People's Republic of Bangladesh
Ministry of Irrigation, Water Development
and Flood Control

Flood Plan Coordination Organisation

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION

Asian Development Bank
TA 1396 - BAN

FAP 9A

FINAL REPORT
Main Report - Volume 1A

April 1992

Sir William Halcrow and Partners Ltd.

in association with
Halcrow Fox and Associates
Engineering & Planning Consultants Ltd.

HALCROW

People's Republic of Bangladesh
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Sir William Halcrow & Partners Ltd has prepared this report in accordance with the instructions of the Asian Development Bank and the Flood Plan Coordination Organisation for their sole and specific use. Any other persons who use any information contained herein do so at their own risk.

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in association with
Halcrow Fox and Associates
Engineering & Planning Consultants Ltd.

HALCROW

Consulting Engineers

in association with
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FLOOD PROTECTION PROJECT

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9 May 1992

Our ref HBD/IFP/323/290

Your ref

Mr. P.K. Thomas
Manager
Water Supply and Urban
Development Division (West)
Asian Development Bank
Manila
Philippines

Dear Mr. Thomas

T.A. NO. 1396-BAN
SECONDARY TOWNS INTEGRATED FLOOD PROTECTION, BANGLADESH
FINAL REPORT - FAP 9A

We have pleasure in submitting 55 copies of the Final Report for the above study, which we trust fulfills your requirements. As requested, we are submitting 50* copies to the Co-ordinating Agency (FPCO) and 5 copies to the ADB.

The Report is produced in four volumes, namely:

Main Report (including Executive Summary)	-	Volume 1A
Appendices	-	Volume 1B
Drawings (essential for reading Main Report)	-	Volume 2A
Drawings (additional detailed drawings)	-	Volume 2B*

As you are aware, the Final Report has been produced after a full dialogue with the April 1992 "ADB Appraisal Mission to the Project" and informal meetings with

FPCO and others. It incorporates the Consultant's replies to comments made on the draft Final Report by both the GOB (including FPCO) and the Bank. These replies were discussed at the FAP Review Committee Meeting on 22nd April 92 as minuted in their memorandum reference 840/(C31)/FPCO R 001/90 dated 27 April 92. The Review Committee accepted the Consultant's responses in general and requested some minor modifications, as a result of which several further additions and amendments by way of clarification were made to the Final Report.

We hope that the results of this study will be translated into detailed design and implementation at an early stage.

Yours sincerely

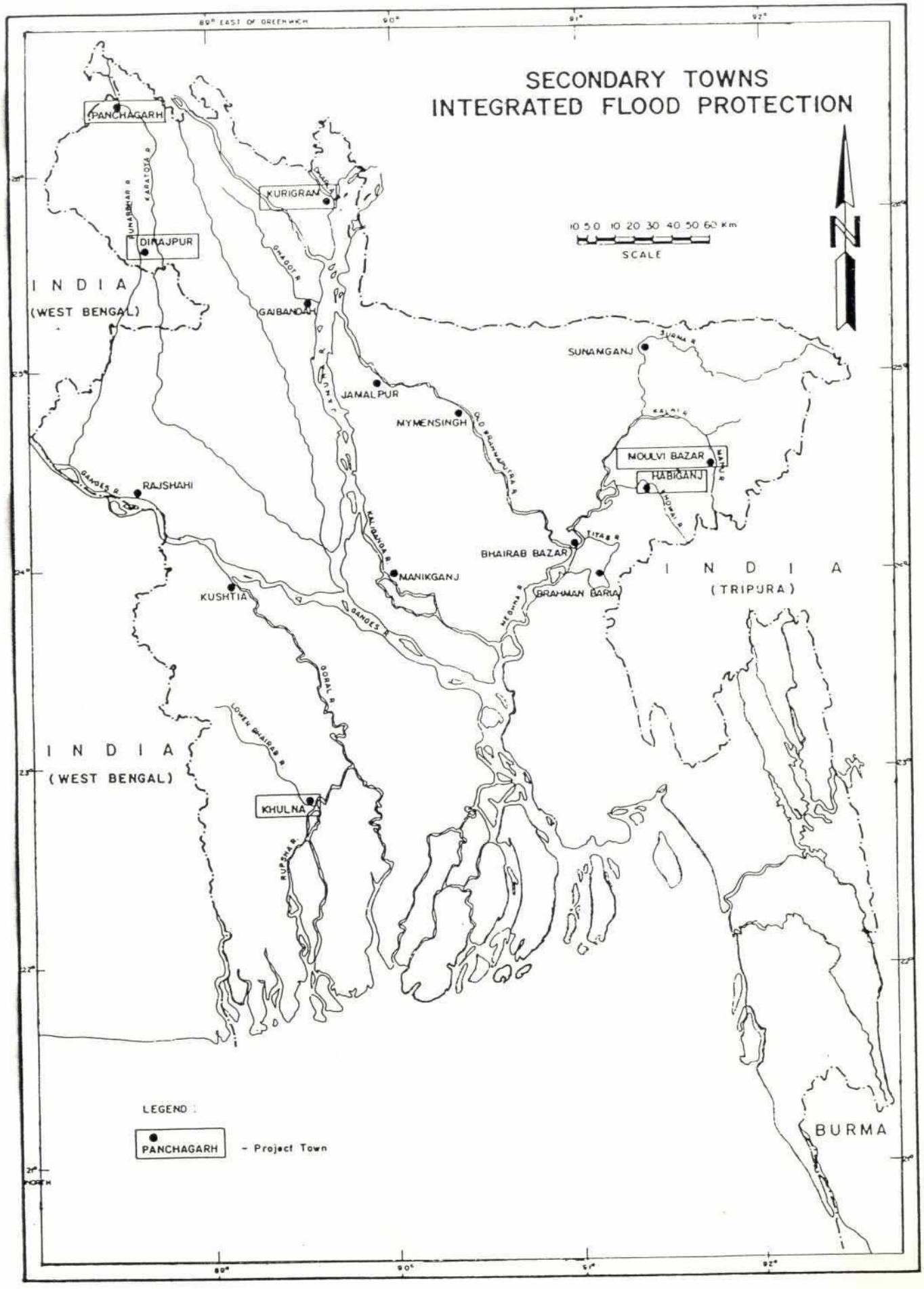
E. G. Thomas

E.G. Thomas
Team Leader

cc.: Mr. M.H. Siddiqi, Chief Engineer, FPCO, (+ 50* copies)
Mr. K.H. Talukdar, Project Officer, ADB, Dhaka, (5 formal + 1 extra copy)

Note: * FPCO has requested 10 copies only of Volume 2B.

EGT/ZR


SECONDARY TOWNS
INTEGRATED FLOOD PROTECTION
89° EAST OF GREENWICH
90°
91°
92°
PANCHAGARH
KURIGRAM
DINAJPUR
GAIBANDHA
JAMALPUR
MYMENSINGH
SUNAMGANJ
MOULVI BAZAR
HABIGANJ
RAJSHAHI
KUSHTIA
MANIKGANJ
BHAIRAB BAZAR
BRAHMAN BARIA
KHULNA
INDIA
(WEST BENGAL)
INDIA
(TRIPURA)
BURMA
10 5 0 10 20 30 40 50 60 Km
SCALE
LEGEND :
PANCHAGARH - Project Town

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The Consultants also wish to acknowledge the cooperation received from related FAP consultants and the consultants associated with the Secondary Towns Infrastructure and Services Development Project.

ABBREVIATIONS

A. INSTITUTIONS :

ADB	=	Asian Development Bank
ATE	=	Associated Technical Enterprise
ACE	=	Associated Consulting Engineers Ltd.
BBS	=	Bangladesh Bureau of Statistics
BMD	=	Bangladesh Meteorology Department
BT&T	=	Bangladesh Telephone & Telegraph
BUET	=	Bangladesh University of Engineering & Technology
BWDB	=	Bangladesh Water Development Board
DEPH	=	Directorate of Environment and Pollution Control
DOE	=	Department of Environment
DPHE	=	Department of Public Health Engineering
ERD	=	External Resources Division
FAP	=	Flood Action Plan
FPCO	=	Flood Plan Coordination Organisation
GOB	=	Government of Bangladesh
IDA	=	International Development Agency
JICA	=	Japanese Internation Cooperation Agency
KCC	=	Khulna City Corporation
KDA	=	Khulna Development Authority
LGB	=	Local Government Division (MLGRDC)
LGEB	=	Local Government Engineering Bureau
ML	=	Ministry of Land
MLGRDC	=	Ministry of Local Government, Rural Development and Cooperatives

MOW	=	Ministry of Works
MIWDFC	=	Ministry of Irrigation, Water Development and Flood Control
MPO	=	Master Plan Organisation
NGO	=	Non - Governmental Organisation
PC	=	Planning Commission
PIU	=	Project Implementation Unit
PMO	=	Project Management Office
PMU	=	Project Monitoring Unit
POE	=	Panel of Experts
PWD	=	Public Works Department
SARM	=	SARM Associates Ltd.
SRP	=	System Rehabilitation Project
STP	=	Secondary Towns Integrated Flood Protection Project
UNICEF	=	United Nations International Childrens Fund

B. ECONOMIC AND FINANCIAL :

EIRR	=	Economic Internal Rate of Return
ERR	=	Economic Rate of Return
EV	=	Extreme Value
FFYP	=	Fourth Five Year Plan
FIRR	=	Financial Internal Rate of Return
FOR X %	=	Foreign Exchange
FY	=	Financial Year (July 01 to June 30)
ICB	=	International Competitive Bidding
IS	=	International Shopping
LCB	=	Local Competitive bidding
NPV	=	Net Present Value

PBME	=	Project Benefit Monitoring and Evaluation
SCF	=	Standard Conversion Factor
MTK	=	Million Taka
US $ Million	=	Million US Dollars

C. TECHNICAL :

ARF	=	Areal Reduction Factor
CC	=	Cement Concrete
DD (F)	=	Depth - Duration - Frequency
EIA	=	Environmental Impact Assessment
IA	=	Impact Area
IDF	=	Intensity - Depth - Frequency
O & M	=	Operation and Maintenance
PWM	=	Probability Weighted Moments
RI	=	Rainfall Intensity
RC (RCC)	=	Reinforced Cement Concrete
SC	=	Sand Cement

D. MISCELLANEOUS :

ADC (General)	=	Additional Deputy Commissioner
AE	=	Assistant Engineer
CE	=	Chief Engineer
CSD	=	Central Storage Depot
DC	=	Deputy Commissioner
FFW	=	Food for Works Programme
HES	=	Household Expenditure Survey
HQ	=	Headquarters

NE	=	North East (Zone / Zonal Office)
NW	=	North West
SAE	=	Sub Assistant Engineer
SIP	=	Slum Improvement Programme
SMA	=	Statistical Metropolitan Area
SW	=	South West (Zone / Zonal Office)
TA	=	Technical Assistance
XEN	=	Executive Engineer
18 DTP	=	18 Towns Water Supply and Sanitation Project under Dutch Assistance (with DPHE)

Executive Summary

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION

TA NO 1396 - BAN

FINAL REPORT

EXECUTIVE SUMMARY

INTRODUCTION

After the Independence of Bangladesh in the mid 70s, a number of plans were prepared for the flood protection of secondary towns throughout the country. However, funding constraints and other priorities of a higher profile meant that these works were not implemented. The widespread damage resulting from the exceptionally large floods in 1987 and 1988 once again focused attention on the need to protect heavy investments concentrated in secondary towns. In addition migration from rural areas was causing, and continues to cause, rapid urban growth throughout the country, placing a great strain on the towns' existing resources and creating additional social and environmental problems.

The need for secondary towns to be protected from flooding is one of the twenty six components of the Flood Action Plan prepared in September 1989. The Project has been formulated to identify strategic secondary towns for priority protection and to prepare, for each of the selected Project towns, a plan providing for flood protection and related environmental and social needs.

The Project aims to provide a relatively flood-free and secure living environment in the six selected Project towns of Khulna, Dinajpur, Kurigram, Panchagarh, Habiganj and Moulvi Bazar which have a combined 1991 census population of 0.83 million within the boundaries of existing local government responsibility and 1.16 million if one also includes the metropolitan area of Khulna. The Project also aims to improve environmental conditions therein for the promotion of sustainable long term development.

The Project has four Parts: Part A (Flood Protection Works) covers augmentation of embankments/flood walls, regulator structures and river bank protection works; Part B (Drainage) includes rehabilitation and cleaning of internal drains, remodelling and provision of new drainage and culverts to minimize internal flooding of low-lying areas; Part C (Environmental Improvements) includes complementary sanitation, solid waste improvement and slum improvements; and Part D (Implementation Assistance) covers incremental administration and consulting services' support.

The 10 month study which commenced on the 19th May 1991 was concerned with the development of Integrated Plans for selected towns for flood protection, bank protection and selected municipal and environmental components. A priority list of six towns was selected during the initial phase by screening a given list of towns. This phase culminated in the Inception Report submitted in July 1991 in which it was concluded that the towns of Khulna, Dinajpur, Kurigram, Panchagarh, Habiganj and Moulvi-Bazar were suitable candidate towns for development to a feasibility study level of Integrated Development Plans. The investment components for this development cover all necessary flood protection and erosion control measures coupled with associated municipal works improvements to the internal drainage, sanitation, solid waste collection and disposal and slum improvement areas.

The Interim Report submitted in November 1991 outlined the findings of the additional investigations carried out, and developed an Integrated Plan for each of the towns. These plans followed in-depth investigations including the undertaking of household surveys in the project towns in order to gather up-to-date statistics on basic socio-economic conditions and to determine the provision of municipal services in each of the towns.

The draft Final Report submitted on 20 February 1992 further refined the proposed works identified in the Interim Report. These works were based on, inter alia, technical, economic, social and environmental assessment of alternative development schemes. The cost estimates for the works were based on "preliminary/outline engineering design" as specified in the terms of reference for the study. The report presented the final Integrated Plans for each of the project towns including the identification of the works deemed necessary for early implementation. From an engineering and safety viewpoint these works are considered of great importance for early design and implementation. They are required to prevent/minimise the risk of serious flooding in the towns and to reinforce and protect existing major assets in the towns.

This Final Report essentially followed the same lines as the draft Final Report, but included additions in response to comments by the Flood Plan Co-ordination Organisation (FPCO) and the Asian Development Bank (ADB). These additions covered, amongst other matters, the updating of the cost estimates to include compensation for resettlement and disruption to the small number of people affected by the works and also various additions to the sections of the report on Institutional Arrangements, Cost Recovery and on the Environmental Impact Assessment.

It should be noted however that the Integrated Plans that have been developed under this project are linked with the wider development plans for the adjacent areas being undertaken by other studies, for example plans under FAP 4 (South-west Area Water Management Study) and the Coastal Rehabilitation Project, both being undertaken with an ADB assistance. Also the Integrated Plans under this project are those of immediate priority and are not necessarily comprehensive, having been based on criteria such as affordability. They are a fast response to the reduction of flood risk and to the need for environmental improvement and should be viewed in the context of an incremental approach to development. As other studies are completed there will be potential for extending the coverage of certain scheme components (eg surface water drainage).

CONDITIONS IN THE PROJECT TOWNS

Socio-Economic Characteristics

The 1991 census population figures were used as the basis of the estimates and have been adjusted to relate to the boundaries of the areas of local government responsibility, which are the appropriate development areas for this project. Khulna city with a 1991 population of 0.55 million within the municipal boundary and 0.88 million within the metropolitan boundary is the largest town, followed by Dinajpur (126,000). Population projections to 1997 were made in order to make estimates of sanitation demand. These were based on an estimated average annual growth rate of 2% (Scenario 1) for all the towns. The concerned authorities have, however, suggested this rate to be on the low side, one factor being that it takes no account of the daily migration of people from metropolitan areas immediately outside the municipal boundaries into the towns. The authorities suggested annual growth rates of 4% in the case of Khulna, and 3 % in the other towns, and the populations were projected on this basis as (Scenario 2).

The six towns under study are similar in that they serve as market and administrative centres for their regions. There is some small and medium scale industrial development but economic activity is predominantly commercial. Khulna is the exception in that it is much larger than the other towns and has important, port-related activities.

Relative incomes in the towns vary tremendously. More than 50% of the residents of Kurigram have household incomes of Tk 2,000 per month or less despite having the largest average family size. This contrasts with Moulvi Bazar, where only 5% of the population are in the lowest income classification and almost 50% are in receipt of Tk.10,000 or more per month. Moulvi Bazar's relative wealth is largely due to remittance income from abroad. Khulna, Habiganj, Dinajpur and Panchagarh fall between these extremes.

Flood Protection

The municipal/pourashava areas, both urban as well as the rural portions, are generally subject to a high or moderate risk of flooding from the adjacent rivers. However, the original urban centres of most of the project towns have been established on relatively high land adjacent to rivers for reasons of flood protection and ease of communication by water. Except for Moulvi-Bazar and Habiganj, which have embankments on both banks of the rivers and are at risk from high flood levels, the other town areas are relatively free from the risk of deep flooding. However these project towns including Khulna, which is adjacent to the major tidal Rupsa and Bhairab rivers, do suffer additional inundation from rainfall due to their limited drainage systems, particularly at the restricted river outlets.

With the increase of population in the urban areas and the upgrading of some of the sub-division towns to the status of district towns, the new urban areas (pourashavas) of the project towns are expanding on the alluvial terrace fringes. These extended municipal (pourashava) areas include low-lying areas, depressions, old river channels and active khals which have a direct connection with river. These areas need flood protection.

All six selected protect towns have problems of river bank erosion of varying extent and severity. River bank erosion puts the flood protection embankment at risk of breaching and this is a major factor affecting the reliability of flood protection. In some cases erosion has placed roads, drainage or flood protection infrastructure at risk of serious damage, and in others such damage has already occurred.

Drainage

In all six project towns surface water drainage systems exist to some extent. It is evident from a review of the existing systems that these have evolved in a haphazard fashion following no predetermined plan. In general, in all the towns the existing network drains towards natural khals within the town or to low-lying areas on the periphery of the urban areas. The main problems identified are the inability of the existing drainage systems to drain the urban areas with the result that, particularly during the monsoon season, large urban areas in all the towns suffer periodic flooding. As a result of the flooding, deterioration occurs to the road network and areas of stagnant and polluted water develop for prolonged periods in low-lying areas around the towns. The flooding causes major distress to the population and also affects commercial activities.

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Environmental Facilities

The provision of sanitary facilities is generally the sole responsibility of the householder. Only where public waterborne systems exist in the project towns, such as a small area of Khulna, is the operation and maintenance of the system outside the householder's responsibility. Both the awareness of the general public regarding the need for sanitation and the levels of sanitation facilities vary considerably from town to town. Moulvi-bazar households with 93 percent sanitary facilities and Kurigram with only 20 percent represent the extremes of the range for the six project towns.

Although solid waste collection and disposal is one of the major prescribed responsibilities of the city corporation/pourashavas, in all the project towns there are very limited resources available to undertake these duties.

Within all the project towns localised areas with poor housing and basic infrastructure facilities are evident. As might be expected in the larger towns of Khulna and Dinajpur, where the density of urbanisation is greater, the more classical urban slum areas have developed. In the smaller regional towns slum areas, in the normal sense, do not occur but generally house landless families or migrants from the rural hinterland who come to the town for work. The housing in these areas is of a marginally better quality than housing in the larger towns, but infrastructure facilities are comparable.

Institutional Aspects

At central government level there are thirty ministries in addition to the Presidential Secretariat. The country is divided into 4 divisions, 64 districts, 460 upazilas, 4,400 unions and over 68,000 villages.

Local government in the urban areas is provided by the pourashava, or municipality, with the exception of the four largest urban areas (Dhaka, Chittagong, Khulna and Rajshahi). which are served by city corporations. Municipal organisations play an important part in the system of government in Bangladesh both as key local government bodies for urban areas and as agencies providing a wide range of public services to the urban population. In 1983 the GOB adopted a comprehensive approach of decentralisation of development activities to the upazilas (sub-districts formerly known as thanas), the basic administrative unit in Bangladesh. Today, at a time when decentralisation continues to be emphasised, the institutional capabilities of the pourashavas remain relatively weak. The pourashavas are responsible for local planning, administration and finance, and the operation and maintenance of urban services. However, in practice they lack the resources to undertake such tasks and do not receive adequate support from central government agencies.

The two ministries concerned with flood protection and municipal services are the Ministry of Irrigation, Water Development and Flood Control (MIWDFC) and the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC).

The executing agencies for the programme will be the Bangladesh Water Development Board (BWDB) of MIWDFC and the Local Government Division (LGD) of the MLGRDC. The implementing agencies will be the BWDB (through their NE, NW, and SW Zone offices); the five pourashavas of Kurigram, Habiganj, Panchagarh, Dinajpur and Moulvi Bazar; and Khulna City Corporation under the Khulna Development Authority. The Local Government Engineering Bureau (LGEB) can provide technical support to the pourashavas on request to the LGD, but it is mainly responsible for the rural areas.

The BWDB has a long tradition of involvement in flood protection works. Its strength is in its substantial engineering, organisation and implementation capabilities. Its weakness is its relative lack of emphasis on operation and maintenance, which tend to receive less attention than capital works and suffer from inadequate funding. BWDB maintains an establishment of 18,000 with few vacancies. Staff members, who have a wide variety of skills, can be moved from one office to another as regional work demands.

The LGEB is a central government agency with a rapidly growing workload and is presently working at the full limit of its staff capacity. The LGEB is currently responsible for a programme of 20 - 30 major projects. The LGEB, one of whose major functions is to provide technical assistance to the municipalities/ pourashavas, has a total permanent establishment of 9,800 (2,500 technical) with few vacant posts.

DEVELOPMENT CRITERIA

Component Selection Criteria

The works to be incorporated in the project programme have been developed taking into account factors encompassing technical, social, environmental and economic considerations. In particular the project components have been selected with due regard to need, affordability, technical appropriateness, implementation capabilities, operational suitability and environmental concerns.

The need for each component has been determined with regard to improving deficiencies in both flood protection works and infrastructural facilities in each of the project towns. The components must be affordable both by the GOB, the municipalities and individual beneficiaries in order to ensure that the project is economically viable. The works defined must be technically appropriate to the problem being solved and also take due regard of environmental factors. In addition, the works need to be capable of rapid implementation utilising locally available materials, techniques and equipment wherever possible, to ensure that costs are minimised. The components included in the project have all be identified as being necessary, affordable and suitable for immediate implementation.

It should be noted, however, that the Integrated Plans that have been drawn up under this project are linked with the wider development plans for the adjacent areas being undertaken by other studies, including the FAP studies, and therefore any design criteria should be compatible. As other studies are completed there will be potential for extending the coverage of certain scheme components incrementally (eg surface water drainage), using consistent design criteria.

Design Criteria and Standards

All works selected for inclusion in the project have been identified on the basis of needs of the urban population for both protection from flooding and improvement to the environment. The flood protection works, drainage and environmental improvements (ie, sanitation, solid waste and the slum/squatter area improvement programmes) will complement each other, providing a healthier and safer environment for the residents of each town. The design criteria suggested are fully detailed in Appendix B "Basis of the Integrated Plans." These criteria are consistent with BWDB and LGEB current

practice and are considered to be technically appropriate as the basis for designs under this study. During the coordination process with other studies full attention has been given to the need for engineering and hydrological standards under this study to be compatible with those for works of similar nature within the other FAP studies.

The principle criteria utilised in the development of appropriate design standards have been based on economy of construction, durability and ease of maintenance. In particular, for the flood and bank protection measures, use of locally available materials such as boulders, cement concrete (cc) blocks, bamboo piles etc, has been specified wherever feasible, in preference to imported materials, whether from outside the regional locality of the town or from abroad. Similarly, for construction of the latrines in the sanitation sector, the use of locally available bricks for construction of the surrounds for the pit is preferred to the use of precast concrete rings, unless economics of scale can produce savings in the overall context of the town programme.

Based on the above premises, advice and assistance from the local offices of the BWDB have been used in the development of the proposed works for the flood and bank protection. The nature of works to be constructed, coupled with the materials used in the construction, should thus be well known to both the Contractor and the local BWDB, who will be required to maintain the works after completion of the project programme. With regard to the municipal programme a similar approach is required and in this context LGEB standards designs for infrastructural improvement works should be used. These designs have been formulated, developed and implemented throughout Bangladesh and have a proven record of providing a satisfactory level of service at a reasonable cost. In addition the LGEB designs promote the maximum use of local materials, technology and resources and are familiar to the municipal agencies, contractors and the public.

Basis of Cost Estimates

Cost estimates for the flood and bank protection works have been based on local rates, determined following discussions and reviews of preparatory designs for similar works produced by the local office of the BWDB. This has led, in certain instances, to variations in rates for similar work-items from town to town but reflects the local availability of labour or materials and the consequent increase/decrease in the cost of the works. Where land acquisition is required, specific reference has been made to the local BWDB office, in order to define an accurate cost per hectare and reflect the prevailing conditions in this area.

Similarly, for the municipal engineering elements of the work programme, unit costs for the various proposed works have been developed, using cost information from various sources. Details are outlined below.

- Unit rates produced by LGEB for the year 1990/91.
- Costs utilised in the Secondary Towns Infrastructure and Services Development Project, June 1990.
- Costs utilised in the Dhaka Integrated Flood Protection Project, (FAP 8B), August 1991.
- Costing information provided by the local municipal officers of the various towns.

Unit costs were initially developed at a mid 1991 base and later adjusted to January 1992.

The total project costs derived in the cost estimates include all costs relating to land acquisition, civil works, operation and maintenance, provision of material and equipment, detailed engineering design and tender documentation, and training. Physical and price contingencies were added to these costs as an integral part of the financial and economic evaluations.

In determining the total base costs, various factors were added to the individual works' costs, the details of which are presented below.

Operation and maintenance costs for civil works:

- For flood protection and bank protection works - 2% for earthworks element and 1% for all other elements
- For surface water drainage works - 1.25% of the civil works' cost.
- For sanitation civil works elements (but not including latrines, the O and M of which would be the responsibility of the beneficiary) and solid waste civil works elements - 5% of the civil works cost.

Design and Tender documentation of flood and bank protection works and surface water drainage works - 5% of the civil works cost.

Physical Contingencies

- For design and tender documentation costs - 15%.
- For all other elements - 10%.

Feasibility Study

In the first two phases of the design development (at Inception and Interim Report stages) study reviews, data collection and preliminary proposals for all aspects of the integrated plans were made.

The main purpose of the feasibility study was to define the scope of the project adequately, in order that the benefits to be expected can be considered fully and quantified, and estimates costed with a reasonable degree of accuracy. Major decisions on project development are normally made following the study of the feasibility designs and report.

The "preliminary/outline" designs required for the feasibility study, for each component of the integrated plans, have been based on design criteria which generally conform to the existing design standards of the BWDB and the LGEB. For example, suggested design criteria for the flood protection embankments have been based on guidance provided from a number of recent reports including the BWDB "National Flood Protection Programme for 85 Towns" dated 1988. The LGEB and BWDB have similar design standards for drainage in comparable situations.

Similarly, for the municipal works, the standards adopted for the "Secondary Towns Infrastructure and Services Development Project" issued in June 1990, and the "UNICEF funded Slum Improvement Project" have been used.

In order to define the scope of the propqsed works to be included in the programme, comprehensive field surveys were made in each of the selected towns to determine the existing conditions in those towns.

Comprehensive socio-economic surveys were also carried out in each of the project towns to obtain up to date information on income, household size, sanitation facilities and solid waste disposal methods and techniques. Existing public health situation bench mark surveys and a resettlement/disruption survey were undertaken in Khulna as part of the Environmental Impact Assessment.

Strategic Drainage Disposal in Khulna

In the case of Khulna, detailed consideration was given in the feasibility study to the wider issue of strategic drainage disposal, primarily because the town is considerably larger (both in area and population) than the other five towns, but also because the main receiving river is tidal. The magnitude of the problem was thus determined and the technically appropriate design standards and strategy confirmed. It should be noted that this preliminary work on the "strategic drainage disposal for Khulna" was undertaken in order to support the design work on the improvement of the existing drainage system within Khulna municipality itself. In no way is this preliminary work intended to prejudice the studies presently being undertaken by the Khulna Coastal Embankment Rehabilitation Project.

Coordination with Other FAP Studies

The regional studies which are being undertaken in the FAP programme have been consulted in relation to basic design criteria for flood protection and river training works in the areas of the country concerned. FAP 1 study have provided water level data for the Brahmaputra in relation to studies on the Dharla River at Kurigram by FAP 2. FAP 6 have been consulted in the studies for Moulvi-Bazar and Habiganj.

During the detailed design phase FAP4 will provide data on the Bhairab River and other rivers in connection with both the drainage of Khulna and also the design of river bank protection works.

At the meeting on the 3rd October 1991, the timing and the method of incorporating the results from these regional studies, (FAP 2, 4 and 6), into this study were discussed. It was agreed that, where the results were available in time, they would be incorporated into the feasibility designs of this study; otherwise the results, particularly with respect to flood levels, would be incorporated later at the detailed design stage. In addition, close coordination was maintained with relevant supporting studies, including FAP 15 (Land Acquisition and Resettlement), FAP 16 (Environmental) and FAP 25 (Flood Modelling/Management).

The effect of embankments, which may be proposed later in the regional studies in relation to compartmentalisation, will eventually be fully incorporated into the design of flood protection and drainage works proposed in the present study.

However, despite the shortcomings in the timely availability of certain river stage and flow information to the present study, it is not anticipated that future data from the above FAP studies will have any major impact on the present designs used for the feasibility study. The present designs have been developed cautiously taking full consideration of the existing hydrological data summarised in a major Appendix A and based on sound practical knowledge of the sites' past and present flood history.

THE INTEGRATED PLANS

The Project Components

General

The Government of Bangladesh has in their current (Fourth) Five-Year Plan adopted a policy supporting an integrated approach to urban development, together with greater reliance on community, NGO and formal private sector participation.

With this in mind, the proposed plans include as the project components a mixture of urgent flood protection, river erosion rehabilitation and drainage works, and also the provision of environmental improvement facilities in the areas of sanitation, solid waste collection and disposal and slum area improvement. These works will complement each other to provide an improved and safer environment for the residents of each town. Details of the reasoning behind each of the elements incorporated in the proposals is presented below and more specific details of the location of the works on a town-by-town basis are set out in Section 4 of the Main Report. The Integrated Plans themselves are set out in the drawings in Volume 2A. It should be noted that these components have not been development in isolation but have been built up on the experience of earlier work supported by the ADB, notably on the Secondary Towns Infrastructure and Services Development Project (ADB Loan 1059-BAN) approved December 1990, and the Dhaka Integrated Flood Protection Project (ADB Loan 1124-BAN) approved November 1991.

Flood Protection Works

The works proposed in the towns are those that are considered urgent to maintain the existing levels of service according to the criteria adopted by the BWDB. The works are required in order to strengthen and reinforce the existing protection works and to provide increased protection from flood risk for the residents of the towns. The crest levels chosen for strengthening of the existing town flood protection embankments and for new construction of "retired" embankments (between existing embankments) will generally correspond to a 100 year return period with a freeboard of 0.9 meters. This is for example the case for the north-western towns of Dinajpur, Kurigram and Panchagarh. However this is not the case on the rivers Khowai and Manu which are fully confined through the north-eastern towns of Habiganj and Moulvi Bazar by embankments. These embankments serve to protect both the towns and the adjacent rural areas, but in the latter case a lower design standard of 50 year return period is normally applied.

The bank protection works are necessary to protect areas in the existing flood defences which are being eroded. The works are necessary to both protect the existing investments and where applicable, prevent potentially catastrophic failure of the town defences. Revetment works above low water level are generally formed from boulders/concrete blocks or brick mattressing laid on a khoa filter. Some filters are now being formed with geotextiles though maximum use is being made of local filter materials. Below low water level, traditional launching (falling) aprons of boulders and cement concrete blocks are used to support and protect the upper revetment slopes.

Drainage Works

Drainage improvement works are required in order to create an integrated drainage network and to eliminate or reduce drainage congestion in the towns. Poor drainage is a serious health hazard and contributes substantially to road deterioration and attendant high maintenance costs. The component has been integrated with the flood protection component in order maximise the affect of, and permanently protect, these improved drainage facilities. Because of funding constraints this component was reduced in coverage from that originally envisaged eliminating, for example, several peri-urban areas with a lower population density. Also because of the high contribution to the project costs, alternative arrangements to expensive pumping facilities were adopted in Khulna. These cheaper methods, involving the provision of larger regulators and truncation of the existing drainage system, will not totally eliminate the drainage problems but should improve the situation.

The scope of the work includes the rehabilitation and cleaning of all drains, the remodelling and provision of new (primary and secondary) main drains and tertiary drains. These drains will all be either pucca or kutcha standard of the types used traditionally in large towns in Bangladesh including Khulna. Cover slabs will be provided over pucca drains of the whole range of sizes to provide personal and vehicular access as required. This may be more continuous cover in certain constricted areas where the full roadway width has to be maintained.

Environmental Improvement Works

The environmental improvement programme relates primarily to areas selected for drainage improvement and comprises sanitation, solid waste management and slum area improvement components.

The provision of low cost sanitation services in the towns is necessary in order to provide an improved and healthier environment for the residents of the town. The provision of sanitary facilities will significantly reduce the risk of outbreaks of water related diseases with the attendant benefits to the residents of the town savings for the health authorities. The original aim was the provision of these facilities to the level of the Government target of 90% in each town but this has been tempered by the financial constraints limiting coverage only to the areas selected for drainage improvements. The affordability criteria which were introduced at a late stage may also reduce take-up of the pit latrines. Other facilities to be provided include public

IMPLEMENTATION ARRANGEMENTS

Institutional Arrangements

The institutional proposals (Scenarios 1 and 2) presented in Section 5 are based on the principal of building on existing systems, and strengthening where necessary, rather than introducing new organisations and ways of doing things. They have adopted the principles embodied in the Secondary Towns Infrastructure and Services Development Project (ADB Loan 1059-BAN), approved December 1990, and the Dhaka Integrated Flood Protection Project (ADB Loan 1124-BAN), November 1991. Both have received wide support from central and local government and the ADB.

Scenario 1 was originally developed during the Inception and draft Final Report phases. It was proposed that the project be implemented under the Ministry of Irrigation, Water Development and Flood Control (MIWDFC), through the Bangladesh Water Development Board (BWDB). Support on the municipal aspects will be provided by the Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC).

Overall coordination, monitoring and supervision would be provided by the MIWDFC through the FPCO, under procedures which have been standardized for all FAP projects. The existing Steering Committee that has provided policy guidance during project formulation would continue to oversee detailed design and implementation. The implementation agencies would be the BWDB and the LGD. A Project Management Unit (PMU) headed by a Project Director at the Senior Superintending Engineer/Chief Engineer level was proposed.

Following the presentation of the draft Final Report a modified version of the original Institutional Arrangement (Scenario 1) was suggested. This was presented to the GOB by the ADB in their Aide Memoire dated 29 February 1992. This is the Scenario eventually agreed with the consultant and adopted. It is fully described in Section 5 of the Main Report.

With this proposed arrangement there is a PMO (Project Management Office) under the charge of a BWDB Project Director (Superintending Engineer). Linked with this will be a PMU (Project Management Unit under the existing LGEB Director for the Secondary Towns Project (loan 1059-BAN). The intended functions and responsibilities of the involved agencies are set out fully in Section 4. However the function of the Steering Committee is amongst other matters to provide guidance on policies regarding the overall implementation of the Secondary Towns Integrated Flood Protection Project in the Project towns, including interlinkages with FAP activities. They would also expedite project implementation through timely action on problems and issues requiring resolution at interministerial level.

Also the Bangladesh Water Development Board (BWDB) would amongst other matters undertake the overall technical supervision and execution of the project including tendering, award and supervision of contracts, payment to contractors, supervision and quality control of construction works under the Part A components (Flood Protection Works). They would also undertake the O&M, PBME and reporting activities regarding Part A components and would supervise and support the work of PMO, including coordination with other implementing and supporting agencies and interaction with the Bank Missions.

Likewise the Local Government Engineering Bureau (LGEB) and their town PIU's would undertake the overall technical supervision and execution of the Project including tendering, award and supervision of contracts, payment to contractors, supervision and quality control of construction works under components Part B (Drainage) and Part C (Environmental Improvements). They would also undertake the O&M, PBME and reporting activities regarding Part B and C components and would supervise and support work of PMU including coordination with other implementing and supporting agencies and interaction with the Bank Missions.

Staffing

The availability of properly qualified staff in the right numbers will be one of the key factors in the success or otherwise of the programme. Recruitment of staff, particularly to the pourashavas, is a priority task. It is proposed that consultants are used to provide project management support to the PMU, BWDB Zonal Offices and the PIUs. Full details of these matters are given in Section 5.

Project Implementation Programme

An implementation programme for the project is included in Section 5 which anticipates that the works would be completed over a 5 year period commencing in late 1992. This programme is presented overleaf. Some construction of "early implementation" (priority) flood protection works could commence in the 1992/93 construction season if designs for these can be completed by the end of 1992. Most major construction works however would not commence until the 1993/1994 construction season. The flood protection and erosion works are mainly programmed to be constructed over the first 3 to 3.5 year period.

Contract Procedures

At the commencement of the Project, consultants would be recruited to complete the detailed designs and prepare tender documents for the whole of the proposed works. It may be necessary to revise certain elements of the designs as the construction programme proceeds, such that some minor additional design work in the second year of the project may be required.

Procurement of major items of equipment, such as the solid waste collection vehicles would follow either International Competitive Bidding (ICB) or International Shopping (IS) procedures, depending on the contract size. Procurement of minor items of equipment, such as shovels for cleaning drainage channels etc. would be by Local Competitive Bidding (LCB).

For any supply contract estimated to exceed $500,000 and for all civil works contracts exceeding $1,000,000 the Implementing Agency will need to submit to the ADB for prior approval both the draft tender document, before issue, and the evaluation report and recommendation for award before any successful bidder is notified.

latrines and septic tanks.

Improvements to the solid waste collection and disposal services in the towns are required to both reduce the instance of indiscriminate disposal of solid waste and to provide an improved environment in the towns. The disposal of waste in watercourses and drainage ditches, which is common practice in a majority of the towns, will be reduced together with the attendant reduction in necessary clearing and maintenance costs. The project targets for solid waste collection and disposal have been set such that at the end of the 5 year project period the city corporation/ pourashavas will be able to provide a service that can effectively collect and dispose of 50% of the household-generated wastes and 70% of other wastes generated in the towns. This will provide an intermediate standard of service in the towns, the long term goal for each town being provision of a service that can collect and dispose of upwards of 80% of household-generated waste and 100% of all other wastes. The facilities will include the rehabilitation of existing and the provision of new bins. There will also be provision of hand push carts, material collection vehicles and land acquisition for sanitary landfills.

Slum improvement works are required to improve the living conditions of the poorer sections of the community, who have insufficient finance to improve their own situations. The improvement to the infrastructural facilities will greatly enhance the environment with attendant benefits to health and welfare. The slum improvement components have been modelled on the very successful UNICEF Slum Improvement Project. Modest infrastructural improvements such as improved water supply, sanitation, footpath access, security lighting, drainage facilities and solid waste collection are covered under this component to benefit over 8,500 households. In addition, as with the UNICEF programme, support will be provided in the way of training, salaries and incentives for community workers and community health workers. Household income generation loans are also proposed.

Institutional support of the city corporation/pourashavas is required to strengthen their capability to implement, maintain and operate the infrastructure facilities and their future extensions, and to better manage municipal finances. Support is also required for the local BWDB divisions, in order to assist the divisions in the implementation and the future maintenance of the flood protection and bank erosion works. It is envisaged that this element of the project will comprise training, the provision of various equipment such as vehicles, surveying equipment, office equipment, small plant and tools for maintenance purposes etc., as well as assistance in the development of O and M systems. In order to promote public health education and environmental factors, provision of finance is proposed for the funding of education programmes in each of the project towns.

Training and logistics support by way of the provision of 4WD Jeeps, motorcycles, and other equipment is required to enable the BWDB and city corporation/pourashavas to effectively implement, manage and maintain the infrastructure services, as well as develop methods of improved financial control and resource generation.

The Integrated Plans

The components have been formulated following extensive site visits to each of the towns, discussions with the BWDB officers and the city corporation/ pourashava officials and use of the results of detailed household surveys to gain information on income, sanitation operating facilities and solid waste disposal methods in all the towns.

The project components have been identified on the basis of both technical, economic, social and environmental considerations. Factors such as need, feasibility, and applicability have been included in the selection process. The components have also been determined in order to fit in with the longer term planning process. The project components have been grouped under the following headings:

i) Part A: Flood Protection Works
ii) Part B: Drainage Works
iii) Part C: Environmental Improvement Works
iv) Part D: Project Implementation Assistance

It must be emphasized again that the Integrated Plans developed under this project are linked with the wider development plans for adjacent areas being undertaken by other studies. For example plans are being prepared under FAP 4 (South-west Area Water Management Study) and the Coastal Rehabilitation Project, both being undertaken with an ADB assistance. Also the Integrated Plans under this project are those of immediate priority and are not necessarily comprehensive, having been based on criteria such as affordability. They are a fast response to the reduction of flood risk and to the need for environmental improvement and should be viewed in the context of an incremental approach to development. As other studies are completed there will be potential for extending the coverage of certain scheme components (eg surface water drainage).

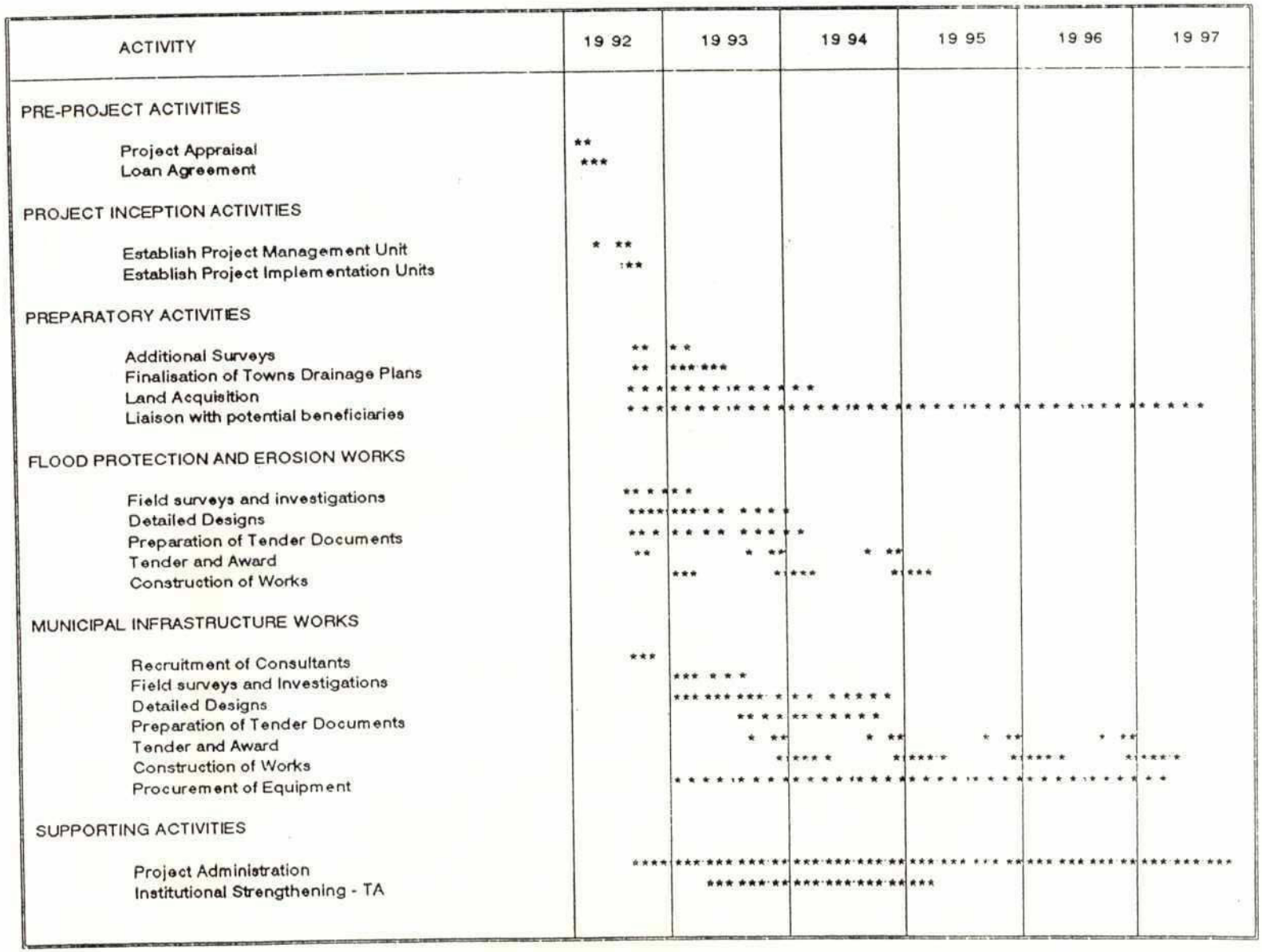
The individual components of the Integrated Plans are fully identified by town in Section 4 of the Report. Cost estimates for the proposed works are presented in Section 6. Project benefits and affordability factors are addressed in Section 7 and environmental aspects in Section 8. The basic design strategy underlying each of the components together with specific references to the individual features of the project are presented in Appendix B.

