APPENDIX A-8-2

Details of Cost Estimates for Alternative Study

Alternative : I

Item	Dimension	Unit Cost (Baht)	Total Cost (x1000 Baht)	Cost Allocation Foreign Cur. Portion (x1000 Baht)	Local Cur. Portion (x1000 Baht)	Remark
1. Raw Water Intake						
a.Site Fill (2,000 cu m)		80	160	48	112	
b.Pumping Station (100 sq m)		3,600	360	108	252	
c.Pump Pit (concrete 100 cu m)		5,400	540	162	378	
d.Pumps (200mm 3cu m/min, 3 units)		380,000	1,140	912	228	
e.Electrical (50% of Mechanical)			570	456	114	
f.Raw Water Pipe (300 mm, 1,000 m)		1,550	1,550	169	108	
Sub-Total of 1.			4,320	1,855	1,192	
2. Transmission Pipe		(B/m)				
A/C Pipe, 300 mm	L=7,000 m	1,550	10,850	3,255	7,595	
A/C Pipe, 300 mm	L=6,000 m	1,550	9,300	2,790	6,510	
Sub-Total of 2.			20,150	6,045	14,105	
3. Treatment Plant						
a.Modification of Exis. Plant	(5,780 cu m/d)	not included				
b.New Treatment plant	(9,400 cu m/d)					
Receiving Well	10 cu m		20	6	14	
Sedimentation Basin	392 cu m/h		7,840	2,352	5,488	
Sand Filter	392 cu m/h		4,704	1,411	3,293	
Clear Water Reservoir	3,200 cu m		8,320	2,496	5,824	
Elevated Tank	250 cu m		1,800	540	1,260	
Pumping House	100 sq m		360	108	252	
Chemical House	100 sq m		380	114	266	
Administration Bldg	100 sq m		500	150	350	
Staff Quarter	200 sq m		1,000	300	700	
(Sub-total)			24,924	7,477	17,447	
Mechanical Works		(B/unit)				
Chemical Equip	Mixer,Tank, 2units	760,000	1,520	1,216	304	
Chlorinator	2 kg/h x 2 sets	440,000	880	704	176	
Pumps	2 cu m/m , 4 units	350,000	1,400	1,120	280	
Miscellaneous	20 % of above		760	608	152	
(Sub-total)			4,560	3,648	912	
Electrical Works	70% of Mech. Works		3,192	2,554	638	
Miscellaneous	10 % of above		3,268	2,480	3,736	
						unit cost
Sub-Total of (b)			35,944	27,284	8,659	3,792
Sub-Total of 3.			35,944	27,284	8,659	

Alternative : 1

Item	Dimension	Unit Cost (Baht)	Total Cost (x1000 Baht)	Cost Allocation Foreign Cur. Portion (x1000 Baht)	Local Cur. Portion (x1000 Baht)	Remark
4.Distribution Pipes		(B/m)				
	dia(mm) length(m)					
Replacement						
A/C Pipe,	300 3,330	920	3,064	919	2,145	
A/C Pipe,	250 1,970	1,220	2,403	721	1,682	
A/C Pipe,	300 530	1,680	890	267	623	
A/C Pipe,	400 740	2,900	2,146	644	1,502	
New Construction						
A/C Pipe,	100 8,235	450	3,706	1,112	2,594	
A/C Pipe,	150 6,940	630	4,372	1,312	3,061	
A/C Pipe,	200 5,690	920	5,235	1,570	3,664	
A/C Pipe,	250 680	1,220	1,074	322	752	
A/C Pipe,	300 2,320	1,680	3,398	1,169	2,728	
Sub-Total of 4.	30,635		26,787	8,036	18,751	
Total Construction Cost			87,201	43,220	42,708	

Note : Allocation Ratio (Foreign : Local) = 0.3 : 0.7 (Civil/Architectural Works)
= 0.8 : 0.2 (Mech./Elect. Works)
= 0.8 : 0.2 (Steel Pipe Construction)
= 0.3 : 0.7 (A/C Pipe Construction)

Alternative : 2

Item	Dimension	Unit Cost (Baht)	Total Cost (x1000 Baht)	Cost Allocation Foreign Cur. Portion (x1000 Baht)	Local Cur. Portion (x1000 Baht)	Remark
1. Raw Water Intake						
a.Site Fill (2,000 cu m)		80	160	48	112	
b.Pumping Station (100 sq m)		3,600	360	108	252	
c.Pump Pit (concrete 100 cu m)		5,400	540	162	378	
d.Pumps (200mm 3cu m/min,4 units)		380,000	1,520	1,216	304	
e.Electrical (50% of Mechanical)			760	608	152	
f.Raw Water Pipe (300 mm, 1,000m)		1,550	1,550	643	907	
Sub-Total of 1.			4,890	2,785	2,105	
2. Transmission Pipe		(B/m)				
A/C Pipe, 300 mm	L=7,000 m	1,550	10,850	3,255	7,595	
A/C Pipe, 400 mm	L=6,000 m	2,900	17,400	5,220	12,180	
Sub-Total of 2.			28,250	8,475	19,775	
3. Treatment Plant						
a.Modification of Exis. Plant	(5,760 cu m/d)	not included				
b.New Treatment plant	(15,150 cu m/d)					
Receiving Well	15 cu m		30	9	21	
Sedimentation Basin	631 cu m/h		12,626	3,786	8,834	
Sand Filter	631 cu m/h		7,572	2,272	5,300	
Clear Water Reservoir	5,000 cu m		12,000	3,600	8,400	
Elevated Tank	250 cu m		1,800	540	1,260	
Pumping House	100 sq m		360	108	252	
Chemical House	100 sq m		380	114	266	
Administration Bldg	100 sq m		500	150	350	
Staff Quarter	200 sq m		1,000	300	700	
Sub total			36,262	10,879	25,383	
Mechanical Works		(B/unit)				
Chemical Equip	Mixer,Tank, 2units	760,000	1,520	1,216	304	
Chlorinator	2 kg/h x 2 sets	440,000	880	704	176	
Pumps	3 cu m/m , 5 units	420,000	2,100	1,680	420	
Miscellaneous	20 % of above		900	720	180	
Sub total			5,400	4,320	1,080	
Electrical Works	70% of Mech. Works		3,780	3,024	756	
Miscellaneous	10 % of above		4,544	1,822	2,722	
						unit cost
Sub-Total of (b)			49,986	35,243	14,743	3,299
Sub-Total of 3.			49,986	35,243	14,743	

Alternative : 2

Item	Dimension	Unit Cost (Baht)	Total Cost (x1000 Baht)	Cost Allocation Foreign Cur. Portion (x1000 Baht)	Local Cur. Portion (x1000 Baht)	Remark
4.Distribution Pipes	dia(mm) length(m)	(B/m)				
Replacement						
A/C Pipe,	200 3,330	920	3,064	919	2,145	
A/C Pipe,	250 1,970	1,220	2,403	721	1,682	
A/C Pipe,	300 530	1,680	890	267	623	
A/C Pipe,	400 740	2,900	2,146	644	1,502	
New Construction						
A/C Pipe,	100 8,235	450	3,706	1,112	2,594	
A/C Pipe,	150 6,940	630	4,372	1,312	3,061	
A/C Pipe,	200 5,690	920	5,235	1,570	3,664	
A/C Pipe,	250 880	1,220	1,074	322	752	
A/C Pipe,	300 2,320	1,680	3,898	1,169	2,728	
Sub-Total of 4.	30,635		26,787	8,036	18,751	
Total Construction Cost			109,914	54,539	55,374	

Note : Allocation Ratio (Foreign : Local) = 0.3 : 0.7 (Civil/Architectural Works)
= 0.8 : 0.2 (Mech./Elect. Works)
= 0.8 : 0.2 (Steel Pipe Construction)
= 0.3 : 0.7 (A/C Pipe Construction)

Alternative : 3

Item	Dimension	Unit Cost (Baht)	Total Cost (x1000 Baht)	Cost Allocation Foreign Cur. Portion (x1000 Baht)	Cost Allocation Local Cur. Portion (x1000 Baht)	Remark
1. Raw Water Intake						
a.Site Fill (2,000 cu m)		80	160	48	112	
b.Pumping Station (100 sq m)		3,600	360	108	252	
c.Pump Pit (concrete 100 cu m)		5,400	540	162	378	
d.Pumps (200mm 3cu m/min,3 units)		380,000	1,140	912	228	
e.Electrical (50% of Mechanical)			570	456	114	
f.Raw Water Pipe (300 mm, 1,000 m)		1,550	1,550	506	1,044	
Sub-Total of 1.			4,320	2,192	2,128	
2. Transmission Pipe		(B/m)				
A/C Pipe, 300 mm	L=7,000 m	1,550	10,850	3,255	7,595	
A/C Pipe, 400 mm	L=6,000 m	2,900	17,400	5,220	12,180	
Sub-Total of 2.			28,250	8,475	19,775	
3. Treatment Plant						
a.Modification of Exis. Plant	(5,760 cu m/d)	not included				
b.New Treatment plant	(9,400 cu m/d)					
Receiving Well	10 cu m		20	6	14	
Sedimentation Basin	392 cu m/h		7,840	2,352	5,488	
Sand Filter	392 cu m/h		4,704	1,411	3,293	
Clear Water Reservoir	3,200 cu m		8,320	2,496	5,824	
Elevated Tank	250 cu m		1,800	540	1,260	
Pumping House	100 sq m		360	108	252	
Chemical House	100 sq m		380	114	266	
Administration Bldg	100 sq m		500	150	350	
Staff Quarter	200 sq m		1,000	300	700	
Sub total			24,924	7,477	17,447	
Mechanical Works		(B/unit)				
Chemical Equip	Mixer,Tank, 2units	760,000	1,520	1,216	304	
Chlorinator	2 kg/h x 2 sets	440,000	880	704	176	
Pumps	2 cu m/m , 4 units	350,000	1,400	1,120	280	
Miscellaneous	20 % of above		760	608	152	
Sub total			4,560	3,648	912	
Electrical Works	70% of Mech. Works		3,192	2,554	638	
Miscellaneous	10 % of above		3,268	1,368	1,900	
						unit cost
Sub-Total of (b)			35,944	26,172	9,772	3,792
Sub-Total of 3.			35,944	26,172	9,772	

Alternative : 3

Item	Dimension	Unit Cost (Baht)	Total Cost (x1000 Baht)	Cost Allocation Foreign Cur. Portion (x1000 Baht)	Local Cur. Portion (x1000 Baht)	Remark
4.Distribution Pipes	dia(mm) length(m)	(B/m)				
Replacement						
A/C Pipe,	200 3,330	920	3,064	919	2,145	
A/C Pipe,	250 1,970	1,220	2,403	721	1,682	
A/C Pipe,	300 530	1,680	890	267	623	
A/C Pipe,	400 740	2,900	2,146	644	1,502	
New Construction						
A/C Pipe,	100 8,235	450	3,706	1,112	2,594	
A/C Pipe,	150 6,940	630	4,372	1,312	3,061	
A/C Pipe,	200 5,690	920	5,235	1,570	3,664	
A/C Pipe,	250 880	1,220	1,074	322	752	
A/C Pipe,	300 2,320	1,680	3,898	1,169	2,728	
Sub-Total of 4.	30,635		26,787	8,036	18,751	
Total Construction Cost			95,301	44,875	50,426	

Note : Allocation Ratio (Foreign : Local) = 0.3 : 0.7 (Civil/Architectural Works)
= 0.8 : 0.2 (Mech./Elect. Works)
= 0.8 : 0.2 (Steel Pipe Construction)
= 0.3 : 0.7 (A/C Pipe Construction)

Alternative : I

Item	1,990	1,991	1,992	1,993	1,994	Y 1,995	1,996	1,997	E 1,998	1,999	2,000	A 2,001	2,002	2,003	E 2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011
1. Planned Daily Average Water Demand (cu m/d)																						
	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
2. Planned Daily Maximum Water Demand: QDM (cu m/d) Peak Factor = 1.30																						
	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

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3. Treatment Plant

Existing Plant ;*****>> Max.Capacity 3,840 cu m/d Effective Capacity (less 8 % loss) 3,560 cu m/d

After Modified ;** 5,760 cu m/d 5,330 cu m/d ************************>>

New Plant(Phase 1) ;************>> 4,700 cu m/d 4,352 cu m/d

New Plant(Phase 2) ;*************** Max.Capa 4,700 cu m/d Eff.Capa 4,352 cu m/d

Item	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011
Effective Capacity (cu m/d) Total	3,560	5,330	5,330	5,330	5,330	9,582	9,682	9,682	9,682	9,682	9,682	9,682	9,682	14,034	14,034	14,034	14,034	14,034	14,034	14,034	14,034	14,034
4. Raw Water Amount to be transmitted from the new intake : QDA(qia) (cu m/d)																						
Daily Average	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
Daily Maximum	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

5. Transmission Pipe ;*****>> shows a starting year of water transmission — Head Loss for Q(2011)DM (m)

P1: A/C Pipe(Exis.WTP) ;*********>> Dia.= 300 mm, L = 7,000 m, I(max) = 0.0067 , Q(max) = 7,480 cu m/d (V: m/s) (0.37) 47.5

P2: A/C Pipe(New WTP) ;*****>> Dia.= 300 mm, L = 6,000 m, I(max) = 0.0078 , Q(max) = 8,130 cu m/d (0.40) 47.5

6. Pump Characteristics

Raw Water Pump

For Pipeline P1 Dia= 200 mm, P = 40 KW, H = 55.0 m, Q = 2.6 cu m/min, No.of Pumps = 2 units (excluding 1 unit stand-by)

For Pipeline P2 Dia= 200 mm, P = 40 KW, H = 55.0 m, Q = 2.8 cu m/min, No.of Pumps = 2 units (excluding 1 unit stand-by)

