PEOPLE'S REPUBLIC OF BANGLADESH

MINISTRY OF IRRIGATION, WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION

DHAKA INTEGRATED FLOOD PROTECTION

FAP-8B

A.D.B. T.A. NO. 1318-BAN

FINAL REPORT

SEPTEMBER 1991

Submitted by:

LOUIS BERGER INTERNATIONAL, INC.

In Association With:

Associated Consulting Engineers (Bangladesh) Ltd.
Desh Upodesh Ltd.
Technoconsult International Ltd.

2

ABBREVIATIONS

ADB	-	Asian Development Bank
AEC	-	Atomic Energy Commission
BWDB	-	Bangladesh Water Development Board
CUS	-	Center for Urban Studies
DCC	-	Dhaka City Corporation
DEPC	-	Department of Environment and Pollution Control
DMA	-	Dhaka Metropolitan Area
DOE	-	Department of Environment
DOF	-	Department of Fisheries
DPHE	-	Department of Public Health Engineering
DWASA	-	Dhaka Water Supply and Sewerage Authority
EQS	-	Environment Quality Standards
FAP	-	Flood Action Plan
FPCO	-	Flood Plan Co-ordination Organization
HBFC	-	House-Building Finance Corporation
IDA	-	International Development Association (of the World Bank)
IPH	-	Institute of Public Health
JICA	-	Japan International Corporation Agency
LGD	-	Local Government Division
LGEB	-	Local Government Engineering Bureau
MEF	-	Ministry of Environment and Forest
MIWDFC	-	Ministry of Irrigation, Water Development & Flood Control
MLGRDC	-	Ministry of Local Government, Rural Development and Cooperatives
MOI	-	Ministry of Information
MOW	-	Ministry of Works
NGO	-	Non-Government Organization
PC	-	Planning Commission
PHED	-	Public Health Engineering Department
PMO	-	Project Management Office
PWD	-	Public Works Department
RAJUK	-	Rajdhani Unnayan Kattripaka (Capital Development Authority)
SOB	-	Survey of Bangladesh
SPARRSO	-	Bangladesh Space Research and Remote Sensing Organization
UDD	-	Urban Development Directorate
UNCHS	-	United Nations Centre for Human Settlements
UNDP	-	United Nations Development Programme
UNICEF	-	United Nations International Childrens Education Fund
WHO	-	World Health Organization

Physical Units

cms	-	Cubic meters per second	m	-	meter
ha	-	hectares	mld	-	million liters per day
kl	-	kilo-liters(thousand liters)	mm	-	millimeter
km	-	kilometer	sq m	-	square meter
l	-	liter	sq km	-	square kilometer

FINAL REPORT
SEPTEMBER 1991

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. Project Rationale and Objectives 1
2. Present Position 1
3. Project Scope 3
4. Project Costs and Financing 4
5. Scheduling and Implementation 5
6. Environmental Impact 5
7. Technical Assistance 6

1.0 INTRODUCTION

1.1 Background 1 - 1
1.2 Flood Action Plan 1 - 5
1.3 Technical Assistance Objectives 1 - 7
1.4 The Report 1 - 7

2.0 BACKGROUND AND PROJECT SCOPE

2.1 General 2 - 1
2.2 Flooding Problems in Bangladesh 2 - 1
2.2.1 General 2 - 1
2.2.2 Flood Action Plan 2 - 2
2.3 Flooding and the Urban Sector 2 - 3
2.3.1 Pattern of Urbanization 2 - 3
2.3.2 Urban Conditions 2 - 4
2.3.3 Urban Poverty 2 - 5
2.3.4 Development Programs 2 - 5
2.4 Flood Control Planning for Dhaka City 2 - 6
2.5 Institutional Setting 2 - 7
2.5.1 National Institutions 2 - 7
2.5.2 Dhaka's Institutional Framework 2 - 10

8

	2.6	Donor Involvement in the Sector	2 - 16
	2.7	Project Area and the Need For the Project	2 - 16
	2.8	Project Rationale and Objectives	2 - 17
	2.9	Scope and Coverage of the Project Components	2 - 18
3.0	INTEGRATED ENVIRONMENTAL MANAGEMENT PLAN FOR DHAKA		
	3.1	Introduction	3 - 1
	3.2	Land Use Management	3 - 1
	3.3	Flood Control and Drainage	3 - 3
	3.3	Solid Waste Management	3 - 4
	3.4	Sanitation and Water Quality	3 - 5
	3.5	Water Supply	3 - 6
	3.6	Slum and Squatter Area Improvement	3 - 7
	3.7	Industrial, Hazardous and Toxic Materials Management	3 - 9
	3.8	Priorities and Programs	3 - 10
4.0	PROPOSED INFRASTRUCTURE INVESTMENT PROGRAM		
	4.1	Component Selection Criteria	4 - 1
	4.2	Design Criteria and Technical Levels	4 - 2
	4.3	Cost Estimates	4 - 3
	4.4	Determination of Scope & Preparation of Outline Designs	4 - 4
	4.5	Engineering Design and Construction Supervision	4 - 6
	4.6	Description of Proposed Works	4 - 6
		4.6.1 Flood Protection & Drainage Alternatives	4 - 7
		4.6.2 Part A: Flood Protection	4 - 12
		4.6.3 Part B: Drainage	4 - 17
		4.6.4 Part C: Environmental Improvement	4 - 18
		4.6.5 Part D: Implementation Assistance	4 - 22
	4.7	Incremental Staffing, Operations and Maintenance	4 - 22
	4.8	Other Issues	4 - 23

5.0 IMPLEMENTATION ARRANGEMENTS

5.1 Execution and Coordination 5 - 1

5.2 Project Implementation Schedule 5 - 6

5.3 Consultant Services 5 - 9

5.4 Procurement 5 - 11

5.5 Disbursement 5 - 11

5.6 Land Acquisition and Resettlement 5 - 11

5.7 Operations and Maintenance 5 - 16

5.8 Reports, Accounting and Audits 5 - 16

5.9 Community and NGO Participation 5 - 16

5.10 Institutional Support Measures 5 - 17

5.11 Mid-Term Review 5 - 18

5.12 Project Benefit Monitoring and Evaluation 5 - 18

6.0 FINANCING PLAN

6.1 Summary of Project Costs 6 - 1

6.2 Loan Agreement 6 - 1

6.3 Agency Fund Requirements 6 - 4

6.4 Revenue Improvement 6 - 5

6.5 Cost Recovery 6 - 5
6.5.1 Background 6 - 5
6.5.2 Direct and Indirect Cost Recovery 6 - 6
6.5.3 Options for Cost Recovery 6 - 8
6.5.4 Conclusions on Cost Recovery 6 - 14

7.0 PROJECT JUSTIFICATION

7.1 Summary 7 - 1

7.2 Project Area, Beneficiaries and Costs 7 - 2

7.3 Methods Used and Approach to Economic Valuation 7 - 2

7.4 General Project Benefits 7 - 5
7.4.1 Environment and Health 7 - 5
7.4.2 Distributional Benefits 7 - 6
7.4.3 Institutional Benefits 7 - 6

7.5 Benefits From an Increase in Land Values 7 - 7
7.5.1 The Role of Current Land Use Patterns 7 - 7
7.5.2 The Market for Land in the Project Area 7 - 8
7.5.3 Estimating the Benefits From Land Appreciation 7 - 10

7.6 Benefits From Flood Damage Avoidance 7 - 13
7.6.1 Experience with Flooding in Greater Dhaka 7 - 14
7.6.2 Physical Flood Damage Potential 7 - 15
7.6.3 Estimated Flood Damage Avoidance Benefits 7 - 17

7.7 Economic Valuation of DIFPP 7 - 18
7.7.1 Assumptions 7 - 18
7.7.2 Calculation of EIRR 7 - 19
7.7.3 Sensitivity Analysis 7 - 20
7.7.4 Conclusions 7 - 21

7.8 Economic Evaluation of Slum Improvement Component 7 - 21
7.8.1 Introduction 7 - 21
7.8.2 Methods and Assumptions 7 - 21
7.8.3 Evaluation Results and Conclusions 7 - 22

7.9 Financial Analysis 7 - 22
7.9.1 Solid Waste Component 7 - 22
7.9.2 Local Sanitation Activities 7 - 23

7.10 Affordability to Implementing Institutions 7 - 25

7.11 Affordability to Households 7 - 25

8.0 RISK ANALYSIS AND RECOMMENDATIONS

8.1 Major Risks 8 - 1

8.2 Recommendations for Safeguarding Against Risks 8 - 2

9.0	ENVIRONMENTAL IMPACT ASSESSMENT		
	9.1	Introduction	9 - 1
	9.2	Description of the Project	9 - 2
	9.3	Description of the Environment	9 - 4
		9.3.1 Physical Resources	9 - 4
		9.3.2 Ecological Resources	9 - 4
		9.3.3 Human and Economic Development	9 - 5
		9.3.4 Quality of Life Values	9 - 5
	9.4	Anticipated Environmental Impacts & Mitigation Measures	9 - 6
		9.4.1 Flood Control and Drainage	9 - 6
		9.4.2 Water Supply and Sanitation	9 - 7
		9.4.3 Solid Waste Management	9 - 9
		9.4.4 Slum & Squatter Area Improvements	9 - 10
		9.4.5 Training and Institutional Strengthening	9 - 10
	9.5	Alternatives	9 - 10
	9.6	Cost Benefit Analyses	9 - 11
	9.7	Institutional Requirements & Environmental Monitoring	9 - 12
		9.7.1 Institutional Requirements	9 - 12
		9.7.2 Environmental Monitoring Plan	9 - 12
	9.8	Public Involvement	9 - 14
	9.9	Conclusions	9 - 15
10.0	PRECONSTRUCTION AND PREPARATORY ACTIVITIES		
	10.1	Major Preconstruction Activities	10 - 1
	10.2	Other Activities to e Undertaken Prior to Construction	10 - 2
11.0	TECHNICAL ASSIST		
	11.1	Introduction	11 - 1
	11.2	Background and Need	11 - 1
	11.3	Objectives	11 - 2
	11.4	Scope and Work Program	11 - 2
	11.5	Cost Estimate and Financing Arrangements	11 - 4
	11.6	Implementation Arrangements	11 - 4

LIST OF FIGURES

Figure 1	FAP-8B Project Works	3
Figure 1.1	1988 Flooded Area	1 - 2
Figure 1.2	Greater Dhaka Flood Protection Project	1 - 3
Figure 1.3	Project Boundaries: FAP-8A & FAP-8B	1 - 6
Figure 2.1	Organization Chart - BWDB	2 - 9
Figure 2.2	Organization Chart - DCC	2 - 12
Figure 2.3	Organization Chart - DWASA	2 - 13
Figure 4.1	Project Works - Overall Plan	4 - 10
Figure 4.2	Project Works - Recommended Phase 1	4 - 13
Figure 5.1	Project Implementation and Management	5 - 2
Figure 5.2	Structure and Staffing of the PMO	5 - 3
Figure 5.3	Project Implementation Schedule	5 - 7
Figure 5.4	Implementation Schedule: Year 1 Work Plan	5 - 8
Figure 5.5	Consultants Recruitment Schedule	5 - 10
Figure 7.1	FAP-8B: Location Map	7 - 3

LIST OF TABLES

Table 1	Summary of Project Costs by Sector	3
Table 3.1	Linkages Between IEMP Components	3 - 13
Table 4.1	Summary of Prc 'ect Costs by Sector	4 - 8
Table 4.2	Summary of Costs of Overall FC&D Plan	4 - 11
Table 5.1	Functions & Responsibilities of Involved Agencies	5 - 4
Table 5.2	Procurement Packaging	5 - 12
Table 5.3	Schedule of Land Acquisition	5 - 14
Table 5.4	Incremental Staffing Requirements	5 - 15
Table 6.1	Summary of Project Costs	6 - 2
Table 6.2	Financing Plan	6 - 3
Table 6.3	Proposed Funding Arrangements	6 - 4
Table 6.4	Land Development Tax Rates	6 - 9
Table 7.1	Summary of Costs	7 - 4
Table 7.2	Major Land Use Catagories (Dhaka 1990)	7 - 7
Table 7.3	Project Impact on Undeveloped Land Prices	7 - 11
Table 7.4	Flood Damage - 1987 & 1988	7 - 14
Table 7.5	Flood Conditio s	7 - 15
Table 7.6	Affected Population - 1990 & 2010	7 - 16
Table 7.7	Estimated Physical Damages - 1990 & 2010	7 - 16
Table 7.8	Value of Estimated Damage - 1990 & 2010	7 - 17
Table 7.9	Benefits From Flood Damage Avoidance	7 - 18
Table 7.10	EIRR & Sensitivity Analysis - DIFPP	7 - 20
Table 7.11	EIRR & Sensitivity Analysis - Phase 1 (Dhaka West)	7 - 20
Table 7.12	FIRR & Sensitivity Analysis - Solid Waste	7 - 23
Table 7.13	FIRR & Sensitivity Analysis - Sanitation	7 - 24
Table 8.1	Action Plan	8 - 3
Table 9.1	Summary of Environmental Impacts of FC&D Works	9 - 17
Table 9.2	Matrix of Environmental Impacts	9 - 18
Table 10.1	Further Project Preparatory Action	10 - 3

LIST OF APPENDICES

APPENDIX 1 :	Consultants Personnel
APPENDIX 2 :	List of References
APPENDIX 3 :	Technical Background and Principal Design Criteria
APPENDIX 4 :	Revised Remedial Design Approach: DIFPP
APPENDIX 5 :	Project Cost Estimates
APPENDIX 6 :	Project Implementation Consultant Services
APPENDIX 7 :	Projection of Urban Expansion
APPENDIX 8 :	Economic Internal Rates of Return - DIFPP
APPENDIX 9 :	Internal Rates of Return - Slum Improvement
APPENDIX 10:	Financial Internal Rates of Return - Solid Waste & Sánitation
APPENDIX 11:	Financial Projections of DCC and DWASA
APPENDIX 11A:	Increase in Land Development Tax Revenues on Reclassification
APPENDIX 12:	Technical Assistance for Land Development Controls and Procedures for Dhaka City
APPENDIX 13:	Indicators for PBME
APPENDIX 14:	Bridging Engineering Services

DHAKA INTEGRATED FLOOD PROTECTION PROJECT: FAP-8B

EXECUTIVE SUMMARY

1. Project Rationale and Objectives

The Project, an integrated flood protection and drainage program for Dhaka City, is a priority component of the Bangladesh Flood Action Plan (FAP). The underlying rationale for the Project is to provide flood security in Dhaka City to improve the urban efficiencies and environmental conditions, particularly for the urban poor, and to promote sustainable long term economic development. To help to achieve this, the Project objective is to undertake an integrated urban development program consisting of: (i) flood control and drainage works; (ii) complementary environmental improvement programs in low cost water supply and sanitation programs for the low income residents, solid waste management, and slum and squatter area development; and (iii) institutional support for improved efficiencies in urban management and revenue generation.

2. Present Position

A feasibility study for the *Dhaka Integrated Flood Protection Project*, financed by the ADB, started in January 1991. The Project is being formulated under the coordination of the FPCO in the context of an Integrated Environmental Management Plan (IEMP)[1] as a long term integrated development strategy for Dhaka. During the ADB Fact Finding Mission in June/July 1991 intensive meetings were held with representatives from all involved Ministries and Departments, and with the international donor community, to confirm the priorities, scope and costs of the proposed Project. Project proposals were further reviewed and refined in close consultation with the implementing agencies and Ministries during the ADB Appraisal Mission of 01 to 14 September 1991. The Project proposals, as described in the Mission's Aide Memoire, were reviewed and discussed at the Technical Committee meeting on 10 September, and at the wrap-up meeting on 14 September, and are to be confirmed by the Government by 25 September 1991.

Under present scheduling, the Project is proposed to be placed before the Bank Board for consideration in October 1991, to enable Project approval and loan effectivity during the current financial year.

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[1] Initially presented in *Interim Report No. 1, May 1991*, with detailed feasibility analyses subsequently presented in the *Combined Interim Report No. 2 and Draft Final Report, August 1991.*

3. Project Scope

The total cost of providing flood protection and drainage for all of Dhaka City (265 sq km) has been preliminarily estimated as costing over $450 million (Taka 16,700 million), which greatly exceeds the presently available financing. The overall works are, however, well suited for incremental development in a phased program over 10 to 15 years.

As a first phase of a long term flood protection program, the Project will initially focus on the highest priority area, the westerly part of Dhaka City. The Project area (see *Figure 1*) covers approximately 136 sq km, encompassing about [illegible]% of the commercial and industrial properties and some 87% of the total city population. The Project scope covers mainly the completion and augmentation of the flood protection and drainage program initiated by GOB following the 1988 floods. It is designed to initially provide flood security against the 50 year recurrence interval flood levels, with complementary environmental improvements focused on the urban poor. The Project works are designed to be self-contained, but will be suitable for expansion in the future.

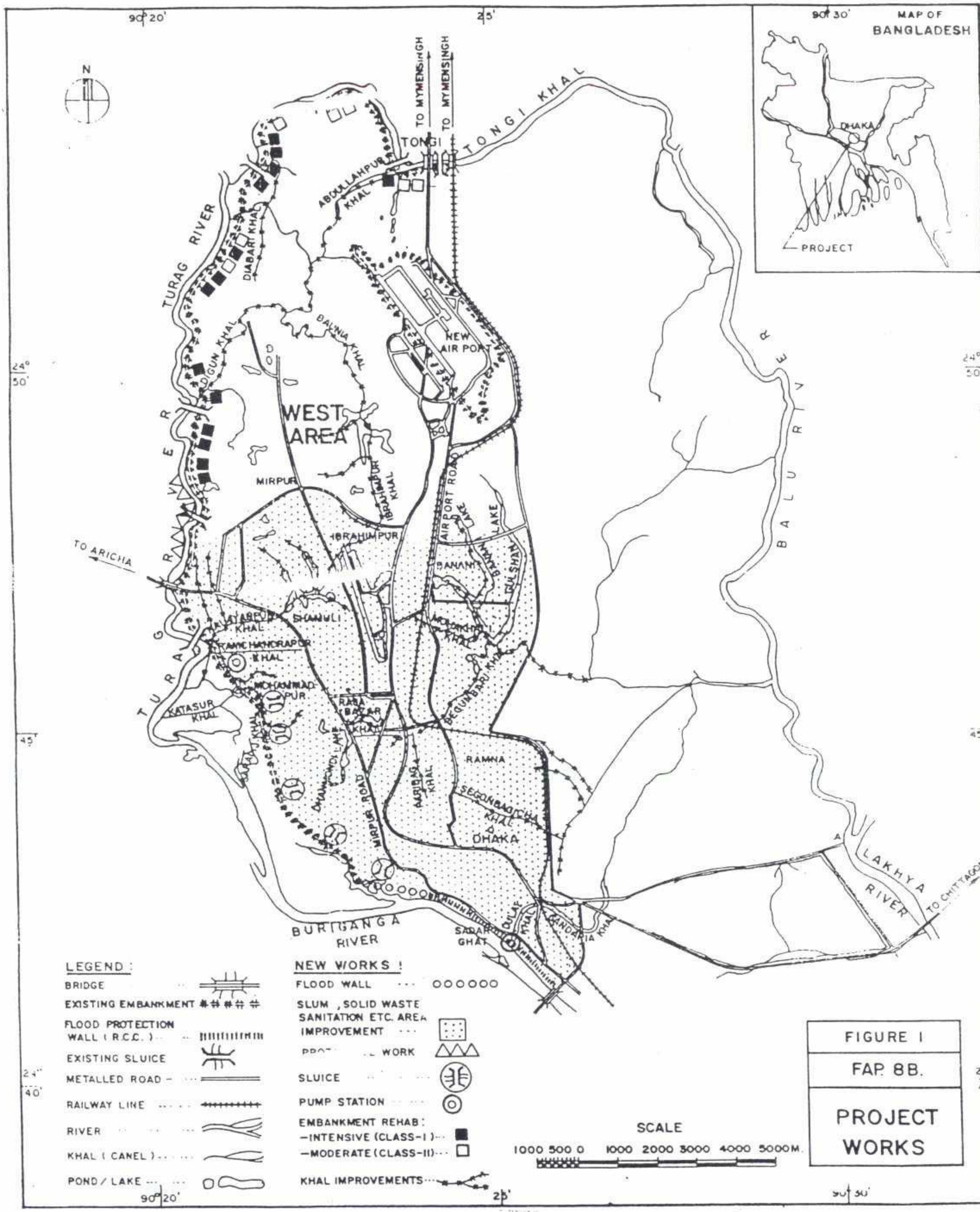
The Project has been prepared in four Parts, with the following major components:

<u>Part A: Flood Protection (BWDB)</u>

- o Specialized remedial works and foundation stabilization on 7.8 km of the existing embankment;
- o Erosion control and slope protection over 11.5 km;
- o Minor remedial works and slope protection over 24.2 km;
- o Repair and stabilization of parts of 5.3 km of existing concrete flood wall;
- o Construction of 1.6 km of new flood wall/embankment;
- o Construction of 5 additional sluices along the existing embankment;
- o Raising and flood proofing of the central spine road (Tongi Railway Bridge to Friendship Bridge);
- o Construction of the first stage (22.5 cms) of Pump Station No. 3 at Goranchatbari along the westerly embankment;
- o Establishment of a maintenance program and supply of maintenance equipment to safeguard the flood protection investment.

<u>Part B: Drainage (DWASA)</u>

- o Rehabilitation and upgrading of 21 existing priority khals (including completion of the crash program initiated by the government), for a total length 78.6 km;
- o Rehabilitation and construction of 50.7 km of pipe drains;
- o Establishment of a maintenance program and supply of maintenance equipment to safeguard the drainage improvement investment.



MAP OF BANGLADESH
DHAKA
PROJECT
TONGI KHAL
TO MYMENSINGH
TONGI
ABDULLAHPUR KHAL
TURAG RIVER
DIABARI KHAL
DIGUN KHAL
BAUNIA KHAL
NEW AIR PORT
WEST AREA
MIRPUR
IBRAHIMPUR KHAL
AIRPORT ROAD
IBRAHIMPUR
BANANI
GULSHAN
BANANI LAKE
GULSHAN LAKE
TO ARICHA
SHAMOLI
KATASUR KHAL
RAMCHANDRAPUR KHAL
MOHAMMADPUR
BEGUNBARI KHAL
RAMNA
SEGONBAGICHA KHAL
DHAKA
DHANMONDI LAKE
MIRPUR ROAD
BURIGANGA RIVER
SADAR GHAT
DOLAI KHAL
PANDARIA KHAL
BALU RIVER
LAKHYA RIVER
TO CHITTAGONG
LEGEND :
BRIDGE
EXISTING EMBANKMENT
FLOOD PROTECTION WALL (R.C.C.)
EXISTING SLUICE
METALLED ROAD
RAILWAY LINE
RIVER
KHAL (CANEL)
POND / LAKE
NEW WORKS :
FLOOD WALL
SLUM , SOLID WASTE SANITATION ETC. AREA IMPROVEMENT
WORK
SLUICE
PUMP STATION
EMBANKMENT REHAB :
—INTENSIVE (CLASS-I)
—MODERATE (CLASS-II)
KHAL IMPROVEMENTS
SCALE
1000 500 0 1000 2000 3000 4000 5000M.
FIGURE I
FAP 8B.
PROJECT WORKS
90°20'
25'
90°30'
24° 50'
45'
24° 40'

28

Part C: Environmental Improvement Program (DCC)

- o Slum and squatter area improvements covering about 8,725 beneficiary families;
- o Solid waste management, including the supply of 30 new trucks and complementary waste handling equipment;
- o Sanitation improvements, including 30 public toilets and 5 mobile toilets, 5,500 low cost sanitary latrines for low income residents, and 2 septic tank desludging trucks;
- o 1,000 public water standpipes for low income communities;
- o Rehabilitation and extension of 131 km of minor local drains, and supply of 1 drain cleaning truck.

Part D: Implementation Assistance

A Project Implementation Office, headed by the BWDB, staffed by representatives of each participating GOB agency, and strengthened by consulting and training services, will be established to provide the following support:

- o Planning, detailed design, construction supervision, monitoring and evaluation;
- o Coordination and management of Project activities;
- o Equipment and logistical facilities;
- o Quality assurance and control (including establishment of a materials testing laboratory, to complement and work in cooperation with existing laboratories).

4. Project Costs and Financing

The estimated Project costs are tabulated in *Table 1*, and are summarized as follows:

Base Cost	$ 99.9 million
Physical and Price Contingencies	18.1 million
Interest During Construction	$ 3.2 million
Total cost:	$ 121.2 million

A Bank loan of about U.S. $92.5 million (76.3%) is being considered for financing of all eligible costs over a 40 year term, including a 10 year grace period, with a 1 percent per annum service charge. The balance of project costs of about U.S. $28.72 million (22.7%) to cover non-eligible costs for land acquisition ($9.38 million) and duties and taxes ($16.57 million), plus 50% of the incremental staff/ operations and maintenance costs ($2.77 million) will be the responsibility of the Government and implementing agencies.

Priority Project components in flood protection and drainage are proposed to be made eligible for retroactive financing to enable an immediate start on critical works during the current construction season.

5. Scheduling and Implementation

The Project is being formulated as a five year program between December 1991 to December 1996 for a first stage integrated flood control and drainage program covering the westerly half of Dhaka city, in the context of progressively developing future facilities to ultimately provide full protection to all Dhaka over a period of about 10 to 15 years.

Interministerial coordination and guidance on policy matters will continue to be provided during Project implementation by the National Committee on Flood Control (Steering Committee), while the Technical Committee will act as an implementation coordination committee to provide interagency coordination, to monitor conformance to the Action Plan, and to approve annual development programs. The BWDB will be the lead implementing agency, and primary responsibilities for execution of the Project components will be shared between: (i) the BWDB for Part A: Flood Protection; (ii) DWASA for Part B: Drainage; and (iii) DCC for Part C: Environmental Improvements. Support will be provided for selected aspects by RAJUK and DOE as required. FPCO will continue to coordinate, monitor and evaluate the Project in the context of the FAP during the implementation period.

A strong Project Management Office (PMO) is proposed to provide overall coordination, technical assistance and quality assurance/control during the Project period. The PMO will be headed by a Project Director at the level of Superintending Engineer from BWDB. Full time professionals at the level of Executive Engineer will be provided from the major involved agencies (BWDB, DCC, DWASA) to be permanently attached to the project office as Deputy Project Directors for development and coordination of the project. Professionals from FPCO, RAJUK and DOE will also be deputed to the Project office on a part time basis.

International and local consultants will be provided to assist in establishing design and administration procedures, training personnel, strengthening DCC financial and conservancy administration, construction supervision and quality control, project benefit monitoring and evaluation, and reporting. The agreed manmonths for design, construction supervision and Project management advisory services include 96 manmonths of Foreign consultant and 666 manmonths of Domestic consultant services over the 5 year Project period. In order to proceed with preparation of high priority Project components without delay for first year implementation, the Government has requested the Bank for approval to extend the services of the T.A. consultants for the bridging period up to loan effectivity, as a part of the above services.

6. Environmental Impact

The proposed Project has been evaluated to provide highly positive benefits, and is recommended for implementation. The EIA carried out during the feasibility study is considered adequate for Project formulation, and the Project design will include provision for follow-up monitoring and evaluation of the Project impacts.

7. Technical Assistan[illegible]

The Bank has agreed to the Government request to provide a complementary advisory technical assistance program, under grant financing, to provide land development controls and procedures for Dhaka, focused on: (i) developing land development controls, standards and procedures to ensure that improvements to the drainage and flood control systems are not negated by uncontrolled and unrestricted growth; (ii) developing improved cost recovery mechanisms for financing increased needs for public infrastructure and services due to urban development; and (iii) rationalizing the needs and uses of vacant/underutilized Government land in Dhaka City.

5

TABLE 1

Summary of Project Costs by Sector
($ million[1])

		Foreign	Local	Total
1.	Base Costs by Sector:			
	Part A: Flood Protection	16.48	30.18	46.66
	Part B: Drainage	9.10	28.28	37.38
	Part C: Environmental Improvement:			
	i) Slum Improvement	0.47	1.41	1.88
	ii) Solid Waste Mgmt.	1.41	2.44	3.85
	iii) San/WS/Local Drain	1.07	3.14	4.21
	Part D: Project Implementation Assistance:			
	i) Incremental Admin.	0.21	1.36	1.57
	ii) Consulting Services	1.43	2.94	4.37
	Subtotal	30.17	69.75	99.92
2.	Contingencies:			
	Physical	3.10	6.29	9.39
	Price	2.48	6.23	8.71
	Subtotal	5.58	12.52	18.10
3.	Interest During Construction:			
	Service charge on Bank loan	3.20	–	3.20
	IDC on Domestic Borrowing	–	–	–
	Subtotal	3.20	–	3.20
	TOTAL	38.95	82.27	121.22

[1] Estimated at Taka 37.25 = $1 U.S.

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1.0 INTRODUCTION

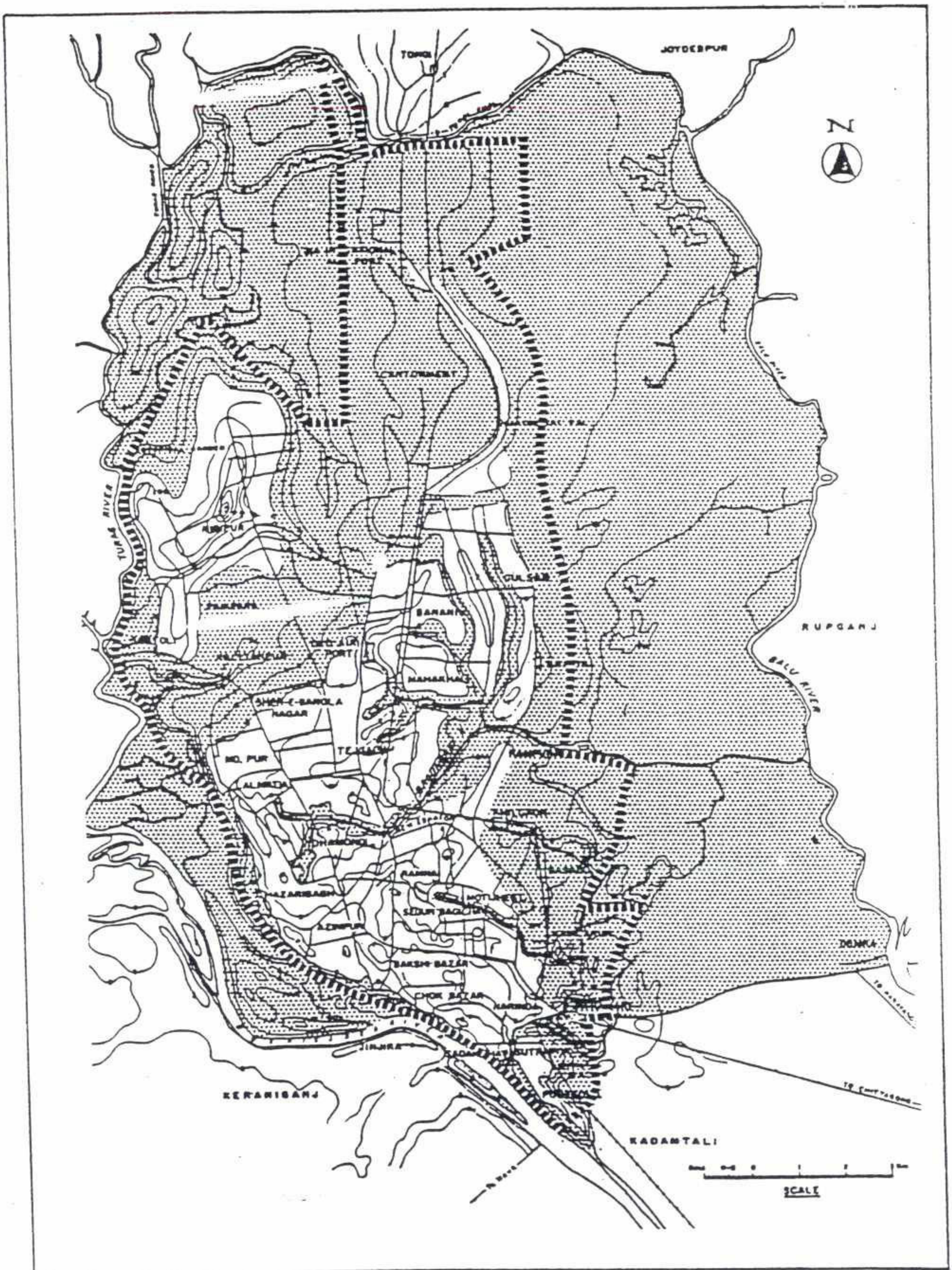
1.1 Background

During the monsoons of 1987 and 1988, Bangladesh suffered two of the most serious floods on record. Vast areas of the country, including the capital city of Dhaka with a population of about 4.8 million people, were flooded to an unprecedented degree with flood levels 1.5 meters higher than normal for periods of up to four weeks. In Dhaka city alone it is estimated that about 200 sq km, or 77% of the total area of 260 sq km, were submerged to depths ranging between 0.3 to over 4.5 meters (see Figure 1.1), and that about 2.5 million people, or 60% of the city population, were directly affected by these floods. City life was totally disrupted during this period. Although there are no comprehensive records of the economic value of losses due to flooding, JICA has estimated that the equivalent 1990 damage of a normal annual flood would be about Taka 1,400 million, and of a 1988 scale flood (70 year recurrence period) would be Taka 10,100 million.

In the wake of these floods, in October 1988 the Government of Bangladesh (GOB) established a Committee for Flood Control and Drainage of Greater Dhaka, with the primary objective of preparing a flood control plan for the Greater Dhaka Metropolitan area, based primarily on the 1987 JICA study on storm drainage system improvements for Dhaka City, and the 1988 "Jansen Report" on causes of the 1988 flood and recommended solutions. In January 1989 the Committee submitted a detailed scheme for phased investments in flood protection and drainage for Dhaka, Tongi, Narayanganj and Savar, which was approved by the Government in March 1989.

Figure 1.2 shows the recommended program for Dhaka. In view of the high priority assigned to the Dhaka protection scheme, the Government immediately initiated Phase I of the recommended works on a crash program basis using their own resources. These works, which were designed to provide protection to about 136.5 sq km in the highly urbanized westerly part of the city, included construction of about 30 km of embankment and 7 km of flood protection wall along the westerly perimeter of the city, complemented by about 2 km of new roads, 8.5 km of road raising to the east, pipe sluices, cleaning and repair of internal drainage khals and sewerage systems. Additional works taken up at the same time included construction of a flood protection bund around Zia International Airport and 30 km of flood protection wall around the Dhaka-Narayanganj-Demra zone to the south of the city.

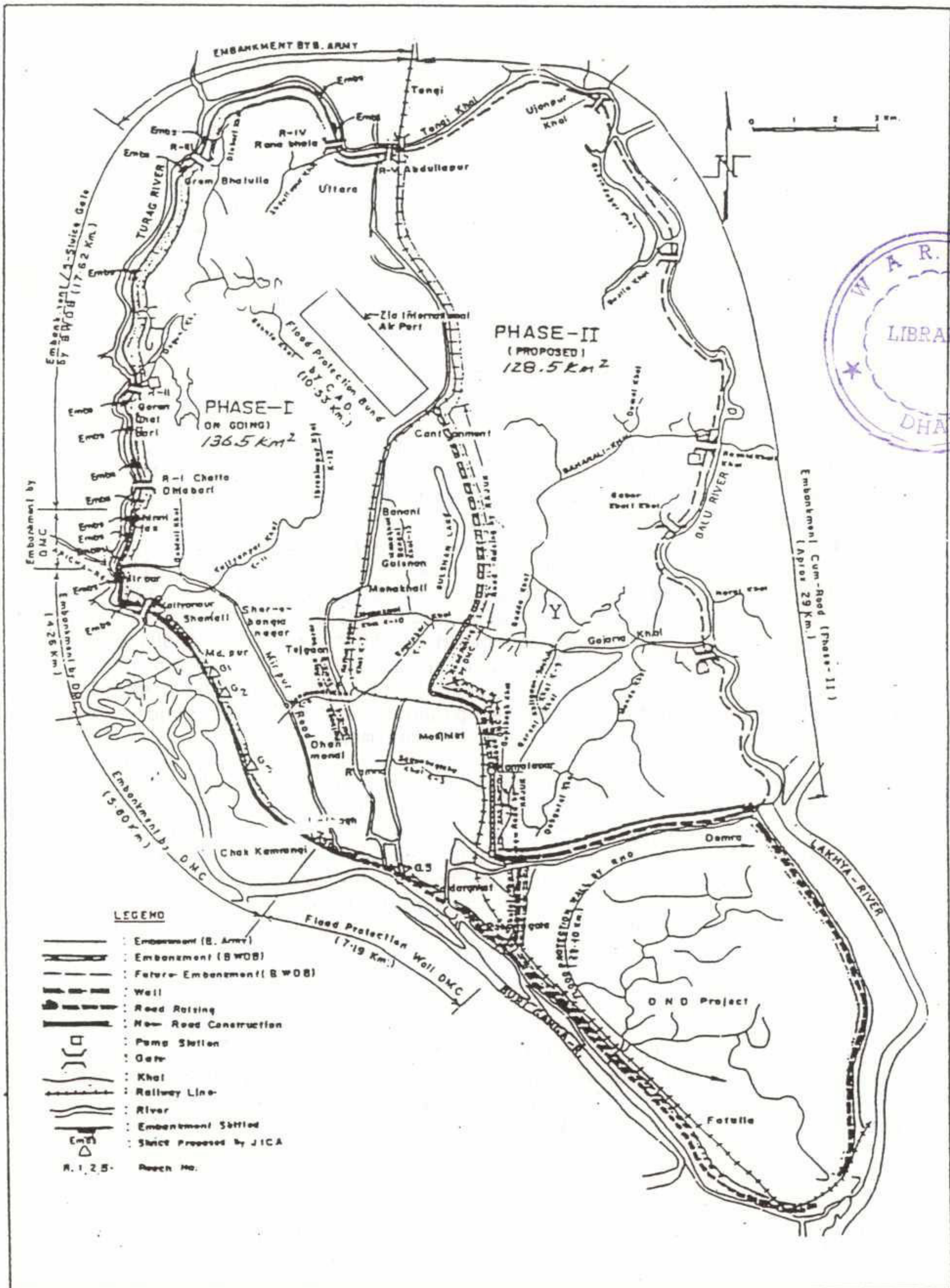
Implementation of the program was a coordinated effort involving the BWDB, DCC, DWASA, RAJUK, CAAB and the Army, with the BWDB taking the lead role. The crash program was initiated in March 1989, and work taken up under the program is now nearly, but not all, complete. Along the west side of the Phase 1 area all embankments have been constructed and are being maintained, six sluices are being or have been constructed, and 5.2 km out of 8.1 km of flood protection walls have been done. Along the east side, all road-cum-embankment raising has been completed.



Dhaka Integrated Flood Protection Project ADB TA No. 1318-BAN Ministry of Irrigation, Water Development and Flood Control	Louis Berger International, Inc. in association with Associated Consulting Engineers Ltd. Desh Upodesh Limited. Technoconsult International Ltd.	Figure 1.1 1988 FLOODED AREA

Source : JICA Storm Water Updating Study, February 1990

20



Dhaka Integrated Flood Protection Project ADB TA No. 1318-BAN Ministry of Irrigation, Water Development and Flood Control	Louis Berger International, Inc. in association with Associated Consulting Engineers Ltd. Desh Upodesh Limited. Technoconsult International Ltd.	Figure 1.2 GREATER DHAKA FLOOD PROTECTION PROJECT.

Source : BWDB Synopsis of Flood Protection and Drainage Project, June 1990

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However, the work on flood protection carried out by the Government using its own resources was started without a proper feasibility study and site investigations, and construction was done under extremely tight time constraints without adequate quality control or adequate scheduling and coordination of interlinking activities. As a result, there have been some serious failures and erosion of large sections of the embankment, drainage congestion due to blocking of the natural drainage paths, and objections to the construction from taxpayers in the old Dhaka area where businesses are seen to be affected. The flood control and drainage system is not yet complete nor fully operative. In order to provide a minimum acceptable level of protection for the western part of Dhaka, and for benefits to be realized and the system to be made secure, it is essential that construction deficiencies be corrected, additional flood protection and drainage venting works be completed, and improvements to the internal drainage system be done. This is planned under the proposed Project.

The overall flood protection program for Dhaka involves remedial works and completion of the westerly embankment (30 km), construction of the easterly embankment (29 km), internal embankments and road raising, construction of additional sluices and pump stations, and improvement of storm water drainage. The program of flood protection has been developed in close coordination with the drainage master planning study under JICA and the North-Central Regional Study being assisted by EEC and France, and provides adequate flexibility to incorporate needed modifications at the detailed engineering stages. The close cooperation that has been established with donor-assisted activities that have an impact on the flood protection scheme is planned to be maintained through the FPCO, and the compatibility of proposed investments with master planning and regional studies will be reconfirmed prior to undertaking any investments.

The cost of an integrated flood protection program for all of Dhaka City to protect the city from floods of 100 year frequency is estimated at over $450 million. In view of the large investment requirements, the flood protection program will need to be phased and implemented over a period of 10 to 15 years. In planning the flood protection program, cost effectiveness of investments is being considered: protecting the existing densely populated residential, industrial and commercial areas is the first priority, followed by increased pumping capacity (as more intensive urban land use of peripheral areas is made) and increased safety (by dividing protected areas into self-contained compartments by building internal embankments). Such an approach will: (i) give more time to the Government to develop appropriate urban land management policies for newly urbanizing areas; (ii) improve economic justification as land value increases take place; and (iii) permit an incremental approach to flood protection in line with affordability of investments.

The first priority components are being covered under the Project, which includes the rehabilitation, protection and completion of the flood protection embankments and walls, the construction of the first stage of the required drainage pumping station, and priority drainage scheme components for the westerly Phase 1 area, covering over half of the City area and containing about 87% of the population. Following the completion of feasibility studies by JICA, in early 1992, the Government intends to request for additional donor assistance, mainly for extension of the flood protection scheme for the easterly Phase 2 part of Dhaka.

1.2 Flood Action Plan

Several additional studies were carried out in 1988 and 1989 to develop a comprehensive flood policy and program for Bangladesh, including Dhaka city. Based on the results of these studies (all of which agreed on the priority to be given for protective works for the urban areas) a Flood Action Plan (FAP) was formulated under the coordination of the World Bank in November 1989. The FAP identified a total of 11 components and 15 supporting activities to be taken up over a five year period as part of a long term plan of physical works and improved preparedness and management of floods. This was confirmed at the London conference of donors in December 1989 for the purpose of formalizing commitments from various donors for FAP components.

In support of the Government's flood action program, both the Government of Japan and the Asian Development Bank agreed to provide assistance for the Dhaka Town Protection component, FAP-8. This is a two part coordinated action plan specifically focused on the Dhaka Metropolitan Area, and includes:

i) FAP-8A JICA Master Plan Study for Greater Dhaka, Tongi, Savar, Keraniganj and Narayanganj, which has the objective of developing Master Drainage and Flood Control Plans for the Dhaka Metropolitan Area of 850 sq. km., identifying priority projects within this area, and preparing feasibility studies for selected components, and

ii) FAP-8B, ADB Dhaka Integrated Flood Protection Project (DIFPP), which has the objective of identifying drainage, flood protection and complementary environmental improvement projects, and preparing feasibility studies for the immediate investment needs in the Greater Dhaka Area of 260 sq. km. (included in the above larger study area).

Figure 1.3 shows the boundaries of the respective study areas. As a part of their work programs, the JICA and ADB consultants are maintaining close liaison and sharing information and findings to ensure that their actions are complementary and that unnecessary duplication of work is avoided.

1.3 Technical Assistance Objectives

As defined in the Terms of Reference and agreed at subsequent tri-partite meetings, the technical assistance for this Project has two primary objectives:

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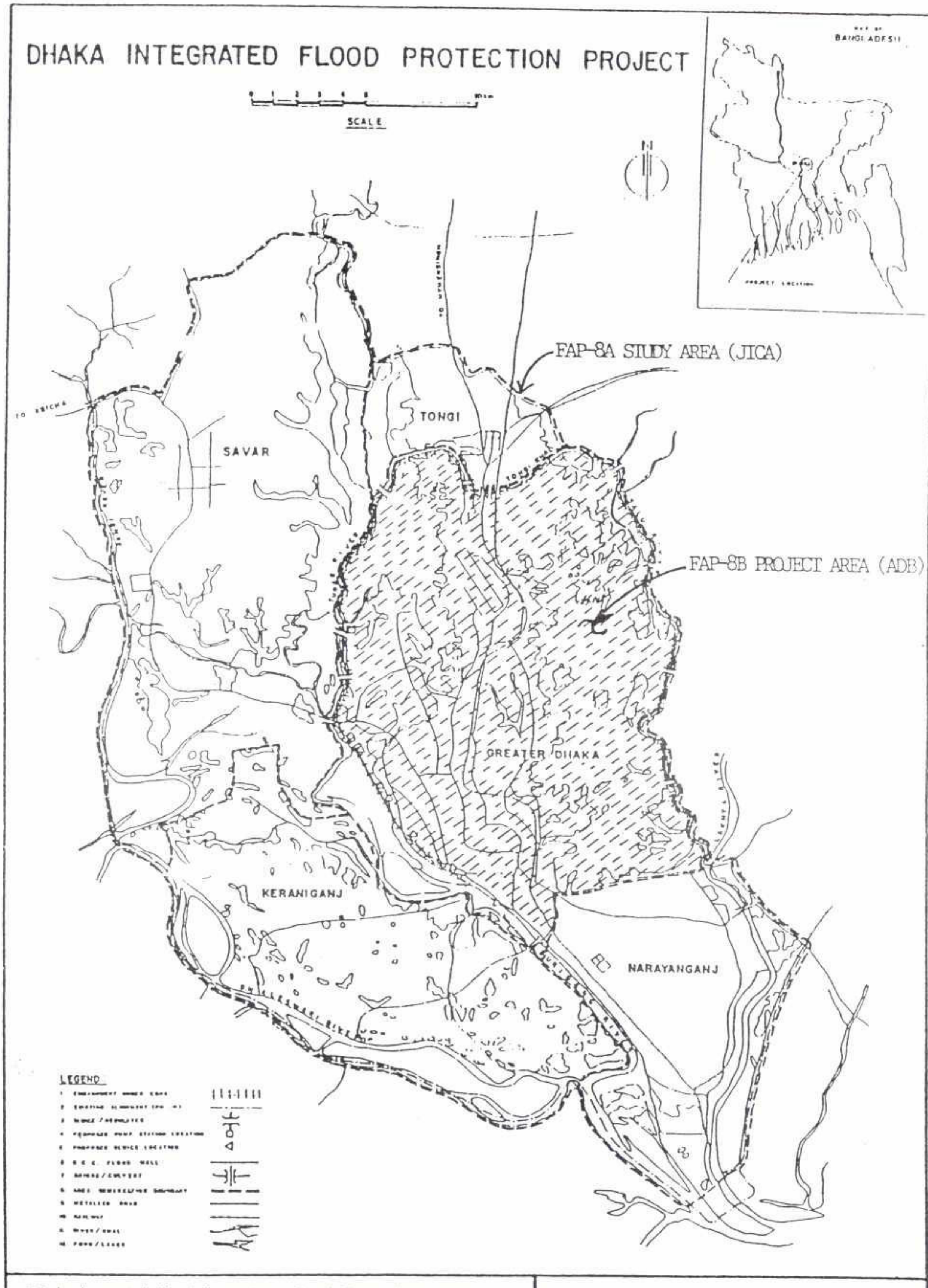

Dhaka Integrated Flood Protection Project
ADB TA No. 1318 BAN
Ministry of Irrigation, Water Development and Flood Control

Louis Berger International, Inc.
In association with
Associated Consulting Engineers Ltd.
Sh Upodesh Limited
Technoconsult International Ltd.

Figure 1.3

PROJECT BOUNDARIES
FAP-8A & FAP-8B

(i) to prepare an integrated urban environmental plan for the Dhaka Metropolitan Area (260 sq km) and surrounding urbanized areas to a pre- feasibility level of detail with emphasis on flood protection and drainage. Other aspects to be considered include management of land use, water quality, sewerage/excreta, solid waste, hazardous and toxic wastes, and slum and squatter areas. Also included will be review and comments on the institutional arrangements and legislation related to environmental policy and controls.

(ii) to prepare a feasibility study (together with selective assistance in detailed design and contract preparation) for priority flood control and drainage components for Dhaka City. Infrastructure works expected to be included include flood protection embankments and walls, roads, internal drainage improvements, sluices and pump stations for the flood protection and drainage components, plus complementary activities in slum area improvement, solid waste management, and sanitation. Recommendations are to be made on the planning and design standards adopted in the works taken up in the Phase I program, on appropriate institutional arrangements for implementation, operation and maintenance of the facilities, and on appropriate cost recovery mechanisms.

In summary, the main objective of the technical assistance is to assist the Government in the implementation of environmental improvements in the DMA, with emphasis on solving the most serious existing problems.

1.4 The Report

This report is the Final Report, and presents the recommended Integrated Environmental Management Plan for Dhaka City, developed to the feasibility level of detail. It incorporates all revisions to the Project components as agreed during the tri-partite meetings held during the ADB Appraisal Mission of 01 to 14 September 1991, and incorporates all Government and Bank comments made on the Draft Final Report. It includes: (i) a summary[1] of the Consultants analysis of the current situation in Dhaka in regards to land use management, flood control and drainage activities, water quality and sanitation/excreta management, water supply, solid waste management, slum and squatter area improvement, hazardous and toxic waste management, environmental legislation, and institutional and policy aspects; (ii) the Consultants recommendations for appropriate short and long term actions for flood protection, drainage and complementary environmental improvement components to be taken to improve the Dhaka environment; (iii) recommendations and cost estimates for taking up of selected high priority components for implementation under ADB assistance in connection with the proposed Dhaka Integrated Flood Protection Project; (iv) recommendations for implementation arrangements and financing plans for the recommended schemes; (v) detailed feasibility analyses for the

For further details of the Integrated Environmental Management Plan (IEMP), refer to *Interim Report No. 1, May 1991.*

proposed investments; and (vi) an analysis of the major environmental impacts of the proposed flood protection and drainage schemes, and the specific activities which must be taken into consideration in order to mitigate potential adverse impacts of such a program.

The Project components recommended herein, and the associated cost estimates, are based on the scope of works as refined and agreed during the ADB Appraisal Mission of 01 to 14 September 1991. The scope and costs of all components have been reviewed and agreed in consultation with the BWDB, DWASA and DCC. It is expected that this report will form the basis for an ADB assisted Dhaka Integrated Flood Protection Project, and for further detailed design and implementation assistance so that project implementation can commence during the current 1991-1992 financial year.

2.0 BACKGROUND AND PROJECT SCOPE

2.1 General

Bangladesh, with a total area of 144,000 sq km and an estimated population of 116 million, is the most populous of the UN-designated "least developed" countries. Having a per capita income of about $170, the country is also one of the lowest-income DMCs. Little or no change has occurred in levels of real income over the past decade in the country, mainly due to factors such as a population growth of 2.4 percent a year during the 1980s, a limited resource base, a high degree of underemployment and unemployment, and slow growth in productivity.

While Bangladesh remains primarily rural, its urban population has been growing at the explosive rate of 10.6 percent per year from 1974 to 1981 and 5.4 percent from 1981 to 1990. At 24 million, the urban population is now over 20 percent of the total population. Even though the urban growth rate is expected to decline to around 5.0 percent, the total urban population will be some 37 million, or 26 percent of the total, by the year 2000, and will increase to about one third by 2010.

2.2 Flooding Problems in Bangladesh

2.2.1 General

With major river systems and some 40 per cent of its inland area under waterways, Bangladesh has a history of flooding, exacerbated by heavy rainfalls during the monsoon period of June to September. The first systematic study of the country's flooding problem was carried out with UNDP assistance over thirty years ago. This was followed by a Master Plan in 1964 which proposed a large number of projects for flood control, drainage and irrigation. Subsequently, some major embankments were built along parts of the main rivers, but no national level major flood control measures were taken. The disastrous floods of 1987 and 1988 - which caused damage estimated at [illegible] billion and $1.3 billion respectively in monetary terms, apart from extensive loss of human life - highlighted the enormity and urgency of the problem and aroused much international concern. Several studies were undertaken in 1988 and 1989 with assistance from UNDP, USAID, Japan and France to develop a comprehensive flood policy and program. At the Government's request, and based upon inputs from the above studies, a Flood Action Plan (FAP) was formulated under coordination of the World Bank and confirmed at the conference of donors held in London in December 1989. At this conference, the ADB expressed its willingness to provide assistance related to mitigating floods in Bangladesh, including urban flooding.

Following a Government of Bangladesh request, the ADB approved a technical assistance[1] to help prepare an integrated flood protection project for Dhaka, a component included in the FAP.

2.2.2 Flood Action Plan

The FAP has been formulated as an action plan for a period of five years as the first step in the Government's long term flood control program. A set of "Eleven Guiding Principles" provides a broad framework for a plan of physical works together with measures to improve preparedness and management of floods. Prominent among the aspects considered are: (i) the planning and design issues (including location and adjustment of embankments); (ii) social aspects (including closer involvement of the beneficiaries and local authorities in the planning, design and management of projects, and better efforts to educate the public); (iii) environmental issues (including preservation and enhancement of favorable environmental impacts); (iv) matters related to staged development; and (v) implementation issues, particularly those relating to enhancing implementation capability and coordination. The FAP has identified a total of 26 activities, including 11 components - Dhaka Town Protection being one of them - and 15 supporting activities. A national Flood Council and a Flood Plan Coordination Organization (FPCO) were established in September 1989. Implementation of the FAP is the responsibility of a Technical Committee with multiagency representation as well as expert panels (local and foreign), in the fields of engineering, agriculture, economics, social sciences and environmental sciences. Various donors are assisting in the implementation of the FAP. In addition to Dhaka Integrated Flood Protection, the ADB involvement includes the South West Region Water Management Study[2] and Secondary Towns Integrated Flood Protection[3].

While Bangladesh remains primarily a rural country, urban flooding problems have become acute because of high densities and inadequate drainage facilities in towns. Since large investments relating to the housing stock, infrastructure, and industrial/commercial/other buildings are concentrated in the urban areas, flood damages in such areas have been extensive. In recognition of this, all the donor-assisted studies carried out during 1988 and 1989 agreed on the high priority for protective works for urban centers.

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1 TA No. 1318-BAN: Dhaka Integrated Flood Protection; in an amount of $600,000 in June 1990. Consultants (Louis Berger International, Inc. (USA), in association with local consultants) commenced work in January 1991.

2 TA No. 1498-BAN: Southwest Area Water Resources Management Study, approved in March 1991 in an amount of $3.837 million.

3 TA No. 1396-BAN: Secondary Towns Integrated Flood Protection, approved in October 1990 in an amount of $600,000.

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2.3 Flooding and the Urban Sector

2.3.1 Pattern of Urbanization

The four largest cities (Dhaka, Chittagong, Khulna and Rajshahi) are the first order of urban centers with current estimated populations of 4.8 million (6 million for the Greater Dhaka Metropolitan Area which includes adjacent urban centers), 2.1 million, 930,000 and 350,000 respectively. These have the status of City Corporations and together have the urban population share of 43 percent. Although all urban areas have been growing rapidly, these have had the highest growth rates over the past 10 years. The next order of centers are the traditional secondary towns such as Comilla, Sylhet, Mymensingh, Barisal, Jessore, Bogra, Pabna, Rajshahi, Sirajganj and Saidpur. These towns have populations ranging from 160,000 to 350,000 and have experienced absolute growths of from 50 to 100 percent during the past ten years. The third order of urban centers consisting of minor towns with a population of between 50,000 to 160,000 is also experiencing a high rate of growth, with some centers growing as much as 100 percent or more between 1981 and 1990. Lower order towns are also growing fast and their number will be increased as villages are upgraded to urban status. With the designation of all sub-district (upazilla) centers as urban in 1981, the total number of urban centers increased from 108 in 1971 to 550 at present[4]. There are some 89 Municipalities (Pourashavas) which contain about 25 percent of the total urban population and another 460 towns, designated as other centers, with approximately 32 percent of the urban population.

Three factors have caused the rapid increase in urban population, i.e., the natural increase of the urban population, the reclassification of urban centers, and rural to urban migration. The last is recognized as a major component of urban growth. Approximately 70 percent of the increase in the population of Dhaka over the last decade has been attributed to such migration. High rural population densities, rural landlessness, natural disasters and other problems for which there are no easy solutions have been major push factors for driving the rural population to urban areas. Another reason for the rural-urban migration has been the relatively more attractive opportunities that the urban areas have offered both for employment and increased earnings. Between 1975 and 1986 employment in the agricultural sector had expanded only 25 percent compared with 175 percent for the non-agricultural sector. Between 1975 and 1988, GDP from the agricultural sector had increased 35 percent compared with 119 percent for the non-agricultural sector. Although the country is still primarily agricultural, in 1988 the non-agricultural sector accounted for 58 percent of the GDP. Per capita GDP gap between the urban and rural areas remain

4 According to the Municipal Administration Ordinance, 1960, an urban area should have a population of 15,000 or more, three quarters of the adult males engaged in non-agricultural activities, and a population density of at least 2,000 per square mile. The 1981 population census classified all upazilla headquarters as "urban" irrespective of the above criteria.

significant. Considering the above, rural-urban migration is likely to continue, and the importance of the urban economy will become increasingly pronounced.

There will be a growing need to rapidly increase employment opportunities in the future. Due to the changing age structure and the increasing participation of women in the labor force (estimated to have increased at 15 percent per year from 1974 to 1983), the national labor force is expected to grow considerably faster than the overall population. In the urban areas alone it is estimated that by the year 2000 there will be some 8.6 million new entrants into the labor force. According to a UNDP study[5] the crop production sector will be able to absorb only 30 percent of the labor force increase between 1989 and 1995, and consequently pressures will increase in the urban areas. The most noticeable shift in urban employment has been in the trade, finance and business sectors which increased their share from some 4 percent to nearly 13 percent in the period 1974-1984. Approximately two thirds of the current employment in the two largest cities of Dhaka and Chittagong is in the informal sector. In Dhaka in particular, with its 36 percent share of the national large-scale manufacturing activity, the informal sector, which provides the bulk of employment to the urban poor, will continue to be critical to future labor absorption.

2.3.2 Urban Conditions

The fast pace of urbanization in Bangladesh is affecting the efficiency of the cities which generate a large proportion of non-agricultural employment. A rapid growth of slum and squatter settlements has followed, and in the Dhaka City Corporation (DCC) area alone 25 percent of the population - some 1.2 million - is living in such conditions. Severe strains on water supply, sanitation, roads, solid waste collection, electricity, transportation, and serviced land for shelter have also resulted. According to the 1981 census, 26 percent of the urban population was served by piped water while only 11 percent had access to adequate excreta disposal facilities. These problems are particularly severe in Dhaka, where the growth rate is comparatively high and where about 66 percent of households are estimated to have incomes below the poverty line[6]. Housing production is grossly inadequate to meet the growing needs of the rapidly increasing population. The environmental conditions throughout ... of the urban centers are poor, with discharges of industrial pollutants into river systems, contamination of groundwater from lack of proper sanitation and sewerage, and inadequate management of solid waste disposal.

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5 Bangladesh Agricultural Sector Review: Performance and Policy, February 1989.

6 The urban poverty line income is estimated by costing the FAO minimum food consumption bundle (2,112 calories) per person per day for Bangladesh using urban retail prices and adjusting upwards by 25 percent to accommodate the purchase of non-food essentials.

60

Drainage conditions, in particular, are poor. In a recent study[1] it was identified that over 90 percent of the urban population in 10 study towns identified poor drainage as being the worst problem and the highest priority for improvement. In Dhaka City, local flooding due to poor drainage conditions is a regular occurrence during the monsoon period. Poor drainage affects 65 percent of the slum and squatter dwellers (800,000 people), and 22 percent (265,000 people) are regularly flooded during minor rainfalls. For external flooding, the central parts of the city are high enough to remain generally free from flooding, but fringe areas are extensively inundated by 2-4 meters for several months each year by overflows of the surrounding rivers. Major floods, however, such as those in 1987 and 1988, affect even the central parts of the city. Heavy rainfall, high surrounding water levels and an inadequate and unsatisfactorily maintained drainage system all contribute to flooding in the city. Heavy rainfall particularly aggravates flooding when it is late in the monsoon period and adds to the overflow of the rivers. Damage to city infrastructure is usually severe. During the floods of 1988, about 400 km of roads in Dhaka were damaged and about 60 per cent of the 1900 km internal road system was submerged. The flood damage in Dhaka was estimated at between $ 15 million and $ 30 million.

2.3.3 Urban Poverty

There is widespread poverty in Bangladesh as a whole, in both the rural and urban areas. In 1987, the World Bank estimated urban "hardcore" poverty at 31 percent of the urban population (rural, 52 percent) and "minimum nutritional" poverty at 66 percent (rural, 74 percent). The urban poverty situation is also compounded by the fact that a dominant proportion of migration to urban areas occurs from the poorest rural groups. The most deprived urban groups (slum dwellers, squatters and pavement sleepers) live in conditions considerably worse than those of the rural poor. With high population growth rates in the urban areas, and assuming no increase in the incidence of urban poverty, the number of urban poor could more than double by 2000, to 30 million.

2.3.4 Development Programs

The government has been aware that increasing urbanization and insufficient employment opportunities are contributing to growing urban poverty and has been taking measures to alleviate the problem. Allocations were made to improve water supply and sanitation services in large urban centers and district headquarters in the Second Five-Year Plan (SFYP), FY1981-FY1985, but the amounts were modest and sector deficiencies increased. In the Third Five-Year Plan (TFYP), FY1986-FY1990, the emphasis continued to be on urban water supply and sanitation, both in large urban centers and Upazilla areas, development expenditures by city development authorities, and housing. The TFYP also included specific allocations for low-income housing and environmental improvement at Mirpur in Dhaka, squatter resettlement programs at Mirpur, Tongi and Demra, and a large sites and

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[1] TA No. 1105-BAN, Secondary Towns Infrastructure Development Project.

services scheme in Chittagong. Following the devastating flood of 1988, the Dhaka City Flood Control Project was undertaken on an emergency basis to construct embankments, protection walls, sluices, pumping stations, and drainage schemes. In addition, the Government has undertaken a large number of land-use plans involving 356 Upazillas and 53 Zillas.

In order to begin to resolve the problems of poverty in both urban and rural areas, the Fourth Five-Year Plan (FFYP), FY1991-FY1995, makes the alleviation of poverty through generation of employment opportunities one of the three major objectives of the Plan, along with accelerated economic growth and increased self-reliance. Another major feature of the FFYP, which sets it apart from previous plans, is the proposed integration of sector based planning with socio-economic group based planning. Because it is felt that the poor and disadvantaged have not been reached through the sector approach, the Plan divides the population of the country into ten socio-economic groups with poor urban informal households, engaged in non-agricultural activities, as one of the main target groups. In order to achieve the dual objectives of poverty alleviation and self-reliance, each sectoral plan will contain programs and policies to assist low income groups to participate in project formulation and implementation. The Physical Planning, Housing and Water Supply sector would be allocated a total of 11 percent of FFYP resources as against 3.4 percent in the TFYP. However, reflecting the emphasis on self-reliance, fully 83 percent of the resources for the sector are to come from the private sector. This indicative allocation to the private sector is meant to reflect the present trends and future response to policies with respect to private sector participation during the Fourth Plan.

The FFYP indicates that the past thrust for urban water supply and sanitation, slum-upgrading, sites-and-services, and land-use planning programs will be continued. An integrated approach to urban infrastructure development and flood protection works will be expanded to secondary towns. A core house program in addition to sites and services may be introduced. More emphasis will be placed on the decentralization of administration, private sector participation, environmental improvement and NGO participation.

2.4 Flood Control Planning for Dhaka City

For the flood protection and drainage of Dhaka city and its surrounding areas, several studies were undertaken in the past, but not thoroughly enough, due to resource constraints. The first full-scale study was prepared by UNDP in 1968. It proposed a master plan covering an area of about 75 sq km area and involving construction of an embankment around the city, pump stations and other drainage facilities. In 1970, another study followed, which was revised and updated after Bangladesh became independent in 1971, involving polders covering about 250 sq km, together with infrastructure improvements. In January 1989, a Government-appointed committee prepared a flood control and drainage plan for Greater Dhaka and its surrounding areas which was officially approved in March 1989. The proposed plan involves: (i) construction of embankments and flood protection walls along the Tongi Khal, Turag and Buriganga rivers, Dhaka-Demra roads and Balu river to protect the Greater Dhaka area of around 260 sq km; (ii) installation of five pumping stations to drain internal water; and (iii) re-excavation and restoration of 12 canals. In view of the urgency of the flood protection works, and pending assistance from donors, the Government has undertaken some emergency works from its own resources[8]. These works were undertaken by several agencies such as the Bangladesh Water Development Board (BWDB), the Dhaka City Corporation (DCC), the Dhaka Water Supply and Sewerage Authority (DWASA), the Bangladesh Army and RAJUK, the capital development authority. The environmental impact of these investments was studied by the Department of Environment (DOE) of the Ministry of Environment and Forests, assisted by consultants financed under a ADB technical assistance project[9].

The various studies related to flood protection that were carried out in the past remained largely at master planning, or at project identification/pre-feasibility level of detail. Where elements were carried out, they were done by the various agencies, generally on an ad hoc basis without proper coordination. These piecemeal efforts have been generally ineffective and, in fact, have in some cases, inadvertently compounded environmental and health hazards. Inadequate drainage has resulted in polluted waters remaining stagnant in low-lying lands (and often densely populated slum areas) for long periods of time. Uncoordinated collection and disposal of solid waste has contributed to localized flooding through clogging of drains. Similarly, inadequate and ineffective excreta management has led to high levels of exposure to water borne pathogens during floods. A clear, urgent need has thus emerged to integrate flood protection works for the Dhaka metropolitan area, encompassing about 260 sq km, with other infrastructure and environment improvement measures to maximize impact.

2.5 Institutional Setting

2.5.1 National Institutions

Overall responsibility for coordination of development projects in Bangladesh, including flood control, urban development and housing programs, is the responsibility of the Planning Commission. Specific responsibility for coordination, review and approval of the consultant studies taken up under the FAP lies with the Flood Plan Coordination Organization (FPCO) of the Ministry of Irrigation, Water Development and Flood Control (MIWDFC).

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8 These include embankments (30 km), flood-walls (34 km), pipe sluices (5), road-raising (9 km), flood protection of the international airport and repair and restoration of sewerage works in the city.

9 TA No. 1104-BAN: National Environmental Monitoring and Pollution Control, for $750,000 financed by JSF, approved on 12 January 1989.

The Ministry of Irrigation, Water Development and Flood Control (MIWDFC) is responsible for major water resource projects nationwide, including flood control, drainage, irrigation and town protection schemes. The Bangladesh Water Development Board (BWDB) is the implementing agency for the Ministry and has primary responsibility for coordinating works programs and implementing programs directly related to flood protection for both urban and rural areas. The BWDB has a long history and wide experience in poldering works throughout Bangladesh. With a total staff of over 18,000 people (see organogram, Figure 2.1), the BWDB has adequate engineering staff and capabilities to perform the work. Their responsibility includes the planning, design and construction of embankments and outlet structures, and operation and maintenance of the completed facilities. The BWDB is a centrally funded Government body, and has no significant revenue generating capability or authority. It relies on central Government allocations in the annual development plan for financing of its' work programs. The greatest strength of the BWDB is its' strong engineering organization and implementation capabilities; the greatest weakness is its' poor operation and maintenance capabilities which tend to be subordinate to the implementation works, and to traditionally suffer from inadequate attention and funding.

Responsibility for urban development in Bangladesh is fragmented. Key functions are shared among two ministries and a wide range of central departments, utility agencies, development authorities, city corporations, and municipalities. Urban utilities, infrastructure, and urban administration are the re ponsibility of the Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC), while physical planning, development control, and housing functions are under the Ministry of Works (MOW). Experience and capabilities in integrated urban development are limited, especially at the local level. There is a particularly widespread lack of expertise in programming and budgeting, in financial and property management, and in social work and community-based activities.

Two types of local governments operate in the urban areas of Bangladesh: city corporations, and pourashavas (or municipalities), both under the overall jurisdiction of MLGRDC. The Local Government Engineering Bureau (LGEB), the technical arm of LGD, provides technical support to pourashavas[10]. City corporations and special purpose Development Authorities[11] have been created in the larger towns of Dhaka, Chittagong, Khulna and Rajshahi, while pourashavas operate in some 89 towns.

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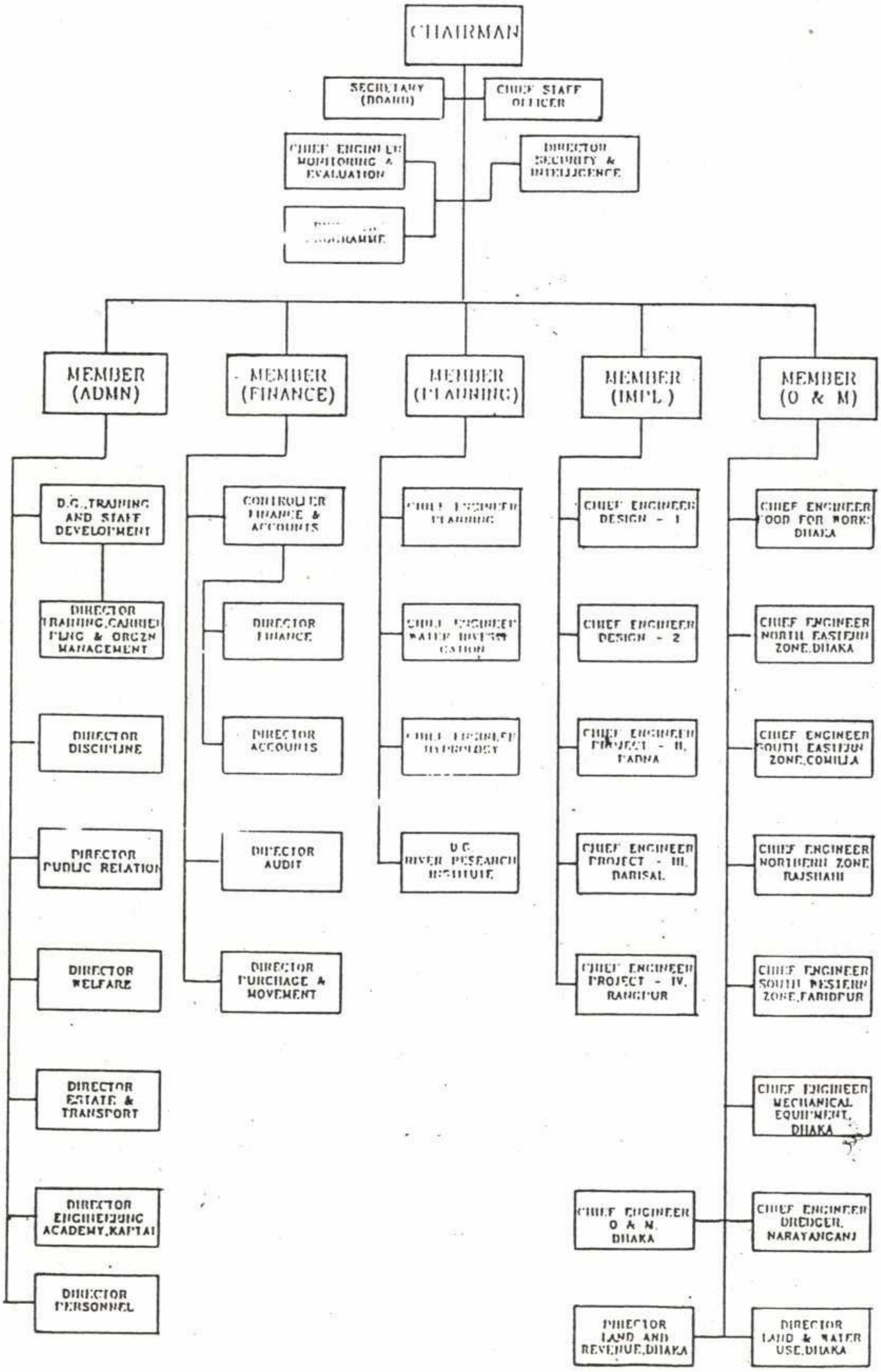
10 Pourashavas are governed by an elected chairman and council members, whereas in city corporations, the Mayor is appointed by the Government. Other than the size of the population served, there is little difference in the responsibility and revenue sources assigned to the two types of urban local governments.

11 The Development Authorities (under the jurisdiction of MOW) prepare master plans, oversee control development of areas, and prepare implement capital investment projects.

Figure 2.1

BANGLADESH WATER DEVELOPMENT BOARD
MINISTRY OF IRRIGATION ,WATER DEVELOPMENT & FLOOD CONTROL

PRESENT ORGANIZATION CHART



The design and construction of water supply and sanitation systems is generally the responsibility of the Department of Public Health Engineering (DPHE), except in Dhaka and Chittagong where autonomous Water and Sewerage Authorities (WASAs) have been created. These Authorities are independent of the local municipal governments, and their chairmen report directly to the Secretary of LGD. Maintenance responsibility for most of the physical infrastructure built by the development authorities is passed on to the local governments. The Government, through MLGRDC, has complete control over the activities of the local governments.

Local government activity, as measured by spending levels, is not large especially when compared with urban service needs. Own funding sources of the municipalities include taxes, rates and fees. The primary local tax is the house or holdings tax levied on all buildings and the land on which the buildings are located. Revenues from these sources are normally applied towards meeting the establishment costs, conservancy services and routine maintenance of existing infrastructure. Development assistance is provided to the municipalities, generally in the form of grants-in-aid by the Government.

National urban programs of the MOW are implemented through the Public works Department (PWD), the Urban Development Directorate (UDD), the Housing and Settlement Directorate (HSD), and the Office of the Deputy Commissioner of Settlements (DCS). PWD is responsible for construction and maintenance of government buildings and staff housing. UDD, as a planning agency, advises the Government on matters of policy relating to urbanization, land use and land development, socioeconomic research, physical planning for human settlements, and regional development. HSD is charged with providing low-cost housing to the general public. DCS is responsible for allocation of plots and houses, execution and registration of leases, and collection of rents and other charges.

Responsibility for environmental planning, management and monitoring, on a national level, lies with the Department of Environment (DOE) of the Ministry of Environment and Forests (MEF). DOE programs include monitoring of the pollution levels of rivers and groundwater used for human consumption, monitoring and analysis of surface water for pesticide residue and heavy metals (in collaboration with Bangladesh Atomic Energy Commission and Bangladesh Center for Advanced Studies), and analysis on request of water and waste water samples which are brought to DOE laboratories by others. DOE has four divisional offices, one of which is located in Dhaka. Although they have a sanctioned staff of 388 people, currently only 70 are recruited, of which approximately 25 have scientific or technical training/ education. DOE has undertaken some surface water monitoring in and around Dhaka, but with the severe constraints on staff and budget this has been limited to only occasional periodic testing up until now.

2.5.2 Dhaka's Institutional Framework

Dhaka's urban institutional framework comprises Dhaka City Corporation (DCC), the Dhaka Water Supply and Sewerage Authority (DWASA), and the Capital Development Authority (RAJUK). DCC and DWASA are under the LGD, which regulates their activities, reviews their project proposals and monitors their project implementation, while RAJUK is within the purview of MOW. Physical planning for government shelter-related projects for Dhaka, like other areas, are provided by UDD and HSD, while other urban services and inputs such as industrial estates, airport facilities, schools an hospitals are provided by the relevant Government agencies. Cantonment areas are regulated by the military authorities.

