 100 Baht per sq.m. Actual market prices of land, however, are thought to be higher than market price.

On the basis of proportionate shares of estimated infrastructure investments in public utilities about five percent of total increase in land values have been attributed to the availability of water supply system. This benefit is developed in Table 17-2-5.

(2) Intensified Land Use

When water supply systems become available, coupled with other public utilities in general, the land in the area can be more intensively used, as the present project is implemented. More people can be supported and more activities in industry, commerce and others can be conducted in the project area. This project will, therefore contribute to this area which is expected to develop the important economic area of Thailand, but can't be immediately quantifiable its economic benefits.

(3) Public Revenue

Public tax revenue to the local and central government will be increased in two ways.

First, the appreciated land value will produce an increase in land tax revenue. On the other hand, buildings, such as for commerce, dwelling and others, will be graded up in quality and quantity, thus making possible an increase in property tax. This benefit cannot necessarily be quantified, but it can stitutes an important reliable tax source for the governments concerned.

Table 17-2-5 Economic Land Value Increase

(Unit : Baht x 1000)

	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Total	Increase	Benefit
Area(sq.km)	5.77408	2.63808	1.34208	13.64552	2.23024	25.63	Land	Due to
year	500	2,000	6,000	300	100	20,532,360	Value	Project
1990	2,887,040	5,276,160	8,052,480	4,093,656	223,024	20,532,360	0	0
1991	3,031,392	5,434,445	8,133,005	4,175,529	234,175	21,008,546	476,186	0
1992	3,182,962	5,597,478	8,214,335	4,259,040	245,884	21,499,698	491,152	0
1993	3,342,110	5,765,402	8,296,478	4,344,220	258,178	22,006,389	506,691	0
1994	3,509,215	5,938,365	8,379,443	4,431,105	271,087	22,529,215	522,826	0
1995	3,684,676	6,116,515	8,463,237	4,519,727	284,641	23,068,797	539,583	4,566
1996	3,868,910	6,300,011	8,547,870	4,610,122	298,873	23,625,786	556,988	9,426
1997	4,062,355	6,489,011	8,633,348	4,702,324	313,817	24,200,856	575,071	14,597
1998	4,265,473	6,683,682	8,719,682	4,796,370	329,508	24,794,715	593,859	20,099
1999	4,478,747	6,884,192	8,806,879	4,892,298	345,983	25,408,099	613,384	25,950
2000	4,702,684	7,090,718	8,894,948	4,990,144	363,283	26,041,776	633,677	26,808
2001	4,937,818	7,303,439	8,983,897	5,089,947	381,447	26,696,548	654,772	27,701
2002	5,184,709	7,522,543	9,073,736	5,191,746	400,519	27,373,252	676,704	28,629
2003	5,443,944	7,748,219	9,164,473	5,295,581	420,545	28,072,762	699,510	29,593
2004	5,716,142	7,980,665	9,256,118	5,401,492	441,572	28,795,990	723,227	30,597
2005	6,001,949	8,220,085	9,348,679	5,509,522	463,651	29,543,886	747,897	31,640
2006	6,302,046	8,466,688	9,442,166	5,619,712	486,833	30,317,446	773,560	38,678
2007	6,617,149	8,720,689	9,536,588	5,732,107	511,175	31,117,707	800,261	40,013
2008	6,948,006	8,982,309	9,631,954	5,846,749	536,734	31,945,752	828,045	41,402
2009	7,295,406	9,251,778	9,728,273	5,963,684	563,571	32,802,712	856,961	42,848
2010	7,660,177	9,529,332	9,825,556	6,082,957	591,749	33,689,771	887,059	44,353
2011	8,043,185	9,815,212	9,923,811	6,204,617	621,337	34,608,162	918,391	45,920

(4) Employment and Local Products

During the construction period, the local economy will benefit through the employment of individuals for construction work and through the purchase of locally made materials and supplies. The amount of investment for the project is sizable. The project after completion will also provide permanent employment opportunities for the operation and maintenance of water supply systems.

These economic benefit of production for employment opportunity should be counted in economic cost analysis by using the shadow pricing factor.

Some of the economic benefits, presently regarded as unquantifiable, may become quantifiable in the future when scientific tools useful for such evaluation are devised. Even at this stage where those benefits cannot be measured in the monetary terms, the benefits justify, it is judged, the proposed investment in the present water supply project. And further, the evaluation justifies that the investment is to be made from the fund sources of public and private beneficiaries, namely, the central, local province governments and PWA and the people in the area involved.

Summary of Economic Benefit is shown in Table 17-2-6.

Benefits of the proposed project have so far been considered from the three viewpoints of health, land value and contribution to the local economy. Some of the benefits were quantified, but most of them were treated as unquantifiable. Therefore, the benefits of the latter category have been elaborated in works. The calculations of the quantifiable benefits show that the monetary values to be gained in the period of 15 years after the completion of the project area equal to 1,129 million Baht, converted to present worth, 191 million Baht.

Table 17-2-6 Summary of Eonomic Benefits

(Unit : Baht x 1000)

Year	Economic Water Value	Health Benefits Cost of Time Loss	Medical Expenses	Total Economic Benefit	Increase Land Value	Total Economic Benefit
1990	10,714	82	1,217	649	0	11,363
1991	11,059	85	1,275	680	0	11,739
1992	11,506	93	1,385	739	0	12,245
1993	11,938	100	1,499	800	0	12,738
1994	12,442	109	1,620	864	0	13,306
1995	12,946	117	1,745	931	4,566	18,443
1996	13,450	126	1,877	1,001	9,426	23,877
1997	13,954	134	2,003	1,069	14,597	29,620
1998	14,486	143	2,134	1,138	20,099	35,723
1999	15,019	152	2,270	1,211	25,950	42,180
2000	15,595	162	2,411	1,286	26,808	43,689
2001	16,128	171	2,557	1,364	27,701	45,193
2002	16,762	183	2,734	1,459	28,629	46,850
2003	17,438	196	2,919	1,557	29,593	48,588
2004	18,130	209	3,111	1,660	30,597	50,387
2005	18,864	222	3,312	1,767	31,640	52,271
2006	19,598	236	3,520	1,878	38,678	60,154
2007	20,362	249	3,722	1,986	40,013	62,361
2008	21,154	263	3,931	2,097	41,402	64,653
2009	21,989	278	4,147	2,212	42,848	67,049
2010	22,853	293	4,370	2,331	44,353	69,537
2011	23,616	308	4,599	2,454	45,920	71,990
2012	23,616	308	4,599	2,454	0	26,070
2013	23,616	308	4,599	2,454	0	26,070
2014	23,616	308	4,599	2,454	0	26,070
2015	23,616	308	4,599	2,454	0	26,070
2016	23,616	308	4,599	2,454	0	26,070
2017	23,616	308	4,599	2,454	0	26,070
2018	23,616	308	4,599	2,454	0	26,070
2019	23,616	308	4,599	2,454	0	26,070
2020	23,616	308	4,599	2,454	0	26,070

17.2.2 Economic Costs of the Project

The direct costs of the project should be transformed into economic costs. For this purpose, the project cost and operating and maintenance costs are considered in the study. These costs will be covered into the economic cost using factors of shadow pricing.

The financial project costs explained in Sub-section 12.1 was converted into economic costs by the following modification.

1) Import duties and domestic taxes are assumed to be 10 percent for foreign portion and five percent for the local portion of the project cost.

2) Shadow exchange rate factor of 1.00 was applied to the foreign currency component. A shadow pricing factor of 0.95 was applied to the local currency component. A premium factor of 0.5 was applied to percent unskilled labor portion, which is estimated about 10 percent of local currency portion of project cost.

Economic Costs of the Project is shown in Table 17-2-7.

Table 17-2-7 Economic Project Cost

(Unit : Baht x 1000)

Year	Financial Project Cost			Tax			Economic Project Cost		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
Total	47,111	48,484	95,595	4,710	2,424	7,134	42,401	41,684	84,085
1990	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0
1992	2,564	2,638	5,202	256	132	388	2,308	2,268	4,576
1993	6,504	5,691	12,195	650	285	935	5,854	4,892	10,746
1994	30,212	31,105	61,317	3,021	1,555	4,576	27,191	26,743	53,934
1995	7,542	8,769	16,311	754	438	1,192	6,788	7,540	14,328
1996	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0
2002	0	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	0	0	0	0
2004	0	0	0	0	0	0	0	0	0
2005	289	281	570	29	14	43	260	242	502
2006	0	0	0	0	0	0	0	0	0
2007	0	0	0	0	0	0	0	0	0
2008	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0

17.2.3 Economic Analysis

To determine the viability of the project, all economic costs and benefits shall be transformed to their present value at nine percent discount rate. This is the rate assumed to represent the pertinent opportunity cost of capital. A low discount rate, however, is considered justified since the project shall benefit the rural consumers whose annual incomes are generally lower than urban consumers.

In this analysis the viability of project shall be measured by the following economic feasibility criteria:

$B/C > 1$

$NPV > 0$

where;

B - present value of benefits

C - present value of costs

B/C - ratio of benefits to costs

NPV - net present value or B - C

A $B/C > 1$, or an $NPV > 0$ at nine percent discount rate, indicates that the project is feasible, i.e. economic benefits exceed economic costs at the prevailing opportunity cost of capital, fence, the project is viable for implementation, Table 17-1-8 represents the tabulation and calculation of Economic Benefit and Cost for the project. As clear in this table, NPV is -191,315 thousand Baht and B.C. Ratio is 0.34 respectively.

These figures are less than economic feasibility criteria but it is to be noted in this connection that these figures refer only to economic water value and if other economic benefits, which are described in this section, are combined, the project is considered economically feasible and a number of unquantifiable benefits will also be conceived from the implementation of the project. The undertaking of the project is suggested itself to be proceeded positively. As a sensitivity study, EIRR, which includes other economic benefits such as health benefit and land value increse, also calculated in Table 17-2-9.

Table 17-2-8 Economic Internal Rate of Return

(Unit : Baht x 1000)

year	Water Value	Total Income	Capital Investement	Operating Expenses	Total Expenses	NET INCOME	Net Present Value Benefit	Cost	Net Income
1990	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0
1992	0	0	4,576	0	4,576	-4,576	0	3,852	-3,852
1993	0	0	10,746	0	10,746	-10,746	0	8,298	-8,298
1994	0	0	53,934	0	53,934	-53,934	0	38,208	-38,208
1995	0	0	14,328	0	14,328	-14,328	0	9,312	-9,312
1996	534	534	0	1,440	1,440	-906	319	859	-540
1997	1,030	1,030	0	1,760	1,760	-731	563	963	-400
1998	1,587	1,587	0	2,112	2,112	-525	796	1,060	-264
1999	2,148	2,148	0	2,623	2,623	-475	989	1,208	-219
2000	2,754	2,754	0	3,016	3,016	-263	1,163	1,274	-111
2001	3,323	3,323	0	3,526	3,526	-204	1,288	1,367	-79
2002	4,065	4,065	0	4,170	4,170	-105	1,445	1,482	-37
2003	4,784	4,784	0	5,583	5,583	-800	1,560	1,821	-261
2004	5,516	5,516	0	6,285	6,285	-770	1,651	1,881	-230
2005	6,290	6,290	502	7,082	7,584	-1,294	1,727	2,082	-355
2006	7,085	7,085	0	8,058	8,058	-973	1,785	2,030	-245
2007	7,825	7,825	0	8,845	8,845	-1,019	1,808	2,044	-235
2008	8,659	8,659	0	10,035	10,035	-1,376	1,836	2,127	-292
2009	9,531	9,531	0	11,197	11,197	-1,665	1,854	2,178	-324
2010	10,437	10,437	0	11,948	11,948	-1,511	1,862	2,132	-270
2011	11,269	11,269	0	12,996	12,996	-1,728	1,845	2,127	-283
2012	11,269	11,269	0	12,996	12,996	-1,728	1,692	1,952	-259
2013	11,269	11,269	0	12,996	12,996	-1,728	1,553	1,791	-238
2014	11,269	11,269	0	12,996	12,996	-1,728	1,424	1,643	-218
2015	11,269	11,269	0	12,996	12,996	-1,728	1,307	1,507	-200
2016	11,269	11,269	0	12,996	12,996	-1,728	1,199	1,383	-184
2017	11,269	11,269	0	12,996	12,996	-1,728	1,100	1,269	-169
2018	11,269	11,269	0	12,996	12,996	-1,728	1,009	1,164	-155
2019	11,269	11,269	0	12,996	12,996	-1,728	926	1,068	-142
2020	11,269	11,269	0	12,996	12,996	15,639	849	980	-130
Salvage Value					-17,367				
					Total Present Value		33,549	99,058	-65,509

B.C.Ratio is 0.34

Table 17-2-9 Economic Internal Rate of Return

(Unit : Baht x 1000)

year	Water Value	Increase Land value	Health Benefit	Total Income	Capital Investemen	Operating Expenses	Total Expenses	NET INCOME	Net Present Value Benefit	Cost	Net Income
1990	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	4576	0	4,576	-4,576	0	3,852	-3,852
1993	0	0	0	0	10746	0	10,746	-10,746	0	8,298	-8,298
1994	0	0	0	0	53934	0	53,934	-53,934	0	38,208	-38,208
1995	0	4,566	0	4,566	14328	0	14,328	-9,762	2,968	9,312	-6,345
1996	534	9,426	70	10,030	0	1,440	1,440	8,590	5,981	859	5,122
1997	1,030	14,597	138	15,765	0	1,760	1,760	14,005	8,624	963	7,661
1998	1,587	20,099	207	21,893	0	2,112	2,112	19,781	10,987	1,060	9,927
1999	2,148	25,950	280	28,378	0	2,623	2,623	25,755	13,066	1,208	11,858
2000	2,754	26,808	355	29,917	0	3,016	3,016	26,900	12,637	1,274	11,363
2001	3,323	27,701	433	31,457	0	3,526	3,526	27,930	12,190	1,367	10,824
2002	4,065	28,629	528	33,222	0	4,170	4,170	29,052	11,812	1,482	10,329
2003	4,784	29,593	626	35,003	0	5,583	5,583	29,420	11,417	1,821	9,596
2004	5,516	30,597	729	36,842	0	6,285	6,285	30,556	11,025	1,881	9,144
2005	6,290	31,640	836	38,766	502	7,082	7,584	31,182	10,643	2,082	8,561
2006	7,085	38,678	947	46,710	0	8,058	8,058	38,652	11,765	2,030	9,735
2007	7,825	40,013	1,055	48,893	0	8,845	8,845	40,049	11,298	2,044	9,254
2008	8,659	41,402	1,166	51,227	0	10,035	10,035	41,192	10,860	2,127	8,733
2009	9,531	42,848	1,281	53,660	0	11,197	11,197	42,464	10,436	2,178	8,259
2010	10,437	44,353	1,400	56,190	0	11,948	11,948	44,242	10,026	2,132	7,894
2011	11,269	45,920	1,523	58,712	0	12,996	12,996	45,716	9,611	2,127	7,484
2012	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,921	1,952	-31
2013	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,762	1,791	-28
2014	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,617	1,643	-26
2015	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,483	1,507	-24
2016	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,361	1,383	-22
2017	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,249	1,269	-20
2018	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,145	1,164	-18
2019	11,269	0	1,523	12,792	0	12,996	12,996	-205	1,051	1,068	-17
2020	11,269	0	1,523	12,792	0	12,996	12,996	17,163	964	980	-15
Salvage Value							-17,367				
						Total Present Value			187,899	99,058	88,841

EIRR is 11.63% B.C. Ratio is 1.90

APPENDICES

APPENDIX A-1-1

Meteorological Data

Meteorologiqical Data

Table A1-1-1 : Monthly Rainfall at Su Ngai Golok

Code; RH 3210
Station; Amphur Su Ngai Golok, Nara Thiwat

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1968	0.0	0.0	36.0	177.0	212.5	227.0	119.2	289.6	108.3	417.7	110.8	196.6	1894.7
1969	103.0	46.3	35.0	14.2	215.2	296.8	173.2	227.1	217.9	246.2	983.2	352.5	2910.6
1970	302.1	28.0	109.1	272.8	174.4	217.6	229.2	260.0	369.3	366.1	470.7	484.4	3283.7
1971	217.0	54.3	211.4	0.0	248.9	102.2	119.3	599.0	326.0	367.7	536.2	543.3	3325.3
1972	41.9	26.8	13.4	156.2	440.5	109.2	418.0	175.5	383.2	126.9	216.9	444.6	2553.1
1973	29.3	79.3	160.9	98.7	156.3	275.8	312.9	219.7	586.7	395.0	165.0	709.4	3189.0
1974	-	142.5	99.5	124.2	82.9	267.3	296.0	167.7	231.9	389.9	374.7	-	-
1975	542.8	148.2	0.0	69.3	326.3	312.0	135.9	372.7	536.6	306.5	460.9	425.3	3636.5
1976	40.6	30.6	0.0	81.7	309.5	173.8	130.5	179.1	140.9	241.1	1126.4	279.7	2733.9
1977	118.9	89.4	30.4	22.3	165.7	328.1	222.3	377.7	178.5	278.7	296.2	447.9	2556.1
1978	62.1	28.6	17.2	138.0	314.7	264.7	77.7	303.1	532.0	209.7	410.6	382.6	2741.0
1979	17.3	46.5	48.5	182.2	185.6	251.6	328.7	261.6	202.1	281.4	834.6	132.2	2772.3
1980	0.0	15.5	117.9	161.1	93.9	216.0	294.2	367.3	254.9	327.7	321.7	663.9	2834.1
1981	18.8	37.5	26.3	121.7	264.1	126.2	173.3	89.3	249.9	332.6	469.7	486.5	2395.6
1982	0.0	49.5	73.5	2.3	269.2	212.4	307.5	449.3	265.1	312.6	151.5	555.6	2648.5
1983	53.8	0.0	72.2	0.0	258.9	225.6	348.5	244.7	209.0	148.1	310.3	1080.5	2951.6
1984	180.2	201.0	129.2	56.4	252.7	186.9	233.2	314.9	227.2	139.6	237.9	896.9	3056.1
1985	28.6	89.3	523.8	146.5	252.6	75.4	186.8	437.8	418.1	351.3	203.1	404.2	3117.5
1986	51.5	0.0	20.0	69.9	221.0	235.6	145.8	111.8	429.7	215.4	891.0	220.5	2612.2
1987	48.1	0.0	42.8	88.1	156.2	242.9	233.4	187.0	254.2	414.7	357.2	836.8	2863.4

