

CHAPTER 10
FINANCIAL ANALYSIS

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10.1 Past and Current Financial Conditions

10.1.1 Past Financial Conditions

DWASA is a public service organization, with its primary purpose of providing water and sewerage to its customers; in as such, it should not be primarily focused earning profits. DWASA's past operations have been characterized by a lack of commercial orientation, governmental interference and organizational inefficiency.

The accounting system within DWASA, plagued by out-dated manual accounting and record keeping practices, also contributed to the woes of the agency as it could not produce reliable data or give an accurate picture of the fiscal operation of the agency. Only records audited by outside sources could be relied upon to provide generally reliable data.

Over the years, DWASA's fiscal situation, while never strong, has become increasingly tenuous, prompting the World Bank, hereinafter referred to as "the WB", to propose a wide-ranging series of projects aimed at improving the organizational, institutional and fiscal capabilities of DWASA.

10.1.2 Current Conditions

The current financial conditions of DWASA are a picture of gradual improvement over the last year and the collection rate, metering rate, computerization of accounts and other items have been increasing the revenues of DWASA. However, there are some problems, a number of which are outlined below.

(1) Existing problems

Inefficient Operations

DWASA has a staff of some 3,264 employees (September 1997) which amounts to nearly 20 employees per 1,000 connections (down from 24 in December 1996). In comparison, the Delhi (India) water supply authority has 8.9 employees per 1,000 connections, and the Karachi (Pakistan) water authority has 11.7.

It should, however, be pointed out that in countries like Bangladesh, labor tends to be substituted for capital due to its low cost and relative efficiency. Also, a large number of people live in apartment complexes that are treated as one connection, thereby affecting the personnel to service ratio connection.

Moreover, the high tariffs charged consumers bears little relation to the level of service provided to DWASA's customers and the public's image of DWASA is a negative one. The latest tariff for a residential user is Tk 16.55 per 1,000 gallons (Imperial) (equivalent to US\$0.37 per 1,000 gallons or US\$.10 per cu.m at a rate of US\$1 = 44 Taka).

Moreover, DWASA only provides water supply service to 50% of the population and water-borne sewage to 15% of the population. In addition, there are problems within the service area with regards to water pressure, water supply and customer service.

Unaccounted-For-Water (UFW)

The estimate for the amount of UFW is officially 47% but this figure is actually much higher. The DWASA MIR of November 1997 shows a water production/water connection ratio of nearly 5 cu.m/day/connection. This is an extremely high amount per connection and it strongly suggests large numbers of illegal connections existing. Further, the MIR reports (page 4) comment "Total no. of connections will not tally with the no. of accounts due to regularization of illegal connections and also connection given but account not yet opened." As such, DWASA is losing large amounts of potential income.

On a positive note, DWASA has embarked on a program for leak detection and a crash meter installation program in an effort to bring down its UFW. As part of the performance agreement between DWASA and the Government of Bangladesh, the target level for UFW is to be a maximum of 39% by December 1998.

Low Collection Ratios

The collection efficiency of DWASA is unsatisfactory. The current ratio (according to the monthly MIR reports, averages 42.6% (page 8 of the MIR). This is grave situation reflects the fact that many connections are billed on the basis of property values rather than actual usage and the fact that water/sewage fee collectors 1) are known to engage in illicit billing/collection activities to supplement their own incomes, 2) have no established route maps or collection procedures and 3) make their own billings.

However, according to DWASA, the collection rate has been improving and is optimistic regarding the current collection rates. DWASA is also planning to take steps towards improving this situation through increasing computerization and, possibly, privatization.

Another related issue is the fact that a significant portion of the uncollected water bills (nearly 7 months on average) is from government agencies. DWASA has been taking steps to reduce the outstanding bills owed by government agencies and has made some progress in this area.

Accounting System

DWASA uses a double-entry accrual based commercial accounting system. This system is still primarily a manual operation and financial statements are prepared only yearly. The value of these yearly statements for management information/accounting is minimal as they contain inaccuracies. Only the statements audited by outside sources are considered useful but even these audits fail to comply with internationally accepted accounting standards.

(2) Improvement programs

DWASA is now in the process of attempting to bring about changes with the assistance of the World Bank, including privatization measures, water meter installation, improved accounting and management schemes, etc. but up to this point, the financial conditions of DWASA have been less than satisfactory overall.

These projects include the following:

- **Crash Metering Program**

This program is intended to significantly increase the number of metered connections, thereby allowing DWASA to improve its billing efficiency and to better track its water production/distribution.

- **Dhaka Water Resources Management Study**

Currently, 98% of DWASA's water supply is provided by deep tubewells, which are costly to operate and maintain and endanger the groundwater resource due to over-drawing. This program is intended to help DWASA assess the alternative sources available and to develop a surface water source to help augment the groundwater sources.

- **Leak Detection and Loss Reduction Program**

The goals of this program are to prepare and implement a comprehensive reform of the DWASA Leak Detection Division, improve worker training, update by-laws, reduce UFW by 12% and prepare a sustainable long-term operation and maintenance program for DWASA. Also, the program will assist DWASA to rehabilitate the water distribution system to handle the increased pressures expected when the Saidabad WTP becomes operational in 1998.

- **Management and Operational Support Program (Twinning)**

In a partnership between Thames Water International Consultancy Ltd. and Sir William Halcrow & Partners of the UK and DWASA, the key objectives of this project are the provision of:

1. sustained technical and managerial support aimed at building up DWASA's capability to the point where, within four years, it can operate independently and efficiently all aspects of its operations
2. assistance in the development and implementation of organizational structures, systems, procedures and practices required by a commercial water utility
3. back-up support in carrying out day-to-day operations

The results of its review of DWASA's organization and operations. In terms of financial matters, the report cites the lack of an effective management information system, poor meter reading performance, and a will to improve within the Finance Department of DWASA. The Twinning Project has recommended that a water billing software system developed by the Custima corporation be adopted.

- **Performance Agreement between DWASA and the Government of Bangladesh**

This is a covenant that establishes a number of numerical targets within a set time period. In the financial sector, DWASA has pledged to strengthen its financial performance, accounting systems, audits and control and to improve its management and operational efficiency. As part of this program, a new accounting manual has been ordered developed, and the computerization of accounting and inventory processes is underway.

DWASA has also agreed to revise its tariff structure, the first stage of which was completed in June 1997 (as can be seen in Section 10.3 Current Tariff Structure).

The tariff structure will be adjusted periodically to enable DWASA to meet its financial obligations, including debt service. The performance agreement sets out, among others, the following financial and operational benchmarks to be achieved by no later than December 1998:

Operational Targets & Indicators

1. achievement of a meter coverage of about 95%
2. reduction of UFW to at most 39%
3. increase the number of connections to at least 187,000
4. enhance the staff productivity level to about 17 staff per 1,000 connections
5. improve the average well productivity to about 4.0 million liters per day

Financial Ratios and Leverage Indicators

1. a working ratio and operating ratio of 0.6 and 0.8 respectively
2. a receivables to monthly billing ratio of about 3 months
3. a contribution to investment of about 27%
4. a revenue collection efficiency of above 100%
5. debt service coverage of about 0.8
6. a debt to equity ratio of about 32%
7. a current ratio of no more than 6.6

Each of these programs, if implemented successfully, will have a marked and positive impact on the future of DWASA's ability to sustain itself financially over the long-term.

10.2 Balance Sheet and Assets

The balance sheet and assets of DWASA were prepared using information from the Audit Report and Statement of Accounts from the years 1992 to 1996. These documents were prepared by an outside accounting firm in accordance with government regulations.

The DWASA assets and income statement in Tables 10.2.1 and 10.2.2 for the years 1992 to 1996 reflect a number of interesting factors, which are listed below.

- DWASA incurred an overall earnings loss for the 1992-1996 period of Tk -43,310,000 (US\$ 9,843,318 at \$1 = Tk 44).

- Income increased significantly between 1992 and 1995 but so did expenses and interest payments. This was because DWASA started to make loan payments on existing loans as can be seen by the fact that long-term liabilities did not increase significantly. The impact of this is clearly shown in 1996, where the income dropped and the overall profit of DWASA fell seriously into the red.

Also of note, was that DWASA was able to accumulate large cash balances because:

- DWASA did not pay its debt servicing and thereby surplus due to improper records at the Ministry of Finance, hereinafter referred to as "the MOF". For example, in FY '92, only Tk 15 million was paid when Tk 35 million should have been paid.
- Funding for various projects was dispersed without consideration for the actual work schedule, allowing DWASA to carry forward large cash balances.

Table 10.2.1 DWASA Assets

(Tk '000)

ASSETS	1992	1993	1994	1995	1996
Fixed Assets	3,605,428	3,871,815	4,531,619	4,534,524	4,653,054
Depreciation	1,159,665	1,243,169	1,356,980	1,473,129	1,591,339
Net Fixed Assets	2,445,763	2,628,646	3,174,639	3,061,395	3,061,715
Intangible Assets	2,384,916	3,024,518	3,058,498	3,064,024	3,082,158
Works In Progress	64,133	434,479	786,674	1,184,663	2,218,180
Deferred Expenses	283,813	304,271	292,172	280,380	427,809
Investments	-	-	-	-	-
TOTAL LONG-TERM ASSETS	5,178,625	6,391,914	7,311,983	7,590,462	8,789,862
CURRENT ASSETS					
Accounts Receivable	278,414	379,643	582,463	678,968	824,392
Stores and Inventories	424,604	225,043	246,436	301,253	218,081
Advances for Materials	136,570	152,501	150,216	179,877	26,035
Other Current Assets	30,787	46,893	62,441	78,293	89,241
Cash Balance	974,968	932,165	743,787	776,300	785,202
Total Current Assets	1,845,343	1,736,245	1,785,343	2,014,691	1,942,951
TOTAL ASSETS	7,023,968	8,128,159	9,097,326	9,605,153	10,732,813

Table 10.2.2 Income Statement

(Tk '000)

	1992	1993	1994	1995	1996
WATER					
Actual Production (ML)	219,363	245,985	260,174	275,326	292,920
Water Billed (ML)	96,624	115,110	133,892	152,563	161,106
System Loss (ML)	122,739	130,875	126,282	122,763	131,814
UFW	56.0%	53.2%	48.5%	44.6%	45.0%
REVENUE (x 1,000)					
Water Revenue	310,343	395,329	528,872	558,403	537,050
Sewerage Revenue	153,061	222,256	263,557	252,060	251,942
Water Connection	7,621	12,701	9,576	9,304	8,365
Sewer Connection	612	723	549	787	808
Street Hydrant	-	-	-	2,968	23,813
Direct Water Sales	641	1,156	1,423	1,273	1,064
Meter Sales	6,752	16,102	3,816	14,527	12,652
TOTAL OPERATING REVENUE	479,030	648,267	807,793	839,322	835,694
DIRECT EXPENSES (x 1,000)					
Power	195,114	250,672	298,668	258,592	287,262
Chemicals	10,416	11,944	14,228	17,376	9,855
Repair and Maintenance	31,262	25,981	30,298	75,707	36,553
Direct Salaries and Wages	44,016	48,111	72,540	67,057	78,015
Other Expenses	50,059	58,646	76,118	72,993	93,234
Total Direct Expenses	330,867	395,354	491,852	491,725	504,919
ADMINISTRATION EXPENSES					
Salaries	32,297	49,214	70,987	66,198	80,717
Other Expenses	11,174	14,780	12,763	17,598	19,439
Insurance	95	96	126	128	501
Provision for Doubtful Debt	23,170	30,879	79,243	81,046	78,899
Total Administration Expenses	66,736	94,969	163,119	164,970	179,556
Total Working Expenses	397,603	490,323	654,971	656,695	684,475
Income Before Depreciation	81,427	157,944	152,822	182,627	151,219
Depreciation	115,701	115,701	117,984	127,936	134,876
Operating Profit	(34,274)	42,243	34,838	54,691	16,343
Add Other Income	74,464	78,305	74,390	53,254	61,304
Income Before Interest	40,190	120,548	109,228	107,945	77,647
Interest	35,706	107,794	108,015	128,087	119,266
Net Profit	4,484	12,754	1,213	(20,142)	(41,619)
Payment to the Exchequer	-	-	1,000	1,000	1,000
Net Earnings	4,484	12,754	213	(21,142)	(42,619)

The most current information from DWASA (MIR of November, 1997), shows that DWASA's revenues and expenses are as follows:

Table 10.2.3 DWASA Revenue/Expenditure 1995-1996 & 1996-1997

(Unit = Tk x 1,000)

Revenue Income	1996-1997 % of Total		1997-1998 % of Total	
Water & sewer rates	326,007	94.39	213,276	87.62
Service Conn. Fee	6,732	1.95	5,756	2.36
Meter sales	5,901	1.71	5,933	2.44
Rent	1,733	0.50	1,173	0.48
Miscellaneous	1,071	0.31	13,222	5.43
DTW License/Royalty	3,066	0.89	3,425	1.41
Water sales (direct)	885	0.26	619	0.25
TOTAL	345,395	100	243,404	100
Revenue Expditures	1996-1997 % of Total		1997-1998 % of Total	
Power	119,991	45.81	116,617	44.49
Chemical	8,843	3.38	2,657	1.01
Maintenance	16,089	6.14	19,992	7.63
Salaries & wages	61,114	23.33	64,728	24.70
Overtime	20,875	7.97	17,457	6.66
Others	24,646	9.41	39,750	15.17
Purchase of stores	10,370	3.96	890	0.34
TOTAL	261,928	100	262,091	100
Depreciation	0		0	
IDA Loan Interest	25,000		25,000	
Bad Debt	0		0	
Total Expenditure	286,928		287,091	
BALANCE	(57,784)		(21,530)	

It should be noted that the MIR figures are based on the data used to up the month of the previous year and up to the month of the current year. The above information points to the following:

- Electric power required to operate the 190-odd tubewells of DWASA, accounts for a huge proportion of DWASA's budget. Any significant increases in the cost of electricity or power shortfalls could be disastrous for DWASA.
- The failure to note depreciation is not acceptable in terms of maintaining an accurate set of accounts.
- The figures for income, ending balance, chemicals and others do not match with the figures shown in the audited accounts.

DWASA has a high debt to equity ratio, which reflects the following situations:

- unused/left over materials and consumables from past projects which have been carried over in the inventory
- uncollected water bills from government agencies, some of which have been unpaid for years
- low amount of accounts payable due to the inadequate billing process of DWASA
- high amount of advances to contractors for materials that haven't been reconciled

Overall, DWASA is low-leveraged, with most of its financing coming from either the GOB the form of grants or equities, or from loans from the International Bank of Reconstruction and Development (IBRD) or the International Development Agency (IDA). The Japanese Grant, and other similar funds are transferred to DWASA by the GOB. The GOB also transferred the assets of the stormwater drainage from the Department of Public Health and Engineering (DPHE) to DWASA in 1989. These assets are treated as equity of DWASA.

Over 80% of DWASA's outstanding loans are from the IDA. This soft money has not been reflected in the performance level of DWASA in its performance. However, the ability of DWASA to obtain local financing is limited due to the structural and economic conditions in Bangladesh.