Early Implementation Components of Integrated Plans

Looked at from an engineering and safety viewpoint, the project components for early implementation will largely be the urgent flood protection and river erosion rehabilitation works. Main drainage outlets through the flood protection embankments should also be constructed at the same time. These works require immediate attention as they are necessary not only for protecting both the lives and properties of the population but also the investment in the existing infrastructure of the towns.

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

PROJECT IMPLEMENTATION PROGRAMME



Operation and Maintenance

Operation and maintenance of the flood protection and river bank erosion works are the responsibility of the BWDB, whereas municipal engineering works in the fields of drainage, public latrine facilities and solid waste collection and disposal are the responsibility of the pourashava or city corporation. The maintenance of private sanitation facilities is the responsibility of the beneficiaries.

It is evident that, due to financial constraints, both the BWDB and the pourashavas/city corporation have difficulty in maintaining works from their existing resources. This is particularly true in the case of the municipalities, where maintenance is only undertaken on works that are in a very serious condition and that the cost can be accommodated within the available budget allocations. The operation and maintenance capabilities of the local governments will need to be improved to effectively manage the municipal works after completion of the project. It is proposed that the costs associated with the operation and maintenance of equipment, such as the expanded solid waste collection service transport, will be catered for during the project period.

Technical assistance by way of training programmes for the pourashava and city corporation staff, will also be required to assist in the development of their operations and maintenance capabilities. In addition, in order to assist the strengthening of the local administrative capabilities for providing improved services, as institutional strengthening TA is proposed. Under the proposed TA, the municipalities will be provided with assistance in meeting the needs for developing their institutional capabilities to implement, manage and maintain the infrastructure services, as well as in the development of methods for improving their financial control and resource generation.

COSTS AND FINANCING PLAN

Project Costs

The total costs of the project components identified in Section 4 have been estimated at Taka 2,718.8 million (US$ 70.1 million) of which some Taka 763.1 million (US$ 19.7 million) represents the foreign exchange both direct and indirect. Full details of these costs are given in Tables in Section 6 and in Appendix F "Finance and Economics". A "Summary Table of Project Investment by Town and by "Sector" (Component) is presented overleaf.

In addition a Technical Assistance project has been proposed for training and strengthening of local government capabilities at a cost of $1.08 million to be funded through grant financing. Terms of Reference and cost estimates are shown in Appendix G.

The costs are expressed in January 1992 prices and include taxes and duties estimated at Tk 389.2 million ($10.0 million). Physical contingencies of 10% have been included for all costs apart from consultancy services (15%) and an allowance of 5% has been made for design of civil works. Detailed estimates have been made of administration costs for the sanitation and slum improvements and the operation and maintenance costs of all components.

SUMMARY OF PROJECT INVESTMENT BY TOWN AND BY SECTOR (Taka Million)

COST ITEM	Khulna	Dinajpur	Kurigram	Pancha-garh	Habiganj	Moulvi Bazar	PMU Dhaka	Sector Total	Sector % Total
A. Flood Protection Works									
Flood Protection	46.14	51.74	6.61	12.62	16.81	52.09		186.01	6.8%
Bank Protection	305.39	137.13	114.81	60.52	70.48	66.53		754.86	27.8%
B. Drainage	601.51	57.55	43.07	21.39	38.74	19.70		781.96	28.8%
C. Environmental Improvements									
Solid Waste Management	30.84	7.12	4.23	3.11	3.59	3.63		52.51	1.9%
Sanitation	95.54	25.40	12.88	3.98	6.20	0.73		144.72	5.3%
Slum Upgrading	32.54	22.17	0.00	2.00	1.77	1.56		60.04	2.2%
D. Implementation									
PIU Support	14.62	10.56	7.60	7.74	8.29	5.24		54.04	2.0%
Consulting Services	45.20	11.54	7.94	4.47	6.00	6.15	35.32	116.62	4.3%
PMU Support (Dhaka)							17.55	17.55	0.6%
Total Base Costs	1,171.77	323.20	197.13	115.82	151.89	155.64	52.87	2,168.31	79.8%
Physical Contingencies	119.49	32.91	20.12	11.81	15.50	15.87	7.01	222.71	8.2%
Price Contingencies	162.66	31.48	17.69	10.94	14.77	13.88	5.38	256.80	9.4%
Service Charge on Loan								70.96	2.6%
TOTAL COST	1,453.92	387.59	234.94	138.57	182.15	185.38	65.26	2,718.78	100.0%
Town as Percent Total Cost	53.5%	14.3%	8.6%	5.1%	6.7%	6.8%	5.0%	100.0%	

Price contingencies have been calculated using escalation factors of 3.7% per annum for foreign costs and 6% for local costs.

Of a total cost of Tk 2,647.8 million ($ 68.2 million) excluding finance charges, 65.% is for flood protection works (flood protection, bank protection and surface water drainage), 9.8% for environmental improvements and 7.1% for institutional improvements and implementation expenses.

Service charge during construction, in the form of a one per cent annual service charge on the Bank Loan is estimated to be $1.8 million (Tk 71.0 million)

The "early implementation" (priority) works are outlined in Section 4 and form an intrinsic part of the overall project costs.

Proposed Financing Plan

The Bank loan is expected to cover all local and foreign costs apart from land acquisition, taxes and duties, and 50% of the incremental staff and operation and maintenance costs on a declining basis, for a total of $55.1 million as shown in Table 6.6 in Section 6 of the Main Report.

Under the proposed financing plan funds for the project would be reflected in executing Agency's Annual Development Programme (ADP) allocations. The GOB would be responsible for payment of the loan and would bear the foreign exchange risk. Part of the loan proceeds would be onlent to the pourashavas for investment in low cost sanitation (50% of the costs) to be fully cost recovered. Investments in sanitation and solid waste management in Khulna would be partly loan financed.

Note that the actual ADB Financial Plan set out in their Aide Memoire to the GOB dated the 25th April 1992 is included in Appendix F.

Cost Recovery

Although some towns are in a stronger financial position than others, none can afford the proposed municipal improvements due to the limited efficiency of their current methods of revenue generation. As in other recent projects, Central Government grants are expected to fund the capital costs of urgently needed flood protection and town protection works, drainage, solid waste disposal, slum improvements, public sanitation and incremental operation, maintenance and administrative costs associated with implementation.

Cost recovery, however, both direct and indirect, is one of the most important features of the project. In order to achieve this, the proposed Institutional and Financial Action Plan (described in Section 6 and shown in detail in Appendix D) will have a long term impact on the local authorities' ability to provide infrastructure and services to their growing populations, and will lessen the dependency on central governments grants.

PROJECT JUSTIFICATION

General

When implemented the project will bring significant benefits to the populations of the study towns and will have indirect benefits for the large catchment areas they serve. The institutional strengthening measures will provide long term improvements in service delivery for the whole community through more efficient use of financial, human and physical resources.

Financial justification for the project as a whole lies largely in improvement of the local government's ability to provide municipal services and, through enhanced land values resulting from capital improvements, to raise sufficient revenues to fund their operation and maintenance and some further development.

Where possible the approach has followed the "FAP Guidelines for Project Assessment" produced by the Flood Plan Coordination Organisation in July, 1991. Modifications have generally been made where rural applications, as proposed in the Guidelines, were not appropriate to an urban setting or to municipal works.

The project components are closely interlinked. A large percentage of the population interviewed in the household surveys indicated that, in the absence of a municipal solid waste service, they disposed of household and market waste in drains and ditches, thus aggravating already severe drainage problems. Similarly, earlier flood protection works have in some cases blocked drainage outlets. Improvements to flood protection and solid waste management will benefit the drainage system and should decrease the maintenance required. Further to this, improvements to drainage and flood protection will decrease road maintenance costs.

The methodology used for each type of evaluation and the results are fully described in Section 7 and the detailed calculations by town are found in Appendix F.

Economic Evaluations

The primary benefit of flood protection works is the minimisation of risk of flood damage or erosion to property and infrastructure, although there are lesser benefits in some cases to livestock and agriculture. There are also health and environmental problems associated with standing flood waters. All the towns show evidence of danger to commercial, industrial and/or residential areas from erosion or embankment failure. Benefits of drainage works come from reduced road maintenance costs, improved health and reduction in rain water flooding.

All of the towns reported significant problems with drainage-related flooding which provides breeding grounds for mosquitos, restricts access and limits use of land in some areas. These benefits are represented by enhanced land values. A one time increase of 1% of land values has been assumed to occur in the year after the works are completed. The Economic Internal Rates of Return (EIRR) for integrated flood protection/drainage varied from approximately 46% for Dinajpur to 14% for Kurigram, mainly because of land value increases and flood damage avoided. The results proved quite robust when subjected to sensitivity tests on critical variables.

Benefits of slum upgrading are quite significant, including environmental and health improvements, reduced infant mortality, enhanced property values and improved

worker productivity and earning capacity. The improvement in conditions for low-income households and women is particularly pronounced in slum upgrading as are the opportunities for community participation. The EIRR for slum improvements varied from approximately 12% for Habiganj to 19% for Khulna and Dinajpur.

Present levels of municipal solid waste collection and disposal are poor, covering only parts of the towns and in most instances providing a less than weekly frequency of service. This results in householders disposing of additional waste on open ground and in canals, ditches and drains. Betterment of municipal solid waste management would enrich the urban environment for the whole town as well as having more specific benefits to those securing new or improved services. Indirect benefits include improvements to the drainage system through fewer blockages and thus decreased maintenance costs and flooding from surface water. Financial Rates of Return for solid waste collection and disposal varied from approximately 13% for Kurigram to 26% at Moulvi-bazar

Benefits of sanitation works will directly affect those households participating in the programme and indirectly improve urban conditions for the town by helping to reduce the use of drainage channels for other purposes and reducing the risk of disease. The importance of this is recognised in the major Government of Bangladesh objective of achieving a level of 90% of households with sanitary facilities by the year 2000. Alternative low-cost solutions have been proposed which should be affordable to the lowest 20th percentile group of the income distribution in most of the towns, thus anticipating full cost recovery with a rolling fund created to serve future population needs. Public toilets are planned for areas such as markets and thus would serve the rural population as well. Financial analysis produced Financial Rates of Return for sanitation around 20% in all towns

Affordability

Although some towns are in a stronger financial position than others, none would be able to fund the proposed municipal improvements from its own revenues. As in other recent projects, Central Government grants are expected to fund the capital costs of flood protection and town protection works, drainage, solid waste disposal, slum improvements, public sanitation and incremental operation, maintenance and administrative costs associated with implementation. A full discussion of this matter is to be found in Section 7.

ENVIRONMENTAL IMPACT ASSESSMENT

Introduction

The Environmental Impact Assessment (EIA) of the Project was prepared as an integral part of the feasibility study and is presented in Section 8. The Project will result in significant beneficial environmental impacts by way of the environmental improvements which are an intrinsic part of the planned development, and no significant adverse impacts are foreseen. Its impact will be largely positive with a low degree of negative impacts. The EIA has been carried out to comply with the Asian Development Bank (ADB), Categorisation of Projects based on Potential for Environmental Impacts. The project has been classified as category `B' (projects likely to have significant adverse environmental impacts, but for which mitigative measures may be readily prescribed).

The EIA has followed the general format of the ADB Summary EIA report. The EIA also follows the accepted practices of Environmental Impact Assessment which are incorporated in the Draft Guidelines prepared under FAP16 taking account of the nature and categorisation of the project as well as the time constraints.

The project designs, as reported in the Interim Report, have been used as the basis for this Environmental Impact Assessment. The possible impacts of these designs have been considered and, where these are considered negative, mitigating measures have been developed. The project design, as set out in this report, has been modified to incorporate these mitigating measures, and the impact of the final project proposals has been further environmentally assessed.

In connection with the environmental issues, although water supplies as a component are not specifically part of the project, they nevertheless form an important part of any Integrated Plan. In general, the towns have well-established water supplies but where there are deficiencies, steps are being taken by the authorities to remedy the situation.

During construction there will be a need to temporarily resettle some families and businesses in the commercial areas of Khulna and Moulvi-Bazar. Apart from Khulna, minimal permanent resettlement is anticipated in any of the other towns. Compensation for permanent resettlement and for temporary resettlement/disruption have been included in the cost estimates.

Cost/Benefits

The overall cost/benefit analysis for the project is given in Section 7, to which reference should be made. In this report, the mitigating measures suggested by the Environment Impact Assessment have been incorporated into the project design, and thus the overall project cost/benefits reflect the cost effectiveness of these measures.

Conclusions

The project as now proposed will be environmentally sensitive, and provide for a low degree of negative impacts. Such negative impacts as have been identified have led to project modifications and to the presentation of a report that integrates environmental issues with the engineering and development plans.

In environmental terms the overall net gains will be the security of the urban, and in many cases the adjacent agricultural lands, from improved flood protection, improved urban drainage, and a general improvement to the quality of life in the towns by improved solid waste management and slum improvements.

Additional to these overall gains, the project design will provide individual areas with specific benefits. In a wider context a major gain will be in the institutional strengthening and awareness of the pourashavas, and the need for the urban authorities to liaise and cooperate with their rural counterparts in the upazilas if project objectives are to be fully met. This interaction will also allow for a greater exchange of information and an understanding of the needs not merely of town dwellers but also of the agricultural workers living in the environs of the towns.

In summary the EIA evaluated all potential impacts, particularly attention being paid to resettlement, loss or degradation of agriculture, aquaculture and fisheries, and public health.

The project does not involve any major resettlement of the affected people. Neither is the project expected to have any adverse impact on agriculture, on the groundwater table, or on the flora or fauna. As a result of the project, there should be a reduction in the potential risk of bacteriological pollution of the groundwater aquifers.

Unfortunately there is presently no baseline data on the chemical quality of existing drainage discharges from the towns. This will have to be obtained under the project monitoring programme, when sampling and analysis of such discharges will have to be undertaken and measures such as industrial pollution control investigated. Some water pollution and salinity data is however presently being collected by the FAP regional studies, for example by FAP4, which covers the south-west of the country including the Khulna area.

Overall the consultant considers that the various components of this integrated project will produce a significantly improved environment for each of the communities concerned.

Introduction

1. INTRODUCTION

1.1 Project Background

After the independence of Bangladesh in the mid 70s, a number of plans were prepared for the protection of secondary towns throughout the country. However, funding constraints and other priorities of a higher profile meant that these works were not implemented. The widespread damage resulting from the exceptionally large floods in 1987 and 1988 once again focused attention on the need to protect heavy investments concentrated in secondary towns. In addition migration from rural areas was causing, and continues to cause, rapid urban growth throughout the country, placing a great strain on the towns' existing resources and creating additional social and environmental problems.

The need for secondary towns to be protected from flooding is one of the twenty six components of the Flood Action Plan prepared in September 1989. The project has been formulated to identify strategic secondary towns for priority protection and to prepare, for each of the selected towns, a plan providing for flood protection and related environmental and social needs. In addition to flood protection for the secondary towns, works will include erosion control and drainage, improvement of flood-prone slum and squatter areas, solid waste management and sanitation.

The project is consistent with the Government's strategy for urban centres, which is directed towards developing an integrated urban development programme for meeting the need of the pourashavas which form the administrative centres for 60 of the 64 districts in Bangladesh. The priority attached to urban development was emphasised by the high level Pourashava Commission set up by the Government in October 1989 to improve the capabilities of the pourashavas.

To address these needs, the Asian Development Bank (ADB) under TA No 1396-BAN appointed Sir William Halcrow and Partners Ltd. in association with Halcrow Fox and Associates of the UK and Engineering and Planning Consultants Ltd. of Bangladesh, to assist the Government of Bangladesh (GOB) in formulating an integrated flood protection project covering about five selected secondary towns in Bangladesh. The Ministry of Irrigation, Water Development and Flood Control (MIWDFC) is the Executing Agency for the technical assistance with the Local Government Engineering Bureau (LGEB) of the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC), and the Urban Development Directorate (UDD) under the Ministry of Works (MOW) providing additional inputs regarding the municipal aspects of the study.

1.2 Project Objectives

The technical assistance is directed towards assisting the Government of Bangladesh in the identification of strategic secondary towns for priority protection, and for each of the selected towns to produce an integrated plan for flood control, drainage improvement, prevention of soil erosion, solid waste collection and disposal, and slum and squatter area improvement; also to prepare, to feasibility level, details of selected investments for the selected towns.

As described in the Terms of Reference, which are included as Appendix H, the above is to be achieved through the following activities :

(i) review of background information and identification of data gaps.

(ii) selection of the priority Secondary Towns.

(iii) preparation of an Integrated Flood Protection Plan for each of the selected towns.

(iv) assessment of the feasibility of the proposed project and the requirements for institutional support/strengthening.

It is the desire of both the ADB and the GOB to initiate, as early as possible, a programme of works which will provide direct and positive benefit to the urban population of secondary towns in Bangladesh.

1.3 Inception Report

In line with the project objectives described above, the Consultants commenced the study in May 1991 and submitted an Inception report in July 1991. The report described the findings of the first two stages of the project which are set out in Section 1.2 above. In addition, the report identified those areas where further information or direction is required to be provided by the Government and/or the ADB to assist the progress of the study.

The report concluded that the towns of Khulna, Kurigram, Panchagarh, Moulvi-Bazar, Habiganj and Dinajpur should be selected as the priority towns for the preparation of Integrated Plans. The towns were distributed throughout Bangladesh, and form a representative cross-section of size, development levels, growth rates and growth prospects. The selection of these towns was subsequently accepted by both the ADB and the GOB. The locations of these towns are shown in the frontispiece map.

Of the criteria adopted in the selection procedure, the risk of damage to infrastructure was considered to be the most important. Where security against flooding was provided by a flood embankment, the effectiveness and security of that embankment was of critical concern. Although only six towns were selected this did not indicate that the remaining towns were secure from flooding, merely that the flooding potential was considered more serious in the selected towns. In general, for all the original listed 15 towns, the need for improvement of flood protection, surface water drainage, sanitation and solid waste disposal was evident. As a consequence, it is considered that the remaining nine towns on the original list should at some stage merit the preparation of similar Integrated Flood Protection Plans. It would obviously be desirable to include all the remaining towns under one project, however financial constraints may preclude this. Therefore a tentative order of priority for the remaining towns is detailed below. This has been produced following the same selection procedures as described in the Inception report.

Second Priority Towns	Third Priority Towns
Sunamganj	Jamalpur
Rajshani	Manikganj
Bhairab Bazar	Kushtia
Gaibandha	Mymensingh
	Brahmanbaria

It should be noted that both Mymensingh and Kushtia have been included in the Secondary Towns Infrastructure and Services Development Project. This project proposes major improvements to the infrastructural facilities of these towns including roads, drainage, sanitation, solid waste and institutional strengthening.

Munshiganj, which was in the original list of priority towns where flood protection was being considered, is at present being studied in FAP 9B. It is therefore excluded under this study as any investment will be evaluated under FAP 9B. The Consultants for this study submitted their Interim report in October 1991 which includes outline cost estimates of the proposed bank protection works in the town. A short synopsis of their findings is presented in Appendix K.

1.4 Interim Report

The Interim Report, submitted in November 1991, provided a comprehensive overview of the interim findings of the project for each of the selected towns. These findings were based on detailed discussions with both local BWDB and City Corporation/Pourashava officers in each of the towns, and also further site inspections and investigations carried out by the Consultants' staff. The findings also drew on the results of socio-economic surveys carried out in five of the towns, Kurigram, Panchagarh, Moulvi-Bazar, Habiganj and Dinajpur, the survey in Khulna being unavailable at the time of submission of the report.

Preliminary Integrated Plans for each of the towns were included in the report, together with tentative cost estimates for the proposed works.

1.5 Final Report

This Final Report, submitted in draft on the 20th February 1992, presents the Integrated Plans for each of the project towns following additional visits to the towns, discussions with the various interested government bodies and the results of surveys and investigations completed subsequent to the submission of the Interim Report. The report presents financial and economic evaluations for each of the project components on a town-by-town basis. The environmental aspects of the proposed works are also considered, having been discussed with the ADB environmentalists during their February 1992 fact finding mission. Implementation proposals for the various elements of the project are discussed and recommendations are presented regarding institutional strengthening.

It should be noted however that the Integrated Plans that have been developed under this project are linked with the wider development plans for the adjacent areas being undertaken by other studies. For example plans under FAP 4 (South-west Area Water

Management Study) and the Coastal Rehabilitation Project, both being undertaken with an ADB assistance. Also the Integrated Plans under this project are those of immediate priority and are not necessarily comprehensive, having been based on criteria such as affordability. They are a fast response to the reduction of flood risk and to the need for environmental improvement and should be viewed in the context of an incremental approach to development. As other studies are completed there will be potential for extending the coverage of certain scheme components (eg surface water drainage).

Conditions in the Project Towns

2. CONDITIONS IN THE PROJECT TOWNS

2.1 Socio-Economic Characteristics

2.1.1 Population

The rate of natural population increase in Bangladesh in 1985 was estimated to be 2.4%, dropping to 2.16% in 1990 as reported in the Fourth Five Year Plan (FFYP). A further decrease to 1.81% was forecast by 1995. The rate of increase above these levels in urban areas is attributable to in-migration. The recently released Preliminary Report Population Census 1991 found that the average rate of growth nationally over the last decade was 1.88%, when the provisional 1991 figures are compared with the adjusted 1981 census (2.17% compared with unadjusted 1981 results), and that the average household size has dropped from 5.78 to 5.31.

Because the census results were not available at the time population data and projections provided in the Interim Report were based on the master/structure plans prepared between 1985 and 1991 by the Urban Development Directorate of the Ministry of Public Works and by the Khulna Development Authority and by estimates made in each town by the pourashava authorities from numbers of households on the tax rolls and assumptions about average household size.

The census results indicate that these were overestimates largely due to changes in average household size. There have also been boundary changes which make comparison with the 1981 figures difficult and there is some confusion over city corporation and statistical metropolitan areas in Khulna. However, the 1991 census population figures shown in Table 2.1 generally relates to the boundaries of the areas of local government responsibility, which are the appropriate development areas for this project.

TABLE 2.1 POPULATION AND HOUSEHOLDS

Town Areas of Local Government Responsibility	Population 1991 Census	Households 1991 Census	Average Household Size	Population 1997 Projected*	
				Scenario 1	Scenario 2
Khulna	*545,849	139,760	3.9	614,700	670,700
Dinajpur	126,186	24,042	5.2	142,100	150,700
Kurigram	57,320	11,230	5.1	64,500	68,400
Panchagarh	30,124	5,654	5.3	33,900	36,000
Habiganj	37,363	6,364	5.9	42,100	44,600
Moulvi-Bazar	30,807	5,734	5.4	34,700	36,800
Total	827,652	192,784	-	932,000	1,027,200

Source: 1991 Statistical Yearbook of Bangladesh, November 1991, Bangladesh Bureau of Statistics. Projections from Consultants' estimates (see text below).

* 545,849 population in municipal area increasing to 877,000 in metropolitan area.

▸ Scenario 1 assumes projection of 2 % annual growth rate for all towns.
Scenario 2 assumes projection of 4 % annual growth rate for Khulna and 3 % annual growth rate for other towns.

Generally migration to secondary towns is a result of land pressure in rural areas rather than a positive pull by the town, although there is some movement in search of better social facilities and urban services. This is confirmed by the age and sex distributions of the town populations (as shown in the master/structure plans) which show a higher than usual incidence of working-age males in relation to the national population distribution.

Table 2.1 shows the projected population in each town for 1997. Census results for Khulna Statistical Metropolitan Area (SMA) indicate that the average annual growth rate between 1981 and 1991 was 2.5% and for Rajshahi SMA 1.7%. These apply to wider areas than the City Corporation boundaries but give some notion of growth patterns in the urban areas over the past decade. Local government boundaries contain the central, developed areas of the town and are likely to experience a lower rate of growth than the surrounding peri-urban areas.

Population projections to 1997 were made in order to make estimates of sanitation demand over the five year project implementation period and to allow estimates of sanitation coverage to be calculated. For these purposes an average annual growth rate of 2% (Scenario 1) has been used for all towns. The concerned authorities have however suggested this rate to be on the low side, one factor being that it takes no account of the daily migration of people from metropolitan areas immediately outside the municipal boundaries into the towns. The authorities consider that a more realistic annual growth rate would be 4% in the case of Khulna, and 3% in the other towns, and the populations were projected on this basis as (Scenario 2).

2.1.2 Economic Base

The six towns under study are similar in that they serve as market and administrative centres for their regions. There is some small and medium scale industrial development but economic activity is predominantly commercial. Khulna is the exception in that it is much larger than the other towns and has important port-related activities. A brief description of the economic base of each town follows.

Khulna is situated 35 miles from Mongla Port, the country's second largest seaport. Ship repair and jute mills are the dominant industries. Khulna is the southern terminus of the railway system serving the western part of Bangladesh and activities associated with the handling of goods and transport form a large part of the local economy.

Kurigram is primarily a market town serving a catchment population of about 150,000. The only major industry is a textile mill, the balance being small-scale rice mills, metal-working and furniture-making. Storage and warehouse facilities are important for agricultural products.

Habiganj markets serve a population of up to 100,000. The surrounding region is agricultural with about 20% of the area triple- cropped. Rice, wheat, sugar cane and jute are grown. Industrial activities are limited to small-scale rice mills, brick making and sawmills.

Panchagarh is more industrial than the other smaller towns with a sugar mill, distillery and a concrete products factory. Its small-scale rice and sawmills and general market activities serve the surrounding population of about 60,000.

Dinajpur serves a catchment population of about 1 million. There is a BSCIC industrial estate with factories making soap, plastic products, furniture and jewellery and also a sawmills. Cottage industries employ about 1,200 people.

Moulvi-Bazar is a major wholesale market for the region and serves a retail market population of about 100,000. An industrial estate was recently established about 4 km from the town but has not yet been fully developed. There are numerous small-scale and cottage industries such as rice mills, furniture making and metal working.

2.1.3 Household Size and Income

A household survey was made of approximately 2.5% of the population in each pourashava and 1% in Khulna. Questions were asked about household size, multiple occupancy and income as well as type and quality of sanitation and the means of solid waste disposal. Details of the survey results by town are found in Appendix C.

Average household size ranges from 6.7 in Khulna to 9 in Kurigram. Over 70% of households live in single family dwellings in Dinajpur, rising to more than 90% in Panchagarh and Habiganj. Khulna is quite different with only 42% of such dwellings. It should be noted that the average household size in each town as found in the census is lower than the household survey results. It is assumed that this is because the census would have enumerated squatter areas, which are likely to have considerably lower household sizes, whereas the project household survey concentrated on established housing areas. The average household size is important in estimating solid waste requirements, the 1991 census figures being used as the basis for this.

It is notoriously difficult to get accurate income data from householders, either because of cultural reticence or fear of tax officials querying returns. Attempts were made to overcome these problems by phrasing the answers in bands of incomes and ensuring that addresses and responses to supporting questions about source of income were not entered on the forms. Apart from a few households in Moulvi Bazar, all respondents provided income data.

Table 2.2 shows the household income distribution in each town. The cumulative distributions are shown graphically in Figure 2.1.

Household Income Distribution

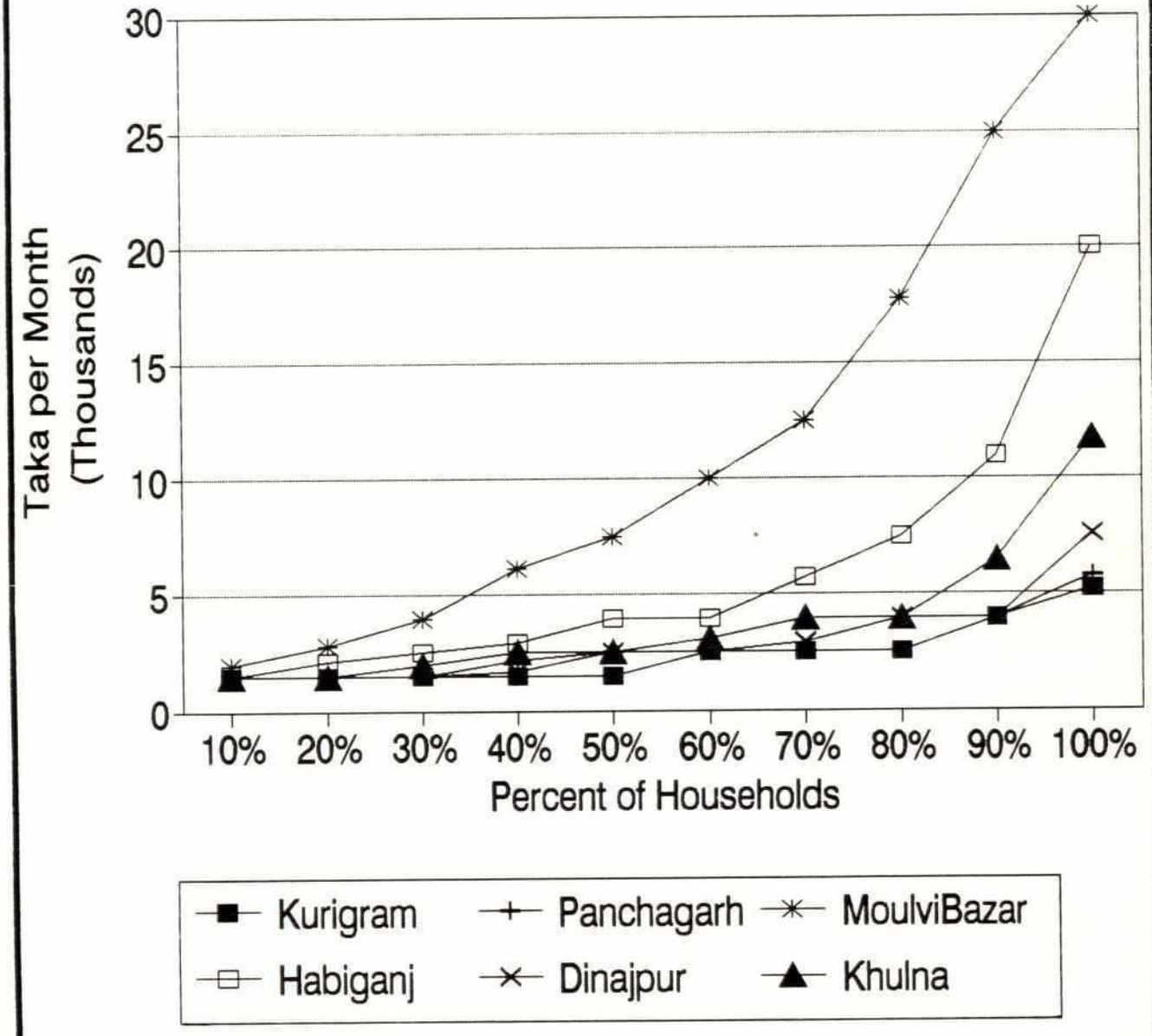


Figure 2.1

TABLE 2.2 HOUSEHOLD INCOME DISTRIBUTION

Taka/Month	Khulna	Dinajpur	Kurigram	Panchagarh	Habiganj	Moulvi Bazar
0 - 2,000	25%	38%	52%	33%	14%	5%
2,001 - 3,000	31%	29%	30%	47%	23%	13%
3,001 - 5,000	27%	27%	16%	17%	28%	15%
5,001 - 10,000	12%	4%	1%	1%	18%	21%
10,000 - 15,000	3%	1%	<1%	1%	8%	15%
15,001 - 20,000	1%	<1%	0%	0%	5%	8%
> 20,000	1%	<1%	0%	0%	4%	21%
Total	100%	100%	100%	100%	100%	99%
Sample	1500	250	150	150	180	500

Source: Consultants' household survey, September - November 1991.
Note: Totals may not add to 100% due to rounding.

Relative incomes in the towns vary tremendously (see Figure 2.2). More than 50% of the residents of Kurigram have household incomes of Tk 2,000 per month or less despite having the largest average family size. This contrasts with Moulvi Bazar, where only 5% of the population are in the lowest income classification and almost 50% are in receipt of Tk 10,000 or more per month. Moulvi Bazar's relative wealth is largely due to remittance income from abroad. Khulna, Habiganj, Dinajpur and Panchagarh fall between these extremes.

The Secondary Towns Infrastructure and Services Development Project estimated that all households earning less than Taka 4,000 per month should be classified as below the poverty line, based on an analysis of the periodic household expenditure surveys (HES) undertaken by the Bangladesh Bureau of Statistics (BBS). The BBS found 56% of the 1986 urban population at or below poverty level based on a food intake level of 2,122 calories/day/person. The Secondary Towns project found that low income families constituted between 30% and 75% of the populations in the ten towns under study in 1990. Applying this measure suggests that there is considerable poverty in the study towns as shown in Table 2.3. It is also likely that inflation since the measure was established has in fact worsened the situation.

TABLE 2.3 RELATIVE POVERTY LEVELS AND PER CAPITA INCOME

	Percent of Households with Income Less than Tk 4,000/month	Per Capita Income
Khulna	69.3%	Tk 586/month
Dinajpur	80.3%	Tk 432/month
Kurigram	90.2%	Tk 262/month
Panchagarh	89.0%	Tk 377/month
Habiganj	50.8%	Tk 869/month
Moulvi Bazar	25.5%	Tk 1450/month

Source: Consultants' household survey.

Relative Poverty Levels

Household Income < Tk 4,000/Month

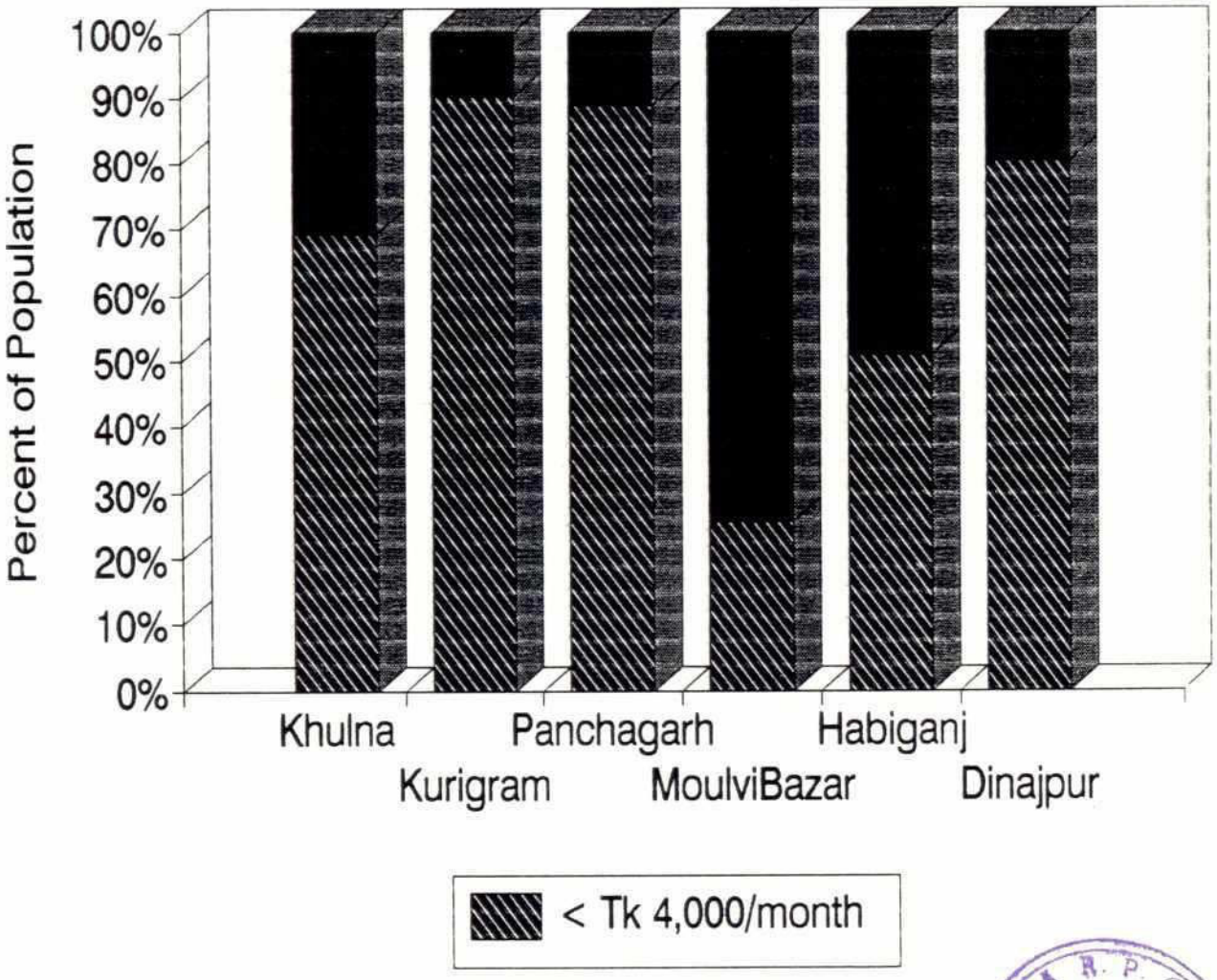


Figure : 2.2

A more revealing measure of relative financial well-being relates household income to family size. Appendix C includes tables for each town showing the distribution of income by family size and an estimate of average income per capita. This cannot be calculated precisely because the data was collected in income bands, but if the mid-point of each band is taken as the average, with Tk 1500 assumed for the lowest band and Tk 25,000 assumed for the highest band, the relative per capita income can be estimated which is consistent within the towns under study. These are shown in Table 2.3.

2.2 Municipal Areas and Flood Risk

The municipal/pourashava areas, both urban as well as the rural portions, are generally subject to high or moderate risk of flooding from the adjacent river. However, the original urban areas of most of the project towns have been established on relatively high land adjacent to rivers for reasons of flood protection and ease of communication by water. Except for Moulvi-Bazar and Habiganj, which have embankments on both banks of the rivers and are at risk from high flood levels, the other town areas are relatively free from the risk of deep flooding.

However these project towns including Khulna, which is adjacent to the major tidal Rupsa and Bhairab rivers, do suffer additional inundation from rainfall due to their limited drainage systems, particularly at the restricted river outlets.

With the increase of population in the urban areas and the upgrading of some of the sub-divisions towns to the status of district towns, the new urban areas (pourashavas) of the project towns are expanding on the alluvial terrace fringes. These extended municipal (pourashava) areas include low-lying areas, depressions, old river channels and active khals which have a direct connection with river.These areas need flood protection.

Flooding patterns vary widely between the project towns. Some towns flood annually but the depths of flooding are not excessive, neither is the damage severe, apart from road deterioration. Moulvi-Bazar, for example, floods less often but the potential damage is much greater. This could involve considerable loss of livestock and probable loss of human life, due to the risk of very high water levels rapidly inundating the town if there should be an embankment failure as happened in 1984. Similarly Habiganj generally suffers relatively little from flooding, because of the protection of the existing flood embankment, but would experience considerable damage should there be a failure of the existing embankment.

Those pourashavas which are not properly protected by flood embankments generally suffer regularly from flooding in the extended low-lying agricultural areas surrounding the urban centres. The low-lying areas, which are normally submerged for several months during the monsoon season by overflowing of the adjacent rivers, cover more than half of the extended pourashava areas. In most cases this is not a serious restriction to the level of the economic activity of the town but it does present a problem in relation to future expansion which will need to be addressed as the population of the town increases.

Urban land development of the low-lying flood plains will however accelerate in future to meet the increasing population pressure, despite the flood risk.

Table 2.4, shows the pourashava areas, the areas prone to flooding by high river levels and the inherent flood risks to these areas in the vicinity of the selected project towns, with the present protection works in place. The Flood Protection and Erosion drawings in Volumes 2A and 2B show the extent of flood protection measures and the locations where erosion is occurring in each of the project towns.

2.3 Flood Protection

The original urban centres of the project towns are located on relatively high land but the new pourashava areas are expanding on the alluvial fringes and the low-lying areas. Apart from the depressions, which have restricted drainage and suffer inundation from rainfall, and the low-lying areas which have a direct connection with the river, the main urban town areas are relatively free from deep flooding.

The low-lying areas of the project towns, which are normally submerged during monsoon period by the overflow from the adjacent rivers, cover a major part of the extended pourashava area.

Flood embankments have been constructed along the river banks for the six selected project towns, Khulna, Dinajpur, Kurigram, Panchagarh, Habiganj and Moulvi-Bazar, to save the pourashava area of these towns from annual flooding.

In some cases, such as Moulvi-Bazar, Habiganj and Dinajpur, embanking of both banks of the river upstream has produced an unjustifiably increased sense of security in the population of these towns. In reality the failure of the embankments would have serious consequences due to the increase of flood levels in the rivers as a result of this embanking.

Flood protection conditions of the selected project towns are stated in the subsequent pages. The present flood protection and erosion sites are shown on drawings in Volume 2A.

- **Khulna**

  The main urban area of Khulna is situated on the west bank of the Bhairab river at the northern edge of the pourashava area. The main urban area has developed along a high ridge of land bordering the Bhairab river running in general in a north-south direction. The main urban area is generally above normal high tide levels and is not subject to flooding directly from the Bhairab-Rupsa river system.

  The southern part of Khulna city is bordered by low-lying land and was, even after the construction of the Khulna flood protection works, subjected to flooding during spring tide. The road which runs from Rupsa Bus Stand to Loban Chara khal via the Shipyard and acted as a flood embankment has, however, recently been raised to protect the area from flooding. The present average level of the embankment is about 4.27 metres (14.00 ft) PWD and the highest tide level so far recorded 2.90 metres (9.50 ft). Thus a 1.37 m (4.50 ft) freeboard has been provided.

TABLE 2.4 - POURASHAVA AREAS, FLOODED AREAS AND FLOOD RISKS

TOWN	POURASHAVA AREAS (sq.km)			FLOODED AREAS * (sq.km)		STATUS OF FLOOD PROTECTION	RISK OF FLOODING	
	Urban	Rural	Total	Urban	Rural		Urban Area	Rural Area
KHULNA	27.69	10.78	38.47	NIL	9.38 ***	Flood Protection Embankment Complete	Moderate **	High **
KURIGRAM	4.05	13.39	17.44	NIL	6.50 ****	Flood Protection Embankment Complete	Moderate **	High **
PANCHAGARH	1.87	8.04	9.91	NIL	1.25	Flood Protection Embankment Partly Eroded	Low	High
MOULVI BAZAR	1.79	6.50	8.29	NIL	6.50	Flood Protection Embankment needs raising	High **	High **
HABIGANJ	1.7	9.24	10.94	NIL	2.5	Flood Protection Embankment needs extention	High **	High **
DINAJPUR	7.95	10.30	18.25	NIL	4.92	Flood Protection Embankment needs raising	High **	High **

NOTES :

* Figures do not include areas flooded directly by rainfall.

** If embankment is eroded or overtopped

*** Area below high tide level at potentially low risk from failure of existing flood protection embankments.

**** Area below flood level at potentially high risk from failure of existing flood protection embankments.

The eroding river bank is very near to the Khulna flood protection embankment at a point between closures at Alutola and Kazibecha. To ensure continued protection at this point a retired embankment of length about 900 metres (2950 ft) may be constructed.

Due to the construction of embankments and sluices under Polders 28/1 and 28/2, there is now no problem of flooding from the Rupsa and Solmari Rivers on the southern and south-western sides at Khulna. The condition of the embankments is fair but requires repairs in places. The local BWDB officials have indicated that due to shortage of funds they are facing difficulties in repairing the embankments in time for the next flood season. Indeed, the embankments are generally repaired under the Food for Work (FFW) programme, but there is an insufficient allocation of wheat under this programme to complete the full repair works.

- **Dinajpur**

The town of Dinajpur is located on the left (east) bank of the rivers Dhapa and Punarbhaba at the crossing point of the Parbatipur to Kanchan railway line. The town is protected from flooding by an embankment along the left bank. Flood embankments, along the left bank of Dhapa and Punorbhara River were constructed during 1951 and 1956 by the erstwhile Irrigation Department and Union Council from Gosaipur to Sundara (a length of some 21 km). The embankment was constructed in order to protect the Dinajpur town and some cultivable areas adjacent to it from flooding due to over bank spill from these rivers.

The part of the left embankment from Gosaipur (ch.00) to Mouthpara (Tut Bagan ch 263), about 8 km in length, borders Dinajpur. To protect Dinajpur and its suburbs, the embankment between Gosipur and the Ghugadanga regulator (a length of some 16 km), requires maintenance. The embankment was not overtopped even during the floods of 1987, 1988 and 1991. However, due to a combination of the sandy soils used for construction and poor maintenance, breaches occurred in the embankment at several places and as a result flood water passed into the town area and submerged many places in 1987 and 1988.

During the August 1991 flood, the left embankment failed near Gosaipur, due to formation of a ghog (a large hole formed by either rats or ants), and near Kanchan bridge, causing flooding in the town. The public also cut the embankment at one place upstream of Kanchan bridge in order to release the excess water which had entered the town area having been derived from both an upstream breach and also from the overbank spill from the river Gorbashawri passing on the eastern side of the town. Near to the BDR camp a big slip occurred on the country-side slope of the embankment. The embankment at this location was being protected by bamboo pins and earth filled gunny bags.

The town area has also been flooded from the eastern side by overbank spill from the river Gorbashwari during high floods, such as occurred in 1987, 1988 and in September 1991. The existing embankment on the right bank of this river is inadequate and requires strengthening.