Source : Meteorological Department

Table A1-1-2 : Monthly Rainfall at Waeng

Code; RM 3204
Station; Amphur Waeng, Nara Thiwat

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1975	364.4	344.0	62.0	10.7	168.0	163.0	204.5	236.8	329.4	101.9	452.7	377.0	2814.4
1976	30.1	0.0	35.2	272.6	304.9	267.7	293.5	342.6	155.8	243.4	925.4	439.9	3311.4
1977	142.0	106.4	23.7	0.0	248.7	335.2	367.4	331.2	212.0	290.2	390.9	437.1	2884.8
1978	139.5	72.2	77.4	213.7	321.0	248.6	326.7	385.2	507.5	421.7	298.9	364.8	3377.2
1979	90.9	62.8	11.4	259.9	225.7	252.5	447.6	324.2	278.9	221.6	669.3	186.0	3030.8
1980	54.2	114.1	138.8	121.2	273.3	163.1	214.9	443.7	193.1	317.9	382.8	435.2	2852.3
1981	59.0	82.1	4.8	225.0	277.9	67.0	169.8	139.3	104.9	399.5	348.0	368.6	2245.9
1982	58.4	8.2	25.4	128.7	328.5	201.3	214.7	226.2	341.0	185.4	150.9	513.9	2382.6
1983	101.6	0.0	16.5	11.6	243.9	208.2	216.3	272.1	169.0	297.4	223.2	1187.1	2946.9
1984	353.6	316.2	206.6	233.3	447.9	286.1	183.0	215.3	380.6	216.9	275.8	837.9	3953.2
1985	32.0	120.8	406.8	189.8	428.6	50.0	318.3	277.4	351.5	518.8	282.5	407.6	3384.1
1986	94.2	0.0	62.4	105.0	230.4	288.4	130.2	117.7	403.6	459.1	65.6	318.7	2893.3
1987	50.9	0.0	209.5	68.5	128.1	241.2	241.7	423.9	263.1	181.2	298.2	869.2	2975.5

Source : Meteorological Department

Table A1-1-3 : Monthly Rainfall at Su Ngai Padi

Code; RM 3211
Station; Amphur Su Ngai Padi, Nara Thiwat

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1971	260.7	81.0	273.7	4.2	149.9	67.2	134.5	550.7	515.0	302.7	500.2	577.4	3417.2
1972	10.9	3.4	25.8	82.5	317.0	99.1	216.2	287.8	174.5	177.1	305.1	397.8	2097.2
1973	34.4	72.5	136.1	53.0	73.2	220.3	238.4	175.6	462.4	289.4	369.3	882.9	3007.5
1974	-	-	-	126.8	-	-	486.5	220.0	159.1	294.0	-	-	-
1975	297.5	33.1	10.6	10.4	207.4	100.5	234.5	252.6	262.6	162.2	224.3	202.8	1998.5
1976	0.0	0.0	0.0	46.9	183.6	64.5	40.6	398.4	38.4	36.3	439.1	82.9	1330.7
1977	0.0	0.0	0.0	0.0	129.2	236.6	147.2	87.3	18.1	214.5	388.4	151.4	1372.7
1978	0.0	0.0	15.0	46.3	0.0	111.0	65.0	54.6	131.5	214.9	153.9	84.1	876.3
1979	-	-	0.0	-	123.0	96.4	159.1	99.2	48.2	144.1	436.1	243.4	-
1980	-	0.0	0.0	100.9	164.8	156.3	177.7	328.2	251.8	223.3	524.8	550.2	2478.0
1981	40.0	30.9	17.6	153.3	360.4	92.7	40.2	54.0	13.4	28.3	191.5	-	-
1982	0.0	0.0	0.0	15.6	68.1	58.0	95.9	369.9	338.3	74.2	413.3	832.8	2266.1
1983	0.0	0.0	12.6	0.0	0.0	144.7	148.8	454.6	202.5	389.1	302.8	1093.7	2748.8
1984	324.7	215.5	101.9	273.5	320.0	510.5	247.8	261.5	238.2	240.9	244.9	790.6	3770.0
1985	24.1	82.4	449.2	229.0	365.9	53.9	96.5	359.4	470.2	422.9	216.8	426.4	3196.7
1986	34.2	0.0	154.1	37.6	133.5	258.2	294.4	108.8	525.2	154.0	121.1	-	-
1987	96.5	0.0	15.0	174.2	302.0	140.0	120.1	281.4	180.0	417.6	467.9	1047.0	2855.9

Source : Meteorological Department

Table A1-1-4 : Meteorological Data at Su Ngai Golok

Station : Naratiwat
Latituds : 06 25' N.
Longtitude : 104 49' E.
Elevation of station above MSL 2 meters

Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (C.degree)													
Mean	26.1	26.8	27.6	28.5	28.4	28.0	27.6	27.5	27.3	27.0	26.2	25.8	27.2
Mean Max.	29.9	30.9	32.0	33.1	33.0	32.6	32.3	32.2	32.0	31.0	29.5	29.0	31.5
Mean Min.	22.2	22.4	22.8	23.5	23.9	23.5	23.2	23.2	23.1	23.2	23.1	22.9	23.1
Ext. Max.	33.6	35.1	36.6	36.4	39.0	36.7	36.2	36.5	36.4	36.0	33.5	32.6	39.0
Ext. Min.	17.1	17.5	19.0	19.8	20.5	21.0	20.7	20.6	20.2	20.3	18.7	19.8	17.1
Relative Humidity (%)													
Mean	80.8	79.0	78.4	77.7	79.2	79.0	79.8	79.9	80.5	83.2	86.4	85.6	80.8
Mean Max.	94.2	93.8	94.1	93.6	93.9	94.1	94.7	94.6	94.7	95.8	96.9	75.1	94.7
Mean Min.	68.7	66.8	64.8	63.5	64.5	63.9	64.9	64.6	65.0	69.9	75.5	75.5	67.3
Ext. Min.	49.0	47.0	40.0	50.0	41.0	37.0	39.0	43.0	42.0	46.0	53.0	56.0	37.0
Evaporation (mm.)													
Mean - Pan	117.7	113.4	140.4	145.3	142.4	123.2	126.5	131.0	121.8	123.0	101.1	xx	-
Sunshine Duration (hr.)													
Mean	No Observation												
Wind (knots)													
Prevailing Wind	E	E	E	E	NE	NE	NE	NE	NE	NE	NE	E	-
Mean Wind Speed	5.2	5.6	4.8	4.4	3.5	3.1	3.0	3.0	3.2	3.1	3.4	4.8	-
Max. Wind Speed	40 NE,E	33 E	40 E	35 E,SE	50 SW	45 N,W	55 NW	50 W	45 W	55 W	60 NE	45 NE	60 NE
Rainfall (mm.)													
Mean	145.0	46.4	86.2	65.9	135.5	125.9	151.1	162.7	196.6	295.6	632.3	534.6	2577.8
Mean Rainy Days	14.1	8.2	6.6	7.2	13.1	12.6	13.8	14.9	16.6	20.3	23.0	23.1	173.5
Greatest in 24 hr.	424.6	42.4	154.2	109.9	94.7	79.3	98.5	86.3	124.3	145.9	366.1	291.5	424.6
Day / Year	6/67	15/64	25/73	23/79	30/68	27/74	12/85	03/83	19/68	20/65	28/59	4/66	6/67

Source : Meteorological Department
Remark : Evaporation 1982-1985
: xx = The Instrument Failure

APPENDIX A-2-1

Hydrological Data

Table A2-1-1: Monthly Flow Records

River : Golok Location : Su Ngai Golok Station : 119 Drainage Area : 1,600 sq m

Year	Streamflow in (MCM)												Annual
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
1981	48.79	138.42	63.88	49.66	30.15	101.02	97.17	362.90	450.49	53.93	24.43	404.00	1,424.88
1982	44.49	73.33	184.44	175.68	140.41	231.87	196.21	182.37	356.89	153.68	28.91	5.85	1,774.14
1983	1.85	9.57	50.80	107.00	138.00	155.00	142.00	260.00	576.00	203.00	299.00	138.00	2,080.00
1984	113.00	205.00	218.00	196.00	157.00	164.00	198.00	161.00	468.00	185.00	95.80	336.00	2,498.00
1985	103.00	245.00	143.00	84.40	135.00	238.00	432.00	275.00	423.00	187.00	45.70	43.20	2,354.00
1986	29.40	51.00	154.00	66.40	52.00	131.00	214.00	178.00	508.00	142.00	43.10	59.60	1,628.00

Table A2-1-2: Monthly Flow Records

River : Golok Location : Waeng Station : 121 Drainage Area : 43 sq m

Year	Streamflow in (MCM)												Annual
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
1981	1.06	7.87	2.53	2.17	0.75	1.87	5.14	13.75	-	2.79	1.17	0.27	39.37
1982	3.22	5.56	8.28	5.52	5.08	9.12	8.21	9.68	20.78	7.74	2.58	0.91	86.68
1983	0.19	1.96	3.02	4.44	5.25	8.20	7.52	8.90	47.98	11.77	18.18	9.41	126.82
1984	0.23	2.01	3.08	4.50	5.31	8.27	7.58	8.97	50.80	11.80	18.30	9.49	130.34
1985	5.81	10.60	7.93	8.69	3.94	7.81	7.65	7.38	33.40	7.37	3.46	13.20	117.24
1986	3.38	10.20	6.08	3.21	3.85	7.94	15.30	14.80	19.20	12.00	3.24	2.85	102.05
1987	1.81	2.13	6.86	2.14	3.27	5.31	13.80	14.00	26.30	5.83	2.18	3.57	87.20

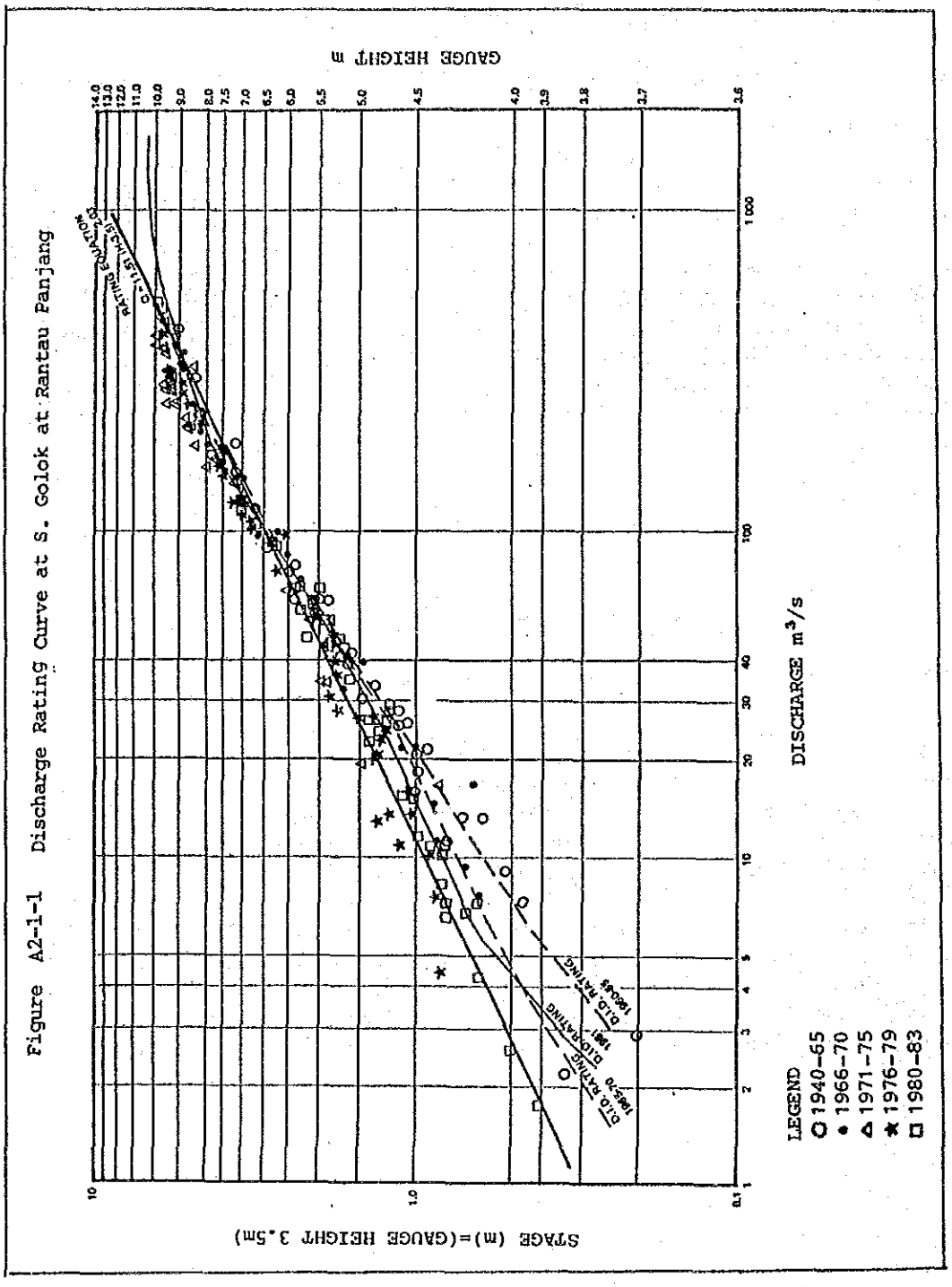


Figure A2-1-1 Discharge Rating Curve at S. Golok at Rantau Panjang

Source : The Golok River Basin Development Study

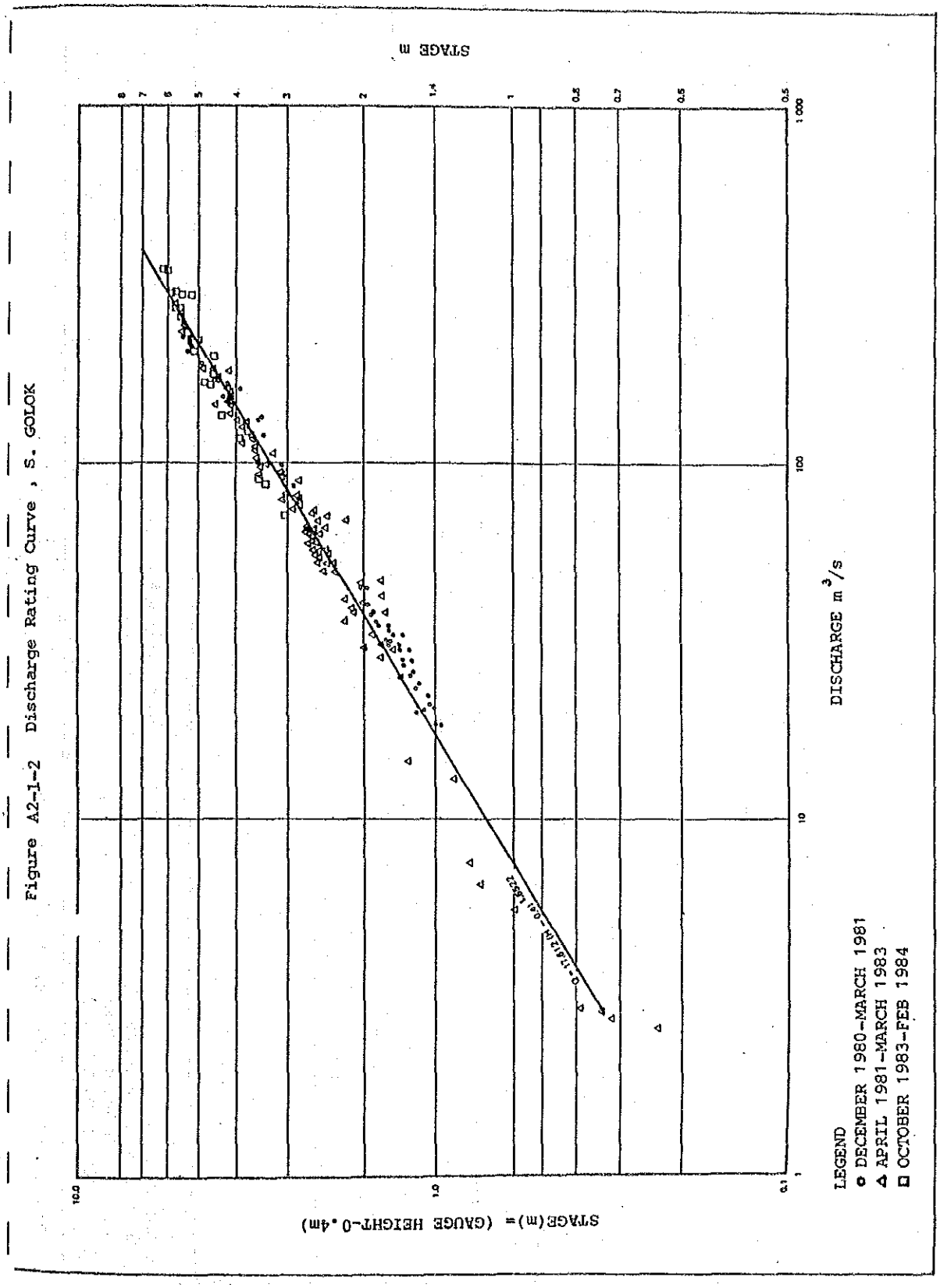
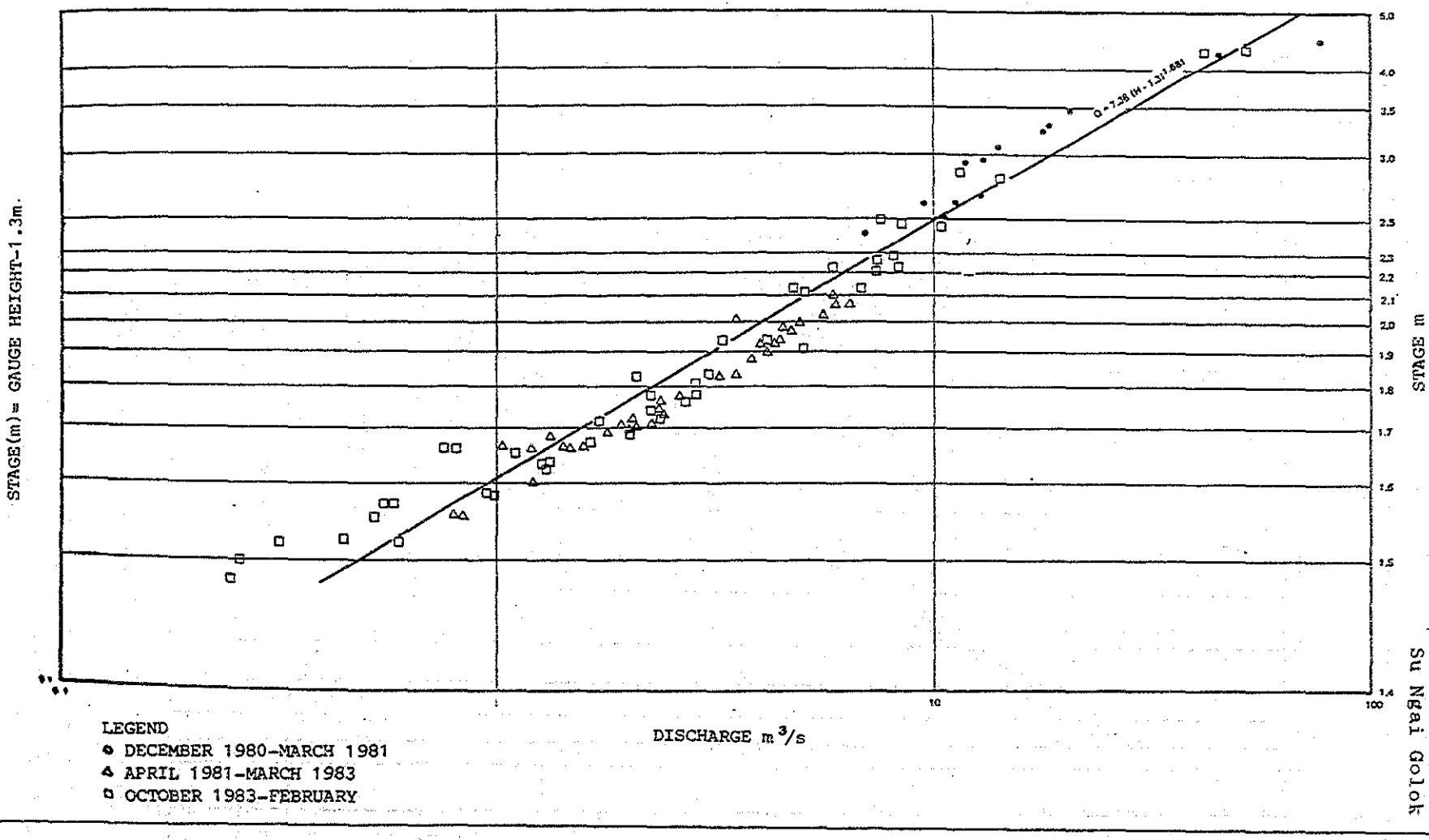