10.3 Current Water and Sewerage Tariffs

As shown in Table 10.3.1, DWASA charges a separate rate for metered and non-metered customers. The non-metered customers pay a rate assessed on the basis of their property value. The sewage rate is the same as that of the water rate and those customers that are not connected but are within 100 feet pay 8.56% of their property value tax. Consumers also pay taxes on their water bill, including valued-added-tax (VAT) of 15%. The current tariffs set by DWASA on April 27, 1997 to be effective starting from June 30, 1997 for water and sewerage are as follows:

Table 10.3.1 Current DWASA Tariff Schedule

Holding Category	Without Meter	With Meter	
		1,000 Gallons (Tk)	1,000 Liters (Tk)
Residential Bldg. & Comm. Centers	Annual Value Assessment (23.77% yearly)	16.55	3.67
Office, Industries & Comm. Bldg.	Annual Value Assessment (23.77% yearly)	54.09	11.92
Bldg. Under Construction (w/o meter)	a) ¾" pipeline per connection per month	Residential (Tk)	Commercial (Tk)
	b) 1" - as above-	797.43	2,392.28
	c) ½" - as above-	1,594.85	4,784.55
	d) 2" - as above-	3,322.60	9,967.81
Minimum monthly charge per connection (with & without meter) is Tk 19.00			
Holdings having both water & sewer lines shall pay for sewer at the same amount of water charges.			
Holdings having only sewer connection shall pay 23.77% annual valuation assessment of holding.			
Holdings that are not connected to the sewer but are situated w/in 100 feet of DWASA's regular sewage line must pay 8.56% annual valuation assessment tax.			

Source: DWASA

The new water and sewerage tariff rates are significant but more so is the approval of Act No. 6 of 1996 which allows DWASA to raise its tariffs by 5% without approval from the Board of Secretaries of the Government of Bangladesh. Previously, all tariff increases had to be approved by the Board of Secretaries; consequently, many tariff rate decisions were based on political considerations. This legislation was viewed as a key factor in enabling DWASA to become a financially responsible organization. However, the political realities are such that DWASA will still have to get approval from higher authorities to raise.

10.4 Financial Analysis

10.4.1 Implementation Plan

As the construction of a sewerage system is one of the most important public works projects, the sewerage project shall be carried out in a manner that will benefit the most number of people at the lowest possible cost. A financial analysis was undertaken of the recommended project in order to illustrate the financial impact that such a project would have on DWASA as well as to illustrate the importance of DWASA meeting certain financial goals necessary to carry out any future project(s).

Estimated project cost

The estimated project cost has been calculated and is summarized as follows:

Table 10.4.1 - Summary of Recommended Project Cost

Land Acquisition Cost:	528,976
Construction Cost:	3,603,744
Engineering Service:	70,083
Administration Cost:	183,689
Physical Contingency:	438,720
<i>SUB TOTAL</i>	<i>4,825,212</i>
Price Contingency:	241,292
TOTAL PROJECT COST	5,067,240

Note: costs are Tk ('000)

The land acquisition costs for the project will be absorbed by the GOB and are treated as a part of the operating costs of DWASA. The price contingency costs, while substantial, are the product of an assumed annual inflation rate of 5%. The costs of custom's duties weren't considered as they are treated as "paper costs" in that no real money changes hands, but is simply passed from one government entity to another as a bookkeeping exercise.

Projected Cash Flow

Based on assumptions with regard to DWASA's performance as well as economic conditions, the projected cash flow of DWASA from 2001 to 2025 was carried out. In addition to the base cash flow assumption, three alternative scenarios were prepared for sensitivity analysis. The projected cash flow and the sensitivity analyses are shown in Tables 10.4.2 to 10.4.5.

TABLE 10.4.2 DWASA Projected Cash Flow (Base)

All Figures in 1,000 Bangladeshi Taka

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Income														
Water Revenue	875,683	924,503	976,044	1,030,458	1,087,906	1,148,557	1,212,589	1,280,191	1,351,562	1,428,013	1,512,988	1,605,177	2,043,063	2,156,964
Domestic	388,181	409,822	432,670	456,791	482,258	509,143	537,528	567,495	599,133	634,980	672,565	712,844	905,669	956,160
Commercial	644,571	680,506	718,444	758,497	800,784	843,275	885,061	932,696	982,430	1,036,033	1,090,423	1,147,330	1,437,394	1,500,804
Sewer Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Project Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Revenue	47,711	50,371	53,179	56,144	59,274	62,574	66,048	69,696	73,519	77,513	81,688	86,052	90,615	95,378
Sub Total	1,566,147	2,065,202	2,180,317	2,301,891	2,430,221	2,585,013	2,762,231	2,952,486	3,156,514	3,376,026	3,612,104	3,865,363	4,271,072	4,709,306
Expenses														
Other Loans	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	583,508	671,034	771,669	887,442	1,020,556	1,181,997	1,368,437	1,580,228	1,827,744	2,103,186	2,417,583	2,771,994	3,275,509	3,839,255
Project O&M	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Salaries & Wages	277,623	319,267	367,157	422,230	485,565	559,554	645,923	748,476	868,476	1,008,030	1,171,758	1,361,222	1,582,991	1,842,691
Other	252,662	270,394	289,413	309,812	331,696	358,538	391,623	429,029	473,088	522,148	577,370	638,804	708,003	786,459
Land Acquisition	529,714	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	1,275,638	697,360	546,212	542,976	545,558	0	0	0	0	0	0	0	0	0
Sub Total	3,811,819	2,452,730	2,669,145	3,057,136	3,294,038	3,800,929	4,452,247	5,303,605	6,354,193	7,614,011	9,112,211	10,900,266	13,040,388	15,615,645
BALANCE:	-1,855,673	-787,528	-688,828	-755,245	-863,817	-1,041,185	-1,229,915	-1,551,119	-1,927,679	-2,407,985	-2,999,107	-3,714,901	-4,569,316	-5,506,339
Income														
Water Revenue	2,277,215	2,439,013	2,574,998	2,718,543	2,864,317	3,011,168	3,170,041	3,336,272	3,503,345	3,676,928	3,859,485	4,049,928	4,249,928	4,459,928
Domestic	1,009,466	1,081,189	1,141,465	1,203,102	1,264,125	1,324,420	1,384,896	1,445,553	1,506,391	1,567,414	1,628,723	1,690,316	1,752,193	1,814,356
Commercial	2,465,011	2,640,151	2,787,340	2,942,734	3,055,581	3,259,491	3,441,207	3,631,055	3,835,598	4,049,514	4,278,762	4,519,612	4,777,735	5,045,572
Sewer Revenue	141,808	146,062	150,444	154,957	159,606	164,443	169,491	174,756	180,239	185,938	191,851	197,976	204,303	210,936
Project Revenue	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Revenue	143,792	154,009	162,595	171,659	177,076	184,943	190,491	196,266	202,092	208,155	214,460	221,007	227,783	234,796
Sub Total	6,037,291	6,490,424	6,816,833	7,192,996	7,419,704	7,980,559	8,420,713	8,845,262	9,275,563	9,693,047	10,109,224	10,524,551	10,939,224	11,353,224
Expenses														
Other Loans	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	2,007,593	2,148,124	2,298,493	2,459,397	2,631,544	2,815,752	3,012,855	3,223,755	3,449,418	3,690,877	3,949,238	4,217,503	4,495,678	4,783,763
Project O&M	61,965	66,302	70,943	75,909	81,223	86,900	92,992	99,502	106,467	113,920	121,894	130,387	139,403	148,943
Salaries & Wages	935,179	1,022,042	1,099,285	1,170,136	1,235,045	1,303,689	1,376,067	1,453,180	1,535,039	1,621,776	1,714,493	1,813,287	1,918,163	2,029,123
Other	633,215	681,954	731,576	784,899	837,102	892,961	949,120	1,004,245	1,061,717	1,121,943	1,185,943	1,253,717	1,325,265	1,400,691
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total	4,497,769	4,736,219	5,024,392	5,350,129	5,641,712	5,985,108	6,380,231	6,824,108	7,317,574	7,861,595	8,469,277	9,141,503	9,879,224	10,683,224
BALANCE:	1,539,522	1,754,205	1,792,441	1,842,867	1,777,992	1,995,451	2,440,482	2,536,154	2,609,989	2,684,432	2,769,948	2,857,048	2,945,903	3,036,691

Accumulated Cash Flow = 25,725,933

Table 10.4.3 DWASA Projected Cash Flow--10% Increase in O&M Costs

All Figures in 1,000 Bangladeshi Taka

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Income														
Water Revenue	875,683	924,503	976,044	1,030,454	1,087,906	1,148,557	1,212,589	1,280,191	1,351,562	1,428,013	1,509,988	1,595,177	2,043,063	2,156,964
Domestic	348,181	409,822	432,670	456,791	482,258	509,143	537,526	567,455	599,133	724,980	812,545	857,644	905,669	956,160
Commercial	644,571	680,506	718,444	758,997	800,764	813,275	835,958	867,777	899,071	1,794,744	1,984,150	2,094,766	2,211,549	2,334,843
Sewer Revenue	0	0	0	0	0	81,513	83,958	86,477	89,071	107,034	110,245	113,552	116,959	120,468
Project Revenue	47,711	50,371	53,179	56,144	59,274	72,524	76,568	80,836	85,343	104,603	115,742	122,195	129,007	136,190
Other Revenue	1,956,147	2,065,202	2,180,237	2,301,391	2,430,221	3,055,013	3,223,231	3,400,764	3,586,130	4,399,464	4,855,669	5,123,534	5,406,247	5,704,634
Sub Total														
Expenses														
Other Loans	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	583,508	671,034	771,689	887,442	1,020,558	1,091,997	1,168,437	1,250,228	1,337,744	1,431,266	1,531,583	1,638,794	1,753,509	1,876,255
Project O&M	0	0	0	0	19,835	39,670	46,692	54,957	64,684	76,133	89,608	105,449	124,137	146,109
Salaries & Wages	277,623	319,267	367,157	422,230	485,565	519,554	555,923	594,808	636,476	681,030	728,702	779,711	834,291	892,691
Other	252,662	270,394	289,413	309,812	331,696	318,538	341,623	366,429	393,088	440,148	478,370	512,904	550,003	589,859
Land Acquisition	529,714	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	1,273,638	697,160	546,212	542,976	545,558	0	0	0	0	0	0	0	0	0
Sub Total	3,811,819	2,852,730	2,669,145	3,057,136	3,295,887	2,864,435	3,007,350	3,161,126	3,326,607	3,523,371	3,722,928	3,931,553	4,156,615	4,399,589
BALANCE:	-1,855,673	-787,528	-688,808	-755,245	-865,666	-190,578	-215,861	-239,638	-261,643	-876,093	-1,132,731	-1,191,981	-1,249,633	-1,305,044
Income														
Water Revenue	2,277,215	2,439,013	2,574,988	2,718,543	2,864,317	3,011,168	3,179,041	3,356,272	3,542,385	3,740,928	3,949,485			
Domestic	1,009,466	1,081,189	1,141,465	1,205,102	1,283,125	1,334,820	1,409,236	1,487,801	1,570,746	1,658,315	1,750,766			
Commercial	2,465,011	2,640,151	2,787,340	2,942,734	3,035,581	3,259,491	3,441,207	3,633,055	3,835,598	4,049,432	4,275,188			
Sewer Revenue	141,808	146,062	150,444	154,957	159,806	184,983	190,491	196,206	202,092	208,155	214,400			
Project Revenue	143,792	154,009	162,595	171,659	177,076	190,137	200,737	211,926	223,743	236,217	249,386			
Sub Total	6,037,291	6,460,424	6,816,831	7,192,946	7,419,704	7,980,559	8,420,713	8,895,262	9,375,563	9,893,047	10,439,224			
Expenses														
Other Loans	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000			
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797			
O&M Costs	2,007,593	2,148,124	2,298,493	2,459,347	2,631,544	2,815,752	3,012,855	3,223,755	3,449,418	3,690,877	3,949,238			
Project O&M	171,971	202,410	236,236	280,404	330,035	388,452	457,208	538,133	633,383	745,492	877,444			
Salaries & Wages	955,179	1,022,042	1,093,585	1,170,136	1,252,045	1,339,889	1,433,467	1,533,810	1,641,176	1,756,059	1,879,983			
Other	633,215	681,954	731,574	794,899	837,102	902,361	969,120	1,040,245	1,116,717	1,198,943	1,287,365			
Land Acquisition	1,190,665	0	0	0	0	0	0	0	0	0	0			
Construction/Installation	326,416	911,566	911,566	911,566	297,547	0	0	0	0	0	0			
Sub Total	6,130,836	5,805,893	6,113,251	5,837,631	6,178,072	6,246,651	6,324,446	6,787,740	7,292,491	7,843,168	8,444,827			
BALANCE:	-93,545	654,531	703,581	1,355,365	1,241,633	1,693,908	2,096,266	2,097,522	2,083,073	2,049,880	1,994,298			
Accumulated Cash Flow =														17,586,733

