CHAPTER 9
BENEFITS

Various types of benefits derived from the sewerage system in the First Phase Area can be expected, including those from health and sanitation improvement, water pollution control, values added to land and other various economic benefits.

Since the benefits are mostly unquantifiable in nature, the results of the analysis are not expressed by benefit-cost ratio except those which are quantifiable ones.

9.1 Health and Sanitation Benefits

The average number of waterborne disease occurred per 1,000 persons are estimated to be 13.76 on the basis of the recorded incidences in the year 1978. Also, a survey on the cost for treatment of the diseases in 1979 indicates that expenses for treating these diseases, including amounts spent for medical care, are about M$31 per person per day for an average of two weeks hospitalization. To estimate the benefit, it is assumed that if about one half of the diseases occurred are attributable to poor excreta disposal and if this can be eliminated by the provision of sewerage system, then reduction rate of incidence of the disease would be 6.88 (or 13.76 x 0.5) within the Study Area. The projection population served by the sewerage system and reduction of incidences in the First Phase Area are calculated as follows:

Table 9.1 Projected Population to be Served and Reduction in Number of Waterborne Diseases in the First Phase Area

	Year	(1) Population Served (1,000 persons)	(2) Reduction in No. of Incidences (persons)
During 20 Years After Commencement of The First Phase Programme	1982	-	-
	1983	-	-
	1984	10.1	69
	1985	17.9	123
	1986	23.0	158
	1987	23.2	160
	1988	23.3	160
	1989	23.5	162
	1990	23.6	162
	1991	23.8	164
	1992	23.9	164
	1993	24.1	166
	1994	24.2	166
	1995	25.4	169
	1996	24.6	169
	1997	24.8	171
	1998	24.9	171
	1999	25.1	173
	2000	25.2	172
	2001	25.4	175

Note: (2) = (1) x6.88

Served population is estimated based on sewered area in accordance with the construction programme for the First Phase Programme. On the basis of the above consideration, reductions in direct costs of illness expected for the years 1982 through 2001 in the sewered areas are estimated and discounted to 1979 price level at 8 percent per annum. As the result, the quantifiable benefits are estimated to be approximately M$453,000 at 1979 price level. This is presented in Table 9.2.

The main element of indirect cost can also be calculated assuming the average wage loss and the number of man-days lost due to disability. On the basis of the data collected, the average income of labour participation group is estimated to be M$275 per person per month. It is also assumed that 47% of the total population based on available data, is affected by the incidence of various diseases which cause wage losses, and that each incidence takes average two weeks off from the work. Factors such as unemployment, ratio of workers to total population are not considered. Indirect cost for wage loss is estimated and discounted to the 1979 price level are 8 percent per annum. The discounted benefit is to be M$63,000 as shown in Table 9.3.

Table 9.2 Reduction Direct Costs by Elimination of Waterborne Diseases

(at 1979 price level)

Year	Population Served (1,000 persons) (1)	Reduction in Number of Incidence (persons) (2)	Saving in Direct Cost (M$) (3)	Discount Factor (4)	Discounted Benefits at 1979 (M$) (5)
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	10.1	69	29,946	0.681	20,393
1985	17.9	123	53,382	0.630	33,631
1986	23.0	158	68,572	0.583	39,977
1987	23.2	160	69,440	0.540	37,498
1988	23.3	160	69,440	0.500	34,720
1989	23.5	162	70,308	0.463	32,553
1990	23.6	162	70,308	0.429	30,162
1991	23.8	164	71,176	0.397	28,257
1992	23.9	164	71,176	0.368	26,193
1993	24.1	166	72,044	0.340	24,494
1994	24.2	166	72,044	0.315	22,694
1995	24.5	169	73,346	0.292	21,417
1996	24.6	169	73,346	0.270	19,803
1997	24.8	171	74,214	0.250	18,554
1998	24.9	171	74,214	0.232	17,218
1999	25.1	173	75,082	0.215	16,143
2000	25.2	173	75,082	0.199	14,941
2001	25.4	175	75,950	0.185	13,975
Total		2,689	1,239,070		452,623

Note: (2) = (1) x 6.88

(3) = (2) x 31 M$/d.cap x 14 days

(4) = $\frac{1}{(1+0.08)^{(x-1979)}}$ (x: year)

(5) = (3) x (4)

Table 9.3 Saving from Wage Loss

(at 1979 price level)

Year	Reduction in Nos. of Incidence (persons) (1)	Affected Population by the Incidence of Diseases (persons) (2)	Saving in Indirect Cost for Wage Loss (M$) (3)	Discount Factor (4)	Discounted Benefits at 1979 (M$) (5)
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	69	32	4,096	0.681	2,789
1985	123	58	7,425	0.630	4,677
1986	158	74	9,472	0.583	5,522
1987	160	75	9,600	0.540	5,184
1988	160	75	9,600	0.500	4,800
1989	162	76	9,728	0.463	4,504
1990	162	76	9,728	0.429	4,173
1991	164	77	9,856	0.397	3,193
1992	164	77	9,856	0.368	3,627
1993	166	78	9,984	0.340	3,395
1994	166	78	9,984	0.315	3,145
1995	169	79	10,112	0.292	2,953
1996	169	79	10,112	0.270	2,730
1997	171	80	10,240	0.250	2,560
1998	171	80	10,240	0.232	2,376
1999	173	81	10,368	0.215	2,229
2000	173	81	10,368	0.199	2,063
2001	175	82	10,496	0.184	1,931
Total	2,689	1,338	171,264		62,902

Note: (2) = (1) x 0.47

(3) = (2) x 275 M$/month.cap x 14/30

(4) = $\frac{1}{(1+0.08)^{(x-1979)}}$ (x: year)

(5) = (3) x (4)

Other benefits expected to be derived from the sewerage system, although mostly unquantifiable, include: (1) reduction of discomfort and distress: (2) improvements in environmental aesthetics from elimination of the present sewage odours (i.e. from accumulated sludge in drains, cesspool and septic tank effluents, excreta in drains and rivers, and direct discharge of sewage water); and (3) reduction of ground water contamination resulting from improved measures for handling sanitary wastes.

9.2 Water Pollution Control Benefits

The reduction of waste loads or improvement of water quality in the rivers and drains is another major benefits to be derived from the sewerage system.

As discussed in the Master Plan Report, most of the drains in urbanized areas have been polluted and are expected to become much worse in the near future unless the sewerage system is provided. Also, rivers will be polluted from the drain flows.

The proposed First Phase Programme could keep future total BOD loadings to drains and stream lower than the present level by the year 1990, and also even in the year 2000. Accordingly, the effect of the system is quite significant, especially in the Sungai Raja and roadside drains which have been receiving wastes loads from highly populated areas.

9.3 Other Benefits

Provision of the new sewerage system can induce investment for land development. Therefore, the sewerage facilities will have the effect of raising the intrinsic values of the land served by the system. These additional land values constitute a major economic benefit in that, not

only by elimination of unsanitary conditions and improvement of drains and rivers through anti-pollution measures in the community, but also as an additional source of taxation for the revenue in favour of the local government authorities. Land buyers are considered to have willingness to pay for properties on which such physical improvements have been made.

9.4 Conclusion

On the basis of the results of evaluations of benefits by the proposed sewerage system in the First Phase Area, both tangible and intangible, it is concluded that the project is definitely justifiable. If no sewerage systems are provided in the Area, sanitary conditions which are already deplorable in many areas of the city will become progressively worse. Moreover, if this project is not undertaken at this time, the cost for the implementation at later times will be increasingly higher.

A N N E X E S

ANNEX 1

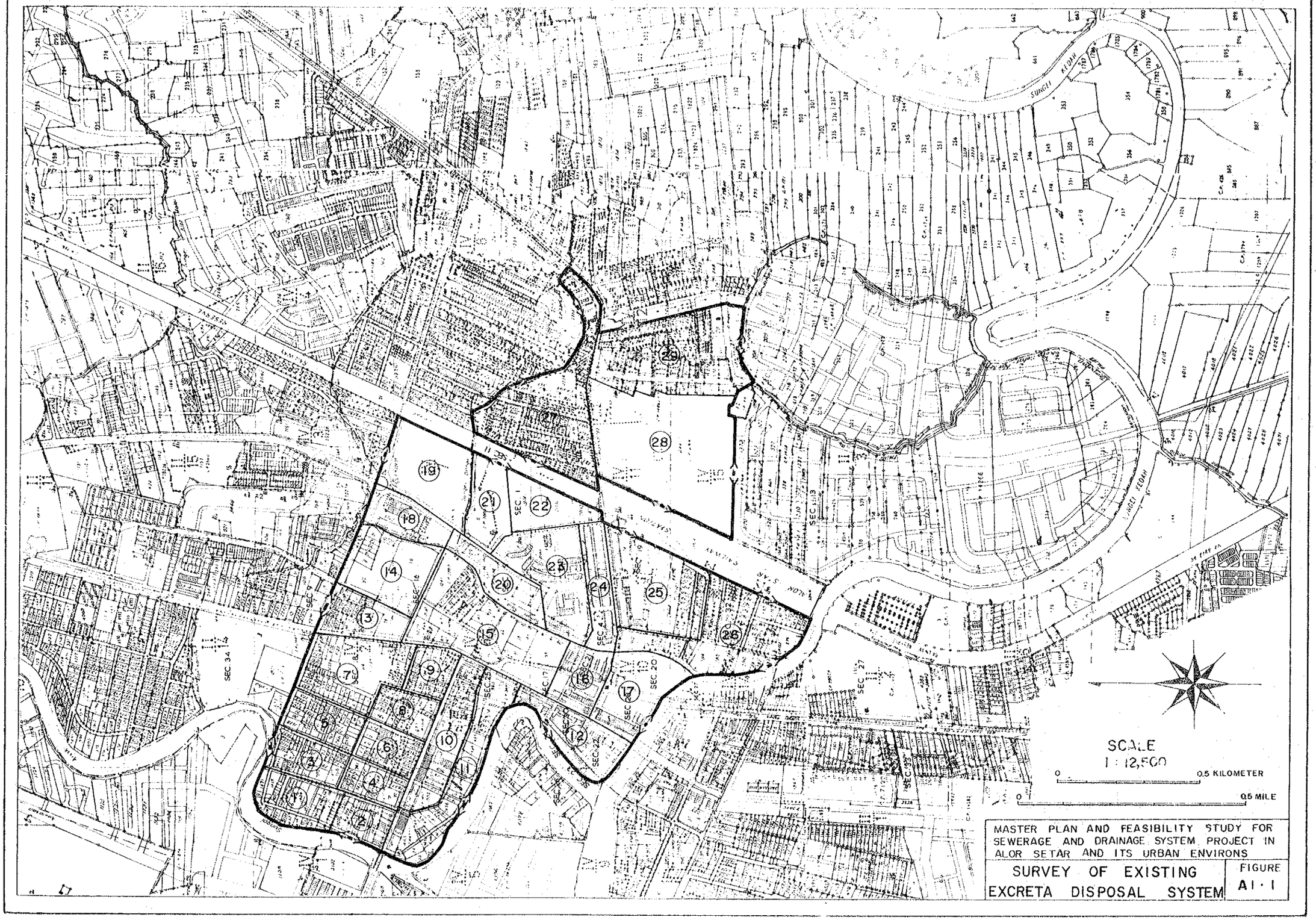
Data of Existing Excreta Disposal Facilities

Table A1.1 Number of Excreta Disposal Facilities with Served Population in the First Phase Area

Block No.	No. of Facility (Unit)			Population Served (Person)			
	Septic Tank System	Bucket System	Others	Septic Tank System	Bucket System	Others	Total
1	43	10	43	501	111	501	1,113
2	24	17	19	320	224	257	801
3	10	15	7	115	174	81	370
4	15	9	5	201	120	66	387
5	21	11	8	281	143	106	530
6	17	17	0	308	309	-	617
7	23	21	1	304	281	12	597
8	12	17	0	216	310	-	526
9	6	17	0	93	2-3	-	356
10	64	45	-	802	557	-	1,359
11	32	30	5	485	454	76	1,015
12	140	60	0	1,206	517	-	1,723
13	16	7	0	307	132	-	439
14	22	1	10	429	79	195	643
15	15	6	4	292	117	78	487
16	7	41	0	164	928	-	1,092
17	50	48	0	478	459	-	937
18	0(2)	0	0	938	-	-	938
19	-	-	-	-	-	-	0
20	3	0	0	-	-	-	0
21	0(1)	0	0	780	-	-	780
22	6	0	0	-	-	-	0
23	0(1)	0	0	940	-	-	940
24	74	21	0	821	232	-	1,053
25	55	32	0	731	425	-	1,156
26	49	43	9	803	719	151	1,673
27	88	28	29	836	266	276	1,378
28	2	0	0	-	-	-	0
29	58	0	34	617	-	363	980
Total	852(3)	496	174	12,968	6,760	2,162	21,890

Note: (1) Block numbers refer to Figure A1.1.
(2) Figures in parentheses indicate number of communal septic tank system.

FIGURE A1-1



MASTER PLAN AND FEASIBILITY STUDY FOR SEWERAGE AND DRAINAGE SYSTEM PROJECT IN ALOR SETAR AND ITS URBAN ENVIRONS

SURVEY OF EXISTING EXCRETA DISPOSAL SYSTEM

FIGURE A1-1

ANNEX 2

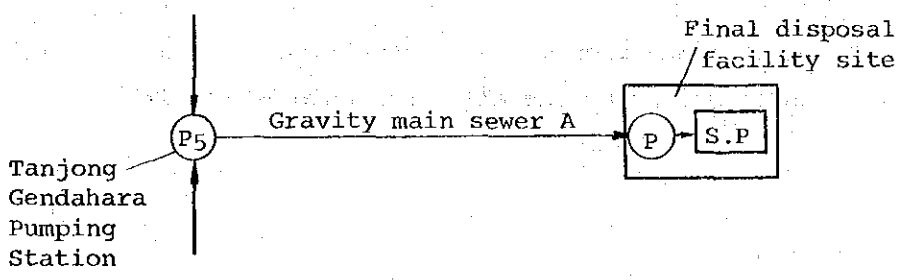
Alternative Study for Sewage Conveyance Facilities

Although the First Phase Area covers approximately two-fifths of B-1 sewerage sub-zone as shown in Figure 3.1, the trunk sewers proposed for the Area is carefully designed considering the influence by other sewerage sub-zone of the same sewerage zone as to sewage quantity, junctions of incoming trunk sewers and their invert elevation, etc.

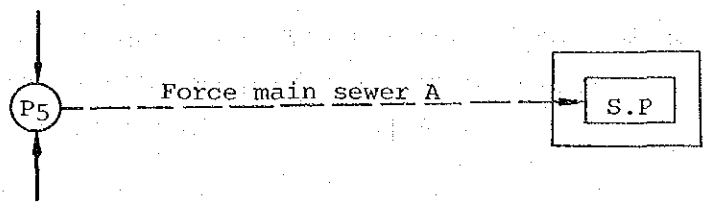
The proposed sewerage layout plan is worked out on the basis to minimize the number of intermediate pumping stations to the extent practicable. It is concluded that two intermediate pumping stations are necessary to construct in the First Phase: P_1 (Kolam Air) and P_5 (Tanjong Bendahara) as shown in Figure 6.1.

To supplement the Master Plan Study for feasibility study purposes, however, it is considered necessary to work with the following three alternatives to determine the best suited sewage conveyance system between P_5 intermediate pumping station and pumping station (P) attached to the final disposal facility (stabilization pond) in sewerage zone B.

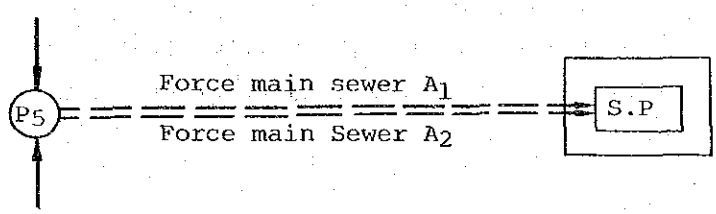
Alternative I : To pump up the incoming sewage at P_5 and convey it by gravity to the pumping station P in the final disposal facility (stabilization pond) by one large trunk sewer A. The trunk sewer is capable to accommodate the 2000 year flow generated in the entire sewerage zone B.



Alternative II : To pump up the incoming sewage at P_5 and convey it by pressure to the treatment facility site by one force main sewer A. It is capable to convey the 2000 year flow generated in the entire sewerage zone B.



