

THE PEOPLE'S REPUBLIC OF CHINA'S AMBASSY  
FLOOD PREVENTION ORGANIZATION

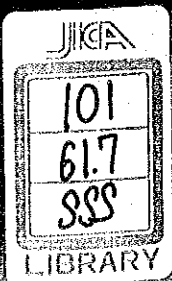
RESEARCH STUDY  
ON  
GREATER HAIKAI PROTECTION PROJECT  
(STUDY IN HAIKAI METROPOLITAN AREA)  
OF  
BANGKOK'S FLOOD ACTION PLAN NO. 8A

MAP 8A

INTERIM REPORT

INDEX

JAPAN INTERNATIONAL COOPERATION AGENCY



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THE PEOPLE'S REPUBLIC OF BANGLADESH  
FLOOD PLAN COORDINATION ORGANIZATION

FEASIBILITY STUDY  
ON  
GREATER DHAKA PROTECTION PROJECT  
(STUDY IN DHAKA METROPOLITAN AREA)  
OF  
BANGLADESH FLOOD ACTION PLAN NO. 8A

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SUPPORTING REPORT I

JUNE 1992

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## ABBREVIATIONS

ADB	Asian Development Bank
AIT	Asian Institute of Technology
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
BUET	Bangladesh University of Engineering and Technology
BWDB	Bangladesh Water Development Board
CAAB	Civil Aviation Authority of Bangladesh
DIT	Dhaka Improvement Trust (now RAJUK)
DMAIUDP	Dhaka Metropolitan Area Integrated Urban Development Plan
DMC	Dhaka Municipal Corporation
DND Triangle	Dhaka - Narayanganj - Demra Triangle
DPHE	Department of Public Health Engineering
DOE	Department of Environment
DWASA	Dhaka Water and Sewerage Authority
ERD	External Resources Division Ministry of Finance
FAP	Flood Action Plan
FPCO	Flood Plan Coordination Organization
GDPP	Greater Dhaka Protection Project
GDFCD Project	Greater Dhaka Flood Control and Drainage Project
GOB	Government of Bangladesh
JICA	Japan International Cooperation Agency
MIWDFC	Ministry of Irrigation, Water Development and Flood Control
MPO	Master Plan Organization
PDB	Power Development Board
PHD	Public Health Department
PWD	Public Works Department
RHD	Roads and Highways Department

<b>RAJUK</b>	<b>Rajdhani Unnayan Katripakkha (Capital Development Authority)</b>
<b>RRI</b>	<b>River Research Institute of the Ministry of Irrigation, Water Development and Flood Control</b>
<b>SOB</b>	<b>Survey of Bangladesh</b>
<b>SWMC</b>	<b>Surface Water Modelling Center</b>
<b>SPARRSO</b>	<b>Space Research and Remote Sensing</b>
<b>UNCHS</b>	<b>United Nations Center for Human Settlements</b>
<b>UNDP</b>	<b>United Nations Development Programme</b>
<b>WAPDA</b>	<b>Water and Power Development Authority</b>
<b>WASA</b>	<b>Water and Sewerage Authority</b>
<b>WMO</b>	<b>World Meteorological Organization</b>



**SUPPORTING REPORT A**  
**URBAN PLANNING AND LAND USE**





## SUPPORTING REPORT - A : URBAN PLANNING AND LAND USE

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## SUPPORTING REPORT A : URBAN PLANNING AND LAND USE

### 1. General

Three areas have been selected for feasibility study. Though they constitute a continuous zone along the eastern side of the metropolitan area, they have different characteristics and are at different stages of urban development. (See Fig. A. 1).

The purpose of this section is to determine which parts of each area are likely to be developed within the flood protection plan period and when, so as to provide a more detailed picture than the master plan for use in determining the feasibility of flood protection proposals. Showing the areas most likely to be developed for urban use permits a better delineation of land needed for flood protection measures (especially retarding areas). This land needs to be protected from further development prior to acquisition. The section also outlines development control measures needed, discusses land acquisition, management, and cost-recovery issues, and makes an initial assessment of suitable uses for retarding areas.

The Greater Dhaka East is by far the largest area but is the least developed of the feasibility study areas. This is mostly because, under current conditions, large parts of the central and southern areas are flooded for most of the year, while the higher land to the north is quite distant from the city. Nevertheless, considerable peripheral development has taken place during the last decade by means of landfill, especially in the southern portion closest to the city centre. The construction of the new RAJUK spine road has also provided a platform for further peripheral development to the East. Further north, in Uttara, RAJUK has initiated sizable developments.

Further planned and unplanned peripheral development may be anticipated during the next decade, both on higher land and on land made higher by landfill. However, more comprehensive development of the area depends on flood protection, and because of the area's size would be over a long period.

The DND is the second largest area bounded by metalled roads and flood walls. As the area was developed for irrigation it is drained and largely flood-free. Because of its proximity to the city, and because it is relatively flood free, the DND has developed quite rapidly during the last decade, particularly in the north west corner. Currently RAJUK is preparing a development plan for the area. Further substantial development is anticipated over the next decade.

Narayanganj West is the third feasibility study area, much smaller but much more intensively developed. The town is on relatively high land and developed independently from Dhaka. However, as Dhaka grew, the area between the two towns has become almost continuously built up. The development of the DND will see Narayanganj further becoming part of Dhaka.

A series of maps and overlays have been prepared for each of these feasibility study areas. These have been used to determine which are the likeliest parts to be developed. The overall development context is that forecast for Dhaka in the Master Plan : the total development distributed in each area corresponds to the population increase forecast for each of these areas in the periods 1990-2000 and 2000-2010. These development areas have been drawn on the basis of land suitability, proximity to existing services and existing developments, and provide the broad picture required. An indicative land use maps 2010 have been prepared to show an ideal distribution of major land uses and road network, but no attempt has been made to distinguish or zone future land uses. Such an exercise would be soon outdated by the metropolitan plan studies due to start in 1992. The intention here is only to forecast the likely extent of development for use in determining the feasibility of flood protection measures.

## 2. GREATER DHAKA EAST

### 2.1. Physical Features. (see Figs. A.2 and A.3)

The area covers 118.62 square kilometers. It is bounded on the north by the Turag river, to the east by the Balu river, to the south by the Demra road, and to the west by the Dhaka-Mymensingh road, the DIT (Rampura) road and Biswa road.

Apart from small portions in the north west and south west, the area is drained east to the Balu river. It forms some two-third of the Greater Dhaka drainage basin, which includes Gulshan and Banani, Tejgaon, and other areas to the south in central Dhaka.

There is an area of higher land (5m+) along the western border, the larger portion being to the north in Uttara East, but with another large portion from Khilgaon to Jatrabari in the south. This land is usually flood-free. However most other areas are low-lying and under water for over half the year. In the central part, in particular, most of the land is under 2.5 metres, with perhaps half of that under 2 metres.

## 2.2. Outline Flood Protection Strategy (see Fig. A.4)

The Greater Dhaka East area is divided into five drainage zones for the purpose of stormwater drainage. The catchment area of these zone extends beyond the Rampura - Biswa road. However for the protection of the area from external sources of flood water the Greater Dhaka East is also divided into four compartments defined by embankments. The compartments and the drainage zones are complementary and serves specific purposes (see Fig. A.4).

Since compartments and their embankments will have profound effect on the urban planning / landuse issues this section emphasises on the four compartments while drainage zones and their related issues are covered in the Supporting Report of E.

The northern and eastern boundaries of Greater Dhaka East will be defined by the main flood protection embankment, designed to a 100 year flood frequency. The western boundary, on the existing new road, will be raised and flood proofed to form a permanent partition within the internal compartmentalization strategy. It will be designed to withstand floods of 50 year frequency. Similarly, the southern boundary of the zone, the existing embankment and flood wall on the Demra road, will be rehabilitated to form a partition in the compartmentalization system.

Four compartments enclosed by embankment are proposed within the Greater Dhaka East (instead of three) as the result of reviewing the three drainage zones at the Master Plan study. These are from the north ;

1)	Northern compartment	(4,070 ha)
2)	Central compartment	(3,200 ha)
3)	Southern compartment - 1	(1,460 ha)
4)	Southern compartment - 2	(3,130 ha)

The southern compartment - 2 has two retarding areas, with a combined size of 525 ha, to cater for one-fourth of the Greater Dhaka East drainage zone which includes Demra and the southern peripheral zone between the Begunbari khal and the Dhaka-Demra road and also extends upto Motijeel and part of Ramna. Water drains through pump and sluice gate to the Balu river.



The southern compartment - 1 also drains east mainly by the Begunbari khal through a pump and sluice gate, to the Balu river. The drainage zone includes Badda and Shatarkul and also extends upto Gulshan, Tejgaon, Dhanmondi and a part of Ramna.

The northern compartment, apart from its northern edge, also drains east through two retarding areas ( 263 ha ), pump and sluice gate, to the Balu river. The central compartment, similarly drains east through a retarding area (558 ha), pump and sluice gate. In addition, half the International Airport drains through this zone.

The internal embankments between the four compartments, the main drainage pattern, and the exclusion of the retarding area areas from development, form a framework within which urban development has to take place.

### 2.3 Existing and Proposed Development (see Figs. A.5 and A.6)

As Dhaka has grown, with land availability not keeping pace with population growth densities have increased and development has been squeezed into those peripheral areas which are relatively flood free and closest to areas of job opportunity, In the Greater Dhaka East, it is the south west portion which has experienced most such peripheral growth. Areas of planned development on existing higher land and on land made higher by fill, are interspersed with areas of katcha and squatter development on lower lying, more peripheral, and less attractive land.

Further north, the completion of the Rampura road has accelerated eastwards growth during the past few years, again mostly on higher or fill land not too far back from the road frontage. Development has not been as intense as to the south, because of greater distance from the city centre. Most of the development has been in planned fashion.

North of the Airport, despite extensive areas of high, flood-free ground, there has been little development to the east of the railway line. There are however, currently, indications of linear growth along the major access roads into the area. Because of distance from city , development pressures clearly been despite the flood-free elevation.

Fig. A.5 shows the existing land use. Apart from the fringe areas along the Rampura road, the predominant land use is agriculture and rural. Only 20% of the area is built-up. The table below shows the areas of existing land use.

## EXISTING LAND USE OF GREATER DHAKA EAST (1990)

	<u>Unit = ha.</u>	
<u>Total Area</u>	<u>11,862</u>	<u>( 100% )</u>
Residential	2,248	( 19 % )
Commercial	40	( 0 % )
Industrial	1	( 0 % )
Institutional	23	( 0 % )
Agricultural	8,814	( 75% )
<u>Water Bodies</u>	<u>735</u>	<u>( 6 % )</u>
Built-up Area	2,313	( 19% )

During the next decade, the absence of a public transport system which allows northern expansion and the non-availability of large areas of serviced land, suggest that peripheral development pressures will persist. The Greater Dhaka East is one of the major areas where such growth will be apparent.

Fig. A.6 shows the areas currently under construction. In addition there are other areas where RAJUK intend to implement their own development and where development is intended to proceed in accordance with a RAJUK zonal plan. There are also commitments for large scale planned private development. Elsewhere, unapproved development is to be proceeding. A continuation of such peripheral growth may be expected even without protection afforded by embankments. But, as public perceptions regarding flood protection become established, an acceleration may be anticipated. Such development, and its associated landfill, may affect the drainage pattern and prejudice flood protection. In the absence of an overall guidance plan for the area, a rational development will be difficult to achieve. It is important then to delineate all areas needed for flood protection measures (and other major infrastructure needs) at the earliest, so that such reservations may be safeguarded until construction take place.

### 2.4 Infrastructure (see Fig. A.7)

The present framework of services shows a predictable pattern, being restricted to areas already developed. Provision of services usually follows the development of unplanned areas, but will be provided at the same time for planned, higher cost, construction. Infrastructure provision may also proceed and influence the pattern of growth. Thus, unplanned growth may follow roads. This is already seen in both the

northern and the southern compartments. Flood protection measures, which create new areas of developable land, will also influence the pattern.

Current infrastructure distribution suggest that over the next decade, incremental peripheral development will continue. services will be extended as demand arises. In the longer term, safeguarding areas of land from flooding will permit a much more extensive scale of development, but, again, it will be incremental, from west to east.

## 2.5 Population and Land Use (see Fig. A.8 and A.9)

The 1981 census and the Master Plan provide the basis for estimates of existing and future population levels in this area.

The Master Plan contains our estimates of current population and forecasts of future growth for the Dhaka conurbation. It also distributes this forecast population growth between different parts of the city. This is based on a number of stated assumptions regarding ;

- the proportion of relatively rich and poor
- the unfair allocation of land between them
- increased densities and new land development
- the attraction of proximity to work opportunities
- the possibility of improved urban land delivery post 2000

Population totals resulting from these assumptions, for 1990, 2000 and 2010, were tabulated into over 100 study area zones. These tabulations are the source of the population distributions for the Greater Dhaka East area which are quoted here. They reflect our strategic forecast regarding the growth of the metropolitan area. Total population of the area for 1990 is estimated around 638,000. An estimated 427,000 are in the southern compartment-2 and 24,000, which is the lowest figure, in the southern compartment-1. The northern compartment holds about 126,000 and the central compartments have 61,000 . By the end of the century, the population of the whole of the area is expected to double to almost 1.15 million. Almost 60% of this will be in the southern compartment-2, but greater percentage gains will be seen in the northern and central parts. By 2010, a further overall increase of almost 90% is anticipated, to over 2.2 million. The greatest proportional increase is anticipated in the north, the rate of growth in the south having decreased in this period.

Over the whole twenty year period, the relative importance of the southern compartment-2 declines. However, it will retain the heaviest concentration of population throughout. Nearly 45% of the population of the whole area will be here even by 2010. This distribution between compartments is summarized below :

	1990	2000	2010
North	126,000	282,000	772,000
Central	61,000	140,000	259,000
South -1	24,000	52,000	212,000
South -2	427,000	677,000	958,000
Total :	638,000	1,151,000	2,201,000

The distribution of population within each of the compartments is made with different degrees of confidence

- 1) for 1990, distribution is made on the basis of the existing land use survey. The population for each zone is distributed between each developed area in that zone.

If our overall assumptions on 1981-1990 growth are reasonable, then it probably provides a reasonably accurate distribution of existing population.

- 2) for 2000 there will be some loss of accuracy, but the development pattern may be predicted with some confidence and commitments in the area are known. Distribution is based on the assumption that peripheral growth will continue in the most favourable areas, closest to existing services and on higher land. An indication of the extent of developed areas and their populations for 1990 and 2000 is shown on Fig. A.8.
- 3) post 2000, the overall population forecast, influenced by a variety of factors, is less sure. The extent of development will depend on whether the flood protection framework will be in place, and whether mechanisms for delivery of urban land will have been developed.
- 4) Fig.A.9 shows an indicative land use pattern at the year of 2010. Although the delineation of future land use pattern is beyond the scope of the study, an ideal distribution pattern of major land use and road network are shown on the

assumption that, further urban growth will be controlled, flood protection measures will be fully implemented as proposed, and finally, planned development of infrastructure and public facilities will be undertaken by relevant public sectors on a certain higher standard which was stated in the Master Plan study. The following table shows the land use table of the area in 2010.