(a) Dhaka City Corporation

Responsible administratively to the LGD, Dhaka City Corporation is empowered to undertake a wide range of urban functions, including road construction and maintenance, surface water drainage, the construction and management of parks and markets, solid waste collection and disposal, public health and sanitation, street lighting and traffic management, and slum improvement projects. In practice, however, much of DCC's work is involved in operating and maintaining existing infrastructure and services. Capital improvement projects are undertaken primarily by RAJUK for new developments, and by DWASA for water supply, sewage and drainage sector works.

DCC is headed by a Mayor/Administrator, and is organized into five principal areas of responsibility (engineering, conservancy, revenues, accounts and health) under the Chief Executive Officer (see organogram, Figure 2.2). The technical wing is headed by a Chief Engineer, with one Additional Chief Engineer, three Superintending Engineers and Executive Engineers and a Terminal Manager. DCC has recently created a low-cost sanitation unit to implement a pilot latrine program financed by IDA, and has plans to develop a slum improvement cell to implement slum improvement programs. Responsibility for overall financial management is a shared function between the Chief Revenue Officer, the Chief Accounts Officer, and the Audit Sections.

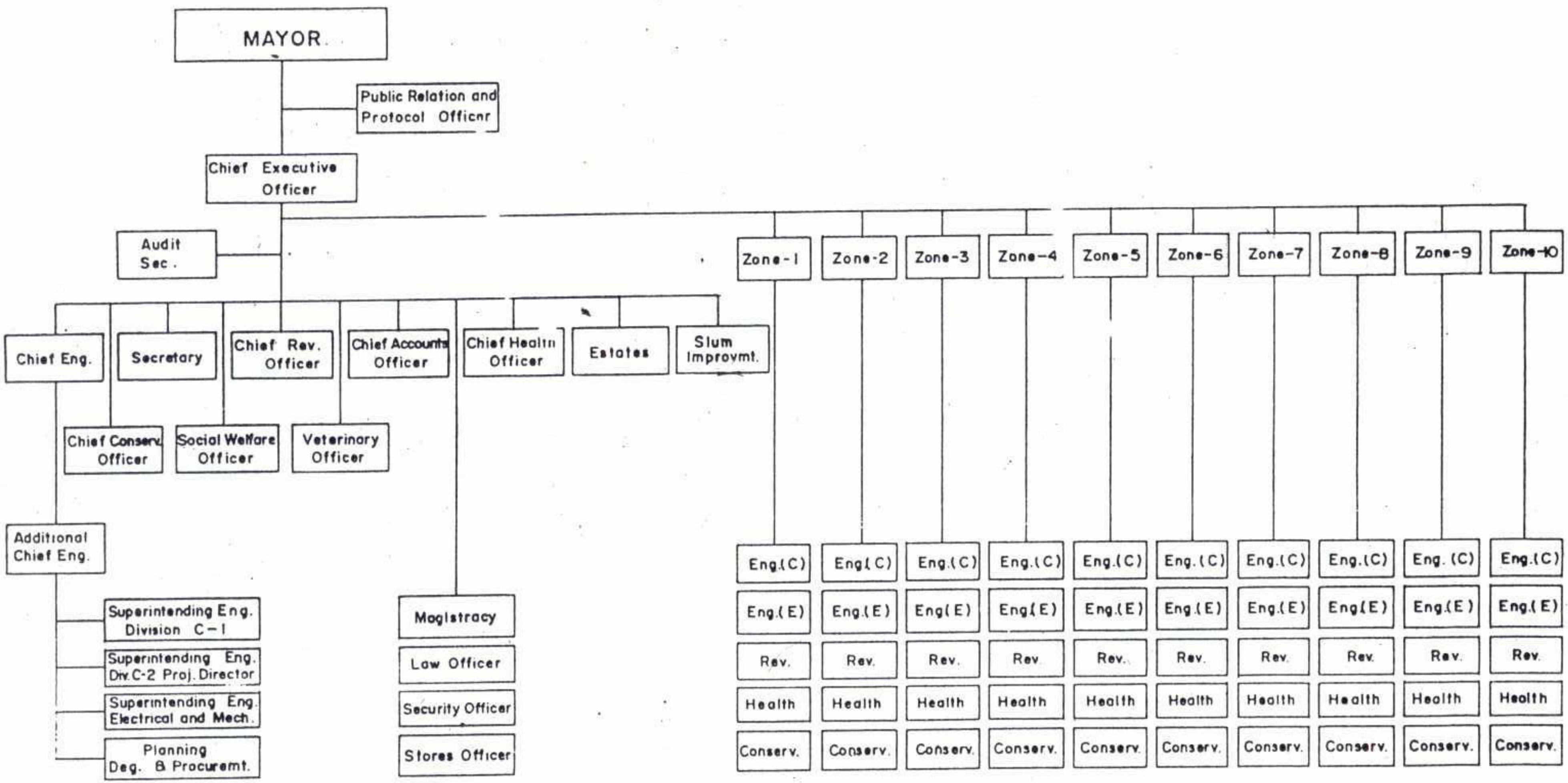
DCC has a sanctioned strength of 4,678 people, but is presently severely under strength with a total staff of 3,800, supplemented by 6,222 muster roll employees (temporary part time laborers). The largest number is in the Conservancy Department (about 4,000, mostly part time laborers for street sweeping and garbage collection), followed by about 1,700 in the Engineering Department. DCC is the executing agency for the Old Dhaka component of IDA's urban development project, including the Dholai Khal pumping station, and has established a project office for administration of the works. The slum improvement cell within DCC has a sanctioned staff of 87 people, but has never been staffed to it's approved levels and has been unable to provide any significant improvements to the slum and squatter areas up until now.

(b) Dhaka Water Supply and Sewerage Authority

DWASA, which also comes under LGD, was set up in 1963 as a semi-autonomous agency with the responsibility for planning, construction, operation and maintenance of water supply and sewerage facilities. Recently (1989) the

Figure 2.2

ORGANIZATION CHART OF DHAKA CITY CORPORATION (DCC)



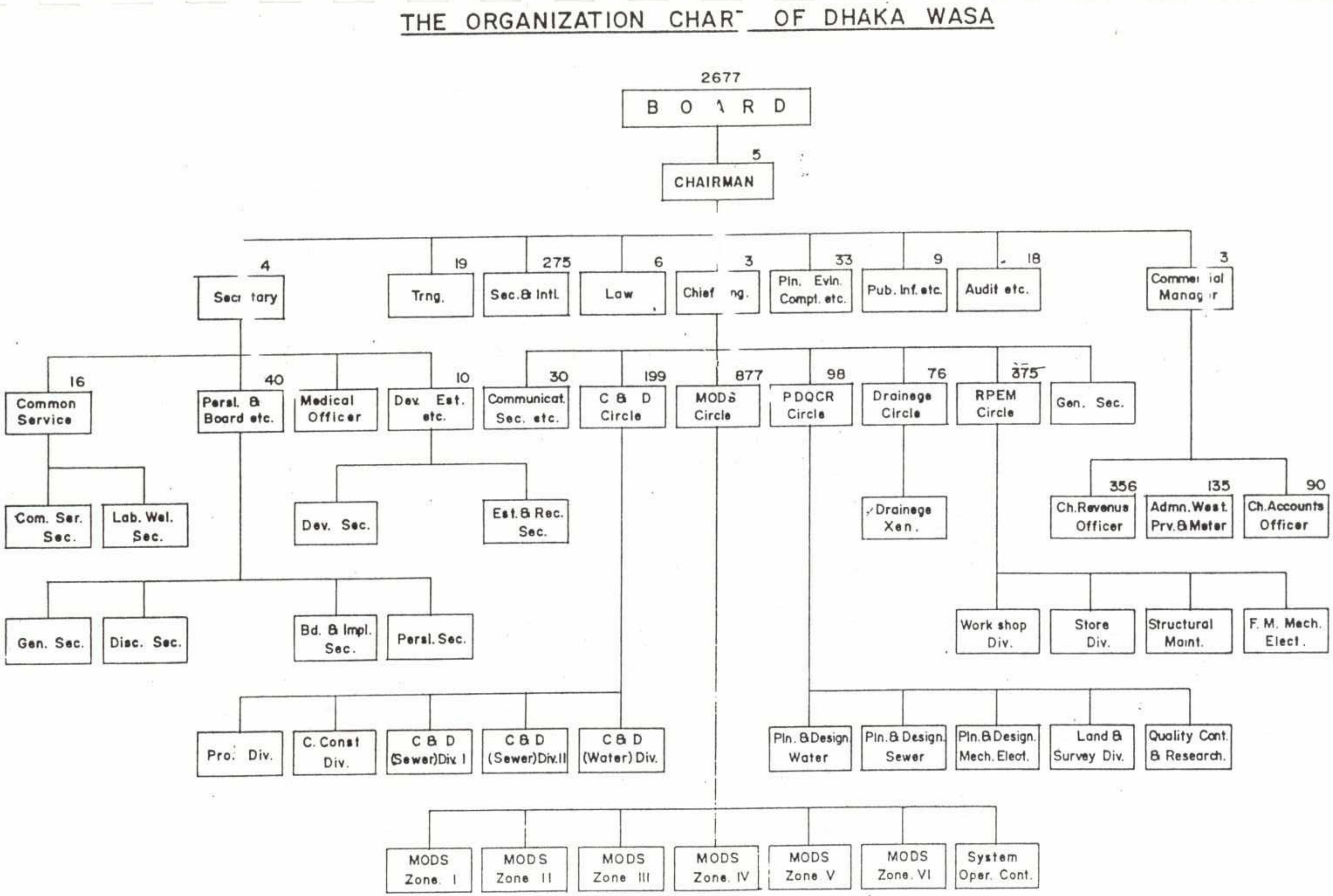
Sanctioned Strength : 4678

Existing Strength : 3800

Master Roll : 6222

Figure 2.3

THE ORGANIZATION CHART OF DHAKA WASA



Government increased DWASA's responsibilities with the transferal from DPHE of responsibility for the operation and maintenance of all major drainage khals and pipe drains within the city. The Authority is governed by a Board of Governors appointed by the Government, with the Chairman also serving as the Chief Executive Officer (see organogram, Figure 2.3). DWASA is divided into Engineering, Commercial and Administration Departments, and six Central Service Divisions, all of which report directly to the Chairman. Engineering operations are divided into five divisions: Planning, Design and Qua'ity Control, Construction and Development, Maintenance and Distribution, and the newly formed Drainage Circle. Four administrative purr[illegible], Dhaka is divided into six zones.

DWASA's total staff has grown from 1,800 in 1979 to a sanctioned staff of 2,677 at present. DWASA's present major program is being implemented as a part of IDA's DWASA III project for water supply and sewer system expansions, expected to be nearing completion in 1992. In view of the high staffing levels in relation to the scale of the operations, IDA's ongoing DWASA III project includes a staff productivity study to review the operation of the administration and all major departments to recommend ways to improve productivity through organizational changes, and to determine appropriate norms for different job functions. Other programs taken up under DWASA III include a leak detection study to devise ways for reducing unaccounted water losses; establishing a waste prevention unit to survey the system for connections and water/sewer use; introducing inventory management for ensuring adequate spare parts supplies for maintenance; and design of a computerized MIS system to facilitate operations and capital planning, financial controls and monitoring.

IDA is presently in the process of formulating their fourth project (DWASA IV), tentatively estimated to cost $540 million, through an ongoing consultancy that includes studies on the availability of both surface and groundwater in the greater Dhaka area. Potential major components include surface water supply (Phase I water treatment plant), ground water supply (tubewells, [illegible] supply mains and a long term development plan), sewerage and sanitation, water resources regulation and assistance for further development of DWASA and sector institutional capabilities. In parallel with the IDA program, the Government of France is also studying the possibility of financing package surface water treatment plants for supplementing the supply of potable water to Dhaka.

(c) RAJUK

Radjahani Unnayan Kattripaka (RAJUK - the Capital Development Authority) has the primary responsibility for land use planning and control in Dhaka and the surrounding areas. RAJUK is a semi-autonomous Government body under the MOW which is responsible for most of the public development activities within Greater Dhaka and the surrounding urban areas, and for regulation and control of the development activities of others within the same area. Primary activities of Rajuk include: (i) capital development works in Dhaka and its' suburbs, (ii) planning and development of residential and commercial areas, including planning and construction of feeder roads, (iii) allotment of land to public for housing and commercial

88

centers, and (iv) registration and control of development plans of private agencies and other public bodies.

RAJUK is responsible for maintaining and updating City Master Plans, and has the legal authority for controlling development within the context of any approved Master Plan zoning regulations. Specific functions include master planning, preparation of zonal or project plans, development of new areas and disposal of serviced plots and market facilities under it's own self-financing development schemes, approval of other public and private development plans, construction of major roads, control of all non-DCC areas and provision of water in non-DWASA areas. RAJUK serves as a control agency for all formal developments within Dhaka, but in practice has little coordination with either DCC, DWASA or DOE during the approval process, and has little involvement in development activities focussed on the urban poor sector.

(d) Other Agencies

Other agencies which have an important, though not necessarily a lead, role in urban management in Dhaka include: (i) the Urban Development Directorate (UDD) of the Ministry of Works for developing overall urban development policies, planning strategies and control legislation; (ii) HSD for providing sites and service projects focused specifically on the urban poor; (iii) the Roads and Highways Department (RHD) of the Ministry of Communications for planning and implementation of major communication networks and bypass roads; and (iv) all other public organizations and private utility companies for providing essential urban services and infrastructure. Agencies which occasionally assist in testing and environmental monitoring include: (i) the Institute of Public Health (IPH) which is responsible for the testing of food products, and provides a supplementary service to the public by providing water quality testing upon request; (ii) the Atomic Energy Commission (AEC) which has more sophisticated laboratory equipment than either DOE or DWASA and has the capability to periodically test for heavy metals and other contaminants upon request; and (iii) the Department of Fisheries (DOF) which has it's own laboratory facilities and programs for testing the water quality in the larger water bodies in Dhaka, and is in a position to provide expert advise on topics directly related to impacts of pollution on the fisheries. All these agencies can provide a supporting service in programs for water quality monitoring for Dhaka.

(e) NGOs and Service Organizations:

There are a large number of NGO and service organizations in Dhaka who are providing support and assistance, particularly to selected slum and squatter areas. Typically, much of this support is modeled on providing education opportunities, community and health care services, income generating opportunities, and family planning services with an emphasis on promoting the welfare of the mother and child groups. There is a large opportunity to utilize the resources of this body of committed people who are concerned with the welfare of the poor in future development of urban slum improvement programs.

82

2.6 Donor Involvement in the Sector

While direct flood protection programs for Dhaka have been undertaken in the past by the Government from its own resources, several international agencies have been assisting the Government in programs relating to environmental improvements. The ADB has assisted in the preparation of an integrated metropolitan development plan for Dhaka during 1979-1981[12] and an ongoing urban infrastructure improvement project in 1989[13], involving improvement of municipal facilities in the Mirpur suburb of Dhaka. The World Bank has assisted in three projects for water supply and an urban project, having components in Dhaka involving improvement of slums, solid waste and drainage improvements in the inner city area. The Japanese International Cooperation Agency (JICA) prepared a drainage plan for the western half of the Dhaka metropolitan area in October 1987. This was updated in February 1990, and priority drainage investments ($15 million) in two of the ten drainage zones are being implemented during 1990-1992. Since November 1990, as part of FAP, JICA is preparing a master plan for drainage and flood protection for the larger regional metropolitan area of 850 sq km, which includes about six towns in the vicinity of Dhaka. UNDP, besides collaborating with the ADB in the 1981 planning study, has also financed feasibility studies that led to urban investments in Dhaka by the World Bank and the ADB. Two further studies are being developed: one with the Planning Commission for the study of traffic and transportation problems of Dhaka and the second with the Capital Development Authority (RAJUK) for updating of the master planning study.

2.7 Project Area and Need for th Project

The Project relates to Dhaka, the national capital, which is estimated to have a population of about 6 million in the metropolitan area (DMA). The area under the responsibility of the Dhaka City Corporation (DCC), covering an area of 260 sq. km., contains an estimated population of 4.8 million. Most of the population of the city is concentrated in the western part; the eastern part of the city is less dense, with considerable areas still under agricultural and non-urban uses. The Project covers the most densely populated western part of the Dhaka city comprising about 136 sq km, which accommodates a population of 4.2 million or some 87 percent of the city population. The population of Dhaka has been growing at a high rate of 5.5 percent per annum.

While the contribution of Dhaka in the national economy is substantial, the living conditions in Dhaka have progressively deteriorated. About 60 percent of the households in Dhaka are estimated to have incomes below the poverty level. Some 25 percent of the population is living in slums. As

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[12] TA No. 282-BAN: Study of Integrated Urban Development of Dhaka Metropolitan Area, for $288,870 financed jointly with UNDP, approved on 6 March 1979.

[13] Loan No. 942-BAN: Dhaka Urban Infrastructure Improvement Project, for $2[illegible] million, approved on 12 January 1989.

the population has increased, severe strains on municipal facilities such as water supply, sanitation, drainage and solid waste management have emerged. During the 1988 floods, one of the most severe on record, some 60 percent of the DMA population and 80 percent of the area remained submerged in water for periods up to four weeks. Even during normal years, drainage congestion and periodic flooding is a chronic problem in Dhaka, particularly for the low income and slum dwellers of whom 22 percent are regularly flooded during even minor rainfalls.

2.8 Project Rationale and Objectives

The proposed Project is being designed in an integrated framework of flood protection, environmental improvements and poverty alleviation. The underlying rationale for the Project is to provide a flood free and secure living environment, and to improve the urban efficiencies and environmental conditions (particularly for the urban poor) in Dhaka City for promotion of sustainable long term economic development. The Project aims at an integrated urban development program consisting of: (i) flood control and drainage works; (ii) complementary environmental improvement programs in low cost water supply and sanitation programs for the low income residents, solid waste management and slum and squatter area development; and (iii) implementation assistance. The Integrated Environmental Management Plan (IEMP) that has been formulated (see Chapter 3) provides a framework for the Project within a long term integrated development strategy for Dhaka, requiring close coordination and integration of parallel programs for optimal results.

The Project scope has been formulated based on the following considerations:

(i) the Project should provide an adequate and realistic beginning (within the limits of affordability) for the implementation of a longer term program for the flood protection of Dhaka in a period of 10-15 years;

(ii) the proposed investments should be cost effective, and should include only the high priority immediately needed flood protection and drainage investments to provide security to those areas of the city where population densities are high, thereby covering a large proportion of the city population;

(iii) in view of the design and construction inadequacies in the newly constructed westerly embankment, which have increased the danger of flooding damage in the city in case of a catastrophic failure, remedial works on this embankment, together with an intensive O&M program should be given the highest priority;

(iv) the Project should enhance the environmental health conditions in Dhaka, and contribute to poverty alleviation through complementary environmental improvement measures for the low-income groups, to reinforce the impact of the Project.

96

2.9 Scope and Coverage of the Project Components

The Project has the following four Parts:

Part A:	Flood Protection
Part B:	Drainage
Part C:	Environmental Improvement
Part D:	Implementation Assistance

Major components covered under each Part of the Project are described below. A more detailed description of each Part is given in Chapter 4 and the scope and terms of reference for the proposed consulting services covered under Part D are given in Appendix 6.

The scope of Part A (Flood Protection) covers mainly the completion and augmentation of the westerly flood protection embankment and flood walls, work on which was initiated by the Government following the 1988 floods. This includes intensive remedial works using wick drains for foundation stabilization in critical sections of the existing embankment, erosion rehabilitation and protection, other remedial works, reprofiling and recompaction, stabilization of parts of existing concrete flood wall and construction of new flood wall, slope protection, construction of additional drainage pumping station and sluices, and the establishment of a maintenance program.

A comprehensive drainage program is envisaged under Part B to alleviate periodic flooding in the city. This includes rehabilitation of priority existing major drainage canals (Khals) throughout the City, construction of new piped drainage facilities, improvement of secondary and tertiary drainage facilities, and the initiation of an intensive O&M program.

The environmental improvement program under Part C includes: (i) slum and squatter area improvement, with intensive community and beneficiary participation, to benefit over 8,750 families; (ii) a solid waste management program, linked to the low-income area being improved under Part B, involving provision of collection trucks, handcarts, and bins; and (iii) sanitation, water supply, and local drainage, involving provision of public toilets, pit latrines, public water supply standpipes, and cleaning of local drains.

Part D covers Project implementation support, including incremental administration and consulting services support for detailed engineering design, construction supervision, and project management. The consulting services requirements are based on an assessment of the institutional capabilities of the involved agencies and the previous implementation experience of the flood protection scheme. For Project management, 312 mm of consulting services (60 mm international, 252 mm domestic) are estimated to be required as detailed in Appendix 6. In addition, for detailed engineering design and construction supervision 450 mm of consulting services are estimated to be required (36 mm international, 414 mm domestic).

88

3.0 INTEGRATED ENVIRONMENTAL MANAGEMENT PLAN FOR DHAKA

3.1. Introduction

In the complex urban environment, proper management of inter-sectoral activities are essential if benefits from improvement programs in any one sector are to be fully realized. Therefore, the Dhaka Integrated Flood Protection Project has bee.. formulated in the context of an Integrated Environmental Management Plan (IEMP) for Dhaka city to provide an integrated fram...rk wherein selected investment components are complementary to the proposed drainage and flood control program, and will mutually reinforce their impacts on an area-wide basis.

In Interim Report No. 1 the existing situation, problems and needs were identified by sector for: (i) land use management, (ii) water quality, sewerage and excreta management, (iii) water supply, (iv) solid waste management, (v) slum and squatter area improvement, and (vi) industrial, hazardous and toxic materials and waste management. Strategies have been identified to address the problems, covering policy and legislation which are solely a Government responsibility, short term remedial actions which could be suitable for inclusion in the project, and medium to long term actions which will require planned and phased actions to be taken by the responsible agencies. Actions recommended, as summarized in the following sections, are complementary to each other, and are suitable for incremental implementation.

3.2 Land Use Management

There is a lack of effective land use management in Dhaka which has resulted in, on the one ha d, uncontrolled and unregulated urban growth with consequent environmental degradation and blocking of natural drainage channels, and, on the other hand, a lack of adequately serviced land to meet the increasing demands for new housing. Some of the key problems which have contributed to this in Dhaka include the lack/absence of: (i) a cohesive urban development policy to provide clear directions for the basic issues of urban development; (ii) up-to-date Master Plan and Structure Plans for long term planning; (iii) effective legislation to guide/control land use and establish appropriate development standards; (iv) coordination amongst sectoral development agencies; (v) a clear Government policy regarding effective use of vacant and under-utilized public lands; and (vi) any mechanism for applying or collecting development surcharges to assist in financing the essential public infrastructure and services which must be provided to sustain development.

Some of the more acute problems which affect Dhaka which are, at least in part, attributable to poor land use management include: (i) an extreme shortage of serviced land for meeting the ongoing growth demands, particularly for the low income and poor groups; (ii) rapid and uncontrolled growth of slum and squatter communities, particularly in the low-lying urban fringe areas which are most susceptible to flooding; (iii) inadequate access to basic sanitation services, particularly for the poor; (iv) sustained environmental degradation due to uncontrolled discharges of wastes; (v) deteriorating public health conditions; (vi) inadequate protection of drainage facilities, leading to increased frequency and severity of local flooding; (vii) indiscriminate and uncontrolled infilling of low lands, which would potentially form an essential part of a planned flood control scheme for the city; (viii) excessive demands on inadequate public infrastructure, utilities and services due to growth and increasing densification; (ix) increasing traffic congestion due to inadequate provision of roads and appropriate traffic controls; (x) failure to provide appropriate park lands and open spaces; and (xi) inadequate financial resources for public bodies to provide essential services.

Actions identified as being necessary to address these problems include the need to: (i) prepare and adopt a national policy for providing clear direction on urban development policies and strategies, and alleviation of urban poverty; (ii) review, approve and adopt physical planning and land use control legislation; (iii) prepare up-to-date Master Plan and Structure Plans for long term guidance and strategic planning; (iv) develop land use standards, development standards, and control mechanisms[1]; (v) review Government land ownership and needs and recommend appropriate Government policies and strategies for rationalizing the use of vacant and under-utilized lands considering the potentials for disinvesting the lands, converting the lands for public use, for use for low income residential use, or transferring/leasing/selling to squatters/ settlers to provide long term security of tenure; (vi) establish a formal development review committee with representatives from RAJUK, DWASA, DCC, DOE and all utility agencies; and (vii) develop a strategic long term plan for land acquisition for public use and for low income housing needs.

Additionally, in connection with the preparation of long term flood control and drainage plans for Dhaka City, appropriate provisions should be made to: (i) prepare/adopt a drainage and flood control master plan for provision of facilities; (ii) develop a surface water management system and enact legislation to protect the drainage, detention pond and flood plain reserves; (iii) establish non-structural measures for flood management and mitigation, including standards on minimum road crest elevations, lot development elevations and plinth levels; (iv) develop integrated drainage/on-site storage standards for new developments; (v) integrate the development of drainage networks and detention pond reserves with provisions for park lands and public open spaces; and (vi) adopt and

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[1] Such standards and controls would: (a) include standards for maximum development densities, minimum park and open space provisions, and provision of land for low income housing areas; (b) identify long term needs for drainage, flood plain reserves, transportation, solid waste disposal, park land and open space areas, and include appropriate controls to restrict/control development in these areas; (c) give consideration to development charges for all new developments or changes in land use to assist in financing the essential public infra-structure, services and amenities.

83

implement an operations and maintenance program which is complementary to the land uses in the affected area and assists in maintaining an appropriate ecological balance.

3.3 Flood Control and Drainage

Effective FC&D programs are one of the highest priority items for improving the security and health of Dhaka residents. This is especially true for the low income groups and slum dwellers who live in areas of highest risk, and of whom 66% are reported to be regularly affected by floods. In order for these programs to be effective, they must be well integrated; flood control works alone without accompanying drainage improvements, sluices and pump stations are ineffective, and possibly detrimental. For the current situation in Dhaka City, the highest priority zone for a phased protection scheme is the westerly "Phase 1" area of 136 sq km, with 87% of the population. The rehabilitation and completion of the westerly embankment/flood wall scheme has been identified as having top priority over extending improvements to the easterly zone. At present, about 37% of the existing embankment is unstable and potentially subject to failure, and over 16% is potentially subject to catastrophic failure. This could be a life threatening situation for thousands of people in lowlying areas who may have a false sense of security, and for whom failure would mean sudden inundation rather than the past slow and predictable rise of flood waters.

The design and construction of the flood control, erosion protection, and drainage works in the Greater Dhaka area requires planning, coordination between the responsible parties, and experienced design and construction. Innovative, cost-effective, and stable construction methods and materials are needed to rehabilitate and complete the Phase I embankments and floodwalls, and to design and construct the future east embankments.

The development of a unified strategy to deal with the immediate, short-term, and medium to long-term flood control, erosion protection, and drainage problems is an essential component of the DIFPP. The immediate and short-term activities are required to minimize the risk of catastrophic failure of the Phase I embankment and to reduce the risk for failure of the embankment in the future, while the medium and long-term activities will complete the flood protection and drainage schemes for, respectively, the first priority westerly half of the city, and the remaining easterly half. Immediate needs include: (i) preparing a conceptual design for remediation of the Phase I embankments; (ii) initiating a remedial action plan focused on sections which could fail catastrophically; (iii) assessing the integrity of the existing R/C wall and preparing amended designs; (iv) preparing QA and QC plans; (v) reconstructing critical sections of the failed Phase I embankment to Stage I elevations (8.0 m PWD); (vi) undertaking a crash drain clearing program to relieve acute drainage congestion; and (vii) initiating land acquisition proceedings for additional needed lands. Short term needs include: (i) establishing a project office to coordinate and administer the proposed project; (ii) developing a strategic development plan for the flood control, erosion protection, and drainage works in the Greater Dhaka area; (iii) completing

89

the remedial action plan for the Phase I embankment and reconstructing the remaining damaged or unstable sections of the Phase I embankment to the Stage I elevation (8.0 m PWD); (iv) constructing remaining embankments, flood walls and drainage sluices; (v) constructing internal drainage improvements; (vi) raising the spine road to the 50 year flood level and constructing associated drainage sluices; (vii) providing temporary pumping facilities; and (viii) developing an Operation and Maintenance Plan and training an effective, well organized inspection, operation, and maintenance staff. The medium-term components include: (i) implementing the operation and maintenance program; (ii) completing construction of the westerly embankments to the design level for the 100 year recurrence with 1.2 m freeboard: (iii) improving design of breaches in the R/C wall and constructing the R/C wall redesign at the breach points; (iv) constructing permanent pump stations and retention ponds for the priority westerly area; (v) developing flood plain regulations and initiating development controls; and (vi) developing and initiating emergency flood response programs. Long term components include: (i) designing and constructing the easterly embankments and structures; and (ii) designing and constructing the easterly pumping stations and retention ponds.

3.4 Solid Waste Management

Approximately 50% (about 1,250 tons per day) of the solid waste generated within Dhaka is never collected. Some is deposited in adjacent vacant lots, low lying areas, ponds or rivers, but a large percentage is deposited into the local drainage ditches, storm sewers and khals. This includes household refuse, tannery scraps, refuse from restaurants and hotels, residues from numerous cottage industries, scraps of cloth and dyes from textile shops, sludge and refuse from industries, animal wastes from over 100 uncontrolled slaughter areas, and refuse from street sweeping by municipal employees. From field observations, it appears that about 10% to 15% of the dry season volume in downtown drainage khals is comprised of solid waste. The resulting adverse impacts include clogging of the drainage system, accumulation of noxious decaying material on the water surface, degradation of water quality, attraction of disease carry insects and rodents, and an overall degradation of the environment. Collection practices are inefficient and unsanitary, and garbage collectors are in constant contact with the wastes they collect. Waste dumps are unregulated and unsanitary. Factors which contribute to this include: (i) inefficient and irregular municipal collection; (ii) a lack of municipal solid waste collection in many parts of the City, including all slum and squatter areas; (iii) a lack of convenient access to community bins; (iv) the ease of discarding waste rather than transporting it to a community bin; (v) a lack of public awareness of the adverse environmental and health impacts; and (vi) a lack of social pressure to promote sanitary solid waste management practices.

In order to address these problems, a combination of actions is required, including development of appropriate policies and strategies, and implementation measures. Recommended short term actions include: (i) identifying priorities and developing a formal policy for collection and disposal of solid waste; (ii) establishing national policies, strategies and administrative guidelines for solid waste management, including standards for "sanitary" collection and disposal of solid waste, the types of waste that may be placed in a solid waste landfill, disposal options for hazardous waste materials, guidelines for construction and operation of solid waste and hazardous waste landfills, and the minimum staffing requirements and qualifications for management personnel; (iii) legislating and enforcing regulations regarding the collection, transport and disposal of solid and hazardous waste; (iv) improving efficiencies for waste collection and disposal; (v) extending solid waste collection services to include all slum and squatter areas, and other portions of the city which are presently not served or are under-served; (vi) rehabilitating local community collection/storage bins; (vii) developing operation and maintenance manuals for sanitary landfills; (viii) developing a training program for management and technical personnel; (ix) providing municipal sanitation workers with gloves, clothing, protective shoes, nose masks and access to medical facilities; and (x) developing public education programs regarding the health hazards related to solid waste. Longer term measures include developing a long term strategy for solid waste management, including zoning of solid waste landfills, developing strategies for reducing the organic waste stream through recycling, selecting sites for construction of future sanitary landfills, developing improved financial planning for conservancy services, and monitoring leachate movement from landfills.

3.4 Sanitation and Water Quality

There is no comprehensive sanitation policy in place at either the national or local levels. The Dhaka sewer and treatment facilities are operating at or near their full capacity, and on completion of ongoing upgrading programs will be capable of servicing not more than 20% of the total population, or about 1 million people. Of the remaining 80%, about half (40%, or 1.9 million people) are serviced by private on-site "sanitary" systems, while the remaining half (1.9 million), primarily from the low income groups, are serviced by unsanitary systems or have no facilities. Population growth is presently estimated to average about 5.5% per year, or equivalent to about an additional 260,000 persons per year. Based on current trends, roughly half of these (25,000 households) will establish residence without adequate sanitary facilities. Sanitary, commercial and industrial waste discharges are virtually uncontrolled, and storm drains and open drainage channels convey highly polluted waste water, equivalent in effect in most areas to that of raw sewage. The greatest impact of flooding from these systems is felt by the low income groups who most commonly live in low lying areas. The proposed drainage improvement project under consideration in this Dhaka Integrated Flood Protection Project will benefit the urban dwellers in the short term by reducing the frequency and severity of flooding. It will not, however, have any effect on the longer term effects of pollution and water quality. Environmental legislation is inadequate to control pollution.

In order to address this situation the government must recognize the growing seriousness of the problems, adopt a comprehensive sanitation policy and allocate adequate resources to meet the needs. For Dhaka, multi-agency cooperation is needed to develop a priority program to protect the population (in the short term) by containing and diverting the wastes away from the immediate living environment, stop the accelerating degradation of the enviro ment by exercising strict controls over all new developments, and reverse the degradation by a combination of actions including land use control legislation, eliminating or reducing all point and non-point sources of pollution, extending sewer collection and treatment systems and/or exercising pollution control options on offenders, and promoting an intensive low-cost sanitation program.

Specific recommendations to meet the needs include, in the short term: (i) preparing and adopting a clear national policy for providing sanitation services, with time-bound goals to be achieved; (ii) adopting revised pollution control legislation and standards to provide the essential legal foundation for guidance, control and regulation of environmental issues; (iii) rehabilitating and upgrading the storm drainage system within Dhaka to contain and vacate the wastes away from the immediate living environment; (iv) completing ongoing sewer and treatment plant rehabilitation and expansion works; (vi) ensuring adequate resources for continued routine maintenance and repairs; (vii) establishing a formal development review committee to ensure that all new developments have satisfactory provisions for utility services and waste disposal prior to approval; (viii) initiating a comprehensive, and long term, low cost sanitation program for Dhaka city with the primary objective of reducing or eliminating the disposal of human wastes in the urban environment; (ix) initiating a long term municipal program for desludging of septic tanks, and introducing effective regulations to prevent the unauthorized dumping of septic wastes into the drains and low-lying areas; (x) initiating a public information campaign for promotion of sanitation and environmental awareness; (xi) sealing off abandoned and active landfill sites; (xii) undertaking a detailed sanitary and storm sewer condition survey; (xiii) undertaking a consumer survey of all households, industries and commercial establishments to determine source and conditions of water supply service, water usage and consumption rates, type and conditions of solid and liquid waste disposal system(s), characteristics of wastes disposed, and water and sewer invoicing and payment records; (xiv) undertaking a short term pollution study; (xv) initiating a long term water quality monitoring program; and (xvi) providing assistance to DWASA to upgrade the laboratory facilities, staffing and training. In the medium and long term it is recommended that: (i) a new Master Plan for sewerage and drainage be developed; and (ii) legislation be reviewed to develop a system of discharge controls and requirements for discharge permits for all industrial and commercial waste discharges into the municipal collection systems (sewers and drains).

3.5 Water Supply

In Dhaka City, 3.6 million (75%) of the 4.8 million residents have direct connections to, or access to, the water supply system. The majority of people who are not directly connected are the slum and squatter dwellers, who obtain water through a secondary connection or from an alternative source. Despite the past and on-going improvement programs related to the municipal water supply system, the existing need for potable water still far exceeds the capability of the existing facilities. This is exacerbated by losses estimated at 56% of water production due to leakage (30%) and unaccounted losses (26%). Contamination of water in the transmission system occurs due to low pressure, cracked pipes, poor quality joints, and illegal connections. An increase in system pressure would reduce the inflow of contaminates but may result in an increase in line losses. Substantial exploitable groundwater reserves remain despite current high rates of groundwater abstraction. There is an urgent need for a comprehensive program to provide potable water to the approximately 36% of the residents of slums and squatter settlements who currently rely upon unsanitary sources for their daily needs, and for further expansion of the municipal water supply system to address existing shortages in production as well as anticipated future demand. The transmission system must be expanded to accommodate new development, with special emphasis upon the existing and future need for low income housing, and identifying leaks and improving pressure in the existing municipal system to eliminate the incidence of contamination during transmission and to reduce line losses.

In order to meet these needs, it is recommended that, in the short term: (i) a clear national policy be prepared for providing potable water to the public, with specific attention to ensuring access to supplies for the urban poor as a priority; (ii) a comprehensive water supply plan for Dhaka City be initiated, with the priority attention on providing access to potable water to all residents of slum and squatter settlements (regardless of their legal residence status) through extended public standpipes; (iii) all building permit issuances be formally reviewed and approved by an inter-agency committee before issuance to ensure adequate availability of water and other utility supplies; (iv) a comprehensive consumer-survey be initiated for use in developing a Master Plan for Water Supply; (v) legal proceedings be taken against parties who illegally connect to the water supply system; (vi) a study be done to determine how increased revenue could be generated by DWASA to finance urgently needed maintenance and expansion programs; (vii) essential facilities operated by DWASA be protected against the adverse impact of flood inundation; (viii) system chlorination stations be introduced to ensure positive chlorine residuals in the delivered water for elimination of sanitation related diseases; and (ix) treated water from the Chandnighat Water Works be tested for an expanded range of contaminates to determine whether the existing treatment system is removing contaminates from industries located up-stream from the in-take pipe. For the medium and long term, it is recommended that a new Water Supply Master Plan be developed for Dhaka City, which updates the Long Term Plan prepared in 1981.

3.6 Slum and Squatter Area Improvement

Approximately 25% of the Dhaka population, or about 1.2 million people, reside in slum and squatter settlements. At the estimated present growth rate, the slum and squatter population is increasing by at least 60,000 people, or 10,000 households, each year. Slum settlements range in size from 10 households to over 500 households, and are scattered throughout the city, generally in relatively small pockets. Although there are areas where over ~,000 people are clustered into larger slums, notably within the Mirpur area and in the Old City areas around Islambagh, Shaheed Nagar and Rasulpur, on average about 80% of the clusters are less than 1 acre in size, with average population densities of about 655 persons per acre (110 households). 29% (30,000 households) of the settlements are located on government or semi-government land (mainly squatters), 67% are on private land, and the remaining 3% on disputed land. 41% of the dwellers own their own house, 49% are renters, and 10% are rent free.

The sanitation and environmental conditions within most of the slums are extremely poor. The best service is for water supply, where about 50% have access to municipal standpipes or their own connection, and 14% have access to community tubewells; the remaining 36% however rely on neighbors supplies, or on nearby ponds and streams. Sanitation services are extremely poor; 87% of the population use community facilities, most of which are unsanitary kutcha latrines, and the remaining 13% either use others facilities or defecate in open spaces. 65% of the slums have poor drainage (affecting about 0.8 million people), of which 22% are regularly flooded during even minor rainfalls. 50% were totally inundated during the 1987 floods while 15% were partially flooded, and the situation was worse in the following year. 51% have no internal pathways, and 31% have very narrow paths. Only 9% of the slum dwellers have any form of regular solid waste collection service; the remaining 91% (over 1.0 million people, generating about 100 tons of garbage per day) dispose of their garbage onto nearby low lands, vacant lots, roadside drains or khals. As an inevitable result of these conditions, the living environment and general health of the slum and squatter residences is measurably worse than that of the urban population as a whole. The high rate of disposal of garbage and faeces into the immediate local environment of the slum areas, combined with the poor drainage conditions, lack of access to clean water supplies, and lack of access to proper health care services for a large portion of the population, renders the slum and squatter populations highly susceptible to disease. The infant mortality rate, at 152 to 180 per thousand, is double that of the non-slum urban areas, and the highest crude death rate, at 44 per thousand, is six times that of the non-slum areas. At any given time 30% to 46% of the slum and squatter population is suffering from disease.

The extreme poverty, poor environmental conditions, and poor health conditions are not only a sociological problem, which must be addressed and resolved, but could also ultimately become an explosive political problem. The effects of this are not restricted to the slum areas alone. The predominance of environmental pollution and of disease which affects 25% of the total city population poses a hazard to the entire city, not just the poor. To meet these urgent needs it is recommended that, in the short term, the Government: (i) prepare and adopt a national policy for providing clear direction on urban development policies and strategies, and alleviation of urban poverty; (ii) issue clear directions to executing agencies identifying poverty alleviation programs as a high priority item; (iii) set up and staff the DCC Slum Improvement Cell without delay; (iv) initiate and extend the LGEB/UNDP SIP program for slum and squatter areas within Dhaka where the dwellers meet the basic requirements for security of tenure and willingness to participate; (v) extend, on an urgent and priority basis, the basic water supply and sanitation services into those areas which do not meet the criteria for inclusion in the SIP program; (vi) extend solid waste collection services into all areas covered under both the SIP program, and the urgent water and sanitation program area; (vii) alternatively, provide community motivation and technical direction to assist slum dwellers and squatters in adopting local sanitary methods of solid waste disposal, such as composting or burying; and (viii) ensure adequate allocation of resources to meet the annual poverty alleviation program needs. For the medium and long term it is recommended that: (i) physical planning and land use control legislation be adopted for effective control of land use and development; (ii) a strategic long term plan be developed for land acquisition for provision of land for public use and for low income housing needs; (iii) policies and strategies be developed, including consideration of incentives, disincentives and regulatory methods, for promoting active private sector participation in providing serviced lands and/or affordable shelter for the low income segment of the population.

3.7 Industrial, Hazardous and Toxic Materials and Waste Management

The present state of industrial, hazardous, and toxic waste and material management in Dhaka can be summarized as follows: (i) a clearly defined national policy for management of industrial, hazardous, and toxic wastes and materials does not exist; (ii) enforcement actions against known polluters are non-existent; (iii) impacts of industrial discharges on public health and the environment are unknown; (iv) industrial discharges to the existing sewage systems are unregulated, and could upset treatment processes; (v) most industries discharge directly to surface water and open sewers; (vi) environmental management and enforcement is spread between several agencies; (vii) existing legislation is not extensive enough and must be expanded; (viii) only draft environmental standards exist for discharges; (ix) there are no formal permitting requirements; (x) there are no guidelines for monitoring and inspection; (xi) there are no guidelines for sampling and analysis; (xii) remediation of existing contamination has not yet been initiated at any level; (xiii) cost reimbursement and enforcement of guidelines and rules have not been developed; and (xiv) there exists a concern on the part of existing industry that enforcement actions will be unequally applied, giving certain industries economic advantages over other industries, both within and outside the country.

Future strategies for the management of industrial, hazardous, and toxic wastes and materials must be developed in concert with other waste management considerations. This includes both the assessment and analysis of impacts of existing industries on public health and the environment, and the development of permitting requirements for future industrial development. In order to address the situation, the government must recognize the seriousness of the situation and adopt a comprehensive national environmental policy. This policy must be consistent with the national environmental goals, and should promote economic development, protect human health and the environment, and preserve the cultural heritage through protection of human and natural resources. It is therefore recommended that, in the short term: (i) a clear national policy be prepared and adopted to deal with environmental issues, including industrial, hazardous, and toxic waste management; (ii) a single department (DOE) be designated as the manager of the environmental programs of the country, with formal requirements for delegation of responsibilities to other government departments and agencies; (iii) the draft environmental regulations and standards be adopted as constituted; (iv) modification of existing and draft legislation be started, to be consistent with the national environmental policy; (v) a comprehensive monitoring and inspection program be established for existing industry; (vi) guidelines for monitoring, inspection, testing, and analysis be developed; (vii) a national permitting program for both existing and proposed facilities be established; (viii) siting issues be addressed through the DOE; (ix) permitting fees be established which cover the cost of government review of permit applications; (x) environmental impact assessments be required as a part of the permitting process; (xi) existing industry be required to submit permit applications for all points of discharge from their facilities; and (xii) the impacts of existing industry on public health and the environment be evaluated. For the longer term, it is recommended that: (i) an effective public education and awareness program be established with regard to industrial, hazardous, and toxic wastes; (ii) waste reduction and toxicity reduction methods be implemented on a national basis; (iii) long-term monitoring and inspection programs be continued and a statistical database be implemented; (iv)regular monitoring and reporting requirements to be undertaken by industry be implemented; (v) discharge standards for air, surface water, ground water, soil, and sewage be developed which are consistent with the national environmental policy; (vi) national guidelines for laboratory analysis, sampling, remediation, and preparation of environmental impact assessments be established; (vii) the qualifications and education of the staff of DOE be upgraded through a comprehensive long range plan of hiring, short-courses, on-the-job training, and education release programs.

3.8 Priorities and Programs

Based on an evaluation of the needs, it has been concluded that the scale of the needs to solve todays problems is so great that the amount of work actually taken up for implementation will initially be determined more by resource availability than by the identified needs. Therefore, priority consideration has been given to those elements which are suitable for incremental upgrading and which: (i) in the short term, will provide the greatest benefit to the low income and poor groups at the least cost; (ii) are complementary to each other, and serve to reinforce their impacts; (iii) are not reliant upon major institutional changes or Government actions for successful implementation; (iv) do not duplicate ongoing programs; and (v) provide a foundation for promoting lasting environmental improvements for Dhaka in the long term.

Consideration has been taken of the present ongoing and proposed programs in Dhaka which address some of the problems in Dhaka noted in the preceding. Included in these are: (i) the LGEB/UNDP Slum Improvement

Project (SIP) which includes modest infrastructural improvements to slum areas, plus intensive public motivation and community participation; (ii) the ADB financed Dhaka Urban Infrastructure Improvement Project for an area based urban service rehabilitation and upgrading for about 520 ha within the existing development area in Mirpur, and including strengthening of DOE's environmental monitoring capabilities; (iii) the World Bank/UNDP financed Environmental Improvement Project for an integrated urban development project within the Old City area covering Islambagh, Shaheed Nagar and Rasulpur, and including construction of the Dholai Khal pump station and drainage improvements; (iv) the JICA financed Greater Dhaka Protection Project, FAP-8A, for preparation of a flood control Master Plan for Dhaka and the surrounding areas; (v) the upcoming UNDP/UNCHS assisted project for Preparation of Structure Plan, Master Plan and Detailed Area Plan for Dhaka and Chittagong, including strengthening of the planning and management capabilities of RAJUK and CDA; (vi) the upcoming UNDP assisted Greater Dhaka Metropolitan Integrated Transportation Study; (vii) the ongoing UNDP technical assistance support for financial management and solid waste management strengthening of DCC; (viii) the proposed UNDP assisted urban land policy project; (ix) the ongoing IDA financed DWASA-III Urgent Expansion Project (and possible DWASA-IV Project) for expansion and rehabilitation of portions of the DWASA sewer and water network, including consumer surveys, pilot leak detection programs and strengthening of the DWASA financial management capabilities; (x) the JICA assisted Urgent Sewerage Construction and Expansion Project for the rehabilitation and up-grading of the Pagla treatment plant, and existing sewers, pump stations and outfall; (xi) the JICA financed Kallyanpur Khal improvement and pump station construction program; (xii) the ADB assisted National Environmental Monitoring and Pollution Control Project for strengthening of DOE's capabilities in national environmental planning, assessment and monitoring; (xiii) the Government of France assisted surface water supply feasibility study program; and (xiv) the Government sponsored own programs for urgent water supply expansion, drain cleaning and flood protection programs.

Accordingly, priority for implementation under the Project has been given to providing complimentary environmental improvements to those areas where drainage and flood control works will be taken up, with a focus on improving environmental conditions for the low income groups in particular. Works recommended to be taken up include: (i) extending access to clean water supplies to all residents in Dhaka, irrespective of their status or whether they have legal tenure; (ii) developing a comprehensive low cost sanitation program to reduce/eliminate disposal of human wastes in the environment; (iii) developing a comprehensive slum improvement program for slum areas where there is security of tenure, modeled on the ongoing LGEB/UNICEF programs; (iv) promoting improved collection, disposal and local storage of solid wastes to reduce the intrusion of wastes into the local environment, the drainage systems and the surface water bodies. The programs have also been developed to be complimentary to other ongoing projects within Dhaka, and are suitable for expansion or extension.

Table 3.1 following shows the inter-relationship between the various components selected for review and for implementation under the Project. Components will be taken up on an area basis focused on improving mainly low income regions in lowlying areas to complement and enhance the benefits from the proposed drainage and flood control works.

Descriptions of the selected Project components are described in the following Chapter 4.

64

TABLE 3.1

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LINKAGES BETWEEN INTEGRATED ENVIRONMENTAL MANAGEMENT AND COMPONENTS

IMPACT OF / ON	LAND USE MANAGEMENT	FLOOD CONTROL AND DRAINAGE	SOLID WASTE MANAGEMENT	SANITATION AND WATER SUPPLY	SLUM IMPROVEMENT	ENVIRONMENTAL MONITORING AND ENFORCEMENT
LAND USE MANAGEMENT		Increased land values leading to potential for cost recovery. Reduces costs of land development to flood-free elevations.	Reclamation of low lying areas by landfill for ultimate use as recreation areas, parks, low income housing, bus terminals.	New areas for housing development opened up by extension of sanitation and water supply.	Must be preceded by assurance of security of tenure for slum residents, otherwise cost contribution is impossible.	Enforcement of environmental standards & pollution control may force some polluters to relocate, possibly to city outskirts/industrial estates.
FLOOD CONTROL AND DRAINAGE	Zoning o[illegible] flood detention areas. R[illegible]ervation of drainage rout[illegible] & embankments. Compensat[illegible]n of land holders.		Reduced blockage of drain by solid waste. Landfill of reclaimed areas above flood level.	Reduced cont[illegible]ination of flood detent[illegible]n & drainage waters due t[illegible] improved sanitation.	Regularizing slum areas may make it more difficult to remove such areas if necessary to implement flood control and drainage works. Improved waste disposal practices will reduce drain blockages.	Enforcement of solid waste disposal and collection will help avoid blocking of drains, thus contributing to flood control.
SOLID WASTE MANAGEMENT	Reservation of su[illegible]ble landfill areas & ultimate use of filled areas. Buffer zones around landfills.	Reduced capacity to remove solid wastes in flood & drainage waters. Increased need for proper disposal.		Improved water supply will enable area surrounding solid waste receptacles to be cleaned.	Improved tenure, community education and cost contribution will induce slum communities to upgrade solid waste disposal practices.	Enforcement against illegal solid waste dumping will increase collection volumes and landfill area requirements. Monitoring may result in some landfills requiring sealing.
SANITATION AND WATER SUPPLY	Zoning for industrial uses. Permit system for new developments based on availability of services.	Improved performance of low cost sanitation systems. Possible lowering of groundwater table from reduce recharge.	Reduced contamination of drainage waters from better collection. Possible contamination of shallow groundwater aquifers by landfill leachate, reducing suitability for water supply.		Need to extend water supply mains into slum areas & establish standpipes. Shared latrines and improved waste disposal will improve sanitation.	Monitoring quality of tap water will help detect cross contamination and leakages. Monitoring well water is necessary to ensure safety of groundwater. Monitoring surface water will help detect pollution zones for determining corrective measures and warning public.
SLUM IMPROVEMENT	Security of tenure for existing slums. Prevention of new slum areas. Assurance of basic services for new low income areas.	Reduced frequency and intensity of flooding. Increased tendency to locate slums in flood protected areas. Slum areas located on embankments.	Improved solid waste collection will help improve living conditions in slums, reduce vermin populations and smells and spread of disease.	Improved sanitation and water supply are major components of slum improvement plan, leading to improved living conditions and reduced disease incidence.		Monitoring will provide data on progressive improvement in slum living conditions and reduction in disease incidence. Enforcement may be necessary to consolidate environmental improvements.
ENVIRONMENTAL MONITORING & ENVIRONMENT	Coordination of planning and environmental enforcement agencies.	Need to monitor water held in detention ponds which are used for fishing, bathing etc. Need for rigorous monitoring of maintenance procedures for flood security.	Need to monitor possible contamination of groundwater by landfill leachate.	Need to design monitoring program to detect improvements due to sanitation & water supply. Enforcement to prevent illegal connections & cross contamination.	Increased community awareness will increase pressure on reducing sources of pollution and help enforcement agencies.	

4.0 PROPOSED INFRASTRUCTURE INVESTMENT PROGRAM

4.1 Component Selection Criteria

Within the framework of available financing, the selection of individual components are recommended for incorporation into the Project is based upon a blending of technical, social and economic considerations. Included among these are the key factors of :

a) Needs: Each component considered has to have a clearly identifiable need based upon the present degree of deficiency of the service, the general community's perception of their own priority needs, the resulting demand for improved service, the expected growth rate in Dhaka, and the long range projections for development.

b) Benefits: Each component must provide an immediately identifiable benefit to the urban population (particularly the urban poor), must improve the urban services to the broader community, and should complement and support the long range development plans for the City as a whole (including the residential, commercial and industrial sector expansion).

c) Implementability: Components selected must be capable of being taken up, operated and maintained by the implementing agencies, and where required include strengthening measures to enable the agencies to do so.

d) Affordability: All components selected must be affordable at all levels - not only to GOB, but also to the implementing agencies and to the individual beneficiaries, and be supported by a complementary financing plan to ensure that affordability can be realistically achieved.

e) Security: Flood protection components, in particular, must be designed and constructed to appropriate technical standards to minimize risks and to ensure security for the Dhaka residents living within the flood protection area.

f) Feasibility: All components selected must be clearly feasible, based upon rigorous environmental, financial and economic analyses, and an evaluation of the social benefits.

Based upon an evaluation of these criteria it was concluded that the priority needs for the Dhaka Integrated Flood Protection Project should be focused towards providing a flood free and secure living environment, supported by complementary environmental improvement programs targeted towards further improving the living conditions for the urban poor. In planning the flood protection program, the cost effectiveness of investments has been considered: protecting the existing densely populated residential, industrial and commercial areas is the first priority, followed by increased pumping capacity (as more intensive urban land use of peripheral areas is made), increased flood security (by dividing protected areas into self-contained compartments by building internal embankments), and expansions to the protected areas. While the immediate planning period is to the year 2000, the longer term planning considers the urban development needs to year 2010.

The components recommended further in this section for inclusion within the five year Project period have all been identified as being necessary, affordable and feasible for immediate implementation and inclusion under the proposed Project, and to be suitable for incremental expansion over the longer term. Those further field investigations which are essential for detailed design have been included as a part of the Project works. In addition, complementary works have also been preliminarily identified as being desireable for the long term success of the operation and management of the Project works - particularly in the urban land development and building [illegible] sectors - but as requiring further study before final recommendations can be made, and proposals have been made for implementing additional studies under technical assistance grant.

4.2 Design Criteria and Technical Levels

All works proposed for inclusion in the Project have been selected on the basis of identifying the priority flood control and drainage needs for the residents of Dhaka City, plus complementary environmental improvement programs to meet the basic needs for the low income residents in particular, and to developing low cost, technically appropriate solutions within the financial constraints of the project.

The key criteria utilized in evaluating appropriate design alternatives focused on the aspects of risk minimization, functional utility, economy of construction, durability and maintainability of the facilities. The highest priority for selection of program elements was directed towards remedying flood control and drainage defects by upgrading, rehabilitation and betterment programs, and towards optimizing the benefits by incremental extensions of complementary environmental services into areas of greatest need. Support for strengthening operations and maintenance capabilities has been integrated into the management plan for the infrastructure program, and has been complemented by specific provision within the Project budget to ensure that operation and maintenance service is up to an acceptable standard by the end of the five year implementation program.

Based upon these factors, the Consultant and the implementing agencies (BWDB, DWASA and DCC) have agreed on technical approaches and appropriate design standards for infrastructural improvements in the flood protection, drainage, water supply, sanitation, solid waste, and slum improvement components of the Project. They promote, to the greatest extent possible, maximum use of local materials, technologies and resources. However, they also incorporate the introduction of new cost effective technologies and training for the use of geosynthetic materials for construction of flood protection embankments appropriate to the special needs of the Project, and suitable for applications on similar projects throughout Bangladesh in the future.

Typical design sections agreed for works included in the Project, plus the agreed technical approach for further field investigations and detailed engineering designs for remedial works on the western embankment, are presented in Appendix 3 and Appendix 4.

4.3 Cost Estimates

In order to develop the cost estimates for the Project, the Consultant worked in close cooperation with the engineering personnel in the BWDB, DWASA and DCC to develop appropriate unit rates for the proposed program elements, based on current 1991/92 prices. Such factors as the local cost and availability of construction materials, the accessibility of the proposed work elements, the distance from the nearest supply sources for major equipment and materials, and contractor availability were also evaluated.

The base costs developed for the project elements were computed either as a product of the applicable unit cost times the estimated quantity of work, or as a lump sum item to cover a grouping of works within a particular element, as applicable.

The total Project costs are derived from these 1991/92 base costs, with adjustment factors added to cover all related costs including physical contingencies, O&M during construction, site investigations and detailed engineering design, incremental administration, public information programs, and price escalations (inflation) related to the proposed year of implementation.

Due to the high degree of reliability of the scope of the proposed works under Parts A, B and C, physical contingencies have been estimated at a flat rate of 10% on the base cost of civil works, equipment and material supply, and operations and maintenance. Price contingencies have been estimated separately for the foreign exchange and local exchange components of the works, with F.C. contingencies at 4.9% for FY 92/93 and FY 93/94, and at 3.7% thereafter, and L.C. contingencies at 6.0% from FY 92/93 onwards. For Part D, Project management and consulting services, contingencies have been estimated at a flat rate of 15% throughout the Project period. Equipment for routine operations and maintenance has been provided under the equipment and materials supply portion of the works. For the flood control and drainage Parts, routine O&M costs have been estimated on a crew-month basis for O&M crews to be established during the Project period, and annual lump-sum provisions have been made for additional periodic O&M services which are beyond the capacity of the O&M crews. Under the environmental improvement Part, vehicle O&M has been estimated on a monthly operating cost basis, while O&M for minor civil works has been allowed at 5% of the capital investment cost.

Appendix 5 provides a summary of the costs of the recommended infrastructure investment program by sector (Parts A, B, and C), including the base costs for land acquisition, civil works, equipment supply and operation and maintenance during the Project period, plus allowances for physical and price contingencies. Additional costs for establishing and staffing the Project Management Office, management support services, detailed engineering design and construction supervision have been estimated separately under Part D. Interest during construction has been calculated separately for the Project as a whole. Cost summaries are presented in Tables 4.1 and 6.1.

4.4 Determination of Project Scope and Preparation of Outline Designs

In order to determine the scope of works required for each element of the program, the Consultants firstly: (i) undertook a comprehensive review of available reports, studies and mapping to identify data gaps and investigation needs; (ii) undertook reconnaissance field surveys of the existing and proposed embankments, flood walls and main drainage channels to preliminarily determine conditions, problems and needs; (iii) established a close working liaison with the major implementing agencies (BWDB, DWASA and DCC) to identify problems and priorities as identified by the local authorities; and (iv) established a close liaison with the parallel JICA FAP-8A program to share information and coordinate supplemental data gathering programs.

Based on this, it was determined that additional field investigation programs and analyses would be required in order to accurately determine the magnitude of observed problems, particularly for failed sections observed in the existing embankment, and to develop technically appropriate solutions. Accordingly, the following supplemental field investigation programs were taken up:

i) a comprehensive condition survey for the existing westerly embankment and floodwalls to determine the extent and magnitude of readily observable deficiencies,

ii) supplemental subsoil investigations along the existing westerly embankment through both failed and apparently stable sections to determine the likely causes of past failures, the probability of further future failures, and to determine remediation techniques for repair and stabilization of the existing embankment,

iii) supplemental subsoil investigations along critical sections of the proposed easterly embankment, and along proposed access routes to the embankment, to determine appropriate subsoil treatment and construction methods for future embankment construction,

iv) supplemental crest survey and typical cross sections along the existing westerly embankment, coupled with establishing a series of settlement gauges and piezometers for monitoring, in both failing and apparently stable sections: (i) the rate of settlement of the embankment foundation, (ii) the rate of consolidation of the embankment, and (iii) the changes in pore water pressure in the subsoil, y2

v) preliminary condition survey of the existing reinforced concrete floodwall to determine it's effectiveness and remedial works required;

vi) supplemental topographic survey along the central spine road to determine the existing elevation and the need for raising to serve as a temporary flood protection embankment as part of a phased program of flood protection for Dhaka City, and

vii) preliminary survey of drainage crossings of the central spine road to determine floodproofing needs as part of a phased program for flood protection for Dhaka City;

viii) geotechnical evalua ion of the subsoil investigation programs to recommend technically appropriate alternatives for embankment repair and stab[illegible]ion in order to increase the security of the flood protection scheme for Dhaka.

The readers attention is directed to the summary of the major results and recommendations arising from the above programs which have been presented the separate report entitled "Preliminary Analysis and Design, Phase 1 Embankment, June 1991". Conclusions and recommendations arising from this report and subsequent reviews of Project needs with the BWDB engineering staff are included in Appendix 4.

Based upon this information and intensive coordination meetings with the engineering staff of the BWDB, DWASA and DCC, an unconstrained program of improvements was initially prepared focused on meeting the critical deficiencies for the flood control and drainage schemes for Dhaka, and on developing appropriate environmental improvement programs which would complement the FC&D schemes, with specific emphasis on alleviating critical deficiencies for the urban poor. Cost estimates were prepared and compared against the expected availability of program financing. Benefits of each element were analyzed and preliminary estimates of affordability and feasibility prepared.

Following the first approximations, the scope of the works program was progressively ref[illegible] to bring the total project costs down to within the level of the funding expected to be made available. Those program elements which provided the greatest level of benefits, which had the highest cost effectiveness, which had the best levels of affordability and which were judged most feasible were retained for the Project, while other components were progressively eliminated. The final works program presented in this report is the end result of an iterative process of progressive reduction in the number of elements originally proposed, supported by an increasingly refined analysis of benefits, affordability and financial and economic viability.

The work program has been developed to the feasibility stage of analysis, with the location, scope, costs and phasing of each element proposed to be included in the Project clearly identified, reviewed, and agreed with the government and the Bank. The recommended components for all sectors are described in the follow,ng sections, and detailed in the cost estimates presented in Appendix 5

4.5 Engineering Design and Construction Supervision

It will be necessary to prepare detailed engineering designs for all proposed annual works programs before proceeding to tendering and construction. Work to be included under this will include, to the extent required for each component, additional field surveys and subsoil investigations, preparation of final engineering design drawings, bills of quantities, specifications and tender documents. The estimated cost of Project Management assistance, detailed engineering designs and construction supervision has been detailed under PArt D of the Project estimates contained in Appendix 5.

Further details of the above services, including broad Terms of Reference for the Project Implementation Consultant Services, are included in Appendix 6. Special preconstruction and preparation activities which are required in order for the Project to get off to a fast and effective start and to meet the schedule for the first years activities are discussed further on in Chapter 10.

4.6 Description of Proposed Wc -ks

As described in C' ,pter 2, the proposed Project is being designed in an integrated framework of flood protection, drainage, environmental improvements and poverty alleviation. The underlying rationale for the Project is to provide a flood free and secure living environment, and to improve the urban efficiencies and environmental conditions, particularly for the urban poor in Dhaka City.

The Project aims at an integrated urban development program consisting of: (i) flood control and drainage works; (ii) complementary environmental improvement programs in low cost water supply and sanitation programs for the low income residents, solid waste management and slum and squatter area development; and (iii) implementation assistance. In conjunction with this, emphasis has been placed on ensuring that adequate O&M capabilities are developed during the Project period.

The Project has the following four Parts as summarized in Chapter 2 and briefly described below; a more detailed description of each Part is given in the text following, while the scope and terms of reference for the proposed consulting services under Part D are given in Appendix 6.

<u>Part A: Flood Protection:</u> covers mainly the completion and augmentation of the westerly flood protection embankment and flood walls, work on which was initiated by the Government following the 1988 floods. This includes intensive remedial works and erosion protection on the existing embankment, stabilization of parts of existing concrete flood wall and construction of new flood wall, construction of an additional drainage pumping station and sluices, raising and flood proofing the central spine road, and the establishment of a maintenance program.

Part B: Drainage: a comprehensive drainage program is envisaged to alleviate periodic flooding in the city. This includes rehabilitation of existing major drainage canals (Khals), construction of new piped drainage facilities, improvement of secondary and tertiary drainage facilities, and the initiation of an intensive O&M program.

Part C: Environmental Improvement: includes (i) slum and squatter area improvement, with intensive community and beneficiary participation, to benefit over 8,750 families; (ii) solid waste management program, linked to the low-income areas being benefitted under Part B, involving provision of collection trucks, handcarts, and bins; and (iii) sanitation, water supply, and local drainage, involving provision of public toilets, pit latrines, public water supply standpipes, and cleaning of local drains.

Part D: Implementation Assistance: covers Project implementation support, including incremental administration and consulting services support for detailed engineering design, construction supervision, and project management.

The following sections provide a summary of the focus of attention and the general approach taken for developing the sectoral programs, plus summaries of the scope and cost of major works taken up. Summary descriptions of the overall approach has been previously provided in Chapter 2, a summary of the total costs by category are presented in Chapter 6, and detailed estimates of the costs of the annual works programs and individual work items are included in Appendix 5. Table 4.1 following provides a summary of the total costs of the recommended Project by sector, expressed in million U.S. Dollars. An equivalent summary, expressed in million Taka, is included in Appendix 5.

4.6.1 Parts A and B: Flood Protection and Drainage Alternatives

In Interim Report No. 1 discussions were presented on the existing conditions, evaluation and status of flood protection works, problems and needs, alternative flood control and drainage strategies, and recommended strategies to meet those needs. The strategies as presented have been further reviewed and discussed in detail with representatives from the various involved agencies and ADB officials, and this Report presents the results and conclusions for proceeding with the planned activities.

Two basic alternatives were selected for further evaluation: (i) the overall plan for providing flood protection and drainage to the entire 265 sq km area comprising the Dhaka City Corporation as presented in Plan A in Interim Report No. 1, and (ii) a staged program for flood protection and drainage which will be suitable for progress expansion as funding becomes available, initially covering the highly urbanized 136 sq km westerly portion of Dhaka City which was evaluated as being the highest priority area for immediate attention.

TABLE 4.1

Summary of Project Costs by Sector
($ million[1])

	Foreign	Local	Total
1. Base Costs by Sector:			
Part A: Flood Protection	16.48	30.18	46.66
Part B: Drainage	9.10	28.28	37.38
Part C: Environmental Improvement:	2.95	6.99	9.94
i) Slum Improvement	(0.47)	(1.41)	(1.88)
ii) Solid Waste Mgmt.	(1.41)	(2.44)	(3.85)
iii) San/WS/Local Drain	(1.07)	(3.14)	(4.21)
Part D: Project Implementation Assistance:	1.64	4.30	5.94
i) Incremental Admin.	(0.21)	(1.36)	(1.57)
ii) Consulting Services	(1.43)	(2.94)	(4.37)
Subtotal	30.17	69.75	99.92
2. Contingencies:			
Physical	3.10	6.29	9.39
Price	2.48	6.23	8.71
Subtotal	5.58	12.52	18.10
3. Interest During Construction:			
Service charge on Bank loan	3.20	-	3.20
IDC on Domestic Borrowing	-	-	-
Subtotal	3.20	-	3.20
TOTAL	38.95	82.27	121.22

[1] Estimated at Taka 37.25 = $1 U.S.

(a) Flood Protection and Drainage - Overall Plan:

Plan A which was presented in Interim Report No. 1 was prepared to include all work required to provide complete flood protection and drainage improvements in the Dhaka City Corporation area of approximately 265 sq km for the full 100 year recurrence period. The proposed activities required for the overall plan are shown on Figure 4.1 and Table 4.2 and are briefly described as follow:

- i) perform site investigations, rehabilitate and stabilize the existing west flood protection embankment along Turag and Buriganga Rivers,
- ii) repair eroded areas and provide slope protection along the existing west embankment,
- iii) construct remaining drainage sluices on the west embankment between Satmasjid and Kellar Morh area,
- iv) construct remaining embankment/floodwall to complete flood protection in West Dhaka from Kellar Morh to Mitford Hospital,
- v) rehabilitate existing floodwall,
- vi) perform site investigations and construct new east flood protection embankment along Balu River,
- vii) construct sluices along east embankment,
- viii) rehabilitate internal drainage khals and construct storm drainage improvements,
- ix) perform site investigations and construct Pump Station No. 3 at Goran Chatbari for the west area, and Pump Stations Nos. 4, 5, and 6 for the east area,
- x) raise central spine road to provide flood protection during the construction period, and to form a permanent internal partition for future development of compartmentalization programs.

The base construction cost for the complete flood protection and drainage scheme for Dhaka City, including duties and taxes, physical contingencies, engineering and administration, and right of way acquisition, is estimated at approximately Taka 16,400 million (US $450 million), of which right-of-way costs amount to about 29%, and duties and taxes amount to about 16%. Operation and maintenance during the implementation period plus price contingencies, together amounting to about 15% of the capital costs, would be additional to the above estimate.

As evaluated in Chapter 7, the concept of providing full flood protection and drainage for all of Dhaka City is economically viable and is feasible. However, it was clear that the total cost of this approach would far exceed the presently available financing. Accordingly, it was agreed that complete flood protection for Dhaka City would be considered in the context of a long-term strategy for development in a staged program over a period of 10 to 15 years, and that no additional evaluation of this option would be done under this Project. It was further agreed that attention would be focused on developing an immediate action plan for protection of the highest priority areas only, which would be suitable for incremental expansion in the future.

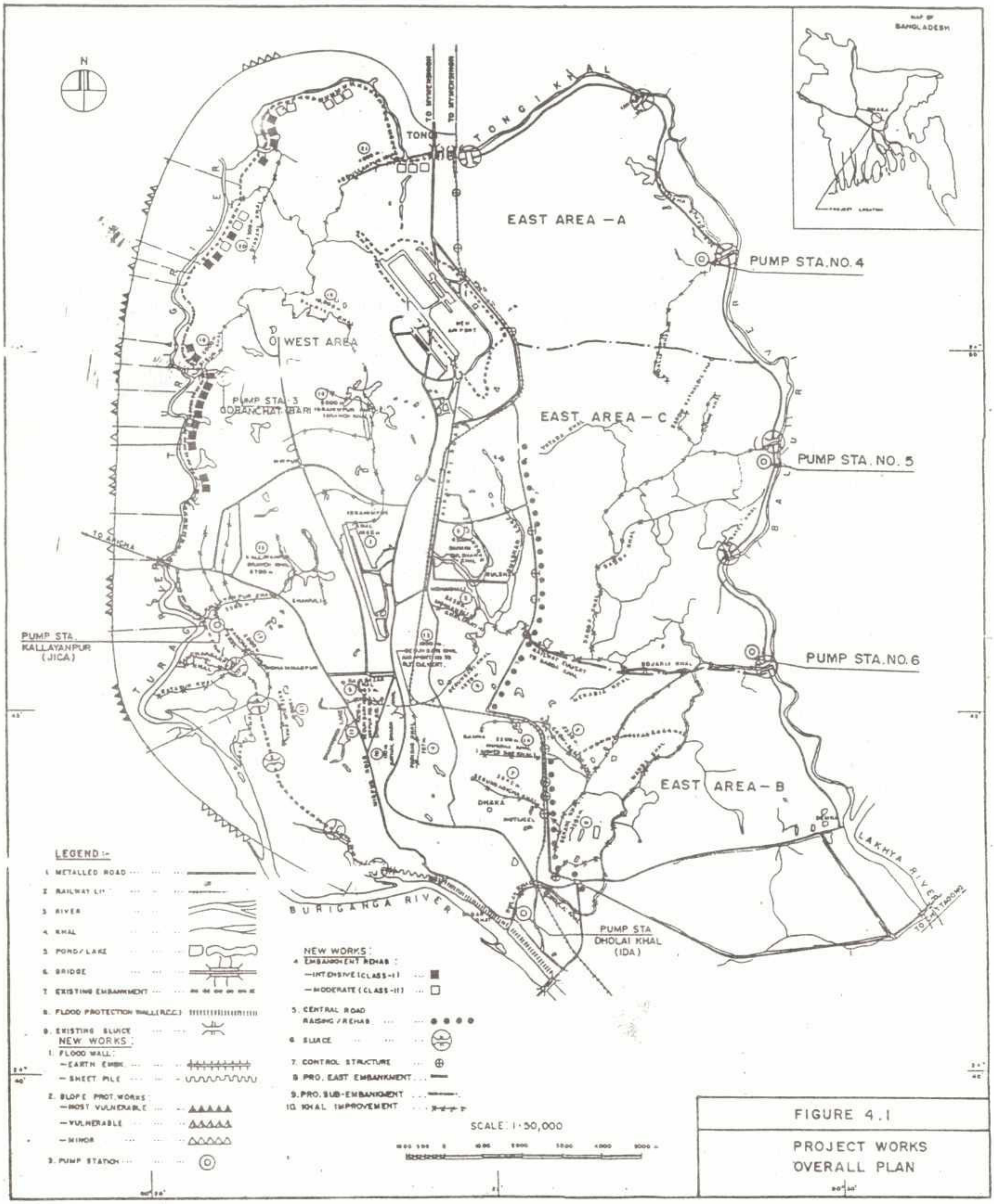

FIGURE 4.1

PROJECT WORKS OVERALL PLAN

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COST ESTIMATE TO PROVIDE 100 YEAR LEVEL OF PROTECTION WHEN ALL WORKS ARE COMPLETED
AND ABOUT 50 YEAR LEVEL OF PROTECTION FOR WEST AREA WITH COMPLETION OF PHASE I WORKS
FOR FLOOD PROTECTION AND DRAINAGE

DESCRIPTION	BASE CONST. COST W/O DUTIES & TAXES	DUTIES & TAXES (MAJOR ITEMS ONLY)	BASE CONST. COST INCL. DUTIES & TAXES	RIGHT OF WAY	BASE CONST. COST INCL. R/W	TOTAL COST INCL. D&T R/W & CONT.	TOTAL COST INCL. D&T R/W & CONT. MILLION $ US
	(1)	(2)	(3) (1)+(2)=(3)	(4)	(5) (3)+(4)=(5)	(6) (5)x1.2=(6)	(7) (6) - 36.5 = (7)
FLOOD PROTECTION - PHASE I							
1. Intensive remedial works	295.45	23.37	318.82	15.00	333.82		
2. Moderate remedial works	87.83	3.88	91.71	2.85	94.56		
3a. Minor remedial works (borrow pit)	36.40	0.00	36.40	0.00	36.40		
3b. Minor remedial works (Jute & sod)	13.25	0.00	13.25	0.00	13.25		
4. Slope protection (major)	177.76	19.08	196.84	0.00	195.84		
5. Sluices	37.50	2.50	40.00	10.00	50.00		
6a. New Floodwall/Embankment	202.04	100.00	302.04	19.55	321.59		
6b. Remediation of existing Floodwall	87.83	3.61	91.44	0.00	91.44		
7a. Central road raising	21.81	0.00	21.81	0.00	21.81		
7b. Central road floodproofing	49.14	2.99	52.13	5.00	57.13		
8. Pump Station No. 3 Goranchatbari	252.00	148.00	400.00	30.00	430.00		
9. Functional buildings	10.00	0.00	10.00	0.00	10.00		
Subtotal	1271.01	303.43	1574.44	82.40	1656.84		
DRAINAGE - PHASE I							
1. Main Khal rehabilitation & upgrading	311.16	0.00	311.16	55.24	366.40		
2. 2nd year Khal rehabilitation & upgrading	201.31	0.00	201.31	74.11	275.42		
3. 3rd year Khal rehabilitation & upgrading	175.80	0.00	175.80	124.06	299.86		
4. Pipe drain rehabilitation & construction	391.58	0.00	391.58	0.00	391.58		
Subtotal	1079.85	0.00	1079.85	253.41	1333.26		
PHASE I WORK - BASE CONSTRUCTION COST	2350.86	303.43	2654.29	335.81	2990.10		
10% physical + 10% Engr. & Administration	470.17		530.86		598.02		
TOTAL COST - PHASE I WORK	2821.03		3185.15		3588.12		
% of Total cost - Phase 1 work	78.62		88.77		100.00		
FLOOD PROTECTION - REMAINING WORK							
1. East Embankment - Section A	978.95	58.69	1037.68	321.00	1358.68	1630.42	44.67
2. East Embankment - Section B	311.87	34.25	346.12	103.20	449.32	539.18	14.77
3. East Embankment - Section C	780.33	75.82	856.15	195.88	1052.03	1262.44	34.59
4. East Sub-Embankment - Section A'	108.25	5.60	113.85	60.86	174.71	209.65	5.75
5. East Sub-Embankment - Section B'	277.91	22.34	300.25	69.90	370.15	444.18	12.17
6. Sluices - East	129.00	71.00	200.00	0.00	200.00	240.00	6.58
7. Pump Station No. 3 - West	422.00	238.00	660.00	937.50	1597.50	1917.00	52.52
8. Pump Station No. 4 - East	470.34	264.66	735.00	330.00	1065.00	1278.00	35.01
9. Pump Station No. 5 - East	514.80	289.60	804.40	420.87	1225.27	1470.32	40.28
10. Pump Station No. 5 - East	1057.68	594.92	1652.60	1228.26	2880.86	3457.03	94.71
Subtotal	5051.17	1654.88	6706.05	3667.47	10373.52	12448.22	341.05
DRAINAGE - REMAINING WORK							
1. Khal Improvements - East	267.72	0.00	267.72	44.16	311.82	374.26	10.25
REMAINING WORK - BASE CONSTRUCTION COST	5318.89	1654.88	6973.77	3711.63	10685.40		
+10% Physical & 10% Eng. & Admn. cont.	1063.78		1394.75		2137.08		
TOTAL COST - REMAINING WORK	6382.67		8368.52		12822.48	12822.48	351.30
PERCENTAGE OF TOTAL COST-REMAINING WORK	49.78		65.26		100.00		
TOTAL COST-ALL WORK (100 YEAR PROTECTION)	9203.70		11553.67		16410.60		449.61
PERCENTAGE OF TOTAL COST ALL WORK	56.08		70.40		100.00		

NOTES

1. All amounts are expressed in millions of Tk. unless otherwise specified.
2. Exchange rate: 1 $US = 36.5 Tk.
3. Right of Way requirements for Pump Stations have been estimated based upon acquiring the lands at pre-inflation rates. Detailed design studies may determine that other combinations of higher pump capacities and lower right of way requirements are more cost effective.
4. The cost estimate does not include any amounts for operation and maintenance during construction nor for any price increases during the construction period. Prices are based upon mid-1991 rates.
5. Under Duties and Taxes, only major items are shown seperately. Minor items, averaging from 2 to 5%, are included in base construction cost.
6. Abbreviations :

W/O : Without
D&T : Duties & Taxes
Incl. : Including
R/W : Right of Way
Cont. : Contingencies
Eng. : Engineering
Admin. : Administration
Const. : Construction

(b) Flood Protection and Drainage - Phased Program:

Due to the high costs of providing full protection for all of Dhaka City and the lack of available funding for the overall plan, consideration was given to phasing the Project works to provide maximum early benefits at minimum costs. Accordingly, full consideration was given to optimizing the benefits of past investments, and to incorporating existing roads and embankments into the phasing schemes for maximum efficiency. Based on this, the original Government proposal for developing the westerly half of Dhaka City, which contains over 95% of the commercial and industrial infrastructure and more than 87% of the City population, was evaluated as having the highest priority for completion.