Alternative III : To pump up the incoming sewage at P_5 and convey it by pressure to the treatment facility site by two barrels of force main sewers A_1 and A_2 of equal size. The integrated capacity can meet the 2000 year condition in sewerage zone B. A_1 is constructed in the First Phase and A_2 in the Second Phase.



For evaluating the above three alternatives, the capital costs of the trunk sewers, pumping stations, and land acquisition cost are estimated on the basis of the costs developed in Appendix G of Volume VII. Annual operation and maintenance costs for these facilities are also estimated using the basic operation and maintenance costs for each sewerage component as described in Chapter 7.

The cost comparison of the alternatives is made on the basis of present worth method of the all costs associated with each alternative.

The results shown on Table A2.1 indicate that Alternative III is superior to other alternatives.

In addition to the cost comparison, Alternative III is preferable to second lowest alternative in that:

1. Material of force main sewer is available in Malaysia.

2. The flow velocity can be maintained under more desirable condition (min: 60 m/sec) as proposed in Alternative III by constructing two barrels force main sewer.

Table A2.1 Total Costs for Each Alternative

(M$1,000)

	Year	Construction	Replacement	O & M	Total	Discount Rate	Present Value
Alternative I	1980 - 1985	4,049.4	-	-	4,049.4	0.564	2,283.9
	1986 - 1990	409.4	-	396.4	805.8	0.350	282.0
	1991 - 1995	409.4	-	558.6	968.0	0.218	211.0
	1996 - 2000	-	190.4	753.45	943.85	0.135	127.4
	2001 - 2005	-	63.4	753.45	816.85	0.084	68.6
	2006 - 2010	-	63.4	753.45	816.85	0.052	42.5
	2011 - 2015	-	190.4	753.45	943.85	0.032	30.2
						Land Cost	20.5
						Total	3,066.1
Alternative II	1980 - 1985	2,405.5	-	-	2,405.5	0.564	1,356.7
	1986 - 1990	213.1	-	283.7	496.8	0.350	173.9
	1991 - 1995	240.1	-	420.0	660.1	0.218	143.9
	1996 - 2000	-	95.1	638.6	733.7	0.135	99.0
	2001 - 2005	-	31.7	638.6	670.3	0.084	56.3
	2006 - 2010	-	31.7	638.6	670.3	0.052	34.9
	2011 - 2015	-	95.1	638.6	733.7	0.032	23.5
	Note: 8%					Land Cost	22.8
						Total	1,911.0
Alternative III	1980 - 1985	1,816.5	-	-	1,816.5	0.564	1,024.5
	1986 - 1990	728.5	-	260.1	988.6	0.350	346.0
	1991 - 1995	240.7	-	417.0	657.7	0.218	143.4
	1996 - 2000	-	95.1	635.65	730.75	0.135	98.7
	2001 - 2005	-	31.7	635.65	667.35	0.084	56.1
	2006 - 2010	-	31.7	635.65	667.35	0.052	34.7
	2011 - 2015	-	95.1	635.65	730.75	0.032	23.4
						Land Cost	22.8
						Total	1,749.6

Note: (1) Table A2.1 is supported by Table A2.2 through A2.6.
(2) 8% of discount rate is applied.

Table A2.2 Proposed Construction Schedule by Alternative

	Facilities \ Yr. of Construction	Phase 1 (1985)	Phase 2 (1990)	Phase 3 (1995)
Alternative I	Trunk sewer	A line	—	—
	Pumping station (P_5)			
	. Civil works	Whole structure		
	. Elec. & Mech. works (cumulative)	3 pumps Qp=0.38 m^3/s Qd=11,850 m^3/d	4 pumps Qp=0.60 m^3/s Qd=21,130 m^3/d	5 pumps Qp=0.86 m^3/s Qd=32,430 m^3/d
	Pumping station (P)			
	. Civil works	Whole structure		
	. Elec. & Mech. works (cumulative)	3 pumps Q =0.38 m^3/s Q =11,850 m^3/d	4 pumps Q =0.60 m^3/s Q =21,130 m^3/d	5 pumps Q =0.95 m^3/s Q =36,390 m^3/d
Alternative II	Trunk sewer	A line	—	—
	Pumping station (P_5)			
	. Civil works	Whole structure		
	. Elec. & Mech. works (cumulative)	3 pumps Qp=0.38 m^3/s Qd=11,850 m^3/d	4 pumps Qp=0.60 m^3/s Qd=21,130 m^3/d	5 pumps Qp=0.95 m^3/s Qd=36,390 m^3/d
Alternative III	Trunk sewer	A1 line	A2 line	
	Pumping station (P_5)			
	. Civil works	Whole structure		
	. Elec. & Mech. works (cumulative)	3 pumps Qp=0.38 m^3/s Qd=11,850 m^3/d	4 pumps Qp=0.60 m^3/s Qd=21,130 m^3/d	5 pumps Qp=0.95 m^3/s Qd=36,390 m^3/d

Note: (1) Refer to Diagram.

(2) All costs in each construction phase are assumed to be expended at the final year of each phase for the convenience of economic analysis.

Table A2.3 Capital Costs by Alternative

(1) Alternative I

Facilities	Outline Specification	Unit Cost	Phase 1 Quantity	Phase 1 Cost[1] ($)	Phase 2 Quantity	Phase 2 Cost[1] ($)	Phase 3 Quantity	Phase 3 Cost[1] ($)	Total
Trunk sewer									
A line	ø1,050 mm	543 $/m	435 m	236.2					
A line	ø1,200 mm	942 $/m	1,045 m	984.4					
River crossing	ø1,200 mm	1,413 $/m	70 m	98.9					
Manhole	Type II	2,102 $/unit	3 units	6.3					
	Type III	3,416 $/unit	11 units	37.6					
Pumping station (P_5)									
Civil works	Qp=0.860 m^3/s H=7.7 m			608.4					
Elec. & machinery works			3 pumps	322.3	1 pump	164.8	1 pump	164.8	651.9
Pumping station (P)									
Civil works	Qp=0.947 m^3/s H=7.3 m			628.2					628.2
Elec. & machinery works			3 pumps	317.2	1 pump	162.7	1 pump	162.7	642.6
Engineering and contingencies				809.9		81.9		81.9	973.7
Total Capital Cost				M$4,049.4		M$409.4		M$409.4	M$4,868.2

Note: All costs are at 1979 price levels.
(1) : costs in thousands of Malaysian dollars
ø : sewer diameter
Qp : peak flow
H : total head

- to be continued -

(2) Alternative II

Facilities	Outline Specification	Unit Cost	Phase 1 Quantity	Phase 1 Cost(1) ($)	Phase 2 Quantity	Phase 2 Cost(1) ($)	Phase 3 Quantity	Phase 3 Cost(1) ($)	Total
Trunk sewer									
*A line	ø800 mm	570 $/m	1,550 m	883.5					883.5
Pumping station (P_5)									
Civil works	Qp=0.947 m^3/s H=24.2 m			706.1					706.1
Elec. & machinery works			3 pumps	334.8	1 pump	170.5	1 pump	170.5	675.8
Engineering and contingency				481.1		42.6		70.2	593.9
Total Capital Cost				M$2,405.5		M$213.1		M$240.7	M$2,859.3

Note: All costs are at 1979 price levels.

(1) : costs in thousands of Malaysian dollars
(2) : * force main sewer
ø : sewer diameter
Qp : peak flow
H : total head

- to be continued -

(3) Alternative III

Facilities	Outline Specification	Unit Cost	Phase 1 Quantity	Phase 1 Cost(1) ($)	Phase 2 Quantity	Phase 2 Cost(1) ($)	Phase 3 Quantity	Phase 3 Cost(1) ($)	Total
Trunk sewer									
*A1 line	ø600 mm	266 $/m	1,550 m	412.3					412.3
*A2 line	ø600 mm	266 $/m			1,550	412.3			412.3
Pumping station (P_5)									
Civil works	Qp=0.947 m^3/s H=25.6 m			706.1					706.1
Elec. & machinery works			3 pumps	334.8	1 pump	170.5	1 pump	170.5	675.8
Engineering and contingency				363.3		145.7		70.2	579.2
Total Capital Cost				M$1,816.5		M$728.5		M$240.7	M$2,785.7

Note: All costs are at 1979 price levels.

(1) : costs in thousands of Malaysian dollars
(2) : * force main sewer
ø : sewer diameter
Qp : peak flow
H : total head

Table A2.4 Land Acquisition Cost by Alternative

(M$ 1,000)

	Cost	Remarks
Alternative I	20.5	38 $/m^2 x 540 m^2
Alternative II	22.8	38 $/m^2 x 600 m^2
Alternative III	22.8	38 $/m^2 x 600 m^2

Table A2.5 Replacement Costs of Pumps by Alternative

	2000	2005	2010
Alternative I	190.4	63.4	63.4
Alternative II	95.1	31.7	31.7
Alternative III	95.1	31.7	31.7

Note: (1) All costs are at 1979 price levels and in thousands of Malaysian dollars.

(2) Useful life of pump equipment is assumed to be 15 years.

(3) Replacement cost is calculated for a duration of 30 years.

Table A2.6 Operation and Maintenance Costs (1986 - 2000)

		1986 - 1990	1991 - 1995	1996 - 2000
Alternative I				
(a)	Wage	37	37	148.0
(b)	Power	165.4	294.9	1,828.0
(c)	Repairs and overhauling	194.0	226.7	1,037.8
	Total	396.4	558.6	753.45
Alternative II				
(a)	Wage	18.5	18.5	74.0
(b)	Power	152.2	271.5	1,870.1
(c)	Repairs and overhauling	113.0	130.0	610.3
	Total	283.7	420.0	638.6
Alternative III				
(a)	Wage	18.5	18.5	74.0
(b)	Power	152.2	271.5	1,870.1
(c)	Repairs and overhauling	89.4	127.0	598.5
	Total	260.1	417.0	635.65

ANNEX 3

Study on Implementation Priority in The First Phase Area

1. Technical Evaluation for Implementation Priority

Details of the four elements considered for technical evaluation are as follows:

(1) Population Density

The provision of sewerage facilities in the most densely populated area incurs the maximum return by limited capital expenditure. Thus, the present population density is compared in the residential area of the three blocks as shown in Table A3.1.

(2) Existing Condition of Land Uses

Day-time population in the commercial and institutional areas increase conspicuously, because these areas comprise a number of various buildings owned by public and/or private sectors as a provincial seat of Kedah.

Evaluation of each block is made comparing the area among commercial, institutional and residential by taking the ratio of the area of the former two versus all the three areas as shown in Table A3.2.

(3) Organic Generation

By comparing BOD generated from unit area in each block, urgency of implementation of the blocks are evaluated. A block in higher priority

is considered urgently required for pollution control within the Study Area.

(4) Existing Condition of Excreta Disposal System

According to the investigation carried out in the First Phase Area, excreta disposal systems such as bucket system, latrine over waterways, pit privy, and borehole latrine exist plentifully. All the excreta through these systems are either carried to landfill by vacuum lorries, or directly discharged to waterways. Such condition is considered not satisfactory from the viewpoint of the environmental sanitation. Therefore, this factor is considered determining the urgency of the sewerage system.

The each factor above is assigned points from 1 to 3 according to urgency. The evaluated result is given in Tables A3.1 through A3.4.

Table A3.1 Evaluated Points for Population Density

	Block 1	Block 2	Block 3
Population (person)	4,689	9,530	7,671
Area* (ha)	39.40	48.81	45.89
Population density (persons/ha)	119	195	167
Rated Points	1	3	2

Note: * is a habitable area (i.e. residential and commercial area).

Table A3.2 Evaluated Points for Existing Condition by Land Use

	Block 1	Block 2	Block 3
Residential area (ha)	35.97	9.01	33.22
Commercial area (ha)	3.43	39.80	12.67
Institution area (ha)	-	12.20	-
Rate* (%)	8.7	85.2	27.5
Rated Points	1	3	2

Note: * = (Commercial + Institution)/(Commercial + Institution + Residential)

Table A3.3 Evaluated Points for Existing Organic Generation

	Block 1	Block 2	Block 3
Residential Area			
Population (person)	3,780	1,460	6,450
Quantity of wastewater (m^3/d)	642.6	248.2	1,096.5
Waste loading (kg/d)	128.5	49.6	219.3
Commercial Area			
Population (person)	800	8,200	1,200
Quantity of wastewater (m^3/d)	272	2,788	408
Waste loading (kg/d)	54.4	557.6	81.6
Institution Area			
Population (person)	—	3,000	—
Quantity of wastewater (m^3/d)	—	69	—
Waste loading (kg/d)	—	13.8	—
School			
Population (person)	4,527	5,242	3,979
Quantity of wastewater (m^3/d)	384.8	445.6	338.2
Waste loading (kg/d)	77.0	89.1	67.6
Total waste loading (kg/d)	259.9	710.1	368.5
Area	61.46	76.48	49.06
Waste loading per hectare	4.2	9.3	7.5
Rated Points	1	3	2

Table A3.4 Evaluated Points for Existing Excreta Disposal System and Others

	Block 1	Block 2	Block 3
Number of Buckets	103	184	209
Number of Other System	72	14	88
Total	175	198	297
Area (ha)	61.46	76.48	49.06
Number of Bucket and Other System per Hectare	2.8	2.6	6.1
Rated Points	2	1	3

2. Economic Evaluation for Implementation Priority

The three alternative implementation orders of the three blocks are:

Case 1 : Block 1 is implemented in the years 1982 and 1983, and similary blocks 2-1, 2-2 and 3 in the years 1985 respectively.

Case 2 : Block 2-1 is implemented in 1982, and similary blocks 2-2, 3 and 1 in the years 1983, 1984 and 1985 respectively.

Case 3 : Block 3 is implemented in 1983, and similarly blocks 2 and 1 in the years 1984 and 1985 respectively.

To evaluate these cases by present worth method, most suitable implementation schedule by case is worked out as shown in Table A3.5, then based on these implementation schedules, expenditures for construction, operation as well as revenues incurred by case are estimated at 1979 price level as shown in Table A3.6. The expenditures and revenues are estimated for a period of five years (1982 - 1986). Finally the figures in Table A3.7 are expressed by present values taking 1979 as the base year, discounting at 10 percent annually.

It is evident, from Table A3.7, that Case 2 (R/C ratio is 0.108) is the most effective case than others (R/C ratios for Case 1 and 3 are 0.083 and 0.085 respectively).

3. Recommendation for Implementation Priority

Referring to both the technical and economic evaluations undertaken in the above two sections, it is justificable that implementation priority of the three blocks should be in the order of Blocks 2, 3 and 1.

Table A3.5 Proposed Implementation Schedule by Case

Item	1981	1982	1983	1984	1985
Case 1					
Trunk Sewer (No. 131 to S.P., No. 113 to 117)*					
Branch & Lateral Sewer					
(1) Block 1					
(2) Block 2					
(3) Block 3					
Kolam Air Pumping Station					
(1) Civil works					
(2) Mech. & electrical works					
Tanjong Bendahara Pumping Station					
(1) Civil works					
(2) Mech. & electrical works					
Waste Stabilization Pond					
Case 2					
Trunk Sewer (P1 to Stabilization Pond)*					
Branch & Lateral Sewer					
(1) Block 1					
(2) Block 2					
(3) Block 3					
Kolam Air Pumping Station					
(1) Civil works					
(2) Mech. & electrical works					
Tanjong Bendahara Pumping Station					
(1) Civil works					
(2) Mech. & electrical works					
Waste Stabilization Pond					
Case 3					
Trunk Sewer (No. 113 to Stabilization Pond)*					
Branch & Lateral Sewer					
(1) Block 1					
(2) Block 2					
(3) Block 3					
Kolam Air Pumping Station					
(1) Civil works					
(2) Mech. & electrical works					
Tanjong Bendahara Pumping Station					
(1) Civil works					
(2) Mech. & electrical works					
Waste Stabilization Pond					

Note: * Refer to Figure SD-17 of Volume VIII.