#### FUTURE LAND USE OF GREATER DHAKA EAST ( 2010 )

	<u>Unit = ha</u>	
<u>Total Area</u>	11,862	( 100% )
Residential	5,917	( 50 % )
Commercial	436	( 4 % )
Industrial	39	( 0 % )
Institutional	2,158	( 18 % )
Agricultural	1,310	( 11 % )
<u>Water Bodies</u>	2,002	( 17 % )
Built-up Area	8,550	( 72 % )

- 5) if these assumed acts on the part of the government are not carried out as planned, then the developed pattern could be more intensive, with smaller areas being development after landfilling, especially in the southern compartment - 2 and the northern compartment.

#### 2.6 Major Development Issues affecting Flood Protection Proposals

The implementation of flood protection measures will provide part of the framework for future urban development. But there are also overall development, acquisition, control and land management issues which will affect the achievement of such a flood protection plan. These overall issues are discussed in Sections 5 and 6. In addition, there are specific development issues in the Greater Dhaka East which touch upon the nature of the flood protection measures. These are discussed below :

- 1) A by-pass linking Demra and Tongi, on the proposed Balu river embankment, has been proposed in some quarters. The provision of such a road would affect embankment design. The proposed Dhaka Transportation Study should provide a reasoned answer to whether such a road is needed. As, unfortunately, this study is unlikely to start until early 1992, we assume that this authoritative answer is unlikely until late '92, after the completion of our study. Current

traffic levels on segments of the Biswa/Rampura road, which forms the current eastern 'by-pass' are low. This suggests that provision is unwarranted.

While embankment design could incorporate the later addition of a by-pass, additional land acquisition would be needed for the increased width. In view of the magnitude of prospective land acquisition costs overall, and other road priorities elsewhere, we suspect that further present costs to provide for a long term need would be unjustified. We would therefore advise that while embankment design can reflect possible long term widening, actual land acquisition and construction should be at a later stage. At present, the external embankment should reflect flood protection requirements.

- 2) The current nature of development in the area makes no allowance for long term growth. Thus no reservations are made for long term needs. In particular, there is no framework of roads outlined which would enable the area to be developed in a planned fashion. In the southern portion it is already difficult to see how a major E-W distributor could be provided in the area without substantial demolition. Already the existing roads are inadequate and crowded.

We therefore consider that development of the four compartments could be on a framework where the access roads into the area would be on the internal embankments. However, those access roads would not function as major roads of the new areas, so that internal and inter-regional trunk roads will be required both for E-W and N-S directions. These roads could be phased as development requires. Again, the prospective transportation study may propose the most appropriate width. Provisionally, we suggest that the reservations for the major roads to serve such large area should be of dual carriageway standard (though the road itself could be widened in stages) allowing two vehicles, two rickshaws and a footpath in each direction. This could be incorporated within a 30 metre road reserve. Careful coordination with the stormwater drainage system must be taken up for more integrated development.

- 3) The need to protect retarding areas is commented on in Sections 5 and 6. The retarding areas are located in low-lying areas, mostly some distance from existing development. However, the pace of growth, particularly in the south-west (which could well accelerate if further E-W links are provided in Dhaka West) is such that particular difficulty may be experienced in protecting the pond in this south-west corner.

- 4) Current development control policies take limited account of flood protection requirements. The need to do so is discussed in subsequent sections. Applications such as that by Eastern Housing for the development of 830 acres in this area have not taken the required ground height level into account and limited attention is paid on their effect on major drainage channels. The plotting of this development by RAJUK suggests that the development does impinge on a major drainage channel. We proposed therefore that any future major applications in this areas should only be approved after ensuring that it complies with flood protection requirements.
- 5) Again, in Section 6, we comment on the need to recognize that settlement on embankments cannot be prevented in some areas. Accordingly, we suggest that in such areas, the design of the embankment takes this into account. In Greater Dhaka East, the internal embankments are likely to be attractive places for development, while the Balu river embankment is too distant from work opportunities to be regarded as such.
- 6) For most of the year, navigable water exists between the Balu River on one side and Rampura road and Madartek on the other (through the Begunbari Khal). the Rampura road by the T.V. Station is a major port for the Balu river. Major items transferred to road transport here include passengers, bamboo, sugarcane, building supplies, pottery, and some foodstuffs. There are distinct benefits in keeping this waterway open, given the advantages of water transport.

It therefore appears that the embankment road dividing the southern compartment -1 and the southern compartment - 2, will replace this waterway.

- 7) There is currently no overall strategy for development of the Greater Dhaka East area. RAJUK plans in preparation for a narrow strip fronting the Rampura road are not being prepared in accordance with any overall framework. Decisions on private development applications are not made in accordance with any overall framework. No consideration is being given to medium and long term probabilities. Neither the future rational development of the area is possible without such a framework, nor can flood protection requirements be safeguarded in its absence. We therefore very strongly recommended that some overall plan is prepared for the Greater Dhaka East. In Section 5.4 we consider how the proposed metropolitan planning study may satisfy this requirement.

### 3. DND

#### 3.1 Physical Features ( see Figs. A.10 and A.11 )

The area covers a total of 56.79 km<sup>2</sup>. The area is of a triangular shape and formed by three major roads. North of this area is bounded by the Demra road. A second road, Dhaka-Narayanganj highway bounds the area on the western side and the third road is Demra to Narayanganj highway and bounds the area on the East. The last two joins together in the south of the area to form the triangular shape.

The area was subject to annual flooding prior to the construction of the road-cum-embankment in the mid 1960s that encompass the area. However the flood of 1988 was higher than the embankment and the government constructed a flood wall in 1988 to stop the water. With the construction of the road-cum-embankments in the mid 1960s the area became generally flood free with good agricultural potential. Apart from a small area in the south and built up areas on the north-west, generally the better part of DND has an elevation less than 5 m. Large areas in the centre and east are below 2.5 m.

The entire DND area is criss-crossed by irrigation canals, the pump station in the peripheral roads pump water in and out as the area demands. There are pockets of permanent water bodies and linear canals along the DND flood wall.

One central spine of Dhaka-Katchpur highway cuts across the DND area and other than that, the rest of the roads are unplanned and sporadic.

#### 3.2 Outline Flood Protection Strategy ( see Fig. A.12 )

The DND area is already protected by the three roads and the concrete wall on top forming the flood wall. There is a lot to be said about the effectiveness of this concrete wall, though it forms an integral part of the present flood wall. It is noted that the present flood wall was sufficient to provide flood protection in 1988 and the water was upto the level of this flood wall.

The flood protection strategy recommends that the present flood wall be rehabilitated. Certain parts of this flood wall will have to be raised to give the flood wall equal height in all parts.



The strategy outlines two drainage zones for the DND area. Fig. A.12 shows an internal drainage sub-zones separating the DND area into that northern part and the southern part.

Three new canals are proposed (shown in double broken lines) within this area to facilitate drainage. These will add to the already existing network of canals to form an efficient system.

One pumphouse already exists near the Katchpur bridge and this will be supported by a new pumphouse further south. Mostly the DND drainage will be handled by these pumpstations. The existing pumpstation is of limited capacity and the area around the pumpstation does not allow the creation of a sufficiently large retarding area. This prompted the necessity of a second larger station in the south with sufficiently large retarding area. The canal network is also adjusted to facilitate smooth functioning of the system.

Six retarding areas are proposed in the DND area. The location and sizes were determined after careful consideration of land contours, existing settlements, RAJUK's scheme, population growth areas (projected to 2010) and DND area drainage requirements. Three retarding areas are in the northern drainage zone cumulatively occupies 266 hectares, while the other three on the southern zone occupies 377.5 hectares. The entire DND area drains eastwards and water is pumped out through pumphouses.

### 3.3 Existing and Proposed Development ( see Figs. A.13 and A.14 )

The DND area is in between Dhaka and Narayanganj. This fact in the past has initiated development pressures from Dhaka and Narayanganj side. The high cost of land and high densification around the CBD area of Dhaka has spilled developments over the northern part of the DND. All along the three major highways around the DND, sporadic development has taken place.

Around the north-west of DND area there is a large settlement opposite the Jatrabari area. On the southern tip of the area the land adjacent to the Narayanganj West is also developed to an extent. There are village settlements of small and large sizes throughout the DND in general.

Commercial enterprises such as brick fields, building materials trans-shipment points, have grown along the western highway. Dhaka WASA has a large area designated as sewage treatment area, also in the west. Medium density settlements have grown all along the highway housing commuters working either in Dhaka or Narayanganj. Recent developments along the Dhaka-Katchpur highway suggests that within a short time unless planned settlements are made, the growth of the unplanned settlements will continue.

Table below and Fig. A.13 shows the existing land use pattern.

#### EXISTING LAND USE OF DND ( 1990 )

	Unit = ha	
<u>Total Area</u>	5,679	( 100% )
Residential	1,864	( 33 % )
Commercial	56	( 1 % )
Industrial	196	( 3 % )
Institutional	59	( 1 % )
Agricultural	3,173	( 56 % )
<u>Water Bodies</u>	332	( 6 % )
Built-up Area	2,174	( 38 % )

Fig. A.14 shows the areas presently under construction. There are substantial RAJUK project in the pipeline designated for this area. A better part of the added new development areas of the DND during the next decade will be initiated by the RAJUK. There are at least four settlements to be developed by the RAJUK out of which one in the south, namely Panchabati is in an advanced stage of land acquisition.

Unplanned developments are sure to continue in the future with the existing metropolice becoming more dense day by day. The recent floods in 1988 which inundated a better part of Dhaka, could not penetrate the DND area. This in itself has provided a moral boost to the would be developers of DND area and it is reasonable to assume development of further settlements in the area at an accelerated rate in the coming decade.

RAJUK has drawn up a schematic master plan for the DND area, showing roads and settlement areas. This plan is on the process of Government approval. Apparently this scheme does not take into account certain issues such as topography, ground height of

landfilling, drainage, etc. With the completion of the JICA study and the Metropolitan Plan study in 1992, the RAJUK master plan may have to undergo certain changes.

#### 3.4 Infrastructure (see Fig. A.15)

The new N-S spine road connecting middle of the Demra road and Narayanganj is now under construction and being executed by Roads and Highways Department. This road will stimulate the escalation of urban development of DND.

The present provision of services are clearly inadequate for any large scale development. Though electrical connections are quite developed and the proximity to the Siddirganj Power Station renders considerable potential, the water and gas services leaves a lot to desire. With the planned growth of the settlement areas these services however will develop rapidly as suggested by similar trends in other areas of the city.

#### 3.5 Population and Land Use (see Figs. A.16 and A.17)

The total population of DND in 1990 was calculated at 449,000. The study area was segmented into 14 zones and population were calculated for the year 2000 and 2010 against each of the areas. These increases took into account new areas of development and further densification of the existing settlement areas. The larger part of the 1990 population is concentrated along the boundary roads, and also in the north-east and the south of the area. However new areas of development either sporadic or planned, will be in the central area. By the turn of the century the total population will amount to 880,000. This again will increase to 1,314,000 in the year 2010. Table A.4 shows the growth of population and land use for the three dates.

The new areas of development are largely known for the next decade. The proposed areas of RAJUK are included in the tabulations. It is assumed that RAJUK will be able to control development in the retarding areas. However, in the event of RAJUKs developments and if alternate urban areas in the Dhaka conurbation is slow to develop, the DND will bear the highest pressure of development.

Fig. A.17 shows an indicative land use pattern at the year 2010. This ideal map shows most of the new areas will be developed according to RAJUK scheme and necessary areas for retarding areas and agricultural areas will be well controlled. The land use composition is shown in the table below :

## FUTURE LAND USE OF DND ( 2010 )

	<u>Unit = ha</u>	
<u>Total Area</u>	5,679	( 100% )
Residential	2,463	( 43 % )
Commercial	172	( 3 % )
Industrial	482	( 8 % )
Institutional	1,153	( 20 % )
Agricultural	532	( 9 % )
<u>Water Bodies</u>	877	( 15 % )
Built-up Area	4,270	( 75 % )

### 3.6 Major Development Issues affecting Flood Protection Proposals

The future developments in the study area must follow guidelines as spelled out by the flood protection proposals. However certain issues with regard to RAJUK's plans will affect flood control plans. These are summarized below :

- 1) The Dhaka Narayanganj road which is under construction by the Roads and Highways Department will provide a barrier to the drainage plans. RAJUK intends to extend this road upto the Demra road, which again will further compartmentalize the area.
- 2) The irrigation canals within the DND should be kept away from development.
- 3) RAJUK's new settlements must be in conformity with the drainage plan. Indiscriminate cutting or filling for levelling purposes may also adversely effect the drainage plan.
- 4) Retarding areas will be hard to control. Given the pressure on land and the developments by RAJUK, holding the retarding areas away from development may pose to be one of the main problems facing RAJUK. We must therefore suggest that some form of control and management procedure be drawn up along with development schemes that would enable RAJUK or BWDB (as the case may be) to control developments in the retarding areas.
- 5) The Metropolitan Development Plan to be commissioned in 1992 will make an in-depth study into this area vis-a-vis the rest of urban Dhaka. Their

recommendations will directly influence the growth of the area along with safeguarding the flood protection plans.

#### 4. NARAYANGANJ WEST

##### 4.1 Physical Features (see Figs. A.10 and A.11)

The area covers 18.63 km<sup>2</sup>. The wider mass of this area has the Dhaka Manikganj road on the west and the Lakhya river on the east. The area extends upto Saiyedpur on the South and the Dhaka Narayanganj road on the north. A linear part of the Narayanganj West area extends all the way upto the Demra road and is placed between the DND and the Lakhya river.

The area is predominantly built up and only a small portion on the south-west is low land and drains to the Dhaleswari river. All along the Sitalakya river bank the area is dominated by industrial and non-agricultural landuse. The major part of the south-east comprises of the Narayanganj urban area. The central part of the wider segment on the south has multitudes of water bodies. Only a small part of the north east is below 3 m elevation and almost all the land along the Lakya river bank is well above 5 m. Most of the land is usually flood free.

##### 4.2 Outline Flood Protection Strategy (see Fig. A.12)

It is proposed in our flood protection strategy that Narayanganj West area will be bounded by embankment on the west, south and east (along Lakhya river). The DND area is on the north and therefore protects it. The embankment, following the river line will vary in design depending on the nature of the area where it is proposed.

After careful consideration the strategy outlines that Narayanganj West area be divided into five drainage zones. The first and second being the western half of the lower wider part. These areas will drain westwards. Water will be collected in three retarding areas and pumped out by two pump stations. The total area of retarding area will be 84 hectares.

The third zones includes the Eastern half of the Narayanganj West area together with a portion of the Northern linear segment. This zone reaches upto the Adamjee Jute Mills. Since this zone is relatively high and predominantly built-up, it is proposed that it showed drain to the Lakhya river by gravity.

The fourth and fifth zones are the northern one. It is proposed that these zones would drain east with the help of two retarding areas and pump stations. The total area of the retarding area being 26 hectares.

#### 4.3 Existing and Proposed Development (see Figs. A.13 and A.14)

Narayanganj town has grown on its own, independent of Dhaka, but the last quarter of the century has witnessed growth along the Dhaka-Narayanganj highway. The major settlement areas of Narayanganj is in the south-east where population pressure is highest. The urban area concentration will show major industrial and manufacturing establishments in the northern part. Apart from the Siddirganj Power Station and Adamjee Jute Mills there are large and medium sized industrial units all along the eastern belt. There is little buildable land left in the Narayanganj West area except in the south-western part.