Clear Water Pump

Exis.Plant Dia= 200 mm, P = 30 KW, H = 30.0 m, Q = 3.0 cu m/min, No.of Pumps = 3 units (excluding 1 unit stand-by)

New WTP Dia= 200 mm, P = 30 KW, H = 30.0 m, Q = 3.0 cu m/min, No.of Pumps = 3 units (excluding 1 unit stand-by)

7. No.of Operating Pumps	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011
Raw Water Pump																						
For Pipeline P1		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Max. Capacity of Pump		7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480	7,480
For Pipeline P2						1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2
Max. Capacity of Pump						4,065	4,065	4,065	4,065	4,065	4,065	4,065	4,065	4,065	8,130	8,130	8,130	8,130	8,130	8,130	8,130	8,130
Total Capacity (cu m/d)		7,480	7,480	7,480	7,480	11,545	11,545	11,545	11,545	11,545	11,545	11,545	11,545	11,545	15,610	15,610	15,610	15,610	15,610	15,610	15,610	15,610
Clear Water Pump																						
Exis.& New Plant	3	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	5	5	5
Max.Capa.of Pump	8,640	8,640	8,640	12,960	12,960	12,960	12,960	12,960	12,960	12,960	12,960	12,960	17,280	17,280	17,280	17,280	17,280	17,280	17,280	21,600	21,600	21,600

Sa Ngai Golok Water Transmission Cost 08-Dec-89

Alternative : 1

Item	1,990	1,991	1,992	1,993	1,994	1,995	1,996	1,997	1,998	1,999	2,000	2,001	2,002	2,003	2,004	2,005	2,006	2,007	2,008	2,009	2,010	2,011
8. Motor Output (Kw)																						
Raw Water Pump	0	80	80	80	80	120	120	120	120	120	120	120	120	120	160	160	160	160	160	160	160	160
Clear W.Pump	60	60	60	90	90	90	90	90	90	90	90	90	120	120	120	120	120	120	120	150	150	150
9. Energy Consumption (Kwh/day)																						
Raw Water Pump	0	1,116	1,171	1,229	1,290	1,315	1,379	1,441	1,506	1,573	1,644	1,716	1,796	1,883	1,945	2,037	2,132	2,226	2,327	2,430	2,536	2,647
Clear W.Pump	706	725	761	798	838	879	921	963	1,006	1,051	1,098	1,147	1,201	1,258	1,318	1,380	1,445	1,509	1,577	1,646	1,718	1,793
10. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge	165	385	385	467	467	577	577	577	577	577	577	577	660	660	769	769	769	769	769	852	852	852
Energy Charge	314	826	867	910	955	985	1,033	1,079	1,128	1,178	1,231	1,285	1,347	1,410	1,465	1,534	1,606	1,678	1,752	1,838	1,918	1,994
Total Cost	479	1,211	1,252	1,377	1,422	1,562	1,610	1,656	1,705	1,755	1,808	1,863	2,006	2,070	2,234	2,303	2,375	2,447	2,522	2,682	2,762	2,845
																				Total (1991-2011) =		41,169

Chemical Cost

Alum (Ave 15.0mg/l)																						
Chemical (kg/y)	21,900	24,983	26,228	27,513	28,882	30,276	31,653	33,054	34,535	36,072	37,672	39,462	41,334	43,290	45,330	47,457	49,582	51,789	54,078	56,452	58,913	
Cost(Baht 1000)	96.4	101.2	106.2	111.4	116.9	122.6	128.1	133.9	139.9	146.1	152.6	159.8	167.4	175.3	183.6	192.2	200.8	209.7	219.0	228.6	238.6	
Lime (Ave 9.0 mg/l)																						
Chemical (kg/y)	14,280	14,599	15,732	16,508	17,317	18,152	18,990	19,832	20,720	21,643	22,603	23,677	24,800	25,974	27,198	28,474	29,749	31,073	32,447	33,871	35,348	
Cost(Baht 1000)	17.8	18.7	19.7	20.6	21.6	22.7	23.7	24.8	25.9	27.1	28.3	29.6	31.0	32.5	34.0	35.6	37.2	38.8	40.6	42.3	44.2	
Chlorine Gas (2.0 mg/l)																						
Chemical (kg/y)	3,173	3,331	3,496	3,668	3,848	4,036	4,218	4,407	4,604	4,810	5,023	5,262	5,511	5,772	6,044	6,328	6,611	6,905	7,216	7,522	7,855	
Cost(Baht 1000)	43.5	52.0	54.5	57.2	60.0	63.0	65.8	68.8	71.8	75.0	78.4	82.1	86.0	90.0	94.3	98.7	103.1	107.7	112.5	117.4	122.5	
Total Cost(Baht 1000)	163.7	171.9	180.4	189.3	198.6	208.3	217.6	227.4	237.6	248.2	259.2	271.5	284.4	297.8	311.9	326.5	341.1	356.3	372.1	388.4	405.3	
																				Total		5,657

Note: Pumps is designed for Qda (Daily Average Demand)
1. Energy Consumption (EEk) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(qla)/max.capacity of pump(8))
2. Demand Charge = Baht 225 /KW/mon x 12 mon/year x Motor Demand(Y) KW
Energy Charge = Baht 1.23 /EEh x Energy Consumption (8) KEh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(Actual Head for H.R.L)+(Pump Head 1.5 m)
DA : Daily Average
DM : Daily Maxiam
Electricity Fee = Rate of Provincial Electricity Authority(PEA) for Narathiwat as of January, 1989.
Chemical cost (PEA Procurement Division,1989 Cost)
Alum : Baht 4.85 /kg
Lime : Baht 1.25 /kg
Cl gas : Baht 15.5 /kg

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Operation/Chemical Cost	0	0	1,375	1,424	1,558	1,612	1,761	1,818	1,874	1,932	1,993	2,056	2,122	2,278	2,354	2,532	2,615	2,702	2,788	2,878	3,056	3,151	3,251
Discount Rate	10.00 %																						
PW	13,906 x 1000 Baht																						

Alternative : 2

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
1. Planned Daily Average Water Demand (cu m/d)																						
	4,138	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
2. Planned Daily Maximum Water Demand: QDM (cu m/d)																						
Peak Factor =	1.30																					
Planned 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

3. Treatment Plant

Existing Plant (****>>) — Max.Capacity 3,840 cu m/d — Effective Capacity (less 8 % loss) 3,560 cu m/d

After Modified (******************************>>)(Abandoned in 1995) — 5,760 cu m/d — 5,330 cu m/d

New Plant(Phase 1) (*************>>) — 11,350 cu m/d — 10,500 cu m/d

New Plant(Phase 2) (****>>)Max.Capa 3,780 cu m/d Eff.Capa 3,500 cu m/d

Effective Capacity (cu m/d)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total	3,560	5,760	5,760	5,760	5,760	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	10,500	14,000	14,000	14,000	14,000	14,000	14,000	14,000

4. Water Amount for Pipeline Design : (cu m/d) — Treated Water from New Plant (Hourly Max) (****************>>)

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Raw water for Existing Plant (Daily Max)	3,560	5,760	5,760	5,760	5,760	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400	7,400
Treated water from New Plant (Hourly Max)						2,089	2,352	3,000	3,467	3,953	4,459	4,985	5,574	6,189	6,832	7,503	8,202	8,901	9,626	10,379	11,160	11,969
Total						9,489	9,952	10,400	10,867	11,353	11,859	12,385	12,974	13,589	14,232	14,903	15,602	16,301	17,026	17,779	18,560	19,369

5. Transmission Pipe :******>> shows a starting year of water transmission — Head Loss for Q(2011)DM (V: m/s) (m)

P1: Raw water for Existing Plant — *********>> — Dia.= 300 mm, L = 7,000 m, I(max) = 0.0066 , Q(max) = 7,400 cu m/d — (0.36) 46.6

P2: Treated water from New Plant — (**********>> — Dia.= 400 mm, L = 6,000 m, I(max) = 0.0070 , Q(max) = 16,310 cu m/d — (0.60) 42.5

6 Daily Average Transmission Amount

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Raw water for Exis. Plant		4,347	4,563	4,789	5,025																	
Treated water from New Plant						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

Alternative : 2

Item	1990	1991	1992	1993	1994	Y 1995	1996	1997	E 1998	1999	2000	A 2001	2002	2003	R 2004	2005	2006	2007	2008	2009	2010	2011
7. Pump Characteristics																						
Raw Water Pump																						
for Exis.WTP				Dia=	200 mm,	P =	40 KW,	H =	55.0 m,	Q =	2.6 cu m/min,	No.of Pumps =			2 units (excluding 1 unit stand-by)							
for New WTP				Dia=	200 mm,	P =	20 KW,	H =	10.0 m,	Q =	4.5 cu m/min,	No.of Pumps =			3 units (excluding 1 unit stand-by)							
Clear Water Pump																						
at New WTP				Dia=	200 mm,	P =	50 KW,	H =	55.0 m,	Q =	3.4 cu m/min,	No.of Pumps =			4 units (excluding 1 unit stand-by)							
at Exis.WTP				Dia=	200 mm,	P =	30 KW,	H =	30.0 m,	Q =	3.0 cu m/min,	No.of Pumps =			3 units (excluding 1 unit stand-by)							
8. No.of Operating Pumps																						
Raw Water Pump																						
for Exis. WTP		2	2	2	2																	
Max. Capacity of Pump		7,400	7,400	7,400	7,400																	
for New WTP						2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3
Max. Capacity of Pump						12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	19,369	19,369
Total Capacity		7,400	7,400	7,400	7,400	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	12,912	19,369	19,369
Clear Water Pump																						
		2	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4
		9,792	9,792	9,792	9,792	9,792	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	14,688	19,584	19,584	19,584	19,584	19,584	19,584	19,584

Alternative : 2

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
						Y			E			A			R							

Note: Pumps is designed for Qda (Daily Average Demand)
- R. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(qla)/max.capacity of pump(R))
- 5 . Demand Charge = Baht 229 /KW/mon x 12 mon/year x Motor Demand(?) KW
  Energy Charge = Baht 1.33 /KWh x Energy Consumption (R) KWh/day x 365 days/year
- Design Pump Head=(Head Loss of Pipeline)+(Actual Head for M.W.L)+(Pump Head 1.5 m)
- DA : Daily Average
- DM : Daily Maximum
- Electricity Fee = Rate of Provincial Electricity Authority(PEA) for Narathiwat as of January, 1989.
- Chemical Cost
  - Alum :Baht 4.05 /kg
  - Lime :Baht 1.25 /kg
  - Cl gas :Baht 15.69 /kg

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Operation Chemical Cost	0	0	1,312	1,389	1,439	1,491	1,539	1,523	1,568	1,615	1,664	1,715	1,768	1,857	1,885	1,954	2,159	2,229	2,299	2,372	2,446	2,562	2,663
Discount Rate	10.00 %																						
PPF	11,881 x 1000 Baht																						

Su Ngai Golok Water Transmission Cost 05-Dec-89

Alternative : 3

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
						Y			K			A			E							
1. Planned Daily Average Water Demand (cu m/d)																						
	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	7,558	7,907	8,279	8,664	9,056	9,459	9,877	10,311	10,760
2. Planned Daily Maximum Water Demand: QDM (cu m/d)																						
Peak Factor = 1.30																						
Planned 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	11,266	11,773	12,297	12,840	13,406	13,988

3. Treatment Plant

Existing Plant ;****)); Max.Capacity 3,848 cu m/d Effective Capacity (less 8 % loss) 3,560 cu m/d

After Modified ;***)) 5,760 cu m/d 5,330 cu m/d ******************************))

New Plant(Phase 1) ;****************************)) 4,680 cu m/d 4,330 cu m/d ******************************))

New Plant(Phase 2) ;********************))) Max.Capa 4,680 cu m/d Eff.Capa 4,330 cu m/d

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Effective Capacity (cu m/d) Total	3,840	5,760	5,760	5,760	5,760	9,660	9,660	9,660	9,660	9,660	9,660	9,660	9,660	13,990	13,990	13,990	13,990	13,990	13,990	13,990	13,990	13,990
4. Water Amount for Pipeline Design : (cu m/d)																						
Raw water for Existing Plant (Daily Max)	3,840	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760
Treated water from New Plant (Hourly Max)						1,530	1,998	2,451	2,924	3,415	3,927	4,459	5,054	5,676	6,326	7,005	7,732	8,418	9,152	9,933	10,702	11,520

5. Transmission Pipe :******)) shows a starting year of water transmission Head Loss for Q(2011)DM (m) (V: m/s)

P1: Raw water for Existing Plant *********)) Dia.= 300 mm, L = 7,000 m, I(max) = 0.0066, Q(max) = 7,400 cu m/d (0.36) 46.6

P2: Treated water from New Plant ;*********)) Dia.= 400 mm, L = 6,000 m, I(max) = 0.0074, Q(max) = 16,310 cu m/d (0.60) 42.5

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
6 Daily Average Transmission Amount																						
Raw water for Existing Plant	4,198	4,347	4,563	4,789	5,025	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300	4,300
Treated water from New Plant						972	1,229	1,478	1,737	2,007	2,228	2,581	2,905	3,250	3,607	3,979	4,368	4,756	5,159	5,577	6,011	6,460