The average crest level of the left embankment is 35.45 m and recorded highest flood level is 34.35 m (Pulhat Gauge Station) and this provides a free board of 1.1 m. Crest width of the embankment is 4.27 m (14 ft) and side slopes are 1:2 on the country-side and 1:1.5 river-side.

On the right bank of River Punarbhava about 16 km of flood embankment was also constructed from Kanchan Railway Bridge (about 6.5 km downstream of left embankment) to the Indian Border (Sundara) so as to give flood protection to 5670 ha (14000 acres) of agricultural land on the western bank of river Punarbhava. The crest level of the embankment is 35.36 m (near Kanchan Railway Bridge) and the top width is 4.27 m (14 ft). Side slopes of the embankments are 1:2 on the river-side and 1:3 on the country-side.

- **Kurigram**

Kurigram town is located on the right bank of the river Dharla, approximately 9km from the right bank of the river Brahmaputra. Originally the town was established on high ground and did not suffer from normal flooding. A major area of the original town, with government offices and other installations, was subjected to erosion and was relocated on the southern side of the original town area. The eroding bank was then shifted away from the side of main town by making a cut across the neck of the loop and also constructing a bund across the Old River on the eastern side of the town.

In order to further deflect the flow of the river from the town embankment, the BWDB constructed two groynes on the right bank. The consequence of all these works is that the pourashava area has been extended on the eastern side up to the bank of the loop cut and on the southern side to include the new area of the town.

The town area is situated within the Kurigram Flood Control and Irrigation Project (South Unit). A flood protection embankment of about 110 km length, from the Moghalhat railway line up to the Teesta railway line along the banks of Dharla, Brahmaputra and Teesta rivers, was constructed under this Project during 1973-74 to 1977-78. A portion of the embankment from a closure on Old Dharla river (km 30.00) upstream of Kurigram town to km 39.50 (9.5 km) acts as the flood protection embankment for Kurigram town.

Although the old Kurigram town area is well above the normal annual flood level the newly earmarked pourashava area contains several areas of low land and some depressions associated with inundated channels formed by the river meanders, training works and loop cutting. These areas were subjected to annual flooding before the construction of the embankment along the right bank of Dharla river under the Kurigram project.

During floods, water cannot now enter the Kurigram pourashava area due to the presence of the flood embankment. The condition of the embankment

from the closure point (km 30.00) up to Palashbari regulator (km 33.60) is good and this portion of the embankment is well maintained under FFW Programme. The portion of the embankment from the Palashbari Regulator up to the RDRS road however, was constructed using sandy soils and requires repair in places.

The crest level of the embankment from the closure site (km 30.00) up to Groyne No. 1 (km 31.57) is 30.78 m, (101 ft) PWD, and that from Groyne No. 1 up to RDRS road (km 35.03) is 29.26 m (96 ft) PWD against the recorded high water level of 27.70 m (90.88 ft) PWD. The embankments thus provide a freeboard of 3.1 m and 1.6 m respectively. Top width of the embankment from km 30.00 to the RK road (km 34.00) is 7.31 m (24 ft) and that from the RK road to (km 39.50) is 4.27 m (14 ft). Side slopes are 1:3 on both sides of the embankment.

- **Panchagarh**

Panchagarh town is located on the banks of the river Korotoa, approximately 6km from the border with India. The main part of the town is on the left bank. The main urban areas of Panchagarh are located on high land on the left bank of the river and are free from flooding from the overbank spill from the river Korotoa. Due to the upgrading of Panchagarh town from Sub-Divisional HQ to District HQ status, the increasing population of the new urban area is expanding on to the alluvial terrace strip and other low-lying areas. The extended pourashava area contains a low-lying area on the eastern side (Tulardanga), and this area is subjected to annual flooding during the flood season.

To solve the flooding problem in this area, an earthen embankment of some 4km in length, from Nutun Basti to the Panchagarh Talma road, was constructed in 1973 by the local thana parishad (since this area was outside the pourashava area at that time). However the embankment was constructed, without any gated structure, on the existing channel that passed through the embankment. A portion of the embankment at Tulardanga was heavily eroded and breached, with houses and some agricultural land in the locality being submerged and damaged.

The breach was closed by constructing a retired embankment but still without any gated structure on the channel passing through the embankment. The eroding river bank is presently passing near to the toe of the retired embankment and already about half of the newly built embankment of length about 100 m has eroded.

Reconstruction of the embankment at Tulardanga is proposed together with the installation of a two vent (each vent being 1.52mx1.83m) gated structure on the channel. In addition, embankment revetment works are required to be carried out which will protect the embankment from further erosion. The flood protection works would enable an area of some 400 ha to be reclaimed for urban development and agriculture.

The crest level of the embankment is 72.30 m which is the same as the highest recorded water level, and thus there is no embankment freeboard. The crest width of the embankment is 3.6m and side slopes are 1 to 2 on

both on the country-side and on the river-side. Resectioning of the existing embankment from Nutun Basti to the Panchagarh Talma road together with the construction of some 4 small diameter drainage outlets through the embankment is required.

- **Habiganj**

Habiganj town is located on the left bank of the Khowai river approximately 25km from the Indian border. The flood embankment along the left bank of river was constructed under the Khowai River Project from a point 17.70 km (11 miles) from the Indian border to Monirampur, a distance of 43.5 km (27 miles). An embankment on the right bank of the river from a point 21.00 km (13 miles) from the Indian border to Monirampur was also constructed under the same project.

The Habiganj town area is protected from flooding by a part of the left embankments of Khowai River Project which extends from Shaistaganj to Monirampur, a distance of some 23 km. This part of the embankment joins a railway embankment at the upstream end, some 16 km upstream of the town. The downstream end of the embankment terminates in agricultural land west of the town and is not connected to high ground. As a result during river floods, water levels west of the town are determined by those in the river channel at the downstream end of the embankments.

The right embankment of Khowai River Project was completed between Chunarughat and Monirampur leaving the upstream portion of approximately 21km and downstream portion about 8 km uncompleted as of June 1991. The left embankment was completed between Bongawn and Monirampur leaving the upstream portion of approximately 17.70 km (11 miles) and downstream portion about 3km uncompleted as of June 1991.

River improvement works carried out under the Khowai River Project include seven loop cuts. A further loop cut, which was planned immediately downstream of the present termination point of the embankment works, is being completed this year under the FFW programme. In conjunction with the loop cut the proposed extension of both the left and right embankments over a distance of about 2km along the realigned river course is also being constructed. These embankments will require an extension of 1 km on both banks under the present project.

One of the original loop cuts was located just on the eastern side of the main town and the new pourashava area extends up to the bank of this cut. An outfall structure on the old river was constructed to assist drainage of surface water from the town. Additional outfall structures, one located on the line of the northern end of the loop cut and one located by the side of the road bridge are also required to improve drainage from the town.

- **Moulvi Bazar**

The town of Moulvi Bazar is located mainly on the left bank of the River Manu about 1km downstream of the Manu Barrage and 60 km from the border with India. Flood protection for the town area is provided by earth embankments, a core wall and a flood wall constructed between 1984 and

1987. These have crest levels which varies between 14.02 m (46.00 ft. earth embankments) at the upstream and downstream extremities and 13.41 m (44.00 ft. Flood wall) above datum. The low section covers about 0.70 km where protection is provided by a "flood wall" near the downstream limit of the town which replaces the embankment through a congested market area.

The area on the right bank is largely agricultural land with some urban development near to the Manu bridge and the principal highway leading to Rajnagar. The main canal of the Manu River Project runs roughly parallel to the Manu River at an average distance of 1 km from the right bank, but this reduces to approximately 75 m at the narrowest point. The canal is protected by an embankment having a crest level of about 13.71 m (45.00 ft) above datum.

Following the construction of the left embankment and the Manu main canal, pressure from the inhabitants and farmers on the right bank caused a further embankment to be constructed on the right bank to give protection to the land between the river and the Manu main canal. These works were started in 1990 and are not yet complete. It is proposed to complete the section of 1 km earth embankment from the newly constructed right bank embankment to the Manu Barrage and extend the embankment downstream to Balia Kandi by a distance of about 0.5km. In addition it is proposed to resection the existing embankment over a length of some 4.56km. After Balia Kandi Bazar the embankment continues up to Monomukh along the right bank. The condition of the embankment in this area is satisfactory and the BWDB officers indicated that the embankment in this area would be further improved by Moulvi-Bazar O & M Division II. The crest level of this embankment is said to be 14.32 m (47.00 ft) and has been constructed with a base width which will allow the crest level to be increased to 15.24 m (50.00 ft) above datum at the Barrage site.

In May 1991, flood levels reached to within a few centimeters of the crest of the flood wall on the lowest section 13.41 m (44.00 ft) above datum. The average ground level within the town is 10.97 m (36 ft) above datum and a large proportion of the population of the town left the area until the flood receded.

The flood wall and other sections of the left bank embankment will require major modifications to raise the crest to a standard consistent with the proposed design criteria as set out in Appendix B. The embankments on the right bank will need to be completed as proposed above to give full protection to the land between the river and the Manu main canal.

2.4 River Bank Erosion

All six selected project towns have problems of river bank erosion of varying extent and severity. River bank erosion puts the flood protection embankment at risk of breaching and this is a major factor affecting the reliability of flood protection. In some cases erosion has placed roads, drainage or flood protection infrastructure at risk of serious damage, and in others such damage has recently occurred. Notable examples in the first category are the road bridge at Panchagarh and the revetment works of Kurigram, including the Palashbari regulator. In the second category erosion at Roosevelt Jetty

in Khulna has led to the loss of a large part of the jetty and damaged storage sheds.

In all the project towns except Panchagarh, some bank protection works have been carried out but they are seldom constructed to the extent and nature required due to inadequate funding.

Revetment works are generally formed with a falling apron of boulders, cement concrete (cc) or sand cement (sc) block toe protection below low water level. Above low water level the revetment is of concrete blocks or brick mattressing laid on a khoa filter. Some filters are now being formed with geotextiles and it is expected that more widespread use will be made of this material in future.

The works are normally carried out to check erosion after it has occurred and as such, requires a rapid response in terms of preparation/approval of designs and allocation of funds. Works are generally carried out in the following dry season and reserve stockpiles of materials are not held to enable interim protective measures to be carried out.

The present bank erosion conditions of the individual project towns are described in the subsequent pages.

- **Khulna**

  The six reaches of the west bank of Bhairab - Rupsa river where bank protection works had been proposed in earlier studies (Associated Technical Enterprise 1975, and BWDB 1990) were inspected by the consultants during site visits in August and October, 1991.

  Bank profile surveys were carried out during August 1991 at four of the six locations, namely C.S.D. Godown, Daulatpur College, Roosevelt Jetty, Hospital stretch, and in addition at the Ansar Flour Mills, upstream of C S D Godown where a retaining wall has failed at two locations.

  At the "Ansar Flour Mills" site and the "Daulatpur College" site, the gravity retaining walls are damaged over short distances. The bank profile surveys at these locations show that the present slope of the river bed is uniform and of stable slope from the deepest point on the section to the present bank line. The failure of the retaining walls is considered to be due either to a build-up of water pressure on the landward side, settlement of the foundation, washing out of material below foundation level or a combination of these factors. There are no buildings or important installations under immediate threat at either location. Extensive bank protection works were therefore not considered necessary at either of these locations, as mentioned in the Interim Report.

  The present bank line in the "Hospital Stretch" site was compared with the bank line shown in the survey carried out in 1972 by Associated Technical Enterprise. There appears to have been substantially no erosion in the Hospital stretch as is reflected in the position of the bank line.

  The present deep water channel as determined from the recent bank profile survey has been superimposed on the 1972 deep water channel at the locations where sections were taken in the recent survey. This comparison

has shown that there has been no appreciable movement of the deep water channel in the period 1972-1991, and it is concluded that the risk of erosion at this location has not increased. At one point, namely cross-section No. 10, the slope of the bed profile approaches 1:1 in the steepest section, over a plan distance of 10 m. At other profiles the maximum slopes range approximately from 1:1.7 to 1:2 in the steepest sections.

The overall stability of both the deep water channel and the bank line in the period 1972-1991 indicates a greater stability of this reach than was thought to be the case in earlier reports. However in the vicinity of cross-section No. 10 the bank is for geotechnical reasons in a more potentially unstable condition. After the flood of 1991, erosion is now active just upstream and downstream of the launch ghat attached to the Hospital stretch. This reach is very important to the Municipality as it includes the main market place and important buildings such as the hospital, customs office and other important buildings. However, during discussions held in Khulna in late December, with Mr Halimur Rahman SE, FPCO and Mr Mahbubur Rahman, Khulna O & M Circle BWDB, regarding the erosion situation in Khulna, it was felt strongly that revetment works in the Hospital Stretch should be extended up to the Customs Ghat. The actual length of protection work will be determined after taking more sections at this location. In addition, revetment works at upstream end of C S D Godown and Ansar Flour Mill (153m) and at Daulatpur College (305m), were recommended. These items have been included in the present proposals.

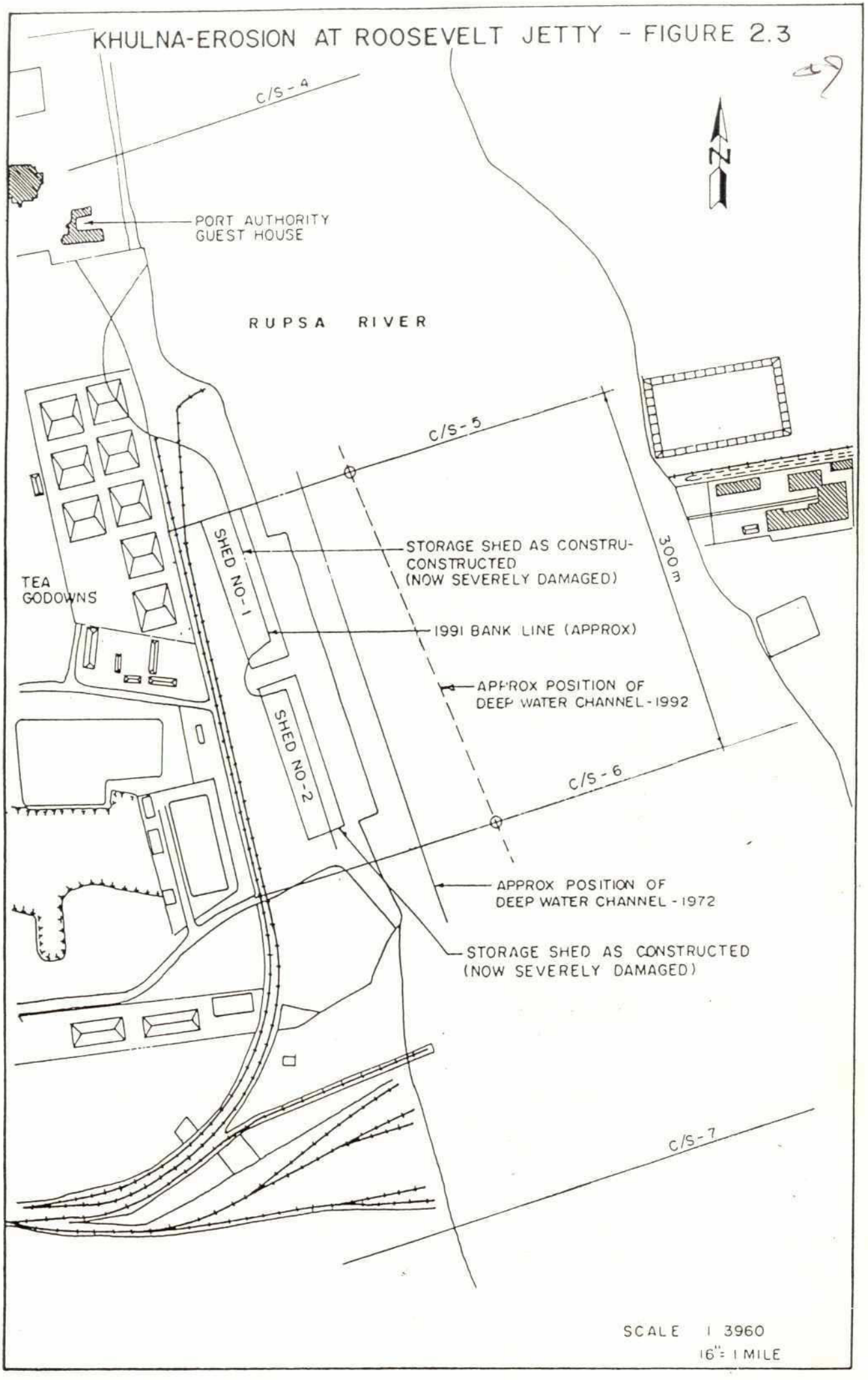
At the lower part of the"C S D Godown" site and "Khulna Newsprint" site, the river frontages appear to be in a stable condition and there were no indications of recent bank erosion. This view is also supported by the bank profile survey. Bank protection works are therefore not considered to be necessary at these locations.

At "Khulna Shipyard" there are two locations where the concrete retaining wall has failed and where the bank is now supported by piling and steel sheets. Upstream of Khulna Shipyard the bank between high and low water has a shallow slope. This reach appears to be generally stable at the present time and repair of the damaged retaining walls in the shipyard itself is not urgent.

"Roosevelt Jetty" is situated on the west bank of the Bhairab river at the confluence with the Atai river. The Atrai flows from the lower Nabaganga which in turn originates from the Modhumati via the Halifax cut. The report of Associated Technical Enterprise (ATE) (Consulting Engineer) states that in the period prior to 1972 flows through the Halifax cut had increased due to siltation of the Modhumati.

The Roosevelt Jetty was first constructed after the second World War and was reconstructed in 1967-68. The layout of the jetty is shown in Figure 2.3. (This figure was based on a map of Khulna obtained from the Khulna Municipality in August 1991).

Erosion began immediately upstream of the jetty in 1971 and is thought to have been caused by the projection of the jetty into the river after reconstruction in 1968. Prior to 1971 erosion had been noted between 213


KHULNA-EROSION AT ROOSEVELT JETTY - FIGURE 2.3
C/S-4
PORT AUTHORITY
GUEST HOUSE
RUPSA RIVER
C/S-5
STORAGE SHED AS CONSTRU-
CONSTRUCTED
(NOW SEVERELY DAMAGED)
300 m
TEA
GODOWNS
SHED NO-1
1991 BANK LINE (APPROX)
APPROX POSITION OF
DEEP WATER CHANNEL-1992
SHED NO-2
C/S-6
APPROX POSITION OF
DEEP WATER CHANNEL-1972
STORAGE SHED AS CONSTRUCTED
(NOW SEVERELY DAMAGED)
C/S-7
SCALE 1 3960
16" = 1 MILE

m (700 ft) and 396 m (1300 ft) upstream of the jetty in the area which is now an extensive char.

During the 1972 monsoon season the embayment formed in 1971 was enlarged and at the same time the deep water channel is reported to have moved closer to the face of the jetty. A second embayment had also been formed further upstream from the first and in 1972 the two embayments were expected to merge into one. At that time the jetty structure was still intact.

The next phase of erosion after 1972 caused undermining of the piling of the jetty which subsequently collapsed. It is probable that about this time one of the tea godowns immediately behind and upstream of the jetty may have been undermined and collapsed as a result.

In the latest phase of erosion the front face of the hard standing area behind the jetty suffered further erosion and collapsed into the river together with parts of Shed No. 1 and No. 2. An embayment was also formed between the sheds. The Roosevelt Jetty reach requires protection in order to prevent further damage occurring in the future.

At present erosion is also very active by the side of the retired embankment at Alutola and by the sides of the sluice S-2 of Polder 28/2 on Solmari River side and these locations need immediate protection. The eroding bank by the side of the proposed retire embankment at Alutola site was also inspected by the Consultant during December 1991 along with SE, FPCO and SE, Khulna O&M Circle. Recent bank profile surveys of the Alutola retired embankment site were carried out by the BWDB and these bank profile Surveys were collected by the Consultant.

The Alutola retired embankment site and the sites of the sluice S-2 of Polder 28/2 require bank protection works at these locations and have been considered in the Final Report by adjusting some protection length on the Hospital Stretch.

- **Dinajpur**

Active bank erosion of the east (left) bank of Dhapa-Punarbhaba is taking place at five locations. Of these, four are close to the town and could influence flooding through damage to the embankment. The four locations of the east bank where bank protection works had been proposed by the BWDB and mentioned in the Inception Report were inspected by the consultant during visits in September and October 1991.

Bank profile surveys were carried out during September 1991 at all four locations namely Gosaipur, Bangibechapara, Lalbag (Graveyard) and Mouthpara (Tut Bagan).

At the "Gosaipur" site, the erosion is active in the concave bend. A portion of the embankment was eroded earlier and a retired embankment was constructed at this location. The set back distance of the retired embankment has been eroded and the embankment is again threatened. The length of the eroded bank as measured is some 500 m. The bank profile survey carried out in September 1991 showed that the deep water channel is passing close by the side of the embankment and as a result the embankment is potentially in an unstable condition at this location. At this location a large char is being formed on the right bank. Bank protection works together with the construction of groynes would appear to be the most suitable solution at this site.

At the "Bangibechapara" site, the set back distance of the embankment has been eroded away. The erosion is not very active now at this location. A bank profile survey carried out during September 1991 showed that the deep water channel is passing close by the eastern side of the river. The eroding length at this location as measured is some 300 m.

At the "Lalbag" (Graveyard) site, the eroding river bank is about 150/180 m from the existing embankment. The graveyard is situated between the river bank and embankment. The bank profile survey carried out in September 1991 showed that the deep water channel is passing close by the side of left bank. Consequently erosion is acute at this place and if protection works are not undertaken soon, the whole Graveyard may disappear. The length of eroding bank measured at this location is some 300 m.

At the "Mouthpara (Tut Bagan)" site, the eroding river bank is about 150/180 m away from the existing embankment. A part of the Tut Bagan (translated as trees for Reshom thread) is located between the river bank and embankment. The bank profile survey carried out during September 1991 showed that the deep water channel passes close by the side of left bank of the river. Erosion is active at this location and the Tut Bagan along with the flood protection embankment will be eroded away if protective measures are not undertaken soon. The measured length of eroding bank at this location is some 1000 m.

- **Kurigram**

The flood control embankment to the east of Kurigram town is under threat of river erosion over a distance of approximately 1.2 km. The sections concerned includes the Palashbari regulator constructed on the outfall of the old river, the spur at the ferry ghat of the R.K. road, and the section between the regulator and cross-bar No. 2 downstream of the town.

The eroding sites were inspected by the Consultant during the site visits in June and October 1991. Some revetment works have been carried out in the affected reach using brick mattressing and boulders under the Second Flood Rehabilitation Project, and the Rangpur-Dinajpur Rural Service has maintained the RDRS road by dumping of sand cement (sc) blocks.

Bank profile surveys were carried out in October 1991. The deep water channel is at present passing close by the side of the protective works and the embankment from the Palashbari regulator to Crossbar No. 1.

Although the brick mattressing completed under FDR just upstream of Cross Bar No. 2 appears to be in good order, there is now no "set-back" distance of the embankment. The bank profile surveys indicated that the protective work formed with boulders below water level is unstable.

Serious erosion also took place in front of the groynes No.1 and R.K. road and part of the groynes has been eroded away during the last floods. The eroded portion of the groyne No 1 is to be protected and the head of the R.K. road is to be extended and protected.

The recently constructed Palashbari regulator is also in danger of erosion from a newly formed channel as is also the embankment downstream. The spacing of spurs between the Palashbari regulator and Cross Bar No. 1 is not adequate and the boulder protection below water level needs strengthening.

- **Panchagarh**

The two locations of the left bank of the Korotoa River, where protective works had been proposed by the BWDB were inspected by the Consultant during site visits in June and September, 1991.

Bank profile survey were carried out during September 1991 at both locations, upstream and downstream of road bridge and at Tulardanga site. A plane table survey was also undertaken covering both the eroding locations.

At the road bridge site erosion has been progressive in recent years both upstream and downstream of the bridge and this may damage the left abutment of the bridge if protective works are not carried out. An earthen groyne, which was constructed earlier upstream of bridge is now itself subject to erosion. Design and estimates for the protective works were prepared by the BWDB based on the construction of cement concrete (cc) block revetment but so far no works have been carried out.

A bank profile survey carried out during September 1991 showed that the deep water channel was passing close by the side of the left bank abutment of the road bridge and as a result the bank, along with the bridge abutment, is in an unstable condition at this location.

At the Tulardanga site the eroding river bank passes close by the side of the embankment. Consequently a portion of the embankment, in length about 100m, was eroded away. A retired embankment was constructed but the river-side slope of the retired embankment has been eroded away.

The bank profile survey carried out during September 1991 showed that the present section of the river bed is not stable from the thalweg, or deepest point, up to the present bank line.

- **Habiganj**

  The flood embankments are generally in good condition although erosion has taken place at several points which could lead to the breaching of the embankment unless protection works are carried out.

  The total number of eroding sections was 23. During the last flood period active erosion took place in another location, thus the total number of eroding points now stands as 24. The eroding points were inspected by the Consultant during site visits in June, October and November 1991. Of the 24 locations where bank erosion is active, 18 locations are situated between Shaistaganj and Monirampur and considered in the programme. It was observed that lengths over which erosion is taking place are in most cases relatively short. In one location on the right bank there was severe erosion of the embankment itself and retirement of the embankment was carried out at that place.

  The bank profile surveys carried out during October 1991, showed that the deep water channel is passing close by the sides of the embankment resulting in erosion. In some cases the setback distances of embankments are also being eroded.

- **Moulvi Bazar**

  The four reaches (2 reaches on left bank and 2 reaches on right hand of the River Manu) where bank protective works have now been proposed by the BWDB officer, were inspected by the consultant during the site visits in June, October and November 1991. Active erosion was taking place at additional places on the left bank during the last flood period, thus the total number of sites at present is 5.

  The majority of the left bank through the town is protected from erosion by boulder and block pitching under FDR. Some protection works using bullah posts, sand filled gunny bags and stone boulders have been completed at one location on the right bank. However, no major revetment works have been carried out on that bank. Active bank erosion is now taking place both upstream and downstream of the existing right and left bank embankments. Bank erosion at the upstream end of the existing right bank embankment is taking place on a concave curve and a large charland is being formed on the left bank at that point. If a loop cut along with the revetment works is undertaken, the erosion at that location will be reduced.

  Bank profile surveys were carried out in October 1991, and showed that the deep water channel was passing close by the side of the eroding banks.

2.5 Surface Water Drainage

In all six project towns surface water drainage systems exist to some extent. These systems are shown on the Existing Drainage drawings in Volume 2A of the report. It is evident from a review of the existing systems that these have evolved in a haphazard fashion following no predetermined plan. In general, in all the towns the existing network drains towards natural khals within the town, such as in Dinajpur, or

to low lying areas on the periphery of the urban areas such as in Kurigram and Habiganj. The main problems identified are the inability of the existing drainage systems to drain the urban areas with the result that, particularly during the monsoon season, large urban areas in all the towns suffer periodic flooding. As a result of the flooding, deterioration occurs to the road network and areas of stagnant and polluted water develop for prolonged periods in low-lying areas around the towns. The flooding also causes major distress to the population and also affects commercial activities. The main factors which reduce the effectiveness of the evacuation of surface runoff from the urban areas are basically similar in each of the towns. These are:

- the flat topography of the land in the towns.
- poorly defined secondary and tertiary channels which are in part unconnected to the main drainage systems, coupled with inadequately sized drainage outlets and culverts.
- in some instances the absence of an intermediate network of secondary drainage channels to adequately convey the surface runoff to the primary network, coupled with the absence of an integrated network of roadside drains to convey the flows to the secondary network.
- the general undersizing of the drainage channels which as a result are inadequate to meet their demands.
- the disposal of solid waste directly into the drainage channels which further reduces the ability of the drains to convey the required drainage flows.
- encroachment on the channels of unauthorised construction coupled with the lack of regulations and enforcement to prevent such encroachment.
- the lack of a coordinated and planned drainage maintenance programme to effectively maintain the drainage system.
- poor communal awareness of the need to maintain an effective drainage system, thus restricting the disposal of waste, and building encroachment on the system. Also the throttling of the flow in the drains, particularly on the outskirts of the urban areas, in order to maintain high water levels in the channels or for the development of ponds for other purposes.

As noted above for all the project towns flooding of considerable areas of the towns occur regularly, particularly during the monsoon season. Information on the exact extent of the areas prone to flooding, specifically from rainfall falling on the town, has been obtained from discussions with the pourashava/city corporation officials. Details are presented below in Table 2.5

The existing drainage networks comprise a series of pucca (concrete lined) and katcha (earth lined) drainage channels, pucca channels being located in the more commercial areas of the towns. Detailed in Table 2.6 are the lengths of pucca and katcha channels in each of the towns. For simplicity, semi-pucca drains (ie channels with concrete sides but with an earth base) have been included under pucca drains.

TABLE 2.5 FLOODED URBAN AREAS DUE TO RAINFALL

City Corporation/ Pourashava	Total Area (sq km)	Area suffering from Flooding (sq km)	Percentage (%)
Khulna	38.47	26.44	71
Dinajpur	18.25	12.00	66
Kurigram	17.44	6.89	40
Panchagarh	9.91	6.60	67
Habiganj	10.94	6.80	62
Moulvi-Bazar	8.29	2.50	30

Source: Consultants measurement of City Corporation/ Pourashava maps and information supplied by the town officials.

TABLE 2.6 LENGTHS OF EXISTING DRAINAGE CHANNELS

City Corporation/ Pourashava	Pucca Drains (km)	Katcha Drains (km)	Khals (km)	Total (km)
Khulna	42.7	44.0	20.8	107.5
Dinajpur	20.4	20.2	10.7	51.3
Kurigram	5.5	9.7	-	15.2
Panchagarh*	4.8	7.6	0.5	12.9
Habiganj	1.7	16.2	-	17.9
Moulvi-Bazar*	6.2	17.0	6.2	29.4

* Information obtained from the Netherlands/ Bangladesh Development Cooperation Programme - DPHE Water Supply and Sanitation Project.

The layout of the existing drainage systems in all the project towns are presented in The Existing

Drainage drawings in Volume 2A. Details of the nature and operation of the systems are presented below.

- **Khulna**

  The main urban areas of Khulna city are situated on the west bank of the tidal Bhairab/Rupsha river. Khulna originally developed along a ridge of land bordering the Bhairab/Rupsa river running in a general north-south direction. The main urban areas bordering the Rupsha river are generally above normal high tide levels by about 0.5 m and not subject to flooding directly from rivers. Tidal surges due to the effect of cyclones in the Bay of Bengal do not normally affect this section of the coast to any appreciable degree.

In recent years the city has steadily expanded towards, and in some cases on to, low-lying land immediately to the west and south of the city. This land was always largely agricultural, despite being subjected to tides from the Rupsha and Solmari rivers, but has more recently been empoldered. Bordering the eastern edge of this agricultural area and bounding the Khulna municipal area to the west is the Gallamari river which acts as a natural interception drain. This continues southwards as the Hatia Nadi (river). Water levels in the lower Gallamari/ Hatia river are maintained at around low tide level by flap gates at the major outfall to the Rupsa river. This structure is the largest and most southerly of seven regulators in the flood defence embankment along the Rupsa river constructed in 1983. This embankment now provides tidal flood protection to most of the low lying-urban, peri-urban and agricultural areas south and west of the city.

The 1983 flood defence embankment along the Rupsa river was initially linked with an embankment which ran north to south parallel to the western bank of the Gallamari/Hatia river. However the latter embankment is no longer maintained and Khulna is now effectively protected from the west by the Solmari river embankment system which is directly linked with the 1983 embankment along the Rupsa river. The area between the Solmari embankment and Khulna is officially designated as polders 28/1 and 28/2.

A limited area to the north-west of the Khulna, but still within the municipal area, lies north of a road embankment forming the present northern limit of the Khulna flood protection system, and forms part of polder 25. This polder has an outlet to the tidal Solmari river. Because of siltation/drainage complications in polder 25 since its construction, plans were made in the past for excess run-off from the polder to pass in emergency firstly into the Solmari river and hence through a sluice in the protection embankment, into polder 28/1. The original plan was for this discharge to pass through polder 28/1 along a specially constructed emergency drainage channel and then into the Gallamari/Hatia river. The construction of the emergency channel was started in early May 1990 and was in fact 40 % complete by June 1990 when the work was suddenly terminated. Should the emergency channel ever be operated as originally intended it would add considerably to the drainage load of the Gallamari /Hatia river system which eventually drains by gravity to the tidal Rupsa river through the major ten vent regulator in the 1983 protection embankment.

The city already has an extensive, though inadequate, drainage system. There are 43 km of pucca, and 44 km of katcha drains plus 21 km of natural khal in the existing system, with upwards of 14 formal outlets. The main urban area largely outfalls to the Bhairab/Rupsa river. Gravity drainage to the Rupsha river is generally effective during periods of low tide. However, during high or intermediate tide periods most of the outfalls are closed and are therefore incapable of evacuating the flows generated by intense rainfall in the city. As a result, flooding occurs in several parts of the city and serious damage has occurred to parts of the road system, disrupting traffic movement in the city for long periods. Other newer parts of the city, particularly to the west and south, drain to the Gallamari/Hatia river which is protected from tides by the Polders 28/1 and 28/2. A small part in the north drains to Polder 25 and the Solmari river which, due to the

circumstances in which the Polder 25 alleviation works were suspended, is no longer fully tidal protected.

In general, the existing drainage network has been developed in an unplanned fashion without effective main drains or adequate outfall arrangements. The problem is exacerbated during periods of prolonged and heavy rainfall, with ponded rainfall remaining in certain parts of the city for long periods.

It is estimated that around 27km^2 of the 37 km^2 municipal area of Khulna within the flood defence embankment is liable to flooding after heavy rainfall. The extent of this area is shown the drawings in Volume 2A. Flooding occurs in the following type categories:

i) A 3.8km^2 belt of the main urban centre, despite being partly on higher ground and served by three outfalls above high tide level plus four major outfalls with tidal gates all connecting direct to the Rupsa river, nevertheless suffers periodically from flooding after heavy rain. This is largely because of a combination of a number of factors including backing-up from these outfalls to the tidal Rupsa river, and also because of inadequate falls and dimensions of the existing drains. Backing-up has been reduced at one outfall through the use of a pumping station operated by the Khulna City Corporation at a particularly low-lying point on the main drain, at the junction of Khan Jahan Ali road and Shipyard road. Although the pumps were intended to maintain drainage outflow when the flap gate was closed at high tide and were sized accordingly, the flap gate is not completely serviceable and allows the ingress of flow from the tidal Rupsha river. The pumps (2 No of 6 cusec capacity each) are therefore probably of insufficient capacity for the required additional duty.

ii) Another 13km^2 belt somewhat further from the Rupsha/Bhairab river, despite being on moderately high ground draining naturally to the Gallamari/Hatia non-tidal river, floods after heavy rainfall purely because of inadequate falls and dimensions of the existing drains.

iii) Further still to the south and west there are 12 km^2 of partially urbanised low lying land, either flooded regularly during the rainy season because of backing-up from the Gallamari/Hatia river system, or inundated artificially because of rice cultivation or fish culture in the peri-urban areas.

There is additionally another 2 km^2 outside the Khulna flood defence embankment which are below the high tide levels in the Rupsha and Solmari rivers.

In order to improve the flooding-due-to-rainfall situation, the City Corporation in association with the Khulna Development Authority have recently developed an outline drainage improvement plan. This plan envisages some 260 km of largely new "main" and "feeder" drainage improvements. Also included is the construction of a number of additional sluice gates and

drainage outlets to both the Bhairab/Rupsha and to the Gallamari/Hatia rivers. This scheme also envisages a number of main pumping stations, behind both new and existing sluices along the Bhairab/Rupsha river, to allow the continued discharge of storm drainage at times when the tidal outfalls are closed. There is also provision made for intermediate pumping stations in the main drains in the flatter low-lying western areas, to assist with discharges to the non-tidal Gallamari/Hatia river when water levels are higher than normal. These drainage proposals were, however, prepared without topographical information and are basically proposed layouts, based on local knowledge of the areas flooding patterns.

- **Dinajpur**

Dinajpur is located on the left bank of the Purnarbhaba river. The river is embanked throughout the whole of the length in the vicinity of the town. Drainage in the town is predominately directed to two Khals (the Ghagra and the Girija) which flow in a generally southerly direction to outfall via a 5 vent regulator structure to the main river some 5km from the town. The Ghagra khal has a catchment that extends to agricultural land to the north of the limits of the town. Indeed, the severe flooding of the town in September 1991 was principally due to overland flood flows from the Gorbheswari river to the east of the town entering the Ghagra khal. The khal had insufficient capacity to convey these flows and spilled significant volumes of flood flow throughout the urban area. The capacity of the Girija Khal in particular is limited due to siltation, lack of maintenance and some encroachment by residents. In addition several of the existing culverts on the canal are grossly undersized and inhibit the drainage flow. The Ghagra khal appears to be in a better condition than the Girija, possibly the result of the removal of debris by the recent floods. However, the remaining culverts (some being destroyed during the floods), are generally of adequate size and do not restrict the flow, but are in need of maintenance and in places bed protection. Elsewhere in the north western part of the town, drainage is directed towards local outlets constructed through the flood embankment. One of the outlets which has a 2ft 6inch (.76m) dia pipe culvert is ungated and thus during periods of high river stage backflow occurs. A similar result occurs at another location some 500m downstream, where an old ungated culvert was not removed following the construction of a new regulator alongside.

Within the town itself the drainage network is not continuous and has been constructed without regard to an overall plan. Indeed, there appears to be no secondary drainage system in the network to convey flows to the primary system - the Ghagra and Girija khals. Additionally, due to the lack of an effective maintenance program and the deposition of debris and solid waste etc. in the channels, the overall effectiveness of the system is severely limited. In a normal year the pourashava indicated that parts of the town were inundated for up to 6 hours and that, during periods of exceptionally high rainfall and high river stage, flooding of parts of the town can occur for considerably longer periods.

- **Kurigram**

Kurigram is located on the high ground to the south east of the Dharla river.

Drainage from the town is to the north and east towards low lying areas at the foot of the flood protection embankments. There are two drainage outlets through the flood embankment of which the Palashbari regulator to the north east of the town is the most important. The regulator, which has two vents, each 5ft (1.5m) wide by 6ft (1.8m) depth, is located to connect the present river to its former channel which was closed earlier. At periods of high river stage the regulator is closed to prevent backflooding from the river to the town. Fortunately the old river channel, allied with the adjacent low lying land, has sufficient storage to accommodate surface runoff derived from the town during periods when the regulator is closed. The second outlet to the main river is located some 3 km downstream of the Palashbari regulator and comprises a single 3 ft (.9m) dia. ungated pipe culvert through the flood embankment. The culvert is of inadequate capacity to convey the required flows and hence inhibits the discharge of drainage from the town. In addition, as the structure is ungated, during high river stages backflow of flood water towards the town can occur.

Within the urbanized area the drainage flow is restricted by either the total absence of, or the inadequate size of culverts. The existing system is in places not continuous and there is basically no formal secondary drainage network. In addition, particularly on the south eastern section of the town where significant expansion is occurring, there is a need to upgrade the existing katcha network to pucca. In this part of the town the important Governmental offices are being relocated and urbanization is proceeding. rapidly

- **Panchagarh**

Panchagarh is located on both banks of the Karatoya river on gently sloping land. The existing drainage network comprises some 4.8 km of pucca drains, 7.6 km of katcha drains and 0.5 km of khals. The majority of the pucca drains are in a reasonable state of repair, but due to inadequate maintenance contain significant quantities of silt, debris, and solid waste, which greatly reduce their efficiency. The majority of the katcha drains are in a poor condition, often choked with weeds/debris etc. with consequent poor flow characteristics. In addition several of the drainage culverts are of inadequate size to convey the required flow and hence further inhibit drainage flow. In essence, the drainage problems in the town result from the unplanned development of the drainage network which has not kept pace with the development of the town. Solutions are further aggravated by the inherent difficulties in constructing a tertiary drainage network in the core area of the town. The pourashava officials indicated that standing water can remain in certain parts of the town for up to 10 days following significant rainfall events.

Panchagarh has been included in the Netherlands /Bangladesh Development Cooperation Programme, 18 District Towns Water Supply, Sanitation and Drainage Project, and the improvement and upgrading of parts of the drainage system have been recommended for inclusion in their programme. However funds for this project are limited and as such only the necessary drainage improvement works in the core part of the town (of the order 20% of the total urban area), are planned to be implemented under the project. At present designs for the drainage improvements are being

produced, however the exact timing of the implementation of the programme is not known.

- **Habiganj**

Habiganj is located on the left bank of the Khowai river which is embanked around and beyond the whole of the town. At the downstream end the embankment terminates in agricultural land to the west of the town but is not connected to high ground. During river floods, water levels rise rapidly and those in the vicinity of the town are determined by the levels in the river channel at the downstream end of the embankment. The Haripur regulator, a single vent structure (5ft (1.5m) wide by 6ft (1.8m) depth), is located through the flood embankment on the eastern outskirts of the town so that surface runoff from the south eastern outskirts of the town can be discharged to the river. At periods of high river stage the regulator is closed to prevent backflooding from the river to the town. Unfortunately, in May 1991, the regulator gate jammed open and water from the river inundated the town causing severe distress to the population.

The topography of the town is such that water naturally drains to the eastern and western fringes of the town. To the east of the urban area drainage is naturally directed towards the old channel of the main river, which has been isolated from the river by the flood embankments. Although, as mentioned above, the Haripur regulator has been incorporated in the flood embankment, the regulator only has command of part of the land around the old channel. As a consequence, a significant portion of the surface runoff derived from the main core of the town tends to pond up behind the flood embankment towards the north of the town. This runoff remains around for significant periods until natural infiltration into the ground occurs. As a consequence of the regular inundation, development in this area, which is a natural extension of the existing urban area, has been restricted.

On the western fringes of the town drainage flows are directed towards the agricultural land. However due to siltation from past river flooding of the agricultural land, two of the main drainage Khals in this area have been completely silted up and are consequently incapable of evacuating the drainage flows.

Within the town itself, the existing drainage network has been constructed without regard to an overall plan with the result that several of the drainage channels, particularly those serving the main core area of the town, are undersized. In addition, throughout the system, many of the existing culverts are undersized and are incapable of conveying the necessary drainage flows, thus further aggravating the situation. Existing pucca drains in the central part of the town have been constructed with removable concrete covers, principally due to the need to maintain the available road width. The incorporation of these drain covers results in far less waste and debris being deposited in the drains than is noticeable in other project towns.

Consideration is being given at present of providing funds via the Netherlands/ Bangladesh Development Cooperation Programme, for drainage improvements in Habiganj. However a final decision on the inclusion or otherwise of Habiganj in this programme has yet to be made.

It is very unlikely, due to funding limitations that all the necessary drainage improvements could be accommodated within any budgetary allocation. As is the case in Panchagarh and Moulvi-Bazar, only drainage priority area improvement works, say in the core part of the town, are likely to be included in any programme. ,

- **Moulvi-Bazar**

  Moulvi-Bazar is located on the left bank of the Manu river. The flood embankment for the river was constructed to protect the town from inundation from the river but has also resulted in severe problems relating to the evacuation of storm rainfall from the urban area. The existing drainage network comprises approximately 29km of drainage channels of which some 6 km are pucca, 17km are katcha and 6 km are khals. Due to inadequate maintenance it is estimated that some 50% of the pucca drains are in a poor state of repair. In addition these drains contain significant quantities of silt, debris, and solid waste which greatly reduce their efficiency. The katcha drains are also in a poor condition, often choked with weeds/debris etc. with the consequent poor flow characteristics which further inhibit drainage flow. Indeed, the pourashava officials indicated that standing water can remain in certain parts of the town for up to 6 days following significant rainfall events.

  Like Panchagarh, Moulvi-Bazar has been included in the Netherlands/ Bangladesh Development Cooperation Programme, 18 District Towns Water Supply, Sanitation and Drainage Project, and the improvement and upgrading of parts of the drainage system have been recommended for inclusion in their programme. However funds for this project are limited (as at Panchagarh), and as such only the necessary priority drainage improvement works in the core part of the town (of the order 20% of the total urban area), are planned to be implemented under the project. At present designs for the drainage improvements are being produced, however the exact timing of the implementation of the programme is not known.

2.6 Sanitation

The provision of sanitary facilities is generally the total responsibility of the householder. Only where public waterborne systems exist, such as in parts of Dhaka, is the operation and maintenance of the system outside the householder's responsibility. In the project towns only one small area of Khulna is served by a sewerage system. However, that system discharges the untreated sewage directly into an adjacent channel thus posing a serious health hazard.

The relative distribution of sanitation facilities was investigated as part of the Household survey undertaken in each of the project towns. Details of the distribution of the onsite sanitation facilities as determined from the survey are presented in Table 2.7.

TABLE 2.7 DISTRIBUTION OF HOUSEHOLD SANITATION FACILITIES

City Corporation /Pourashava	Type of Facility				
	Septic Tank	Pucca Pit Latrine	Open Pit Latrine	Service Latrine	No Facility
Khulna	41%	28%	30%	1%	1%
Dinajpur	30%	25%	25%	14%	6%
Kurigram	9%	11%	44%	3%	32%
Panchagarh	13%	48%	38%	0%	1%
Habiganj	38%	32%	26%	3%	1%
Moulvi-Bazar	82%	11%	6%	1%	0%

Source: Consultant's Household Survey 1991
Note: The percentages may not add up to 100 due to rounding.