Figure A2-1-2 Discharge Rating Curve , S. GOLOK

SOURCE : GOLOK RIVER BASIN DEVELOPMENT STUDY

Figure A2-1-3 Discharge Rating Curve, K.Waeng



SOURCE : GOLOK RIVER BASIN DEVELOPMENT STUDY

APPENDIX A-3-1

Study on Flow and Pressure Measurement in Distribution System

Appendix STUDY ON FLOW AND PRESSURE MEASUREMENTS IN DISTRIBUTION SYSTEM

(1) Introduction

To evaluate the characteristics of the distribution system, pressure and flow measurements were made from 16 to 17 August, 1988.

(2) Method and Results

The flow measurements of 24-hours were conducted of the main distribution pipe in the treatment plant using the ultrasonic flow meter with pen recorder.

The pressure measurement were made by installing pressure gage at 5 house connections in the distribution system.

The results of flow measurement at the Su Ngai Golok waterworks, Location of pressure measurement points and the results of pressure measurement are shown in Figure A3-1, A3-2 and A3-3 to A3-8, Respectively.

The results of pressure measurements in the distribution system show similar pressure conditions with distribution network analysis (refer to section 3.1.3).

The results also confirm the low pressure area identified by Su Ngai Golok waterworks' official.

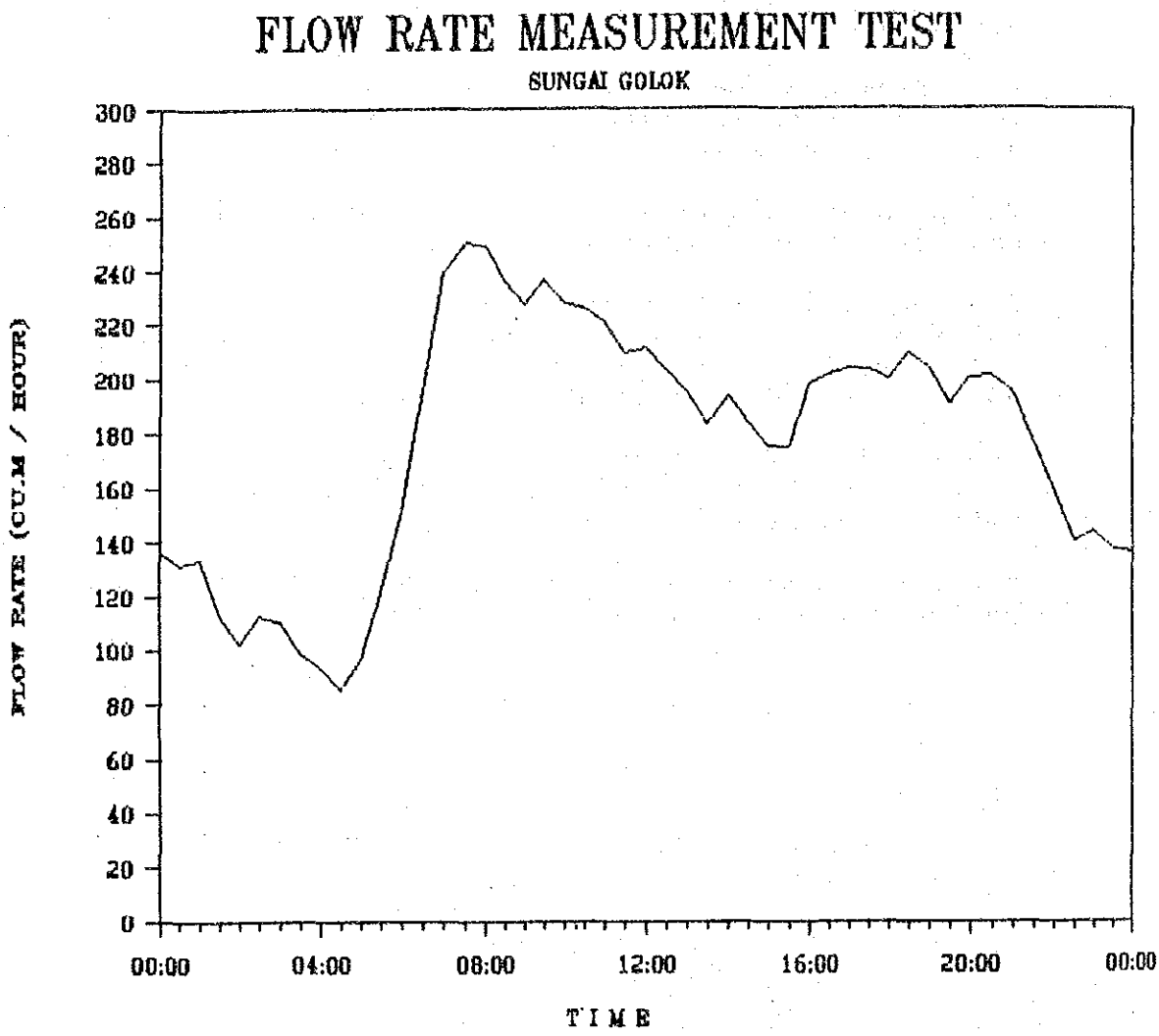


FIGURE A3-1-1

FLOW RATE MEASUREMENT TEST

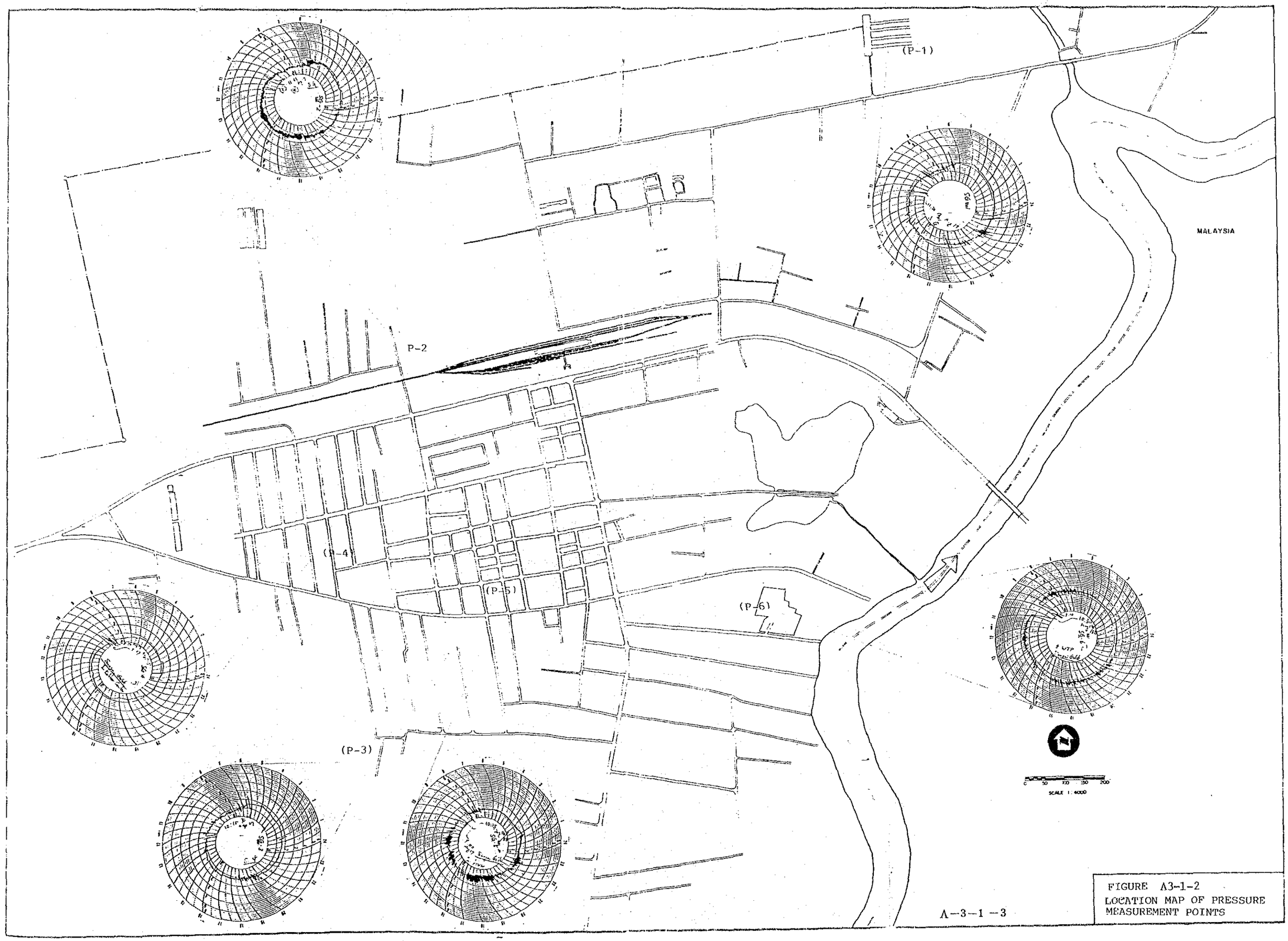


FIGURE A3-1-2
LOCATION MAP OF PRESSURE MEASUREMENT POINTS

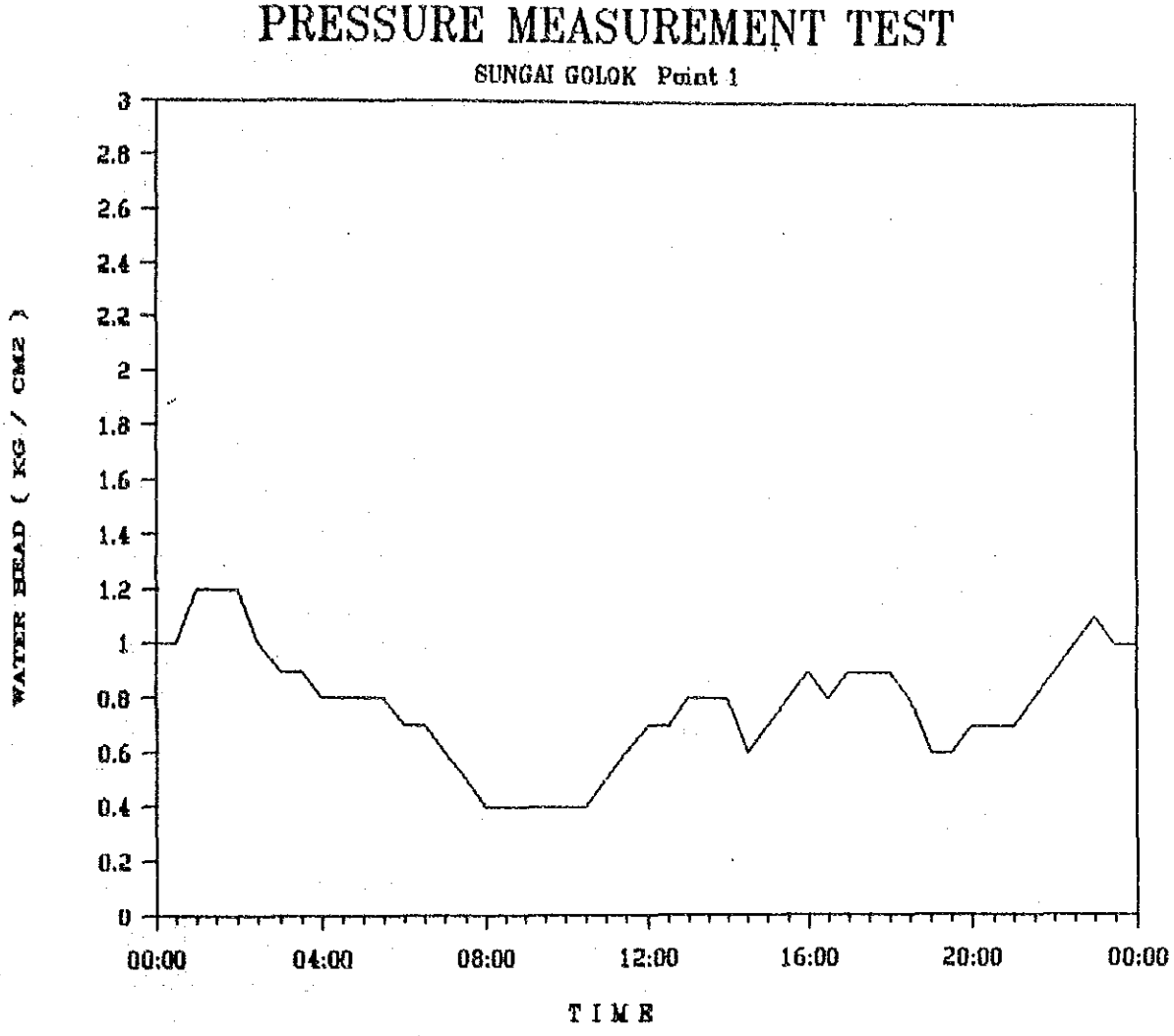


FIGURE A3-1-3

PRESSURE MEASUREMENT TEST
(Point 1)

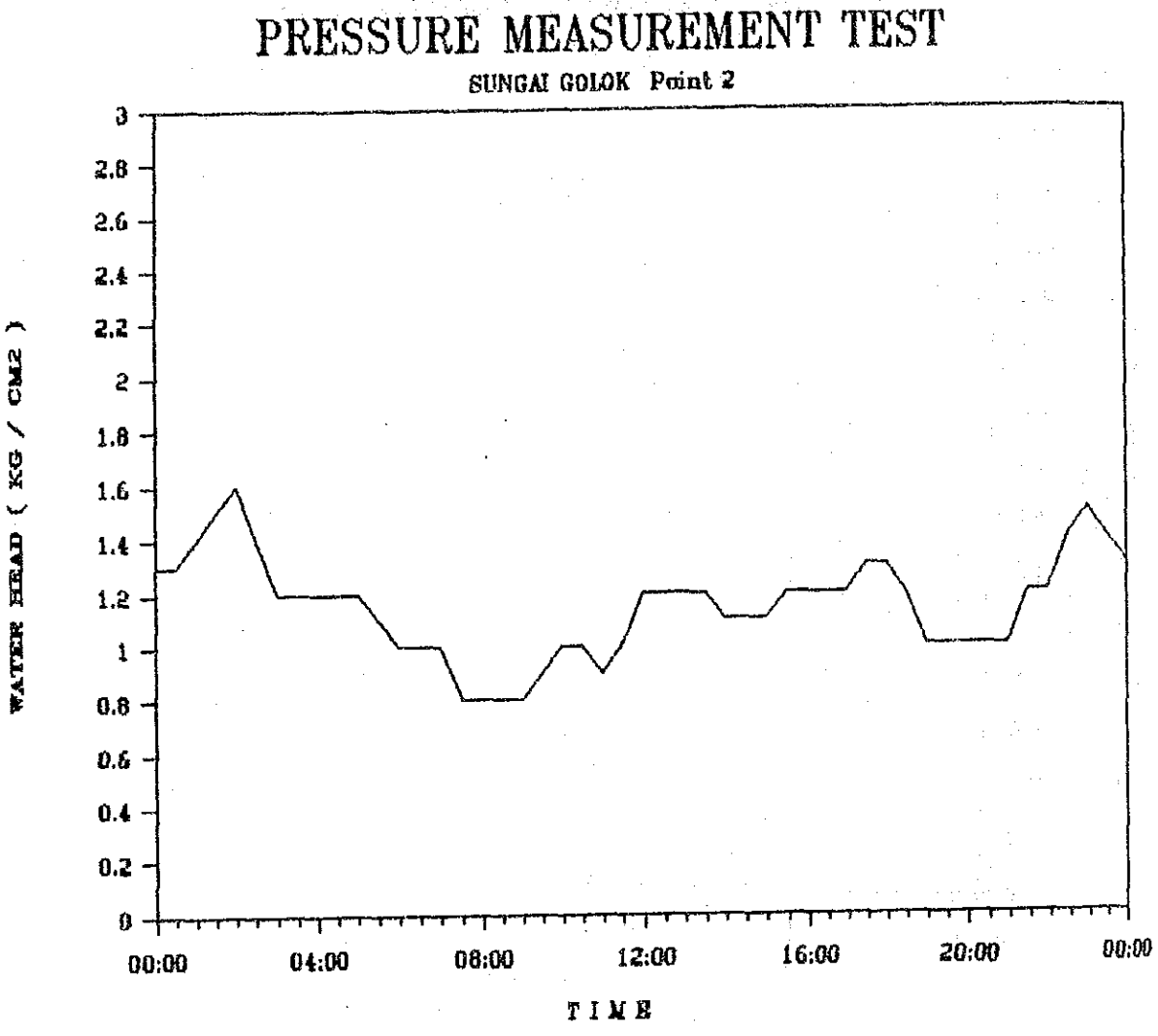


FIGURE A3-1-4

PRESSURE MEASUREMENT TEST
(Point 2)