Table A3.6 Construction, Operation Costs and Revenued by Case

(M$1,000 at 1979 price level)

Case	Item	1982	1983	1984	1985	1986
Case 1	Construction Cost					
	Sewer	2,588	542	2,288	1,402	-
	Pumping Station	504	703	295	360	-
	Stabilization Pond	-	555	852	314	-
	Contingency (1)	618	360	687	415	-
	Total	3,710	2,160	4,122	2,491	-
	O&M Cost	-	20	34	69	86
	Revenues (2)	-	-	94	469	690
Case 2	Construction Cost					
	Sewer	2,690	1,675	1,053	1,402	-
	Pumping Station	784	718	-	360	-
	Stabilization Pond	-	800	607	314	-
	Contingency (1)	695	639	332	415	-
	Total	4,169	3,832	1,992	2,491	-
	O&M Cost	-	32	52	74	86
	Revenues (2)	-	-	381	564	690
Case 3	Construction Cost					
	Sewer	2,623	1,402	2,172	1,053	-
	Pumping Station	784	718	-	360	-
	Stabilization Pond	-	800	607	314	-
	Contingency (1)	681	584	556	345	-
	Total	4,088	3,504	3,335	2,072	-
	O&M Cost	-	30	41	75	86
	Revenues (2)	-	-	64	563	690

Note: (1) is estimated at 20 percent of the construction cost.
(2) is estimated at 10 percent of the water charge.

Table A3.7 Present Values of Construction, Operation Costs and Revenues by Case

(M$1,000)

Year	Construction and Operation Costs					Revenue		
	Construction Cost	O&M Cost	Total	Discount	Present Value	Charge	Discount	Present Value
Case 1								
1982	3,047	-	3,047	0.7513	2,289	-	-	-
1983	2,831	6	2,837	0.6830	1,938	-	-	-
1984	3,739	25	3,764	0.6209	2,337	94	0.6209	58
1985	2,778	47	2,825	0.5645	1,595	469	0.5645	265
1986	-	76	76	0.5132	39	690	0.5132	354
				Total	8,198			677
				R/C = 677/8,198 = 0.083				
Case 2								
1982	3,713	-	3,713	0.7513	2,790	-	-	-
1983	4,019	8	4,027	0.6830	2,750	-	-	-
1984	2,998	41	3,039	0.6209	1,887	381	0.6209	237
1985	1,665	52	1,717	0.5645	969	564	0.5645	318
1986	-	76	76	0.5132	39	690	0.5132	354
				Total	8,435			909
				R/C = 909/8,435 = 0.108				
Case 3								
1982	3,276	-	3,276	0.7513	2,461	-	-	-
1983	4,727	7	4,737	0.6830	3,233	-	-	-
1984	2,594	41	2,635	0.6209	1,636	64	0.6209	40
1985	1,798	50	1,848	0.5645	1,043	563	0.5645	318
1986	-	76	76	0.5312	39	690	0.5312	354
				Total	8,412			712
				R/C = 712/8,412 = 0.085				

ANNEX 4

Data for Estimating Electric Charges for Operation of Pumping Stations and Treatment Facilities

Electric costs for operation of the pumping stations and waste stabilization ponds (refer to Chapter 7.2.2) are estimated relating to the sewage amount to be pumped, taking account of the implementation programme.

Table A4.1 and A4.2 indicate the estimated population by land use in the year 1979 and 2000 respectively, and Table A4.3 indicates annual wastewater generated by block from 1979 through 2000 for calculation of the power costs. Table A4.4 summarizes incoming amounts of sewage.

Table A4.1 1979 - Population for Each Block by Land Use

(persons)

	Block 1	Block 2-1	Block 2-2	Block 3	Total
Residential	3,780	780	680	6,450	11,690
Commercial	800	2,493	5,707	1,200	10,200
Institution	-	1,608	1,392	-	3,000
School*	4,527	-	5,242	3,979	13,748

Note: (1) Day-time population are counted in institutional area.

(2) * Numbers of students are included.

(3) P_1 pumping station serves only for Blocks 2 and 3.

(4) Refer to Figure 7.1 for the Blocks.

Table A4.2 2000 - Population for Each Block by Land Use

Land Use \ Block / Unit		Block 1	Block 2-1	Block 2-2	Block 3	Total
Residential (120 persons/ha)	ha	26.89	-	1.09	14.25	42.20
	persons	3,227	-	127	1,710	5,064
Residential (Police quarters)	ha	-	3.40	-	-	3.40
	persons	-	780	-	-	780
Commercial	ha	12.51	16.86	35.99	31.64	97.0
	persons	3,502	3,372	7,198	6,328	19,400
Institution	ha	-	6.54	5.66	-	12.2
	persons	-	6,443	5,567	-	12,000
School	ha	22.06	-	6.97	1.67	30.7
	persons	9,300	-	10,760	8,300	28,360
Mosque	ha	-	-	-	1.50	1.50
Total	ha	61.46	26.80	49.68	49.06	187.00

Table A4.3 Annual Wastewater Generated by Block

Block 1

Year	Residential			Commercial			Institution			School			Total Wastewater Quantity (m^3/d)
	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Staff (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Student (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	
1979	3,780	0.170	642.6	800	0.340	272.0		0.023		4,527	0.0085	38.5	953
1983	3,675	0.181	665.2	1,124	0.363	408.0		0.023		5,436	0.0091	49.5	1,123
1984	3,648	0.184	671.2	1,205	0.369	444.6		0.023		5,663	0.0092	52.1	1,168
1985	3,662	0.187	677.3	1,286	0.374	481.0		0.023		5,891	0.0094	55.4	1,214
1986	3,596	0.190	683.2	1,367	0.380	519.5		0.023		6,118	0.0095	58.1	1,261
1987	3,569	0.193	688.8	1,448	0.386	558.9		0.023		6,345	0.0096	60.9	1,309
1988	3,543	0.196	694.9	1,529	0.391	597.8		0.023		6,573	0.0098	64.1	1,356
1989	3,517	0.199	699.9	1,610	0.397	639.2		0.023		6,800	0.0099	67.3	1,406
1990	3,490	0.201	701.5	1,692	0.403	681.9		0.023		7,027	0.0101	71.0	1,454
1991	3,464	0.204	706.7	1,773	0.409	725.2		0.023		7,254	0.0102	74.0	1,506
1992	3,438	0.207	711.7	1,854	0.414	767.6		0.023		7,482	0.0104	77.8	1,557
1993	3,411	0.210	716.3	1,935	0.420	812.7		0.023		7,709	0.0105	80.9	1,610
1994	3,385	0.213	721.0	2,016	0.426	858.8		0.023		7,936	0.0106	84.1	1,664
1995	3,359	0.216	725.5	2,097	0.431	903.8		0.023		8,164	0.0108	88.2	1,718
2000	3,227	0.230	742.2	2,502	0.460	1,150.9		0.023		9,300	0.0115	107.0	2,000

- to be continued -

Table A4.3 Annual Wastewater Generated by Block (Cont'd)

Block 2-1

Year	Residential			Commercial			Institution			School			Total
	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Staff (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Student (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Wastewater Quantity (m^3/d)
1979	780	0.170	132.6	2,493	0.340	847.6	1,608	0.023	37.0	-	0.0085		1,107
1983	780	0.181	141.2	2,660	0.363	965.6	2,527	0.023	58.1	-	0.0091		1,165
1984	780	0.184	143.6	2,702	0.369	997.0	2,757	0.023	63.4	-	0.0092		1,204
1985	780	0.187	145.9	2,744	0.374	1,026.3	2,986	0.023	68.6	-	0.0094		1,241
1986	780	0.190	148.2	2,786	0.380	1,058.7	3,216	0.023	74.0	-	0.0095		1,281
1987	780	0.193	150.6	2,828	0.386	1,091.6	3,446	0.023	79.3	-	0.0096		1,322
1988	780	0.196	152.9	2,870	0.391	1,122.2	3,676	0.023	84.5	-	0.0098		1,360
1989	780	0.199	155.2	2,912	0.397	1,156.1	3,906	0.023	89.9	-	0.0099		1,401
1990	780	0.201	156.8	2,953	0.403	1,190.4	4,135	0.023	95.1	-	0.0101		1,442
1991	780	0.204	159.1	2,995	0.409	1,225.0	4,365	0.023	100.4	-	0.0102		1,485
1992	780	0.207	161.4	3,037	0.414	1,257.3	4,595	0.023	105.7	-	0.0104		1,524
1993	780	0.210	163.8	3,079	0.420	1,293.2	4,825	0.023	111.0	-	0.0105		1,568
1994	780	0.210	166.1	3,121	0.420	1,329.5	5,054	0.023	116.3	-	0.0106		1,612
1995	780	0.216	168.5	3,163	0.431	1,363.3	5,284	0.023	121.5	-	0.0108		1,653
2000	780	0.230	179.4	3,372	0.460	1,551.2	6,433	0.023	148.0	-	0.0115		1,879

- to be continued -

Table A4.3 Annual Wastewater Generated by Block (Cont'd)

Block 2-2

Year	Residential			Commercial			Institution			School			Total
	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Staff (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Student (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Wastewater Quantity (m^3/d)
1979	680	0.170	115.6	5,707	0.340	1,940.3	1,392	0.023	32.0	5,242	0.0085	44.6	2,133
1983	575	0.181	104.1	5,991	0.363	2,174.3	2,187	0.023	50.3	6,293	0.0091	57.3	2,386
1984	548	0.184	100.8	6,062	0.369	2,236.9	2,375	9,923	54.9	6,556	0.0092	60.3	2,453
1985	552	0.187	97.6	6,133	0.374	2,293.7	2,585	0.023	59.5	6,819	0.0094	64.1	2,515
1986	496	0.190	94.2	6,204	0.380	2,357.5	2,784	0.023	64.0	7,081	0.0095	67.3	2,583
1987	469	0.193	90.5	6,275	0.386	2,422.2	2,983	0.023	68.6	7,344	0.0096	70.5	2,651
1988	443	0.196	86.8	6,346	0.391	2,481.3	3,181	0.023	73.2	7,607	0.0098	74.5	2,715
1989	417	0.199	83.0	6,417	0.397	2,547.5	3,380	0.023	77.7	7,820	0.0099	77.4	2,786
1990	390	0.201	78.4	6,488	0.403	2,614.6	3,579	0.023	82.3	8,132	0.0101	82.1	2,857
1991	364	0.204	74.3	6,559	0.409	2,682.6	3,778	0.023	86.9	8,395	0.0102	85.6	2,929
1992	338	0.207	70.0	6,630	0.414	2,744.8	3,976	0.023	91.4	8,658	0.0104	90.0	2,997
1993	311	0.210	65.3	6,701	0.420	2,814.4	4,175	0.023	96.0	8,921	0.0105	93.7	3,069
1994	285	0.213	60.7	6,772	0.426	2,884.9	4,375	0.023	100.6	9,183	0.0106	97.3	3,143
1995	259	0.216	55.9	6,843	0.431	2,949.3	4,573	0.023	105.2	9,446	0.0108	102.0	3,213
2000	127	0.230	29.2	7,198	0.460	3,311.0	5,567	0.023	128.0	10,760	0.0115	123.7	3,592

- to be continued -

Table A4.3 Annual Wastewater Generated Block (Cont'd)

Block 3

Year	Residential			Commercial			Institution			School			Total
	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Population (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Staff (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Student (persons)	Wastewater Quantity	Wastewater Quantity (m^3/d)	Wastewater Quantity (m^3/d)
1979	6,450	0.170	1,096.5	1,200	0.340	408.0		0.023		3,979	0.0085	33.8	1,538
1983	5,547	0.181	1,004.0	2,177	0.363	790.3		0.023		4,802	0.0091	43.7	1,838
1984	5,321	0.184	979.1	2,421	0.369	893.3		0.023		5,008	0.0092	46.1	1,919
1985	5,096	0.187	953.0	2,665	0.374	996.7		0.023		5,214	0.0094	49.0	1,999
1986	4,870	0.190	925.3	2,909	0.380	1,105.4		0.023		5,419	0.0095	51.5	2,082
1987	4,644	0.193	896.3	3,154	0.386	1,217.4		0.023		5,625	0.0098	54.0	2,168
1988	4,419	0.196	866.1	3,398	0.391	1,328.6		0.023		5,831	0.0098	57.1	2,252
1989	4,193	0.199	834.4	3,642	0.397	1,445.9		0.023		6,037	0.0099	59.8	2,340
1990	3,967	0.201	797.4	3,886	0.403	1,566.1		0.023		6,242	0.0101	63.1	2,427
1991	3,741	0.204	763.2	4,130	0.409	1,689.2		0.023		6,448	0.0102	65.8	2,518
1992	3,516	0.207	727.8	4,374	0.414	1,810.8		0.023		6,654	0.0104	69.2	2,608
1993	3,290	0.210	690.9	4,619	0.420	1,940.0		0.023		6,860	0.0105	72.0	2,703
1994	3,069	0.213	652.6	4,863	0.426	2,071.6		0.023		7,065	0.0106	74.9	2,799
1995	2,839	0.216	613.2	5,107	0.431	2,201.1		0.023		7,271	0.0108	78.5	2,893
2000	1,710	0.230	393.3	6,328	0.460	2,910.9		0.023		8,300	0.0115	95.5	3,400

Table A4.4 Incoming Amounts of Sewage into the Pumping Stations and Stabilization Pond from 1984 through 2000

Year	Name of Area Served	Inflows (m^3/d)	
		*P1 Pumping Station	*P5 Pumping Station & Stabilization Pond
1984	Blocks 2-1, 2-2	2,691	4,022
1985	Blocks 2-1, 2-2, 3	5,004	6,371
1986	Blocks 1, 2-1, 2-2, 3	5,846	8,189
1987	"	6,040	8,432
1988	"	6,228	8,666
1989	"	6,429	8,915
1990	"	6,630	9,162
1991	"	6,837	9,420
1992	"	7,038	9,668
1993	"	7,251	9,932
1994	"	7,468	10,200
1995	"	7,677	10,458
2000	"	8,813	11,852

Note: (1) * P1 is Kolam Air Pumping Station, and * P5 is Tanjong Bendahara Pumping Station.

(2) Inflows include extraneous water.

ANNEX 5

Estimated Water Charges from 1984 through 2000

Sewer charges to be raised from direct benefitiaries are proposed surcharged to the water bills by multiplying certain percentage.

Therefore, this paper estimates water billing rates from 1984 through 2000 as follows:

The rates of the water charge are classified into three by the authority concerned as follows:

- Code A (for domestic use, and for government quarters, departments, institutions, schools, clubs, bath houses, charitable and religious institutions and local authorities)
  Initial 13.64 m^3 per month at M$1.00 per 4.55 m^3, and M1.2 for each additional 4.55 m^3.

- Code B (for business premises where the water is used for purpose of sanitation and hygiene and for the purposes of business or trade)
  M$1.5 for each 4.55 m^3.

- Code C (for trade purpose including restaurants, coffee shops, ice-shops, markets, building operations, service stations, etc.)
  M$2.0 for each 4.55 m^3.

On the base of above water charge system, the rates of water charge per 1 m^3 by land use are calculated as follows:

Residential, Institutional Area, and School:

Based on 5.5 persons per household and per capita water consumption rate of 170 l/day in the year 1979, monthly water consumption rate amounts to be 28.05 m^3/household (i.e. 5.5 person x 0.17 m^3/capita x 30 days), thus water charge per 1 m^3 is M$0.242, i.e.[(28.05 - 13.64) x 1.20/4.55 + 3] + 28.05. In the same manner, per month water consumption in the year 2000 is 5.5 person x 0.23 m^3/capita x 30 days = 37.95 m^3/household, also the rates of water charge per 1 m^3 is [(37.95 - 13.64) x 1.20/4.55 + 3] + 37.95 = M$0.248.

Commercial Area:

The type of water use is mainly Code B and C. The ratio for Code B and Code C is estimated to be 1 to 9. The rate of water charge per 1 m^3 for Code B and C are M$0.33 and M$0.44 respectively, thus the average rate being M$0.429 (i.e. M$0.33 x 0.1 + M$0.44 x 0.9).