** For daily average demand, the treatment plants are to be operated in not more than 80 % of Daily Maximum Capacity.

Alternative : 3

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1. Pump Characteristics																						
Raw Water Pump																						
For Pipeline P1				Dia=	200 mm,	P =	30 KW,	H =	55.0 m,	Q =	2.6 cu m/min,	No.of Pumps =		2 units (excluding 1 unit stand-by)								
for New WTP				Dia=	200 mm,	P =	20 KW,	H =	30.0 m,	Q =	3.3 cu m/min,	No.of Pumps =		2 units (excluding 1 unit stand-by)								
Clear Water Pump																						
at New WTP				Dia=	200 mm,	P =	40 KW,	H =	55.0 m,	Q =	2.7 cu m/min,	No.of Pumps =		3 units (excluding 1 unit stand-by)								
at Exis.WTP		Exis.Pump		Dia=	200 mm,	P =	30 KW,	H =	30.0 m,	Q =	3.0 cu m/min,	No.of Pumps =		3 units (excluding 1 unit stand-by)								
2. No.of Operating Pumps																						
Raw Water Pump																						
for Pipeline P1		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Max.Capa.of Pump		5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760
for New WTP						1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
Max.Capa.of Pump						3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840	3,840	7,680	7,680	7,680	7,680	7,680	7,680	7,680
Total Capacity(cu m/d)		5,760	5,760	5,760	5,760	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	13,440	13,440	13,440	13,440	13,440	13,440	13,440
Clear Water Pump																						
at New WTP						1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3	3
Max.Capa.of Pump						4,320	4,320	4,320	4,320	4,320	4,320	8,640	8,640	8,640	8,640	8,640	8,640	8,640	12,960	12,960	12,960	12,960
at Exis.WTP	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Max.Capa.of Pump	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640	8,640
Total Capacity (cu m)	8,640	8,640	8,640	8,640	8,640	12,960	12,960	12,960	12,960	12,960	12,960	17,280	17,280	17,280	17,280	17,280	17,280	17,280	21,600	21,600	21,600	21,600
3. Motor Output (Kw)																						
Raw Water Pump		60	60	60	60	80	80	80	80	80	80	80	80	80	80	100	100	100	100	100	100	100
Clear Water Pump	60	60	60	60	60	100	100	100	100	100	100	140	140	140	140	140	140	140	180	180	180	180
10. Energy Consumption (Kwh/day)																						
Raw Water Pump		1,440	1,440	1,440	1,440	1,631	1,699	1,768	1,836	1,907	1,981	1,987	2,072	2,150	2,231	2,316	2,404	2,492	2,584	2,679	2,778	2,880
Clear Water Pump	700	721	741	762	838	903	999	1,045	1,101	1,153	1,225	1,290	1,363	1,439	1,518	1,601	1,687	1,774	1,863	1,956	2,052	2,152
11. Pump Operation Cost (Baht x1,000/year)																						
Demand Charge	165	330	330	330	330	495	495	495	495	495	495	605	605	605	605	660	660	660	769	769	769	769
Energy Charge	314	972	988	1,005	1,022	1,151	1,203	1,253	1,306	1,360	1,417	1,476	1,542	1,611	1,683	1,758	1,837	1,915	1,997	2,081	2,169	2,259
Total Cost	479	1,302	1,318	1,335	1,352	1,646	1,698	1,748	1,800	1,855	1,912	2,080	2,147	2,216	2,288	2,418	2,496	2,575	2,766	2,850	2,938	3,028
																				Total (1991-2011) =		43,766
Chemical Cost																						
Alum (ave 15.0mg/l)																						
Chemical (kg/y)		23,800	24,983	26,220	27,513	28,862	30,270	31,633	33,054	34,533	36,072	37,672	39,462	41,334	43,290	45,330	47,457	49,582	51,789	54,078	56,452	58,913
Cost (Baht 1000)		96.4	101.2	106.2	111.4	116.9	122.6	128.1	133.9	139.9	146.1	152.6	159.8	167.4	175.3	183.6	192.2	200.8	209.7	219.0	228.6	238.6
Lime (ave 9.0 mg/l)																						
Chemical (kg/y)		14,280	14,990	15,732	16,508	17,317	18,162	18,980	19,832	20,720	21,643	22,603	23,677	24,800	25,974	27,198	28,474	29,749	31,073	32,447	33,871	35,348
Cost (Baht 1000)		17.8	18.7	19.7	20.6	21.6	22.7	23.7	24.8	25.9	27.1	28.3	29.6	31.0	32.5	34.0	35.6	37.2	38.8	40.6	42.3	44.2
Chlorine (ave 2.0 mg/l)																						
Chemical (kg/y)		3,173	3,331	3,496	3,668	3,848	4,036	4,218	4,407	4,604	4,810	5,023	5,262	5,511	5,772	6,044	6,328	6,611	6,905	7,210	7,527	7,855
Cost (Baht 1000)		49.5	52.0	54.5	57.2	60.0	63.0	65.8	68.8	71.8	75.0	78.4	82.1	86.0	90.0	94.3	98.7	103.1	107.7	112.5	117.4	122.5
Total cost(Baht 1000)		163.7	171.9	180.4	189.3	198.6	208.3	217.6	227.4	237.6	248.2	259.2	271.5	284.4	297.8	311.9	326.5	341.1	356.3	372.1	388.4	405.3
																					Total	5,057

Alternative : 3

Item	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
						Y			E			A			R							

Note: Pumps is designed for Qda (Daily Average Demand)
B. Energy Consumption (KWh) = No.of Pumps x Motor Output(KW) x 24 h/day x (actual daily demand(q1a)/max.capacity of pump(3))
9 . Demand Charge = Baht 225 /KW/mon x 12 mon/year x Motor Demand(7) KW
Energy Charge = Baht 1.23 /KWh x Energy Consumption (8) KWh/day x 365 days/year
Design Pump Head=(Head Loss of Pipeline)+(actual Head for M.W.A)+(Pump Head 1.5 m)
DA : Daily Average
DM : Daily Maximum
Electricity Fee = Rate of Provincial Electricity Authority(PEA) for Narathiwat as of January, 1987.
Chemical Cost
Alum :Baht 4.05 /kg
Lime :Baht 1.25 /kg
Cl gas :Baht 15.60 /kg

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Operation Chemical Cost	0	0	1,465	1,496	1,515	1,542	1,844	1,956	1,568	2,028	2,092	2,160	2,340	2,418	2,500	2,585	2,730	2,823	2,916	3,122	3,222	3,326	3,434

Discount Rate 10.00 %
NPV 14,493 x 1000 Baht

Table 8.3.3 Cost Study on Alternatives

Alternative 1

Year	Water Demand (cu m/d)	Construction Cost Intake	WTP	Trans.Pipe	Land Cost	Operation Cost Energy	Chemical	Manning	Total Cost
NPV r= 9 %	62,423								66,459
1990	4,198				20,000	479			20,479
1991	4,347					1,211	164		1,375
1992	4,503					1,252	172		1,424
1993	4,789		8,936			1,377	180		10,543
1994	5,025	4,320	8,986	9,300		1,422	189		24,217
1995	5,272					1,562	199	482	2,243
1996	5,529					1,610	208	507	2,325
1997	5,778					1,656	218	532	2,405
1998	6,037					1,705	227	559	2,491
1999	6,307					1,755	238	586	2,579
2000	6,583					1,808	248	616	2,672
2001	6,881		8,986			1,863	259	646	11,755
2002	7,208		8,986			2,006	272	679	11,942
2003	7,550					2,070	284	713	3,067
2004	7,907					2,234	298	748	3,280
2005	8,279					2,303	312	786	3,401
2006	8,668					2,375	327	825	3,527
2007	9,056					2,447	341	866	3,654
2008	9,459					2,522	356	910	3,788
2009	9,877					2,682	372	955	4,009
2010	10,311					2,762	388	1,003	4,153
2011	10,760					2,845	405	1,053	4,303
Total		4,320	35,944	9,300	20,000	41,946	5,657	12,466	129,634

Alternative 2

Year	Water Demand (cu m/d)	Construction Cost Intake	WTP	Trans.Pipe	Land Cost	Operation Cost Energy	Chemical	Manning	Total Cost
NPV r= 9 %	52,075								54,661
1990	4,198				0	397			397
1991	4,347					1,178	164		1,342
1992	4,563					1,218	172		1,390
1993	4,789		12,497			1,259	180		13,936
1994	5,025	4,890	12,497	17,400		1,302	189		36,278
1995	5,272					1,141	199		1,340
1996	5,529					1,315	208		1,523
1997	5,778					1,351	218		1,569
1998	6,037					1,388	227		1,615
1999	6,307					1,427	238		1,665
2000	6,588					1,467	248		1,715
2001	6,881		12,497			1,509	259		14,265
2002	7,208		12,497			1,556	272		14,324
2003	7,550					1,605	284		1,889
2004	7,907					1,656	298		1,954
2005	8,279					1,847	312		2,159
2006	8,668					1,903	327		2,230
2007	9,056					1,958	341		2,299
2008	9,459					2,016	356		2,372
2009	9,877					2,076	372		2,448
2010	10,311					2,193	388		2,581
2011	10,760					2,258	405		2,663
Total		4,890	49,986	17,400	0	34,020	5,657	0	111,953

Alternative 3

Year	Water Demand (cu m/d)	Construction Cost Intake	WTP	Trans.Pipe	Land Cost	Operation Cost Energy	Chemical	Manning	Total Cost
NPV r= 9 %	52,075								54,097
1990	4,198				0	479			479
1991	4,347					1,302	164		1,466
1992	4,563					1,318	172		1,490
1993	4,789		8,986			1,335	180		10,501
1994	5,025	4,320	8,986	17,400		1,352	189		32,247
1995	5,272					1,646	199	482	2,327
1996	5,529					1,698	208	507	2,413
1997	5,778					1,748	218	532	2,497
1998	6,037					1,800	227	559	2,586
1999	6,307					1,855	238	586	2,679
2000	6,588					1,912	248	616	2,776
2001	6,881		8,986			2,080	259	646	11,972
2002	7,208		8,986			2,147	272	679	12,083
2003	7,550					2,216	284	713	3,213
2004	7,907					2,288	298	748	3,334
2005	8,279					2,418	312	786	3,516
2006	8,668					2,496	327	825	3,648
2007	9,056					2,575	341	866	3,782
2008	9,459					2,766	356	910	4,032
2009	9,877					2,850	372	955	4,177
2010	10,311					2,938	388	1,003	4,329
2011	10,760					3,029	405	1,053	4,487
Total		4,320	35,944	17,400	0	44,248	5,657	12,466	120,036

APPENDIX A-8-3

Capacity Calculation of the Water Treatment Plant

Capacity Calculation for Treatment Plant

Item		Total System (for 2011)
Planned Flow (Daily Max)	Q=	9,400 cu m/d
	=	392 cu m/hr
	=	6.5 cu m/min
	=	0.109 cu m/sec
No. of Treatment Line		2 Lines
		4,700 cu m/d x 2 lines
(1) Receiving Well		
Criteria	T=	1.5 min
	d=	2.0 m
No.		1 unit
Dimension	Circular	
	Dia	2.5 m
	v=	10 cu m
	t=	1.5 min
(2) Mixing Tank		
Criteria	T=	1.0 min
Dimension	Square	x 2 units
	L m x	W m x D m x units
	1.5	1.5 1.5 2
	v =	7 cu m
	t =	1.0 min
Mixer	Mechanical Flush Mixer	

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)
(3) Coagulant Mixing	
Type	Hydraulic Mixing
Coagulant	Solid Aluminum Sulphate (Al2(SO4)3) containing 15 % Al2-03
	Dosage Rate : 10-25 mg-solid alum/l Average 10 mg/l
	Coagulant Solution : 5 % solution
	Dosage Amount : 94 kg-Alum/day
	Coagulant Solution (5 % solution) = 2 cu m/day
No. of Mixer	2 units
Type	Batch Type Mixing
Capacity	0.9 cu m/unit
Dimension	Square x 2 units (1 stand by) L m x W m x D m x units 1.5 1.5 2.0 2
	v = 4.5 cu m/unit
	Total V = 9.0 cu m

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)
(4) Flocculator	
Type	Hydraulic Flocculation
No.	N = 2 lines x 2 units
	= 4 units
Unit Flow	q = 1.63 cu m/min/unit
Criteria	T = 30 min
Dimension	W m x L m x D m x n lines
	1.7 12.0 2.5 4
	v = 51 cu m/unit
	t = 31.3 min

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)
(5) Sedimentation Basin	
Type	Rectanglar, Horizontal Flow
No.	N = 2 line x 2 basins
	= 4 basins
Unit Flow	q = 97.9 cu m/hr/basin
Criteria	Retention Time
	T = 4 hours
Dimension	W m x L m x D m x N
	4 25 4.0 4
	v = 400 cu m/basin
	t = 4.1 hours
Flow velocity	v = 10.2 cm/min
Surface Load	a = 23.5 m3/m2/day
Sludge Removal	Hydraulic Removal
Sludge Amount	
Solid Amount (ton-DS)	So = Q(K(T1-T2)+0.16xB)x10^-6
	where So:Sludge dry weight(ton)
	Q :Treated water amount(m3/d)
	K :Coefficient converting turbidity to SS (0.8-1.5 ->>1.2)
	T1 :Turbidity in raw water(ave= 57)
	T2 :Turbidity after Sedimentation (ave = 7)
	B :Alum dosage rate (ave.= 10 mg/l)
	So = 0.58 ton-DS/day
	Water Contents of Drained Sludge
	w = 99.5 %
	Sludge Volume
	v = 116 cu m/d

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)
(6) Rapid Sand Filter	
Type	Down Flow, Single Media
No.	N = 2 lines x 4 units = 8 units
Unit Flow	q = 1,175 cu m/day/unit
Criteria	Surface Load 120 - 150 m3/m2/day
Dimension	W m x L m x N units 2.5 4.0 8 a = 10 sq m/unit
Surface Load	La = 117.5 m3/m2/day
Filter Washing Frequency	Once a day for each filter
Rate	Surface Washing 0.2 m3/m2/min x 5 min Backwashing 0.6 m3/m2/min x 10 min
Water Amount required	Surface Washing v = 10 sq m/unit x 8 units x 0.2 m3/m2/min x 5 min = 80 cu m/day Backwashing v = 10 sq m/unit x 8 units x 0.6 m3/m2/min x 10 min = 480 cu m/day
Total q=	560 cu m/day