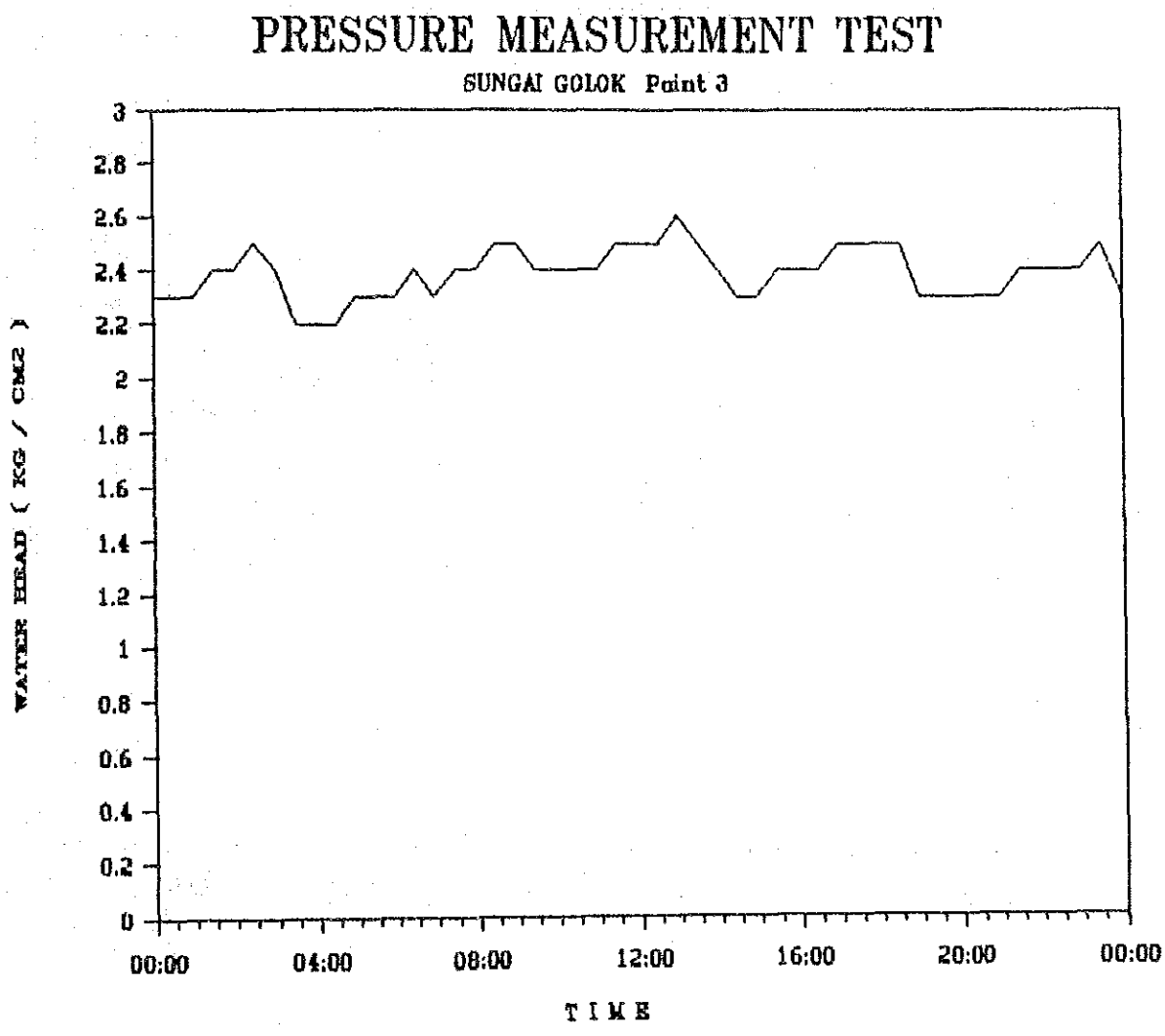


FIGURE A3-1-5

PRESSURE MEASUREMENT TEST
(Point 3)

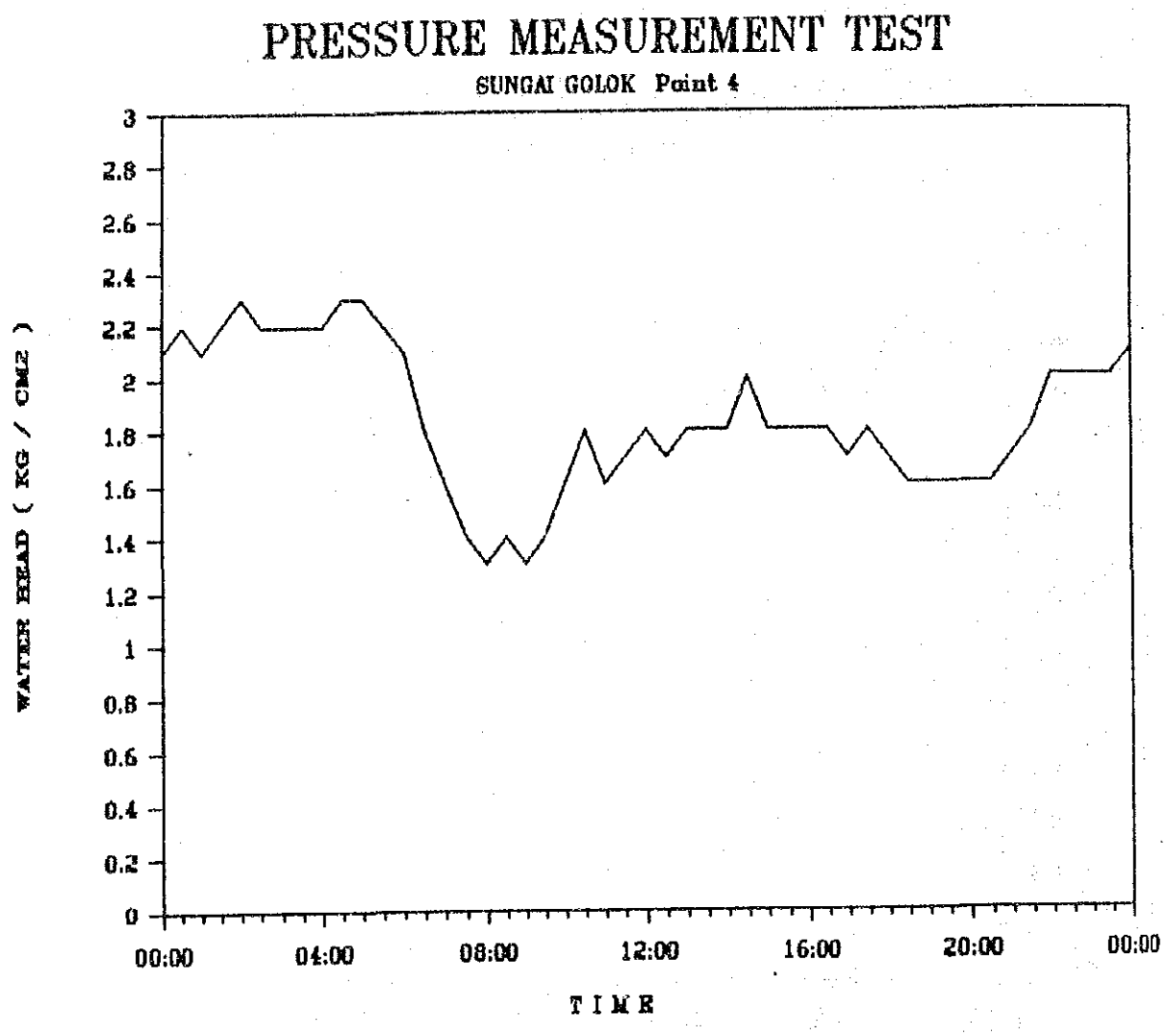


FIGURE A3-1-6

PRESSURE MEASUREMENT TEST
(Point 4)

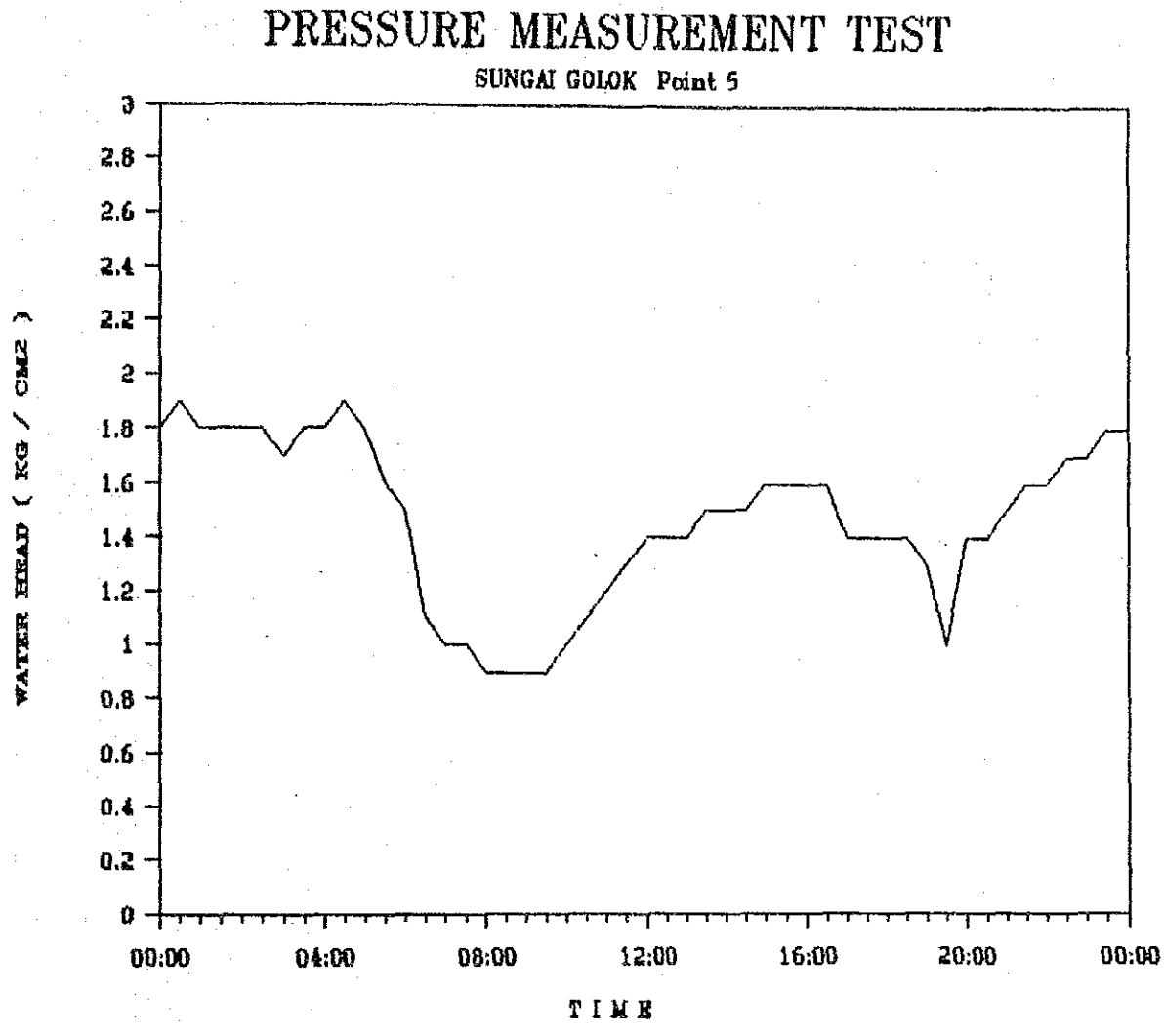


FIGURE A3-1-7

PRESSURE MEASUREMENT TEST
(Point 5)

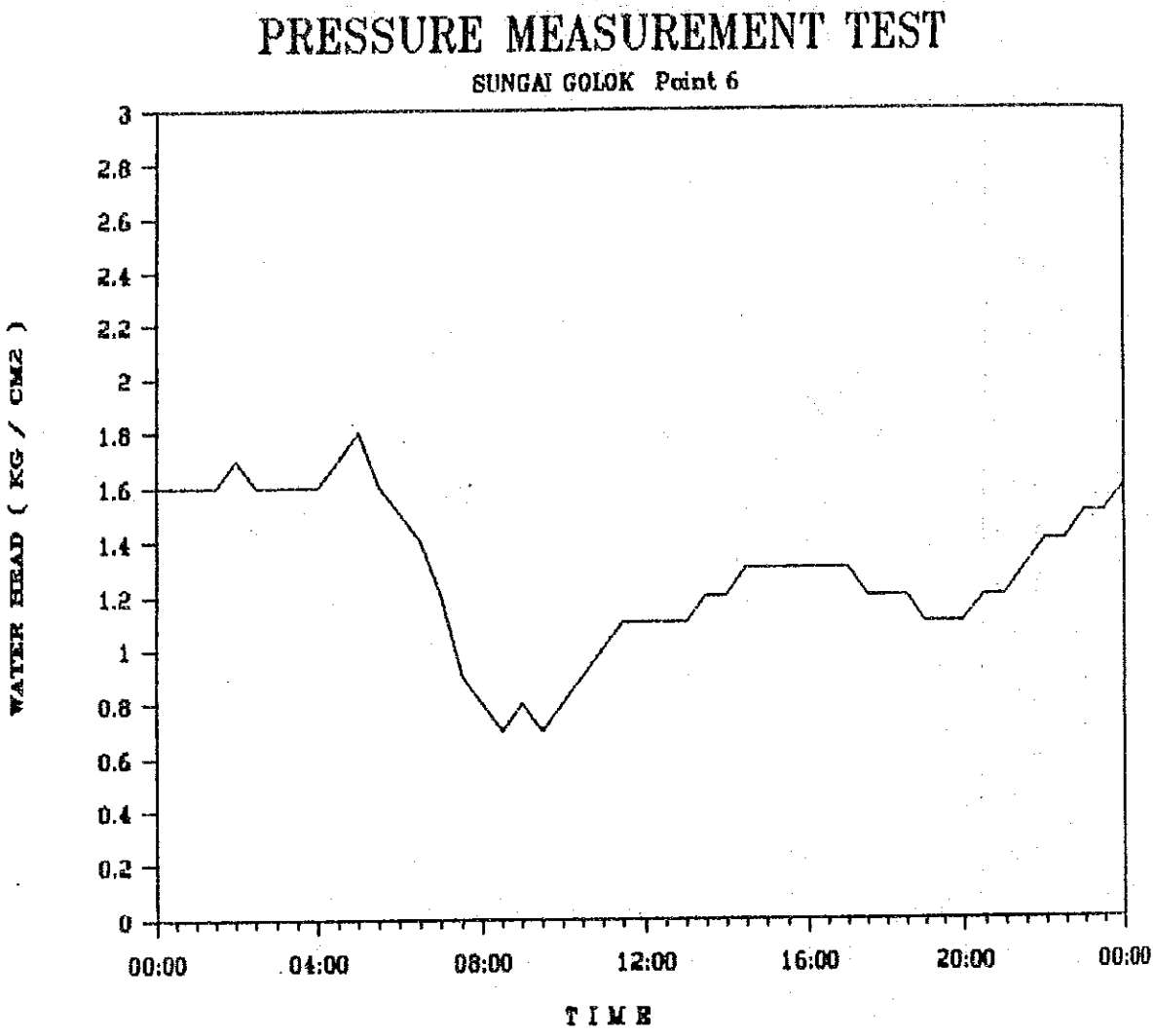


FIGURE A3-1-8

PRESSURE MEASUREMENT TEST
(Point 6)

APPENDIX A-3-2

Jar Test on Raw Water of the Water Treatment Plant

APPENDIX JAR TEST

1 General

Jar Test was conducted to evaluate the present dosage rate of coagulant and to verify the appropriate dosage rate. The test was conducted on August 15, 1988 for the raw water presently used by the waterworks.

2 Coagulant Used

Aluminum sulfate is being used as coagulant at Su Ngai Golok Waterworks as well as the other waterworks. The chemical is a solid type in a package of 25 kg bag, which is dissolved in the coagulant solution tank with an effective volume of about 1.5 cu.m.