In the Interim Report, the figures quoted for Khulna were based on updated figures produced in the Municipal Services Sub-Project - Phase III Report - Khulna by Louis Berger International Inc. in 1985. These original figures indicted that overall the sanitation stock distributed throughout the town was in a far poorer condition than was in fact the case. In addition, the household survey for Khulna did not identify any households connected to a sewerage system - as noted in the 1985 Louis Berger report. It is suspected however, that these households may not in fact realise that they are on a piped system but instead believe that they are served by a septic tank.

From the above table it is evident that the provision of sanitary facilities, ie septic tanks and pucca pit latrines, varies dramatically between the project towns. Of note are the figures for Moulvi-Bazar and Kurigram, where respectively 93% and 20% of the householders use sanitary facilities. Although no firm conclusions can be drawn from the limited number of towns surveyed, it does appear that the towns in the north eastern part of the country, ie. Moulvi-Bazar and Habiganj, have significantly better sanitation facilities than towns in other parts of the country.

As part of the household survey, respondents were asked if they would be willing to contribute labour, materials or finance to the improvement of their sanitation facility. In all the project towns, other than Kurigram, some 70 to 90% of the householders indicated their willingness to contribute. However in Kurigram only 46% of householders were willing, probably reflecting the poorer income levels and hence the inability of the householders in the town to contribute.

The provision of a sanitary facility does not necessarily result in a safe environment. Indeed in both Khulna and Dinajpur it is evident that some householders have omitted to install a soakwell with their facility and the effluent from the well is being discharged via a pipe into the local drainage channel. This is a major risk to public health.

Moulvi-Bazar and Panchagarh have both been included in the Netherlands/Bangladesh assisted 18 Towns Water Supply and Sanitation project. These two towns will benefit under the project by the provision of 377 and 425 subsidised sanitary pit latrines respectively.

The distribution of public sanitation facilities in the project towns is presented in Table 2.8. These facilities are serviced by the city corporation/pourashavas and provide an important service by reducing the instance of open defecation in public places.

With regard to the cleaning and disposal of the contents of septic tanks, in all the project towns other than Khulna, this is undertaken by sweepers who manually clean the pit. Khulna City Corporation however possess four 200 gallon (1000 litre) capacity vacuum tankers which are used for cleaning tanks. Contents of the tanks are generally disposed of at the solid waste disposal sites. It is likely however that some householders use private contractors to clean tanks and in these cases the contents are sometimes disposed of convenient locations, such as in drainage channels etc. around the town.

TABLE 2.8 DISTRIBUTION OF PUBLIC SANITATION FACILITIES

City Corporation /Pourashava	Number	Location	Condition
Khulna	5	Rupsha Bus Stand	Usable
		Water works	Usable
		Goal para	Usable
		Maniktala	Usable
		Shaikh para Bazar	Usable
Dinajpur	2	Chak Bazar	Unusable
		Bahadur Bazar	Usable
Kurigram	1	-	Poor
Panchagarh	2	Panchagarh Bazar	Requires repair
		Puraton Panchagarh Bus Terminal	Requires repair
Habiganj	3	-	Good
		-	Good
		-	Good
Moulvi-Bazar	None		

Source: City Corporation/Pourashavas

2.7 Solid Waste Collection and Disposal

Although solid waste collection and disposal is one of the major prescribed responsibilities of the city corporation/pourashavas, in all the project towns there are very limited resources available to undertake these duties. Detailed in Table 2.9 are the available resources in each of the towns.

TABLE 2.9 SOLID WASTE COLLECTION AND DISPOSAL RESOURCES

City Corporation/ Pourashava	Waste Receptacles (no)	Transport	
		Trucks (no)	Trolleys/Rickshaws (no)
Khulna	300	4 no 5 Tonne truck 1 no Tractor	8
Kurigram	20	1 no 3 Tonne truck	None
Panchagarh	25	1 no 3 Tonne truck	None
Moulvi-Bazar	7	1 no 5 Tonne truck	10
Habiganj	9	1 no 5 Tonne truck 1 no .5 Tonne truck	6
Dinajpur	250	2 no 5 Tonne trucks	1

Source: City Corporation/Pourashavas

Of particular note are the two 5 Tonne capacity trucks supplied to Moulvi-Bazar and Habiganj. In both these towns the pourashavas are unable to utilise these vehicles to any significant degree since the majority of the roads in the towns are too narrow for the truck to manoeuvre.

The method of solid waste disposal in each of the project towns was investigated as part of the household survey. Details of the results of the survey are presented in Table 2.10.

TABLE 2.10 SOLID WASTE DISPOSAL ROUTES

City Corporation/ Pourashava	Municipal Service (%)	Burnt/Buried (%)	Open Ground Drain/Canal (%)
Khulna	31	15	54
Dinajpur	27	20	53
Kurigram	21	10	69
Panchagarh	21	5	73
Habiganj	62	1	58
Moulvi-Bazar	12	47	45

Source: Household Survey 1991

Note: Percentages may not add up to 100 due to rounding.
Additionally in the case of Habiganj and Moulvi Bazar the percentages add up to a figure in excess of 100 because a proportion of the people are using more than one form of disposal route.

From the results of the survey it is evident that the present service operated by the towns is only utilised by a very limited number of householders. The figures for open ground/drain and canal disposal are interesting and verify the significant volume of solid waste which is disposed of in an uncontrolled manner. This is particularly important for the disposal of waste in drainage systems which, as mentioned in section 2.5, inhibits the flow and effective operation of the system.

The frequency of the domestic collection service is generally similar in all the project towns. In general, all people who made use of the municipal service received at least a weekly collection service, whereas only about 25% of the users received a daily or twice weekly service. Further details of the results of the survey are given in Appendix C.

The distribution of collection bins around the towns is generally confined to specific areas. Collection centres are not well defined or distributed in a manner to ensure proper coverage for the residents. In particular, the size and nature of the collection bins are inadequate to meet the needs, particularly in the market areas, core urban zones and bus terminals. These facts coupled with the limited transport facilities, result in the limited use of the service by residents.

Although attempts are being made by the municipal authorities to rationalise and identify specific locations for disposal, further strengthening of this approach is required. Landfilling systems need to be improved by the introduction of sanitary landfill practices, coupled with education of the population to ensure that solid waste is disposed of at assigned locations.

2.8 Slum/ Squatter Areas

Within all the project towns localised areas with poor housing and basic infrastructure facilities are evident. As might be expected in the larger towns of Khulna and Dinajpur, where the density of urbanisation is greater, the classical urban slum areas have developed. In the smaller regional towns slum areas in the normal sense, do not occur but generally house landless families or migrants from the rural hinterland who come to the town for work. The housing in these areas is of a marginally better quality than housing in the larger towns, but infrastructure facilities are comparable.

Details on the numbers of households living in slum/squatter areas and the land tenure situation in each of the project towns is presented in Table 2.11. The location of the slum/squatter areas are shown on the Existing Drainage drawings in Volume 2A.

TABLE 2.11 SLUM/ SQUATTER AREAS

City Corporation /Pourashava	Slum Squatter Area (no)	Population (no)	Households Number (no)	Private (no)	Ownership Households (no)
Khulna	54	53000	10000	51	7800
Dinajpur	41	47000	6600	28	4000
Kurigram	3	1200	270	0	0
Panchagarh	5	5000	1100	1	240
Habiganj	16	3400	500	6	168
Moulvi-Bazar	10	1500	190	7	127

Source: City Corporation/Pourashavas

It should be noted that in both Khulna and Dinajpur some of the slum areas are at present being improved under the UNICEF funded Slum Improvement Project. In Khulna two areas, comprising some 3200 households and in Dinajpur eight areas, with some 900 households, are benefitting under the SIP project. Specific details on all the individual slum/squatter areas in each of the project towns are presented in Tables 2.12 to 2.17.

In general, the numerous slums and squatter areas have the most acute environmental problems. This is particularly true in the two largest towns, Khulna and Dinajpur, where land for housing is at a greater premium. Although each of the slum areas has its individual characteristics, the worst of the slums have common features. The slums are generally located in the lower pockets of land with poor or no drainage facilities. Indeed in the wet season the land is often subject to flooding. Solid waste disposal is non existent, and waste as a consequence is either left within the compound area or dumped into adjacent watercourses. Sanitation facilities, where they exist, are primitive, comprising unsanitary service latrines or katcha latrines. Open defecation is common, and most of the excreta ends up in local ditches or ponds. Water supply is often available only on a very limited basis and for lack of an alternative option residents have to use polluted ponds in the vicinity for all general household duties such as dish washing, clothes washing and bathing. Most slums are constructed on privately owned land. However some individuals have colonised areas such as flood embankments and areas beside factories etc where they have illegally constructed houses with no right of tenancy or land ownership.

TABLE 2.12 SLUM/SQUATTER AREAS - KHULNA

Slum/Squatter Area		Location	Area (m2)	Population (no)	Households (no)
1		Labanchara Khalpar	9000	650	122
2		Shipyard	18000	1000	188
3		Smallpox ward	4000	150	28
4		Kheteat oil mill	* 12000	300	56
5	*	Liakat Ali park	4000	250	47
6	**	Rupsha char elaka	75000	15000	2825
7		Kalaghat 2nd lane	2000	125	24
8		2nd Kaston ghat	1500	400	75
9		Bagmara	3000	600	113
10		Nirala	7500	200	38
11		Shere Bangla road-2 areas	3500	400	75
12		Farajee para	1500	250	47
13		Daben Babu-3 areas	3500	800	151
14		Railway station	500	200	38
15	*	Shaikh para-3 areas	5000	1000	188
16		Hazi Ismail road	1500	500	94
17		Shaikh para siaf Quarter	500	200	38
18		Rear of Gibon Bima Corp	500	200	38
19		Bus Terminal	37000	3000	565
20	**	Sonadanga	21000	2000	377
21		Choto Boyra Kundupara	4000	300	56
22		Prem kanon road	1500	200	38
23		Boyra Palpara	5500	300	56
24		Rayer Mahal Jaila para	2000	100	19
25	*	BIDC road	30000	10000	1883
26		Alam Nagar para Mosjid	9000	2000	377
27		Muzgunni railway line	1500	200	38
28		Muzgunni Utterpara	2000	250	47
29		Goalkhali Munshi Bari	2000	400	75
30		Khalishpur Naya Bati	1000	200	38
31		Khalishpur Rd no 11 East	500	150	28
32		Khalishpur Natun Rasta	3000	300	56
33		Khalishpur Khama No 1	9000	1000	188
34		Khalishpur Trade School	1000	200	38
35		Khalishpur Khama No 2	4000	600	113
36		Khalishpur Baitulfalha	500	100	19
37		Khalishpur Bihere Bazar	500	100	19
38		Khalishpur Market road	2500	250	47
39		Khalishpur T & T	1000	100	19
40		Khalishpur Platenum Jublee Jute mills	500	150	28
41		Khalishpur Goalpara Community centre	4000	500	94
42		Khalishpur Kashipur Akman	17000	800	151
43		Daulatpur Datta para	4000	500	94
44		Mashwerpasha Kuli bagan	3000	200	38
45		Daulatpur railway gate	4000	400	75
46		Mashwer pasha Manik tola CSD Godown	2000	200	38
47		Mashwer pasha Maniktola	3000	200	38
48		Mashwer pasha Police fari	500	100	19
49		Mashwer pasha Daroga Dhigirpar	500	150	28
50		Mashwer pasha Banikpara	3000	550	104
51		Mashwer pasha Government Laboratory School	500	100	19
52		Mashwer pasha Dey para	1000	150	28
53		Mashwer pasha Moddodanga School	500	150	28
54		Muzgunni Rehabilitation Bustee camp	23000	5000	942
		Totals	357500	53125	10005

Source : Khulna City Corporation

Note * Area to be relocated

** Area included under the UNICEF Slum Improvement Project

TABLE 2.13 SLUM/SQUATTER AREAS - DINAJPUR

Slum/Squatter Area		Location	Area (m2)	Population (no)	Households (no)
1		Balu Bari	16000	982	140
2		Fakir Para Gurgola	27000	1300	185
3		Jogen Babur Field	17000	2100	299
4		Raj Bari/ Hatath para	8000	854	121
5		Paharpur	11000	731	104
6		Mirzapur Khristan Para	170000	3174	451
7		Kashba Khristan para	220000	1305	186
8		Gobra Pra	29000	871	124
9		Gulap Bagh	100000	1200	171
10		Bganghi Becha Para	31000	682	97
11		Upashar Mistri Para	31000	819	117
12		Dakhin Lalbagh	13000	876	125
13		Goal Kuti	10000	2300	327
14		Hatath Para	35000	1300	185
15		Islam Bagh	11000	851	121
16		Raj Bari Ulaw Para	30000	603	86
17		Kodaldha Para	13000	729	104
18		Nutun Para/ Hatath para	64000	861	122
19		Shipai Para	8000	524	75
20	*	Power House	5000	740	105
21	*	Baluadangah	7000	831	118
22	*	Balu Bari Muslim	5000	917	130
23	*	Kanchan Ghat	19000	726	103
24	*	Munshi Para Tal Pukur	4000	696	99
25	*	Moharaja School Dakhin	7000	732	104
26	*	Gudi Bridge	12000	698	99
27	*	Public Health	22000	703	100
28	*	Lalbagh Graveyard	9000	622	88
29	*	Chethra Para	24000	727	103
30	*	Rail Line	30000	2675	381
31	*	Ghagra Khal	20000	2975	423
32	*	Near Embankment	41000	5250	747
33	**	Ghasi Para	5000	455	65
34	**	South Balu Bari	7000	663	94
35	**	Mission Road	15000	821	117
36	**	Kanchan Colony	39000	1260	179
37	**	Sweeper Colony	3000	968	138
38	**	Dhaptari Para	56000	941	134
39	**	Hati Bagan	10000	790	112
40	**	Chotto Gurgola	12000	422	60
41		Suihari Ashram para	68000	?	?
		Totals	1196000	46674	6639

Source : Dinajpur Pourshava

Note * Area to be relocated
** Area included under the UNICEF Slum Improvement Project

TABLE 2.14 SLUM/SQUATTER AREAS - KURIGRAM

Slum/squatter Area		Location	Area (m2)	Population (no)	Households (no)
1	*	Power House	7500	534	110
2	*	New Hospital	2000	84	19
3	*	Ferry Ghat	13000	603	142
		Totals	22500	1221	271

Source: Kurigram Pourshava

Note * Area to be relocated

TABLE 2.15 SLUM/SQUATTER AREAS - PANCHAGARH

Slum/Squatter Area		Location	Area (m2)	Population (no)	Households (no)
1	*	Puratan Camp, Rameyar Banga	71000	2299	525
2		Bhular Banga	135000	1177	236
3	*	Nutun Basti Khalpara	30000	972	191
4	*	Puratan Panchagarh Nimangar Khalpara	8000	501	107
5	*	Near Pourashava Office	8000	395	72
		Totals	252000	5344	1131

Source : Panchagarh Pourshava

Note * Area to be relocated

TABLE 2.16 SLUM/SQUATTER AREAS - HABIGANJ

Slum/Squatter Area		Location	Area (m2)	Population (no)	Households (no)
1	*	Cows Market	3000	350	50
2	*	Danialfur	9000	730	104
3		Kurihati	3000	175	25
4		Anwarfur	5000	210	30
5		Natirfur	2000	175	25
6	*	Noahati	1500	105	15
7	*	Moddaahati Natirabad	1500	210	30
8		Rathanagor	1500	175	25
9		Gasainagar (Risihati)	8000	380	55
10	*	Cinema hall market	1000	70	10
11		Rajnagar (Risihati)	1000	60	8
12	*	Kaoli Patti (Edgah Rd)	6000	175	25
13	*	Chowdhury Bazar Sweeper Colony	300	60	8
14	*	Nag Company Sweeper Colony	600	80	11
15	*	Rajnagor Sweeper Colony	1500	105	15
16	*	Umednagor Talafi para	1500	350	50
		Totals	46400	3410	486

Source : Habiganj Pourshava

Note * Area to be relocated

TABLE 2.17 SLUM/SQUATTER AREAS - MOULVI-BAZAR

Slum/squatter Area	Location	Area (m2)	Population (no)	Households (no)
1 *	Salyer pur	150	150	19
2 *	Salyer pur	100	110	14
3	Berirchar road	750	230	30
4 *	Berirchar road	700	250	32
5	Dhaka Sylhet road	200	110	14
6	Dhakapan road	600	130	17
7	Dhakapan road	200	100	13
8	Gobindasree	250	125	16
9	Sultanpur road	300	200	26
10	Kazirgoan road	250	85	11
	Totals	3500	1490	192

Source : Moulvi - Bazar Pourshava

Note * Area to be relocated

2.9 Institutional Aspects

Following is a brief description of the government administrative system and the agencies involved in the proposed project works. Further details are found in Appendix G.

2.9.1 Bangladesh Government Administration System

At central government level there are thirty ministries in addition to the Presidential Secretariat. The country is divided into 4 divisions, 64 districts, 460 upazilas, 4,400 unions and over 68,000 villages.

Local government in the urban areas is provided by the pourashava, or municipality, with the exception of the four largest urban areas (Dhaka, Chittagong, Khulna and Rajshahi), which are served by city corporations.

Municipal organisations play an important part in the system of government in Bangladesh both as key local government bodies for urban areas and as agencies providing a wide range of public services to the urban population.

In 1983 the GOB adopted a comprehensive approach of decentralisation of development activities to the upazilas (sub-districts formerly known as thanas), the basic administrative unit in Bangladesh.

Today, at a time when decentralisation continues to be emphasised, the institutional capabilities of the pourashavas remain relatively weak. The pourashavas are responsible for local planning, administration and finance, and the operation and maintenance of urban services. However, in practice they lack the resources to undertake such tasks and do not receive adequate support from central government agencies.

In 1990, government accepted the findings of an earlier commission and decided to strengthen the pourashavas. In practice little has happened although the administrative framework does now exist for improvement.

2.9.2 Agencies Involved in the Programme

The two ministries concerned with flood protection and municipal services are the Ministry of Irrigation, Water Development and Flood Control (MIWDFC) and the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC).

The executing agencies for the programme will be the Bangladesh Water Development Board (BWDB) of MIWDFC and the Local Government Division (LGD) of the MLGRDC. The implementing agencies will be the BWDB (through their NE, NW, and SW Zone offices); the five pourashavas of Kurigram, Habiganj, Panchagarh, Dinajpur and Moulvi Bazar; and Khulna City Corporation under the Khulna Development Authority. The Local Government Engineering Bureau (LGEB) can provide technical support to the pourashavas on request to the LGD, but it is mainly responsible for the rural areas.

2.9.3 Institutional Capacity of Central Government Agencies

BWDB has a long tradition of involvement in flood protection works. Its strength is in its substantial engineering, organisation and implementation capabilities. Its weakness is its relative lack of emphasis on operation and maintenance, which tend to receive

less attention than capital works and suffer from inadequate funding. BWDB maintains an establishment of 18,000 with few vacant posts. The staff members, who have a wide variety of skills, can be moved from one office to another as regional work demands.

The Systems Rehabilitation Project (SRP) begun in October, 1991 is looking at the organisational structure of the BWBD with a particular view to strengthening the financial, operation and maintenance functions to ensure that the FAP projects, as well as other on-going BWBD projects, can be implemented and maintained efficiently. Staff training in operation and maintenance methods and skills is to begin in November, 1992 in regional and local BWBD offices and will continue for two years. Discussions with BWBD officials suggest that there should be little difficulty in implementing and maintaining the proposed project works in view of existing work commitments at local level and the improvements in skills and funding allocations for maintenance anticipated as a result of the SRP.

The LGEB is a central government agency with a rapidly growing workload. The Secondary Towns Infrastructure and Services Development (ADB TA No.1105-BAN) Final Report, June 1990 reported that ".....the LGEB is presently working at the full limit of its resource capabilities and it is expected that the majority of the newly created positions (as a result of the Project) would have to be filled through the recruitment of new staff."

This remains the situation. There does not seem to be a shortage of professionals to recruit from. However the LGEB establishment is now full and additional staff are appointed on a "temporary" basis and salaries paid by projects. Continuity of employment is achieved by a succession of new projects.

LGEB are currently responsible for a programme of 20-30 major projects, mainly funded under multi- or bilateral agencies, totalling around Tk 22,000 million. It would be difficult for them to take on the detailed design of project components for the municipalities. The LGEB, one of whose major functions is to provide technical assistance to the municipalities/ pourashavas, has a total permanent establishment of 9,800 (2,500 technical) with few vacant posts.

2.9.4 Institutional Capacity of the Municipalities

Staffing is a significant problem in local government. Of the 2,071 posts in the six municipal authorities, 524 (25%) are currently vacant. In four of the municipalities - Kurigram, Habiganj, Panchagarh and Moulvi Bazar - the problem is acute with 58%, 61%, 49% and 57% respectively, of all posts being vacant in August 1991. The current staffing situation in each town is presented in Table 2.18.

Within this overall picture some municipal divisions are better staffed than others. The divisions that will be particularly involved in implementation, operation and maintenance of the project are engineering, revenue and accounts.

The engineering divisions in the project towns appear to be in the worst position with 154 (36%) posts vacant out of a total of 426. Only Khulna has more than half of its posts filled. The other five all have high levels of vacancies with Habiganj 66%, Panchagarh 68% and Kurigram 71% being the worst. If the establishment of the engineering divisions is correct they must be having difficulties in fulfilling their current duties. Any additional responsibilities for implementation, operation and maintenance will inevitably increase the burden.

TABLE 2.18 : Existing Staffing Levels by Municipal Organisation, 1991.

DIVISION	Khulna	Dinajpur	Kurigram	Panchagarh	Habiganj	Moulvibazar	Total
SECRETARIAT							
Existing Staff	47	14	9	12	10	14	106
Vacancies (no.)	25	1	3	4	6	5	44
Vacancies (per cent)	35%	7%	25%	25%	38%	26%	29%
ENGINEERING							
Existing Staff	208	27	6	7	15	9	272
Vacancies (no.)	54	27	15	15	29	14	154
Vacancies (per cent)	21%	50%	71%	68%	66%	61%	36%
REVENUE							
Existing Staff	97	28	8	7	8	10	158
Vacancies (no.)	46	5	1	4	9	6	71
Vacancies (per cent)	32%	15%	11%	36%	53%	38%	31%
HEALTH							
Existing Staff	536	258	2	7	4	3	812
Vacancies (no.)	67	48	14	7	24	19	179
Vacancies (per cent)	11%	16%	88%	50%	86%	86%	18%
WATER SUPPLY							
Existing Staff	141	9	0	0	8	0	158
Vacancies (no.)	24	13	6	5	5	9	62
Vacancies (per cent)	15%	59%	100%	100%	38%	100%	28%
MAGISTRACY							
Existing Staff	0	0	0	0	0	1	1
Vacancies (no.)	5	0	0	0	1	0	6
Vacancies (per cent)	100%	0%	0%	0%	100%	0%	86%
ACCOUNTS							
Existing Staff	21	7	3	3	3	3	40
Vacancies (no.)	4	1	0	0	2	1	8
Vacancies (per cent)	16%	13%	0%	0%	40%	25%	17%
TOTAL							
Existing Staff	1052	343	28	36	48	40	1547
Vacancies (no.)	225	95	39	35	76	54	524
Vacancies (per cent)	18%	22%	58%	49%	61%	57%	25%

Source: Information collected from Khulna Municipal Corporation and the Pourashava Offices in August 1991.

Generally the accounts and revenue divisions are relatively better staffed but even these have nearly a fifth of their posts unfilled. Optimising revenue collection and improving accounting and management techniques is essential to the success of the project.

2.9.5 Municipal Finance

The two major sources of revenue for pourashavas and city corporations are government grants and locally raised funds. Government transfers consist of recurrent grants for salary and octroi compensation, which are generally consistent from year to year, and development and maintenance grants which are dependent on the particular needs of the pourashava in that year. In most pourashavas Government transfers now make up more than half the pourashava's revenue.

The major sources of internal revenue are from property based charges, including rental value based taxes; rates for street lighting, water supply and conservancy; and immovable transfer property tax. Individual pourashavas are required to reassess all properties every five years, and have the discretionary power to reassess in the interim period if conditions warrant it.

The one additional source of revenue that the municipal corporation has is that it is able to raise loans in its own right.

About half of local government own revenues are derived from taxes levied on property (holding tax, conservancy, street lighting, and water supply), usually totalling 17% - 23% of 10 months rental value (the other two months are assumed to be used by households and businesses for maintenance).

In most of the towns property assessments were made in 1985/86 and have been updated within the past two years. The results were used in determining the 1991/92 budget and so the impact on collection efficiency and total revenues cannot yet be assessed. In one instance the new assessment should yield a revenue increase of 50%. Collection efficiency ranges from 30% to 60%, however, suggesting that higher rates might further reduce efficiency and yield less than anticipated. It has been suggested that in some towns the collection rates for newly billed taxes is as much as 90% and that the lower efficiency rates reflect large, longstanding arrears from a small number of householders. If this proves to be the case, the potential for increasing revenues through improving collection efficiency may be limited.

The pourashavas and the municipal corporations are required to prepare budgets which are submitted to government for approval and/or modification. They are also required to prepare revised budgets, usually before the end of the financial year. In addition they are required to prepare annual statement of accounts at the end of the financial year and submit this to government by December 31 of the following financial year.

Proposed and actual municipality budgets for recent years are shown in Appendix D. It will be noted that differences between proposed and actual budgets are often quite marked, especially in expectations of grants for development works. The last one or two year's (depending on town assessment schedules) budget estimates are based on increased property valuations for own revenues.

The Secondary Towns Project found that accounts were maintained in strict accordance with the established rules, but that these procedures contain weaknesses.

They also discovered that the extremely wide variations found in tax collection levels were directly related to the quality of service the pourashava/city corporation was able to provide. This has also been the experience of this project. Some of the difficulties of the current budgeting and accounting systems in local government are summarised below:

- Budget preparation for capital expenditure for development projects is based on the past year's grant levels and the desire for improvements, without knowledge of what is available from central government;

- Revenue estimates include arrear taxes and rates added to the current year's demands making it impossible to assess collection efficiency from year to year and overstating potential revenue;

- Assigned revenue and expenditure headings are unclear and often enumerate many small items while leaving larger ones grouped together in miscellaneous categories. Also capital development and maintenance works are often combined;

- Assessment records are not kept in sufficient detail to note property improvements and ensure that the full potential tax can be realised;

- Penalties for late payment are so miniscule as to make it worthwhile for the taxpayer to delay payments, especially since the penalty is a one time only fine of 5% - once the payment is late, this is due regardless of how long the account is in arrears.

Development Criteria

3. DEVELOPMENT CRITERIA

3.1 Component Selection Criteria

The works to be incorporated in the Project programme have been developed taking into account factors encompassing inter alia technical, economic, social and environmental considerations. In particular the project components have been selected with due regard to need, affordability, technical appropriateness, implementation capability, operational suitability and environmental concerns.

The need for each component has been determined with regard to improving deficiencies in both the flood protection works and infrastructural facilities in each of the project towns. The components must be affordable both by the GOB, the municipalities and individual beneficiaries in order to ensure that the project is economically viable. The works defined must be technically appropriate to the problem being solved and also take due regard of environmental factors. In addition, the works need to be capable of rapid implementation utilising locally available materials, techniques and equipment wherever possible, to ensure that costs are minimised.

The components included in the project have all been identified as being necessary, affordable and suitable for immediate implementation.

It should be noted, however, that the Integrated Plans that have been drawn up under this project are linked with the wider development plans for the adjacent areas being undertaken by other studies, including the FAP studies, and therefore any design criteria should be compatible. Also these Plans are of immediate priority and are not necessarily comprehensive. They are a fast response to the reduction of flood risk and to the need for environmental improvement and should be viewed in the context of an incremental approach to development. As other studies are completed there will be potential for extending the coverage of certain scheme components (eg surface water drainage), using consistent design criteria.

3.2 Design Criteria and Standards

All works selected for inclusion in the project have been identified on the basis of needs of the urban population for both protection from flooding and improvement to the environment. The flood protection works and drainage and environmental improvements (ie, sanitation, solid waste and the slum/squatter area improvement programmes) will complement each other, providing a healthier and safer environment for the residents of each town. The Design Criteria suggested are fully detailed in Appendix B "Basis of the Integrated Plans." These criteria are set out fully in paragraphs B1 to B7 of Appendix B, are consistent with BWDB and LGEB current practice and are considered to be technically appropriate as the basis for designs under this study. For a full design statement and methodology for the design of flood protection and bank protection, reference should be made to Annex B1 of Appendix B. Statements on river levels for embankment design and design flow velocities are covered in Appendix A "Hydrology". During the coordination process with other studies, full attention has been given to the need for engineering and hydrological standards under this study to be compatible with those for works of a similar nature within the other FAP studies.

The principle criteria utilised in the development of appropriate design standards have been based on economy of construction, durability and ease of maintenance. In particular, for the flood and bank protection measures, use of locally available materials, such as boulders, cement concrete (cc) blocks, bamboo piles etc, has been specified wherever feasible, in preference to imported materials, whether from outside the regional locality of the town or from abroad. Similarly, for the construction of the latrines in the sanitation sector, the use of locally available bricks for construction of the surrounds for the pit is in general preferred to the use of precast concrete rings, unless economics of scale can produce savings in the overall context of the town programme.

Based on the above premises, advice and assistance from the local offices of the BWDB have been used in the development of the proposed works for the flood and bank protection. The nature of works to be constructed, coupled with the materials used in the construction, should thus be well known to both the Contractor and the local BWDB, who will be required to maintain the works after completion of the project programme. With regard to the municipal programme a similar approach is required and in this context LGEB standards designs for infrastructural improvement works should be used. These designs have been formulated, developed and implemented throughout Bangladesh and have a proven record of providing a satisfactory level of service at a reasonable cost. In addition the LGEB designs promote the maximum use of local materials, technology and resources and are familiar to the municipal agencies, contractors and the public.

Some standard type designs (which have been developed from the LGEB standards) are included in Appendix B for reference.

In summary, the design criteria adopted for different items of works of flood control, erosion control, drainage, sanitation, solid waste disposal and slum improvement have been described in detail in Appendix B of the Final Report. Paragraphs B.2, B.3 and Annex B 1 of Appendix B provide all design criteria and the methodology for the design of flood protection and bank erosion works. Paragraphs B.4, B.5, B.6 and B.7 represent the corresponding criteria for drainage, sanitation, solid waste disposal and slum improvement works respectively.

3.3 Basis of Cost Estimates

The cost estimates for the works were based on "preliminary/outline engineering design" as specified in the terms of reference for the study.

Cost estimates for the flood and bank protection works have been based on local rates, determined following discussions and reviews of preparatory designs for similar works produced by the local office of the BWDB. This has led, in certain instances, to variations in rates for similar work-items from town to town but reflects the local availability of labour or materials and the consequent increase/decrease in the cost of the works. The rates are based on mid-1991 costs. Where land acquisition is required, specific reference has been made to the local BWDB office, in order to define an accurate cost per hectare and reflect the prevailing conditions in this area. At the request of the ADB all cost tables were later adjusted to January 1992 levels.

Similarly for the municipal engineering elements of the work programme, unit costs for the various proposed works have been developed using cost information from various sources. Details are outlined below.

- Unit rates produced by LGEB for the year 1990/91.
- Costs utilised in the Secondary Towns Infrastructure and Services Development Project, June 1990.
- Costs utilised in the Dhaka Integrated Flood Protection Project, (FAP 8B), August 1991.
- Costing information provided by the local municipal officers of the various towns.

Unit costs were initially developed at a mid-1991 base and later adjusted to January 1992 using the LGEB standard rates for the appropriate town. It was determined that although some variation in the unit cost of the work items varied from town to town, the variation was not significant (within generally 10%), and thus an overall national average rate could be adopted. The rates were then compared with those adopted in the two infrastructure projects noted above (suitably adjusted for inflation where necessary) and also, in certain instances these were compared with estimates for specific work items produced by the municipalities. The resultant unit rates ultimately used in the costings exercise were determined taking into account the above rate variations from these various sources.

For the cost of land acquisition in connection with the solid waste and sanitary landfill sites, reference was made to the appropriate municipality regarding specific parcels of land, in order to obtain an accurate estimate for the cost per hectare. Indeed, in two of the project towns, ie Khulna and Habiganj, the designated land was already owned by the municipalities and thus no cost was allowed in the estimates. The notional costs of this land has however been obtained from the authorities and reference made to them in Section 6.

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

The total project costs derived in the estimates include all costs relating to land acquisition, civils works, operation and maintenance, provision of material and equipment, detailed engineering design and tender documentation, and training. Physical and price contingencies were added to these costs as an integral part of the financial and economic evaluations and are discussed in Section 6.

In determining the total base costs, various factors were added to the individual works' costs, the details of which are presented below.

Operation and maintenance costs for civils works:

- For flood protection and bank protection works - 2% for earthworks elements and 1% for all other elements
- For surface water drainage works - 1.25% of the civils works' cost.
- For sanitation civil works elements (but not including latrines, the O and M of which would be the responsibility of the beneficiary) and solid waste civil works elements - 5% of the civil works cost.

Design and Tender documentation of flood and bank protection works and surface water drainage works - 5% of the civil works cost.

Physical Contingencies

- For design and tender documentation costs - 15%.
- For all other elements - 10%.

Individual base costs estimates (based on mid-1991 rates and our tables adjusted to Jan 1992) for flood protection, bank protection, surface water drainage, sanitation, solid waste collection and disposal, slum area improvements, the Project Management Unit and the six Project Implementation Units including logistics support to both the Khulna City Corporation, the five pourashavas and the six BWDB offices involved; are presented in Appendix F.

3.4 Feasibility Study

In the first two phases of the design development (at Inception and Interim Report stages) study reviews, data collection and preliminary proposals for all aspects of the integrated plans were made.

The main purpose of the feasibility study was to define the scope of the project adequately in order that the benefits to be expected can be considered fully and quantified, and estimates costed with a reasonable degree of accuracy. Major decisions on project development are normally made following the study of the feasibility report.

The "preliminary/outline" designs required for the feasibility study, for each component of the integrated plans, have been based on design criteria which generally conform to the existing design standards of the BWDB and the LGEB. For example, suggested design criteria for the flood protection embankments have been based on guidance provided from a number of recent reports including the BWDB "National Flood Protection Programme for 85 Towns" dated 1988. The LGEB and BWDB have similar design standards for drainage in comparable situations.

Similarly, for the municipal works, the standards adopted for the "Secondary Towns Infrastructure and Services Development Project" issued in June 1990, and the "UNICEF funded Slum Improvement Project" have been used. These criteria are set out fully in Appendix B where they form a key part of the discussions on the "basis of the integrated plans."

In order to define the scope of the proposed works to be included in the programme, comprehensive field surveys were made in each of the selected towns to determine the existing conditions in these towns. The field surveys were undertaken to gain information on the following factors:

- To meet and have discussions with local BWDB, city corporation and pourashava staff to obtain information on existing problems in the town and to gain information on the local attitudes to items to be included in the project programme. Also to assess the present deficiencies in the town.

- To review areas/locations where active bank erosion was occurring and where embankments had failed and to discuss with the BWDB officials the extent of the inadequacies in the existing flood defences.

- To review the extent of the surface water drainage systems in each of the towns and to discuss with the local officials underlying inadequacies in the systems.

- To obtain information on the existing municipal services provided in the fields of sanitation and solid waste collection and disposal, and to identify any ongoing infrastructure improvement projects including any recently completed, or projects that are programmed to commence in the immediate future.

- To obtain information on municipal finance, tax collection and land prices, together with information on present staffing and hence staffing deficiencies of the various municipal departments.

- To identify areas where slum improvements were required and to review areas of the towns (in Khulna and Dinajpur) where slum improvements were already being undertaken under the UNICEF Slum Improvement Project including holding discussions with beneficiaries to determine their views on the ongoing programme.

Comprehensive socio-economic surveys were also carried out in each of the project towns to obtain up to date information on income, household size, sanitation facilities and solid waste disposal methods and techniques. The results of these surveys are presented in Appendix C.

In the case of the flood protection and bank protection works, outline rehabilitation proposals produced by the BWDB were reviewed and discussed with the local staff. Also, additional localised topographic surveys were instigated (bank profile, local plane table and cross sections) in order to define the present profiles and extent of the sections under review. The outline designs produced by the BWDB were reviewed and revised proposals were formulated taking into account the up-to-date information provided by the topographic surveys.

With regard to the municipal elements of the project, base plans for each of the towns were produced from existing plans and maps provided by the pourashava officers, or other planning studies (such as for Habiganj and Panchagarh where recent mapping had been produced by the Netherlands/Bangladesh 18 Towns Project team). Although the existing municipal maps are generally poor, often produced at non standard scales, they were found to be adequate for the purposes of the study. Visits were made to each of the towns to accurately mark and locate on these plans the existing surface water drainage systems and slum areas as defined by the municipal authorities.

In order to assist in the development of the drainage proposals, topographic spot levelling surveys at road intersections were undertaken in the towns of Khulna, Dinajpur and Kurigram. Survey information was already available at Panchagarh and Moulvi-Bazar from the Netherlands/Bangladesh project. No survey was carried out in Habiganj since it was possible that the town would also be included in an extension to the Netherlands project programme (see Appendix K for details).

Using the topographical information provided from the survey, the individual surface water drainage catchments were identified in each of the project towns. An example of this was in Khulna where some 28 individual catchments were identified. The individual networks within each of the catchments were then rationalised by the insertion of additional or enlarging the existing main drainage channels as appropriate. A computer programme based on the well known "Rational Method", normally used for the design and analysis of urban storm drainage, was used to analyse all catchments, in order to highlight deficiencies in the drainage cross-sections and gradients. A demonstration of this analysis is attached to Appendix B.

Using this method, improvement works required to create an integrated drainage network and to eliminate or reduce drainage congestion in Khulna, Dinajpur, Habiganj, and Kurigram were evaluated and costed. For Moulvi-Bazar and Panchagarh preliminary proposals were already available from the Netherlands/Bangladesh 18 Towns project. For these towns the Dutch proposals have been adopted as a basis for the currently proposed design layouts. The Dutch, however, have only proposed to implement portions of their designed work. Costings for the remaining portions proposed to be implemented under this project were independently produced based on sizing by the same method as used for similar catchments in Khulna as a model.

In general for all towns, the surface water drainage proposals of the improved systems will utilise existing channels and drainage routes. However, in Khulna a radical new strategy will be required in order to accommodate the flows derived from the municipal area. This is discussed separately in Section 3.5.

With regard to the environmental elements of the project (sanitation, solid waste and slum improvements), the components to be included in the project have been developed from information derived from the socio-economic surveys for sanitation and solid waste, and from information provided by the municipal authorities with respect to security of tenure for the slum area improvements (see Section 2 for further details). Only those areas, where security of tenure is assured, have been included in the programme.

3.5 Strategic Drainage Disposal in Khulna

The disposal of stormwater (at the terminal drainage outlets) can sometimes be impeded by high water levels in the receiving river. This is generally due to river flood events (which are often generated by heavy rainfall in the upper river catchments many kilometres away) and in the case of Khulna by the additional component of high tides, which are seasonally elevated during the monsoon period.

Therefore consideration has to be given to both the strategy and the design details for eventual disposal of the water either by storage within the drainage system itself, or alternatively in protected storage detention basins with provision of flap valves at outlets as appropriate.

In the case of Khulna, detailed consideration was given in the feasibility study to the wider issue of strategic disposal, primarily because the town is considerably larger (both in area and population) than the other five towns, but also because the main receiving river is tidal. The magnitude of the problem was thus determined and the technically appropriate design standards and strategy confirmed. Urban Khulna is largely built on a natural river levee which fronts the Rupsa river. This natural levee

constitutes the major watershed for the town, with land to the east (approx 9km^2) draining direct to the Rupsa, and land to the west (approx 20 km^2) draining to the adjoining tidally protected polders via the Khudi Khal, Gallamari and Hatia Nadi rivers. (see drawing in Volume 2A).

The majority of the outfalls to the river are such that even at the highest recorded tide level (approximately 3.1m PWD), full impedance of the drainage at outfalls will not occur. However, for those catchments in the south of the town, the whole cross section of the drainage outfalls can be completely blocked during high tides. These outfalls therefore require flap valves to prevent back flooding up the drainage system by tidal waters. Moreover, if a storm event occurs when such impedance is present, then flooding from the stormwaters would occur, and the only way to completely eliminate such flooding is by pumping. This situation is currently reflected by the existing pumping station at Rupsa Ghat. The drainage analysis indicated that for storms of duration equal to the period of complete closure of the flap valves, the Rupsa Ghat pumping station is undersized for handling flows from the existing area. Also, for full alleviation of flooding considerable new pumping capacity would be required for two catchments to the north of the station and one to south.

Consideration of the initial capital cost (estimated at 800 million Taka) and on-going maintenance and operation costs of these new stations, in relation to the areas protected, and the probable incidence of extreme flooding, precludes provision of the pumps. The approach adopted, therefore, has been to truncate, wherever possible, the drainage of those catchments leading to the relevant outfalls, and to direct the drainage (in some instances against the natural grade) towards the western drainage routes and flood protected polders.

Currently the whole of the westward draining area of approximately 20 km^2, is intercepted by the Khudi Khal or Gallamari river and directed to the southern polder (East 28/2). This constitutes an additional surcharge from the drainage of the city of 107% by area, as the area of the receiving polder is only 18.72 km^2.

Consideration of the following:

- design full supply level for the existing polder embankment (approx. 3m. PWD.),
- average ground levels of the peri-urban areas of Khulna (circa 2m. PWD. and higher),
- local residents' reports of depth and duration of flooding from storm waters,
- indicated areas and causes of flooding for peri-urban Khulna shown on the relevant drawings (see Volume 2A),

leads to the conclusion that the Polder East 28/2 is currently over-surcharged in respect of its role as a tidally-protected basin for reception of urban storm water. Moreover, the proposed internal drainage network improvements to the town will tend to exacerbate the "under-design" of the existing polder basin capacity. This is because blockages in the natural outlets from the current flood detention in channels within the town will be reduced, allowing the waters to be carried more directly and more quickly to the polder detention basin. Unless the polder drainage is properly addressed, the significance of introducing the new drainage will be both a greater depth and longer

duration of flooding in the polder, together with an increase in the quantities of pollutants (collected from the catchments and drains within the town), and transferred to the western polders.

In order to mitigate this problem, it is currently proposed to radically divide the combined storm flows from the catchments of the town. For example, the flow from those catchments to the north of the existing Budhukhali sluice will be redirected to Polder 28/1, rather than to the Gallamari river. Additionally, the resulting urban runoff will be routed directly to the Polder outlet sluices by specific main drainage routes thereby avoiding dispersion of pollutants except when it becomes unavoidable when general inundation of the polder occurs.

The fundamental division of the catchments, as proposed above, results in an area of 11 km^2 remaining to be disposed of to Polder 28/2 (East), constituting an additional surcharge of 59%. Also 9 km^2 would be disposed of to Polder 28/1 (with an area of approx 40 km^2) constituting an additional surcharge of 22%. The topography and existing drainage lines will not permit a more even distribution of the urban drainage surcharge.

A preliminary evaluation of the behaviour of the Polder 28/2 East basin with the proposed urban drainage load imposed on it was undertaken. The evaluation assumed that the basin had an initial "flood level" due to the requirements of rice cultivation and that the existing ten vent sluice would be operated to ensure optimum discharge of retained flood waters as soon as tidal levels at the outfall into the River Rupsa permitted. Relevant rainfall depths on the catchments, in the range between 2 and 24 hours, were interpolated between the intensity duration frequency and depth duration frequency analyses which are outlined in Appendix A. An areal reduction factor (ARF) was taken from the analysis published by the Japan International Cooperation Agency (1987). The resulting analysis showed that a storm of duration of about 6 hours occurring at the critical period, just prior to and during closure of the tidal flaps, produced the greatest water level rise in the basin.

Indications are that this potential event would cause an overall rise in water level in the polder to a level of some 2m. This level is probably just acceptable in respect of allowing drainage of the peri-urban areas of the town for which the largest proportion has a level of over 2m. PWD. However, no account has been able to be taken of backwater curve effects or of the detailed topography of the basins because of the lack of reliable up to date survey data. Detailed design work would need to consider these aspects so as to enable the analysis to be undertaken with a greater degree of confidence in the predicted result. It is however considered that the current analysis based on a simplistic view of the topography and filling sequence is not overly conservative.

Taking into account the likely sensitivity of the drainage basin model and the margin of "freeboard" available to ensure peri-urban areas do not "backflood", it is concluded that further significant incursion of the urban area onto the Polder 28/2 East (as proposed by the Khulna City planning proposals) will probably be unacceptable. This is because it would cause loss of storm water storage volume and consequently result in unacceptable water level rises in the polder. Also any proposal to divert additional flood water from the rural areas of Polder 25/1 (to the north of the city) into Polder 28/1 and thence to Polder 28/2 would be unacceptable in the context of the efficient drainage of Khulna.