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)
Solid Amount in Wastewater	
Solid Amount (ton-DS)	So = Q*K*(T1-T2)*10^-6 where So:Sludge dry weight(ton) Q :Treated water amount(m3/d) K :Coefficient converting turbidity to SS (0.8-1.5 ->>1.2) T1 :Turbidity before filter(ave= 7) T2 :Turbidity after filter(ave = 0) So = 0.08 ton-DS/day
SS Contents	s = 141 mg/l

(7)
Clear Water Reservoir

No.	N = 1 units
Criteria	Retention Time
	T = 8 hours
Required Volume	V = 3,133 cu m
Dimension	L m x W m x D m x N units 30 22 5 1
	Total Volume
	v = 3,300 cu m
Retention Time	t = 8.4 hours

Capacity Calculation for Treatment Plant

Item	Total System (for 2011)
(8) Chlorination Equipment	
Injection Point	at the Inlet of Clear Water Reservoir
Dosage Rate	2.0 ppm
Type	Liquid Chlorine (1-ton cylinder)
Amount	19 kg- Cl gas/day
Injector	Vacuum Type Injector
	No. of unit 2 units (excl. 1 units stand-by)
	Rate 0.39 kg/h/unit
	Capacity 10 kg/h/unit
Storage	1 month
Storage Amount	19 kg /day x 30 day = 564 kg = 12 cylinders (50 kg)
(9) Sludge Lagoon	
Filter Washing Water	q1 = 560 cu m/day
Retention Time	T = 1.0 day
Required Volume	v = 560 cu m
No of Lagoon	n = 2 units
Dimension	(Bottom) L m x W m x D m x N 10 8 2.0 2 (Top) L m x W m 16 14 v = 608 cu m
Side Slope	s = 1 : 2.0
Retention Time	t = 1.09 Day

Capacity Calculation for Treatment Plant

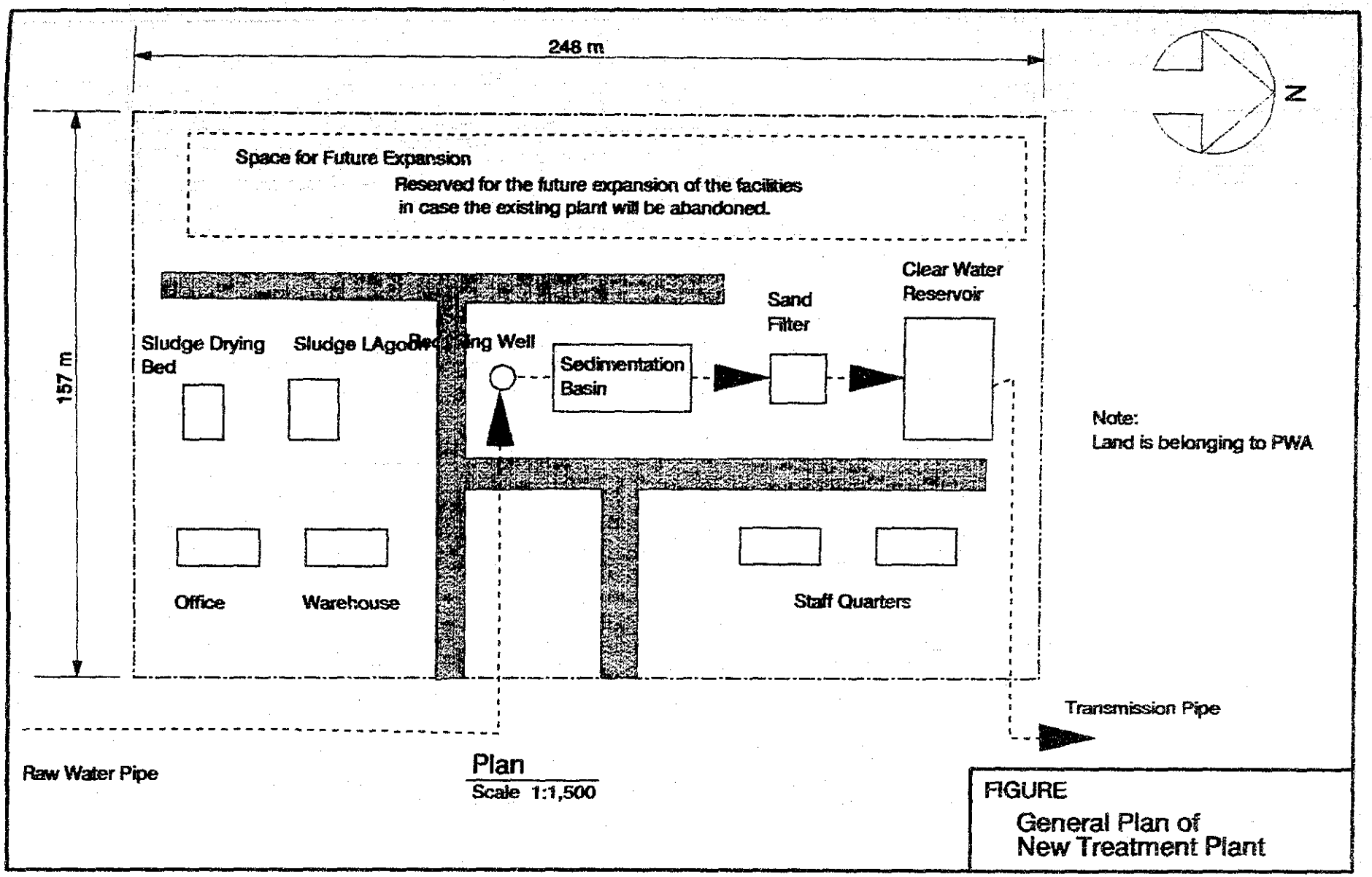
Item	Total System (for 2011)
(10) Sludge Drying Bed	
Drain Water from Sedimentation Basin	
Volume	v1 = 116 cu m/d
Solid	s1 = 0.6 ton-DS/d
Drain Water from Sludge Lagoon (Thickened backwash water)	
Solid	s1 = 0.1 ton-DS/d
Water Contents	w = 99.0 %
Volume	v = 8 cu m/d
Total Solid	s = s1 + s2 = 0.7 ton-DS/d
Water Contents of Dried Sludge	w = 55 %
Sludge Thickness	d = 30 cm after dried
Drying Period	t = 30 day
Required Area	a = 146 sq m
No of Unit	n = 2 units
Type	Recutanglar, Concrete Made
Dimension	L m x W m x D m x N 5 15 1 2
Surface Area	a = 150 sq m at Bottom

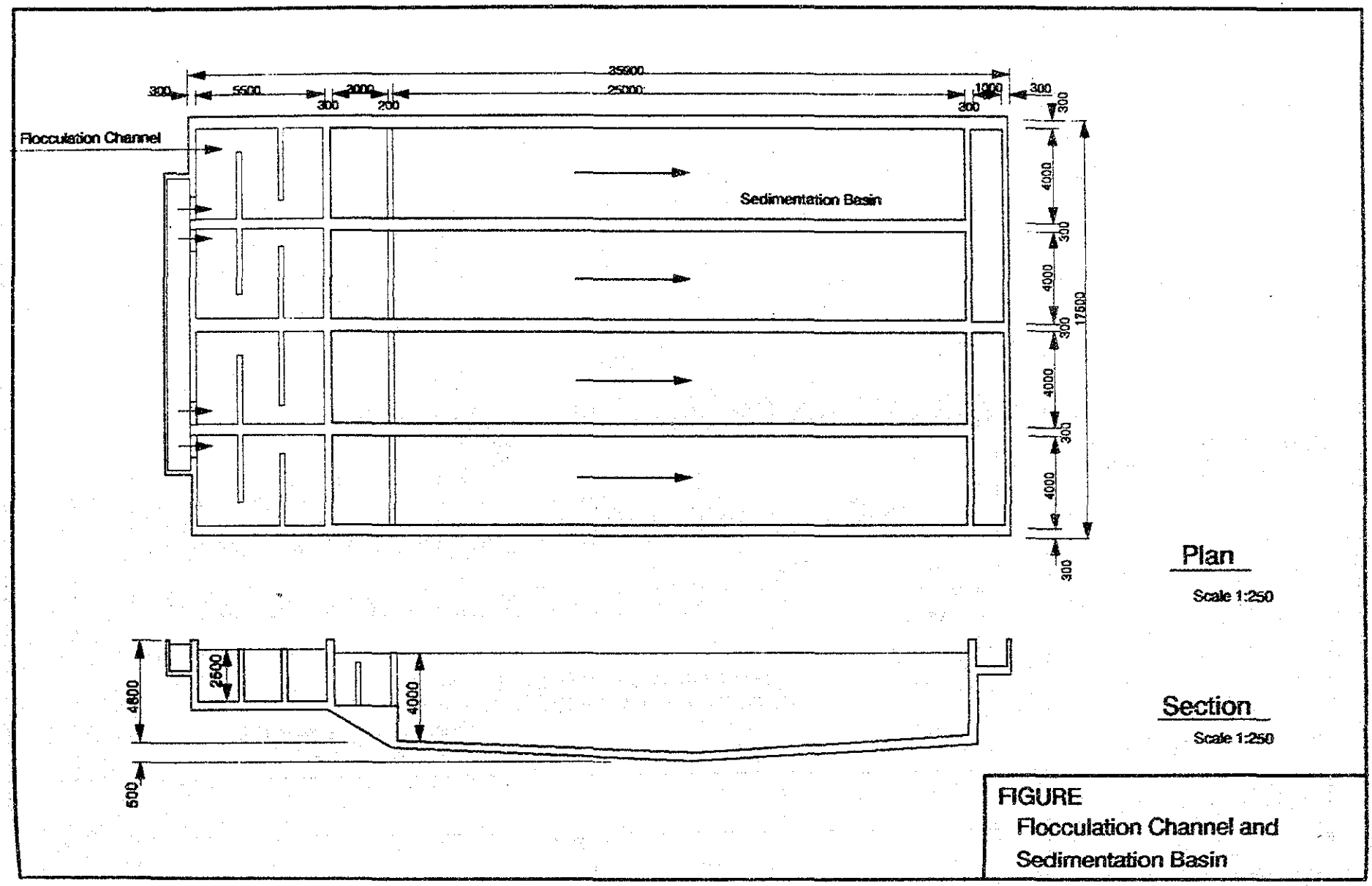
Capacity Calculation for Treatment Plant

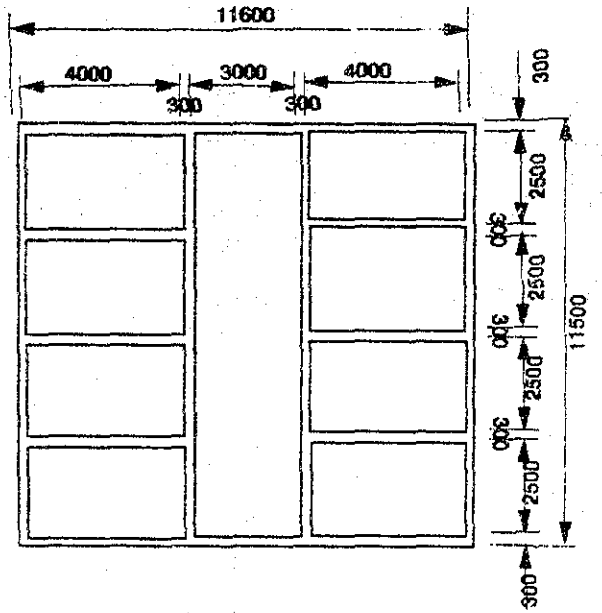
Item		Total System (for 2011)
(10) Clear Water Pump		
No.	N =	3 units + 1 stand-by
Flow per unit	q =	3.0 cu m/min/unit
Diameter	D =	200 mm
Head	H =	30 m
Motor output	P =	30 KW
Total Capacity	Q =	13,160 cu m/day
(11) Sludge Lagoon Drain Pump		
No.	N =	1 units + 1 stand-by
Quantity drained	Q =	560 cu m/day
Draining Time	t =	6.0 hours
Pump Flow	q =	1.6 cu m/min/unit
Diameter	D =	100 mm
Head	H =	5 m
Motor output	P =	2 KW

APPENDIX A-8-4

Water Treatment Plant Facility Plan

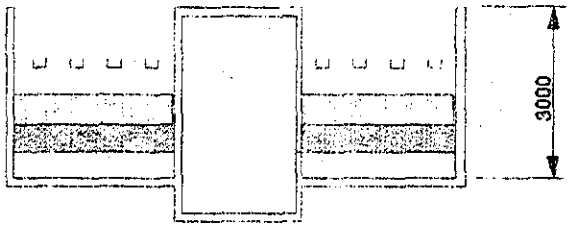

248 m
157 m
N
Space for Future Expansion
Reserved for the future expansion of the facilities
in case the existing plant will be abandoned.
Sludge Drying
Bed
Sludge LAgoon
Sedimentation
Basin
Sand
Filter
Clear Water
Reservoir
Note:
Land is belonging to PWA
Office
Warehouse
Staff Quarters
Transmission Pipe
Raw Water Pipe
Plan
Scale 1:1,500
FIGURE
General Plan of
New Treatment Plant


35900
300
5500
2000
25000
1000
300
300
200
300
300
Flocculation Channel
Sedimentation Basin
4000
300
4000
300
17500
4000
300
4000
300
Plan
Scale 1:250
4800
2500
4000
500
Section
Scale 1:250
FIGURE
Flocculation Channel and
Sedimentation Basin