Estimates of costs and feasibility (see Chapter 7) have confirmed this conclusion, and the recommended flood control and drainage components are described in the following:

4.6.2 Part A: Flood Protection

The recommended flood protection works for inclusion in the Project encompass protection of approximately 136 sq km of the westerly portion of Dhaka City as shown in Figure 4.2, and cover those activities necessary to complete the works in this area initiated by GOB following the 1988 floods, as well as the first stage of Pumping Station No. 3 at Goran Chatbari. The boundary between the western and eastern areas is provided by a sequence of main roads and railway embankments, referred to as the Central Road in this chapter. This boundary forms the eastern boundary for the Phase 1 Project area.

The level of flood protection offered by the western boundary, which will consist of a combination of earth embankment and concrete flood wall, will correspond to the 100 year flood recurrence level (which is about 0.14 meter higher than the maximum water elevation sustained during the 1988 floods), with an additional freeboard added to the elevation of the structures of about 1.2 m for earth embankments and 0.6 m for concrete floodwalls.

The return period of the 1988 flood has been estimated at a minimum of 70 years. Following the 1988 flood, GOB also initiated the raising of the Central Road to an elevation corresponding to a 50-year flood. Preliminary survey data indicates that this elevation has not been reached over the entire length of the Central Road. The Project therefore includes provision to raise the elevation of the Central Road to match the 50-year flood where surveys show this is required, and to provide gate controls for all drains crossing the roadway.

The scope of Part A covers the following:

i) Intensive and moderate remedial works over a total 7.8 km length of existing embankment on the western side of the Project area. These areas are located where the embankment crosses redundant river channels - principal reason for the present serious instability

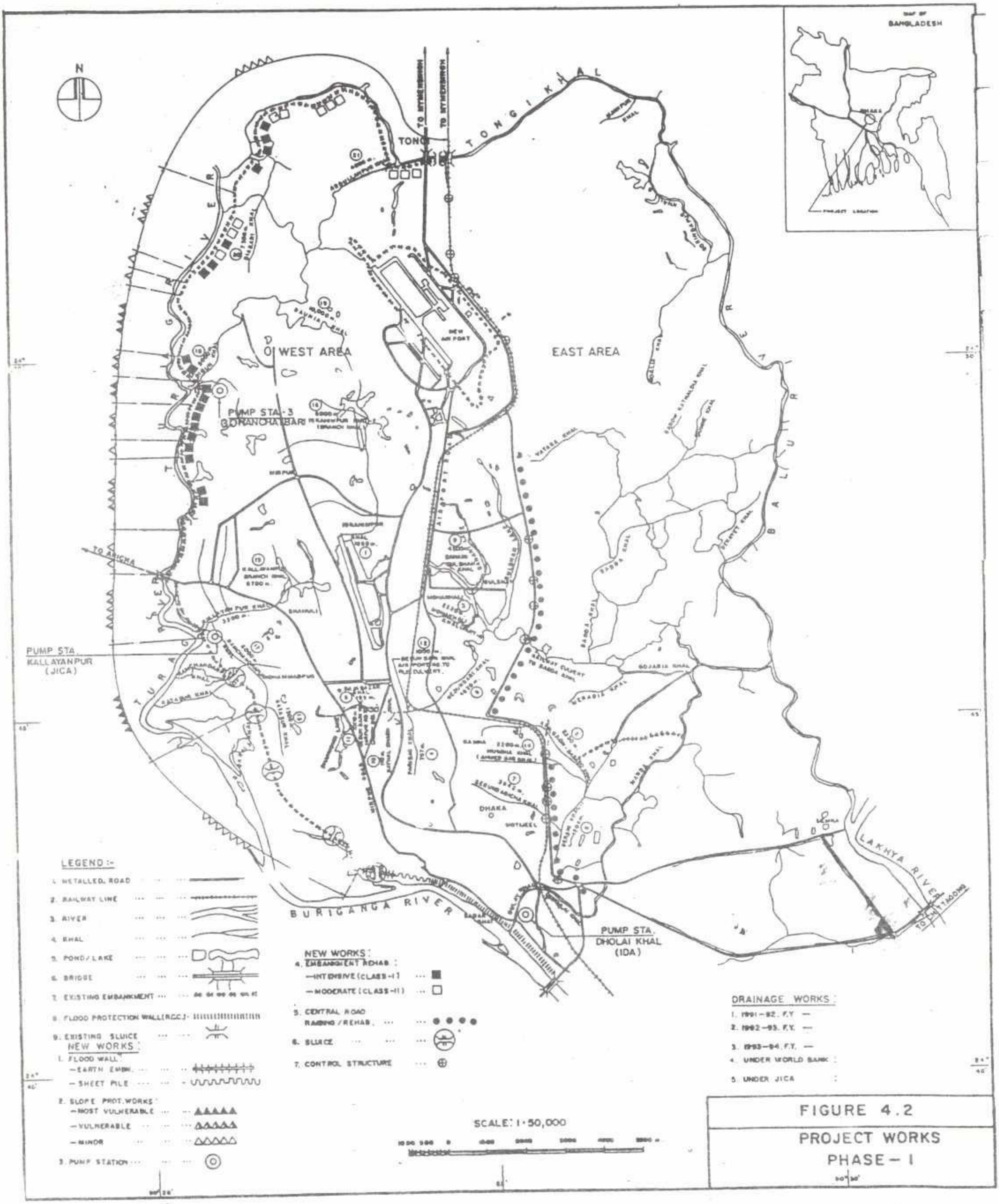

FIGURE 4.2

PROJECT WORKS

PHASE – I

of these parts of the embankment is the weakness of the underlying soils. Effective completion of the works requires stabilization of the embankment foundation, which in turn requires installation of extensive foundation drainage works (to permit rapid consolidation and strengthening of the foundation soils).

The initial preliminary design prepared for the Class I areas indicated that removal of most of the embankment would be required to near the original foundation level before installation of the wick drains. Wick drains were to be installed vertically into the original subgrade to provide the necessary rapid consolidation to improve the foundation strength, and the entire embankment base area would then be covered with high strength geotextile to distribute and support the embankment load.

Subsequent discussions between the BWDB Engineers and the Consultants resulted in a modified approach which would leave most of the main embankment in place, but would reduce the factor of safety for the structure a small amount. The final proposed design for Intensive Remedial Works on the west embankment (Class I areas) has been agreed as follows:

- o the embankment will be left in place with removal of only the top portion to an elevation of between 6.5 m to 8.0 m, depending upon soil test results, and subsequent remedial design requirements;
- o wick drains will be installed to depths and at spacing as determined by soil test results and remedial design considerations, to obtain the desired rapid consolidation of the embankment; and
- o the top of embankment will be replaced, including allowances for settlement, using strict quality control procedures to obtain required results.

It is estimated that this change in design will result in a factor of safety against subgrade failure for the structure of about 1.1 within one year, gradually increasing to about 1.2 in three to five years. This is a reduction from the original proposal which was estimated to result in a value of about 1.3 upon completion.

ii) Moderate remedial works on a further 3.1 km of the existing embankment, consisting of foundation drainage measures as for the 4.7 km section described above, except that the extent and spacing of wick drains may be changed depending upon soil test results and subsequent final design considerations.

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iii) Minor remedial works, which were intended to cover provision for restoration of areas of minor drainage due to shallow slope failures and minor erosion, have become much more extensive due to embankment damage during the 1991 high river stages and the extent of minor remedial works has been modified to include the following:

- o filling of borrow areas at the river side toe of the embankment by dredge, where the borrow area is too close to the embankment toe; and

- o restoration of eroded areas on the river side of the embankment and placing jute/sod protection with plantation of dholkolmi or doncha bushes at riverside toe of slope or berm (approx length 17.67 km.).

iv) Slope protection, which was originally prepared for about 7.8 km of more severe wave affected areas, has been extended to provide cement-concrete blocks on geotextile filter fabric in areas of severe wave action, including about 3.97 km of most vulnerable area and about 7.52 km of vulnerable area. Blocks for the most vulnerable areas will be 24" x 24" x 12", and for vulnerable areas will be 21" x 21" x 9". This work includes restoration of eroded sections of river side embankment.

v) Sluices will be placed along the existing embankment, in the area from Satmasjid to Mitford Hospital, at five separate locations as indicated in the Master Plan report prepared by JICA.

vi) A new section of floodwall/embankment approximately 1.6 km in length is to be constructed extending from Kellar Morh south-easterly to tie into the existing floodwall of Mitford Hospital. Preliminary plans for this work include:

- o construction of about 800 m of earthen embankment extending from Kellar Morh south-easterly; and

- o construction of about 800 m of steel sheet pile wall for the remaining length along the Buriganga River to Mitford Hospital.

The estimated costs for this work include filling on the land side of the wall with dredged material. The alignment and extent of embankment/floodwall proportions will be determined when detailed surveys, public acceptance and final designs are completed.

vi) Remediation of approximately 5.3 km. of the existing reinforced concrete floodwall has been refined to include the following:

- o detailed inspection and sub-surface investigations of the wall, and construction of subsequent remedial works needed; and

- o closure of openings in the existing floodwall by means of installing steel gates which can be securely fastened both at time of flooding as well as when open during non-flood periods, plus construction of approximately 281 m of steel sheet pile flood wall at larger openings.

vii) Central Road improvement involving a combination of road raising and closure of drainage channels which cross the roadway. The work required includes the following:

- construction of a new median, and/or raising the height of existing medians, along the center of the existing road to protect to the 50 year overtopping level;

- raising of a section of roadway around the Jatrabari turnabout to a maximum height of approximately 60 cm for a distance of about 200 m; and

- construction of gate control structures at each of the 13 drainage channel crossings, including Begunbari Khal.

viii) Construction of the first stage of Pump Station No. 3 at Goran Chatbari with a capacity of 22 cubic meters per second (cms) to provide about one third of the ultimate design capacity required to remove two days consecutive rainfall with a 5 year recurrence frequency. The area required for the retarding pond for the full capacity of 65.2 cubic meters per second is about 686 hectares. However, it is considered that the pumping capacity provided by this first stage will significantly reduce the accumulated rainfall runoff from within the tributary drainage area during the monsoon season, and will have a very favorable impact upon the higher lands within the influence of the pump station. As more of the lower lands become urbanized, the capacity of the pump station can be increased to accommodate those needs, and to reduce the corresponding retarding pond areas.

ix) Construction of functional buildings at various locations throughout the Project area.

x) Provision of temporary pumping facilities along the easterly boundary for evacuation of internal rainfall during periods of high river stage combined with heavy rainfall (included as a part of the O&M costs for the Project).

The estimated capital cost of the recommended flood protection component of the Project, including base costs for land, civil works, materials and equipment, and O&M during construction, but excluding physical and price contingencies and interest/charges during construction, is Taka 1,737.88 million ($46.66 million), representing 46.7% of the total base cost of the investments proposed under the Project. Detailed estimates are presented in Appendix 5.

Upon completion of this first phase of the flood protection works, the westerly portion of Dhaka City will be provided with protection against external flooding for an estimated 50 year flood recurrence level. The embankments along the westerly boundary will be completed to the final design elevation of 9.8 m PWD, suitable for protection against a 100 year recurrence flood with a 1.2 meter freeboard, while the central spine road will be completed to an intermediate overtopping level averaging elevation 7.4 m PWD, suitable for protection against the 50 year recurrence flood. The existing flood walls along the southerly portion of the westerly boundary will similarly provide an intermediate protection level, equivalent to approximately a 70 year recurrence flood with a 0.6 m freeboard.

Upon completion of the Project, protection against internal flooding from extreme rainfall events will be provided along the westerly boundary by the first stage of the required permanent pumping stations, which will be suitable for future expansion by providing additional pumping units as urban growth and runoffs increase. Discharges towards the easterly boundary will, however, remain dependant upon gravity flow discharge and the capability of temporary pumping facilities to evacuate excess water until such time as the overall flood protection scheme is further expanded in subsequent stages. During normal years performance will be satisfactory, as the maximum rainfall occurs during the June, July and early August period, while the peak flood flows occur in late August and early September. With temporary pumping facilities in operation, it is recommended that operational procedures be established so that internal water levels are maintained below elevation 5.5 m, or about 0.8 m less than the average flood.

4.6.3 Part B: Drainage

The proposed drainage works are a necessary complement to the flood protection works, and the primary focus of the drainage improvement program is on creating an integrated drainage system within the Dhaka urban area to eliminate/reduce the drainage congestion and regular local flooding which prevails during the monsoon season. The poor drainage is not only a serious health hazard, but also contributes significantly to accelerated road deterioration rates with attendant high maintenance costs. The Project will cover the drainage requirements of the flood protection area, including those drainage facilities which lie outside the area but which are connected to the Project area drainage network.

Included in the infrastructure improvement program are:

i) cleaning and rehabilitation of 21 major existing open drainage khals totalling 78 km in length, of which about 11 to 14 km will be covered due to right of way restrictions or road crossing requirements. The rehabilitation works will consist of dredging and reprofiling to restore the khals to their design capacity, including lining where needed;

ii) rehabilitation and construction of 51 km of piped drainage facilities to relieve drainage congestion in the built-up areas of the City;

iii) completion of urgent drainage works which commenced under the GOB crash program designed after the heavy pre-monsoon rains of 1991. This work includes mainly cleaning and unblocking existing covered and open drains in the more densely populated parts of the City, together with a limited program of construction of small capacity new drains; and

iv) implementation of a rigorous operations and maintenance program for the drainage works over the Project implementation period as the Project construction works are completed.

The estimated capital cost of the recommended drainage component of the Project, including base costs for land, civil works, materials and equipment, and O&M during construction, but excluding physical and price contingencies and interest/charges during construction, is Taka 1,392.35 million ($37.38 million), representing 37.4% of the total base cost of the investments proposed under the Project. Detailed estimates are presented in Appendix 5.

4.6.4 Part C: Environmental Improvement

The urban infrastructure and services in Dhaka have severe deficiencies, and the slum dwellers/squatters which form more than 25% of the total population do not have access to most of the basic services which are available to other City residents. Local flooding is an annual event in these areas, garbage collection services are generally not available, and sanitation, water supply and access facilities are poor. Health conditions in particular are extremely bad in the slum areas due to the lack of basic services and the consequent pollution within the living environment.

The Environmental Improvement Program will encompass three components which are complementary to the flood control and drainage programs and which will serve to enhance the overall impact of the Project within the Project area: (i) slum and squatter area improvements, (ii) solid waste management, and (iii) sanitation, water supply and local drainage.

The scope of this Part C includes the following components:

(i) <u>Slum and Squatter Area Improvement</u>:

Slum improvement programs modeled on the highly successful LGEB/UNICEF slum improvement project have been included in the proposals. Included in the programs are modest infrastructural improvements to slum areas in water supply (1 hand tube well or standpipe per 10 families), sanitation (1 twin pit latrine per 3 families), footpath access and security lighting, improved drainage facilities and solid waste storage and collection services.

One of the most significant aspects of the program is the high priority placed on motivation and community participation in the improvement works, which will be coordinated through the Slum Improvement Cell to be established by the Dhaka City Corporation. Selection of the slum areas for inclusion in the program is restricted to those areas where security of tenure is guaranteed, either through ownership of the lands by the slum dwellers themselves, secure tenure on government lands, or guaranteed secure tenure on private properties for a minimum period of five years through contract with the property owner. The slum dwellers are involved in the entire development process from the beginning of the project, form their own council and select their own representatives for receiving training. A part of the initial cost of water supply and sanitation services is paid for by the recipients, and this money is returned to supplement a loan fund for income generating activities.

Funding is provided in the program for training, health care and support for income generating activities. Community health workers (CHWs) are selected from within the slum area to receive basic primary health and child care training (1 per 50 households), and primary health care equipment ([illegible], scales, growth charts, etc.) is provided. Groups of ten households each are formed from within the beneficiaries, are trained in operation and maintenance of the infrastructure provided, and operate as a unit to receive further project benefits.

Training in income generating activities is provided for the female beneficiaries and income generating loans are made available to the women within the groups. Operating on the proven Grameen Bank model, each group selects their own recipient for financial assistance, and when the initial loans are repaid select other recipients, in rotation, for further aid. NGO assistance is actively solicited to help in providing training for the slum dwellers and to assist in formulating education programs for the children. Guidance for the overall program will be coordinated through the LGEB slum improvement project to draw upon the extensive experiences gained in this national program.

A total of 8,000 families are proposed to be assisted over the five year Project period under this scheme. A further 725 families, presently squatting on public lands and along khals, and contributing to drainage system deterioration, will be resettled under this component.

The estimated capital cost of the slum and squatter area improvement component of the project, including base costs for land, civil works, materials and equipment, and O&M during construction, but excluding physical and price contingencies and interest/charges during construction, is Taka 69.90 million ($1.88 million), representing 1.9% of the total base cost of the investments proposed under the Project. Detailed estimates are presented in Appendix 5.

9D

(ii) Solid Waste Management:

Solid waste collection se vices are, at the present time, at a low level in Dhaka, and are generally limited to the cleaning of major roads and collection of ma .. wastes, with private coverage provided only within the more affluent areas of the City. Accordingly, most of the residents must rely on their own disposal methods, with the result that about half the wastes are uncollected and are disposed of by throwing onto vacant lands or into drains within the locality. This practice is hazardous to the health of the residents, accelerates the clogging of the drainage systems resulting in local flooding and drainage congestion during the rainy periods, and increases the annual cost of drainage system maintenance. There is currently no enforcement of regulations to prevent this practice nor, in the absence of any alternative, is there any scope for the City to begin to do so.

The focus of the proposed project is to provide additional equipment and facilities to enable the City to upgrade their service levels within existing areas and to extend their services into new areas, particularly into the low income areas and those areas adjacent to the drains which are to be taken up under Part B of the Project. Included in the Project are: (a) rehabilitation and new construction of 3,000 dustbins for local short term storage prior to collection, (b) 2,000 hand push carts for collection in congested areas and for transfer of wastes to convenient collection points, (c) 30 garbage trucks for collection and transportation to end disposal sites, and (d) 120 demountable containers.

Improvement of collection efficiencies is also seen to be a necessary component to complement the Project investments, and technical assistance to achieve this is being provided under the parallel ongoing World Bank financed Dhaka environmental improvement project. Consulting services provided under this Project will further assist in developing appropriate practices to optimize effective utilization of the new equipment.

The estimated capital cost of the solid waste management component of the Project, including base costs for land, civil works, materials and equipment, and O&M during construction, but excluding physical and price contingencies and interest/charges during construction, is Taka 143.55 million ($3.85 million), representing 3.9% of the total base cost of the investments proposed under the Project. Detailed estimates are presented in Appendix 5 .

(iii) Sanitation, Water Supply and Local Drainage:

Sanitation: The provision of public sanitation facilities and services for the collection and end disposal of human wastes, or the assurance that such services are provided, are a part of the Cities designated responsibility, whereas the provision of private sanitary facilities for personal use is traditionally the homeowners responsibility. However, open defecation and unsanitary human waste facilities constitute one of the major public health hazards in the urban environment, and a strong commitment to extending proven low cost technologies and to increasing the acceptance level for sanitary disposal methods is essential to the health of the community. There is a strong need for intensive municipal support to, and direct involvement in, the promotion and distribution of sanitary facilities.

In line with this the consultants recommend that the elimination of open defecation, replacement of service latrines and upgrading of unsanitary facilities to sanitary facilities form the priority target areas for this program. Included in the proposed project are: (a) 3,000 very low cost sanitary pit latrines which are affordable down to about the 90th percentile of the City residents, (b) 2,500 low cost twin pit latrines which are affordable down to approximately the 70th percentile, (c) 2,500 latrine shelters to promote public interest and acceptance of the program, (d) 30 public toilet/wash houses plus 5 mobile toilets for market areas and public gatherings, and (e) 2 septic tank desludging trucks for collection of sanitary wastes. All private sanitary facilities are proposed to be financed through Project loans on a 100% cost recovery basis, and accordingly the affordability of the facilities to the various income groups is an essential element of this sector of the program, and has been taken into consideration in the development of the proposals.

Under Part D of the Project, adequate funding has been included for the dissemination of public information and education literature to promote the acceptance and use of sanitary disposal methods, and it is envisaged that the City will actively solicit the assistance of local NGOs, community groups and public media services to generate a heightened community awareness of the problems and options available.

Water Supply: The water supply component is very minor, though socially important, part of the Project focused on providing public water supply facilities to extremely disadvantaged families in slum and squatter areas, irrespective of tenure status, where existing supplies are not available. It includes the provision of 1,000 new standpipes within the existing service zones where supply capacity is adequate to support such moves and/or modest extensions of tubewell service to needy areas.

Local Drainage: The DCC currently maintains about 120 km of local drain pipes plus all roadside surface drains, many of which are damaged, blocked or broken causing localized shallow flooding during even minor rainfalls. Under this component is included: (a) the cleaning and rehabilitation of 120 km of local drains, (b) extension of 71 km of minor drains, (c) cleaning and rehabilitation of 60 km of surface/roadside drains, and (d) the supply of one drain gully sweeper for improved drain maintenance.

The estimated capital cost of the sanitation, water supply and local drainage component of the Project, including base costs for land, civil works, materials and equipment, and O&M during construction, but excluding physical and price contingencies and interest/charges during construction, is Taka 156.70 million (**$4.21 million**), representing 4.2% of the total base cost of the investments proposed under the Project. Detailed estimates are presented in Appendix 5.

9b

4.6.5 Part D: Implementation Assistance

As discussed previously in Section 4.5 provision has been made in the Project for incremental administration and consulting services for detailed engineering designs, construction supervision and project management services to assist in the overall coordination and management of the Project. A Project Management Office (PMO) will be established under the Project, staffed by representatives of each participating GOB agency and by the Project consultants, to provide:

i) detailed engineering design and construction supervision;
ii) coordination and management of the Project activities;
iii) equipment and logistic support facilities;
iv) quality assurance and control, including establishment of a materials testing laboratory and program;
v) development of O&M guidelines and procedures; and
vi) PBME and community development coordination and services.

Broad Terms of Reference for Project Implementation Consultant Services are described in Appendix 6.

The estimated cost of the implementation support services, excluding physical and price contingencies and interest/charges during construction, is Taka 222.47 million ($5.94 million), representing 6.0% of the total base cost of the investments proposed under the Project. Of this, Taka 58.73 million (1.6%) is for the set-up and administration costs of the PMO, and Taka 162.74 million (4.4%) is for consulting services for Project management assistance, design and construction supervision.

4.7 Incremental Staffing, Operations and Maintenance

The cost of providing incremental staffing increases for operating and maintaining the project facilities during the Project implementation period, plus the cost of routine and periodic maintenance works, has been included as a part of the Project costs. Included in this item is also the estimated cost of operating and maintaining the solid waste collection service during the Project period, based on estimates of actual operating costs. The costs of operation and maintenance of private facilities which do not fall under the Pourashava control are not included.

The base costs of operation and maintenance activities for Parts A, B and C during the Project are estimated at Taka 159.72 million ($4.29 million), for an average of 4.6% of the total base costs of these Parts. This amount is included in the sectoral totals described previously. In addition to these, however, essential equipments for routine operation and maintenance of the Project facilities have been provided under the Project, and the costs have been included under the equipment and materials supply portion of each Part. It is recommended that flexibility be maintained during the Project implementation period so that additional essential equipments of a minor nature may be purchased on an "as needed" basis. Further discussions on O&M are contained in Chapter 5.

4.8 Other Issues

a) Roadway Along Embankment

At the time the Inception Report was prepared in February 1991 it was observed that the four lane ring road which was proposed to be constructed along the flood protection embankment was an important need for the Dhaka metropolitan area and future expansion. However, it was also noted that many problems would be faced in attempting to integrate those much needed sections of the roadway network into the overall roadway planning schemes. For these reasons it was determined that the integration of roadway development into the present Project was not appropriate at this time, and that further studies and activities in this regard should be delayed until after completion of planned overall roadway studies which are scheduled to begin during 1991 under the UNDP assisted Dhaka master planning study and Dhaka integrated transportation planning project.

However, it should be noted that the present Project plans, as proposed in this Final Report, do not change the roadway planning concepts as proposed in the original Government work program. The embankment can still be widened in the future to accommodate a roadway. However, due to the rather irregular alignment, straightening of the roadway alignment may be required at some locations. The east embankment which is proposed for future construction activities can be designed to incorporate the results of roadway studies as they are completed. For the existing west embankment, it is recommended that the Government introduce building controls to restrict development within 50 m of the toe of the embankment so as to preserve a strip of land along the country side of the embankment to accommodate any future roadway.

b) Pump Station No. 3 at Goran Chatbari

The first stage of Pump Station No. 3 at Goran Chatbari has been included in the Project works program. This first stage of construction will provide limited controls on the flooding levels within the empoldered area. As the area develops and the low-lying, presently agriculture, lands are converted to urban uses the timing and extent of further expansions of the Pump Station can be determined. Preliminary planning on the pump station includes provision for further expansion of the pumping capacity without modifications to the proposed structure. The general layout and pumping procedures will be similar to those established for the adjacent Mirpur area which will be served by the Pump Station at Kallyanpur, now being constructed under contract with the Japanese Government.

5.0 IMPLEMENTATION ARRANGEMENTS

The implementation arrangements described in this Chapter are primarily relevant to the execution of the recommended Project, or Phase 1 of the overall flood protection plan for Dhaka City. Only some of these arrangements may applicable for further stages in the future.

5.1 Execution and Coordination

The project implementation structure is shown in Figures 5.1 and 5.2, and summary descriptions of principle functions and responsibilities are indicated on Table 5.1.

The overall coordination, monitoring and supervision for the Project will be provided by the Minis.ry of Irrigation, Water Development and Flood Control (MIWDFC) through the FPCO, under procedures that have been standardized und... the FAP. The existing Steering Committee chaired by the Minister for MIWDFC that has provided policy guidance during Project formulation will continue during Project implementation. For the Project, members would include, inter alia, Chairmen of BWDB, DWASA, and RAJUK, Secretary LGD, Mayor of DCC, Director General DOE, Director UDD, Secretaries MOW and MOL, Members (Flood Control, Planning, Agriculture, Programming and Physical Infrastructure) of PC, and Secretary/Additional Secretary MIWDFC.

Similarly, the Technical Committee set up under the FPCO that has been operative during the Project formulation phase, having representatives from the agencies included in the Steering Committee at the technical level, will continue as Project Implementation Coordination Committee during Project implementation to provide guidance on operational matters, coordinate Project implementation, and prepare working papers for consideration of policy-related matters by the Steering Committee.

The overall technical supervision and execution of the Project will be the responsibility of the Bangladesh Water Development Board (BWDB), which will be the lead Project Executing Agency, and will implement Parts A and D of the Project. The implementing agencies for Parts B and C will be DWASA and DCC respectively, while DOE and RAJUK will be involved in Project implementation in a supportive role: the former in overall monitoring of environmental impacts of the Project, and the latter in central spinal road improvement under Part A and in land development planning and control. The FPCO will continue during Project implementation with coordination, monitoring and evaluation under the FAP. The capacity of BWDB, DCC and DWASA to successfully implement the Project and operate and maintain the facilities after their completion has been assessed. Based on this assessment incremental staffing requirements have been identified and incorporated in the Project (see Section 5.7).

Figure 5.1

PROJECT IMPLEMENTATION AND MANAGEMENT

I. PROJECT IMPLEMENTATION STRUCTURE

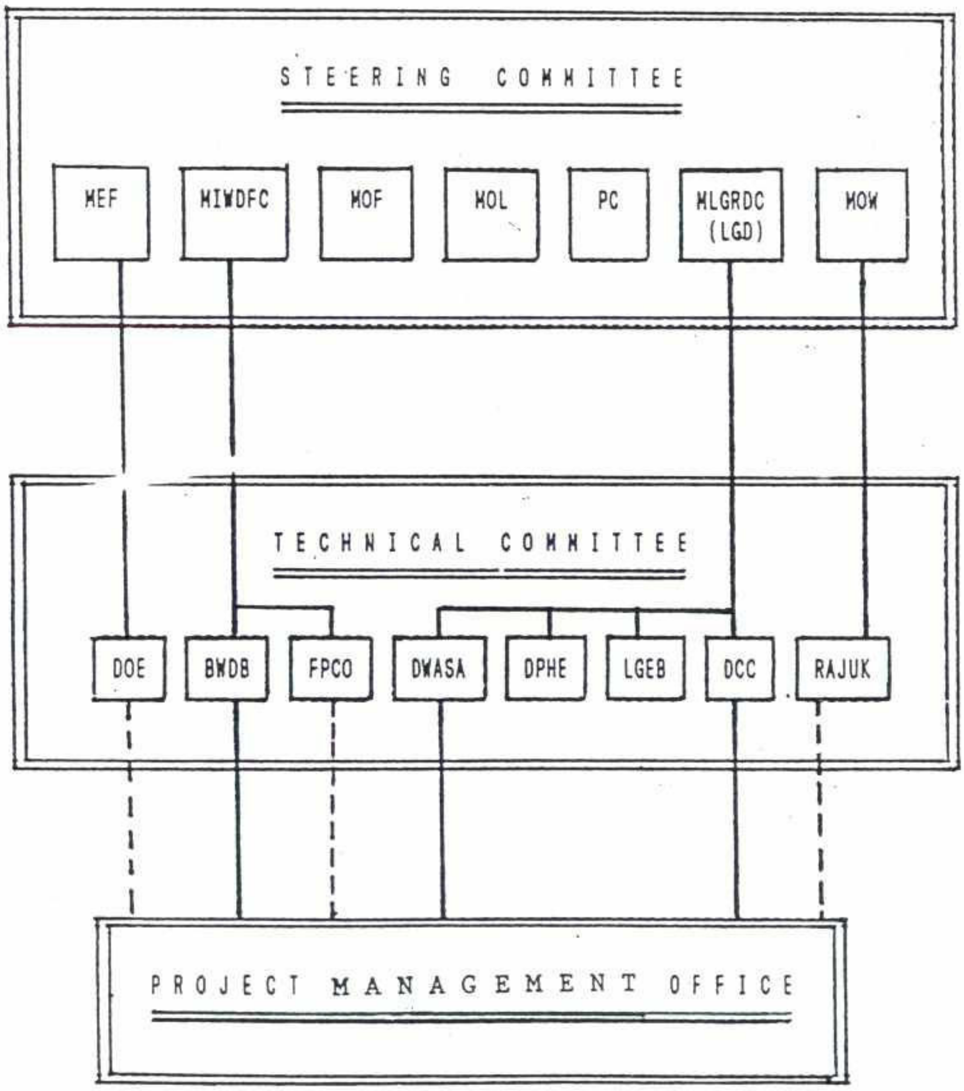
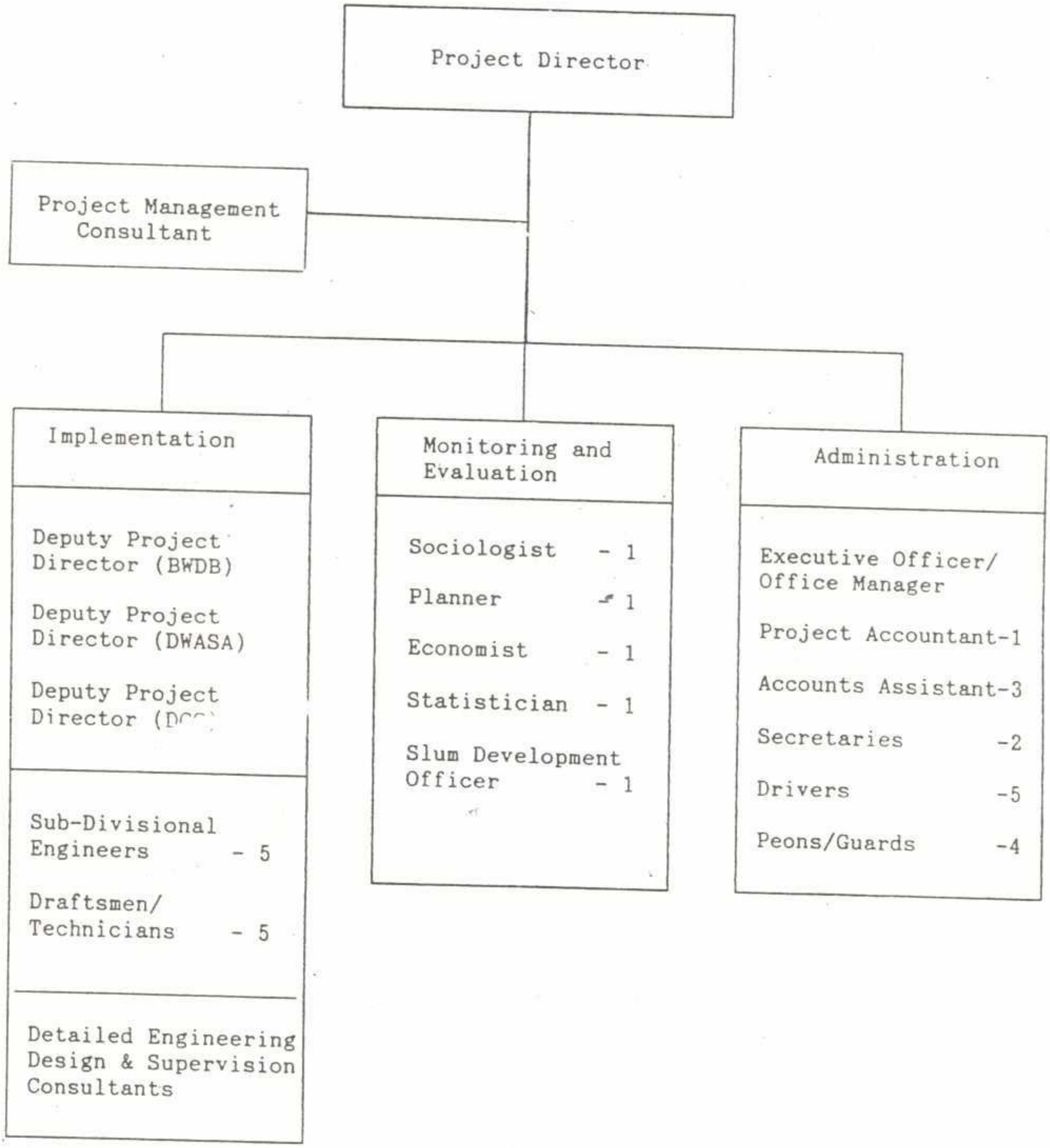


Figure 5.2

Structure and Staffing of the
Project Management Office



60

Table 5.1

Functions and Responsibilities of Involved Agencies

A. **Steering Committee**

o Guidance on policies regarding the overall implementation of the Flood Protection Program for Dhaka Metropolitan Area, including parallel donor assisted programs and interlinkages with the FAP activities.

o Review and approval of the recommendations of the Technical Committee.

o Periodic (quarterly) review of Project progress, including review of progress on implementation of the Action Plan (particularly financial matters and cost recovery aspects), and providing instructions to the Technical Committee.

o Resolution of issues, particularly interdepartmental coordination.

o Assessing and removing various obstacles and complexities for expediting implementation of the Flood Control Program.

B. Technical Committee

o Project implementation c ordination and issuance of administrative decisions at the operational/interdepartmental level to ensure and facilitate Project implementation in accordance with the plan, including recommendations for annual budgeting, release of funds and deployment of staff.

o Consideration and approval of terms of reference and short lists of consultants/firms, and recommending for appointment of consultants/firms to the Steering Committee.

o Necessary works related to the processing of reports and investment projects, particularly including examination and clearance of PCP/PPP/TAPP/PP before referring to the Planning Commission.

o Regular review of Project implementation including the Action Plan and loan covenants, resolution of problems and issues and preparation of briefing papers for the Steering Committee.

o Coordination with donor agencies through ERD for implementation of the Project.

C. Flood Plan Coordination Organization (FPCO)

o Provide support directly to the MIWDFC in the planning, project preparation, monitoring and evaluation of the Project. Provide interministerial coordination, at the technical and operational level. Responsibilities would include:

o Technical guidance on design parameters, standards and specifications and coordination with other FAP activities, including review and recommendations for acceptance of reports and recommendations.

o Acting as executing agen y for the planning and preparation of the Project.

o Plan coordination, monitoring and evaluation during implementation of the Project.

o Liaison, coordi , monitoring, evaluation and feedback during post implementation operations and maintenance period.

D. Ministry of Irrigation, Water Development and Flood Control (MIWDFC)

o Administrative support for Project implementation, including convening of Steering Committee and Technical Committee Meetings, and coordination with the Ministry of Finance and the Planning Commission regarding budgetary allocations and other aspects.

68

E. Bangladesh Water Development Board (BWDB)

- Principal Executing Agency for the overall technical supervision of the Project and execution of Parts A and D, including tendering, award and supervision of contracts, payment to contractors, supervision and quality control of construction works under Part A.
- Principal Executing Agency for O&M, PBME and reporting activities regarding Part A of the Project.
- Super... ... support of work of PMO, including coordination with other Implementing and supporting agencies and interaction with the Bank Missions.

F. Project Management Office (PMO)

- Overall Project management and day-to-day coordination with the Project Executing/Implementing Agencies.
- Programming, financial planning, detailed engineering design (including various engineering surveys), contract packaging, participation in the tendering and award process of the Executing/Implementing Agencies, top-level supervision of construction works to ensure strict quality control, laboratory testing, standardization of O&M procedures and methods, design, coordination and monitoring of PBME progress, conducting benchmark and periodic socio-economic surveys, and developing community/NGO participation and public information campaigns.
- Recruitment and management of all consultancy services for detailed engineering design, construction supervision and Project Management.
- Operational coordination with parallel donor assisted and other government programs having impact on the Project.
- Preparation of working papers for Technical Committee and Steering Committee meetings and for MIWDFC/BWDB, as appropriate, to resolve Project-related issues and problems and to facilitate Project implementati...
- Preparation of periodic progress reports, reimbursement applications, operations of the Imprest Account... ... general interaction with the Bank Missions.
- Follow-up on compliance of loan covenants and implementation of the Action Plan, including inter-agency meetings and coordination to ensure that target dates are maintained.

G. Dhaka Water and Sewerage Authority (DWASA) for Part B, and Dhaka City Corporation (DCC) for Part C

- Executing agencies for implementing the relevant Project components, including tendering, contract award, supervision and quality control of construction works as well as payments to contractors.
- Carry out O&M, PBME and reporting activities.
- Implement agreed upon Action Plan, including financial management and cost recovery measures.

A separate Project Management Office (PMO) headed by a Project Director at a senior Superintending Engineer level will be set up by BWDB, as shown on Figure 5.2. The PMO, which will incorporate all consultancy services under the Project, will be involved in coordination and management of Project facilities, programming, financial planning, detailed engineering design, tendering and construction supervision, design and implementation of PBME activities, socioeconomic and engineering surveys, community/NGO participation, and public information campaigns.

The PMO will be staffed by full time representatives from the Project implementing agencies (as well as part time representatives from DOE and RAJUK). It include Deputy Project Directors from BWDB, DCC and DWASA, at Executive Engineer level, who will be responsible for liaison with their respective agencies. The PMO will have engineering, administration and finance, and community development sections, and the staffing will include seconded staff from respective agencies as well as new staff recruitment. The PMO will be established and the Project Director, Deputy Project Directors, Project Accountant and the Executive Officer appointed prior to the effective date of the loan. Deployment of all the remaining PMO staff will be completed within six months of loan effectivity.

The PMO will maintain records of the progress of all Project activities and be responsible for ensuring timely Project implementation. The Government will ensure timely and adequate staffing in number and experience in PMO and in the implementing agencies throughout Project implementation. To facilitate a smooth implementation of various Project activities, the roles and functions of the Steering and Technical Committees, the PMO and the implementing agencies have been agreed and are provided in Table 5.1. It is planned that effective coordination mechanism would continue during the post-completion period.

5.2 Project Implementation Schedule

The recommended Project is planned to be implemented over a period of five years from December 1991 to December 1996, as shown in Figure 5.3.

The first years work plan involves considerable preparatory activities in most project components that begin in September/October 1991. These will be followed by initial construction activities in February/March 1992. The quick start for many project activities is facilitated by the fact that many of the activities in both the flood protection and drainage components involve modifications and improvements on existing infrastructure. The details of this first years work plan are shown in Figure 5.4.

For the remainder of the Project period, the work program will follow an annual cyclical pattern, with the surveys, investigations, designs, preparation of tender documents, tendering, and award of contracts being scheduled during the dry season, so that contractors can mobilize at the beginning of each construction season and complete the work program in the scheduled year.

Figure 5.3

IMPLEMENTATION SCHEDULE

	Activity Item	
	Fiscal Year: (1991/92) (1992/93) (1993/94) (1994/95) (1995/96)	
	Calendar Year: 1991 1992 1993 1994 1995 1996	
	Cal. Quarter: 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4	
Project Preparation	Establish Project Management Office	
	Mobilise counterpart staff	
	Select & mobilise Project consultants	
PART A Flood Protection	Intensive remedial works	Rate of construction determine by geotechnical factors
	Remedial works	
	Minor remedial works	
	Slope (wave) protection	
	Flood wall stabilisation	
	New flood wall/embankment	
	Sluices	
	Central Road Improvements	
	Pump Station No. 3 & Goranchatbari	
	Incremental maintenance	Mtce. continues beyond Project completion
PART B Drainage	Khal rehabilitation	
	Pipe drain construction	
	Secondary & tertiary drains	Completion of GOB Crash Program
	Incremental maintenance	Mtce. continues beyond Project completion
PART C Environmental Improvement Program	Slum & Squatter Area Improvement	
	Solid Waste Management	
	Sanitation, Water Supply, & Local Drainage	
	Incremental maintenance	Mtce. continues beyond Project completion

Project Milestones: Project Appraisal; Loan Effectiveness; Drainage Completion; Flood Protection Completion; Environmental Program & Project Completion

Legend: Preparatory activities (surveys, investigations, designs, tenders); Construction/concentrated activity

Notes:

64

Figure 5.4

IMPLEMENTATION SCHEDULE: YEAR 1 WORK PLAN

Activity				Principal Concerned Agencies
Project Preparation	Project Appraisal			All Agencies/ADB
	Establish Project Management Office			BWDB/DWASA/DCC
	Procure equipment & vehicles for PMO			Cons./BWDB
	Mobilise PMO			BWDB/DWASA/DCC
	Select Consultants			
	Mobilise consultants			
PART A Flood Protection	West Embkt.	Intensive Remedial Works (IRS)	Survey & sub-soil investigation	Cons./BWDB
			Finalise design concept	Cons./BWDB
			[illegible] design	BWDB/Cons.
			Prequalification of contractors	BWDB/ADB
			Tender preparation & Invitation	Cons./BWDB/ADB
		Minor Remedial Works	Detailed design	BWDB/Cons.
			Tender & contract preparation	BWDB/Cons.
			Construction	BWDB/Cons.
	Flood Wall	Existing Wall	Field Inspection/investigation	Cons./BWDB
			Outline design of remedial works	Cons.
			Detailed design of remedial works	BWDB/Cons.
			Tender & contract preparation	BWDB/Cons.
			Construction	BWDB/Cons.
		New Wall	Survey & sub-soil investigation	Cons./BWDB
			Outline design	Cons.
			Detailed design	BWDB/Cons.
	Slope (Wave) Protection	Detailed design		Cons./BWDB
		Tender & contract preparation		BWDB/Cons.
		Construction		BWDB/Cons.
	[illegible]ces	Detailed design		BWDB/Cons.
		Tender & contract preparation		BWDB/Cons.
		Construction		BWDB/Cons.
	[illegible]tral [illegible]ad	Complete topographical survey		RAJUK/Cons.
		Detailed design of [illegible]ement works		Cons.
		Tend[illegible] preparation		RAJUK/Cons.
		Construction		Cons./RAJUK
	Mtce. Program	Prepare earthworks O&M manual		Cons./BWDB
		Investigation & design for Year 2 maintenance		BWDB/Cons.
PART B Drainage	Khal Rehab.	Detailed design of rehabilitation works		Cons./DWASA
		Tender & contract preparation		DWASA/Cons.
		Construction		DWASA/Cons.
	Pipe Drains	Detailed design of pipe drains		Cons./DWASA
		Tender & contract preparation		DWASA/Cons.
		Construction		DWASA/Cons.
	Sec. & Tertiary Drains	Detailed design of secondary & tertiary drains		Cons./DWASA
		Tender & contract preparation		DWASA/Cons.
		Construction		DWASA/Cons.
PART C Environ-mental Program	Procure program equipment			DCC/Cons.
	Slum & squatter improvement program			DCC/Cons.
	Solid waste management program			DCC/Cons.
	Sanitation, water supply, & local drainage			DCC/Cons.

Legend: Preparation/administration activity; Construction activity

Notes

Specific provision has been included to allow essential preparation activities for the first year program to begin soon after appraisal. It is planned that advance action will be undertaken for procurement of goods and services, including recruitment of consultants. This will include, among other things, procurement for completion of field surveys and subsoil investigations, preparation of detailed engineering designs for the first year components for flood control and drainage, preparation of tender documents, prequalification of contractors, and tendering and award for urgent contracts of flood control and drainage (Part A and B) that need to utilize the dry season of FY 1991-1992. Early recruitment of bridging engineering consultants for completion of the first years program of design and tendering will be essential for the success of the proposed schedule.

In view of the urgency of the flood protection and drainage works and to utilize the coming dry season for construction works, it is recommended that the Government request the Bank to provide retroactive financing under the loan, in an amount tentatively estimated at $5.0 million and covering: (i) engagement of consultants for Project preparation for the interim period (October 1991 to April 1992) including detailed engineering, sub-soil investigations, topographic surveys, prequalification of contractors, tendering and evaluation ($0.9 million); (ii) minor remedial works on existing embankments/flood walls, slope (wave) protection and sluices ($1.0 million); (iii) drainage works, involving urgent cleaning of secondary and tertiary drains and installation of priority drainage piping ($2.6 million); and (iv) Project management support for the PMO ($0.5 million).

5.3 Consultant Services

As described in Appendix 6, it is estimated that 350 man-months of consulting services (314 mm domestic, 36 mm international) will be required for the detailed engineering design and construction supervision of flood protection and drainage works (Parts A and B), . These consultants will be recruited under one package to supplement the in-house inputs by BWDB and DWASA. The lead consultants will be domestic who will be required to associate with international consultants to supplement inputs for geotechnical, civil/hydraulic and electrical/mechanical engineering aspects for works related to the embankment and the pump house in Part A. Consulting package(s) for detailed engineering design and construction supervision of Part C (slum improvement, sanitation, solid waste management, water supply and local drainage) will involve purely domestic inputs of about 100 man-months. For consulting services related to Project management, involving 312 mm of inputs (252 mm domestic, 60 mm international), the lead international firm will be required to associate with local firms.

To ensure that the Project preparation continues uninterrupted following completion of the project-preparatory technical assistance, it is proposed that the Government engage the ADB TA consultants to continue the work under the proposed loan for the interim period from 15 October 1991 to 30 April 1992 (6.5 months) before the recruitment process for the loan consultants is completed. The services to be provided during this bridging period will be a combination of Project Management advisory services, and of detailed engineering design and supervision for the priority first year construction work program. It is estimated that the bridging engineering services will include some 63.0 man-months of consulting services (13.0 mm international and 50.0 mm domestic), and will include about eighty percent of the required subsoil investigations, as described in Appendix 14. The cost of these services will be deducted from the original costs estimated for consulting services, and will not result in any overall increase.

Consultants will be engaged in accordance with the Bank's Guidelines on the Use of Consultants in accordance with the agreed schedule, as shown on Figure 5.5. For purely domestic consultancy contracts, standard Government procedures acceptable to the Bank will be followed.

Figure 5.5

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CONSULTANTS RECRUITMENT SCHEDULE

	Consulting Services	1991 S	1991 O	1991 N	1991 D	1992 J	1992 F	1992 M	1992 A	1992 M
1.	Project Management (International 60 mm, Domestic 252 mm)	S.L.	I.I.		S.P.	E.P.		C.N.	F.	
2.	Detailed Engineering Design & Construction Supervision									
2-1	Part A (Flood Protection) & Part B (Drainage) (Domestic 314 mm, International 36 mm)		S.L.	I.I.	S.P	E.P	C.N.		F.	
2-2	Part C (Environmental Improvement) (Domestic 100 mm)		S.L.	I.I.	S.P	E.P	C.N.		F.	
3.	Bridging Services (Project Management) 1) (International 13 mm, Domestic 50 mm)	(Current Contract)								
		2) C	N F							

S.L. Short Listing

I.I. Issuance of Invitation

S.P. Submission of Proposal

E.P. Evaluation of Proposal

C.N. Contract Negotiations

F. Fielding

0 Bank's Approval

1) TA Consultants currently in the field (up to October 1991) will be retained for bridging services.

2) Request of direct appointment.

5.4 Procurement

Procurement of goods and services for the Project will be carried out in accordance with the Bank's Guidelines on Procurement in line with the components under their respective financing. Table 5.2 lists tentative procurement packaging, which has been discussed and generally agreed with the implementing agencies.

All major civil works contracts, including embankment remedial works, the pump station and the flood wall under Part A, will be undertaken through International Competitive Bidding (ICB) procedures. Other civil works contracts are expected to be small in size and will require the use of local materials and techniques, and thus would not be attractive to foreign bidders. Such works are planned to be awarded under Local Competitive Bidding (LCB) procedures acceptable to the Bank.

Solid waste collection trucks and associated containers under Part C will be procured following ICB procedures. The remaining equipment, such as vehicles, waste collection hand carts and office equipment, will be small in size and would be procured locally under LCB/direct purchase procedures.

5.5 Disbursement

It is planned that Special (Imprest) Account(s) will be established in Bangladesh Bank to ensure the timely release of the Loan proceeds for the purpose of making payments in local currency for Project implementation. These account(s) shall be denominated in U.S. dollars, and shall be operated and maintained in accordance with the Bank's Guidelines on Imprest Funds and Statement of Expenditure Procedures.

5.6 Land Acquisition and Resettlement

In Western Dhaka, much of the land required for flood protection has already been purchased for the construction of the current embankment. Despite this, it is foreseen that some new land will need to be acquired to allow the construction or expansion of flood control embankments and walls, pumping stations, sluices, and other project infrastructure. In some cases, this will involve the resettlement of resident populations, particularly slum dwellers. Funds for land acquisition and resettlement will be provided as part of the Government's contribution to the project.

Ongoing donor assisted projects with DCC/DWASA have been substantially delayed due to difficulties in land acquisition and inadequate budgetary provisions. A detailed operational plan for land acquisition (see Table 5.3) and resettlement of the affected population, and alternative recommendations for land control measures, are being developed. It will be essential to acquire the needed land prior to planned implementation in order to minimize risks associated with project implementation.

Table 5.2

PROCUREMENT PACKAGING

PART A - FLOOD PROTECTION

CIVIL WORKS	Total Base Cost	Type of Contract ICB	IS	LCB	
Intensive remedial works (class 1)	318.82	X			Possible Multiple Contracts
Moderate remedial works (class 2)	91.71	X			
Minor remedial works/borrow pit backfill	36.40			X	
Minor remedial works - Jute & Sod prot.	13.25			X	
Slope protection (conc. block)	196.84			X	
Sluices	40.00			X	
New Floodwall/embankment	302.04	X		X	Multiple contracts
Remediation of existing floodwall	91.44			X	
Central road raising	21.81			X	
Central rd. flood proofing (13 location)	52.13			X	
Pump Station No. 3 - Goran Chatbari	400.00	X			
Functional buildings	10.00			X	
Sub-total:	1574.44	1052.57 (67%)		521.87 (33%)	

Note: Equipment and materials required for flood protection construction to be procured through civil works contracts.

PART - B DRAINAGE

CIVIL WORKS	Total Base Cost	Type of Contract ICB	IS	LCB	
Main Khal rehabilitation & upgrading	311.16			X	Multiple contracts
Second year Khal rehab. & upgrading	201.31			X	Multiple contracts
Third year Khal rehab. & upgrading	175.80			X	Multiple contracts
Pipe drain rehab. & construction	391.58			X	Multiple contracts
Sub-total:	1079.85			1079.85 (100%)	

Note: Equipment and materials required for drainage construction to be procured through civil works contracts.

92

PART - C ENVIRONMENTAL IMPROVEMENT PROGRAM

CIVIL WORKS	Total Base Cost	Type of Contract ICB	IS	LCB	
Slum/Squatter Area Improvement	61.90			X	Multiple Contracts
Solid Waste Management	8.50			X	Multiple Contracts
Sanitation,Water Supply & Local Drainage	135.61			X	Multiple Contracts
EQUIPMENT					
Solid Waste Trucks	72.00	X			Phased Contracts
Solid Waste Containers	24.00			X	Phased Contracts
Motor Cycles	1.60			X	
Borrows	10.00			X	
Portable Toilets	1.80		X		
Drain Gulley Sweeper	7.60		X		
Desludging Trucks	4.40		X		
Others	7.65			X	
	330.06	72.00 (22%)	8.80 (3%)	249.26 (76%)	

PART - D IMPLEMENTATION ASSISTANCE

CIVIL WORKS	Total Base Cost	Type of Contract ICB	IS	LCB
EQUIPMENT				
Computers/Printers/Voltage Stabilizers	0.55			X
Typewriters	0.15			X
Photocopiers	0.36			X
Calculators	0.18			X
Furnishings, A.C.s.	0.73			X
Car/Jeep/Minibus	7.30		X	
Motorcycles	0.80			X
Laboratory Equipment	5.00		X	
	15.07	- (0)	12.30 (82%)	2.77 (18%)
Total :	2999.42	1124.57 (37.5%	21.10 0.7%	1853.75 61.8%

26

Table 5.3

SCHEDULE OF LAND ACQUISITION

Part A. Flood Protection

FY 1991/92.

		Area (ha).	Cost (Tk. Mil.)
1.	Borrow area for stage 2 & finishing	11.9	17.85
2.	Sluices, Pump Station & Diversion Channels	30.0	45.00
3.	Floodwall & Embankment	17.0	19.55
	Total :	58.9	82.40

Part B. Drainage

FY 1991/92.

	Khal	Area (ha)	Cost (Tk. Mil)	Implementation	Legal Process
1.	Ibrahimpur	1.99	7.38	1991/92	requested
2.	Mohakhali (Part I)	2.97	14.68	-do-	approved
3.	Begunbari (Mirpur Rd.-Green Rd.)	0.22	1.10	-do-	surveyed
4.	Segunbagicha Arambag	3.25	32.08	60% - 1991/92 40% - 1992/93	requested 60% approved
5.	Gerani.	2.30	11.34	1992/93	approved
	Total :	10.23	66.58		

FY 1992/93

	Khal	Area (ha)	Cost (Tk. Mil)	Implementation	Legal Process
1.	Khilgaon - Basabo	4.26	21.02	1992/93	requested
2.	Katasur	1.94	7.20	-do-	surveyed
3.	Ramchandrapur	4.86	12.00	-do-	-do-
4.	Begunbari (Airport Rd. Rly Culvert)	0.30	1.88	-do-	requested
5.	Banani - Gulshan	8.32	20.54	-do-	-do-
6.	Begunbari (Tongi Divn-Badda)	10.42	38.60	1993/94	approved
	Total :	30.10	101.24		

FY 1993/94

	Khal	Area (ha)	Cost (Tk. Mil)	Implementation	Legal Process
1.	Mukda	3.56	17.60	1993/94	surveyed
2.	Kallyanpur (branch)	3.10	11.49	-do-	-do-
3.	Digun	9.72	18.00	-do-	-do-
4.	Banani	8.10	15.00	-do-	-do-
5.	Diabari	6.07	11.25	-do-	-do-
6.	Abdullapur	4.05	5.00	-do-	-do-
7.	Ibrahimpur (Part II)	2.43	7.20	-do-	-do-
	Total :	37.03	85.54		
	Grand Total :	77.36	253.36		

Part A & B

	Area (ha)	Cost (Tk. Mil)
1991/92	69.13	148.98
1992/93	30.10	101.24
1993/94	37.03	85.54
Total:	136.26	335.76

Table 5.4

INCREMENTAL STAFFING REQUIREMENTS

1. Based on an assessment of the existing staff within the implementing agencies, it was agreed that no additional staff would be required for DCC. For BWDB, the additional staff requirement relates only to the incremental O&M needs. For DWASA, additional staff is needed for both capital works as well as for incremental O&M needs. The incremental staffing needs that have been incorporated in the Project are outlined below:

I. DWASA

a) Capital Works:

o Sub-Divisional Engineers	:	3
o Sub-Assistant Engineers	:	5
o Work Assistants	:	10
o Accountant	:	1
o Accounts Assistant	:	3
o Steno Typists	:	2
o Computer Operator	:	1
o Driver	:	1
o Support Staff/Messengers	:	4

b) Operations and Maintenance:

During the Project period the above personnel will assume increasing responsibility for the operations and maintenance as the needs grow, and upon completion of the capital works program will form the operations and maintenance cell of DWASA. Three permanent maintenance crews will be recruited during Project years 2, 3 and 4 (one each year) to perform timely routine maintenance works and to supplement the above staff as follows:

o Drivers	:	1 per crew
o Pump Operators	:	1 per crew
o Skilled Laborers	:	2 per crew
o Semi Skilled Laborers	:	2 per crew

II. BWDB:

a) Operations and Maintenance:

Similar to the above, three permanent maintenance crews will be developed during the Project period to assume responsibility for regular inspection and timely performance of minor repairs, as follow:

o Sub-Assistant Engineers	:	1 per crew
o Work Assistants	:	1 per crew
o Drivers	:	1 per crew
o Pump Operators	:	1 per crew
o Skilled Laborers	:	2 per crew
o Semi Skilled Laborers	:	2 per crew

26

5.7 Operations and Maintenance

Responsibility for operations and maintenance activities is divided between the implementing agencies along the same lines as project activities. BWDB would be responsible for the flood protection infrastructure, DWASA for the major drainage works, and DCC for some of the solid waste, sanitation, local drainage, and water infrastructure. In the case of some of the activities under the Environmental Improvement program, particularly the slum improvement components, O&M will be the responsibility of the beneficiaries and not DCC.

Guidelines for handling specific O&M activities still need to be defined by the institutions involved. The Project design gives considerable attention to O&M issues, including: streamlining institutional responsibilities, strengthening the role of DCC, and developing O&M guidelines and procedures during the implementation period. Provision has been made in the Project for providing incremental staff increases for DWASA and BWDB, as detailed in Table 5.4 on the preceding page, focused on building up inspection and routine O&M capabilities during the Project period. Similarly, basic equipment for routine O&M operations has been included in Parts A and B of the Project.

As was discussed in Section 4.7, the Government will need to earmark adequate resources for O&M needs. Mechanisms for raising these funds are discussed in the section on cost recovery in Chapter 6.

5.8 Reports, Accounting and Audits

Regular progress reports will be prepared for the individual Project components and submitted by the PMO to the Bank and the Government agencies concerned on a quarterly basis. The progress reports will be in such form and detail as the Bank may request, including information on the physical and financial progress of works and the status of other related organizational and financial issues. Within three months of physical completion of the Project, a Project Completion Report will be prepared and submitted to the Bank by the PMO.

It is planned that the budgets for the implementing agencies will be managed by the PMO. While separate accounts will be maintained by the Implementing Agencies for the respective Project components, the record keeping will be centralized at PMO. The PMO will submit to the Bank consolidated unaudited Project accounts within six months of the close of each financial year, and audited Project accounts, by auditors acceptable to the Bank, within nine months of the close of each financial year. All reports will be prepared and submitted in English.

5.9 Community and NGO Participation

Community and NGO participation is an important feature of the Project design and implementation, particularly in relation to information programs, PBME activities, O&M, and implementation of environmental improvement programs (e.g. sanitation, slum area improvement). It is recommended that the PMO have a community development cell together with adequate allocations for community information campaigns and related costs. To enhance the beneficial impact of the Project, the PMO, in association with the implementing agencies will develop a coordinated public information/public education campaign. The campaign, which will be sustained over the implementation period of the Project, would focus on the proper use of the facilities provided and on encouraging active community participation (including payment of fees and charges as well as assistance in the mainten nce of public facilities) in the implementation of the integrated flood protection scheme. It is planned that part of the retroactive financing support for PMO will be utilized for early community information campaigns, beginning in October 1991. Possibilities of appropriate NGO involvement with the carrying out of this campaign will also be considered.

5.10 Institutional Support Measures

Considerable institutional strengthening of the involved agencies will be required, particularly directed towards improved financial management by DCC and DWASA. As described in Section 5.3, provision is included in the Project for consulting services support at the PMO; other institutional strengthening aspects are discussed in the following.

Much of the needed institutional strengthening is underway, for which training and staff development programs, additional staff recruitment, and international/domestic consultancy support is being provided under ongoing and planned UNDP/UNCHS/World Bank programs. DWASA is in the process of improving its billing and accounts receivable control through computerization. DCC will soon have an advisory support, through the UNDP Project, which is aimed at improved revenue generation, budgeting, accounting and general financial control. The success of these financial management undertakings at both DWASA and DCC will also improve the overall financial capacity of these two executing agencies. In view of this ongoing assistance, the Project does not include any additional consultancy services for institutional strengthening so as to avoid duplication of efforts. However, this matter will be closely monitored by the Project during implementation and the Government will ensure that the various reports of these consultants are provided to the Bank, and Bank comments are given due consideration.

The Government has also made a request for provision of an advisory technical assistance in conjunction with the loan for land development controls and procedures for Dhaka. Following major investments in flood protection and drainage, considerable low-lying area will become suitable for intensive urban use, with manifold increases in land values. It is important that the public sector should be able to capture part of the increases in land values, and that effective land use controls be developed. Coordination is required among the Ministries of Finance, Planning, and Land, RAJUK and the Dhaka City Corporation to develop appropriate policies to address matters relating to land development/ transfer taxes, zoning, and development and land use controls, together with appropriate legislative cover. This TA activity is outlined in detail in Chapter 11 and in Appendix 12.

5.11 Mid-Term Review

As the Project is relatively complex and will be implemented in the context of the Integrated Environmental Management Plan (IEMP) and a longer term program for comprehensive flood protection of Dhaka and urban land development scheme, it is planned to carry out a mid-term review of the Project. This would enable the Government and the Bank to make appropriate adjustments of the design to ensure the successful outcome of the Project.

5.12 Project Benefit Monitoring and Evaluation

Within six months of the loan effectiveness, the PMO will develop a comprehensive PBME system with assistance from the Project management consultants. The project benefit monitoring and evaluation (PBME) activities will be coordinated by the PMO with the active involvement of the DOE. The actual carrying out of PBME activities, including the establishment of bench marks, data collection, and analyses will be the responsibility of the respective implementing agencies.

It is planned that the PBME system will become part of the Management Information Systems (MIS) of the implementing agencies. Among other things, it will involve continuous monitoring of the environmental and socio-economic indicators, including monitoring of the Project design/EIA, involving a review of the measures incorporated to maximize positive Project impacts and the mitigating measures being undertaken to minimize the adverse effects. PBME indicators recommended to be included in the monitoring program are described in Appendix 13.

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6.0 FINANCING PLAN

This chapter provides the financing plan for the recommended Project, or Phase 1 of the overall flood protection plan for Dhaka City. The complete flood protection and drainage program as a whole is expected to be implemented over a 10 to 15 year period and the financing for further stages will be arranged at a later date.

6.1 Summary of Project Costs

The cost of the recommended Project is estimated at $121.22 million equivalent, including a direct and indirect foreign exchange cost component of $38.95 million (32.1%) and a local currency cost of $82.27 million. The cost summary is shown in Table 6.1 and detailed cost estimates are given in Appendix 5.

The above total includes physical and price contingencies, as well as interest during construction. Physical contingencies account for $9.39 million, with most items (except land acquisition) calculated at 10%, and with 15% for consultants and project administrative support. Price contingencies are estimated at $8.72 million based on a 6.0% rate for local costs and a 4.9% rate for foreign costs up to 1994 (3.7% after that). The service charge on the Bank loan accounts for a further $3.2 million.

Out of a total cost of $118.02 (excluding interest during construction), $98.5 million is split between the Flood Protection and Drainage portions of the Project. Another $12.6 million corresponds to the Environmental Improvement components, and $6.8 million for implementation assistance (See Table 6.2).

A total of approximately $92.5 million, or 76.3% of Project costs, are eligible for Bank financing. The central government and local agencies will be responsible for the remaining $28.72 million, or 23.7% of Project costs.

6.2 Loan Agreement

The proposed Bank loan is for $92.5 million, if approved by the Bank's Management and agreed to by all parties. The Bank loan is proposed to have a term of 40 years, including a grace period of 10 years and a service charge of 1% per annum.

The Bank loan will finance: (i) the entire foreign exchange cost, including the service charge on the Bank loan estimated at $3.2 million; (ii) all local currency costs relating to civil works, equipment and materials, excluding duties and taxes; (iii) all Project engineering and management costs (including all consulting services); and, (iv) an average of 50% of incremental staff and O&M costs on a declining basis.

22

TABLE - 6.1

Summary of Project Costs
($ million) [1]

		Foreign	Local[2]	Total
1.	Base Costs [3]			
	Land	-	9.02	9.02
	Materials and Equipment [4]	9.11	12.38	21.49
	Civil Works	18.33	40.85	59.18
	Incremental Staff/O&M	1.09	3.19	4.29
	Project Management	0.21	1.36	1.58
	Consulting Services	1.43	2.94	4.37
	Subtotal-Base Costs	30.17	69.74	99.91
2.	Contingencies			
	Physical [5]	3.10	6.29	9.39
	Price [6]	2.48	6.24	8.71
	Subtotal	5.58	12.53	18.11
3.	Interest During Construction			
	Service charge on Bank loan	3.20	-	3.20
	Subtotal	3.20	-	3.20
	TOTAL	38.95	82.27	121.22

[1] At Taka 37.25 = 1 US$
[2] The local cost includes an estimated $16.57 Million in duties and taxes.
[3] Base Costs are at June 1991 Prices
[4] Includes O&M equipment and vehicles.
[5] 10 percent for various items of civil works and materials and equipment; and 15 percent for consultants and project administration support. No physical contingencies allowed for land acquisition.
[6] Price escalation includes (a) for foreign costs, 4.9 percent per annum during 1992-1994 and 3.7 percent per annum thereafter; and (b) for local costs, 6 percent per annum throughout.

TABLE 6.2

FINANCING PLAN
SOURCES AND ALLOCATION OF FUNDS BY AGENCY AND COMPONENT

US $ MILLION

PROJECT COMPONENT	TOTAL COST TO BE FINANCED	EXTERNAL FINANCING -ADB TOTAL	NATIONAL BUDGET ALLOC.	SUB-LOAN	BANGLADESH GOVT.FINANCING NATIONAL BUDGET ALLOC.	DHAKA WASA	DCC	TOTAL FINANCING SOURCES
PART A: FLOOD PROTECTION	55.8	40.1	40.1	0.0	15.7			55.8
PART B. DRAINAGE	42.7	32.7	31.1	1.6	9.2	0.8		42.7
PART C: ENVIRONMENTAL IMPROVEMENT :								
- Slum Improvement	2.4	2.2	1.5	0.7	0.2		0.0	2.4
- Solid Waste	5.1	3.2	2.3	1.0	1.4		0.4	5.1
- Sanitation,Water - Supply & Drain.	5.1	4.5	3.1	1.3	0.4		0.3	5.1
PART D: IMPLEMENTATION ASSISTANCE	6.8	6.6	6.6	0.0	0.2			6.8
GRAND TOTAL	118.0	89.4	84.7	4.6	27.1	0.8	0.7	118.0

Exchange rate: US$ 1 = Taka 37.25

Above figures do not include interest during construction of $3.20 million on the Bank Loan.

202

TABLE 6.2

FINANCING PLAN
SOURCES AND ALLOCATION OF FUNDS BY AGENCY AND COMPONENT

US $ MILLION

PROJECT COMPONENT	TOTAL COST TO BE FINANCED	EXTERNAL FINANCING -ADB			BANGLADESH GOVT.FINANCING			TOTAL FINANCING SOURCES
		TOTAL	NATIONAL BUDGET ALLOC.	SUB-LOAN	NATIONAL BUDGET ALLOC.	DHAKA WASA	DCC	
PART A: FLOOD PROTECTION	55.8	40.1	40.1	0.0	15.7			55.8
PART B: DRAINAGE	42.7	32.7	31.1	1.6	9.2	0.8		42.7
PART C: ENVIRONMENTAL IMPROVEMENT :								
- Slum Improvement	2.4	2.2	1.5	0.7	0.2		0.0	2.4
- Solid Waste	5.1	3.2	2.3	1.0	1.4		0.4	5.1
- Sanitation,Water - Supply & Drain.	5.1	4.5	3.1	1.3	0.4		0.3	5.1
PART D: IMPLEMENTATION ASSISTANCE	6.8	6.6	6.6	0.0	0.2			6.8
GRAND TOTAL	118.0	89.4	84.7	4.6	27.1	0.8	0.7	118.0

Exchange rate: US$ 1 = Taka 37.25

Above figures do not include interest during construction of $3.20 million on the Bank Loan.

The Government of Bangladesh, DCC and DWASA will meet the balance of the costs of $28.72 million not covered under the Bank loan, including $9.02 million for land acquisition, $16.57 million for duties and taxes, $2.77 million for incremental operation and maintenance costs. The allocation of Bank and Government funding for various Project components is shown in the preceding Table 6.2. Proposed funding arrangements are shown below in Table 6.3.

TABLE - 6.3

Proposed Project Funding Arrangements
($ million)

	Foreign Exchange	Local Currency	Total
External Sources			
Bank Financing	38.95	53.55	92.50
Domestic Sources			
Central Government	-	27.18	27.18
DCC	-	0.74	0.74
DWASA	-	0.80	0.80
Total	38.95	82.27	121.22

6.3 Agency Fund Requirements

The Environmental Improvement Program (Part C) is estimated to cost $12.6 million, of which most will be expended by the DCC. Of this amount, the DCC will need to provide $0.7 million to cover direct costs. The DCC will also be receiving external financing that will be channelled through the central government.

It is planned that the funds to be provided to DCC will be on-lent on the basis of a mix of 70% grants and 30% loans. The loan portion is planned to carry an interest rate of 12.5% per annum and be repayable over a period of 20 years, including a grace period of 5 years. The grant:loan mix has been determined at Apprais l based on the nature of Project components, potential for cost recovery, financial position and affordability and considerations of basic needs/poverty alleviation.

206

DWASA will be primarily responsible for the Drainage portion (Part B) of the Project, which is estimated to cost $42.7 million. Of this amount, $0.8 million is to come out of agency funds. The remainder will come from the national budget ($4.3 million) and from external financing ($37.6 million).

The current financing plan is based on 95% grant financing for DWASA on the basis that the provision of improved drainage facilities is a public good and that no direct cost recovery for capital investments in drainage currently exists. However, to increase the efficiency of DWASA operations a small amount of the capital cost of drainage (5%) will be provided to DWASA on loan terms similar to those for DCC, to serve as a pilot scheme for this type of service. It has been proposed that DWASA would recover the enhanced costs of operations and maintenance through the imposition of a new drainage charge in conjunction with their existing system of charging for water supply and sewerage, as discussed in the section on Cost Recovery below.

The central government will need to provide $27.19 million in Project costs as well as interest payments on external loans. Of this amount, $20.7 million will be expended by BWDB for the Flood Protection component.

6.4 Revenue Improvement

Both DCC and DWASA are currently undertaking major projects under UNDP/UNCHS/World Bank programs to improve their financial and economic management. It is expected that these programs will begin to take effect during the life of this Project, and will provide the basis for revenue improvement. This study has developed revenue improvement and cost recovery options that are particularly pertinent to meeting the cost requirements of this Project, which are discussed in detail in the next section.