RAJUK has lately taken up planned residential development schemes in the DND-Narayanganj area and one such scheme (Panchabati) overlaps into the north-western part of the Narayanganj West area (see Fig. A.14 ). With the completion of the embankment, the rest of the low land on the western periphery is expected to be urbanized fast since it is both close to the workplaces and transportation has also improved in the recent times. However, such developments may effect the drainage pattern of the whole area in the event that a comprehensive master plan is not adhered to.

Table below and Fig. A.13 shows the existing land use pattern.

#### EXISTING LAND USE OF NARAYANGANJ WEST ( 1990 )

	Unit = ha	
<u>Total Area</u>	1,863	( 100% )
Residential	981	( 53 % )
Commercial	86	( 5 % )
Industrial	178	( 10 % )
Institutional	67	( 4 % )
Agricultural	464	( 25 % )
<u>Water Bodies</u>	87	( 5 % )
Built-up Area	1,312	( 70 % )

#### 4.4 Infrastructure (see Fig. A.15)

The present pattern of the infrastructure clearly encompass the entire built up area. Electricity, gas and water lines follow all the existing roads. This leaves only the south-western low land (which is still not urbanized) unserved.

As far as the electrical distribution is concerned, it may extend to the south west at will. In the event that this area may be urbanized in the coming decades the power lines can easily accommodate their demand and stretch westwards. WASA has already done a comprehensive plan and most of the urbanized land is served by their system. It can be assumed that further development on the west can also be accommodated. RAJUK's planned Panchabati model town is also located on the north western part of this area and will surely be served by WASA.

Gas connections are so far limited to the Narayanganj area, however distribution of gas lines will also follow from east to west.

Fig. A.15 shows the existing and proposed main services as laid out by their concerned departments.

#### 4.5 Population and Land Use ( see Figs. A.16 and A.17 )

The 1981 census and the Master Plan provide the basis for estimates of present and future population. Unlike the Dhaka East area, the Narayanganj West is already densely populated.

The tabulated population figures reflect our forecast regarding the Narayanganj West area. The total population in the Narayanganj West in 1990 is estimated at 470, 000. This population is expected to increase to 696,000 by the year 2000. After the turn of the century the growth rate will decline from 4.0% to 2.9% and the 2010 population is expected to be 927,000. It is important to understand the fact that the present high density of the study area coupled with non-availability of further buildable land will arrest further concentration of population in this area. Urbanization ratio of the study area at 1990 is already 70% by year 2000 it is expected to become 92% which is almost a ceiling after reservation of land for drainage purposes.

Table A.7 shows the growth of population and land use for the three dates.

Urban density is also expected to increase between 1990 and the year 2010. The density in persons per hectare will move from 359 in 1990 to 450 in 2000 and culminate in 539 by the year 2010.

Fig. A.17 shows an indicative land use pattern at the year 2010, and land use table is shown in the table below ;

#### FUTURE LAND USE OF NARAYANGANJ WEST ( 2010 )

	<u>Unit = ha</u>	
<u>Total Area</u>	1,863	( 100% )
Residential	827	( 44 % )
Commercial	173	( 9 % )
Industrial	292	( 16 % )
Institutional	427	( 23 % )
Agricultural	8	( 0 % )
<u>Water Bodies</u>	135	( 7 % )
Built-up Area	1,720	( 92 % )

#### 4.6 Major Development Issues affecting Flood Protection Proposals

The Narayanganj West area to most part is already urbanized. However current trends of the growth disregards every long term plan. With the flood protection scheme in motion some issues must be dealt with before further developments are allowed to take place. Some of these issues which affects the flood protection measures are discussed below :

- 1) The current trend of development is from east to west. The eastern river bank is densely populated and structural density diminishes towards the west. The services are also concentrated in the eastern region. However the central part of the wider segment is low land with scattered water bodies and with the western most part of the area being the lowest, the central areas also drains through this place. Therefore a long term planning strategy incorporating development areas, retarding areas, drainage channels and road network should be formulated.
- 2) Retarding areas if any must be located in the low-lying areas of the western or the central part. The present growth trend is limiting this possibility and must be controlled before all the central low land water bodies are encroached upon.



- 3) The development control policies as they stand today takes no account of the flood control needs. This is evident by the RAJUK's Panchabati project that encroaches the very low-land which forms a part of the natural drainage channels. Since the Narayanganj West area is predominantly built up and area for retarding areas are in short supply, we must suggest that any future development proposal must incorporate the flood protection requirements and be strictly adhered to.
- 4) The under construction Dhaka-Narayanganj link road will increase the commercial potential of the central low-land area and subsequent development will take place in this area. With view to reserving retarding area certain amount of development control should be enforced in the immediate future. With major part of the area in urban use, the remaining scattered water body should be held back from development to fulfill drainage needs.

## 5. MANAGEMENT OF FUTURE URBAN DEVELOPMENT

### 5.1 The Need for Management

Management and control of land use changes are needed if urban development is to proceed in accordance with a preferred strategy; to ensure that land is developed effectively, to safeguard public interest, and to allow most efficient provision of major infrastructure investments.

Flood control and protection measures will be major determinants of city form. Major investment may be anticipated in this sector. It has to be ensured that land needed for flood protection purposes will be available where required : such land will have to be delineated, safeguarded, and in many cases, acquired. Control, management and acquisition powers should be sufficiently powerful to :

- maintain certain areas in rural use, by preventing urban development and preventing infill.
- acquire land for flood protection structures and measures.
- acquire land for resettlement of those affected by proposed embankment and khal improvement works and retarding areas.
- prevent further development (including landfill) in areas to be subsequently acquired by the government, (but permit appropriate temporary use) so as to prevent an increase in purchase costs.

- prevent encroachment onto land already government owned which might cause later difficulties .
- ensuring sufficient protection in low-lying areas by enforcing standards regarding infill and road crests heights.
- control/modify particular development proposals which might hinder efficient drainage or impede flood water flow, for example, by ensuring that road alignments do not cut across such flows but are in accord with compartmentalization requirements.

These powers should be available at the earliest to safeguard the areas of land needed for flood control and protection, given the pace of peripheral urban development, and the rate of increase in land prices.

Control and acquisition are complementary measures, but the former is clearly preferable if a choice exists. It is particularly significant that funds for land acquisition will need to be found locally. Thus, as well as making maximum use of control methods to reduce acquisition costs, it is imperative that the government manages to recoup some of the benefits of its investments from the beneficiaries, to allow further purchases in a rolling programme. Necessity to recover these public service costs means that the public authority is able to have the resources to service new land for development at the required rate. The resulting shortage in serviced land sees a continuing rapid increase in land value, and further difficulties in project implementation.

## 5.2 Existing Legislation

RAJUK is the planning and land development authority for Dhaka Metropolitan Area. It has development and control powers. In its development role, it can acquire land and prepare improvement schemes (by providing layouts, services and sub-divisions). This can be for the improvement of existing areas, but more usually is for the development of new ones. The major area developments initiated by RAJUK (or DIT) have been listed in the Master Plan Report. However, the scale and speed of urbanization in Dhaka is such that existing legislation and its enforcement has only a minimal impact. Current mechanisms cannot bring about the implementation of major infrastructure (including flood prevention) proposals needed, in an orderly fashion.

### 1) Land Use Control and Construction Control

The East Bengal Construction Act of 1952, and subsequent updates in 1961 and 1986, provides that within any area where Government may extend its application, all construction shall have previous permission from the designated "authorized officer". The Act also empowers the discontinuation of non-conforming use. RAJUK is responsible for control of construction in Dhaka. In general, there is some control of permanent buildings, but specifically as regards planning - as opposed to construction - the act operates mainly through the application of set-back (building line) rules.

The Town Improvement Act of 1953 established the Dhaka Improvement Trust (DIT) as a development body with powers to take over, improve, and return land to and from private and municipal owners. For guidance, it was authorized to prepare "schemes" and "zone plans". Planning control took the form of urban on all construction not conforming to such plans. In 1958, references to schemes and zonal plans were replaced by references to a "master plan". At the same time, it was mandated that an official of DIT should be designated as the "authorized officer" for the area within the jurisdiction of DIT. RAJUK (DIT) has the power to approve or reject proposals for building which are not in conformity with the Master Plan. The development control system is minimal, being based on the need to apply for the granting of an exception where a proposal is not in conformity with the plan. But the plan, prepared in 1960, is now clearly outdated and only covers part of the RAJUK area - not including many of the peripheral areas where development pressures are greatest. In this peripheral urban area, RAJUK can prevent/permit development, but decisions are made on an ad hoc basis. In actual fact, except in instances where private developers need official approval prior to obtaining a bank loan, most development proceeds without application for permission. There is also little control over development by public bodies, and a reluctance to enforce action against private uses.

Overall, there is some control over development in RAJUK's own development areas. But there is little over the rest of the city or its fastest developing peripheral areas (where, in fact, most of the land needed for flood protection is located). Further, while permission is needed for excavation of tanks, none is needed for changing the land level by landfilling. The prospects for the control of development so as to safeguard flood protection needs must, if present practices continue, be regarded as slim.

## 2) Land Acquisition

The Acquisition and Requisition of Immovable Property Act of 1982, with subsequent minor amendments, has replaced previous acquisition acts. After notice of intent to acquire land in the public interest, the district officer will determine compensation on the basis of the average market value for one year of similar land in the vicinity. The compensation includes an addition of 20% of market value, to compensate for the compulsory nature of the acquisition. The entire amount is to be paid in full before the land can be legally acquired and handed over. The law prohibits the use of acquired land for a purpose other than that for which it is acquired. If the land remains unutilized after acquisition or is used for another purpose, the land is liable to be surrendered to the district officer. The Act aims to ensure the the organisation requiring land for public and development purposes will decide upon the minimum requirement. RAJUK is the principal single land acquisition and development agency, but the private sector, overall, undertakes most development.

However, the legislation does have drawbacks. The Background Report to the Metropolitan Development Plan Preparation and Management, Dhaka and Chittagong, notes that difficulties arise from :

- high prices. Most land that is developable on the urban fringe is privately held. Unless it can be serviced and released at the rate needed for urban growth, its shortage will fuel a continuing rise in land prices. However, as public authorities fail to recover services cost from beneficiaries, they lack the resources to service land at the rate needed
- the legal registration system, involving two ministries, the Ministry of Lands and the Ministry of Works, also hinders the efficient and speedy operation of the land market.
- lengthy land acquisition procedures further reduce the capacity to service land at the required rate. There are 16 steps involved, in a process which has to be completed in 1 year.
- public sector landowners also contribute to land scarcity/high prices by failing to service and develop land. Public sector agencies hold about half the buildable land in Dhaka. Much remains vacant or under - used

In such a context, it will be difficult to acquire land for flood prevention measures, unless it is done well in advance of urbanization pressures, before any substantial increase in land values.

The 1989 Property Emergency Acquisition Act provides for emergency acquisition to control inundation and prevent river erosion. Its duration is restricted to five years, but has so far only been applied in connection with the Jamuna Bridge Construction Project and the existing Dhaka Embankment.

The Act attempts to accelerate acquisition. The order to acquire is issued by the DCC on condition of previous Government approval. Appeals are required in ten days, as are claims of interest in the land for compensation. Within the same days, the DCC will determine provisional compensation based on an assessment of appropriate market value. Thereafter payment of provisional compensation is made in full and possession is taken. Final compensation is calculated within ninety days on the same qualifications as the 1982 Ordinance. Appeal is also the same as for the '82 Act, with the difference that the claimant may accept payment 'on protest' without forfeiting his right to appeal.

Clearly, the '89 legislation speeds up the acquisition process, but cannot have any effect on the increase in land prices.

### 3) Cost Recovery

The Betterment Fees Act of 1952 allows the government to levy betterment if land value is enhanced as a result of any Government improvement scheme, fixed at one-half the increase in land value. DMAIUDP notes serious inconsistencies and drawbacks in the legislation :

- it takes no account of increases in value unrelated to the Government improvement.
- it can levy betterment fees for works executed before 1953
- procedure for determining market value is not laid down
- there is no guidance for determining the extent of the area within which land values enhanced

The Town Improvement Act 1953 contains the power to impose a betterment fee on DIT (RAJUK), though the legislation differs in some respect from the 1952 Act.

The betterment laws have not, in the past, been enforced in Bangladesh.

The Wealth Tax Act of 1963 could (according to DMAIUDP) be used to realize a portion of windfall gains, but is not designed for such purpose and has been ineffective.

The East Pakistan Finance Act 1966 allows a capital gains tax to be collected on profits or gains arising from sale, transfer, or exchange of property. Capital gains are now treated as income, liable to tax. The 1976 Finance Ordinance attempted to reduce evasion by requiring tax authority approval prior to the issue of any document transferring any property valued over Tk. 20,000. As tax on capital gains is collected with income tax, it is not possible to discover how much of the increase in land value is recouped by the method.

The Gift Tax Act 1963 and The Estate Duty Act 1958 also attempt to recoup the unearned increment in land values. DMAIUDP concluded that this goal is unlikely to be achieved by this legislation, without reorganized tax administration and removal of loopholes.

It is difficult to see any effective recovery of costs of infrastructure investment/land development by an agency such as RAJUK under the legislation now existing as now applied. Without this, effective action to cater for anticipated rapid growth is not possible, in any sector. Indeed, continuing failure to recoup costs, in this urbanization context, means that conditions in the capital will get worse rather than better, as the amount of land and the major infrastructure required cannot be provided in a sensible fashion.

### 5.3 Land Improvement Issues

- 1) While this study is particularly concerned with flood prevention and control, the factors which can, and will, prejudice the achievement of a successful flood control system will also prevent progress in other major sectors. Any legal, administrative and institutional changes should apply to urban development in general, and not just address the flood prevention sector. Otherwise there is a danger of a mass of sector-specific legislation which could better be catered for under a single multi-sectoral law.

- 2) A corollary to point 1) is that the activities connected to urban development and management should be the responsibility of one agency. While a number of organizations - BWDB, DWASA, DCC etc - are involved in flood control and associated aspects, and do need to be consulted as required, the responsibility for land acquisition, control, and management of land should be the responsibility of one agency, RAJUK. Any cost recovery, though, could well involve more than one agency.
- 3) If land is needed for flood control structures, acquisition at market value appears unavoidable. If the land needed remains unzoned (as at present), such value would reflect the urbanization potential and would become increasingly expensive within the proposed embankment area as urbanization prospects drew closer. If however, land needed for retarding areas was zoned for retarding areas, its market value would continue to be its agricultural value. In fact, less, as its agricultural value would decrease, though compensation if acquisition took place would still be at agricultural value. There would be no potential urban use value. Owners of such land would feel understandably aggrieved, but any zoning system makes decisions with quite different implications for land values, even for adjacent plots. It may then be possible to reduce acquisition costs by speedy zoning.
- 4) The development of land readjustment mechanisms could allow a more equitable spread of costs and benefits. Under such a system, the public development agency would prepare a development plan for an area, consolidate land holdings and reserve land for infrastructure needs. The remainder is reconstituted into plots, the agency possibly selling a number to recoup some costs. The remaining plots are re-allocated to all the original owners in the area on the basis of percentage held of the whole delineated area. While the plots would be smaller, their value would be much higher as following flood protection measures, they would now have urban development potential. There is also no arbitrary differentiation between land needed for storage of water and land with urban development potential following the formation of retarding areas on adjacent plots.