No rigorous assessment of the result of the urban drainage surcharge on Polder 28/1 was able to be undertaken because of the lack of topographical information. However, on the basis of assumptions regarding the capacity and behavior of Polder 28/2 (East) it is possible to extrapolate a need for additional outlet sluices for Polder 28/1, to be located at Kayerhat.

Moreover, as Polder 28/1 currently experiences flooding which is deemed unacceptable by the local landowners, there will be a need to provide additional sluices to resolve this drainage outfall capacity problem. This current unsatisfactory performance of the drainage of Polder 28/1, and the resulting need for additional sluices to resolve both this problem and that of the proposed additional urban load, therefore, precludes any proposal to further load the polders with flood waters from the rural Polder 25/1 to the north of the town. It should be noted that even if yet more sluices were added to handle a further load, the resulting short term rise in polder flood level would be unacceptable on both environmental and engineering grounds.

The area of the city to the north of the C.S.D. Godown (North Daulatpur) which naturally drains to the west, suffers flooding at its perimeter due to the inadequate drainage of Polder 25. Resolution of the flooding in this peri-urban area is dependent on a solution being found to the problems of the Polder 25 drainage. This will also apply to any proposal to provide adequate drainage to any further northerly extension of the town. Significant development of the drainage in this presently limited area, should accordingly be postponed .

It should be noted that this preliminary work on the "strategic drainage disposal for Khulna" set out above, was undertaken in order to support the design work on the improvement of the existing drainage system within Khulna municipality itself. In no way is this preliminary work intended to prejudice the studies presently being undertaken by the Khulna Coastal Embankment Rehabilitation Project.

3.6 Coordination with Other FAP Studies

The regional studies which are being undertaken in the FAP programme have been consulted in relation to basic design criteria for flood protection and river training works in the areas of the country concerned. FAP 1 study has provided water level data for the Brahmaputra in relation to studies on the Dharla River at Kurigram by FAP 2. However, it should be noted that none of the north-western secondary towns under this study fall within the boundaries of the proposed NW regional model. This model is in any case for 1:20 year return period flows and not for the 1:100 years required for the design of town protection. FAP6 has been consulted in the studies for Moulvi Bazar and Habiganj. The FAP6, NE regional model will incorporate reaches of the Manu and Khowai rivers through Moulvi-Bazar and Habiganj respectively but the calibration period will only be completed towards the end of 1992.

77 During the detailed design phase FAP 4 will provide data on the Bhairab River and other rivers in connection with both the drainage of Khulna and also the design of river bank protection works.

At the meeting on the 3rd October 1991, the timing and the method of incorporating the results from these regional studies, (FAP 2, 4 and 6), into this study were discussed. It was agreed that, where the results were available in time, they would be incorporated into the feasibility designs of this study; otherwise the results, particularly

with respect to flood levels, would be incorporated later at the detailed design stage. In addition, close coordination was maintained with relevant supporting studies, including FAP 15 (Land Acquisition and Resettlement), FAP 16 (Environmental) and FAP 25 (Flood Modelling/Management).

The effect of embankments, which may be proposed later in the regional studies in relation to compartmentalisation, will eventually be fully incorporated into the design of flood protection and drainage works proposed in the present study.

However, despite the shortcomings in the timely availability of certain river stage and flow information to the present study, it is not anticipated that future data from the above FAP studies will have any major impact on the present designs used for the feasibility study. The present designs have been developed cautiously taking full consideration of the existing hydrological data summarised in a major Appendix A and based on sound practical knowledge of the sites' past and present flood history.

The Integrated Plans

4. THE INTEGRATED PLANS

4.1 The Project Components

The proposed plans include as the project components a mixture of both urgent flood protection, river erosion rehabilitation and drainage works and also the provision of environmental improvement facilities in the areas of sanitation, solid waste collection and disposal and slum area improvement. These works will complement each other to provide an improved and safer environment for the residents of each town. Details of the reasoning behind each of the elements incorporated in the proposals is presented below and more specific details of the location of the works on a town-by-town basis are set out in Section 4.2. Integrated plan drawings for each of the project towns are presented in Volume 2A.

It should be noted that these components have not been developed in isolation but have been built up on the experience of earlier work, supported by the ADB, notably on the Secondary Towns Infrastructure and Service Development Project (ADB Loan 1059-BAN) approved December 1990, and the Dhaka Integrated Flood Protection Project (ADB Loan 1124-BAN) approved November 1991.

4.1.1 Flood Protection Works

The works proposed in the towns are those that are considered urgent to maintain the existing levels of service according to the criteria adopted by the BWDB. The works are required in order to strengthen and reinforce the existing protection works and to provide increased protection from flood risk for the residents of the towns.

The crest levels chosen for strengthening of the existing town flood protection embankments and for new construction of "retired" embankments (between existing embankments) will generally correspond to a 100 year return period with a freeboard of 0.9 meters. This is the case for example with the north-western towns of Dinajpur, Kurigram and Panchagarh. However this is not the case on the rivers Khowai and Manu which are fully confined through the north-eastern towns of Habiganj and Moulvi Bazar, by embankments on both the left and right banks. These embankments serve to protect both the towns and the adjacent rural areas but in the latter case a lower design standard of 50 year return period is normally applied. Though it is intended to generally adopt a standard of 1 in 100 year return period, this could not for practical reasons be applied in the towns of Habiganj and Moulvi Bazar where there are special difficulties due to the Railway bridge at Shaistaganj, upstream of Habiganj town, and Monu Barrage upstream of Moulvi Bazar town. The deck level (open level) of Shaistaganj railway bridge, which is well above the recorded highest occurrence of flood, is recommended as the design flood level for Habiganj flood protection embankment. The flood protection embankment for Moulvi Bazar will be designed on the basis of the existing Monu Barrage flood level ie 14.32 m PWD with gates fully opened.

It is understood that the town of Khulna is not considered by the BWDB to be at risk from overtopping of the existing embankment along the tidal Rupsa river. Crest levels of the proposed retired embankment at the Alutola site will therefore be the same as that of the existing embankment at that location.

To define the necessary works in this field site visits to each of the project towns have been made and discussions held with the local BWDB officials. Where available existing preliminary designs were reviewed. In addition, localised plane table surveys (in Panchagarh and Moulvi-Bazar), and embankment longitudinal surveys (in Kurigram, Moulvi-Bazar, Habiganj and Dinajpur) have been completed to provide base information for the development of the flood protection proposals. Embankment longitudinal and cross section surveys have also been collected from the BWDB offices at Khulna and Panchagarh.

Detailed below in Table 4.1 is the proposed scope of the flood protection works to be included in the project. In addition, drawings detailing the outline of the proposed works are presented in Volumes 2A and 2B.

TABLE 4.1 FLOOD PROTECTION WORKS

City Corporation/ Pourashava	Embankment Construction		Flood/ Core Wall	Regulator Structures	
	New (m)	Rehabilitated (m)	(m)	New (no)	Rehabilitated (no)
Khulna	900	-	-	5	1
Dinajpur	-	28000	-	8	1
Kurigram	-	2000	-	2	-
Panchagar	150	3500	-	5	-
Habiganj	2000	-	-	2	-
Moulvi-Bazar	1500	7700	1800	-	-
Total	4550	41200	1800	22	2

4.1.2 Bank Erosion Protection Works

The bank protection works are necessary to protect areas in the existing flood defences which are being eroded. The works are necessary to both protect the existing investments and, where applicable, prevent potentially catastrophic failure of the town defences. Revetment works above low water level are generally formed from boulders/concrete blocks or brick mattressing laid on a khoa filter. Some filters are now being formed with geotextiles though maximum use is being made of local filter materials. Below low water level, traditional launching (falling) aprons of boulders and cement concrete blocks are used to support and protect the upper revetment slopes.

Similarly, site visits were made to each of the project towns to review the areas where erosion was occurring, in order to establish the location and extent of the areas of erosion, the factors contributing to the damage being caused and to define the most appropriate design for the remedial measures. Where available, existing designs were reviewed. In addition, local bank profile surveys of specific sections where protection measures are envisaged have been completed in all the project towns, to provide base information for the development of the flood protection proposals.

Detailed below in Table 4.2 is the proposed scope of the bank protection works in the project. In addition, drawings detailing the outline of the proposed works are presented in Volumes 2A and 2B.

TABLE 4.2 BANK PROTECTION WORKS

City Corporation/ Pourashava	Bank Locations (no)	Revetment Works Length (m)	Groyne/ Spur Works Repairs (no)	New (no)
Khulna	5	3650	-	-
Dinajpur	4	2700	-	2
Kurigram	4	*1000	2	2
Panchagarh	2	1000	1	-
Habiganj	18	3640	-	-
Moulvi-Bazar	5	2350	-	-
Total	38	14340	3	4

Note * Not continuous, at specific designated locations only.

4.1.3 Surface Water Drainage Improvement Works

Drainage improvement works are required in order to create an integrated drainage network and to eliminate or reduce drainage congestion in the towns. Poor drainage is a serious health hazard and contributes substantially to road deterioration and attendant high maintenance costs.

This component has been integrated with the flood protection component in order to maximise the affect of, and permanently protect, these improved drainage facilities. Because of funding constraints this component was reduced in coverage from that originally envisaged eliminating, for example, several peri-urban areas with a lower population density. Also because of the high contribution to the project costs, alternative arrangements to expensive pumping facilities were adopted in Khulna. These cheaper methods, involving the provision of larger regulators and truncation of the existing drainage system, will not totally eliminate the drainage problems but should improve the situaion.

Site visits have been made to four of the project towns, Khulna, Kurigram, Habiganj and Dinajpur to review the present drainage systems and to produce plans of the existing drainage layouts in the towns. Drainage layout plans of the remaining two project towns, Panchagarh and Moulvi-Bazar, have already been produced as part of the ongoing Netherlands/Bangladesh 18 Towns Water Supply, Sanitation and Drainage Project. In addition, as part of the design development process, during the site visits the dimensions of the existing drainage channels at various locations throughout the town were measured.

Topographic surveys, comprising spot levelling at road intersections, have been completed in three of the project towns (Khulna, Dinajpur and Kurigram), to provide base information for the development of the drainage upgrading proposals. Contour plans of both Panchagarh and Moulvi-Bazar are already available from the 18 Towns project mentioned above. At present it is not proposed to undertake a topographical survey in Habiganj. During discussions with the 18 Towns project team, consideration was being given to the expansion of their project to include drainage improvements for a further 6 towns, one of which would be Habiganj. A decision on the inclusion of Habiganj in the expanded 18 Towns project is still to be taken at the time of production

of this report. However, it is known that the Dutch aid project has sufficient funds to implement only a portion (of the order 20 to 25%) of the necessary drainage works in both Panchagarh and Moulvi-Bazar and thus will certainly not implement the whole of the necessary works in Habiganj should they include the town in their project.

The scope of the drainage improvement works is outlined in Table 4.3. In addition, drawings detailing the outline of the proposed works are presented in Volume 2A. The scope of the work also includes the rehabilitation and cleaning of all drains the remodelling and provision of new (primary and secondary) main drains and tertiary drains. These drains will all be either pucca or katcha standard of the types used traditionally in large towns in Bangladesh including Khulna. Cover slabs will be provided over pucca drains of the whole range of sizes to provide personal and vehicular access as required. This may be more continuous cover in certain constricted areas where the full roadway width has to be maintained.

TABLE 4.3 DRAINAGE IMPROVEMENT WORKS

City Corporation/ Pourashava	Rehab/Clean Existing Drains (km)	Urban Drainage Area Coverage (ha)	Remodelling/ New Drainage Main (km)	Tertiary (km)	Culverts (Road Cross-section (no)
Khulna	86.7	21.26	75.0	125.0	700
Dinajpur	40.6	7.95	16.3	12.0	41
Kurigram	15.2	4.05	21.3	10.0	30
Panchagarh	12.4	1.87	3.4	8.4	19
Habiganj	17.9	1.70	13.3	9.9	50
Moulvi-Bazar	23.2	1.79	6.9	9.0	16
Total	196.0	38.62	136.2	174.3	856

Note: The lengths of new and remodelled drainage in Panchagarh and Moulvi-Bazar relate to the additional works over and above the drainage works in the central areas of the towns for which funds have already been allocated under the Netherlands/Bangladesh Development Cooperation Programme, 18 Towns Water Supply, Sanitation and Drainage Project - see Appendix K for details.

* Note that both primary and secondary drains are included under the general heading "main" drain.

4.1.4 Sanitation

The provision of low cost sanitation services in the towns is necessary in order to provide an improved and healthier environment for the residents of the town. The provision of sanitary facilities will significantly reduce the risk of outbreaks of water related diseases with the attendant benefits to the residents of the town and savings for the health authorities.

The recommended long-term target for the Government is the adoption of sanitary disposal facilities by 90% of the pourashava populations by the year 2000. The original aim was the provision of sanitary facilities in the project towards this target also taking account of the findings of the household surveys (see Appendix C). However, due to affordability criteria introduced at a late stage, the take-up of pit latrines may be reduced. It is not possible to reach the long term national goal in any of the project towns by the end of the project period other than Moulvi-Bazar which is already in that position (see Section 7 for details). Details of the individual sanitation service levels and needs in each of the project towns are presented in Appendix B. Also the target was tempered by financial constraints limiting coverage only to areas selected for drainage improvements.

The scope of the sanitation components are outlined in Table 4.4.

TABLE 4.4 SANITATION IMPROVEMENTS

City Corporation/ Pourashava	Pit Latrines Single (no)	Pit Latrines Twin (no)	Public Latrines (no)	Septic Tanks (no)	Land Acquisition (ha)
Khulna	15700	9400	10	300	* 1.5
Dinajpur	3000	1650	3	100	1.0
Kurigram	2750	750	2	90	0.5
Panchagarh	800	60	2	25	0.5
Habiganj	570	700	2	25	* 0.5
Moulvi-Bazar	-	-	2	-	0.5
Total	22820	12560	21	540	4.5

Note * Land already owned by the City Corporation/Pourashava

4.1.5 Solid Waste Management

Improvements to the solid waste collection and disposal services in the towns are required to both reduce the instance of indiscriminate disposal of solid waste and to provide an improved environment in the towns. The disposal of waste in watercourses and drainage ditches, which is common practice in a majority of the towns (see Appendix C), will be reduced together with the attendant reduction in necessary clearing and maintenance costs.

The project targets for solid waste collection and disposal have been set such that at the end of the 5 year project period the city corporation/pourashavas will be able to provide a service that can effectively collect and dispose of 50% of the household-generated wastes and 70% of other wastes generated in the towns. This will provide an intermediate standard of service in the town, the long term goal for each town being provision of a service that can collect and dispose of upwards of 80% of household-generated waste and 100% of all other wastes. Details of the individual solid waste collection and disposal requirements for each of the project towns are presented in Appendix B.

The present municipal service in the towns is used by a relatively small section of the population (upwards of 20 to 25% in most towns, see Appendix C - Households Surveys). Significant proportions of the population practice private disposal methods of which the majority (of the order 50 to 70%), dispose of their waste by dumping either on open ground or in local drainage ditches or canals. In general the existing municipal service only covers specific areas of the towns. Thus the aim of the project will be to upgrade and extend the existing service to cover the whole of the urban area of each town by the provision of additional collection equipment and facilities.

The scope of the solid waste collection and disposal improvements is outlined in Table 4.5. The locations of the proposed solid waste disposal sites are shown on the Town and Environs drawings in Volume 2A.

TABLE 4.5 SOLID WASTE COLLECTION AND DISPOSAL IMPROVEMENTS

City Corporation/ Pourashava	Storage Bins (no)	Trucks 3 Ton (no)	Trucks 5 Ton (no)	Hand Push Carts (no)	Land Acquisition (ha)
Khulna	600	5	4	60	* 6.84
Dinajpur	100	2	-	30	1.81
Kurigram	90	1	-	15	0.75
Panchagarh	30	1	-	10	0.61
Habiganj	50	1	-	10	* 0.50
Moulvi-Bazar	45	1	-	10	0.45
Total	915	11	4	135	10.96

Note ** Land already owned by the City Corporation/Pourashava (Notional costs given in Section 6).

4.1.6 Slum Improvement Works

Slum improvement works are required to improve the living conditions of the poorer sections of the community, which has insufficient finance to improve its own situation. The improvement to the infrastructural facilities will greatly enhance the environment with attendant benefits to health and welfare.

The slum improvement components have been modelled on the very successful UNICEF Slum Improvement project. At present, several slum areas in both Khulna and Dinajpur are benefiting under this programme. In both these towns it is proposed that under the project the slum improvements be extended to additional areas where security of tenure of the slum dwellers is assured. In addition in the other towns (other than Kurigram, where all the slum/squatter areas are located in areas with no security of tenure), it is proposed that slum improvement schemes should be initiated in areas with security of tenure. It should be noted that in some of the towns the pourashava officials have indicated areas in the town where relocation of slum/squatter communities is being considered. However, the land tenure situation in these ares of relocation is not clear and thus these communities where relocation is necessary have

been omitted from the programme. As noted above, it is proposed that the UNICEF model and standards of service are adopted, with the provision of modest infrastructural improvements for improved water supply, sanitation, footpath access, security lighting, drainage facilities and solid waste collection. In addition, as with the UNICEF programme, support will be provided in the way of training, salaries and incentives for community workers and community health workers. Household income generation loans are also proposed.

The scope of the slum improvement programme for each of the project towns is outlined in Table 4.6. The location of the areas to be included in the programme are shown on the Existing Drainage Systems drawings in Volume 2A. In addition, the areas to be included in the programme (ie those with security of tenure and not at present included in the UNICEF Slum Improvement project), are outlined on Tables 2.12 to 2.17 in Section 2.

TABLE 4.6 SLUM/SQUATTER AREAS IMPROVEMENTS

City Corporation/ Pourashava	Project Coverage Areas (no)	Households (no)	Community Level Training (groups)	Community Health Workers (no)
Khulna	49	4685	469	106
Panchagarh	1	236	24	4
Moulvi-Bazar	7	127	13	7
Habiganj	6	168	17	6
Dinajpur	20	3140	314	63
Total	83	8536	837	186

4.1.7 Institutional Support Measures

Institutional support of the city corporation/pourashavas is required to strengthen their capability to implement, maintain and operate the infrastructure facilities and their future extensions, and to better manage municipal finances. Support is also required for the local BWDB divisions, in order to assist the divisions in the implementation and the future maintenance of the flood protection and bank erosion works.

It is envisaged that this element of the project will comprise training, the provision of various equipment such as vehicles, surveying equipment, office equipment, small plant and tools for maintenance purposes etc. as well as assistance in the development of O and M systems. In addition, in order to promote public health education and environmental factors, provision of finance is proposed for the funding of education programmes in each of the project towns.

In the case of the BWDB, logistics support by way of the provision of 4WD Jeeps, motorcycles, survey equipment and photocopiers is required to enable the BWDB officers to effectively manage and supervise the construction programme. In Dinajpur, it is also proposed that an outboard motor boat be provided for use in the inspection of the river during times of high flow. In addition, in Habiganj the local divisional offices of the BWDB are in a very poor state of repair and it is thus proposed that provision is made for new accommodation to be provided for this division only.

The scope of the logistics element of the institutional support programme for each of the project towns is outlined in Table 4.7 overleaf.

In addition, in order to develop the institutional capabilities of the city corporation/pourashavas to implement, manage and maintain the infrastructure services, and also develop methods of improved financial control and resource generation, it is proposed that Technical Assistance by way of training programmes, be included in the Project. Further details of the TA are presented in Section 5 and in Appendix G of the report.

TABLE 4.7 INSTITUTIONAL IMPROVEMENTS - LOGISTICS SUPPORT

Town	BWDB Office		City Corporation/ Pourashava	
	4WD Jeeps (no)	Motorcycles (no)	4WD Jeeps (no)	Motorcycles (no)
Khulna	1	1	2	3
Dinajpur	1	1	1	2
Kurigram	1	1	-	2
Panchagarh	1	1	-	2
Habiganj	-	1	-	2
Moulvi-Bazar	-	1	-	2
Total	4	6	3	13

4.2 The Integrated Plans

4.2.1 General

The components have been formulated following extensive site visits to each of the towns, discussions with the BWDB officers and the city corporation/pourashava officials and use of the results of detailed household surveys to gain information on income, sanitation operating facilities and solid waste disposal methods in all the towns. The detailed results of the household surveys are presented in Appendix C.

The project components have been identified on the basis of both technical, economic, social and environmental considerations. Factors such as need, feasibility, and applicability have been included in the selection process. The components have also been determined in order to fit in with the longer term planning process. The project components have been grouped under the following headings:

i) Part A: Flood Protection Works
ii) Part B: Drainage Works
iii) Part C: Environmental Improvement Works
iv) Part D: Project Implementation Assistance

It is emphasized again that the Integrated Plans developed under this project are linked with the wider development plans for adjacent areas being undertaken by other studies. For example plans are being prepared under FAP 4 (South-west Area Water

Management Study) and the Coastal Rehabilitation Project, both being undertaken with ADB assistance. Also the Integrated Plans under this project are those of immediate priority and are not necessarily comprehensive, having been based on criteria such as afforability. They are a fast response to the reduction of flood risk and to the need for environmental improvement and should be viewed in the context of an incremental approach to development. As other studies are completed there will be potential for extending the coverage of certain scheme components (eg surface water drainage).

The individual components of the Integrated Plans are fully identified by town in Section 4 of the Report.

Cost estimates for the proposed works are presented in Section 6. Project benefits and affordability factors are addressed in Section 7 and environmental aspects in Section 8. The basic design strategy underlying each of the components, together with specific references to the individual features of the project, are presented in Appendix B.

The project components which are envisaged in each of the towns are detailed below.

4.2.2 Khulna

The construction of approximately 900 m of earth embankment (retired embankment) between the existing embankment closures at Alutola and Kazibacha.

The construction of a 7 vent regulator at Kayerhat.

The construction of two 2 vent and two single vent regulators on the Rupsa river through the flood embankments for drainage purposes.

The construction of some 3200 m of bank revetment works with falling apron over three sections beside the Roosevelt Jetty, Alutola site and in the vicinity of the Hospital stretch. In addition, the inclusion of some 450 m of protection works at two locations on the Bhairab river at Daulatpur College and in the vicinity of the CSD Godown/Ansar Flour mill.

The rehabilitation, enlargement and extension of the surface water drainage system over an area of some 21 km^2 out of a total urban area of 31 km^2. These works include the provision of additional main (primary and secondary) drainage outlets of total length 69.5 km, and 125 km of tertiary drainage. Also the construction of a new main drainage channel of some 5.5 km length across Polder 28/1 to facilitate the strategic disposal of the storm runoff.

The construction of some 300 septic tanks, 15700 single pit and 9400 twin pit sanitary latrines throughout the town.

The construction of some 950 soakpits to existing septic tanks throughout the town which at present discharge effluent to adjacent drainage channels.

The construction of 10 additional public latrine facilities at strategic locations throughout the town together with the rehabilitation of the existing public latrine facilities.

The provision of some 600 additional solid waste collection bins throughout the town together with the repair of the existing collection bins.

The supply of 5 no. 3 Tonne and 4 no. 5 Tonne solid waste disposal vehicles to reinforce the existing collection fleet. Additionally, the supply of 60 hand push carts to service congested areas of the town where access is restricted.

Land acquisition of approximately 4 ha for the flood protection works together with some 31 ha to facilitate the construction of the main drainage outfalls and the strategic disposal channel for the surface water drainage system.

Slum improvements for some 4685 households including the provision of basic infrastructure improvements, community training in health and income-generation activities.

Institutional strengthening for both the City Corporation and the BWDB offices by the provision of equipment (eg photocopiers, vehicles etc). In addition the attendance on training programmes for staff of the City Corporation together with the provision of finance for an Environmental and Public Health education programme throughout the town.

4.2.3 Dinajpur

Resectioning/reparation works on the existing flood embankment on both the Gorbeshwari and the Punarbhara rivers over a length of some 28000 m.

The construction of regulators through the flood embankments at Rajapur (4 vent), Nayanpur (3 vent), Shibranpur (2 vent) and at Mujahidpur (2 vent).

Remodelling/rehabilitation works to the existing 5 vent Ghugadanga regulator.

The construction of 4 small gated drainage outlets through the flood embankment of the Punarbhara river.

The construction of a total of some 2700 m bank revetment works with falling apron at four separate locations (Goshaipur, Bangibecha ghat, Lalbag and Mouthpara) around the town. In addition at Goshaipur, the construction of 2 spurs.

The rehabilitation, enlargement and extension of the surface water drainage system covering an urban area of some 8 km^2. These works include the provision of additional main drainage outlets of total length 16.3 km (5.0 km of pucca, 11.3 km of katcha), tertiary drainage and the construction of some 30 new drainage culverts.

The construction of some 100 septic tanks, 3000 single pit and 1650 twin pit sanitary latrines throughout the town.

The construction of some 350 soakpits for existing septic tanks throughout the town which at present discharge effluent to adjacent drainage channels.

The supply of one 3000 litre capacity vacuum tanker for use in cleaning out septic tanks in the town.

The construction of 3 additional public latrine facilities at strategic locations in the town together with the rehabilitation of the existing public latrine facilities.

The provision of some 100 additional solid waste collection bins throughout the town together with the repair of the existing collection bins.

The supply of 2 no. 3 Tonne solid waste disposal vehicles to reinforce the existing collection fleet. Additionally, the supply of 30 hand push carts to service congested areas of the town where access is restricted.

Land acquisition of approximately 2.8 ha for waste disposal (both solid and sanitary waste) together with some 15 ha for the construction of the embankment works and the construction of the regulator structures.

Slum improvements for some 3140 households including the provision of basic infrastructure improvements, community training in health and income generation activities.

Institutional strengthening for both the Pourashava and the BWDB offices by the provision of equipment (eg photocopiers, vehicles etc). In addition the attendance on training programmes for staff of the Pourashava together with the provision of finance for an Environmental and Public Health education programme throughout the town.

4.2.4 Kurigram

Localised repairs to the flood embankment between Groyne No 1 and the Rangpur-Kurigram road.

The construction of two number regulators in the flood protection embankment.

The construction of some 1000 m of bank revetment works between the Palashbari regulator and Crossbar No 1.

The construction of two new groynes between the Palashbari regulator and Crossbar No 1.

The extension and rehabilitation of the existing groyne at the head of the Rangpur-Kurigram road and Spur No 2.

The rehabilitation, enlargement and extension of the surface water drainage system covering an urban area of some 4 km^2. The works include the construction of some 3.3 km of pucca and 18 km of katcha main drainage channels, tertiary drainage and some 30 drainage culverts. In addition the construction, through the flood embankment, of 2 additional single vent regulators at Shitaldhar.

The construction of some 90 septic tanks, 2750 single pit and 750 twin pit sanitary latrines throughout the town.

The construction of 2 additional public latrine facilities at strategic locations in the town together with the rehabilitation of the existing public latrine facilities.

The provision of some 90 additional solid waste collection bins throughout the town together with the repair of the existing collection bins.

The supply of 1 no. 3 Tonne solid waste disposal vehicles to reinforce the existing collection fleet. Additionally, the supply of 15 hand push carts to service congested areas of the town where access is restricted.

Land acquisition of approximately 1.25 ha for waste disposal (both solid and sanitary waste) over the period of the project.

Institutional strengthening for both the Pourashava and the BWDB offices by the provision of equipment (eg photocopiers, vehicles etc). In addition the attendance on training programmes for staff of the Pourashava together with the provision of finance for an Environmental and Public Health education programme throughout the town.

4.2.5 Panchagarh

Resectioning of the existing flood embankment over a length of some 3500 m together with the construction of some 150 m of new flood embankment in and around Tulardanga.

The construction of a 2 vent drainage regulator through the flood embankment at Tulardanga.

The construction of 4 small gated drainage outlets through the flood embankment in the vicinity of the town.

The construction of some 1000 m of bank revetment works with falling apron in the vicinity of the main road bridge and Tulardanga.

The rehabilitation, enlargement and extension of the surface water drainage system covering an urban area of some 2 km^2. These works include the provision of additional main drainage outlets of total length 3.4 km (1.8 km of pucca, 1.6 km of katcha), tertiary drainage and the construction of some 19 new drainage culverts. The works will complement existing improvements to the drainage system being undertaken as part of the Netherlands/Bangladesh development Cooperation Programme, 18 Towns Water Supply, Sanitation and Drainage Project.

The construction of some 25 septic tanks, 800 single pit and 60 twin pit sanitary latrines throughout the town.

The construction of 2 additional public latrine facilities at strategic locations in the town together with the rehabilitation of the existing public latrine facilities.

The provision of some 30 additional solid waste collection bins throughout the town together with the repair of the existing collection bins.

The supply of a single 3 Tonne solid waste disposal vehicles to reinforce the existing collection fleet. Additionally, the supply of 10 hand push carts to service congested areas of the town where access is restricted.

Land acquisition of approximately 1.1 ha for waste disposal (both solid and sanitary waste) over the period of the project together with some 10 ha for the construction of the retired embankment and the regulator structure.

Slum improvements for some 236 households including the provision of basic infrastructure improvements, community training in health and income-generation activities.

Institutional strengthening for both the Pourashava and the BWDB offices by the provision of equipment (eg photocopiers, vehicles etc). In addition the attendance on training programmes for staff of the Pourashava together with the provision of finance for an Environmental and Public Health education programme throughout the town.

4.2.6 Habiganj

The extension of the existing flood embankment (both left and right banks) over a length of 2000 m downstream of the town including the construction of 3 cross dams over the river channel.

The construction through the flood embankment, of two single vent regulator structures, the first in the locality of the old abandoned river channel on the north west side of the town, the second beside the road bridge at the western end of the town.

The construction of some 3600 m bank revetment works with falling apron at eighteen separate locations on both banks of the river in the vicinity of the town.

The rehabilitation, enlargement and extension of the surface water drainage system covering an urban area of some 2 km^2. These works include the provision of additional main drainage outlets of total length 13.3 km (3.0 km of pucca, 10.3 km of katcha), tertiary drainage and the construction of some 50 new drainage culverts.

The construction of some 25 septic tanks, 570 single pit and 700 twin pit sanitary latrines throughout the town.

The construction of 2 additional public latrine facilities at strategic locations in the town together with the rehabilitation of the existing public latrine facilities.

The provision of some 50 additional solid waste collection bins throughout the town together with the repair of the existing collection.

The supply of 1 no. 3 Tonne solid waste disposal vehicles to reinforce the existing collection fleet. Additionally, the supply of 10 hand push carts to service congested areas of the town where access is restricted.

Land acquisition of some 7 ha for the construction of the flood protection works.

Slum improvements for some 168 households including the provision of basic infrastructure improvements, community training in health and income generation activities.

Institutional strengthening for both the Pourashava and the BWDB offices by the provision of equipment (eg photocopiers, vehicles etc). In addition the attendance on training programmes for staff of the Pourashava together with the provision of finance for an Environmental and Public Health education programme throughout the town.

4.2.7 Moulvi-Bazar

Resectioning of the existing flood embankment over a length of some 7700 m together with the extension of the right bank flood embankment over a length of some 1500 m located both upstream and downstream of the town.

The raising of the existing flood wall and also the core wall within the town over a length of some 1800 m.

The construction of a total of some 2350 m bank revetment works with falling apron at some five separate locations on both banks of the river.

The rehabilitation, enlargement and extension of the surface water drainage system covering an urban area of some 2 km^2. These works include the provision of additional main drainage outlets of total length 6.9 km (4.8 km of pucca, 2.1 km of katcha), tertiary drainage and the construction of some 16 new drainage culverts. The works will complement existing improvements to the drainage system being undertaken as part of the Netherlands/Bangladesh development Cooperation Programme, 18 Towns Water Supply, Sanitation and Drainage Project.

The construction of 2 additional public latrine facilities at strategic locations in the town.

The provision of some 45 additional solid waste collection bins throughout the town together with the repair of the existing collection bins.

The supply of 1 no. 3 Tonne solid waste disposal vehicles to reinforce the existing collection fleet. Additionally, the supply of 10 hand push carts to service congested areas of the town where access is restricted.

Land acquisition of approximately 0.95 ha for waste disposal (both solid and sanitary waste) over the period of the project together with 5 ha for the flood protection works.

Slum improvements for some 127 households including the provision of basic infrastructure improvements, community training in health and income generation activities.

Institutional strengthening for both the Pourashava and the BWDB offices by the provision of equipment (eg photocopiers, vehicles etc). In addition the attendance on training programmes for staff of the Pourashava together with the provision of finance for an Environmental and Public Health education programme throughout the town.

4.3 Early Implementation Components of Integrated Plans

Looked at from an engineering and safety viewpoint, the project components for early implementation will largely be the urgent flood protection and river erosion rehabilitation works. Main drainage outlets through the flood protection embankments should also be constructed at the same time. These works require immediate attention as they are necessary not only for protecting both the lives and properties of the population but also the investment in the existing infrastructure of the towns.

In many cases such works will also be necessary to protect the proposed additional (municipal) works infrastructure, in the areas of drainage, sanitation, solid waste collection and disposal and slum improvements. The urgent flood protection and river erosion rehabilitations works should in fact be in an advanced state of completion before construction commitments are made to any further municipal works in the vulnerable areas.

The towns most at risk from river flooding at the present time, and the circumstances associated with these risks, have been set out earlier in Section 2 of this report. Details of the works to be included in the early implementation programme outlined below are presented in Table 4.8. The costs of these works, which form an intrinsic part of the Project, are already included in the overall summary of Project Costs as set out in Section 6 of the report.

- **Flood Protection**

  Although, all six selected towns have existing flood protection embankments which are generally in good order, immediate improvement/extension of these is required in Moulvi-Bazar, Dinajpur and Panchagarh.

  Moulvi-Bazar's left bank flood protection embankment consists of flood walls and a core wall whose levels respectively are 0.60 m (2.0 ft) and 0.30 m (1.0 ft) below that of the earthen embankment. The present level of the earthen embankment is 14.02 m (46.00 ft) PWD, yet the crest level of the existing right bank embankment is 14.32 m (47.00 ft) PWD, against the highest recorded water level at Moulvi-Bazar of 13.10 m (43.00 ft) PWD. As the maximum gate opening of Manu Barrage upstream is limited, and the embankment heights designed accordingly to 14.32 m (47.00 ft) PWD level, the Moulvi-Bazar left bank earthen embankment and core wall logically also needs to be raised accordingly. Also the flood wall should be reconstructed to make the crest level up to 14.32 m (47.00 ft) PWD. The upstream and downstream portions of right bank embankment are also to be extended for a length of about 2.34 km so as to protect the area between the river bank and the Manu main canal.

  The general condition of the embankments at Dinajpur is not good as they are constructed from poorly compacted sandy soil with side slopes of 1:1.5 and 1:2 on river-side and country-side respectively. During the high floods of 1984, 87, 88 & 91, several breaches occurred in the embankment causing heavy damage to the town. The existing embankment needs urgent resectioning and repair.

  At Panchagarh (Tulardanga site), part of the flood embankment has been eroded away and urgently needs retirement by construction of a length of some 150 m of new flood embankment.

- **Erosion Protection**

  At each of the six selected project towns, river bank erosion is of varying extent and severity. The erosion has placed the flood protection

TABLE 4.8 EARLY IMPLEMENTATION WORKS

Town	Early Implementation works
Khulna	Construction of the retired embankment at Kazibacha over a length of some 900m. Construction of Regulators at Kayer Kayerhat (7 Vent), on the Rupsa river (2 no single vent and 2 no 2 vent), together with the rehabilitation of the existing regulator near to the Rupsa ferry ghat. Construction of the bank protection works for the Ansar Flour Mill, Daulatpur College site, Roosevelt Jetty, Alutulo site, Solmari river site and the Hospital stretch over a length of some 3650 m.
Dinajpur	Resectioning of the flood embankments for both the Punarbhara and Gorbeshwari rivers over a total lengths of some 28000 m. Construction of Regulators at Rajapur (4 vent), Nayanpur (3 Vent), Shibranpur (2 vent) and Mujahidpur (2 vent) together with the construction of 4 minor drainage outlets through the flood embankments. Rehabilitation of the existing 5 vent Ghugadanga regulator. Bank protection works at Goshaipur, Bangibecha ghat, Lalbag and Mouthpara over a length of some 2700 m and 2 Nos Spurs at Goshaipur.
Kurigram	Extension and rehabilitation works to the existing groynes at the head of the Rangpur-Kurigram road and Spur No 2. The construction of two new groynes Between the Palashbari regulator and Crossbar No 1. Bank revetment works over some 1000 m between the Palashbari regulator and Crossbar No 1. The construction of two new single vent regulators at Shitaldhar.
Panchagarh	Construction of some 1000 metres bank revetment works beside the main road bridge and at Tulardanga. Construction of 150 m of new retired embankment at Tulardanga. Construction of a 2 vent regulator at Tulardanga and 4 minor drainage outlets in the vicinity of the town.
Habiganj	Construction of new embankments (both left and right bank) over a length of 2000 m. along with 3 Nos cross-dams. Construction of bank revetment works over a total length of 3640 m. Construction of 2 single vent regulators in the vicinity of the town.
Moulvi-Bazar	Construction of right bank flood embankment over a length of 1500 m together with the resectioning of the existing embankment over a length of some 7700 m. The raising the core wall and flood wall over a length of some 1800 m in the vicinity of the town. Construction of bank revetment works over a total length of 2350 m.

embankments, roads and other physical infrastructures at risk of serious damage. All the selected towns need immediate bank protection measures. At Khulna, out of the five stretches, (Roosevelt Jetty, the Hospital site, Ansar Flour Mill, Daulatpur College, Alutola site), the Roosevelt stretch, Hospital stretch and Alutola sites need immediate attention. In recent years some protection works have been completed in all the selected towns, but these are not up to standard. To reduce the risk of damage to flood protection embankments and other associated structures and properties, proper bank protective measures need to be implemented at an early stage.

- **Drainage**

All the selected project towns suffer from drainage problems. The drainage systems in all the towns have been constructed in an unplanned and disjointed fashion. As a result the runoff from rainfall cannot be effectively evacuated from the town since, amongst other things, the main drainage outlets and channels have not been properly designed and constructed. As a priority, new and improved drainage outlets for the main drains through the protection embankments, should be designed and constructed.

Implementation Arrangements

5. IMPLEMENTATION ARRANGEMENTS

5.1 Institutional Arrangements

5.1.1 General

The institutional proposals (Scenario 1 and 2) are based on the principal of building on existing systems, and strengthening where necessary, rather than introducing new organisations and ways of doing things. They have adopted the principles embodied in the Secondary Towns Infrastructure and Services Development Project (ADB Loan 1059-BAN), approved December 1990 and the Dhaka Integrated Flood Protection Project (ADB Loan 1124-BAN), approved November 1991. Both have received wide support from central and local government and the ADB.

5.1.2 Scenario 1

This institutional arrangement was originally developed during the Inception and draft Final Report phases. It was proposed that the project be implemented under the Ministry of Irrigation, Water Development and Flood Control (MIWDFC), through the Bangladesh Water Development Board (BWDB). Support on the municipal aspects will be provided by the Local Government Division (LGD) of the Ministry of Local Government, Rural Development and Cooperatives (MLGRDC).

Figure 5.1 shows the "implementation structure" of (Scenario 1) as originally proposed by the consultant. The crossponding staffing (Scenario 1) is presented in Figures 5.2 and 5.3a, b and c.

Overall coordination, monitoring and supervision would be provided by the MIWDFC through the FPCO, under procedures which have been standardized for all FAP projects. The existing Steering Committee that has provided policy guidance during project formulation will continue to oversee detailed design and implementation.