6.5 Cost Recovery

6.5.1 Background

Out of the total Project cost of US$121.22 million (spread over a five year period, FY 1991/92 through FY 1996/97), about 76.3% of the Project cost is expected to be financed from concessional loans from the ADB. As a result, it is envisioned that the GOB will have to provide the remaining 23.7%, or $ 28.7 million. In addition, after project completion, the GOB will be responsible for financing recurrent O&M costs, as well as providing annual budgetary allocations for debt service requirements starting in the year 2002. Given its limited financial resources, the Government needs to recover both debt service requirements and the O&M costs from the project beneficiaries.

A major economic benefit of the Project will be the expansion of Dhaka's economic infrastructure in the form of residential, commercial and industrial real estates into the low-lying, predominantly agricultural areas presently subject to seasonal flooding. Given these benefits, there is a substantial scope for the Government to recover costs associated with the Project.

Various cost recovery options are available, either direct or indirect, at the national or city level, which may be considered for adoption. These options, together with an indicative estimate of their financial impacts, are discussed below.

6.5.2 Direct and Indirect Cost Recovery

Direct cost recovery refers to a fee or charge levied that would correspond to a discreet good or service provided. This type of cost recovery is important because it discourages waste and over utilization, and also enables officials to extend the service provided to more people, including the ultra-poor who are clearly unable to pay.

Indirect cost recovery refers to a general increase in tax revenues available to the government which occurs as a result of an increase in economic activity, and is reflected in higher incomes or land values.

While direct cost recovery mechanisms are generally preferable, they may not be possible for this particular Project. This is due to the fact that (a) there is a poor existing record for direct cost recovery in Bangladesh, and (b) most flood protection projects do not usually lend themselves particularly well to direct cost recovery, although some project sub-components may.

The problems with direct cost recovery in Bangladesh should not be underestimated. Discussions with Bangladesh officials and donors indicate that cost recovery has not received much attention in the implementation of past projects. This has resulted in the development of numerous projects for which the recurrent costs have become a serious drain on limited fiscal resources.

As this situation cannot persist indefinitely, it is important to identify and implement mechanisms to make the recurrent project costs affordable for the government. But this will not be easy as a brief survey conducted for this analysis found that systemic problems and formidable institutional obstacles would be present no matter how clever the design of the cost recovery mechanism for any particular project.

A World Bank report (An Agenda for Tax Reform) notes the complete absence of cost recovery mechanisms in educational and health programs in the country and a lack of administrative capabilities that would facilitate their introduction. Even the power sector, where cost recovery should be relatively straightforward (monthly electric bills), has demonstrated serious problems with systems losses. As a result, the Bangladesh Power Development Board is in serious financial difficulty.

A more relevant example of cost recovery is the experience of the BWDB in the recovery of O&M costs for its main irrigation systems. Currently, most BWDB projects have a backlog in fee assessments of two years or more. As of June 30, 1989, about Taka 3.5 million (about US$110,000) had been collected for FY 1989, or about 10% of the amount assessed. (World Bank, Staff Appraisal Report.)

The poor performance of BWDB in the collection of irrigation charges is due in part to the fact that the supply of irrigation water in many of the projects is insufficient or irregular, and that assessments and collections are cumbersome and require too much staff. While these factors may be remedied, the theoretical case for cost recovery in irrigation is stronger than for flood protection since costs and benefits of irrigation facilities are generally much larger, can be more readily identified and quantified, and beneficiaries of irrigation are generally in a better financial position (and have more motivation) to contribute to a project's O&M costs, because the benefit they receive is directly tied to their ability to produce.

A second, more fundamental problem with direct cost recovery for the Project is the nature of the benefits arising from flood protection. The GOB's ability to impose direct charges is limited by three factors:

i) the fact that flood protection in Bangladesh is, as in many countries, considered a social service for which no charges have traditionally been collected. Thus, the important element of willingness to pay may be absent.

ii) benefits of flood control and drainage works vary from one plot to another, depending on location, elevation, and soil quality. It would be very difficult to determine fair rates as a reflection of the benefits obtained by Greater Dhaka residents and their ability to pay.

iii) it would be difficult to withhold flood protection services from someone who refuses to pay a direct fee, as one could do in theory with water, power supply, health, and education. Flood protection thus has the characteristic of a public good.

Given these problems with direct cost recovery, indirect cost recovery would be preferable, except in the case of certain project components as discussed below. Currently, O&M costs are financed from general tax revenues. To assure the availability of sufficient funds to cover these costs over the life of the Project, mechanisms should be introduced which meet the following criteria:

i) tax revenues should increase sufficiently as a result of the project to cover O&M costs;

ii) these additional tax revenues need to be channelled to the institutions responsible for the O&M of the flood control and drainage systems;

iii) any additional fees or taxes should fall primarily on residents of the project area; and

iv) existing systems for assessment and collection should be used, when possible, in order to avoid creating new bureaucracies and burdening and complicating the tax structure.

As the major economic benefi.s of the Project will be reflected in a rise in land values, the preferable means for indirect cost recovery should be land based taxes. I. the next section several national and local land and property based taxes that could be combined to provide a cost recovery mechanisms for the Project are reviewed.

6.5.3 Options for Cost Recovery

A. National Level

The three national taxes considered below, the Land Development Tax, the Non-Judicial Stamp Tax, and the Capital Gains Tax should all show increased revenues as a result of the Project. With some modifications in administration and structure of these taxes, the additional revenues should be more than sufficient to cover O&M costs, and they will primarily fall on project beneficiaries. The problem with all three taxes as a means of indirect cost recovery is that revenues go to the GOB treasury. There are no established mechanisms to earmark specific revenues collected for project O&M. Therefore a means would have to be worked out with the central government to allocate the revenues for Project O&M costs. The following discussion of each of these taxes assesses their advantages and disadvantages.

Land Development Tax:

This annual t..., administered by the Ministry of Land, is based solely on the acreage of land ownership. This approach avoids the problem of estimating an intrinsic value for the land. Historically, this tax has not been particularly efficient, as collection costs have averaged about 60% or higher of the amount collected.

Recently, the government has modified the land Development Tax to exclude agricultural land holdings below 8.3 hectares in size. The current rate structure has been greatly simplified compared to previous ones, and is presented in Table 6.4. While revenues have increased in recent years, they could begin to decrease as a result of the new simplifications. But this should be compensated by a reduction in administrative costs.

Since the Land Development Tax is specific rather than ad-valorem, no incremental revenue would be realized per se from the increase in land values. But it seems very likely that revenues from the Dhaka area will increase as a result of the Project as land is upgraded to the higher revenue yielding residential and commercial/industrial uses.

Table 6.4

Land Development Tax Rates

Agricultural Land:	Tk Rate per Decimal/acre
Less than 8.33 Acres	nil
More than 8.33 Acres	2.0
Non-Agricultural Land:	
Commercial and Industrial	100
Residential	20

Source: Ministry of Land

The Government has agreed to encourage this process through a more timely re-classification by the MInistry of Land of agricultural land to non-agricultural land so that increased revenues are assured as soon as actual development has taken place. Since developers must apply for permission from RAJUK before changing the use of agricultural land, greater coordination with RAJUK is needed. This process will be facilitated by the PMO through periodic contact and follow-up with the involved agencies. Timely re-classification of agricultural lands into non-agricultural land will potentially translate into a substantial increase in tax assessments.

The additional revenue that be achieved by the year 2000 from the prompt reclassification of newly built-up land is estimated at about Tk 10 million for the Project area and at about Tk 15.43 million for Greater Dhaka as a whole. These estimates incorporate both areas that have recently been built up but not reclassified and areas that are expected to be built up during the 1993-2000 period. It is expected that any modifications in the tax assessment system will not have their full effect until 1993. The full calculations are presented in Appendix 11A.

A more radical, but potentially more lucrative, reform would be to change the basis for the land development tax from "area" to "ad valorem", using market value. While instituting such a reform on the national level would be quite complex and costly, the Government has agreed that it can be done for the Project area itself. It is recommended that the change to ad valorem tax assessment be initially focused on non-agricultural land and that rates be set such that initial revenue per hectare be at least as high as it is under the current system. If this is done, then the increase in land values expected from the project will cause revenues to increase beyond the estimate provided above.

ODb

The Non-Judicial Stamp Tax:

The non-judicial Stamp tax is the most important tax on the value of transferred land and property in Bangladesh. It is administered by the National Board of Revenue. The rates range from 10% for declared value under Tk 100,000 to 18% for declared value exceeding Tk 100,000. This guarantees that transfers of more valuable urban or flood protected property will be assessed at a higher rate. The Stamp Tax is therefore progressive, although this progressivity is based on the total value of the transferred property, and not on the income or wealth of either the buyer or seller.

One weakness of this tax is that despite potential fines of 10% to 15% of the value of the land, the undervaluation of property transfers is very common, and there is a strong incentive for landowners to split property into smaller units to avoid high marginal rates.

Despite this problem, revenues from this tax have exhibited very substantial growth since 1976/77. Landowners have an incentive to pay the tax since it legitimizes land and property transfers. It is also relatively inexpensive to collect.

Revenues from the Stamp Tax will increase along with land values, though this will depend in part of the scope of the activity in the land market. Revenues could be further enlarged by improving enforcement and by fixing a minimum value for the purpose of land and property transfer.

The issue is whether any of these revenues can be channelled back to the Project for O&M. One possibility worth exploring is that the central government could introduce a zoning system for Dhaka that would allow the identification of increased revenues from the project area and then earmark some of the increased revenue as a type of revenue sharing for Project O&M costs.

If the central government is unwilling or unable to earmark funds for legal or other tax reasons, then an alternative would be to attach a flood-protection related surcharge to the non-judicial stamp tax for land and property transfers in the Dhaka metropolitan area.

A potential drawback of an added surcharge is that it could further exacerbate a current trend in which the high rate of the stamp tax discourages land transfers that would otherwise make economic sense. This is particularly important to keep in mind given that for the full benefits of flood protection to be realized, the development of new areas should not be discouraged.

Capital Gains Tax:

Land and properties are subject to a capital gains tax. Unfortunately, the government's current tax accounting practices appear to consolidate capital gains with other forms of income tax and it cannot be readily extracted and quantified. Therefore, little is known about the level of collections in the past on capital gains from land and property, either at the national level or in the Project area.

The capital gains tax on land and properties has some similarities to the non-judicial Stamp Tax: it is periodic in that it is levied only when land is transferred; and the amount of the tax is also related to sales price, though the amount actually levied depends on the level of the capital gain and the applicable capital gains rates.

As such, it has some of the same advantages and disadvantages as the non-judicial Stamp Tax; as well as the added disadvantage that the lack of data makes it impossible to assess any increases that are due to the Project or any specific amounts that should be earmarked for O&M activities.

B. Local Taxes and Charges

The local taxes that are relevant to this Project are charged directly by three of the primary participating agencies who will be involved in the Project: the Dhaka City Corporation, Dhaka DWASA, and RAJUK. As a result, these taxes and fees have a major advantage over the national taxes in that revenues flow directly to the interested parties.

Unfortunately, the utility of some of these local taxes as a means of indirect cost recovery is limited in that generally revenue increases are not tied as directly to increases in land values. Furthermore, all three agencies face serious administrative limitations in their ability to manage the taxes and fees. As is discussed in Chapter 5, the project team feels that there could be benefits from the privatization of many of the activities.

DCC Taxes and Charges:

About half of the environmental improvement facilities which will be operated by DCC are targeted mainly for poverty alleviation in the slums. The other half may be attributed to services for which the cost may be recovered from the users (i.e. solid waste, public toilets and standpipe water supplies).

DCC's current cost recovery mechanisms primarily involve indirect cost recovery schemes under the holding tax. The holdings tax is composed of three elements: a tax on the property rental value (7%), a charge for solid waste/conservancy services (3%) based on rental values, and a charge for street lighting (2.5%), again based on rental value. DCC also receives 1% from the Non-Judicial Stamp Tax in the form of the Immovable Property Transfer Tax, but DCC's revenue from this IPTT has traditionally been fairly low, averaging less than half a million dollars per year.

The holdings tax is one of the few local taxes for which revenues will increase automatically because of the Project. This is because revenues are linked directly to both land values where rental units currently exist and to the increase in the number of rental units that takes place with

220

the physical expansion of urban areas made possible in part by the project. Furthermore, for the public toilets and standpipe/tubewells provided under the Project, DCC should be able to recover it's O&M costs through standard user fees.

Unfortunately, for the slum improvement and solid waste components the additional revenue from the holdings and IPTI taxes will probably not be sufficient to cover project O&M costs. This conclusion is based on a detailed projection of DCC's revenues and expenditures over the next few years (see Appendix 11). Thus, additional charges will be necessary.

One possibility is for DCC to adjust the present charge for solid waste/conservancy services by the amount needed to generate revenues which can be allocated for the incremental O&M costs and debt service requirement for the environmental improvement facilities comprising Part C of the Project. Annual incremental O&M costs and debt service requirements for Part C for the years 1996-2010 are estimated to be about Taka 401 million, at mid 1991 prices. Spread over the estimated 141,000 holdings in the project area, recovery of the annual O&M and debt service requirements would mean an additional charge of Taka 190 per holding. This amount may be recovered through a 21.57 per cent increase in the solid waste/conservancy rate presently assessed (based on annual rental value of the property an increase from 3% to 4% would be enough).

In a current project with DCC, the World Bank has included as a covenant that DCC raise the conservancy fees from 3% to 6%. DCC is now considering an alternate plan that would raise the fees for different types of holdings at varying rates. This alternate plan is estimated by DCC to provide a similar revenue flow as to that of the World Bank proposal.

Before this is done, however, DCC needs to continue improving the efficiency of its financial management systems. A recent study[1] has outlined a number of general problems associated with DCC municipal taxes. First, the basis of property valuation is "actual rent" and not "market rent." Second, in any case, the "actual rent" is easily manipulated through false documentation, often in collusion with tax assessors. Third, lower level tax officials are poorly paid and trained, and have few career prospects. As a result, according to this study, "inefficiency and corruption are endemic in the system". Furthermore, though DCC collects more than Tk 770 million in municipal taxes every year, it is owed over Tk 410 million in back-payments. There have been recent improvements in the collection of back-payments.

Given these inefficiencies, it may be hard to justify a large increase in charges until current efforts to improve DCC's financial management have an effect. Thus, if the rate increases mentioned above become politically difficult, an alternative would be for DCC to adjust the basis of the annual rental value of the property from that of actual reported value to

[1] Social Formation in Dhaka City: by Kamal Siddiqui, et. al.

"market value". This could then be accompanied by more gradual percentage increases in the solid waste/conservancy rate.

DWASA Charges:

DWASA is expected to play a fairly major role in the Project as the lead agency for improvement of Dhaka's drainage system. The investment cost of drainage projects does not normally lend itself to cost recovery; be it from the points of view of institutional aspect or from the beneficiaries' willingness to pay. In view of this constraint and the substantial amount of investment cost, it is a widely accepted practice among developing countries in Southeast Asia to have the investment cost of drainage projects financed by the government, rather than by autonomous public enterprises. Despite this, there is merit in having DWASA finance a modest amount (5%) of the investment cost in order to prod the enterprise to improve its operating efficiency and financial management.

Currently, DWASA levies water charges of Tk. 2.76 per 1,000 liters of water for metered accounts and 17.88% of the value of the building for non-metered accounts. For those who have sewerage connections, the charge is the same as water. Those holdings which don't have a direct connection, but are within 100 feet of one, have to pay a portion of the water charges.

In 1989, DWASA was assigned responsibility for the development and O&M of Dhaka's main drainage system. The costs of the drainage system continue to be financed from DWASA's water and sewerage revenue, to the further detriment of DWASA's overall financial situation.

DWASA needs to generate revenues sufficient to cover the O&M costs of the drainage component that it will implement and subsequently operate. Unfortunately, the Project will have little immediate effect in raising revenues from the water and sewerage charges as the increase in fees received from further development will be matched by the expense of expanding water and sewerage services to those areas. DWASA will need to find other methods of increasing revenues.

Like DCC, DWASA should first sharply improve its collection rate, particularly for water. About 56% of the water produced by DWASA is unaccounted for. An estimated 30% of the losses are through leakage, and an estimated 26% through administrative losses. Thus, there is ample room to reduce leakage (which in neighboring countries is in the range of 15% to 20%) and to improve revenue efficiencies.

DWASA is currently involved in a proposed fourth Dhaka Water Supply and Sanitation Project with the World Bank. This project is attempting to correct several problems which directly limit its ability to implement cost recovery. DWASA is also undertaking a study, funded by IDA, on waste prevention and leak detection, which should lead to recommendations to prevent water loss and increase revenue. Unfortunately, the impact of these projects may not be sufficient in the short run.

One option for recovering Project O&M costs that has met with a positive response from the GOB is for DWASA to add a drainage charge on the water bills of its consumers. This would be practicable from the point of view of coverage inasmuch as about 80% of registered holdings within the City are covered. The drainage surcharge will be levied progressively in line with the phased implementation of the program. For the interim period, the Government would allow DWASA to retain a sufficient portion of the 15% development surcharge that it presently collects for the national government.

The amount that the drainage charge should reach by 1997 (in 1991 Taka) is estimated based upon the DWASA financial projection provided in Appendix 11. Annual recurrent O&M costs for the drainage component are estimated to reach close to Tk 20 million. Overall O&M costs for drainage (including the Project) are expected to surpass Tk 40 million by 1997. Repayment of the on-lent portion of Project funding will reach Tk 9.9 million in annual payments on the interest and principal by 1996-97. Assuming that only current water consumers in the Project area are to be assessed the additional charge for drainage, the monthly charge for drainage needed in 1997 to cover these costs would amount to about Taka 38 per holding, or about Taka 9 per household in 1991 Taka.

RAJUK Development Charges:

Private land developers are supposed to obtain RAJUK's permission before undertaking any land development project. RAJUK will therefore be in a position to assess a lump-sum (one-time) development fee that will be used to meet overall development costs for the Greater Dhaka region related to the Project.
The lump-sum charge will be payable by the developer and based on the size and value of the development. The rationale for the charge would rest on the extra burden that the development would place on the infrastructural needs of the Dhaka metropolitan area as a result of the Project. This development charge would be less related to Project O&M than to infrastructural needs such as roads, drainage and parks.

6.5.4 Conclusions on Cost Recovery

The primary conclusions of this section are as follows:

i) past efforts at cost recovery for projects in Bangladesh have met with very limited success;

ii) improving cost recovery is critical to the improved fiscal performance of the GOB in general, and the sustainability of this Project in particul r;

iii) in general cost recovery for a flood protection project is best met through indirect (tax revenue) rather than direct means (user fees);

20C

iv) since a major benefit of the Project will be an increase in land values, the best means of cost recovery would be land-based taxes that capture some of this increase in value. Utilizing and strengthening existing land and property taxes is recommended, rather than creating new taxes and bureaucracies;

v) it is estimated that the revenues from these taxes should increase sufficiently as a result of the Project to potentially cover project O&M and loan service costs. Unfortunately, each of these taxes faces constraints that must be overcome if they are to be used as a means of indirect cost recovery for project costs;

vi) the options examined for using land and property based taxes included three main national taxes: the Non-Judicial Stamp Tax, the Land Development Tax, and the Capital Gains Tax on land and property. All three should experience increasing revenues as a result of the Project. The primary difficulty is in earmarking these additional revenues for the Project.

vii) Several means for increasing revenues from these national taxes to meet Project O&M costs are discussed and the Government has agreed to consider modifying the Land Development Tax in the Project area by changing its assessment from area to "ad valorem" and by improving the timeliness of the reclassification of land from agriculture to non-agriculture usages.

vii) three applicable local based taxes and charges are also discussed. Both DCC and DWASA levy taxes and service charges in the Dhaka metropolitan area. These should grow as land and property values increase, but probably not sufficiently to cover increased O&M costs. Therefore, both agencies have agreed to add or increase their taxes and charges, as well as improve their management and financial systems in order to make more efficient use of those taxes and charges they levy but often fail to collect. A development fee will also be collected by RAJUK on new development areas.

228

7.0 PROJECT JUSTIFICATION

The economic justification of this Project has been separated into two distinct analyses. The first and primary analysis focuses on the Project as a whole, while the second covers the Slum Improvement component of Part C. Sections 7.3 through 7.7 report on the first analysis and Section 7.8 describes the second. Section 7.9 provides financial analyses of the Solid Waste subcomponent and the Sanitation activities within the Sanitation, Water Supply and Local Drainage sub-component, both of Part C.

7.1 Summary

The primary results from the cost-benefit analyses of the Project, to date, are as follows:

i) the major economic and financial benefit from the Flood Protection and Drainage programs of the Project will be the expected increase in land values for low, lying and medium elevation areas which are subjected at present to regular and periodic flooding. Flood protection and control will lead to an expansion of Dhaka's economic infrastructure in the form of residential dwellings, industry and other types of real estate. These benefits, which can be estimated by projected increases in land values, appear to be significantly greater than Project costs.

ii) a second important benefit from the Project will be protection of Dhaka's existing economic infrastructure, primarily on higher lands, that is subject to damage from exceptional flooding.

iii) about 65% of Dhaka's poorer inhabitants are presently subject to regular flooding and would benefit from substantially better environmental conditions which the Project will promote through flood protection and control, and ancillary activities.

iv) the slum improvement component was found to offer quantifiable economic benefits that do not exceed the costs involved, when discounted for the cost of capital. But this component can still be justified if the large number of non-quantifiable benefits are taken into account.

v) The financial analysis of the Solid Waste subcomponents demonstrate that it is fully justified in financial terms. The financial analysis of the Sanitation portion of the Sanitation, and Local Drainage sub-component would indicate that improved cost recovery would be needed to make financially viable in itself, though much of this subcomponent as a whole can be financed through the conservancy fees collected for solid waste.

vi) the Project was found to be affordable to both the implementing agencies and to the beneficiaries.

7.2 Project Area, Beneficiaries & Costs:

The Project covers those portions of the Dhaka metropolitan area that are under the responsibility of the Dhaka City Corporation (DCC). The project area consists of 260 sq km and contains an estimated population of 4.8 million. Approximately 4.2 million people, or some 87% of the city population, reside in the Western portion of the project area; which comprises about 136 sq km (See Figure 7.1). The eastern part of the city is less dense, with considerable areas still under agricultural and non-urban uses.

The base cost of flood protection and drainage components for an integrated flood protection program to protect the entire city from floods of 100 year frequency is estimated at over $450 million (See Chapter 4). In view of the large investment this would require, the flood protection program will need to be implemented in stages over a period of 10 - 15 years.

The staging of the overall Project takes into account the cost effectiveness of the required investments. Factors taken into consideration include the need to: protect existing densely populated residential, industrial and commercial areas; increase pumping capacity as more intensive urban land use of peripheral areas takes place; and increase internal safety within areas protected during each stage (by dividing protected areas into self-contained compartments through the building of internal embankments).

Based on these considerations, the recommended Project comprises Stage I of the overall flood protection and drainage scheme, and is focused on completing and improving the flood control and drainage systems in the western portion of the city, as mapped in Figure 7.1. The cost for the recommended Project is estimated at $121.22 million, as discussed in Chapter 6 and presented in Table 6.1. Table 7.1 contains annual cost projections in Taka for each component of the Project.

7.3 Methods Used and Approach to Economic Valuation

Owing to time and budget constraints, it was agreed in the terms of reference that the DIFPP portion of the Flood Action Plan would rely on readily available secondary data. Accordingly, no provisions were made in the Project budget for additional new socio-economic surveys.

Instead, the Project has been able to benefit from the cooperation of several GOB and donor agencies. JICA has been particularly cooperative in supplying data from many of their detailed surveys in the 850 sq km area which will be the subject of their FAP-8A Master Plan, and which incorporates the area that is the subject of our study. The World Bank has also provided a number of useful reports.

Figure 7.1

Project Area Map

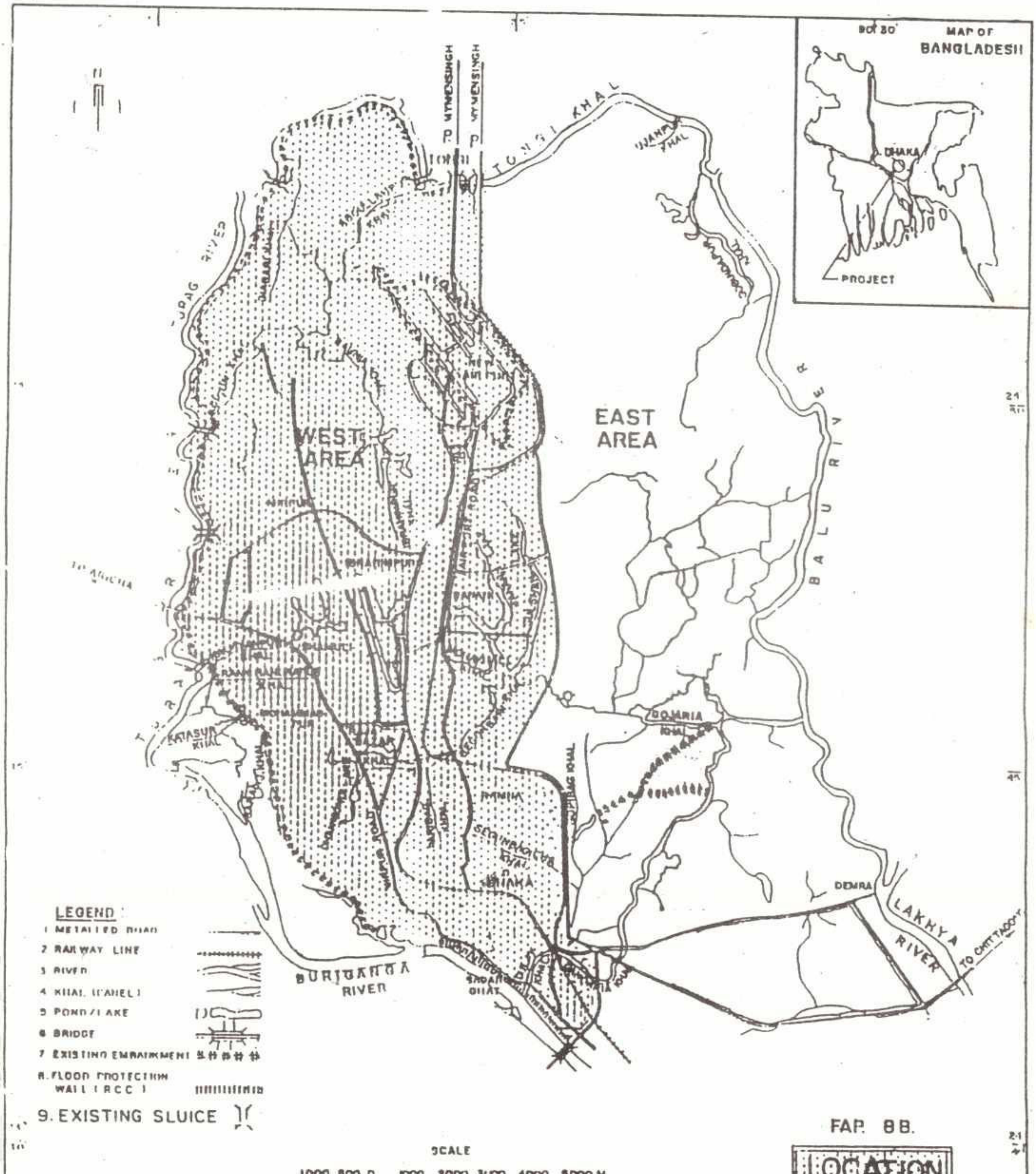

TABLE 7.1

SUMMARY OF COSTS (TK. IN MILLION)

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (STAGE ONE)

		91-92 (FY)	92-93 (FY)	93-94 (FY)	94-95 (FY)	95-96 (FY)	96-97 (FY)	TOTAL
Part A		390.86	574.17	528.32	481.50	63.91	41.00	2079.76
Part B		558.47	580.60	400.31	16.92	16.29	17.19	1589.78
	a	7.44	12.88	4.04	47.54	55.76	63.37	191.03
Part C	b	5.29	14.02	18.35	15.46	16.06	20.92	90.10
	c	30.82	70.25	31.39	18.62	19.89	19.81	190.78
Total: a+b+c		43.55	97.15	53.78	81.62	91.71	104.10	471.91
A+B+C		992.88	1251.92	982.41	580.04	171.91	162.29	4141.45
Part D		70.21	[illegible]	53.43	26.36	15.87	5.92	254.68
A+B+C+D		1063.09	1334.81	1035.84	606.40	187.78	168.21	4396.13

Abbreviation:

* Cost excludes service charge on Bank loan.

Part A: Flood Protection
Part B: Drainage
Part C: Environmental Improvement
i) Solid Waste
ii) Slum Improvement
iii) Sanitation, Water Supply & Local Drainage
Part D: Implementation Assistance

This analysis generally follows the "Guidelines on Economic Analysis" provided by the Flood Plan Coordination Organization (FPCO) though some modifications were necessary because of the more urban nature of the project area in comparison to other areas. Greater weight has been given to the appreciation in land values resulting from conversion of low-lying agricultural and marginal and fringe lands to urban uses. The value from housing and other construction on this land is expected to far outweigh the increase in agricultural productivity within the project area.

There are two approaches to evaluating Project benefits. One is the income-flow approach, and the other is the asset-value approach. The first approach is used in evaluating projects where changes in output and income generated by the projects can readily be assessed, such as industrial and agricultural projects. This approach could be used in evaluating a flood control project primarily affecting rural areas.

The second, the asset value approach, is a commonly accepted approach in projects where changes in output and income generated are not so readily apparent, such as urban land improvement, housing, and urban flood protection projects. The Asian Development Bank, for example, has used this approach in evaluating such projects as the Low-Cost Urban Housing Project (Korea), the Bandung Urban Development Project (Indonesia), and the Karachi Urban Development Project (Pakistan).

In this particular case, the Project has used the guidelines on the asset value approach provided by the ADB to estimate the benefits arising in low lying areas from the Project's effect in increasing the value of those lands. The benefits of the Project on already developed higher lands are estimated through a calculation of the value derived from the avoidance of flood damage to existing property. The sum of these two estimates is used to represent the quantifiable economic benefits arising from the Project. Other less quantifiable benefits are also discussed below.

7.4 General Project Benefits

Benefits from the Project fall into four categories: (i) environmental and health; (ii) distributional; (iii) institutional; and (iv) economic.

7.4.1 Environmental and Health

Perhaps the most obvious benefit of the Project is the prevention of loss of life. The GOB estimates that 68 people died in the 1987 flood, and 149 in the 1988 flood. Loss of life from future similar scale floods is expected to be worse if the Project is not implemented.

The general health and welfare of the city's population is also expected to improve. A major health problem facing Dhaka is the pollution and contamination that results from stagnating flood waters, lack of drainage and poor sanitary infrastructure. The current embankment has worsened this problem in some areas by retaining flood waters within the project area.

Thus, improved flood protection, better drainage and other Project subcomponents such as slum improvement and improved solid waste collection will help to reduce disease vectors and significantly improve environmental conditions within the city.

7.4.2 Distributional Benefits

Some of Dhaka's ultra poor, primarily the squatters, are the most prone to suffering and displacement from the annual flooding in the lower lying areas, and reductions in flood frequencies and levels will have the greatest beneficial impact on this segment of the community. The Project also includes components which are specifically targeted on improving the living conditions of a large number of people, the majority of whom belong to low-income groups and live in extremely poor environmental conditions. In sum, most of the loss of life and health benefits mentioned above will primarily benefit this segment of the population. Furthermore, many lower income families will benefit by the employment generated by the Project as discussed below in Section 7.4.4.

7.4.3 Institutional Benefits

The Project should also benefit the institutions that are implementing the project (BWDB, DWASA, DCC, etc.) by increasing their technical and financial managerial capabilities. As has been discussed elsewhere in this report, the Project will be providing direct technical assistance to these agencies during the implementation period. Furthermore, the cost recovery components of the Project should help introduce a more sustainable approach to financial planning within some of the agencies.

A more specific institutional benefit will be a decrease in the need for maintenance of the road network in Greater Dhaka; as well as other public infrastructure. During the floods of 1988 about 400 km of roads in Dhaka were damaged and about 60% of the 1900 km internal road system was submerged.

7.4.4 Economic Benefits

As has been mentioned earlier, a primary economic benefit of the Project will be that the flood control and drainage components will allow the development of low-lying lands. This benefit can be quantified by estimating the increase in land values that will result. A second quantifiable economic benefit is the avoidance of flood damage to economic infrastructure. These benefits are further discussed and estimated in Sections 7.5 and 7.6 below.

There will also be other economic benefits that are not quantified here. The impact of improved security from floods, as well as the investments made by the Project itself, are expected to assist in stimulating the overall economic activity in Dhaka. This should generate new employment opportunities, many of which will be of benefit to the poor.

As one housing development company argues, there should be dynamic benefits from forward and backward linkages from the expected stimulus to construction. Forward linkages would include increased production of household accessories, such as furniture, electrical fittings, and sanitary fittings. Backward linkages would include increases in production of construction materials, such as cement, bricks, glass, wood, and iron materials. The domestic resource content of construction activity is high. Construction is a highly labor-intensive activity, and should create new jobs.

7.5 Benefits from an Increase in Land Values

7.5.1 The Role of Current Land Use Patterns

The topography of the project area has relegated a substantial portion (45% of the land) to fairly low opportunity cost agricultural endeavors at the same time as the urbanized areas are seriously overcrowded (see Table 7.2 following). Dhaka suffers from a severe shortage of usable land for continued expansion, which has hindered the normal development of the city.

Table 7.2

Major Land Use Categories
Dhaka (1990)

	(ha)	(%)
Residential	5,320	19.3%
Commercial	410	1.5%
Industrial	340	1.2%
Institutional	1,630	5.9%
Roads & Other	2,930	10.6%
Village	1,110	4.0%
Agricultural	12,370	44.9%
Water Bodies	3,430	12.5%
Urban Total	10,630	39.0%
Rural Total	16,910	61.0%
	27,540	100.0%

Source: JICA, Interim Report, March 1991

The major features of land use, as noted in the JICA study, are:

i) an intensity of land use brought about by increasing population pressure;

ii) the lack of a transportation system which would allow for a more extensive development pattern;

iii) the wide scatter of very poor and dense slum and squatter settlements, which house a third of the city's population in very small areas.

The study notes that a major factor in determining urban versus rural land use is freedom from flooding. High land or relatively flood free land that is close to the city and major commercial areas will be rapidly developed.

Transportation is also critical in patterns of land use. For the majority of the city's inhabitants, the need to live near work, or near transportation to work, determines the place of habitation. Thus, population densities will continue to be higher in inner city zones and near major transport corridors. The provision of mass transit to more distant flood free areas would however increase the attraction of more distant land relative to central locations. At the same time, improved transportation without providing security from flooding will also have a limited effect in deconcentrating the city.

Therefore, creating greater physical security from flooding in the low lying lands provides the greatest potential for the Project to add economic value. Flood control and protection will enable the expansion of the existing economic infrastructure of Dhaka at a much faster rate.

Benefits will also come in part because low-lying areas will not have to be raised as much as previously to prevent damage from normal flooding. The costs for land filling alone are about 150 to 250 Taka per cubic meter. After the Project, some lands will still have to be raised to protect against internal flooding, but to a much lesser extent.

These benefits can be measured by the increase in the land's value. Land values are good measures of the benefits that will come from the improvement in land quality. Land prices take into account the discounted value of the cash flow attributable to land, above and beyond other factors of production (labor, capital). This is particularly true if land prices arise from a competitive market. Thus, the structure of the land market in the Dhaka area becomes important.

7.5.2 The Market for Land in the Project Area

The market for land is dominated by the private sector, as the vast majority of land is in private hands. The Government owns only about 7% of the land in the Dhaka area, and has a limited ability to intervene in the land market.

Real estate development is also the domain of the private sector, primarily through large cooperatives such as Eastern Housing Limited and East-West Properties. RAJUK is the primary public sector land development agency and has undertaken extensive planned development throughout Dhaka in the past. It will continue to play an important role in the future.

Population increase and rapid urbanization are the primary causes of demand for urban land in Bangladesh. Specific identified sources include:

i) It has been estimated that about a third of the remittances from Bangladesh citizens who work overseas go into the purchase of land;

ii) Land is used as a means of savings because the underdeveloped financial markets in Bangladesh lead to a lack of alternate attractive means for saving money and maintaining purchasing power. Investment in land has historically been a superior hedge against inflation compared to term deposits, where the maximum rate of interest has been 16% per year against a measured inflation rate that has averaged about 12% a year.

The demand for land has been in a slump following the Gulf War which curtailed incomes and remittances from overseas. With the fall in demand, land prices have been depressed. However, purchases of low-lying agricultural land near the existing western embankment by land developers is a notable exception.

As work resumes in the Gulf, the behavior of land prices will be dependent on whether the Project is implemented. If the current embankment is left as it stands, prices are not expected to rise much beyond natural increases due to inflation and speculation. This is because embankment failures and the lack of proper drainage have resulted in continued internal flooding and a dramatic increase in water pollution as flood waters stagnate behind the embankment. Though some of the low-lying land that offers the best potential for development has already been purchased by developers, much of it has not yet been built upon, in part because of the problems outlined above. With the Project, this land will be developed more quickly and prices should continue to rise as they did before the limits of the current embankment became apparent and the war intervened (see the next section).

Discussions with real estate developers, real estate agents, RAJUK, and others reflect a consensus that most of the land made available for development by the Project will go towards meeting the demand for residential accommodation.

Dhaka has an acute housing shortage. Because of limited resources, high standards for construction, and high prices for urban land, the provision of formal housing is only a small fraction (4% by some estimates) of current need and. in addition to the scarcity of useable land, lack of finance also acts as a constraint on real estate development. Housing finance is poorly developed, and mortgages are generally unavailable. Housing construction by the Government is very limited, and is mainly for civil servants.

Over the years, most conventional housing has been built by the private sector. Given the scarcity of housing, it is not surprising that the market for rental housing is very profitable in Bangladesh. In some instances entire slum communities have developed as a result of enterprising landlords who develop the land, build kutcha housing with rudimentary services, and then rent the structure to lower income families.

Both RAJUK and the cooperatives target their developments exclusively at the middle and upper income groups. HSD, which has the responsibility to provide housing for the lower income groups, has not been effective in the past.

With a few exceptions, most housing for the poor has been developed without planning along the urban fringes, in high density pockets in the urban core, in low lying vacant lands subject to regular flooding, and on vacant public lands. Nearly all these areas have inadequate basic services for water, sanitation, drainage, access, or public services such as solid waste collection, health and education facilities.

The dominance of the private sector in real estate and housing development supports the use of land prices as an indicator of the increased value of the land that results from flood protection activities.

7.5.3 Estimating the Benefits from Land Appreciation

The benefits arising on low-lying lands are calculated by first estimating the rate of increase of the development of these lands, and then by estimating the associated increase in land values.

Projections of the pattern of development of the land made available by the Project over the next 20 years is a function of further projections of population growth and incomes over that time period, as well as estimates as to which low lying areas will be most attractive for new development.

The JICA study estimates that from 1981 to 1990, the built-up area in Greater Dhaka increased from 104 square kilometers (39% of the city) to 114 square kilometers (43%). They also project that the population growth rate for Dhaka city will diminish in the coming years, to an average of 4.6% from 1990-2000, and 2.0% between 2000-2010, resulting in populations of 7.1 million in 2000, and 8.7 million in 2010.

According to JICA's projections, much of this population growth will be absorbed by increased densification in existing developed areas, and the demand for new land for development will grow at a lower rate averaging about 2.2% for the period up to 2010. In spite of this, however, it is estimated that the built-up area will increase from its 1990 level of 114 square kilometers (43% of the city area) to 177 square kilometers (67% of the area) over the next 20 years.

The major growth pressures will occur along the perimeter of existing built-up areas, on what are now marginal or agricultural lands. The primary demands for new development are expected to take place in the West Embankment, Eastern Dhaka, Mirpur and the Eastern Embankment areas. Of these, only Mirpur has extensive publicly owned lands. Appendix 7 summarizes the growth in these areas by Dhaka districts.

The benefits from land appreciation are estimated only for those lands which are predominantly low-lying. The benefits from the high areas are captured in the "flood damages avoided" estimates considered in Section 7.6. The estimated impact of the Project on the value of low lying land that is projected to be developed within the next 20 years is presented in Table 7.3.

Table 7.3

Project Impact on Land Prices for Currently Undeveloped Lands

District	(1)	(2)	(3)	(4)	(5)
West Embankment	750-1000	875	150%	1,313	2,188
Mirpur Area	1500-2000	1,750	150%	2,625	4,375
Other Central Areas	1000-1500	1,250	150%	1,875	3,125
Cantonment	2500	2,500	150%	3,750	6,250
Eastern Embankment	200-250	225	300%	675	900

(1) Current Price Range in Tk/m2
(2) Average Current Price in Tk/m2
(3) Percentage Price Increase Attributable to Project
(4) Price Increase Attributable to Project in Tk/m2
(5) Post-Project Price, less increases not attributable to Project

Source: derived from private sector developers, RAJUK, Land Registration Offices.

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In preparing this table, adjusted market prices have been used as the basis for land valuation. Estimates of the increase in market prices of low-lying lands that occur with the Project are based on discussions with the city's land developers and housing societies. Presumably, these private sector entrepreneurs are in the best position to make judgments on the value of new economic activities to be generated. They expect a sharp increase in market prices in the order of 200% to 500% that will be spread over time as land is developed.

These estimates are in line with the magnitude of the current difference in market values between land above and below annual flood levels in the same district (a range of 250% to 600%). They are rather conservative when considering the current difference in value between developed and undeveloped land in the same areas (up to 1000%).

It is assumed that much of the increase in land prices that is attributable to the sunk investment in the existing embankment has already been reflected in the sharp increase in the prices for undeveloped land that took place after the existing embankment was constructed. As was mentioned earlier, the problems that have arisen with the existing embankment have already had a dampening effect on the rate of price increases. Therefore, current (mid-1991) prices should already incorporate many of these non-Project benefits.

In any case, in order to adjust for the possible role of the sunk investment in future land price increases, as well as for speculation, the consultants have considerably reduced the proportion of the expected price increase that is directly attributable to the Project. It follows that this reduction has been less for the Eastern Embankment area where no current embankment exists.

One further assumption on land valuation is that the estimates of percentage price increases attributable to the Project, while indicative only are reasonable averages for what in reality are a vast range of different land types, locations, and prices in each of the districts indicated.

In order to estimate the benefits, it was assumed that the total number of hectares of increase in built up land estimated by JICA for the years 2000 and 2010 will be added evenly throughout each decade. It is also assumed that the benefits will not begin to be realized until the fifth year of the Project 1996-97, when there has been significant improvement upon the current flood control system.

This method of calculation is based on the recognition of the appreciation in land values only once the land is actually developed. In fact, it would normally be more appropriate to realize the benefit once the flood protection is afforded to the land, since it effectively takes on new economic characteristics whether or not the land is actually developed. Realizing the benefits shortly after the Project is completed, of course, would increase the net present value significantly. However, in this case, the land opened up by the Project will not completely attain its

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new economic characteristics until it is reclassified from agricultural to commercial or residential use. Developers apply to RAJUK for a change in land usage when they are considering new development.

Taking the above assumptions into account, the annual stream of benefits attributable to the Project is derived by multiplying the increase in land prices per hectare attributable to the Project by the number of hectares developed each year. This stream of benefits is then discounted by the standard rate of 12% to give the net present value of this particular Project benefit. The results are given in Section 7.7.2.

Given the large errors possible in this type of valuation, care has been taken to err on the side of conservatism by estimating the benefits on the low side. In addition to the points made above,

i) many people interviewed indicated that they thought that the development of land would take place much more rapidly than indicated by the JICA study. They point out, for example, that development is already taking place in some areas that JICA predicts will remain undeveloped until after 2010;

ii) benefits have only been taken beginning in the 5th year of the Project.

iii) this analysis does not include an expected increase of approximately 50% in the value of low-lying agricultural land that remain agricultural.

7.6 Benefits from Flood Damage Avoidance

Another major benefit to be derived from the Project will be a reduction in damage from flood and rain waters in the project area through the completion of the embankment around Greater Dhaka, and improvements of the drainage system.

The benefits of flood protection can be measured as the difference in expected damage from flooding "with the Project" and "without the Project" and are estimated based on damages from recent floods. Benefits arising from flood damage avoidance include reductions in: (i) household damages and losses; (ii) business revenue losses; (iii) public institutions and services damages and losses; (iv) costs of evacuation, relief, and rehabilitation of victims, and emergency measures; and (v) road user damages and losses.

Average annual benefits are computed by summing up the benefits expected by prevention of flooding at a particular flood stage, multiplied by the probability of occurrence of that stage in any given year.

7.6.1 Experience with Flooding in Greater Dhaka

Heavy rainfall, high surrounding water levels and an inadequate and poorly maintained drainage system all contribute to flooding in the Greater Dhaka area. Major floods recorded in the Dhaka Metropolitan area occurred in 1954, 1955, 1970, 1974, 1987 and 1988.

The central parts of the city are high enough to remain generally free from flooding, but low-lying fringe areas are inundated by 2-4 meters of water for several months. Major floods, however, such as those in 1987 and 1988, affect even the central parts of the city.

Under FAP-8A, JICA has prepared an assessment of the flood damages in 1987 and 1988. Flood Damage Records as collected by JICA from the agencies concerned are summarized in Table 7.4. Because of the lack of comprehensiveness of the sources used in collecting this data, JICA undertook a flood damage sample survey in the Dhaka area. The results of this survey indicate that the official figures used for earlier flood damage estimates, as shown in Table 7.4, considerably understate the probable [illegible] damages.

Table 7.4

Flood Damage - 1987 & 1988

(in Quantity)

		1987 Flood	1988 Flood
No. of affected people	:	497,000	805,843
No. of human deaths	:	38	63
No. of damaged Homesteads	:	43,735	146,894
Length of damaged road (Km)	:	241	660
Area of damaged [illegible]	:	13,820	17,099
No. of livestock deaths	:	2,282	1,519
No. of damaged education facilities	:	298	379

The return periods of the 1987 and 1988 floods are estimated to be 10 years and 70 years respectively. Flood damages for the average annual external floods and internal floods were found to be much less substantial due to the general lack of development of lands prone to seasonal floods. The overall picture is summarized in Table 7.5.

Table 7.5

External Flood Conditions

	Area	Flood Area	Flood Depth (m)			Flood duration (day)			Affected
	ha	ha	Max	Avg.	Min	Max	Avg.	Min	People
Annual Flood	27527	12915	0	0	0	0	0	0	
1987 Flood	27527	17801	1.65	0.51	0	32.0	12.4	0	964651
1988 Flood	27527	22125	3.20	0.94	0	65.0	22.8	0	2233418

Internal Flood Conditions

		Flood Area	Flood Depth (m)			Flood duration (day)		
	ha	ha	Max	Avg.	Min	Max	Avg.	Min
Annual Flood	27527	1013	0.61	0.38	0	0.9	0.6	0
Worst Flood	27527	1051	4.00	0.48	0	6.0	1.4	0

7.6.2 Physical Flood Damage Potential

Based on the survey results, JICA went on to make projections on the extent of the damage should similar size floods occur in the future. These projections indicate that if the Project is not implemented, a repetition of 1987 and/or 1988 scale floods in 1990 and/or 2010 would not only affect much larger populations (as Dhaka grows), but also affect a significantly larger percentage of the city's population. These estimates are presented in Table 7.6.

Table 7.6

Affected Population in 1990 and 2010 - (Dhaka)

Year	1/10 Return Period e.i. 1987	1/70 Return Period e.i. 1988	Internal flood	Total
1990	[illegible] (34.6%)	2,468,928 (55.2%)	594,499 (13.3%)	4,472,633
2010	3,977,411 (46.3%)	5,721,355 (66.6%)	856,965 (10%)	8,588,909

Table 7.7 describes the expected effects on property in terms of the numbers of homes, shops, factories, and institutions that would be damaged if 1987 and 1988 scale floods in 1990 and 2010.

Table 7.7

Estimated Physical Damage to Properties in 1990 and 2010

	1990				2010			
	Houses	Shops	Factories	Inst.	Houses	Shops	Factories	Inst.
Scale of flood 1987	274611	8354	882	8223	424790	14093	1344	14643
Scale of flood 1988	685360	17423	1532	19698	963850	27380	2307	31096

7.6.3 Estimated Flood Damage Avoidance Benefits

As was mentioned earlier, the economic benefits arising from the prevention of flood damage can be estimated based on the amount of the losses that would otherwise occur. The value of the estimated physical losses from potential future 1987 and 1988 scale floods (as listed in Table 7.6) is presented in Table 7.8 below.

Table 7.8

Value of Estimated Damage to Properties in 1990 and 2010

(Million Tk.)

	1990 (year)	2010 (year)
Scale of flood - 1987	2723.50	8603.30
Scale of flood - 1988	7917.80	24703.70
Average annual flood	1174.70	3408.00

These estimates, however, understate the flood damage that is avoided because they don't include damage to infrastructure, vehicles and livestock. According to the aforementioned survey, flood damage to these items accounted for 20% of total damage in 1987 and 24% in 1988. As a result, an additional allowance of 20% has been taken by JICA.

Therefore, if the flood protection and drainage scheme were not implemented before the year 2010, potential flood damage would be as presented below in Table 7.9. Flood damage for each of the intervening years has been calculated using a regression analysis based on the JICA projections.

Though the current embankment offers little protection against potential major floods, some benefits are accounted for by this sunk investment. Therefore, the flood damage avoidance benefits arising from the Project have been estimated at 75% of potential flood damage to the Dhaka West area. In the case of Dhaka East, 100% of potential flood damage is taken as a benefit because no current embankment exists.

Table 7.9

Benefits from Flood Damage Avoidance
(Million Tk.)

Project	1987 - Scale Flood	1988 - Scale Flood	Avg. Annual Flood
Year 1990			
C. Dhaka West	2,419.1	7,605.9	1,042.6
C. Dhaka East	745.6	2,548.2	326.1
Total :	3,164.7	10,154.1	1,368.7
Year 2010			
C. Dhaka West	6,525.4	19,448.5	2,787.4
C. Dhaka East	2,917.7	10,122.8	1,279.7
Total :	9,443.1	29,571.3	4,067.1

7.7 Economic Evaluation of DIFPP

7.7.1 Assumptions

The economic life of the Dhaka Integrated Flood Protection Project (DIFPP) (including Phase One) has been assumed to be 20 years. The opportunity cost of land has been assumed to be equal to the current market price of land. Benefits arising out of flood damage avoidance has also been adjusted with the standard conversion factor. All other costs are treated as net of duty and taxes. A standard conversion factor of 0.82 (taken from the GOB Planning Commission's Guidelines) has been used for all local currency costs.

The salvage value of land (100%) and civil works (5%) has been added with the benefit of the last year of the project life. The opportunity cost of capital is assumed to be 12%.

362

The Economic Internal Rates of Return (EIRR) have been calculated separately for DIFPP as a whole and also for the recommended Project, the westerly half or Phase 1 of DIFPP. The costs for the remaining work to be undertaken after Phase 1 is completed include projected costs. It is assumed that the work in East Dhaka will commence in 1997/98 and will last (5) years.

For both cases Phase One and DIFPP as a whole, three combinations of the benefits discussed above have been considered, including: (i) increase in land values; (ii) avoidance of flood damage; and (iii) a combination of increase in land values and avoidance of flood damage. The assumptions made in calculating these benefits have already been discussed in Sections 7.5 and 7.6. Benefits have only been included beginning in the 5th year (1996-97).

7.7.2 Calculation of EIRR:

For the DIFPP as a whole, the estimated EIRR's are as follow:

i) when benefits for both an increase in land value and avoidance of flood damage are used, they provide a hefty EIRR of 37.17%, and a very positive NPV of the Project when the benefits stream is discounted at 12%;

ii) on the basis of increase in land value alone, the EIRR is 29.13%, which is more than double the opportunity cost of capital and also represents a very positive NPV; and

iii) on the basis of avoidance of flood damages alone, the EIRR of DIFPP has been calculated at 10.89%, which is lower than the opportunity cost of capital.

The estimated EIRR's of the recommended Dhaka Integrated Flood Protection Project (Phase 1 of the overall scheme) are as follow:

i) a combination of benefits provides a very high EIRR of 43.26%, and a very high positive NPV of the Project, when the benefits stream is discounted at 12%;

ii) on the basis of increase in land value alone, the EIRR is also very high at 37.50%, which represents a positive NPV; and

iii) on the basis of avoidance of flood damage alone, the ERR of Dhaka West has been estimated at 17.41% which is over 5% higher than the opportunity cost of capital. When discounted at 12%, the net benefits stream also shows a positive NPV for the Project.

Detailed calculations for the overall DIFPP and for the recommended Project are shown in Appendix 8.

7.7.3 Sensitivity Analysis

A sensitivity analysis was carried out to test the EIRR of the overall DIFPP and the recommended Project. The analysis measures the impact of changes in the following variables: (i) that there will be a slippage of one year in the benefit streams; (ii) assuming a 10% decrease in the benefits; and (iii) assuming a 10% increase in costs. The results of the analysis pertaining to the case when both benefits are considered together are shown in Tables 7.10 and 7.11. Details of the calculations for these and the other cases are given in Appendix 8.

Table 7.10

EIRR and Sensitivity Analysis - DIFPP

Assumptions	EIRR
Original Calculation of EIRR	37.17%
10% decr[illegible] benefits	34.29%
10% increase in Costs	34.63%
10% decrease - Benefits & 10% increase - Costs	31.82%
One year delay - Benefits	30.08%
10% increase in costs & benefits delayed by one year	28.12%
10% decrease in benefits & benefits delayed by one year	27.82%

Table 7.11

EIRR and Sensitivity Analysis - Phase One (Dhaka West)

Assumptions	EIRR
Original Calculation of EIRR	43.26%
10% decrease in Benefits	40.85%
10% increase i[illegible]	41.12%
10% decrease - Benefits & 10% increase - Costs	38.78%
One year delay - Benefits	36.36%
10% increase in costs as benefits delayed by one year	34.68%
10% decrease in benefits & benefits delayed by one year	34.44%

208

7.7.4 Conclusions

The estimated EIRR's and sensitivity analysis provided above indicate that both the recommended Project (Phase 1), and the DIFPP as a whole, are attractive and economically viable.

In addition, the recommended Project (Phase 1) is clearly justified as of being of primary importance within the overall flood protection and drainage scheme because of its higher EIRR's in comparison to the project as a whole. This is a reflection of: (i) the lower completion costs involved in protecting Dhaka West alone; and (ii) the larger benefits derived from protecting the more valuable existing assets in that portion of the city from future flood damage. Though the EIRR is very high when both benefits are considered, it must be stressed once again that the benefits were estimated very conservatively. The importance of flood protection for the country's primary city should not be underestimated.

7.8 Economic Evaluation of the Slum Improvement Component

7.8.1 Introduction

The Slum Improvement component will cost $2.4 million and is divided into two activities. The first includes the provision of basic low-cost water supply, sanitation, footpaths, street lighting, roadside drainage, and solid waste storage in slum areas to the benefit of approximately 8,000 families. The second includes providing basic services to complete the partially built homes (City Pallis) of the families of 725 part-time municipal workers currently squatting on public properties. Because these activities are of entirely different natures, they are considered separately.

An economic analysis for the first of these activities is presented below. The City-Pallis activity is justified under the Project because it will serve two important purposes: (i) to remove squatters who are currently blocking key drainage canals; and (ii) to assist these squatters (who are homeless part-time city workers) in meeting their basic needs. These workers are directly responsible at the neighborhood level for many of the sanitation and solid waste activities which will be important to the success of the Project.

7.8.2 Methods and Assumptions

As with the earlier analysis presented in this chapter, the asset value approach to measuring the benefits of this component of the Project was adopted. The benefits from slum improvement are estimated through rental value increases that result from this activity.

Because the specific slum areas that will benefit have not yet been defined, it was not possible to calculate detailed value increases. As a result, assumptions were made as for similar ADB supported slum improvement programs in Bangladesh within the Secondary Towns Infrastructure and Services Development Project using an assumed rental value increase of 25%.

Economic local currency costs and benefits have been shadow priced using a standard conversion factor of 0.82. Recurring costs have been assumed at 2% of capital costs. It is also assumed that most of the maintenance will be carried out by the beneficiaries of the Project. The economic life of the Project has been estimated at 20 years.

7.8.3 Evaluation Results and Conclusions

The estimated EIRR for this component of the Project was found to be 17.60%, which when discounted at 12% yields a positive NPV (see Appendix 9).

In particular, the investment becomes worthwhile when considering the positive health effects of improved water supply, sanitation, and solid waste management.

7.9 Financial Analysis

Financial analyses have been prepared for portions of the Environmental portion (Part C) of the Project; namely the solid waste subcomponent and the local Sanitation activities. The DCC does not have cost recovery mechanisms for the other activities in Part C.

The Water Supply activities primarily consist of the provision of standpipes to low income dwellers. Though DCC provides the standpipes, the costs involved are recovered as part of the water bills that are collected by DWASA. The Local Drainage activities carried out by DCC are usually financed out of the conservancy charges associated with Solid Waste Collection. An economic analysis of the Slum Improvement sub-component was provided above. The affordability to DCC of carrying out all these activities has been checked in the budgetary projections provided in Appendix 11.

7.9.1 Solid Waste Component

The Solid Waste component of Part C of Stage One of the Project is expected to cost Tk. 191.03 million during the five years of Project implementation. Vehicles provided in the Project have an estimated useable life of 8 years and replacement costs have been included. Recurring O&M costs have been estimated at 14% of total capital costs per year, or Tk. 18.31 million per year. Thus, total recurring costs will be Tk. 315.85 and the total cost used in calculating the financial internal rate of return is Tk. 545.76 million which includes appropriate replacement costs in 11th, 12th and 13th years.

The primary source of benefits will derive from the conservancy fees charged by DCC for solid waste collection on holdings covered by the trucks that are provided by the Project. It is assumed that coverage will increase at the rate of 10%, 20% and 30% of holdings from 1994-95 to 1996-97. Because the conservancy fees finance some non solid waste activities, only 75% of the conservancy fees is included as a benefit.

Conservancy fees are estimated at the rate of 6% of the rental value per holding. Though the current rate is 3%, it is expected that the rates will increase from 1996-97. This increase in the conservancy fee rate is based on a covenant of a current IBRD project. Total benefits used in calculating the FIRR are Tk. 921.69 million.

No benefits or costs are included for the landfilling. The solid waste collected as a result of the Project will be disposed in a large landfill which will not be sold until after the estimated Project life. Costs are not included to avoid double counting because the Project itself is providing the equipment and O&M for landfilling this solid waste.

Based on these assumptions, the estimated FIRR is positive at 18.43%. The robustness of this result was tested through a sensitivity analysis involving a 10% decrease in benefits, a 10% increase in costs, and a one year slippage in the realization of these benefits. As can be seen in Table 7.12 below, the FIRRs remain positive throughout, though they do become quite low. Calculations are provided in Appendix 10.

Table 7.12

FIRR and Sensitivity Analysis - Solid Waste

Assumptions	FIRR
Original Calculation of FIRR	18.43%
10% decrease in Benefits	14.63%
10% increase in Costs	16.31%
10% decrease - Benefits & 10% increase - Costs	12.67%
One year delay - Benefits	13.26%
10% increase in costs and benefits delayed by one year	11.72%
10% decrease in benefits & benefits delayed by one year	10.29%

7.9.2 Local Sanitation Activities

Local Sanitation activities within Part C of the Project consist of the provision of latrines, public toilets and mobile public toilets. The economic life of the Sanitation, Water and Local Drainage component of Part C of the Project is assumed at 20 years.

These activities are expected to cost Tk. 58.42 million during the five years of Project implementation and necessary replacements in 10th and 11th years. Recurring O&M costs over the remaining 15 years of the assumed economic life of the Project have been estimated at 2% of the cost of civil works and Tk. 0.48 million per year for vehicles. Thus, total recurring costs will be Tk. 26.39 and the total cost used in calculating the financial int...nal rate of return is Tk. 84.81 million.

Benefits are estimated as the sum of the income provided by sales, rentals, or user fees that will be applied to the services rendered under this component of the Project. These user fees have bees estimated as follows:

- Fees on use of public toilets: 30 toilets at Tk. 400 per day each one, for 365 days a year.

- Rental fees for mobile public toilets: 5 toilets at Tk. 300 per day, for 182.5 days a year.

- Sale of sanitary latrines: 2,500 twin pit latrines at about Tk. 4000 each and 3000 single pit latrines at about Tk 3000 each. Income will be received in the form of a down payment of 20%, with the remainder paid over two years at an interest rate of 18% per year.

- The desludging trucks will charge Tk 500 per trip, 2 trips per day, 300 days a year.

Based on these assumptions, the estimated FIRR is 9.10%. This result was tested through a ...sitivity analysis involving a 10% decrease in benefits, a 10% increase in costs, and a one year slippage in the realization of these benefits, as shown in Table 7.13. Calculations are provided in Appendix 10.

Table 7.13

FIRR and Sensitivity Analysis - Sanitation

Assumptions	FIRR
Original Calculation of FIRR	9.10%
10% decrease in Benefits	5.95%
10% increase in Costs	6.82%
10% decrease - Benefits & 10% increase - Costs	3.99%
One year delay - Benefits	6.50%
10% increase in costs and benefits delayed by one year	4.78%
10% decrease in benefits and benefits delayed by one year	4.04%

265

Though the FIRR is not very high, it is important to consider the positive environmental and health effects which are not included in this financial analysis. If expected costs or benefits change to cause a negative financial return, the option of increasing the user fees associated with the Sanitation activities is not necessarily a good idea. Other projects which have provided latrines at cost have had problems in that the beneficiaries who most need them tend to be those who can least afford them. The fees associated with the public toilets are already set at a high level. Therefore, if necessary, it may be preferable that these activities be funded through the proposed increase in the conservancy fees.

7.10 Affordability to Implementing Institutions

The affordability of the Project to DCC, DWASA and the central government has been discussed in the section on cost recovery (Section 6.5). This discussion was based, in part, on the financial projections for DCC and DWASA provided in Appendix 11.

Financial projections of DCC, based on actual performance of the last few years and the budget of the current year, as well as assumptions made for the projection, indicate that subject to satisfactory financial management and revenue recovery, the D.C.C. will be able to service the debts and maintain the development needed for providing the civic amenities. The corporation will have a comfortable cash flow during the next ten years.

The Projection of Income Statement and Cash Flow of DWASA, based mainly on the data available from the DWASA sources and the IDA projection, shows that although the Authority will have sufficient cash flow to maintain the current proposed activities, it will need GOB assistance to maintain the drainage system until such time as additional revenues are generated.

If the cost recovery recommendations that have been agreed to are carried out, then these [illegible]ies will be able to cover Project costs.

7.11 Affordability to Households

The poorest segment of the city dwellers live in slums. Most of the costs related to slum improvements are, however, not proposed to be borne directly by them. Moreover, the lowest income groups do not usually own land or households within the city, and indirect cost recovery opportunities from this group are small. Accordingly, the bulk of the indirect cost recovery will come from the middle to higher income groups, who are the majority private property owners in the City, through additional landholding taxes or conservancy fees, whichever may be the case. At present the average annual conservancy fee has been estimated at approximately Tk. 881.00 per holding, and in order to meet the debt servicing and the O&M costs of the proposed improvements it is estimated that an increase of approximately Tk. 190.00 per holding in conservancy fees will be required. This represents less than a one third increase to the existing conservancy fees, and is less than the fee increases already proposed to be implemented by DCC. Accordingly, the proposed Project will not necessitate any additional charges to be made, and is judged to be affordable to the City households.

8.0 RISK ANALYSIS AND RECOMMENDATIONS

8.1 Major Risks

The main risks which have been assessed during preparation of the Project include the following:

a) delays in Project start-up due to slow recruitment of staff and establishment of the PMO;

b) delays in recruitment of consultants, preparation of detailed engineering designs and award of contracts for the first years work programs;

c) delays in prequalifying contractors and suppliers, and/or delays in tendering and contract award, leading to delayed construction starts;

d) delays in implementation scheduling due to lack of inter-agency coordination, inadequate local fund allocations, protracted land acquisition delays, poor contractor performance, etc.;

e) insufficient quality and/or financial controls during construction to assure proper contractor performance and satisfactory construction of facilities;

f) inability of the implementing agencies to fulfill all of the staffing requirements resulting in poor coordination and delayed implementation of the proposed investment program,

g) slow progress in effecting the institutional improvements under ongoing UNDP/UNCHS/World Bank assistance, leading to improved financial management by DCC/DWASA;

h) failure to develop acceptable methods and/or levels of cost recovery adequate to support the annual costs of the required operations and management of the facilities;

i) failure to take full advantage of cost recovery opportunities created by an increase in land values that will accompany the development of previously flood prone low-lying areas;

j) failure to develop appropriate O&M procedures, or to provide adequate staffing, equipment or levels of funding for recurrent operations and maintenance needs.

8.2 Recommendations for Safeguarding Against Risks

In general, the Project has been formulated in a manner designed to safeguard against or minimize the above risks. The project team has worked closely with the implementing agencies and the ADB to develop realistic and achievable action plans, and to develop technically appropriate solutions to the unique problems associated with the Project. The Project proposals are in accordance with the national development objectives and have received the full support of the Government.

The proposed implementation schedules have taken into consideration the complex nature of the proposed investments and the flow of work has been designed so that the work loads are lightest in the first and last years of the project to: (i) allow the implementing agencies adequate time to establish their systems and procedures before the full impact of the enhanced development activities come on-stream; and (ii) to allow adequate time for completion of any carry-over works in the last program year should implementation be delayed during the course of the Project. The need for particular attention to ensuring proper contractor performance and quality control during construction is fully recognized and agreed by all parties.

In spite of this, however, the first program year is going to be one of the hardest and most critical years for getting the Project off to an effective start. The success of the first year program will be wholly dependent upon early action by the government and implementing agencies, and close adherence to the Preconstruction and Preparatory Activities described in Chapter 10 will be essential for a successful start to the entire Project.

The following Table 8.1, Action Plan, presents a time bound institutional and financial action plan designed to meet some of the concerns, including: (i) improving inter-agency coordination in planning and implementation of the development programs; (ii) identifying and removing constraints in the functioning of the city economy; (iii) improving/facilitating greater private sector activity; and improving urban management and O&M practices. This plan has been reviewed and agreed by the government during the Bank Appraisal Mission, and will be reviewed and updated annually during Project implementation. In addition, a time bound land acquisition schedule, as presented in Chapter 5, has been developed in coordination with the implementing agencies during Project Appraisal.

Risks associated with land management and a possible failure to take full advantage of the cost recovery opportunities that will arise from the development of low-lying areas will be reduced through a specific technical assistance program that is detailed in Chapter 11.

282

Table 8.1

ACTION PLAN

Objective/Task	Action By	Completion Date
I. INTER-AGENCY COORDINATION		
1. Formulate along term institutional arrangements for inter-agency coordination for urban development activities in Dhaka and obtain Government approval for implementation.	PC	31 December 1992
II. PROJECT IMPLEMENTATION		
1. Establish PMO, appoint PD, designate key staff and arrange support facilities.	MIWDFC	Before loan effectivity.
2. Complete staff deployment/ consultant recruitment.	PMO	Within six months of loan effectivity.
3. Develop Operational details of implementation of (a) slum improvement program, (b) management of stand pipes.	DCC	31 December 1992
III. DEVELOP O&M CAPABILITY		
1. Establish detailed O&M procedures.	BWDB/DWASA/DCC	31 March 1992
2. Prepare multiyear O&M program (staff/equipment/finance).	-do-	30 June 1992
3. Implement periodic and special maintenance program.	-do-	Throughout the Project.
4. Develop staff O&M training program.	-do-	-do-

	Objective/Task	Action By	Completion Date
IV.	STRENGTHENING OF FINANCIAL MANAGEMENT		
	1. Improvement in local revenue mobilization : establish a detailed plan with time-bound annual growth targets based on improvements in collection of arrears, reassessment of property values, property tax mapping, improving collection of current taxes, better cost recovery practices, and control of operating costs.	DCC	31 December 1992
	2. Installation and progress report on improved financial accounting, budgeting and planning systems (including computerization).	DCC/DWASA	31 December 1992
V.	URBAN MANAGEMENT		
	1. Formulate proposals for (a) privatization of urban infrastructure services, including billings and collection of taxes and charges and O&M, and devise a program of phased implementation; and (b) better cooperative framework for public-private sector operations in the Dhaka Metropolitan Area.	DCC/DWASA	31 December 1992
	2. Develop urban land development controls for Dhaka including (a) land development standards, regulations and control mechanisms and (b) rationalize the use of Government-owned lands.	RAJUK (in association with Ministry of Land and DCC)	30 June 1993
VI.	COST RECOVERY		
	1. Timely reclassification of agricultural land in the Project area into non-agricultural land (residential, commercial, industrial, etc) in conjunction with the phased implementation of the Project.	RAJUK and Ministry of Land	1. Based on an actual survey of land use, reclassify all agricultural land currently under urban use to urban by 30 June, 1992.

28

Objective/Task	Action By	Completion Date
		2. Reclassify an average of 140 ha of agricultural land to urban (in line with consultants projections) by 30 June each year. 3. Following completion of UNDP Land Use Master Plan, reclassify according to recommendations of the Master Plan.
2. Work out operational details of the program for conversion of land development tax from area base to "ad valorem".	Ministry of Land in consultation with Ministries of Works, Finance and Local Government, RAJUK and DCC	30 June 1992
3. Implement land development tax on "ad valorem" basis.	-do-	Date to be agreed with the Bank
4. Levy drainage surcharge on water bills to cover the O&M costs of the drainage component and debt servicing.	DWASA and LGD	30 June 1992
5. Adjust charges for solid waste/conservancy.	DCC and LGD	30 June 1992
6. Adjust Development Fees for private land developers.	RAJUK and MOW	30 June 1993

9.0 ENVIRONMENTAL IMPACT ASSESSMENT

9.1 Introduction

The Dhaka Integrated Flood Protection Project (FAP-8B), is part of the Bangladesh Flood Action Plan (FAP). Based on recommendations of the Committee for Flood Control and Drainage of Greater Dhaka as approved in March 1989, the complete flood protection scheme for Dhaka City involves: (i) construction of embankments and flood protection walls along the Tongi Khal, Turag and Buriganga rivers, Dhaka-Narayanganj roads and Balu river to protect the Dhaka City Corporation area of around 265 sq km; (ii) raising and new construction of internal roads cum embankments; (iii) installation of pumping stations to drain internal water; and (iv) re-excavation and restoration of 12 drainage canals.

During 1989-90, considerable work, costing Tk. 4,000 million, was undertaken by GOB on the first phase of the scheme, covering the highly urbanized westerly half of the city with about 87% of the population, using its own resources. This includes construction of westerly embankments and flood walls, some of the programmed pipe sluices, road construction and raising, flood protection of the international airport and restoration of sewerage works in the city. However, most of this work was started without adequate investigation, coordination and quality control. As a result there have been some serious failures and erosion of large sections of the embankment, drainage congestion due to blocking of the natural drainage paths, and objections to the construction from taxpayers in the old Dhaka area where businesses are seen to be affected. The flood control and drainage system is not yet complete, nor is it operative. For the benefits to be realized and for the system to be made secure, it is essential that construction deficiencies be corrected, flood protection and drainage venting works be completed, and improvements to the internal drainage system be done. These activities are planned under the Project, as part of a longer term program.

The cost of integrated flood protection of Dhaka to protect the entire city from floods of 100 year frequency is estimated at over $450 million. In view of the large investment requirements, the flood protection program will need to be phased over a period of 10-15 years. In planning the phasing of the flood protection program, cost-effectiveness of investments has been considered: protecting the densely populated/existing industrial and commercial areas is the first priority; followed by increased pumping capacity and increased safety. Such an approach will: (i) give the Government more time to develop appropriate urban land management policies for newly urbanizing areas; (ii) improve economic justification as land value increases take place; and (iii) permit an incremental approach to flood protection in line with affordability of investments.

A feasibility study for the integrated flood protection of Dhaka, financed by ADB, commenced in January 1991. The project is being formulated in the context of an Integrated Environmental Management Plan (IEMP) completed in May 1991, presented in Interim Report No. 1, and summarized in Chapter 3 of this report. Following completion of the feasibility study in July

1991, consultant assistance in project refinement and detailed engineering continues until September 1991. This environmental impact assessment (EIA) is based on: (i) evaluations prepared by the consulting team under the Bank TA, as presented in the Inception Report and Interim Report No. 1; (ii) comments provided by the Flood Plan Coordination Organization (FPCO) interministerial review panel; (iii) comments of the Bank Office of the Environment; and (iv) the Progress EIA (PEIA) for the government-funded flood protection improvements prepared by the Department of Environment (DOE) in 1989-90. The latter document and this EIA were prepared with the assistance of Bank-financed consultants under the National Environmental Monitoring and Pollution Control Project.

9.2 Description of The Project

The Project relates to Dhaka, the national capital, which is estimated to have a population of about 6 million in the metropolitan area (DMA). The area under the responsibility of the Dhaka City Corporation (DCC), covering an area of 265 sq km, contains an estimated population of 4.8 million. Most of the population of the city is concentrated in the western part; the eastern part of the city is less dense, with considerable areas still under agricultural and non-urban uses. The Project covers the most densely populated western part of the Dhaka city comprising about 136 sq km, which accommodates a population of 4.2 million or some 87 percent of the city population.

The underlying rationale for the Project is to improve the urban efficiencies and environmental conditions (particularly for the urban poor) in Dhaka City for promotion of sustainable long term economic development. The objective of the Project is to undertake an integrated urban development program consisting of: (i) flood control and drainage works; (ii) complementary environmental improvement programs in low cost water supply and sanitation programs for low income residents, solid waste management, slum and squatter area improvement, and pollution abatement; and (iii) institutional strengthening for improved efficiencies in urban management and revenue generation. The IEMP has been formulated as a long term integrated development strategy for Dhaka, requiring close coordination and integration of parallel programs for optimum success. Also, the Project has been formulated in the context of an overall Flood Action Plan (FAP) coordinated by the FPCO of the Government of Bangladesh (GOB). In particular, intensive coordination with the JICA Drainage Master Plan, and FPCO guidelines for economic analysis and environmental impact assessment of flood control projects, has guided and will continue to guide formulation of the Project.

The proposed Project involves implementation of recommendations from the project preparatory technical assistance (ADB TA 1318-BAN). Table 9.1 itemizes the agreed Project components and the agencies of the GOB responsible for their implementation. The central component involves flood control and drainage, including: (i) remedial work for repair of embankments constructed by GOB (some of which require re-building) together with an additional pumping station and sluices, and an operations and maintenance program; (ii) remediation of primary and secondary drainage channels within the Dhaka area; and (iii) improvement of the central spine road. The flood protection component is being developed in conjunction with the drainage master plan for Dhaka (FAP-8A, under JICA) and includes development of standards for drainage works, as well as operations and maintenance guidelines and procedures.