Nevertheless, there must be some doubt about whether such procedures could be applicable over large areas, given the amount of agreement and coordination required. But, given possible benefits, some further consideration would be appropriate.

There are some specific issues with regard to the flood protection project, its land acquisition cost and management mechanisms, these are

- 5) As pointed out in the Master Plan, though huge areas would be reserved for retarding areas, most of the retarding areas could be used for cultivation pre and post monsoon. Such cultivable areas were estimated as constituting 70% of total pond areas. Thus, the Government could consider not acquiring outright but rather control the owner for use of retarding areas.
- 6) An alternative means of controlling retarding areas would be to make developers provide their own storage capacity. This should be on the basis of 1200m<sup>3</sup>/ha or a retarding area corresponding to 12% of the development area as on-site retarding areas. This could be imposed as a condition of development. This is an equitable measure as it is the beneficiaries who have to contribute. However, problems would arise from obtaining a contribution from those who develop without permission, and from those not developing not contributing : the area of retarding area needed would be the same, irrespective of whether the surrounding area was developed officially, unofficially, or undeveloped.
- 7) Everyone in Dhaka would benefit from flood protection measures. Everyone should in principle contribute towards the cost. A tax based on the increase in land values (as suggested in the ADB Aide-memoire) would be an equitable measure. It would reflect the disproportionate benefits that flood protection will bring some owners (in allowing conversion from rural to urban) as well as the increased land values overall resulting from flood protection. (It would also reflect increase in values resulting from other public infrastructure investment).
- 8) In the following section, there is a summary of the measures underway to bring about more efficient land management and cost recovery. Thus, in the medium term, say from 1994 on, there is the possibility of an approved zoning master plan for all of Dhaka metropolitan area, incorporating flood protection needs, which would (with difficulty) be enforceable by RAJUK. Until that time, control will have to be undertaken under existing legislation.

#### 5.4 Prospects for Improvements

A number of plans and proposals are underway which will investigate and recommend improved mechanisms for land control, development, and management.



The adoption - and vigorous enforcement - of the measures recommended, should provide the means whereby flood protection (and other infrastructure) measures can be implemented.

- 1) The prerequisite for the successful application of any land management legislation is a zoning map which defines future needs.

The proposed Metropolitan Development Plan Study for Dhaka will prepare an integrated development plan and sectoral priority plans for the city. The project document for this study lists the outputs as including :

- a structure plan, indicating broad land uses and the framework for development
- a master plan, with a strong spatial basis, which will specify in more detail permissible land uses and development standards. This will be incorporated into the legal/administrative framework, and will be the basis for regulatory activities by RAJUK (Such a master plan should incorporate the major land requirements needed for flood protection, as contained in this JICA Master Plan, and zone them for particular flood protection purposes as required.)
- detailed area/project plans, which will include the land use, engineering, cost, and institutional elements needed for proposed priority developments.

The study will also assist RAJUK to produce and review plans, and improve its regulatory and management functions. The terms of reference for the study specify an examination of land acquisition and assembly procedures within RAJUK, the development of improved land management machinery, and the installation and evaluation of new approaches, including guided land development techniques and land pooling/readjustment. The tasks will include;

- an assessment of planning and control area boundaries
- a review of the enabling powers and regulations under the Acts, with particular reference to flexible and differentiated development control

zones and performance - related construction codes, and of RAJUK's powers in relation to urban utility agencies

- an assessment of the degree and nature of unauthorized construction and of practical levels of operations, prior to recommending flexible arrangements of land use control and construction approvals in accordance with varying levels of performance related building and planning regulations

- 2) We have noted, in previous sections, the need for development in the Dhaka East and DND areas to be in accordance with an overall framework which allows rational, phased development. There is no such framework for Dhaka East. For the development of the DND, RAJUK's plan does not take into account the topographical characteristics of the area, the drainage pattern or the need to reserve land for flood protection measures. It does not seem to take into consideration the pattern of the existing road network or the need to retain as much of existing development as possible. We think it may require some re-casting before it reflects these considerations fully.

The 'detailed area/project plans' proposed for the Metropolitan Plan Study would permit major infrastructure (including flood protection) needs to be coordinated and safeguarded in a manner which would take all factors - investment, institutional needs, land availability, development pressures - into account.

The TORs for this study also propose that the current RAJUK zonal plans should be reviewed. It proposes the identification of priority investment projects for which the development problems are clearly evident. It further notes that particular attention should be given to the outlying urbanization areas of the RAJUK zone.

While we cannot forecast the particular priorities which will be identified in the study, the foregoing suggests very strongly that the DND and at least the southern part of Greater Dhaka East would be identified as areas where detailed plans will be given priority. In this event, we can be confident that flood protection requirements will be safeguarded.

Currently, we estimate a realistic starting date for this study to be March 1992. The initial set of plans are to be prepared within two years. The Reporting

Schedule shows that the draft metropolitan plans should be produced at the end of month 18 (July 1993 if our starting date is correct). Within two years, then, a satisfactory plan for the two larger feasibility areas should be produced.

- 3) FAP 15, the Land Acquisition and Resettlement Study, may also identify improvements in acquisition and resettlement procedures, in urban as well as the rural areas covered by the various flood action programmes. FAP 15 is based on the rationale that efforts are needed to minimize the negative impacts of embankment construction and provide fair compensation to those affected. It notes that many of those affected by acquisition, and not resettled, end up squatting on embankments. Delays in resettlement (as in the case of the current Dholai Khal improvement where land acquisition and cost problems have led to delays) can also lead to increased settlement on the embankment. This is discussed further under 6.2(b).

Neither the 1982 nor 1989 Land Acquisition Acts make any reference to householders losing land due to acquisition

- 4) Following the ADB Mission in July 1991 in connection with FAP 8B (Dhaka Integrated Flood Protection), ADB has agreed to provide the Government of Bangladesh with advisory technical assistance in conjunction with the loan. This is for a study which will :

- recommend appropriate building and land development standards to ensure that investments in better flood control and drainage are not negated by uncontrolled growth
- develop improved cost recovery methods for meeting the growing needs for infrastructure and services as the city grows
- rationalize the needs and uses of vacant and underused Government land in the city

It is anticipated that this programme will start in June 1992 and continue for a period of 8 months. The team will be responsible for coordinating its activities with other related projects, to ensure that recommendations are complementary. The proposed study clearly has some overlaps with the proposed metropolitan plan study. It should also establish mechanisms which would apply to the implementation of the JICA Flood Protection proposals as well as those under

FAP 8B, as indeed they would apply to infrastructure investments in other sectors.

- 5) A review of physical planning and development control legislation was undertaken in 1985, leading to the Draft Physical Planning (Land Use) and Development Control Ordinance. The first main thrust of the draft is to provide very flexible formulae permitting the assignment to any public agency, at any level of government, for any area of jurisdiction, such planning responsibilities or development control powers (out of an all-inclusive list) as may seem desirable taking into account the capacity of the agency and the characteristics of the problems it faces. The second is to encourage coordination and collaboration among various branches of Government in the uses of powers which could influence the effectiveness of planning and development.

In Dhaka, control would be exercised by means of specific development control rules appropriate to particular areas and as specified in the prospective metropolitan plan. RAJUK would be responsible for all planning and control.

The adoption of this draft legislation could provide the basis for land control and management in the city.

We have already noted the needs, the inadequacies of current plans and mechanisms, and made general observations on changes needed. As these are soon to be examined in a comprehensive fashion, it is premature to comment further. But until comprehensive measures are enacted, existing methods will have to be employed more efficiently.

## 6. DEVELOPMENT CONTROL MEASURES AND MULTIPLE USES

### 6.1 Land Acquisition and Resettlement

As noted in Section 5, a large amount of land will be needed for construction of flood prevention structures. Despite of the land already purchased for the Eastern embankment along the Balu river, new land will be need to be acquired for the construction or expansion of embankments, flood walls, sluices, pumping station, drainage channels and those related works. This amounts to a total of 636.9 hectares in the three feasibility study areas, of which 304.9 hectares would be for embankments and associated works and 332.0 hectares for drainage channels and the related facilities sites.

This will involve the resettlement of resident populations and compensation for demolishing the existing building structures including shops and industrial factories in some cases.

The resettlement figures are as follows :

- Population ..... 7,000
- No. of houses ..... 1,200
- No. of commercial / industrial buildings ..... 200  
(Partial demolition in most cases)

Although the land acquisition and resettlement works are usually very difficult to implement within the limited resources and period, it will be essential to acquire the required land prior to planned implementation in order to minimize risks associated with project implementation

### 6.2. Development Control Measures

- 1) On and around flood prevention structures

Set back from the retarding area and drainage channel :

It is logical to assume that the development pressures will eventually lead to encroachment of the retarding areas and drainage channel. Technically, a set back is required from the retarding area boundary and the reasons are two fold:

- a) The wet season water level and the dry season level will vary. It is assumed that dry season water will occupy a small portion of the retarding area and open up large dry areas around it, for which various uses are discussed in Section 6.3. There is also a danger of encroachment of this dry season open area by squatters and even by the neighbouring land owners. The example of Gulshan area will show that due to the placement of the lake on the rear side of the plots, a lot of the plot owners actually disregarded RAJUK's regulations and encroachment upon the lake. Since the lake cannot be seen from the road, this encroachment goes unnoticed. Encroachment by the squatters is a common sight and needs no elaboration.

A scrutiny of the Dhanmondi lake will provide pleasant respite from such problems. In case of the Dhanmondi area, the road network is placed so that the lakes are encircled by road network and a strip of park area (protected by barbed wire) lies between the lake and the road. The lakes are managed and looked after by concerned government agency who also has an office at the spot. There are capital generating schemes such as rent of angling platforms and annual catch of fish by farming. All these put together create an environment where encroachment have been averted so far. It is our assessment that in case of Gulshan it could not be done mainly because the lake was on the negative space and did not serve any other use.



- Some form of revenue generating scheme should be attached to the use of the retarding area. Uses such as fish pond, agriculture, recreation etc. are discussed in detail in Section 6.3.
- Maintenance and management should be carried out by concerned government bodies or by private entrepreneur who wish to take the pond area on lease for fish culture or other uses which conform to the flood control project. They should have a site office in the project area to maintain constant vigilance.

### Embankment

It will likely prove difficult to prevent encroachment onto flood embankments as examples on those parts already constructed already illustrate. In addition to those who might be affected by embankment construction (as already mentioned), there will be a greater number attracted to the embankment from adjacent slum and squatter areas. The embankment offers a rent-free, flood-free opportunity, close to place of work, to those whose other choices are few.

Unfortunately, settlement, whether urban or rural in character, has detrimental effects on the embankment. Construction cuts into the embankment's profile, and the removal of the vegetation cover together with associated development of footpaths brings about erosion. Free access for maintenance purposes is hindered. Grazing and cropping will also lead to accelerated erosion. Ideally, then, development on embankments should be discouraged. But this is likely to prove difficult. It would clearly be impossible to remove people sheltering on the embankment immediately after flooding, and little easier to move them later when they become established. It would also be particularly difficult to resist the claims of those who move onto the embankment as a result of being affected by embankment construction.

From a flood protection point of view then, habitation on embankments should be resisted. To some extent, the numbers may be minimized by speedier land acquisition and resettlement procedures. But in practice, we suspect this will be impossible to achieve, particularly nearest to more densely populated areas. It may therefore be more realistic to acknowledge this and take appropriate measures to avoid the worst effects.



Clearly, unhindered rights of way for maintenance must be preserved. Elsewhere, consideration should be given to modifying embankment design to allow shallower slopes which could more safely accommodate settlement on the land side of the embankment. One of the objectives of FAP 15 (currently underway) is to review embankment design criteria to see if development or use of the embankment can be permitted in a manner which does not threaten safety and stability. Employing some of the squatters to be responsible for upkeep of sections of the embankment may be one possibility. Nevertheless, where the embankment section has not been designed to permit settlement, such settlement has to be discouraged.

As mentioned before. The modified embankment structure will be allowed the road construction along the embankment. It is recommended that the Government introduce building controls to restrict development within 50 meter (minimum) of the edge of the right of way of the embankment so as to preserve a strip of land along the country side of the embankment to accommodate any future roadway and also other type of land uses.

## 2) Regulations for site development

### Minimum heights for development

In addition to control activities associated with suitable land uses, control of minimum height levels is also needed to ensure flood protection. Development in areas protected by embankment should be by filling up the land higher than the proposed internal design water level of the retarding area, khal and trunk drain as illustrated in fig. below.

The Master Plan specified the minimum ground elevations of future low land development as being from 4.5 to 5.5m PWD for the Greater Dhaka drainage zone (including Dhaka East and the DND) and from 4.5 to 5.0 m PWD for Narayanganj. The different height requirements for different areas are shown on Fig. A.18.

#### Required On-site retarding area

For RAJUK's approval, the private developers are required to prepare the public land, which is around 30-40% of the development area. Those areas has to keep for non-housing uses such as commercial, educational, medical and openspace. We propose, as described in Section 5.3, within or encouraging the condition, certain portion say 5-10% of the development area should be allotted to provide their own water storage as on-site retarding area.

### 6.3. Multiple Use of Retarding Areas

In the three feasibility study areas it has been estimated that retarding areas will cover an area of 26 km<sup>2</sup>. They will (when full) constitute the second major land use in terms of area (after residential, and if rural / agricultural use is not considered). Those huge area should be reserved by way of proper measures which are discussed in the previous sections by the government because their primary use is clearly for flood protection. But, in a country with such major population/land ratios as Bangladesh with such intensive urban densities as Dhaka, and for realization of the proposed retarding areas to be practical, maximum multiple usage should be encouraged.

#### 1) Recreation

DMAIUDP notes that the majority of recreational pursuits are carried out in or near the home. While there is a wide demand for sports pitches, it reasons that this should be met in local residential areas. A total of 145 hectares was considered to be available for public and semi-public recreation in the city, mostly in newer areas. In the old town, a ratio of only 0.024 hectares per 1000 people was available. Given the scarcity of available and suitably priced land, it considered the attainment of higher standards in these areas as unrealistic.

The study identified the reservation of larger scale outdoor areas for day trips within easy travelling distance of the city as a major recreational requirement. This need is currently being (partly) met to the north of the city but a number of other potential

locations were suggested. Within the metropolitan area also, some potential recreational locations were identified. None of these areas are located within the feasibility study areas.

DMAIUDP's underlying concept behind providing recreational space is to use the natural potential of the city environment together with the engineering works proposed for urban development purposes, to create a number of outdoor recreational spaces. An opportunity exists to use at least some of the works associated with flood protection for such purposes, for very limited extra costs. This can be done both by ensuring right of way and access to embankments and use of the most suitable retarding areas as recreational areas.

Not all the proposed retarding areas should be reserved for such use, and it is probably realistic that at best, given lack of funds, only one such pond could be so developed. The northernmost areas are too distant from the city's centre of population and will continue to be too distant, to justify selection. The area on the south-eastern edge of the city is however identified in DMAIUDP as "urgently requiring planned provision of public open spaces". This area is closest to the poorly served Old Dhaka and the equally poorly served and currently growing eastern extension. It offers the most central location for serving a wider catchment than other possible choices.