The implementing agencies would be the BWDB and the LGD. A Project Management Unit (PMU) headed by a Project Director at the Senior Superintending Engineer/Chief Engineer level is proposed. The PMU would be responsible for:

- overall supervision of all activities and projects under the programme and ensuring timely project implementation;
- ensuring co-ordination with other FAP studies and projects;
- setting up effective financial procedures for the receipt and onward disbursement of project funds, for control and reporting systems, and for the maintenance of up-to-date accounts and records;
- setting up systems and procedures to monitor physical and financial progress on all projects;
- preparing and submitting quarterly progress reports to the GOB and the ADB for each component of the programme;

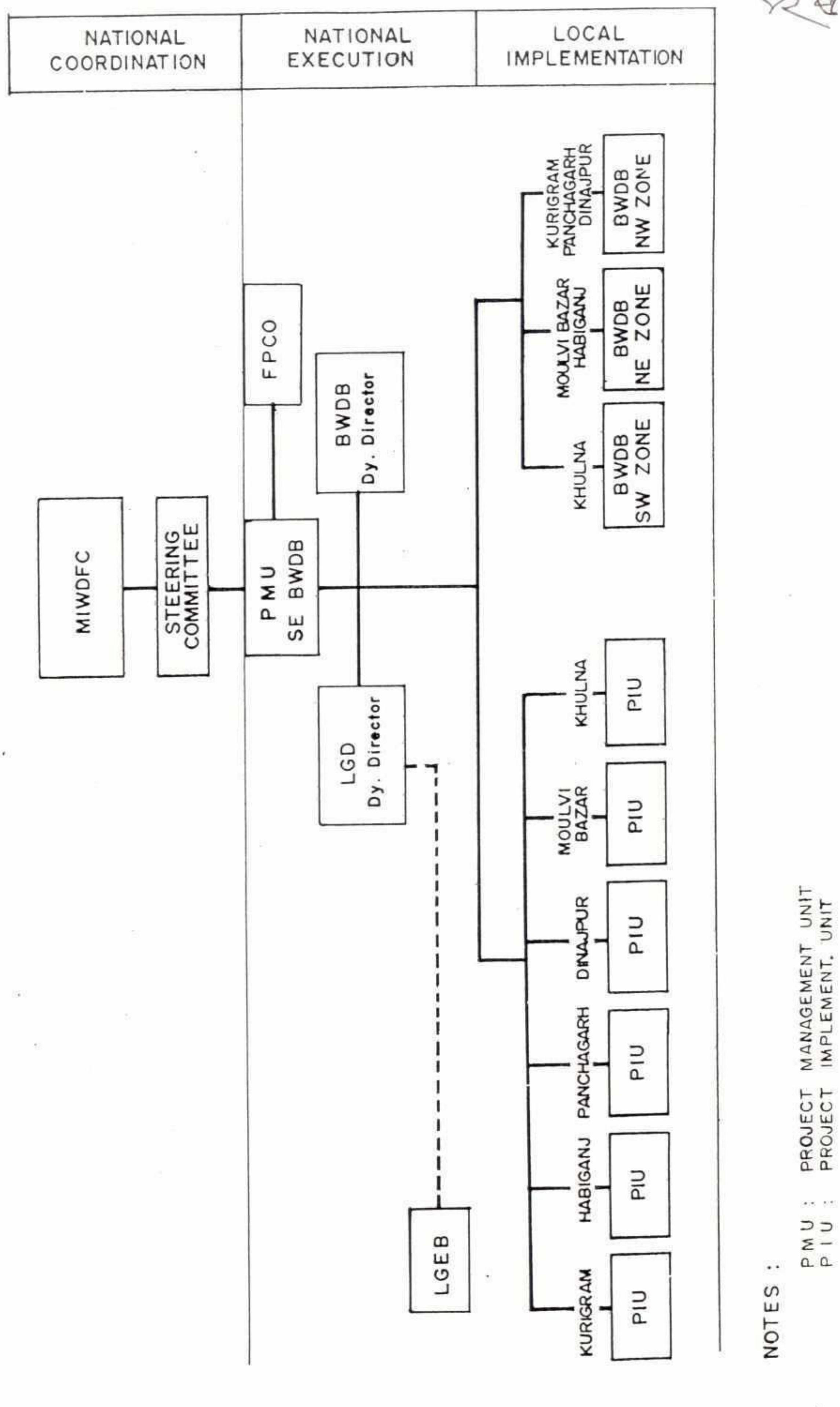


Figure 5.1 : Proposed Implementation Structure (Scenario I)

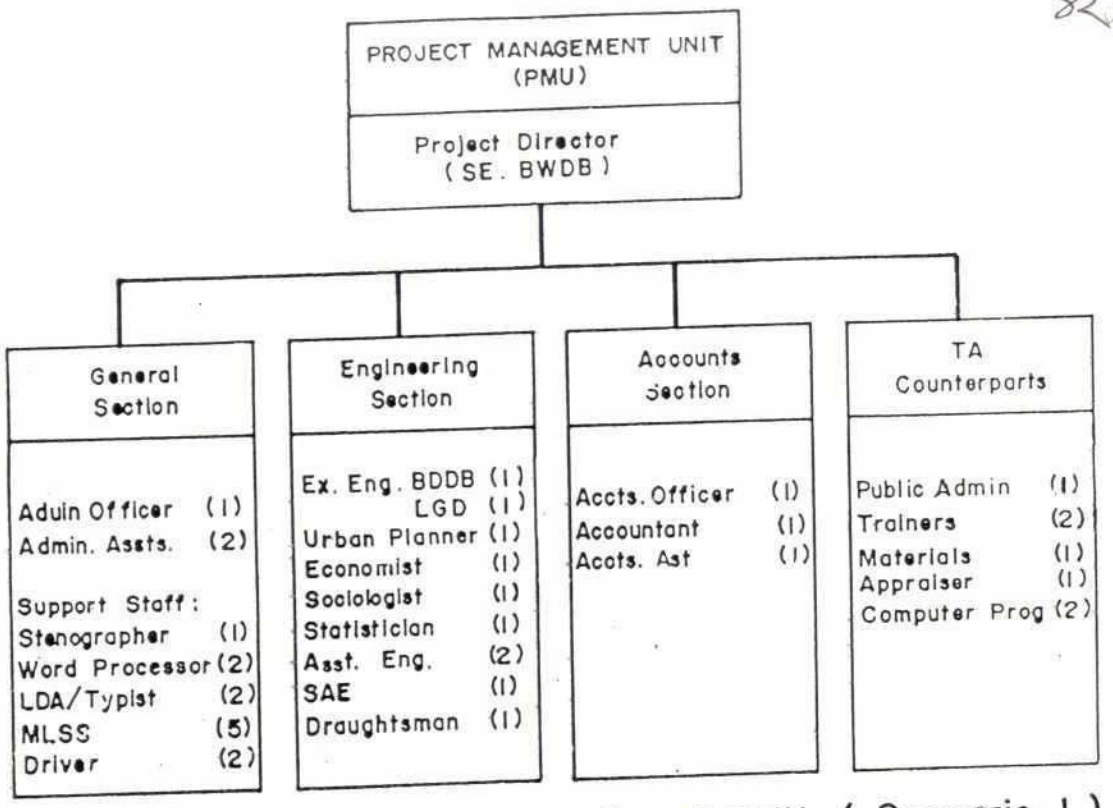


Figure 5.2 : Organisation and Staffing of PMU (Scenario 1)

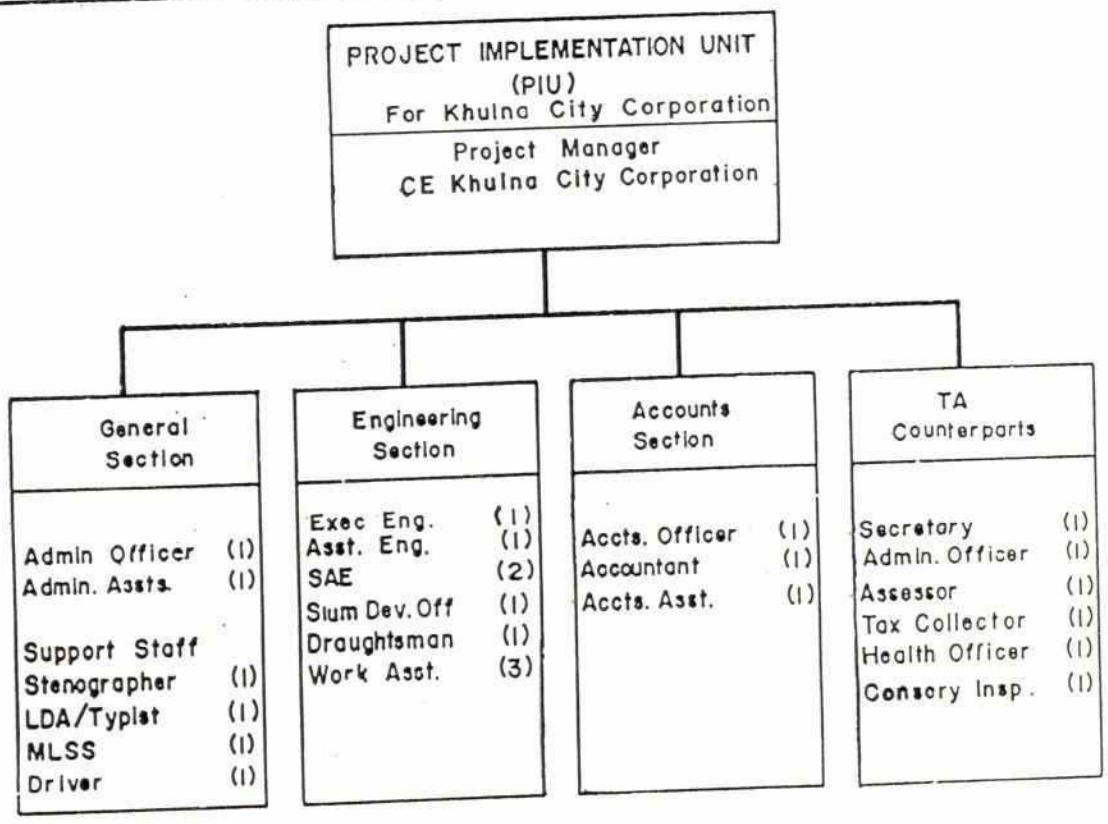


Figure 5.3a: Organisation and Staffing of PIU (Scenario 1)
For Khulna City Corporation

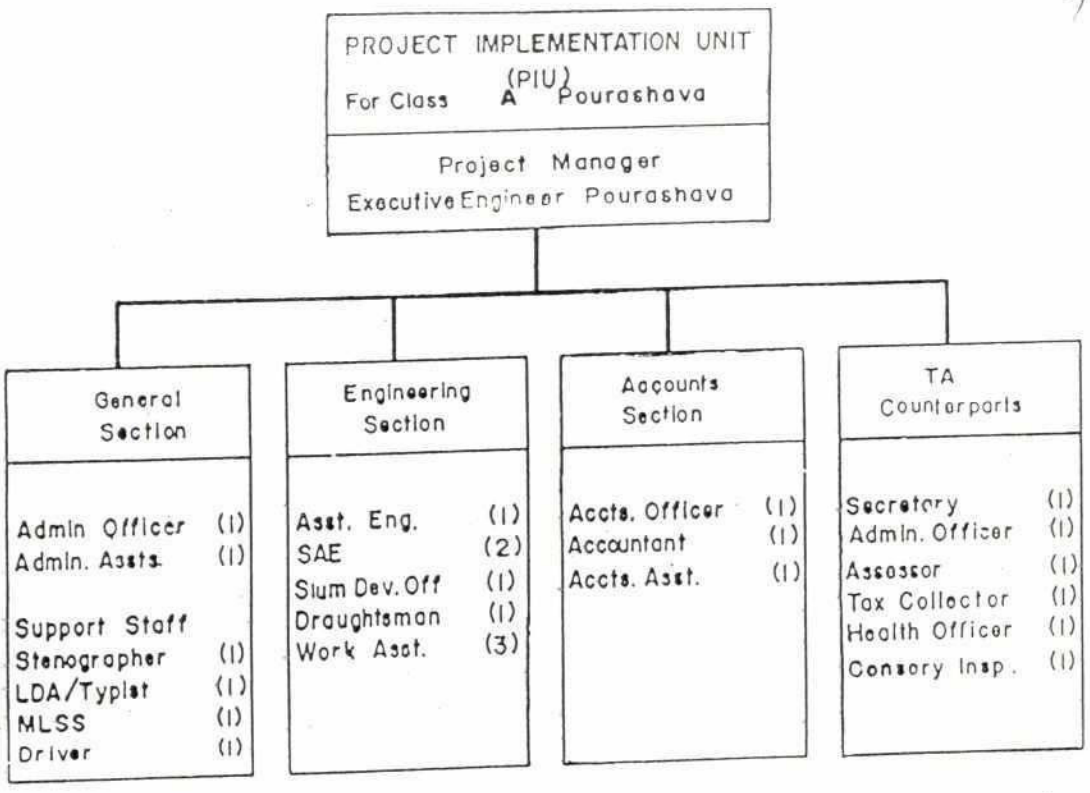


Figure 5.3b: Organisation and Staffing of PIU (Scenario I)
For Class A Pourashava

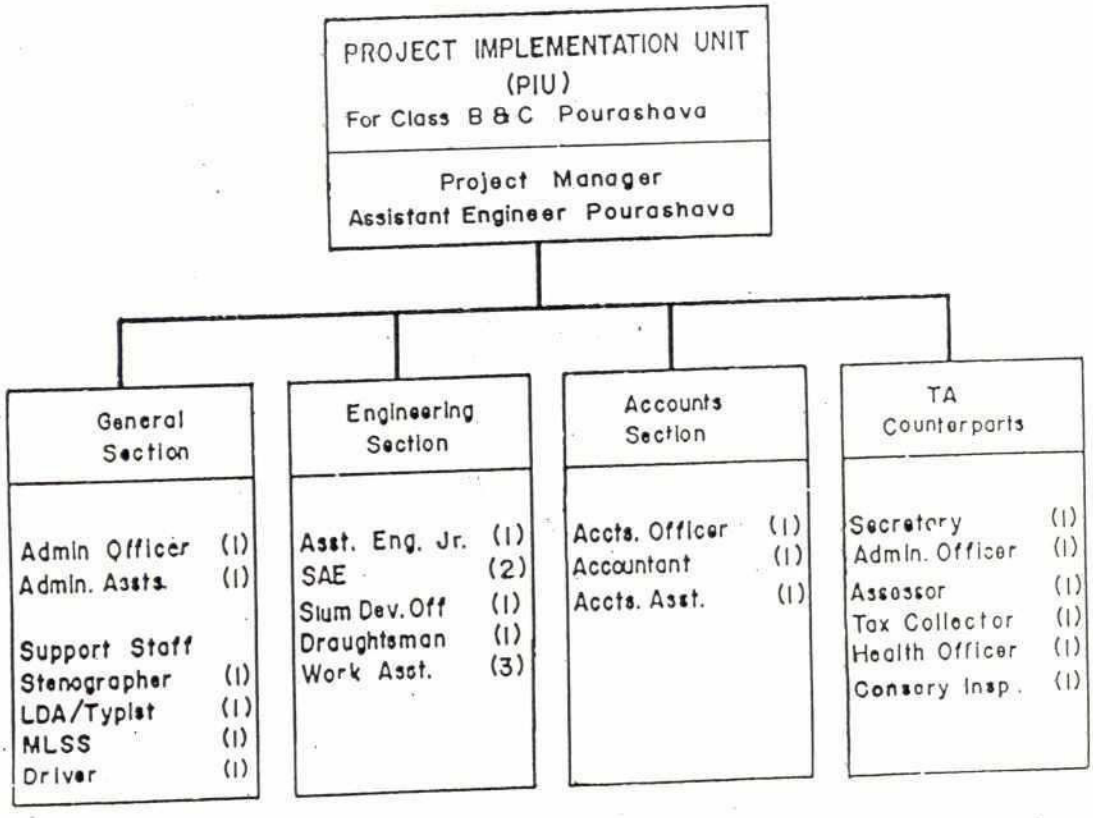


Figure 5.3c: Organisation and Staffing of PIU (Scenario I)
For Class B & C Pourashava

- preparing and submitting completion reports for each component of the programme to the GOB and the ADB within three months of the physical works being completed;

- maintaining comprehensive up-to-date project accounts in addition to those kept by the executing and implementing agencies;

- coordinating and reviewing the annual works programmes of the five pourashavas and Khulna City Corporation on behalf of the MLGRDC, with powers to make modifications;

- recruitment and coordination of all consultants used under the programme;

- providing technical assistance through LGEB to the municipal organisations on design, tendering, procurement, construction supervision, quality control, and review of tenders and tender procedures to ensure compliance with ADB procedures;

- developing promotional programmes aimed at informing the public about the aims and objectives and enlisting support and participation; and

- developing appropriate training programmes for BWDB, LGD, PIU and pourashava/city corporation staff.

The PMU would have two Deputy Project Directors, one each from BWDB and LGD. These would probably be at the Executive Engineer level and would be responsible for liaison with their respective agencies. The PMU staff would include seconded staff from respective agencies as well as new recruitment. The PMU would be divided into Administration, Engineering, and Accounts/Finance sections.

The BWDB projects under the programme (flood protection and river bank erosion works) would be implemented through the BWDB's North East, North West, and South West zonal offices. The Chief Engineer of each of these offices would report directly to both the PMU and his head office in Dhaka.

The LGD projects (municipal works) would be implemented through the five pourashavas of Dinajpur, Kurigram, Panchagarh, Habiganj and Moulvi-Bazar, together with Khulna City Corporation.

A Project Implementation Unit (PIU) is proposed within the municipal organisation of each of the six towns. The PIUs would be responsible for the planning, coordination, implementation, quality control, and operation and maintenance of the programme components in their respective towns. Their responsibilities would include:

- preparing and submitting to the PMU for review and approval the annual development programmes for the implementation of programme works;

- recruiting local consultants (with the knowledge of the PMU) and supervising consultants' activities in the preparation of engineering designs, cost estimates and tender documents for the annual works programmes;

- tendering and awarding contracts for local works programmes under local competitive bidding procedures;

- implementing effective quality control procedures and ensuring timely completion of all works;
- preparing guidelines for the proper operation and maintenance of the assets created;
- maintaining accounts and records in a form specified by the PMU which are acceptable to the ADB;
- preparing and submitting reports in accordance with the Loan Agreement and internal GOB procedures;
- generating public support for the Programme, encouraging the participation of NGOs and other groups, and forming training and motivating groups for slum and sanitation, and flood-proofing programmes; and
- Co-ordinating works programmes for drainage with the regional BWBD office to ensure regulator structures are operational.

5.1.3 Scenario 2

Following the presentation of the draft Final Report a modified version of the original Institutional Arrangement (Scenario 1) was suggested. This was presented by the ADB in their Aide Memoire dated 29 February 1992. This is the Scenario presented below and is the one eventually agreed with the consultant and adopted. Figure 5.4 shows the "proposed project implementation structure" (Scenario 2). The proposed staffing (Scenario 2) is presented in Figures 5.5, 5.6 and 5.7.

With this proposed arrangement there is a PMO (Project Management Office) under the charge of a BWDB Project Director (Superintending Engineer). Linked with this will be a PMU (Project Management Unit under the existing LGEB Director for the Secondary Towns Project (Loan 1059-BAN). The intended functions and responsibilities of the involved agencies are set out in the following pages.

The intended functions and responsibilities of the involved agencies are as follows:

i) Steering Committee

- Guidance on policies regarding the overall implementation of the Secondary Towns Integrated Flood Protection Project in the Project towns including interlinkages with FAP activities.
- Periodic (quarterly) review of Project progress, including review of progress on implementation of the Action Plan (particularly financial matters and cost recovery aspects).
- Resolution of issues, particularly inter-ministerial coordination.
- Expediting Project implementation through timely action on problems and issues requiring resolution at interminsterial level.

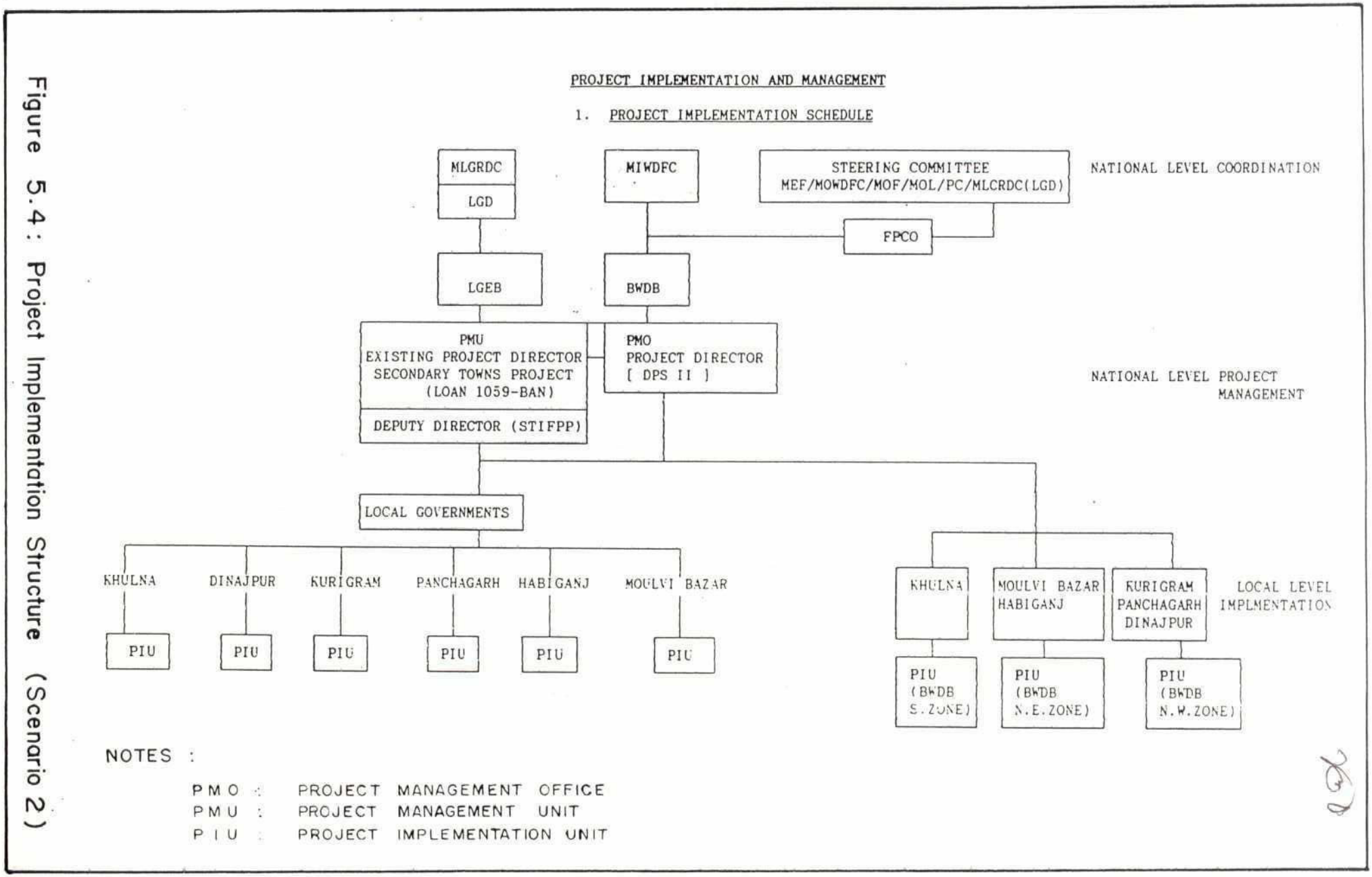


Figure 5.4 : Project Implementation Structure (Scenario 2)

Organization and Staffing of PMO

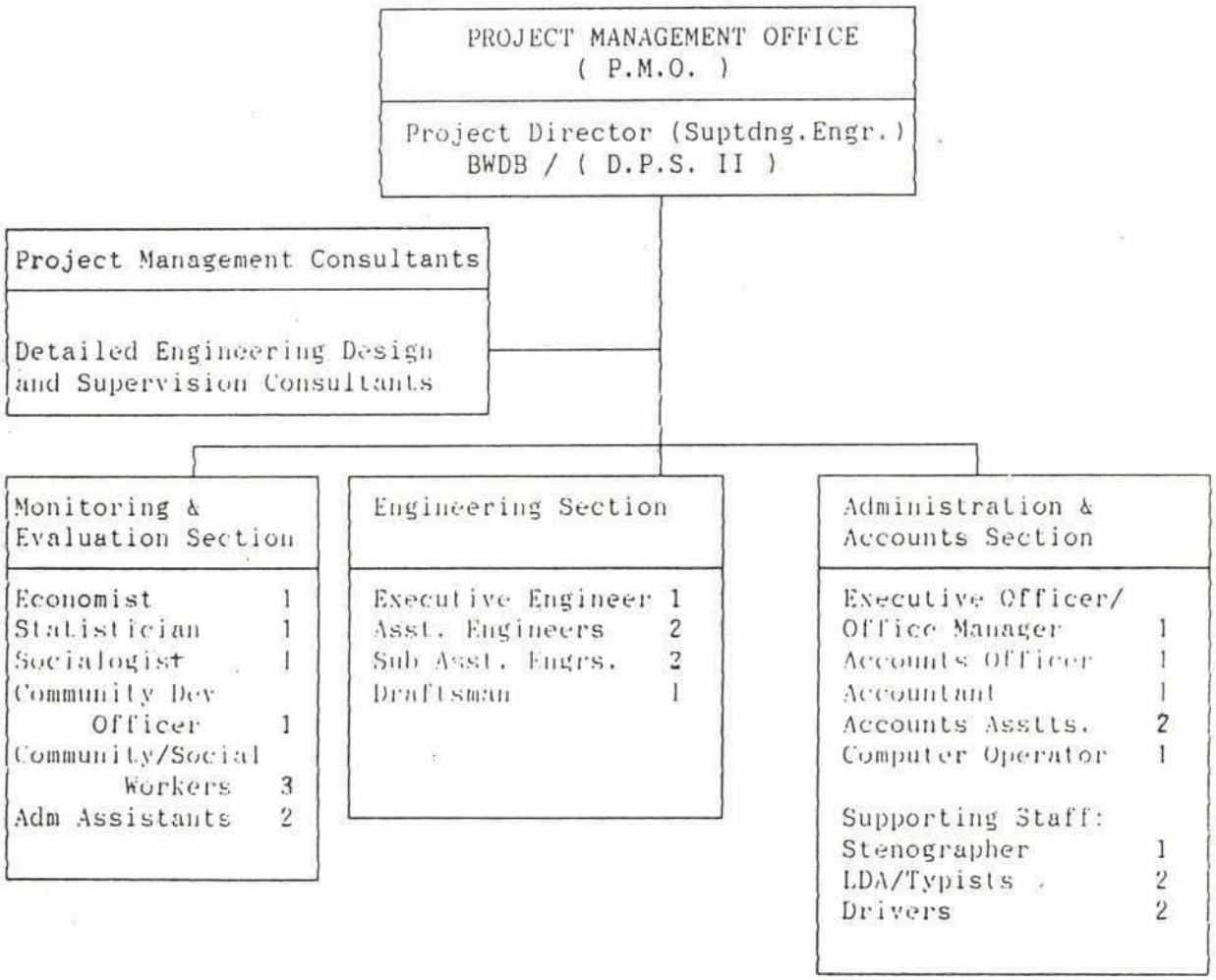


Figure : 5.5 : Organization And Staffing Of PMO (Scenario 2)

Strengthening of the Existing Office of Project Director
Secondary Towns Infrastructure Development Project

(STIDP - Loan 1059-BAN)

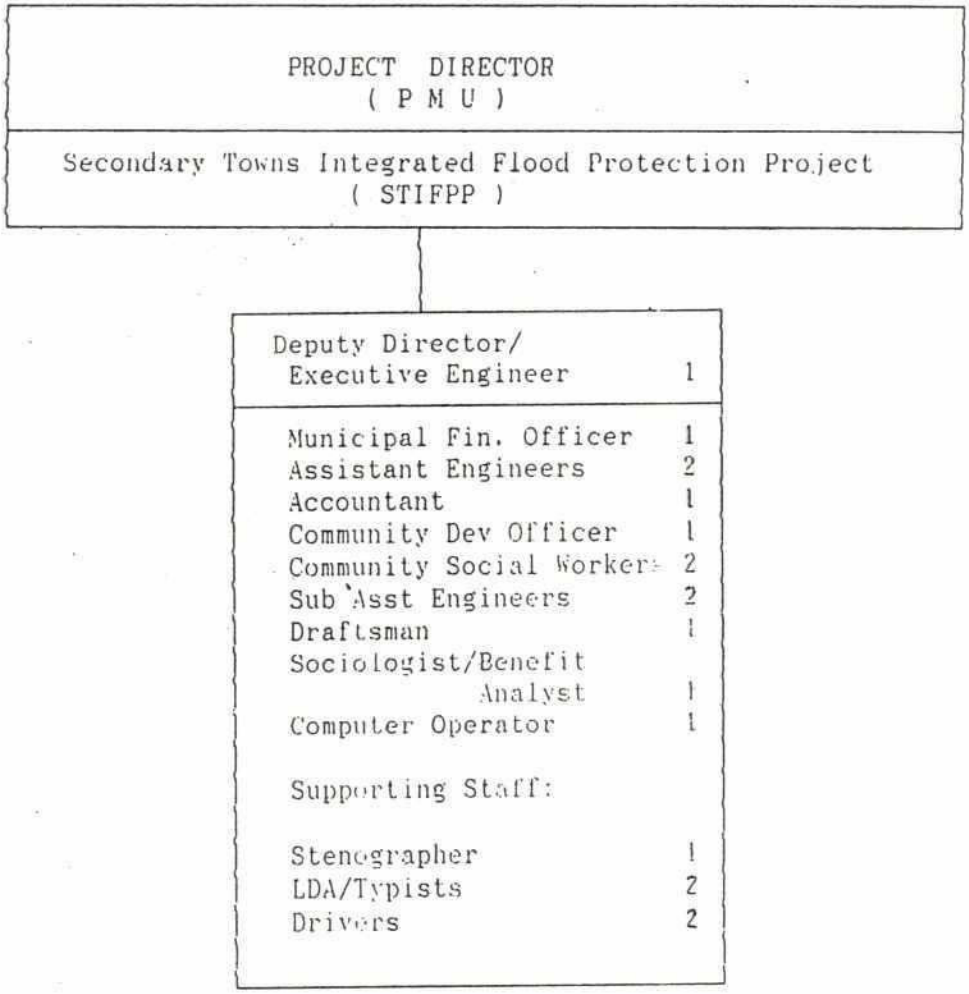
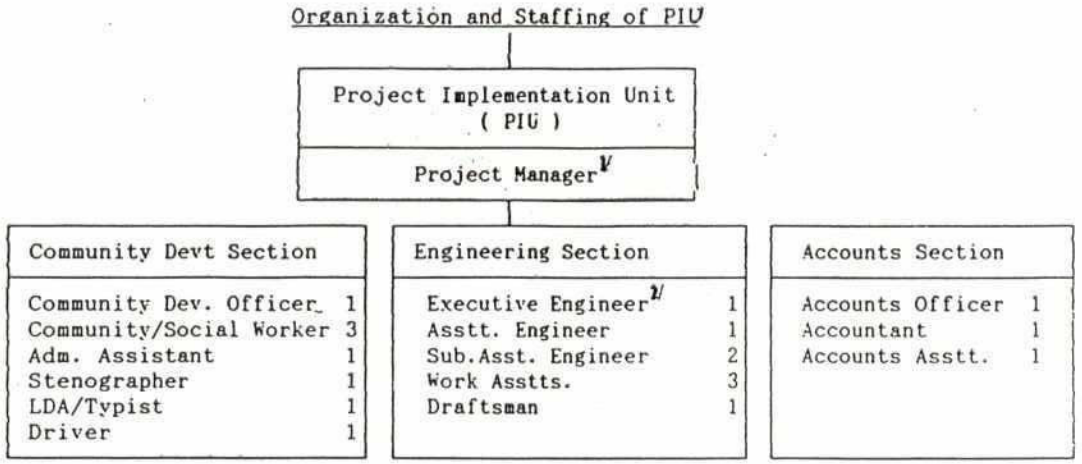


Figure : 5.6 : Organization. And Staffing Of P M U (Scenario2)

Figure : 5.7 : Organization And Staffing Of PIU (Scenario 2)



1/ For Khulna City Corporation, the Project Manager will be the Chief Engineer; for Class A Pourashavas (Dinajpur and Habiganj), the Project Manager will be of the rank of Executive Engineer and for the remaining three towns (Class B and C Pourashavas), the Project Manager will be of the rank of Asst. Engineer.

2/ The Executive Engineer will be only for Khulna City Corporation and Asstt. Engineer one each for Class A Pourashavas (Dinajpur and Habiganj).

ii) Flood Plan Coordination Organisation (FPCO)

- Technical guidance on design parameters, standards and specifications, including review and recommendations on various reports.
- Coordination of Project implementation with FAP activities.
- Liaison, coordination, monitoring, evaluation and feedback during post implementation operations and maintenance period.

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

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

iv) Ministry of Local Govt., Rural Development & Cooperatives (MLGRD&C/LGD)

Administrative support for Project implementation and coordination with Ministry of Finance and the Planning Commission.

v) Bangladesh Water Development Board (BWDB)

- Overall technical supervision and execution of the Project including tendering, award and supervision of contracts, payment to contractors, supervision and quality control of construction works under Part A (Flood Protection).
- O&M, PBME and reporting activities regarding Part A of the Project.
- Supervision and support of work of PMO, including coordination with other implementing and supporting agencies and interaction with the bank Missions.

vi) Local Government Engineering Bureau (LGEB)

- Overall technical supervision and execution of the Project including tendering, award and supervision of contracts, payment to contractors, supervision and quality control of construction works under Parts B (Drainage) and C (Environmental Improvements).
- O&M, PBME and reporting activities regarding Parts B and C of the Project.
- Supervision and support of work on PMU including coordination with other implementing and supporting agencies and interaction with the Bank Missions.

vii) 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, standaredization of O&M procedures and methods, design and 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 programmes, having impact on the Project.
- Preparation of working papers for Steering Committee meetings and for MIWDFC/BWDB, as appropriate, to resolve Project-related issues and problems and to facilitate Project implementation.
- Preparation of periodic progress reports, reimbursement applications, operations of the Imprest Accounts, and 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.

viii) Project Director - Secondary Towns Project

- Overall Project management and day to day coordination with Project Implementing Agencies for Parts B (Drainage) and C (Environmental Improvements) of the Project.
- Programming, financial planning, coordination of detailed engineering design with PMO (including various engineering surveys), contract packaging, participation in tendering and award of 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 for Parts B and C of the Project.

- Operational coordination with parallel donor assisted and other Government programmes, having impact on the Project.

- Providing inputs to PMO for Working Papers for Steering Committee meetings and for LGD/LGEB as appropriate to resolve Project-related issues and problems related to Parts B and C of the Project.

- Preparation of periodic progress reports, reimbursement applications, operations of the Imprest Account, and general interaction with the Bank Missions regarding Parts 13 and C of the Project.

- 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.

ix) PIUs

- Tendering, contract award, supervision and quality control of construction works as well as payments to contractors (Parts B and C).

- O&M, PBME and reporting activities (Parts B and C).

- Implementation and monitoring of the agreed Action Plan, including financial management and cost recovery measures.

5.2 Staffing

The availability of properly qualified staff in the right numbers will be one of the key factors in the success or otherwise of the programme. Recruitment of staff, particularly to the pourashavas, is a priority task.

It is proposed that consultants are used to provide project management support to the PMU, BWDB Zonal Offices and the PIUs. In this context, allowances have been made in the costings for specialist consultants to be assigned to the PMU to provide advice throughout the term of the project. Details are presented below.

- Project Implementation and Management Specialist - 24 man months foreign input followed by 36 man months local input in order to cover the total project period.

- Quality Control Specialist - 24 man months local input.

- Flood Protection/Drainage Design Specialist - 18 man months local input

- Construction Supervision Specialist - 24 man months local input.

Similarly, although the LGEB and BWBD would be responsible for approving designs and providing technical guidance on engineering aspects, their current workloads suggest that consultants might best be used for detailed design.

Most of the PIU staff should come from the recently approved enhanced staffing levels. However many of the approved positions remain vacant and the process of recruitment can be long and time consuming. It is vital however that permanent local government staff are in place and involved in the projects as early as possible in order to ensure the right level of local commitment to the programme and ongoing operation and maintenance.

It will be important to obtain the GOB's agreement to give priority to filling the establishment of the five pourashavas and Khulna City Corporation. Making money available for salaries and allowing a greater degree of local control over recruitment may go a long way towards quickening the process.

5.3 Project Implementation Programme

It is anticipated at this stage that the project will be implemented over a 5 year period commencing towards the end of 1992. A project implementation programme to achieve this goal is shown in Figure 5.8. Some construction of "early implementation" (priority) flood potention works could commence in the 1992/93 construction season if designs for these can be completed by the end of 1992.

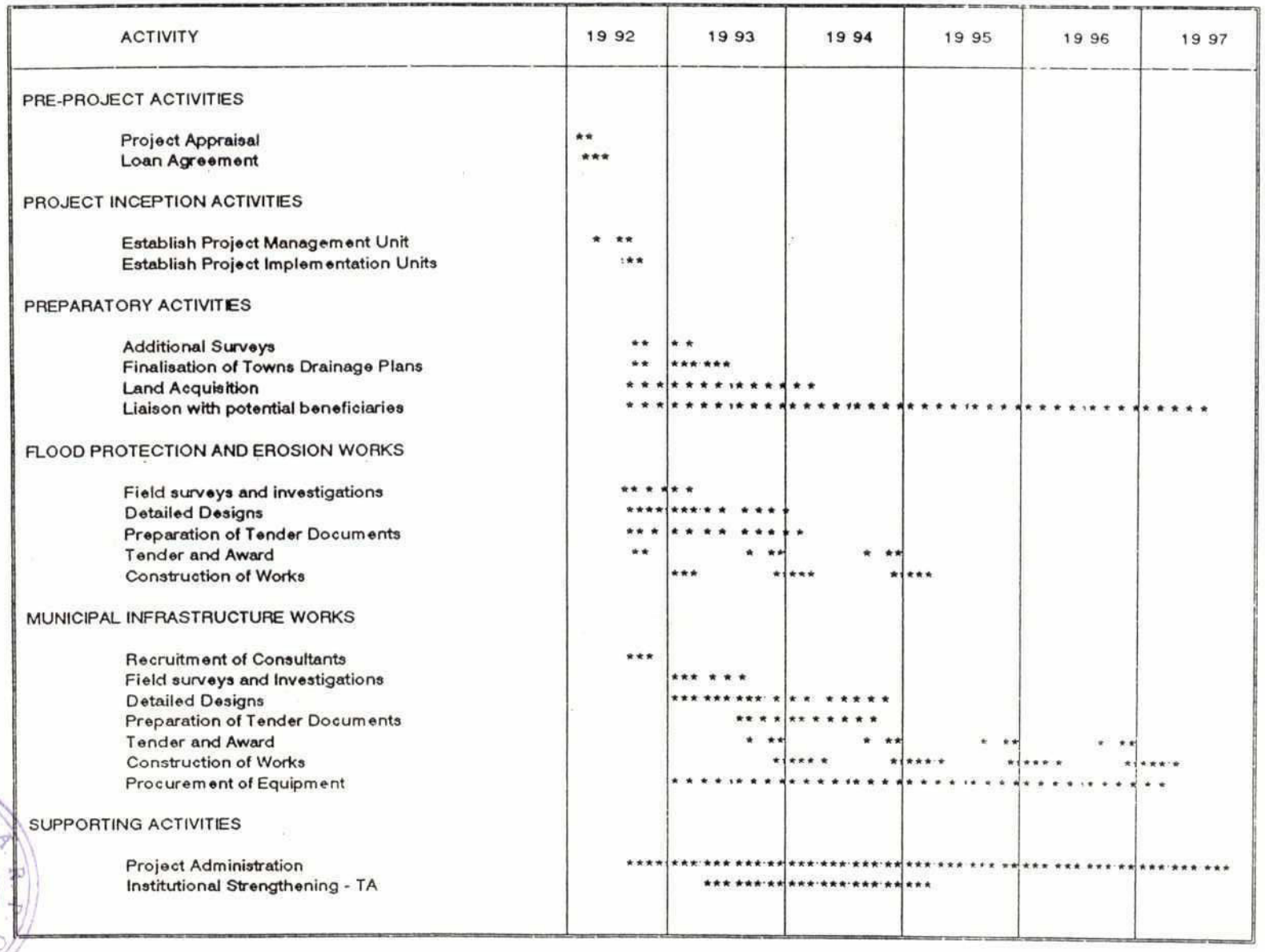
During the first year of the project it is anticipated that the actual construction programme will be relatively small. During this initial startup period the work on the project will involve the following key activities:

- Setting up of the Project Management Unit and Project Implementation Units in each town, including the recruitment or secondment of staff from the various government bodies.
- Undertaking any additional topographical survey as required to enable the works to be designed in detail.
- Land acquisition.
- Recruitment and mobilisation as necessary of consultants and contractors to undertake the initial work programmes.
- Initial contacts with potential beneficiaries of the sanitation and slum improvement components, including advertisement in local papers, the holding of organisation and public meetings and having local discussions with individuals to explain the terms and conditions of acceptance from the potential recipients for these elements of the project.
- Collection of construction materials.

For the main implementation stages of the project these will follow a similar pattern for all the project towns. For the flood protection and river bank erosion elements it is anticipated that these will be undertaken by the BWDB over a 3 year period commencing in early 1993. Land acquisition procedures will need to be completed in sufficient time to ensure that construction activities are not delayed. During the first construction period it is expected that only preparatory works will be undertaken, such as purchase of materials and minor localised rehabilitation works. The main construction works will be undertaken during the 1993/94 and 1994/95 dry seasons.

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

FIGURE 5.8: PROJECT IMPLEMENTATION PROGRAMME



Construction activities will be programmed to commence in November and completed by March/April each year. The timely completion of these works is singularly the most important aspect of the work elements in all the project towns. These works will protect the towns from flooding and safeguard both the townsfolk and infrastructure.

The municipal engineering aspects of the project will follow a different pattern. It is anticipated that these works (other than drainage outlets through the flood embankments which would be undertaken by the BWDB), will be undertaken by the LGD (pourashava/city corporation). The construction of the works will extend over the duration of the project period. The drainage works would be completed on a catchment-by-catchment basis to ensure that real benefits from the construction programme are achieved and also recognised by the beneficiaries. The yearly construction programme would be timed, similarly to the flood protection works, to be completed during the dry season over a five month period commencing November each year. The major elements of the drainage improvement works are anticipated to be undertaken over the central three years of the project. In the first year the construction programme will be restricted in order to allow time for the management and implementation units to gain experience in the operating procedures. During the final year of the project only relatively minor completion works will be undertaken.

For the slum improvement programme, the aim will be to create improvements aimed at completing the upgrading programme in individual areas each year, rather than extending programmes over several years.

With regard to solid waste the aim will be to gradually improve and extend the service throughout the towns over the term of the project, thus giving the municipalities time to develop and administer the greatly expanded service.

5.4 Contract Procedures

At the commencement of the Project, consultants would be recruited to complete the detailed designs and prepare tender documents for the whole of the proposed works. It may be necessary to revise certain elements of the designs as the construction programme proceeds, such that some minor additional design work in the second year of the project may be required. However, by the end of the second year the total work programme should be finalised with tender documents and drawings produced and ready for forwarding to prospective contractors in good time to ensure that contractor(s) are appointed in time for construction operations to commence at the start of the next dry season. The programme for the improvements will follow a similar pattern each year. Contract packages would be sized to be suitable for award to local contractors using standard BWDB or LGEB procedures as appropriate. It may be necessary to divide the works up into sub-packages between several contractors to ensure the whole works are completed and operational by the commencement of the following wet season.

Procurement of equipment would be undertaken to ADB guidelines for procurement and follow Government regulations. The packages should be sized to attract competitive tendering and to gain economies due to discounts. Only equipment conforming to the technical requirements should be purchased. Of particular importance would be the local availability of spare parts/replacements for any equipment purchased.

Procurement of major items of equipment, such as the solid waste collection vehicles would follow either International Competitive Bidding (ICB) or International Shopping (IS) procedures, depending on the contract size. Procurement of minor items of equipment, such as shovels for cleaning drainage channels etc. would be by Local Competitive Bidding (LCB)

For any supply contract estimated to exceed $500,000 and for all civil works contracts exceeding $1,000,000 the Implementing Agency will need to submit to the ADB for prior approval both the draft tender document, before issue, and the evaluation report and recommendation for award before any successful bidder is notified.

5.5 Operation and Maintenance

Operation and maintenance of the flood protection and river bank erosion works are the responsibility of the BWDB, whereas municipal engineering works in the fields of drainage, public latrine facilities and solid waste collection and disposal are the responsibility of the pourashava or city corporation. The maintenance of private sanitation facilities is the responsibility of the beneficiaries.

It is evident that, due to financial constraints, both the BWDB and the pourashavas/city corporation have difficulty in maintaining works from their existing resources. This is particularly true in the case of the municipalities, where maintenance is only undertaken on works that are in a very serious condition and the cost can be accommodated within the available budget allocations. As a consequence there are no routine operation and maintenance programmes undertaken in any of the project towns, maintenance being directed to the rehabilitation and repair of the most seriously affected areas rather than in the development of routine preventative maintenance programmes.

The operation and maintenance capabilities of the local governments will need to be improved to effectively manage the municipal works after completion of the project. It is proposed that the costs associated with the operation and maintenance of equipment, such as the expanded solid waste collection service transport, will be catered for during the project period. Both consumable items, such as fuel, and spare parts etc will need to be allowed for in the financial package in order to ensure the continued success of the investments. In addition, allowances for the routine maintenance of the permanent project components will also be required, and used in the purchase of essential maintenance equipment.

Technical assistance by way of training programmes for the pourashava and city corporation staff, will also be required to assist in the development of their operations and maintenance capabilities. In addition, in order to assist the strengthening of the local administrative capabilities for providing improved services, an Institutional Strengthening TA is proposed. Under the proposed TA, the municipalities will be provided with assistance in meeting the needs for developing their institutional capabilities to implement, manage and maintain the infrastructure services as well as in the development of methods for improving their financial control and resource generation. A draft Terms of Reference for the proposed TA is presented in Appendix G.

Costs and Financing Plans

6. COSTS AND FINANCING PLAN

6.1 Project Costs

The total costs of the project components identified in Section 4 have been estimated at Taka 2,718.8 million (US$ 70.1 million) of which some Taka 763.1 million (US$ 19.7 million) represents the foreign exchange both direct and indirect. Table 6.1 summarises the costs by component. A breakdown of the estimate on a town and "sector" (component) basis is presented in Table 6.2 and shown phased by "implementation unit" (agency) in Table 6.3. Table 6.4 indicates the cost distribution by type of work.

Cost summary tables (base cost plus contingencies) initially grouped by component and then sub-divided by town are presented in Appendix F[1]. These are supported by the detailed base cost estimates initially grouped by town and then sub-divided by component within project Parts A, B, C and D.

In addition a Technical Assistance project has been proposed for training and strengthening of local government capabilities at a cost of $1.08 million to be funded through grant financing. Terms of Reference and cost estimates are shown in Appendix G.

The costs are expressed in January 1992 prices and include taxes and duties estimated at Tk 389.2 million ($10.0 million). Physical contingencies of 10% have been included for all costs apart from consultancy services (15%) and an allowance of 5% has been made for design of civil works. Detailed estimates have been made of administration costs for the sanitation and slum improvements and the operation and maintenance costs of all components.

Price contingencies have been calculated using escalation factors of 3.7% per annum for foreign costs and 6% for local costs.

Of a total cost of Tk 2,647.8 million ($ 68.2 million) excluding finance charges, 65.% is for flood protection works (flood protection, bank protection and surface water drainage), 9.8% for environmental improvements and 7.1% for institutional improvements and implementation expenses.

Service charge during construction, in the form of a one per cent annual service charge on the Bank Loan is estimated to be $1.8 million (Tk 71.0 million).

The "early implementation" (priority) works are outlined in Table 4.8 of the report. The costs associated with these, which form an intrinsic part of the overall project costs, are presented in Table 6.5.

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[1] *Note, that the detailed cost estimates, presented in the "by town and component" summary sheets in Appendix F, include design costs as part of the base cost. When compiling Table 6.2 from the summary sheets it is important to note that the base costs under Civil Work Cost Items A, B and C specifically excluded these design costs, these being transferred instead to Cost Item D Implementation (Consulting Services).*

TABLE 6.1 PROJECT COST ESTIMATES: SUMMARY (Taka Million)

Item	Foreign Currency Cost	Local\2 Currency Cost	Total Taka million	Total US $ million
1. BASE COST\1				
A. Flood Protection Works				
Flood Protection	55.14	130.86	186.01	4.79
Bank Protection	261.84	493.02	754.86	19.46
B. Drainage	153.20	628.76	781.96	20.15
C. Environmental Improvements				
Solid Waste	21.02	31.49	52.51	1.35
Sanitation	37.08	107.64	144.72	3.73
Slum Improvement	14.32	45.73	60.04	1.55
D. Implementation				
PMU & PIU Project Support	22.45	49.14	71.59	1.85
Consulting Services	21.56	95.06	116.62	3.01
Sub-total Base Cost	586.61	1,581.70	2,168.31	55.88
2. CONTINGENCIES				
Physical Contingencies\3	59.73	162.98	222.71	5.74
Price Contingencies\4	45.79	211.02	256.80	6.62
Sub-Total Contingencies	105.52	373.99	479.51	12.36
3. INTEREST AND OTHER CHARGES				
Service Charge on Bank Loan\5	70.96		70.96	1.83
TOTAL PROJECT COSTS	763.09	1,955.69	2,718.78	70.07

\1 Base costs expressed in January 1992 prices; Taka 38.8 = US$1.
\2 Includes taxes and duties estimated at Tk 389.2 million charged on the base cost foreign component of civil works, materials and equipment to include VAT at 15% (Tk 77.84 million) and duties for a total of Tk 311.36 million on steel (40%), cement (75%) and vehicles and spare parts (60%).
\3 Physical contingencies 10% of base costs (15% Consultancy Services)
\4 Price contingencies estimated at 3.7% p.a. foreign and 6% p.a. local.
\5 1 percent per annum.