According to the operator, they are consuming 75 kg (three bags) of aluminum sulfate in three days. amount of consumption, dosage rate is calculated as below:

Dosage rate (R) for daily average flow rate:

R = 75,000 g/3 days/3,500 cu m/day = 7.14 mg/l

Concentration of the coagulant in the solution tank is calculated from the amount of chemical dissolved and the volume of the tank as follows:

Concentration of coagulant solution (C)

C = 75,000 g/1.5 cu m = 50,000 mg/l

This solution was diluted 2 times for use of Jar Test; therefore, solution had the concentration of:

50,000 x (1/2) = 25,000 mg/l

3 Test Procedure

Test procedure followed the PWA's regulation for Jar Test. Sequence and time are shown as follows:

a) Coagulant dosed

b) Rapid Mixing, 60 rpm - 7.5 min

c) Flocculation, 40 rpm - 7.5 min

d) Flocculation, 25 rpm - 5.0 min

e) Sedimentation, about 5 min

4 Condition and Results

Jar Test was conducted with a series of six different dosage rates. The condition and results are as shown in Table A3-2-1

Table A3-2-1 Jar Test Condition and Result

	1	2	3	4	5	6
1. Coagulant Solution (ml)	0.1	0.2	0.4	0.6	0.8	1.0
2. Dosage Rate (mg/l)	2.5	5.0	10	15	20	25
3. Turbidity after settling	20.5	12.5	2.5	1.2	1.0	1.0
4. pH	6.51	6.25	5.61	5.20	5.05	5.01
5. Conductivity (micro ohm/cm)	2.8	3.0	3.3	4.3	3.9	5.4
6. Characteristics of floc	large floc	large floc	large floc	large floc	large floc	large floc

From the results above, it is observed that dosage rate of 10.0 to 15.0 mg/l shows the most effective removal of turbidity. Considering this, present dosage rate (7.14 mg/l) should be increased.

APPENDIX A-4-1

Study on Water Consumption

APPENDIX STUDY ON WATER CONSUMPTION

1 Data Collection

Present water consumption data was collected from the waterworks' meter reading records for the study of water demand and distribution network analysis. Meter reading records at the waterworks office consist of volumes of cards in PWA's format for each connection. Monthly consumptions from September 1987 to August 1988 of each connection are recorded on this card.

Data collection was made in a manner of copying figures water consumption of each consumer for every month. For distribution network analysis, each consumer was located on the map by interviewing meter readers of the waterworks. When the exact locations were not identified, they were located in some extent of the pipeline. Big consumers were also identified for further analysis.

2 Collected Data

Raw data copied from meter reading books was then summed up by month and by area. The attached sheets hereafter show the summary of water consumption.

WATER SALE OF SUNGAI GOLOK W.W.

DAILY AVE. BY MONTH

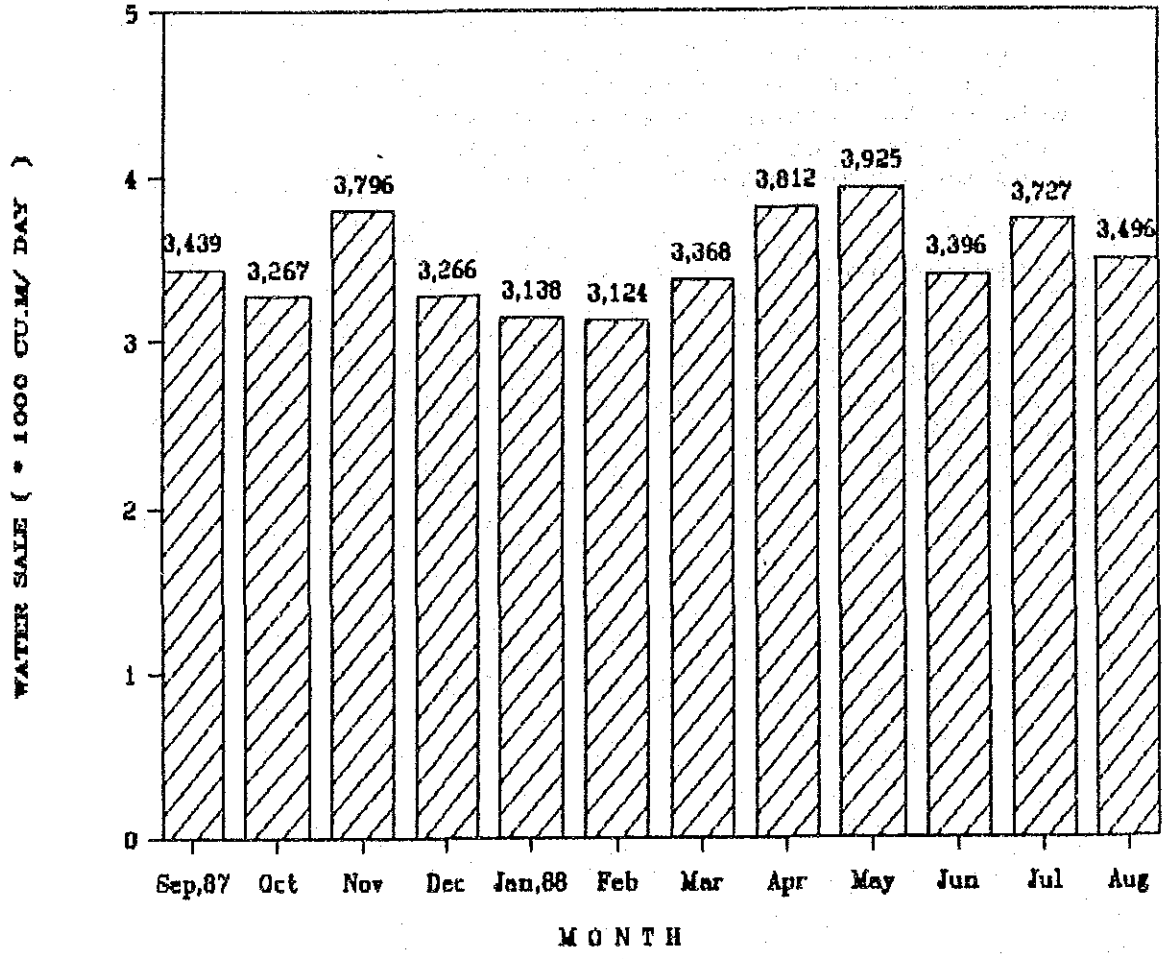


FIGURE
A4-1-1

Table A4-1-1

Grand Summary of Sungai Golok

Book No.	Sep,87	Oct	Nov	Dec	Jan,88	Feb	Mar	Apr	May	Jun	Jul	Aug	Total	Day Ave.
(Bk 1)	13,863	14,783	15,148	13,822	15,724	12,897	12,682	13,978	15,127	13,152	15,697	17,149	174,022	476.77
(Bk 2)	1,328	1,262	1,216	1,428	1,627	1,183	1,506	1,880	1,864	1,822	1,501	2,144	18,761	51.26
(Bk. 3)	896	872	914	867	873	870	975	1,060	1,002	933	917	979	11,158	30.57
(Bk.4)	1,177	1,186	1,201	1,044	1,118	1,033	1,128	1,264	1,473	1,276	1,067	1,029	13,996	38.35
(Bk.5-1)	940	854	908	870	857	785	878	975	1,032	924	999	987	11,009	30.16
(Bk.5-2)	225	241	224	208	213	208	283	411	607	552	634	687	4,493	12.31
(Bk. 6)	1,213	1,210	1,310	1,215	1,255	1,185	1,234	1,459	1,431	1,177	1,186	1,164	15,039	41.20
(Bk. 7)	655	700	746	767	754	665	751	851	807	820	779	850	9,145	25.05
(Bk. 8)	1,634	1,581	1,774	1,548	1,642	1,445	1,394	1,732	1,933	1,735	1,553	1,491	19,462	53.32
(Bk. 9)	1,502	1,523	1,898	1,605	1,752	1,636	1,688	2,016	2,202	2,215	2,464	2,896	23,397	64.10
(Bk10)	1,942	1,889	2,002	1,847	1,849	1,924	1,806	1,936	2,558	1,951	1,935	1,968	23,607	64.68
(Bk 11)	1,270	1,330	1,497	1,446	1,617	1,334	1,311	1,527	1,668	1,454	1,517	1,413	17,384	47.63
(Bk. 12)	4,552	4,468	4,994	4,989	5,636	3,715	5,176	4,714	5,373	4,609	4,433	4,777	57,436	157.36
(Bk.13)	1,611	1,529	1,676	1,399	1,396	1,585	1,651	1,861	2,048	1,555	1,543	1,396	19,250	52.74
(Bk.14)	993	969	1,156	1,037	1,184	1,039	1,234	1,471	1,426	1,239	1,344	1,170	14,262	39.07
(Bk. 15)	1,443	1,585	2,486	1,475	1,578	1,434	1,532	1,708	1,904	1,667	1,965	1,631	20,408	55.91
(Bk. 16)	3,491	2,647	3,974	3,660	2,751	2,683	3,912	4,271	4,178	3,785	4,321	3,540	43,213	118.39
(Bk. 17)	1,570	1,272	1,445	1,316	1,359	1,272	1,369	1,382	1,547	1,227	1,359	1,673	16,791	46.00
(Bk. 18)	1,653	1,779	2,243	2,168	2,061	1,753	1,867	1,849	1,968	1,720	1,799	1,664	22,524	61.71
(Bk. 19)	1,084	1,046	1,149	962	946	932	973	1,266	1,354	1,202	1,528	1,366	13,808	37.83
(Bk. 20)	1,889	1,970	1,857	1,655	1,781	1,553	1,522	1,973	1,952	1,648	1,851	1,578	21,229	58.16
(Bk21)	10,663	9,951	9,599	8,913	9,027	8,042	9,192	10,902	9,093	9,299	10,503	10,053	115,237	315.72
(Bk 22)	1,604	1,784	1,341	1,241	1,359	1,576	1,754	2,206	2,215	1,488	1,596	1,470	19,634	53.79
(Bk. 23)	4,289	5,062	4,226	5,436	4,112	4,113	4,502	5,329	5,149	4,183	5,062	4,178	55,641	152.44
(Bk.24)	1,543	1,570	1,677	1,639	1,443	1,592	1,698	1,836	2,170	1,363	1,670	1,420	19,621	53.76
(Bk.25)	6,769	6,656	7,083	6,110	5,190	4,499	6,048	6,606	7,349	6,201	7,403	6,451	81,183	222.42
(Bk. 26)	1,378	1,356	1,538	1,539	1,393	1,357	1,585	1,512	1,753	1,423	1,712	1,464	18,010	49.34
(Bk. 27)	5,237	4,272	4,765	4,430	3,548	3,512	4,530	4,548	5,115	4,134	8,327	4,138	56,556	154.95
(Bk. 28)	1,316	1,265	1,489	1,112	1,316	1,112	1,219	1,439	1,611	1,108	1,401	1,104	15,492	42.44
(Bk. 29)	1,724	1,752	2,209	1,442	1,495	1,663	1,857	2,216	2,294	1,685	2,061	1,706	22,104	60.56
(Bk. 30)	1,176	1,251	1,479	1,245	1,107	1,189	1,297	1,608	1,596	1,223	1,436	1,149 :	15,756 :	43.17
(Bk31)	1,357	1,384	2,041	1,435	1,258	1,656	1,504	1,740	1,554	1,336	1,612	1,262	18,139	49.70
(Bk 32) :	1,008	955	1,210	1,163	1,066	1,107	1,077	1,326	1,252	1,017	1,160	998	13,339	36.55
(Bk. 33)	1,326	1,296	1,648	1,340	1,174	1,342	1,409	1,704	1,584	1,252	1,577	1,254	16,906	46.32
(Bk.34)	6,299	6,108	8,368	6,559	5,849	5,963	7,809	7,237	8,255	6,813	6,888	6,405	82,553	226.17
(Bk.35)	2,273	2,276	2,770	2,134	1,930	1,927	2,549	2,405	2,691	2,202	2,393	2,633	28,183	77.21
(Bk. 36)	4,767	4,389	5,040	4,065	3,542	3,570	5,218	4,597	5,241	4,083	4,219	4,010	52,661	144.28
(Bk.37-1)	1,692	1,627	2,041	1,835	1,447	1,586	2,140	1,981	2,170	1,686	1,788	1,674	21,667	59.36
(Bk.37-2)	256	270	339	297	263	297	310	448	450	389	545	544	4,408	12.08
(Bk. 38)	927	916	1,509	1,031	881	1,003	1,170	1,293	1,249	1,062	1,109	995	13,205	36.18
(Bk. 39)	1,322	1,034	2,074	1,670	872	1,117	1,271	2,185	3,503	1,841	1,061	2,471	20,421	55.95
(Bk. 40)	1,316	1,352	1,617	1,282	1,046	1,241	1,395	1,660	1,926	1,498	1,607	1,432	17,372	47.59
Total(cu.m/mo)	103,173	101,282	113,681	101,246	97,291	90,595	104,406	114,362	121,674	101,869	115,522	108,363 :	1,278,482 :	3502.55
Total(cu.m/d)	3,439	3,267	3,796	3,266	3,138	3,124	3,368	3,812	3,925	3,396	3,727	3,496		

APPENDIX A-4-2

Questionnaire Survey for Residents

APPENDIX QUESTIONNAIRE SURVEY IN SU NGAI GOLOK (RESIDENTIAL)

1 Objective

The door-to-door questionnaire survey was conducted to obtain the basic information on the resident's living conditions, water use patterns, responses to the municipal system and/or their own water sources and willingness for house-connection supply, and covered the area served or unserved by the municipal water supply system.

2 Survey Area

The survey area was divided into 6 blocks by the roads as shown in Figure A1-2-1. All blocks were at present partially served by the municipal system.

3 Survey Item

The form used for the questionnaire survey was originally written by Thai and included the following items.

1. General
   - 1.1 Address
   - 1.2 Type of House
   - 1.3 No. of Persons in Family
   - 1.4 No. of Employees
   - 1.5 Average Monthly Income
   - 1.6 Average Monthly Medical Expense
2. Type of Water Supply
3. Conditions in case of Municipal System
   - 3.1 Pressure
   - 3.2 Quantity
4. Other Sources than Municipal System
   - 4.1 Type of Source
   - 4.2 Conditions in case of Groundwater
5. Potability
6. Water Quality in case of Municipal System
   - 6.1 Color
   - 6.2 Smell
   - 6.3 Turbidity
7. Average Monthly Water Consumption
8. Average Monthly Water Charge

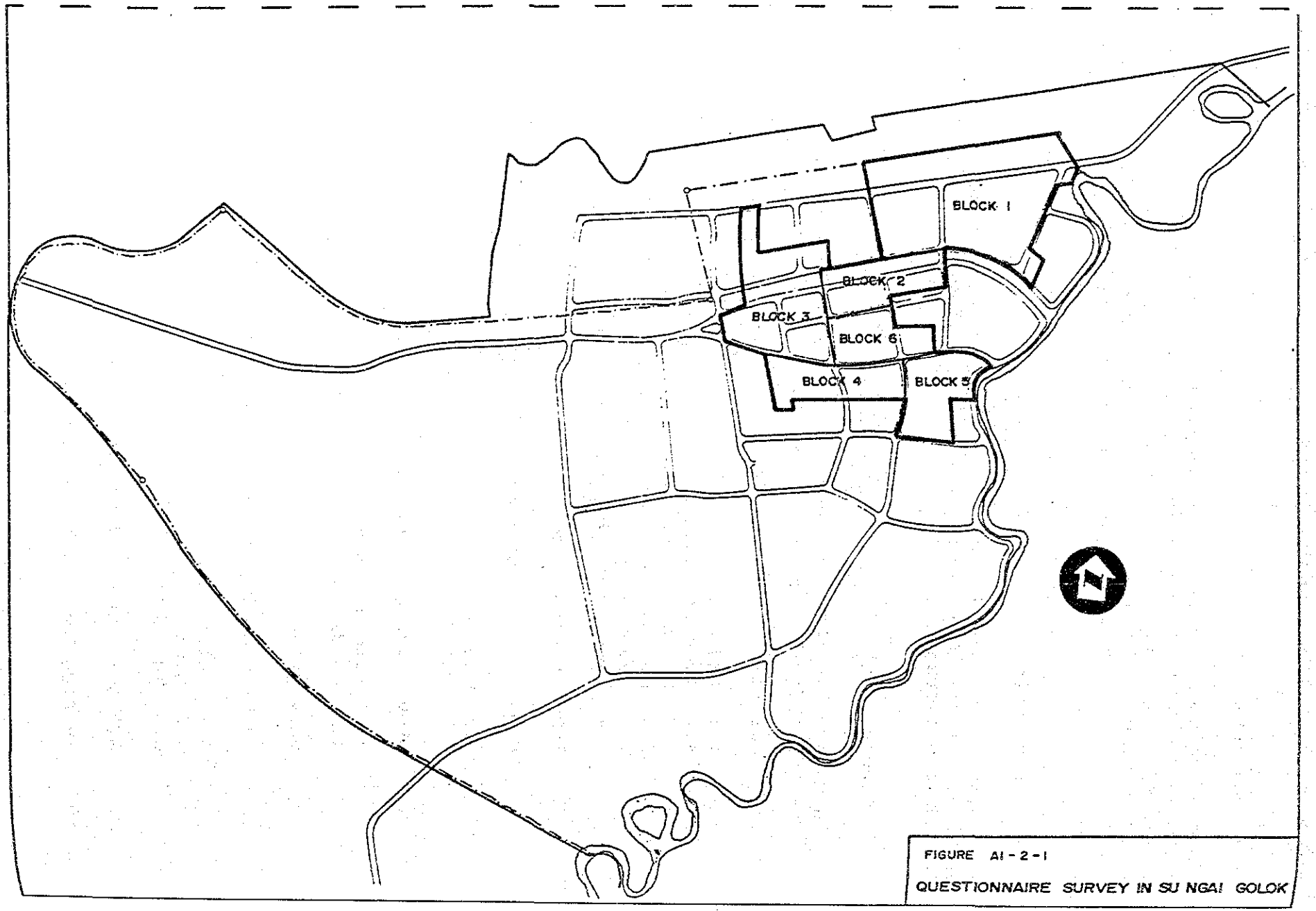


FIGURE A1-2-1

QUESTIONNAIRE SURVEY IN SU NGAI GOLOK

9. Willingness to Pay for Water Charge

10. Water Quality in case of Other Source

    10.1 Color
    10.2 Smell
    10.3 Turbidity

11. Willingness to Connect to the Municipal System

12. Willingness to Pay for Connection Fee

13. Willingness to Pay for Water Charge

4 Survey Method

The unemplyed graduates were employed as interviewers and were engaged in the questionnaire survey with the guidance of the PWA Head Office staff. The survey was conducted to 77 residents on August 16 and 17, 1988.

5 Survey Results

The results of the questionnaire survey are summarized in Table A1-5-1.