Table A5.1 Estimated Water Charges by Code from 1984 through 2000 in the First Phase Area

Year	Name of Area Served	Water Consumption Rates		Estimated Water Charge (M$/d)
		Code A (m^3/d)	Code B, C (m^3/d)	
1984	Blocks 2-1, 2-2	423.0	3,233.9	1,490
1985	Blocks 2-1, 2-2, 3	1,437.7	4,316.7	2,203
1986	Blocks 1, 2-1, 2-2, 3	2,165.8		
1987	"	2,159.5	5,290.1	2,796
1988	"	2,153.6	5,529.9	2,900
1989	"	2,144.6	5,788.7	3,009
1990	"	2,127.6	6,052.7	3,178
1991	"	2,116.0	6,322.0	3,231
1992	"	2,105.0	6,580.5	3,341
1993	"	2,089.9	6,860.3	3,457
1994	"	2,073.6	7,144.8	3,575
1995	"	2,085.5	7,417.5	3,691
2000	"	1,946.3	8,942.0	4,309

ANNEX 6

Financial Analysis for Alternative Plans

Table A6.1 Project Income Statement, 1981 - 1991 Alternative I-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	974	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	805	566	533	546	630	448
Total Operating Revenue	289	333	520	677	769	2,381	2,461	2,559	2,716	2,835	2,938
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,570	1,579	1,604	1,568	1,571	1,571
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,222	1,199	1,182	1,159	1,136	1,118
Net Income (Deficit)	72	75	27	(240)	(394)	(151)	(119)	(77)	(90)	(64)	(48)

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.2 Projected Cash Flow Statement, 1981 - 1991 Alternative I-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,570	1,579	1,604	1,568	1,571	1,571
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	744	908	2,181	1,049	497	-	-	-	-	-	-
Government Loan	3,619	4,163	4,387	3,091	2,234	-	-	-	-	-	-
Government Contribution (Interest-free Advance)		-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,577	1,584	1,610	1,584	1,581	1,579
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	172	167	167	162	156	156
Government Loan	-	-	-	-	-	1,050	1,032	1,015	997	980	962
Amortization of Principal											
Foreign Loan	-	-	-	-	-	108	113	113	118	124	124
Government Loan	-	-	-	-	-	210	228	245	263	280	298
Total Debt Service	-	-	-	-	-	1,540	1,540	1,540	1,540	1,540	1,540
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,553	1,560	1,545	1,546	1,546	1,545
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table.

Table 6.3 Project Balance Sheet, 1981 - 1991 Alternative I-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	3,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,437	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	744	1,652	3,833	4,882	5,271	5,158	5,045	4,927	4,803	4,679	4,550
Government Loan	3,619	7,782	12,169	15,260	17,284	17,058	16,811	16,548	16,268	15,970	15,655
Total Long Term Debt	4,363	9,434	16,002	20,142	22,555	22,216	21,856	21,475	21,071	20,649	20,205
Current Liabilities											
Accounts Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities					318	341	358	381	404	442	444
Total Current Liabilities	18	22	41	50	377	407	429	458	497	525	555
Equity											
Government Capital Contribution											
Retained Earnings	72	147	174	(66)	(460)	(611)	(730)	(807)	(897)	(961)	(1,009)
Total Equity	72	147	174	(66)	(460)	(611)	(730)	(807)	(897)	(961)	(1,009)
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

Table A6.4 Project Income Statement, 1981 - 1991 Alternative I-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	974	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	752	306	480	493	459	395
Total Operating Revenue	289	333	520	677	769	2,328	2,408	2,506	2,663	2,782	2,885
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,517	1,526	1,551	1,515	1,518	1,518
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,149	1,126	1,111	1,088	1,065	1,050
Net Income (Deficit)	72	75	27	(240)	(394)	(131)	(99)	(59)	(72)	(46)	(31)

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.5 Projected Cash Flow Statement, 1981 - 1991 Alternative I-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,517	1,526	1,551	1,515	1,518	1,518
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	1,104	1,352	3,246	1,560	736	-	-	-	-	-	-
Government Loan	3,259	3,719	3,322	2,580	1,995	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	-	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,524	1,531	1,557	1,531	1,528	1,526
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	256	248	248	240	232	232
Government Loan	-	-	-	-	-	893	878	863	848	833	818
Amortization of Principal											
Foreign Loan	-	-	-	-	-	160	168	168	176	184	184
Government Loan	-	-	-	-	-	178	193	208	223	238	253
Total Debt Service	-	-	-	-	-	1,487	1,487	1,487	1,487	1,487	1,487
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,500	1,507	1,492	1,493	1,493	1,492
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table.

Table A6.6 Project Balance Sheet, 1981 - 1991 Alternative I-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,437	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	1,104	2,456	5,702	7,262	7,838	7,670	7,502	7,326	7,142	6,958	6,766
Government Loan	3,259	6,978	10,300	12,880	14,697	14,504	14,296	14,073	13,835	13,582	13,314
Total Long Term Debt	4,363	9,343	16,002	20,142	22,535	22,174	21,789	21,399	20,977	20,540	20,080
Current Liabilities											
Accounts Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	338	361	376	399	422	437	460
Total Current Liabilities	18	22	41	50	397	427	447	486	515	540	571
Equity											
Government Capital Contribution	-	-	-	-	-	-	-	-	-	-	-
Retained Earnings	72	147	174	(66)	(460)	(591)	(690)	(749)	(821)	(867)	(898)
Total Equity											
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

Table A6.7 Project Income Statement, 1981 - 1991 Alternative II-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	979	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	1,068	829	796	809	775	711
Total Operating Revenue	289	333	520	677	769	2,644	2,724	2,822	2,979	3,098	3,201
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,833	1,842	1,867	1,831	1,834	1,834
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,480	1,452	1,424	1,395	1,367	1,333
Net Income (Deficit)	72	75	27	(240)	(394)	(146)	(109)	(56)	(63)	(32)	(2)

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.8 Projected Cash Flow Statement, 1981 - 1991 Alternative II-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,833	1,842	1,867	1,831	1,834	1,834
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	744	908	2,181	1,049	497	-	-	-	-	-	-
Government Loan	3,619	4,163	4,387	3,091	2,234	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	-	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,840	1,847	1,873	1,847	1,844	1,842
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	430	420	409	398	387	371
Government Loan	-	-	-	-	-	1,050	1,032	1,015	997	980	962
Amortization of Principal											
Foreign Loan	-	-	-	-	-	113	123	134	145	156	172
Government Loan	-	-	-	-	-	210	228	245	263	280	298
Total Debt Service	-	-	-	-	-						
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,816	1,823	1,808	1,809	1,809	1,808
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	23
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table

Table A6.9 Project Balance Sheet, 1981 - 1991 Alternative II-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,437	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	744	1,562	3,833	4,882	5,266	5,143	5,009	4,864	4,708	4,536	4,353
Government Loan	3,619	7,782	12,169	15,260	17,284	17,056	16,811	16,548	16,268	15,970	15,655
Total Long Term Debt	4,363	9,434	16,002	20,142	22,550	22,199	21,820	21,412	20,976	20,506	20,008
Current Liabilities											
Accounts Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	323	351	379	408	436	470	498
Total Current Liabilities	18	22	41	50	382	417	450	485	529	573	609
Equity											
Government Capital Contribution	-	-	-	-	-	-	-	-	-	-	-
Retained Earnings	72	147	174	(66)	(460)	(606)	(715)	(771)	(834)	(866)	(868)
Total Equity	72	147	174	(66)	(460)	(606)	(715)	(771)	(834)	(866)	(868)
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses: in the previous table

Table A6.10 Project Income Statement, 1981 - 1991 Alternative II-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	974	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	1,144	905	872	885	851	787
Total Operating Revenue	289	333	520	677	769	2,720	2,800	2,898	3,055	3,174	3,277
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,909	1,919	1,943	1,907	1,910	1,910
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,533	1,502	1,471	1,440	1,409	1,370
Net Income (Deficit)	72	75	27	(240)	(394)	(123)	(83)	(27)	(32)	2	41

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table 6.11 Projected Cash Flow Statement, 1981 - 1991 Alternative II-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,909	1,918	1,943	1,907	1,910	1,910
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	1,104	1,352	3,246	1,560	736	-	-	-	-	-	-
Government Loan	3,259	3,719	3,322	2,580	1,995	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	-	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,916	1,923	1,949	1,923	1,920	1,918
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	640	524	608	592	576	552
Government Loan	-	-	-	-	-	893	878	863	848	833	818
Amortization of Principal											
Foreign Loan	-	-	-	-	-	168	184	200	216	232	256
Government Loan	-	-	-	-	-	178	193	208	223	238	253
Total Debt Service	-	-	-	-	-						
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,892	1,899	1,884	1,885	1,885	1,884
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table

Table A6.12 Project Balance Sheet, 1981 - 1991 Alternative II-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,434	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	1,104	2,456	5,702	7,262	7,830	7,646	7,446	7,230	6,998	6,742	6,470
Government Loan	3,259	6,978	10,300	12,880	14,697	14,504	14,296	14,073	13,835	13,582	13,314
Total Long Term Debt	4,363	9,434	16,002	20,142	22,527	22,150	21,742	21,303	20,833	20,324	19,784
Current Liabilities											
Account Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	346	377	408	439	470	509	540
Total Current Liabilities	18	22	41	50	405	443	479	516	583	612	651
Equity											
Government Capital Contribution	-	-	-	-	-	-	-	-	-	-	-
Retained Earnings	72	147	174	(66)	(460)	(583)	(666)	(693)	(725)	(723)	(682)
Total Equity	72	147	174	(66)	(460)	(583)	(666)	(693)	(725)	(723)	(682)
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

Table A6.13 Project Income Statement, 1981 - 1991 Alternative III-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	974	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	597	358	325	338	304	240
Total Operating Revenue	289	333	520	677	769	2,173	2,253	2,351	2,508	2,627	2,730
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,362	1,371	1,396	1,360	1,363	1,363
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,049	1,029	1,015	995	975	960
Net Income (Deficit)	72	75	27	(240)	(394)	(186)	(157)	(118)	(134)	(111)	(96)

Note: (a) Estimated at 5% of "Property Tax".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.14 Projected Cash Flow Statement, 1981 - 1991 Alternative III-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,362	1,371	1,396	1,360	1,363	1,363
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	744	908	2,181	1,049	497	-	-	-	-	-	-
Government Loan	742	4,163	4,387	3,091	2,234	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	2,287	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,369	1,376	1,402	1,376	1,373	1,371
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	172	167	167	162	156	156
Government Loan	-	-	-	-	-	877	862	848	833	819	804
Amortization of Principal											
Foreign Loan	-	-	-	-	-	108	113	113	118	124	124
Government Loan	-	-	-	-	-	175	190	204	219	233	248
Total Debt Service	-	-	-	-	-						
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,345	1,352	1,337	1,338	1,338	1,337
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table

Table A6.15 Project Balance Sheet, 1981 - 1991 Alternative III-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,669	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,434	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	744	1,652	3,833	4,882	5,271	5,158	5,045	4,927	4,803	4,679	4,550
Government Loan	742	4,905	9,292	12,383	14,442	14,252	14,048	13,829	13,596	13,348	13,085
Total Long Term Debt	1,486	6,557	13,125	17,265	19,713	19,410	19,093	18,756	18,399	18,027	17,635
Current Liabilities											
Account Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	283	303	317	337	357	372	392
Total Current Liabilities	18	22	41	50	343	369	388	414	450	475	503
Equity											
Government Capital Contribution	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Retained Earnings	72	147	174	(66)	(460)	(646)	(803)	(921)	(1,055)	(1,166)	(1,262)
Total Equity	2,949	3,024	3,051	2,811	2,417	2,231	2,074	1,956	1,822	1,711	1,615
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

Table A6.16 Project Income Statement, 1981 - 1991 Alternative IV-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	974	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	860	621	588	601	567	503
Total Operating Revenue	289	333	520	677	769	2,436	2,516	2,614	2,771	2,890	2,993
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,625	1,634	1,659	1,623	1,626	1,626
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,307	1,282	1,257	1,231	1,206	1,175
Net Income (Deficit)	72	75	27	(240)	(394)	(181)	(147)	(97)	(107)	(79)	(48)

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.17 Project Cash Flow Statement, 1981 - 1991 Alternative IV-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,625	1,634	1,659	1,623	1,626	1,626
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	744	908	2,181	1,049	497	-	-	-	-	-	-
Government Loan	742	4,163	4,387	3,091	2,234	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	2,877	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,632	1,639	1,665	1,639	1,636	1,634
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	430	420	409	398	387	371
Government Loan	-	-	-	-	-	877	862	848	833	819	804
Amortization of Principal											
Foreign Loan	-	-	-	-	-	113	123	134	145	156	172
Government Loan	-	-	-	-	-	175	190	204	219	233	248
Total Debt Service	-	-	-	-	-						
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,608	1,515	1,600	1,601	1,601	1,600
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table

Table A6.18 Project Balance Sheet, 1981 - 1991 Alternative IV-A

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,434	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	744	1,652	3,833	4,882	5,266	5,143	5,009	4,864	4,708	4,536	4,353
Government Loan	742	4,905	9,292	12,383	14,442	14,252	14,048	13,829	13,596	13,348	13,085
Total Long Term Debt	1,486	6,557	13,125	17,265	19,708	19,395	19,057	18,693	18,304	17,884	17,438
Current Liabilities											
Account Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	288	313	338	364	389	420	446
Total Current Liabilities	18	22	41	50	347	379	409	441	482	523	557
Equity											
Government Capital Contribution	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Retained Earnings	72	147	174	(66)	(460)	(641)	(788)	(885)	(992)	(1,071)	(1,119)
Total Equity	2,949	3,024	3,051	2,811	2,417	2,236	2,089	1,992	1,885	1,806	1,758
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

Table A6.19 Project Income Statement, 1981 - 1991 Alternative IV-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	974	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	937	698	665	696	644	580
Total Operating Revenue	289	333	520	677	769	2,513	2,593	2,691	2,848	2,967	3,070
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,702	1,711	1,736	1,700	1,703	1,703
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,360	1,332	1,304	1,276	1,248	1,212
Net Income (Deficit)	72	75	27	(240)	(394)	(157)	(120)	(67)	(75)	(44)	(8)

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.20 Projected Cash Flow Statement, 1981 - 1991 Alternative IV-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,702	1,711	1,736	1,700	1,703	1,703
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	1,104	1,352	3,246	1,560	736	-	-	-	-	-	-
Government Loan	382	,719	3,322	2,580	1,995	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	2,877	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,709	1,716	1,742	1,716	1,713	1,711
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	640	624	608	592	576	552
Government Loan	-	-	-	-	-	720	708	696	684	672	660
Amortization of Principal											
Foreign Loan	-	-	-	-	-	168	184	200	216	232	256
Government Loan	-	-	-	-	-	144	156	158	180	192	204
Total Debt Service	-	-	-	-	-						
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,685	1,692	1,677	1,678	1,678	1,677
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table

Table A6.21 Project Balance Sheet, 1981 - 1991 Alternative IV-B

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,434	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	1,104	2,456	5,702	7,262	7,830	7,646	7,446	7,230	6,998	6,742	6,470
Government Loan	382	4,101	7,423	10,003	11,854	11,698	11,530	11,350	11,158	10,954	10,738
Total Long Term Debt	1,486	6,557	13,125	17,265	19,684	19,344	18,976	18,580	18,516	17,696	17,208
Current Liabilities											
Account Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	312	340	368	396	424	460	488
Total Current Liabilities	18	22	41	50	371	406	439	473	517	563	599
Equity											
Government Capital Contribution	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Retained Earnings	72	147	174	(66)	(460)	(617)	(737)	(804)	(879)	(923)	(931)
Total Equity	2,894	3,024	3,051	2,811	2,417	2,260	2,140	2,073	1,998	1,954	1,946
Total Liabilities and Equity	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

Table A6.22 Project Income Statement, 1981 - 1991 Alternative V

(MS1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Operating Revenue											
Sewerage Charge	-	-	-	381	564	690	921	954	991	1,026	1,063
Sewerage Tax (a)	-	-	-	-	-	886	979	1,072	1,179	1,297	1,427
Municipal Fund Allocation	289	333	520	296	205	901	466	433	446	412	348
Total Operating Revenue	289	333	520	677	769	2,281	2,361	2,459	2,515	2,735	2,838
Operating Expenses											
Billing and Collection Fees (b)	-	-	-	8	11	14	18	19	20	21	21
Provision for Bad Debts (c)	-	-	-	4	6	7	9	10	10	10	11
Payroll	197	234	438	473	527	569	615	664	820	907	980
Power	-	-	-	31	56	75	83	92	104	114	126
Maintenance	-	-	11	51	78	89	96	104	112	121	131
Administration	20	24	44	47	52	57	61	66	82	91	98
Total Operating Expenses	217	258	493	614	730	811	882	955	1,148	1,264	1,367
Net Operating Income	72	75	27	63	35	1,470	1,479	1,504	1,468	1,471	1,471
Depreciation (d)	-	-	-	303	429	499	499	499	499	499	499
Interest	-	-	-	-	-	1,200	1,180	1,160	1,140	1,120	1,100
Net Income (Deficit)	72	75	27	(240)	(394)	(229)	(200)	(155)	(171)	(148)	(128)

Note: (a) Estimated at 5% of "Property Value".

(b) Estimated at 2% of "Sewerage Charge".

(c) Estimated at 1% of "Sewerage Charge".

(d) Composite rate of 2.5% for "Assets in service" in the following table.