TABLE 6.2 SUMMARY OF PROJECT INVESTMENT BY TOWN AND BY SECTOR (Taka Million)

COST ITEM	Khulna	Dinajpur	Kurigram	Pancha-garh	Habiganj	Moulvi Bazar	PMU Dhaka	Sector Total	Sector % Total
A. Flood Protection Works									
Flood Protection	46.14	51.74	6.61	12.62	16.81	52.09		186.01	7.0%
Bank Protection	305.39	137.13	114.81	60.52	70.48	66.53		754.86	28.5%
B. Drainage	601.51	57.55	43.07	21.39	38.74	19.70		781.96	29.5%
C. Environmental Improvements									
Solid Waste Management	30.84	7.12	4.23	3.11	3.59	3.63		52.51	2.0%
Sanitation	95.54	25.40	12.88	3.98	6.20	0.73		144.72	5.5%
Slum Upgrading	32.54	22.17	0.00	2.00	1.77	1.56		60.04	2.3%
D. Implementation									
PIU Support	14.62	10.56	7.60	7.74	8.29	5.24		54.04	2.0%
Consulting Services	45.20	11.54	7.94	4.47	6.00	6.15	35.32	116.62	4.4%
PMU Support (Dhaka)							17.55	17.55	0.7%
Total Base Costs	1,171.77	323.20	197.13	115.82	151.89	155.64	52.87	2,168.31	81.9%
Physical Contingencies	119.49	32.91	20.12	11.81	15.50	15.87	7.01	222.71	8.4%
Price Contingencies	162.66	31.48	17.69	10.94	14.77	13.88	5.38	256.80	9.7%
TOTAL COST	1,453.92	387.59	234.94	138.57	182.15	185.38	65.26	2,647.82	100.0%
Town as Percent Total Cost	54.9%	14.6%	8.9%	5.2%	6.9%	7.0%	2.5%	100.0%	

Note: Service Charge on Bank Loan not included

TABLE 6.3 PHASED EXPENDITURE BY IMPLEMENTATION UNIT

Taka Million

Town	Agency	Total	Foreign	Local	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	ForX%
Khulna	BWDB	440.16	138.86	301.29	64.02	213.51	152.69	4.26	4.47	1.20	32%
	City Corporation	995.91	195.11	800.79	76.53	249.57	212.36	233.91	209.47	14.07	20%
Dinajpur	BWDB	231.82	72.88	158.94	55.43	166.32	4.40	2.47	2.59	0.61	31%
	Pourashava	142.92	32.25	110.67	12.44	49.66	27.39	33.48	16.87	3.08	23%
Kurigram	BWDB	148.64	48.80	99.83	66.74	57.20	21.15	1.53	1.60	0.42	33%
	Pourashava	77.01	15.97	61.04	6.53	28.58	17.42	17.65	5.24	1.59	21%
Panchagarh	BWDB	90.06	28.97	61.09	35.15	31.37	21.39	0.93	0.97	0.25	32%
	Pourashava	39.06	8.28	30.78	3.62	11.76	10.40	10.60	2.09	0.59	21%
Habiganj	BWDB	107.78	34.43	73.35	37.13	42.03	25.95	1.14	1.20	0.32	32%
	Pourashava	64.43	13.29	51.14	5.43	24.74	13.63	16.75	3.03	0.84	21%
Moulvi Bazar	BWDB	146.16	43.62	102.54	45.48	64.83	31.98	1.66	1.74	0.47	30%
	Pourashava	32.76	7.04	25.72	4.65	8.39	9.73	8.56	1.15	0.29	21%
Implementation Costs		131.12	52.61	78.51	39.64	29.95	23.07	19.09	15.49	3.89	40%
TOTAL EXPENDITURE											
	BWDB	1,164.62	367.57	797.05	303.95	575.27	257.56	12.00	12.58	3.27	32%
	Municipal	1,352.08	271.95	1,080.14	109.20	372.70	290.93	320.94	237.85	20.47	20%
	Implementation	131.12	52.61	78.51	39.64	29.95	23.07	19.09	15.49		40%
TOTAL		2,647.82	692.13	1,955.69	452.78	977.92	571.56	352.02	265.92	23.74	26%

TABLE 6.4 SUMMARY OF PROJECT COSTS BY TYPE OF WORK

Taka million

DESCRIPTION	Total Tk Million	Total US$ million	Foreign Tk million	Local Tk million	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Land Acquisition	53.88	1.39	0.00	53.88	48.73	5.15	0.00	0.00	0.00	0.00
Civil Works	1,792.90	46.21	499.37	1,293.53	216.62	777.38	415.13	224.40	150.04	9.33
Equipment/Materials	39.29	1.01	19.75	19.54	28.28	5.92	3.43	1.25	0.41	0.00
Implementation Support	78.18	2.01	16.11	62.07	10.66	17.41	16.72	16.52	14.45	2.42
Incremental O&M	87.44	2.25	29.82	57.62	1.10	8.50	18.96	24.49	27.28	7.11
Consultancy Services	116.62	3.01	21.56	95.06	92.29	13.02	6.55	2.72	1.64	0.41
TOTAL BASE COST	2,168.31	55.88	586.61	1,581.70	397.67	827.37	460.79	269.39	193.82	19.27
Physical Contingency	222.71	5.74	59.73	162.98	44.34	83.41	46.43	27.10	19.48	1.95
Price Contingency	256.80	6.62	45.79	211.02	10.77	67.14	64.35	55.53	52.61	6.41
Service Charge on Bank Loan	70.96	1.83	70.96	0.00		3.35	11.20	15.98	19.04	21.39
TOTAL COST	2,718.78	70.07	763.09	1,955.69	452.78	981.27	582.76	368.00	284.96	49.02

TABLE 6.5 EARLY IMPLEMENTATION PROGRAMME

(Taka million)

Town	Land	Civil	Materials	O&M	Con-sultancy	Physical Contingency	Total
Khulna	12.36	309.80		9.27	15.55	35.48	382.47
Dinajpur	8.24	174.13		6.57	8.74	20.21	217.88
Kurigram	0.52	115.02	1.42	4.26	5.84	13.00	140.06
Panchagarh	2.32	55.11	1.77	1.90	2.85	6.54	70.48
Habiganj	2.25	82.05		2.99	4.12	9.35	100.74
Moulvi Bazar	11.02	103.38		4.22	5.19	12.64	136.15
Price Contingency							76.38
TOTAL	36.70	839.48	3.20	29.20	42.30	97.20	1,124.47

6.2 Proposed Financing Plan

The Bank loan is expected to cover all local and foreign costs apart from land acquisition[2], taxes and duties, and 50% of the incremental staff and operation and maintenance costs on a declining basis, for a total of $55.1 million as shown in Table 6.6.

Also shown for information as requested are the costs of the drainage works being done in Panchagarh (Tk 4.45 million) and Moulvi Bazar (Tk 3.77 million) by the Netherlands - Bangladesh Development Cooperation Programme for water supply, sanitation and drainage improvements and the IDA funded FAP - 9B project estimates for the Munshiganj component of the Meghna River Bank Protection Project as derived from the Interim Report of October 1991.

Under the proposed financing plan, funds for the project would be reflected in the Executing Agency's Annual Development Programme (ADP) allocations. The GOB would be responsible for payment of the loan and would bear the foreign exchange risk. Part of the loan proceeds would be onlent to the pourashavas for investment in low cost sanitation (50% of the costs) to be fully cost recovered. Investments in sanitation and solid waste management in Khulna would be partly loan financed.

Projections of expected revenues and expenditures have been made for each Pourashava (see Appendix D). These indicate that with improvements in own source revenue generation there will be sufficient funds to operate and maintain the infrastructure improvements proposed in this project.

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[2] *Note that the estimates presented in this report, do not include the cost of land (already owned by Khulna City Corporation and Habiganj) which is necessary for the sanitation and solid waste disposal improvements set out in Section 4. The notional cost of this land for the solid waste disposal at Khulna is 0.74 million taka per hectare. At Habiganj it would be between 0.25 and 0.37 million taka per hectare depending on the site chosen.*

TABLE 6.6 PROPOSED FUNDING ARRANGEMENTS

(US$ million)

	Foreign Exchange	Local Currency	Total Amount	Percent
EXTERNAL SOURCES	19.67	35.46	55.13	78.7%
DOMESTIC SOURCES				
Central Government	13.90	13.90		19.8%
Local Government	1.04	1.04		1.5%
TOTAL	19.67	50.40	70.07	100.0%
RELATED PROJECT FUNDING				
Meghna River Bank Protection				
Munshiganj Component	5.04	2.26	7.30	
Additional Drainage (18DTP)				
Panchagarh	N.A.	N.A.	0.11	
Moulvi Bazar	N.A.	N.A.	0.10	

The ADB Financing Plan, as set out in the ADB Aide Memoire to GOB dated 21st April 1992 and approved at the 25th April 1992 "wrap-up" meeting, is included as Annex F1 of Appendix F. This Plan shows the proposed allocation of Bank and Government funding for the various project components (sectors). This Plan gives, a summary table setting out the loan amount from the Bank (55.00 US$ million). This loan amount is intended to finance the entire foreign exchange costs (19.69 US$ million) and also the local currency (RPA element) costs (35.31 US$ million). The Plan referred to above is intended to form the basis of the more detailed financing plan required for the preparation of a "Project Proforma" (PP) as required by GOB. The normal procedure is for this detailed plan to be prepared by the Executing Agency (BWDB) for approval by the Planning Commission.

6.3 Cost Recovery

Although some towns are in a stronger financial position than others, none can afford the proposed municipal improvements due to the limited efficiency of their current methods of revenue generation. As in other recent projects, Central Government grants are expected to fund the capital costs of urgently needed flood protection and town protection works, drainage, solid waste disposal, slum improvements, public sanitation and incremental operation, maintenance and administrative costs associated with implementation.

Cost recovery, however, both direct and indirect, is one of the most important features of the project. In order to achieve this, the proposed Institutional and Financial Action Plan (described below and shown in detail in Appendix D) will have a long term impact on the local authorities' ability to provide infrastructure and services to their growing populations, and will lessen the dependency on central governments grants. Note that the Action Plan set out in Appendix D is the one presented to GOB by the ADB in their Aide Memoire dated 21 April 1992 and generally approved on 25 April 1992.

At the national level, Government will recover funds invested in infrastructure through the land development tax which captures part of the increase in land value arising as

a direct result of the investments. Changes in the approach to this tax and the development of a land value record system are currently underway. These should enable recovery of a significant portion of Central Government expenditure.

Direct cost recovery at the municipal level is concerned with the capital costs of household sanitation. As shown in Appendix D and Section 7, revenue from low cost sanitation loans (at 18% interest over three years with 20% down) will be more than sufficient to repay the loan advanced to each pourashava (50% of the cost of the low cost sanitation programme to be repaid at 1% interest over 20 years with a five year grace period) and provide a rolling fund for future sanitation improvements.

Construction labour and future maintenance in slum upgrading areas will be provided primarily by the local community in line with their recent experience of such programmes, thus reducing local government maintenance requirements. In effect this can be seen as full cost recovery of the labour component of the slum upgrading works.

The most significant local element of cost recovery comes from additional municipal taxes and major improvements in coverage, collection efficiency and valuation methods of existing revenue sources which will be achievable as a project work. The present tax base is narrow and takes insufficient note of affordability, thereby aggravating collection problems. At the same time charges are too low to fund even operation and maintenance costs, let alone new capital expenditure. Current levels of service reflect these financial constraints and further hinder collection performance. Other difficulties with municipal finance have been described in Section 2.9.5 and Appendix D which sets out the current status of tax collection coverage and efficiency.

The proposed Action Plan (see Appendix D) will contribute to cost recovery as follows:

- **Land classification and valuation**

  In some cases recently developed land is still classified as agricultural: this should be reclassified to reflect current use so that it can be taxed accordingly. Similarly, conversion of the land development tax from an area basis to an ad valorem basis will enable government to better realise the financial benefits of the increased land values which are due to the project and thus contribute to cost recovery.

- **Flood Protection/Drainage surcharge**

  A surcharge to be levied on the holding tax to cover the operation and maintenance costs of the flood protection and drainage components. In order to have community participation it is recommended that 50% of the O&M costs of flood protection be recovered from beneficiaries. This would be a unique project feature and would have potential for being replicated in development projects countrywide.

- **Conservancy charges**

  Khulna City Corporation and Moulvi Bazar currently have conservancy charges at rates lower than the maximum allowed by law (7% of annual property value). It is proposed that these be increased in order to fund the operation and maintenance costs of the solid waste component.

  In addition, extension of conservancy charges to additional households covered by the improved solid waste management service and

improvements in property tax collection, which included conservancy charges, will provide added funds for solid waste operation and management in all towns.

- **Property taxes**

  Improvements in property tax assessment and collection efficiency will have a significant impact on municipal finances and local government ability to provide and maintain services and cost recovery. The proposals include improvements in the collection of arrears and current taxes, reassessment of property values using more accurate market prices and improved valuation techniques, property tax mapping and expanding coverage, ultimately to all households benefiting from municipal services. There are also proposals for more effective financial accounting and budgeting systems.

  All of the towns have carried out a reassessment of property values within the past year and, thus would not be expected to do another before 1995/96. It is, however, proposed that this be done by 1993/4 using improved valuation techniques and with greater effort made to include the large numbers of families not currently on the tax rolls as indicated by the 1991 Population Census results.

Appendix D includes the Action Plan with target dates for each town to achieve certain levels of performance in tax collection coverage and efficiency and a more detailed, typical plan for Dinajpur. The ADB Institutional and Financial Action Plan presented in their Aide Memoire dated 21st April 1992 is also included in Appendix 'D'.

With regard to onlending, it is estimated that about $ 1.2 million out of the loan proceeds would be onlent to Khulna City Corporation/Municipalities. For Khulna City Corporation, the financing of the sanitation and solid waste management components could involve 90 percent grants and 10 percent loans. The loans will bear interest at 12.5 percent per annum repayable over 20 years, including a grace period of 5 years[3]. For the smaller towns, relending should only be for the sanitation component (50 percent of the component cost) and the terms of the loans could include an interest rate of 1 percent, with a repayment period of 20 years, including a grace period of 5 years[4]. For all Project towns, the local governments will recover the costs of the

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[3] *Note, that for Khulna City Corporation, the terms of relending are similar to those agreed for Dhaka City Corporation under the Dhaka Integrated Flood Protection Project (Loan No. 2235-BAN), approved in November 1991. The Dhaka project also provided for 5 percent relending for the drainage component and 10 percent relending for the slum improvement component. Unlike Dhaka, however, there is no water and sewerage authority in Khulna. With a large drainage component, any loan financing will have an adverse effect on municipal finances. Further, the cost recovery from drainage and slum improvements will mainly be indirect through property value increases and land development taxes. As such, the drainage and slum improvement components in Khulna are recommended to be fully grant financed.*

[4] *Note, that these are similar to those agreed for the sanitation component in the Secondary Towns Infrastructure Development Project (Loan No. 1059-BAN), approved in December 1990. The financial condition of the municipalities in the smaller towns is such that 100 percent grant financing has been proposed for the solid waste management (SWM) component for them.*

sanitation components fully from the beneficiaries, over a period of three years at an interest rate of 18 percent per annum.

Higher revenue collection efficiencies than hitherto should gradually be possible in the future, once the environmental improvement works are made and operated efficiently and the community feels that it is getting a reasonable level of service. Improvements will be perceived more readily by the community, especially the women who have such a direct interest in them if they have been involved in the process of consultation and liaison from the earliest stage of the project. Such community participation is intended to be an important feature of the project. Community development efforts should 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 maintenance of public facilities) in the implementation of the Integrated Plans for the project towns.

Project Justification

7. PROJECT JUSTIFICATION

7.1 General

When implemented the project will bring significant benefits to the populations of the study towns and will have indirect benefits for the large catchment areas they serve. The institutional strengthening measures will provide long term improvements in service delivery for the whole community through more efficient use of financial, human and physical resources.

Financial justification for the project as a whole lies largely in the improvement of the local government's ability to provide municipal services and, through enhanced land values resulting from capital improvements, to raise sufficient revenues to fund their operation and maintenance and some further development.

An economic assessment has been made of the flood protection and slum improvements. The solid waste management and sanitation components were evaluated in financial terms.

Where possible the approach has followed the "FAP Guidelines for Project Assessment" produced by the Flood Plan Coordination Organization in July, 1991. Modifications have generally been made where rural applications, as proposed in the Guidelines, were not appropriate to an urban setting or to municipal works.

The project components are closely interlinked. A large percentage of the population interviewed in the household surveys indicated that, in the absence of a municipal solid waste service, they disposed of household and market waste in drains and ditches, thus aggravating already severe drainage problems. Similarly, earlier flood protection works have in some cases blocked drainage outlets. Improvements to flood protection and solid waste management will benefit the drainage system and should decrease the maintenance required. Further to this, improvements to drainage and flood protection will decrease road maintenance costs.

The following sections describe the methodology used for each type of evaluation and the results. Detailed calculations by town are found in Appendix F.

Financial costs are expressed in taka in January 1992 prices. A Standard Conversion Factor (SCF) of 0.82 has been applied to local costs to convert them to economic prices as per the `FAP Guidelines for Project Assessment'. Economic evaluation was carried out over 30 years, financial evaluation over ten. The opportunity cost of land has been taken as equal to the current market price.

7.2 Economic Evaluation of Flood Protection Works

The analysis of flood protection groups the costs and benefits of flood protection, bank protection and surface water drainage to value flooding avoided regardless of cause. This has the advantage of avoiding double counting, especially of infrastructure damage which occurs as a result of both river flooding and standing rain water but can not be practicably allocated to either. It is also the case that most of the bank protection works are for the purpose of protecting existing embankments, and the flood protection costs include for drainage regulators in the embankments because they

become the responsibility of the BWDB despite being a part of town drainage. For these reasons flood protection has been evaluated as one entity. Benefits have been derived as described below.

7.2.1 Benefits of Flood Protection and Bank Protection Works

The primary benefit of flood protection works is the minimization of risk of flood damage or erosion to property and infrastructure, although there are lesser benefits in some cases to livestock and agriculture. There are also health and environmental problems associated with standing flood waters. All the towns show evidence of danger to commercial, industrial and/or residential areas from erosion or embankment failure.

The general approach used to quantify the benefits to flood and bank protection works where embankments exist has been to:

- Assess the area of the town which is now or would be flooded with a breach in the embankment or if it overtopped;

- Identify from the Master/Structure Plans prepared by the Urban Development Department for each town the land uses in effected areas and the numbers of structures by broad descriptions of type and quality;

  In four of the towns 80% to 100% of the municipality would be effected and thus these broad categories from the 1981 census or later surveys, updated to 1991 in the case of residential structures using the 1991 Census, are reasonable estimates. The Master/Structure Plans detailed numbers and quality of public buildings, shops, industrial uses and the like from surveys carried out within the past five years and these have been used without change.

- Estimate economic prices for property at risk;

  The Training Studies of the Brahmaputra River (FAP 1) Second Interim Report Economic Assessment included the results of extensive surveys of property values carried out as part of their evaluation and from which they derived average economic prices for property as follows:

Type of Property	Unit Value (Taka)	
	Financial	Economic
Public Building		
- Pucca	2,000,000	1,640,000
- Semi-Pucca	200,000	164,000
Private Houses/Shops		
- Pucca	250,000	205,000
- Semi-Pucca	10,000	8,200
- Katcha	5,000	4,100

Pucca buildings have been valued at their full replacement cost (based on LGEB rates). For semi-pucca and katcha buildings the values are based on the costs of relocation coupled with the damage to the existing structure during dismantling. Economic unit values were derived from current financial values adjusted by the standard conversion factor.

Because construction prices vary little from one town to another (total property values vary primarily due to land prices), these unit values have been used for all towns.

- Using the frequency analysis for maximum one-day flood levels for each town and the embankment ground level (or level of existing breach), determine the return period of the water level which would cause serious damage, usually a two metre flood level;

- Calculate the probability of catastrophic failure using the formula:

$$P = (n + T)/(2T(n+1))$$

where

P = Average probability of all events above the T year event.
n = Number of years in the analysis (30)
T = Return period of design event defined above.

- Calculate annual flood damage avoided.

  Few of the towns were able to estimate property damage in past floods. Moulvi Bazar detailed a loss of about Tk 5 million in property and livestock in the 1984 flood and Habiganj estimated losses of 4% in 1987 and 7% in 1988. All towns, however, provided specific lists of infrastructure damage from two years flooding.

  The flood damages to be avoided as a result of the works have been estimated to be:

  a. The value of actual infrastructure losses in the most recent flood updated to 1992 prices and factored by the probability of risk;

  b. 5% of the economic value of property at risk, as described above, factored by the probability of occurrence.

Benefits are assumed to occur in the first year after completion of all works and continue in every year thereafter, increasing by 1% per year to allow for population growth, property and infrastructure improvements etc. Exceptions and additions to this general approach are described below for Khulna and Panchagarh.

Panchagarh floods over 30% of the town area due to breaches in the embankment. Benefits to the property in this area have been assessed as

described above. The works required to achieve this protection will also make available an additional 400 ha of low-lying land for agriculture and future urban development. The incremental value (the underdeveloped less the low-lying price/ha) of this land has been included as a benefit phased evenly over thirty years to allow for gradual development in line with population growth.

A further serious concern in Panchagarh is the rapidly increasing erosion occurring around the left abutment of the road bridge connecting the two parts of the town, in particular linking major employment areas with residential areas. It is impossible to accurately assess the cost of the repairs required if the abutment collapses, not to mention the potential loss of life and vehicles in the event of a collapse. However, a notional value of Tk 7 million repair cost has been included in the benefit stream, factored by a probability of 10% occurrence, as the potential damage avoided as a result of the bank protection works at this site. This is thought to be a conservative estimate.

The problems in Khulna are quite different from those of the other towns. There is a portion of the town which floods due to failures in the existing retired embankment which are to be rectified. Although much of this land is agricultural, benefits to the built-up areas have been calculated as described above.

The main concerns for bank protection in Khulna are those areas where erosion threatens commercial areas, major public buildings, infrastructure and the Roosevelt Jetty facilities, many of which have already suffered badly from erosion in recent years. Detailed site surveys have identified the properties at risk and they have been valued as described above. Estimates have been made of the replacement costs of the railway line and major public roads under threat. An estimate has also been made of the value of the land which would be lost at each site as a result of bank failure. Each site has different assumed probabilities of failure based on engineering judgement. These have been applied to the total value of property, land and infrastructure at each site to calculate the annual benefit of the works, i.e. the value of damages avoided each year, which are assumed from the year after civil works have been completed.

Appendix F contains a working table which shows the derivation of each set of benefits of flood protection.

7.2.2 Benefits of Drainage Improvements

Benefits of drainage works come from reduced road maintenance costs, improved health and reduction in rain water flooding. All of the towns reported significant problems with drainage-related flooding which provides breeding grounds for mosquitos, restricts access and limits use of land in some areas.

These benefits are represented by enhanced land values. The areas to be improved were measured and valued using the land-use information described in the Master/ Structure Plans and land values provided by local authorities in October 1991 (see Appendix F). It would have been desirable to compare areas of similar land-use with and without flooding from inadequate surface water drainage to determine the value

of drainage improvements but this has not been possible, largely because drainage problems are common to almost the entire urban area. A one time increase of 1% of land values has been assumed to occur in the year after the works are completed. Since the works will be completed on a catchment basis, the benefits have been phased by percentage of the works done in each year. The exception is Kurigram where a 5% increase in value has been assumed.

There is a further benefit from the sale of arisings from the works which are used as land fill, a scarce and valuable commodity in Bangladesh. These have been valued in terms of the developable land created as a result of adding fill, the incremental benefit being the difference between the low-lying land price and the undeveloped land price per hectare. Areas were defined in each town where this would most usefully occur and the number of hectares of land improved was calculated on the basis of the depth of fill required for each. Because the size of the land to be filled amounts to only a few hectares per year and the sites have been carefully selected, the benefit is assumed to occur in the year after the associated civil works have been completed.

7.2.3 Results of the Analysis

Full results of the analysis including sensitivity tests and switching values for each town are shown in Appendix F. The Economic Internal Rates of Return (EIRR) are as follows:

	Economic Rate of Return Flood Protection Works
Khulna	32.8%
Dinajpur	46.0%
Kurigram	14.3%
Panchagarh	28.7%
Habiganj	44.4%
Moulvi Bazar	28.5%

The results have proved to be quite robust when subjected to sensitivity tests on critical variables, although Kurigram has a much lower EIRR than the other towns. The assumptions used to calculate benefits have been conservative and have not taken into account any commercial activity or livestock or agricultural losses due to lack of data, therefore the results may be understated.

7.3 Economic Evaluation of Slum Improvements

Benefits of slum upgrading are quite significant, including environmental and health improvements, reduced infant mortality, enhanced property values and improved worker productivity and earning capacity. The improvement in conditions for low-income households and women is particularly pronounced in slum upgrading, as are the opportunities for community participation.

Because individual benefits are very difficult to measure, increases in house rental values are commonly used to represent the stream of benefits attributable to upgrading works. The Secondary Towns Infrastructure project found that the average slum dweller was at the 20th percentile of the household income distribution and pays between 10% and 20% of income in rent. An increase of 25% on the average rent thus

calculated has been assumed as the benefit attributable to the physical works of the slum upgrading project.

The ERR of the slum upgrading component for each town is shown below. Details of the calculations, sensitivity analyses and switching values are found in Appendix F. The results are quite robust in that variations in capital costs, benefits, operation and maintenance costs and phasing of benefits all result in positive rates of return very near the base case. It should be noted that the operation and maintenance costs shown are notional costs, since they are the responsibility of the beneficiaries, and most of the requirement will be for voluntary labour.

Economic Rate of Return Slum Improvement	
Khulna	18.7%
Dinajpur	18.8%
Panchagarh	13.7%
Habiganj	12.3%
Moulvi bazar	14.7%

7.4 Financial Evaluation of Solid Waste Management Improvements

Present levels of municipal solid waste collection and disposal are poor, covering only parts of the towns and in most instances providing a less than weekly frequency of service. This results in householders disposing of additional waste on open ground and in canals, ditches and drains.

Betterment of municipal solid waste management would enrich the urban environment for the whole town as well as having more specific benefits to those securing new or improved services. Indirect benefits include improvements to the drainage system through fewer blockages and thus decreased maintenance costs and flooding from surface water.

Although there are no direct user charges for solid waste collection services, conservancy rates charged to households in the areas served by municipal collection are used to fund them. An improved collection service is expected to make tax collection efficiency easier to achieve, will increase the tax base by serving more families and will allow higher rates to be charged commensurate with the service provided.

Conservancy fees are meant to be charged only to households having access to the municipal service, but in practice they are charged to all households on the holding tax rolls in most of the project towns.

A financial evaluation was made of the solid waste component in each town, with results as shown below and detailed calculations found in Appendix F. Increases in the conservancy taxes collected have been used as the benefit (see Appendix D and Section 7.7 for description), along with an allowance for salary compensation from Central Government grants which would not be expected to be covered by conservancy charges. It should also be noted that the operation and maintenance costs include depreciation on equipment.

Consideration was given to the improved value of the land filled in the sanitary waste disposal sites as an additional benefit when sold. However, the proposed sites (on low-lying, poor land) are expected to last for 12 to 15 years, beyond the period of the analysis, and at that time more land will have to be acquired. Even allowing the full cost of land acquisition as a residual value in the calculations made little difference to the results and this amount probably overstates the possible profit between potential sale price and the cost of the new site required.

It is not possible to quantify the benefit of savings in drainage maintenance costs for two reasons. Firstly, the drainage networks in the towns do not at present work efficiently nor are they maintained properly so the benefit would not necessarily be a savings on present expenditure; secondly, it is difficult to assess future drainage maintenance costs with and without the present levels of solid waste which are deposited in the drains.

The most important consideration is that increases in conservancy charges are more than sufficient in all towns to meet the increased costs of operation and maintenance of the proposed solid waste components.

Financial Rate of Return
Solid Waste Improvements

Khulna	20.0%
Dinajpur	14.7%
Kurigram	13.3%
Panchagarh	17.0%
Habiganj	14.3%
Moulvi Bazar	26.1%

7.5 Financial Evaluation of Sanitation Improvements

Benefits of sanitation works will directly affect those households participating in the programme and indirectly improve urban conditions for the town by helping to reduce the use of drainage channels for other purposes and reducing the risk of disease. The importance of this is recognised in the major Government of Bangladesh objective of achieving a level of 90% of households with sanitary facilities by the year 2000. Alternative low-cost solutions have been proposed which should be affordable to the lowest 20th percentile group of the income distribution in most of the towns, thus anticipating full cost recovery, with a rolling fund created to serve future population needs. Public toilets are planned for areas such as markets and thus would serve the rural population as well.

An analysis was made of the household survey data which identified the income levels, average family size and willingness to contribute to improvements of those households presently without sanitary facilities. These are shown by town in Appendix C. Loan terms assumed were 20% down with loan repayments at 18% interest over three years. Assuming a maximum monthly repayment of 3% of household income for low income families, as applied in the Municipal Services Sub-Project for Khulna, and removing that percentage expressing unwillingness to contribute, an affordable programme was devised as shown in Section 4.

The level of coverage reached by 1997 as a result of the programme ranges between 73% and 88% for Khulna, Dinajpur, Panchagarh, and Habiganj. Kurigram is much lower at 49%. The town has by far the greatest need for sanitary facilities but also the lowest income levels. In fact many respondents to the household survey expressed unwillingness to contribute even labour to sanitation improvements, saying that all available household resources of labour must generate income for family survival.

The financial analysis produced a financial rate of return of 20.5% for all towns. Sensitivity analysis on the loan term showed that two year loans (as proposed in other recent projects) would increase the rate of return by only a very small amount to 20.9%, but would have a serious impact on affordability. This is shown below in a comparison of the coverage rates achievable by town in 1997/98 which also takes other sanitation projects into consideration.

Sanitation Coverage Achievable in 1997

Town	Without Project Case	2 Year Loan Term	3 Year Loan Term
Khulna	69%	75%	85%
Dinajpur	55%	61%	73%
Kurigram	20%	27%	49%
Panchagarh	61%	62%	82%
Habiganj	70%	81%	88%

It should be noted that the lowest cost sanitary facility offered in the Secondary Towns Infrastructure Development Project has roughly doubled in price over the past two years but incomes have changed very little.

7.6 Multi-Criteria Analysis

Table 7.1 presents a multi-criteria analysis of the project by sector. Composite rates of return and net present values have been calculated for each type of work.

7.7 Affordability

Although some towns are in a stronger financial position than others, none would be able to fund the proposed municipal improvements from its own revenues. As in other recent projects, Central Government grants are expected to fund the capital costs of flood protection and town protection works, drainage, solid waste disposal, slum improvements, public sanitation and incremental operation, maintenance and administrative costs associated with implementation.

TABLE 7.1 MULTI-CRITERIA ANALYSIS
SUMMARY OF PROJECT RESULTS

Taka million

Data Type	Variable/ Measure/ Units	Flood Protection	Solid Waste	Sanitation	Slum Improvement
1. Economic	EIRR	33.5%			18%
	NPV at 12%	1,527.4			12.41
2. Quantitative					
	Beneficiary Households	217,106	67,151	56,852	8,356
	Increased property value	959.39			7.58 per year
3. Qualitative\1					
	Environmental conditions	3	3	3	3
	Health	3	3	3	3
	Infant mortality	2	1	3	3
	Unit cost of service delivery	1	0	0	0
	Fisheries	-1	0	0	0
	Employment opportunities	1	0	0	1
	Absentees/productivity	1	1	1	2
	Damage risk	3	0	0	0
	Public participation	1	1	2	3
	Condition of women	2	1	3	3
4. Financial					
	FIRR		18.5%	21.0%	
	NPV at 12%		9.4	7.1	
	Cost recovery		Yes	Yes	

\1 Ranked from +3 ..0..-3 to give indication and direction of importance
Note: See town results, Appendix F for more detail.

Cost recovery in the context of this project is concerned with the capital costs of household sanitation and the ability of the pourashavas/city corporation to fund land acquisition and operation and maintenance costs after implementation of the drainage, public sanitation and solid waste management works. It has been assumed that future maintenance in slum areas which have been upgraded will be carried out primarily by the local community, in line with recent experience of other such programmes.

7.7.1 Municipal Affordability

Proposed and actual municipality budgets for recent years are shown in Appendix D and are discussed briefly in Section 2.9 in relation to the institutional ability to implement the projects. Additional financial responsibilities to be incurred as a result of the project include land acquisition, non-salary costs of operation and maintenance of the new works (additional salary costs to be covered by salary compensation grants) and interest and loan repayments of the low cost sanitation sub-loans.

The sub-loan (50% of the cost of the low cost sanitation component) will be repaid semi-annually over 20 years at 1% interest with a five year grace period. Income from these funds on-lent to beneficiaries at 20% down and repayments over three years at 18% interest will be more than adequate to repay the sub-loan and create a rolling fund for future investment.

The amounts required by each local government authority for land acquisition and property compensation in the first year of implementation (first two years in the case of Moulvi Bazar) and additional on-going operation and maintenance costs are shown below. Salary costs are not shown, but the additional staff numbers proposed are all within the establishment for each town and are thus to fill vacant posts.

	Land Acquisition Taka Million	Annual O & M Costs from 1996 Taka Million
Khulna	15.97	5.5
Dinajpur	0.63	1.2
Kurigram	0.25	0.6
Panchagarh	0.15	0.4
Habiganj		0.5
Moulvi Bazar	0.15	0.4

These costs are more than covered by the additional holding tax collections as shown in the budgets in Appendix D.

7.7.2 Affordability to Local Households

It has been proposed as part of the low-cost sanitation component to provide loans to householders to cover the full cost of a latrine apart from the shelter around it (to be constructed separately by the household). Terms applied in other recent projects include a 20% down payment and payments over two years at 18% interest. The lowest cost option, the single pit latrine, will cost about Tk 2,000 requiring a down

payment of Tk 400 and monthly payments of Tk 80. This is equivalent to a down payment of 20% and a monthly payment of 4% of a monthly household income of Tk 2,000 which is the top of the income band of over half of the families with no sanitary facilities.

Appendix C provides a breakdown from the household surveys carried out in each town of the desire for improvement in facilities, willingness to contribute, household size by income category and the income distribution of those families without sanitary facilities. The average household size of those families with incomes of less than Tk 2,000 per month ranges from 6.5 to 8.

Most households expressed a desire for better sanitation and in Dinajpur and Panchagarh similar numbers of those needing sanitary facilities indicated a willingness to contribute to their improvement with labour, materials or finance. In Habiganj and Khulna, 77% and 70% respectively of those in need were willing to contribute. In Kurigram, however, only 38% of those in need expressed the willingness or ability to participate. The reasons given were extreme poverty, lack of family members capable of contributing labour, and the inability to release any family labour for anything not financially rewarded. Given the large household sizes in Kurigram and the particularly low income levels, this is not surprising.

Applying an affordability threshold of 3% of income for monthly payments under the prevailing loan terms results in the town coverage shown in Section 7.5 under a two year loan term. It can be seen that this falls far short of the GOB target of 90% by the year 2000, despite making optimistic assumptions about take-up (i.e. that all who can notionally afford the programme will participate, and that families below the poverty line identified in Section 2.1 can actually afford 3% of their income). Consideration was given to more favourable loan terms. Modifying the interest rate made relatively little difference to the number of households able to participate, but an extension of the term to three years had a marked impact and is the term proposed for this project. The results are shown in Section 7.5.

Increases in property taxes have been proposed to help fund the operation and maintenance costs of the project works. Appendix D contains an assessment of household affordability and the percentage of income at various percentiles which would be required to pay the average tax. Because these are calculated on the basis of assessed property value, the poorest households will be least affected and the average tax as a proportion of income at the 20th percentile overstates the position; the most important change would to be to bring more households onto the tax rolls.

Environmental Impact Assessment

8. ENVIRONMENTAL IMPACT ASSESSMENT

8.1 Introduction

The Environmental Impact Assessment (EIA) of the Project was prepared as an integral part of the feasibility study and has been carried out to comply with the Asian Development Bank (ADB), Categorization of Projects based on Potential for Environmental Impacts. The project has been classified as category 'B' (projects likely to have significant adverse environmental impacts, but for which mitigative measures may be readily prescribed).

The EIA has followed the general format of the ADB Summary EIA report. The EIA also follows the accepted practices of Environmental Impact Assessment which are incorporated in the Draft Guidelines prepared under FAP16 taking account of the nature and categorisation of the project as well as the time constraints.

The project designs, as reported in the Interim Report, have been used as the basis for this Environmental Impact Assessment. The possible impacts of these designs have been considered and, where these are considered negative, mitigating measures have been developed. The project design, as set out in this report, has been modified to incorporate these mitigating measures, and the impact of the final project proposals has been further environmentally assessed.

The EIA was executed through a series of field visits by the Environmental Specialist and a Project Engineer to all the project sites, discussions with local officials and people, and internal discussions between team members on environmentally sensitive areas of the project.

Maps, aerial photography and satellite imagery were used as reference baselines. Available data from the Interim Report stage and previous reports, together with new data made available through the site visits were used in the determination of this EIA. Further data on specific areas was obtained through discussions with specialists working on other projects within the Flood Action Plan (FAP), as well as national institutions.

Although water supply as a component is not specifically part of this project, other than as part of slum improvement, it is nevertheless important in any Integrated Plan. For this reason outline details of the existing supplies are set out in paragraph 8.3, town by town, supported by a separate general sub paragraph 8.3.7. In general the towns have well established water supplies. Where there are deficiencies, steps are being taken by the authorities to remedy the situation.

The mitigating measures resulting from this EIA have now been incorporated into the project designs as detailed in this report.

8.2 Description of Project

The project covered by this feasibility study is for the flood protection, drainage and public health improvements within six secondary towns in Bangladesh. The towns are located in three regions: Khulna in the South West Region; Dinajpur, Panchagarh and

Kurigram in the North West Region; Habiganj and Moulvi-Bazar in the North East Region. The location map of these towns is given in the Frontispiece and details of the project and its objectives are given in Section 1.2. Individual 'Town and Environs' drawings have been prepared to facilitate understanding of this EIA. These are presented in Volume 2A.

The towns chosen for the project are all at risk from flooding. The project will provide both new and rehabilitated flood defences which are needed to minimise the risk of serious urban flooding from the rivers and to protect major existing assets. The project will improve the drainage from these urban areas, ensuring that future flood events from rainfall are reduced. Additionally the project has a component of improving public health by the installation of new pit latrines, improving the collection and disposal of solid waste by the municipalities, and by some improvements to the quality of life within slum/squatter areas.

The need for the project is determined by the fact that these towns are subject to seasonal flooding, with the consequential damage to property, and the carriage by flood waters of waste material and excreta (detrimental to public health). In most cases the people most disadvantaged by these flooding events are the very poor. The project should not be seen as a solution to social or public health problems, but rather as an important first step in an ongoing programme of urban improvement. The project has been developed to illustrate the means of integrating public health improvements with the engineering of flood control and drainage.

The magnitude of the project is, in terms of costs of works, variable in relation to each town, and the project size (in terms of costs) is given in Section 6 of the report. The project should be considered as a major project, for it geographically affects three regions of the country, serves as a model for future projects of its kind, and institutionally will require both national and local improvements to ensure that the objectives of the project are fulfilled.

8.3 Description of the Environment

8.3.1 Khulna

Khulna is a large town of approximately 545,000 population. The town follows the banks of the Rupsa river on the east, and on all other sides is bounded by empoldered agricultural land. In the north-west of Khulna is Polder 25. The western, and the southern, boundaries of the town are bounded by Polder 28.

The agricultural lands of Polder 28 fall into two main sections, Polder 28/1 and Polder 28/2 lying north and south (respectively) of the Khulna-Satkhira road. Polder 28/1 is further divided by the embankment of a katcha road that runs southwest from the Gallamari river in the area of the village of Rayermahal, ending at the village of Kayerhat on the Solmari river. The embankment of this road is not extensively culverted, thus dividing the drainage basin of Polder 28/1. About 2 km north east of Kayerhat is the village of Char Alipur, from where a spur embankment and katcha road (culverted and bridged to allow drainage) runs north- west across Beel Pabla to the Solmari river flood embankment.

The embankments of the Rayermahal-Kayerhat road, the western flood embankments for Khulna along the west bank of the Gallamari river, and the Khulna-Satkhira road

form a triangle in the southern part of Polder 28/1 (Char Asankhali) that finally drains through the Khulna-Satkhira road, and into the Solmari river via sluices in Polder 28/2.

Polder 28/2 comprises the area south of the Khulna-Satkhira road and the present city boundaries. The Gallamari river divides this polder into east/west sections. The flood embankment and road along the west bank of the Gallamari, and the flood protection embankment on the north bank of the Solmari river, separate the western part of Polder 28/2 into a separate basin, draining through two sluices to the Solmari river and one to the Gallamari river. The Gallamari river is the final drainage channel for the eastern part of Polder 28/2, via a single 10 vent sluice.

Polder 28 is predominately a rice growing area, although there are significant differences between Polder 28/1 and 28/2. In 28/1 broadcast Aman rice is grown, being a tall crop able to survive the seasonal inundation of the area. Yields are reported to be about 18 md/acre. Observations during the field visit (in the dry season) showed few cattle grazing in the polders, and a few channels had been dammed across to provide fish ponds. Villages are few within this part of the polder, and are concentrated in the tree belt and levee area along the main drainage streams through Beel Pabla.

In Polder 28/2, the main crop is transplanted Aman rice, which is lower growing than the broadcast variety, but providing a yield of about 30 md/acre. Villages are common throughout the area, with established fruit trees and well protected compounds. From observation of the size and types of trees, the height of compound platforms and surrounding bunds, there is little evidence of major inundation of village areas. The rice fields (stubble) were grazed by a large amount of cattle (one herd estimated at over 100 animals); small plots and channel shoulders were being extensively cultivated for winter vegetables. Many channels were dammed for fish culture (both from anecdotal reports and observation). Ponds have been made on the Rupsa river flood shoulder, and are apparently being stocked with shrimp larvae, netted from the shallows of the Rupsa river.

Khulna, being the third largest city in Bangladesh has an extensive water supply system based on groundwater. The Khulna City Corporation estimates that they provide 32 million litres per day for the city from a system of large deep tubewells and small handpumped tubewells. This average provision based on the whole present-day population amounts to approximately 60 litres/capita/day. The Municipality is understood to be planning works for a much higher demand for which they are trying to obtain international finance, so far unsuccessfully. The extent of the other existing environmental/measuring components have already been described in Section 2.

8.3.2 Dinajpur

Dinajpur is a town of about 126,000 inhabitants, situated in an agricultural landscape, and aligned within a north-south depression between the Dhepa/Purnarbhaba and the Gorbhaswari rivers. The Ghagra khal meanders through the town, exiting in the south and flowing through agricultural land for some 8 km before joining the Purnarbhaba river. The Girija Canal flows through the center of the town, joining the Ghagra Khal just before the southern town boundary.

The town contains low level (1-2 storey) housing, and large areas of slum/squatter dwellings. The shops are a mixture of small, permanent shops with a large number of stalls/workshops in the slum areas and lining the main roads. Large fish ponds have been created to the east of the town, but apart from these, fishing does not appear to

be a full time occupation. Many of the roads have no drainage system. Existing katcha drains have become blocked by weed growth.

The soils in the area are predominately sandy, with little clay or loam, save in the flood plain of the Purnarbhaba where alluvial silts are found. The agricultural landscape around the town is a flat, arable crop landscape, with rice, wheat and vegetables forming the main crops.

Dinajpur has an old water supply system based on the abstraction of groundwater using deep tubewells. That operating in the "Opshahar" part of town needs rehabilitation, as it was damaged during the war of liberation. Further water supply works are understood to have been taken up with DANIDA funding from Denmark. Additional details of the extent of the other existing environmental/municipal components have already been described in Section 2.

8.3.3 Kurigram

Kurigram is a small, rural town, with a population of about 57,000 bounded to the west and south by agricultural rice lands, and to the north and east by the Dharla river. Kurigram has developed in an ancient floodplain, and is now protected from flooding by river embankments, which also serve to protect the surrounding agricultural lands and rural villages. The agricultural landscape is dominated by rice fields, with winter vegetables being alternative crops in the dry season.

The Dharla river has considerable influence on the landscape of the area. The river is highly mobile, and the study of maps (produced from 1975-1980 data) and present satellite imagery (1989), shows major swings of the main channel across both banks of the river. The river has moved dramatically closer to the northern defences of the town, and has cut away the north eastern corner, depositing a large sand char within the floodplain. The main channel has moved up to the flood embankment.

The soils in the area are generally sandy, with some alluvial silts deposited in the north west in the area around the two crescent Dasherhater khals (formed by the cut off of earlier Dharla river channels). These khals now form a drainage basin discharging through the flood embankment by a sluice at Palashbari.

Kurigram has a water supply system based on the abstraction of groundwater using deep tubewells which is said to extend to the whole area of the town. Maintenance of the system has been a continuing problem over the years, largely because of revenue shortcomings. Recently the Suzu Company of Japan has completed some treatment works for the town. Additional details of the extent of the other existing environmental/municipal components have already been described in Section 2.

8.3.4 Panchagarh

Panchagarh is a small town of around 30,000, situated on the northern bank of the Koratoa river, with expansion of the town taking place on the southern side. The river flows north south, with high levees, and a wide floodplain (demarcated by the road embankments on both banks). Sandy chars have formed at the bends along the river.

The environs of the town are agricultural lands, with rice being the dominant crop, though wheat and winter vegetables are also grown. The floodplain is extensively used for winter crops. Soils are sandy with a topsoil of alluvial silt. The villages are closely

grouped within the near environs of the town, and towards the edge of the town these form the peripheral housing (especially in the west and south east). The area west of the college, and between the northern and southern access roads (katcha) is extensively farmed from the villages, mainly for rice and sugarcane, with winter vegetables and rice being grown on the river shoulder. Sand is extracted from the river char.