Two retarding areas are proposed in this area, one based on the northern part of the Dholai Khal, the other, smaller, pond further north, on the Gerani khal linked with Begunbari Khal. Given the current rate of development in this area, the likely greater degree of encroachment near to the city as well as lower land prices further out for any complementary acquisition, the latter location is preferred for recreation development.

Provision of the spaces for green, sports, fishing, boating, etc. will be possible at the part of the pond, especially in dry season.

## 2) Agriculture

The change from agricultural to urban use in the DND will clearly see a reduction in agricultural output. In Greater Dhaka East however, an area currently under water for large parts of the year and where in most parts therefore only one crop is possible, will be empoldered. This will permit more than one crop in most areas, at least for that period until the area becomes developed.

In the long term, overall, as urban development proceeds, the effects of flood protection will be to reduce the area under agricultural use. Given the forecast doubling of population over the next twenty years, food requirements will also need to be doubled, even to maintain existing sub-standard nutritional levels.

Due to the importance of agriculture in or near the metropolitan area, around 10% of Greater Dhaka East and Narayanganj DND feasibility areas are zoned for agricultural use. In addition to that, it has been estimated in the Master Plan Report that 70% of the pond areas would be cultivable for most of the year. The availability of irrigation water from the retarding areas should also allow higher yields in these areas. Continuing agricultural activities should then be encouraged given the loss of agricultural land to urban development and the difficulties of supplying Dhaka with foodstuffs as it doubles in size.

### 3) Fishing ponds

Most flooded areas in Bangladesh are used for fishing. Self-contained ponds are usually fished in a managed fashion, while larger seasonal water bodies are fished in a less organized manner. Currently, in addition to small privately owned tanks, fish culture is practised in a number of ponds in Khilgaon and in the DND Canal. Less organized fishing takes place in the khals, ditches, ponds and beels within the seasonally inundated areas. The variety of fish caught is likely to amount to around thirty types.

Generally, with empoldering, the importance of fishing is reduced as-

- inward movement of wild fish into the water bodies of the flood plain either ceases or declines drastically as a result of the embankment. Spawning usually takes place in large rivers, with fish fries and fingerlings coming into an area with annual floods. Poldering curtails this process of natural recruitment.
- there is virtual disappearance of water bodies traditionally used for wild fishing.
- the quality of water inside the embankment deteriorates as a result of lack of flow, resulting in depleted oxygen levels and an inferior habitat for fish.

The importance of maintaining fish production may be gauged from the fact that 70%-80% of animal protein supplies in Bangladesh is obtained from fish. Fish is also

the cheapest form of such animal protein. While the construction of the embankment will clearly affect the present pattern of fishing, it does also offer an opportunity for higher yields from fish farming.

A total of 2,660 hectares of retarding areas are proposed in the three feasibility study areas. Though one such pond has been suggested for recreational use, this does not preclude some form of pisciculture. Of this total, some 30%, or 800 hectares, will be permanently under water, in fifteen separate ponds. These ponds will vary in size (at minimum) from under 10 ha to 170 ha.

The arguments for fish farming in the permanent water bodies of the retarding areas are :

- good value of catches, especially of the marketable carp family, estimated conservatively at Tk.60 per Kg, with production at 500-600 Kg per hectare. Possible fish varieties suitable for such lakes include silver, common, and grass carp, katla and ruhi, sarputi, mrigal and magur.
- immediate access to a large and growing market.
- tried and tested technology and existing institutional mechanisms. Ponds could be leased to entrepreneurs or groups of fishermen by government, or if government leased rather than purchased the land, by the original owners.
- possible opportunity to introduce lower priced fish such as tilapia niloti (which could reproduce within the ponds) and which are more affordable by poorer people.
- management of the water body reduces a potential health hazard. If no use was made of the ponds after the original stock had been fished out, the pond would increasingly become a breeding ground for insect larvae.
- management similarly would deal with the periodic removal of water hyacinth from pond areas, which would not be flushed out in annual floods, and which would otherwise reduce fish harvest and constrict drainage channels.

Currently, ponds may be leased to entrepreneurs or groups of fishermen by government. If the government leased rather than purchased land for retarding areas,

the original owners could practise fish farming, with advice from the Ministry of Fisheries. Management would need to stock the ponds annually with large fingerlings produced by local hatcheries, as carp needs to reproduce in spawning grounds away from ponds. At present, the capacity of hatcheries and nurseries in the Dhaka area is insufficient to produce fingerlings for this area of pond. One or more new hatcheries would be required. The establishment of such hatcheries would need to be done by government, as private investment, at least initially, would be unlikely.

A possible danger would derive from pollution as the city continued to grow. Large inflows of domestic sewage would consume large amounts of oxygen, resulting in BOD levels too low for good yields. Water quality management would thus be crucial. Though carp is very resilient to high organic inflows there could also be dangers from chemical pollutants and illegal discharges. This would be particularly so for those ponds to which the existing industrial areas drain. The likely nature and degree of toxicity of possible effluents would have to be determined. In addition, after completion of embankments, cultivation of higher yield crops with irrigation would increase the use of fertilizer. Thus the amount of agro-chemicals could have an effect on the ponds.

Given the considerable potential of fish farming in retarding areas, it is recommended that further study be carried out into :

- possible variety of fish and estimates of yields and markets for different types ;
- costs and returns ;
- preferred institutional arrangements for managing ponds and nature of advising assistance required ;
- number and type of beneficiaries with emphasis on potential for assisting those affected by embankment construction ;
- risk from agricultural and industrial effluents ;
- prerequisites for further pisciculture schemes in the area, in the form of nursery and hatchery requirements.

#### 4) Oxidation ponds for sewage treatment

Although, the investigation sewerage of is not the scope of this study, as the existing oxidation pond in Pagla has been provided for purification of sewage water from part of the Old Dhaka area, development of new oxidation ponds serving the other part of urban area and the new urban development area in low land zone would be one of the options for the future sewage treatment in the metropolitan area.

The proposed retarding areas would be potential location to facilitate those oxidation ponds. It is assumed that if all the sewer water would be treated by new oxidation ponds in the whole feasibility study area, some 1,000 ha of such oxidation ponds area is required, while the proposed retarding areas is 2,660 ha.

And it is noticed that a multiple use, such as oxidation pond cum fishing pond or oxidation pond cum irrigation, of retarding areas is more realistic.

Further investigations on the above four options for the multiple use of the retarding areas are strongly required.

The Fig. 19-A~C illustrate a general idea of the development steps in the existing low land agricultural area where are going to be urbanized in the future.

YEAR	1990	2000	2010
TOTAL AREA (sq.km)	118.62		
POPULATION (person)	637,500	1,150,656	2,201,935
BUILT UP AREA (sq.km)	22.85	50.27	85.49
URBAN DENSITY (p/ha)	279	229	258
URBAN RATIO	19%	42%	72%
<b>NORTHERN COPM</b>			
	40.69 sq.km		
POPULATION (person)	126,079	281,674	772,278
BUILT UP AREA (sq.km)	8.49	19.43	35.41
URBAN DENSITY (p/ha)	149	145	218
URBAN RATIO	21%	48%	87%
<b>CENTRAL COMP</b>			
	32.04 sq.km		
POPULATION (person)	61,195	139,572	259,314
BUILT UP AREA (sq.km)	3.36	9.97	15.52
URBAN DENSITY (p/ha)	182	140	167
URBAN RATIO	10%	31%	48%
<b>SOUTHERN COMP-1</b>			
	14.57 sq.km		
POPULATION (person)	23,574	52,157	212,482
BUILT UP AREA (sq.km)	1.14	4.35	8.91
URBAN DENSITY (p/ha)	207	120	238
URBAN RATIO	8%	30%	61%
<b>SOUTHERN COMP-2</b>			
	31.32 sq.km		
POPULATION (person)	426,652	677,253	957,861
BUILT UP AREA (sq.km)	9.86	16.52	25.65
URBAN DENSITY (p/ha)	433	410	373
URBAN RATIO	31%	53%	82%

TABLE A.1

POPULATION GROWTH AND URBANIZATION, 1990-2010 : DHAKA EAST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



POPLAND DATA OF DHAKA EAST DRAINAGE ZONE 1990												
ZONE NAME	TOTAL AREA (ha)	DETAILED LAND USE (ha)				Com'cial	Industry	Inst'n	Agr'ture	Water	BUILT UP POP'TION	
		Residential			1990						1990	
		high	mid	low								
DHAKA EAST TOTAL	11,862	168	328	1,752	40	1	23	8,814	735	2,313	637,500	
NORTHERN COMPT	4,069	0	27	811	8	0	3	3,080	140	849	126,079	
1A Uttar Khan	1,811	0	0	180	8	0	0	1,585	38	188	23,111	
1A D. Khan Cant	186	0	6	113	0	0	0	9	58	119	26,179	
1A D. Khan Gulshan	766	0	9	171	0	0	2	580	5	182	25,847	
1A Cantonment 3	12	0	0	5	0	0	0	6	0	5	431	
1A Beraid U. Gulshan	281	0	1	20	0	0	0	260	0	21	4,688	
	3,056	0	16	490	8	0	2	2,440	101	516	80,256	
1B D. Khan Cant	102	0	3	62	0	0	0	5	32	65	14,336	
1B D. Khan Gulshan	681	0	8	152	0	0	1	515	4	162	22,977	
1B Cantonment 3	230	0	0	106	0	0	0	120	3	107	8,510	
	1,013	0	11	321	0	0	1	641	39	334	45,823	
CENTRAL COMPT	3,204	0	20	315	1	0	0	2,698	169	336	61,195	
2 Cantonment 3	500	0	0	231	1	0	0	261	7	231	10,928	
2 Beraid U. Gulshan	1,590	0	2	43	0	0	0	1,544	0	45	10,789	
2 Gulshan 57	1,114	0	18	42	0	0	0	893	161	60	39,478	
SOUTHERN COMPT-1	1,457	0	56	85	0	0	0	1,070	246	141	23,574	
3A Beraid U. Gulshan	2	0	0	0	0	0	0	1	0	0	150	
3A Gulshan 57	976	0	55	12	0	0	0	773	136	67	11,102	
3A Beraid Demra	404	0	0	55	0	0	0	240	110	55	7,309	
3A Demra	75	0	1	18	0	0	0	56	0	20	5,013	
SOUTHERN COMPT-2	3,132	168	224	541	31	1	20	1,965	180	986	426,652	
3B Ward 34	147	73	16	0	1	1	8	23	24	99	77,957	
3B Ward 36	167	20	45	68	9	0	3	8	16	144	65,467	
3B Ward 38	98	21	36	27	7	0	0	0	7	91	54,056	
3B Ward 39	185	54	61	38	1	0	0	30	1	155	109,560	
3B Ward 40	351	0	43	174	11	0	8	59	56	236	65,378	
3B Beraid Demra	173	0	0	6	0	0	0	108	59	6	812	
3B Demra	1,160	0	18	157	1	0	0	979	5	176	45,118	
3B Matuall GD	850	0	4	72	1	0	1	758	13	79	8,304	

TABLE A.2

DETAIL LAND USE TABLE, 1990 : DHAKA EAST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

POPLAND DATA OF DHAKA EAST DRAINAGE ZONE 2010 (ha)											
ZONE NAME	TOTAL AREA (ha)	DETAILED LAND USE (ha)			Com'cial	Industry	Ins'tion	Agr'ture	Water	BUILT UP	POP'TION
		Residential high	mid	low						AREA(ha)	2010
<b>DHAKA EAST TOTAL</b>	<b>11,862</b>	<b>2,031</b>	<b>2,997</b>	<b>889</b>	<b>436</b>	<b>39</b>	<b>2,158</b>	<b>1,310</b>	<b>2,002</b>	<b>8,550</b>	<b>2,201,935</b>
<b>NORTHERN COMP'T</b>	<b>4,069</b>	<b>695</b>	<b>1,196</b>	<b>626</b>	<b>181</b>	<b>24</b>	<b>819</b>	<b>240</b>	<b>288</b>	<b>3,541</b>	<b>772,278</b>
1A Uttar Khan	1,811	203	405	405	96	19	295	240	149	1,422	292,073
1A D. Khan Cant	186	54	43	11	9	0	70	0	0	186	62,693
1A D. Khan Gulshan	766	176	322	88	31	3	143	0	4	762	160,124
1A Cantonment 3	12	2	2	0	1	0	6	0	0	11	1,861
1A Beraid U. Gulshan	281	11	74	29	1	0	38	0	128	153	31,004
	<b>3,056</b>	<b>446</b>	<b>845</b>	<b>533</b>	<b>138</b>	<b>22</b>	<b>552</b>	<b>240</b>	<b>281</b>	<b>2,535</b>	<b>547,756</b>
1B D. Khan Cant	102	29	24	6	5	0	38	0	0	102	34,332
1B D. Khan Gulshan	681	156	286	78	27	3	127	0	4	677	142,342
1B Cantonment 3	230	64	41	9	11	0	102	0	3	227	47,849
	<b>1,013</b>	<b>249</b>	<b>351</b>	<b>93</b>	<b>43</b>	<b>3</b>	<b>268</b>	<b>0</b>	<b>7</b>	<b>1,006</b>	<b>224,522</b>
<b>CENTRAL COMP'T</b>	<b>3,204</b>	<b>257</b>	<b>665</b>	<b>88</b>	<b>71</b>	<b>0</b>	<b>471</b>	<b>1,070</b>	<b>582</b>	<b>1,552</b>	<b>259,314</b>
2 Cantonment 3	500	136	87	29	24	0	216	0	7	492	76,992
2 Beraid U. Gulshan	1,590	95	138	6	2	0	69	720	561	309	62,790
2 Gulshan 57	1,114	26	439	53	46	0	186	350	13	751	119,532
<b>SOUTHERN COMP'T-1</b>	<b>1,457</b>	<b>287</b>	<b>270</b>	<b>59</b>	<b>27</b>	<b>0</b>	<b>248</b>	<b>0</b>	<b>566</b>	<b>891</b>	<b>212,482</b>
3A Beraid U. Gulshan	2	0	0	1	0	0	0	0	0	2	133
3A Gulshan 57	976	287	186	9	19	0	191	0	284	692	203,906
3A Beraid Demra	404	0	79	42	7	0	50	0	225	179	7,394
3A Demra	75	0	5	7	1	0	6	0	57	19	1,049
<b>SOUTHERN COMP'T-2</b>	<b>3,132</b>	<b>793</b>	<b>866</b>	<b>117</b>	<b>156</b>	<b>15</b>	<b>620</b>	<b>0</b>	<b>566</b>	<b>2,565</b>	<b>957,861</b>
3B Ward 34	147	107	10	0	2	1	11	0	17	130	142,679
3B Ward 36	167	100	40	8	9	0	11	0	0	167	110,446
3B Ward 38	98	56	33	0	6	0	2	0	0	98	79,509
3B Ward 39	185	76	44	6	25	0	32	0	1	184	134,871
3B Ward 40	351	115	56	0	40	0	138	0	3	348	171,774
3B Beraid Demra	173	21	44	20	3	0	42	0	43	131	7,803
3B Demra	1,160	149	516	67	43	7	185	0	194	967	113,389
3B GE-Matuail	850	170	124	15	27	7	198	0	309	541	197,390