Plan

Scale 1:200



Section

Scale 1:200

FIGURE

Sanf Filter

FIGURE

Clear Water Reservoir

Section

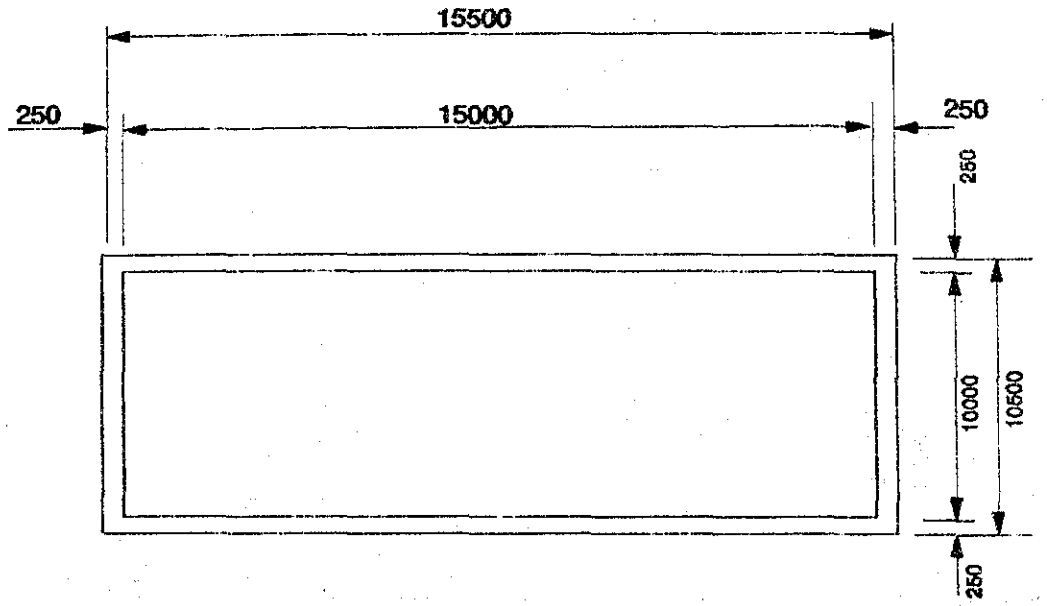
Scale 1:250

Plan

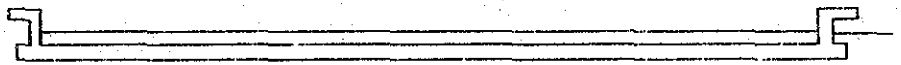
Scale 1:250

FIGURE Sludge Lagoon

Plan
Scale 1:150



Plan
Scale 1:150



Section
Scale 1:150

FIGURE
Sludge Drying Bed

APPENDIX A-8-5

Distribution Network Analysis

T I T L E : Su Ngai Golok (Proposed 1)
NO. OF PIPES : 205
NO. OF NODES : 169
PEAK FACTOR : 1.718
MAX HEADLOSS/Km : 100
MAX UNBAL(LPS) : .009

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	HEADLOSS (M)
1	300	1	22.00	400	100	99.15	0.79	2.56	0.06
2	1	2	365.00	350	100	46.92	0.49	1.23	0.45
3	2	3	22.00	300	100	45.39	0.64	2.45	0.05
4	3	4	45.00	250	100	11.98	0.24LO	0.51	0.02
5	5	4	20.00	250	100	16.95	0.35	0.96	0.02
6	5	6	482.00	100	100	1.30	0.17LO	0.72	0.35
7	7	5	80.00	250	100	20.36	0.41	1.35	0.11
8	7	8	474.00	100	100	1.29	0.16LO	0.71	0.34
9	9	7	105.00	250	100	22.11	0.45	1.57	0.17
10	9	10	510.00	100	100	0.48	0.06LO	0.11	0.06
11	1	38	350.00	350	100	52.23	0.54	1.50	0.52
12	11	9	142.00	250	100	22.71	0.46	1.65	0.23
13	11	12	312.00	100	100	0.25	0.03LO	0.04	0.01
14	12	13	162.00	100	100	0.13	0.02LO	0.01	0.00
16	14	11	260.00	250	100	41.37	0.84	5.01	1.30
17	15	14	40.00	250	100	41.49	0.85	5.04	0.20
18	11	16	154.00	200	100	18.27	0.58	3.28	0.50
19	16	17	104.00	200	100	4.33	0.14LO	0.23	0.02
20	4	17	68.00	200	100	1.36	0.04LO	0.03	0.00
21	4	19	108.00	250	110	27.44	0.56	1.97	0.21
22	17	18	116.00	150	100	5.56	0.31	1.47	0.17
23	16	27	104.00	200	100	13.78	0.44	1.94	0.20
24	19	20	80.00	250	100	29.73	0.61	2.72	0.22
25	18	19	68.00	150	100	3.35	0.19LO	0.58	0.04
26	18	27	100.00	150	100	1.15	0.07LO	0.08	0.01
27	20	83	20.00	150	100	17.22	0.97	11.92	0.24
28	20	21	183.00	250	100	11.27	0.23LO	0.45	0.08
29	21	22	70.00	200	100	10.40	0.33	1.15	0.08
30	22	88	20.00	100	100	9.57	1.22	28.97	0.58
31	23	22	98.00	100	100	0.93	0.12LO	0.39	0.04
32	24	23	60.00	200	100	4.06	0.13LO	0.20	0.01
33	23	30	90.00	200	100	1.71	0.05LO	0.04	0.00
34	25	24	56.00	200	100	7.01	0.22LO	0.56	0.03
35	26	25	60.00	200	100	8.31	0.26LO	0.76	0.05
36	27	26	132.00	200	100	14.58	0.46	2.16	0.28
37	26	21	212.00	200	100	4.25	0.14LO	0.22	0.05
38	24	28	40.00	100	100	1.74	0.22LO	1.23	0.05
39	28	29	62.00	100	100	0.84	0.11LO	0.32	0.02
40	31	32	100.00	150	100	11.75	0.67	5.88	0.59
41	30	31	182.00	200	100	0.48	0.02LO	0.00	0.00
42	33	31	80.00	200	100	12.51	0.40	1.63	0.13

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	HEADLOSS (M)
43	33	34	275.00	100	100	0.70	0.09LO	0.23	0.06
44	35	33	145.00	200	100	15.64	0.50	2.46	0.36
45	35	36	284.00	100	100	0.14	0.02LO	0.01	0.00
47	3	38	16.00	300	100	33.28	0.47	1.38	0.02
48	38	39	53.00	300	110	85.33	1.21	6.60	0.35
49	39	40	20.00	200	110	31.63	1.01	7.58	0.15
50	40	41	350.00	150	100	4.60	0.26LO	1.04	0.36
51	41	42	180.00	100	100	0.85	0.11LO	0.33	0.06
52	39	43	22.00	300	100	53.43	0.76	3.31	0.07
53	43	44	525.00	250	100	1.53	0.03LO	0.01	0.01
54	44	45	125.00	100	100	0.26	0.03LO	0.04	0.00
55	43	46	134.00	300	100	51.04	0.72	3.04	0.41
56	46	47	234.00	100	100	0.71	0.09LO	0.23	0.05
57	46	48	108.00	300	100	47.05	0.67	2.62	0.28
58	48	49	254.00	150	100	1.08	0.06LO	0.07	0.02
59	48	50	134.00	300	100	40.10	0.57	1.95	0.26
60	50	51	98.00	250	100	40.09	0.82	4.73	0.46
61	51	52	74.00	250	100	30.41	0.62	2.84	0.21
62	53	52	20.00	150	100	4.93	0.28LO	1.18	0.02
63	52	63	32.00	250	100	34.93	0.71	3.67	0.12
64	51	54	18.00	150	100	9.27	0.52	3.79	0.07
65	54	53	73.00	150	100	5.85	0.33	1.62	0.12
66	54	55	147.00	150	100	3.14	0.18LO	0.51	0.08
67	55	56	50.00	100	100	0.28	0.04LO	0.04	0.00
68	55	57	14.00	150	100	2.58	0.15LO	0.36	0.00
69	57	58	50.00	100	100	0.28	0.04LO	0.04	0.00
70	57	59	117.00	150	100	2.02	0.11LO	0.23	0.03
71	53	61	294.00	150	100	0.64	0.04LO	0.03	0.01
72	59	61	88.00	100	100	0.69	0.09LO	0.22	0.02
73	59	60	125.00	150	100	1.05	0.06LO	0.07	0.01
74	61	62	22.00	150	100	0.28	0.02LO	0.01	0.00
75	63	64	378.00	250	100	31.20	0.64	2.97	1.12
76	64	65	70.00	100	100	4.83	0.61	8.16	0.57
77	64	66	108.00	250	110	25.93	0.53	1.77	0.19
78	66	67	484.00	250	100	15.47	0.32	0.81	0.39
79	66	68	254.00	250	100	9.78	0.20LO	0.35	0.09
80	68	69	440.00	250	100	3.31	0.07LO	0.05	0.02
81	68	72	178.00	150	100	4.58	0.26LO	1.03	0.18
82	69	70	150.00	250	100	2.13	0.04LO	0.02	0.00
83	70	71	688.00	100	100	0.61	0.08LO	0.18	0.12
84	72	73	420.00	150	100	2.19	0.12LO	0.26	0.11
85	73	74	126.00	150	100	1.82	0.10LO	0.19	0.02
86	74	75	123.00	100	100	0.14	0.02LO	0.01	0.00
87	74	76	12.00	150	100	1.40	0.08LO	0.11	0.00
88	76	77	122.00	100	100	0.14	0.02LO	0.01	0.00
89	76	78	26.00	150	100	1.12	0.06LO	0.08	0.00
90	78	79	118.00	100	100	0.14	0.02LO	0.01	0.00
91	78	80	10.00	150	100	0.85	0.05LO	0.05	0.00

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	HEADLOSS (M)
92	80	81	128.00	100	100	0.14	0.02LO	0.01	0.00
93	80	82	20.00	150	100	0.57	0.03LO	0.02	0.00
94	40	83	75.00	250	100	26.79	0.55	2.24	0.17
95	83	84	66.00	250	100	43.87	0.89	5.59	0.37
96	84	85	18.00	250	100	25.78	0.53	2.09	0.04
97	85	86	80.00	200	100	11.75	0.37	1.45	0.12
98	87	86	110.00	200	100	3.41	0.11LO	0.15	0.02
99	87	88	18.00	150	100	0.06	0.00LO	0.00	0.00
100	88	89	120.00	150	100	8.59	0.49	3.29	0.39
101	89	90	96.00	150	100	2.78	0.16LO	0.41	0.04
102	90	91	150.00	150	100	0.34	0.02LO	0.01	0.00
103	92	91	60.00	150	100	0.90	0.05LO	0.05	0.00
104	93	92	120.00	150	100	2.88	0.16LO	0.44	0.05
105	94	93	260.00	150	100	4.03	0.23LO	0.81	0.21
106	95	94	55.00	150	100	5.49	0.31	1.44	0.08
107	96	95	775.00	150	100	6.69	0.38	2.07	1.61
108	84	103	358.00	250	100	16.69	0.34	0.94	0.33
109	103	50	110.00	200	100	0.53	0.02LO	0.00	0.00
110	85	97	72.00	150	100	12.94	0.73	7.03	0.51
111	97	98	18.00	150	100	8.96	0.51	3.56	0.06
112	98	99	96.00	150	100	7.82	0.44	2.76	0.27
113	99	100	60.00	150	100	9.72	0.55	4.13	0.25
114	100	101	90.00	150	100	0.24	0.01LO	0.00	0.00
115	101	102	190.00	100	100	0.47	0.06LO	0.11	0.02
116	32	87	300.00	250	100	4.45	0.09LO	0.08	0.02
117	86	112	182.00	200	100	13.73	0.44	1.93	0.35
118	112	111	146.00	100	100	2.99	0.38	3.37	0.49
119	111	101	100.00	100	100	1.74	0.22LO	1.24	0.12
120	112	99	90.00	100	100	3.32	0.42	4.09	0.37
121	97	125	324.00	200	100	2.46	0.08LO	0.08	0.03
122	124	98	324.00	150	100	0.66	0.04LO	0.03	0.01
123	100	114	140.00	100	100	4.01	0.51	5.80	0.81
124	114	115	90.00	100	100	0.90	0.12LO	0.37	0.03
125	114	116	56.00	100	100	1.91	0.24LO	1.46	0.08
126	116	117	97.00	100	100	0.95	0.12LO	0.40	0.04
127	103	104	16.00	250	100	14.09	0.29LO	0.68	0.01
128	104	105	100.00	150	100	2.05	0.12LO	0.23	0.02
129	105	106	90.00	100	100	0.28	0.04LO	0.04	0.00
130	105	107	70.00	150	100	1.31	0.07LO	0.10	0.01
131	107	108	44.00	150	100	0.84	0.05LO	0.04	0.00
132	108	109	55.00	100	100	0.28	0.04LO	0.04	0.00
133	108	110	18.00	150	100	0.28	0.02LO	0.01	0.00
134	89	125	50.00	100	100	1.31	0.17LO	0.73	0.04
135	125	126	90.00	100	100	0.64	0.08LO	0.19	0.02
136	125	124	20.00	100	100	1.89	0.24LO	1.44	0.03
137	124	123	68.00	100	100	0.65	0.08LO	0.20	0.01
138	123	122	92.00	100	100	0.35	0.04LO	0.06	0.01
139	123	118	48.00	100	100	1.12	0.14LO	0.55	0.03