1) General

76.6% of the respondents lived in residential houses, 11.7% in commercial buildings, 10.4% in residential/commercial buildings and the remaining 1.3% was unknown due to the omission of confirmation by the interviewers.

The total numbers of persons in families and employees were 369 and 168, respectively. Accordingly, one household is composed of 4.79 family members and 2.21 employees on an average with a total of 7.00 persons.

Regarding the average monthly income, 78.0% respondents were in the up-to-4,500 Baht bracket, or 20.8% in the up-to-2,000 Baht, 35.1% in the 2,001-3,000 Baht and 22.1% in the 3,001-4,500 Baht brackets, respectively. The average in respondents weighted by the number of persons and the median in each income bracket was approximately 3,500 Baht, but the number of persons was biggest in the 2,001-3,000 Baht bracket.

As to the average monthly medical expense, only 7.7% was in the up-to-50 Baht bracket and 11.7%, 27.3%, 29.9 and 16.9% were in the 51-100, 101-200, 201-500 and 501-1,000 Baht brackets, respectively. The average in respondents calculated by the same method as the above is 460 Baht, and the number of persons was biggest in the the 201-500 Baht bracket.

2) Type of Water Supply

9.1% of the respondents used the municipal system only, only 83.1% the other source than the municipal system and 7.8% the combined system of the municipal system and other source(s).

100% or 70 out of 70 other sources was groundwater as shown below.

Block No.	1	2	3	4	5	6	Total
Municipal System Only	-	1	-	-	-	6	7
plus Well	-	-	-	-	-	6	6
Well Only	10	5	6	10	18	4	53
plus Rain/River	4	2	-	-	1	1	8
plus Water Vendor	-	-	2	-	-	-	2
plus Others	-	1*	-	-	-	-	1
Total	14	9	8	10	19	17	77

* Rain/Reservoir and Water Vendor

3) Response to Municipal System

The reputation of the PWA waterworks among 13 respondents using the municipal system was so-so, that is to say, 23.1% complained of low pressure, 7.7% of insufficient water, 7.7% of color, 23.1% of smell and 7.7% of turbidity. Those people mostly lived in Block 6.

4) Potability

This question was originally intended to know the potability of tap water, but the answer seemed to be made not only for the tap water but also for other source water, since the question followed that on other sources.

Accordingly, the evaluation was made extracting the data from respondents using tap water or well water only.

	Tap Water	Well Water
Drinking	- (-)	1 (1.9%)
Not Drinking	- (-)	1 (1.9%)
Both	7 (100%)	49 (92.4%)
Unknown	- (-)	2 (3.8%)
Total	7 (100%)	53 (100%)

1.9% used well water for drinking and 92.4% for drinking and not-drinking.

The doubt as to the kind of water the respondents (who answered that they didn't use only one source for drinking) used for drinking is remained. They may use the water vendor, although this is not expressed clearly in the survey.

5) Water Quality of Other Sources

As mentioned above, groundwater was the main water source. 10.0% complained of color, 4.3% of smell and 10.0% of turbidity. Scrutinizing the data block by block, such complaints mostly took place in Blocks 1 and 3. However, generally speaking , the people were blessed with well water.

6) Conditions of Wells

The well depth distribution is shown below. Between 2.4 and 20 m and 88.6% wells had depths of not more than 10 m. The well with a depth of more than 15 m was located in Block 3.

Block No.	>5m	>5m <10m	>10m <15m	>15m <20m	Un-known	Total
1	8	6	-	-	-	14
2	3	4	-	-	1	8
3	3	3	-	1	1	8
4	-	8	2	-	-	10
5	3	16	-	-	-	19
6	1	7	2	-	1	11
Total	18	44	4	1	3	70
Well Depth (m)	3.9 (18)	7.9 (44)	11.5 (4)	20.0 (1)		
Water Depth (m)	2.4 (19)	3.7 (38)	5.8 (4)	5.0 (1)		
Operation Time (h/d)	2.5 (12)	1.3 (26)	0.5 (2)	6.0 (1)		
No.of Fetching Times (1/d)	22.4 (8)	28.8 (10)	16.5 (2)	- (-)		

The figures in parentheses show the number of wells used for the average calculation.

7) Average Monthly Water Consumption, Water Charge and Willingness-to-Pay.

Regarding the average monthly water consumption, 30.8% of the respondents belonged to the up-to-15 cu m bracket and 30.8% and 15.3 % to the 16-30 cu m and 31-50 cu m brackets, respectively.

38.4% of the respondents paid the water charge in the up-to-50 Baht bracket and 23.1% in the 51-100 Baht brackets, while, according to the result on the willingness-to-pay for water charge, 23.1% wanted that the water charge would be in the up-to-50 Baht bracket and 46.1% in the 51-100 Baht bracket. The expectant amount was rather less than the actual payment.

8) Willingness-to-Connect

Out of 77 respondents, 64 didn't use the municipal system at present. However, only 20.3% was willing to connect to the municipal system. They wanted that the connection fee would be less than 2,000 Baht (76.9%) and the water charge less than 100 Baht (84.6%). The response to the water charge of the possible consumers was severer than that of the existing consumers.

Reasons for unwillingness-to-connect were summarized below.

Block No.	1	2	3	4	5	6	Total
There is a well	6	3	3	3	12	3	30
Well water is enough	2	-	1	1	1	-	5
Well water is clean	2	1	1	1	1	-	6
Well water is convenient	-	-	-	-	1	-	1
Lack of money	1	-	2	1	1	-	5
Not my own house	-	-	1	-	-	-	1
Others	-	-	-	1	1	1	3
Total	11	4	8	7	17	4	51

Contents of others were as follows:

- The well water is better. The tap water sometimes doesn't flow.
- I will connect to the municipal system when constructing the new house.
- The well water is cool and fresh in taking a bath.

Most people who were unwilling to connect to the municipal system thought that they already had wells and those were enough or clean. The wells were very close and indispensable to their living.

Table A1-5-1 SUMMARY OF QUESTIONNAIRE SURVEY IN SU NGAI GOLOK (RESIDENTIAL)

Block No.	1	2	3	4	5	6	Total	Rate (%)
No. of Samples	14	9	8	10	19	17	77	
1. General								
1.1 Address								
1.2 Type of House								
Residential	11	7	7	7	18	9	59	76.6
Commercial	1	-	-	3	-	5	9	11.7
Residential/Commercial	2	2	1	-	-	3	8	10.4
Unknown	-	-	-	-	1	-	1	1.3
1.3 No.of Persons in Family	55	39	51	37	107	80	369	
Unknown (No.of Samples)	-	-	-	-	-	-	-	
1.4 No.of Employees	23	17	25	30	35	38	168	
Unknown (No.of Samples)	-	-	-	-	1	-	1	
1.5 Ave. Monthly Income								
Baht								
up to 2,000	3	2	2	3	1	5	16	20.8
2,001-3,000	6	3	3	3	9	3	27	35.1
3,001-4,500	2	3	-	1	7	4	17	22.1
4,501-6,000	1	1	1	3	1	2	9	11.6
6,001-7,500	-	-	1	-	1	1	3	3.9
7,501-10,000	1	-	-	-	-	1	2	2.6
10,001-15,000	1	-	1	-	-	1	3	3.9
15,001-50,000	-	-	-	-	-	-	-	-
Over 50,000	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-	-
1.6 Ave. Monthly Medical Expense								
Baht								
up to 50	3	-	1	1	1	-	6	7.7
51-100	1	2	2	2	-	2	9	11.7
101-200	5	2	1	3	3	7	21	27.3
201-500	5	2	1	2	9	4	23	29.9
501-1,000	-	3	2	1	4	3	13	16.9
1,001-2,000	-	-	-	-	-	1	1	1.3
2,001-5,000	-	-	1	-	1	-	2	2.6
Over 5,000	-	-	-	-	1	-	1	1.3
Unknown	-	-	-	1	-	-	1	1.3
2. Type of Water Supply								
Municipal System	-	1	-	-	-	6	7	9.1
Combined	-	-	-	-	-	6	6	7.8
Other Sources	14	8	8	10	19	5	64	83.1
Unknown	-	-	-	-	-	-	-	-
3. Municipal System								
3.1 Pressure								
Low	-	-	-	-	-	3	3	23.1
High	-	1	-	-	-	8	9	69.2
Unknown	-	-	-	-	-	1	1	7.7
3.2 Quantity								
Sufficient	-	1	-	-	-	10	11	84.6
Not Sufficient	-	-	-	-	-	1	1	7.7
Unknown	-	-	-	-	-	1	1	7.7

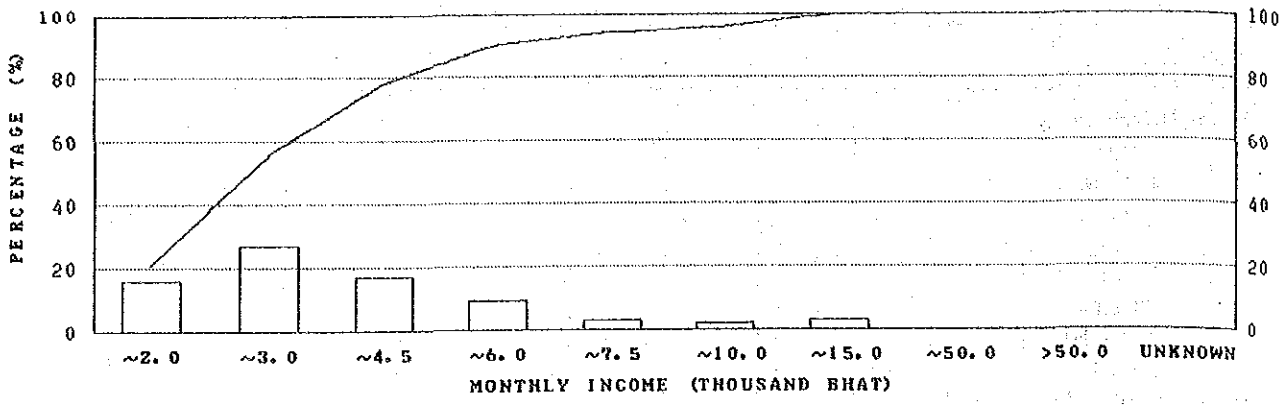
Table A1-5-1 SUMMARY OF QUESTIONNAIRE SURVEY IN SU NGAI GOLOK (RESIDENTIAL) (CONT'D)

Block No.	1	2	3	4	5	6	Total	Rate (%)
4. Other Sources								
Rain/River	4	3	-	-	1	1	9	
Pond/Reservoir	-	-	-	-	-	-	-	
Water Vendor	-	1	2	-	-	-	3	
Groundwater-Shallow Well	14	8	8	10	19	11	70	
-Deep Well	-	-	-	-	-	-	-	
Unknown	-	-	-	-	-	-	-	
5. Potability								
Drinking	1	-	-	-	-	-	1	1.3
Not Drinking	4	1	1	1	-	-	7	9.1
Both	8	8	7	9	18	17	67	87.0
Unknown	1	-	-	-	1	-	2	2.6
6. Water Quality (Municipal System)								
6.1 Color								
Yes	-	-	-	-	-	1	1	7.7
No	-	1	-	-	-	11	12	92.3
Unknown	-	-	-	-	-	-	-	-
6.2 Smell								
Yes	-	1	-	-	-	2	3	23.1
No	-	-	-	-	-	10	10	76.9
Unknown	-	-	-	-	-	-	-	-
6.3 Turbidity								
Yes	-	-	-	-	-	1	1	7.7
No	-	1	-	-	-	11	12	92.3
Unknown	-	-	-	-	-	-	-	-
7. Ave. Monthly Water Consumption								
Up to 15 cu m	-	1	-	-	-	3	4	30.8
16-30 cu m	-	-	-	-	-	4	4	30.8
31-50 cu m	-	-	-	-	-	2	2	15.3
51-75 cu m	-	-	-	-	-	-	-	-
76-100 cu m	-	-	-	-	-	1	1	7.7
101-150 cu m	-	-	-	-	-	-	-	-
151-200 cu m	-	-	-	-	-	-	-	-
201-300 cu m	-	-	-	-	-	1	1	7.7
Over 300 cu m	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	1	1	7.7
8. Ave. Monthly Water Charge								
Baht								
Up to 50	-	1	-	-	-	4	5	38.4
51-100	-	-	-	-	-	3	3	23.1
101-150	-	-	-	-	-	1	1	7.7
151-200	-	-	-	-	-	4	4	30.8
201-300	-	-	-	-	-	-	-	-
301-500	-	-	-	-	-	-	-	-
501-1,000	-	-	-	-	-	-	-	-
Over 1,000	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	-	-	-

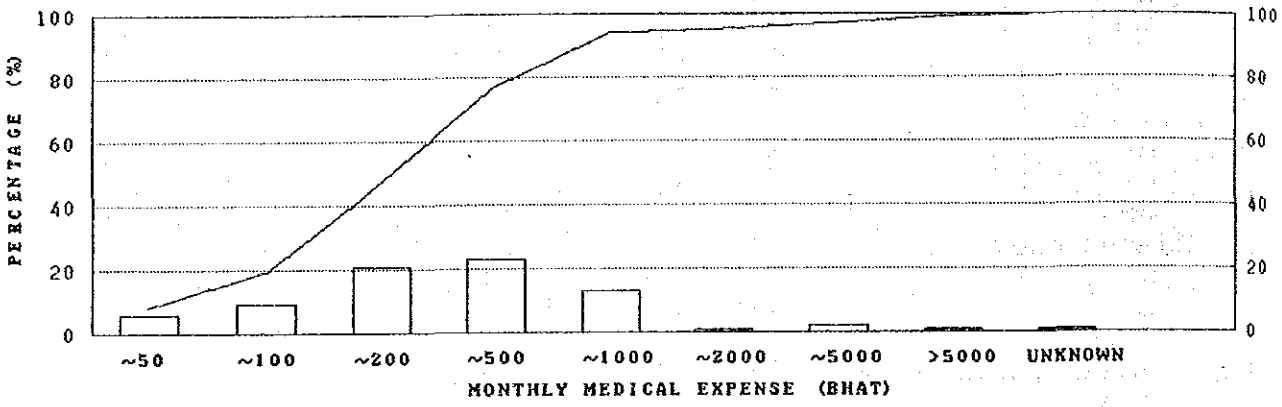
Table A1-5-1 SUMMARY OF QUESTIONNAIRE SURVEY IN SU NGAI GOLOK (RESIDENTIAL) (CONT'D)

Block No.	1	2	3	4	5	6	Total	Rate (%)
9. Willingness to Pay								
Baht								
Up to 50	-	-	-	-	-	3	3	23.1
51-100	-	1	-	-	-	5	6	46.1
101-200	-	-	-	-	-	-	-	-
201-500	-	-	-	-	-	-	-	-
501-1,000	-	-	-	-	-	-	-	-
Over 1,000	-	-	-	-	-	-	-	-
Unknown	-	-	-	-	-	4	4	30.8
10. Water Quality (Other Source)								
10.1 Color								
Yes	5	-	2	-	-	-	2	10.0
No	9	8	6	10	17	11	52	87.1
Unknown	-	-	-	-	2	-	2	2.9
10.2 Smell								
Yes	2	-	1	-	-	-	1	4.3
No	12	8	7	10	17	11	53	92.9
Unknown	-	-	-	-	2	-	2	2.8
10.3 Turbidity								
Yes	5	-	2	-	-	-	2	10.0
No	9	8	6	10	17	11	52	87.1
Unknown	-	-	-	-	2	-	2	2.9
11. Willingness to Connect								
Yes	3	4	-	3	2	1	10	20.3
No	11	4	8	7	17	4	40	79.7
Unknown	-	-	-	-	-	-	-	-
12. Willingness to Pay for Connection Fee								
Baht								
Up to 1,000	2	1	-	-	-	-	1	23.1
1,001-2,000	1	2	-	2	2	-	6	53.8
2,001-2,500	-	-	-	-	-	1	1	7.7
2,501-3,000	-	-	-	1	-	-	-	7.7
3,001-4,000	-	-	-	-	-	-	-	-
4,001-5,000	-	-	-	-	-	-	-	-
5,001-6,000	-	-	-	-	-	-	-	-
Over 6,000	-	-	-	-	-	-	-	-
Unknown	-	1	-	-	-	-	1	7.7
13. Willingness to Pay for Water Charge								
Baht								
Up to 50	2	1	-	-	-	-	1	23.1
51-100	1	2	-	2	2	1	7	61.5
101-200	-	-	-	1	-	-	1	7.7
201-500	-	-	-	-	-	-	-	-
501-1,000	-	-	-	-	-	-	-	-
Over 1,000	-	-	-	-	-	-	-	-
Unknown	-	1	-	-	-	-	1	7.7