Table 10.4.4 DWASA Projected Cash Flow--Reduced Tariff Collection Rate

All Figures in 1,000 Bangladeshi Taka

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Income														
Water Revenue	875,683	924,503	976,044	1,030,456	1,087,906	1,148,557	1,212,589	1,280,191	1,351,862	1,428,013	1,508,298	1,593,177	1,683,063	1,766,964
Domestic	388,181	409,822	432,670	456,791	482,258	509,143	537,528	567,495	599,133	632,460	667,444	704,444	743,444	783,444
Commercial	644,571	680,506	716,444	758,497	800,744	843,275	875,061	912,696	952,729	995,553	1,040,854	1,090,733	1,144,619	1,193,520
Sewer Revenue	0	0	0	0	0	61,135	62,969	64,858	66,803	68,804	70,861	72,974	75,143	77,367
Project O&M	0	0	0	0	0	72,524	76,508	80,456	84,363	88,232	92,065	95,862	99,623	103,350
Salaries & Wages	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total	1,556,147	2,085,202	2,140,337	2,301,891	2,430,221	2,554,635	2,702,242	2,839,145	2,965,862	3,092,528	3,219,161	3,345,794	3,472,427	3,599,060
Expenses														
Other Loans	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	583,508	671,034	771,689	887,442	1,020,558	1,091,997	1,168,437	1,250,228	1,337,794	1,431,386	1,531,585	1,638,794	1,753,509	1,876,255
Project O&M	0	0	0	0	18,032	36,064	36,588	41,290	44,190	47,273	50,862	54,122	57,911	61,965
Salaries & Wages	277,623	319,267	367,157	425,250	485,665	549,554	555,923	594,438	636,476	681,030	728,702	779,711	834,291	892,691
Other	252,662	270,394	299,413	309,812	331,696	318,538	341,623	366,429	393,088	440,148	478,370	512,904	550,903	589,859
Land Acquisition	529,714	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	1,273,638	697,360	546,212	542,976	543,558	543,558	0	0	0	0	0	0	0	0
Sub Total	3,811,819	2,852,730	2,869,143	3,057,136	3,294,084	2,860,829	2,992,247	3,147,859	3,308,163	3,494,511	3,683,911	3,880,206	4,090,388	4,315,445
BALANCE:	-1,855,673	-767,528	-668,808	-755,245	-863,862	-173,806	-205,996	-251,686	-259,699	-862,017	-1,148,134	-1,218,995	-1,290,796	-1,343,375
Income														
Water Revenue	2,277,215	2,439,013	2,574,988	2,719,543	2,804,317	3,011,168	3,179,041	3,356,272	3,543,385	3,740,928	3,949,485	4,168,766	4,398,888	4,639,888
Domestic	1,099,466	1,181,189	1,241,465	1,305,102	1,243,125	1,334,820	1,409,236	1,487,401	1,570,746	1,658,315	1,750,766	1,843,315	1,936,888	2,031,444
Commercial	2,465,011	2,640,151	2,797,340	2,945,734	3,035,581	3,259,491	3,441,207	3,633,055	3,835,598	4,049,613	4,275,719	4,514,451	4,767,000	5,034,444
Sewer Revenue	115,219	118,675	122,235	125,903	129,680	154,119	158,743	163,505	168,410	173,463	178,666	184,017	189,523	195,185
Project Revenue	143,792	154,060	162,495	171,659	177,076	190,137	200,737	211,928	223,743	236,217	249,365	263,197	277,723	292,945
Other	6,010,702	6,433,037	6,788,623	7,163,941	7,399,778	7,949,735	8,386,564	8,852,361	9,341,861	9,858,355	10,403,491	10,980,388	11,593,888	12,245,444
Sub Total	10,000,000	10,673,888	11,269,746	11,900,787	12,437,861	13,419,331	14,174,589	14,999,866	15,891,889	16,860,681	17,918,979	19,077,979	20,338,979	21,700,979
Expenses														
Other Loans	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	2,007,593	2,148,124	2,298,493	2,459,387	2,631,544	2,815,752	3,012,655	3,223,755	3,449,418	3,690,238	3,946,877	4,219,977	4,509,238	4,809,238
Project O&M	66,302	70,943	75,909	81,223	86,909	92,992	99,502	106,467	113,920	121,894	130,426	139,566	149,266	159,566
Salaries & Wages	955,179	1,022,042	1,093,585	1,170,136	1,252,045	1,339,689	1,433,467	1,533,810	1,641,176	1,756,059	1,878,983	1,999,444	2,128,944	2,267,444
Other	633,215	681,954	731,574	784,899	837,102	902,961	969,120	1,040,245	1,116,717	1,198,943	1,287,365	1,377,444	1,472,444	1,573,444
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub Total	4,502,686	4,762,661	5,039,358	5,335,442	5,647,398	5,991,191	6,366,740	6,773,073	7,212,570	7,687,609	8,198,944	8,754,444	9,354,444	9,999,444
BALANCE:	1,508,616	1,670,176	1,749,265	1,825,499	1,948,544	2,028,140	2,122,224	2,246,488	2,568,854	2,638,785	2,705,642	2,777,979	2,854,444	2,935,444

Note:

Accumulated Cash Flow =

25,109,901

Table 10.4.5 DWASA Projected Cash Flow--50% Increase In Land Aquisition Costs

All Figures in 1,000 Bangladeshi Taka

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Income														
Water Revenue	875,683	924,503	976,044	1,030,458	1,087,906	1,148,557	1,212,589	1,280,191	1,351,562	1,428,013	1,509,298	1,595,177	2,043,063	2,156,964
Domestic	348,181	409,122	432,670	456,791	482,258	509,143	537,528	567,495	599,133	634,980	672,844	713,444	905,669	956,160
Commercial	644,571	680,506	718,444	756,497	800,784	853,275	891,588	935,765	982,429	1,034,744	1,086,454	1,141,733	1,477,394	1,556,804
Sewer Revenue	0	0	0	0	0	81,513	83,958	86,477	89,071	91,744	94,497	97,329	116,959	120,468
Project Revenue	47,711	50,871	53,179	56,144	59,274	62,524	65,888	69,367	72,953	76,648	80,454	84,372	109,007	113,190
Other Revenue	1,950,147	2,065,202	2,180,337	2,301,891	2,430,221	2,565,013	2,705,251	2,850,044	2,999,484	3,153,684	3,312,993	3,477,524	3,642,297	3,704,634
Sub Total														
Expenses														
Other Loans	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878	442,878
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	583,508	671,034	771,689	887,442	1,020,558	1,091,997	1,168,437	1,250,228	1,337,744	1,431,386	1,531,583	1,638,794	1,753,509	1,876,255
Project O&M	0	0	0	14,032	36,064	38,064	41,290	44,180	47,273	50,882	54,122	57,911	61,965	66,302
Salaries & Wages	277,623	319,267	367,157	422,230	485,565	519,554	555,923	594,838	636,476	681,070	728,702	779,771	834,291	892,691
Other	252,662	270,364	289,413	309,812	331,696	318,538	341,623	366,429	393,088	440,148	478,270	512,904	550,003	589,859
Land Acquisition	744,571	0	0	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	1,273,638	697,760	546,212	542,974	543,558	0	0	0	0	0	0	0	0	0
Sub Total	4,076,676	2,852,730	2,889,145	3,073,168	3,312,116	2,463,553	3,001,948	3,150,350	3,309,256	3,497,820	3,687,452	3,883,945	4,094,442	4,319,782
BALANCE:	-2,120,530	-787,528	-688,808	-773,277	-881,894	191,640	221,283	250,415	278,875	901,644	1,168,217	1,239,539	1,311,805	1,384,852

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Income											
Water Revenue	2,277,215	2,439,013	2,574,968	2,714,543	2,804,317	3,011,168	3,179,041	3,356,272	3,543,345	3,740,928	3,949,485
Domestic	1,009,466	1,081,189	1,141,465	1,203,102	1,243,125	1,334,820	1,409,236	1,487,801	1,570,746	1,658,315	1,750,766
Commercial	2,462,011	2,640,151	2,787,340	2,942,734	3,035,581	3,249,491	3,441,207	3,633,055	3,835,598	4,049,632	4,275,188
Sewer Revenue	141,808	146,062	150,444	154,957	159,696	164,943	169,491	174,206	179,092	184,155	189,400
Project Revenue	143,792	154,000	162,595	171,659	177,076	184,137	190,737	200,737	211,928	223,743	249,386
Other Revenue	6,037,291	6,400,424	6,816,831	7,192,496	7,419,704	7,980,559	8,420,713	8,885,262	9,375,563	9,893,047	10,439,224
Sub Total											
Expenses											
Other Loans	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000	388,000
Project Loan	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797	451,797
O&M Costs	2,007,593	2,148,124	2,298,493	2,459,387	2,631,544	2,815,752	3,012,855	3,223,755	3,449,418	3,690,877	3,949,238
Project O&M	70,943	75,909	81,223	86,909	92,992	99,502	106,467	113,920	121,864	130,426	139,556
Salaries & Wages	955,179	1,022,042	1,091,585	1,170,136	1,252,045	1,339,689	1,433,467	1,533,810	1,641,176	1,756,059	1,878,983
Other	633,235	681,954	731,574	784,499	837,102	902,961	969,120	1,040,245	1,116,717	1,198,943	1,287,365
Land Acquisition	0	0	0	0	0	0	0	0	0	0	0
Construction/Installation	0	0	0	0	0	0	0	0	0	0	0
Sub Total	4,508,727	4,767,627	5,044,672	5,341,128	5,653,481	5,997,701	6,373,705	6,781,001	7,226,102	7,706,939	8,223,285
BALANCE:	1,530,564	1,692,597	1,772,160	1,851,868	1,766,223	1,982,868	2,447,077	2,521,736	2,594,562	2,664,945	2,732,285

Accumulated Cash Flow = 25,253,058

Assumptions for base cash flow scenario

The base cash flow scenario is based on a number of assumptions. These assumptions are deemed reasonable but it must be remembered that the projections made in this study are for illustrative purposes only.

Water Production

The assumed water production of DWASA is shown in Table 10.4.6. The water production amounts are based on the data of Figure 7.7.3 in Chapter 7 of the Master Plan. The water production capacity is assumed to have a base amount of 80% of the initial capacity and then increase by 2.5% each year until a new water supply source comes on-line. The new actual water production amount is then assumed once again to be 80% of the possible production amount. Domestic water accounts for 88% of the total, while commercial accounts for the remaining 12%. The UfW ratio for 2001 is set at 32.5% in accordance with the Performance Agreement between DWASA and the GOB.

Water Tariff

Also shown in Table 10.4.6 is the assumed tariff rate per 1,000 gallons. The rate for the Cantonment is a hypothetical number as the actual tariff will have to be set as part of a detailed agreement between DWASA and the Cantonment. The domestic tariff in 2001 is set at Tk 18.98 per 1,000 gallons and is projected to climb 3.0% annually to Tk 38.58 per 1,000 gallons in 2025. A summary of these assumptions is shown in Figure 10.4.1 below.

Figure 10.4.1 Assumed Tariff Rate from 2001 to 2025

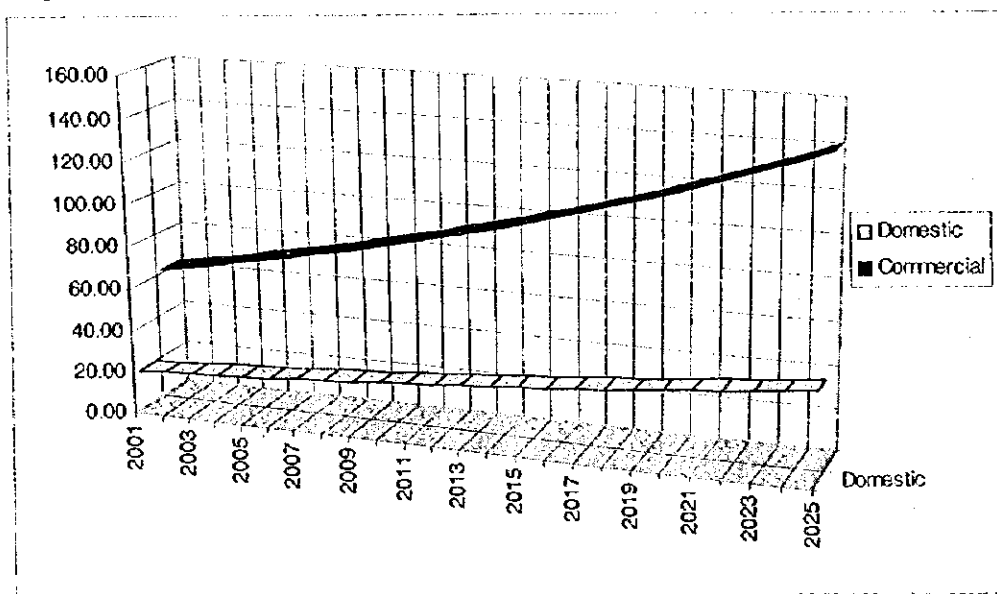


Table 10.4.6 Projected Water Production & Sale Quantities

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Production Capacity (MGY)	97,090	97,090	97,090	97,090	97,090	97,090	97,090	97,090	97,090	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800	140,800
Actual Production (MGY)	77,072	79,614	81,604	83,644	85,735	87,879	90,076	92,328	94,636	112,712	118,348	121,806	124,339	127,447	130,634	133,899	137,247	140,678	140,800	140,800	140,800	140,800	140,800	140,800	140,800
UPW	32,599	32,599	32,599	32,599	32,599	32,599	32,599	32,599	32,599	32,599	31,079	31,079	31,079	31,079	31,079	30,079	30,079	30,079	30,079	30,079	30,079	30,079	30,079	30,079	30,079
Available for Sale	52,429	53,739	55,093	56,460	57,873	59,338	60,901	62,523	64,179	76,041	81,660	85,701	89,794	93,939	98,137	102,380	106,675	111,023	115,324	119,579	123,788	127,950	132,066	136,137	140,164
Domestic Consumption	46,137	47,291	48,475	49,685	50,927	52,200	53,505	54,843	56,214	66,951	71,681	76,657	81,499	86,266	90,952	95,564	100,101	104,578	108,996	113,364	117,693	121,992	126,269	130,524	134,768
Commercial	6,291	6,449	6,610	6,775	6,945	7,118	7,296	7,479	7,665	9,130	9,790	10,444	11,095	11,742	12,386	13,026	13,662	14,294	14,922	15,546	16,166	16,782	17,394	18,002	18,606
Conservation Avg. Ann. New	0	0	3,225	4,968	6,650	8,293	9,940	11,589	13,242	7,460	7,466	7,594	7,692	7,792	7,900	7,979	8,059	8,139	8,221	8,306	8,393	8,487	8,581	8,677	8,773
Water Treated (T% per 1,000 gal)																									
Domestic	18.98	19.55	20.14	20.74	21.36	22.00	22.66	23.34	24.04	24.79	25.51	26.27	27.06	27.87	28.71	29.57	30.46	31.37	32.31	33.28	34.28	35.31	36.37	37.46	38.56
Commercial	61.70	63.55	65.46	67.42	69.44	71.53	73.67	75.84	78.16	86.50	92.92	95.41	97.97	100.61	103.33	106.13	109.01	111.94	114.94	118.19	121.44	124.78	128.22	131.77	135.42
Conservation (T% per m3)	4.25	4.38	4.51	4.64	4.78	4.93	5.07	5.23	5.38	5.55	5.71	5.88	6.06	6.24	6.43	6.62	6.82	7.02	7.24	7.45	7.68	7.91	8.14	8.39	8.64
Conservation Increase	0	0	15	25	32	33	35	37	39	41	43	45	47	49	51	53	55	57	59	62	64	67	70	72	75

Income

Sewer revenue is projected to amount to 51% of water revenues until the year 2006 when it is expected that this will be raised to 75% due to increases in DWASA's efficiency and scope of operations. Project revenue is based on the number of households in the project area. The details of the assumptions used for this data are shown in Table 10.4.7.

Other revenue is assumed to be 25% of the sum of the other income and accounts for meter sales, service connections, etc.

Expenses

Other loans are based on the outstanding loans of DWASA to various international funding organizations and are based on WB estimates. Additional details can be found in Table 10.4.8 Projected DWASA Expenses.

The Project loan is based on a 7% interest rate over a period of 30 years with a grace period of five years. Table 10.4.9 shows the disbursement schedule for this loan.

O&M costs are based on figures drawn from the DWASA balance sheet; O&M costs include power, repairs and maintenance, and chemicals. O&M costs are projected to increase by 15% annually until the year 2006 whereupon they are assumed to increase at an annual rate of 7%.

Project O&M includes the wages of the personnel of the facilities and is assumed to increase annually at a rate of 7%. Salaries and wages are projected from DWASA balance sheets. The annual increase is set at 15% until the year 2006 whereupon it is assumed to drop to 7% per annum.

The Other category is projected from DWASA balance sheets. The annual increase is set at 8%. This category includes insurance costs, provision for doubtful debt etc. as projected from DWASA balance sheets.