TABLE A.3

DETAIL LAND USE TABLE, 2010 : DHAKA EAST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

Table A.4: POPULATION GROWTH AND URBANIZATION, 1990-2010: DND

YEAR	1990	2000	2010
POPULATION (person)	448,590	879,523	1,313,749
BUILT UP AREA (sq.km)	21.74	36.14	42.70
URBAN DENSITY (p/ha)	206	243	308
URBAN RATIO	38%	64%	75%

Table A.5: DETAIL LAND USE TABLE, 1990: DND

ZONE NAME	TOTAL	DETAILED LAND USE(ha)							BUILT UP	POPATION	
	AREA	Residential			Com'cial	Industry	Ins'tion	Ag'r'ture	Water	AREA(ha)	(persons)
	(ha)	(high)	(mid)	(low)						1990	1990
Ward 31	8	4	0	0	0	3	1	0	0	8	4,992
Ward 32	162	41	61	34	9	14	3	0	0	162	90,448
Ward 33	52	12	18	10	4	1	2	4	1	47	26,947
DND-Matuail	1,479	0	0	568	5	0	7	886	12	581	102,331
Shyampur	397	40	40	9	9	35	10	129	126	142	71,224
DND-Siddirganj	564	0	0	105	1	22	1	428	7	129	20,383
DND-Simulpara	198	3	14	38	9	61	25	1	47	150	19,876
Kutubpur	1,243	0	0	286	5	19	0	869	64	310	37,098
DND-Godnail	826	0	0	211	8	19	0	584	5	238	14,351
Fatullah	478	0	0	231	6	10	6	159	66	253	37,593
DND-Enayetnagar	22	0	0	6	0	4	1	9	1	12	1,173
DND-N'ganj 1	44	0	1	11	0	2	1	27	2	15	2,817
DND-N'ganj 2	49	0	1	28	0	4	0	14	1	34	4,170
DND-N'ganj 3	156	5	0	86	0	0	3	63	0	93	15,186
DND TOTAL	5,679	104	135	1,625	56	196	59	3,173	332	2,174	448,590

Table A.6: DETAIL LAND USE TABLE, 2010: DND

ZONE NAME	TOTAL	DETAILED LAND USE(ha)							BUILT UP	POPATION	
	AREA	Residential			Com'cial	Industry	Ins'tion	Ag'r'ture	Water	AREA(ha)	(persons)
	(ha)	(high)	(mid)	(low)						2010	2010
Ward 31	8	4	1	0	0	2	1	0	0	8	5,936
Ward 32	162	103	18	0	10	11	12	0	7	155	145,427
Ward 33	52	28	12	0	6	2	2	0	2	50	37,330
DND-Matuail	1,479	349	349	78	63	52	390	78	119	1,282	353,378
Shyampur	397	154	27	0	7	85	88	0	36	361	227,928
DND-Siddirganj	564	97	75	43	20	74	96	31	127	406	88,232
DND-Simulpara	198	26	12	9	6	43	18	0	84	114	26,752
Kutubpur	1,243	179	281	51	21	83	229	188	212	844	167,402
DND-Godnail	826	74	92	18	9	42	82	235	275	317	74,396
Fatullah	478	95	118	24	11	53	166	0	11	467	91,832
DND-Enayetnagar	22	5	4	2	1	3	8	0	0	22	4,778
DND-N'ganj 1	44	13	7	1	2	9	9	0	2	42	15,007
DND-N'ganj 2	49	13	8	1	2	16	9	0	0	49	15,716
DND-N'ganj 3	156	51	32	9	13	6	43	0	2	154	59,635
DND TOTAL	5,679	1,189	1,038	236	172	482	1,153	532	877	4,270	1,313,749

TABLE A.4 POPULATION GROWTH AND URBANIZATION, 1990-2010 : DND  
 TABLE A.5 DETAIL LAND USE TABLE, 1990 : DND  
 TABLE A.6 DETAIL LAND USE TABLE, 2010 : DND

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF  
 BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

Table A.7: POPULATION GROWTH AND URBANIZATION, 1990-2010: NARAYANGANJ WEST

YEAR	1990	2000	2010
POPULATION (person)	470,449	696,123	926,820
BUILT UP AREA (sq.km)	13.12	17.20	17.20
URBAN DENSITY (p/ha)	359	405	539
URBAN RATIO	70%	92%	92%

Table A.8: DETAIL LAND USE TABLE, 1990: NARAYANGANJ WEST

POPLAND INFORMATION OF N'GANJ WEST DRAINAGE ZONE(ha) 1990											
ZONE NAME	TOTAL	DETAILED LAND USE(ha)			Com'cial	Industry	Ins'tion	Agr'ture	Water	BUILT UP	POPTION
	AREA	Residential								AREA(ha)	(persons)
	(ha)	(high)	(mid)	(low)						1990	1990
NW-Matuail	136	0	52	63	1	0	1	17	1	118	38,687
NW-Siddirganj	183	2	10	28	0	8	0	132	2	49	14,556
NW-Simulpara	411	25	57	17	16	108	44	75	70	266	63,869
NW-Godnail	164	0	0	61	2	5	0	95	1	68	7,686
NW-Enayetnagar	33	0	4	14	0	11	3	0	0	32	5,865
Kashipur	140	11	11	88	0	0	0	27	3	110	41,173
NW-N'ganj 1	85	5	22	27	0	11	3	10	7	68	24,140
NW-N'ganj 2	86	0	7	67	1	11	0	0	0	86	19,810
NW-N'ganj 3	78	0	14	42	0	0	2	20	0	58	17,518
N'ganj 4	184	31	43	49	3	22	10	26	1	157	71,058
N'ganj 5	100	28	28	14	12	1	4	14	0	86	52,632
N'ganj 6	55	43	2	0	1	0	0	8	0	47	62,977
N'ganj 7	124	5	19	70	0	0	0	28	2	94	32,318
N'ganj 8	85	11	7	6	50	0	0	12	0	73	18,161
<b>N'GANJ WEST TOTAL</b>	<b>1,863</b>	<b>160</b>	<b>275</b>	<b>546</b>	<b>86</b>	<b>178</b>	<b>67</b>	<b>464</b>	<b>87</b>	<b>1,312</b>	<b>470,449</b>

Table A.9: DETAIL LAND USE TABLE, 2010: NARAYANGANJ WEST

POPLAND INFORMATION OF N'GANJ WEST DRAINAGE ZONE(ha) 2010											
ZONE NAME	TOTAL	DETAILED LAND USE(ha)			Com'cial	Industry	Ins'tion	Agr'ture	Water	BUILT UP	POPTION
	AREA	Residential								AREA(ha)	(persons)
	(ha)	(high)	(mid)	(low)						2010	2010
NW-Matuail	136	34	27	7	5	5	45	6	7	123	48,440
NW-Siddirganj	183	39	35	13	18	24	52	1	5	177	47,874
NW-Simulpara	411	103	30	15	24	143	85	0	11	400	130,942
NW-Godnail	164	44	20	16	4	22	54	1	2	161	53,431
NW-Enayetnagar	33	2	0	0	0	1	2	0	28	5	5,865
Kashipur	140	35	27	5	8	3	11	1	48	91	41,173
NW-N'ganj 1	85	33	2	0	4	19	25	0	1	83	59,959
NW-N'ganj 2	86	33	2	0	4	29	17	0	1	85	63,455
NW-N'ganj 3	78	33	6	2	7	4	24	0	1	76	56,962
N'ganj 4	184	59	3	0	24	36	57	0	6	178	135,802
N'ganj 5	100	46	11	0	24	2	14	0	4	96	76,221
N'ganj 6	55	34	9	2	2	0	4	0	4	51	62,977
N'ganj 7	124	55	10	3	9	5	28	0	15	110	93,246
N'ganj 8	85	26	3	0	45	0	8	0	3	82	50,475
<b>N'GANJ WEST TOTAL</b>	<b>1,863</b>	<b>578</b>	<b>186</b>	<b>64</b>	<b>173</b>	<b>292</b>	<b>427</b>	<b>8</b>	<b>135</b>	<b>1,720</b>	<b>926,820</b>

TABLE A.7 POPULATION GROWTH AND URBANIZATION, 1990-2010 : NARAYANGANJ WEST  
 TABLE A.8 DETAIL LAND USE TABLE, 1990 : NARAYANGANJ WEST  
 TABLE A.9 DETAIL LAND USE TABLE, 2010 : NARAYANGANJ WEST  
 GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF  
 BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