The town drains flow directly to the river in the west, whilst drainage in the north and east is to the lower lands leading up to the eastern flood embankment. The road embankment leading south-east from the town, forms the flood defence over the river shoulder.

Panchagarh has a water supply system being rehabilitated/extended under the DPHE/ Netherlands Government 18 Towns Water Supply, Sanitation and Drainage Project. Additional details of the extent of the other existing environmental/municipal components have already been described in Section 2. The DPHE 18 Towns Project component for Panchagarh is also described in Appendix K.

8.3.5 Habiganj

Habiganj is situated in a depression in a loop of the Khowai river. The town is protected by a high earth embankment, which forms part of a continuous canalization of the river, from near the Bangladesh/Indian border to about 10 km downstream of Habiganj. The surrounding land is low lying, and given over to rice cultivation (almost as monoculture). Flood protection (for Habiganj) relies on maintaining flooding at a distance from the town, with the intervening agricultural land acting as a flood basin (although flood waters do backup to the town boundaries in the west).

On the eastern edge of the town, an old river channel (isolated by a loop cut) marks the urban boundary. The levees of this channel have been used for village development. Between these villages and the embankment to the east, the land (the old flood plain) is poorly drained, with extensive flooded areas showing in the dry season, although monsoon flood waters can be partly drained by the existing regulator.

The western boundary of the town is defined by the railway embankment, which is culverted to allow town drainage into the agricultural lands. During the site visit these lands, and the land on the town side of the railway were ponded with heavy weed growth, indicating a long term flooding condition. The Babar Khal rises to the south east of the town and flows into the agricultural flood plain to the west. This is a natural drainage channel, which is also used as a supplementary irrigation source by the farmers along its banks.

The Khowai river enters the Meghna river and, when both rivers are in spate, considerable backup is produced, with the Khowai rising to the design freeboard of the embankment crest. Flood protection seems to have traditionally depended on extension of this river canalization, and the BWDB is extending the embankments to the west, presently executing a river loop cut in the area of Chandpur. This work is expected to be completed by April 1992.

Habiganj has a water supply system, whose supply network and operational performance is being improved under Phase 1 of the DPHE/Netherlands Government, 18 Towns Water Supply, Sanitation and Drainage Project. Additional details of the

extent of the other existing environmental/municipal components have already been described in Section 2.

8.3.6 Moulvi-Bazar

Moulvi-Bazar is a town of about 30,000 people, situated in the southern flood plain of the Monu river. The town is protected by a river embankment to the north, by embankment and hills to the east and south east. A major barrage upstream of the town is used to divert water through a right bank regulator for irrigation purposes. To the south west there is a large extending flood plain with numerous beels. Into this area the town has a natural drainage channel through the Kodalichara.

The main town area running along the river embankment is heavily built up with narrow streets and permanent shops. There is a market area immediately north of the central lake (an old river loop) with residential housing to the east of the lake. This area of town is protected from the river by the embankment and by a brick, flood wall. The security of this wall during high flood is in some doubt and, if breached, the town would experience severe and extensive flooding. There are a few slum areas in the town, though the general quality of life is very high. Town expansion is proceeding in all areas, and at all levels.

The hills to the south east are wooded, forestry land. In the south west the land is cultivated for rice, but in the dry season a large temporary brick industry flourishes. On the northern bank of the river, irrigated rice cultivation predominates.

Moulvi-Bazar has a water supply system which is being rehabilitated/extended under the DPHE Netherlands Government, 18 Towns Water Supply Sanitation and Drainage Project. The extent of the other existing environmental/municipal components have already been described in Section 2. The DPHE 18 Towns Project component for Moulvi-Bazar is described in Appendix K.

8.3.7 Water Supplies General

In general water supplies to most permanent houses and commercial premises are by means of private boreholes. It has not been possible under this EIA to obtain reliable quantitative data on the quality of these water supplies, or to develop a full picture of the future supply situation. With the exception of Khulna, and possibly Dinajpur, the town populations are very small and the economic feasibility of, for example, a complete network of piped public water in an urban sense would need careful investigation and justification outside this Project.

The vulnerability of the aquifers to pollution, particularly microbiological contamination, cannot be adequately judged as no data was obtained during the field visits. Anecdotal evidence suggests borehole depths range from 25-50 m. In most cases where there are clay or impervious layers close to the surface, the aquifers themselves can be considered to be safe from pollution. However, the integrity of the boreholes and the distribution system should be questioned, as should the general positioning of, and hygiene, around public pumps. These factors may have a greater negative influence on water supplies (at the point of collection) rather than any contamination of the aquifer.

It is not possible, within this EIA, to judge the adequacy of public (or private) water supplies. The variation of housing, the existence of squatter communities, the poor

environmental/municipal components have been described in Section 2 of the main report. The DPHE 18 Towns Project component for Panchagarh is also described in Appendix K.

- Habiganj has a water supply system, whose supply network and operational performance is being improved under Phase 1 of the DPHE/Netherlands Government, 18 Towns, Water Supply, Sanitation and Drainage Project. Additional details of the extent of the other existing environmental/municipal components have been described in Section 2 of the main report.

- Moulvi-Bazar has a water supply system been rehabilitated/extended under the DPHE Netherlands Government, 18 Towns Water Supply Sanitation and Drainage Project. The extent of the other existing environmental/municipal components have been described in Section 2 of the main report. The DPHE 18 Towns Project component for Moulvi-Bazar is also described in Appendix K.

TABLE 8.1 ANALYSIS OF KHULNA PUBLIC HEALTH SURVEY (SHORT LIST OF KEY QUESTIONS ONLY)

GENERAL			
Number of households surveyed.			336 Nos.
a)	**Water Supply.**		
	i)	% of households on mains supply (single or multiple tap) within the compound.	48 %
	ii)	% of households with no mains but with their own handpump.	23 %
	iii)	% of households using water carriers to bring in their supplies from neighbours or standpipe.	25 %
	iv)	Number and % of households being billed for water.	160 Nos, 48 %
	v)	Number and % of households taking water for washing from unprotected source (eg open well or pond).	33 Nos, 10 %
	vi)	Average estimated per capita consumption of water per day.	100 litres
	vii)	Range of per capita consumptions of water per day met during survey.	Minimum= 80 litres Maximum= 120 litres

conditions of many of the slum communities, are all factors that affect the quality of water at the point of collection. Public supplies, in the form of public handpumps are found in all towns, and the Slum Improvement Programme (SIP) would increase the present number. Where there are no sources of borehole water, or supply is inadequate, communities make use of tanks and streams. The quality of this surface water, particularly in the absence of proper sanitation, must be in considerable doubt.

The main concern in respect of water supplies (from observation on the field visits) must be in the use of surface waters by slum/village people. These waters are at major risk from flooding events, when there will a considerable loading of excreta and solid waste, particularly in the first floods. This problem will be exacerbated by the use of tanks and streams for bathing and washing, which both add to the polluting load as well as the risk of human exposure to pollutants. In such cases the integrated components of the project will greatly reduce these risks. The components of sanitation, solid waste disposal and water supply (in the SIP) provide a means of reduction in the risk of surface water contamination by faeces (through open defecation) and waste material being carried in runoff during high rainfall, as well as an alternative water supply (public handpumps) to the communities at risk.

Details of the water supplies in the individual towns are given below.

- Khulna, being the third largest city in Bangladesh has an extensive water supply system based on groundwater. The Khulna City Corporation estimates that they provide 32 million litres per day to the city from a system of large deep tubewells and small handpumped tubewells. This average provision based on the whole present day population amounts to approximately 50 litres/capita/day. Details of the existing public health situation in Khulna (including access of the population to these supplies) are given in Table 8.1. The Municipality is understood to be planning works for a much higher demand for which they are trying to obtain international finance, so far unsuccessfully. The extent of the other existing environmental/measuring components have been described in Section 2 of the main report.

- Dinajpur has an old water supply system based on the abstraction of groundwater using deep tubewells. That operating in the "Opshahar" part of town is in need of rehabilitation, as it was damaged during the war of liberation. Further water supply works are understood to have been taken up with DANIDA funding from Denmark. Additional details of the extent of the other existing environmental/municipal component have been described in Section 2 of the main report.

- Kurigram has a water supply system based on the abstraction of groundwater using deep tubewells, which is said to extend to the whole area of the town. Maintenance of the system has been a continuing problem over the years, largely because of revenue shortcomings. Recently the Suzu Company of Japan has completed some treatment works for the town. Additional details of the extent of the other existing environmental/municipal components have been described in Section 2 of the main report.

- Panchagarh has a water supply system being rehabilitated/extended under the DPHE/Netherlands Government 18 Towns Water Supply, Sanitation and Drainage Project. Additional details of extent of the other existing

TABLE 8.1 ANALYSIS OF KHULNA PUBLIC HEALTH SURVEY (SHORT LIST OF KEY QUESTIONS ONLY) Cont'd

b)	**Sanitation**		
	i)	% of households on sewerage system.	0 %
	ii)	% of households on septic tank.	44 %
	iii)	% of households on pucca latrine.	37 %
	iv)	% of households on open pit latrine.	17 %
	v)	% of households on open service latrine.	2 %
c)	**Solid Waste Disposal**		
	i)	% of households using municipal service.	52 %
	ii)	% of households using contractor service.	0 %
	iii)	% of households using own private disposal.	48 %
d)	**Flooding**		
	i)	% of households flooded regularly from river.	10 %
	ii)	% of households flooded regularly by rain-water flowing in from outside their compound.	54 %
	iii)	% of household regularly flooded by rainwater 0-10 times per year.	27 %
	iv)	% of households regularly flooded by rainwater in excess of 10 times per year.	
e)	**Community Development**		
	i)	% of households who have access to a community development person who can advise them on water supplies, sanitation and general public health.	100 % (usually voluntary agencies)

8.4 Anticipated Environmental Impacts & Mitigating Measures

8.4.1 Anticipated Environmental Impacts

There are components of the project (and their associated positive and negative impacts) that are common to all towns. This section will note only the specific, important impacts for each town, and reference should be made to Appendix J for further details.
In general the flood and erosion protection works will have relatively small impacts in relation to possible sedimentation in the rivers. Where such impacts are identified they will be localised and provide no major negative impacts on the catchments concerned. In most cases the problem of relocation of squatter families to other Government lands will be the main impact of the works. The scale of the need for both temporary and permanent relocation due to the proposed flood and erosion protection works is marginal. Relocation in the case of the drainage and other environmental works will be largely avoidable through the careful alignment of drains and the location of facilities. The question of the losses and temporary impacts due to construction and the resettlement of displaced families and businesses are discussed later in Section 8.4.3.

Drainage components may have impacts on agricultural land both in terms of water quantity and quality (especially in Khulna). Where these impacts are seriously negative they are discussed here.

For all towns solid waste management will require considerable institutional strengthening within the pourashavas. This has been addressed in the institutional aspects in Appendix G. The main concern in each town has been the identification of a suitable waste disposal site, that will allow the pourashavas to economically improve their garbage disposal. Disposal will be by landfill or land spread, with adequate earth/sand cover. This conforms with established practices, and will (in time) provide further raised land which all officials and local people have indicated to be their preferred priority. The details of solid waste management are given in Appendix J.

Slum improvement works are likely to have a wholly positive benefit, in that they will provide an improvement to the quality of life of the people in these slum/squatter areas (who are amongst the most disadvantaged of the area). The improvements in the provision of water supply (through hand tube wells), drainage, pit latrines and waste bins, will in themselves improve the hygiene and public health of these areas. The provision of paved paths and lighting will be a direct improvement to the quality of life of these areas.

(a) Khulna

- **Drainage**

  Khulna is effectively divided by the railway embankment into two east/west parts with relation to drainage. The total area of the town to be drained is 31.7 km^2, of which 9.03 km^2 drains directly into the Rupsa river. A small area in the north of the town (2.5 km^2) will drain into Polder 25. The remaining area of the town (20.17 km^2) drains into the polder land to the west. The Interim Report proposed that this flow would be channeled through the Gallamari river, and discharged via the 10-vent sluice into the Rupsa river.

Within Polder 28, five areas that would be significantly impacted by the drainage proposals have been identified: Impact Areas (IA) 1, 1a, 2, 2a, & 3 (see Town and Environs drawing in Volume 2A). The areas that would receive the western discharge of the town drainage (as proposed in the Interim Report) are Impact Areas 2 & 2a, which have a total area of some 18.72km^2.

The Interim Report proposals would have provided an acceleration of the urban drainage waters from a surcharge of 106.84% of the area in IA/2 & 2a. The present situation is that Khulna town (by flooding) acts as its own flood storage basin, whilst the project would divert this water rapidly to the Gallamari river. This rapid increase in flood waters in Impact Areas 2 & 2a could seriously impact on the agriculture of the area. Higher flood levels could force a change from low-growing, high yield, transplanted Aman species, to the more traditional, high growing, broadcasted Aman rice (as in Polder 28/1). The fall off in yield that such a new regime would bring, could result in a major loss of overall rice production (see Table 8.2).

TABLE 8.2: IMPACT OF INTERIM REPORT DRAINAGE PROPOSALS ON RICE PRODUCTION (Polder 28)(IMPACT AREAS 1/1A & 2/2A)

Environmental Impact area/ situation	Estimated area (acres)	Reported yield (mds/acre)	Production (mds)
PRESENT ESTIMATED PRODUCTION			
IA/1 & Ia (broadcast Aman)	990,099	18	17,821,782
IA/2 & 2a (transplanted Aman)	463,366	30	13,900,980
INTERIM REPORT PROPOSAL			
IA/1 & 1a (no change)	990,099	18	17,821,782
IA/2 & 2a (Impacted area) (change to broadcast Aman)	463,366	18	8,340,588
Loss in production			(5,560,392)

A second potentially negative impact would be the rapid increase in freshwater flows into the Rupsa river, made up of the eastern direct town discharges (directly into the Rupsa river) and the total western discharge passing through the 10 vent sluice. This area is presently netted in the dry season for post larval shrimp (generally Paeneus monodon) which require a reasonably high salinity (20+ ppt). The possibility of a negative impact on the shrimp fishery (Impact Area 3) due to large amounts of

freshwater discharged into the larval catching area during dry weather storms cannot be discounted.

- **Solid Waste and Sanitation**

Night soil is collected, entrenched and covered at the Corporation waste site at Hogladanga. At present solid waste is not carried to the waste site, but dumped at random points within the town boundaries. Most of the areas seen in the site visit showed these `low lands' to be existing drainage channels, roadside verges, and channel banks.

The present situation is aggravated by the fact that refuse piles seen were poorly covered, attracting considerable insect activity; are next to areas of housing and trade; and are not compacted or supported, to prevent washing into channels by periods of heavy rain.

The project will impact positively on the present situation by ensuring that solid waste and night soil are disposed of by surface spreading in a specific area, away from housing areas, and with sufficient available soil to allow adequate cover.

(b) **Dinajpur**

- **Flood and Erosion Protection**

The retiring of the embankment at Goshaipur on the Dhepa river will allow the exposed segments of the existing embankment to be washed away; whilst training of the river at the Mothpara(Tutbagan) reinforcements is likely to cause some erosion of the opposite char. This sediment load is likely to have only a local short term effect on sedimentation of the Purnarbhaba river downstream of the town.

(c) **Kurigram**

- **Flood and Erosion Protection**

From anecdotal evidence and inspection of maps and satellite imagery, it is clear that the Dharal river channel is constantly changing. Due to the lack of control over this river system, there is no means of estimating future scour/siltation, or of mitigating these impacts without upstream flow control. The project seeks to ensure the integrity of the flood defences, and the proposed flood protection works should not cause major direct environmental impact, except for possible scour of the chars in the river; the impact of which, within the overall context of the river, catchment, should be minimal.

(d) **Panchagarh**

- **Flood and Erosion Protection**

The works required to protect the banks around the bridge are essential for the integrity of this asset, and negative effects from these works are likely to place only a small sediment load into the river.

The proposed Tulardanga outfall will have some local environmental impact as the new outfall will require retirement of the embankment at this point. The present situation shows that river course is likely to continue to attack the northern bank, as it is a major bend in the river; and the exposed old embankment, and the river shoulder up to the new alignment, can be expected to erode in the future. This erosion is likely to have two effects: (i) the eroded material will cause future siltation downstream, and (ii) the new outfall will itself come under erosive attack.

(e) **Habiganj**

- **Flood and Erosion Protection**

The project will rehabilitate the embankments and construct revetment works to safeguard the embankments in areas where erosion is occurring. The execution of the loop cut, as initially proposed in the Interim Report, has been removed from the project as the BWDB is presently executing these works. There are no negative environmental impacts expected from the project works.

- **Drainage**

The town drainage will now take account of the natural drainage channels in the area, and the project will provide additional drainage through the river embankment, via two new sluices.

In the west, the Interim Report proposed that town drainage should pass into the agricultural lands west of the railway embankment. Given the existing poor drainage of these lands, this proposal would exacerbate the present flooding situation.

In the north of the town there is a natural depression at the foot of the embankment which is permanently flooded, showing extensive weed growth (dominated by water hyacinth). This area will be provided with relief through an outfall situated in the area of the Khowai river bridge. This is a positive benefit of the project.

(f) Moulvi-Bazar

- **Flood and Erosion Protection**

The remodeling of the town flood wall is an important aspect of the project, and essential for the security of the town. The exact form of new protection will be defined during the design stage, and so no measure can be made of the future impact.

The rehabilitation of the embankments and revetment works should in themselves cause few negative impacts. The retirement of some of the old embankments, may allow for future erosion of the present bunds. Sediments from this erosion would be deposited downstream, though the problems caused by this sedimentation are likely to be localised.

The BWDB is proposing to excavate the 'nose' of the existing char at the river bend east of the bridge, to straighten the channel during flood conditions and reduce erosion of the northern bank. However, sediments dislodged from upstream works, are likely to deposit on this bend, which would reestablish the char on the southern bank and continue river erosion of the northern shore.

No definition of the areas of sedimentation (due to the works) can be made. It may be necessary to re-excavate the 'nose' of the char at the river bend east of the bridge after works have been completed if dislodged upstream sediments build up along this bank of the river.

8.4.2 Mitigating measures

(a) Khulna

- **Drainage**

To mitigate against the potential negative impacts of the Interim Report proposals, particularly in Impact Areas 2,2a & 3, it would be necessary either not to drain Khulna or to find a means of reducing the impact to these Impact Areas. The first option is rejected as being unacceptable, being in conflict with the objectives of the project, detrimental to the quality of life in Khulna and offering no solution to the urban flooding problem.

To reduce the amount of water in IA/2 & 2a, the western drainage flows in Khulna need to be split, and a second drainage area identified. The natural drainage in Polder 28/1 is through the channels leading to Beel Pabla and the outfall at Kayer Hat. It should be possible to lead part of the drainage water of Khulna to this area, leaving the rest of the western discharge to pass through the Gallamari. By taking the Khulna areas between

Rayermahal & Daulatpur, a town area of 9.12 km^2 can be drained into IA/1, leaving 11.02 km^2 to be drainage (via the Gallamari river) into IA/2 & 2a.

- **Result of the Mitigating Option**

The immediate result of the mitigating option proposed above will be to reduce the impact of drainage in IA/2 & 2a from a surcharge in drainage area of 106.84% to 58.86%. This would be a significant improvement in design, and would largely preserve the existing quality of life in the area. Conversely, IA/1 & 1a would suffer an increase in flooding, due to diverting part of the town drainage into this area. This increase is of the order of 22.8% of total drainage in IA/1, though the negative impact of flooding in IA/1 & 1a could be partly mitigated by an improvement in the outfalls into the Solmari river in IA/1a.

Given the use of broadcasted Aman in IA/1 the possible increase in flood levels should have little significant effect on production. There may indeed be a final benefit to the area, if the removal of flood water can be improved via improved outlets at Kayer Hat. If these could cope with larger flows the agricultural area, as well as the town, would benefit from improved flood drainage.

The main area of dis-benefit would be IA/1a, which forms the natural flood collection basin. The homes in this area should be largely safe from the increased flood, being built on embanked ground, but agriculture within the depression may suffer if flood levels are too high. Whether these negative conditions occur will depend on the drainage regime that could be achieved by new outfalls at Kayerhat. These should be designed for maximum discharge in the shortest time, and if the tidal patterns in the Solmari permit such discharge, the negative impact on IA/1a would be effectively reduced.

The project has been redesigned to incorporate the findings of the EIA, and provision has been made for a new town drainage channel, using much of the natural drainage in Polder 28/1, and a new 7 vent outlet at Kayerhat, together with protection for the brickworks and hatchery.

The final impacts on agriculture in IA/2 & 2a cannot be quantified, will require further investigation and would need to be carefully monitored by project benefit monitoring and evaluation activities (PBME's). The notes on the freshwater impact on shrimp fisheries (IA/3) are still valid, although the total discharge volumes would be significantly reduced by the proposed mitigating measures and the new drainage design.

There is a potential negative environmental impact on the project as now designed by an outside factor as discussed below. This impact could seriously affect IA/2, 2a & 3, and so negate the present project design. Polder 25 suffers from poor drainage, and

was the subject of drainage proposals in the Khulna Coastal Embankment Rehabilitation Project (suspended in June 1989). This proposed drainage of Polder 25 through a new channel leading into the Gallamari river. Such a drainage solution for Polder 25 would produce similar negative environmental impacts as have been herein determined for the Interim Report design. The new drainage proposals for Khulna have alleviated most of these negative impacts, but the imposition of drainage water from Polder 25 on to the new system proposed for Khulna drainage would now increase the negative impacts in Polder 28, particularly IA/2, 2a & 3. Thus any future consideration of the drainage of Polder 25, should pay careful attention to the proposals herein, and the environmental impact of further flood conditions in Polder 28.

With respect to this potential negative impact on the project, two further observations must be made. Polder 25 contains two large beels: Beel Salua and Beel Dakatia. To the drainage of these areas must be added the drainage of the present northern area of Khulna, as well as any future expansion of the town to the north.

The future expansion of Khulna is an important consideration in its impact on the existing environment, and the drainage systems proposed herein. It is noted that development of the southern area, and the expansion of Daulatpur in the mid-section of the town, will impact directly on the drainage plans developed by the project, though the result of such impact will be a function of the rapidity and spatial concentration of town expansion.

The second area of concern, which cannot be presently determined (due to a complete lack of suitable data), are the impacts on the polders and the rivers due to the chemical water quality of the town drainage water. The town drainage water will be rapidly flushed as a result of the project to these areas. Khulna has concentrations of small industries (metal workshops, mechanics, etc.) in specific areas of the town, and the 'first flush' from these areas could be highly toxic, both to fish and crops (dependent on the situation at the time of occurrence). A project monitoring programme including sampling and analysis of such "flush" water should be undertaken and measures such as industrial pollution control investigated.

To determine the likely water quality of the drainage water, a survey to develop a baseline for water quality will need to be executed. This should determine the quality of the receiving waters, as well as the potential water quality in different drainage areas of the town, with particular reference to any concentrations of small-scale industry in specific areas. Extrapolation of the likely composition of the drainage water can then be made, to establish whether any negative impacts are likely as a result of water quality.

(b) **Dinajpur**

- **Flood and Erosion Protection**

  There is little that can be done to reduce the small negative impacts of local sedimentation that can be expected as a result of the project.

  There has been a breach in the eastern flood embankment 3-4 km outside the southern town boundary causing backup and flooding in the environs of the town, through the outfall channel of the Ghagra Khal, which will be the main drainage outfall for the town. It would be prudent to ensure that the embankment all the way to the outfall structure is secure, and that all breaches (including rural breaches) are repaired by the project, in order to ensure the integrity of the drainage system, and the project has ben modified to do this.

- **Drainage**

  The villagers at Kharipara (7 km from the drainage outfall) requested that, iffeasible, the system allow water to retained in the khal in the dry season to improve their source of supplementary irrigation water. This is intrinsically a sounn additional project benefit to the agricultural economy in the environs of the town.

  The project design has been altered to a gated structure on the outfall to accommodate the request of the villagers of Kharipara. Concerns on the water quality and possibility of increased vector breeding, cannot be quantified as there is no data. The problem of increased water surface for vector breeding will depend on how undisturbed is the water surface, and the degree, and species, of aquatic plant cover. In overall terms, this water surface increase may be relatively insignificant in relation to the overall exposed water available in the fields, tanks and ponds around the village. The lack of concentrated areas of industry in Dinajpur considerably reduces any risk of toxic contaminants in the water, whilst the length and storage capacity of the khal will provide some natural treatment of the organic components of the drainage water. On balance, negative impacts from this option are not likely to be significant.

(c) **Panchagarh**

- **Flood and Erosion Protection**

  To mitigate the effect of erosion of the old embankment at the new Tulardanga outfall, consideration should be given to training the river away from the northern bank. Alternatively, as erosion and downstream siltation appears inevitable, the embankment around the structure could be protected by additional revetment works.

Training the river away from the northern bank at the Tulardanga outfall may still cause some siltation through scour of the char formed on the southern bank; however this would both protect the new structure and place a lower sediment load into the river than would erosion of the old embankments.

(d) Habiganj

- **Drainage**

Drainage through the railway culverts in the west will be improved. However, the area draining through culvert 14 (see Figure on Habiganj : Town and Environs in Volume 2A) is extensively ponded due to local development. Accordingly it is suggested that this drainage be diverted through culvert 13 (presently unused).

Concern about drainage to agricultural land to the west of the railway embankment can, in part, be alleviated by ensuring that drains are led to the natural main drainage stream. The Babar Khal should be used as the ultimate drainage channel, and all town drains connected to the khal by new katcha drains. The project design has been modified to accomplish this, by the extension of katcha drains from the railways culverts (Nos: 11, 12, 13, and 15 -see Drawing in Volume 2A)

The project has been modified to take account of the mitigating measures proposed, and will improve the drainage of the town area,and in part, some of the surrounding agricultural lands. However, the Babar Khal is used as an irrigation source for dry season crops. Presently farmers dig out field channels to the khal and create bunds to divert flows. Such practices interfere with flood drainage.

Accordingly the local agricultural extension services and the rural upazilas should educate and encourage farmers in the use of simple irrigation lift systems (buckets, lever-lifts, etc.) to permit irrigation, whilst at the same time ensuring the integrity of the drainage channels.

8.4.3 Losses and Construction Impacts

(a) General Resettlement of Displaced Families/Businesses

The scale of the need for both temporary as well as permanent relocation due to the proposed flood and erosion protection works is marginal. Relocation in the case of the drainage and other environmental works will be largely avoidable through both the careful alignment of drains and the location of facilites. The question of the lossess and temporary impacts due to construction and the resettlement of displaced families and businesses are discussed later in this Section.

One common problem to all the flood and erosion protection works will be the moving of people that have settled on the embankments, berms and crests. Many of these people have migrated to the towns after being displaced by natural or domestic events in rural areas. Many represent migrants that have sought safe, high ground after their homes/lands have been destroyed, damaged or rendered uneconomic. For most of these communities, the standard of shelter is very poor: palm weave mats for walls and roofs, set on a simple pole frame; but the communities have themselves caused considerable damage (in some areas) to the embankments by the driving in of poles, and the leveling of living areas.

Discussions with the authorities in all the towns has raised the question of the legal status of the squatters to the lands they have settled upon. The flood embankments ae the property (generally) of the BWDB; other embankment belong to the appropriate authority (eg: railways, pourashava). Under these circumstances the families colonizing these structures have no legal right to their present homes.

Most authorities, during the field visits, indicated that the displacement of some families was a necessary requirement of the works under the project (to allow for improvements) and that the people could be rehoused on other Government lands). There was little evident enthusiasm for project solutions of what is seen as a common, nationa problem (political solutions to which are unlikely until many other gwographic and social factors have been dealt with). Some authorities were concerned that if they povide solutions through the project, which neighboring authorities are unable to provide, this would encourage more migrants to come into their areas to obtain grater advantages.

The plight of these people is not in question. They are representeative of the largest re-settlement group identified by the Land Aquisition and Re-settlement Study (FAP 15). This study has recommended that amendments are needed both in the legal framework and in the procedures for dealing with this group of people.

Authorities indicated that the migrants would be relocated to other Government lands. In some cases this new land will be char lands, which are likely to be at risk from flooding during the monsoon; causing a new wage of migrants on to the high areas (possibly the earlier displacements themselves). Many officials accepted that the new defenses would be colonized; and offered no solution to this long term problem. In consideration of this problem within the project, some acceptance of inevitable relocation to migrant communities must be accepted. In all cases this will be temporary. If re-colonization is accepted as inevitable, then in most cases the problem will be a temporary one.

(b) Losses and Construction Impacts

- **Khulna**

  Some 100 shopkeepers and households along the Hospital Stretch and by the side of the Proposed New Regulators to south will be temporarily disrupted during works construction. They are

expected to want to dismantle their buildings and re-erect on the same site after work is completed. They will require temporary resettlement and compensation to enable them to carry out the re-erection. Also about 20 shopkeepers and households will be permanently displace. A few squatter houses exist on the river sides of the embankment and these will need permanent relocation elsewhere. A summary of the number and type and compensation of housing affected is given in Table 8.3. The project has a sum of Tk.10 million compensation for permanent resettlement and temporary resettlement/disruption for Khulna.

TABLE 8.3 KHULNA RESETTLEMENT/ DISRUPTION SURVEY

Type	Unit	Hospital Stretch	New Regulator Areas
1) Total number of properties surveyed	No	100	34
2) Properties used as home only	%	8	47
3) Properties used as shop only	%	12	44
4) Properties which are godowns only	%	40	-
5) Properties which are used as saw-mills	%	-	9
6) Properties used as materials stock yards	%	35	-
7) Properties used as mosque and places of worship	%	5	-
8) Total number of shopkeepers/ house-holds that will be disrupted in any way	%	96	10
9) Percentage of shopkeepers temporarily disrupted	%	75	80
10) Percentage of households temporarily disrupted	%	13	-
11) Percentage of shopkeepers permanently displaced	%	8	2
12) Percentage of households permanently displaced	%	3	6
13) % of all properties constructed from cast iron sheets/wood planks	%	90	-

- **Dinajpur**

The relocation of squatter households from the flood embankment is inevitable in most areas, in order to allow regrading to proceed, and rehabilitate weakened areas.

However, in the area south of the Kanchan Railway Bridge, there is a large shoulder of land in the flood-plain below the eastern embankment. The embankment is generally secure in this area,

although some reforming of the crest, and the river slope may be necessary.

In this specific area, the homes between the embankment and the final outfall channel of the Ghagra Khal (landward side) are particularly well established: with kitchen and commercial gardens, mud walled houses, established fruit and shade trees, and well maintained plots. If these people are moved (as a requirement of works) to other Government land; after completion of works a new wave of migrants can be expected to colonize the refurbished embankment. It would be more desirable to inflict as little disruption to these present occupants as is possible, and to use a public awareness programme to educate them in the preservation of what has become their home. Such a course of action is more likely to ensure less damage in future to the refurbished embankment, as these people have a vested interest in maintaining and improving their homes. Should a new wave of migrants colonize the new embankment, more damage could well occur. Tk.0.5 million compensation for temporary disruption has been allowed.

- **Kurigram**

There are migrant communities along the flood embankments, anecdotal evidence reports these are mainly refugees from earlier flooding of the Dharla River. Considerable damage to the embankment was seen in these areas. These people will have to be relocated, and the BWDB has indicated that there is local Government land that they can be moved to. Tk.0.5 million compensation for temporary disruption has been allowed.

- **Panchagarh**

There are a few migrant communities along the embankment and it is reported that there is available land locally to which these few families can be relocated.

- **Habiganj**

The number of settlements along the flood embankments is surprisingly small, and the local authorities are confident of successfully relocating the few families involved, probably on the northern bank. Tk.0.5 million compensation for temporary disruption has been allowed.

- **Moulvi-Bazar**

There will be a major impact on the central area of the town during the remodeling of the flood wall. As the area is a major shopping thoroughfare, and with the market area close by, disruption by construction vehicles, material storage, etc. can be expected to be severe, and cannot be completely avoided during the construction period. The drainage in the area may be

affected, and this in turn would affect shopkeepers on the opposite side of the road. There also may be a need to purchase property adjacent to the flood wall, to make way for new structures.

These works are essential to the security of Moulvi-Bazar, and there is little that can be done to reduce such limited term disruption, other than for the programme of works to proceed in a phased, and socially sensitive manner. The temporary disruption of commercial business in the remodeling of the flood wall is inevitable. Tk.10 million property compensation has been provided for this in the project.

8.5 Cost/ Benefits

The overall cost/benefit analysis for the project is given in Section 7, to which reference should be made. In this report, the mitigating measures suggested by the Environmental Impact Assessment have been incorporated into the project design, and thus the overall project cost/benefits reflect the cost effectiveness of these measures.

8.6 Institutional Requirements and Environmental Monitoring Programme

The project will not directly impact on natural resources or sensitive ecological zones, but may provide local changes that need to be taken account of in regional river and floodplain management programmes, which fall within the remit of other projects under the Flood Action Plan (FAP). The liaison with the FAP Regional Projects (Southwest (FAP 4), Northwest (FAP 2) and Northeast (FAP 6)) has alerted these projects to the environmental impacts probable from the Secondary Towns Integrated Flood Protection Project, and this liaison should continue throughout all stages of these projects.

The main environmental impacts, that the Interim Report proposals might have caused, have been considered and the suggested mitigating measures have been incorporated into modifications to the project design as proposed in this report.

There are no authorities that could monitor environmental changes in these six towns, or adequately provide a record of environmental and social change at this time. Accordingly a method must be found whereby some records can be presented at regular intervals to allow for independent scrutiny and evaluation of any ongoing negative impacts.

With respect to flood and erosion protection works it is likely that the social disruption caused by these works, and localised sedimentation in the rivers, will be the only major impacts. The BWDB should take on the responsibility for assessing these impacts during the course of the project and of reporting on these aspects of the work. The BWDB Executive Engineer for each town should be given the responsibility of recording the observed social and environmental changes, and reporting at six monthly intervals (November and May) on these changes.

Specifically the record should contain monthly observations on the following:

(i) any slum/squatter or other persons moved from the area to allow works to proceed. This information should record number of families affected; number of persons moved; places to where they were relocated (if any); date of movement/relocation.

(ii) any houses or shops temporarily closed or vacated as a result of works. This information should record number of families affected; number and types of businesses affected; number of persons affected in each family/business; places to where they were relocated (if any); date of movement/relocation.

(iii) any specific aspect of works that caused prolonged disrupting (eg: street closures; traffic delays; loss of power/communication services)

(iv) any change in the nature of the river at any point during construction. Specifically this should be done by observation and discussion with local communities, and should report on new channels, chars, sand banks or erosion that is occurring, with either sketch maps or subjective quantification of the changes noted.

Drainage works are also likely to cause similar social disruption and this should be reported by the Pourashava Engineer, using the same format and timetable set out for flood and erosion protection above.

The half-yearly records and report should be provided to the Project Management Unit (PMU). It is recommended that the PMU coordinate with the Department of the Environment (DoE), Ministry of Environment and Forests, as the identified authority responsible for national environmental monitoring and regulation. The DoE should be requested to provide an evaluation of these environmental reports to the PMU. The PMU, under its normal mandate, should also coordinate the implementation of Project Benefit Monitoring and Evaluation (PBME) activities from the perspective of the Project as a whole. They should prepare compendiums which summarise benchmark information prepared by the respective PIUs.

Although the DoE is the national environmental body, it is conceded that this authority is both young and weak (institutionally) at present. However, the DoE is undertaking a programme of institutional strengthening, and it would be useful if its role as a regulator and evaluator of environmental monitoring progress within projects could become an early component of this institutional development.

With respect to the disposal of solid waste, the institutional strengthening component of the project that will improve pourashava capabilities has specifically been identified component, and an institutional expert is proposed to provide the necessary training and guidance in solid waste management (Appendix 'G'). It is expected that this expert will provide, in his/her final report, an evaluation of the capabilities and effectiveness of the individual pourashava and city corporation departments with respect to their solid waste management.

There is a need to ensure that local people and officials are made aware of the works that will be undertaken, of the local importance of these works, of the benefits that will

accrue to the communities and of how best the people themselves might benefit from these works. This public awareness programme should be undertaken by the pourashava or upazilas, although is may be possible to involve local bodies and NGOs in the programme.

8.7 Public Involvement

The timing and small inputs allocated for this EIA has meant that the data base and local involvement in the investigation has been limited. The EIA has relied on personal observation and discussions with the project and local engineers, local officials, and local people where this has been possible; as well as data on the socio-economic survey executed and reported in the Interim Report.

In each town the BWDB and Pourashava Engineers were able to accompany the project team in the inspection of impact sites. In many towns, other officials where involved in the visits and provided further insights to local problems, solutions and aspirations. In many cases, where the team stopped by villages, local people were asked about the local conditions and improvements that they might wish to see. It has been possible to accommodate some of these views into project design.

8.8 Conclusions

The project as now proposed will be environmentally sensitive, and provide for a low degree of negative impacts. Such negative impacts as have been identified have led to project modifications, and the presentation of a report that integrates environmental issues with the engineering and development plans. The Environmental Impact Assessment Matrix (Project on Environment) by town are set out in Tables 8.4 to 8.9. Similarly, the EIA matrix (Environment on Project) for Khulna and Kurigram is set out in Table 8.10.

In environmental terms the overall net gains will be the security of the urban, and in many cases the adjacent agricultural lands, from improved flood protection, improved urban drainage, and a general improvement to the quality of life in the towns by improved solid waste management and slum improvements.

Additional to these overall gains, the project design will provide individual areas with specific benefits. In a wider context a major gain will be in the institutional strengthening and awareness of the pourashavas, and the need for the urban authorities to liaise and cooperate with their rural counterparts in the upazilas, if project objectives are to be fully met. This interaction will also allow for a greater exchange of information and an understanding of the needs not merely of town dwellers but also of the agricultural workers living in the environs of the towns.

In summary the EIA evaluated all potential impacts, particular attention being paid to resettlement, loss or degredation of agriculture, aquaculture and fisheries, and public health.

The project does not involve any major resettlement of the affected people. Neither is the project expected to have any adverse impact on agriculture, on the groundwater table, or on the flora or fauna. As a result of the project there should be a reduction in the potential risk of bacteriological pollution of the groundwater aquifers. In the case of Khulna some baeline data on bacteriological analyses of the existing drinking water supplies (based on groundwater) are available from the Public Health Department Office and Hospitals.

Unfortunately there is presently no baseline data on the chemical quality of existing drainage discharges from the towns. This will have to be obtained under the project monitoring programme, when sampling and analysis of such discharges will have to be undertaken and measures such as industrial pollution control investigated. The terms of reference for such a baseline water quality survey for Khulna are set out in Annex J1 of Appendix J "Environmental Impact Assessment". Some water pollutions and salinity data is however presently being collected by the FAP regional studies, for example by FAP4, which covers the south-west of the country including the Khulna area.

The project will result in significant beneficial environmental impacts by way of the environmental improvements which are an intrinsic part of the planned development, and no significant adverse impacts are foreseen. Its impact will be largely positive with a low degree of negative impacts. Overall the consultant considers that the various components of this integrated project will produce a significantly improved environment in each of the communities concerned.

TABLE 8.4: ENVIRONMENTAL IMPACT MATRIX - PROJECT ON ENVIRONMENT - KHULNA

PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT							
		PHYSICAL-CHEMICAL		ECOLOGICAL		SOCIAL		ECONOMIC	
		WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
Flood & Erosion Protection Works	Movement of Squatter Families	0	0	0	0	0	-	?	?
Drainage	Increase in Flooding Polder 28/1	-	-	0	0	-	-	0	0
	Better Drainage Polder 28/1	-2	+	0	?	-	+	0	?+
	Increase in Flooding Polder 28/2	0	-	0	?	0	?	0	0
	Fisheries	0	?	0	?-	0	?	0	?
	Public Health Aspects	0	0	?	?	-	+	-	+
Sanitation & Solid Waste	Public Health Aspects	0	0	-	+	-2	+2	0	0
Slum Improvements	Public Health Aspects	0	0	-	+	-2	+2	-	+
	Water Supplies	-	+	0	0	-2	+2	-	+

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

TABLE 8.5: ENVIRONMENTAL IMPACT MATRIX - PROJECT ON ENVIRONMENT - DINAJPUR

PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT							
		PHYSICAL-CHEMICAL		ECOLOGICAL		SOCIAL		ECONOMIC	
		WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
Flood & Erosion Protection Works	Movement of Squatter Families	0	0	0	0	0	-2	?	?
	River Sedimentation	0	?-	0	?	?	?	0	0
	Additional Rural Flood Protection	0	0	0	0	0	+	0	+
Drainage	Public Health Aspects	0	0	?	?	-	+	-	+
	Supplement Rural Irrigation	0	0	0	0	0	+	0	+
Sanitation & Solid Waste	Public Health Aspects	0	0	-	+	0	+	0	0
Slum Improvements	Public Health Aspects	0	0	-	+	-	+2	-	+
	Water Supplies	-	+	0	0	-	+2	-	+

TABLE 8.6: ENVIRONMENTAL IMPACT MATRIX - PROJECT ON ENVIRONMENT - KURIGRAM

PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT							
		PHYSICAL-CHEMICAL		ECOLOGICAL		SOCIAL		ECONOMIC	
		WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
Flood & Erosion Protection Works	Movement of Squatter Families	0	0	0	0	0	-	?	?
	River Sedimentation	?	?	?	?	?	?	?	?
	Additional Rural Flood Protection	0	0	0	0	0	+	0	+
Drainage	Public Health Aspects	0	0	?	?	-	+	-	+
	Supplement Rural Irrigation	0	0	0	0	0	+	0	+
Sanitation & Solid Waste	Public Health Aspects	0	0	-	+	+	+2	0	0

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

TABLE 8.7: ENVIRONMENTAL IMPACT MATRIX - PROJECT ON ENVIRONMENT - PANCHAGARH

PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT							
		PHYSICAL-CHEMICAL		ECOLOGICAL		SOCIAL		ECONOMIC	
		WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
Flood & Erosion Protection Works	Movement of Squatter Families	0	0	0	0	0	-	?	?
	River Sedimentation	0	-	0	?	?	?	0	0
	Additional Rural Flood Protection	0	0	0	0	-	+	0	+
Drainage	Public Health Aspects	0	0	?	?	?	?+	?	?+
Sanitation & Solid Waste	Public Health Aspects	0	0	?	?	0	0	0	0
Slum Improvements	Public Health Aspects	0	0	-	+	-	+	-	+
	Water Supplies	-	+	0	0	-	+	-	+

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

TABLE 8.8: ENVIRONMENTAL IMPACT MATRIX - PROJECT ON ENVIRONMENT - HABIGANJ

PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT							
		PHYSICAL-CHEMICAL		ECOLOGICAL		SOCIAL		ECONOMIC	
		WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
Flood & Erosion Protection Works	Movement of Squatter Families	0	0	0	0	0	?	?	?
	River Sedimentation	0	-	0	?	?	?	0	0
	Additional Rural Flood Protection	0	0	0	0	0	+	0	+
Drainage	Public Health Aspects	0	0	?	?	-	+2	-	+
	Supplement Rural Irrigation	0	0	0	0	0	+	0	+
Sanitation & Solid Waste	Public Health Aspects	0	0	-	+	-2	+2	0	0
Slum Improvements	Public Health Aspects	0	0	-	+	-2	+2	-	+
	Water Supplies	-	+	0	0	-	+2	-	+

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

TABLE 8.9: ENVIRONMENTAL IMPACT MATRIX - PROJECT ON ENVIRONMENT - MOULVI BAZAR

PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT							
		PHYSICAL-CHEMICAL		ECOLOGICAL		SOCIAL		ECONOMIC	
		WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT	WITHOUT PROJECT	WITH PROJECT
Flood & Erosion Protection Works	Movement of Shops and Families	0	0	0	0	0	-2	?	?-
	River Sedimentation	0	-	0	?	?	?	0	0
	Additional Rural Flood Protection	0	0	0	0	0	+	0	+
Drainage	Public Health Aspects	0	0	?	?	-	+2	-	+
Sanitation & Solid Waste	Public Health Aspects	0	0	-	+	-2	+2	0	0
Slum Improvements	Public Health Aspects	0	0	-	+	-2	+2	-	+
	Water Supplies	-	+	0	0	-	+2	-	+

SECONDARY TOWNS INTEGRATED FLOOD PROTECTION PROJECT

TABLE 8.10: ENVIRONMENTAL IMPACT MATRIX - ENVIRONMENT ON PROJECT

TOWN PROJECT ACTIVITY	POTENTIAL IMPACT	QUALITATIVE ASSESSMENT OF ENVIRONMENTAL IMPACT			
		PHYSICAL-CHEMICAL	ECOLOGICAL	SOCIAL	ECONOMIC
KHULNA					
Drainage from Polders 25 and 27	Discharge to R.Gallamari. Impact on Polder 28/2	-3	?-	-2	-2
	Discharge to R.Solmari via Polder 28/1	?-	?-	-	-
	Fisheries (Rupsa R. and Polder 28/2.	-	-	-	-
Expansion of Khulna	Increased drainage and waste disposal.	-	?	-	-
Drainage Water Quality	Impact on crops/fish (first flush)	?-	?-	?-	?-
KURIGRAM					
Channel changes in the Dharla river	Erosion of Flood defences	0	-	-2	-2