The Land Acquisition costs for the recommended project is based on the estimates obtained in Dhaka.

The Construction/Installation costs of the project were taken from Chapter 8.

Table 10.4.7 Core Area Projected Project Income

<u>DWASA Area Assumptions</u>		<u>Cantonment Area Assumptions</u>	
Total Target Population	386,000	Daily Avg. Sewage Flow	6,650 m ³ /day
Person per HH	6.7	Annual Avg. Sewage Flow	2,427,250 m ³ /day
No. of HH	57,612		
Avg. Monthly HH Income	15,536	1998 Base Charge for Sewage	3.67 m3
Avg. HH Annual Income	186,432		
Avg. Per Capita Water Use	166 lpd		
Avg. HH Annual Water Use	405,953 liters		
	107,172 gallons		
Avg. HH Annual Billing	107.171592	1,000 gal	

		2001	2002	2003	2004	2005
Annual Tariff:		0	0	0	0	0
Canton Income		0	0	0	0	0
Collection Rate						60%
Base Cash Flow	50%	0	0	0	0	0
Sensitivity Cashflow 2	35%	0	0	0	0	0
		2006	2007	2008	2009	2010
Annual Tariff:		2,358	2,429	2,502	2,577	2,654
Canton Income		33	35	37	39	41
Collection Rate						70%
Base Cash Flow	60%	81,513	83,958	86,477	89,071	107,034
Sensitivity Cashflow 2	45%	61,135	62,969	64,858	66,803	81,098
		2011	2012	2013	2014	2015
Annual Tariff:		2,734	2,816	2,900	2,987	3,077
Canton Income		43	45	47	49	51
Collection Rate						80%
Base Cash Flow	70%	110,245	113,552	116,959	120,468	141,808
Sensitivity Cashflow 2	55%	86,621	89,220	91,896	94,653	115,219
		2016	2017	2018	2019	2020
Annual Tariff:		3,169	3,264	3,362	3,463	3,567
Canton Income		53	55	57	59	62
Collection Rate						90%
Base Cash Flow	80%	146,062	150,444	154,957	159,606	184,943
Sensitivity Cashflow 2	65%	118,675	122,235	125,903	129,680	154,119
		2021	2022	2023	2024	2025
Annual Tariff:		3,674	3,784	3,898	4,015	4,135
Canton Income		64	67	70	72	75
Collection Rate						
Base Cash Flow	90%	190,491	196,206	202,092	208,155	214,400
Sensitivity Cashflow 2	75%	158,743	163,505	168,410	173,463	178,666

Table 10.4.8 Projected DWASA Expenses

EXPENSES	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
<i>Direct Expenses</i>																									
Power	502,423	577,766	664,454	764,123	879,741	940,253	1,046,071	1,076,466	1,151,850	1,232,460	1,318,753	1,411,666	1,509,641	1,613,430	1,724,617	1,849,620	1,979,095	2,117,636	2,265,964	2,424,474	2,594,185	2,775,781	2,970,085	3,177,041	3,404,450
Chemicals	17,153	19,726	22,685	24,098	30,001	32,101	34,348	36,752	39,325	42,078	45,023	48,175	51,547	55,155	59,016	63,147	67,568	72,297	77,358	82,773	88,567	94,767	101,401	108,499	116,994
Repairs & Maintenance	63,931	73,521	84,549	97,232	111,816	119,644	126,019	136,980	146,569	156,826	167,806	179,453	192,122	205,570	219,660	235,357	251,832	269,460	288,323	308,565	330,101	353,298	377,932	404,387	432,694
Direct Salaries & Wages	136,449	156,916	180,453	207,521	238,680	265,355	273,250	292,356	312,821	334,719	358,149	383,219	410,045	438,744	469,460	502,332	537,465	575,109	615,366	658,442	704,533	753,650	806,020	863,083	923,499
Other Expenses	175,844	186,981	147,951	159,787	172,570	146,375	201,265	217,348	234,779	253,461	273,866	295,754	319,414	344,967	372,565	402,379	434,540	469,324	506,870	547,420	591,214	638,511	689,502	744,759	804,300
<i>Direct Expense Total</i>	<i>846,800</i>	<i>944,941</i>	<i>1,100,049</i>	<i>1,254,780</i>	<i>1,431,778</i>	<i>1,533,728</i>	<i>1,642,952</i>	<i>1,759,972</i>	<i>1,885,344</i>	<i>2,019,666</i>	<i>2,163,576</i>	<i>2,317,767</i>	<i>2,482,968</i>	<i>2,659,970</i>	<i>2,846,617</i>	<i>3,052,816</i>	<i>3,270,537</i>	<i>3,503,920</i>	<i>3,753,741</i>	<i>4,021,614</i>	<i>4,308,602</i>	<i>4,616,116</i>	<i>4,945,629</i>	<i>5,296,719</i>	<i>5,677,077</i>
<i>Administration Expenses</i>																									
Salaries	141,175	162,351	146,703	214,709	246,915	264,199	282,693	302,442	323,653	346,311	370,553	396,492	424,246	453,943	485,719	519,720	556,100	595,027	636,679	681,247	728,934	779,459	834,556	892,475	955,384
Other Expenses	26,447	28,562	30,847	33,315	35,980	38,859	41,967	45,325	48,951	52,867	57,060	61,664	66,597	71,925	77,679	83,895	90,604	97,653	105,641	114,135	123,246	133,126	143,778	155,280	167,702
Insurance	564	581	598	616	635	654	673	694	714	736	758	781	804	828	853	879	908	932	960	989	1,018	1,049	1,080	1,113	1,146
Prov. for Doubtful Debt	97,897	107,359	109,017	115,095	121,611	127,650	134,697	142,023	149,844	158,194	166,970	176,187	185,854	195,993	206,613	217,719	229,305	241,368	253,901	266,917	280,417	294,404	308,871	323,791	339,177
<i>Admin. Exp. Total</i>	<i>266,062</i>	<i>294,754</i>	<i>327,168</i>	<i>393,735</i>	<i>408,041</i>	<i>395,362</i>	<i>422,031</i>	<i>450,525</i>	<i>480,994</i>	<i>511,908</i>	<i>544,077</i>	<i>577,642</i>	<i>612,654</i>	<i>649,805</i>	<i>688,370</i>	<i>728,304</i>	<i>769,614</i>	<i>812,114</i>	<i>855,911</i>	<i>901,768</i>	<i>949,640</i>	<i>1,000,644</i>	<i>1,054,962</i>	<i>1,112,660</i>	<i>1,173,519</i>

The salaries, etc. for the additional personnel for the project facilities have been included in the above figures.

NOTE:

(1) Revolving Fund for Consumer Connection Fees

In this project, the costs for the fund mentioned in Chapter 9 to be used to promote consumer participation in the project, were calculated. For the sake of this Feasibility Study, it was assumed that DWASA would make a revolving fund available to households that were willing to connect to the system. The details of this fund (loan terms, etc.) would have to be worked out after discussion between DWASA and the relevant authorities and would have to be structured in a manner that would preclude waste and abuse.

As part of this financial analysis, it was assumed that a fund of Tk 20,000,000 (approximately US\$ 450,000) would be made available and that this amount would be part of the loan extended to DWASA. This amount is based on the fact that the average cost of connecting to the sewer system is an estimated Tk 6,000 to Tk 8,000 per household and there are an estimated 57,612 households in the project area (the approximate total loan demand would be Tk 150,000,000 assuming a 50% connection ratio). The addition of this loan would have minimal impact on the debt burden of DWASA.

10.4.2 Funding Scheme/Investment Schedule

The assumed financing for the project is a 30-year soft loan at 7% interest, and a 5-year grace period. The particulars of the loan are shown in Table 10.4.9. However, to illustrate the impact of different loan interest rates, Table 10.4.10 contains the debt service costs for the recommended project resulting from different interest rates along with their associated FIRR returns under the base scenario assumptions.

Table 10.4.9 Projected Debt Service Burden for Recommended Project

Loan Amount:		5,265,053				
Interest Rate:	10%	8%	6%	4%	2%	
Annual Debt Service	580,041	493,244	411,688	337,026	269,268	
FIRR (base)	11.26%	12.64%	14.02%	15.38%	16.07%	

Note: costs in Tk ('000)

Table 10.4.10 Loan Disbursement Schedule

Figures = Taka x 1,000

YEARS: 25 RATE: 7.00% GRACE (yrs): 5

Year	Principal	Interest	Payment	Loan
2001	0	0	0 Grace	
2002	0	0	0 Grace	
2003	0	0	0 Grace	
2004	0	0	0 Grace	
2005	0	0	0 Grace	
2006	83,243	368,554	451,797	5,265,053
2007	89,070	362,727	451,797	5,181,810
2008	95,305	356,492	451,797	5,092,740
2009	101,977	349,820	451,797	4,997,434
2010	109,115	342,682	451,797	4,895,458
2011	116,753	335,044	451,797	4,786,343
2012	124,926	326,871	451,797	4,669,590
2013	133,670	318,127	451,797	4,544,664
2014	143,027	308,770	451,797	4,410,994
2015	153,039	298,758	451,797	4,267,967
2016	163,752	288,045	451,797	4,114,928
2017	175,215	276,582	451,797	3,951,176
2018	187,480	264,317	451,797	3,775,961
2019	200,603	251,194	451,797	3,588,481
2020	214,645	237,151	451,797	3,387,878
2021	229,671	222,126	451,797	3,173,233
2022	245,748	206,049	451,797	2,943,562
2023	262,950	188,847	451,797	2,697,814
2024	281,356	170,441	451,797	2,434,864
2025	301,051	150,746	451,797	2,153,508
2026	322,125	129,672	451,797	1,852,457
2027	344,674	107,123	451,797	1,530,332
2028	368,801	82,996	451,797	1,185,658
2029	394,617	57,180	451,797	816,857
2030	422,240	29,557	451,797	422,240
	5,265,053	6,029,870		

The terms of the loan used in the base scenario were chosen to reflect an average rate (the IBRD is 7.74%, the IDB is 8.1%, and the ADB is 6.37%). There is also lower interest rate financing available from the IDA (0%) and the OECF (2.74% or 0%). However, it was decided to use a higher interest rate (although a low discount rate was applied—2.5% in the FIRR) to give a more rigorous result.

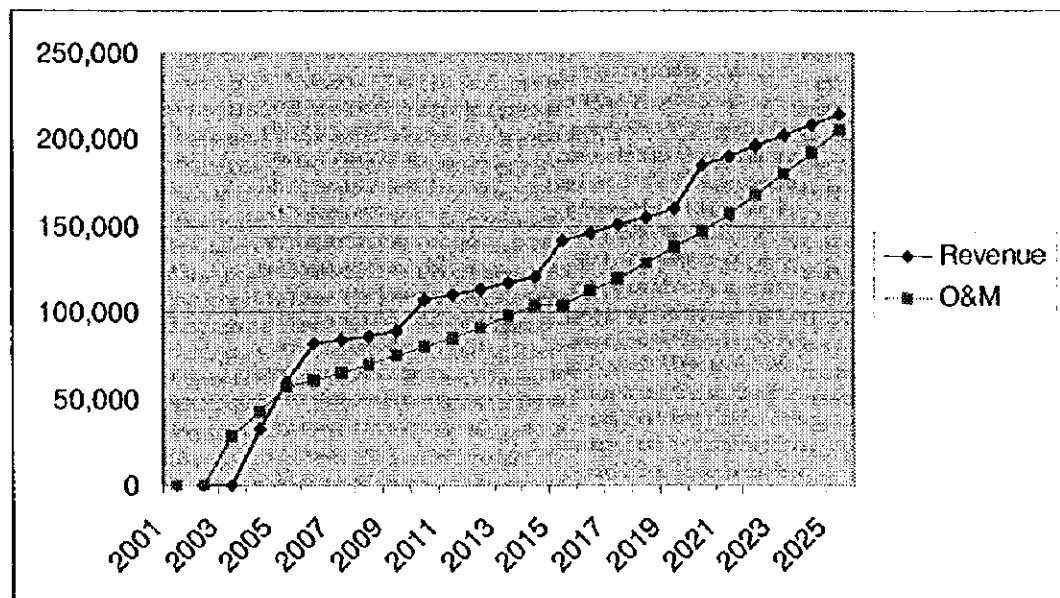
It must be pointed out that the financial condition of DWASA will not be able to cope with the debt requirements associated with higher interest loan. This assertion is based on the fact that DWASA is now attempting to undertake a series of institutional/financial changes and that in such an environment financial burdens should be minimized. Therefore most advan-

lagueous financing terms possible should be arranged, possibly through the IDA or OECF.

(1) O&M Costs vs. Operating Budget

The O&M costs of a project are usually a significant factor in project affordability. However, the O&M costs of this project can be met by the income projected to be generated by the project. To illustrate this, the graph below shows the amounts of revenue and O&M costs (Tk '000) over the 2001-2025 period.

Figure 10.4.2 Project Revenue and O&M Costs Comparison



10.4.3 Conclusion

To determine the viability of any proposed project, all costs and benefits will be transformed to represent their values at an appropriate discount rate. This is the rate assumed to represent the opportunity cost of capital. A low discount rate, however, is considered justified, as this project shall benefit low-income persons. If the FIRR is above the cost of capital, then it can be assumed that the project is feasible; i.e. the financial benefits exceed the financial costs at the prevailing opportunity cost of capital.

Table 10.4.11 shows the FIRR of the base scenario and the three alternative scenarios. The base scenario is FIRR is 13.33%, which is above the cost of the capital of the project (2.5%) and therefore the recommended project is deemed feasible (given the assumed conditions).