Table 9.1

SUMMARY OF AGREED PROGRAMS

DESCRIPTION	LEAD AGENCY
FLOOD CONTROL AND DRAINAGE	
Prepare Drainage Development Standards	PMO
Prepare Operation & Maintenance Guidelines/Procedures	BWDB/PMO
Repair/Complete Westerly Embankments/Walls	BWDB
Raise Internal N-S Road System	RAJUK
Construct Sluices/Closures Along Easterly N-S Road	BWDB
Construct first stage of Pump Station 3 at Goran Chatbari	BWDB
Rehabilitate/Upgrade Main Drain System	DWASA
Rehabilitate/Upgrade Secondary Drain System	DWASA
Rehabilitate/Upgrade Local Drain System	DCC
Provide Temporary Pumping Facilities	BWDB/BADC
WATER SUPPLY AND SANITATION	
Urgent Water Supply for Slum and Squatter Areas	DCC/DWASA
Low Cost Sanitation Program	DCC
Septic Tank Desludging and Control Program	DCC/DWASA
Public Information Program	PMO/DOE
SOLID WASTE MANAGEMENT	
Local Collection Rehabilitation & Expansion Program	DCC
Training and Health Equipment for Sanitation Workers	DCC
SLUM AND SQUATTER AREA IMPROVEMENTS	
Comprehensive Slum Improvement Program	DCC
TRAINING AND INSTITUTIONAL STRENGTHENING	
Solid Waste Operations and Management Strengthening	DCC
Review of Govt. Land Ownership & Land Use Policies	RAJUK
Review of Development Policies, Controls & Legislation	RAJUK

The complementary environmental improvement program includes water supply, solid waste management and slum area improvements. The water supply and sanitation component involves provision of standpipes and a low cost sanitation program mainly for slum settlements. A program for desludging septic tanks and control of sludge from these sources is also proposed. Finally, a public information component is included to heighten awareness of public health issues associated with water supply and sanitation.

Solid waste management involves rehabilitation of local collection stations (trash bins), supply of trucks and handling equipment, expansion of solid waste disposal services into new areas, and upgrading of worker conditions through training and provision of health equipment.

Slum and squatter area improvements will be introduced using techniques based on the UNICEF approach, in which local involvement is stimulated, and local residents are given significant continuing roles in the management of slum areas.

The Project is scheduled to commence in the current 1991-92 financial year. Urgent flood protection and drainage improvement components are to receive priority attention, with completion scheduled within the first three years, while the entire Project is to be completed over a five year period.

9.3 Description of the Environment

9.3.1 Physical Resources

Dhaka City is comprised of flat terrain seldom varying more than 4 m in elevation. The City is surrounded by waterways and interlaced with natural drainage channels and lakes which make up 19% of the total land area of 265 sq km. Deltaic soil types predominate, and are variable within a limited range, including clays, silty clays and sand at varying depths. Traditional land uses exploited the natural fertility of the soil, brought about by annual inundation from the region's major river systems. Soils remain saturated most of the year. Deep aquifers yield plentiful supplies of groundwater, the source of most of the city's water supply.

9.3.2 Ecological Resources

The area has bountiful vegetation typical of a settled and tropical environment. Native ecology has almost entirely been displaced by agricultural and urban land uses. Aquatic life in the major waterways is affected by human pollutants, yet still is relatively plentiful. Secondary waterways, lakes and natural drainage channels within the circumference of the major rivers may harbor fish, depending on their proximity to urban wastewater discharges. Many of these internal waterways are devoid of aquatic life due to pollution loads.

9.3.3 Human and Economic Development

By 1990, 39% of the land area within Dhaka City was in urban use, with the balance considered rural or semi-rural. The current population residing within the Dhaka City Corporation is estimated to be 4.8 million, with surrounding areas containing an additional 2.2 million people. About 25% to 30% of the urban population are low income slum and squatter dwellers.

Industrial activities include tanneries, textile manufacturers, pharmaceutical plants, steel mills, and a variety of other small and medium industrial units. Industrial zones within the City include Hazaribagh and Tejgaon, with a scattering of activities within Old Dhaka.

Infrastructure is typical of an urban setting. Many aspects of infrastructure are either non-existent or in degraded condition, such as systems for sewage collection and treatment (serving 15% to 20% of the population), water supply (serving 60%), drainage and solid waste handling and disposal.

Infrastructure, planning and management of Dhaka City is provided by the Dhaka City Corporation (DCC), the Dhaka Water and Sewage Authority (DWASA), and the Capital Development Authority (RAJUK). Being the capital of Bangladesh, many Government agencies are located in Dhaka and have roles in management of internal affairs. The project will be implemented by the Bangladesh Water Development Board (BWDB), DCC and DWASA, with assistance from RAJUK and the Department of Environment (DOE).

9.3.4 Quality of Life Values

A wide diversity of income levels exists among the residents of Dhaka, which is perhaps best reflected in land use. There is a low proportion of parks, roads, commercial and industrial areas in comparison to major residential use; the prevalence of densely populated slums and squatter areas housing a third of the population; and the disproportionately large areas used for housing upper income groups.

Public health is a critical cause for concern within the area. Child mortality among slum dwellers is in the range of 130 to 160 deaths per thousand population, three times the levels found among upper income groups within the study area. The conditions within slum communities with respect to sanitation, water supply and solid waste are particularly acute.

The low-lying elevations within the City are subjected to annual flooding. Floods in 1987 and 1988 caused excessive hardship and loss of life. About 200 sq km, or 75% of the total area of 265 sq km, were submerged to depths ranging from 0.3 meters to over 4.5 meters and about 2.5 million people, or 60% of the city population were directly affected by these floods.

90

9.4 Anticipated Environmental Impacts and Mitigation Measures

9.4.1 Flood Control and Drainage

The Project is geared to rectifying environmental, safety and quality of life issues that were raised concerning the national government initiative on flood protection and drainage for the Dhaka area. The project is oriented toward remediation of inadequate design and construction, and in addition makes significant contributions toward solution of pervasive environmental issues within Dhaka City, all of which are linked. Chapter 11 of the FAP-8B Interim Report No. 1 (May 1991) directly addresses the environmental, safety and qu lity of life issues of the flood protection and drainage component. Only a brief summary is included here.

The potentially disastrous impacts of a breach in the embankment/wall could be worse than the current situation as a breach would be sudden and unexpected and people would not have time to move out of the flood wave. While the highest standards of engineering design and construction quality control will be adopted, some additional studies of risk assessment, time to maximum flood after a breach, and assessment of damage potential are recommended. Review of the engineering design to minimize potential damage, development of land use controls, and possible compartmentalizing of potentially flooded areas are also proposed as a part of the Project. In addition to all of these precautions, prior to putting the flood protection system into operation, an emergency management plan under FAP-11 (Flood Disaster Preparedness Program) will be developed and tested.

Location of the original embankments gave inadequate attention to social impacts, resulting in threats to the safety and effectiveness of the flood protection works due to people cutting sections of the dikes and walls, as well as severance of properties causing extreme problems for some residents. New dike/wall alignments will be based on social and engineering considerations, with all communities along proposed alignments surveyed and mapped, and mitigation measures proposed following an extensive program of public participation. Compensation and assistance with resettlement will also be required for affected families.

Without careful design, the flood protection proposals could cause some negative impacts on the city's stormwater drainage system. However it is proposed that drainage design would take into account the current drainage patterns and through excavation of previously blocked drains would generally improve the drainage situation. The need for some retention ponds as part of the flood control system behind the embankments/walls will result in pools of water which could stagnate and lead to increased insect populations, such as mosquitoes, and associated disease problems. Ponds will be monitored for harmful insects, and drained and/or sprayed if necessary. It is suggested that retention ponds and other semi-permanent water bodies should be landscaped and used to increase the area of public open space in the city.

270

Concern has been expressed that communities outside the protected area may be made worse off in the event of a flood. Backwater curves for areas outside the walls will be checked and remedial actions taken if necessary. Excluded communities should be included in the public participation process, so that they can be educated about the project, express any concerns and offer possible remedial measures which they would like to see implemented.

As already observed in Dhaka, people will migrate into the protected areas and even build residences on the embankment. A study of migration patterns will be undertaken to determine the likely extent and settlement pattern of new migrants into the protected areas. Measures to discourage migration to the protected area at an unacceptable rate or into undesirable areas will be adopted through appropriate land use controls.

The construction of dikes and walls will block some waterways serving commercial boat traffic and cut a number of establishments off from their transportation routes. The most important case is the Gajaria Khal connecting to the Balu River, which is proposed to be closed in the long-term flood protection plan proposals. A lock or substitute access road is being considered for this area.

The impacts on aquatic life, especially fish, are not clear, although likely to be negative as the various species have probably adapted to the current flooding regime. A detailed study is proposed under FAP-16 (Environmental Study) with possible mitigation measures to include some degree of controlled flooding in certain areas.

The remaining environmental management components of the project are benign in the sense that each directly confronts existing environmental, sanitation, public health and human habitation shortcomings. It is important to consider the secondary impacts that may develop around the environmental components of the proposed investment projects. However further details on these components are required to provide a basis for environmental assessment. Some recommendations can be made for incorporation into future terms of reference for these project components. In addition, further environmental assessments of appropriate content and scope may be needed for each component, and should be prepared during their design stages. In most cases, adequate consideration of good engineering design principles and incorporation of local expectations and patterns of use will be sufficient to assure maximum functionality and minimum levels of secondary environmental impact.

9.4.2 Water Supply and Sanitation

The sub-components under this sector include management studies, dissemination of information concerning public health, and small-scale infrastructure improvements. The first two types of work have no direct environmental consequences related to execution. The infrastructure work may have secondary impacts, even though the overall effects are benign. These are considered in the following paragraphs.

(a) Urgent Water Supply for Slum and Squatter Areas:

The work will involve extension of water distribution piping into slum areas and provision of approximately one stand pipe for every ten households. Possible environmental impacts include:

(i) disruption of paths of travel during pipe laying and possible easement problems. Both these impacts are minor in comparison to the benefits gained by people inhabiting the service area. The small scale technology needed for this work will lead to only temporary disruption during construction. Acquisition of easements may impact individual households; however the temporary dwellings in these areas can be relocated to nearby areas. The project should guarantee settlement rights in nearby areas for individual households that are affected by the location of the pipe alignment.

(ii) bacteriological contamination of installed water supplies due to low water pressure. This problem exists throughout Dhaka City at the present, and the piped water supplies will provide far better sources of water to the slum dwellers than are presently available to them. Nevertheless the design of the system should incorporate materials and workmanship that will prevent line leakage and guarantee safe quality of water at least from the point of take-off from existing distribution mains.

(iii) unsanitary conditions in the immediate vicinity of the stand-pipes due to leakage, continually flowing taps or inadequate drainage. The design of the distribution points should incorporate good local area drainage, concrete aprons at a higher grade than the surrounding ground elevation, and improved footpaths to the location. Long-life, positive shut-off valves that are designed for intensive use should be incorporated into the project specifications.

(b) Low Cost Sanitation Program:

This component consists of (i) installing twin-pit water seal latrines in slum areas, (ii) construction of community sanitation latrines in public areas, and (iii) improvement of existing on-site disposal systems to reduce or eliminate the discharge or overspill of partially treated human wastes. Because these elements do not involve routing of buried sewer lines, little or no disruption during the construction phase is anticipated. Potential environmental impacts are mainly concerned with use of the facilities, as follows:

(i) unsanitary conditions will develop either within or in the immediate area of the latrines. Generally this has not been a problem for the existing community latrines in Dhaka City, as these are privately operated, a fee is charged for the service, and a lease/royalty is due the Dhaka municipality. Operators maintain generally clean conditions. Twin-pit water seal latrines in slum areas may develop

202

unsanitary conditions due to over-use and maintenance neglect. The project should ensure proper education of the beneficiaries, including information on proper operating procedures for maintenance, such as desludging and wash-down, and beneficial uses for the degraded wastes. The design should provide easy access for desludging.

(ii) insect vectors could affect those living nearby. The pits for the latrines will be sealed to prevent free movement of insects.

(iii) disposal of residues from desludging will need to be handled properly. This issue is addressed as part of the septic tank desludging component in item 4.2 (c).

(c) <u>Septic Tank Desludging and Control Program:</u>

This element involves initiating a long term municipal program for desludging of septic tanks in the Dhaka area, and transport of the sludge to the Pagla Treatment Plant for disposal. This proposal will have direct positive benefits in performance of on-site treatment units. Negative impacts again are virtually non-existent, and concern sludge transport and the capacity of the Pagla plant to receive the waste sludge.

Without proper management, sludge will be transported improperly and open dumping of sludge to open water courses will occur. The management proposal for this work will incorporate safeguards against these eventualities. These might include training of DWASA personnel in the correct handling and environmental risks of sewage sludge and development of a logical and realistic approach for day-to-day operations.

The Pagla Plant is not equipped to receive and dispose of the wastes properly and needs to be equipped with sludge handling and disposal facilities. Therefore to achieve net positive benefits, adequate facilities must be provided.

(d) <u>Other Water Supply and Sanitation Components :</u>

The remaining items involve studies, mapping and maintenance operations for correcting leakage. Environmental impacts are insignificant for all these items.

9.4.3 Solid Waste Management

There are two components within this sector: rehabilitation and expansion of local collection stations, and equipment for personnel safety and health. Neither of these components have any negative environmental impacts that will not be addressed through facility design and/or equipment purchase. The project consulting team will be responsible for cost effective proposals for best utilization of expenditures under these two components.

9.4.4 Slum and Squatter Area Improvements: Comprehensive Slum Improvement Program

The thrust of this work is to "provide additional support to complement and extend the LGEB/UNDP SIP program to a level sufficient to meet the needs of all slum and squatter areas within Dhaka where the dwellers meet the basic requirements for security of tenure and willingness to participate and pay for a portion of the services provided."

The LGEB/UNDP SIP (slum improvement) program provides modest infrastructure and services within slums through motivation and community participation. Improvements generally encompass water supply, sanitation, solid waste collection, drainage, foot path access and outdoor lighting.

This program is wholly beneficial, and due to the modesty and small scale of infrastructure, no environmental damages are expected to result either in the construction or operations stages of the work.

9.4.5 Training and Institutional Strengthening

This component includes PMO assistance during implementation for studies for pollution control source assessment, strengthening of financial management, administration and solid waste operations within DCC, a review of Government land ownership and policies, and a study concerning development policies, controls and legislation within RAJUK.

None of these elements involve investment in physical infrastructure; therefore there are no environmental impacts associated with their implementation.

9.5 Alternatives

Interim Report No. 1 prepared for FAP-8B considered a wide range of alternatives for flood protection both from environmental and economic points of view. The reader is directed to that report for further information on that component of the project, and to the summary provided in Chapter 4 of this report.

As previously stated, the remaining components are geared explicitly toward environmental improvement. While the Interim Report No. 1, as summarized in Chapter 3 of this report, has put forth a number of recommendations for near term and for long term implementation by both local and national agencies and by international funding groups, the selection of specific items for incorporation into the Project is dictated primarily by considerations of cost effectiveness in the use of available funds. As stated, the need for these and similar projects for slum improvement, sewage collection and treatment, industrial pollution control and a host of other infrastructure and social ills is unlimited in Dhaka City. The selection of Project Components has been based on packaging together the most cost effective components related in a logical manner to the primary thrust of the project (flood control and drainage) for near term implementation. The selected environmental improvement components have been formulat' ' ..iuiin the framework of the IEMP to reinforce the overall impact of the Project on an area-wide basis, with particular emphasis on the needs of low income groups.

9.6 Cost Benefit Analyses

As expansion of Dhaka is severely constrained by the risk of flooding, the major economic benefit of the Project will be the expansion of Dhaka's economic infrastructure (residential dwellings, commercial and industrial real estate, transportation) into the low-lying, predominantly agricultural areas presently subject to seasonal flooding. The major economic benefit is measured as the increase in land values immediately after the completion of the project, treated conservatively as a one-time increase spread over a period of twenty years in pace with the projected demand for new urban development areas. A second important benefit will be protection of existing economic infrastructure on higher lands, which is subject to damage from seasonal and exceptional flooding. Improved drainage will help remove stagnant water leading to improved environmental conditions and some health benefits. The Project will also help improve the living conditions of a large number of people, the majority belonging to low-income groups at present living in extremely poor environmental conditions in low-lying areas in the western part of the city. The complementary environmental improvement works are all aimed at these low-income groups presently residing in slum conditions.

For the major component of flood protection and drainage, the benefits to 87% of the urban population or about 4.2 million persons will far outweigh the costs for this component, which not only improves property values but also is geared specifically towards protection of human life and livelihood. Assuming that the results of previous investigations are incorporated into future design and construction, the economic costs associated with any negative environmental impacts outlined above will not significantly affect the cost-benefit equation.

From the preliminary economic analysis, initial calculations show that the increase in land values alone will be more than sufficient to cover the economic costs of the project, at a 12 per cent discount rate. If the project is taken as a whole, then the cumulative environmental improvement measures must be weighed in on the benefit side of the equation. While the costs of these components are generally minor, their effects of human health and livelihood will be significant and wholly beneficial.

Individual environmental im rovement components can be considered from the standpoint of cost effectiveness: whether or not the benefits accrued from individual investment decisions represent the best possible use of funds. At this stage the selected environmental improvement components represent the best possible, cost-effective, proven technology/approach gleaned from previous experience in Dhaka and other cities with similar problems.

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9.7 Institutional Requirements and Environmental Monitoring Program

9.7.1 Institutional Requirements

A Project Management Office (PMO) is proposed to be established for implementing the integrated flood protection project, in order to bring together the various agencies which will be involved with the work. Details on staffing and terms of reference are provided in Chapter 5.

The environmental improvement components address institutional issues in a variety of ways. These include policy issues; administrative capabilities and arrangements; operational skills and training; financial aspects of cost recovery for water supply, sanitation and solid waste management in particular; creation of cells within the city administrative offices to address specific issues; policies and programs within the Department of Environment; technical studies for improvements in management; surveys for the provision of information and other types of institutionally related components. Consideration of ongoing and proposed institutional strengthening activities under other projects, mainly World Bank and UNDP assisted programs, have been considered in the Project formulation, and adequate institutional arrangements have been incorporated into the project design.

9.7.2 Environmental Monitoring Plan

Environmental monitoring should focus on two aspects of the project: (i) minimizing environmental impact during the construction and remediation of the embankment; and (ii) monitoring environmental improvements that result from specific project components. The environmental monitoring plan should build to the extent possible on existing monitoring programs of DOE and DWASA, and utilize existing facilities, making provisions for necessary strengthening of operational budgets in order to assure that the work can be performed.

(a) <u>Impact Minimization During Construction:</u>

Interim Report No. 1 notes that erosion control is a significant issue both during construction and operations. Erosion can affect local water quality, and recommendations are in place for inclusion of erosion control costs in the project capital budget.

A program for measurement of surface water turbidity in the vicinity of construction areas can easily be incorporated in the tender documents. Turbidity may be measured in the field using relatively simple techniques, such a Secchi disk, or through use of nephelometric readings in a laboratory or in the field. In order to gain an indication of the contributions to total turbidity arising from construction of the embankment and internal drainage works, readings would need to be taken both upstream and downstream of flowing water bodies, or before and after rainfall events in still water bodies. The results of these measurements could be used to indicate preferred methods of erosion control during construction operations. Excessive turbidity levels would indicate the need for improving erosion control measures in subsequent construction operations.

(b) <u>Monitoring Environmental Improvements:</u>

Depending on the timing for implementation of the environmental improvement components of the project, the following types of measurable improvements in environmental and public health parameters are possible: (i) surface water quality parameters in rivers (specifically the Buriganga) and in internal drainage systems (the khals within Dhaka); (ii) epidemiological parameters (frequency and susceptibility to gastrointestinal and/or respiratory illness) among slum populations served by the improvement programs; (iii) drinking water quality (chlorine residual and coliform count) in the overall water supply system and in the extensions made into slum areas; (iv) quantities of solid wastes found deposited on land and in waterways; and (v) shallow groundwater quality in the vicinities of industrial outfalls and landfills. The rather small magnitude of the improvements that are planned in relation to the sizes of the overall problems would indicate that improvements may be measurable only in the immediate vicinity where project components are being implemented. However good monitoring data can be used to convince future projects to adopt those measures which have been shown to bring about improvements in environmental quality.

Measurable improvements in surface water quality of the khals may occur from the rehabilitation/upgrading of main/secondary/local drainage systems, and in local areas from slum rehabilitation and improved solid waste management. Water quality parameters in the Buriganga and in the khals are presently monitored by the Dhaka Division of DOE. The river monitoring program has been evaluated and recently upgraded. The monitoring of internal drainage water quality should be extended to include 10 to 15 monitoring points on a quarterly basis for pH, conductivity, TDS, TSS, oil and grease, BOD and DO. The locations for monitoring should be selected following a field reconnaissance, and should incorporate the elements of the induced drainage scheme that will result following completion of the flood control works. Other parameters in addition to those mentioned above should be included in special circumstances where industrial discharges are involved.

A reduction in the quantity of floatable materials should result both from sanitation and solid waste management measures. An accurate sampling of the content of floatables is difficult to obtain, being influenced by surface winds and other factors. One possibility is to equip khals with manually cleaned bar screens at culvert crossings, and to clean these screens at regular intervals, taking a volumetric measurement of the materials impinging on the screens. Depending on the local configuration of the water body (flow velocity, surface area and wind fetch) a relatively accurate temporal comparison may be obtained.

289

Though there are no specific aspects of the Project to enhance chlorine residual in the water supply system, a program of monitoring chlorine residual would be beneficial if followed by improved dosing in order to maintain adequate levels for bacteriological safety. This should extend throughout the distribution system, and should include the extensions that are planned under the Project.

There is a need for limited investigation of shallow groundwater quality in the vicinities of solid waste dumps and industrial outfalls. Not much is currently known about this problem. In the long term, shallow polluted groundwater may affect deeper aquifers if draw down in the latter becomes excessive. Shallow drinking water wells may also be affected, a factor which might influence decisions on extension of drinking water supply and distribution within Dhaka City. The design of a monitoring system, in order to be cost effective yet still yield meaningful results, requires considerable attention by a qualified contaminant hydrogeologist.

Epidemiological surveys provide the most direct means, over time, to measure the benefits of the slum improvement program components. These also require careful design by a public health specialist. Many of the environmental improvement components are directly related to public health. A reduction in gastrointestinal illnesses should be immediately measurable in slum areas served with piped water supplies. Infant mortality may be significantly reduced. Other distinctive health benefits can be expected; and it would be highly beneficial over the long term to document these improvements to the best possible extent, in order to serve as a guide for future project preparations, and to understand better the implications for cost and benefit analysis.

Within six months of the loan effectiveness, the PMO will develop a comprehensive PBME system with assistance from the Project management consultants, including indicators as outlined in Appendix 13. The PBME activities will be coordinated by the PMO with active involvement of the DOE. The actual carrying out of PBME activities, including the establishment of bench marks, data collection, and analyses will be the responsibility of the respective implementing agencies.

9.8 Public Involvement

There are three basic mechanisms for public involvement in the Project work. First, the Project is designed to alleviate human (individual and societal) problems. The environmental components are oriented specifically to human needs. For many of the Project elements, canvassing public opinions and modes of behavior will be necessary for effective Project design. (This applies specifically to the water and sanitation, and the slum improvement components). For at least one component, public information (which would infer involvement) is an explicit aim. Finally, the Report specifically refers to the need (and excellent potential for) involvement of NGOs in aspects of the upcoming work effort, specifically because of their history of work with slum dwellers in the Dhaka area. NGOs are probably best qualified to assist in cost effective implementation of those aspects of the Project dealing directly with the public.

286

At this stage in the devel pment of the Project, there are no explicit requirements for public meetings related to the work effort, or mechanisms described for receiving public comments on its various aspects. Because of the significant levels of direct human involvement (i.e. provision of human services, settlement of severance and resettlement problems, etc.) the ways through which the public will be involved with the Project need to be stipulated, including how public participation can influence the approach to design and implementation.

9.9 Conclusions

The Project FAP-8B (technical assistance and implementation stages) originated from the need to correct inadequacies in flood protection embankments which, if left unattended, threatened human life through catastrophic failure and, at the least, brought about severe impacts in daily living as well as some degree of social inequity. The remedial nature of this work, following as it did on the heels of efforts by the GOB to mitigate future flood hazards, leaves open only two relevant questions: (i) whether the Project in its present formulation provides every possible (or economically justifiable) means to minimize environmental impact; and (ii) whether there are irreversible losses that will occur as a result of its implementation.

The flood protection and drainage component has been wholly directed to rectifying design and construction problems; thus it can be concluded that every effort has been made to minimize environmental impact, to the degree possible within the scope of the available budget.

The environmental assessment effort related to this Project has been extensive, beginning with the Progress EIA prepared by DOE, and including the TA consultant's work. No irreversible impacts have been noted as a result of the work proposed under the Project. Irreversible losses may well occur if the Project does not proceed, as the Project addresses means for averting catastrophic failure of the embankment during times of flooding, with consequent loss of life. It has been noted in Interim Report No. 1 that:

"no design or construction method can be entirely free of risk of collapse of a dike or wall. While foundation investigations and analyses are not complete at the time of writing, there is an understanding that soil conditions are poor, both for the embankment foundation and for the supply of construction materials. The integrity of the design is also dependent on adequate inspection and maintenance during the operational life of the system. Maintenance of infrastructure is a major problem in Bangladesh, as in other developing countries, and therefore the potential for failure through lack of maintenance must be considered."

Thus, while risk cannot be eliminated, it may be reduced to insignificant levels through proper design, analysis and evaluation. Much of this work will continue, such as (i) risk assessment for dike failure, (ii) hydrological assessment of the resultant flood wave during failure, (iii) assessment of damage potential, particularly for public institutions, and

(iv) compartmentalizing of flood prone areas. Early warning systems (sirens and public broadcasts) as well as other disaster preparedness measures are proposed. Thus every conceivable measure (economically justifiable) to reduce risk and eliminate the possibility of irrecoverable loss has been evaluated.

Further, the Project incluues complementary components for environmental enhancement within an Integrated Environmental Management Plan. These components address specific environmental problem areas that are linked to, but not directly dependent upon, implementation of the flood protection works. Unlike many past flood control projects, the present Project is focused on human needs throughout all of its aspects. The human focus is not compensatory, as there are few if any aspects of the Project that do not attend to the needs of the populace within the Dhaka urban area. Thus there are virtually no aspects of the Project that require compensation. Under the circumstances, benefits can be seen to far outweigh costs, and the Project should proceed.

The following Tables 9.1 and 9.2 present, respectively, a summary of the major environmental impacts of the flood control and drainage works, and a matrix of actions v.s. impacts within and without the flood protected area.

330

Table 9.1

SUMMARY OF ENVIRONMENTAL IMPACTS OF THE FLOOD CONTROL AND DRAINAGE WORKS

Type	Description	In PEIA?	Mitigation Measures
Potentially Disastrous Impacts in the Event of a Breach in the Walls or Dikes.			
Integrity of design and construction for dikes/walls	While maximum integrity is planned, a dike/wall break during a flood could cause a catastrophic flood	Yes	1. Risk assessment 2. Redesign of critical wall sections to improve stability and decrease risk of failure. 3. Implementation of emergency management system (FAP11)
Impacts, Which if They Are Not Adequately Addressed, May Lead to the Sabotaging of the Flood Protection System			
Dike routing/location, severance problems, resettlement	Existing Phase I dikes and walls have been damaged or destroyed apparently in protest by local people over routing, severance and isolation of communities, commercial establishments and residents. If this is repeated during the operation of the system it could destroy its integrity.	Yes	1. Study problems for existing dams/walls 2. Determine impacts of Phase II 3. Modify design and take other measures to minimize impacts. 4. Improve administration of compensation system 5. Encourage participation of affected people in decision making
Positive Impacts			
Agriculture	Potential for improving agricultural production through controlled water regime.	No	
Sewerage system	... will protect sewer system from flooding	yes	
Expansion	The DFPP creates room for expansion of the city to areas which are protected from major flooding.	yes	
Flood Control	The DFPP reduces the maximum design flood level to 5.0 m PWD. Future improvements could further reduce flood stage levels, reducing the number of people at risk during flooding.	yes	
Plastic Health	Reduction of flood stage levels reduces the number of areas within the city that would be flooded. This reduces cross-contamination from exposure to flooded open sewers, which in the past have been a primary source for the spread of disease.	no	
Negative Impacts			
Impacts of drainage system	1. Creation of stagnant pools (probably not significant) 2. Impacts on electrical power system	yes/no	1. Check health impacts, drain if necessary 2. Use diesel driven pumps, use energy efficient motors, pump in off-peak hours
Higher flood levels outside DFPP	The DFPP works will increase flooding in populated areas outside the protected zone.	yes	Check backwater curves (FAP-8A), determine impact and mitigate as required.
Induced in-migration	The existence of flood free zone will encourage in-migration further straining infrastructu[illegible] and government services.	no	1. Study issue 2. Increase land use controls 3. Improve infrastructure and service to meet demand
Waterways will be cut	Dikes will cut [illegible]rways and isolate commer[illegible] [illegible]sinesses	no	1. Study potential Impacts 2. Investigate use of locks of improvement of river access outside dike on Gojaria Khal.
Access to River	Many business depend on access to the river for their livelihood	no	1. Study impacts 2. Improve will breach design 3. Improve river access
Public Health	The DFPP may increase the number of polluted stagnant pools which are breeding grounds for disease vectors and unsafe for bathing. Induced in-migration will add strain on water supply, sewer and publi health services.	Yes/no	Determine extent of risk of formation of stagnant pools and design operation of pumping system to minimize health risks. Increase investment in water supply, sewage and public health services to meet demand.
Water Quality	Cutting of natural drainage channels may increase water pollution problems.	No	Study issue and design pumping system to minimize impacts or even improve water quality if possible.
Soil Erosion	Lack of soil erosion control could cause sedimentation of waterways and fields during and after construction	No	Include requirements for soil erosion control and re-vegetation in contract specifications.

230

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Table 9.2

MATRIX OF ENVIRONMENTAL IMPACTS

Action	Loss of Life	Impacts Within Protected Area					Impacts Outside Protected Area
		Socio economics	Agriculture	Commerce	Water Supply	Public Health	
Completion of System	Reduced risk	Protection of property. Development pressure in Dhaka. Disequities in benefits/losses.	Stable water regime	Improvements in transport system Severance	Controlled water regime inside containment area	Reduced Risk	Increased risk of flooding. Fisheries
Taking of land		Loss of property. Severance	Loss of land Severance				
Drainage/ Pumping System		Local flooding	P :ential for improved agricultural systems.	Electrical power Demand	Contamination mitigated by pumping	Risk of water borne disease transmission reduced by pumping	
Interference with drainage and waterways				Blocking of waterways Decreased access to river		Interference with sewage disposal Stagnant pools breeding mosquitoes mitigated by pumping	
Risk of collapse*	Increased risk	Property damage		Damage to infrastructure	Loss and contamination	Water borne diseases	
Construction		Disturbance to utilities and transportation systems	Loss of land and damage from soil erosion	Interference with transportation routes		Breeding grounds for mosquitoes (Temporary, mitigated by pumping during and after construction).	

* Risk of Collapse mitigated by redesign of wall and construction of critical sections using materials and techniques which increase stability over time.

10.0 PRECONSTRUCTION AND PREPARATION ACTIVITIES

10.1 Major Preparatory Activities

The major Project preparatory activities are detailed on the attached schedule, Table 10.1. Some are once only actions that need to be taken prior to the effectivity of the loan, while others are continuing activities which will carry over into the Project implementation period.

Key amongst these activities is the need for early establishment of the Project Management Office (PMO). This unit should be responsible for initiating and undertaking the preconstruction activities, and early identification and recruitment of key Project personnel should ideally be done before the Project Appraisal.

In order to maintain the tight time schedule proposed for this Project and to ensure effective implementation of the first years work program, an early recruitment of consultants is required. This includes recruitment of consultants for Project implementation assistance, for detailed engineering design of the first years work components, and for the proposed additional topographic surveys and subsoil investigations which are a prerequisite to the preparation of the detailed designs for the urgent embankments remedial works. To achieve this, the consultants short list should be prepared immediately, since recruitment of consultants is sometimes made a precondition of loan effectivity. As a special case, and for the first years activities only, it is recommended that the GOB request the ADB for permission to extend the services of the existing T.A. consultants for completion of the first years field investigations, detailed engineering design works, contractor prequalification and tendering.

The preparation and negotiation of any subloans and lending agreements between the National Government and the various Implementing Agencies should be carried out after loan negotiations, when the terms, conditions and covenants of the loans will be known. The subloan agreements should be concluded before the loan becomes effective and disbursements commence.

Land acquisition is a vital and often time consuming activity which, if not completed on time, can cause serious delays to implementation. It is sometimes a condition of loan that a specified amount of the land needed for the project must be acquired before the loan can become effective. Although new land acquisition has been kept to a minimum for the Project components, the land acquisition process should start immediately, and should be completed in accordance with the schedule shown in Chapter 5.

10.2 Other Activities to be Undertaken Prior to Procurement

It is important that procurement/construction contracts for the first batch of components be ready for award so that physical implementation can commence as soon as the loan becomes effective so that the first years program is achieved. In order to achieve this the early recruitment of consultants (as described above) is an essential prerequisite.

The detailed engineering design activities must be completed to a sufficient level of detail with adequate documentation to enable competent contractors to prepare reasonable bids and submit competitive tenders. If tenders are to be received during the last quarter of 1991 or the first quarter of 1992, then the preliminary activities for the detailed design, such as conducting supplemental field investigations, must be commencing now. The actual design work should commence not later than November 1991.

Similarly, to conform with ADB procurement guidelines the award of most contracts is normally by competitive tender. This can be a time consuming process with considerable preparatory work to be completed to pre-qualify contractors, organize the tender evaluations, and award the contracts. In order to complete these activities the pre-qualification of contractors should commence immediately after appraisal so that the tendering process can begin as soon as the designs and documentation are complete.

An important implication of this preconstruction preparation schedule is that the costs of all agreed topographic surveys, subsoil investigations, engineering services and construction/procurement works are eligible for funding through the loan, provided that related expenditures are incurred after completion of the Project Appraisal. If these tasks are undertaken prior to loan effectivity - and it is essential that they are - then GOB resources will be required to provide the interim financing, and the loan agreement must be made to ensure that retroactive financing is available.

TABLE 10.1

FURTHE PROJECT PREPARATORY ACTION

Action Required	Action By	Completion Date
Preparatory Activities		
(i) Preparation and approval of PCP.	MIWDFC/BWDB (in Consultation with other agencies and consultants)/Planning Commission/ECNEC.	25 July '91. 31 Aug. '91.
(ii) Preparation and Approval of PP.	-do-	31 Sept '91/ 30 Nov. '91.
(iii) Preparation of detailed staff deployment plan (secondments/ new recruitment).	MIWDFC/FPCO/ Consultants.	31 Aug. '91.
(iv) Preparation of detailed plan for recruitement of staff and establishment of slum Improvement cell.	MLGRDC/DCC	31 August '91.
(v) Shortlisting of implementation consultants.	MIWDFC in consultation with Bank.	15 Sept. '91.
(vi) Recruitment of implementation consultants.	MIWDFC/PMO	30 April '92.
(vii) Prequalification of contractors.	PMO/Consultants	31 Oct. '91.
(viii) Preparation of tender and procurement documents.	PMO/Consultants	31 Oct. '91.
(ix) Preparation of detailed land acquisition program.	DCC/DWASA/Consultants	31 Aug. '91.
(x) Provision of Supplementary Budget for FY1991-92 construction works.	PMO/BWDB/DCC/DWASA/ PC/MOF	31 Oct. '91.

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(xi) Recruitment of Consultants for Subsoil investigations and detailed design/supervision.	PMO/BWDB/Consultants	31 Oct. '91.
Administrative Matters		
(i) Establishment of Project Management Office (PMO).	MIWDFC in consultation with BWDB, DWASA, DCC	30 Sept. '91.
(ii) Appointment of Project Director (PD), Deputy Directors, Skeleton Key Profess'onal/ Support Staff.	-do-	30 Sept. '91.
(iii) Offi... rental for PMO.	PD	30 Nov. '91.
(iv) Recruitment of new staff for PMO.	PMO in consultation with executing agencies.	30 Dec. '91 to mid 1992.
(v) Procurement of Office equipment/vehicles (Direct Purchase).	PMO	30 Dec. '91 to mid 1992.
Retroactive Financing		
(i) Detail Proposal for retroactive financing (engineering, consultancy, construction).	BWDB/Consultants	15 Sept. '91.
(ii) Approve extension of bridging services (Oct. 91-April 92) for consultants.	MIWDFC/Bank	30 Sept. '91.
(iii) Obtain internal Govt. permission for ex...itures on items ident...ed under (i) and (ii) above.	MIWDFC	30 Sept. '91.

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11.0 TECHNICAL ASSISTANCE

11.1 Introduction

During thi ...uy period it became apparent that:

i) the unregulated and uncontrolled urban growth in Dhaka City has been creating serious drainage problems, particularly where this growth has impinged upon traditional drainage channels and low-lying pond areas. Drains have been indiscriminately blocked, natural retention ponds have been filled, and as a result local flooding during rainy periods has been increasing in both frequency and duration over recent years. The regulating agencies - mainly RAJUK and DCC - have no defined development standards or effective control mechanisms to address these problems;

ii) following major investments in flood protection and drainage, considerable low-lying areas will become suitable for intensive urban use, resulting in manifold increases in land values and increasing demands on scarce public services. Although it is important that the public sector should be able to capture a part of the increases in land values and/or recover the costs of the escalating needs for providing public infrastructure and services, no mechanism presently exists to enable the public sector agencies to do so; and

iii) there are large tracts of government owned land in Dhaka City which have ... ...sed or underutilized for many years, or which have been taken over by squatters, and for which no long term land use plans have been formulated. There is a need to determine the actual extent of this underutilization, and to develop strategies for rationalizing the needs and uses for these lands for the benefit of the government and the public.

Although there are a number of projects and programs which are proposed to be taken up in the near future to address the urban drainage, planning and management issues (see Section 11.4), none have been specifically designed to meet these needs. Accordingly, the technical assistance proposed in the following sections has been formulated to address these issues in order to develop policies and strategies to ensure that the investments in improved flood control and drainage facilities are complimented by appropriate land use development standards and controls, and are not negated by uncontrolled and unrestricted growth.

11.2 Background and Need

As a continuum of TA No. 318-BAN for Dhaka Integrated Flood Protection Project the proposed technical assistance will assist in meeting the urgent land development ...ol needs which have been identified as a priority for Dhaka City. These include: (i) developing appropriate land development standards, regulations and control mechanisms/procedures to ensure that the investments in improved flood control and drainage facilities are complemented by appropriate land use development standards and controls, and are not negated by uncontrolled and unrestricted growth; (ii) developing improved cost recovery methods for meeting the escalating needs for providing public infrastructure and services occasioned by the expansion/densification of the urbanized areas in Dhaka; and (iii) rationalizing the needs and uses of vacant and underutilized Government owned lands within Dhaka city.

11.3 Objectives

The proposed technical assistance will help the Government formulate appropriate land development requirements, policies, standards, regulations and control procedures in order: (i) to facilitate the orderly urban growth of Dhaka City, to ensure that the benefits of improved flood control and drainage are complemented by appropriate land development standards and are not negated by uncontrolled growth, and (ii) to develop improved policies, including cost recovery mechanisms, for meeting the needs for upgrading public infrastructure and services occasioned by urban growth. In addition, the proposed technical assistance will assist the Government in reviewing Government land ownership and needs in Dhaka City, and in developing new policies and strategies for optimum utilization of vacant or underutilized Government lands.

11.4 Scope and Work Program

The technical assistance provides for expert consultant services to assist the Government in: (i) preparing improved building/land development standards and regulations; (ii) developing new land development policies and cost recovery mechanisms to support the cost of providing public infrastructure; and (iii) rationalizing the needs and uses of under-utilized Government land holdings in Dhaka City. The work will comprise of three parts as follow:

<u>Part A: Building/Land Development Standards and Regulations:</u> The consultants will assist to:

(i) review existing land development standards, regulations and procedures within Dhaka City;

(ii) develop and recommend improved land development standards, building regulations and controls; and

(iii) develop and recommend new land development/building approval procedures for developments in Dhaka City.

<u>Part B: Land Development Policies and Fees:</u> The consultants will assist to:

(i) review existing land development policies and land development taxation methods applied in Dhaka City;

(ii) analyze the development requirements and the amount, sources, recipient... utilization of existing land taxes;

(iii) analyze the impact of increased offsite service needs and costs to the public sector resulting from new land development and urban densification;

(iv) recommend appropriate policies for modifying existing land development requirements, with particular consideration to the practicality, affordability and impacts of introducing new regulations for land developers to provide onsite and/or offsite public infrastructure and services such as roads, drains, drainage retention ponds, water supply systems, schools, health centers, parks, etc.;

(v) recommend appropriate policies for modifying existing land development taxation, with particular consideration to the practicality, affordability and impacts of introducing new land development fees to assist in providing public infrastructure and services for development within Dhaka City;

(vi) prepare draft legislation for any new development policies and/or development fees recommended.

Part C: Review of Government Land Ownership and Needs: The consultants will assist to:

(i) review the existing Government land ownership and needs within Dhaka City;

(ii) prepare an inventory of all Government owned lands in Dhaka, along with a description of present use, future projected uses and a statement of need for vacant or underutilized land; and

(iii) recommend appropriate Government policies and strategies for rationalizing the use of vacant and/or underutilized Government owned lands with particular consideration to potentials for disinvesting the lands, converting the lands for public use, converting the lands for use for low income residential use, and/or transferring/leasing/selling to squatters/settlers to provide long term security of tenure.

The technical assistance program will be carried out over a period of eight months starting about mid-1992. The assistance will require 16 man months of international consultants and 28 months of domestic consultants specialized in municipal land management, municipal finance, land use policy, and land use control and building regulations.

The likely project timing coincides with a number of other important and inter-related technical assistance programs in Dhaka City and the national urban sector, including:

232

- the implementation of the Dhaka Integrated Flood Protection Project to be undertaken with ADB and NDF assistance,
- the preparation of the Greater Dhaka Flood Protection Master Plan being completed with JICA assistance,
- the on-going support for Urban Management and Municipal Services Programmes in Dhaka and Chittagong (UNDP/UNCHS/IDA),
- the proposed Urban S elter Sector Study intended to indicate broad strategies for the sector and assisted action programs (UNCHS/ADB/[illegible]),
- the preparation of Structure Plan, Master Plan and Detailed Area Plans for Dhaka and Chittagong with a strong emphasis on improved land management (UNCHS/UNDP),
- the proposal for a National Land Use Planning Project,
- the proposal for development of a national Urban Land Management strategy with an emphasis on modernizing urban land records and formulating urban land management policies (UNDP), and
- the preparation of the Greater Dhaka Metropolitan Integrated transportation Study (UNDP/UNDTCD).

The study team will be responsible to coordinate their activities with those of other related projects and to cooperate with other study teams to ensure that recommendations made are complementary.

11.5 Cost Estimate and Financir Arrangements

The total cost of t[illegible] technical assistance is estimated at US $596,000, including $[illegible],000 in foreign exchange and $214,000 equivalent in local currency costs. It is proposed that the entire foreign exchange cost and $190,000 of the local currency cost be financed on a grant basis from the Bank. The local cost financing will include domestic travel and transportation, field office rental and equipment, and surveys of Government owned land uses. The Government has agreed to provide the remainder of the local currency requirements, estimated at $24,000 equivalent, which includes the provision of local staff, vehicle operation and office supplies.

11.6 Implementation Arrangements

The Government will establish an interministerial Steering Committee chaired by the Mayor of Dhaka City Corporation with representatives from all concerned Ministries for ensuring effective inter-ministerial and inter-departmental liaison, and for reviewing and approving consultant recommendations. Radjahani Unnayan Kattripaka (RAJUK - the Capital Development Authority) will be the principal Implementing Agency for the technical assistance. The RAJUK Chairman will be the consultants counterpart, and the Chief of Planning will act as the coordinator for the consultants activities.

The consultants will establish an office in Dhaka in coordination with RAJUK.

The consultants will submit an inception report at the end of six weeks of service, a mid-term report at the end of four months, a draft final report at the end of seven months, and a final report upon completion of services.

Outline Terms of Reference and costs estimates for the consulting services are detailed in Appendix 12.

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LIST OF APPENDICES

APPENDIX 1 :	Consultants Personnel
APPENDIX 2 :	List of References
APPENDIX 3 :	Technical Background and Principal Design Criteria
APPENDIX 4 :	Revised Remedial Design Approach: DIFPP
APPENDIX 5 :	Project Cost Estimates
APPENDIX 6 :	Project Implementation Consultant Services
APPENDIX 7 :	Projection of Urban Expansion
APPENDIX 8 :	Economic Internal Rates of Return - DIFPP
APPENDIX 9 :	Internal Rates of Return - Slum Improvement
APPENDIX 10:	Financial Internal Rates of Return - Solid Waste & Sanitation
APPENDIX 11:	Financial Projections of DCC and DWASA
APPENDIX 11A:	Increase in Land Development Tax Revenues on Reclassification
APPENDIX 12:	Technical Assistance for Land Development Controls and Procedures for Dhaka City
APPENDIX 13:	Indicators for PBME
APPENDIX 14:	Bridging Engineering Services

392

LIST OF STUDY TEAM MEMBERS

A) Louis Berger International, Inc.

R. Berlin	Team Leader/Municipal Planning Engineer
M. Williams	Drainage Design Engineer
M. Everitt	Road Engineer
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M. Raabe	Environmental Engineer
M. McLindon	Development Economist/Financial Analyst
D. Crowther	Development Economist/Financial Analyst
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B) Associated Consulting Engineers (Bangladesh) Ltd.

F. Ahmed	Municipal/Environmental Planning Engineer
M. Islam Miah	Design Engineer
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C) Desh Upodesh Ltd.

S. Islam	Flood Control/Planning Engineer
A. H. Chowdhury	Road Engineer
M. G. Mostafa	Intermediate Engineer
M. A-As-Saqui	Agronomist

D) Technoconsult International Ltd.

B. A. Hamid	Financial Analyst/Institutional Development Specialist

326

LIST OF SELECTED REFERENCES

1. "Bangladesh Action Plan for Flood Control", Document of The World Bank, December 11, 1989.

2. "Flood Control in Bangladesh", A Plan for Action, Asia Region Technical Department, World Bank Technical Paper Number 119.

3. "Greater Dhaka City Flood Control : Recommendations to the Committee", T.G.H. Jensen, A.F.M. Abdul Hadi and F. R. Asgar, November 1988.

4. "Report on Flood Control and Drainage of Greater Dhaka", Report of the Committee for Flood Control and Drainage of Greater Dhaka, January 1989.

5. "Study on Storm Water Drainage System Improvement Project in Dhaka City", Main Report, Japan International Corporation Agency (JICA), October 1987.

6. "Updating Study on Storm Water Drainage System Improvement Project in Dhaka City", Japan International Cooperation Agency (JICA), February 1990.

7. "Greater Dhaka Protection Project (Study in Dhaka Metropolitan Area) of Bangladesh Flood Action Plan No. 8A", Japan International Corporation Agency (JICA):

   - Inception Report, October 1990.
   - Preliminary Review Report, December 1990.
   - Interim Report, March 1991.
   - Draft Final Report, July 1991.

8. "Detailed Design Report, for the Improvement of the Storm Water Drainage System for Dhaka City", Pacific Consultants International, Tokyo, Japan, June 1990.

9. "Tender Documents, for the Improvement of the Storm Water Drainage System in Dhaka City", Pacific Consultants International, Tokyo, Japan, June 1990.

10. "Environment Action Plan (Draft)", MOEF of GOB, 1990.

11. "Bangladesh Environment and Directorate of Environment", Department of Environment, 1990.

248

12. "Initial Environmental Examination for Dhaka Flood Protection Project", Department of Environment, October 1989.

13. "Progress Environmental Impact Assessment (EIA) for Dhaka Flood Protection Project (DFPP)", Department of Environment, July 1990.

14. "Year Book of the Department of Environment Pollution Control Vol-II", Environment Department, July 1975 to March 1980.

15. "Report of Tanneries and Various Industries in Dhaka and Other Cities of Bangladesh", Environment Department, June 1986.

16. "The Environmental Pollution Control Ordinance", Environment Department, 1977.

17. "Bangladesh Environment Preservation Ordinance", Environment Department, 1989.

18. "Appraisal Report for Dhaka Urban Infrastructure Improvement Project (Loan 942-BAN), Asian Development Bank (ADB), November 1988.

19. "Guidelines for Social Analysis of Bank Projects", Main Report, Asian Development Bank (ADB), Office of the Environment, November 1990.

20. "Environmental Guidelines for Selected Infrastructure Projects", Asian Development Bank (ADB), Office of the Environment, 1990.

21. "Environmental Guidelines for Selected Industrial and Power Development Projects", Asian Development Bank (ADB), Office of the Environment, 1990.

22. "Guidelines for Integrated Regional Economic-cum-Environmental Development Planning", A Review of Regional Environmental Development Planning Studies in Asia, Asian Development Bank (ADB), October 1988.

23. "Project Preparatory Technical Assistance for Dhaka Integrated Flood Protection Project", Aide Memoire, Asian Development Bank (ADB), April 1990.

24. "Draft Design Report of Final Engineering Design of the Dholai Khal Rehabilitation Dhaka", by BKH Consulting Engineers, February 1990.

25. "Final Report - Summary Volume, Dholai Khal Rehabilitation and Area Development Study", by BKH Consulting Engineers, October 1986.

26. "Study of Project Delivery Systems for the Bangladesh Water Development Board", (World Bank) Mid Term Report, April 1990.

27. "Staff Appraisal Report on BWDB System Rehabilitation Project", The World Bank, February 1990.

28. "Flood Problem and Planned Urban Growth", Nazrul Islam, Geography Dept. University of Dhaka, 1989.

29. "Social Formation in Dhaka City", Siddiqui Kamal et-al-Dhaka University Press Ltd. 1990.

30. "Slums and S[illegible]s in Dhaka City", CUS, Department of Geography, University of Dhaka, 1988.

31. "Dhaka City Drainage and Flood Control Project", Sir William Halcrow and Partners Ltd., August 1973.

32. "Dhaka City Drainage and Flood Control Project : Project Brief", Sir William Halcrow and Partners Ltd; October 1988.

33. "Report of the Task Force on Social Implications of Urbanisation", Planning Commission, GOB, February 1991.

34. "Cleaner Environment at Lower Cost, A New Approach for Solid Waste Management", Prof. K. J. Nath, April 1991.

35. "Bangladesh Population Census 1981", Report on Urban Area, November 1987.

36. "Pourashava & Municipal Corporation Law Manual", Bangladesh Local Government Law Series, August 1989.

37. "Housing Development Project Subcontract "A", Dholai Khal Rehabilitation and Area Development Study, Final Report, Dhaka City Corporation (DCC), October 1986.

38. "Estimated Annual Budget", Dhaka City Corporation (DCC), 1990-91.

39. "Proposed Organization and Staffing Arrangement", Dhaka City Corporation, March 1990.

40. "Support for Urban Management and Municipal Services; Final Engineering Design of the Dholai Khal Rehabilitation Dhaka.", Wasa Drainage Division, February 1990.

41. "Emergency Flood Fight Manual", A Manual of Construction and Field Practices During Flood Emergencies, U.S. Army Engineer District, OMAHA, March 1988.

42. "Report on Reconnaissance Soil Survey Dhaka District", Soil Resources Development Institute, Second Edition, 1981.

43. "Dhaka Urban Infrastructure Improvement Project (HSD-Component) and Institutional Strengthening of Housing and Settlement Directorate", Housing and Settlement Directorate, Segunbagicha, June 1989.

44. "Position of Dhaka City Canals" (MAP), Dhaka Wasa Drainage Division, 1990.

45. "Report on Flood Control and Drainage System of Greater Dhaka", Wasa Sewerage Division, January 1989.

46. "Greater Dhaka Flood Control and Drainage Project (Phase - I) Report for Cleaning of 13 Khals/Canals in the Dhaka City", WASA (MOD CIRCLE), 1990.

47. "Greater Dhaka Flood Control and Drainage Project (Phase - I) Repairing and Restoration of the Sewerage of Dhaka City", Accounts Section, WASA BHABAN, 1990.

48. "Master Plan of Sewerage System (DMA) Present and Proposed", Wasa Main Office, 1990.

49. "Rule for Construction of Building", RAJUK, 1984.

50. "Report of the Slum Area Census", Bangladesh Bureau of Statistics (BBS), June 1988.

51. "A Case Study on Floating Population in Dhaka City", Bangladesh Bureau of Statistics, June 1988.

52. "Bangladesh Population Census Dhaka Statistical Metropolitan Area (Dhaka SMA)", Bangladesh Bureau of Statistics, July 1985.

53. Information and Maps received from Japan International Corporation Agency (JICA) for the Greater Dhaka Area (Master Plan Study):

- Administrative boundary Map, Scale 1:50,000
- Existing and Future land use Maps, Scale 1:50,000 and survey information.
- External flood data survey information and Maps.
- Topographic Maps Scale 1:50,000 and 1:20,000
- Survey information for associated Drains and Rivers
- Survey information for Phase I embankment with Bench mark data.

54. "Geological S[illegible] map of Bangladesh & A Report on Geology of Dhaka & Adjoining Areas", 1988.

55. "Water Treatment Plant at Demra and Other Works", Interim Report for Water Supply and Sewage, Camp Dresser & Mc Kee International, Inc. etc., February 1990.

56. "Investment Strategy for Improvement of Sanitation in Municipal Area of Bangladesh", Local Government Engineering Bureau, Local Government Division; Low Cost Sanitation Project BGD/85/004 UNDP - DANIDA - World Bank, December 1989.

299

57. "Dhaka Regional Ground Water and Subsidence Study" Dhaka WASA Water Supply and Sanitation Urgent Expansion Project, Interim Report, Sir Mott MacDonald & Part. Ltd. etc., November 1990.

58. "Staff Study Report" under Dhaka WASA Water Supply and Sewerage Urgent Expansion Project, Bangladesh Project Management Institute and Checchi & Company Consultants, Inc., 1990.

59. "The Long Term Development Plan and Feasibility Study for the Dhaka Metropolitan Area Water Supply and Waste Water System", RMP/ Montgomery, 1981.

57

PROJECT COMPONENTS: TECHNICAL BACKGROUND AND PRINCIPAL DESIGN CRITERIA

A. Technical Background

Following the 1988 floods, the Government initiated a crash flood control program for Dhaka City. The components of this program included (i) construction of 29.2 km of embankment on the western side of the City; (ii) construction of 8.5 km of reinforced concrete flood protection walls bordering the densely populated south-western side of the City. (iii) construction of embankments around Zia International Airport and around the Narayan... area south of the City; (iv) construction of 2.0 km of new roads, with a top elevation corresponding to the 1988 flood level, together with improvement and raising of a further 8.5 km, on the eastern side of the area of this Project; (v) cleaning and repair of drainage khals and sewerage systems; and (vi) construction of drainage sluices to allow discharge of rainfall run-off through the flood protection structures. These works were undertaken as a coordinated effort by BWDB, DWASA, DCC, RAJUK, and the Bangladesh Army.

The western flood protection embankment was the subject of a damage survey and site investigation undertaken by the Consultants in May 1991.1/ The survey included a review of earlier pre-and post-construction site investigations carried out by the Bangladesh University of Engineering and Technology (BUET) and by BWDB. A preliminary damage survey of the floodwall was undertaken concurrently. The following were the principal findings of the survey:

i) parts of the embankment, totalling approximately 4.7 km in length, are subject to sudden failure resulting from inadequate subgrade shear strength. In many locations failure has already occurred. A stability analy is for these areas based on soil strength parameters obtained by site investigation indicates a factor of safety aga... deep-seated slip failure of less than unity. These areas require immediate and short-term remedial works. Due to the very low shear strength of the subgrade soils in these areas, it would not have been possible to prevent the failures that have already occurred without improving subgrade strength;

ii) a further 3.1 km of the embankment is extensively damaged and requires repair, but is not likely to fail catastrophically. This damage could have been reduced by proper compaction and moisture control during construction. Remedial works are required in the short-term in these areas;

1/ Preliminary Analysis and Design, Phase I Embankment: prepared by GeoSyntec Consultants for Louis Berger International Inc., June 1991.

iii) approximately 3.1 km of the embankment has been damaged through wave erosion. This damage could have been reduced if the conventional jute mesh and sod erosion protection materials had been placed immediately after construction, and if the embankment had been properly constructed with regard to compaction and moisture control; and

iv) the preliminary survey of the flood wall indicates damage due to cracking of the concrete, erosion (piping) under the wall, and inadequate design of the wall with respect to overturning.

The survey concluded that the unsatisfactory state of the embankment was mainly due to (i) lack of moisture control: in most areas the soils were placed immediately after excavation, without moisture conditioning. Some of the soils were excavated from below the water table and were saturated at the time of placement; (ii) inadequate compaction: soils were end-dumped and no effective attempt was made to compact the fill material. Payment for compaction was not linked to field performance; (iii) inadequate erosion protection: in many areas, erosion protection materials were not placed before the embankment was subject to wage loading. In addition, the materials used (jute mesh and turf) were not found to be suitable for the more exposed locations of the embankment; and (iv) inadequate subgrade improvement: in many locations, the subgrade shear strength was inadequate to support the load of the embankment.

A subsequent damage survey was conducted in August 1991, towards the end of the monsoon period. The survey confirmed the initial findings and conclusions, with the additional observation that sever wave erosion damage had occurred on approximately 11.5 km of the exposed westerly face of the embankment during the monsoon season. The results of this survey served to refine and finalize the scope of remedial works required under the Project. Additional studies and investigations are required to prepare detailed engineering designs for a remedial works program.

As regards drainage, problems result mainly from an increase of run-off due to expansion of the City and surfacing of natural ground areas; insufficient number of drains; blocking of existing open drains by unauthorized construction and garbage disposal; blocking of pipe drains by non-degradable garbage, in particular plastic materials; infilling of low-lying City areas through housing development, reducing the area available for natural storm water storage; insufficient provision of sluices in the (new) western embankment; and the absence of coordination between the various development agencies in the City. A limited amount of cleaning and rehabilitation of the drainage canals (khals) was undertaken concurrently with the embankment construction. However, drainage efficiency in the City area was not measurably improved by this activity. In May and June 1991, heavy pre-monsoon rainfall again caused flooding in the City area; in response to this, DWASA and DCC have prepared a crash program for drainage improvement.

B. Principal Design Criteria

1. Flood Protection

The flood embankment and flood wall along the westerly side of the Project area will be constructed to an average top elevation determined as follows:

	EMBANKMENT			FLOODWALL		
	TONGI	MIRPUR	DHAKA	TONGI	MIRPUR	DHAKA
Design Flood Stage (100 year) :	8.8	8.6	7.8	-	8.6	7.8
Freeboard :	1.2	1.2	1.2	-	0.6	0.6
Top Elevation :	9.8	9.8	9.0	-	9.2	8.4

This design flood stage corresponds to a flood with an estimated minimum return period of 100 years, which is about 0.14 m greater than the 1988 floods, and is in conformity with the flood protection standards proposed in the FAP-8A Master Plan. Actual embankment and wall elevation will vary with location, according to the calculated flood water surface profile. The initial construction levels will include provision for settlement during the Project period. Any subsequent settlement will be made good as part of the flood protection maintenance program.

Along the easterly boundary of the Project area, the existing Central Spine road will be raised to an elevation corresponding to the 50 year overtopping level, according to the calculated flood water surface profile, as a part of the first stage protection for Dhaka City. Following future extension of the flood protection embankments to encompass the entire City; this will remain a permanent internal compartment boundary for internal flood security and management of flood water levels.

The embankment works have been categorized according to the Class of embankment, as described above, as follows:

Class 1 embankment: intensive remedial works

Class 2 embankment: remedial works

Class 3 embankment: minor remedial works

With regard to the deficiencies in the existing embankment, as described above, the remedial works will include the following provisions:

i) intensive and moderate remedial works over a total of about 7.8 km of Class 1 and 2 embankment sections with the following provisions:

- o excavation and lowering of the existing embankment to an elevation of between 8.0 m to 6.5 m PWD (depending on soil test results and subsequent remedial design requirements) corresponding to approximately 6.0 m to 4.5 m above original ground level;

o installation of subgrade drainage measures to accelerate the consolidation period for strengthening the subsoils. In view of the probable large extent of subgrade deformation synthetic wick drains will be used, with spacings as determined by soil test results and remedial design considerations;

o compaction of replaced fill in 20 cm layers, with proper moisture control; and

o staging of construction to match the increase in subsoil strength due to damage and consolidation.

ii) minor remedial works over about 17.7 km for restoration of minor damage due to shallow stope failure, including filling of borrow pit areas at the river side toe using dredged material, and restoration and protection of minor eroded areas using jute/sod protection and plantation of dholkolmi or dhoncha bushes on the river side berm;

iii) repair of severely eroded areas and provision of permanent slope protection over about 11.5 km of the most severely eroded areas, using cement concrete blocks over geotextile filter fabric;

iv) execution of the major works using prequalified international contractors. Top level monitoring and quality control testing will be done though the Project Management Office (PMO) and the material testing laboratory to be established as a part of the Project.

Design and construction of the flood wall will incorporate similar provisions, including engagement of an international-qualified contractor, to ensure the high technical standard of the works.

Both intensive remedial works and remedial works have been designed so that application of the above provisions will result in a minimum embankment subgrade safety factor estimated at 1.1 in the first year following construction, and increasing to about 1.2 within 5 years, under normal dry season conditions. Safety factors will increase slightly during the flood season due to additional surcharge outside the embankment, and decrease slightly during the post-flood season due to embankment saturation. Floodwalls will be designed with a structural safety factor of 1.3. The spacing of embankment wick drains has been optimized with respect to the costs and scheduling of construction (which determines time available for consolidation) to result in a satisfactory balance between speed and cost of construction.

Adequate sluices and regulators will be provided along both the westerly embankment/floodwall and easterly control spine road to vent the internal drainage flows by gravity during low external flood stages, and to prevent entrance of river flood waters during high external flood stages.

2 ↑R

2. Drain...

The drainage system in the Project area has been designed as an integrated network, in accordance with the JICA Storm Drainage Master Plan recommendations, with the capacities of the various parts of the system being designed to cope with all relevant sources of inflows and run-off for the flood and rainfall conditions. Khal rehabilitation works, pump stations and the capacity of the discharge sluices, have been designed on the basis of the following criteria:

i) average maximum internal flooding elevations on low-land retention areas of 4.5 m to 5.0 m PWD resulting from a 5 year recurrence storm rainfall;

ii) minimum conveyance capacity of khals and drains to be capable of carrying the peak 2 year recurrence interval storm runoffs;

iii) maximum use of existing khals and minimum land acquisition requirements, commensurate with the above criteria; and

iv) construction of the first stage (22 cms, or one third of the ultimate design capacity of ^5 cms) of Pump Station No. 3 at Goran Chatbari to complete the construction of the first stage of all pumping stations rec...d within the Dhaka Integrated Flood Protection Proj... area (Phase I of the overall Project Area [1]) for a fully integrated flood protection and drainage scheme.

v) the operating costs of emergency pumping facilities that may be employed at critical locations along the Central Spine road, as and when needed has been provided for during the Project period (pumps previously acquired by the Government). If employed, such pumping may be viewed as providing a safety factor to ensure that the design flood elevation is not exceeded in the Project Area.

In assessing the effects of installing approximately one-third of the final design capacity (22.0 cms out of an ultimate design capacity of 65.2 cms) at the pump station, the following general approaches were considered:

o a full season of 5 months from May 1 through September 30 was considered as the closure period for the sluice, and pumps were considered to be operating at full capacity for the entire period. For these conditions, for the 5 year frequency of occurrence the Q=22.0 cms pumps would be operating about 46% of the time, and the Q=65.2 cms pumps would be operating about 15% of the time; and

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[1] Other pump stations include the Dholai Khal Pump Station now being constructed under the World Bank Urban 1 Project and Kallyanpur Pump Station under the JICA Storm Drainage Improvement Project.

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o a one month period of study was considered, assuming the gates would be closed at elevation 3.0 m PWD with routing of : (a) 5 yr frequency probable storm runoff, (b) 2 yr. frequency probable storm runoff, and (c) average annual probable storm runoff, assuming the runoff factor to be 0.8.

From the study it was concluded that: (i) for the 5 year event with discharge at 22.0 cms the maximum water level in the retarding pond would be approximately 5.1 m over a flooded area of about 32 sq km; (ii) for the 2 year event with discharge at 22.0 cms the maximum water level in the retarding pond would be approximately 4.25 m over a flooded area of about 22 sq km; (iii) for the average annual event with discharge of 22.0 cms the maximum water level in the retarding pond would be approximately 3.6 m over a flooded area of about 12 sq km; and (iv) with the full capacity of 65.2 cms the 5 year event would reach a maximum water level of about 4.0 m with a flooded area of about 19.9 sq. km.

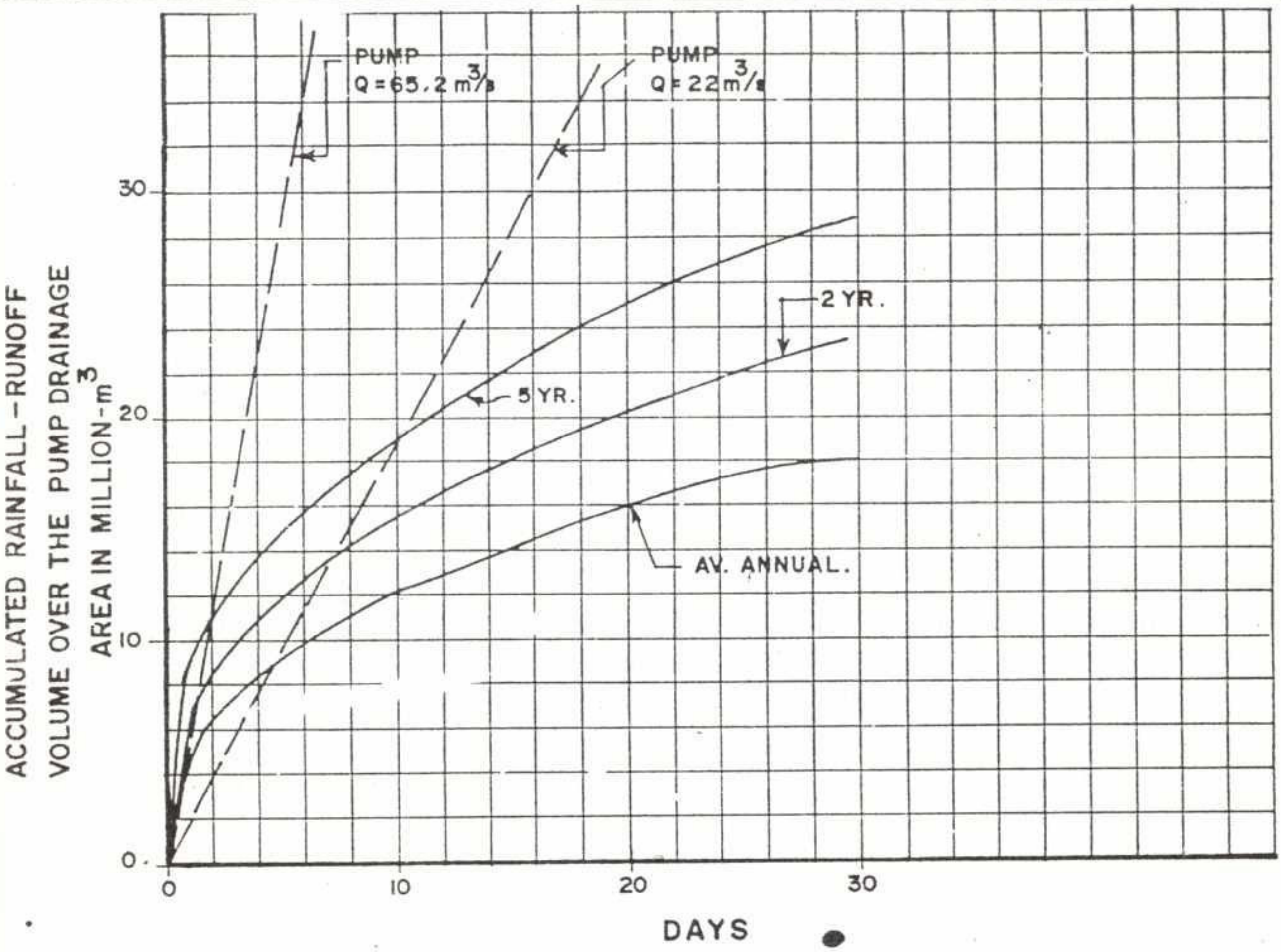
Based upon this brief review, it appears that installation of the first phase of the Pump Station of about one-third of the design capacity for controlling the 5 year storm event, will have a significant positive impact upon the flooding conditions within the drainage area of the pump station. For the 5 year storm event the maximum water level of about 5.1 m for a pump discharge of 22 cms would protect and permit further development of the higher lands within the area. The estimated cumulative runoff and corresponding flood levels and durations for rainfall events corresponding to the average annual, 2 year and 5 year frequencies for the proposed 22 cms pump capacity at Goran Chatbari are shown on Figure 1. Further studies are needed to determine the best combination of ultimate pumping capacity and corresponding flooded areas.

The pipe and covered drains proposed for construction in the more densely populated areas have been designed on the basis of the Rational Method, where:

$$Q = kCIA$$

- Q = design discharge;
- k = conversion factor;
- C = runoff coefficient, varying between 0.2 and 0.8 depending on the nature of the runoff surface;
- I = rainfall intensity;
- A = catchment area.

The above criteria have also been adopted for new drains to be constructed under Part C: Environmental Improvement Program. Slopes of both open and covered drains have been selected according to existing topography, likelihood of settlement, changes in land use, and other related factors, to result in a balance between drain efficiency and cost.



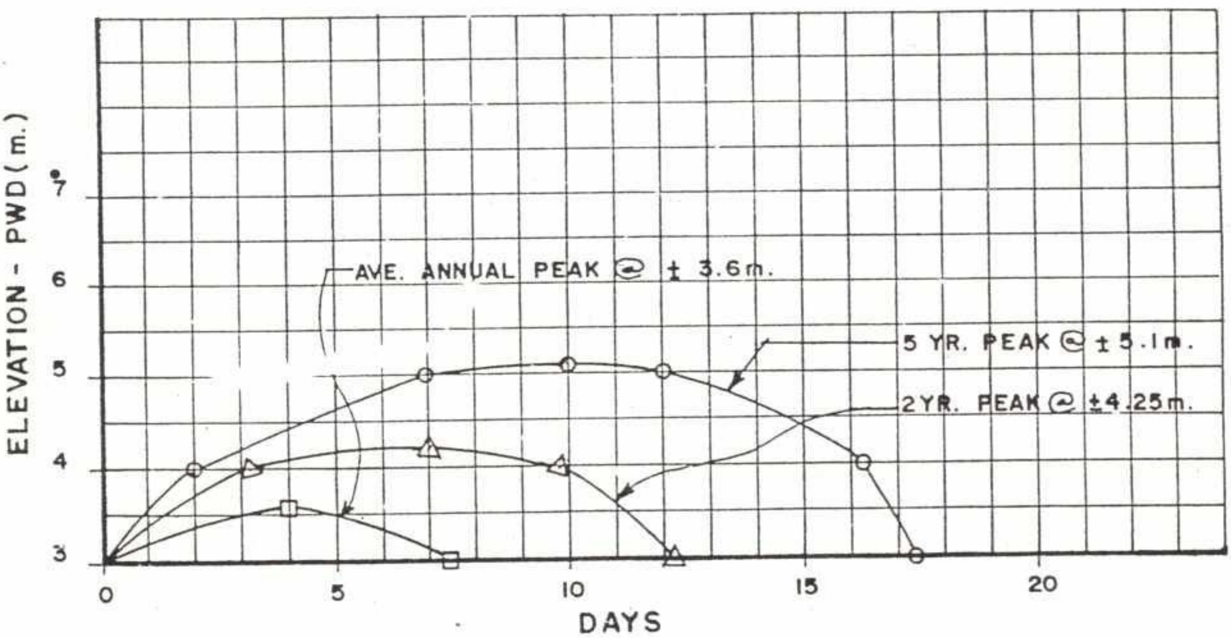


FIGURE 1

PUMP STATION NO.-3.
GORAN CHATBARI.

(Capacity of 22 cms)

392

3. Solid Waste Disposal

The solid w... management program has been designed on the basis of the following principal criteria:

o	waste generation:	0.5 kg/capita/day
o	waste density:	275 kg/m^3 (at collection bin)
		575 kg/m^3 (for transport in truck container)
		1000 kg/m^3 (at landfill site)
o	collection bins:	1 m^3 (250 kg) capacity
o	truck containers:	6 m^3 (3000 kg) capacity
o	population served:	1 collection bin per 150 persons
o	service interval:	collection bins emptied daily to twice weekly

On the basis of the above criteria, it is estimated that the proposed fleet of 1000 local collection bins, 120 truck containers, and 30 trucks will provide the required service level to a minimum of 150,000 persons, with suitable allowance for equipment maintenance and downtime. The landfill sites have not been specified, but it has been assumed that they will be located at a maximum distance from the City that will permit two to three truck/container collection and disposal cycles per working shift (up to 2 shifts per day)

4. Sanit...

The low cost sanitation program within the slum and squatter areas has been designed on the basis of existing LGEB, DWASA, UNICEF and WHO standards. In particular, latrines will conform to the following criteria:

o	diameter:	900 mm (construction with concrete rings 50 mm thick);
	minimum depth:	2.0 m below ground level;
o	rotation:	for twin pit latrines, change every 18 months;
o	spacing:	minimum 1.5 m between pits;
o	elevation:	450 mm above surrounding ground level
o	service level:	1 latrine per 3 households

Construction of pits will be restricted to areas where site investigations show soil is sufficiently permeable.

For sewer/drain rehabilitation, the following operations will be undertaken: (i) removal of sludge, cleaning of blocked pipes, and all necessary repairs and associated plumbing; (ii) cleaning of blocked manholes and provision of vandal-proof lids; (iii) excavation and repair of all damaged pipes with replacement where necessary; (iv) minor extensions of drains to reach undrained pockets; and (v) installation of fresh racks at key locations to facilitate cleaning and reduce maintenance costs.

5. Water Supply

The public standpipes to be provided in the slum and squatter areas will be installed in accordance with the following standards:

o pipeline material:	PVC pipes;
o standpipe consumption:	35 liters/capita/day;
o service level:	1 standpipe per 500 persons (squatter areas) 1 standpipe per 10 h.h. (slum areas)

6. Access

The access facilities to be provided will consist of footpaths and rickshaw routes. Respective design criteria are as follows:

(i) Footpaths

o Right-of-way:	2.5 m
o Pavement width:	1.25 m
o Pavement type:	75 mm brick soling surface course 50 mm sand base course 150 mm compacted subgrade
o Drainage:	250 mm wide rectangular drains both sides

(ii) Rickshaw routes

o Right-of-way:	4.0 m
o Pavement width:	3.0 m
o Pavement type:	200 mm brick herring bone bond and soling surface course 50 mm sand base course 150 mm compacted subgrade
o Drainage:	250 mm wide rectangular drains both sides

7. Electricity and Street Lighting

Street lights will be provided at public locations within slum areas such as at footpath and rickshaw route intersections, in accordance with LGEB/DCC standards and criteria. The associated extensions to the electricity distribution network will be designed in accordance with existing Power Development Board (PDB) standards.