Table A6.23 Projected Cash Flow Statement, 1981 - 1991 Alternative V

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Sources of Funds											
Net Operating Income	72	75	27	63	35	1,470	1,479	1,504	1,468	1,471	1,471
Increase in Account Payable	18	4	19	9	9	7	5	6	16	10	8
Decrease in Current Assets (Less Cash)	-	-	-	-	-	-	-	-	-	-	-
Foreign Loan	-	-	-	-	-	-	-	-	-	-	-
Government Loan	1,486	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Government Contribution (Interest-free Advance)	2,877	-	-	-	-	-	-	-	-	-	-
Total Sources	4,453	5,150	6,614	4,212	2,775	1,477	1,484	1,510	1,484	1,481	1,479
Application of Funds											
Capital Expenditure	4,363	5,071	6,568	4,140	2,731	-	-	-	-	-	-
Interest											
Foreign Loan	-	-	-	-	-	-	-	-	-	-	-
Government Loan	-	-	-	-	-	1,200	1,180	1,160	1,140	1,120	1,100
Amortization of Principal											
Foreign Loan	-	-	-	-	-	-	-	-	-	-	-
Government Loan	-	-	-	-	-	240	260	280	300	320	340
Total Debt Service	-	-	-	-	-						
Increase in Current Assets (Less Cash)	4	1	5	34	17	13	20	5	6	6	5
Decrease in Current Liabilities	-	-	-	-	-	-	-	-	-	-	-
Total Applications	4,367	5,072	6,573	4,174	2,748	1,453	1,460	1,445	1,446	1,446	1,445
Net Cash Increase (Decrease)	86	78	41	38	27	24	24	65	38	35	34
Cash Available at End of Year (a)	86	164	205	243	270	294	318	383	421	456	490

Note: (a) Estimated at 1/3 of "Operating Expenses" in the previous table

Table A6.24 Project Balance Sheet, 1981 - 1991 Alternative V

(M$1,000)

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Assets											
Fixed Assets											
Land	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Utility Plant in Service	-	-	-	13,125	17,265	19,996	19,996	19,996	19,996	19,996	19,996
Less Accumulative Depreciation	-	-	-	303	732	1,231	1,730	2,229	2,728	3,227	3,726
Net Fixed Assets in Service	-	-	-	15,699	19,410	21,642	21,143	20,644	20,145	19,646	19,147
Construction in Progress	1,486	6,557	13,125	4,140	2,731	-	-	-	-	-	-
Total Fixed Assets	4,363	9,434	16,002	19,839	22,141	21,642	21,143	20,644	20,145	19,646	19,147
Current Assets											
Cash	86	164	205	243	270	294	318	383	421	456	490
Account Receivable (a)	-	-	-	32	47	58	77	80	83	86	89
Inventory (b)	4	5	10	12	14	16	17	19	22	25	27
Total Current Assets	90	169	215	287	331	368	412	482	526	567	606
Total Assets	4,453	9,603	16,217	20,126	22,472	22,010	21,555	21,126	20,671	20,213	19,753
Liabilities and Equity											
Long Term Debt											
Foreign Loan	-	-	-	-	-	-	-	-	-	-	-
Government Loan	1,486	6,557	13,125	17,265	19,756	19,496	19,216	18,916	18,596	18,256	17,896
Total Long Term Debt	1,486	6,557	13,125	17,265	19,756	19,496	19,216	18,916	18,596	18,256	17,896
Current Liabilities											
Account Payable (c)	18	22	41	50	59	66	71	77	93	103	111
Current Debt Maturities	-	-	-	-	240	260	280	300	320	340	360
Total Current Liabilities	18	22	41	50	299	326	351	377	413	443	471
Equity											
Government Capital Contribution	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877	2,877
Retained Earnings	72	147	174	(66)	(460)	(689)	(889)	(1,044)	(1,215)	(1,363)	(1,491)
Total Equity	2,949	3,024	3,051	2,811	2,417	2,188	1,988	1,833	1,662	1,514	1,386
Total Liabilities and Equity	4,453	9,603	16,217	20,026	22,472	22,010	21,555	21,126	20,671	20,213	19,753

Note: (a) Estimated at 1/12 "Sewerage Charges" in the previous table

(b) Estimated at 2% of "Operating Expenses" in the previous table

(c) Estimated at 1/12 of "Operating Expenses" in the previous table

ANNEX 7

Computation for Design of Sewers

Table A7.1 Computation for Design of Sewers

No. of Sewers	Area by Land Use and Population: Commercial 400 persons/ha — Area Increment (ha)	Commercial 400 persons/ha — Area Total (ha)	Commercial 400 persons/ha — Population	Residential 120 persons/ha — Area Increment (ha)	Residential 120 persons/ha — Area Total (ha)	Residential 120 persons/ha — Population	Residential 229.4 persons/ha — Area Increment (ha)	Residential 229.4 persons/ha — Area Total (ha)	Residential 229.4 persons/ha — Population	Institution 98.4 persons/ha — Area Increment (ha)	Institution 98.4 persons/ha — Area Total (ha)	Institution 98.4 persons/ha — Population	School — Area Increment (ha)	School — Area Total (ha)	School — Population	Mosque 0 person/ha — Area Increment (ha)	Mosque 0 person/ha — Area Total (ha)	Mosque 0 person/ha — Population	Area — Increment (ha)	Area — Total (ha)	Area — Population	Peaking Factor	Design Flow: Domestic Waste (m³/sec)	Design Flow: Other (m³/sec)	Infiltration I — Area (ha)	Infiltration I — Flow (m³/sec)	Infiltration II — Area (ha)	Infiltration II — Flow (m³/sec)	Design Flow: Total (m³/sec)	No. of Sewers	Designed Sewer: Diameter (mm)	Length (m)	Slope (‰)	Velocity (Full) (m/sec)	Capacity (Full) (m³/sec)	Elevation: Ground Surface (m)	Elevation: Sewer Invert (m)	Earth Covering (m)	Remarks
1				1.49		179													1.49		179	6.39	0.003				1.49	0.001	0.004	1	225	170.00	2.8	0.61	0.025	(1.50) 1.05	0.255	1.00	
	to 3																													to 3									
2				0.98		118													0.98		118	6.79	0.002				0.98	0.001	0.003	2	225	105.00	2.8	0.61	0.025	(1.50) 1.05	0.255	1.00	
3				0.55	3.02	362													0.55	3.02	362	5.76	0.006				3.02	0.001	0.007	3	225	85.00	2.8	0.61	0.025	1.81 1.90	-0.221 -0.469	1.79 2.11	
	to 5																													to 5									
4				0.82		98													0.82		98	6.97	0.002				0.82	0.001	0.003	4	225	105.00	2.8	0.61	0.025	1.44 1.90	0.195 -0.099	1.00 1.75	
5				0.08	3.92	470													0.08	3.92	470	5.57	0.007				3.92	0.001	0.008	5	225	90.00	2.8	0.61	0.025	1.90 (1.87)	-0.469 -0.643	2.11 2.17	
	to 7																													to 7									
6				0.59		71													0.59		71	7.30	0.001				0.59	0.001	0.001	6	225	105.00	2.8	0.61	0.025	1.90 (1.87)	0.655 0.361	1.00 1.26	
7				0.12	4.69	556													0.12	4.69	556	5.45	0.008				4.69	0.001	0.009	7	225	45.00	2.8	0.61	0.025	(1.87) (1.83)	-0.643 -0.669	2.17 2.25	
	to 9																													to 9									
8				0.91		97													0.91		97	6.81	0.001				0.91	0.001	0.002	8	225	105.00	2.8	0.61	0.025	(1.80) 1.18 1.82	0.255 -0.029	1.00 1.62	
9				0.04	4.98	598													0.04	4.98	598	5.36	0.009				4.98	0.001	0.010	9	225	25.00	2.8	0.61	0.025	(1.68) 1.60	-0.669 -0.739	2.25 2.29	
	to 10																													to 10									
10				0.70		84													0.70		84	7.12	0.002				0.70	0.001	0.003	10	225	130.00	2.8	0.61	0.025	2.00 1.92	-0.041 -0.425	2.82 2.10	
11	0.35		140	0.08	0.78	94													0.43	1.13	234	6.15	0.004		0.35	0.001	0.78	0.001	0.006	11	225	70.00	2.8	0.61	0.025	1.92 (1.88)	-0.625 -0.821	2.27 2.46	
	to 13																													to 13									
12				0.82		98													0.82		98	6.97	0.002				0.82	0.001	0.003	12	225	130.00	2.8	0.61	0.025	(1.50) 1.18 1.88	0.255 -0.109	1.00 1.94	
13	0.39	0.74	296	0.08	1.68	202													0.47	2.42	498	5.52	0.007		0.74	0.001	1.68	0.001	0.009	13	225	75.00	2.8	0.61	0.025	(1.68) (1.64)	-0.821 -1.031	2.46 2.63	
	to 15																													to 15									
14				0.94		113													0.94		113	6.83	0.002				0.94	0.001	0.003	14	225	140.00	2.8	0.61	0.025	1.91 (1.84)	0.665 0.279	1.00 1.32	
15	0.23	0.97	388	0.16	2.78	334													0.39	3.75	722	5.24	0.010		0.97	0.001	2.78	0.001	0.012	15	225	40.00	2.8	0.61	0.025	(1.84) (1.81)	-1.051 -1.163	2.63 2.71	
	to 17																													to 17									
16				0.47		56													0.47		56	7.55	0.001				0.47	0.001	0.002	16	225	110.00	2.8	0.61	0.025	1.91 (1.81)	0.465 0.257	1.00 1.21	
17	0.08	1.05	420	0.12	3.97	404													0.20	4.42	824	5.14	0.011		1.05	0.001	3.27	0.001	0.012	17	225	25.00	2.8	0.61	0.025	(1.81) 1.80	-1.163 -1.213	2.71 2.77	
18	0.19	1.24	496	0.27	8.62	1024							0.95		69				1.41	10.81	1599	4.68	0.020		1.24	0.001	9.57	0.001	0.022	18	225	140.00	2.8	0.61	0.025	1.80 1.77	-1.213 -1.605	2.77 3.12	
	to 21																													to 21									
19	0.31		124																0.91		124	6.74	0.002		0.91	0.001			0.003	19	225	60.00	2.8	0.61	0.025	1.58 1.50	0.335 0.167	1.00 2.59	
20	1.00	1.91	524																1.00	1.91	524	5.48	0.008		1.31	0.001			0.009	20	225	195.00	2.8	0.61	0.025	3.00 (1.92)	0.167 -0.279	2.59 2.05	

No. of Sewers	Commercial 400 persons/ha Area Increment (ha)	Commercial Area Total (ha)	Commercial Population (persons)	Residential 120 persons/ha Area Increment (ha)	Residential Area Total (ha)	Residential Population (persons)	Residential 229.4 persons/ha Area Increment (ha)	Residential Area Total (ha)	Residential Population (persons)	Institution 98.4 persons/ha Area Increment (ha)	Institution Area Total (ha)	Institution Population (persons)	School Area Increment (ha)	School Area Total (ha)	School Population (persons)	Mosque 0 persons/ha Area Increment (ha)	Mosque Area Total (ha)	Mosque Population (persons)
	to 22																	
21	1.68		648															
22	1.23	4.16	1664															
	to 24																	
23	2.08		832															
24	0.19	6.43	2572															
	to 27																	
25	1.23		492															
	to 27																	
26	0.42		168															
27	0.08	8.16	3264															
	to 29																	
28	0.39		156															
29	2.20	10.75	4300															
	to 31																	
30				3.12		374												
31	0.95	12.94	4936	0.51	12.35	1470								0.95	69			
	to 38																	
32	0.81		324															
	to 34																	
33	0.31		124															
34	0.15	1.27	508															
	to 36																	
35				0.51		61												
36	1.23	2.50	1000	1.49	2.00	240												
	to 38																	
37	2.39		956															
38	0.73	17.96	7184		14.25	1710								0.95	69			
	to 40																	

No. of Sewers	Area Increment (ha)	Area Total (ha)	Population (persons)	Peaking Factor	Design Flow Domestic Waste (m3/sec)	Other (m3/sec)	Infiltration I Area (ha)	Infiltration I Flow (m3/sec)	Infiltration II Area (ha)	Infiltration II Flow (m3/sec)	Total (m3/sec)	No. of Sewers	Diameter (mm)	Length (m)	Slope (‰)	Velocity (Full) (m/sec)	Capacity (Full) (m3/sec)	Ground Surface Elevation (m)	Sewer Invert Elevation (m)	Earth Covering (m)	Remarks
												to 22									
21	1.62		648	5.32	0.009		1.62	0.001			0.010	21	⌀225	90.00	2.8	0.61	0.025	1.32 (1.92)	0.075 -0.177	1.00 1.85	
22	1.23	4.16	1664	4.65	0.021		4.16	0.001			0.022	22	⌀225	155.00	2.8	0.61	0.025	(1.92) 1.92	-0.879 -0.812	2.05 2.49	
												to 24									
23	2.08		832	5.13	0.011		2.08	0.001			0.012	23	⌀225	145.00	2.8	0.61	0.025	(1.96) 1.92	-0.285 -0.791	2.10 2.47	U~14.5m Drain
24	0.19	6.43	2572	4.37	0.030		6.43	0.001			0.031	24	⌀300	85.00	2.2	0.65	0.047	1.92 (1.76)	-0.888 -1.075	2.49 2.51	
												to 27									
25	1.23		492	5.59	0.007		1.23	0.001			0.008	25	⌀225	140.00	2.8	0.61	0.025	1.80 (1.76)	0.555 0.163	1.00 1.25	
												to 27									
26	0.42		168	6.45	0.003		0.42	0.001			0.004	26	⌀225	90.00	2.8	0.61	0.025	1.92 1.76	0.675 0.428	1.00 1.09	
27	0.08	8.16	3264	4.22	0.037		8.16	0.001			0.038	27	⌀300	60.00	2.2	0.65	0.047	(1.76) 1.80	-1.075 -1.307	2.61 2.69	
												to 29									
28	0.39		156	6.52	0.003		0.39	0.001			0.004	28	⌀225	95.00	2.8	0.61	0.025	1.92 1.80	0.675 0.409	1.00 1.15	
29	2.20	10.75	4300	4.06	0.046		10.75	0.001			0.047	29	⌀300	215.00	2.2	0.65	0.047	1.80 1.77	-1.207 -1.680	2.69 [illegible]	U~0m Drain
												to 31									
30	3.12		374	5.75	0.006				3.12	0.001	0.007	30	⌀225	265.00	2.8	0.61	0.025	1.93 1.77	0.024 -0.542	1.65 2.07	
31	0.86	25.54	6475	3.83	0.066		12.34	0.001	13.20	0.001	0.068	31	⌀275	140.00	2.2	0.75	0.086	1.77 1.89	-1.755 -2.063	2.12 2.48	
												to 38									
32	0.81		324	5.97	0.005		0.81	0.001			0.006	32	⌀225	105.00	2.8	0.61	0.025	1.95 1.95	0.705 0.411	1.00 1.29	
												to 34									
33	0.31		124	4.74	0.002		0.31	0.001			0.003	33	⌀225	110.00	2.8	0.61	0.025	2.27 1.95	1.013 0.705	1.01 1.00	
34	0.15	1.27	508	5.51	0.007		1.27	0.001			0.008	34	⌀225	75.00	2.8	0.61	0.025	1.95 1.96	0.411 0.201	1.29 1.51	
												to 36									
35	0.51		61	7.46	0.001				0.51	0.001	0.002	35	⌀225	195.00	2.8	0.61	0.025	1.99 1.95	-0.415 -0.792	2.10 2.50	
36	2.72	4.50	1240	4.85	0.016		2.50	0.001	2.00	0.001	0.018	36	⌀225	275.00	2.8	0.61	0.025	1.96 1.89	-0.792 -1.569	2.50 3.15	U~0m Drain
												to 38									
37	2.39		956	5.03	0.013		2.39	0.001			0.014	37	⌀225	330.00	2.8	0.61	0.025	1.80 1.82	-0.545 -1.469	2.10 3.05	U~120m Drain
38	0.73	32.16	8963	3.66	0.087		17.96	0.001	15.20	0.001	0.089	38	⌀450	170.00	2.0	0.81	0.132	1.82 1.84	-2.178 -2.476	3.48 3.97	
												to 40									