MONTHLY INCOME DISTRIBUTION



MONTHLY MEDICAL EXPENSE DISTRIBUTION



TYPE OF WATER SOURCE & WILLINGNESS-TO-CONNECT

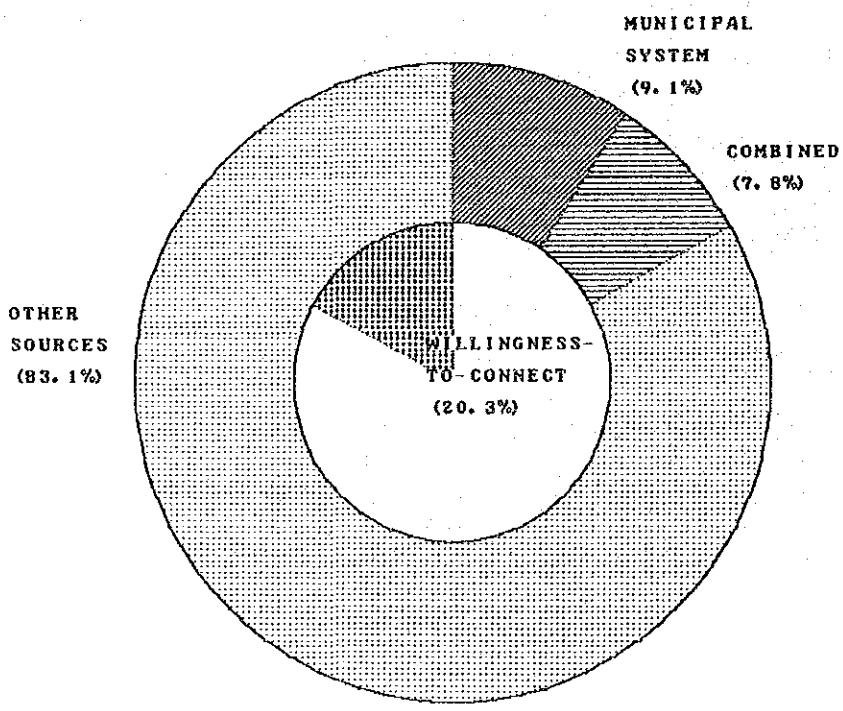
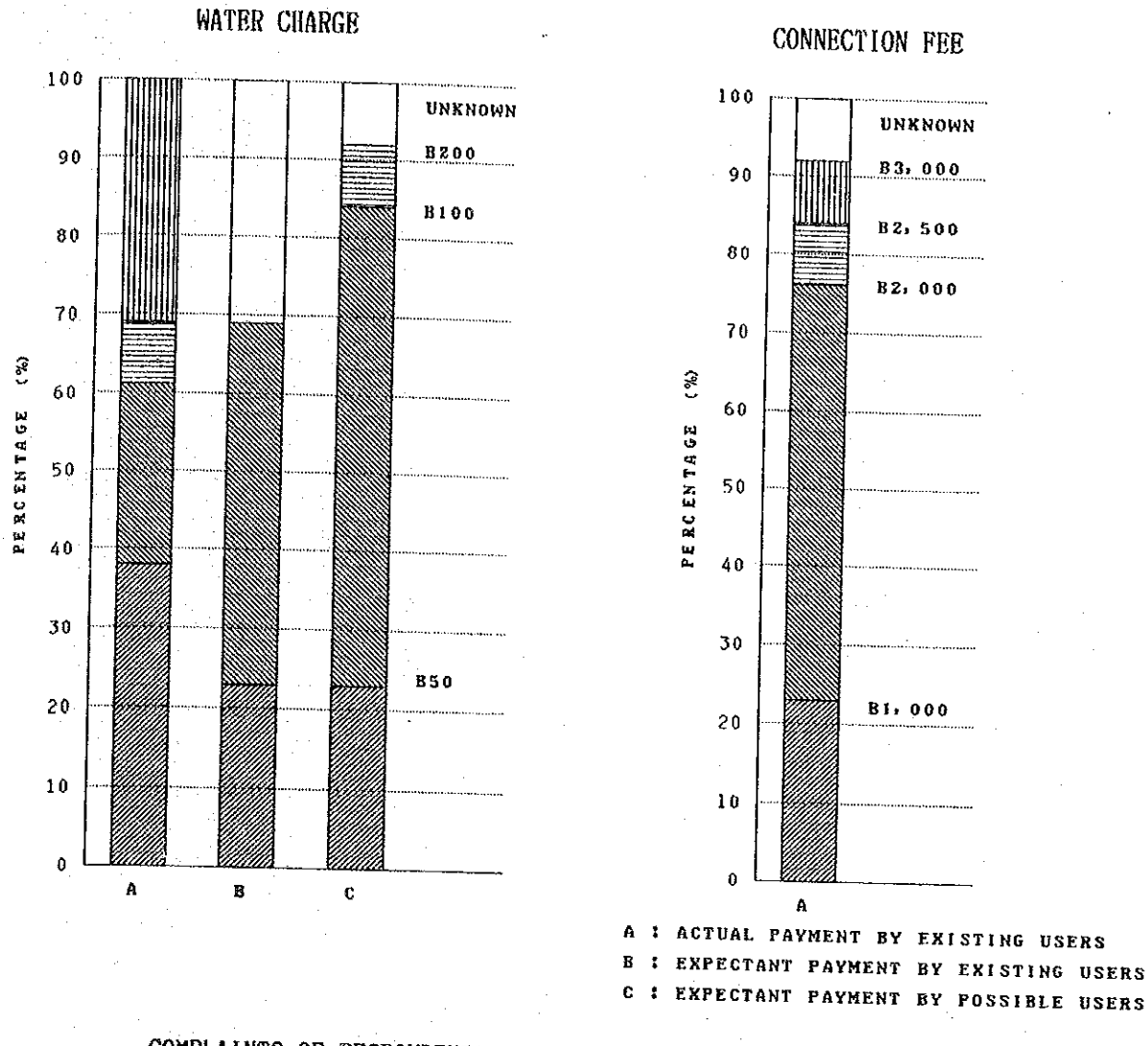


FIGURE A1-5-2
RESULTS OF
QUESTIONNAIRE SURVEY (1)
(SU NGAI GOLOK)

WILLINGNESS-TO-PAY



COMPLAINTS OF RESPONDENTS

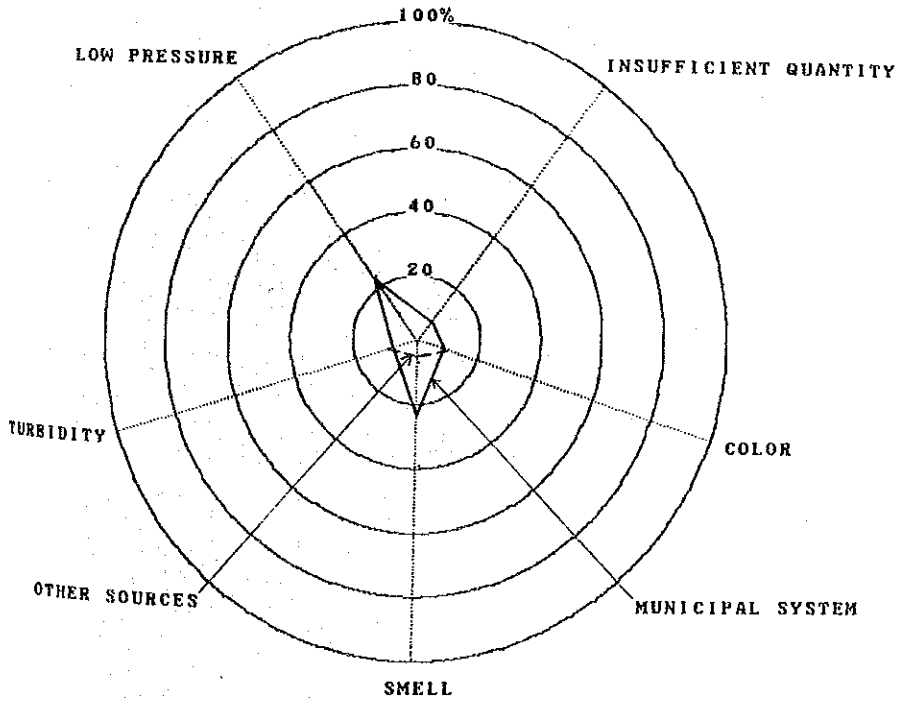


FIGURE A1-5-2
RESULTS OF
QUESTIONNAIRE SURVEY (2)
(SU NGAI GOLOK)

APPENDIX A-4-3

Questionnaire Survey for Hotels

APPENDIX QUESTIONNAIRE SURVEY IN SU NGAI GOLOK (HOTELS)

1 Objective

The door-to-door questionnaire survey was conducted to obtain the basic information on the hotels' usage condition, water use patterns, responses to the municipal system and/or their own water sources and willingness for house-connection supply, and covered the area served or unserved by the municipal water supply system aside from that for the residents.

2 Survey Area

All hotels were targeted for the questionnaire survey. The area located by hotels are at present served by the municipal system.

3 Survey Item

The form used for the questionnaire survey was originally written by Thai and included the following items.

1. General

    1.1 Name of Hotel
    1.2 Address
    1.3 Average of Occupancy Rate

2. Facilities

    2.1 No. of Rooms
    2.2 Average Room Rate
    2.3 Swimming Pool
    2.4 Restaurant and Others

3. Type of Water Supply

4. Water Consumption by Water Source

5. Average Monthly Water Charge

6. Conditions in case of Municipal System

    6.1 Pressure
    6.2 Quantity

7. Other Sources than Municipal System

    7.1 Type of Source
    7.2 Conditions in case of Groundwater

8. Potability

9. Water Quality

   9.1 Municipal System
   9.2 Other Source

10. Willingness to Connect to the Municipal System

11. Willingness to Pay for Connection Fee

12. Willingness to Pay for Water Charge

4 Survey Method

The unemployed college graduates were employed as interviewers and engaged in the questionnaire survey after the guidance by the PWA Head Office staff. The survey was conducted to 52 hotels on August 16 and 17, 1988.

5 Survey Results

1) General

The occupancy rate weighted by the number of rooms were 52.2% on an average, 26.0% in the low season and 73.7% in the high season, respectively

2) Facilities

The total number of rooms in 51 hotels answered was 1,800 rooms out of which 1,108 rooms (61.6%) were air-conditioned. The average number of rooms per hotel was 37 rooms. The distribution of the room charges are shown below. 73.1% was less than 200 Baht.

Room Charge (Baht)	No.of Hotels	Rate (%)
< 100	14	26.9
101 - 200	24	46.2
201 - 300	9	17.3
301 - 500	2	3.8
Unknown	3	5.8
Total	52	100

Only one hotel had a swimming pool with a volume of 420 cu m and there are 19 restaurants and others at 14 hotels.

3) Type of Water Supply

40.4% used the municipal system, 3.8% other sources than the municipal system and 55.8% the combined system of the municipal system and other sources.

In other sources, 96.8% was groundwater including the combination with others as shown below:

Municipal System Only	21
Plus Water Vendor	1
Plus Well	28
Well Only	2
Total	52

4) Monthly Water Consumption by Water Source

The monthly water consumption in the municipal system was studied under the cooperation of the PWA Su Ngai Golok Waterworks staff. 47 hotels with 1,699 rooms used tap water with a total amount of 36,677 cu m in July, 1988. Accordingly, the average per hotel water consumption was 780 cu m/mo and the average per room water consumption was 21.6 cu m/mo.

While 7 hotels with 244 rooms in all used well water with a total amount of 3,370 cu m/mo. The average water consumption were 481 cu m/mo. hotel and 13.8 cu m/mo. room, respectively.

5) Monthly Water Charge

48 hotels with 1,719 rooms paid an amount of 291,714 Baht for the water charge in July, 1988. Accordingly, the average water charges were 6,077 Baht/mo. hotel and 169.7 Baht/mo. room.

6) Condition in case of Municipal System

Out of 50 hotels using the municipal system, 24.0% had a complaint of low pressure, 14.0% of insufficient water, 46.0% of color, 54.0% of smell and 52.0% of turbidity. As compared with the results for residents, the response of hotels were rather severer than that of the residents.

7) Conditions in Case of Other Sources

As mentioned above, almost hotels used groundwater. 3.3% complained of color, 16.7% of smell and 13.3% of turbidity. As compared with tap water, the complaints of water quality was rather less in groundwater.

8) Potability

21 hotels used the municipal system only and answered they used tap water for both drinking and not-drinking.

9) Willingness-to-Connect

Only 2 hotels didn't use the municipal system but both were willing to connect to the municipal system and wanted that the connection fee would be less than 3,000 Baht and the monthly water charge less than 2,000 Baht.

APPENDIX A-4-4

Questionnaire Survey for Factories

APPENDIX QUESTIONNAIRE SURVEY IN SU NGAI GOLOK (INDUSTRIAL)

1 Objective

The door-to-door questionnaire survey was conducted to obtain the basic information on the factories' production conditions, water use patterns, responses to the municipal system and/or their own water sources and willingness for house-connection supply, and covered the area served or unserved by the municipal water supply system aside from that for residents.

2 Survey Area

Major factories were targeted for the questionnaire survey. The area located by those factories are at present served by the municipal system.

3 Survey Item

The form used for the questionnaire survey was originally written by Thai and included the following items.

1. General

    1.1 Name of Company
    1.2 Address
    1.3 Type of Factory
    1.4 Annual Production
    1.5 No. of Present Employees
    1.6 Area of Factory

2. Water Consumption by Usage

    2.1 Washing
    2.2 Cooling
    2.3 Raw Materials
    2.4 Boiling
    2.5 Re-use
    2.6 Others

3. Wastewater Treatment Facility

4. Type of Water Supply

5. Conditions in case of Municipal system

    5.1 Pressure
    5.2 Quantity

6. Other Sources than Municipal System

    6.1 Type of Source
    6.2 Conditions in case of Groundwater

7. Potability

8. Water Quality

   8.1 Municipal System (Color, Smell and Turbidity)
   8.2 Other Sources (Color, Smell and Turbidity)

9. Willingness to Connect to the Municipal System

10. Willingness to Pay for Connection Fee

11. Willingness to Pay for Water Charge

4 Survey Method

The unemployed college graduates were employed as interviewers and engaged in the questionnaire survey after the guidance by the PWA Head Office staff. The survey was conducted to 20 factories on August 16 and 17, 1988.

5 Survey Results

1) General

A various type of factories such as food processing, metal fabrication, construction materials, wooden products and others were in operation in the particular areas.

The average number of employees per factory was 20 persons and 70% was small with a number of employees of not more than 20.

The average area of factory was approximately 2,206 sq m, however excluding three (3) factories with an area of more than 5,000 sq m, it was 854 sq m.

2) Water Consumption by Usage

Except for one factory with a monthly water consumption of 135 cu m and unknown four factories, the monthly water consumptions were less than 20 cu m which require no special consideration.

3) Wastewater Treatment Facility

25.0%, or 5 out of 20 factories had their own wastewater treatment facilities.

4) Type of Water Supply

25.0% used the municipal system only, 60.0% other source than the municipal system and the remaining 15.0% the combination system of the municipal system and other sources

In other sources, 93.3% or 14 out of 15 other sources were the groundwater only, 23.3% the rain/river water

Municipal System Only	5
Plus Well	3
Well Only	11
Pond/Reservoir Only	1
Total	20

The distribution of the well depth is as follows:

Well Depth (m)	No. of Wells
Up to 5.0	-
5.1 - 10.0	7
10.1 - 15.0	4
15.1 - 20.0	-
20.1 - 30.0	3

5) Conditions of Municipal System

Out of 8 factories using the municipal system, 2 factories complained of low pressure, one factory of insufficient water and 2 factories of color, smell and turbidity.

6) Conditions of Other Sources

Out of 15 factories using the other sources, 2 factories complained of color and smell and one factory of turbidity, but the complaint of water quality was less in other sources, as compared with tap water.

7) Potability

The majority of factories using only one source used it for drinking as shown below.

	Tap Water	Well Water
Drinking	1	1
Not Drinking	-	2
Both	3	9
Total	4	12

8) Willingness to Connect

58.3% was willing to connect to the municipal system. Those factories wanted that the connection fee would be less than 3,000 Baht (71.4%) and the water charge less than 2,000 Baht (71.4%).

APPENDIX A-6-1

Construction Unit Cost

Unit Cost

Item	Material	Fitting	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2
Pipeline									
	<**********			P W A 's	Unit Rate (1987)		**********		>
a. A/C Pipe(Normal Tyipe)		(25%)							
100 mm	85	21	56	162	6	35	224	140	364
150 mm	142	36	77	255	11	56	353	154	507
200 mm	255	64	90	409	19	90	569	166	735
250 mm	352	88	126	566	29	125	792	179	971
300 mm	507	127	167	801	40	177	1119	223	1342
400 mm	970	243	248	1461	80	324	2050	248	2298
500 mm	1362	341	278	1981	132	444	2812	283	3095
600 mm	1761	440	354	2555	161	570	3615	319	3934
b. Steel Pipe		(35%)							
150 mm	545	191	99	835	12	178	1127	140	1267
200 mm	720	252	111	1083	22	232	1471	154	1625
250 mm	1080	378	153	1611	38	346	2195	166	2361
300 mm	1330	465	202	1998	58	432	2736	179	2915
400 mm	1420	497	250	2167	80	472	2991	223	3214
500 mm	1785	625	361	2771	160	615	3901	248	4149
600 mm	2140	749	468	3357	264	760	4820	283	5103
700 mm	2495	873	582	3950	322	897	5686	319	6005

Unit Cost

For Transmission Pipeline (Transportation < 800 km)

Item	Material	Fitting (10%)	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2	PWA Price (1987)	Ratio	Adopted (1988)
	(****** Unit Rate Based on Pipe Material Cost as of December,1988								******)			
a. A/C Pipe (Class 20 Normal type)		(10 %)										
100 mm	115	12	63	190	7	41	261	153	414	364	1.14	410
150 mm	189	19	87	295	12	64	408	168	577	507	1.14	580
200 mm	328	33	101	462	21	101	643	181	824	735	1.12	820
250 mm	454	45	142	641	32	141	895	196	1091	971	1.12	1,090
300 mm	643	64	188	895	44	197	1249	244	1493	1342	1.11	1,490
400 mm	1217	122	279	1618	87	358	2270	271	2541	2298	1.11	2,540
500 mm	1699	170	313	2182	144	488	3096	309	3405	3095	1.10	3,410
600 mm	2187	219	398	2804	176	626	3967	349	4315	3934	1.10	4,320
b. Steel Pipe		(15 %)										
150 mm	550	83	111	744	13	159	1008	168	1176	1267	0.93	1,270
200 mm	908	136	125	1168	24	250	1587	181	1769	1625	1.09	1,770
250 mm	1210	182	172	1564	42	337*	2136	196	2332	2361	0.99	2,360
300 mm	1507	226	227	1960	63	425	2693	244	2937	2915	1.01	2,940
400 mm	1887	283	281	2451	87	533	3378	271	3649	3214	1.14	3,650
500 mm	2261	339	406	3006	175	668	4233	309	4542	4149	1.09	4,540
600 mm	2723	408	526	3657	288	829	5252	349	5600	5103	1.10	5,600
700 mm	3179	477	655	4311	352	979	6206	407	6612	6005	1.10	6,610
800 mm	4527	679	932	6138	460	1385	8781	465	9246			9,250
900 mm	5104	766	1051	6921	582	1575	9986	523	10508			10,510
1000 mm	6804	1021	1401	9225	718	2088	13234	581	13815			13,820
1100 mm	7926	1189	1632	10746	869	2439	15460	639	16099			16,100
1200 mm	9048	1357	1863	12268	1034	2793	17705	697	18402			18,400
1350 mm	11000	1650	2265	14915	1309	3407	21594	784	22378			22,380
1500 mm	12953	1943	2667	17563	1616	4027	25526	871	26398			26,400