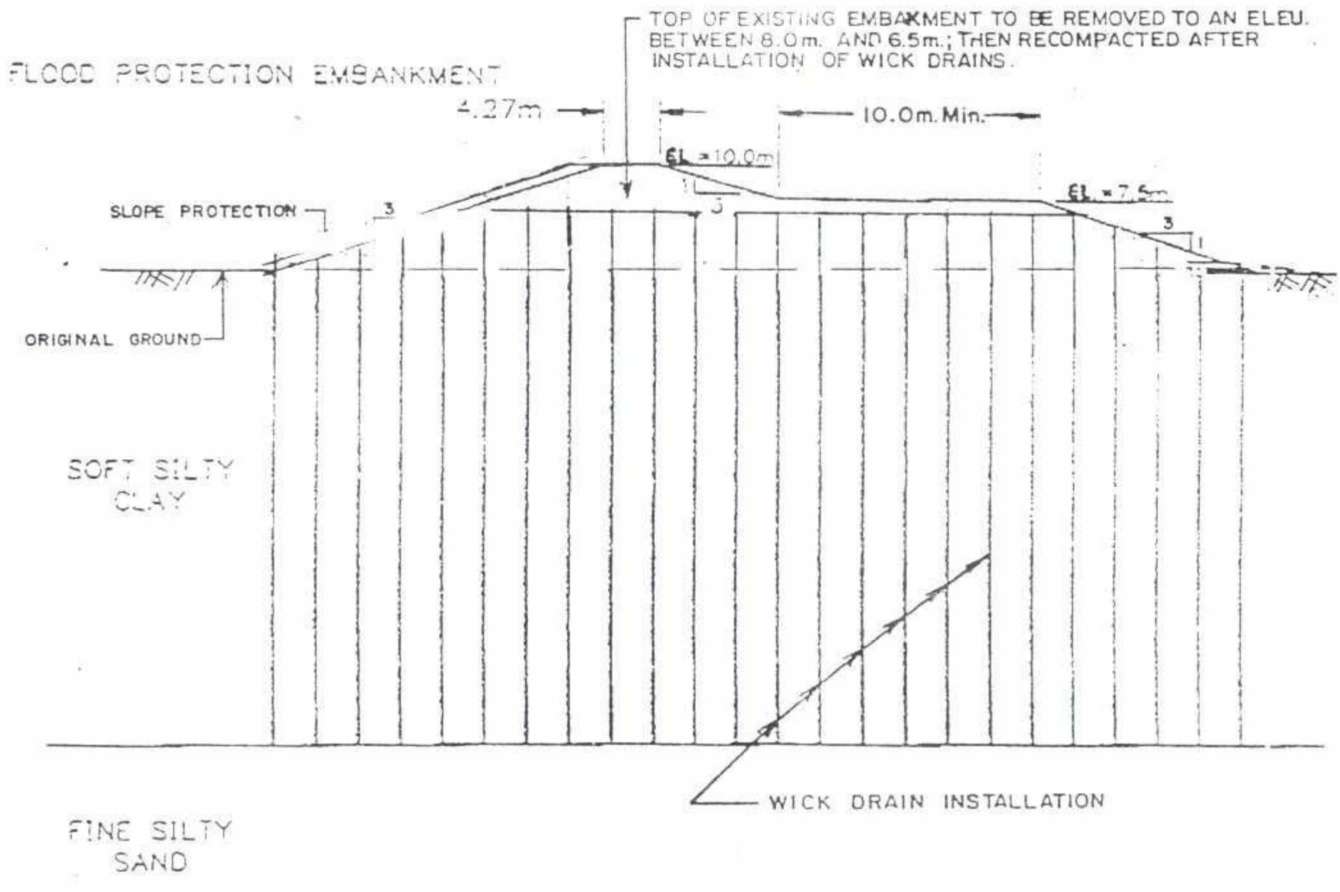
279

APPENDIX

SECTION A - FLOOD PROTECTION

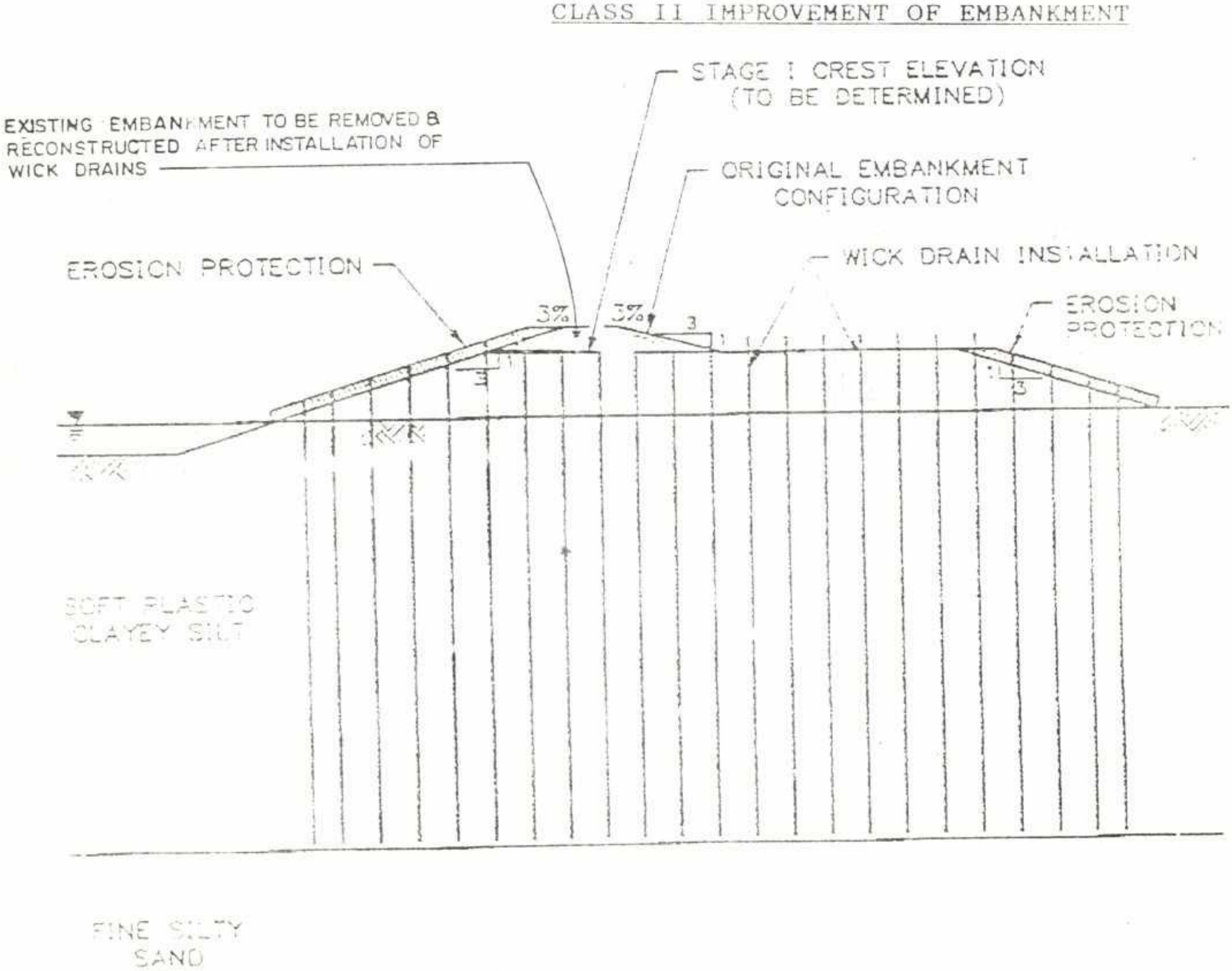
TYPICAL CROSS-SECTION FOR INTENSIVE REMEDIAL WORK
ON EXISTING WEST EMBANKMENT

CLASS I IMPROVEMENT OF EMBANKMENT



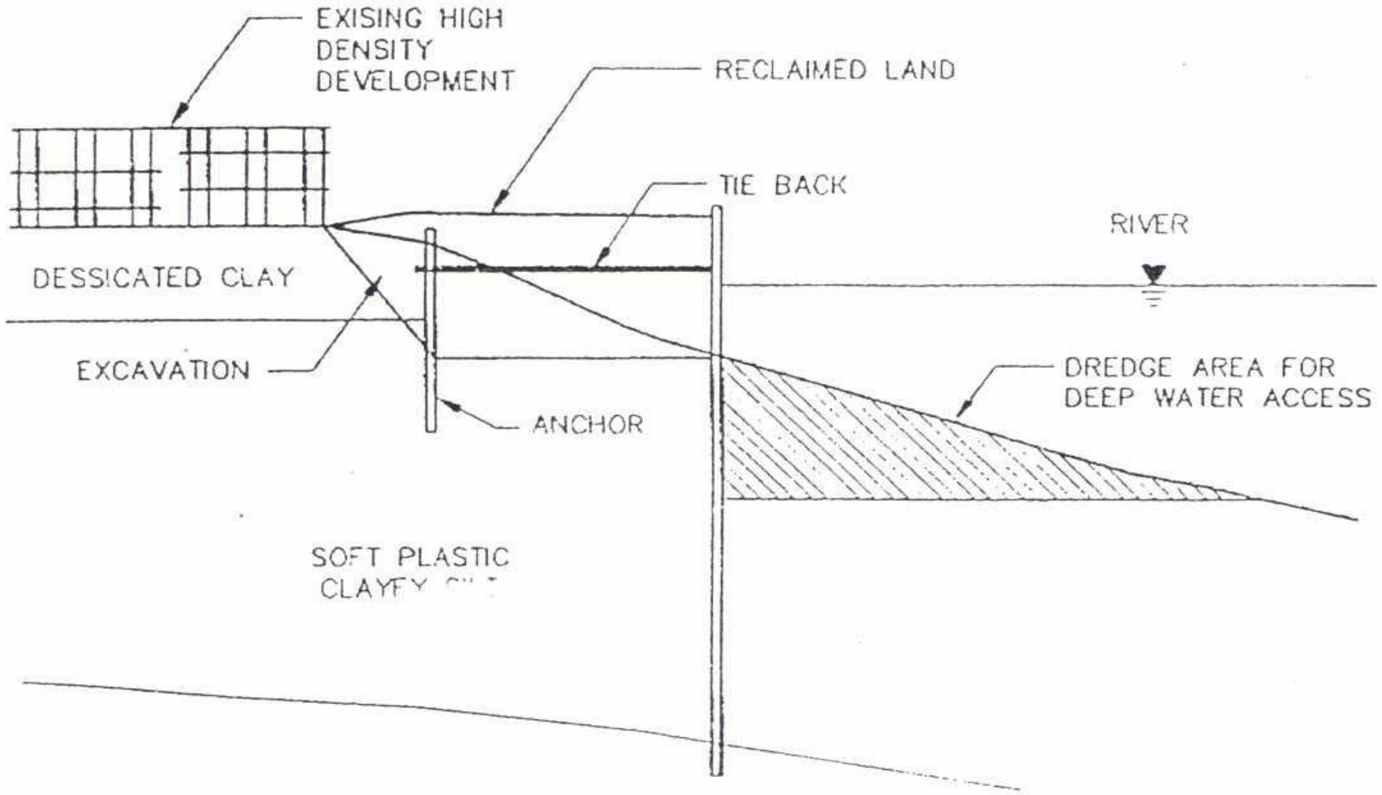
PRELIMINARY CONCEPTIONAL SHORT-TERM REMEDIAL DESIGN FOR THE PHASE I EMBANKMENT IN THE CLASS I AREAS

TYPIC... CROSS-SECTION FOR MODERATE REMEDIAL WORK
ON EXISTING WEST EMBANKMENT

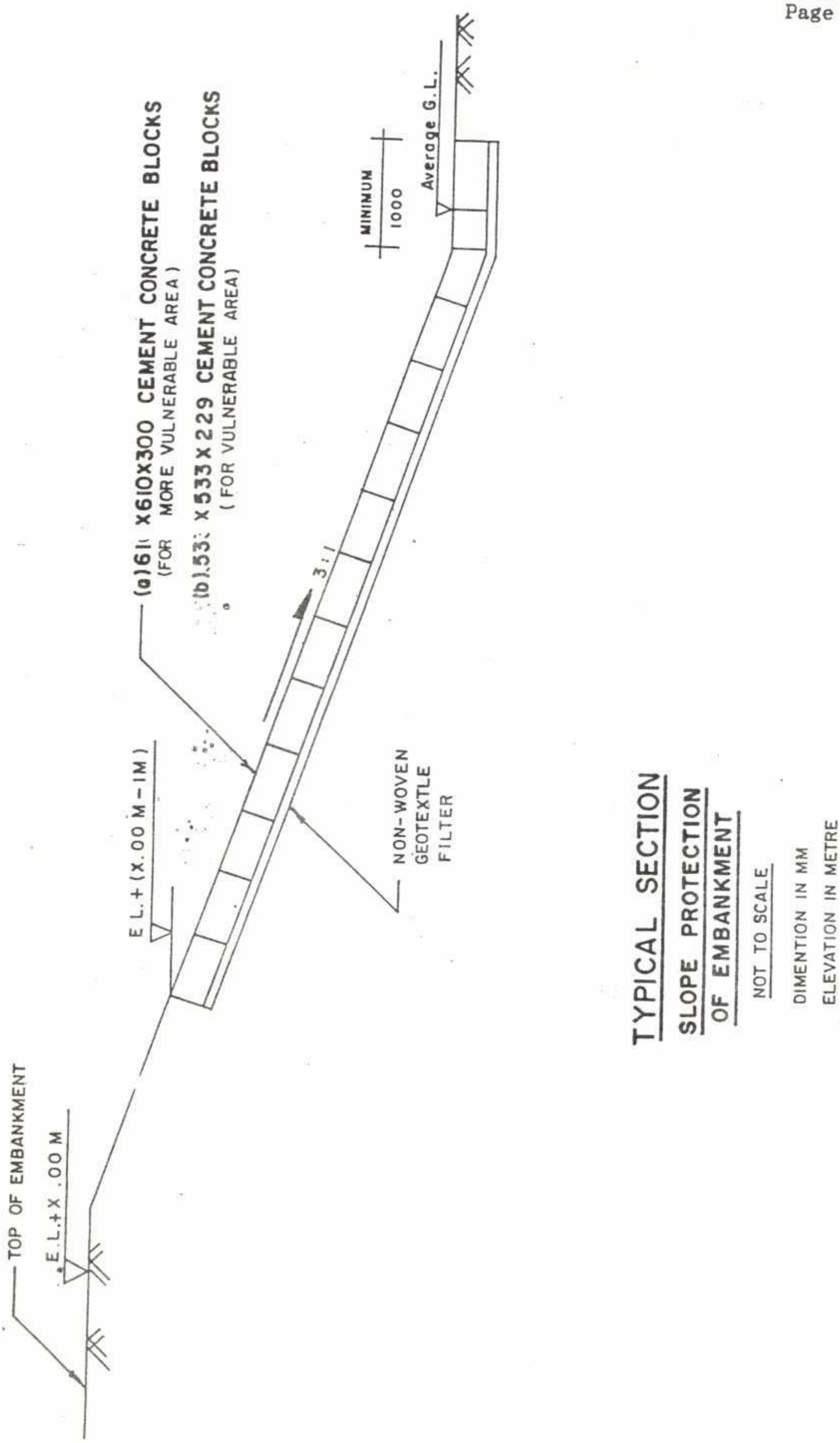


OPTION FOR REMEDIATION OF CLASS II AREAS OF THE EMBANKMENT, USING LIMITED EXCAVATION, WICK DRAINS TO CONSOLIDATE EMBANKMENT AND SUBGRADE SOILS, AND STAGED CONSTRUCTION

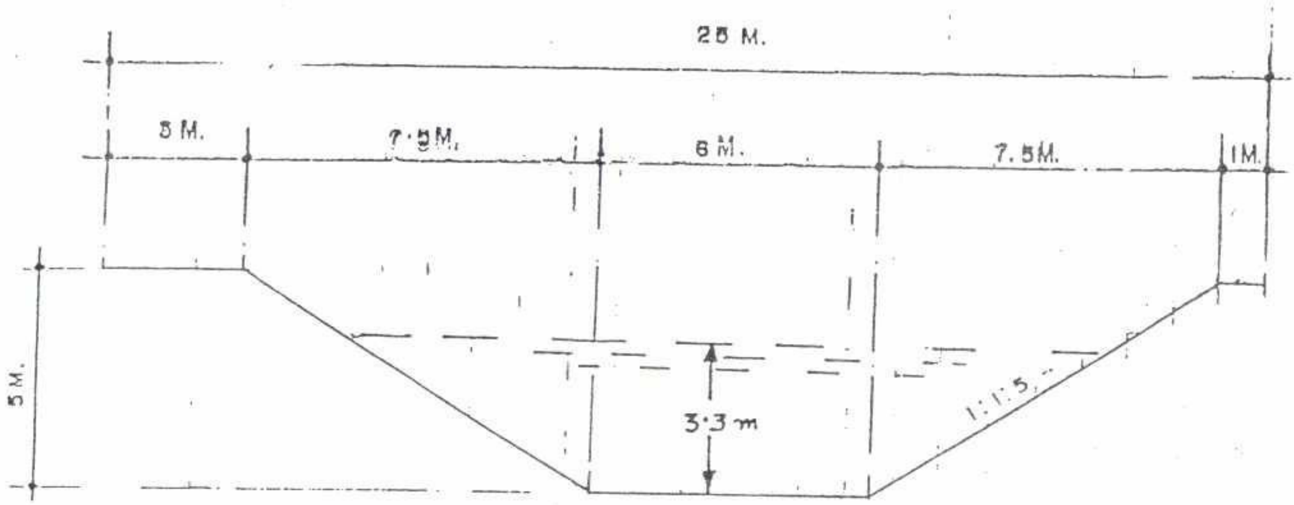
TYPICAL CROSS-SECTION FOR EXTENSION OF FLOODWALL IN OLD DHAKA WEST AREA



SHEET PILE WALL ALTERNATIVE, ILLUSTRATION RECLAIMED LAND ON DEEP WATER CHANNEL


TOP OF EMBANKMENT
E.L.+X .00 M
E L.+(X.00 M-1M)
(a)610 X610X300 CEMENT CONCRETE BLOCKS
(FOR MORE VULNERABLE AREA)
(b)533 X 533 X 229 CEMENT CONCRETE BLOCKS
(FOR VULNERABLE AREA)
3:1
NON-WOVEN
GEOTEXTLE
FILTER
MINIMUM
1000
Average G.L.
TYPICAL SECTION
SLOPE PROTECTION
OF EMBANKMENT
NOT TO SCALE
DIMENTION IN MM
ELEVATION IN METRE

2220



TYPICAL KHAL SECTION

Scale = 1:50

EXISTING SECTION OF KHAL = 12.86 m (assumed)
THE REQUIRED WIDTH OF KHAL = 25 m (typical section taken)
HENCE WIDTH OF LAND PER METRE OF LENGTH =25-12.86 =12.14 m
FOR ONE KILO-METRE OF LENGTH OF KHAL= 12.14x1000=12140 m^2
= 2.999 acres
= 3 acres/km.

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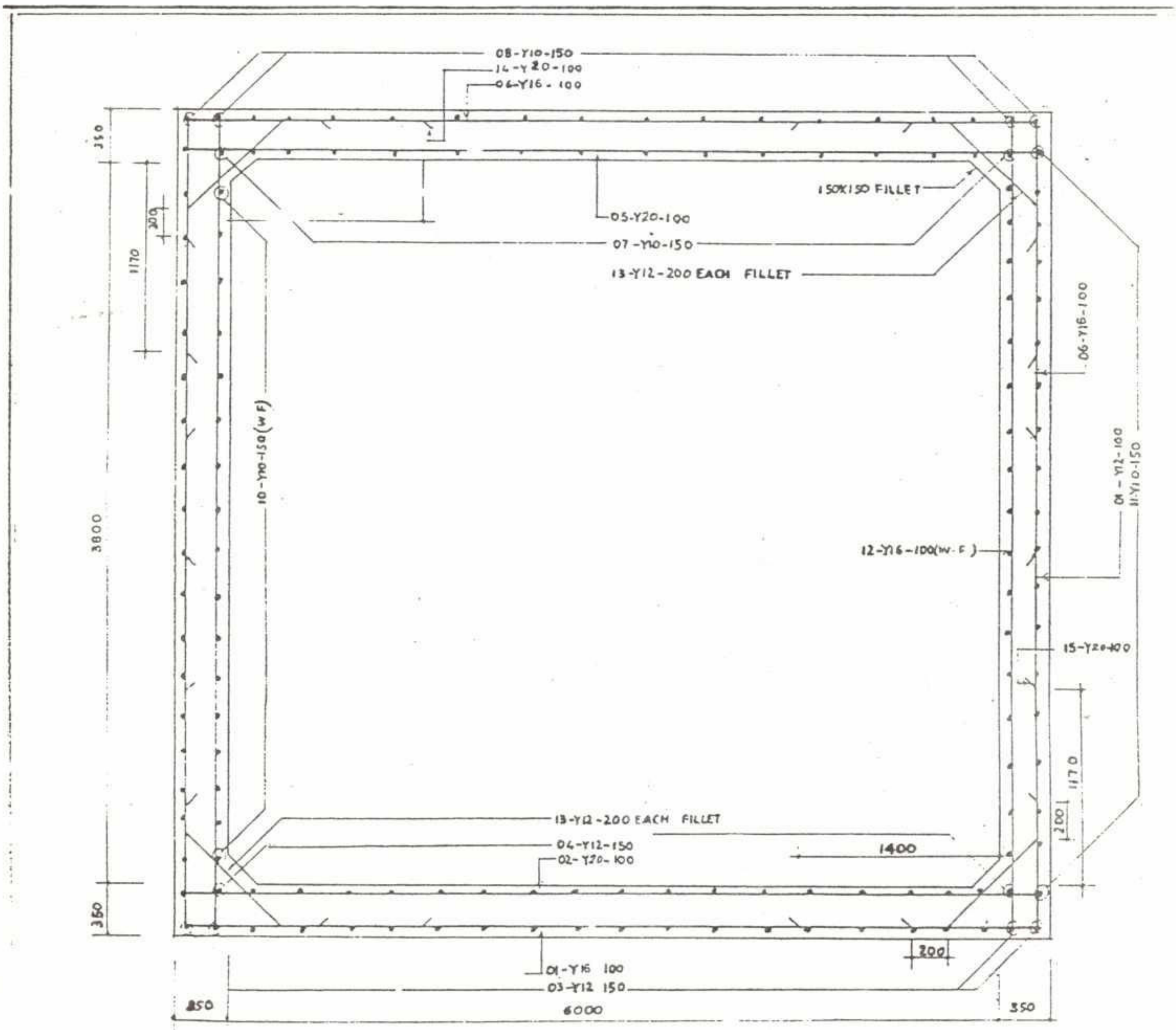
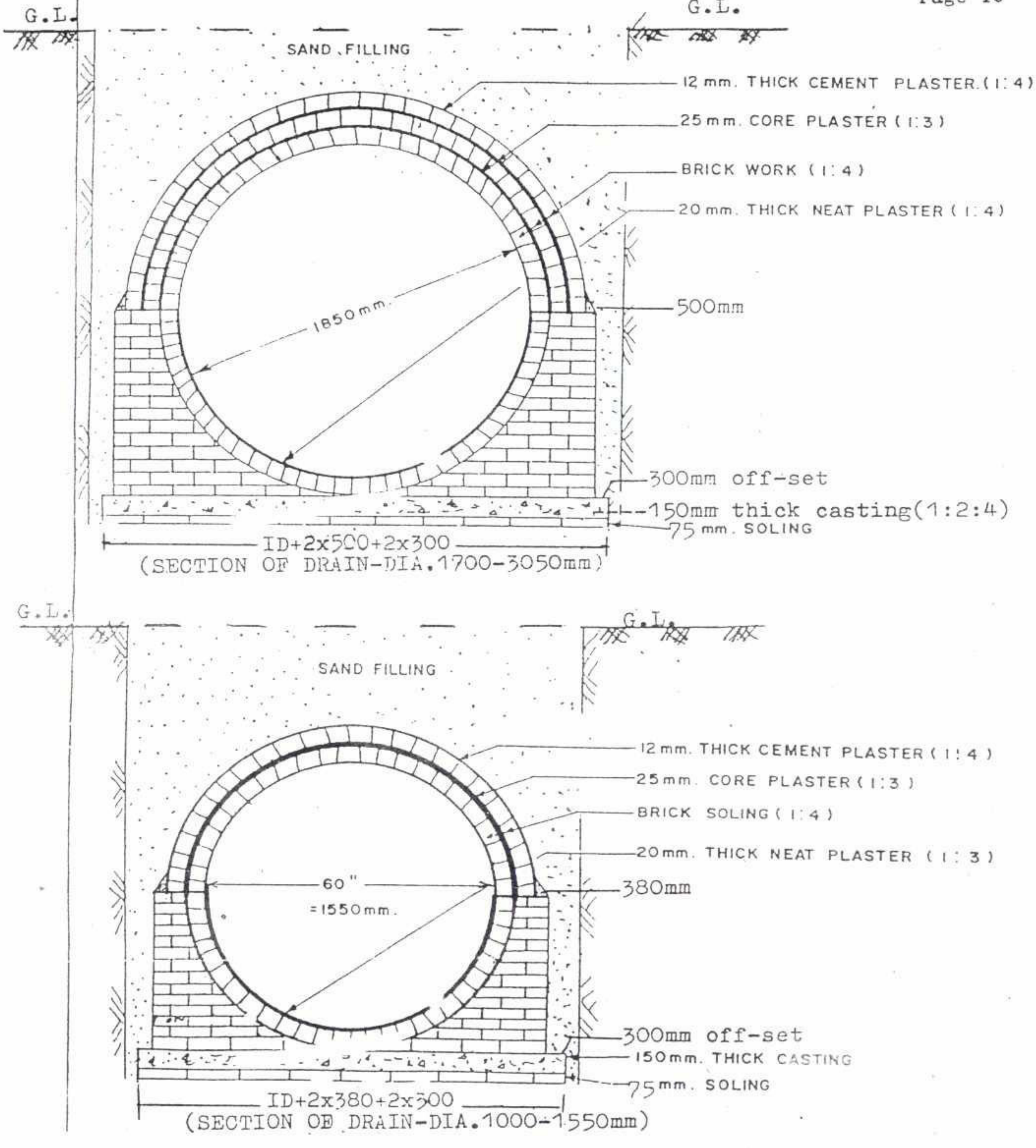
A TYPICAL SECTION OF BOX CULVERT



BOX SECTION REINF DETAILS (TYP)

226

CROSS SECTION OF MASONRY DRAIN



Notes:

i. Back filling the trenches is made by the excavated earth in the reaches other than the road sides; by sand and earth in the ratio of fifty-fifty at the road side portions; and by 100% sand along road portions.

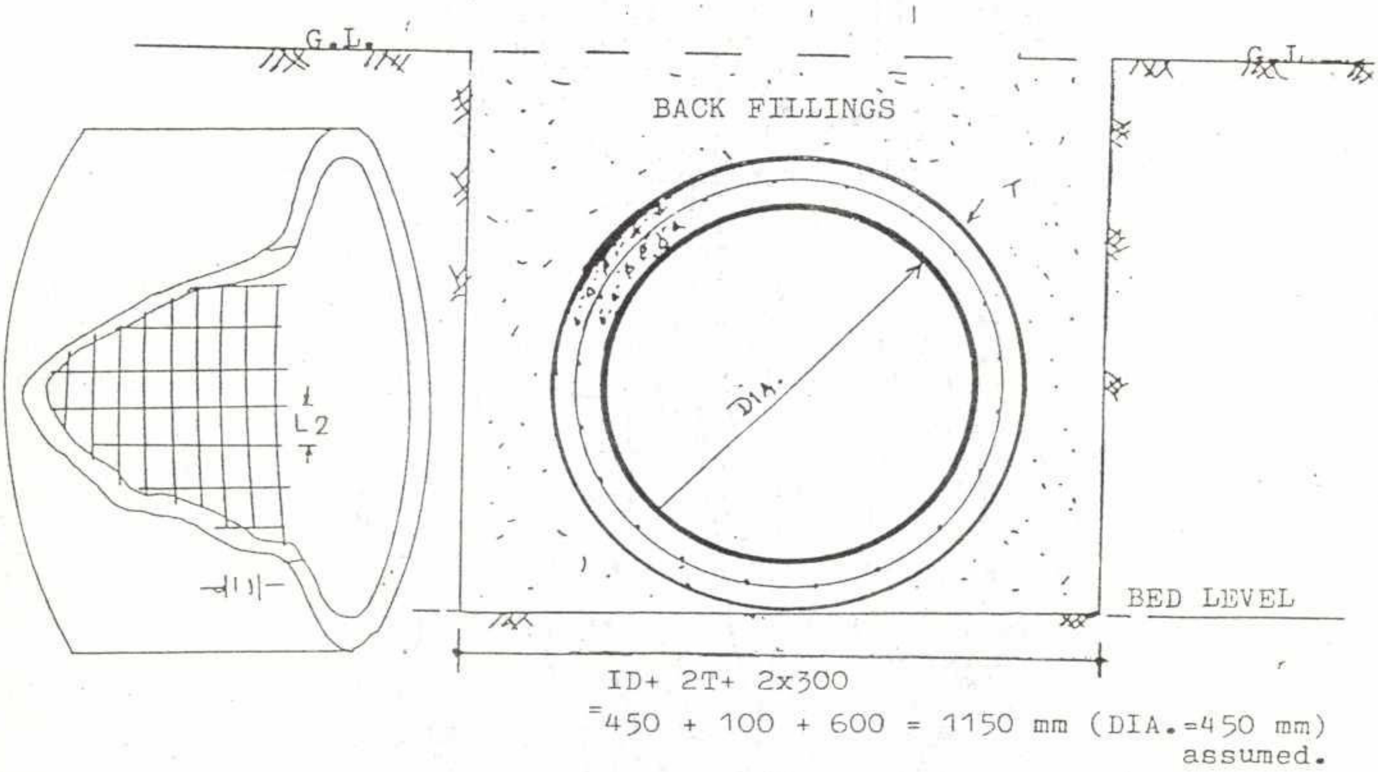
ii. If foundation is on loose soil then loose concrete(1:1 of sand and khoa) is used for consolidation.

iii. If more slushy earth is encountered with in the foundation soil then RCC may be provided.

iv. In case of alignment passing through the ditch or canal & the earth is found to be also very loose then green salballah piles with or without RCC in bed may be used.

Appendix 3

CROSS SECTION OF R.C.C. PIPE DRAIN



SINGLE REINFORCEMENT

INTERNAL DIAMETER	THICKNESS	REINFORCEMENT					
		CIRCULAR TRANSVERSE			HORIZONTAL LONGITUDINAL		
		L_1	wire gage	dia of wire	L_2	wire of gage	dia of wire
450 m.m.	50 m.m.	75 m.m.	9	0.492 m.m	150 mm	9	0.492 mm
750 m.m.	62. mm	75 mm.	5	0.688 mm	200 m.m.	7	0.590 mm

NOTES:

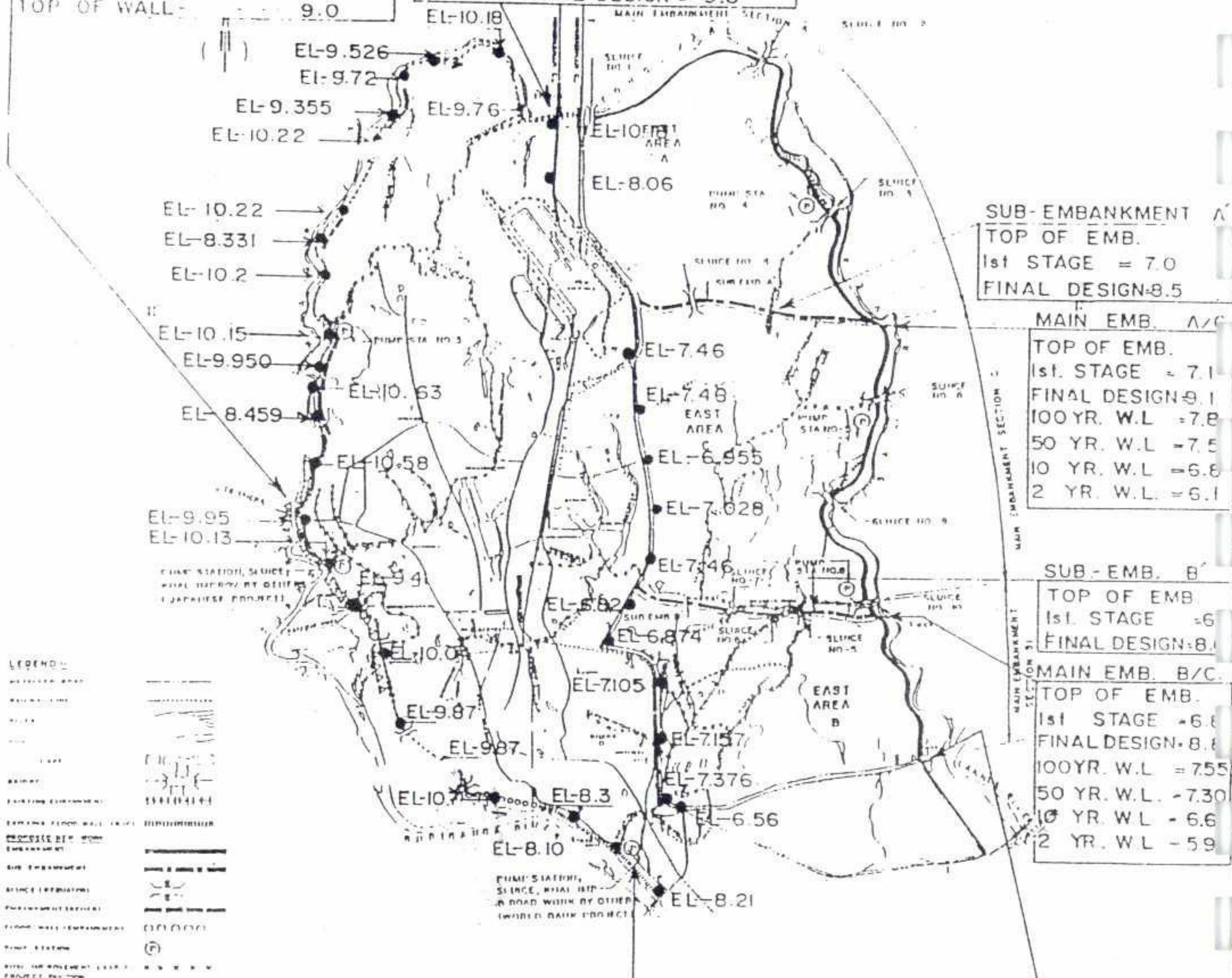
i. BACK FILLING IS MADE BY THE EXCAVATED EARTH IN PORTIONS OTHER THAN THE ROAD SIDES;
ii. BACK FILLING IS MADE IN ROAD SIDE PORTIONS AT THE RATIO OF 50:50 (SAND AND EARTH)·
iii. BACK FILLING IS MADE BY 100% SAND AT ROAD PORTIONS;
iv. IF FOUNDATION IS ON LOOSE SOIL THEN LOOSE CONCRETE IN THE RATIO .. 1:1 (SAND:KHOA) IS USED FOR CONSOLIDATION.

MIRPUR STA. 302.

1988 FLOOD WATER LEVEL = 8.39
DESIGN HIGH WATER LEVEL = 8.60
100 YR. WATER LEVEL - 8.53
50 YR. WATER LEVEL = 8.17
20 YR. WATER LEVEL - 7.68
10 YR. WATER LEVEL - 7.30
2 YR. WATER LEVEL - 6.30
TOP OF EMBANKMENT
1st. STAGE = 7.8
FINAL DESIGN = 9.8
TOP OF WALL = 9.0

TONGI STA. 299.

1988 FLOOD WATER LEVEL = 7.96
DESIGN HIGH WATER LEVEL - 8.6
100 YR. WATER LEVEL - 8.30
50 YR. WATER LEVEL - 7.96
20 YR. WATER LEVEL - 7.53
10 YR. WATER LEVEL - 7.18
2 YR. WATER LEVEL - 6.28
TOP OF EMBANKMENT
1st. STAGE = 7.8
FINAL DESIGN = 9.8



SUB-EMBANKMENT A'
TOP OF EMB.
1st STAGE = 7.0
FINAL DESIGN = 8.5

MAIN EMB. A/C
TOP OF EMB.
1st. STAGE = 7.1
FINAL DESIGN = 9.1
100 YR. W.L = 7.8
50 YR. W.L = 7.5
10 YR. W.L = 6.8
2 YR. W.L = 6.1

SUB.-EMB. B'
TOP OF EMB.
1st. STAGE = 6
FINAL DESIGN = 8.

MAIN EMB. B/C.
TOP OF EMB.
1st STAGE = 6.
FINAL DESIGN = 8.
100 YR. W.L = 7.55
50 YR. W.L. - 7.30
10 YR. W.L - 6.6
2 YR. W.L - 5.9

MILLBARAK STA. 42.

1988 FLOOD WATER LEVEL = 7.54
DESIGN HIGH WATER LEVEL = 7.8
100 YR. WATER LEVEL = 7.72
50 YR. WATER LEVEL - 7.40
20 YR. WATER LEVEL - 6.98
10 YR. WATER LEVEL - 6.65
2 YR. WATER LEVEL - 5.78
TOP OF EMBANKMENT
1st. STAGE = 7.8
FINAL DESIGN = 9.8
TOP OF WALL = 8.3

DEMRA STA. 7.5

1988 FLOOD WATER LEVEL = 7.10
DESIGN HIGH WATER LEVEL - 7.40
100 YR. WATER LEVEL - 7.32
50 YR. WATER LEVEL - 7.09
20 YR. WATER LEVEL - 6.77
10 YR. WATER LEVEL = 6.53
2 YR. WATER LEVEL = 5.89
TOP OF EMBANKMENT
1st. STAGE - 6.6
FINAL DESIGN - 8.6

NOTES:

1. TOP EL. OF EXISTING EMBANKMENTS, FLOODWALL, CENTRAL ROADWAY RAIL ROAD ARE SHOWN AS: • — EL. 7.00.
2. TOP EL. OF NEW EMBANKMENTS AND W.L. DATA SHOWN WITH IN BOX, INDICATED LOCATIONS WITH ARROW MARK.
3. ALL ELEVATION (EL.) IN PWD. (M) DATUM.

DHAKA INTEGRATED FLOOD PROTECTION PROJECT
FAP. 8 B.

PROPOSED FLOOD PROTECTION AND DRAINAGE ACTIVITIES

SPOT ELEVATIONS & WATER LEVEL DATA.

REVISED REMEDIAL DESIGN APPROACH

DHAKA INTEGRATED FLOOD PROTECTION PROJECT

FAP-8B

Prepared for

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17 September 1991

TABLE OF CONTENTS

1. INTRODUCTION

   1.1 Terms of Reference
   1.2 Background
   1.3 Organization

2. REVISED TECHNICAL APPROACH

   2.1 Introduction
   2.2 BWDB Concerns
   2.3 Response to BWDB Concerns
   2.4 Changes to Technical Support
   2.5 Implications

3. FIELD INVESTIGATION

4. LABORATORY INVESTIGATION

5. ASSESSMENT

6. REMEDIAL DESIGN

7. SUMMARY

1. INTRODUCTION

1.1 Terms of Reference

GeoSyntec Consultants is pleased to present this summary of the discussions and meetings between the Bangladesh Water Development Board (BWDB) and the Louis Berger International, Inc. (Berger) design team. The summary has been prepared by Dr. Neil D. Williams, P.E. of GeoSyntec Consultants, and was reviewed by Mr. Max G. Williams, P.E. of Berger.

1.2 Background

At the request of the BWDB, meetings were held between the Berger design team and the BWDB to discuss remedial technologies for the Dhaka Integrated Flood Protection Project embankment. As discussed in "Interim Report No. 1, Dhaka Integrated Flood Protection, FAP-8B," Berger, May 1991 and "Preliminary Analysis and Design, Phase I Embankment, Dhaka Integrated Flood Protection Plan," GeoSyntec Consultants, June 1991, about 18.1 miles (29.2 km) of embankment and 3.2 miles (5.2 km) of reinforced concrete flood protection walls (R/C walls) were installed under the direction of the Government of Bangladesh. The effort involved the BWDB, Dhaka Water and Sewage Authority (DWASA), Dhaka City Corporation (DCC), Rajdhami Unnayan Kattripaka (Capitol Development Group) (RAJUK), and the Bangladesh Army.

A damage survey conducted by the Berger design team in February 1991 showed extensive damage. The survey showed that approximately 15,420 ft (4700 m) of the embankment was subject to imminent and catastrophic failure resulting from inadequate subgrade shear strength. These areas were termed Class I areas and required immediate and short-term remedial actions. Approximately 10,000 ft (3050 m) of the embankment was damaged and required repair, but would not likely have failed catastrophically.

These sections of the embankment were termed Class II areas and required short-term remedial actions.

At the time of the survey, about 10,330 ft (3150 m) of the embankment were damaged by erosion. These areas were termed Class III areas, and at the time of the survey, constituted only minor damage. However, a subsequent survey of the embankment in August 1991 showed extensive erosion damage. In some areas the erosion damage extended to the crest of the embankment. Additional work is ongoing to determine the extent and magnitude of the erosion damage.

A preliminary damage survey of the R/C wall indicated damage due to cracking, erosion (piping) under the walls, and inadequate design of the wall for overturning. Additional studies are required to determine the extent of damage to the R/C wall and to prepare remedial designs for the wall.

A preliminary assessment of the embankment stability was performed at Location H3, Station 13+900, near Sluice 2 of the Phase I embankment. These analyses were based on available data using conventional limit equilibrium and plasticity methods of analysis. Using the available data, the factors of safety for bearing capacity and deep stability of the embankment were much less than 1.0, indicating imminent failure. These analyses were confirmed by several catastrophic failures in the Class I areas (some areas have been repaired more than 10 times).

Due to the very low shear strength of the highly plastic clayey silt subgrade, subgrade improvement was recommended to stabilize the embankments in the Class I and Class II areas. The recommended actions in the Class I and Class II areas consisted of:

- installation of vertical drains and high strength geosynthetic reinforcement at the base of the embankment, with embankment reconstruction; or

- partial excavation of the embankment to an elevation between 21 and 33 ft (6.5 and 10 m) PWD, installation of vertical drainage, and reconstruction of the embankment after consolidation.

Additional remedial measures were recommended for the R/C wall, Class III areas, and areas where the embankment had not yet been constructed.

The BWDB reviewed the Berger (May 1991) and GeoSyntec Consultants (June 1991) reports and provided comments to the design team. GeoSyntec Consultants responded to the comments in an 8 August 1991 letter. Subsequent meetings were held at the BWDB offices in August 1991 to discuss the BWDB concerns. A revised technical approach was developed jointly by the BWDB and the Berger design team. The revised technical approach and discussions leading to its development are described subsequently.

1.3 Organization

The remainder of the report is organized as follows:

- Section 2 introduces the revised technical approach. The discussions with and concerns of the BWDB are discussed.

- Section 3 describes the proposed field investigation program. A Field Investigation Plan will be developed describing the locations of borings, sampling methodology, and the laboratory investigation program.

- Section 4 describes the proposed laboratory investigation program. The laboratory investigation program will be designed to assess the stability of the existing embankment and to provide the data needed to perform a detailed remedial design of the embankment.

2 02

- Section 5 describes the assessment of remedial technologies and selection process for the remedial alternatives to be implemented for the embankment and R/C wall.

- Section 6 presents the remedial design approach.

- Section 7 presents the summary and conclusions.

2. REVISED TECHNICAL APPROACH

2.1 Introduction

Meetings were held between the Berger design team and the BWDB at the BWDB offices on 21, 24, 26, and 27 August 1991. The purpose of the meetings was to discuss the BWDB concerns and comments on the preliminary conceptual design of the embankment, and to jointly develop a revised technical approach for the remedial design which addressed the BWDB concerns and provided adequate stability and performance of the embankment.

2.2 BWDB Concerns

Based on our discussions in the August meetings, the BWDB concerns were as follows:

- The preliminary conceptual design and assessment was performed using available data and did not fully characterize the field conditions in all Class I and Class II areas. Additional data are required to assess the existing conditions in the Class I and Class II areas and to select appropriate remedial actions.

- The compaction conditions in the existing embankment have not been well documented. Additional analyses are required to determine the strength properties of the existing embankment.

- The BWDB has successfully constructed embankments on soft subgrades in other parts of the country. These embankments may have failed shortly after construction, but were stable after reconstruction.

- The BWDB recognized that the use of high strength geosynthetic reinforcement improved the stability of the embankment in the Class I areas. However, they were concerned that excavation and reconstruction of the embankment, which would be required to install the high strength geosynthetic reinforcement, would not be well received by the general public.

- The BWDB recognized that static factors of safety of 1.3 for global stability and bearing capacity were the state of practice. However, they believed lower short-term factors of safety may be appropriate if combined with an effective inspection and maintenance program.

- Wick drains have not been used previously in Bangladesh. The BWDB suggested that sand drains or wrapped sand drains be installed through the existing embankment.

- Slides and lateral deformations in the subgrade soils can be prevented by installing piezometers, settlement plates, side stakes, and slope indicators. Additional berms may be added in areas where laterals deformations are excessive.

2.3 Response to BWDB Concerns

The response to the BWDB concerns is presented in an 8 August 1991 letter from Dr. Neil Williams, P.E. of GeoSyntec Consultants to Mr. Max Williams, P.E., Project Team Leader of Berger. This response to comments is attached as Appendix A.

2.4 Changes to Technical Approach

The BWDB indicated that in the past they had successfully constructed embankments on soft soils. In several cases these embankments failed either during construction or shortly after construction. After reconstruction, these embankments had performed satisfactorily.

The Berger design team explained that this type of construction of embankments on soft soils is termed the displacement method. Since the soft subgrade soils do not have adequate shear strength to support the embankment, the subgrade fails, displacing the subgrade soils and replacing them with embankment soils. Assuming the embankment soils are stronger than the subgrade soils, stability can be achieved by reconstructing the embankment each time it fails, thereby displacing the weaker soils (and hence the name "displacement method"). Since this method depends on replacing weak soils with stronger soils, and if stability is defined as preventing large deformations in the embankment, the displacement method provides only a marginal factor of safety in areas where the failures have occurred. The static factors of safety are approximately 1.0 for bearing capacity and deep stability at the point where deformations become tolerable, and the factors of safety increase slightly over time as the subgrade consolidates.

Since the embankment in the Dhaka Integrated Flood Protection Plan encompasses highly populated areas, the static factors of safety for bearing capacity and global stability obtained from the displacement method are unacceptable. However, the BWDB suggested that static factors of safety lower than 1.3 be considered for the remedial design.

Based on these discussions, the BWDB and Berger design team developed and alternative technical approach. The technical approach was based on the fundamental assumption that short-term and long-term factors of safety could be less than 1.3. Additional field and laboratory investigations are included to provide the data needed to accurately

208

assess existing stability and to design the proposed remedial measures. The components of the revised technical approach are as follows:

- Field Investigation. A field investigation will be conducted to assess existing conditions, obtain the data required to refine estimates of areas requiring remediation (Class I, Class II, and Class III areas), and to obtain the data required for remedial design. A Field Investigation Plan will be developed describing in detail the proposed field investigation.

- Laboratory Investigation. A laboratory investigation will be performed to evaluate the properties of the embankment and subgrade soils which affect performance and design. The laboratory investigation will focus on evaluation of those parameters required to accurately analyze the stability of the existing embankments, and the evaluation of the parameters required for remedial design and analysis of the effectiveness of the proposed remedial design.

- Assessment. An assessment of the stability of the embankment under existing conditions will be performed. This detailed assessment will utilize the data and information collected from the field and laboratory investigations to assess the stability of the embankment for both existing and future conditions. A Remedial Action Plan will be prepared summarizing the analysis of candidate remedial technologies. Detailed analyses will be performed for each segment of the embankment needing remediation to determine the most appropriate and cost-effective remedial technologies which satisfy the stability, design, and performance criteria. The selected remedial technologies will then be described in detail.

- Remedial Design. Following the analysis, screening, and selection process, the recommended remedial actions will be designed. Design details, preliminary drawings, and detailed construction cost estimates will be developed.

This revised technical approach allows the BWDB and Berger design team to obtain the data and information needed to perform a detailed assessment of existing conditions and to design a cost-effective remedy.

2.5 Implications

The BWDB indicated that they would prefer to minimize excavation of the existing embankment and would like to eliminate the high strength geosynthetic reinforcement. After lengthy discussions, the following conceptual design was agreed upon as a starting point for remediation of the Class I and Class II areas.

- Excavation of the top of the existing embankment to an elevation between 21 and 33 ft (6.5 and 10 m) PWD. The amount of excavation will depend on stability analyses performed using the data obtained from the proposed field and laboratory investigations.

- Installation of wick drains through the existing embankment and into the subgrade soils. The depths of the wick drains will be evaluated using the data from the proposed field and laboratory investigations. The design criteria for the drain spacing will be developed based on minimum static factors of safety for bearing capacity and global stability of 1.0 within 1 year. The long-term factors of static factors of safety for bearing capacity and global stability will be greater than 1.2.

209

- Reconstruction of the top portion of the embankment with adequate compaction to achieve the design shear strengths.

- Construction of toe berms as needed to achieve the desired factors of safety.

- Placement of erosion protection materials.

There is some risk associated with the above approach, because the minimum static factors of safety of 1.0 are not achieved for approximately one year. Failure is possible in all of the Class I areas during that time frame. However, the factors of safety will increase rapidly after the wick drains are installed, and the risk of failure will decrease significantly with time. The wick drains will be designed to sustain substantial lateral deformations without failure. This will minimize the potential for replacement of wick drains in failed sections of the embankment. However, there is a strong possibility that failure of the embankment will occur during the first year after placement of the wick drains, and that replacement of the wick drains and reconstruction of the embankment will be required in some areas.

There is also risk associated with designing a critical structure, such as an flood protection embankment around a heavily populated area, to factors of safety less than the state of practice. This risk can be minimized by obtaining better data for the subgrade and embankment soils and by providing a more complete and extensive assessment of the variability of soil properties along the embankment alignment. However, due to the nature of the alluvial soils along the embankment alignment, and the variability of the soil properties, the risk associated with designing to a lower factor of safety must be carefully considered.

3. FIELD INVESTIGATION

A field investigation will be conducted to evaluate the lithostratigraphy along the embankment alignment. The investigation will assess the extent of subgrade soils which are subject to catastrophic failure. It is anticipated that the length of the embankment requiring Class I and Class II remedial actions may be reduced following interpretation of the data from the field investigation. The length of the embankment requiring Class III remedial actions is likely to increase due to damage sustained during the current wet season.

Soil borings will be advanced both in areas where failure has occurred and in areas where failure has not occurred. Soil samples will be obtained continuously in the borings advanced in areas where failure has occurred in order to determine the precise location of the zone of maximum shear stress, and the base of the fill material. In areas where failure has not occurred, continuous soil samples will be obtained through the embankment, and soil samples will be obtained at 5 ft (1.5 m) intervals and changes in stratigraphy thereafter.

Field testing will also be performed to evaluate the in-situ properties of the subgrade soils. It is anticipated that borehole vane shear, cone penetration, and in-situ permeability testing (slug testing) will be performed. Standard Penetration Testing (SPT) will also be performed at all locations where split spoon samples are obtained. The field testing methodology will be discussed in a Field Investigation Plan.

A Field Investigation Plan (FIP) will be prepared by the BWDB and Berger design team. The FIP will present the soil boring locations and depths, sample locations and types, and sampling methodology.

202

4. LABORATORY INVESTIGATION

A laboratory investigation will be performed to determine the engineering properties of the soils for assessment of the stability of the existing embankment and for remedial design. It is anticipated that the following types of analyses will be performed:

- Atterberg Limits Tests (ASTM D 4318);
- Sieve Analyses (ASTM D 422);
- Hydrometer Tests (ASTM D 422);
- One-Dimensional Consolidation Tests (ASTM D 2435);
- Triaxial Permeability Tests:
  - radial drainage only (GeoSyntec Consultants Procedure), and
  - vertical drainage only (ASTM D 5084);
- Triaxial Consolidation Test:
  - radial drainage (no vertical drainage) with vertical loading (GeoSyntec Consultants Procedure);
- Unconsolidated Undrained Triaxial Compression (UU) Tests (ASTM D 2850):
  - Samples from the triaxial consolidation test with radial drainage (no vertical drainage) and vertical loading will be obtained after 0, 25, 50, 75, and 90 percent consolidation. UU tests will be performed on these samples to evaluate the increase in undrained shear strength as a function of degree of consolidation (UUS);

- Consolidated Undrained Triaxial Compression Tests with Pore Pressure Measurement ($\overline{CU}$) (ASTM D 4767); and

- Hydraulic Conductivity Ratio Tests (GeoSyntec Consultants Procedure). This tes. is performed to evaluate the smear zone characteristics adiacent to the wick drain geotextile.

It is anticipated that the laboratory testing program will be performed by the BWDB and Berger design team. A Laboratory Quality Control Plan will be developed by Berger to address sample storage, preparation, testing methodology, quality control procedures, and data reduction procedures. Strict compliance with the Laboratory Quality Control Plan will be required.

222

5. ASSESSMENT

As data from the field and laboratory investigations become available, an assessment of existing conditions will be performed. Bearing capacity, slope stability, and global stability analyses will be performed to evaluate the stability of critical sections of embankment. These critical sections will include representative sections from each Class I, Class II, and Class III area, as well as adjacent areas which have not failed. The purpose of this assessment will be to evaluate the conditions leading to failure of the embankment and to refine the estimate of the Class I, Class II, and Class III areas needing remediation.

It is anticipated that numerical modeling will be performed using an elastic-plastic constitutive model for the soil. This type of model is required to predict the deformations of the soil in very soft soils such as those found in the Class I areas. The data from the field investigation will be used to accurately depict the location of the fill material and area of maximum shear stress in the subgrade. The prospect of failure in the future and the magnitude of future deformations will be evaluated.

Following the assessment described previously, a Remedial Action Plan will be prepared. The Remedial Action Plan will summarize and describe the candidate remedial technologies for each area where additional work is planned. It is anticipated that numerical modeling will be performed to evaluate the impacts and factors of safety of proposed remedial actions. An assessment of the factors of safety as a function of time will be prepared for each of the remedial actions which are considered. The Remedial Action Plan will be the basis of the remedial design. The remedial actions which satisfy the design requirements, provide an acceptable factor of safety for stability, and are cost effective will be selected for remedial design. The Remedial Action Plan will be prepared by the BWDB and Berger design team.

6. REMEDIAL DESIGN

Detailed design of the selected remedial actions will be performed. The results of the numerical modeling will be summarized and additional design calculations will be performed as needed. Design details and preliminary sketches of the design cross-sections will be developed. These design calculations and drawings will be prepared by the BWDB and Berger design team.

7. SUMMARY

Remediation of the existing embankment will require an organized and logical design approach. Additional data are required to characterize the properties of the embankment and subgrade soils, determine the extents of the Class I, Class II, and Class III areas, assess the stability of the existing embankment, and to evaluate the performance of potential remedial alternatives. In order to obtain the required data and to evaluate and select cost effective remedial measures, the following revised remedial design approach is recommended:

- Field Investigation;
- Laboratory Investigation;
- Assessment; and
- Remedial Design.

The BWDB suggested that lower static factors of safety than 1.3 be used for bearing capacity and global stability. Based on the BWDB suggestion, it is anticipated that the remedial design for the Class I and Class II areas will consist of:

- Excavation of the top of the existing embankment to an elevation between 21 and 33 ft (6.5 and 10 m) PWD;
- Installation of wick drains through the existing embankment and into the subgrade soils;
- Reconstruction of the top portion of the embankment with adequate compaction to achieve the design shear strengths;

- Construction of toe berms as needed to achieve the desired factors of safety; and

- Placement of erosion protection materials.

There is some risk associated with installation of wick drains through the embankment before the static factors of safety reach 1.0, and with designing the embankments for short-term and long-term static factors of safety less than the state of practice (1.3). However, in light of the political and socio-economic conditions in Bangladesh, the revised approach appears to be a calculated risk designed to minimize construction cost while still achieving an acceptable level of performance.

22a

APPENDIX A

RESPONSE TO BWDB COMMENTS

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GeoSyntec Consultants (formerly GeoServices Inc. Consulting Engineers)

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8 August 1991

Max G. Williams, P.E.
Louis Berger International, Inc.
7/5, Block B, Lalmatia
GPO Box 4289
Dhaka-1207, Bangladesh

Subject: Response to Bangladesh Water Development Board Comments
Dhaka Integrated Flood Protection Project

Dear Mr. Williams:

I received your fax dated 10 July 1991. I have reviewed the comments provided by the Bangladesh Water Development Board (BWDB) and I have prepared responses to those comments. In an effort to be complete and accurate, I have listed the observation/comment number, paragraph number, and page number from the BWDB letter, followed by my response.

BWDB comment (i), paragraph 1, page 4

"The strength of the soil generally decreases with an increase in amount of water in the soil pore and in the pressure existing in this pore water. Various means have been used to expedite the escape of soil pore water and thereby increase the rate of strength building and rate of settlement in the draining soil. An accurate design lies with the accuracy of the knowledge of the boundary condition and soil properties used in the theoretical expressions. Generally high compressibility is associated with low shear strength, and as the degree of consolidation cannot be reliably determined in advance, the shearing resistance at any given time is also a matter of considerable uncertainty."

Response

The BWDB is correct in their assessment that an accurate design requires an understanding of site conditions and soil properties. The report prepared by GeoSyntec Consultants entitled, "Preliminary Analysis and Design, Phase I Embankment, Dhaka Integrated Flood Protection Plan", June 1991 (Preliminary Design Report), presented analyses for the embankment at station 13 + 900, location H3, where there was considerable data. However, additional field investigations and laboratory testing are required to fully characterize subgrade conditions, evaluate soil properties, and to determine design parameters.

FE2000-02/F910491

8 August 1991
Page 2

A field investigation program will be developed and performed. The purpose of the field investigation program will be to:

- Determine the lithostratigraphy along the embankment alignment. The investigation will determine the extents of subgrade soils which are subject to catastrophic failure. It is anticipated that the length of the embankment requiring Class I remedial action may be reduced following interpretation of the data from the field investigation.

- Obtain soil samples for laboratory analysis.

- Determine the profile of the base of the embankment at critical locations.

The boring locations and depths, and sample locations and types will be presented in a Field Investigation Plan. This Field Investigation Plan will be submitted to the BWDB for review.

A laboratory testing program will be performed to obtain additional data for design. It is anticipated that the following types of analyses will be performed:

- Atterberg Limits Tests (ASTM D 4318);

- Sieve Analyses (ASTM D 422);

- Hydrometer Tests (ASTM D 422);

- One Dimensional Consolidation Test (ASTM D 2435);

- Triaxial Permeability Tests

  - radial drainage only (GeoSyntec Consultants Procedure), and
  - vertical drainage only (ASTM D 5084);

- Triaxial Consolidation Test
  - radial drainage (no vertical drainage) with vertical loading;
- Unconsolidated Undrained Triaxial Compression Tests (UU) (ASTM D 2850)
  - Samples from the triaxial consolidation test with radial drainage (no vertical drainage) and vertical loading will be obtained after 0, 25, 50, 75, and 90 percent consolidation. UU tests will be performed on these samples to evaluate the increase in undrained shear strength as a function of degree of consolidation;
- Consolidated Undrained Triaxial Compression Test with Pore Pressure Measurement ($\overline{CU}$) (ASTM D 4767);
- Pullout Tests between high strength geotextile and site soils (ASTM D 35.01.87.02);
- Direct Shear Tests between high strength geotextile and site soils (ASTM D 35.01.81.07); and
- Hydraulic Conductivity Ratio Tests (GeoSyntec Consultants Test Procedure). This test is performed to evaluate the smear zone characteristics adjacent to the wick drain geotextile.

It is anticipated that a soils laboratory will be established in Bangladesh to perform the required analyses. The laboratory testing equipment will be provided by GeoSyntec Consultants.

<u>BWDB comment (i), paragraph 2, page 5</u>

"All final design prepared by consultants must be vetted and approved by BWDB design office. The 2 m spaced wick drains which would give 90 percent consolidation in the soft subgrade in a 2 year period has been proposed by Dr. Williams. The BWDB design office could not check the contention and the validity, as Dr. Williams has not given the detailed engineering design computation."

222

8 August 1991
Page 4

Response

A Design Report will be prepared summarizing the analyses and calculations performed in support of the embankment redesign. The Design Report will be submitted to the BWDB for review, comment, and approval prior to construction activities. It is the intention of the Louis Berger International, Inc. (Berger) design team to work closely with the BWDB in the analysis and redesign of the embankments.

As stated above, a preliminary analysis was performed to address the feasibility of using wick drains to consolidate the soft, plastic clayey silt beneath the embankment. The spacing of the wick drains required to achieve various degrees of consolidation was evaluated using the equation developed by Hansbo (1979) in, "Consolidation of Clay by Band-Shaped Prefabricated Drains," Ground Engineering, Vol. 12, No. 5, pp. 16-25:

$$t = \frac{D^2}{8\,C_r}\left[\ln\left[\frac{D}{d_e}\right] - 0.75\right]\ln\left[\frac{1}{(1-\overline{U}_r)}\right]$$

where t = time; D = center to center spacing between the drains; d_e = equivalent diameter of the drain; $\overline{U}_r$ = average degree of consolidation due to radial drainage; and C_r = coefficient of radial consolidation. The equivalent diameter of the drain is calculated as follows:

$$d_e = \frac{2\,(a+b)}{\pi}$$

where a = width of drain; and b = thickness of drain. At station 13 + 900, location H3, the following parameters were used in the analyses:

- $C_r = 6 \times 10^{-4}\ cm^2/s$;
- a = 10.2 cm;
- b = 0.64 cm;
- D = varied; and
- $\overline{U}_r$ = varied.

BWDB comment (i), paragraph 3, page 5

"For improvement of the subgrade in the deep seated failures in class-I areas the use of wick drains/sand drains (sand piles) is acceptable. Sand drain is preferred because of its easier installation under the prevailing circumstances in Bangladesh."

Response

The BWDB states that use of vertical drains is acceptable, but indicates that sand drains are preferred because they are easier to install under the prevailing conditions in Bangladesh.

GeoSyntec Consultants believes, based on the preliminary analyses performed at station 13 + 900, location H3, that vertical drainage is a requirement for successful construction of the embankment in the Class I areas. The use of sand drains or wick drains must be evaluated during the design phase. GeoSyntec Consultants conducted preliminary analyses which indicated that wick drains were preferable to sand drains in the Class I areas. The primary reasons why wick drains would perform significantly better than sand drains in the Class I areas are as follows:

- Medium, uniform, clean sand with a gradation suitable for use in sand drains does not occur naturally in Bangladesh. This sand would either have to be manufactured in country or imported. If the sand is manufactured in country, the sand drain diameter is 6 in. (15.2 cm), and the unit cost of the sand is 280 Tk/yd^3 (US \$8.00/yd^3), the cost of the sand drain would more than 140 Tk/ft (US \$4.00/ft) installed. The unit cost of wick drains would be on the order of 35 to 70 Tk/ft (US \$1.00 to 2.00/ft), installed.

- Failure conditions already exist in many sections of the embankment. Movement will continue to occur along the failure surfaces until equilibrium conditions are achieved. Sand drains which are installed across the failure surfaces will be sheared, greatly decreasing the flow efficiency in the drains. Due to the tensile strength and high elongation at yield of the wick drains,

222

the wick drains will continue to function efficiently even though substantial deformations occur.

- In order to prevent shearing of the sand drains, the existing embankment would have to be removed, the sand drains installed, and the first stage of the embankment constructed. The height of the first stage would be such that it did not induce sufficient lateral deformation to shear the sand drains. In very soft, highly plastic soils such as those encountered in the Class I areas the rate at which the embankment could be constructed without shearing the sand drains would be very slow. The primary advantage of the wick drains, when used in conjunction with high strength base reinforcement of the embankment, is that much higher deformations of the subgrade can be tolerated. This means that the embankment could be constructed much faster with wick drains and base reinforcement than it could be constructed with sand drains.

- The use of wick drains has almost completely replaced the use of sand drains in this type of construction because of the cost, ease of installation, and improved durability, survivability, and performance.

It is the belief of GeoSyntec Consultants that wick drain technology and high strength geotextile technology are appropriate, cost-effective, and beneficial to the project. It is also the opinion of GeoSyntec Consultants that the use of wick drains, high strength geotextiles, and other geosynthetics in Bangladesh could significantly improve the performance of the embankment and many other types of structures and materials. This project affords the BWDB with an excellent opportunity to introduce new technologies to Bangladesh which would have far reaching beneficial impacts.

Notwithstanding the results of the preliminary analysis, it is the intention of GeoSyntec Consultants to consider sand drains, fabric or jute wrapped sand drains, and wick drains in the design of the vertical drainage system. The vertical drainage system which satisfies all of the design requirements in the most cost-effective manner will be selected.

BWDB comment (i), paragraph 4, page 5

"As for preventing slides in sand drains, prompt and proper observation of piezometers, settlement plates, side stakes, slope indicators should be done. Additional berms or bigger berms and lowering of hydrostatic pore pressure by pumping should be resorted to when needed. In case of sand wicks, stockings made of jute hessian filled with sand or pure coirs have been used in India."

Response

As stated in the response to comment (i), paragraph 3, page 5, it is possible to minimize shear of sand drains. This can be accomplished by using piezometers, slope indicators, and other instrumentation to monitor pore pressure and deformation, and assess the maximum rate at which the embankment could be constructed without damaging the sand drains.

However, in very soft soils, such as those in the Class I areas beneath the embankment, the rate at which the embankment could be constructed using sand drains would be significantly lower than the rate at which the embankment could be constructed with wick drains and high strength base reinforcement of the embankment. This is because wick drains can undergo considerable deformation and still function adequately. The high strength geotextile could be used to further increase the rate of construction.

As stated in the Preliminary Design Report, use of jute will likely not be appropriate for the drains because of the limited life of the material (typically about one year in this environment).

BWDB comment (ii), paragraph 1, page 5

"The phase-I embankment of Dhaka Integrated flood protection plan has been completed and put to service during late flood of 1989 (August-Sept). In 1989 flood level rose up to 5.50 m PWD datum. At that time the embankment has been constructed about 75 percent in full length. At present all the sluices are in operation with 1 m head difference and the embankment is in the service."

226

Response

It is recognized that the embankment was constructed in 1989, and that parts of the embankment have been placed in service. However, due to the unstable condition of the embankment in the Class I areas, and the potential for catastrophic failure of the embankment during periods of high water, putting the embankment in service prior to remediation of the Class I areas is a very high risk.

If water levels remain low, and head differentials across the embankment remain low the ris' is minimized. However, if a major flood occurs and head differentials are high, the consequence of failure would be irreconcilable.

BWDB comment (iii), paragraph 1, page 5

"Compaction of existing embankment shall be evaluated by actual data rather than assumption."

Response

GeoSyntec Consultants concurs with the BWDB that assessment of compaction should be based on data rather than assumption. In fact, significant amounts of shear strength data for the embankment have already been obtained and are summarized in the Preliminary Design Report [GeoSyntec Consultants, 1991]. Standard Penetration Resistance (SPT) blow counts of 0 to 2 were measured at many locations in the embankment.

Additional data are needed and will be obtained during the field investigation.

BWDB comment (iv), paragraph 1, page 5

"Utilize the existing embankment for subgrade improvement without excavating existing embankment and without providing base reinforcement but with wick drain/sand drain with stage construction in three years. Sand drain is preferred due to anticipated low cost."

Response

As stated in the Preliminary Design Report [GeoSyntec Consultants, 1991], remediation of sections of the embankment with vertical drainage (wick drains or sand drains) without excavation and without base reinforcement will be investigated. This may be possible in Class I areas where the depth of the very soft, highly plastic subgrade soils is low to moderate. The influence of thickness and characteristics of the subgrade soils must be evaluated to determine the threshold values at which full remediation with excavation and base reinforcement will be required.

As discussed in the response to BWDB comment (i), paragraph 3, page 5, the existing embankment in the Class I area is in a condition of failure. Movement along a failure surface or across a failure zone continues to occur. If sand drains were installed across the failure surface or through the failure zone they would be sheared off in a very short period of time (probably just a few days). Wick drains could survive much longer, but analyses would be required to determine if the wick drains would survive long enough to achieve the desired factors of safety for stability.

BWDB comment (v), paragraph 1, page 6

"For Class II and Class III areas stability of embankment can be achieved by providing toe berm on both the country side and river side. Without excavation of existing embankment with stage construction in three years. For the erosion protection, design for the corrective measure has been given. The jute and sod did not serve the purpose in all places as the erosion was from wind wave induced effect with very long fetch lengths.

Response

GeoSyntec Consultants agrees that some of the Class II areas can be remediated by construction of toe berms. The use of toe berms in Class II areas was recommended in the Preliminary Design Report [GeoSyntec Consultants, 1991]. Additional analyses are required to determine when toe berm construction is adequate and cost effective.

Remediation of Class III areas which were damaged by erosion requires additional study. The Preliminary Design Report [GeoSyntec Consultants, 1991] recommends that a limited feasibility study be performed to assess the appropriateness of various technologies. These technologies would include, but not be limited to:

- jute fiber reinforcement with sod;
- random brick protective layer;
- brick blocks;
- geotextile/concrete or sand cushion;
- block armour; and
- conventional graded rock.

It is GeoSyntec Consultants' understanding that many of the areas where the jute fiber/sod erosion protection system failed may have been caused by:

- subjection of the embankment to wave loading prior to placement of erosion protection materials;
- subjection of the embankment to wave loading without allowing the sod adequate time to catch hold; or
- poor compaction of the underlying embankment.

The feasibility study will consider the severity of the loading and will attempt to select erosion protection materials which are appropriate for each section of the embankment.

BWDB comment (vi), paragraph 1, page 6

"The stability analysis of embankment of ch.13+900 has been done with single soil parameter within a layer of 31 m. We consider that the analysis should be based with data of different layers. Dr. Williams did

not analysis embankment stability any where other than ch.13+900 with their soil test data. Whereas soil parameter of different layers are available."

Response

GeoSyntec Consultants agrees with the BWDB assessment that additional analyses are required to redesign the embankment. Subsequent designs will take into consideration the variability of the soil in both the embankment and the subgrade. Since the analyses were preliminary, and more detailed elastic-plastic analyses were clearly required, GeoSyntec Consultants elected to perform the preliminary analyses with simplified boundary conditions.

Additional analyses will be required to design the embankment for the myriad of conditions encountered in the field. It is anticipated that detailed design analyses will be performed using elastic-plastic finite element analyses. Simplified analyses may still be performed using limit equilibrium methods and the data obtained from the proposed field and laboratory investigations.

The preliminary analyses performed at station 13 + 900 illustrate the magnitude of the problem in a Class I area. The preliminary analyses used average shear strength data for a single layer of soil. The shear strengths used in the analyses were at the high end of the range for the Class I areas. The use of multiple layers of shear strength data would not materially affect the results of the analyses.

BWDB comment (vii), paragraph 1, page 6

"For stabilization of embankment implementation of the recommendations of Design Review committee is recommended."

Response

Remediation of the existing embankment to acceptable design standards will require an organized design approach. It is highly recommended that the design approach consist of:

- Development of a Field Investigation Plan, including
  - field investigation program, and
  - laboratory investigation program;
- Development of Remedial Action Plan
  - review remedial alternatives, and
  - select remedial actions;
- Feasibility Study of Erosion Protection Alternatives; and
- Design Report for Remediation of Embankment.

This will assure that the redesign of the embankment is handled in a logical, cost-effective, and appropriate way. Each of the plans and reports will be submitted to the BWDB for review and approval prior to progressing to the next step. This will assure that the input of the BWDB is considered for each phase of the design.

It is important to communicate the intention of the Berger Project Team and GeoSyntec Consultants to integrate the BWDB into each phase of the design. Indeed, the Project Team looks forward to working with the BWDB on this important project. We firmly believe that this will provide for the free exchange of ideas, and the introduction of new technologies in Bangladesh which could have far reaching and extremely useful benefits.

See you soon.

Sincerely,

Neil D. Williams, Ph.D., P.E.
President/CEO

228

COST ESTIMATES

Summary of Project Costs by Sector
(Taka million)

	Foreign	Local	Total
1. Base Costs by Sector:			
Part A: Flood Protection	613.71	1124.17	1737.88
Part B: Drainage	339.08	1053.27	1392.35
Part C: Environmental Imp'vmt:	109.88	260.28	370.16
i) Slum Improvement	(17.45)	(52.45)	(69.90)
ii) Solid Waste Mgmt.	(52.62)	(90.94)	(143.55)
iii) San/WS/Local Drain	(39.81)	(116.89)	(156.70)
Part D: Project Implementation Assistance:	61.61	159.86	221.47
i) Incremental Admin.	(8.33)	(50.40)	(58.73)
ii) Consulting Services	(53.28)	(109.46)	(162.74)
Subtotal	1124.28	2597.58	3721.86
2. Contingencies:			
Physical	115.51	234.18	349.69
Price	92.32	232.27	324.59
Subtotal	207.83	466.45	674.28
3. Interest During Construction:			
Service charge on Bank loan	119.20	-	119.20
IDC on Domestic Borrowing	-	-	-
Subtotal	119.20	-	119.20
TOTAL	1451.31	3064.03	4515.34

Notes: a) Base costs are mid-1991 costs.
b) Includes an estimated Taka 617.4 million equivalent CDST
c) Physical contingencies estimated at 10% of base cost, excluding land costs (15% on Part D: Implementation Assistance).
d) Price contingencies estimated at 4.9% on Foreign Currency costs up to 1994, and 3.7% thereafter, and at 6.0% on Local Currency costs.