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	HEADLOSS (M)
140	121	118	95.00	100	100	0.21	0.03LO	0.02	0.00
141	118	119	108.00	100	100	0.57	0.07LO	0.16	0.02
142	120	119	104.00	100	100	0.30	0.04LO	0.05	0.00
143	90	126	24.00	100	100	1.17	0.15LO	0.59	0.01
144	126	122	85.00	100	100	0.90	0.11LO	0.36	0.03
145	122	121	38.00	100	100	1.03	0.13LO	0.47	0.02
146	121	120	104.00	100	100	0.54	0.07LO	0.14	0.01
147	128	120	20.00	100	100	0.03	0.00LO	0.00	0.00
148	104	127	312.00	200	100	9.46	0.30	0.97	0.30
149	127	128	102.00	200	100	1.49	0.05LO	0.03	0.00
150	128	129	144.00	200	100	1.19	0.04LO	0.02	0.00
151	91	129	214.00	100	100	0.90	0.11LO	0.36	0.08
152	129	130	54.00	200	100	1.87	0.06LO	0.05	0.00
153	92	130	190.00	100	100	0.99	0.13LO	0.44	0.08
154	130	131	15.00	200	100	1.48	0.05LO	0.03	0.00
155	131	132	184.00	100	100	0.45	0.06LO	0.10	0.02
156	131	133	54.00	150	100	0.72	0.04LO	0.03	0.00
157	133	134	184.00	100	100	0.27	0.03LO	0.04	0.01
158	133	135	96.00	150	100	0.13	0.01LO	0.00	0.00
159	93	136	340.00	150	100	0.38	0.02LO	0.01	0.00
160	94	137	185.00	100	100	0.50	0.06LO	0.12	0.02
161	127	138	198.00	200	100	6.80	0.22LO	0.53	0.10
162	139	138	1046.00	200	100	4.36	0.14LO	0.23	0.24
163	138	140	165.00	200	100	10.85	0.35	1.25	0.21
164	140	141	405.00	200	100	10.56	0.34	1.19	0.48
165	141	142	460.00	100	100	0.50	0.06LO	0.12	0.06
166	142	143	135.00	100	100	0.07	0.01LO	0.00	0.00
167	142	144	70.00	100	100	0.17	0.02LO	0.02	0.00
168	144	145	85.00	100	100	0.07	0.01LO	0.00	0.00
169	112	123	290.00	100	100	0.91	0.12LO	0.37	0.11
170	112	123	290.00	100	100	0.91	0.12LO	0.37	0.11
200	201	70	470.00	200	110	2.18	0.07LO	0.05	0.03
201	202	201	570.00	200	110	6.87	0.22LO	0.45	0.26
202	203	202	880.00	100	110	0.49	0.06LO	0.10	0.09
203	204	203	600.00	100	110	1.97	0.25LO	1.30	0.78
204	206	204	200.00	200	110	9.05	0.29LO	0.75	0.15
205	204	205	970.00	200	110	5.29	0.17LO	0.28	0.27
206	141	205	300.00	200	110	9.14	0.29LO	0.76	0.23
207	206	207	980.00	150	110	1.76	0.10LO	0.15	0.14
208	208	206	600.00	150	110	6.45	0.37	1.63	0.98
209	208	139	220.00	150	110	5.17	0.29LO	1.08	0.24
210	209	206	1230.00	150	110	8.18	0.46	2.52	3.10
211	210	209	720.00	100	110	1.33	0.17LO	0.63	0.45
212	210	208	1030.00	200	110	17.37	0.55	2.50	2.58
213	211	209	1110.00	150	110	10.08	0.57	3.71	4.12
214	212	211	1130.00	200	110	12.62	0.40	1.38	1.56
215	212	213	1080.00	300	110	49.38	0.70	2.40	2.59
216	213	210	520.00	200	110	25.45	0.81	5.07	2.64

PIPE NO.	FROM Node	TO Node	LENGTH (M)	DIA (MM)	HWC	FLOW (LPS)	VELOCITY (MPS)	HEADLOSS (M/KM)	HEADLOSS (M)
217	213	96	380.00	150	110	16.65	0.94	9.39	3.57
218	213	219	500.00	100	110	4.16	0.53	5.19	2.60
219	219	37	380.00	150	110	9.73	0.55	3.47	1.32
220	96	37	500.00	200	110	8.57	0.27LO	0.68	0.34
221	218	219	500.00	150	110	8.15	0.46	2.50	1.25
222	218	15	440.00	250	110	21.62	0.44	1.26	0.56
223	212	218	1200.00	300	110	58.48	0.83	3.28	3.94
224	212	214	1400.00	100	110	2.68	0.34	2.30	3.22
225	214	215	880.00	100	110	1.79	0.23LO	1.09	0.96
226	216	215	930.00	100	110	0.31	0.04LO	0.04	0.04
227	216	217	500.00	100	110	1.29	0.16LO	0.60	0.30
228	218	216	660.00	150	110	2.62	0.15LO	0.31	0.20
229	218	15	440.00	250	110	21.62	0.44	1.26	0.56
230	65	220	650.00	100	110	1.91	0.24LO	1.24	0.80
231	67	221	880.00	150	110	5.23	0.30LO	1.10	0.97
232	221	222	1140.00	100	110	0.84	0.11LO	0.27	0.31
233	112	113	35.00	100	110	3.47	0.44	3.72	0.13
234	205	202	500.00	200	110	11.71	0.37	1.21	0.60
46	37	35	40.00	200	110	15.79	0.50	2.10	0.08
235	1000	212	40.00	300	110	127.50	1.80	13.87	0.55

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
1	0.000	8.50	33.44	24.94
2	-1.532	14.50	33.00	18.50
3	-0.127	14.50	32.94	18.44
4	-0.127	15.00	32.92	17.92
5	-2.109	15.00	32.94	17.94
6	-1.297	8.50	32.59	24.09
7	-0.461	16.00	33.05	17.05
8	-1.288	8.00	32.71	24.71
9	-0.127	16.50	33.21	16.71
10	-0.478	8.50	33.15	24.65
11	-0.127	14.50	33.45	18.95
12	-0.127	8.50	33.43	24.93
13	-0.127	9.50	33.43	23.93
14	-0.127	12.50	34.75	22.25
15	-1.742	11.00	34.95	23.95
16	-0.166	16.50	32.94	16.44
17	-0.127	16.00	32.92	16.92
18	-1.060	15.50	32.75	17.25
19	-1.060	15.50	32.71	17.21
20	-1.240	15.50	32.49	16.99
21	-5.125	13.50	32.41	18.91
22	-1.755	13.50	32.32	18.82
23	-1.419	11.00	32.36	21.36

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
24	-1.218	10.00	32.38	22.38
25	-1.298	9.50	32.41	22.91
26	-2.019	10.00	32.45	22.45
27	-0.354	15.00	32.74	17.74
28	-0.901	9.50	32.33	22.83
29	-0.836	9.50	32.31	22.81
30	-1.232	13.50	32.36	18.86
31	-1.232	10.00	32.36	22.36
32	-7.307	9.00	31.77	22.77
33	-2.429	11.50	32.49	20.99
34	-0.702	17.00	32.43	15.43
35	0.000	13.50	32.85	19.35
36	-0.143	16.00	32.85	16.85
37	-2.511	13.50	32.94	19.44
38	-0.187	14.50	32.92	18.42
39	-0.268	15.00	32.57	17.57
40	-0.239	15.00	32.42	17.42
41	-3.745	11.00	32.06	21.06
42	-0.854	12.50	32.00	19.50
43	-0.860	15.00	32.50	17.50
44	-1.275	9.00	32.49	23.49
45	-0.256	8.50	32.49	23.99
46	-3.285	13.50	32.09	18.59
47	-0.709	9.50	32.03	22.53
48	-5.869	10.50	31.81	21.31
49	-1.079	9.20	31.79	22.59
50	-0.541	11.00	31.55	20.55
51	-0.408	12.50	31.08	18.58
52	-0.408	12.50	30.87	18.37
53	-0.281	12.50	30.90	18.40
54	-0.281	12.50	31.01	18.51
55	-0.281	12.50	30.94	18.44
56	-0.281	12.50	30.94	18.44
57	-0.281	12.50	30.93	18.43
58	-0.281	12.50	30.93	18.43
59	-0.281	12.50	30.91	18.41
60	-1.050	12.50	30.90	18.40
61	-1.050	12.50	30.89	18.39
62	-0.281	12.50	30.89	18.39
63	-3.729	12.50	30.75	18.25
64	-0.447	11.00	29.63	18.63
65	-2.913	11.00	29.06	18.06
66	-0.677	11.50	29.44	17.94
67	-10.240	11.50	29.05	17.55
68	-1.890	10.50	29.35	18.85
69	-1.181	13.50	29.33	15.83
70	-3.700	13.00	29.33	16.33
71	-0.612	11.00	29.20	18.20

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
72	-2.393	13.50	29.17	15.67
73	-0.370	9.00	29.06	20.06
74	-0.278	7.00	29.03	22.03
75	-0.138	6.00	29.03	23.03
76	-0.138	7.00	29.03	22.03
77	-0.138	6.00	29.03	23.03
78	-0.138	7.00	29.03	22.03
79	-0.138	6.00	29.03	23.03
80	-0.138	7.00	29.03	22.03
81	-0.138	6.00	29.03	23.03
82	-0.570	7.00	29.03	22.03
83	-0.141	15.50	32.25	16.75
84	-1.387	15.50	31.88	16.38
85	-1.091	15.50	31.84	16.34
86	-1.427	14.50	31.73	17.23
87	-0.979	13.50	31.74	18.24
88	-1.050	13.50	31.75	18.25
89	-4.500	16.00	31.35	15.35
90	-1.261	18.00	31.31	13.31
91	-0.351	18.50	31.31	12.81
92	-0.987	18.00	31.31	13.31
93	-0.773	18.00	31.37	13.37
94	-0.949	13.00	31.60	18.60
95	-1.204	12.50	31.68	19.18
96	-1.389	14.00	33.28	19.28
97	-1.522	15.00	31.34	16.34
98	-1.804	15.00	31.27	16.27
99	-1.420	13.00	31.01	18.01
100	-5.465	11.50	30.76	19.26
101	-1.510	11.50	30.76	19.26
102	-0.466	13.50	30.74	17.24
103	-2.068	11.50	31.55	20.05
104	-2.573	11.50	31.54	20.04
105	-0.466	12.00	31.51	19.51
106	-0.281	12.00	31.51	19.51
107	-0.466	13.50	31.50	18.00
108	-0.281	13.50	31.50	18.00
109	-0.281	12.50	31.50	19.00
110	-0.281	13.50	31.50	18.00
111	-1.255	12.50	30.88	18.38
112	-2.130	13.50	31.38	17.88
113	-3.473	13.50	31.25	17.75
114	-1.204	14.00	29.95	15.95
115	-0.904	15.00	29.91	14.91
116	-0.958	15.00	29.87	14.87
117	-0.948	16.00	29.83	13.83
118	-0.758	18.00	31.24	13.24
119	-0.874	17.00	31.23	14.23

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
120	-0.268	18.00	31.23	13.23
121	-0.283	19.50	31.25	11.75
122	-0.218	19.00	31.26	12.26
123	-0.983	18.00	31.27	13.27
124	-0.589	17.50	31.28	13.78
125	-1.240	17.50	31.31	13.81
126	-0.910	18.00	31.29	13.29
127	-1.172	17.00	31.23	14.23
128	-0.268	18.00	31.23	13.23
129	-0.224	18.50	31.23	12.73
130	-1.381	18.50	31.22	12.72
131	-0.314	18.00	31.22	13.22
132	-0.447	17.00	31.20	14.20
133	-0.314	18.00	31.22	13.22
134	-0.268	17.00	31.21	14.21
135	-0.135	18.00	31.22	13.22
136	-0.380	17.00	31.36	14.36
137	-0.502	15.00	31.58	16.58
138	-0.312	14.50	31.13	16.63
139	-0.810	15.00	31.37	16.37
140	-0.289	12.00	30.92	18.92
141	-0.925	15.00	30.44	15.44
142	-0.255	10.00	30.39	20.39
143	-0.073	9.00	30.38	21.38
144	-0.097	10.00	30.38	20.38
145	-0.073	9.00	30.38	21.38
201	-4.690	9.00	29.35	20.35
202	-5.325	12.00	29.61	17.61
203	-1.477	14.80	29.70	14.90
204	-1.795	19.20	30.48	11.28
205	-2.719	14.80	30.21	15.41
206	-3.811	20.00	30.63	10.63
207	-1.764	18.50	30.49	11.99
208	-5.750	15.00	31.61	16.61
209	-3.231	12.00	33.76	21.76
210	-6.741	8.50	34.22	25.72
211	-2.541	15.00	37.88	22.88
212	-4.338	11.50	39.44	27.94
213	-3.132	10.00	36.85	26.85
214	-0.884	10.00	36.23	26.23
215	-2.101	7.00	35.26	28.26
216	-1.016	8.00	35.30	27.30
217	-1.291	7.00	35.01	28.01
218	-4.482	10.00	35.51	25.51
219	-2.576	10.00	34.26	24.26
220	-1.914	10.00	28.25	18.25
221	-4.392	8.50	28.07	19.57
222	-0.842	7.00	27.77	20.77

NODE NO.	FLOW (LPS)	ELEVATION (M)	H G L (M)	PRESSURE (M)
300 R	99.151	8.50	33.50	25.00
1000 R	127.497	11.50	40.00	28.50

APPENDIX A-17-1

Alternatives for Debt Service, Cash Flow and Unit Cost of Water

Table A17-1-1 Debt Services (Alternative 1)

(Unit : Baht x 1000)