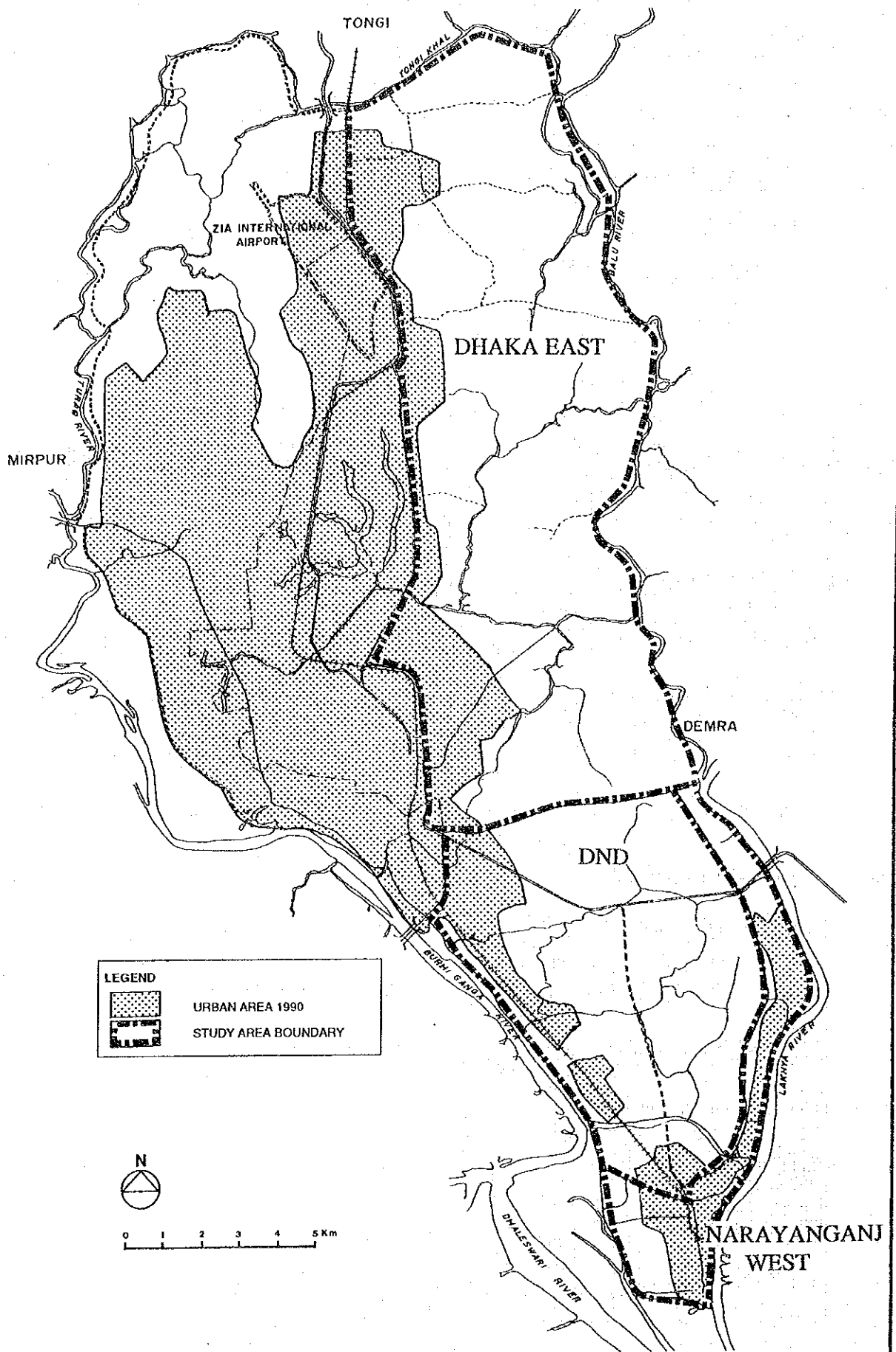


FIG. A.1

LOCATION OF FEASIBILITY STUDY AREA

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

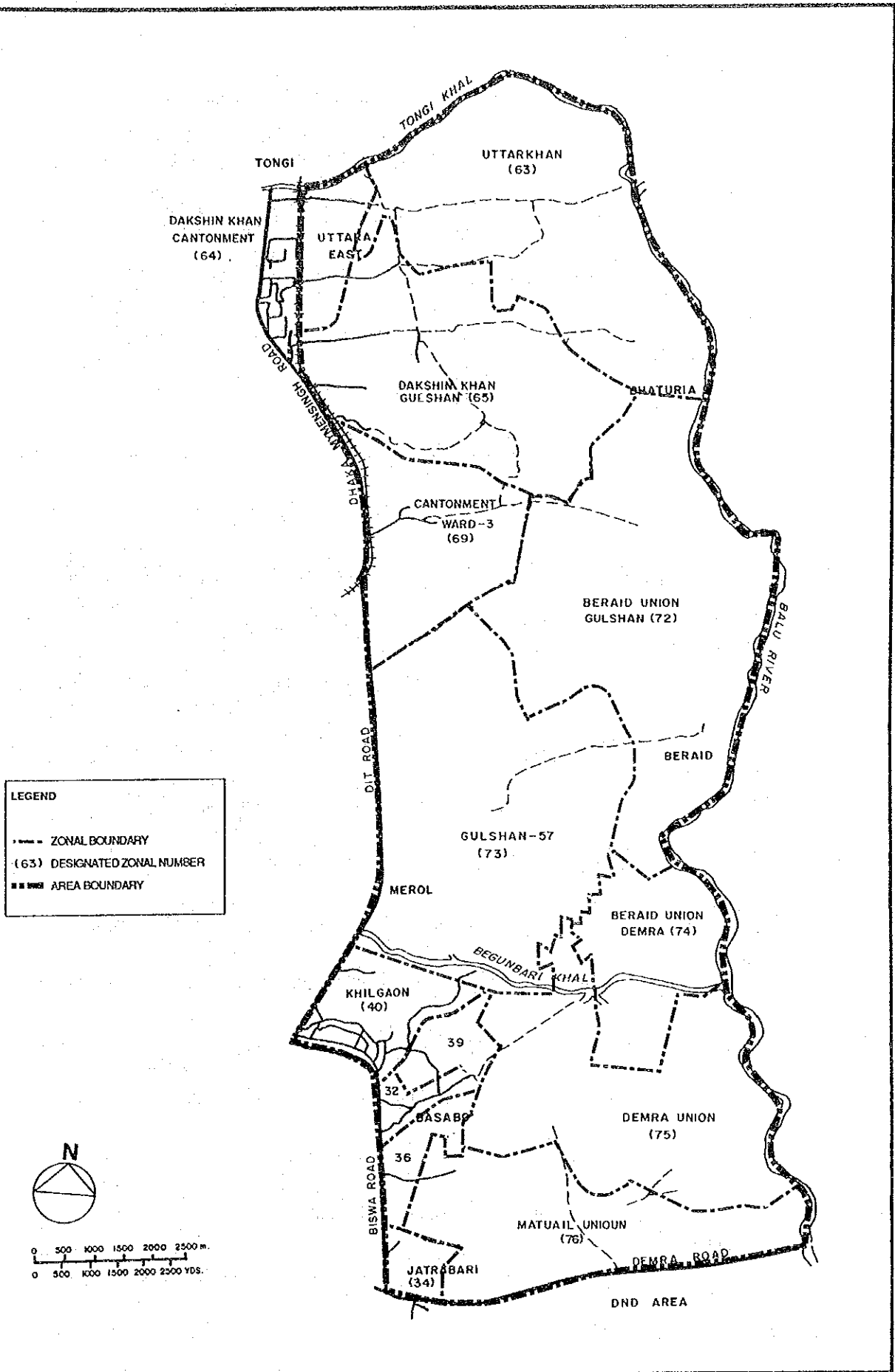
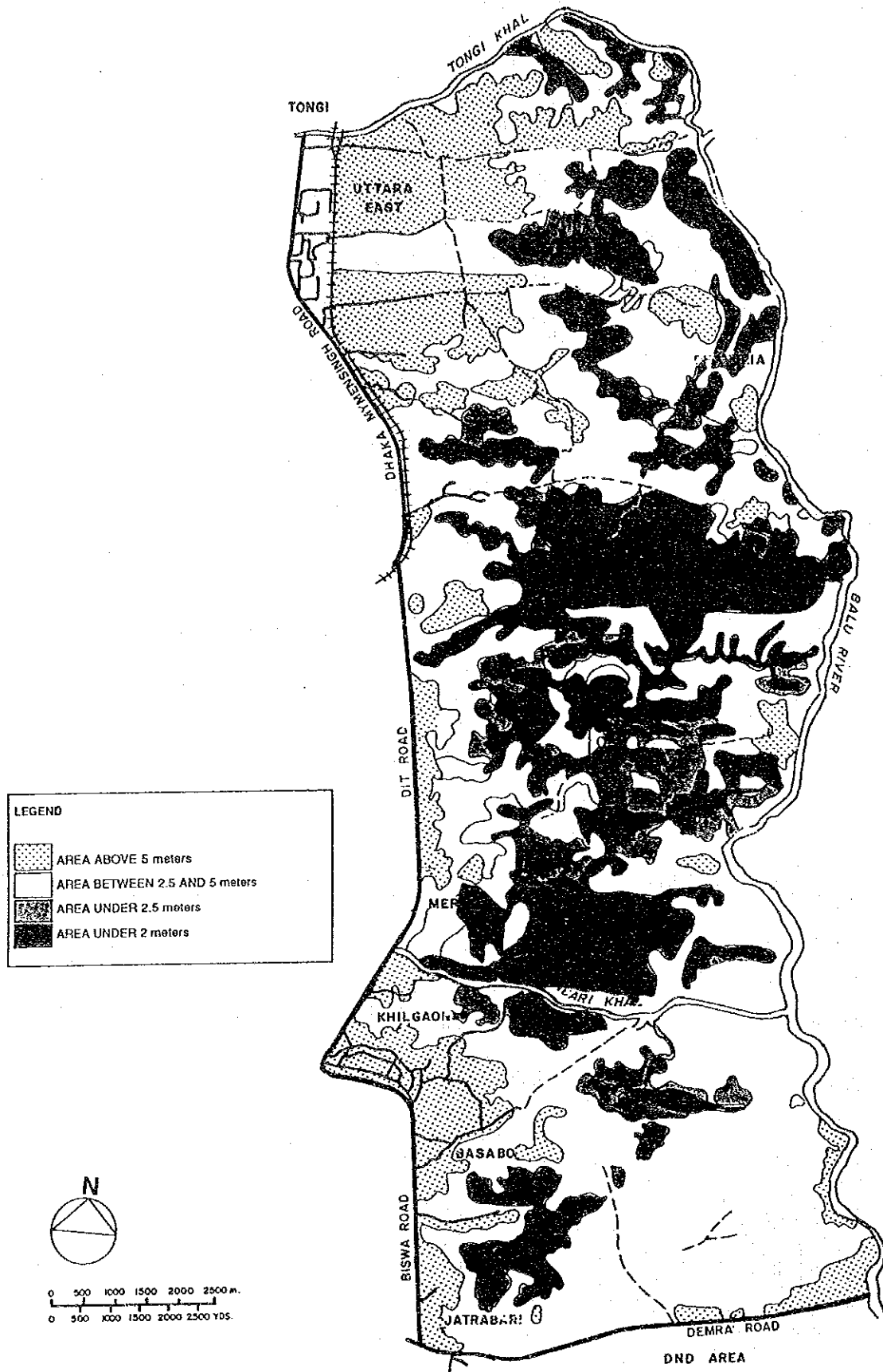


FIG. A.2

BASE MAP : DHAKA EAST

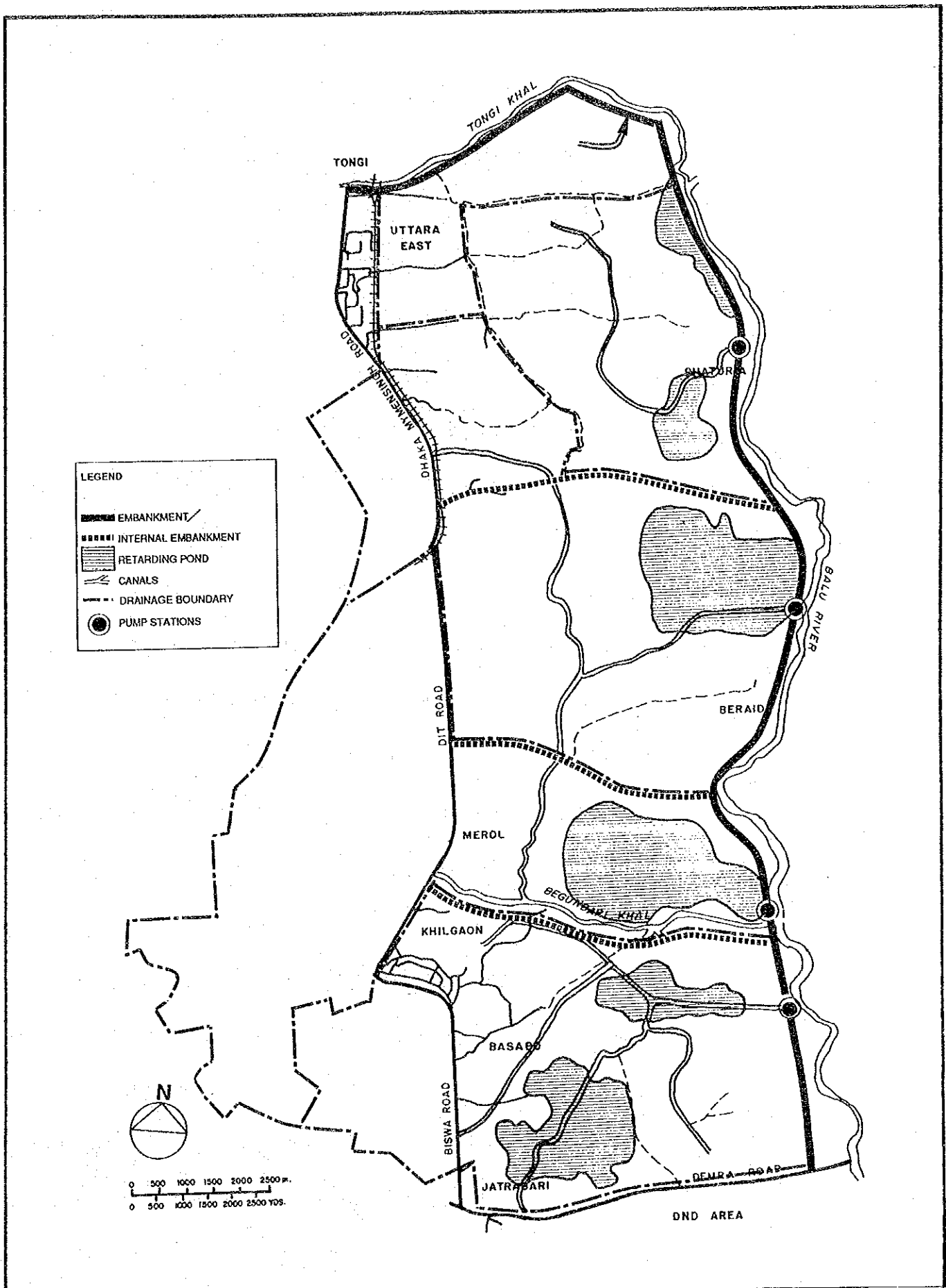
GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



**FIG. A.3**

**EXISTING LAND HEIGHT : DHAKA EAST**

**GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH**



**FIG. A.4**

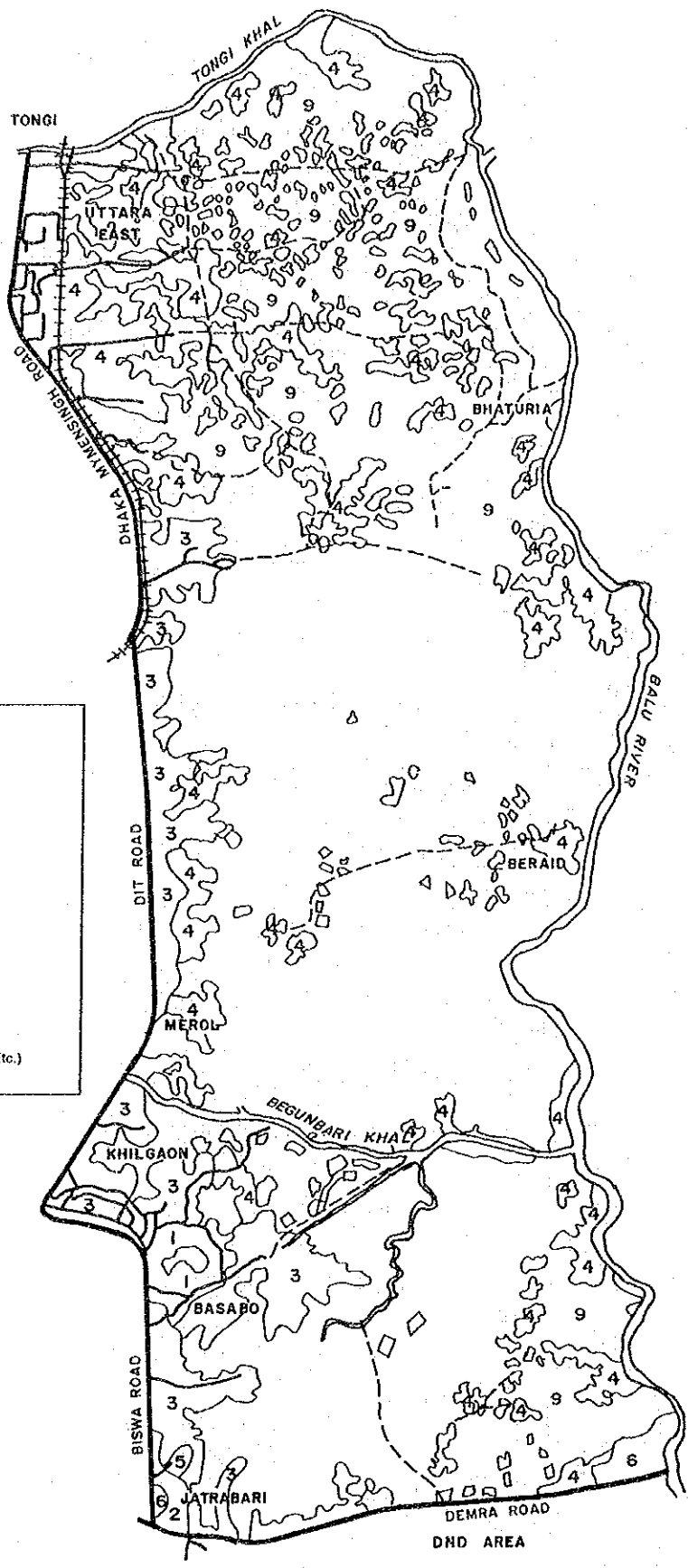
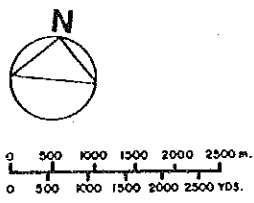
**FLOOD PROTECTION PROPOSAL : DHAKA EAST**

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



**LEGEND**

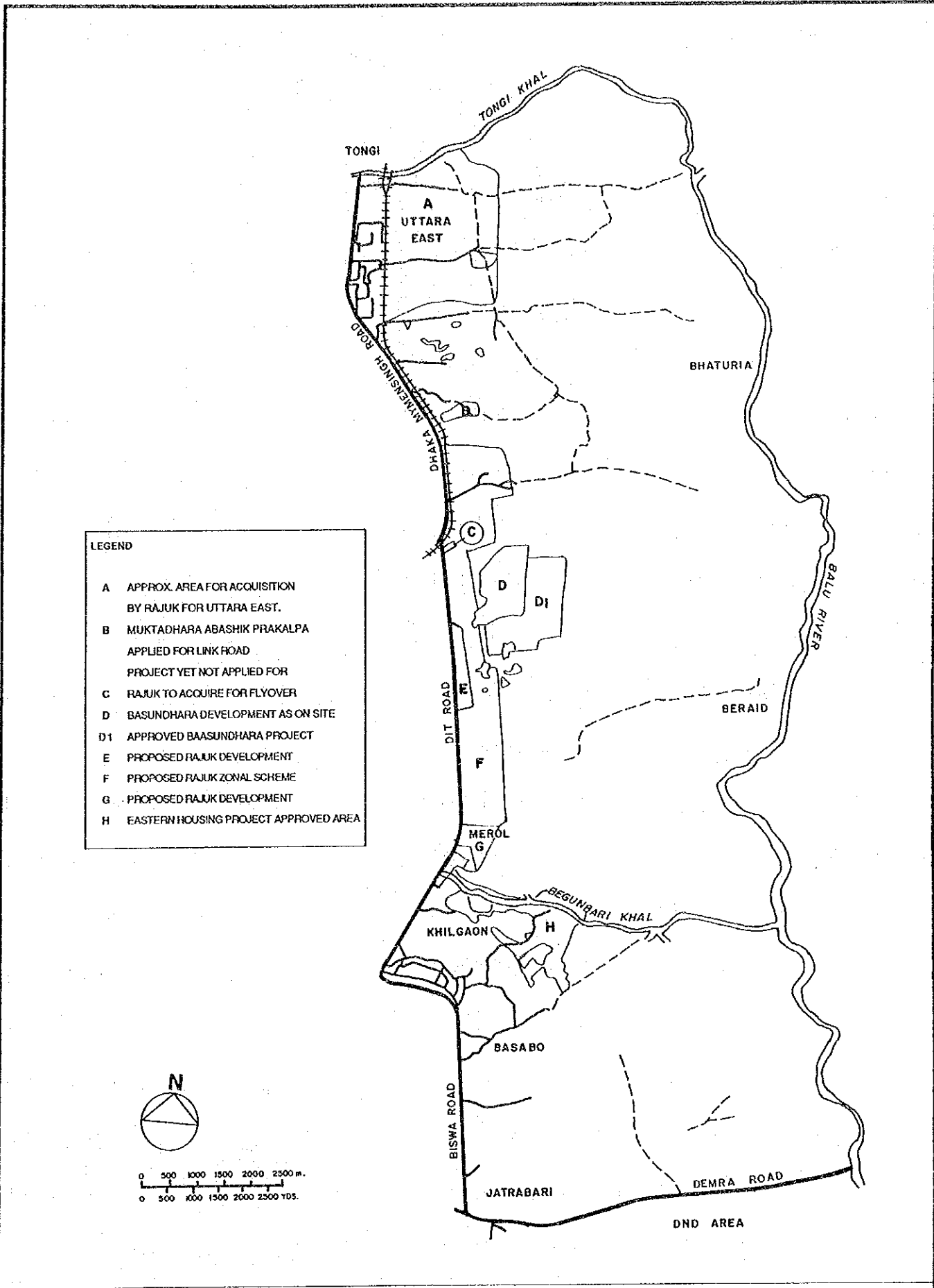
1	HIGH DENSITY RESIDENTIAL
2	MID HIGH DENSITY RESIDENTIAL
3	MID DENSITY RESIDENTIAL
4	LOW DENSITY RESIDENTIAL
5	COMMERCIAL
6	INDUSTRIAL
7	INSTITUTIONAL
8	OPEN SPACE/PARKS
9	AGRICULTURE
10	WATER BODY
11	OTHERS (Graveyards, Brickfields Etc.)