TABLE 10.4.11 SENSITIVITY ANALYSIS FOR RECOMMENDED PROJECT

Discount Rate	Base Scenario	2.50%			
		YEAR	BALANCE	NPV	
		2001	-1,855,673	-1,810,412	
		2002	-787,528	-768,320	
		2003	-688,808	-672,008	
		2004	-755,245	-736,824	
		2005	-863,862	-842,793	
		2006	194,185	189,448	
		2007	223,965	218,522	
		2008	253,305	247,127	
		2009	281,967	275,090	
		2010	904,953	882,881	
		2011	1,171,758	1,143,178	
		2012	1,243,328	1,213,003	
		2013	1,315,859	1,283,765	
		2014	1,389,189	1,355,306	
		2015	1,539,542	1,501,992	
		2016	1,702,404	1,660,687	
		2017	1,782,439	1,738,965	
		2018	1,862,867	1,817,431	
		2019	1,777,992	1,734,627	
		2020	1,995,451	1,946,782	
		2021	2,460,482	2,400,470	
		2022	2,536,154	2,474,297	
		2023	2,609,989	2,546,331	
		2024	2,681,452	2,616,051	
		2025	2,749,948	2,682,876	
			FIRR	13.33%	

Sensitivity 1: 10% Increase in O&M Costs			
YEAR	BALANCE	NPV	
2001	-1,855,673	-1,810,412	
2002	-787,528	-768,320	
2003	-688,808	-672,008	
2004	-755,245	-736,824	
2005	-863,866	-842,793	
2006	190,578	185,930	
2007	215,881	210,616	
2008	239,638	233,793	
2009	261,463	255,086	
2010	876,093	854,725	
2011	1,132,731	1,105,104	
2012	1,191,981	1,162,908	
2013	1,249,633	1,219,154	
2014	1,305,044	1,273,214	
2015	-97,545	-91,263	
2016	654,531	638,567	
2017	703,581	686,420	
2018	1,355,365	1,322,307	
2019	1,241,633	1,211,349	
2020	1,693,908	1,652,593	
2021	2,096,266	2,045,138	
2022	2,097,522	2,046,363	
2023	2,083,073	2,032,266	
2024	2,049,880	1,999,882	
2025	1,994,398	1,945,754	
	FIRR =	10.95%	

Sensitivity 2: Lower Tariff Collection Rate			
YEAR	BALANCE	NPV	
2001	-1,855,673	-1,810,412	
2002	-787,528	-768,320	
2003	-688,808	-672,008	
2004	-755,245	-736,824	
2005	-863,862	-842,793	
2006	173,806	169,567	
2007	202,995	198,044	
2008	231,686	226,035	
2009	259,699	253,365	
2010	882,017	860,505	
2011	1,148,134	1,120,131	
2012	1,218,995	1,189,264	
2013	1,290,796	1,259,313	
2014	1,363,375	1,330,122	
2015	1,508,616	1,471,820	
2016	654,531	638,567	
2017	703,581	686,420	
2018	1,355,365	1,322,307	
2019	1,241,633	1,211,349	
2020	1,693,908	1,652,593	
2021	2,096,266	2,045,138	
2022	2,097,522	2,046,363	
2023	2,083,073	2,032,266	
2024	2,049,880	1,999,882	
2025	1,994,398	1,945,754	
	FIRR =	11.71%	

Sensitivity 3: Land Costs +50%			
YEAR	BALANCE	NPV	
2001	-2,120,530	-2,068,809	
2002	-787,528	-768,320	
2003	-688,808	-672,008	
2004	-755,245	-736,824	
2005	-881,894	-860,385	
2006	191,660	186,985	
2007	221,283	215,886	
2008	250,415	244,307	
2009	278,875	273,073	
2010	901,644	879,653	
2011	1,168,217	1,139,724	
2012	1,239,539	1,209,307	
2013	1,311,805	1,279,810	
2014	1,384,852	1,351,075	
2015	1,530,564	1,493,233	
2016	1,692,597	1,651,314	
2017	1,772,160	1,728,936	
2018	1,851,868	1,806,700	
2019	1,766,223	1,723,144	
2020	1,982,858	1,934,496	
2021	2,447,007	2,387,324	
2022	2,521,736	2,460,230	
2023	2,594,562	2,531,280	
2024	2,664,945	2,599,946	
2025	2,732,285	2,665,644	
	FIRR =	12.71%	

Note: a discount rate of 2.5% is applied due to the public service nature of the project

CHAPTER 11
SOCIO-ECONOMIC ANALYSIS



CHAPTER 11 SOCIO-ECONOMIC ANALYSIS

11.1 Project Benefits

The value of the Project will be viewed in terms of economics as well as purely financial terms. A sewerage Project provides the community with a wide range of economic benefits that, while sometimes not readily apparent to the average citizen, are nonetheless significant in terms of health, sanitation and overall living conditions. The various benefits expected to be brought about by the Project are discussed in the following sections. Unfortunately, the overall poor health/sanitation conditions in Dhaka make the direct impact of the sewage Project more difficult to Project with any degree of validity. In addition, the lack of data severely hampered efforts to present an economic analysis.

11.1.1 Economic Benefits of the Project

(1) Health benefits

Benefits pertaining to health, which are one the main reasons for installing a sewerage system, involves both the community concerned and the individuals in the area. The anticipated benefits concerning health, viewed from the public's and the individual's standpoints, are detailed below.

Public Health Benefits

The health benefits that accrue to the community from the sewerage system have two aspects. Namely, 1) the preventive effect brought about by the sewerage system reduces the burden on the local and central governments concerned with disease prevention and patient treatment activities, and 2) the reduction of opportunities of contact with infected matters reduces the incidence of diseases on the part of the individual.

Regarding the first item above, budgetary and physical provisions of the government will be reduced with respect to the requirements of chemical disinfection for prevention of epidemics, and of hospitals together with the necessary personnel, equipment and materials. Regarding the second item, details are presented in the following subsection.

3) Individual Health Benefits

The provision of the proposed sewerage system will result in health benefits to individuals in the service area, such as the reduction in the risk and incidence of water-borne diseases, the consequent elongation of people's life spans, reduced expenditure on medical care, reduction in income loss because of absence from work, and others.

The mortality and morbidity rates associated with water-borne diseases in the Dhaka are fairly high—especially among the urban poor/slum dwellers. For example, the incidence of persons suffering from diarrhea by period was as follows:

<u>Period</u>	<u>Incidence (per 1,000)</u>
Mid-Feb. '94 to Mid-Feb. '95	18.08
Mid-Feb. '94 to Mid-May '94	20.71
Mid-Aug. '94 to Mid-Nov. '94	20.23
Mid-Nov. '94 to Mid-Feb. '95	13.19

Unfortunately, the amount of relevant data relating to water-borne diseases is quite limited in Bangladesh. In any case, the validity of the data is open to question. Another limiting factor is that the vast majority of people in Dhaka do not visit organized care facilities when they are ill. This is due to the general scarcity of health care facilities and to the fact that only relatively wealthy people can afford such care.

The general lack of valid data makes quantification of the possible economic benefits relating to cost of time lost due to illness extremely difficult.

(2) Environmental benefits

One of the primary purposes of the Project, as important as health improvement, is the enhancement of the living conditions in areas where water and air pollution have been worsening every year. This will be achieved by the construction of the currently planned sewerage system project, in the following forms:

Improvement of Environment from Aesthetic Standpoint

The unpleasant and filthy conditions of the area will be reduced by some extent by the proposed Project. The offensive smell emitted by the sludge and trash in the area will

likewise be reduced. Thus, in areas where human activities are most concentrated, the living conditions in the Project Area will be enhanced to a degree.

(3) Local economic benefits

The construction of the sewerage system will contribute to the local economy in several ways. First, the land values in the area will appreciate, and together with such an increase in land value, related properties will also rise in value. Second, the construction of the system will boost the sales of local materials and equipment.

1) Value added to land

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

In the Project area, the benefit is considered significant because the project area contains significant portions of land which are in areas destined to be in high-growth areas in the future under the DNDP Urban Development Plan. However, due to the current conditions in Dhaka, a viable estimation of the projected economic benefits for this item was not possible.

2) Intensified land use

When sewerage systems become available, together with other public utilities in general, the land in the area can be more intensively used, as the present Project is implemented. More people can be supported and more activities in industry, commerce and others can be conducted in the Project area. This Project will, therefore, contribute to the development of the area through intensified land use. However, these economic benefits cannot be immediately quantified.

11.1.2 Public Revenue Benefits

The appreciation in land values will produce an increase in tax revenues. Second, commercial, residential, and other buildings will increase in number and improve in quality; thus, property taxes will increase. This benefit cannot be readily quantified, but it could constitute an important and reliable tax source for the governments concerned.

(1) Employment and local products benefits

During the construction period, the local economy will benefit from the employment of individuals for construction work and through the sale of locally made products and services. The amount of investment for this Project is considerable. The Project, after completion, will also provide permanent employment opportunities for a number of people related to the operation and maintenance of the sewerage system, both in direct and indirect economic terms (i.e. the benefits of those directly employed and the benefits to those who sell goods/services to such people).

To illustrate the economic costs of the Project, a technique called “shadow pricing” is used. In this technique the economic costs of the Project’s components are calculated. For illustrative purposes, the shadow pricing calculation is shown in Table 11.2.1.

11.2 Economic Analysis

11.2.1 Introduction

The economic analysis of sewage Projects in developing countries is not an exact science due to the existing sanitation, education, and health conditions. In addition, much of the data taken for granted in developed countries is simply not available and many (if not most) of the assumptions used are purely conjectural.

While the economic benefits of a sewerage system can be identified to a certain extent, as shown above, the majority of these benefits cannot be quantified. The value of cleaner air, water, and improved sanitation are understandable to all but any attempt to apply numerical values to such benefits is an elusive exercise at best. The costs of a sewerage project are more identifiable, but the exercise of comparing the costs and benefits of a Project such as this are not going to be of any use in real terms. The EIRR and Benefit/Cost analysis will always be negative due to the lack of “hard data” and the assumptions of the benefit values would be suspect.

However, the economic viability of a Project can be determined, in terms of the beneficiaries’ ability-to-pay (affordability) and willingness-to-pay. The affordability of the Project in financial terms was demonstrated in Chapter 10 but the economic validity of the Project can be seen in the ability of the beneficiaries to afford the system.

Table 11.2.1 Economic Project Costs

Construction Work	Financial Proj. Cost	Foreign Exchange Component	Domestic Component	Foreign Portion Tax (20%)	Local Portion Tax (15%)	ForEx Comp x 1.5	Unskilled Labor x .05	Economic Cost
Sewer System	685,309	538,611	146,698	646,333	168,703	969,500	8,435	977,935
Trunk Main	334,621	334,621						
Supplementary Pipe	203,990	203,990						
Branch Sewer	146,698		146,698					
Merul Pump Station	235,401	235,033	59,373	282,040	68,279	423,059	34,139	457,199
Civil Work	59,005	59,005	59,005					
Civil Work	368		368					
M&E Work	176,028	176,028						
Gulshan Pump Station	150,576	150,232	344	180,278	396	270,418	198	270,615
Civil Work	32,117	32,117						
Civil Work	344		344					
M&E Work	118,115	118,115						
Sewage Treatment Plant	1,977,763	1,022,934	954,829	1,227,521	1,098,053	1,841,281	549,027	2,390,308
Civil Work	835,893	835,893						
Civil Work (reclamation)	925,020		925,020					
Civil Work (others)	29,809		29,809					
M&E Work	187,041	187,041						
TOTAL	3,049,049						TOTAL	4,096,057

11.2.2 Social Aspects

The social aspects of the Project, in other words how the Project will directly affect the lives of the people in the Project area, were considered. Efforts were taken to consider any unique characteristics the wards/pourshavas in terms of the relative affluence of the people and their requirements/desires in terms of the sanitation and income levels.

11.2.3 Residents' Willingness and Ability to Pay

(1) Willingness-to-pay

The willingness to pay for the sewerage system was measured in the Household Survey on Sanitation conducted in DEVCONSultants Ltd. In this survey, it was found that of the independent and apartment house dwellers, around 95% were willing to pay for sewerage service. Slum dwellers, on the other hand, were only willing to pay 30% of the time.

(2) Ability to Pay

The Household Survey on Sanitation found that the apartment and independent house dweller were willing to pay around Tk 200 per month. This is roughly half of their existing water tariff bill. However, the existing official sewerage tariff is 100% of the existing water bill. The average income in the study area varies greatly from area to area, but a simple average produces an amount of Tk 15,536 per household per month.

In many Projects, the ability to pay is commonly expressed as the ratio of the proposed sewerage charge to the total income of potential beneficiary households. The maximum limit of the ratio usually adopted for sewerage charges in developing countries is about 2%. If the proposed sewerage charge is below 2% of household income, the owners of such households are considered capable of paying the sewerage charge.

To determine the affordability of the Project's tariff rate, the annual tariff charged for sewage (DWASA charges equally for water and sewage as noted in Chapter 10) was compared to the average household income in the target area. The affordability of the Project was calculated as shown below Table 11.2.2.

Table 11.2.2 Sewerage Tariff Affordability

Year	Annual HH Income	Sewage Tariff (Tk/000 gal)	Annual Bill (Tk)	% of Income
2001	186,432	18.98	2,034	1.09
2002	186,432	19.55	2,095	1.12
2003	186,432	20.14	2,158	1.16
2004	186,432	20.74	2,223	1.19
2005	186,432	21.36	2,289	1.23
2006	186,432	22.00	2,358	1.26
2007	186,432	22.66	2,429	1.30
2008	186,432	23.34	2,502	1.34
2009	186,432	24.04	2,577	1.38
2010	186,432	24.76	2,654	1.42
2011	186,432	25.51	2,734	1.47
2012	186,432	26.27	2,816	1.51
2013	186,433	27.06	2,900	1.56
2014	186,434	27.87	2,987	1.60
2015	186,435	28.71	3,077	1.65
2016	186,436	29.57	3,169	1.70
2017	186,437	30.46	3,264	1.75
2018	186,438	31.37	3,362	1.80
2019	186,439	32.31	3,463	1.86
2020	186,440	33.28	3,567	1.91
2021	186,441	34.28	3,674	1.97
2022	186,442	35.31	3,784	2.03
2023	186,443	36.37	3,898	2.09
2024	186,444	37.46	4,014	2.15
2025	186,445	38.58	4,135	2.22

This analysis used the same assumptions for household size (6.7 persons), income, water usage, etc. as in Chapter 10.

It can be seen in the above analysis that the overall tariff affordability is quite good. The income level of the average household was kept static, although the tariff charged by DWASA reflects an annual 3% increase. This was done to take into account the possible future loss of purchasing power by the beneficiaries and thereby provides a less optimistic view of the affordability of the tariff rate.

The viability of the Project in economic terms was further enhanced by the fact that the Tk 200 per month figure (Tk 2,400 annually) determined in the willingness-to-pay survey is met up to the year 2006. In terms of real income this is a favorable indication as it is very probable that the income level of the target beneficiaries will improve over time and that the willingness-to-pay will increase proportionally.

11.3 Conclusions

Bangladesh is one of the most densely populated countries in the world and as the migration rural persons to Dhaka City continues, along with the commercial/industrial growth of Dhaka City, the need for sanitation will continue to increase as well. Furthermore, the existing sanitation conditions in the Project area are already unsatisfactory and will rapidly deteriorate to an even lower level without a sewerage system.

The analyses performed above, while imperfect in terms of costs/benefits and BIRR, indicate the overall economic viability of the Project due to the affordability of the Project and the many positive impacts (in unquantifiable terms) on the target area's living environment.

CHAPTER 12
ENVIRONMENTAL IMPACT
ASSESSMENT (EIA)



CHAPTER 12 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

12.1 General

As an integral part of the feasibility study, an Environmental Impact Assessment (EIA) was conducted for the proposed scope of the priority project. Specifications adopted to this EIA was prepared based on the results of the Initial Environmental Evaluation (IEE) conducted during the Stage 1 field work from May to July, 1997 (refer to "Chapter 14 Environmental Aspects" of the Interim Report of the Study, September 1997).