Year	Capital	Interest	Total annual repayment	Balance of Capital
1992	0	364	364	5,202
1993	0	1,218	1,218	17,397
1994	0	5,510	5,510	78,714
1995	0	6,652	6,652	95,025
1996	0	6,652	6,652	95,025
1997	3,781	6,652	10,433	95,025
1998	4,046	6,387	10,433	91,244
1999	4,329	6,104	10,433	87,197
2000	4,632	5,801	10,433	82,868
2001	4,957	5,476	10,433	78,235
2002	5,304	5,130	10,433	73,279
2003	5,675	4,758	10,433	67,975
2004	6,072	4,361	10,433	62,300
2005	6,497	3,976	10,473	56,798
2006	6,952	3,521	10,473	50,300
2007	7,439	3,034	10,473	43,348
2008	7,959	2,514	10,473	35,910
2009	8,517	1,957	10,473	27,950
2010	9,135	1,360	10,496	19,433
2011	9,775	721	10,496	10,298
2012	26	37	63	523
2013	28	35	63	497
2014	30	33	63	469
2015	32	31	63	440
2016	34	29	63	408
2017	36	26	63	374
2018	39	24	63	337
2019	42	21	63	298
2020	45	18	63	257
2021	48	15	63	212
2022	51	11	63	164
2023	55	8	63	113
2024	58	4	63	58
Total	95,595.0	82,437.2	178,032.2	

Table A17-1-2 Debt Services (Alternative 2)
for Foreign Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	69	69	2,564
1993	0	245	245	9,068
1994	0	1,061	1,061	39,280
1995	0	1,264	1,264	46,822
1996	0	1,264	1,264	46,822
1997	0	1,264	1,264	46,822
1998	0	1,264	1,264	46,822
1999	0	1,264	1,264	46,822
2000	0	1,264	1,264	46,822
2001	0	1,264	1,264	46,822
2002	1,796	1,264	3,061	46,822
2003	1,845	1,216	3,061	45,026
2004	1,895	1,166	3,061	43,181
2005	1,946	1,123	3,068	41,575
2006	1,998	1,070	3,068	39,629
2007	2,052	1,016	3,068	37,631
2008	2,108	961	3,068	35,579
2009	2,165	904	3,068	33,471
2010	2,223	845	3,068	31,306
2011	2,283	785	3,068	29,083
2012	2,345	724	3,068	26,800
2013	2,408	660	3,068	24,456
2014	2,473	595	3,068	22,047
2015	2,551	529	3,079	19,574
2016	2,620	460	3,079	17,024
2017	2,691	389	3,079	14,404
2018	2,763	316	3,079	11,713
2019	2,838	242	3,079	8,950
2020	2,914	165	3,079	6,112
2021	2,993	86	3,079	3,198
2022	13	6	19	205
2023	14	5	19	191
2024	14	5	19	178
2025	14	4	19	164
2026	15	4	19	149
2027	15	4	19	134
2028	16	3	19	119
2029	16	3	19	103
2030	17	2	19	87
2031	17	2	19	71
2032	17	1	19	54
2033	18	1	19	36
2034	18	0	19	18
Total	47,111	24,779	71,890	

Table A17-1-2 Debt Services (Alternative 2)
for Local Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	185	185	2,638
1993	0	583	583	8,329
1994	0	2,760	2,760	39,434
1995	0	3,374	3,374	48,203
1996	0	3,374	3,374	48,203
1997	1,918	3,374	5,292	48,203
1998	2,052	3,240	5,292	46,285
1999	2,196	3,096	5,292	44,232
2000	2,350	2,943	5,292	42,036
2001	2,514	2,778	5,292	39,686
2002	2,690	2,602	5,292	37,172
2003	2,879	2,414	5,292	34,481
2004	3,080	2,212	5,292	31,603
2005	3,296	2,016	5,312	28,803
2006	3,527	1,786	5,312	25,508
2007	3,773	1,539	5,312	21,981
2008	4,038	1,275	5,323	18,208
2009	4,320	992	5,323	14,170
2010	4,634	689	5,323	9,850
2011	4,958	365	5,323	5,216
2012	13	18	31	258
2013	14	17	31	245
2014	15	16	31	231
2015	16	15	31	217
2016	17	14	31	201
2017	18	13	31	184
2018	19	12	31	166
2019	21	10	31	147
2,020	22	9	31	127
2,021	24	7	31	105
2,022	25	6	31	81
2,023	27	4	31	56
2,024	29	2	31	29
Total	48,484	41,740	90,246	

Table A17-1-2 Debt Services (Alternative 2)

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	254	254	5,202
1993	0	828	828	17,397
1994	0	3,821	3,821	78,714
1995	0	4,638	4,638	95,025
1996	0	4,638	4,638	95,025
1997	1,918	4,638	6,557	95,025
1998	2,052	4,504	6,557	93,107
1999	2,196	4,360	6,557	91,054
2000	2,350	4,207	6,557	88,858
2001	2,514	4,042	6,557	86,508
2002	4,487	3,866	8,353	83,994
2003	4,724	3,629	8,353	79,507
2004	4,975	3,378	8,353	74,784
2005	5,242	3,139	8,380	70,379
2006	5,525	2,856	8,380	65,137
2007	5,826	2,555	8,380	59,612
2008	6,145	2,235	8,392	53,786
2009	6,485	1,896	8,392	47,641
2010	6,857	1,535	8,392	41,156
2011	7,241	1,150	8,392	34,299
2012	2,358	742	3,099	27,058
2013	2,422	677	3,099	24,701
2014	2,488	611	3,099	22,279
2015	2,567	544	3,110	19,791
2016	2,637	474	3,110	17,225
2017	2,708	402	3,110	14,588
2018	2,782	328	3,110	11,879
2019	2,858	252	3,110	9,097
2020	2,936	174	3,110	6,239
2021	3,017	94	3,110	3,302
2022	39	11	50	286
2023	41	9	50	247
2024	43	7	50	207
2025	14	4	19	164
2026	15	4	19	149
2027	15	4	19	134
2028	16	3	19	119
2029	16	3	19	103
2030	17	2	19	87
2031	17	2	19	71
2032	17	1	19	54
2033	18	1	19	36
2034	18	0	19	18
Total	95,595	66,520	162,137	

Table A17-1-3 Debt Services (Alternative 3)
for Foreign Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	69	69	2,564
1993	0	245	245	9,068
1994	0	1,061	1,061	39,280
1995	0	1,264	1,264	46,822
1996	0	1,264	1,264	46,822
1997	0	1,264	1,264	46,822
1998	0	1,264	1,264	46,822
1999	0	1,264	1,264	46,822
2000	0	1,264	1,264	46,822
2001	0	1,264	1,264	46,822
2002	1,796	1,264	3,061	46,822
2003	1,845	1,216	3,061	45,026
2004	1,895	1,166	3,061	43,181
2005	1,946	1,123	3,068	41,575
2006	1,998	1,070	3,068	39,629
2007	2,052	1,016	3,068	37,631
2008	2,108	961	3,068	35,579
2009	2,165	904	3,068	33,471
2010	2,223	845	3,068	31,306
2011	2,283	785	3,068	29,083
2012	2,345	724	3,068	26,800
2013	2,408	660	3,068	24,456
2014	2,473	595	3,068	22,047
2015	2,551	529	3,079	19,574
2016	2,620	460	3,079	17,024
2017	2,691	389	3,079	14,404
2018	2,763	316	3,079	11,713
2019	2,838	242	3,079	8,950
2020	2,914	165	3,079	6,112
2021	2,993	86	3,079	3,198
2022	13	6	19	205
2023	14	5	19	191
2024	14	5	19	178
2025	14	4	19	164
2026	15	4	19	149
2027	15	4	19	134
2028	16	3	19	119
2029	16	3	19	103
2030	17	2	19	87
2031	17	2	19	71
2032	17	1	19	54
2033	18	1	19	36
2034	18	0	19	18
Total	47,111	24,779	71,890	

Table A17-1-3 Debt Services (Alternative 3)
for Local Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance Capital
1992	0	145	145	1,319
1993	0	458	458	4,165
1994	0	2,169	2,169	19,717
1995	1,179	2,651	3,830	24,102
1996	1,309	2,521	3,830	22,922
1997	1,453	2,377	3,830	21,614
1998	1,875	2,218	4,092	20,161
1999	2,081	2,011	4,092	18,286
2000	2,310	1,783	4,092	16,205
2001	2,564	1,528	4,092	13,895
2002	2,846	1,246	4,092	11,331
2003	3,159	933	4,092	8,485
2004	3,507	586	4,092	5,326
2005	544	216	760	1,960
2006	604	156	760	1,415
2007	671	89	760	811
2008	8	15	24	141
2009	9	15	24	132
2010	10	14	24	123
2011	11	12	24	112
2012	13	11	24	101
2013	14	10	24	88
2014	16	8	24	74
2015	17	6	24	58
2016	19	4	24	41
2017	21	2	24	21
Total	24,242	21,187	45,429	192,605

Table A17-1-3 Debt Services (Alternative 3)

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	214	214	3,883
1993	0	703	703	13,233
1994	0	3,229	3,229	58,997
1995	1,179	3,915	5,094	70,924
1996	1,309	3,786	5,094	69,744
1997	1,453	3,642	5,094	68,436
1998	1,875	3,482	5,357	66,983
1999	2,081	3,276	5,357	65,108
2000	2,310	3,047	5,357	63,027
2001	2,564	2,793	5,357	60,717
2002	4,642	2,511	7,153	58,153
2003	5,004	2,149	7,153	53,511
2004	5,401	1,752	7,153	48,507
2005	2,490	1,338	3,828	43,535
2006	2,603	1,226	3,828	41,045
2007	2,723	1,105	3,828	38,442
2008	2,116	976	3,092	35,719
2009	2,174	918	3,092	33,603
2010	2,233	859	3,092	31,429
2011	2,295	798	3,092	29,196
2012	2,357	735	3,092	26,901
2013	2,422	670	3,092	24,544
2014	2,489	603	3,092	22,122
2015	2,568	535	3,103	19,633
2016	2,639	464	3,103	17,064
2017	2,712	391	3,103	14,425
2018	2,763	316	3,079	11,713
2019	2,838	242	3,079	8,950
2020	2,914	165	3,079	6,112
2021	2,993	86	3,079	3,198
2022	13	6	19	205
2023	14	5	19	191
2024	14	5	19	178
2025	14	4	19	164
2026	15	4	19	149
2027	15	4	19	134
2028	16	3	19	119
2029	16	3	19	103
2030	17	2	19	87
2031	17	2	19	71
2032	17	1	19	54
2033	18	1	19	36
2034	18	0	19	18
Total	71,353	45,966	117,319	

Table A17-1-4 Debt Services (Alternative 4)
for Foreign Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	99	99	3,663
1993	0	350	350	12,954
1994	0	1,515	1,515	56,114
1995	0	1,806	1,806	66,888
1996	0	1,806	1,806	66,888
1997	0	1,806	1,806	66,888
1998	0	1,806	1,806	66,888
1999	0	1,806	1,806	66,888
2000	0	1,806	1,806	66,888
2001	0	1,806	1,806	66,888
2002	2,566	1,806	4,372	66,888
2003	2,635	1,737	4,372	64,322
2004	2,707	1,666	4,372	61,686
2005	2,780	1,604	4,383	59,393
2006	2,855	1,529	4,383	56,613
2007	2,932	1,451	4,383	53,758
2008	3,011	1,372	4,383	50,826
2009	3,092	1,291	4,383	47,815
2010	3,176	1,208	4,383	44,723
2011	3,262	1,122	4,383	41,547
2012	3,350	1,034	4,383	38,286
2013	3,440	943	4,383	34,936
2014	3,533	850	4,383	31,496
2015	3,644	755	4,399	27,963
2016	3,743	657	4,399	24,319
2017	3,844	556	4,399	20,577
2018	3,947	452	4,399	16,733
2019	4,054	345	4,399	12,786
2020	4,163	236	4,399	8,732
2021	4,276	123	4,399	4,568
2022	19	8	27	293
2023	20	7	27	274
2024	20	7	27	254
2025	21	6	27	234
2026	21	6	27	213
2027	22	5	27	192
2028	22	5	27	170
2029	23	4	27	148
2030	24	3	27	125
2031	24	3	27	101
2032	25	2	27	77
2033	26	1	27	52
2034	26	1	27	26
Total	67,301	35,399	102,700	

Table A17-1-4 Debt Services (Alternative 4)
for Local Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	85	85	770
1993	0	244	244	2,222
1994	0	1,243	1,243	11,300
1995	676	1,548	2,223	14,069
1996	750	1,473	2,223	13,393
1997	833	1,391	2,223	12,643
1998	1,090	1,299	2,389	11,810
1999	1,210	1,179	2,389	10,720
2000	1,343	1,046	2,389	9,511
2001	1,490	898	2,389	8,168
2002	1,654	735	2,389	6,678
2003	1,836	553	2,389	5,023
2004	2,038	351	2,389	3,187
2005	344	135	479	1,227
2006	382	97	479	884
2007	424	55	479	502
2008	5	9	13	79
2009	5	8	13	74
2010	6	8	13	69
2011	6	7	13	63
2012	7	6	13	56
2013	8	5	13	49
2014	9	5	13	41
2015	10	4	13	33
2016	11	3	13	23
2017	12	1	13	12
Total	14,147	12,386	26,533	

Table A17-1-4 Debt Services (Alternative 4)