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL SECTORAL COSTS BY CATAGORY

PART A: FLOOD PROTECTION
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL COST	1991-92 COST	1992-93 COST	1993-94 COST	1994-95 COST	1995-96 COST	1996-9[illegible] COST
LAND ACQUISITION	82.40	82.40					
CIVIL WORKS	918.60	273.51	297.45	181.65	142.00	24.00	
EQUIPMENT SUPPLY	661.08	6.76	188.89	241.44	224.00		
INCREMENTAL O & M	75.80	0.15	8.03	8.03	8.03	23.03	28.53
BASE COST SUB-TOTAL	1737.88	362.82	494.37	431.11	374.03	47.03	28.53
PHYSICAL CONTINGENCY	165.55	28.04	49.44	43.11	37.40	4.70	2.85
PRICE CONTINGENCY	176.33		30.36	54.10	70.08	12.18	9.62
TOTAL COST	2079.76	390.86	574.17	528.32	481.50	63.91	41.00

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL FC, LC AND COST

PART A: FLOOD PROTECTION
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
LAND ACQUISITION		82.40		82.40										
CIVIL WORKS	308.29	610.31	67.16	206.35	103.54	193.91	71.20	110.45	56.80	85.20	9.60	14.40		
EQUIPMENT SUPPLY	284.75	376.33	2.95	3.81	81.67	107.22	103.82	137.62	96.32	127.68				
INCREMENTAL O & M	20.67	55.13	0.05	0.11	2.00	6.04	2.00	6.04	2.00	6.04	6.50	16.54	8.15	20.39
BASE COST SUB-TOTAL	613.71	1124.17	70.15	292.[illegible]7	187.20	307.17	177.01	254.10	155.11	218.91	16.10	30.94	8.15	20.39
PHYSICAL CONTINGENCY	61.37	104.18	[illegible]	21.03	18.72	30.72	17.70	25.41	15.51	21.89	1.61	3.09	0.81	2.04
PRICE CONTINGENCY	59.00	117.33			10.09	20.27	19.55	34.55	24.08	46.00	3.25	8.93	2.03	7.58
TOTAL COST	734.08	1345.68	77.16	313.69	216.01	358.15	214.26	314.06	194.70	286.80	20.95	42.96	10.99	30.01

260

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL SECTORAL COSTS BY CATAGORY

PART B: DRAINAGE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL COST	1991-92 COST	1992-93 COST	1993-94 COST	1994-95 COST	1995-96 COST	1996-97 COST
LAND ACQUISITION	253.41	92.29	102.49	58.63			
CIVIL WORKS	1079.85	415.51	401.46	262.88			
EQUIPMENT SUPPLY	13.41	7.36	1.15	3.75	1.15		
INCREMENTAL STAFF/O&M	45.69	0.93	3.42	5.64	11.90	11.90	11.90
BASE COST SUB-TOTAL	1392.36	516.09	508.52	330.90	13.05	11.90	11.90
PHYSICAL CONTINGENCY	113.90	42.38	40.60	27.23	1.31	1.19	1.19
PRICE CONTINGENCY	83.52		31.48	42.18	2.56	3.20	4.10
TOTAL COST	1569.78	558.47	580.60	400.31	16.92	16.29	17.19

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL FC, LC AND COST

PART B: DRAINAGE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
LAND ACQUISITION		253.41		92.29		102.49		58.63						
CIVIL WORKS	323.96	755.90	124.65	290.86	120.44	281.02	78.86	184.02						
EQUIPMENT SUPPLY	5.72	7.69	2.67	4.69	0.64	0.51	1.76	1.99	0.64	0.51				
INCREMENTAL STAFF/O&M	9.41	36.29	0.05	0.89	0.45	2.97	0.90	4.74	2.67	9.23	2.67	9.23	2.67	9.23
BASE COST SUB-TOTAL	339.08	1053.27	127.37	388.72	121.53	386.98	81.53	249.37	3.31	9.74	2.67	9.23	2.67	9.23
PHYSICAL CONTINGENCY	33.91	79.99	12.74	29.64	12.15	28.45	8.15	19.07	0.33	0.97	0.27	0.92	0.27	0.92
PRICE CONTINGENCY	17.27	66.25			6.55	24.93	00	33.18	0.51	2.05	0.54	2.66	0.67	3.43
TOTAL COST	390.26	1199.51	140.11	418.37	140.24	440.36	98.68	301.63	4.16	12.76	3.48	12.82	3.60	13.59

2002

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL SECTORAL COSTS BY CATAGORY

PART C(i): ENVIRONMENTAL IMPROVEMENT; SLUM IMPROVEMENT
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL COST	1991-92 COST	1992-93 COST	1993-94 COST	1994-95 COST	1995-96 COST	1996-97 COST
LAND ACQUISITION							
CIVIL WORKS	61.90	4.38	11.26	13.76	10.00	10.00	12.50
EQUIPMENT SUPPLY	5.60	0.40	0.65	0.90	1.40	1.00	1.25
INCREMENTAL STAFF/O&M	2.40	0.03	0.15	0.27	0.51	0.72	0.72
BASE COST SUB-TOTAL	69.90	4.81	12.06	14.93	11.91	11.72	14.47
PHYSICAL CONTINGENCY	6.99	0.48	1.21	1.49	1.19	1.17	1.45
PRICE CONTINGENCY	13.20		0.75	1.93	2.35	3.16	5.01
TOTAL COST	90.09	5.29	14.02	18.35	15.46	16.06	20.92

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL FC, LC AND COST

PART C(i): ENVIRONMENTAL IMPROVEMENT; SLUM IMPROVEMENT
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
LAND ACQUISITION														
CIVIL WORKS	14.57	47.33	1.31	3.07	3.13	8.13	3.63	10.13	2.00	8.00	2.00	8.00	2.50	10.00
EQUIPMENT SUPPLY	2.16	3.44	0.24	0.16	0.32	0.34	0.39	0.51	0.54	0.86	0.30	0.70	0.38	0.88
INCREMENTAL STAFF/O&M	0.72	1.68	0.01	0.02	0.05	0.11	0.08	0.19	0.15	0.36	0.22	0.50	0.22	0.50
BASE COST SUB-TOTAL	17.45	52.45	1.56	3.25	3.49	8.57	4.10	10.83	2.69	9.22	2.52	9.20	3.09	11.38
PHYSICAL CONTINGENCY	1.75	5.25	0.16	0.32	0.35	0.86	0.41	1.08	0.27	0.92	0.25	0.92	0.31	1.14
PRICE CONTINGENCY	2.34	10.87			0.19	0.57	0.45	1.47	0.42	1.94	0.51	2.66	0.77	4.23
TOTAL COST	21.53	68.56	1.72	3.57	4.02	9.99	4.96	13.39	3.38	12.08	3.28	12.78	4.17	16.75

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL SECTORAL COSTS BY CATAGORY

PART C(ii): ENVIRONMENTAL IMPROVEMENT; SOLID WASTE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL COST	1991-92 COST	1992-93 COST	1993-94 COST	1994-95 COST	1995-96 COST	1996-97 COST
LAND ACQUISITION							
CIVIL WORKS	8.50	0.30	2.13	2.88	1.83	1.38	
EQUIPMENT SUPPLY	111.11	6.46	8.65		32.00	32.00	32.00
INCREMENTAL STAFF/O&M	23.94		0.31	0.41	3.06	7.75	12.42
BASE COST SUB-TOTAL	143.55	6.76	11.08	3.29	36.88	41.12	44.42
PHYSICAL CONTINGENCY	14.36	0.68	1.11	0.33	3.69	4.11	4.44
PRICE CONTINGENCY	33.13		0.69	0.42	6.97	10.53	14.52
TOTAL COST	191.03	7.44	12.88	4.04	47.54	55.76	63.37

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL FC, LC AND COST

PART C(ii): ENVIRONMENTAL IMPROVEMENT; SOLID WASTE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
LAND ACQUISITION														
CIVIL WORKS	2.55	5.95	0.09	0.21	0.64	1.49	0.86	2.01	0.55	1.28	0.41	0.96		
EQUIPMENT SUPPLY	42.88	68.23	2.13	4.33	2.60	6.06			12.72	19.28	12.72	19.28	12.72	19.28
INCREMENTAL STAFF/O&M	7.18	16.76			0.09	0.21	0.12	0.29	0.92	2.14	2.32	5.42	3.73	8.69
BASE COST SUB-TOTAL	52.62	90.94	2.22	4.54	3.32	7.76	0.99	2.30	14.18	22.70	15.46	25.67	16.45	27.97
PHYSICAL CONTINGENCY	5.20	9.09	0.22	0.45	0.33	0.78	0.10	0.23	1.42	2.27	1.55	2.57	1.64	2.80
PRICE CONTINGENCY	9.72	23.41			0.18	0.51	0.11	0.31	2.20	4.77	3.12	7.41	4.11	10.41
TOTAL COST	67.59	123.44	2.44	5.00	3.84	9.05	1.19	2.84	17.80	29.74	20.12	35.64	22.20	41.18

2660

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL SECTORAL COSTS BY CATAGORY

PART C(iii): ENVIRONMENTAL IMPROVEMENT; SANITATION, WATER SUPPLY AND LOCAL DRAINAGE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL COST	1991-92 COST	1992-93 COST	1993-94 COST	1994-95 COST	1995-96 COST	1996-97 COST
LAND ACQUISITION							
CIVIL WORKS	135.61	27.62	52.02	22.47	11.50	11.50	10.50
EQUIPMENT SUPPLY	9.20	0.40	8.08	0.72			
INCREMENTAL STAFF/O&M	11.89		0.30	2.34	2.89	3.08	3.28
BASE COST SUB-TOTAL	156.70	28.02	60.40	25.53	14.39	14.58	13.78
PHYSICAL CONTINGENCY	15.67	2.80	6.04	2.55	1.44	1.46	1.38
PRICE CONTINGENCY	18.40		3.81	3.30	2.80	3.85	4.65
TOTAL COST	190.78	30.82	70.25	31.39	18.62	19.89	19.81

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL FC, LC AND COST

PART C(iii): ENVIRONMENTAL IMPROVEMENT; SANITATION, WATER SUPPLY AND LOCAL DRAINAGE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
LAND ACQUISITION														
CIVIL WORKS	33.27	102.34	5.77	21.85	11.55	40.47	5.89	16.58	3.45	8.05	3.45	8.05	3.15	7.35
EQUIPMENT SUPPLY	3.77	5.43	0.22	0.18	3.33	4.75	0.22	0.50						
INCREMENTAL STAFF/O&M	2.77	9.13			0.09	0.21	0.56	1.78	0.67	2.22	0.71	2.38	0.75	2.53
BASE COST SUB-TOTAL	39.81	116.89	6.00	22.02	14.98	45.42	6.67	18.86	4.12	10.27	4.16	10.43	3.90	9.88
PHYSICAL CONTINGENCY	3.98	11.69	0.60	2.20	1.50	4.54	0.67	1.89	0.41	1.03	0.42	1.04	0.39	0.99
PRICE CONTINGENCY	3.99	14.41			0.81	3.00	0.74	2.56	0.64	2.16	0.84	3.01	0.97	3.68
TOTAL COST	47.79	142.99	6.60	24.[illegible]	17.28	52.96	8.07	23.32	5.17	13.46	5.41	14.48	5.26	14.55

268

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL SECTORAL COSTS BY CATAGORY

PART D: IMPLEMENTATION ASSISTANCE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL CO..	1991-92 COST	1992-93 COST	1993-94 COST	1994-95 COST	1995-96 COST	1996-97 COST
PIO STAFF COSTS	12.96	1.30	2.59	2.59	2.59	2.59	1.30
EQUIPMENT AND VEHICLES	15.07	15.07					
OFFICE RENT & RUNNING COS	30.70	3.07	6.14	6.14	6.14	6.14	3.07
CONSULTING SERVICES	162.74	41.62	63.35	37.73	14.19	5.07	0.78
BASE COST SUB-TOTAL	221.47	61.05	72.08	46.46	22.92	13.80	5.15
CONTINGENCIES (15%)	33.22	9.16	10.81	6.97	3.44	2.07	0.77
TOTAL COST	254.68	70.21	82.89	53.43	26.36	15.87	5.92

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
SUMMARY OF ANNUAL FC, LC AND COST

PART D: IMPLEMENTATION ASSISTANCE
All Costs in Taka x 1,000,000 (Million Taka)

DESCRIPTION	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC	FC	LC
PIO STAFF COSTS		12.96		1.30		2.59		2.59		2.59		2.59		1.30
EQUIPMENT AND VEHICLES	6.35	8.72	6.35	8.72										
OFFICE RENT & RUNNING	1.98	28.72	0.20	2.87	0.40	5.74	0.40	5.74	0.40	5.74	0.40	5.74	0.20	2.87
CONSULTING SERVICES	53.28	109.46	17.21	24.42	20.54	42.82	12.21	25.52	3.33	10.86		5.07		0.78
BASE COST SUB-TOTAL	61.61	159.86	23.75	37.30	20.93	51.15	12.61	33.86	3.73	19.20	0.40	13.41	0.20	4.95
CONTINGENCIES (15%)	9.24	23.96	3.56	5.59	3.14	7.67	1.89	5.08	0.56	2.88	0.06	2.01	0.03	0.74
TOTAL COST	70.85	183.83	27.32	42.89	24.07	58.82	14.50	38.93	4.28	22.08	0.46	15.42	0.23	5.69

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
DETAILED SECTORAL COST ESTIMATES

PART A: FLOOD PROTECTION
All Costs in Taka x 1,000,000 (Million Taka)

SL NO	DESCRIPTION	UNIT	UNIT COST	TOTAL QTY.	TOTAL COST	1991-92 QTY.	1991-92 COST	1992-93 QTY.	1992-93 COST	1993-94 QTY.	1993-94 COST	1994-95 QTY.	1994-95 COST	1995-96 QTY.	1995-96 COST	1996-97 QTY.	1996-97 COST
	LAND ACQUISITION																
1	Borrow area for stage 2 & finishing	ha	1.50	11.9	17.85	11.9	17.85										
2	Sluices, Pump Stn & Diversion Channels	ha	1.50	30.0	45.00	30.0	45.00										
3	Floodwall/Embankment	ha	1.15	17.0	19.55	17.0	19.55										
	SUB-TOTAL, LAND ACQUISITION				82.40		82.40										
	CIVIL WORKS																
1	Intensive remedial works (Class 1)	km	57.89	4.7	272.08			1.9	109.	1.9	109.99	0.9	52.10				
2	Moderate remedial works (Class 2)	km	27.53	3.1	83.97			1.2	33.	1.2	33.04	0.7	17.89				
3a	Minor remedial works/borrow p. backfill	km	5.60	6.5	36.40	6.5	36.40										
3b	Minor remedial works/jute & so. prot'n	km	0.75	17.7	13.25	17.7	13.25										
4	Slope protection (concrete block)	km	13.81	11.5	158.68	11.5	158.68										
5	Sluices	ea	7.00	5.0	35.00	5.0	35.00										
6a	New flood wall/embankment	km	63.76	1.6	102.02			1.6	102.02								
6b	Remediation of existing flood wall	L.S.	19.24	100.0%	19.24			50.0%	9.62	50.0%	9.62						
7a	Central road improvement/raising	km	2.02	10.8	21.82	5.8	11.72	5.0	10.10								
7b	Central road flood proofing (13 location	L.S.	46.15	100.0%	46.15	40.0%	18.46	60.0%	27.69								
8	Pump Station No. 3 @ Goranchatbari	L.S.	120.00	100.0%	120.00					20.0%	24.00	60.0%	72.00	20.0%	24.00		
9	Functional building	L.S.	10.00	100.0%	10.00			50.0%	5.00	50.0%	5.00						
	SUB-TOTAL, CIVIL WORKS				918.60		273.51		297.45		181.65		142.00		24.00		
	MATERIALS & EQUIPMENT SUPPLY																
1	Geotextiles and wick drains	L.S.	92.67	100.0%	92.67			50.0%	46.34	50.0%	46.34						
2	Steel sheet piling	L.S.	278.20	100.0%	278.20			50.0%	139.10	50.0%	139.10						
3	Steel gates	L.S.	4.98	100.0%	4.98	100.0%	4.98										
4	Pump Station No. 3; Pumps & Equipment	L.S.	280.00	100.0%	280.00					20.0%	56.00	80.0%	224.00				
5	Supervision Jeep	ea	1.46	1.0	1.46	1.0	1.46										
6	3 ton maintenance trucks	ea	1.00	3.0	3.00			3.0	3.00								
7	Motorcycles	ea	0.08	4.0	0.32	4.0	0.32										
8	Dewatering pumps & misc maint'ce equip	set	0.15	3.0	0.45			3.0	0.45								
	SUB-TOTAL, MATERIALS & EQUIPMENT				661.08		6.76		188.89		241.44		224.00				
	INCREMENTAL STAFFING AND O&M																
1	Inspection & maintenance crew staffing	mo	0.030	180.0	5.40			36.0	1.08	36.0	1.08	36.0	1.08	36.0	1.08	36.0	1.08
2	Sluice gate operators	mo	0.005	300.0	1.50			60.0	0.30	60.0	0.30	60.0	0.30	60.0	0.30	60.0	0.30
3	Vehicle running costs	mo	0.025	216.0	5.40	6.0	0.15	42.0	1.05	42.0	1.05	42.0	1.05	42.0	1.05	42.0	1.05
4	Routine maintenance materials/supplies	mo	0.050	60.0	3.00			12.0	0.60	12.0	0.60	12.0	0.60	12.0	0.60	12.0	0.60
5	Periodic maintenance contracts	yr	15.00	2.0	30.00									1.0	15.00	1.0	15.00
6	Pump operating costs	yr	L.S.		30.50				5.00		5.00		5.00		5.00		10.50
	SUB-TOTAL, INCREMENTAL STAFFING & O&M				75.80		0.15		8.03		8.03		8.03		23.03		28.53
	BASE COST SUB-TOTAL				1737.88		362.82		494.37		431.11		374.03		47.03		28.53
	PHYSICAL CONTINGENCY	%	10.0%		165.55		28.04		49.44		43.11		37.40		4.70		2.85
	PRICE CONTINGENCY				176.33				30.36		54.10		70.08		12.18		9.62
	TOTAL COST				2079.76		390.86		574.17		528.32		481.50		63.91		41.00

264

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
DETAILED SECTORAL COST ESTIMATES

PART B: DRAINAGE
All Costs in Taka x 1,000,000 (Million Taka)

SL NO	DESCRIPTION	UNIT	AVG. UNIT COST	TOTAL QTY.	TOTAL COST	1991-92 QTY.	1991-92 COST	1992-93 QTY.	1992-93 COST	1993-94 QTY.	1993-94 COST	1994-95 QTY.	1994-95 COST	1995-96 QTY.	1995-96 COST	1996-97 QTY.	1996-97 COST
	LAND ACQUISITION																
1	Land acquisition for Year 1 program	ha	6.96	7.9	55.24	7.9	55.24										
2	Land acquisition for Year 2 program	ha	3.37	22.0	74.11	1.0	37.05	11.0	37.05								
3	Land acquisition for Year 3 program	ha	2.62	47.4	124.06			25.0	65.43	22.4	58.63						
	SUB-TOTAL, LAND ACQUISITION				253.41		92.29		102.49		58.63						
	CIVIL WORKS																
1	Main khal rehabilitation & upgrading	km	40.14	7.8	311.16	7.[illegible]	311.16										
2	Second year khal rehab/upgrade program	km	10.28	19.6	201.31			19.58	201.31								
3	Third year khal rehab/upgrade program	km	3.43	51.2	175.80					51.22	175.80						
4	Pipe drain rehab & construction	km	7.72	50.7	391.58	15.11	104.35	23.62	200.15	12.02	87.08						
	SUB-TOTAL, CIVIL WORKS				1079.85		415.51		401.46		262.88						
	MATERIALS & EQUIPMENT SUPPLY																
1	Supervision Jeep	ea	1.46	1	1.46	1.0	1.46										
2	3 ton maintenance trucks	ea	1.00	3	3.00			1.0	1.00	1.0	1.00	1.0	1.00				
3	Drain cleaning truck	ea	2.60	1	2.60					1.0	2.60						
4	Motorcycles	ea	0.08	30	2.40	30.0	2.40										
5	Office furnishings & equipment	L.S.	3.50	1	3.50	1.0	3.50										
6	Dewatering pumps & misc maint'ce equip	set	0.15	3	0.45			1.0	0.15	1.0	0.15	1.0	0.15				
7																	
	SUB-TOTAL, MATERIALS & EQUIPMENT				13.41		7.36		1.15		3.75		1.15				
	INCREMENTAL STAFFING AND O&M																
1	Division staffing: Implementation & O&M	mo	0.130	66	8.58	6.0	0.78	12.0	1.56	12.0	1.56	12.0	1.56	12.0	1.56	12.0	1.56
2	Inspection & maintenance crew staffing	mo	0.030	192	5.76			12.0	0.36	36.0	1.08	48.0	1.44	48.0	1.44	48.0	1.44
3	Vehicle running costs	ea	0.025	270	6.75	6.0	0.15	36.0	0.90	48.0	1.20	60.0	1.50	60.0	1.50	60.0	1.50
4	Routine maintenance materials/supplies	mo	0.050	192	9.60			12.0	0.60	36.0	1.80	48.0	2.40	48.0	2.40	48.0	2.40
5	Periodic maintenance contracts	L.S.			15.00								5.00		5.00		5.00
6																	
	SUB-TOTAL, INCREMENTAL STAFFING AND O&M				45.69		0.93		3.42		5.64		11.90		11.90		11.90
	BASE COST SUB-TOTAL				1392.36		516.09		508.52		330.90		13.05		11.90		11.90
	PHYSICAL CONTINGENCY	%	10.0%		113.90		42.38		40.60		27.23		1.31		1.19		1.19
	PRICE CONTINGENCY				83.52				31.48		42.18		2.56		3.20		4.10
	TOTAL COST				1589.78		558.47		580.60		400.31		16.92		16.29		17.19

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
DETAILED SECTORAL COST ESTIMATES

PART C(i): ENVIRONMENTAL IMPROVEMENT; SLUM IMPROVEMENT
All Costs in Taka x 1,000,000 (Million Taka)

SL NO	DESCRIPTION	UNIT	UNIT COST	TOTAL QTY.	TOTAL COST	1991-92 QTY.	1991-92 COST	1992-93 QTY.	1992-93 COST	1993-94 QTY.	1993-94 COST	1994-95 QTY.	1994-95 COST	1995-96 QTY.	1995-96 COST	1996-97 QTY.	1996-97 COST
	LAND ACQUISITION																
1																	
2																	
	SUB-TOTAL, LAND ACQUISITION																
	CIVIL WORKS																
1	Completion works for City Pallis	L.S.	21.900	00.0%	21.90	20.0%	4.38	40.0%	8.76	40.0%	8.76						
2	Integrated slum improvement program	hh	0.005	8000	40.00			500	2.50	1000	5.00	2000	0.00	2000	10.00	2500	12.50
	SUB-TOTAL, CIVIL WORKS				61.90		4.38		11.26		13.76		0.00		10.00		12.50
	EQUIPMENT SUPPLY																
1	Motorcycles	ea	0.0800	20	1.60	5	0.40	5	0.40	5	0.40	5	0.40				
2	Health and training aids	hh	0.0005	8000	4.00			500	0.25	1000	0.50	2000	1.00	2000	1.00	2500	1.25
	SUB-TOTAL, EQUIPMENT SUPPLY				5.60		0.40		0.65		0.90		1.40		1.00		1.25
	INCREMENTAL STAFFING AND O&M																
1	Civil works (by beneficiaries)	ea	N.C.														
2	Motorcycle running costs	mo	0.002	1200	2.40	15	0.03	75	0.15	135	0.27	255	0.51	360	0.72	360	0.72
	SUB-TOTAL, INCREMENTAL STAFFING AND O&M				2.40		0.03		0.15		0.27		0.51		0.72		0.72
	BASE COST SUB-TOTAL				69.90		4.81		12.06		14.93		11.91		11.72		14.47
	PHYSICAL CONTINGENCY	%	10.0%		6.99		0.48		1.21		1.49		1.19		1.17		1.45
	PRICE CONTINGENCY				13.20				0.75		1.93		2.35		3.16		5.01
	TOTAL COST				90.09		5.29		14.02		18.35		15.46		16.06		20.92

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
DETAILED SECTORAL COST ESTIMATES

PART C(ii): ENVIRONMENTAL IMPROVEMENT; SOLID WASTE
All Costs in Taka x 1,000,000 (Million Taka)

SL NO	DESCRIPTION	UNIT	UNIT COST	TOTAL QTY.	TOTAL COST	1991-92 QTY.	1991-92 COST	1992-93 QTY.	1992-93 COST	1993-94 QTY.	1993-94 COST	1994-95 QTY.	1994-95 COST	1995-96 QTY.	1995-96 COST	1996-97 QTY.	1996-97 COST
	LAND ACQUISITION																
1																	
2																	
	SUB-TOTAL, LAND QUISITION																
	CIVIL WORKS																
1	Rehabilitate existing collect n bins	ea	0.0015	2000	3.00	200	0.30	500	0.75	1000	1.50	300	0.45				
2	Construct new collection bins	ea	0.0055	1000	5.50			250	1.38	250	1.38	250	1.38	250	1.38		
	SUB-TOTAL, CI L WORKS				8.50		0.30		2.13		2.88		1.83		1.38		
	EQUIPMENT SUPPLY																
1	Detachable body garbage trucks	ea	2.400	30	72.00							10	24.00	10	24.00	10	24.00
2	Demountable containers	ea	0.200	120	24.00							40	8.00	40	8.00	40	8.00
3	Supervision Jeep	ea	1.460	1	1.46	1	1.46										
4	Hand wheel barrows	ea	0.005	2000	10.00	1000	5.00	1000	5.00								
5	Hand tools and health equipment	L.S.	3.650	1	3.65			1	3.65								
	SUB-TOTAL, EQUIPMENT SUPPLY				111.11		6.46		8.65				32.00		32.00		32.00
	INCREMENTAL STAFFING AND O&M																
1	Civil works	ea	5.0%		1.18				0.02		0.12		0.27		0.36		0.43
2	Containers and tools	ea	20.0%		6.26				0.29		0.29		0.29		1.89		3.49
3	Vehicle running costs	mo	0.025	660	16.50							100	2.50	220	5.50	340	8.50
	SUB-TOTAL, INCREMENTAL STAFFING AND O&M				23.94				0.31		0.41		3.06		7.75		12.42
	BASE COST SUB-TOTAL				143.55		6.76		11.08		3.29		36.88		41.12		44.42
	PHYSICAL CONTINGENCY	%	10.0%		14.36		0.68		1.11		0.33		3.69		4.11		4.44
	PRICE CONTINGENCY				33.13				0.69		0.42		6.97		10.53		14.52
	TOTAL COST				191.03		7.44		12.88		4.04		47.54		55.76		63.37

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
DETAILED SECTORAL COST ESTIMATES

PART C(iii): ENVIRONMENTAL IMPROVEMENT; SANITATION, WATER SUPPLY AND LOCAL DRAINAGE
All Costs in Taka x 1,000,000 (Million Taka)

SL NO	DESCRIPTION	UNIT	UNIT COST	TOTAL		1991-92		1992-93		1993-94		1994-95		1995-96		1996-97	
				QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST	QTY.	COST
	LAND ACQUISITION																
1																	
2																	
	SUB-TOTAL, LAND ACQUISITION																
	CIVIL WORKS																
1	Construct pu[illegible]ic toilets/wash houses	ea	0.500	30	15.00	5	2.[illegible]	5	2.50	10	5.00	5	2.50	5	2.50		
2	Twin pit san[illegible]ary PF latrines	ea	0.004	2500	10.00			500	2.00	500	2.00	500	2.00	500	2.00	0	2.00
3	Single pit s[illegible]tary latrines	ea	0.003	3000	9.00			500	1.50	500	1.50	500	1.50	500	1.50	[illegible]	3.00
4	Sanitary latr[illegible]e shelters	ea	0.003	2500	7.50			500	1.50	500	1.50	500	1.50	500	1.50	[illegible]	1.50
5	Install public standpipes/tubewells	ea	0.020	1000	20.00			200	4.00	200	4.00	200	4.00	200	4.00	[illegible]	4.00
6	Clean & rehabilitate local storm drains	km	0.087	120	10.44	60	5.22	60	5.22								
7	Minor drain extension	km	0.770	71	54.67	20	15.40	40	30.80	11	8.47						
8	Surface drain reha[illegible]itation	km	0.150	60	9.00	30	4.50	30	4.50								
	SUB-TOTAL, CIVIL WORKS				135.61		27.62		52.02		22.47		11.50		11.50		10.50
	EQUIPMENT SUPPLY																
1	Mobile public toilets	ea	0.360	5.0	1.80			3.0	1.08	2.0	0.72						
2	Drain gulley sweeper	ea	2.600	1.0	2.60			1.0	2.60								
3	Septic tank desludging trucks	ea	2.200	2.0	4.40			2.0	4.40								
4	Motorcycles	ea	0.080	5.0	0.40	5.0	0.40										
	SUB-TOTAL, EQUIPMENT SUPPLY				9.20		0.40		8.08		0.72						
	INCREMENTAL STAFFING AND O&M																
1	Civil works (except private latrines)	ea	3.0%		7.99						1.44		1.99		2.18		2.38
2	Vehicle running costs	mo	0.025	156	3.90			12	0.30	36	0.90	36	0.90	36	0.90	36	0.90
	SUB-TOTAL, INCREMENTAL O&M				11.89				0.30		2.34		2.89		3.08		3.28
	BASE COST SUB-TOTAL				156.70		28.02		60.40		25.53		14.39		14.58		13.78
	PHYSICAL CONTINGENCY	%	10.0%		15.67		2.80		6.04		2.55		1.44		1.46		1.38
	PRICE CONTINGENCY				18.40				3.81		3.30		2.80		3.65		4.65
	TOTAL COST				190.78		30.82		70.25		31.39		18.62		19.89		19.81

269

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (FAP 8B)
DETAILED SECTORAL COST ESTIMATES

PART D: IMPLEMENTATION ASSISTANCE
All Costs in Taka x 1,000,000 (Million Taka)

SL NO	DESCRIPTION	UNIT	UNIT COST	TOTAL QTY.	TOTAL COST	1991-92 QTY.	1991-92 COST	1992-93 QTY.	1992-93 COST	1993-94 QTY.	1993-94 COST	1994-95 QTY.	1994-95 COST	1995-96 QTY.	1995-96 COST	1996-97 QTY.	1996-97 COST
	PIO STAFF COSTS																
11	Project Director	mm	0.012	60	0.72	6	0.07	12	0.14	12	0.14	12	0.14	12	0.14	6	0.07
12	Dy. Project Director	mm	0.010	180	1.80	18	0.18	36	0.36	36	0.36	36	0.36	36	0.36	18	0.18
13	Sociologist	mm	0.008	60	0.48	6	0.05	12	0.10	12	0.10	12	0.10	12	0.10	6	0.05
14	Planner	mm	0.008	60	0.48	6	0.05	12	0.10	12	0.10	12	0.10	12	0.10	6	0.05
15	Economist	mm	0.008	60	0.48	6	0.05	12	0.10	12	0.10	12	.10	12	0.10	6	0.05
16	Statistician	mm	0.008	60	0.48	6	0.05	12	0.10	12	0.10	12	.10	12	0.10	6	0.05
17	Slum Development Officer	mm	0.008	60	0.48	6	0.05	12	0.10	12	0.10	12	.10	12	0.10	6	0.05
18	Technical Support	mm	0.007	0	4.20	60	0.42	120	0.84	120	0.84	120	84	120	0.84	60	0.42
19	Administrative Support	mm	0.005	0	3.84	78	0.38	156	0.77	156	0.77	156	77	156	0.77	78	0.38
	SUB-TOTAL, PIO STAFF COSTS				12.96		1.30		2.59		2.59		79		2.59		1.30
	EQUIPMENT AND VEHICLES																
11	Computers/Printers/Voltage Stabilizers	ea	0.110	5	0.55	5	0.55										
12	Typewriters	ea	0.030	5	0.15	5	0.15										
13	Photocopiers	ea	0.180	2	36	2	0.36										
14	Calculators	ea	0.007	25	0.18	25	0.18										
15	Furnishings, A.C.s, Etc.	L.S.	0.730	100.0%	0.73	100.0%	0.73										
16	Car/Jeep/Minibus	ea	1.460	5	7.30	5	7.30										
17	Motorcycles	ea	0.080	10	0.80	10	0.80										
18	Materials & Laboratory Equipment	L.S.	5.000	100.0%	5.00	100.0%	5.00										
	SUB-TOTAL, EQUIPMENT & VEHICLES				15.07		15.07										
	OFFICE RENT & RUNNING COSTS																
11	Office rent & utilities	mo	0.060	60	3.60	6	0.36	12	0.72	12	0.72	12	0.72	12	0.72	6	0.36
12	Communications	mo	0.020	60	1.20	6	0.12	12	0.24	12	0.24	12	0.24	12	0.24	6	0.12
13	Office supplies	mo	0.020	60	1.20	6	0.12	12	0.24	12	0.24	12	0.24	12	0.24	6	0.12
14	Office maintenance	mo	0.010	60	0.60	6	0.06	12	0.12	12	0.12	12	0.12	12	0.12	6	0.06
15	Equipment maintenance	mo	0.010	60	0.60	6	0.06	12	0.12	12	0.12	12	0.12	12	0.12	6	0.06
16	Vehicle running costs	vm	0.020	300	6.00	30	0.60	60	1.20	60	1.20	60	1.20	60	1.20	30	0.60
17	Reports, HH surveys & monitoring	mo	0.025	60	1.50	6	0.15	12	0.30	12	0.30	12	0.30	12	0.30	6	0.15
18	Motivation & training	L.S.	16.00	100.0%	16.00	10.0%	1.60	20.0%	3.20	20.0%	3.20	20.0%	3.20	20.0%	3.20	10.0%	1.60
	SUB-TOTAL, OFFICE RENT & RUNNING COSTS				30.70		3.07		6.14		6.14		6.14		6.14		3.07
	CONSULTING SERVICES																
1	Subsoil investigations	L.S.	5.120	100.0%	5.12	50.0%	2.56	50.0%	2.56								
2a	Design & Const'n. Supervision - Foreign	mm	0.740	36	26.64	12	8.88	17	12.58	7	5.18						
2b	Design & Const'n. Supervision - Local	mm	0.130	414	53.82	81	10.53	179	23.27	100	13.00	39	5.07	15	1.95		
3a	Project Mgn't. Assistance - Foreign	mm	0.740	60	44.40	19	14.06	20	14.80	15	11.10	6	4.44				
3b	Project Mgm't. Assistance - Local	mm	0.130	252	32.76	43	5.59	78	10.14	65	8.45	36	4.68	24	3.12	6	0.78
	SUB-TOTAL, CONSULTING SERVICES				162.74		41.62		63.35		37.73		14.19		5.07		0.78
	BASE COST SUB-TOTAL				221.47		61.05		72.08		46.46		22.92		13.80		5.15
	CONTINGENCIES (15%)	%	15.0%		33.22		9.16		10.81		6.97		3.44		2.07		0.77
	TOTAL COST				254.68		70.21		82.89		53.43		26.36		15.87		5.92

Appendix 5
Page 13

280

282

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DHAKA INTEGRATED FLOOD PROTECTION PROJECT
YEARWISE SUMMERY ESTIMATE FOR DRAINAGE WORKS
WORKS UNDER FINANCIAL YEAR 1991-92

In Million Taka

Phase I Works: West Area

Sl. No.	Khal No./ Pipe Drain No.	Khal Rehabilitation	Length in metre Open	Closed	Total	Construction Cost W/O R/W	Right of Way in Acre	Cost of Right of Way	Total
1	1	Ibrahimpur khal	290	1,570	1,860	67.74	3.69	7.38	75.12
2	3	Mahakhali (Part I) khal	1,270	950	2,220	58.27	7.34	14.68	72.95
3	11	Begunbari (Mirpur Rd-Green Rd) khal		1,000	1,000	54.00	0.55	1.10	55.10
4	7	Segunbagicha khal (60%)	0	2,366	2,366	127.94	8.02	32.08	160.02
5	5	Rajabazar (west)	0	195	195	2.04	0.00	0.00	2.04
6	10	Kathalbagan	0	110	110	1.17	0.00	0.00	1.17
			1,560	6,191	7,751	311.16	19.60	55.24	366.40
		Pipe drain (Secondary and Tartiary drain)	Cost/km of khal = 311.16/7.751 = 40.144 million						
7	1	Connection of storm sewer at Basabo - Shahjahanpur	0	450	450	1.41	0.00	0.00	1.41
8	2	Airport Rd Culvert before president sectt. to Mohakhali Rly culvert	0	1,530	1,530	13.99	0.00	0.00	13.99
9	3	Mirpur Rd to Burigonga river via. BDR compound	0	2,960	2,960	21.45	0.00	0.00	21.45
10	4	Science laboratory to Paribagh khal	0	1,290	1,290	6.24	0.00	0.00	6.24
11	5	Santinagar to Natre Dame college culvert across Segunbagicha khal	0	3,730	3,730	31.51	0.00	0.00	31.51
12	6	Dilkusha Commercial Area	0	1,140	1,140	7.08	0.00	0.00	7.08
13	7	Kolmilata market to Tejkonipara mosque	0	850	850	5.43	0.00	0.00	5.43
14	8	Phoner Rd to Siddique bazar main drain	0	1,310	1,310	6.66	0.00	0.00	6.66
15	9	Removal of obstruction & laying of pipe lines in Ibrahimpur area	0	1,850	1,850	10.58	0.00	0.00	10.58
			0	15,110	15,110	104.35	0.00	0.00	104.35
		Total	1,560	21,301	22,861	415.51	19.60	55.24	470.75

Cost/km of pipe drain = 104.35/15.110 = 6.906 million
Average cost for khal & pipe drain/km
= 415.51/22.861 = 18.18 million

WORKS UNDER FINANCIAL YEAR 1992-93

Sl. No.	Khal No./ Pipe Drain No.	Khal Rehabilitation	Open	Closed	Total	Construction Cost W/O R/W	Right of Way	Cost of Right of Way	In Million Taka
1	2	Khilgaon-Basabo khal	2,518	517	3,035	34.68	10.51	21.02	55.70
2	6	Gerani khal	1,204	0	1,204	2.85	5.67	11.34	14.19
3	13	Katasur khal	1,500	0	1,500	2.25	4.80	7.20	9.45
4	17	Ramchandrapur	6,000	0	6,000	15.00	12.00	12.00	27.00
5	7	Segunbagicha khal (40%)	978	598	1576	85.30	0.00	0.00	85.30
6	12	Begunbari (Airport Rd to Rly Culvert) khal	1000	0	1000	10.00	0.75	1.88	11.88
7	9	Banani-Gulshan khal	4,350	150	4500	6.75	20.54	20.54	27.29
8	4	Paribagh khal	0	767	767	44.48	0.00	0.00	44.48
			17,550	2,032	19,582	201.31	54.27	73.98	275.29
		Pipe drain construction			Cost/km of khal = 201.31/19.582 = 10.280 million				
	1	Adjacent area of Gopibag & Golapbag	0.00	4,315	4,315	29.26	0.00	0.00	29.26
10	2	Adjacent area of Faridabad	0.00	2,140	2,140	12.73	0.00	0.00	12.73
11	3	Airport Rd kolmilata Market to Agargaon culvert through Bijoy shoroni	0.00	4,230	4,230	38.49	0.00	0.00	38.49
12	5	Farmgate to Panto-path	0.00	1,120	1,120	8.99	0.00	0.00	8.99
13	7	Mirpur section 10 to Ibrahimpur khal along Cant. Rd.	0.00	5,040	5,040	60.37	0.00	0.00	60.37
14	8	Kallyenpur Rd 2 & 3	0.00	120	120	2.86	0.00	0.00	2.86
15	10	Nimtoli to Burigonga river	0.00	2,250	2,250	19.24	0.00	0.00	19.24
16	13	Moghbazar Railway crossing to Begunbari Khal	0.00	1,250	1,250	9.40	0.00	0.00	9.40
17	14	Inner Circular Road to Navana Culvert	0.00	500	500	5.20	0.00	0.00	5.20
18	15	Bijoy Nagar to DIT extn.	0.00	1,050	1,050	8.09	0.00	0.00	8.09
19	19	Short distance pipe drains at different places	0.00	1,000	1,000	5.52	0.00	0.00	5.52
			0.00	23,015	23,015	200.15	0.00	0.00	200.15
			Cost/km of pipe drain = 200.15/23.615 = 8.475 million						
			17,550	25,047	42,597	401.46	54.27	73.98	475.44
				Average cost/km of khal & pipe drain/km =401.46/43.197 = 9.29 million					

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WORKS UNDER FINANCIAL YEAR 1993-94

In Million Taka

Sl. No.	Khal No./ Pipe Drain No.	Khal Rehabilitation	Open	Closed	Total	Construction Cost W/O R/W	Right of Way in Acre	Cost of Right of Way	Total
1	14	Mugda (Ahmed) khal	1,000	1,200	2,200	19.50	8.80	17.60	37.10
2	15	Kaliyanpur branch khal	8,500	200	8,700	35.00	7.66	11.49	46.49
3	18	Dugun khal	8,000	0	8,000	20.00	24.00	18.00	38.00
4	19	Baunia khal	10,000	0	10,000	24.00	20.00	15.00	39.00
5	20	Diabari khal	7500	0	7,500	18.75	15.00	11.25	30.00
6	21	Abdullahpur khal	4000	0	4,000	9.60	10.00	5.00	14.60
7	16	Ibrahimpur (Part 2) (branch) khal	4,500	1,500	6,000	32.75	6.00	7.20	39.95
8	8	Begunbari (Rly culvert to Badha khal) khal	4,820	0	4,820	16.20	25.74	38.60	54.80
			48,320	2,900	51,220	175.80	117.20	124.14	299.94
		Pipe drain construction		Cost/km of khal = 175.8/51.220 = 3.43 million					
9	4	Siddeshsuri area	0.00	1,600	1,600	7.88	0.00	0.00	7.88
10	6	Kathal bagan	0.00	800	800	4.25	0.00	0.00	4.25
11	9	D.U. Dowell Chatter to Rokeya Hall	0.00	950	950	4.82	0.00	0.00	4.82
12	11	Kazipara to k15 khal west of Rokeya Shoroni	0.00	2,220	2,220	23.97	0.00	0.00	23.97
13	12	Cantonment Kochakhat gate to Ibrahim pur culvert	0.00	900	900	8.30	0.00	0.00	8.30
14	16	Rampura Rd	0.00	1,050	1,050	10.50	0.00	0.00	10.50
15	17	Basabo area	[illegible]	[illegible]	[illegible]	5.45	[illegible]	[illegible]	[illegible]
16	18	Janapath to Basobo khal	0.00	720	720	5.20	0.00	0.00	5.20
17	19	Short distances pipe drains at different place	0.00	3,030	3,030	16.71	0.00	0.00	16.71
		Total	0.00	12,020	12,020	87.08	0.00	0.00	87.08
				Cost/km of pipe drain = 87.08/12020 = 7.24459 million					
		Total of khal & pipe drain	48, .0	14,920	63,240	262.88	117.20	124.14	387.02
				Average cost/km of khal & pipe drain =262.88/63,240=4.156 million					

Future Works : East Area

In Million Taka

Sl. No.	Khal No./ Pipe Drain No.	Khal Rehabilitation	Open	Closed	Total	Construction Cost W/O R/W	Right of Way in Acre	Cost of Right of Way	Total
1	22	Gerani (Part 2) khal	3,200	-	3,200	8.00	8.00	12.00	21.60
2	23	Manda (Part 1) khal	5,500	-	5,500	13.75	9.50	9.50	26.00
3	24	Manda (Part 2) khal	6,500	-	6,500	16.25	16.00	16.00	35.00
4	25	Gozaria khal	5,000	-	5,000	15.00	12.50	6.25	24.25
5	26	Badda khal	6,000	-	6,000	15.00	7.50	3.75	21.75
6	27	Barakatalia	5,000	-	5,000	12.50	7.50	3.75	18.75
7	28	Dumni khal	4,000	-	4,000	10.00	9.00	4.50	16.50
8	29	Bupar khal	5,000	-	5,000	12.50	9.00	4.50	19.50
		Total	40,200	-	40,200	103.00	79.00	60.25	183.35
				Construction cost/km of khal = 130/40.2 = 3.23 million					

PHASE I ACTIVITIES

ESTIMATED COST OF VARIOUS COMPONENTS

PART A - FLOOD PROTECTION

Sheet 1 of 11

ITEM No.	DESCRIPTION	CONST COST Million tk.
	CIVIL WORKS	
1	Embankment - intensive remedial works - CLASS I	
	- excavation of top of embankment and placement as toe berm 242967 @ 75 tk/m³ = 18,222,525 = 18.22 million tk.	
	- Wick drain installation = 1[illegible]-08 L.M @ 100 tk/lm. = 186988800 = 186.98 mill. tk.	
	- Furnish, Place & Compact fill at top of Embank = 242,967 m³ @ 250 tk/m³ = 60,741,625 = 60.74 million tk.	
	- Furnish, Place & Compact fill after settlement. = 24,530 m³ @ 250 tk/m³ = 6,132,500 = 6.13 mill. tk.	
	sub total = 272.07 mill. tk.	
	MATERIAL & EQUIPMENT	
	Wick drain material - supply = 1,869,880 LM @ 25 tk/lm = 46,747,000 = 46.75 mill tk.	
	Duties & taxes for wick drain material are not known since this material has not been imported previously. Local geo-textile supplier in Dhaka have estimated the cost of material at about 12.5 tk per lin m. w/o tax with 100 % added for D & T. D & T = 23.37 million tk.	
	TOTAL BASE COST 318.82 Million tk	318.82
	Million US$	8.85

2 8 8

COST ESTIMATE
REMEDIAL MEASURES FOR WEST EMBANKMENT

CLASS I AREAS

Sheet 1.a

1. EXCAVATION OF TOP OF EMBANKMENT AND PLACEMENT AS TOE BERM

BEGINNING STATION	ENDING STATION	LENGTH (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	UNIT COST (tk/m3)	TOTAL COST (tk)	TOTAL COST ($)
6350	7750	1400	3.50	51.70	72373	75.00	5427975.00	$159,646.32
10600	11100	500	3.50	51.70	25848	75.00	1938562.50	$57,016.54
13700	14350	650	3.50	51.70	33602	75.00	2520131.25	$74,121.51
14550	15250	700	3.50	51.70	36187	75.00	2713987.50	$79,823.16
15650	15700	50	3.50	51.70	2585	75.00	193856.25	$5,701.65
15800	17200	1400	3.50	51.70	72373	75.00	5427975.00	$159,646.32
TOTALS		4700			242967		18222487.50	$535,955.51

2. WICK DRAIN INSTALLATION

BEGINNING STATION	ENDING STATION	LENGTH (m)	WIDTH (m)	AREA (m2)	DRAIN SPACING (m)	NO. DRAINS	AVER DEPTH (m)	UNIT COST (tk/m)	TOTAL COST (tk)	TOTAL COST ($)
6350	7750	1400	62	86800	2.00	22432	24	125.00	67296000.00	$1,979,294.12
10600	11100	500	62	31000	2.00	8032	24	125.00	24096000.00	$708,705.88
13700	14350	[illegible]	62	40300	2.00	10432	29	125.00	37816000.00	$1,112,235.29
14550	15250	700	62	43400	2.00	11232	24	125.00	33696000.00	$991,058.82
15650	15700	50	62	3100	2.00	832	34	125.00	3536000.00	$104,000.00
15800	17200	1400	62	86800	2.00	22432	24	125.00	67296000.00	$1,979,294.12
TOTALS		4700		291400					233736000.00	$6,874,588.24

3. PLACE AND COMPACT FILL IN TOP OF EMBANKMENT

BEGINNING STATION	ENDING STATION	LENGTH (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	UNIT COST (tk/m3)	TOTAL COST (tk)	TOTAL COST ($)
6350	7750	1400	3.50	51.70	72373	250.00	18093250.00	$532,154.41
10600	11100	500	3.50	51.70	25848	250.00	6461875.00	$190,055.15
13700	14350	650	3.50	51.70	33602	250.00	8400437.50	$247,071.69
14550	15250	700	3.50	51.70	36187	250.00	9046625.00	$266,077.21
15650	15700	50	3.50	51.70	2585	250.00	646187.50	$19,005.51
15800	17200	1400	3.50	51.70	72373	250.00	18093250.00	$532,154.41
TOTALS		4700			242967		60741625.00	$1,786,518.38

4. PLACE AND COMPACT FILL AFTER SETTLEMENT

BEGINNING STATION	ENDING STATION	LENGTH (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	UNIT COST (tk/m3)	TOTAL COST (tk)	TOTAL COST ($)
6350	7750	1400	0.75	4.89	6846	250.00	1711500.00	$50,338.24
10600	11100	500	0.75	4.89	2445	250.00	611250.00	$17,977.94
13700	14350	650	1.00	7.27	4726	250.00	1181375.00	$34,746.32
14550	15250	700	0.75	4.89	3423	250.00	855750.00	$25,169.12
15650	15700	50	0.75	4.89	244	250.00	61125.00	$1,797.79
15800	17200	1400	0.75	4.89	6846	250.00	1711500.00	$50,338.24
TOTALS		4700			24530		6132500.00	$180,367.65

TOTAL COST ESTIMATE FOR CLASS I AREA 318832612.50 $9,377,429.78

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

Sheet 2 of 11

ITEM No.	DESCRIPTION	CONST COST Million tk.
	CIVIL WORKS	
2.	Embankment moderate remedial works-Class II	
	- excavation of top of embankment and placement as toe berm 157,670 m³ @ 75 tk/m³ = 11,825,231 = 11.825 mill tk.	
	- Wick drain installation = 310,209 LM @ 100 tk/LM = 31,020,900 = 31.02 mill. tk.	
	- Furnish, place, & compact fill in top of embankment. = 157,670 m³ @ 250 tk/m³ = 39,417,437 = 39.42 mill. tk.	
	- Furnish, place & compact fill after settlement. = 6778 m³ @ 250 tk/m³ = 1,694,487 = 1.69 mill. tk.	
	subtotal = 83.955 mill tk.	
	MATERIALS & EQUIPMENT	
	- Wick drain material supply = = 310,209 LM @ 25 tk/LM = 7,755,225 = 7.755 mill. tk.	
	Wick drain material w/o duties & taxes = = ± 12.5 tk / LM.	
	Wick drain material including D & T = ± 25 tk/LM.	
	D+T = 3.88 million tk.	
	TOTAL BASE COST 91.71 mill. tk.	91.71
	mill $ US	2.55

289

COST ESTIMATE
REMEDIAL MEASURES FOR WEST EMBANKMENT

CLASS II AREAS

Sheet 2.a

1. EXCAVATION OF TOP OF EMBANKMENT AND PLACEMENT AS TOE BERM

BEGINNING STATION	ENDING STATION	LENGTH (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	UNIT COST (tk/m3)	TOTAL COST (tk)	TOTAL COST ($)
900	1600	700	3.50	51.70	36187	75.00	2713987.50	$79,823.16
4100	4700	600	3.50	51.70	31017	75.00	2326275.00	$68,419.85
6200	6350	150	3.50	51.70	7754	75.00	581568.75	$17,104.96
7900	8000	100	3.50	51.70	5170	75.00	387712.50	$11,403.31
9100	10000	900	3.50	51.70	46526	75.00	3489412.50	$102,629.78
10000	10600	600	3.50	51.70	31017	75.00	2326275.00	$68,419.85
TOTALS		3050			157670		11825231.25	$347,800.92

2. WICK DRAIN INSTALLATION

BEGINNING STATION	ENDING STATION	LENGTH (m)	WIDTH (m)	AREA (m2)	DRAIN SPACING (m)	NO. DRAINS	AVER DEPTH (m)	UNIT COST (tk/m)	TOTAL COST (tk)	TOTAL COST ($)
900	1600	700	62	43400	3.00	5077	14	125.00	8885136.89	$261,327.61
4100	4700	600	62	37200	3.00	4355	14	125.00	7621250.00	$224,154.41
6200	6350	150.	62	9300	3.00	1105	14	125.00	1933750.00	$56,875.00
7900	8000	100	62	6200	3.00	744	14	125.00	1301805.56	$38,288.40
9100	10000	900	62	55800	3.00	6522	14	125.00	11412916.67	$335,674.02
10000	10600	600	62	37200	3.00	4355	14	125.00	7621250.00	$224,154.41
TOTALS		3050		189100					38776111.11	$1,140,473.86

3. PLACE AND COMPACT FILL IN TOP OF EMBANKMENT

BEGINNING STATION	ENDING STATION	LENGTH (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	UNIT COST (tk/m3)	TOTAL COST (tk)	TOTAL COST ($)
900	1600	700	3.50	51.70	36187	250.00	9046625.00	$266,077.21
4100	4700	600	3.50	51.70	31017	250.00	7754250.00	$228,066.18
6200	6350	150	3.50	51.70	7754	250.00	1938562.50	$57,016.54
7900	8000	100	3.50	51.70	5170	250.00	1292375.00	$38,011.03
9100	10000	900	3.50	51.70	46526	250.00	11631375.00	$342,099.26
10000	10600	600	3.50	51.70	31017	250.00	7754250.00	$228,066.18
TOTALS		3050			157670		39417437.50	$1,159,336.40

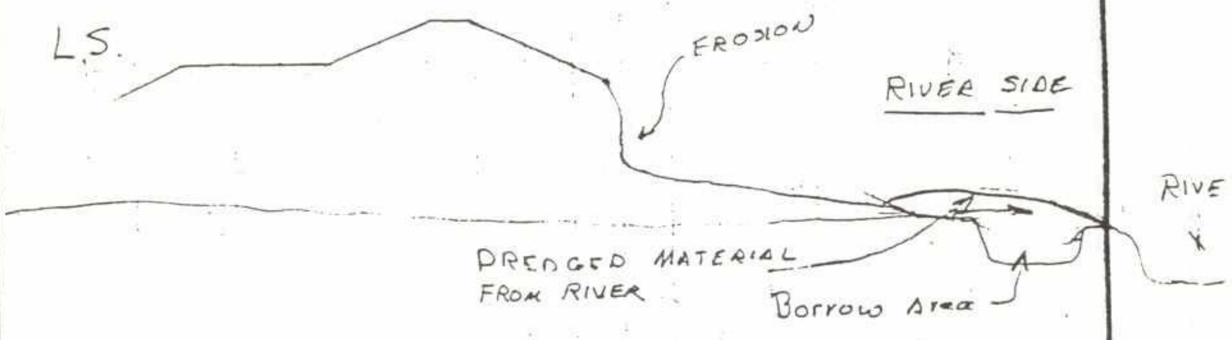
4. PLACE AND COMPACT FILL AFTER SETTLEMENT

BEGINNING STATION	ENDING STATION	LENGTH (m)	DEPTH (m)	AREA (m2)	VOLUME (m3)	UNIT COST (tk/m3)	TOTAL COST (tk)	TOTAL COST ($)
900	1600	700	0.40	2.19	1532	250.00	382900.00	$11,261.76
4100	4700	600	0.40	2.19	1313	250.00	328200.00	$9,652.94
6200	6350	150	0.50	2.89	433	250.00	108187.50	$3,181.99
7900	8000	100	0.40	2.19	219	250.00	54700.00	$1,608.82
9100	10000	900	0.40	2.19	1969	250.00	492300.00	$14,479.41
10000	10600	600	0.40	2.19	1313	250.00	328200.00	$9,652.94
TOTALS		3050			6778		1694487.50	$49,837.87

TOTAL COST ESTIMATE FOR REMEDIATION OF CLASS II AREAS 91713267.36 $2,697,449.04

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

ITEM No.	DESCRIPTION	CONST COST Million tk.
	CIVIL WORKS	
3	i. Embankment - minor remedial works - CLASS III slope restoration & minor protection a. Slope restoration by dredging to fill borrow areas and provide material for restoration Total length = 6.50 km @80 m^2/m = 520,000 m^3 520,000 m^3 @ 70 tk/m^3 = 36,400,000 Subtotal 3a = 36.40 mill tk	



	b. Slope protection by jute - sod on embankment and dholkolmi or doncha bush at riverside toe berm. Restoration of eroded areas = 17,670 L.M. × 6 m^2 = 106,020 106,020 m^3 @ 100 tk/m^3 = 10,602,000 tk Slope protection by jute - sod with bush at toe for entire 17,670 LM @ 15 m = 265,050 m^2 265,050 @ 10 tk/m^2 = 2,650,500 tk 3.b. sub total = 13,252,000	
	TOTAL BASE COST Item 3.a = 36.40 TOTAL BASE COST ITEM 3b = 13.25	

TOTAL BASE COST ITEMS 3a + 3b = 49.65 Mill. tk 49.6
$US. 1.38

287

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

Sheet 4 of 1

ITEM No.	DESCRIPTION	CONST COST Million tk
	CIVIL WORKS	
4	Slope Protection (Major) - to provide cement-concrete blocks on [illegible] side in areas of severe wave action. a. Most vulnerable area = 3970 LM - Restoration of eroded areas 3970 LM x 10 m^2/LM = 39,700 m^3 @200 = 7,940,000 tk - Slope protection with 2'x2'x12" cc blocks and geo textile - 7m high = 3970 LM x 22.14 m = 87,896 M^2 @ 650 tk/m^2 = 57,132,400 tk. b. Vulnerable area = 7520 LM - Restoration of eroded areas. = 7520 LM x 8 m^2/LM = 60,160 m^3 @200 = 12,032,000 - slope protection with 21"x21"x9" cc blocks and geo textile 7m high. = 7520 LM x 22.14 = 166,493 m^2 166,493 m^2 @ 490 tk/m^2 81,581,600 SUB TOTAL = 158,686,000 tk Materials Geo textile 150 tk/m^2 x 254,389 m^2 = 38,158,000 tk Geo textile materials have been estimated at 150 tk/m^2 including duties and taxes. From local geo textile supplier, the D&T for [illegible] material is ± 100% D&T = 19.08 million tk. TOTAL BASE COST 196.84 mill tk.	196.84

Million $US 5.47

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

ITEM No.	DESCRIPTION	CONST COST Million tk.
	CIVIL WORKS	
5	Sluices - West Old Dhaka FLOW AREA REQ. (JICA) — COST G.1 — 10.0 — 11.00 G.2 — 5.0 — 6.0 G.3 — 5.0 — 6.0 G.4 — 5.0 — 6.0 G.5 — ±6.0 — 6.0 35.00 million taka	
	MATERIALS Steel sheet Piles LS = 5,000,000 Duties and taxes for this material has been estimated at about 100%, based upon info from local suppliers. Material w/o D&T is estimated at ± 2,500,000 tk D&T = 2.5 million tk.	
	TOTAL BASE COST — 40.00 Mill tk.	40.0 1.11

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PHASE I ACTIVITIES
ESTI[illegible] COST OF VARIOUS COMPONENTS

Sheet 6 of

ITEM No.	DESCRIPTION	CONST COST Million tk
	CIVIL WORK	
6	Flood Wall/Embankment - Keller Mohr to Friendship Bridge	
	a, New Floodwall/Embankment - Keller Mohr to Milford Hospital.	
	- New earth embankment 800 m @ 75,000 Tk / LM incl. D&T x800 = 60,000,000	
	- Sheet pile wall installation 800 m @ 40,000 tk / LM = 32,000,000	
	- Dr[illegible]y 800 m x 30 x 3 deep 72,000 m^3 @ 70 = 5,040,000	
	- Misc work, drainage, etc LS 5,000,000	
	Total 102,040,000 = 102.04 mill. taka	
	MATERIALS & EQUIPMENT	
	- steel [illegible] piling incl D&T 200,000,000 250,000 tk per LM	
	This estimate for steel sheet piling includes Duties & Taxes, The piling w/o D&T is estimated at 100,000,000 tk. (100% D&T) D&T = 100.00 million tk.	
	TOTAL BASE COST ITEM 6 b 91.44	
	" " " ITEM 6 a 302.04	
	TOTAL BASE COST ITEM 6a + 6b. 393.48 Mill tk	393.48
	Mill $US	10.8

282

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

Sheet 7 of 11

ITEM No.	DESCRIPTION	CONST COST Million tk.
	CIVIL WORKS (cont.)	
6	Flood wall / Embankment - Kellar Morh to Friendship Bridge	
	b. Rehabilitation of existing flood wall - Mitford Hospital to Friendship Bridge	
	Closure of gaps in existing wall by steel gates 111 openings ranging from 1 m to 9.44 m wide = LS : 3,000,000	
	Sheet pile section 281 Lm @ 40,000 tk / Lm = 11,240,000	
	Restoration of existing flood wall LS = 5,000,000	
	SUBTOTAL 19,240,000	
	MATERIALS & EQUIPMENT	
	Steel sheet piling LS = 70,200,000	
	Steel gates LS = 2,000,000	
	sub total = 72,200,000	
	Duties and Taxes for steel sheet piling & steel gates is estimated at 100%, based upon information from local suppliers.	
	Estimated Cost w/o D&T = 36,100,000 tk	
	Estimated Cost incl. D&T = 72,200,000 tk.	
	D&T = 3.61 Million tk.	
	Total 6.a = 91,440,000	

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PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

Sheet 8 o

ITEM No.	DESCRIPTION	CONST COST Million tk
	CIVIL WORKS (CONT.)	
7	Central Road Raising and Flood Proofing - Tonge to Friendship Bridge.	
	a. Road raising (R.JUK/OCC)	
	- Con... new brick median + 5,600 Lm north from Rampura bridge ave ht 0.3 m. = 5,980,000	
	- Raise brick median + 2,350 lm south from Rampura bridge ave ht. 0.3 m = 1,670,000	
	- Construct brick median + 2100 near railway station, ave ht. 0.3 m. = 1,499,000	
	- construct road raising around Jatabari round-about ave ht. 0.3 m =10,626,000	
	sub total 19,712,000	
	Cost to furnish & place sa... ... at openings in median 119,800	
	19,831,800	
	Add 10% for 1991 prices = 1,983,200	
	TOTAL 21,815,000	
	USE 21.81 million tk	
	TOTAL BASE COST = 21.81 mill. tk	21.8
	= million $ US.	0.6

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

ITEM No.	DESCRIPTION	CONST COST Million tk.
	CIVIL WORKS (cont.)	
7	Central Road Raising & Flood Proofing - Tongi to Friendship Bridge	
	b Flood Proofing (WDB)	
	- Rehabilitation of existing floodwall from Jatrabari to Friendship Bridge	
	Closure of gaps 31 openings = LS = 700,000	
	Construct ' wall = LS. = 150,000	
	Closure @ Narayanganj Rd. = 300,000	
	sub. 1,150,000	
	- Closure from Jatrabari to Tongi (DRAINAGE) 13 locations total = 45,000,000	
	sub total b = 46,150,000	
	MATERIALS	
	steel gates LS. = 2,980,000	
	steel sheet piling = 3,000,000	
	Estimated cost for duties & taxes for steel gates and for sheet piling is 100%. The costs shown above includes duties & taxes. D&T = 2.99 mill. tk.	
	TOTAL BASE COST ITEM 7.a = 21.81	
	TOTAL BASE COST ITEM 7.b = 52.13	
	TOTAL BASE COST ITEMS 7.a + 7.b = 73.94 mill. tk.	73.94
	mill. $US	2.05

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PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS
PART A - FLOOD PROTECTION

Sheet 10

ITEM No.	DESCRIPTION	CONST COST Million tk.
8	PUMP STATION NO.3 $Q = 65.3\ m^3/sec$	
	TOTAL COST INCLUDING DUTIES AND TAXES FOR 65.2 m^3/sec (2300 cfs) IS ESTIMATED AT 1060 million tk.	
	WITHOUT D&T THE COST IS ESTIMATED AT 678.6 million tk.	
	D&T = 381.40 million tk.	
	The above costs are based upon use of 3 horizontal pumps at 600 cfs each and 2 vertical pumps at 210 cfs each. The cost to furnish & install one horizontal unit would be about 148 million without D&T and about 252 million tk including D&T.	
	D&T = 148.00 million tk.	
	FOR THIS ESTIMATE WE HAVE PROPOSED THAT THE PUMP STATION CAN BE STARTED WITH INITIAL CAPACITY OF ABOUT 22 m^3/sec WITH PROVISION FOR EXPANSION AT A LATER TIME, FOR AN ESTIMATED COST INCLUDING D&T OF ABOUT 400 million tk.	400.00
	Civil works 30% = 120 million	
	Materials & Equip 70% = 280 million	
	TOTAL BASE COST = 400.00 mill tk	400.00
	million $US	11.11

PHASE I ACTIVITIES
ESTIMATED COST OF VARIOUS COMPONENTS

ITEM No.	DESCRIPTION	CONST. COST Million Tk.
9	Construction of functional buildings for Project use. Construction of building for functional purposes at various locations throughout the Project area	
	TOTAL BASE COST 10.00 million Tk.	10.00
	Million $ US.	0.27

2

Consulting Services

A. Detailed Engineering Design and Construction Supervision

1. It is envisaged that domestic consultants with limited assistance from international consultants will assist the PMO and Executing/ Implementing Agencies in detailed engineering design and construction supervision. The Terms of Reference (TOR) for the services will encompass the carrying out of soil investigations and various engineering surveys, the preparation of contract drawings, specifications, bills of quantities, engineering calculations and contract documents. They will include provision of assistance to PMO in the prequalification of contractors, the bidding, evaluation, and award of contracts and contract supervision in accordance with the accepted norms of professional services. The TOR will define the areas and likely extent of specialist advice required and the qualifications and experience of staff which would be acceptable to the Government and the Bank.

2. It is estimated that an amount of $ 2.16 million will be required for detailed engineering design and construction supervision for some 450 man-months of consulting services (414 mm domestic, 36 mm international). All these consultants will be recruited by and be based in the PMO.

B. Project Management

3. The Project management consultants team will support and assist the PMO in planning, implementing, and evaluating Project activities, with the overall objective of achieving the physical, financial, and scheduling targets established under the Project. Among other things, the consultants will assist in overall technical monitoring and supervision, monitoring of the Action Plan including cost recovery measures, financial management, PBME activities, community development programs, standards and procedures for O&M, and on-the-job training of counterpart staff. It is estimated that 312 mm of consulting services (60 mm international, 252 mm domestic) will be required for Project management, as shown on Table 1.

Table 1: Project Management Consulting Services (man-months)

Position	International	Domestic	Total
Project Implementation Advisor/Team Leader	36	-	36
Civil/Hydraulic Engineer/co Team Leader	-	60	60
Geotechnical Specialist	12	24	36
Accounting, Financial and MIS Specialist	12	36	48
Municipal Engineer	-	24	24
Urban Planner	-	12	12
Monitoring & Evaluation Specialist	-	12	12
Community Development Specialist	-	36	36
Construction Specialist	-	48	48
Total:	60	252	312

6. Urban Planner (Domestic)

i) review the Project implementation proposals and ensure that each component of the Project conforms with existing City and Municipal development plans and standards;

ii) advise City and Municipal authorities on the scope for possible improvement of existing plans and standards, based on standards developed for specific Project components, where these are appropriate for more general adoption; and

iii) coordinate the urban planning activities of the Project Office with the respective GOB authorities.

7. Monitoring & Evaluation Specialist (Domestic)

i) define the methodology for monitoring and evaluating the impact of the Project, with particular reference to the targets agreed at the time of Project appraisal and as may be incorporated as loan covenants;

ii) as part of the definition of M&E methodology, establish the benchmark data relating to pre-Project conditions, in conjunction with the relevant GOB agencies; and

iii) implement the M&E methodology, furnish required M&E data to concerned authorities, and train GOB staff in application of Project M&E procedures.

8. Community Development Specialists (Domestic)

i) through a program of meetings and discussions with concerned agencies, municipal and public officials, and community representatives in the Project areas, ensure public awareness of the Project and Project works, and record and report viewpoints and opinions of these bodies that may be significant with respect to Project implementation;

ii) liaise between the Project Office and local people, and mediate and explain to all concerned parties in those cases where clarification of Project activities with respect to local needs and aspirations is required; and

iii) establish procedures for dissemination of Project publicity and public awareness materials.

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9. Construction Specialist (Domestic)

i) review contractors proposed work plans and methods, and recommend any appropriate changes to meet Project scheduling and quality objectives;

ii) establish inspection and quality control procedures for all Project construction works;

iii) ensure these procedures are understood by all concerned parties, including contractors and local consultants;

iv) implement these procedures and maintain full records of all matters relating to contractor/consultant/Project Implementation Office relations with respect to the construction works; and

v) train GOB and contractors/consultants staff in the efficient implementation of the quality control and quality assurance measures adopted for the Project.

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4. Outline terms of reference for these consulting services are given below:

1. Project Implementation Advisor (International)

i) assist the Project Director in the overall management of all Project activities and in initiating action where required to maintain progress;

ii) coordinate implementation of the various Project activities and ensure that all activities are carried out in a manner that optimises their individual and mutual impact;

iii) liaise with the various implementing agencies, including the Asian Development Bank, and arrange for the provision of data on Project planning and progress as is satisfactory to these agencies; and

iv) manage the activities of the Consulting team members and ensure that the scheduling of Consultants inputs matches Project requirements as closely as [illegible]

2. Civil/Hydraulic Engineer (Domestic)

i) review the technical designs and implementation plans for Project components prepared by local consultants, and advise on modifications where appropriate;

ii) liaise closely with counterpart Project Implementation Office staff on preparation of contracts and specifications for implementation of Project components; and

iii) assist with establishment of a quality assurance and control regime for implementation of the Project works, including assisting with the establishment of the materials testing program and the training of local staff in the appropriate laboratory methods and testing procedures.

3. Geotechnical Specialist (International & Domestic)

i) advise and assist the designers (local consultants and/or GOB departments) in the [illegible]eparation of designs and quantity and cost estimates for the embankment rehabilitation works;

ii) in conjunction with the Construction Engineer, determine and establish the earthworks testing procedures, ensure these are clearly understood by the contractors and by the responsible Project Office staff, and maintain the testing and earthworks quality control program; and

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iii) through a structured program of tuition, assist in training GOB and local consultants and contractors staff in any new earthworks design and construction procedures introduced through the Project.

4. Accounting, Financial Analysis and MIS Specialist

i) review existing Government financial and physical monitoring and reporting procedures and design a set of simplified accounting, budgetary control and management information systems for the Project;

ii) in consultation with the Municipal Financial Advisor for DCC (provided under a UNDP project) and any future financial management advisor assigned to DWASA, monitor the introduction of cost recovery mechanisms agreed as part of the Project and determine progress in the overall improvements related to revenue generation and financial management of these agencies;

iii) in conjunction with counterpart staff, provide the necessary interfere· upon financial matters between the Project Implementation Officer, the participating agencies, other departments and ministries of Government and the Bank;

iv) facilitate the production and audit of required Project Accounts, records and other reports in a timely and acceptable fashion;

v) conduct on the job training for financial and accounting personnel in all relevant techniques and procedures including the designed sub-systems; and

vi) provide advisory support and assistance to the Project finance manager in order to secure the efficient discharge of his functions and the finance units contribution to an effective Project Implementation Office.

5. Municipal Engineer (Domestic)

i) advise on the planning, design, and implementation of all Project works carried out under the authority of the Project municipal and associated agencies (DCC, DWASA, RAJUK);

ii) advise on streamlining of municipal management and operation procedures where appropriate, including the establishment of management information systems; and

iii) oversee the technical aspects of the works carried out under the Environment Improvement Program, and to advise on modifications where appropriate

Appendix-7

Projection of Urban Expansion

AREA	LAND USE (HA.) Built-Up Area By District			
	TOTAL	1990.00	2000.00	2010.00
High Established A	1,072	1,072	1,072	1,072
West Embankment	1,043	330	627	627
Old Dhaka	1,166	1,142	1,156	1,156
Commercial/Indust/	1,541	1,367	1,404	1,404
Mirpur Area	5,653	1,732	2,595	3,300
Cantonment	3,175	1,717	1,943	2,023
East Embankment	10,101	1,642	2,422	5,325

Source: JICA

	LAND USE (HA.) Increase in Built-Up Area over previous decade			
	TOTAL	1990.00	2000.00	2010.00
High Established A	1,072		0	0
West Embankment	1,043		297	0
Old Dhaka	1,166		14	0
Commercial/Indust/	1,541		37	0
Mirpur Area	5,653		863	705
Cantonment	3,175		226	80
East Embankment	10,101		780	2,883

Source: Derived from JICA

ANNUAL INCREASE IN BUILT-UP AREA (HA.)

	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/2000	2000/01
West Embankment	29.70	29.70	29.70	29.70	29.70	29.70	29.70	29.70	29.70	29.70
Mirpur Area	86.30	86.30	86.30	86.30	86.30	86.30	86.30	86.30	86.30	86.30
Other Central Areas	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70	3.70
Cantonment	22.60	22.60	22.60	22.60	22.60	22.60	22.60	22.60	22.60	22.60
East Embankment	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
West Embankment	-	-	-	-	-	-	-	-	-	-
Mirpur Area	70.50	70.50	70.50	70.50	70.50	70.50	70.50	70.50	70.50	70.50
Other Central Areas	-	-	-	-	-	-	-	-	-	-
Cantonment	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
East Embankment	201.0	201.0	-201.0	201.0	201.0	201.0	201.0	201.0	201.0	201.0

Source: D..ived from JIC.