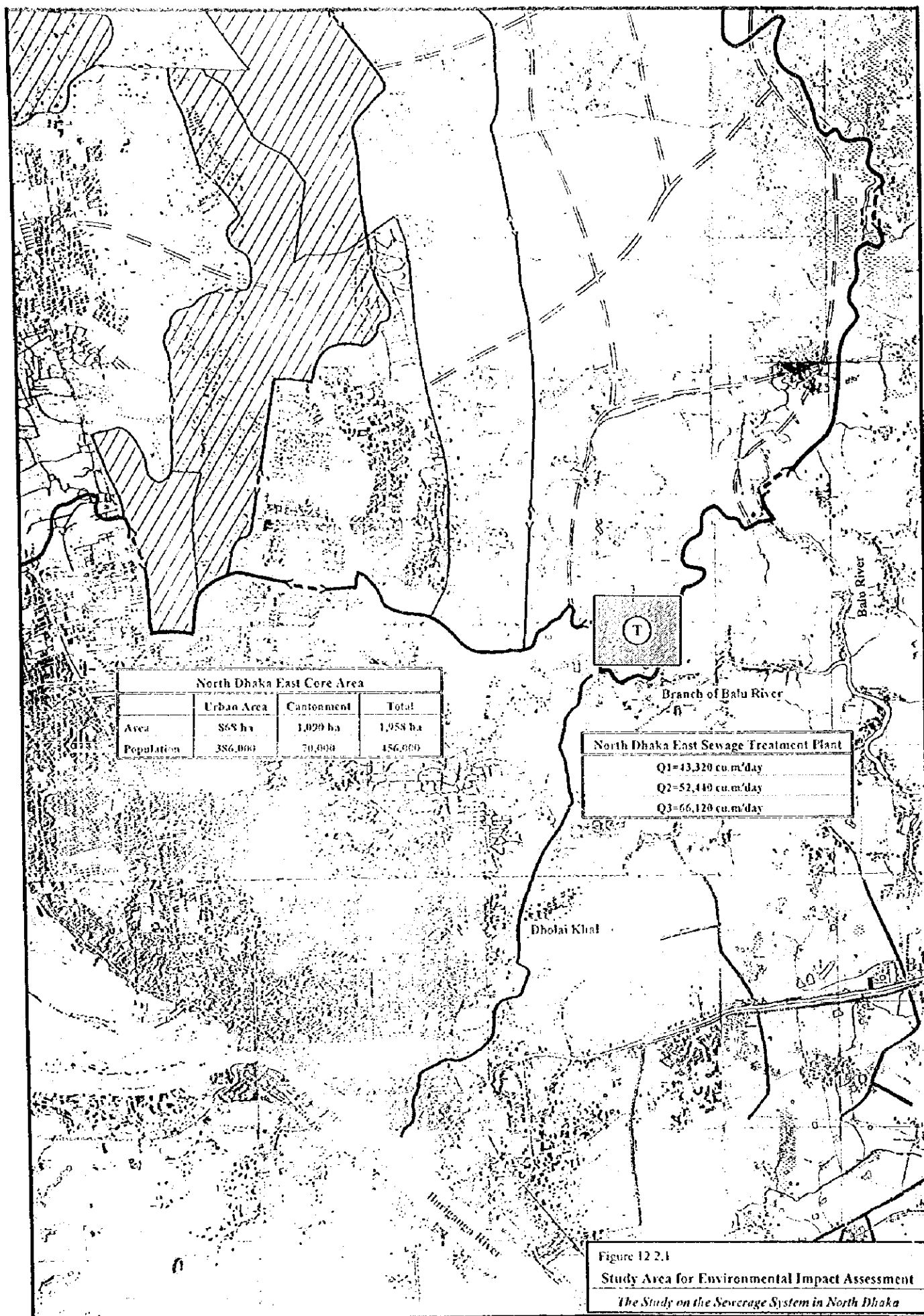
Although the proposed project has a principal benefit to help maintain desirable environmental sanitation in Dhaka City, several environmental impacts were anticipated to be occurred during and after the implementation of priority project. Among others, those which identified in the IEE were, for example, loss of flood plain fisheries, resettlement of local residents from the proposed site of sewage treatment plant, construction hazard, i.e. traffic jam, and water quality problem to downstream of receiving water body by discharge of treated effluent.

EIA study was contracted out to the local consultants and carried out during the Stage 2 fieldwork under the guidance and supervision of the Study Team. The results of EIA were then evaluated during the Stage 2 domestic work and incorporated into this Draft Final Report.

12.2 Scope of EIA

12.2.1 Study Area of EIA

The Study Area shall cover the North Dhaka East Core Area being identified as the target area of priority project for feasibility study. Possible location of main sewer lines and possible site to locate sewage treatment plant are indicated in Figure 12.2.1.



12.2.2 Conditions and Requirements of EIA

(1) Project description

Although the feasibility study of the priority project (North Dhaka East area) is yet under preparation, the presumed project description is prepared as shown in Table 12.2.1.

(2) Environmental conditions of the Project

Environmental conditions of the Project so far as clarified as this moment are described in terms of social environment, natural environment and public nuisance as shown in Table 12.2.2. The local consultants was required to examine the environmental conditions in the Study Area for further discrimination of such conditions.

Table 12.2.1 Project Description

Item		Description
Project Name		Feasibility Study on the North Dhaka East Sewerage System
Project Background		The North Dhaka East core area is identified as the target area of priority project for feasibility study based on the master plan study for the North Dhaka Area. The identified area shows a rapid urban development associated with high rate of population growth. The urgency to develop basic facility of sewerage system in this area is thus urgently required.
Objective of the Project		To develop a feasibility study on the priority project (North Dhaka East core area) for the target year of 2005.
Project Location		North Dhaka East core area covering Banani, Badda, Gulshan, Baridhara, and Cantonment (residential area)
Executing Agency		Dhaka Water Supply and Sewerage Authority (DWASA)
Number of Beneficiaries		Projected population in the target area in 2005 is estimated at about 456,000 based on the Dhaka Metropolitan Development Plan (DMDP) prepared by RAJUK.
Scope of Project	Type of Project	Development of New Sewerage System (sewer lines, pumping stations and sewage treatment plant)
	Project Area	Area: About 1,958 ha (including 1,090 ha of Cantonment) Planned Population: 456,000 (including 70,000 of Cantonment) Planned Sewage Flow: About 43,320 cu.m/day (daily average)
	Sewage Collection Method	Separate Sewer System
	Sewage Treatment Plant	Treatment Method: Stabilisation Pond Treatment Capacity: 43,320 cu.m/day (daily average)
	Sludge Treatment/Disposal	Sludge Lagoon (sun drying)
	Sewer Pipeline	Diameters ranging from about 300 mm to 1,500 mm
	Effluent Disposal	Discharge Point: Dholai Khal connected to the Buriganga River Effluent Quality: BOD \leq 40 mg/L; SS \leq 100 mg/L

Table 12.2.2 Environmental Conditions of the Project

Item		Description
Project Name		Feasibility Study on the North Dhaka East Sewerage System
Social Environment	Local Residents (Awareness on inhabitants/ aborigines/project)	Majority of local residents are private and government employees with their dependants and increasing migrants.
	Land Use (City/agriculture/historic ruins/ sightseeing spots/hospitals, etc.)	National capital city, under redevelopment and expansion of urban area with rapid population increase, encounters flooding/inundation in low elevation area during rainy season.
	Economy/Transportation (Commerce/agro-fisheries/ industrial estate/bus terminal)	Proposed site of sewage treatment plant is currently swamp area and limited number of families are working for fisheries.
Natural Environment	Topography/Geology (Steep slope/loose foundation/ swamp/faults)	The city has been developed on flood plain and delta area and includes many low lands wherein flooding/inundation occurs during rainy season.
	Conditions of Coastal Area (Erosion, sand deposits, tidal current, etc.)	Not Applicable
	Important Fauna & Flora (Natural park, endangered species, etc.)	Not identified yet.
Public Nuisance	Status of Public Complaints (Noteworthy public nuisance)	Flooding/inundation, deterioration of sanitary conditions, water pollution and offensive odour
	Status of Adopted Countermeasures	Laws and regulations on environmental protection are in force, but not officially acknowledged. Houses in unserved area of sewerage system are obliged to have septic tanks, but their untreated grey water is discharged into nearby water courses.

12.2.3 Scope of Work for EIA

(1) Results of scoping

The IEE conducted during the master plan preparation is shown in Table 12.2.3.

Table 12.2.3 Results of Scoping

Item			Score	Description
Social Environment	1	Relocation of Local Residents	C	Depending on location of sewage treatment plant
	2	Economic Activity	C	Same as above
	3	Transportation & Social Facilities	C	Same as above
	4	Separation of Local Society	D	No separation foreseen
	5	Ruins & Cultural Assets	C	No presence identified so far
	6	Water Right & Right of Common	C	Depending on location of effluent discharge point
	7	Public Hygiene	C	Depending on disposal manner of excess sludge
	8	Wastes from Project	B	Same as above
	9	Natural Disaster	C	No significant interference to flood control is foreseen.
Natural Environment	10	Topography & Geology	D	No significant change planned
	11	Soil Erosion	D	Same as above
	12	Groundwater	C	Depending on disposal manner of excess sludge
	13	River, Lake & Pond	C	Depending on location of effluent discharge point
	14	Coast & Sea	D	No coastal line exists
	15	Flora & Fauna	D	No endangered species identified yet
	16	Climate	D	No large scale facility planned
	17	Scenery	D	Same as above
Public Nuisance	18	Air Pollution	C	Possible, if excess sludge is incinerated
	19	Water Pollution	C	Depending on location of effluent discharge point
	20	Soil Pollution	C	Depending on disposal manner of excess sludge
	21	Noise and Vibration	C	Depending on location conditions of sewage treatment plant/s and pumping station/s
	22	Land Subsidence	D	No groundwater utilisation planned
	23	Odour	B	Possible to emit odour from sewage treatment plant/s and pumping station/s

Note: Score; A - Significant impact anticipated.

B - Slight impact anticipated

C - Unknown (subject to further verification)

D - Almost no impact anticipated and not subject for IEE (Initial Environmental Evaluation) and EIA (Environmental Impact Assessment)

(2) Overall evaluation in IEE

An overall evaluation on the anticipated environmental impacts was then carried out during the course of IEE as shown in Table 12.2.4.

Table 12.2.4 Preliminary Overall Evaluation on Anticipated Environmental Impacts

Item	Score	Scope of Required Study	Remarks
Wastes from Project	B	Disposal method of excess sludge	
Odour	B	Climate Present conditions of similar facilities	Direction and velocity of wind
Relocation of Local Residents	C	Site conditions of pumping station and treatment plant	
Economic Activity	C	Same as above	
Transportation & Social Facilities	C	Same as above	
Ruins & Cultural Assets	C	No presence identified so far	
Water Right & Right of Common	C	Conditions at effluent discharge point	
Public Hygiene	C	Disposal method of excess sludge	
Groundwater	C	Disposal method of excess sludge Review of possible leachate	
River, Lake & Pond	C	Conditions at effluent discharge point	
Air Pollution	C	To be studied, if sludge is to be incinerated	Direction and velocity of wind
Water Pollution	C	Impact to receiving water body of effluent	
Soil Pollution	C	Disposal method of excess sludge	
Noise and Vibration	C	Site conditions of pumping station and treatment plant	

Note: Scores are to be referred in Table 12.2.3.

(3) Summary of main negative impacts and their countermeasures identified in IEE

The IEE was conducted for the preliminary master plan, while additional master plan alternatives were further considered and evaluated taking into account the inclusion of domestic sewage to be generated in the Cantonment Security Zone (military installation). However, such additional alternatives did not show any remarkable change on the general configuration of preliminary alternatives in view of potential/anticipated environmental impacts.

As a whole, it is regarded that the implementation of the proposed sewerage system development will bring about significant improvement of urban sanitation in the project area. But, the proposed project necessitates a comprehensive environmental study, so called the Environmental Impact Assessment (EIA), on some major potential impacts, so that appropriate preventive measures can be taken up during planning, design and implementation phases to avoid costly environmental restoration afterward.

The IEE report identified issues on anticipated environmental impacts and prospective countermeasures to avoid or to mitigate such negative impacts beforehand, as shown in Table 12.2.5.

Table 12.2.5 Summary of Main Negative Impacts and Their Countermeasures Identified in IEE

No.	Project Activity	Possible Negative Impacts	Identified Countermeasures
1	Land acquisition (flood plain, swamp-land, high land)	<ul style="list-style-type: none"> - Ecological loss - Loss of agricultural land - Loss of flood plain fisheries - Resettlement issues 	<ul style="list-style-type: none"> - Careful relocation (alternative sites) - Provision of a nearby compensation
2	Construction of <ul style="list-style-type: none"> - Treatment plant - Pump station - Sewer mains 	<ul style="list-style-type: none"> - Community displacement - Construction hazard - Regional drainage problem - Navigation - Traffic hazard - Health hazard 	<ul style="list-style-type: none"> - Provision of adequate street - Careful relocation of site - Employment of displaced persons in project works - Proper planning and management - Navigation facility to regional/local areas - Adequate protection & public relations
3	Operation & Maintenance	<ul style="list-style-type: none"> - Inadequacy in O&M - Downstream water quality problem - Health hazard 	<ul style="list-style-type: none"> - Check & analysis of design - Develop proper O&M guidelines including monitoring - Application of preventive & remedial measures - Monitor health problem - Proper monitoring & develop public relations

(3) Scope of work for EIA

The following work shall be undertaken by the local consultants in the course of EIA study:

1) Laws and regulations on EIA, environmental protection and sewerage project

The existing laws and regulations pertaining to the EIA, environmental protection and sewerage project shall be collected and reviewed to identify the need and field of EIA.

Legislative requirements on environmental aspects relative to the implementation of sewerage project shall be clarified. This particular study shall cover not only the existing laws and regulations, but also such requirements under consideration or proposed for the governmental approval.

2) Itemised assessment of anticipated environmental impacts

Based on the results of IEF, particularly shown in Tables 12.2.4 and 12.2.5, itemised assessment and preparation of necessary countermeasures shall be carried out in the course of EIA.

12.3 Identification of Impact

12.3.1 General Consideration

As is the case for most development projects, potential negative impacts sometime could be far more numerous than beneficial impacts. The regional and national economic benefits associated with the implementation of any development project are considered to fall outside the scope of an EIA, and therefore not considered here. However, it is generally expected that these long-term benefits will ultimately trickle down to the local population and will make a contribution to an improvement in the quality of life.

Likewise, the indirect benefits of strengthening of technical capabilities of local persons through association with foreign experts and other training elements which may form part of a project, have been considered to fall outside the scope of EIA.

Impact identification of the proposed North Dhaka East Sewerage System is based on the development of two scenarios.

- *Future without project:* This considers physical, biological and socio-economic changes likely to occur within the next 20 years due to prevailing environmental and social trends.
- *Future with project:* This considers the total changes likely to occur over the next 20 years with the project in place, and attempts to separate the impacts of the project from underlying natural trends in the baseline environment.

The difference between the two scenarios for various environmental components and resources were considered as the project impacts. The purpose of considering a future-without-project scenario as a basis for comparison and assessment of impacts is to take account of future trends in many environmental components which are independent of any project actions, e.g. human population growth, changes in resource bases, etc.