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Distribution Pipeline (Transportation < 800 km)

Item	Material	Fitting	Labor	SubTotal	Transprt (<800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2	PWA Price (1987)	Ratio	Adopted (1988)
	(****** Unit Rate Based on Pipe Material Cost as of December,1988								******)			
a. A/C Pipe (Class 20 Normal type)		(25 %)										
100 mm	115	29	63	207	7	45	284	153	437	364	1.20	440
150 mm	189	47	87	323	12	70	446	168	614	507	1.21	610
200 mm	328	82	101	511	21	112	708	181	890	735	1.21	890
250 mm	454	113	142	709	32	155	986	196	1181	971	1.22	1,180
300 mm	643	161	188	991	44	217	1378	244	1621	1342	1.21	1,620
400 mm	1217	304	279	1801	87	397	2513	271	2784	2298	1.21	2,780
500 mm	1699	425	313	2437	144	542	3435	309	3744	3095	1.21	3,740
600 mm	2187	547	398	3132	176	695	4403	349	4752	3934	1.21	4,750
b. Steel Pipe		(35 %)										
150 mm	550	193	111	854	13	182	1154	168	1322	1267	1.04	1,320
200 mm	908	318	125	1350	24	289	1829	181	2010	1625	1.24	2,010
250 mm	1210	424	172	1806	42	388	2459	196	2654	2361	1.12	2,650
300 mm	1507	527	227	2262	63	488	3095	244	3338	2915	1.15	3,340
400 mm	1887	660	281	2828	87	612	3880	271	4151	3214	1.29	4,150
500 mm	2261	791	406	3458	175	763	4835	309	5144	4149	1.24	5,140
600 mm	2723	953	526	4202	288	943	5977	349	6325	5103	1.24	6,330
700 mm	3179	1113	655	4946	352	1113	7052	407	7459	6005	1.24	7,460
800 mm	4527	1584	932	7043	460	1576	9986	465	10451			10,450
900 mm	5104	1786	1051	7941	582	1790	11344	523	11867			11,870
1000 mm	6804	2381	1401	10586	718	2374	15045	581	15626			15,630
1100 mm	7926	2774	1632	12332	869	2772	17570	639	18209			18,210
1200 mm	9048	3167	1863	14077	1034	3173	20113	697	20810			20,810
1350 mm	11000	3850	2265	17115	1309	3869	24522	784	25307			25,310
1500 mm	12953	4533	2667	20153	1616	4571	28974	871	29846			29,850

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Transmission Pipeline (Transportation >= 800 km)

Item	Material	Fitting (10%)	Labor	SubTotal	Transprt (>=800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2			Adopted (1988)
<<<<<< Unit Rate Based on Pipe Material Cost as of December,1988 >>>>>>												
a. A/C Pipe (Class 20 Normal type)		(10 %)										
100 mm	115	12	63	190	13	43	270	153	423	364	1.16	420
150 mm	189	19	87	295	24	67	424	168	593	507	1.17	590
200 mm	328	33	101	462	42	106	670	181	852	735	1.16	850
250 mm	454	45	142	641	63	148	937	196	1133	971	1.17	1,130
300 mm	643	64	188	895	87	206	1308	244	1551	1342	1.16	1,550
400 mm	1217	122	279	1618	175	377	2387	271	2658	2298	1.16	2,660
500 mm	1699	170	313	2182	288	519	3288	309	3597	3095	1.16	3,600
600 mm	2187	219	398	2804	352	663	4201	349	4549	3934	1.16	4,550
b. Steel Pipe		(15 %)										
150 mm	550	83	111	744	26	162	1025	168	1193	1267	0.94	1,270
200 mm	908	136	125	1168	48	255	1619	181	1801	1625	1.11	1,800
250 mm	1210	182	172	1564	83	346	2192	196	2387	2361	1.01	2,390
300 mm	1507	226	227	1960	127	438	2778	244	3022	2915	1.04	3,020
400 mm	1887	283	281	2451	175	551	3495	271	3766	3214	1.17	3,770
500 mm	2261	339	406	3006	350	705	4466	309	4775	4149	1.15	4,780
600 mm	2723	408	526	3657	577	889	5636	349	5984	5103	1.17	5,980
700 mm	3179	477	655	4311	704	1053	6674	407	7081	6005	1.18	7,080
800 mm	4527	679	932	6138	919	1482	9393	465	9857			9,860
900 mm	5104	766	1051	6921	1163	1698	10760	523	11283			11,280
1000 mm	6804	1021	1401	9225	1436	2239	14190	581	14771			14,770
1100 mm	7926	1189	1632	10746	1738	2622	16616	639	17256			17,260
1200 mm	9048	1357	1863	12268	2068	3011	19081	697	19778			19,780
1350 mm	11000	1650	2265	14915	2617	3682	23336	784	24120			24,120
1500 mm	12953	1943	2667	17563	3231	4367	27677	871	28548			28,550

*** Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

For Distribution Pipeline (Transportation >= 800 km)

Item	Material	Fitting	Labor	SubTotal	Transprt (>=800km)	Profit etc.(21%)	Total 1 (w/10%cont)	Pavement	Total 2			Adopted (1988)
(###### Unit Rate Based on Pipe Material Cost as of December,1988 ######)												
a. A/C Pipe (Class 20 Normal type)		(25 %)										
100 mm	115	29	63	207	13	46	293	153	446	364	1.23	450
150 mm	189	47	87	323	24	73	462	168	630	507	1.24	630
200 mm	328	82	101	511	42	116	736	181	917	735	1.25	920
250 mm	454	113	142	709	63	162	1028	196	1223	971	1.26	1,220
300 mm	643	161	188	991	87	227	1436	244	1680	1342	1.25	1,680
400 mm	1217	304	279	1801	175	415	2630	271	2901	2298	1.26	2,900
500 mm	1699	425	313	2437	288	572	3627	309	3936	3095	1.27	3,940
600 mm	2187	547	398	3132	352	732	4637	349	4986	3934	1.27	4,990
b. Steel Pipe		(35 %)										
150 mm	550	193	111	854	26	185	1171	168	1340	1267	1.06	1,340
200 mm	908	318	125	1350	48	294	1861	181	2042	1625	1.26	2,040
250 mm	1210	424	172	1806	83	397	2514	196	2709	2361	1.15	2,710
300 mm	1507	527	227	2262	127	502	3179	244	3423	2915	1.17	3,420
400 mm	1887	660	281	2828	175	631	3997	271	4268	3214	1.33	4,270
500 mm	2261	791	406	3458	350	800	5068	309	5377	4149	1.30	5,380
600 mm	2723	953	526	4202	577	1004	6361	349	6709	5103	1.31	6,710
700 mm	3179	1113	655	4946	704	1187	7520	407	7927	6005	1.32	7,930
800 mm	4527	1584	932	7043	919	1672	10598	465	11062			11,060
900 mm	5104	1786	1051	7941	1163	1912	12118	523	12641			12,640
1000 mm	6804	2381	1401	10586	1436	2525	16001	581	16582			16,580
1100 mm	7926	2774	1632	12332	1738	2955	18726	639	19365			19,370
1200 mm	9048	3167	1863	14077	2068	3391	21490	697	22187			22,190
1350 mm	11000	3850	2265	17115	2617	4144	26264	784	27049			27,050
1500 mm	12953	4533	2667	20153	3231	4911	31125	871	31996			32,000

Note: Pipe material prices are estimated from the contractor's purchasing price as of Dec.1988

Unit Cost

Construction Works		Price in 3 Lowest Tenders (1988) (A)		Estimated Cost (A)*1.35	PWA's Unit Cost (for 1987)	Adopted Cost (1988)
Concrete Work (incl.Form Work,Scafolding)	Baht	2,200 /cu m	Baht	2,970 /cu m	-	
Re-Bar	Baht	18 /kg	Baht	24 /kg	-	
Unit Concrete Cost (incl.Form Work,Scafolding, Re-Bar(100kg/cu m concrete))			Baht	5,370 /cu m	-	5,400
Earth Work						
Excavation (with Backfill)		55 /cu m		79 /cu m	-	80
Soil Fill		53 /cu m		76		120 (From PWA Cost)
Architectural Works						
Administration Bldg.		4,516 /sq m		6,451 /sq m		
Head Quarter Bldg.		3,612		5,160		5,000
Chlorination House	Baht	2,830 /sq m	Baht	4,043 /sq m	3610 - 4300	3,800
Pump House (excl.pump pit)	Baht	1,860 /sq m	Baht	2,657 /sq m	3540 - 4200	3,600

Unit Cost

Construction Works	PWA's Cost (for 1987) (Baht 1000)	Unit Cost (Baht/cu m/h) (A)	Estimated Cost (for 1989) (A)*1.30	Adopted Cost (1988)
Treatment Facilities			Unit Cost (Baht/cu m/h)	Unit Cost (Baht/cu m/h)
Sedimentation Basin				
50 cu m/hr	1,310	26,200	34,100	34,000
100 cu m/hr	1,633	16,330	21,200	21,000
200 cu m/hr	3,136	15,680	20,400	20,000
250 cu m/hr	5,133	20,532	26,700	27,000
500 cu m/hr	7,708	15,416	20,000	20,000
1000 cu m/hr	17,723	17,723	23,000	23,000
Filters				
50 cu m/hr	588	11,760	15,300	15,000
100 cu m/hr	1,044	10,440	13,600	14,000
200 cu m/hr	2,227	11,135	14,500	15,000
250 cu m/hr	2,337	9,348	12,200	12,000
500 cu m/hr	4,674	9,348	12,200	12,000
1000 cu m/hr	11,356	11,356	14,800	15,000
Clear Water Reservoir			Unit Cost (Baht/cu m)	Unit Cost (Baht/cu m)
500 cu m	887	1,774	2,300	2,300
1000 cu m	1,628	1,628	2,100	2,100
1500 cu m	2,699	1,799	2,300	2,300
2000 cu m	2,803	1,402	1,800	1,800
2250 cu m	3,282	1,459	1,900	1,900
3000 cu m	6,633	2,211	2,900	2,900
3300 cu m	6,603	2,001	2,600	2,600
4000 cu m	7,730	1,933	2,500	2,500
5800 cu m	10,809	1,864	2,400	2,400
Elevated Tank			Cost (Baht 1000)	Cost (Baht 1000)
50 cu m	722		940	900
120 cu m	1,146		1,490	1,500
250 cu m	1,394		1,810	1,800

APPENDIX A-8-1

Details of Water Demand Prediction

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Population in Service Area																						
High Density Area	11,958	12,258	12,558	12,858	13,157	13,457	13,757	14,071	14,385	14,699	15,013	15,327	15,650	15,972	16,295	16,617	16,940	17,265	17,590	17,916	18,241	18,566
Medium Density Area	12,419	12,660	12,901	13,142	13,383	13,624	13,865	14,107	14,348	14,590	14,831	15,073	15,318	15,562	15,783	16,020	16,257	16,493	16,708	16,934	17,159	17,385
Low Density Area	6,773	7,268	7,763	8,258	8,753	9,248	9,743	10,387	11,032	11,676	12,321	12,965	13,795	14,625	15,455	16,285	17,115	18,173	19,231	20,288	21,346	22,404
Total	31,150	32,186	33,222	34,258	35,293	36,329	37,365	38,565	39,765	40,965	42,165	43,365	44,754	46,144	47,533	48,923	50,312	51,921	53,529	55,138	56,746	58,355
Service Ratio (%)																						
High Density Area	70	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Medium Density Area	18	20	23	25	28	30	33	35	38	40	43	45	48	50	53	55	58	60	63	65	68	70
Low Density Area	0	0	3	6	9	12	15	17	19	21	23	25	28	31	34	37	40	42	44	46	48	50
Served Population																						
High Density Area	8,371	8,581	8,916	9,257	9,605	9,958	10,318	10,694	11,076	11,465	11,860	12,262	12,678	13,097	13,525	13,959	14,399	14,848	15,304	15,766	16,234	16,709
Medium Density Area	2,235	2,532	2,916	3,312	3,720	4,142	4,575	4,994	5,424	5,865	6,318	6,783	7,287	7,804	8,334	8,875	9,429	9,955	10,493	11,041	11,600	12,170
Low Density Area	0	0	233	495	788	1,110	1,461	1,766	2,096	2,452	2,834	3,241	3,863	4,534	5,255	6,025	6,848	7,633	8,461	9,333	10,246	11,202
Total	10,606	11,113	12,065	13,065	14,113	15,210	16,355	17,454	18,596	19,782	21,012	22,286	23,826	25,435	27,113	28,859	30,674	32,436	34,258	36,139	38,080	40,081
Average Service Ratio(%)	34.0	34.5	36.3	38.1	40.0	41.9	43.8	45.3	46.8	48.3	49.8	51.4	53.3	55.1	57.0	59.0	61.0	62.5	64.0	65.5	67.1	68.7
Unit Water Consumption (lpcd)																						
High Dens Area	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210
Med Dens Area	114	115	116	117	119	120	121	122	124	125	127	128	129	130	132	133	134	135	136	138	139	140
Low Dens Area	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Domestic Water Consumption by Area																						
High Density Area	1,406	1,459	1,534	1,611	1,690	1,773	1,857	1,946	2,038	2,133	2,230	2,330	2,434	2,541	2,651	2,764	2,880	2,999	3,122	3,248	3,377	3,509
Medium Density Area	254	291	339	389	441	496	554	611	671	734	800	868	942	1,018	1,097	1,179	1,263	1,346	1,431	1,519	1,610	1,704
Low Density Area	0	0	19	41	65	93	124	152	182	216	252	292	351	417	489	566	650	733	821	915	1,014	1,120
Total	1,661	1,750	1,891	2,040	2,197	2,362	2,535	2,709	2,892	3,083	3,282	3,490	3,727	3,976	4,236	4,509	4,794	5,078	5,374	5,682	6,001	6,333

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gov/Institutional Consumption (based on Population Ratio by Zone)																						
A. Government (unit consumption = 5.0 l/day/pop in service area)																						
Consumption	187	193	199	206	212	218	224	231	239	246	253	260	269	277	285	294	302	312	321	331	340	350
B. School (Number of student = 14.9 % of population in service area)																						
B-1 Number of student	4,649	4,804	4,958	5,113	5,268	5,422	5,577	5,756	5,935	6,114	6,293	6,472	6,680	6,887	7,095	7,302	7,509	7,749	7,989	8,230	8,470	8,710
B-2 Water Consumption (unit consumption = 20 l/day/student)																						
Consumption	93	96	99	102	105	108	112	115	119	122	126	129	134	138	142	146	150	155	160	165	169	174
C. Hospital Use (unit consumption = 1.5 cu m/bed/d) (unit consumption = 1.5 cu m/d/bed)																						
C-1 No. of Bed (Trend from 215 in 1988)	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215	215
Consumption	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323	323
A+B+C Total of Governmental/Institutional Consumption																						
Total	602	612	621	630	640	649	658	669	680	691	701	712	725	737	750	762	775	789	803	818	832	847

Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tourism Consumption																						
A. No. of Annual Tourist Arrival	300,300	305,400	310,420	315,440	320,460	325,480	330,500	332,760	335,020	337,280	339,540	341,800	342,760	343,720	344,680	345,640	346,600	347,000	347,400	347,800	348,200	348,600
B. Annual Total of Tourist (A./1.40)	420,532	427,560	434,588	441,616	448,644	455,672	462,700	465,864	469,028	472,192	475,356	478,520	479,864	481,208	482,552	483,896	485,240	485,800	486,360	486,920	487,480	488,040
C. Average Daily No. of Tourist (B./365)	1,152	1,171	1,191	1,210	1,229	1,248	1,268	1,276	1,285	1,294	1,302	1,311	1,315	1,318	1,322	1,326	1,329	1,331	1,332	1,334	1,336	1,337
D. Consumption (unit consumption = 850 lpcd)	979	996	1,012	1,028	1,045	1,061	1,078	1,085	1,092	1,100	1,107	1,114	1,117	1,121	1,124	1,127	1,130	1,131	1,133	1,134	1,135	1,137
Commercial Water Consumption (consumption = 13 % of tourism consumption)																						
Consumption	127	129	132	134	136	138	140	141	142	143	144	145	145	146	146	146	147	147	147	147	148	148
Industrial Water Consumption																						
Industrial Water Consumption (1.2 % of (Domestic + Governmental Consumption))																						
Consumption	27	28	30	32	34	36	38	41	43	45	48	50	53	57	60	63	67	70	74	78	82	86
Other Consumption																						
Other Water Consumption (11.3 % of (Domestic + Governmental Consumption))																						
Consumption	256	267	284	302	321	340	361	382	404	426	450	475	503	533	563	596	629	663	698	734	772	811

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Prediction of Service Population and Demand

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total Daily Average Consumption (cu m/d)																						
Consumption	3,653	3,782	3,970	4,166	4,372	4,586	4,810	5,027	5,252	5,487	5,732	5,986	6,271	6,568	6,879	7,203	7,541	7,879	8,229	8,593	8,971	9,361
Unaccounted-for Water Ratio (%)																						
	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Total Daily Average Demand (cu m/d)																						
Total	4,198	4,347	4,563	4,789	5,025	5,272	5,529	5,778	6,037	6,307	6,588	6,881	7,208	7,550	7,907	8,279	8,668	9,056	9,459	9,877	10,311	10,760
Total Daily Maximum Demand by Zone (cu m/d)																						
Peak Factor = 1.30																						
Total	5,458	5,651	5,932	6,226	6,533	6,853	7,187	7,511	7,848	8,200	8,565	8,945	9,370	9,814	10,279	10,763	11,268	11,773	12,297	12,840	13,404	13,988
Treatment Plant Capacity (cu m/day)					Starting in 1995																	
					Line 1	4,700																
					Line 2									4,700								
					Total Capacity	4,700	4,700	4,700	4,700	4,700	4,700	4,700	4,700	9,400	9,400	9,400	9,400	9,400	9,400	9,400	9,400	9,400
Exis.Plant	5,760																					
Effective Capacity	5,333	5,333	5,333	5,333	5,333	9,685	9,685	9,685	9,685	9,685	9,685	9,685	9,685	14,037	14,037	14,037	14,037	14,037	14,037	14,037	14,037	14,037