No. of Sewers	Area by Land Use and Population																						Area		Peaking Factor	Design Flow								No. of Sewers	Designed Sewer							Remarks
	Commercial 400 persons/ha			Residential 120 persons/ha			Residential 229.4 persons/ha			Institution 984 persons/ha			School			Mosque 0 person/ha										Infiltration I			Infiltration II													
	Area		Population	Area		Population	Area		Population	Area		Population	Area		Population	Area		Population							Domestic Waste	Other	Area	Flow	Area	Flow	Total										
	Increment	Total		Increment	Total		Increment	Total		Increment	Total		Increment	Total		Increment	Total																								
	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons							m^3/sec	m^3/sec	ha	m^3/sec	ha	m^3/sec	m^3/sec										
39	0.69		276																0.69		276	6.01	0.004		0.69	0.001				0.005	39	225	110.00	2.8	0.61	0.025	1.55	0.305	1.00	
																																							1.84	-0.009	1.60	
40	0.15	18.80	7520		14.25	1710								0.95	69				0.15	34.00	9299	2.64	0.090		18.80	0.001	15.20	0.001		0.092	40	450	40.00	2.0	0.81	0.133	1.84	-0.278	1.89	
	to 55																																						1.85	-2.558	3.92	
41	1.27		508										0.72		347				1.99		855	5.11	0.012		1.27	0.001	0.72	0.001		0.014	41	225	130.00	2.8	0.61	0.025	(1.96)	0.715	1.00	
																																							(1.99)	0.951	2.10	
	to 43																																									
42	0.27		108															1.50	1.77		108	6.87	0.002		0.27	0.001	1.50	0.001		0.004	42	225	75.00	2.8	0.61	0.025	2.00	0.755	1.00	
43	0.39	1.93	772											0.72	347			1.50	0.39	4.15	1119	4.92	0.015		1.93	0.001	2.22	0.001		0.017	43	225	105.00	2.8	0.61	0.025	(1.99)	0.545	1.20	
	to 48																																						(1.99)	0.941	2.10	
																																							1.94	0.057	1.64	
44	0.81		324																0.81		324	5.87	0.005		0.81	0.001				0.006	44	225	120.00	2.8	0.61	0.025	1.89	0.585	1.00	
	to 48																																							1.94	0.249	1.45	
45	0.39		156																0.39		156	6.52	0.003		0.39	0.001				0.004	45	225	70.00	2.8	0.61	0.025	2.00	0.755	1.00	
	to 47																																							2.09	0.559	1.39	
46	0.15		60																0.15		60	7.47	0.001		0.15	0.001				0.002	46	225	45.00	2.8	0.61	0.025	2.28	0.971	1.06	
																																							2.09	0.665	1.00	
47	0.27	0.81	324																0.27	0.81	324	5.87	0.002		0.81	0.001				0.006	47	225	95.00	2.8	0.61	0.025	2.09	0.559	1.39	
																																							1.94	0.299	1.40	
48	0.04	3.59	1436											0.72	347			1.50	0.04	5.81	1783	4.60	0.022		3.59	0.001	2.22	0.001		0.024	48	225	20.00	2.8	0.61	0.025	1.94	0.057	1.64	
	to 50																																							1.94	0.001	1.69	
49	0.77		308																0.77		308	5.92	0.005		0.77	0.001				0.006	49	225	150.00	2.8	0.61	0.025	2.27	1.025	1.00	
																																							1.94	0.605	1.59	
50	0.12	44.8	17920											0.72	347			1.50	0.12	6.70	2139	4.49	0.026		0.12	0.001	2.22	0.001		0.028	50	300	40.00	2.2	0.65	0.047	1.94	-0.074	1.69	U-0" Storm Sewer
	to 52																																							1.92	-0.162	1.76	
51	0.81		324																0.81		324	5.87	0.005		0.81	0.001				0.006	51	225	120.00	2.8	0.61	0.025	1.83	0.585	1.00	
52	0.23	5.52	2208											0.72	347			1.50	0.23	7.74	2555	4.27	0.030		5.52	0.001	2.22	0.001		0.032	52	300	85.00	2.2	0.65	0.047	1.92	0.221	1.45	
	to 54																																							(1.92)	-0.162	1.76	
																																							(1.90)	-0.339	1.82	
53	0.31		124																0.31		124	6.74	0.002		0.31	0.001				0.003	53	225	90.00	2.8	0.61	0.025	1.43	0.185	1.00	
																																							(1.90)	-0.068	1.72	
54	0.35	6.18	2472											0.72	347			1.50	0.35	8.40	2819	4.31	0.032		6.18	0.001	2.22	0.001		0.034	54	300	75.00	2.2	0.65	0.047	(1.90)	-0.229	1.82	
55	1.04	26.02	10408		14.25	1710								1.67	416			1.50	1.04	43.44	12594	3.48	0.116		26.02	0.001	3.17	0.001		0.118	55	450	165.00	2.0	0.81	0.133	1.85	-0.404	1.99	
	to 57																																							1.85	-2.558	3.992	
																																							2.96	-2.680	4.76	
56	1.39		556							0.98		37							1.77		593	5.29	0.009		1.39	0.001	0.38	0.001		0.011	56	225	240.00	2.8	0.61	0.025	2.92	1.075	1.00	
57	0.23	27.64	11056		14.25	1710					0.98	37		1.67	416			1.50	0.23	45.44	13219	3.46	0.122		28.02	0.001	17.42	0.001		0.124	57	450	55.00	2.0	0.81	0.133	2.96	-2.680	4.76	
	to 59																																							2.96	-2.998	4.87	

No. of Sewers	Commercial 400 persons/ha Area Increment (ha)	Commercial Area Total (ha)	Commercial Population (persons)	Residential 120 persons/ha Area Increment (ha)	Residential 120 Area Total (ha)	Residential 120 Population (persons)	Residential 229.4 persons/ha Area Increment (ha)	Residential 229.4 Area Total (ha)	Residential 229.4 Population (persons)	Institution 98.4 persons/ha Area Increment (ha)	Institution Area Total (ha)	Institution Population (persons)	School Area Increment (ha)	School Area Total (ha)	School Population (persons)	Mosque 0 person/ha Area Increment (ha)	Mosque Area Total (ha)	Mosque Population (persons)
58	396		1584															
59	0.04	31.60	12656		14.25	1710					0.38	37		1.67	416		1.50	
	to	62																
60	1.43		572															
	to	62																
61	0.89		356															
62	0.27	34.19	13692		14.25	1710					0.38	37		1.67	416		1.50	
	to	69																
63	0.39		156															
	to	65																
64	0.77		308															
65	0.08	1.24	496															
	to	67																
66	0.89		356															
67	0.19	2.32	928										2.38		247			
68	1.69	4.01	1604											2.38	247			
69	0.95	38.59	15436		14.25	1710					0.38	37		4.05	663		1.50	
	to	103																
70	0.23		92															
	to	72																
71	0.19		76															
72	0.27	0.69	276															
73	0.19	0.88	352															
	to	75																
74	0.46		184															
75	0.02	1.86	544															
	to	77																
76	0.89		356															
77	0.15	2.40	960															

No. of Sewers	Area Increment (ha)	Area Total (ha)	Population (persons)	Peaking Factor	Design Flow Domestic Waste (m³/sec)	Other (m³/sec)	Infiltration I Area (ha)	Infiltration I Flow (m³/sec)	Infiltration II Area (ha)	Infiltration II Flow (m³/sec)	Total (m³/sec)	No. of Sewers	Diameter (mm)	Length (m)	Slope (‰)	Velocity (Full) (m/sec)	Capacity (Full) (m³/sec)	Ground Surface Elevation (m)	Sewer Invert Elevation (m)	Earth Covering (m)	Remarks
58	396		1584	4.68	0.020		3.96	0.001			0.021	58	225	290.00	2.8	0.061	0.025	2.27 2.24	1.025 0.223	0.99 1.89	
59	0.04	39.44	14819	2.40	0.134		32.02	0.002	17.42	0.001	0.137	59	525	15.00	1.8	0.085	0.191	2.36 2.36	-3.072 -3.100	4.87 4.89	
												to62									
60	1.43		572	5.42	0.008		1.43	0.001			0.009	60	225	295.00	2.8	0.61	0.025	2.27 2.36	1.035 0.209	0.99 1.91	
												to62									
61	0.89		356	5.79	0.005		0.89	0.001			0.006	61	225	160.00	2.8	0.61	0.025	2.37 2.36	1.125 0.687	0.99 1.42	
62	0.27	59.03	15855	3.97	0.142		34.61	0.002	17.42	0.001	0.145	62	525	80.00	1.8	0.85	0.191	2.36 (2.20)	-3.100 -3.244	4.87 4.88	
												to69									
63	0.39		156	6.62	0.003		0.39	0.001			0.004	63	225	100.00	2.8	0.61	0.025	2.27 (1.78)	0.655 0.375	1.37 1.16	
												to65									
64	0.77		308	5.92	0.005		0.77	0.001			0.006	64	225	95.00	2.8	0.61	0.025	2.09 (1.78)	0.801 0.525	1.04 1.00	
65	0.08	1.24	496	5.53	0.007		1.24	0.001			0.008	65	225	40.00	2.8	0.61	0.025	(1.78) 1.80	0.375 0.263	1.16 1.29	
												to67									
66	0.09		356	5.79	0.005		0.89	0.001			0.006	66	225	215.00	2.8	0.61	0.025	2.24 1.80	0.995 0.373	1.00 1.16	Institution 24.0 ha Open Space 86.7 ha
			(12578)	(3.48)	(0.117)	(0.001)	(14.92)	(0.001)	(90.78)	(0.007)	(0.126)										
67	2.57	0.70	1175	4.89	0.015		0.32	0.001	2.38	0.001	0.017	67	450	135.00	2.0	0.81	0.139	1.80 2.00	-3.085 -3.255	4.40 4.87	Residential 40.7 ha School 2.0 ha
			(13754)	(3.46)	(0.122)	(0.001)	(16.61)	(0.001)	(90.78)	(0.007)	(0.131)										
68	1.69	6.29	1851	4.58	0.023		4.01	0.001	2.38	0.001	0.025	68	525	155.00	1.8	0.85	0.191	2.00 2.80	-3.430 -3.709	4.86 5.94	Commercial 10.2 ha U~155m
			(29249)	(3.09)	(0.241)	(0.001)	(51.57)	(0.003)	(108.20)	(0.008)	(0.253)										
69	0.95	59.77	17646	3.31	0.157		38.97	0.002	19.80	0.001	0.160	69	600	80.00	1.6	0.88	0.257	(2.20) (2.15)	-3.780 -3.912	5.24 5.42	Storm Sewer
												to103									
70	0.23		92	7.03	0.002		0.23	0.001			0.003	70	225	55.00	2.8	0.61	0.025	(2.47) (2.13)	1.229 1.085	0.99 0.80	U~55m Storm Sewer
												to72									
71	0.19		76	7.29	0.001		0.19	0.001			0.001	71	225	70.00	2.8	0.61	0.025	(2.40) (2.13)	1.081 0.885	1.07 1.00	
72	0.27	0.69	276	6.01	0.004		0.69	0.001			0.005	72	225	85.00	2.8	0.61	0.025	(2.13) 1.62	0.613 0.375	1.27 1.00	
73	0.19	0.88	352	5.80	0.005		0.88	0.001			0.006	73	225	90.00	2.8	0.61	0.025	1.62 2.13	0.375 0.123	1.00 1.76	
												to75									
74	0.46		184	6.37	0.003		0.46	0.001			0.004	74	225	40.00	2.8	0.61	0.025	1.70 2.13	0.255 0.143	1.20 1.74	U~20m Drain
75	0.02	1.36	544	5.45	0.008		1.36	0.001			0.009	75	225	5.00	2.8	0.61	0.025	2.13 2.13	0.127 0.118	1.76 1.77	
												to77									
76	0.89		356	5.79	0.005		0.89	0.001			0.006	76	225	110.00	2.8	0.61	0.025	2.55 2.13	1.193 0.885	1.11 1.00	
77	0.15	2.40	960	5.03	0.013		2.40	0.001			0.014	77	225	65.00	2.8	0.61	0.025	2.13 2.22	0.118 -0.064	1.77 2.95	

Area by Land Use and Population

No. of Sewers	Commercial 400 persons/ha Area Increment (ha)	Commercial Area Total (ha)	Commercial Population (persons)	Residential 120 persons/ha Area Increment (ha)	Residential 120 Area Total (ha)	Residential 120 Population (persons)	Residential 229.4 persons/ha Area Increment (ha)	Residential 229.4 Area Total (ha)	Residential 229.4 Population (persons)	Institution 98.4 persons/ha Area Increment (ha)	Institution Area Total (ha)	Institution Population (persons)	School Area Increment (ha)	School Area Total (ha)	School Population (persons)	Mosque 0 person/ha Area Increment (ha)	Mosque Area Total (ha)	Mosque Population (persons)
	to	79																
78	0.62		248															
79	0.15	3.17	1268															
	to	81																
80	0.42		168															
81	0.39	3.98	1592															
	to	83																
82	0.50		200															
83	0.08	4.56	1824															
	to	85																
84	1.54		616															
85	0.12	6.22	2488															
	to	89																
86	1.00		400															
	to	88																
87	1.58		632															
88	0.62	3.20	1280															
89	0.08	9.50	3800															
	to	91																
90	0.27		108															
91	0.12	9.89	3956															
	to	97																
92	2.72		1088															
	to	94																
93	0.58		232															
94	0.23	3.53	1412															
	to	96																
95	1.04		416															
96	0.35	4.92	1968															

No. of Sewers	Area Increment (ha)	Area Total (ha)	Population (persons)	Peaking Factor	Design Flow Domestic Waste (m³/sec)	Other (m³/sec)	Infiltration I Area (ha)	Infiltration I Flow (m³/sec)	Infiltration II Area (ha)	Infiltration II Flow (m³/sec)	Total (m³/sec)
to79											
78	0.62		248	6.10	0.004		0.62	0.001			0.005
79	0.15	3.17	1268	4.82	0.016		3.17	0.001			0.017
to81											
80	0.42		168	6.45	0.003		0.42	0.001			0.004
81	0.39	3.98	1592	4.68	0.020		3.98	0.001			0.021
to83											
82	0.50		200	4.29	0.003		0.50	0.001			0.004
83	0.08	4.56	1824	4.59	0.022		4.56	0.001			0.023
to85											
84	1.54		616	5.36	0.009		1.54	0.001			0.010
85	0.12	6.22	2488	4.39	0.029		6.22	0.001			0.030
to89											
86	1.00		400	5.70	0.006		1.00	0.001			0.007
to88											
87	1.58		632	5.34	0.009		1.58	0.001			0.010
88	0.62	3.20	1280	4.83	0.016		3.20	0.001			0.017
89	0.08	9.50	3800	4.13	0.042		9.50	0.001			0.042
to91											
90	0.27		108	4.87	0.002		0.27	0.001			0.003
91	0.12	9.89	3956	4.11	0.043		9.89	0.001			0.044
to97											
92	2.72		1088	4.94	0.014		2.72	0.001			0.015
to94											
93	0.58		232	6.16	0.004		0.58	0.001			0.005
94	0.23	3.53	1412	4.76	0.018		3.53	0.001			0.019
to96											
95	1.04		416	5.67	0.006		1.04	0.001			0.007
96	0.35	4.92	1968	4.54	0.024		4.92	0.001			0.025

Designed Sewer

No. of Sewers	Diameter (mm)	Length (m)	Slope (‰)	Velocity (Full) (m/sec)	Capacity (Full) (m³/sec)	Ground Surface Elevation (m)	Sewer Invert Elevation (m)	Earth Covering (m)	Remarks
to79									
78	225	95.00	2.8	0.61	0.025	2.59 2.23	1.251 0.985	1.09 1.00	
79	225	55.00	2.8	0.61	0.025	2.27 (2.20)	-0.064 -0.218	2.05 2.17	
to81									
80	225	95.00	2.8	0.61	0.025	1.75 (2.20)	0.505 0.407	1.00 1.55	
81	225	120.00	2.8	0.61	0.025	(2.20) (2.98)	-0.218 -0.554	2.17 2.61	
to83									
82	225	80.00	2.8	0.61	0.025	2.39 (2.30)	1.145 0.921	1.00 1.19	
83	225	35.00	2.8	0.61	0.025	(2.30) 2.46	-0.554 -0.652	2.61 2.87	
to85									
84	225	170.00	2.8	0.61	0.025	2.34 2.46	1.095 0.619	1.00 1.60	
85	300	40.00	2.2	0.65	0.047	2.46 2.45	-0.727 -0.815	2.87 2.94	
to89									
86	225	230.00	2.8	0.61	0.025	2.34 2.81	1.095 0.451	1.00 1.61	
to88									
87	225	150.00	2.8	0.61	0.025	2.90 2.91	1.055 0.635	1.00 1.43	
88	225	165.00	2.8	0.61	0.025	2.31 2.45	0.451 -0.011	1.61 2.22	
89	300	30.00	2.2	0.65	0.047	2.45 (2.43)	-0.815 -0.881	2.94 2.99	
to91									
90	225	100.00	2.8	0.61	0.025	2.81 (2.43)	1.065 0.795	1.00 1.39	
91	300	50.00	2.2	0.65	0.047	(2.43) 2.40	-0.881 -0.991	2.99 3.07	
to97									
92	225	170.00	2.8	0.61	0.025	2.94 2.42	1.095 0.619	1.00 1.56	
to94									
93	225	95.00	2.8	0.61	0.025	2.53 2.42	1.285 1.019	1.00 1.16	
94	225	60.00	2.8	0.61	0.025	2.42 2.59	0.619 0.451	1.56 1.89	
to96									
95	225	40.00	2.8	0.61	0.025	2.59 2.59	1.445 1.279	1.00 1.11	
96	225	70.00	2.8	0.61	0.025	2.59 2.40	0.451 0.255	1.89 1.90	