Due to lack of suitable quantitative data, impacts were evaluated in non-economic terms through appropriate analyses. Detail examination of issues unresolved in IEE were examined by the multi-disciplinary EIA team considering all possible intervention by the proposed project.

12.3.2 Critical Unresolved Issues Under IEE

Major critical issues identified under IEE requiring further assessment is shown in Table 12.2.4 and majority of the issues (more than 50 %) fall within the group C which are subject to further verification under EIA. The major issues that have been identified are land (swamp/flood plain), traffic hazard, downstream water quality and partially regional drainage problems. There are slight impacts anticipated in issues like movement of cattle, people, noise hazard, right of way for sewer network, re-settlement, odour problem, air pollution and flood plain fisheries. There are no historic/cultural monuments or endangered species of flora, fauna, aquatic life that may be affected by the interventions.

12.3.3 Other Issues

Among other issues which are of concern to the people of the project area are:

- Management of sludge and effluent from the sewage treatment plant;
- Soil to be used for land filling of STP;

- Compensation of affected people due to land acquisition for access road and STP;
- Road alignment from Rampura Bridge to STP, and
- Possible seepage from stabilisation ponds to the surrounding flood plain.

12.3.4 Scoping, Bounding and Selection of Important Environmental Components

Important environmental components (IECs) were considered as ecological, social and economic components worthy of sustaining at existing or enhanced levels under project conditions. Following the reconnaissance survey, the BIA team scoped the study components and bounded the study area.

Scoping is a process whereby the IECs likely to be affected due to project intervention, project development issues and concerns of local communities are determined. Scoping was performed in consultation with government agencies, and inhabitants within the project area. IECs were chosen for their importance to various interested parties. In many cases, however, not all of the affected publics are equally represented or able to express their views.

Bounding is defined as the area that would be directly impacted by the proposed project and the design year of the project. It is bounded by the Balu River to the east, Turag River to the north and part of west and the Buriganga River to part of west and south. This included the project area plus the adjacent surrounding area covering more than 10 km radius. The temporal bounding of the project was fixed at the year 2005 for the feasibility study. But the planning horizon for the master plan is 2020.

Identification of potential impacts due to implementation of the proposed project is done by using simple checklist. Checklist is a comprehensive list of environmental effects and impacts indicator designed to stimulate the analysis to think broadly about possible consequences of contemplated actions (Munn, 1979). Duly filled-in checklists are contained in Appendix 12.3.1. In this checklist, actions, which may affect at the various stages of the project activities are listed and the degrees of Significant Environmental Impacts (SEIs) are shown. The terms none, minor, moderate and major are used in the checklist to evaluate the magnitude of SEIs. In the checklist, both the construction and operational phases of the proposed development are considered separately in order to distinguish the short term and long term impacts. It should be noted that identification indicated in the checklist relates to the significant level of impact, assuming that no negative impacts mitigation.

12.4 Prediction, Evaluation, Mitigation of Potential Impacts

12.4.1 Impacts on Physical Resources

(1) Water quality

1) Surface water quality

The design effluent quality would be maintained through proper operation, maintenance and monitoring. Without project, the water quality of Norai Khal and Dholai Khal at confluence of the Buriganga River is much worse than the designed effluent quality. So the effluent of the treatment plant would not affect the quality of receiving water bodies, rather it may improve the water quality of receiving water bodies to some extent.

Since a significant portion of North Dhaka East area will be served by the project, the treated effluent of this area will not be discharged through the Norai Khal, which may eventually improve the quality of the khal, reducing the present level of degradation of surface water quality.

2) Groundwater quality

One of the components of STP would be the sludge lagoon where resulting sludge from other unit particularly would be stored for some days for stabilisation. The degradation of sludge would result in production of leachate. This leachate would affect the groundwater quality. The situation will be aggravated if sludge contains any toxic chemical. Proper mitigation measures should be adopted to ensure that no percolation/infiltration should occur at the bottom of sludge lagoon. In this respect, it is recommended that:

- o There should be an impervious clay layer in the bottom of the pond so that no percolation/infiltration can occur.
- o Adequate lagoon storage should be provided to allow for the accumulation of sludge in rainy season, when dewatering will be very slow.

3) Hydrology

The hydrologic regime of the project area under project condition will not be drastically changed as it will be under the FAP 8A and 8B projects. But with the proposed intervention about 127 ha, flood plain land will be converted to high land. This may cause temporary increased flooding to the surrounding area. However, the adverse effect of this to the environment would be minimal as every year the entire area re-

mains deeply flooded for several months.

Supernatant from STP may have an impact on the hydrology of the area. The impact may be positive when it is considered that the treated effluent will raise the dry season flow in otherwise stagnant khals such as Jogger Khal, Gerani Khal and Dholai Khal. However, during field visits of this EIA, the Jogger Khal has now been blocked in several sections. So, the treated effluent from STP will create water logging in the area which may ultimately affect the hydrology.

To keep the hydrologic regime of the project area unaffected, it is recommended that:

- o *There must be a rehabilitation work for Jogger Khal, Gerani Khal and Dholai Khal. This must be treated as a precondition for implementation of the proposed project.*

It should be noted that after rehabilitation of Jogger Khal, Gerani Khal and Dholai Khal, the flow in these khals will be increased tremendously. Because rehabilitation works will facilitate flow not only the effluent from STP, but also the stormwater from this area. This will create tremendous pressure on the pumping system at Dholai Khal. To overcome this situation, it is suggested that:

- o *The integrated flood action plans (FAP 8A and FAP 8B) should be implemented along with implementation of rehabilitation works of Jogger Khal, Gerani Khal and Dholai Khal.*

(2) Air quality

The environment of Dhaka is degrading constantly by emission of lead and carbon monoxide from motorised transport like auto rickshaws, tempos, mechanised boats, cars and trucks. Air of Dhaka has the highest concentration of lead among the cities known for dangerous level of air pollution during low rain periods. The results are health hazards, traffic congestion, traffic jams and traffic accidents. During implementation of the project and reconstruction of roads, smoke and dust that will be emitted can pose a health hazard to the people living nearby and damage vegetation and trees along the roads. Increased amount of mechanised boat will further degrade the environment. During operation of the project, smoke emitted from the sewage lift station, odour and other gases will further add to air pollution.

The air pollution caused by the project is only a mini-fraction of total pollution generated

within the city and will have localised effect only. Through proper planning, smoke and dust emission during implementation stage can be controlled. In addition, movement of mechanised boat should be restricted to eliminate risk of air pollution.

(3) Land

1) Land value

Land value will increase in the areas served by the project as sewerage facility is considered as one of the public service utilities. On the other hand, the areas near sewage treatment plant, land value may be declined depending on the extent of public health hazard. People living near the Pagla Sewage Treatment Plant expressed, that public nuisance (odour, mosquito, etc.) affected land value. Earlier, when treatment plant was not in operation, land value was much less due to sever odour. Now without odour, land value apparently seems same as in other part of the area. If odour and mosquitoes are not controlled, no significant change in land value anticipated.

2) Land drainage

The project area lacks proper drainage system. The main sewer will cross Gulshan lake at two locations. The same line will also cross Badda Khal about one kilometre to the east of Rampura Bridge. At these locations, there will be some temporary drainage obstruction to stormwater. At present, untreated domestic and industrial wastewater are received by the natural khals (Begunbar/Gojaria Khal, Badda Khal, etc.), Gulshan Lake and surrounding swamp areas. As a result, living environment is deteriorating day by day. With the project condition, raw sewage will be separately treated and the water quality of existing lakes and natural khals will be improved.

(4) Agriculture

With the implementation of the project, agricultural land of about 127 ha will be lost. This will directly affect agricultural production, reduce employment in agriculture sector and increase landlessness in the area. So apparently project seems to have a negative impact on agriculture. However, due to rapid urbanisation and existing housing project within the vicinity of STP, the scenario without project would be worse. Opinion of the local people also supports this fact.

During field visit, it was observed that existing housing project has extended almost near the proposed sewage treatment plant site. With this project, it is expected that the expan-

sion of housing project will be limited as people will not be interested to purchase land for housing purpose. So with the project, loss of agricultural land would be less than without project.

Moreover, without project. Crop yield is much less due to direct irrigation from Norai Khal as informed by the local farmers. After implementation of the project, water quality of Norai Khal would be better. This will eventually increase crop yield.

12.4.2 Impacts on Biological Resources

(1) Fisheries

Construction of trunk mains and sewage treatment plant across the flood plains has important consequence on flood plain ecology. It prevents lateral migration of fishes in the flood plain and obstructs movement of fishes into actual feeding and breeding grounds in the flood plains. The extent of impact may be assessed by the length of trunk main and sewage treatment plant passing through flood plains and the length serves the purpose of an embankment separating permanent water bodies from fish spawning and feeding areas in flood plains. However, it has some positive impacts on culture fisheries as permanent water bodies will be protected from being contaminated by polluted water of Norai Khal, particularly during high tide. Also quality of wastewater presently flowing through the Norai Khal will be improved after implementation of the project as a substantial portion of wastewater now discharging into the Khal will be brought to STP. This will improve capture fish habitat particularly during lean periods.

(2) Forest and vegetation

Proposed project may cause destruction of trees and vegetation along the trunk main and sewage treatment plant, which may lead to alteration of the ecology. This loss can be compensated by plantation of tree along the trunk main and within the sewage treatment plant.

(3) Nuisance Plant/Eutrophication

Effluent of sewage treatment plant rich in nutrient after being discharged into surface water will cause eutrophication and surface water pollution, make the water unsuitable for beneficial uses and destroy aquatic environment.

shan/Banani Lakes. Most of the migrating birds commonly known as "Siberian birds" are observed in the wetland on the northern part of the city near Mirpur Zoo and Botanical Garden which is away from the project area and in no case will be affected by project intervention.

(5) Insect and Rodent

The proposed sewage treatment plant would be a potential breeding area for mosquitoes. Sewage and the embankment will attract some other insects and rodents too. This will enhance diseases like malaria, filaria and dengue within the surrounding area.

Without project scenario also is not better as the wastewater in Norai Khal is almost stagnant. But with project, the situation would be worse and may become a health hazard to the local people if no adequate preventive measures are taken.

(6) Wetland and wetland habitat

Trunk mains and STP will encroach into the flood plain and reduce flood plain area, which will alter ecology of flood plain and may cause destruction of wetland habitat particularly during monsoon. It may lead to disappearance of some endangered species of fish and affect bio-diversity, but presence of such species is confirmed.

12.4.3 Impacts on Human Resources

(1) Public health and safety

Only a part of the project area is currently served by the existing sewerage system. The majority of the households or establishments being unserved by the sewerage system are using septic tanks. Grey water and effluent from septic tanks are discharged directly into nearby surface drains or open channels, resulting in the deterioration of the aquatic and living environments. With the implementation of the project, a large number of inhabitant would be served by conventional sewerage system. With improved sanitation, risk of human contacts with excreta and wastewater in sensitive areas would be minimised. Moreover, surface and groundwater would be protected from pollution.

(2) Socio-economic condition

Improved sanitation facilities within the project area would directly influence social value of the people's being served. On the negative side, people not served by the sewerage

system will feel deprived of the circumstances due to inequity among the neighbourhood. No significant changes on the economic conditions of the people is ascertained. Only farmers living along the Norai Khal may have a better economic condition due to increased crop yield. Some employment opportunity will be created during construction and post construction stages of the project.

(3) Recreation

At present, recreation activities within the project area are very restricted to some clubs, park and movie theatres, where people look for some enjoyment. Gulshan/Banani Lakes and Norai Khal could have been a very potential site for recreation as the "Water Front" near Zia International Airport. But due to indiscriminate dumping of solid wastes and direct disposal of domestic sewage into the lakes, water quality is significantly deteriorated. This restricts use of the said lakes and Norai Khal as a recreation place. With implementation of the project, disposal of domestic sewage into the lakes will be stopped and Gulshan/Banani Lakes and possibly Norai Khal can be used as a potential recreation place.

(4) Employment

construction of sewage treatment plant, lift stations, trunk main and laying of secondary/tertiary sewers would generate additional employment and provide income and food security. The additional employment would attract skilled labours and professionals from outside the project area and may increase wage rates. The increased population and the money supply would increase demand on the existing market outlet. New shops and expanded markets would meet the increased demand of essential items. However, there is likely to be extortion from the contractors, so that there would be pressure on security forces. For operation and maintenance of the system, there would be some opportunities for employment of skilled labours and other professionals.

On the negative side, the employment opportunity in the fisheries and farming would be reduced due to loss of fishing ground and agricultural land.

(5) Transportation

During implementation of the project, there will be an increase in the movement of labours both within the project area as well as between the project area and outside. This would increase demand on the existing transport facilities and other services and attract additional vehicles particularly three wheeler rickshaws and vans from other part of the

city. This may cause deficit of such vehicles in other part of the city leading to increased rickshaw fair both within and outside the project area.

Since most of the trunk main will be built beneath the existing road, it will interrupt transportation during construction phase. The impact of this interruption will be felt within as well as outside the project area unless proper planning and measures are taken to control or by pass traffic.

(6) Economic activities

No significant changes in present economic activities of people are expected due to implementation of the project. During construction phase, some poor, particularly fishermen and agriculture labour may be attracted to get involve in construction work due to more wage. Although number of people changing their activities are very negligible as compared to the total population, its significance would be overwhelming as far as people's participation is concerned.

(7) Navigation

Navigation is important only in the sewage treatment plant areas, as boats are the main mode of transportation there, due to poor or no road network. Boat transportation is very important to the economy of the proposed sewage treatment plant area. Most professional fisherman presently use waterways for fishing in the Balu River and eastern flood plain. There would be no impact on navigation activities in the project area. But the proposed underpass to discharge effluent of STP into Jogger Khal may obstruct navigation during construction. However, through proper planning and design of underpass, obstruction to navigation can be prevented.

During construction phase, boat can become major mode of transportation of construction materials, imported earth for land filling and also for carrying labours from outside the project area. Due to increase in demand and easiness to transport materials, the proportions of mechanised and manually operated boats are expected to change significantly.

12.5 Mitigation and Enhancement Measures

12.5.1 General Consideration

In the context of a project, environmental management is concerned with the implementation of the measures necessary to minimise or offset adverse impacts and to enhance beneficial impacts. Unless the mitigation and benefit enhancement measures identified in the EIA are fully implemented, the prime function of EIA, which is to provide a basis for shaping the project so that overall environmental performance is enhanced can not be achieved.

At this stage of the project preparation, the EMP has been prepared in outline only, as many important elements have yet to be fully defined. However, in the following sub-sections, the plan indicates the broad approach that will be adopted. The plan will be expanded during detailed design stage when more information is available, and a detail EMP will then be prepared.

12.5.2 Mitigation and Enhancement Measures

The management measures to be taken with regard to controlling of potential impacts during plant sitting, construction and operational phases of the project are summarised in Table 12.5.1.