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	184	184	4,433
1993	0	594	594	15,176
1994	0	2,758	2,758	67,414
1995	676	3,354	4,029	80,957
1996	750	3,279	4,029	80,281
1997	833	3,197	4,029	79,531
1998	1,090	3,105	4,195	78,698
1999	1,210	2,985	4,195	77,608
2000	1,343	2,852	4,195	76,399
2001	1,490	2,704	4,195	75,056
2002	4,220	2,541	6,761	73,566
2003	4,472	2,289	6,761	69,345
2004	4,745	2,016	6,761	64,873
2005	3,123	1,739	4,862	60,620
2006	3,236	1,626	4,862	57,497
2007	3,355	1,507	4,862	54,260
2008	3,016	1,381	4,397	50,905
2009	3,097	1,299	4,397	47,889
2010	3,182	1,215	4,397	44,792
2011	3,268	1,129	4,397	41,610
2012	3,357	1,040	4,397	38,342
2013	3,448	949	4,397	34,986
2014	3,542	855	4,397	31,538
2015	3,654	759	4,412	27,996
2016	3,753	659	4,412	24,342
2017	3,856	557	4,412	20,589
2018	3,947	452	4,399	16,733
2019	4,054	345	4,399	12,786
2020	4,163	236	4,399	8,732
2021	4,276	123	4,399	4,568
2022	19	8	27	293
2023	20	7	27	274
2024	20	7	27	254
2025	21	6	27	234
2026	21	6	27	213
2027	22	5	27	192
2028	22	5	27	170
2029	23	4	27	148
2030	24	3	27	125
2031	24	3	27	101
2032	25	2	27	77
2033	26	1	27	52
2034	26	1	27	26
Total	81,448	47,785	129,233	

Table A17-1-5 Debt Services (Alternative 5)
for Foreign Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	99	99	3,663
1993	0	350	350	12,954
1994	0	1,515	1,515	56,114
1995	0	1,806	1,806	66,888
1996	0	1,806	1,806	66,888
1997	0	1,806	1,806	66,888
1998	0	1,806	1,806	66,888
1999	0	1,806	1,806	66,888
2000	0	1,806	1,806	66,888
2001	0	1,806	1,806	66,888
2002	2,566	1,806	4,372	66,888
2003	2,635	1,737	4,372	64,322
2004	2,707	1,666	4,372	61,686
2005	2,780	1,604	4,383	59,393
2006	2,855	1,529	4,383	56,613
2007	2,932	1,451	4,383	53,758
2008	3,011	1,372	4,383	50,826
2009	3,092	1,291	4,383	47,815
2010	3,176	1,208	4,383	44,723
2011	3,262	1,122	4,383	41,547
2012	3,350	1,034	4,383	38,286
2013	3,440	943	4,383	34,936
2014	3,533	850	4,383	31,496
2015	3,644	755	4,399	27,963
2016	3,743	657	4,399	24,319
2017	3,844	556	4,399	20,577
2018	3,947	452	4,399	16,733
2019	4,054	345	4,399	12,786
2020	4,163	236	4,399	8,732
2021	4,276	123	4,399	4,568
2022	19	8	27	293
2023	20	7	27	274
2024	20	7	27	254
2025	21	6	27	234
2026	21	6	27	213
2027	22	5	27	192
2028	22	5	27	170
2029	23	4	27	148
2030	24	3	27	125
2031	24	3	27	101
2032	25	2	27	77
2033	26	1	27	52
2034	26	1	27	26
Total	67,301	35,399	102,700	

Table A17-1-5 Debt Services (Alternative 5)
for Local Portion

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	169	169	1,539
1993	0	489	489	4,443
1994	0	2,486	2,486	22,600
1995	1,352	3,095	4,447	28,137
1996	1,500	2,946	4,447	26,785
1997	1,665	2,781	4,447	25,285
1998	2,179	2,598	4,778	23,620
1999	2,419	2,358	4,778	21,441
2000	2,685	2,092	4,778	19,021
2001	2,981	1,797	4,778	16,336
2002	3,309	1,469	4,778	13,355
2003	3,673	1,105	4,778	10,047
2004	4,077	701	4,778	6,374
2005	687	270	957	2,455
2006	763	194	957	1,767
2007	847	110	957	1,004
2008	9	17	27	157
2009	10	16	27	148
2010	12	15	27	137
2011	13	14	27	126
2012	14	12	27	113
2013	16	11	27	99
2014	18	9	27	83
2015	19	7	27	65
2016	22	5	27	46
2017	24	3	27	24
Total	28,294	24,773	53,067	

Table A17-1-5 Debt Services (Alternative 5)

(Unit : Baht x 1000)

Year	Capital	Interest	Total Annual Repayment	Balance of Capital
1992	0	268	268	5,202
1993	0	838	838	17,397
1994	0	4,001	4,001	78,714
1995	1,352	4,901	6,253	95,025
1996	1,500	4,752	6,253	93,673
1997	1,665	4,587	6,253	92,173
1998	2,179	4,404	6,584	90,508
1999	2,419	4,164	6,584	88,329
2000	2,685	3,898	6,584	85,909
2001	2,981	3,603	6,584	83,224
2002	5,875	3,275	9,150	80,243
2003	6,308	2,842	9,150	74,369
2004	6,783	2,367	9,150	68,060
2005	3,467	1,874	5,341	61,847
2006	3,618	1,723	5,341	58,380
2007	3,779	1,562	5,341	54,762
2008	3,020	1,390	4,410	50,983
2009	3,103	1,307	4,410	47,963
2010	3,187	1,223	4,410	44,860
2011	3,274	1,136	4,410	41,673
2012	3,364	1,046	4,410	38,399
2013	3,456	954	4,410	35,035
2014	3,550	859	4,410	31,579
2015	3,664	762	4,426	28,029
2016	3,764	662	4,426	24,365
2017	3,868	558	4,426	20,601
2018	3,947	452	4,399	16,733
2019	4,054	345	4,399	12,786
2020	4,163	236	4,399	8,732
2021	4,276	123	4,399	4,568
2022	19	8	27	293
2023	20	7	27	274
2024	20	7	27	254
2025	21	6	27	234
2026	21	6	27	213
2027	22	5	27	192
2028	22	5	27	170
2029	23	4	27	148
2030	24	3	27	125
2031	24	3	27	101
2032	25	2	27	77
2033	26	1	27	52
2034	26	1	27	26
Total	95,595	60,172	155,767	

Table A17-1-6 Projected Cash Flow at Current Price

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	811	900	999	1,321	1,466	1,627	1,806	2,005	2,225	2,470	439	487	540
Laon	0	0	4,887	12,436	63,496	17,284	0	0	0	0	0	0	0	0	0	
Local loan	0	0	848	1,681	11,035	3,533	0	0	0	0	0	0	0	0	0	163
Foreign loan	0	0	4,038	10,755	52,461	13,751	0	0	0	0	0	0	0	0	0	859
Operating Revenue	9,342	10,122	10,733	11,143	13,446	13,994	14,544	17,414	18,076	18,743	22,529	23,314	24,361	29,348	30,514	31,749
Water Sales	8,928	9,677	10,067	10,445	12,602	13,113	13,623	16,362	16,987	17,611	21,169	21,892	22,752	27,402	28,488	29,642
Connection Fee	208	223	433	455	551	574	600	666	688	713	857	899	1,064	1,286	1,339	1,390
Service Charge	27	29	32	34	41	45	47	59	62	66	80	85	90	111	117	124
Ohter Income	179	194	201	209	252	262	272	327	340	352	423	438	455	548	570	593
Total Inflow	9,342	10,122	15,620	24,390	77,843	32,277	15,865	18,880	19,703	20,549	24,534	25,539	26,831	29,787	31,001	33,311
Cash Outflow																
Project expenditures																
Local portion	0	0	2,908	6,588	37,808	11,192	0	0	0	0	0	0	0	0	0	584
Foreign portion	0	0	2,827	7,529	36,723	9,626	0	0	0	0	0	0	0	0	0	601
Amortization																
Principal	0	0	0	0	0	811	900	999	1,321	1,466	1,627	1,806	5,113	5,417	5,748	3,805
Interest	0	0	202	678	3,308	4,068	3,979	3,880	3,770	3,624	3,463	3,284	3,085	2,781	2,450	2,131
Operating Expenses	4,878	6,320	6,826	7,396	8,346	10,671	13,054	14,560	15,620	17,009	19,009	20,608	22,560	27,101	29,572	32,424
O & M Cost	2,513	3,782	4,116	4,610	5,021	7,247	9,529	10,391	11,334	12,601	13,758	15,210	16,933	20,376	22,633	25,261
Connection Expenses	104	111	216	227	275	287	300	333	344	357	428	450	532	643	669	695
Share of Head Office	2,261	2,427	2,494	2,559	3,050	3,137	3,225	3,836	3,943	4,051	4,823	4,949	5,095	6,081	6,270	6,468
Total Outflow	4,878	6,320	12,763	22,191	86,185	36,367	17,933	19,439	20,711	22,099	24,099	25,698	30,758	35,299	37,770	39,545
Net Cash flow	4,464	3,802	2,857	2,199	-8,343	-4,090	-2,069	-559	-1,008	-1,550	435	-159	-3,927	-5,512	-6,769	-6,233
Accumulated	4,464	8,266	11,123	13,322	4,979	888	-1,180	-1,740	-2,748	-4,298	-3,863	-4,022	-7,950	-13,462	-20,230	-26,464

Table A17-1-6 Projected Cash Flow at Current 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	10	11	12	13	15	16	18	20	22	25					
Loan															
Local loan															
Foreign loan															
Operating Revenue	38,228	39,563	41,098	49,436	51,365	53,306	61,708	61,708	61,708	71,434	71,434	71,434	82,694	82,694	82,694
Water Sales	35,651	37,039	38,480	46,304	48,123	49,882	57,745	57,745	57,745	66,847	66,847	66,847	77,383	77,383	77,383
Connection Fee	1,711	1,622	1,681	2,001	2,065	2,198	2,545	2,545	2,545	2,946	2,946	2,946	3,411	3,411	3,411
Service Charge	153	162	168	205	215	227	263	263	263	305	305	305	353	353	353
Ohter Income	713	741	770	926	962	998	1,155	1,155	1,155	1,337	1,337	1,337	1,548	1,548	1,548
Total Inflow	38,238	39,574	41,110	49,449	51,380	53,322	61,726	61,728	61,730	71,459	71,434	71,434	82,694	82,694	82,694
Cash Outflow															
Project expenditures															
Local portion															
Foreign portion															
Amortization															
Principal	3,944	4,091	3,656	3,756	3,858	3,963	4,071	4,182	4,297	4,447	4,569	4,694	4,795	4,925	5,058
Interest	1,992	1,845	1,690	1,590	1,488	1,383	1,274	1,163	1,049	931	810	685	556	426	293
Operating Expenses	37,059	40,370	44,938	51,249	55,352	60,598	64,868	67,445	70,150	75,092	78,075	81,208	86,929	90,382	94,008
O & M Cost	28,487	31,602	35,895	40,449	44,207	49,083	51,537	54,114	56,820	59,661	62,644	65,776	69,065	72,518	76,144
Connection Expenses	856	811	840	1,001	1,032	1,099	1,272	1,272	1,272	1,473	1,473	1,473	1,705	1,705	1,705
Share of Head Office	7,716	7,957	8,203	9,800	10,113	10,416	12,058	12,058	12,058	13,959	13,959	13,959	16,159	16,159	16,159
Total Outflow	42,995	46,306	50,284	56,595	60,698	65,944	70,213	72,790	75,496	80,470	83,454	86,587	92,280	95,733	99,359
Net Cash flow	-4,757	-6,732	-9,174	-7,146	-9,318	-12,623	-8,487	-11,062	-13,766	-9,011	-12,020	-15,152	-9,586	-13,039	-16,665
Accumulated	-31,221	-37,952	-47,126	-54,273	-63,590	-76,213	-84,700	-95,762	-109,528	-118,539	-130,559	-145,711	-155,297	-168,336	-185,000

Table A17-1-7 Unit Cost of Water after Depreciation

(Unit :Baht x 1000)

year	Water Consumption (cu.m/day)	Capital Investement	Operating Expenses	Head Share	Depre-ciation	Total Expenses	Unit Water Cost (Baht/cu.m)
1990	3,653	0	2,617	2,261	0	7,139	5.35
1991	3,782	0	3,708	2,311	0	8,330	6.03
1992	3,970	5,202	3,939	2,375	0	13,891	9.59
1993	4,166	12,195	4,199	2,437	0	21,268	13.99
1994	4,372	61,317	4,358	2,509	129	70,822	44.38
1995	4,586	16,311	5,914	2,581	1,097	28,484	17.02
1996	4,810	0	7,358	2,653	2,586	15,250	8.69
1997	5,027	0	7,622	2,726	2,586	15,660	8.53
1998	5,252	0	7,916	2,802	2,586	16,106	8.40
1999	5,487	0	8,377	2,879	2,586	16,721	8.35
2000	5,732	0	8,709	2,961	2,586	17,217	8.23
2001	5,986	0	9,169	3,038	2,586	17,831	8.16
2002	6,271	0	9,756	3,128	2,586	18,598	8.13
2003	6,568	0	11,147	3,225	2,586	20,183	8.42
2004	6,879	0	11,786	3,325	2,586	21,022	8.37
2005	7,203	570	12,520	3,430	2,586	22,536	8.57
2006	7,541	0	13,442	3,535	2,605	23,117	8.40
2007	7,879	0	14,160	3,645	2,605	24,055	8.36
2008	8,229	0	15,300	3,758	2,605	25,421	8.46
2009	8,593	0	16,403	3,878	2,605	26,764	8.53
2010	8,971	0	17,070	4,002	2,605	27,679	8.45
2011	9,361	0	18,053	4,122	2,605	28,902	8.46
2012	9,361	0	18,053	4,122	2,605	28,902	8.46
2013	9,361	0	18,053	4,122	2,605	28,902	8.46
2014	9,361	0	18,053	4,122	2,605	28,902	8.46
2015	9,361	0	18,053	4,122	2,605	28,902	8.46
2016	9,361	0	18,053	4,122	2,605	28,902	8.46
2017	9,361	0	18,053	4,122	2,605	28,902	8.46
2018	9,361	0	18,053	4,122	2,605	28,902	8.46
2019	9,361	0	18,053	4,122	2,605	28,902	8.46
2020	9,361	0	18,053	4,122	2,605	28,902	8.46
Average Unit Water Cost (1990-2020) :							9.37