No. of Sewers	Area by Land Use and Population: Commercial 400 persons/ha — Area Increment (ha)	Commercial 400 persons/ha — Area Total (ha)	Commercial 400 persons/ha — Population	Residential 120 persons/ha — Area Increment (ha)	Residential 120 persons/ha — Area Total (ha)	Residential 120 persons/ha — Population	Residential 229.4 persons/ha — Area Increment (ha)	Residential 229.4 persons/ha — Area Total (ha)	Residential 229.4 persons/ha — Population	Institution 98.4 persons/ha — Area Increment (ha)	Institution 98.4 persons/ha — Area Total (ha)	Institution 98.4 persons/ha — Population	School — Area Increment (ha)	School — Area Total (ha)	School — Population	Mosque 0 person/ha — Area Increment (ha)	Mosque 0 person/ha — Area Total (ha)	Mosque 0 person/ha — Population	Area Increment (ha)	Area Total (ha)	Population	Peaking Factor	Design Flow: Domestic Waste (m³/sec)	Design Flow: Other (m³/sec)	Infiltration I: Area (ha)	Infiltration I: Flow (m³/sec)	Infiltration II: Area (ha)	Infiltration II: Flow (m³/sec)	Design Flow: Total (m³/sec)	No. of Sewers	Designed Sewer: Diameter (mm)	Length (m)	Slope (‰)	Velocity (Full) (m/sec)	Capacity (Full) (m³/sec)	Elevation: Ground Surface (m)	Elevation: Sewer Invert (m)	Earth Covering (m)	Remarks
97	1.43	16.84	6496							2.52		248							3.95	18.76	6744	3.81	0.068		18.76	0.001			0.069	97	○ 375	245.00	2.2	0.75	0.086	2.40	-1.082	3.86	
																																				2.48	-1.605	3.68	
98	0.00	16.24	6496	0.08		10				2.41	6.99	685							2.49	21.25	6991	3.79	0.071		21.17	0.001	0.08	0.001	0.072	98	○ 375	235.00	2.2	0.75	0.086	2.48	-1.685	3.68	
	to	100																												to 100						2.67	-2.122	4.39	
99				3.90		108													0.90		108	6.87	0.002				0.90	0.001	0.003	99	○ 225	60.00	2.8	0.61	0.025	2.27	1.125	1.00	
																																				2.67	0.957	1.47	
100	0.00	16.24	6496	0.82	1.00	120				0.81	5.14	506	0.02						0.25	22.40	7183	3.78	0.072		21.38	0.001	1.02	0.001	0.074	100	○ 375	50.00	2.2	0.75	0.086	2.67	-2.122	4.39	
																																				2.67	-2.282	4.50	
	to	102																												to 102									
101													1.19		71				1.19		71	7.30	0.001				1.19	0.001	0.002	101	○ 225	150.00	2.8	0.61	0.825	1.91	0.665	1.00	
																																				2.67	0.245	2.18	
102	0.19	16.43	6572		1.00	120				0.14	5.28	519	0.16	1.37	82				0.49	24.08	7293	3.76	0.072		21.71	0.001	2.37		0.074	102	○ 375	75.00	2.2	0.75	0.086	2.47 (2.15)	-2.282 -2.397	4.50 4.16	U~75" Storm Sewer
																				(36605)		(2.99)	(0.291)	(0.001)	(7328)	(0.004)	(111.60)	(0.008)	(0.302)							(2.15)	-3.981	5.41	
103	0.00	55.00	22008		15.25	1830					5.66	557	1.03	6.45	807	0.00	1.50		1.03	89.88	25202	3.15	0.811		60.48	0.003	29.20	0.002	0.216	103	○ 675	165.00	1.4	0.89	0.327	(1.97)	-4.218	5.47	
	to	106																												to 106									
104	0.50		200																0.50		200	6.29	0.003		0.50	0.001			0.004	104	○ 225	65.00	2.8	0.61	0.025	2.20	0.955	1.00	
																																				2.47	0.719	1.62	
105	0.00	0.50	200										2.15		145				2.15	2.65	345	5.82	0.005		0.50	0.001	2.15	0.001	0.007	105	○ 225	160.00	2.8	0.61	0.025	2.67	0.772	1.62	
																				(97136)	(2.98)		(0.895)	(0.001)	(74.26)	(0.006)	(0.370)	(0.008)	(0.280)							(1.97)	0.269	1.44	
106	0.46	55.98	22592		15.25	1830					5.66	557	0.04	6.49	954		1.50		0.50	87.03	26793	3.14	0.215		61.44	0.003	29.39	0.002	0.220	106	○ 675	95.00	1.4	0.89	0.327	1.95	-4.351	5.58	U~10" Drain
	to	108																												to 108									
107	9.42		1968																2.42		1,368	4.78	0.017		2.42	0.001			0.018	107	○ 225	175.00	2.8	0.61	0.025	1.95	0.265	1.96	
																				(99520)	(2.99)		(0.304)	(0.001)	(77.70)	(0.004)	(119.79)	(0.008)	(0.917)							1.95	-4.351	5.58	
108	0.00	55.98	22592		15.25	1830					5.66	557		6.49	954		1.50		0.50	87.03	26793	3.14	0.215		61.44	0.003	29.39	0.002	0.220	108	○ 675	25.00	1.4	0.89	0.327	1.95	-4.366	5.61	
	to	111																												to 111									
109	1.69		676																1.69		676	5.29	0.010		1.69	0.001			0.011	109	○ 225	185.00	2.8	0.61	0.025	1.95	-0.629	2.23	Residential 4.46 ha Commercial 2.26 ha Mosque 1.20 ha
																				(10,615)		(3.62)	(0.093)		(10.12)	(0.001)	(4.70)	(0.003)	(0.097)							1.85	-2.528	3.89	
110	6.28	7.92	3168																6.28	7.92	3168	4.24	0.026		7.92	0.001			0.027	110	○ 450	285.00	2.0	0.81	0.133	1.95	-3.198	4.66	
																				(46,344)		(1.87)	(0.269)	(0.001)	(99.09)	(0.005)	(141.49)	(0.012)	(0.787)							1.95	-4.461	5.61	
111	0.27	47.69	27052		15.25	1830					5.66	557		6.64	954		1.50		0.27	98.68	28393	3.07	0.848		77.29	0.004	25.99	0.002	0.254	111	○ 750	155.00	1.4	0.95	0.435	1.70	-4.478	5.58	
	to	115																												to 115									
112	2.38		952							0.74		73							3.12		1025	4.98	0.014		3.12	0.001			0.015	112	○ 225	235.00	2.8	0.61	0.025	1.84	0.595	1.00	
	to	114																												to 114									
113										0.77		76							0.77		76	7.23	0.001		0.77	0.001			0.002	113	○ 225	105.00	2.8	0.61	0.025	1.95	0.705	1.00	
																																				1.70	0.411	1.04	
114	0.01	2.39	956								1.51	149							0.01	3.90	1,105	4.93	0.015		3.90	0.001			0.016	114	○ 225	80.00	2.8	0.61	0.025	1.70	-0.063	1.52	
																				(50,988)		(2.96)	(0.394)	(0.001)	(94.59)	(0.005)	(144.89)	(0.012)	(0.452)							1.70	-0.119	1.57	
115		79.02	28008		15.25	1830	2.40		780	2.60	9.77	961		6.64	954		1.50		6.00	108.56	33,537	3.04	0.262		79.79	0.004	28.79	0.002	0.269	115	○ 750	250.00	1.4	0.95	0.435	1.70	-4.478	5.58	
																																				1.94	-5.008	6.17	
	to	117																												to 117									
116	3.50		1400							0.81		90							4.31		1490	4.77	0.019		4.31	0.001			0.020	116	○ 225	85.00	2.8	0.61	0.025	1.83	0.585	1.00	
																				(5) 954		(2.96)	(0.392)	(0.001)	(99.81)	(0.005)	(144.89)	(0.012)	(0.411)							1.94	-0.947	1.95	
117		79.02	29408		15.25	1830		3.40	780	0.91	11.49	1131		6.64	954		1.50		0.91	113.80	34103	3.02	0.274		85.01	0.004	28.79	0.002	0.280	117	○ 750	65.00	1.4	0.95	0.435	1.94	-5.008	6.17	
																																				1.99	-5.119	6.91	

No. of Sewers	Commercial 400 persons/ha Area Increment (ha)	Commercial Area Total (ha)	Commercial Population (persons)	Residential 120 persons/ha Area Increment (ha)	Residential 120 Area Total (ha)	Residential 120 Population (persons)	Residential 229.4 persons/ha Area Increment (ha)	Residential 229.4 Area Total (ha)	Residential 229.4 Population (persons)	Institution 98.4 persons/ha Area Increment (ha)	Institution Area Total (ha)	Institution Population (persons)	School Area Increment (ha)	School Area Total (ha)	School Population (persons)	Mosque 0 person/ha Area Increment (ha)	Mosque Area Total (ha)	Mosque Population (persons)	Area Increment (ha)	Area Total (ha)	Population (persons)	Peaking Factor	Design Flow Domestic Waste (m^3/sec)	Other (m^3/sec)	Infiltration I Area (ha)	Infiltration I Flow (m^3/sec)	Infiltration II Area (ha)	Infiltration II Flow (m^3/sec)	Total (m^3/sec)	No. of Sewers	Designed Sewer Diameter (mm)	Length (m)	Slope (‰)	Velocity (Full) (m/sec)	Capacity (Full) (m^3/sec)	Ground Surface Elevation (m)	Sewer Invert Elevation (m)	Earth Covering (m)	Remarks
	to	137																												to 137									
118				1.76		211													1.76		211	6.24	0.004				1.76	0.001	0.005	118	225	170.00	2.8	0.61	0.025	1.60 1.60	0.047 -0.429	1.31 1.78	
	to	120																												to 120									
119	0.39		156	0.20		26													0.59		180	6.39	0.003		0.39	0.001	0.20	0.001	0.005	119	225	70.00	2.8	0.61	0.025	1.59 1.60	0.265 0.149	1.00 1.21	
120	0.46	0.85	340	0.23	2.19	263													0.69	3.04	603	5.37	0.009		0.85	0.001	2.19	0.001	0.011	120	225	120.00	2.8	0.61	0.025	1.60 1.58	-0.429 -0.765	1.78 2.10	U~120m Drain
	to	122																												to 122									
121				1.45		174													1.45		174	6.42	0.003				1.45	0.001	0.004	121	225	125.00	2.8	0.61	0.025	1.52 1.58	0.285 -0.065	1.00 1.40	
122	1.04	1.89	756		3.64	437													1.04	5.53	1193	4.88	0.015		1.89	0.001	3.64	0.001	0.017	122	225	90.00	2.8	0.61	0.025	1.58 1.60	-0.765 -1.017	2.10 2.37	
	to	124																												to 124									
123	1.58		632																1.58		632	5.34	0.009		1.58	0.001			0.010	123	225	215.00	2.8	0.61	0.025	1.50 1.60	-0.255 -0.745	1.00 2.10	U~215m Drain
124	0.73	4.20	1680		3.64	437													0.73	7.84	2117	4.49	0.025		4.20	0.001	3.64	0.001	0.027	124	300	60.00	2.2	0.65	0.047	1.60 1.68	-1.092 -1.224	2.37 2.58	
	to	126																												to 126									
125	1.16		464																1.16		464	5.58	0.007		1.16	0.001			0.008	125	225	220.00	2.8	0.61	0.025	2.29 1.68	0.899 -0.665	1.15 2.10	U~220m Drain
126	0.42	5.78	2312		3.64	437													0.42	9.42	2749	4.93	0.032		5.78	0.001	3.64	0.001	0.034	126	300	45.00	2.2	0.65	0.047	1.68 (1.65)	-1.224 -1.322	2.58 2.65	
	to	128																												to 128									
127	2.46		984																2.46		984	5.01	0.013		2.46	0.001			0.014	127	225	220.00	2.8	0.61	0.025	(2.20) (1.65)	0.955 -0.695	1.00 2.10	U~230m Drain
128	2.58	10.82	4328		3.64	437													2.58	14.46	4765	4.00	0.051		10.82	0.001	3.64	0.001	0.052	128	375	205.00	2.2	0.75	0.086	1.65 1.96	-1.398 -1.808	2.64 3.36	
129	2.72	13.54	5416		3.64	437													2.72	17.18	5853	3.88	0.061		13.54	0.001	3.64	0.001	0.063	129	375	185.00	2.2	0.75	0.086	1.96 2.01	-1.808 -2.178	3.36 3.78	U~0m U~185m Drain
	to	131																												to 131									
130	2.75		1100																2.75		1100	4.93	0.014		2.75	0.001			0.015	130	225	260.00	2.8	0.61	0.025	2.04 2.01	0.795 0.067	1.00 1.70	
131	0.23	16.52	6608		3.64	437													0.23	20.16	7045	3.78	0.071		16.52	0.001	3.64	0.001	0.073	131	375	95.00	2.2	0.75	0.086	2.01 1.99	-2.178 -2.368	3.78 3.95	
	to	135																												to 135									
132	2.89		1156																2.89		1156	4.90	0.015		2.89	0.001			0.016	132	225	135.00	2.8	0.61	0.025	(1.87) 1.96	0.625 0.247	1.00 1.47	
	to	134																												to 134									
133	1.27		508																1.27		508	5.51	0.007		1.27	0.001			0.008	133	225	90.00	2.8	0.61	0.025	(1.90) 1.96	0.655 0.403	1.00 1.31	
134	0.72	4.88	1952																0.72	4.88	1952	4.54	0.024		4.93	0.001			0.025	134	225	105.00	2.8	0.61	0.025	1.96 1.99	0.247 -0.047	1.47 1.79	
135	1.62	22.02	9208		3.64	437													1.62	26.66	9645	3.62	0.093		22.02	0.001	3.64	0.001	0.095	135	450	210.00	2.0	0.81	0.133	1.99 2.04	-2.443 -2.863	3.95 4.42	
136	0.00	23.08	9208		3.64	437				0.71		70							0.71	27.37	9,715	3.61	0.093		29.73	0.001	3.64	0.001	0.095	136	450	65.00	2.0	0.81	0.133	2.04 1.99	-2.863 -2.993	4.42 4.50	
137	0.46	97.00	38800		18.89	2267		3.40	780		12.80	1200		8.64	954		1.50		0.46	141.62	(61,852) 44001	(2.77) 2.91	(0.457) 0.341	(0.001)	(124.00) 109.20	(0.006) 0.006	(168.57) 38.43	(0.012) 0.002	(0.476) 0.349	137	900	10.00	1.0	0.91	0.598	1.99 1.99	-5.267 -5.279	6.70 6.81	