17-Sep-91

DHAKA INTEGRATED FLOOD PROTECION PROJECT (DIFPP)

CALCULATION OF ECONOMIC RATE OF RETURN

(On the basis of avoidance of flood damage and increase in land value)

Tk.in million

Year	FY	Net Benefits L.C.	Net Benefits F.C.	Total Net Benefit	Net Benefit Discounted at 12% L.C.	Net Benefit Discounted at 12% F.C.
0	1991-92	(693.79)	(255.35)	(949.14)		
1	1992-93	(740.10)	(387.65)	(1,127.75)		
2	1993-94	(520.67)	(311.83)	(832.50)		
3	1994-95	(262.40)	(201.64)	(464.04)		
4	1995-96	(89.73)	(45.44)	(135.17)		
5	1996-97	4,217.61	(37.90)	4,179.71		
6	1997-98	2,049.24	(260.00)	1,789.24		
7	1998-99	2,041.84	(555.00)	1,486.84		
8	1999-2000	2,825.72	(815.00)	2,010.72		
9	2000-2001	4,066.11	(1,017.00)	3,049.11		
10	2001-2002	4,444.22	(820.00)	3,624.22		
11	2002-2003	5,558.61	(112.00)	5,446.61		
12	2003-2004	5,659.43	(112.00)	5,547.43		
13	2004-2005	5,766.47	(112.00)	5,654.47		
14	2005-2006	5,879.65	(112.00)	5,767.65		
15	2006-2007	5,999.50	(112.00)	5,887.50		
16	2007-2008	6,130.40	(112.00)	6,018.40		
17	2008-2009	6,260.79	(112.00)	6,148.79		
18	2009-2010	6,403.13	(112.00)	6,291.13		
19	2010-2011	6,485.90	(158.00)	6,327.90		
20	2011-2012	6,645.63	(158.00)	6,487.63		
21	2012-2013	6,814.82	(158.00)	6,656.82		
22	2013-2014	6,994.09	(158.00)	6,836.09		
23	2014-2015	7,184.03	(158.00)	7,026.03		
24	2015-2016	7,384.48	(158.00)	7,226.48		
25	2016-2017	1,387.76	(96.00)	1,291.76		
26	2017-2018	1,497.79	(96.00)	1,401.79		
27	2018-2019	1,615.51	(96.00)	1,519.51		
28	2019-2020	6,052.92	(96.00)	5,956.92		
				110,124.15	17,814.90	(2,383.47)

Economic Rate of Return (ERR) = 37.17%

Official Exchange Rate US $ 1 = TK. 37.25

Salvage Value

Land	@ 100% =	4,046.81
Civil Works	@ 5% =	264.63
		4,311.44

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DHAKA INTEGRATED FLOOD PROTECTION PROJECT (DIFPP)

ECONOMIC RATE OF RETURN
(On the basis of avoidance of flood damage and increase in land value)

YEAR	CAPITAL COST	RE-CURRENT COST	TOTAL COST	REVENUE	NET BENEFIT
0	949.14		949.14		(949.14)
1	1,127.75		1,127.75		(1,127.75)
2	832.50		832.50		(832.50)
3	464.04		464.04		(464.04)
4	135.17		135.17		(135.17)
5	113.68		113.68	4,293.39	4,179.71
6	2,457.00	90.56	2,547.56	4,336.80	1,789.24
7	2,805.00	90.56	2,895.56	4,382.40	1,486.84
8	2,329.00	90.56	2,419.56	4,430.28	2,010.72
9	2,378.00	181.12	2,559.12	5,608.23	3,049.11
10	[illegible]	181.12	2,074.12	5,698.34	3,624.22
11	0.00	347.12	347.12	5,793.73	5,446.61
12	0.00	347.12	347.12	5,894.55	5,547.43
13	0.00	347.12	347.12	6,001.59	5,654.47
14	0.00	347.12	347.12	6,114.77	5,767.65
15	0.00	347.12	347.12	6,234.62	5,887.50
16	0.00	347.12	347.12	6,365.52	6,018.40
17	0.00	347.12	347.12	6,495.91	6,148.79
18	0.00	347.12	347.12	6,638.25	6,291.13
19	0.00	461.12	461.12	6,789.02	6,327.90
20	0.00	461.12	461.12	6,948.75	6,487.63
21	0.00	461.12	461.12	7,117.94	6,656.82
22	0.00	461.12	461.12	7,297.21	6,836.09
23	0.00	461.12	461.12	7,487.15	7,026.03
24	0.00	461.12	461.12	7,687.60	7,226.48
25	0.00	280.00	280.00	1,571.76	1,291.76
26	0.00	280.00	280.00	1,681.79	1,401.79
27	0.00	280.00	280.00	1,799.51	1,519.51
28	0.00	280.00	280.00	6,236.92	5,956.92
NET PRESENT VALUE (12%)			8,148.70	23,580.14	15,431.44

ECONOMIC INTERNAL RATE OF RETURN	37.17%
10% INCREASE IN INVESTMENT COSTS	34.63%
10% REDUCTION IN BENEFITS.	34.29%
BENEFITS DELAYED BY 1 YEAR	30.08%
10% INCREASE IN INVESTMENT COSTS AND 10% REDUCTION IN BENEFITS	31.82%
10% INCREASE IN INVESTMENT COSTS AND BENEFITS DELAYED BY 1 YEAR.	28.12%
10% REDUCTION IN BENEFITS AND BENEFITS DELAYED BY 1 YEAR.	27.82%

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DHAKA INTEGRATED FLOOD PROTECTION PROJECT (DIFPP)

ECONOMIC RATE OF RETURN
(On the basis of increase in land value)

YEAR	CAPITAL COST	RE-CURRENT COST	TOTAL COST	REVENUE	NET BENEFIT
0	949.14		949.14		(949.14)
1	1,127.75		1,127.75		(1,127.75)
2	832.50		832.50		(832.50)
3	464.04		464.04		(464.04)
4	135.17		135.17		(135.17)
5	113.68		113.68	3,432.16	3,318.48
6	2,457.00	90.56	2,547.56	3,432.16	884.60
7	2,805.00	90.56	2,895.56	3,432.16	536.60
8	2,329.00	90.56	2,419.56	3,432.16	1,012.60
9	2,378.00	181.12	2,559.12	4,027.39	1,468.27
10	1,893.00	181.12	2,074.12	4,027.39	1,953.27
11	0.00	347.12	347.12	4,027.39	3,680.27
12	0.00	347.12	347.12	4,027.39	3,680.27
13	0.00	347.12	347.12	4,027.39	3,680.27
14	0.00	347.12	347.12	4,027.39	3,680.27
15	0.00	347.12	347.12	4,027.39	3,680.27
16	0.00	347.12	347.12	4,027.39	3,680.27
17	0.00	347.12	347.12	4,027.39	3,680.27
18	0.00	347.12	347.12	4,027.39	3,680.27
19	0.00	461.12	461.12	4,027.39	3,566.27
20	0.00	461.12	461.12	4,027.39	3,566.27
21	0.00	461.12	461.12	4,027.39	3,566.27
22	0.00	461.12	461.12	4,027.39	3,566.27
23	0.00	461.12	461.12	4,027.39	3,566.27
24	0.00	461.12	461.12	4,027.39	3,566.27
25	0.00	280.00	280.00	0.00	(280.00)
26	0.00	280.00	280.00	0.00	(280.00)
27	0.00	280.00	280.00	0.00	(280.00)
28	0.00	280.00	280.00	4,311.44	4,031.44
NET PRESENT VALUE (12%)			8,148.70	16,204.85	8,056.15

ECONOMIC INTERNAL RATE OF RETURN	29.13%
10% INCREASE IN INVESTMENT COSTS	26.64%
10% REDUCTION IN BENEFITS.	26.26%
BENEFITS DELAYED BY 1 YEAR	23.42%
10% INCREASE IN INVESTMENT COSTS AND 10% REDUCTION IN BENEFITS	23.85%
10% INCREASE IN INVESTMENT COSTS AND BENEFITS DELAYED BY 1 YEAR.	21.50%
10% REDUCTION IN BENEFITS AND BENEFITS DELAYED BY 1 YEAR.	21.17%

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Appendix - 8
Page - 4

DHAKA INTEGRATED FLOOD PROTECTION PROJECT (DIFPP)

ECONOMIC RATE OF RETURN
(On the basis of avoidance of flood damage)

YEAR	CAPITAL COST	RE-CURRENT COST	TOTAL COST	REVENUE	NET BENEFIT
0	949.14		949.14		(949.14)
1	1,127.75		1,127.75		(1,127.75)
2	832.50		832.50		(832.50)
3	[illegible]		464.04		(464.04)
4	135.17		135.17		(135.17)
5	113.68		113.68	861.23	747.55
6	2,457.00	90.56	2,547.56	904.64	(1,642.92)
7	2,805.00	90.56	2,895.56	950.24	(1,945.32)
8	2,329.00	90.56	2,419.56	998.12	(1,421.44)
9	2,378.00	181.12	2,559.12	1,580.84	(978.28)
10	1,893.00	181.12	2,074.12	1,670.95	(403.17)
11	0.00	347.12	347.12	1,766.34	1,419.22
12	0.00	347.12	347.12	1,867.16	1,520.04
13	0.00	347.12	347.12	1,974.20	1,627.08
14	0.00	347.12	347.12	2,087.38	1,740.26
15	0.00	347.12	347.12	2,207.23	1,860.11
16	0.00	347.12	347.12	2,338.13	1,991.01
17	0.00	347.12	347.12	2,468.52	2,121.40
18	0.00	347.12	347.12	2,610.86	2,263.74
19	0.00	461.12	461.12	2,761.63	2,300.51
20	0.00	461.12	461.12	2,921.36	2,460.24
21	0.00	461.12	461.12	3,090.55	2,629.43
22	0.00	461.12	461.12	3,269.82	2,808.70
23	0.00	461.12	461.12	3,459.76	2,998.64
24	0.00	461.12	461.12	3,660.21	3,199.09
25	0.00	280.00	280.00	1,571.76	1,291.76
26	0.00	280.00	280.00	1,681.79	1,401.79
27	0.00	280.00	280.00	1,799.51	1,519.51
28	0.00	280.00	280.00	6,236.92	5,956.92
NET PRESENT VALUE (12%)			8,148.70	7,536.46	(612.24)

ECONOMIC INTERNAL RATE OF RETURN 10.89%
10% INCREASE IN INVESTMENT COSTS 9.76%
10% REDUCTION IN BENEFITS. 9.45%
BENEFITS DELAYED BY 1 YEAR 9.09%
10% INCREASE IN INVESTMENT COSTS AND
10% REDUCTION IN BENEFITS 8.38%
10% INCREASE IN INVESTMENT COSTS AND
BENEFITS DELAYED BY 1 YEAR. 8.08%
10% REDUCTION IN BENEFITS AND
BENEFITS DELAYED BY 1 YEAR. 7.77%

279 17-Sep-91

D I F P P - DHAKA WEST

CALCULATION OF ECONOMIC RATE OF RETURN

Tk.in millio

(On the basis of avoidance of flood damage and increase in land value)

Year	FY	Net Benefits L.C.	Net Benefits F.C.	Total Net Benefit	Net Benefit Discounted at 12% L.C.	Net Benefit Discounted at 12% F.C.
0	1991-92	(693.79)	(255.35)	(949.14)		
1	1992-93	(740.10)	(387.65)	(1,127.75)		
2	1993-94	(520.67)	(311.83)	(832.50)		
3	1994-95	(262.40)	(201.64)	(464.04)		
4	1995-96	(8[illegible].73)	(45.44)	(135.17)		
5	1996-97	4,217.61	(37.90)	4,179.71		
6	1997-9[illegible]	[illegible],277.24	(31.00)	4,246.24		
7	[illegible]-99	4,322.84	(31.00)	4,291.84		
8	1999-2000	4,370.72	(31.00)	4,339.72		
9	2000-2001	4,361.47	(62.00)	4,299.47		
10	2001-2002	4,414.31	(62.00)	4,352.31		
11	2002-2003	4,469.82	(62.00)	4,407.82		
12	2003-2004	4,528.12	(62.00)	4,466.12		
13	2004-2005	4,589.36	(62.00)	4,527.36		
14	2005-2006	4,653.69	(62.00)	4,591.69		
15	2006-2007	3,396.42	(62.00)	3,334.42		
16	2007-2008	3,467.39	(62.00)	3,405.39		
17	2008-2009	3,541.94	(62.00)	3,479.94		
18	2009-2010	3,620.24	(62.00)	3,558.24		
19	2010-2011	3,702.50	(62.00)	3,640.50		
20	2011-2012	3,788.91	(62.00)	3,726.91		
21	2012-2013	3,879.66	(62.00)	3,817.66		
22	2013-2014	3,974.99	(62.00)	3,912.99		
23	2014-2015	4,075.12	(62.00)	4,013.12		
24	2015-2016	4,611.81	(62.00)	4,549.81		
				77,632.66	16,071.66	(1,125.75

Economic Rate of Return (ERR) = 43.26%

Official Exchange Rate US $ 1 = TK. 37.25

Salvage Value

Land	@ 100% =	335.81
Civil Works	@ 5% =	96.53
		432.34

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19-Sep-91

D'FPP - DHAKA WEST

ECONOMIC RATE OF RETURN
(on the basis of avoidance of flood
damage and increase in land value)

YEAR	CAPITAL COST	RE-CURRENT COST	TOTAL COST	REVENUE	NET BENEFIT
0	949.14		949.14		(949.14)
1	1,127.75		1,127.75		(1,127.75)
2	832.50		832.50		(832.50)
3	464.04		464.04		(464.04)
4	135.17		135.17		(135.17)
5	113.68		113.68	4,293.39	4,179.71
6	0.00	90.56	90.56	4,336.80	4,246.24
7	0.00	90.56	90.56	4,382.40	4,291.84
8	0.00	90.56	90.56	4,430.28	4,339.72
9	0.00	181.12	181.12	4,480.59	4,299.47
10	0.00	181.12	181.12	4,533.43	4,352.31
11	0.00	181.12	181.12	4,588.94	4,407.82
12	0.00	181.12	181.12	4,647.24	4,466.12
13	0.00	181.12	181.12	4,708.48	4,527.36
14	0.00	181.12	181.12	4,772.81	4,591.69
15	0.00	181.12	181.12	3,515.54	3,334.42
16	0.00	181.12	181.12	3,586.51	3,405.39
17	0.00	181.12	181.12	3,661.06	3,479.94
18	0.00	181.12	181.12	3,739.36	3,558.24
19	0.00	181.12	181.12	3,821.62	3,640.50
20	0.00	181.12	181.12	3,908.03	3,726.91
21	0.00	181.12	181.12	3,998.78	3,817.66
22	0.00	181.12	181.12	4,094.11	3,912.99
23	0.00	181.12	181.12	4,194.24	4,013.12
24	0.00	181.12	181.12	4,730.93	4.549.81
NET PRESENT VALUE (12%)			3,333.93	18,279.84	14,945.91

ECONOMIC INTERNAL RATE OF RETURN	43.26%
10% INCREASE IN INVESTMENT COSTS	41.12%
10% REDUCTION IN BENEFITS.	40.85%
BENEFITS DELAYED BY 1 YEAR	36.36%
10% INCREASE IN INVESTMENT COSTS AND 10% REDUCTION IN BENEFITS	38.78%
10% INCREASE IN INVESTMENT COSTS AND BENEFITS DELAYED BY 1 YEAR.	34.68%
10% REDUCTION IN BENEFITS AND BENEFITS DELAYED BY 1 YEAR.	34.44%

D I F P P - DHAKA WEST

CALCULATION OF ECONOMIC RATE OF RETURN

(On the basis of increase in land value)

Tk. in million

Year	FY	Net Benefits L.C.	Net Benefits F.C.	Total Net Benefit	Net Benefit Discounted at 12% L.C.	Net Benefit Discounted at 12% F.C.
0	1991-92	(693.79)	(255.35)	(949.14)		
1	1992-93	(740.10)	(387.65)	(1,127.75)		
2	1993-94	(520.67)	(311.83)	(832.50)		
3	1994-95	(262.40)	(201.64)	(464.04)		
4	1995-96	(89.73)	(45.44)	(135.17)		
5	1996-97	3,356.38	(37.90)	3,318.48		
6	1997-98	3,372.60	(31.00)	3,341.60		
7	1998-99	3,372.60	(31.00)	3,341.60		
8	1999-2000	3,372.60	(31.00)	3,341.60		
9	2000-2001	3,313.04	(62.00)	3,251.04		
10	2001-2002	3,313.04	(62.00)	3,251.04		
11	2002-2003	3,313.04	(62.00)	3,251.04		
12	2003-2004	3,313.04	(62.00)	3,251.04		
13	2004-2005	3,313.04	(62.00)	3,251.04		
14	2005-2006	3,313.04	(62.00)	3,251.04		
15	2006-2007	1,988.20	(62.00)	1,926.20		
16	2007-2008	1,988.20	(62.00)	1,926.20		
17	2008-2009	1,988.20	(62.00)	1,926.20		
18	2009-2010	1,988.20	(62.00)	1,926.20		
19	2010-2011	1,988.20	(62.00)	1,926.20		
20	2011-2012	1,988.20	(62.00)	1,926.20		
21	2012-2013	1,988.20	(62.00)	1,926.20		
22	2013-2014	1,988.20	(62.00)	1,926.20		
23	2014-2015	1,988.20	(62.00)	1,926.20		
24	2015-2016	2,420.54	(62.00)	2,358.54		
				49,035.26	10,996.40	(1,125.75)

Economic Rate of Return (ERR) = 37.50%

Official Exchange Rate US $ 1 = TK. 37.25

Salvage Value

Land	@ 100% =	335.81
Civil Works	@ 5% =	96.53
		432.34

westland

D I F P P - DHAKA WEST

CALCULATION OF ECONOMIC RATE OF RETURN

(On the basis of avoidance of flood damage)

Tk. in million

Year	FY	Net Benefits L.C.	Net Benefits F.C.	Total Net Benefit	Net Benefit Discounted at 12% L.C.	Net Benefit Discounted at 12% F.C.
0	1991-92	(693.79)	(255.35)	(949.14)		
1	1992-93	(740.10)	(387.65)	(1,127.75)		
2	1993-94	(520.67)	(311.83)	(832.50)		
3	1994-95	(262.40)	(201.64)	(464.04)		
4	1995-96	(89.73)	(45.44)	(135.17)		
5	1996-97	785.45	(37.90)	747.55		
6	1997-98	845.08	(31.00)	814.08		
7	1998-99	890.68	(31.00)	859.68		
8	[illegible]-2000	938.56	(31.00)	907.56		
9	2000-2001	929.31	(62.00)	867.31		
10	2001-2002	982.15	(62.00)	920.15		
11	2002-2003	1,037.66	(62.00)	975.66		
12	2003-2004	1,095.96	(62.00)	1,033.96		
13	2004-2005	1,157.20	(62.00)	1,095.20		
14	2005-2006	1,221.53	(62.00)	1,159.53		
15	2006-2007	1,289.10	(62.00)	1,227.10		
16	2007-2008	1,360.07	(62.00)	1,298.07		
17	2008-2009	1,434.62	(62.00)	1,372.62		
18	2009-2010	1,512.92	(62.00)	1,450.92		
19	2010-2011	1,595.18	(62.00)	1,533.18		
20	2011-2012	1,681.59	(62.00)	1,619.59		
21	2012-2013	1,772.34	(62.00)	1,710.34		
22	2013-2014	1,867.67	(62.00)	1,805.67		
23	2014-2015	1,967.80	(62.00)	1,905.80		
24	2015-2016	2,504.49	(62.00)	2,442.49		
				22,237.86	2,892.52	(1,125.75)

Economic Rate of Return (ERR) = 17.41%

Official Exchange Rate US $ 1 = TK. 37.25

Salvage Value

Land	@ 100% =	335.81
Civil Works	@ 5% =	96.53
		432.34

DIFPP - PART - C : SLUM IMPROVEMENT

FINANCIAL INTERNAL RATE OF RETURN

(Taka in million)

YEAR	CAPITAL COST	RE-CURRENT AND O & M	TOTAL COST	REVENUE	NET BENEFIT
0	0.82		0.82		(0.82)
1	3.94		3.94		(3.94)
2	6.63		6.63		(6.63)
3	11.28		11.28	2.02	(9.26)
4	11.06		11.06	5.57	(5.49)
5	13.67		13.67	8.16	(5.51)
6	0.00	0.95	0.95	8.74	7.79
7	0.00	0.95	0.95	9.12	8.17
8	0.00	0.95	0.95	9.60	8.65
9	0.00	0.95	0.95	9.60	8.65
10	0.00	0.95	0.95	9.60	8.65
11	0.00	0.95	0.95	9.60	8.65
12	0.00	0.95	0.95	9.60	8.65
13	0.00	0.95	0.95	9.60	8.65
14	0.00	0.95	0.95	9.60	8.65
15	0.00	0.95	0.95	9.60	8.65
16	0.00	0.95	0.95	9.60	8.65
17	0.00	0.95	0.95	9.60	8.65
18	..00	0.95	0.95	9.60	8.65
19	0.00	0.95	0.95	9.60	8.65
20	0.00	0.95	0.95	9.60	8.65
21	0.00	0.95	0.95	9.60	8.65
22	0.00	0.95	0.95	9.60	8.65
NET PRESENT VALUE (12%)			32.39	42.62	10.23

FINANCIAL INTERNAL RATE OF RETURN . . .	17.60%
10% INCREASE IN INVESTMENT COSTS	15.71%
10% REDUCTION IN BENEFITS.	15.34%
BENEFITS DELAYED BY 1 YEAR	14.47%
10% INCREASE IN INVESTMENT COSTS AND 10% REDUCTION IN BENEFITS	13.59%
10% INCREASE IN INVESTMENT COSTS AND BENEFITS DELAYED BY 1 YEAR.	12.98%
10% REDUCTION IN BENEFITS AND BENEFITS DELAYED BY 1 YEAR.	12.65%

DIFPP - PART - C : SLUM IMPROVEMENT

CALCULATION OF ECONOMIC RATE OF RETURN

Tk.in million

Year	FY	Net Benefits L.C.	Net Benefits F.C.	Total Net Benefit	Net Benefit Discounted at 12% L.C.	Net Benefit Discounted at 12% F.C.
0	1991-92	(0.41)	(0.41)	(0.82)		
1	1992-93	(2.72)	(1.22)	(3.94)		
2	1993-94	(4.75)	(1.88)	(6.63)		
3	1994-95	(6.30)	(2.96)	(9.26)		
4	1995-96	(2.72)	(2.77)	(5.49)		
5	1996-97	(2.10)	(3.41)	(5.51)		
6	1997-98	8.04	(0.25)	7.79		
7	1998-99	8.42	(0.25)	8.17		
8	1999-2000	8.90	(0.25)	8.65		
9	2000-2001	8.90	(0.25)	8.65		
10	2001-2002	8.90	(0.25)	8.65		
11	2002-2003	8.90	(0.25)	8.65		
12	2003-2004	8.90	(0.25)	8.65		
13	2004-2005	8.90	(0.25)	8.65		
14	2005-2006	8.90	(0.25)	8.65		
15	2006-2007	8.90	(0.25)	8.65		
16	2007-2008	8.90	(0.25)	8.65		
17	2008-2009	8.90	(0.25)	8.65		
18	2009-2010	8.90	(0.25)	8.65		
19	2010-2011	8.90	(0.25)	8.65		
20	2011-2012	8.90	(0.25)	8.65		
21	2012-2013	8.90	(0.25)	8.65		
22	2013-2014	8.90	(0.25)	8.65		
				114.06	18.99	(8.76)

Economic Rate of Return (ERR) = 17.60%

Official Exchange Rate US $ 1 = TK. 37.25

-SLUM

DIFPP - PART - C : ENVIRONMENTAL IMPROVEMENT : SOLID WASTE

FINANCIAL INTERNAL RATE OF RETURN

1991 Constant Prices - Incremental Values (Taka in millic)

YEAR	CAPITAL COST	RE-CURRENT AND O & M	TOTAL COST	REVENUE	NET BENEFIT
0	7.44		7.44		(7.44)
1	12.19	1.89	14.08		(14.08)
2	3.62	3.00	6.62		(6.6)
3	40.57	6.09	46.66	9.31	(37.3)
4	45.23	11.91	57.14	18.62	(38.52)
5	48.86	18.31	67.17	55.86	(11.3)
6	0.00	18.31	18.31	55.86	37.5
7	0.00	18.31	18.31	55.86	37.55
8	0.00	18.31	18.31	55.86	37.55
9	0.00	18.31	18.31	55.86	37.5
10	0.00	18.31	18.31	55.86	37.5
11	24.00	18.31	42.31	55.86	13.55
12	24.00	18.31	42.31	55.86	13.5
13	24.00	18.31	42.31	55.86	13.5
14	0.00	18.31	18.31	55.86	37.55
15	0.00	18.31	18.31	55.86	37.55
16	0.00	18.31	18.31	55.86	37.5
17	0.00	18.31	18.31	55.86	37.5
18	0.00	18.31	18.31	55.86	37.55
19	0.00	18.31	18.31	55.86	37.5
20	0.00	18.31	18.31	55.86	37.5
NET PRESENT VALUE (12%)			198.44	237.53	39.1

FINANCIAL INTERNAL RATE OF RETURN	18.43%
10% INCREASE IN INVESTMENT COSTS	16.31%
10% REDUCTION IN BENEFITS.	14.63%
BENEFITS DELAYED BY 1 YEAR	13.26%
10% INCREASE IN INVESTMENT COSTS AND 10% REDUCTION IN BENEFITS	12.67%
10% INCREASE IN INVESTMENT COSTS AND BENEFITS DELAYED BY 1 YEAR.	11.72%
10% REDUCTION IN BENEFITS AND BENEFITS DELAYED BY 1 YEAR.	10.29%

-Sep-91

Appendix - 10
Page - 2

DIFPP - PART - C : SANITATION

FINANCIAL INTERNAL RATE OF RETURN

1991 Constant Prices - Incremental Values (Taka in million)

YEAR	CAPITAL COST	RE-CURRENT AND O & M	TOTAL COST	REVENUE	NET BENEFIT
0	2.50		2.50		(2.50)
1	14.28	0.71	14.99	3.45	(11.54)
2	11.79	0.93	12.72	6.64	(6.08)
3	8.25	1.09	9.34	8.21	(1.13)
4	8.25	1.26	9.51	8.94	(0.57)
5	..15	1.40	8.55	10.38	1.83
6	0.00	1.40	1.40	5.42	4.02
7	0.00	1.40	1.40	5.42	4.02
8	0.00	1.40	1.40	5.42	4.02
9	0.00	1.40	1.40	5.42	4.02
10	5.48	1.40	6.88	5.42	(1.46)
11	0.72	1.40	2.12	5.42	3.30
12	0.00	1.40	1.40	5.42	4.02
13	0.00	1.40	1.40	5.42	4.02
14	0.00	1.40	1.40	5.42	4.02
15	0.00	1.40	1.40	5.42	4.02
16	0.00	1.40	1.40	5.42	4.02
17	0.00	1.40	1.40	5.42	4.02
18	0.00	1.40	1.40	5.42	4.02
19	0.00	1.40	1.40	5.42	4.02
20	0.00	1.40	1.40	5.42	4.02
NET PRESENT VALUE (12%)			45.49	41.73	(3.76)

FINANCIAL INTERNAL RATE OF RETURN . . .	9.10%
10% INCREASE IN INVESTMENT COSTS	6.82%
10% REDUCTION IN BENEFITS.	5.95%
BENEFITS DELAYED BY 1 YEAR	6.50%
10% INCREASE IN INVESTMENT COSTS AND 10% REDUCTION IN BENEFITS	3.99%
10% INCREASE IN INVESTMENT COSTS AND BENEFITS DELAYED BY 1 YEAR.	4.78%
10% REDUCTION IN BENEFITS AND BENEFITS DELAYED BY 1 YEAR.	4.04%

2 a

Assumptions used for Financial Projection of D.C.C.

1. Funds to be provided to DCC under Part C of the Project wil be on lent basis of a mix of 70 percent grant and 30 prcen loans. The loan portion will carry interest @12.5 percent p.a. and be repayable over a period of 20 years, including a grace period of 5 years. Repayment will start after 5 year from 1st disbursement of the entire loan be paid in equal 1 installments.

2. Recurrent expenditures including minor works increase @6% p.a over the inflation rate.

   World Bank projection as a whole has generally been followe as a basis with certain modification as well as addition of project investment for the purpose of cash flow projection.

3. Actual receipt and payment position has been shown till 1990-91 and thereafter adjustment has been made in the Budget of 1991-92.

4. Property Tax (Conservency charge): The rate of Property Tax will increase horizontally due to extension of city limit and vertically due to increase in rental value as well. A increase of 3% in the conservency rate begining in the 3rd year of the project, as suggested by the World Bank, has as such been assumed.

5. Income from Public Toilets, Low cost latrines, Mobile Toilets has been considered.

6. Collection of arrear demand is about 50% paid one year late, 10% is paid two year late and then 5% constantly.

7. Collection of current demand has been made in consonance with World Bank Projections.

8. Market rent and other rents will increase substantially on completion of Nagar Bhavan.

297

Appendix - 11
Page - 2

INTEGRATED FLOOD PROTECTION PROJECT

DHAKA CITY CORPORATION , D C C

PROJECT CASH FLOW STATEMENT

Taka in '000

SOURCES OF FUND	ACTUAL				Actual Budget	ESTIMATED BUDGET									
	1987-88	1988-89	1989-90	1990-91	1991-92	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001
A. REVENUE FROM OWN SOURCES															
1. PROPERTY BASED TAXES & RATES															
i) Taxes	130.778	141.858	217.874	305.742	389.000	307,800	282.495	320,970	375,718	440.048	515.635	604.451	708,808	831.429	975,508
a) Properties (holdings)	70,213	78,847	114.362	173.845	201.600	201,600	236.880	278.334	327,042	384.275	451.523	530.540	623,384	732,476	860,659
b) Tax on transfer of immovable properties	3,225	12,438	17.917	16.000	25,000	25,000	29.375	34,516	0,556	47.653	55.992	65,791	77,305	90,833	106,729
c) Arear Collection	[illegible],340	50,573	85.595	115.897	162,400	81,200	16.240	8,120	8,120	8.120	8,120	5,120	8,120	8,120	8,120
ii) Rates	84,787	91,328	141,842	256.958	266,000	222.200	198.880	226,726	272,062	323,916	385.976	460,265	549,214	655,736	783,333
a) Lighting and Fire Rates	30,737	32,753	49,436	74.505	72,000	72.000	84.600	99.405	116.801	137.241	161.258	189,478	222,637	261,599	307,378
b) Conservancy	21,883	23,515	33,736	49,670	86,400	86,400	101.520	122,941	148.881	180.295	218,337	264.407	320,196	387,758	469,575
c) Arear Collection	32,167	35,060	58.666	132.783	127,600	63.800	12,760	6,380	6,380	5.380	6.380	6,380	6,380	6,380	6,380
iii) Other Taxes and Rates	45,327	47,453	53,470	63.010	66.600	66.600	78.255	91,950	108,041	126.948	149.164	175.268	205.939	241.979	284,325
Sub-total	260,892	280.639	413,186	575,710	741,600	596,600	559.630	641,645	755,821	890.912	1.090.775	1,239.983	1,463,961	1.729,144	2,043,166
2. FEES, TOLLS AND FINES															
a) Salami from Markets	254,833	150,826	79,950	56.000	155,097	155,097	182,239	214,131	251,604	295.634	347,370	406.160	479,588	563.516	662,131
b) Rent from Markets	18,012	28.256	41,464	56.000	60.000	60,000	70.500	82,838	97,334	114,368	134,382	157.899	185,531	217.999	256,149
c) Others	27,416	64,728	60,466	54,720	56.800	56.800	66.740	78,420	92,143	108,266	127.215	149.477	175,636	206,372	242,487
Sub-total	300.261	243,810	181.884	154.720	271.897	271.897	319.479	375,388	441.081	518.276	608.967	715.536	840,755	987.887	1,160,767
3. OWN PROPERTY SALES AND RENTALS															
a) Rent from Land, House, Flats & other properties	29,345	28,655	27,981	35.695	307,100	307.100	360.843	423,990	498,188	597,826	717,391	860.869	1,033.043	1.239,652	1,487,582
b) Low cost sanitation (proposed)	0	0	0	0	0	0	1.270	14,910	29,030	42.516	56.020	68.680	68.210	68.210	68,210
c) Hydrants to slum (proposed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
d) Other Revenue	11,952	9,765	19.368	20.000	30.000	30.000	35.250	41,419	48.667	57.184	67.191	78.949	92,765	108,999	128,074
e) Sale of Property	0	34,963	710	50	0	0	0	0	0	0	0	0	0	0	0
Sub-total	41,297	73,383	47,959	55.745	337.100	337.100	397,363	480,319	575,885	697.526	840.602	1.008.439	1.194.018	1,416.861	1,683.866
4. MISCELLANEOUS REVENUE	29.936	49,318	48,265	45.109	42,850	42,850	50.349	59.160	69,513	81.677	95.971	112.766	132.500	155.686	182,933
TOTAL REVENUE OWN SOURCES	632.386	647.150	691.314	831.284	1.393.447	1.246.447	1.325.826	1.555.511	1.842.300	2.188.379	[illegible]	3.076.724	3.531.235	4.289.580	5.070.733

299

13-Sep-91

DHAKA INTEGRATED FLOOD PROTECTION PROJECT

DHAKA CITY CORPORATION (D C C)

PROJECT CASH FLOW STATEMENT

Taka in '000

SOURCES OF FUND	ACTUAL				Actual Budget	ESTIMATED BUDGET									
	1987-88	1988-89	1989-90	1990-91	1991-92	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001
B. CAPITAL INFLOW															
5. LOAN - OTHERS	18,220	48,457	299,824	89,900	32,600	0	0	0	0	0	0	0	0	0	0
LOAN - ADB (PROPOSED)	0	0	0	0	0	12,292	25,461	13,733	15,632	16,332	15,789	0	0	0	0
LOAN - IDA	0	0	0	80,100	72,400	88,4	131,065	174,769	193,431	167,909	155,915	152,269	[illegible]	0	0
DCC source	0	0	0	0	0	14,820	48,865	38,010	36,209	25,090	26,819		0	0	0
Sub-total	18,220	48,457	299,824	170,000	105,000	115,576	205,391	226,512	245,272	209,331	199,523	152,269	0	0	0
6. GRANTS															
a) Salary Compensation	152	152	500	500	0	0	0	0	0	0	0	0	0	0	0
b) Octroi Compensation	25,460	24,992	24,835	25,500	50,000	29,963	35,206	41,367	48,606	57,112	67,107	78,851	92,650	108,863	127,914
c) Development - Existing	2,500	200,000	10,000	26,600	0	0	0	0	0	0	0	0	0	0	0
d) Development - Proposed	0	0	0	0	0	28,680	59,409	32,044	36,474	38,107	39,175	0	0	0	0
e) Other Grants & Compensation	1,370	1,370	22,500	0	500	7,804	23,938	14,456	39,308	48,276	60,626	0	0	0	0
Sub-total	29,482	226,514	57,835	52,600	50,500	66,447	118,553	87,867	124,388	143,495	166,910	78,851	92,650	108,863	127,914
TOTAL REVENUE SOURCE	680,088	922,121	1,048,973	1,053,884	1,548,947	1,430,469	1,650,764	1,870,890	2,211,960	2,541,205	2,962,748	3,307,904	3,723,884	4,398,443	5,198,647
% increase over previous year		35.59%	13.76%	0.47%	46.98%	35.73%	6.57%	13.33%	18.23%	14.88%	16.59%	11.65%	12.58%	18.11%	18.19%

Appendix - 11
Page - 4

DHAKA INTEGRATED FLOOD PROTECTION PROJECT

DHAKA CITY CORPORATION (D C C)

PROJECTED CASH FLOW STATEMENT

Taka in '000

APPLICATION OF FUND	ACTUAL 1987-88	1988-89	1989-90	1990-91	Actual Budget 1991-92	ESTIMATED 1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	BUDGET 1997-98	1998-99	1999-2000	2000-2001
A. EXPENDITURE															
1. Expenditure															
a) Salaries and Allowances	154,673	168,823	15[illegible] 588	196,115	218,948	218,948	257,264	302,285	355,185	417,342	[illegible]0,377	576,193	677,027	795,507	934,721
b) Office Expenses	5,644	6,482	[illegible] 396	10,500	10,500	10,500	12,338	14,497	17,033	20,014	3,517	27,632	32,468	38,150	44,826
c) Provision for Services	91,226	121,676	150 [illegible]24	206,118	270,255	270,255	317,550	373,121	438,417	515,142	[illegible],289	711,215	835,678	981,921	1,153,757
Sub-total	251,543	296,981	321,[illegible]	412,733	493,703	493,703	587,151	689,902	810,635	[illegible]52,437	1,1[illegible]183	1,[illegible]5,041	1,545,173	1,8[illegible]5,578	2,133,304
2. ADVANCE, LOAN & OTHERS	26,989	18,798	6,5[illegible]	7,500	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000	7,000
3. REFUND OF SALAMI	19,533	45,727	62,586	[illegible]0,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
4. DEBT CHARGES (FINANCIAL EXPENSES)															
a) Debt Charges (Previous)	0	0	0	0	0	11,658	27,441	49,287	73,466	94,455	113,344	132,978	132,978	121,920	105,537
b) Loan Repayment - Others	12,145	0	12,410	144,400	222,500	109,100	154,200	206,200	0	0	0	0	0	0	0
b) Loan Repay. including int. (New ADB)	0	0	0	0	0	768	3,128	5,577	7,413	9,411	11,481	18,378	17,542	16,707	15,871
Sub-total	12,145	0	12,410	144,400	222,500	120,926	184,769	261,065	80,879	103,865	125,424	151,355	150,520	139,626	121,408
5. DEVELOPMENT & MAINTENANCE (EXISTING)	406,011	613,725	645,742	476,950	815,000	560,416	558,489	773,725	909,127	1,068,224	1,255,[illegible]	1,474,816	1,732,909	2,035,168	2,392,498
6. DEVELOPMENT (PROJECT)	0	0	0	0	41,490	48,775	103,909	60,234	91,414	102,715	116,532	0	0	0	0
7. OTHER	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURE	716,221	975,231	1,049,087	1,061,583	1,535,693	1,246,821	1,556,217	1,801,925	1,909,055	2,244,300	2,633,363	2,958,212	3,445,601	4,007,372	4,664,210
% increase over previous year		36.16%	7.57%	1.19%	50.31%	17.45%	2.47%	15.79%	5.95%	17.56%	17.[illegible]	12.34%	16.48%	16.30%	16.39%
NET CASH FLOW	(36,133)	(53,110)	(114)	(7,699)	(46,746)	183,648	94,547	68,965	302,905	296,904	329,385	349,692	278,283	391,071	534,437
OPENING BALANCE	0	(36,133)	(89,243)	(89,357)	(97,056)	(143,802)	39,846	134,393	203,357	506,262	803,166	1,132,551	1,482,243	1,760,526	2,151,596
CLOSING BALANCE	(36,133)	(89,243)	(89,357)	(97,056)	(143,802)	39,846	134,393	203,357	506,262	803,166	1,132,551	1,482,243	1,760,526	2,151,596	2,686,034
Ratios															
Debts Service/Own Sources	1.92%	0.00%	1.80%	17.37%	15.97%	9.69%	13.93%	16.77%	4.39%	4.75%	4.83%	4.32%	4.15%	3.23%	2.39%
Debts Service/Total Revenues	1.79%	0.00%	1.18%	13.70%	14.36%	8.45%	11.19%	13.95%	3.66%	4.09%	4.23%	4.59%	4.04%	3.15%	2.34%
Local Revenue/Total Revenue (excluding Project)	92.99%	70.18%	65.90%	78.88%	89.96%	87.28%	80.38%	83.20%	83.29%	86.12%	87.63%	93.01%	97.51%	97.52%	97.54%
Property Based Taxes/Own Revenue	41.26%	43.37%	59.77%	69.26%	53.22%	47.79%	42.18%	41.22%	41.03%	40.[illegible]	40.47%	40.30%	40.32%	40.31%	40.29%

29b

292

DHAKA WATER SUPPLY & SEWERAGE AUTHORITY
NOTES TO THE ASSUMPTIONS OF THE FINANCIAL PROJECTION

1. The financial projection:

   Total new investment on drainage has been assumed to be made at 95% grant and 5% loan basis.

2. The tariff for Drainage is designed to recover full operational and maintenance cost including depreciation plus 5% service charges.

3. Interest of ADB loan portion is calculation @12.50% on the outstanding balance. The loan is repayable within 20 year including 5 year grace period. Repayment starting at the 6th year from the 1st disbursement and be paid the entire loan in 15 equal installments.

4. Depreciation of drainage (ADB financed) is not considered during construction period.

5. Depreciation is charged on the assets in operation applying straight line method using composit-service life of 25 year.

6. Provisions for uncollected account (bad debt) are set at 10% of total billing for Water & Sewerage & Drainage.

7. Accounts receivable are estimated to be equivalent to 60 days billing likewise account payable are estimated to be equivalent to 2 months operating expenses.

8. WASA to retain sufficient amount from excise duty recovered on account of Water & Sewer charges in the interim period.

9. Other debts as calculated by IDA has been taken into account for the purpose of Projection.

Appendix - 11
Page - 6

PROJECTED BALANCE SHEET

DHAKA.WASA

Taka in 000

PARTICULARS	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002
A. ASSETS											
FIXED ASSETS											
Gross Fixed Assets	4,338,800	5,713,800	6,662,700	6,974,600	7,144,800	7,324,400	7,464,700	7,616,900	7,648,900	7,876,500	8,100,500
Less Accumulated Depreciation	1,193,800	1,311,200	1,449,400	1,598,900	1,754,300	1,916,000	2,147,800	2,386,400	2,632,300	2,885,300	3,145,700
NET FIXED ASSETS	3,145,000	4,402,600	5,213,300	5,375,700	5,390,500	5,408,400	5,316,900	5,230,500	5,016,600	4,991,200	4,954,800
WORK-IN-PROCESS	448,800	16,200	417,100	281,300	281,300	281,300	281,300	281,300	281,300	281,300	281,300
CURRENT ASSETS											
Cash in hand	452,000	6,800	418,800	447,800	490,400	412,600	436,000	459,800	612,700	557,200	533,100
Short term investment	1,300	1,400	1,500	1,700	1,800	1,900	2,000	2,100	2,200	2,300	2,400
Accounts Receivable WS & Sewerage	71,800	200	79,100	83,100	87,200	91,600	96,100	100,900	106,000	111,300	116,900
Drainage	0	0	13,200	17,000	18,000	19,300	31,700	33,000	34,400	35,800	37,800
Inventories	695,300	76 000	741,100	799,900	781,900	486,600	473,600	362,600	55,000	358,400	402,600
Advance	111,600	179 900	152,900	130,000	10,500	93,900	79,800	167,800	55,800	157,400	100,300
Other Current Assets	111,300	210,700	210,200	29,700	28,700	208,200	207,900	207,500	207,200	206,800	206,500
TOTAL CURRENT ASSETS	1,443,300	1,820,000	1,616,800	1,509,200	1,418,500	1,314,100	1,327,100	1,333,700	1,473,300	1,429,200	1,399,600
TOTAL ASSETS	5,037,100	6,338,800	7,247,200	7,166,200	7,090,300	7,003,800	6,925,300	6,845,500	6,771,200	6,701,700	6,635,700
B. LIABILITY AND EQUITY											
CURRENT LIABILITIES											
Accounts Payable	57,100	44,400	66,200	72,600	77,200	82,200	88,500	94,100	100,000	106,400	113,200
Long term debt (current portion)	84,100	84,100	84,100	89,000	97,500	99,300	89,600	89,400	89,400	89,400	89,400
Other current liabilities (inc.provisions)	43,000	45,200	55,900	60,000	63,100	66,600	76,700	80,400	84,200	88,300	92,600
TOTAL CURRENT LIABILITIES	184,200	173,700	206,200	221,600	237,800	248,100	254,800	283,900	273,800	284,100	295,200
TERM LOAN	2,344,400	2,780,000	2,729,700	2,636,600	2,542,000	2,436,600	2,356,600	2,267,300	2,177,900	2,088,500	1,999,300
TOTAL DEBT	2,528,600	2,953,700	2,935,900	2,858,200	2,779,800	2,684,700	2,611,400	2,531,200	2,451,500	2,372,800	2,294,500
GRANT AND EQUITY											
Grant from ADB	530,600	10,822	1,462,500	1,478,800	1,494,100	1,510,400	1,510,400	1,510,400	1,510,400	1,510,400	1,510,400
Equity and Grant - GOB	1,907,400	2,543,800	2,801,800	2,801,800	2,801,800	2,801,800	2,801,800	2,801,800	2,801,800	2,801,800	2,801,800
Retained Earning	70,500	59,100	47,000	27,600	14,600	6,900	1,700	2,100	7,500	16,900	29,000
TOTAL GRANT AND EQUITY	2,508,500	2,613,722	4,311,300	4,308,000	4,310,500	4,319,100	4,313,900	4,314,300	4,319,700	4,329,100	4,341,200
TOTAL LIABILITY AND EQUITY	5,037,100	5,567,422	7,247,200	7,166,200	7,090,300	7,003,800	6,925,300	6,845,500	6,771,200	6,701,700	6,635,700
FINANCIAL RATIOS											
Current Ratio	7.84	10.48	7.84	6.81	5.97	5.30	5.21	5.05	5.38	5.03	4.74
Acid Test Ratio	4.06	6.07	4.25	3.20	2.68	3.34	3.35	3.68	4.09	3.77	3.38
Debt/(Debt+Equity) ratio	50.20%	53.05%	40.51%	39.88%	39.21%	38.33%	37.71%	36.98%	36.20%	35.40%	34.58%

DHAKA WASA

PROJECTED INCOME STATEMENT

Taka in '000

P A R T I C U L A R S	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002
REVENUE - OPERATIONS											
Water Revenue	290,200	304,800	320,000	336,000	352,800	370,500	389,000	408,500	429,000	450,400	472,900
Sewerage Revenue	140,300	147,300	154,700	162,400	170,600	179,100	188,000	197,400	207,200	217,500	228,400
Connection fees/other revenue	45,900	48,100	50,500	53,100	55,700	58,500	61,400	64,500	67,700	71,100	74,600
Drainage revenue	0	0	79,100	102,200	108,500	116,200	190,300	197,900	206,300	214,700	223,800
Excise (Retained)	000	55,600	0	0	0	0		0	0	0	0
Total Operational Revenue	485,100	555,800	604,300	653,700	687,600	724,300	828,700	868,300	910,200	953,700	999,700
EXPENSES - OPERATION AND MAINTENANCE											
Power	155,300	166,900	179,400	192,800	207,300	222,800	239,500	257,400	276,700	297,400	319,700
Salaries,wages and allowances	73,500	77,100	80,900	84,900	89,200	93,600	98,200	103,100	108,200	113,600	119,300
Maintenance	33,300	34,900	36,600	38,500	40,400	42,400	44,500	46,[illegible]00	49,000	51,400	54,000
Chemicals	8,400	8,800	9,200	9,600	10,000	10,500	11,000	11,500	12,100	12,700	13,300
Other expenses (Net of capitalisation)	20,000	21,000	22,100	23,200	24,300	25,500	26,800	28,100	29,500	30,900	32,500
Provision for bad debts - Water Supply & Sewer	43,000	45,200	47,400	49,800	52,300	55,000	57,700	60,600	63,600	66,800	70,200
Drainage - Operation and maintenance	9,000	12,800	13,800	26,500	28,700	32,000	34,600	37,400	40,500	43,900	47,700
Provision for bad debts - Drainage	0	0	7,900	10,200	10,800	11,600	19,000	19,800	20,600	21,500	22,400
Total operating expenses	342,500	366,700	397,300	435,500	463,000	493,400	531,300	584,800	600,200	638,200	679,100
Depreciation - Water supply and sewerage	72,700	74,600	76,600	78,700	80,800	83,000	85,200	87,500	89,900	92,400	94,900
Depreciation - Drainage	0	42,800	61,600	70,800	74,600	78,700	146,600	151,100	156,000	160,600	165,500
Total Depreciation	72,700	117,400	138,200	149,500	155,400	161,700	231,800	238,600	245,900	253,000	260,400
Total operating expenses and depreciation	415,200	484,100	535,500	585,000	618,400	655,100	763,100	803,200	846,100	891,200	939,500
Net Operating profit / (Loss)	70,200	71,700	68,800	68,700	69,200	69,200	65,600	65,100	64,100	62,500	60,200
Interest Expenses - Water Supply & Sewerage	80,600	76,000	71,300	66,600	61,900	57,100	52,400	47,700	43,000	38,700	34,900
Interest Expenses - Drainage	3,500	7,100	9,600	21,500	20,300	19,800	18,400	17,000	15,700	14,400	13,200
Net profit / (Loss)	(13,900)	(11,400)	(12,100)	(19,400)	(13,000)	(7,700)	(5,200)	400	5,400	9,400	12,100
Operating ratio	85.54%	87.10%	88.61%	89.49%	89.94%	90.45%	92.08%	92.50%	92.96%	93.45%	93.98%
FINANCIAL RATIOS											
Average Net Fixed Assets	2,663,400	3,773,800	4,807,950	5,294,500	5,383,100	5,399,450	5,362,650	5,273,700	5,123,550	5,003,900	4,973,000
Net Operating profit / (Loss)	70,200	71,700	68,800	68,700	69,200	69,200	65,600	65,100	64,100	62,500	60,200
Rate of Return on Net Fixed Assets	2.64%	1.90%	1.43%	1.30%	1.29%	1.28%	1.22%	1.23%	1.25%	1.25%	1.21%

Appendix
Page - 7

Appendix - 11
Page - 8

DHAKA WASA

PROJECTED CASH FLOW STATEMENT

Taka in '000

PARTICULARS	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002
SOURCE OF FUND											
Fund from operation - Net Operating profit	70,200	71,700	68,800	68,700	69,200	69,200	65,600	65,100	64,100	62,500	60,200
Depreciation - Added back	72,700	117,400	138,200	149,500	155,400	161,700	231,800	238,600	245,900	253,000	260,400
Total internal cash generation	142,900	189,100	207,000	218,200	224,600	230,900	297,400	303,700	310,000	315,500	32[illegible],600
Grant from GOB for Drainage	698,300	636,400	258,000	0	0	0	0	0	0	0	0
Long Term loan	673,700	406,600	0	0	0	0	0	0	0	0	0
Long Term loan - (ADB for Drainage)	27,900	29,000	20,000	800	800	900	0	0	0	0	0
Grant from ADB for Drainage	530,600	551,600	380,300	18,100	5,500	16,300	0	0	0	0	0
Decrease in working capital (Excluding Cash)	89,400	0	67,700	152,000	1[illegible],500	36,900	17,100	26,300	23,000	0	16,[illegible]0
Total Source of Fund	2,182,800	1,812,700	933,000	387,100	390,400	285,000	314,500	330,000	333,000	315,500	337,200
APPLICATION OF FUND											
Capital expenses - Water supply & sewerage	844,900	85,000	267,300	159,200	153,900	162,400	140,300	152,200	32,000	227,600	224,000
- Drainage	1,295,800	1,257,400	682,500	16,900	16,300	17,200	0	0	0	0	0
Debt service requir.- WS & Sewerage:Principal	0	0	70,300	93,900	95,400	101,000	74,700	84,000	84,100	84,100	83,900
:Interest	80,600	78,000	71,300	66,600	61,900	57,100	52,400	47,700	43,000	38,700	34,900
Debt service requir.- Drainage : Principal	0	0	0	0	0	5,300	5,300	5,300	5,300	5,300	5,300
Interest	3,500	7,100	9,600	21,500	20,300	19,800	18,400	17,000	15,700	14,400	13,200
Increase in working capital (Excluding cash)	0	252,400	0	0	0	0	0	0	0	900	0
Total Application of Fund	2,224,800	1,677,900	1,101,000	358,100	347,800	382,800	291,100	306,200	180,100	371,000	361,300
NET CASH INFLOW / (OUTFLOW)	(62,000)	134,800	(168,000)	29,000	42,600	(77,800)	23,400	23,800	152,900	(55,500)	(24,100)
CASH - BEGINNING OF THE YEAR	514,000	452,000	586,800	418,800	447,800	490,400	412,600	436,000	459,800	612,700	557,200
CASH - END OF THE YEAR	452,000	586,800	418,800	447,800	490,400	412,600	436,000	459,800	612,700	557,200	533,100
FINANCIL RATIO											
Debt-Service Coverage ratio (DSCR)	1.83	1.86	0.99	0.86	0.85	0.80	0.90	0.84	0.83	0.81	0.79

278

INCREASE IN LAND DEVELOPMENT TAX REVENUES IF RECLASSIFICATION OF LAND IMPROVED, 1993-2000

The additional revenue that can be realized by the year 2000 from the prompt reclassification of newly built-up land is estimated at about Tk 10 million for the Phase One area and at about Tk 15.43 million for Greater Dhaka as a whole. These estimates incorporate both the areas that have recently been built up but not reclassified, and those areas that are expected to be built up during the 1993-2000 period. It is expected that any modifications in the tax assessment system will not have their full effect until 1993.

I. INCREASE IN REVENUES FROM RECLASSIFICATION OF NEW BUILT UP AREAS

The estimated increase in built up areas that will take place from 1993 to 2000, based upon the projections given in Appendix 7, has been estimated as:

(a) Expected Increase in Built-Up area, 1992-2000:

West Dhaka:	:	1150 ha.
Eastern Embankment	:	624 ha.

The estimated tax revenues per hectare under the current rates for the primary non-agricultural classifications are estimated as:

(b) Revenues: Residential/Institutional : Tk 4940 per hac.

(c) Revenues: Commercial/industrial : Tk 24700 per hac

The revenues from these areas after they are reclassified is given by the equation: $a*(.93)*b + a*(.07)*c$, where the factors 0.93 and 0.07 represent the proportion of the built up lands that is currently classified at the residential and commercial rates respectively.

(d) Post-Reclassification Revenues from these areas:

West Dhaka	:	Tk 7,271,680
Eastern Embankment	:	Tk 3,945,677

Because almost none of the agricultural land that is expected to be built up lies in parcels of more than 8.3 hac., current revenues from the areas to be built up are insignificant. Thus the figures given above represent the additional revenue that will be achieved through land-use reclassification. This revenue can be expressed in annual terms as follows:

(e) Average Annual Increase in Revenues from New Built-Up Areas in 1993-2000:

West Dhaka	:	Tk 908,960
Eastern Embankment	:	Tk 493,210

265

II. INCREASE IN REVENUES FROM RECLASSIFICATION OF PREVIOUSLY BUILT-UP AREAS NOT ALREADY RECLASSIFIED

The basic assumption behind this calculation is that the Ministry of Land in currently about 3 years behind in reclassifying recently built-up areas. If the projected figures for expected increases in built up hectares for the next few years are used and projected backwards, the estimate of the backlog in unreclassified land is as follows:

(f) Estimated Current Built Up Areas Not Reclassified:

West Dhaka	:	431 hac.
Eastern Embankment	:	235 hac.

Following a similar calculation as to that used in Part I above, it is estimated that the increased revenue that will be achieved when the more efficient classification system allows the Ministry of Land to catch up is:

(g) Estimated Revenue from Reclassifying Recently Rebuilt Land:

West Dhaka	:	Tk 2,725,299
Eastern Embankment	:	Tk 1,485,952

III. TOTAL INCREASED REVENUE FROM IMPROVED RECLASSIFICATION, 1993-2000

Total increased revenues can therefore be calculated by adding the sums in (d) to those in (g), as follow:

(h) Total Increase in Land Development Tax Revenues:

West Dhaka	:	Tk 9,996,979
Eastern Embankment	:	Tk 5,431,629
Totals	:	Tk. 15,428,608

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TECHNICAL ASSISTANCE FOR FORMULATION OF LAND DEVELOPMENT CONTROLS AND PROCEDURES FOR DHAKA CITY

1. Background and Need

As a continuum of TA No. 1318-BAN for Dhaka Integrated Flood Protection Project the proposed technical assistance will assist in meeting the urgent land development control needs which have been identified as a priority for Dhaka City. These include: (i) developing appropriate land development standards, regulations and control mechanisms/procedures to ensure that the investments in improved flood control and drainage facilities are complemented by appropriate land use development standards and controls, and are not negated by uncontrolled and unrestricted growth; (ii) developing improved cost recovery methods for meeting the escalating needs for providing public infrastructure and services occasioned by the expansion/densification of the urbanized areas in Dhaka; and (iii) rationalizing the needs and uses of vacant and underutilized Government owned lands within Dhaka city.

2. Objectives

The proposed technical assistance will help the Government formulate appropriate land development requirements, policies, standards, regulations and control procedures in order: (i) to facilitate the orderly urban growth of Dhaka City, to ensure that the benefits of improved flood control and drainage are complemented by appropriate land development standards and are not negated by uncontrolled growth, ar (ii) to develop improved policies, including cost recovery mechanisms, fc meeting the needs for upgrading public infrastructure and services occasioned by urban growth. In addition, the proposed technical assistance will assist the Government in reviewing Government land ownership and needs in Dhaka City, and in developing new policies and strategies for optimum utilization of vacant or underutilized Government lands.

3. Scope and Work Program

The technical assistance provides for expert consultant services to assist the Government in: (i) preparing improved building/land development standards and regulations; (ii) developing new land development policies and cost recovery mechanisms to support the cost of providing public infrastructure; and (iii) rationalizing the needs and uses of under-utilized Government land holdings in Dhaka City. The work will comprise of three parts as follow:

Part A: Building/Land Development Standards and Regulations: The consultants will assist to:

(i) review existing land development standards, regulations and procedures within Dhaka City;

(ii) develop and recommend improved land development standards, building regulations and controls; and

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(iii) develop and recommend new land development/building approval procedures for developments in Dhaka City.

Part B: Land Development Policies and Fees: The consultants will assist to:

(i) review existing land development policies and land development taxation methods applied in Dhaka City;

(ii) analyze the development requirements and the amount, sources, recipients and utilization of existing land taxes;

(iii) analyze the impact of increased offsite service needs and costs to the public sector resulting from new land development and urban densification;

(iv) recommend appropriate policies for modifying existing land development requirements, with particular consideration to the practicality, affordability and impacts of introducing new regulations for land developers to provide onsite and/or offsite public infrastructure and services such as roads, drains, drainage retention ponds, water supply systems, schools, health centers, parks, etc.;

(v) recommend appropriate policies for modifying existing land development taxation, with particular consideration to the practicality, affordability and impacts of introducing new land development fees to assist in providing public infrastructure and services for development within Dhaka City;

(vi) prepare draft legislation for any new development policies and/or development fees recommended.

Part C: Review of Government Land Ownership and Needs: The consultants will assist to:

(i) review the existing Government land ownership and needs within Dhaka City;

(ii) prepare an inventory of all Government owned lands in Dhaka, along with a description of present use, future projected uses and a statement of need for vacant or underutilized land; and

(iii) recommend appropriate Government policies and strategies for rationalizing the use of vacant and/or underutilized Government owned lands with particular consideration to potentials for disinvesting the lands, converting the lands for public use, converting the lands for use for low income residential use, and/or transferring/leasing/selling to squatters/settlers to provide long term security of tenure.

289

The technical assistance program will be carried out over a period of eight months starting about mid-1992. The assistance will require 16 man months of international consultants and 28 months of domestic consultants specialized in municipal land management, municipal finance, land use policy, and land use control and building regulations.

The likely project timing coincides with a number of other important and inter-related technical assistance programs in Dhaka City and the national urban sector, including:

o the implementation of the Dhaka Integrated Flood Protection Project to be undertaken with ADB and NDF assistance,

o the preparation of the Greater Dhaka Flood Protection Master Plan being completed with JICA assistance,

o the on-going support for Urban Management and Municipal Services Programmes in Dhaka and Chittagong (UNDP/UNCHS/IDA),

o the proposed Urban Shelter Sector Study intended to indicate broad strategies for the sector and assisted action programs (UNCHS/ADB/IBRD),

o the preparation of Structure Plan, Master Plan and Detailed Area Plans for Dhaka and Chittagong with a strong emphasis on improved land management (UNCHS/UNDP),

o the proposal for a National Land Use Planning Project,

o the proposal for development of a national Urban Land Management strategy with an emphasis on modernizing urban land records and formulating urban land management policies (UNDP), and

o the preparation of the Greater Dhaka Metropolitan Integrated transportation Study (UNDP/UNDTCD).

The study team will be responsible to coordinate their activities with those of other related projects and to cooperate with other study teams to ensure that recommendations made are complementary.

4. Cost Estimate and Financing Arrangements

The total cost of the technical assistance is estimated at US $596,000, including $382,000 in foreign exchange and $214,000 equivalent in local currency costs. It is proposed that the entire foreign exchange cost and $190,000 of the local currency cost be financed on a grant basis from the Bank. The local cost financing will include domestic travel and transportation, field office rental and equipment, and surveys of Government owned land uses. The Government has agreed to provide the remainder of the local currency requirements, estimated at $24,000 equivalent, which includes the provision of local staff, vehicle operation and office supplies.

5. Implementation Arrangements

The Government will establish an interministerial Steering Committee chaired by the Mayor of Dhaka City Corporation with representatives from all concerned Ministries for ensuring effective inter-ministerial and inter-departmental liaison, and for reviewing and approving consultant recommendations. Rajdhani Unnayan Kattripaka (RAJUK - the Capital Development Authority) will be the principal Implementing Agency for the technical assistance. The RAJUK Chairman will be the consultants counterpart, and the Chief of Planning will act as the coordinator for the consultants activities.

The consultants will establish an office in Dhaka in coordination with RAJUK.

The consultants will submit an inception report at the end of six weeks of service, a mid-term report at the end of four months, a draft final report at the end of seven months, and a final report upon completion of services.

6. Outline Terms of Reference

The consultants primary responsibility will be to assist the Government of Bangladesh in developing appropriate land development requirements, policies, standards, regulations and control procedures in order: (i) to facilitate the orderly urban growth of Dhaka City, and (ii) to develop improved mechanisms for meeting the needs for upgrading public infrastructure and services occasioned by urban growth. In addition, the proposed technical assistance will assist the Government in developing new policies and strategies for optimum utilization of vacant or underutilized Government lands in Dhaka City.

Four international experts and five local experts will be engaged to provide the necessary support and advisory services, as outlined below.

A1. Municipal Manager/Land Development Advisor (International)

As the Team Leader of the consultants team, the Municipal Manager/Land Development Advisor will be responsible for the overall direction and co-ordination of the teams activities, for maintaining liaison with the Government agencies and with other concerned study teams, and for preparing periodic progress reports and interim discussion papers. Specific responsibilities include:

(i) review existing land development related laws, regulation, procedures and practices in Dhaka City;

(ii) assess the performance and adequacy of administration, application and enforcement of existing land development regulations;

(iii) assist the Project Director in overall evaluation of the problems and needs in land development administration in Dhaka City;

(iv) develop and recommend improved land development standards, building regulations and controls;

(v) develop and recommend new land development/building approval procedures for developments in Dhaka City;

(vi) recommend appropriate policies for modifying existing land development requirements, with particular consideration to the practicality, affordability and impacts of introducing new regulations for land developers to provide onsite and/or offsite public infrastructure and services such as roads, drains, drainage retention ponds, water supply systems, schools, health centers, parks, etc.;

(vii) prepare draft legislation for any new development policies and fees recommended.

A2. Municipal Finance Expert (International)

(i) review existing land development policies and land development taxation methods applied in Dhaka City;

(ii) analyze the development requirements and the amount, sources, recipients and utilization of existing land taxes;

(iii) analyze the impact of increased offsite service needs and costs to the public sector resulting from new land development and urban densification;

(iv) recommend appropriate policies for modifying existing land development taxation, with particular consideration of the practicality, affordability and impacts of introducing new land development fees to assist in providing public infrastructure and services for development within Dhaka City;

(v) assist in preparing draft legislation for any new development fees recommended.

A3. Urban Planning Advisor (International)

(i) assist in determining the existing Government land ownership, uses and future projected uses in Dhaka City;

(ii) review the existing land ownership, uses and projected needs;

(iii) propose appropriate policies and strategies for rationalizing the use of vacant or underutilized Government lands;

(iv) recommend alternative uses for vacant or underutilized Government lands, with particular consideration to potentials for disinvesting the lands, converting the lands for public use, converting the lands

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for use for low income residential use, and/or transferring/leasing/ selling to squatters/settlers to provide long term security of tenure;

(v) assist in developing and recommending improved land development standards, building regulations and controls;

(vi) assist in developing and recommending new land development/building approval procedures for developments in Dhaka City;

(vii) assist in analyzing the impact of increased offsite service needs and costs to the public sector resulting from new land development and urban densification;

(viii) assist in developing appropriate policies for modifying existing land development requirements, with particular consideration to the practicality, affordability and impacts of introducing new regulations for land developers to provide onsite and/or offsite public infrastructure and services such as roads, drains, drainage retention ponds, water supply systems, schools, health centers, parks, etc.;

(ix) assist in preparing draft legislation for any new development policies and standards recommended.

A4. Municipal Engineering Advisor (International)

(i) review existing land development standards, regulations and procedures within Dhaka City;

(ii) assist in developing and recommending improved land development standards, building regulations and controls, with particular consideration to introducing standards/guidelines for provision of adequate drainage facilities (including consideration of on-site retention where appropriate), sanitary disposal facilities for waste discharge, and minimum construction levels for roads, lots and buildings;

(iii) assist in developing and recommending new land development/building approval procedures for developments in Dhaka City;

(iv) assist in analyzing the impact of increased offsite service needs and costs to the public sector resulting from new land development and urban densification;

(v) assist in developing appropriate policies for modifying existing land development requirements, with particular consideration to: (a) the practicality, affordability and impacts of introducing new regulations for land developers to provide onsite and/or offsite public infrastructure and services such as roads, drains, drainage retention ponds, water supply systems, schools, health centers,

222

parks, etc., and (b) to coordinating new road locations into an overall integrated plan for using roadways to compartmentalize Dhaka city for additional long term flood security;

(vi) assist in preparing draft legislation for any new development policies and standards recommended.

B1. Land Development Specialist (Domestic)

(i) As the Deputy Team Leader, assist the Team Leader in carrying out the above Terms of Reference with specific focus on identifying the local land development procedures, practices and constraints, and developing appropriate standards and procedures.

B2. Municipal Finance Management Consultant (Domestic)

(i) Assist the Municipal Finance Expert in carrying out the above Terms of Reference, particularly in regards to the practices and procedures used in valuation of land development projects for assessing taxation levels, and in regards to the present practices used in pricing developed land for resale.

B3. Urban Planning Specialist (Domestic)
B4. Municipal Engineering Specialist (Domestic)

(i) Assist the respective Advisors in carrying out the above Terms of Reference, particularly in regards to local practices and appropriate standards.

B5. Municipal Law Specialist (Domestic)

(i) Assist the Team Leader and Advisors in developing draft legislation for any new development standards, policies, and/or fees recommended.

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B. Staff Requirements

Position	Man-Months
I. Professional Staff (to be engaged under the TA)	
A. International	
1) Municipal Manager/Land Use Specialist	6
2) Municipal Finance Expert	4
3) Urban Planning Advisor	3
4) Municipal Engineering Advisor	3
Sub-total, International	16
B. Domestic	
1) Land Development Specialist	6
2) Municipal Finance Management Consultant	6
3) Urban Planning Specialist	6
4) Municipal Engineering Specialist	6
5) Municipal Law Specialist	4
Sub-total, Domestic	28
II. Counterpart Staff (to be provided by the Government)	
a) Project Director (Part Time)	6
b) Municipal Administration Specialist	6
c) Municipal Engineer	6
d) Urban Planner	6
e) Municipal Finance Expert	6
f) Municipal Law Expert (Part Time)	6
g) Electrical Engineer (Part Time)	6
h) Property Valuation Expert (Part Time)	6
i) Clerk/Secretary/Typist	18
Sub-Total, Counterpart	66

226

C. Estimated Cost

Description		$ '000 Equivalent
I.	Bank Financing	
A.	Foreign Currency Cost	
a)	Remuneration & Per Diem of International Consultants a/	296
b)	International Travel b/	25
c)	Communications and Reports	9
d)	Government Observer Participation	2
e)	Contingencies	50
	Sub-total, (A)	382
B.	Local Cost	
a)	Remuneration of Local Consultants a/	98
b)	Technical and Support Staff c/	12
c)	Domestic Transportation	20
d)	Field Office Rent and Facilities	20
e)	Communications & Report/Document Preparation	10
f)	Land Use Surveys	5
g)	Contingencies	25
	Sub-total, (B)	190
II.	Govrnment Financing	
a)	Remuneration of Counterpart Staff	9
b)	Operation and Maintenance of Vehicles	10
c)	Office Accomodation, Supplies and Equipment	5
	Total Government Financing	24
	Total, (I + II)	596

a/ Based on 16 man-months International (at $15,000 per mm remuneration plus $112 per day per diem) and 28 mm Domestic (at $3,500 per mm).

b/ Five return trips at $5,000 per trip.

c/ 24 man-months at $500 per month.

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INDICATORS FOR PBME

A. General Indicators

1. Flood Protection

i) Risk assessment, time to maximum flood after a breach, and assessment of potential damages in the case of a breach will be undertaken. An emergency management plan will be developed and tested;

ii) Threats to safety and effectiveness of the flood protection works due to people cutting sections of the dikes and walls will be monitored and beneficiaries extensively involved in the public information and monitoring program;

iii) Plans for compensation to be provided to the affected families and their resettlement program will be monitored. Backwater curves for areas outside the flood protection system will be checked, excluded communities included in the participation process and their concerns incorporated in possible remedial measures, with periodic monitoring;

iv) The extent and settlement pattern of new migrants into the protected areas will be monitored together with monitoring of the necessary land use controls;

v) Stagnant pools of water, including those in the retention area near the embankment, will be monitored for drainage needs, harmful insects and periodic spraying as necessary.

2. Water Quality Indicators

i) Water quality monitoring would measure impacts of water supply standpipe service, sanitation and solid waste components on the environmental conditions of Project area, and would establish criteria and standards for the discharge of industrial wastewater to the public sewerage system. the monitoring will consist: (a) of determining incidences of diahorieal and other water borne diseases in affected immunities (see 3 following); and (b) of sampling and testing the water in stream locations, to be selected, at regular intervals before and after the implementation of the Project components.

ii) Water samples should be taken at the locations and tested for water columns analyses of:

- o temperature
- o hydrogen ion concentration, pH
- o dissolved oxygen
- o biochemical oxygen demand (BOD)

22a

- o chemical oxygen demand (COD)
- o chloride
- o ammonia, nitrite and nitrate
- o phosphate
- o detergent (ABS)
- o faecal coliforms
- o suspended solids turbidity

Samples at some locations suspected of industrial pollution should be tested for heavy metals and phenol.

iii) Samples of water should be also taken from selected shallow wells and tested for:

- o hydrogen ion concentration, pH
- o electrical conductivity
- o faecal coliforms

For bottom sediment analysis, all samples should be tested for particle size distribution, hexade extractables, heavy metals, pesticides and fauna.

3. Public Health and Socioeconomic Indicators

i) The incidence of water-borne, water related and vector-borne diseases will be monitored on a regular interval. Especially the incidence of typhoid, cholera and parasitic infections should be monitored with the help of local sanitation departments and hospitals/clinics in the area;

ii) Other indicators to be monitored will include urban services and economic activity within Project towns. The social and economic benefits will be monitored to examine the impact on the urban poor. In this connections, the socioeconomic and demand surveys will be periodically updated during Project implementation.

4. Property Value Increase

i) The Project area being improved and protected from floods would tend to have property value increases. Such increases, due to the Project, would be monitored. Property value increases due to inflation and general economic improvements would not be included.

5. Community and NGO Involvement

i) The effectiveness of community and NGO involvement incorporated in Project design will be monitored through periodic socio-economic surveys; this will include the management of the water supply standpipe program and O&M activities.

6. Operational Efficiency Indicators

i) DCC and DWASA will monitor and control staff growth and devise and introduce measures of operational efficiency.

B. Sector Specific Indicators

1. Drainage

i) The following data would be monitored at regular intervals before and after Project implementation:

- o duration, area (in ha) and frequency of localized flooding
- o number of beneficiaries
- o perception of residents regarding the general conditions of drainage conditions to be compared with such perception at the time of the feasibility study.

2. Sanitation

i) The acceptance of the sanitation component will be the key indicator of success. The number of sanitation facilities (public toilets and latrines) installed and the number of people benefiting from these should be monitored. In addition, the success of cost recovery programs would be monitored.

3. Solid Waste Management

i) Increased collection and disposal methods would be monitored, i.e., number of additional households served, the quantity of solid waste collection, and the quantity of disposal through sanitary land-fill method. Periodic surveys would be done in service areas to evaluate the efficiency of the reduction in waste intrusion into the drainage systems.

4. Slum Improvement

i) The number of household covered and the improvement in the health conditions and employment status of slum dwellers are key indicators of benefit. The incidence of water-borne and vector-borne diseases, infant mortality and unemployment would be monitored before and after the improvement.

5. Improved Management

i) Compliance with the agreed Action Plan would be monitored as indicators of improved management of Dhaka City by DCC, DWASA and RAJUK. Most critical factors to be monitored in this connection are the improved inter-agency coordination measures implemented, land development procedures implemented, increases in the collection efficiency, increases in the tax bases due to revaluation of properties and inclusion of new holdings, and the success in meeting the cost recovery targets.

229

BRIDGING ENGINEERING SERVICES
Description of Tasks

1. To ensure that the Project preparation continues uninterrupted following completion of the project-preparatory technical assistance, it is proposed that the Government engage the ADB TA consultants to continue the work under the proposed loan for the interim period from 15 October 1991 to 30 April 1992 (6.5 months) before the recruitment process for the loan consultants is completed. The services to be provided during this bridging period will be a combination of Project Management advisory services, and of detailed engineering design and supervision for the priority first year construction work program.

2. It is estimated that an amount of $ 0.73 million (Taka 27.2 million) will be required for the bridging engineering services for some 63.0 man-months of consulting services (13.0 mm international and 50.0 mm domestic) plus about eighty percent of the required subsoil investigations. This amount will be deducted from the original costs estimated for consulting services, and will not result in any overall increase.

3. The services to be provided during the bridging period will include the following:

a) assist with ...anizing the Project Management Office (PMO) and staff, including procurement of equipment and set-up of materials testing laboratory.

b) assist the PMO in prequalifying local and international contractors for the flood control, drainage and environmental improvement components of the Project;

c) With the assistance of the PMO and the BWDB:

- prepare site investigation programs, terms of reference and bidding documents for subsoil investigation programs for existing embankments, with emphasis on Class I and Class II embankment sections;

- prepare site investigation program, terms of reference and bidding documents for topographic and cross section survey program for existing embankment;

- supervise field investigation programs and laboratory testing, analyze test results and prepare detailed engineering designs for embankment remedial measures, with emphasis on Class I and Class II areas;

- finalize construction schedule for remedial measures on the westerly embankment;

- prepare detailed engineering designs, drawings, specifications and contract documents for embankment remedial measures:

126

o prepare detailed engineering designs, drawings, specifications and contract documents for sluices along the West Embankment;

o prepare detailed engineering designs, drawings, specifications and contract documents for slope protection works along westerly embankment;

o perform study on Pump Station No. 3 at Goranchakbari to show costs of various pump discharge capacities against areas required for regulator ponds.

d) With the assistance of the PMO, BWDB and DCC:

o perform detailed condition survey of existing floodwall; evaluate and prepare re-designs, specifications, drawings and contract documents as needed to: (i) restore unstable sections, and (ii) provide closure gates and/or sheet piling protection for various sized openings;

o perform detailed survey of sections of incomplete floodwall/embankment from Kellarmorh to Mitford Hospital, and prepare detailed engineering designs, drawings, specifications and contract documents.

e) With the assistance of the PMO, BWDB, RAJUK and DCC:

o perform detailed survey of the central road and determine required road raising and flood proofing measures;

o prepare detailed engineering designs, drawings, specifications and contract documents for Central Road raising and flood proofing works.

f) With the assistance of the PMO and DWASA:

o prepare detailed engineering designs, drawings, specifications and contract documents for priority first year drainage improvement works.

g) Assist the PMO, BWDB, DWASA, DCC and RAJUK:

o in tendering and evaluation for the first years work program components;

o to prepare quality assurance and quality control programs and plans, and assist with implementation;

o to prepare an O&M program, including operations manuals as required;

o with contract administration and construction supervision as required.

4. Staff Requirements

Position		Man-Months
I.	Professional Staff	
A.	International	
1)	Project Implementation Advisor/Team Leader (FC&D/Hydraulic Engineer)	6.5
2)	Project Coordinator	0.5
3)	Geotechnical Expert	2.0
4)	Geotechnical Specialist	4.0
	Sub-total, International:	13.0
B.	Domestic	
1)	Civil/Hydraulic Engineer/co-Team Leader	6.0
2)	Geotechnical Specialist	4.0
3)	Senior Design Engineer	6.0
4)	Design Engineer	6.0
5)	Municipal Engineer	6.0
6)	Construction Supervision Engineer	2.0
7)	Monitoring and Evaluation Specialist	2.0
8)	Junior Engineers	18.0
	Sub-total, Domestic:	50.0
	Total:	63.0

600

5. Estimated Cost

	Description	$ '000 Equivalent
A.	**Foreign Currency Cost**	
a)	Remuneration & Per Diem of International Consultants a/	240
b)	International Travel b/	24
c)	Communications and Reports	9
d)	Contingencies	42
	Sub-total, (A)	315
B.	**Local Cost**	
a)	Remuneration of Local Consultants a/	175
b)	Technical and Support Staff c/	12
c)	Domestic Transportation	20
d)	Field Office Rent and Facilities	10
e)	Communications & Report/Document Preparation	10
f)	Topographic Surveys	8
g)	Subsoil Investigations and Testing	100
h)	Contingencies	54
	Sub-total, (B)	414
	Total	729

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a/ Based on 13.0 man-months International (at $15,000 per mm remuneration plus $112 per day per diem) and 50 mm Domestic (at $3,500 per mm).

b/ Eight return trips at $3,000 per trip.

c/ 24 man-months at $500 per month.

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PROPOSED CONSULTANCY SERVICES SCHEDULE IN MAN-MONTHS
DHAKA INTEGRATED FLOOD PROTECTION PROJECT

ACTIVITY	TOTAL MM EXPAT	TOTAL MM LOCAL	ALLOCATION BRDG.	ALLOCATION IMPL.
PROJECT MANAGEMENT				
Project Imp. Advisor/Team Leader	36.0		4.0	32.0
Civil/Hydraulic Eng./Co Team Leader		60.0	6.0	54.0
Geo-Technical Expert	12.0		2.0	10.0
		24.0		24.0
Financial/MIS Specialist	12.0			12.0
		36.0		[illegible].0
Senior Municipal Engineer		24.0		24.0
Urban Planner		12.0		12.0
Monitor & Evaluation Specialist		12.0		12.0
Community Development Specialist		36.0		36.0
Construction Specialist		48.0		48.0
TOTALS	60.0	252.0	12.0	300.0
DETAILED ENGINEERING DESIGN AND CONSTRUCTION SUPERVISION				
Mechanical & Electrical Engineer	10.0			10.0
		15.0		15.0
Civil/Hydraulic Engineer	20.0		3.0	17.0
		48.0		48.0
Geo-Technical Specialist	6.0		4.0	2.0
		18.0	4.0	14.0
Design Engineer		48.0	[illegible].0	42.0
Senior Design Engineer		48.0	6.0	42.0
Construction Supervision Engineer		[illegible]	2.0	46.0
Municipal Engineer		36.0	6.0	30.0
Monitoring & Evaluation Specialist		48.0	2.0	46.0
Environmental Engineer		12.0		12.0
Community Development Specialist		24.0		24.0
Junior Engineer		60.0	18.0	42.0
Other Discipline		9.0		9.0
TOTALS	36.0	414.0	51.0	399.0

91/92 | 92/93 | 93/94 | 94/95 | 95/96 | /97

1991 | 1992 | 1993 | 1994 | 1995 | 1996

BRIDGING

IMPLEMENTATION PERIOD