The most significant residual impact appears to be discharge of hazardous materials into the sewerage system when basically the system shall be designed for domestic sewage only. It is envisaged that all other negative impacts which can be mitigated to a large extent, bur regarding hazardous waste and other than domestic sewage, it is not only DWASA who can alone manage the problem. In such cases, DWASA will need the assistance of other organisations, like DCC, RAJUK and DOE.

Table 12.5.1 Major Impacts Mitigation and Enhancements

Environmental Components		Impacts	Mitigation/Enhancement
Positive Impacts	1. Environment	<ul style="list-style-type: none"> - Improved pollution abatement; - Protection of surface and groundwater quality 	<ul style="list-style-type: none"> - Increasing sewerage connection through motivating people, legislation and awareness; - Campaign through electronic media
	2. Sanitation and Social Structure	<ul style="list-style-type: none"> - Reduce risk of human contacts with excreta and wastewater; - Increase social value through improved sanitary condition 	<ul style="list-style-type: none"> - Mass campaign and door to door motivation; - Health education messages through electronic media.
	3. Employment	<ul style="list-style-type: none"> - Add to community economy during construction, operation and maintenance. 	<ul style="list-style-type: none"> - Proper planning and make provision for sludge re-use/ recycling and use of effluent for irrigation.
Negative Impacts	1. Resettlement	<ul style="list-style-type: none"> - Social injustice 	<ul style="list-style-type: none"> - Alternate site selection, proper planning and rehabilitation of affected people to ensure social justice.
	2. Public Nuisance/ Health Hazard	<ul style="list-style-type: none"> - Losses in community economy and social value; - Damage to public health and disease hazard to worker. 	<ul style="list-style-type: none"> - Proper design, operation & maintenance and post construction monitoring; - Effective application of legislation; - Provision of tool, equipment and protective uniform to workers.
	3. Traffic Hazard	<ul style="list-style-type: none"> - Losses in community economy and social values 	<ul style="list-style-type: none"> - Make provision for alternate route or by-pass traffic; - Employment of persons to control and guide vehicles.
	4. Construction Hazard	<ul style="list-style-type: none"> - Health and economic loss to workers neighbourhood 	<ul style="list-style-type: none"> - Proper planning, attention and protective measures for noise and dust control; - Employing local people for construction work and frequent meeting with local elite; - Ensure people's participation
	5. Capture Fisheries	<ul style="list-style-type: none"> - Losses in community economy 	<ul style="list-style-type: none"> - Proper planning and design can ensure that feeding and breeding areas of capture fishes are not disrupted; - Monitoring and legislation to improve aquatic environment
	6. Industrial Wastes Intrusion into Sewerage System	<ul style="list-style-type: none"> - Degrade environmental quality and social value; - Increase operational cost. 	<ul style="list-style-type: none"> - Through legislation and strengthening concerned law enforcing agencies.

CHAPTER 13
PROJECT EVALUATION

CHAPTER 13 PROJECT EVALUATION

13.1 General

The proposed project for the improvement of the existing sewerage system in North Dhaka was evaluated from the viewpoints of the expected benefits and appropriateness/feasibility. The composition of the evaluation items was composed of the following aspects: technical, environmental, financial, and socioeconomic.

Since a sewerage system is a major urban infrastructure, the associated legislative and institutional arrangements, including community participation, for the improvement and maintenance of the urban environment are indispensable to maximize the overall benefits of the project. In this respect, comments and recommendations relevant to the sewerage system and urban sanitation are also identified and incorporated.

13.2 Benefits and Justification of the Project

The principal objectives of the sewerage system development and its operation are (1) to smoothly drain sewage/wastewater discharged in the sewerage service area and (2) to treat them at the sewage treatment plant to mitigate water pollution in the receiving water bodies.

The North Dhaka area is one of the fastest-developing parts of Bangladesh and will continue to be so in the foreseeable future. However, North Dhaka lacks an adequate sewerage system infrastructure and the failure to provide such infrastructure will have a profound impact on the future development of the city and on the health and welfare of its inhabitants.

The leakage of sewage from sewer pipes is another problem of the existing sewerage system. This leakage associated with deteriorated water supply system has most likely contributed to the spread of water-borne/related/vector diseases in Dhaka City.

The proposed sewerage project is formulated to improve the existing urban and water environment conditions and to help establish an overall sewerage development plan for North Dhaka. It also includes treatment of collected sewage at a treatment plant to reduce the pollution load of the receiving water body.

13.3 Project Evaluation

13.3.1 Technical Evaluation

Project evaluation from technical viewpoint is carried out as described below.

- (1) The discharged sewage will be collected and conveyed via sewer network to the sewage treatment plant, direct discharge of untreated sewage into lakes and rivers will be prevented. In addition, septage will also be collected and treated at the sewage treatment plant. Through the implementation of the proposed project, water quality in public water bodies, wherein raw sewage is currently discharged, will be considerably improved.
- (2) The sewage treatment method adopted in the proposed sewerage project is selected in due consideration of required level of technical expertise for operation and maintenance, construction cost including land acquisition cost, operation and maintenance cost, and final disposal cost of accumulated sewerage sludge, to attain the most economical way to achieve the objectives of the project.
- (3) The effluent quality from sewage treatment plant will meet the legislated water quality standards of Bangladesh.
- (4) The improvement of the existing sewer network is included in the proposed project as indispensable mean to mitigate inundation/submergence of roads and residential areas.

For furtherance of environmental improvement in the Gulshan and Banani lakes, the following measures are deemed inevitable for those households being situated in their catchment area:

- 1) Appropriate maintenance of septic tanks
- 2) Introduction of advanced biological treatment unit for individual houses

13.3.2 Environmental Consideration

Environmental Impact Assessment (EIA) of the proposed project was carried out during the course of the Study. Results of this EIA study have raised certain possibility of environmental impacts by implementation of the project. Preventive measures and relevant legislative arrangements are thereby considered to mitigate the anticipated environmental impacts.

As a whole, the proposed project including the said preventive measures is determined to have minimal and tolerable impacts to the environment and considered great contribution to improve current environmental problems and conserve aquatic environment.

Among others, the following preventive measures are included in the scope of the proposed project:

- (1) Sewerage sludge will not be disposed into the receiving water body and will instead be removed via truck and be taken to a suitable disposal site.
- (2) Possible emission of offensive odor and growth of undesirable insects will be minimized by appropriate landscaping, concrete banking on the slope of lagoons, and provision of green belt with trees along with the perimeter fence of the treatment plant.

13.3.3 Financial Evaluation

The result of financial analysis is illustrated that, based on the financial projections until the year 2025, the projected recommended in the Feasibility Study is fiscally viable. The FIRR of the Master Plan also gave a positive return, but not at a high ratio. It should be noted, however, the financial projections were based on a fairly optimistic view of DWASA's future fiscal performance and on its ability to raise its tariffs, improve its operation/collection efficiency, etc. to meet the expected expenditures.

As for funding and cost recovery aspect, DWASA is expected to be able to meet with the expected debt servicing requirements and to be able to handle the projected O&M costs.

13.3.4 Economic and Social Evaluation

Safe drinking water and the sanitary disposal of wastes have long been recognized as basic societal needs that function to safeguard human health and enable more productive lifestyles. In North Dhaka, continued population growth and urban development have exacerbated the health and environmental problems caused by inadequate drainage and poor waste disposal.

While it is a given that advanced sewer systems help to alleviate these issues, the positive effects of sewer systems can be broken down into two categories. The first of these is direct effects, i.e., the direct contributions that sewer projects make to those individuals who discharge

waste into the sewer system. The other of these is indirect effects, i.e., the indirect contributions a sewage system makes to those individuals who are not connected to the system, as well as those contributions the system makes to future generations. In economic terms, such indirect benefits are called external economies, in which production or consumption yields positive benefits to even those who are not paying for said service directly. The following is a series of examples of such benefits.

(1) Improved public health

Improved public health is a community benefit that contributes to all members of the community regardless of whether or not they are connected to the sewage system. A concrete example of the benefits of improved overall community health is the decrease in social costs, since an increased level of sanitation will lead to a decrease in health care costs and in auxiliary sanitary service costs.

(2) Infrastructure as a basis for economic development

Investment in a sewage system provides a positive base for economic development, both through the employment generated through the actual building of the system and through contributing to the overall public welfare. This in turn can be used to induce investment into North Dhaka's private sector by both domestic and foreign enterprises. As such, the building of a sewage system can be seen as a long-term investment to generate increased national income for future generations.

(3) Construction's short-term effects on the local economy

During the period of construction of the sewerage system, the public sector's expenditures have the effect of increasing district output (expansionary effect). When these expenditures are initially made, output will rise at first by an equal amount. But as those in capital-goods industries begin receiving more income through this increase in expenditures, they will then set into motion a chain of additional secondary consumption spending and employment. This expansionary effect will generate an increase in national income.

(4) Construction's long-term effects on the local economy

Even after construction has been completed, an expanded sewerage system will have a positive effect on local employment by absorbing a part of the labor force as maintenance workers. The consequent increase in income will increase effective demand, which will in turn contribute to economic growth, as will the derived demand from the project's maintenance activities. This economic growth will be a long-term benefit, not only by the present residents of North Dhaka, but future generations as well.

As explained above, economic benefits of building a sewage system are not limited to individual users, but rather are spread over society as a whole, as well as over multiple generations. Some of the public health benefits, such as the avoidance of epidemics, are external to the individual user and so not necessarily included in the price of service. Since the benefits of a sewage system are reaped over many generations, in theory, the financial burden could be spread out over many generations as well. The annual maintenance and operating costs should also be borne by generations to come as such funds will be necessary in supporting a high level of future service.

However, in actuality it is quite difficult to spread the costs of such projects over the various indirect beneficiaries of the completed project. As a result, the portion of public expenditures which are not attributable to the individual user are not always fairly charged to other possible beneficiaries. Thus, when only calculated in these terms, the projected amount of funds to be generated by charging only direct users may appear to be insufficient. However, when also calculating the broad social benefits which are indirectly created by the project, and which are not included within standard EIRR procedures, one discovers that the negative financial results derived via accounting procedures (EIRR) may not be an appropriate index for gauging the overall economic meaning of a sewage project.

Consequently, in terms of overall economic meaning, it is important that the objectives of a sewage project in a developing nation are as follows: (a) maintaining the quality and quantity of service predetermined at the initial time of investment; (b) maximizing the economic benefits and financial revenues; (c) minimizing public expenditures; and (d) spreading those expenditures over various generations.

13.4 Risks and Uncertainties

The project proposed in the Feasibility Study will be an element of the Master Plan's program to provide North Dhaka with an effective and efficient sewage system, and is also an effort to improve public health and environmental conditions. However, a number of potential risks and uncertainties do remain, the bulk of which the government is aware of, but need to be re-emphasized so as to allow for more efficient discussion and implementation of any resolutions reached. Some risks and certainties are directly related to the project being proposed, but more important risks concern the management of DWASA itself.

13.4.1 Future Urban Development

Sewer systems are usually designed based on urban development planning (forecasting). However, if actual urban development significantly differs from that forecast, such as if the population were to grow at a significantly higher rate, the sewer system would not be able to adapt to the new level of demand, leading to sanitation problems. This would obviously make it necessary to adjust in accordance with the actual rate of urban development, or in a more serious case, to start over from the planning stage once again. For example, were urban development to far surpass expectations, the existing sewer system would no longer be of sufficient capacity. If this is the case, restricting sewer service to the level forecast at the original planning stage would prove to be a burden to those dwelling within the region. Another possible scenario is the revision of environmental laws and regulations to a higher standard after the sewer system has been established. If this were to occur, this would in turn make it impossible for the existing sewer system to meet such standards, and substantial revisions to the original plans would be necessary.

On the other hand, if revisions to the original plan are made too frequently, this makes it difficult to keep a clear view of the sector's long-term objectives and also reduces the level of consistency with other infrastructure planning.

As such, in order to allow the flexible adaptation of sewer service to changing circumstances, deviations from the original plans should be constantly monitored by the sewer management in order to enable the timely implementation of any necessary revisions, such as those taken to adjust to actual developments in other sectors of infrastructure. Accordingly, the sewer management should do its best to maintain a flexible organization and data system, but one that also allows review of existing plans.

13.4.2 Future Economic Development

Although the sewer sector is not able to control future economic development, the financial sustainability of any sewer project depends heavily upon such growth, since this in turn determines the future rate of revenue growth. If the economy of Bangladesh grows favorably, the average income per household will increase, which will in turn increase the general public's ability to pay for sewer service, improving the project's financial viability. However, were the economy to take a downturn, this would accordingly reduce household income and the public's ability to pay. In a worst case scenario, this could force the project to shutdown.

13.4.3 Financial Deficits

DWASA is now working to put its financial house in order and is making some progress. In addition, there are a number of projects that are being discussed with various donor agencies and some of these projects will undoubtedly come to fruition. However, the debt service requirements for any future projects should be examined from a long-term viewpoint. The ability of DWASA to implement a management accounting system and an effective planning department will play a key role in ensuring that DWASA will be able to maintain an acceptable debt level.

13.4.4 Shifts in Foreign Exchange Rates and Inflation

The project is susceptible to inflation in a number of ways. Were inflation to occur during construction, this would make it difficult to complete the project within the projected budget. Moreover, were inflation to arise after service has commenced, there is no guarantee that service rates could be raised in proportion to the rise in inflation, since governments are often reluctant to raise rates due to both the psychological impact of a rate hike and because such increases might set off another round of the inflationary spiral. However, not raising rates may also have an inflationary impact, since that without increased revenues, the project's financial deficit may increase, and additional funds would have to be raised through public borrowing. This in turn could have inflationary effects as well.

The project is also subject to fluctuations in foreign exchange rates. Since machinery and raw material imported during construction is usually paid for in foreign currency, any appreciation in the value of the foreign currency will have negative effects on the project budget. Moreover, during the repayment stage, if the loan is financed in a currency other than the Bangladeshi Taka, repayment is inevitably susceptible to changes in value of the foreign currency. Also, were the Bangladeshi Taka to depreciate in value, this would make it difficult to repay the debt on schedule.

13.4.5 Hidden Costs

In additions to the costs forecast by the project, there are also hidden costs which must also be recognized.

(1) Construction of Household Connections

The budget for construction does not factor in the costs required in making household connections and in extending the main sewer pipe. However, without this infrastructure, the sewer system will be effectively useless to the general populace. In principle, the costs incurred during the construction of the household connections should be paid for by the users. In this project, an allowance was made for the provision of Tk 20,000,000 to establish a fund to allow the users to use special loans to offset the costs of connecting to the system. The details of this fund will have to be worked out at a later stage.

(2) Cost of Processing Industrial Waste Water

Certain sectors, such as the chemical industry, produce contaminated wastewater which should not be discharged into public waters without undergoing processing by a private plant. If such wastewater were to be discharged without undergoing thorough processing, the burden placed upon public processing plants would be beyond their capacity. As such, to minimize public cost, such industries should provide their own treatment facilities at their own cost, in accordance with the "polluter pays" principle. If it is financially difficult for such firms to purchase treatment equipment on their own, financial subsidies to such firms should be implemented. These costs are not included within the original project budget, but instead are regarded as social costs.