No. of Sewers	Area by Land Use and Population: Commercial 400 persons/ha — Area Increment	Commercial Area Total	Commercial Population	Residential 120 persons/ha — Area Increment	Residential Area Total	Residential Population	Residential 229.4 persons/ha — Area Increment	Residential Area Total	Residential Population	Institution 98.4 persons/ha — Area Increment	Institution Area Total	Institution Population	School — Area Increment	School Area Total	School Population	Mosque 0 person/ha — Area Increment	Mosque Area Total	Mosque Population	Area Increment	Area Total	Population	Peaking Factor	Design Flow: Domestic Waste	Other	Infiltration I Area	Infiltration I Flow	Infiltration II Area	Infiltration II Flow	Total	No. of Sewers	Designed Sewer: Diameter	Length	Slope	Velocity (Full)	Capacity (Full)	Ground Surface Elevation	Sewer Invert Elevation	Earth Covering	Remarks
	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons	ha	ha	persons		m³/sec	m³/sec	ha	m³/sec	ha	m³/sec	m³/sec		mm	m	‰	m/sec	m³/sec	m	m	m	
																					(61862)	(3.77)	(0.457)	(0.001)	(196.00)	(0.006)	(168.55)	(0.012)	(0.476)										
P	0.00	97.00	38800		18.89	2274		3.40	780		12.80	1200		8.64	954		1.50		0.00	141.63	44.001	2.91	0.341		109.20	0.006	38.42	0.002	0.349	P	Pumping Station								
																					(61.867)	(2.77)	(0.457)	(0.001)	(124.00)	(0.006)	(168.59)	(0.012)	(0.476)							1.99	0.027	1.00	Cross Railway
137-1	0.00	97.00	38800	0.06	18.95	2274		3.40	780		12.80	1200		8.64	954		1.50		0.06	141.69	44.008	2.91	0.341		109.20	0.006	38.49	0.002	0.349	137-1	900	30.00	1.0	0.91	0.598	2.08	-2.143	3.26	
	to 139																													to 139									
																																				1.50	0.255	1.00	
138				2.03		244													2.03		244	4.12	0.004				2.03	0.001	0.005	138	225	285.00	2.8	0.61	0.025	2.08	-0.543	2.38	
																				(294.98)	(62139)	(2.77)	(0.458)	(0.001)	(194.00)	(0.006)	(170.92)	(0.012)	(0.477)							2.08	-2.148	3.26	
139		97.00	38800	0.30	21.28	2554		3.40	780		12.20	1200		8.64	954		1.50		0.30	144.02	44.288	2.91	0.343		109.20	0.006	34.82	0.009	0.352	139	900	90.00	1.0	0.91	0.598	2.03	-2.238	2.90	
	to 141																													to 141									
																																				1.48	0.245	1.00	
140				1.53		184													1.53		184	6.37	0.003				1.53	0.001	0.004	140	225	255.00	2.8	0.61	0.025	2.03	-0.469	2.85	
																				(296.71)	(62353)	(2.77)	(0.460)	(0.001)	(124.00)	(0.006)	(178.71)	(0.019)	(0.480)							2.03	-2.293	3.20	
141		97.00	38800	0.26	22.07	2768		3.40	780		12.20	1200		8.64	954		1.50		0.26	145.81	44.502	2.91	0.344		109.20	0.006	36.61	0.003	0.353	141	900	85.00	1.0	0.91	0.598	2.03	-2.318	2.59	
	to 147																													to 147									
																																				1.50	0.255	1.00	
142				1.49		179													1.49		179	6.89	0.009				1.49	0.001	0.004	142	225	230.00	2.8	0.61	0.025	1.48	-0.989	1.62	
	to 144																													to 144									
																				(30.63)	(5064)	(3.88)	(0.061)		(6.60)	(0.001)	(27.02)	(0.002)	(0.064)							1.59	-2.000	[illegible]	U-10 Drain Commercial 6.60 Residential 26.66
143				0.23		28													0.23		28	8.33	0.001				0.23	0.001	0.002	143	375	55.00	2.2	0.75	0.086	1.48	-2.121	3.19	
																				(34.20)	(6,138)	(2.86)	(0.062)		(6.60)	(0.001)	(29.15)	(0.002)	(0.066)							1.48	-2.121	3.19	
144				0.69	2.95	282													0.69	2.95	282	5.99	0.005				2.95	0.001	0.006	144	375	70.00	2.2	0.75	0.086	1.47	-2.275	3.94	
	to 146																													to 146									
																																				(1.50)	0.055	1.20	U-140 Storm Sewer
145				0.78		94													0.78		94	7.01	0.002				0.78	0.001	0.003	145	225	140.00	2.8	0.61	0.025	(1.47)	-0.337	1.56	
																				(39.64)	(6545)	(3.82)	(0.067)		(6.60)	(0.001)	(30.04)	(0.002)	(0.070)							1.47	-2.275	3.94	
146				1.72	4.85	582							1.39		107				2.11	6.24	689	5.27	0.010				6.24	0.001	0.011	146	375	235.00	2.2	0.75	0.086	2.02	-2.792	4.42	
																				(377.86)	(69008)	(2.73)	(0.502)	(0.001)	(130.60)	(0.007)	(206.66)	(0.015)	(0.525)							2.03	-2.917	4.38	
147		97.00	38800	0.91	28.83	3460		3.40	780		12.20	1200		10.03	1061		1.50		0.04	152.91	45.201	2.90	0.350		109.20	0.006	43.76	0.003	0.359	147	900	185.00	1.0	0.91	0.598	2.03	-3.502	4.57	
	to 149																													to 149									
																																				2.25	1.105	1.00	U-295 Storm Sewer
148				2.10		252													2.10		252	4.09	0.004				2.10	0.001	0.005	148	225	365.00	2.8	0.61	0.025	2.03	0.087	1.70	
																				(309.06)	(69344)	(2.73)	(0.504)	(0.001)	(130.60)	(0.007)	(209.46)	(0.015)	(0.527)							2.03	-3.502	4.57	
149		97.00	38800	0.70	31.63	3796		3.40	780		12.20	1200		10.03	1061		1.50		0.70	155.76	45.687	2.90	0.352		109.20	0.006	45.56	0.003	0.361	149	900	185.00	1.0	0.91	0.598	1.59	-3.627	4.25	
	to 153																													to 153									
																																				2.03	0.597	1.19	
150				0.53		64													0.53		64	7.40	0.001				0.53	0.001	0.002	150	225	85.00	2.8	0.61	0.025	1.60	0.355	1.00	
	to 152																													to 152									
																																				1.64	0.395	1.00	
151				0.37		44													0.37		44	7.81	0.001				0.37	0.001	0.002	151	225	90.00	2.8	0.61	0.025	1.40	0.142	1.21	
																																				1.40	0.142	1.21	
152				0.23	1.19	196													0.23	1.19	136	6.05	0.002				1.19	0.001	0.003	152	225	85.00	2.8	0.61	0.025	1.59	-0.095	1.44	
																					(69.587)	(2.75)	(0.509)	(0.001)	(130.60)	(0.007)	(211.49)	(0.015)	(0.532)							1.59	-3.627	4.25	
153		97.00	38800	0.90	29.66	4099		3.40	780		12.20	1200		10.03	1061		1.50		0.90	157.79	45.800	2.89	0.359		109.20	0.006	48.59	0.004	0.453	153	900	105.00	1.0	0.91	0.598	1.56	-3.732	4.82	
	to 155																													to 155									
																																				1.64	0.395	1.00	
154				0.47		56													0.47		56	7.55	0.001				0.47	0.001	0.002	154	225	75.00	2.8	0.61	0.025	1.56	0.199	1.12	
																				(363.93)	(70087)	(2.72)	(0.509)	(0.001)	(130.60)	(0.007)	(253.33)	(0.017)	(0.534)							1.56	-3.732	4.35	
155		97.00	38800	0.70	34.83	4180		3.40	780		12.20	1200	20.67	30.70	1420		1.50		21.97	179.63	46.380	2.89	0.357		109.20	0.006	70.43	0.005	0.368	155	900	155.00	1.0	0.91	0.598	1.96	-3.887	4.88	

Area by Land Use and Population

No. of Sewers	Commercial 400 persons/ha Area Increment ha	Commercial 400 persons/ha Area Total ha	Commercial 400 persons/ha Population persons	Residential 120 persons/ha Area Increment ha	Residential 120 persons/ha Area Total ha	Residential 120 persons/ha Population persons	Residential 229.4 persons/ha Area Increment ha	Residential 229.4 persons/ha Area Total ha	Residential 229.4 persons/ha Population persons	Institution 984 persons/ha Area Increment ha	Institution 984 persons/ha Area Total ha	Institution 984 persons/ha Population persons	School Area Increment ha	School Area Total ha	School Population persons	Mosque 0 person/ha Area Increment ha	Mosque 0 person/ha Area Total ha	Mosque 0 person/ha Population persons	Area Increment ha	Area Total ha	Population persons	Peaking Factor	Design Flow: Domestic Waste m³/sec	Design Flow: Other m³/sec	Infiltration I Area ha	Infiltration I Flow m³/sec	Infiltration II Area ha	Infiltration II Flow m³/sec	Design Flow: Total m³/sec	No. of Sewers
to	159																													to 159
156				3.02	3.62	362													3.02	3.62	362	5.78	0.006				2.02	0.001	0.007	156
to	158																													to 158
157				0.71	0.85	85													0.71	0.85	85	7.11	0.002				0.71	0.001	0.003	157
158				0.75	4.48	538													0.75	4.48	538	5.46	0.009				4.48	0.001	0.010	158
159		9.700	38800	2.61	39.82	4778		3.40	780		12.20	1200		30.70	1420		1.50		0.51	184.62	46978	2.88				109.20	0.006	75.42	0.005	0.271	159
to	161																													to 161
160				2.98	2.96	286													2.98	2.96	286	5.98	0.005				2.98	0.001	0.006	160
161		9.700	38800	42.20	50.64			3.40	780		12.20	1200		30.70	1420		1.50		18.70	47.264		2.68	0.363			109.20	0.006	77.80	0.006	0.375	161
to	P.S	Pumping Station																												to P.S
P.S		9.700	38.800	42.20	50.64			3.40	780		12.20	1200		30.70	1420		1.50		97.00	47.264		2.68	0.363			109.20	0.006	77.80	0.006	0.375	P.S
162		9.700	38.800	42.20	50.64			3.40	780		12.20	1200		30.70	1420		1.50		"	"		"	"			"	"	"	"	"	162
to	Treatment Site																													

No. of Sewers	Designed Sewer: Diameter mm	Length m	Slope ‰	Velocity (Full) m/sec	Capacity (Full) m³/sec	Elevation Ground Surface m	Sewer Invert Elevation m	Earth Covering m	Remarks
to	159								
156	ϕ225	280.00	2.8	0.61	0.025	2.94	1.990	1.00	
						1.97	0.017	1.71	
to	158								
157	ϕ225	150.00	2.8	0.61	0.025	1.64	0.295	1.00	
						1.97	-0.125	1.85	
158	ϕ225	180.00	2.8	0.61	0.025	1.97	-0.125	1.85	
						1.96	-0.461	1.16	
159	ϕ900	180.00	1.0	0.91	0.598	1.96	-0.887	1.08	
						1.79	-1.017	1.04	Residential 39.22 ha (120 P/ha)
to	161								- (To P/ha 108 P/ha
160	ϕ750	265.00	1.4	0.95	0.435	1.65	-2.065	3.94	- (Others) 12 P/ha
						1.79	-2.936	4.425	
161	ϕ1050	400.00	1.0	1.01	0.899	1.79	-4.167	4.85	School 15.6 ha
						2.03	-4.567	5.47	Mosque 19.3 ha
to	P.S								
P.S						2.03	0.408	1.00	
162	2×ϕ600	1620.00	Force main sewer			2.02	0.403	1.00	Residential 882 ha (120 P/ha)
									- (109 P/ha) 43.7 ha

Note;

1) To estimate the design flow from the commercial area population and population density are determined in the following manner

(1) Population density in commercial area (persons/ha)	(2) Daily average flow rate per capita for Commercial area (l/cap)	(3) Daily average flow rate per capita for residential area (l/cap)	(4) Equivalent population density (persons/ha)
200	440	280	400

2) For infiltration column I and II in Design Flow indicate the commercial and institution area, and the residential, school and mosque area respectively

3) The columns of "elevation ground surface" "Sewer invert elevation" and "earth covering" in Designed Sewer show both the heights of up stream and downstream piyses.

4) Figures in parenthes in the column "elevation ground surface" are based on our survey or requirement for sewerage system

5) Figures in parenthes in the columns "population" Peaking Factor and "Design Flow" are calculated on based of future wastewater inflow

6) For the Remarks

a) "0 ~ 100 m" indicates the distance from upstream of sewer.

b) "Drain" indicates the location of the crossing points of the sanitary sewer with an existing drain or a drain developed in the Drainage study

c) ⓐ ⓑ ⓒ ⓓ ⓔ indicate rest area to be served in each individual sewerage area

ANNEX 8

Selection of Pump Type for Sewage Pumping Stations

1. Alternatives Considered

In order to select the most suitable pumping station for the purposed sewerage system, a comprehensive study has been made on the alternative pump types, including submersible pump and vertical centrifugal pump, relating to type of structures by screening out application of screw pump from the alternative study because of impracticable pump-up head required for screw pump.

Two pumping stations, namely Kolam Air and Tanjong Bendahara, are constructed in the First Phase. These stations are estimated for their capital and operation and maintenance costs (for details of the recommended stations, see Figure SF-23, Volume VIII). Specifications of the stations are as follows:

Name of Stations	(1) Capacity (m^3/min)		(2) Pump No.	Total Dynamic Head (m)
	Daily Ave.	Peak		
Kolam Air	11.0	28.6	3	10
Tanjong Bendahara	25.2	56.8	3	26

Note: (1) flow rates estimated for 2000 conditions
(2) required pump numbers for 1990 conditions

2. Estimated Capital Costs

Capital costs for the two alternatives have been estimated on the basis of the unit costs developed in Appendix G, Vol. VII. It should be emphasized, however, that the cost estimates are for order-of-magnitude,

or reconnaissance study only, and these are satisfactory for comparative study purposes. The estimated costs are summarized below:

(M$1,000)

	Structure	Equipment	Land Cost	Total Cost
1. Kolam Air				
Submersible	280	443	6	729
Centrifugal	308	465	8	781
2. Tanjong Bendahara				
Submersible	504	635	22	1,161
Centrifugal	554	667	29	1,250

Note: (1) All costs are at 1979 price levels. Land cost for Kolam Air is M$173/$m^2$ and for Tanjong Bendahara M$38/$m^2$.

(2) In the detailed engineering analysis, application of screw pump was found impracticable due to high pumping-up head required.

3. Estimated Annual Operation and Maintenance Costs

The operation and maintenance costs for the alternatives are estimated on the basis of the procedures described in Vol. VII, Appendix G, as summarized in the following:

	Total Dynamic Head (m)	Electricity, Water, Manpower, Spare Part, etc. (M$/yr)
1. Kolam Air		
Submersible	10	31.5
Centrifugal	10	34.0
2. Tanjong Bendahara		
Submersible	26	45.7
Centrifugal	26	49.4

Note: All costs are at 1979 price levels.

4. Total Annual Costs

For cost comparison, all costs of the facilities are expressed on annual basis using the average lives of the components, i.e., 50 years for civil and building works and 15 years for equipment. It is also assumed that annual depreciation payments into the sinking fund would grow at 10 percent per annum. The estimated total annual costs for the alternatives by type are summarized in the following:

(1) Kolam Air Pumping Station

(M$1,000/yr)

Item	Submersible	Centrifugal
Interest at 10%	58.3	62.5
Depreciation		
Structures	0.2	0.3
Equipment	13.9	14.6
O&M costs	31.5	34.0
Total annual costs	103.9	111.4

(2) Tanjong Bendahara Pumping Station

(M$1,000/yr)

Item	Submersible	Centrifugal
Interest at 10%	92.9	100.0
Depreciation		
Structures	0.4	0.5
Equipment	20.0	21.0
O&M costs	45.7	49.4
Total annual costs	159.0	170.9

Note: For land costs full salvage value is considered.

5. Evaluation of the Alternatives

As shown in the tables above, the pumping stations with submersible pumps are superior to other types in terms of the total annual cost, as well as other various advantages. Advantages and disadvantages of the submersible type are summarized as follows:

- Since submersible pumps are installed directly in wet well, dry well can be eliminated thus the costs for land, superstructure and substructure can be significantly reduced.

- Because of its structure, submersible pumping station has less problems with respect to flooding which is expected in other types.

- As the motor is directly connected to the pump, submersible pump does not have long shaft and the lubrication to the intermediate bearing box is not required. This makes the overall pump efficiency higher than other types of pump.

- Since submersible pump is placed completely in the water, the noise from pump operation will be less than other types.

- In the existing sewage pumping stations in the area, submersible pumps have been widely used for years, and the skilled operators familiar with this type of pump are available for operating the new pumping stations.

- One of the disadvantages with respect to submersible pump is that when the pump cleaning is necessary, the unit must be completely withdrawn from the wet well before any work can be carried out.

In view of the above descriptions, it is reasonable to consider that the advantages expected from the adoption of submersible pump overcome the disadvantages.