**FIG. A.5**

**EXISTING LAND USE : DHAKA EAST**

**GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH**



**FIG. A.6**

**DEVELOPMENT COMMITMENTS : DHAKA EAST**

**GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH**

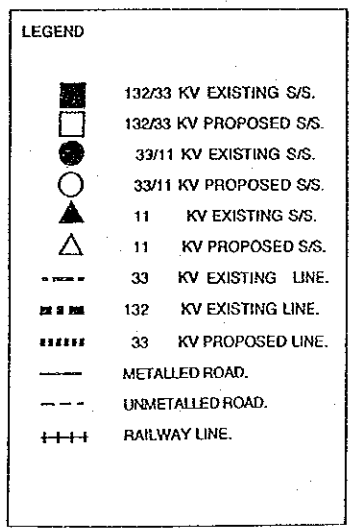
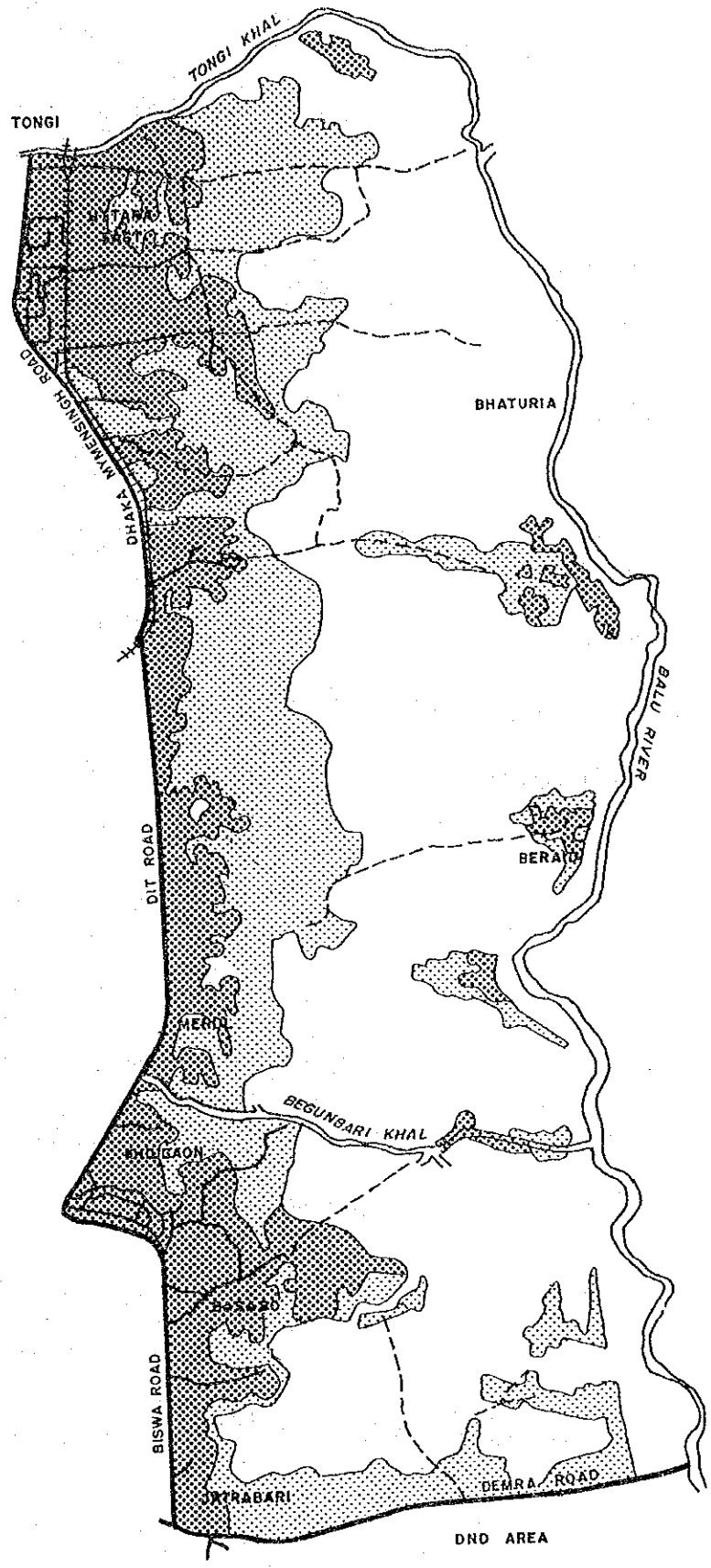
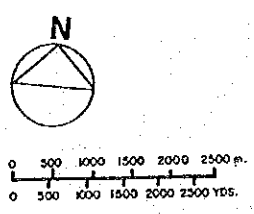
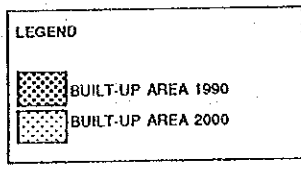


FIG. A.7

INFRASTRUCTURE : DHAKA EAST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



















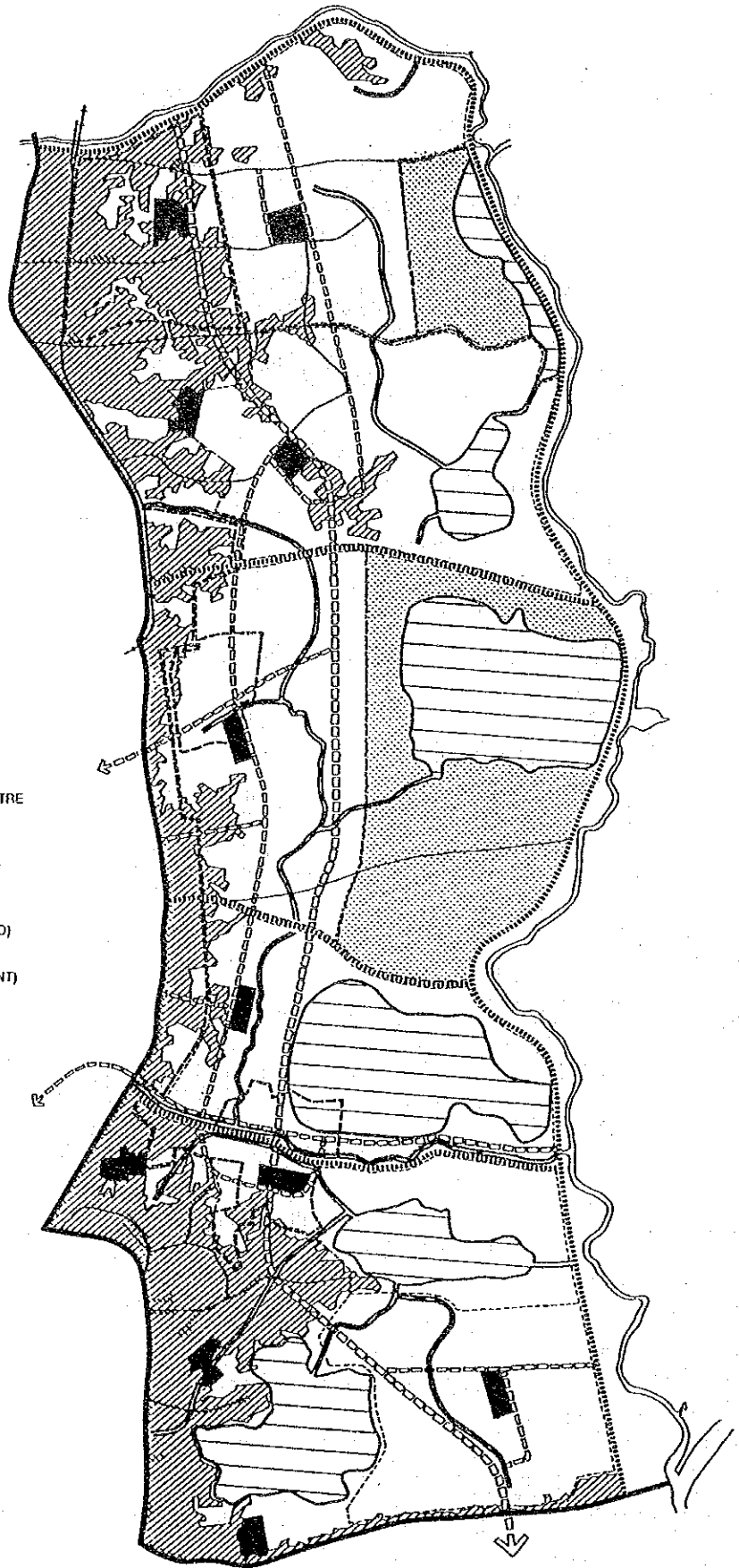
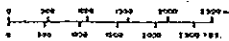
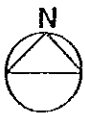


**FIG. A.8** BUILT-UP AREA 1990/2000 : DHAKA EAST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

**LEGEND;**

-  EXISTING BUILT-UP AREA
-  EXISTING COMMERCIAL AREA
-  EXISTING INDUSTRIAL AREA
-  DEVELOPMENT COMMITMENTS
-  FUTURE BUILT-UP AREA(1990-2010)
-  PROBABLE LOCATION OF DISTRICT CENTRE (serving a population of approx. 200,000)
-  PROPOSED SITE FOR RETARDING POND
-  PROPOSED MAJOR DRAINAGE CHANNEL
-  PROPOSED EMBANKMENT(CUM ROAD)
-  RESERVED AREA FOR AGRICULTURE
-  MAJOR ROAD(EXISTING/TO BE IMPROVED)
-  MAJOR ROAD(UNDER CONSTRUCTION)
-  NEW MAJOR ROAD(PROBABLE ALIGNMENT)
-  MINOR ROAD
-  RAILWAY
-  RIVER



**FIG. A.9**

**INDICATIVE LAND USE MAP OF GREATER DHAKA EAST, 2010**

**GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH**

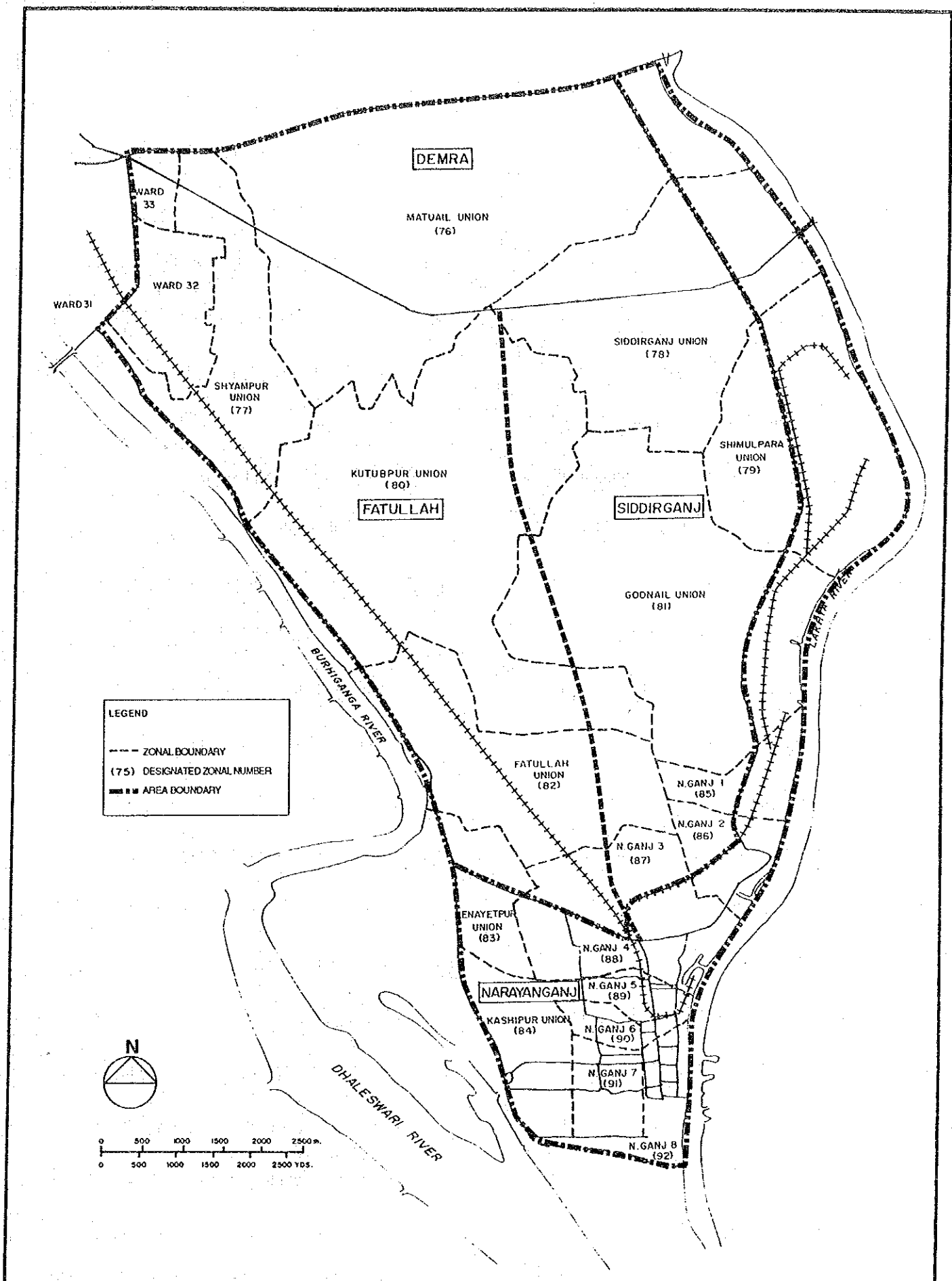


FIG. A.10

BASE MAP : DND/NARAYANGANJ WEST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

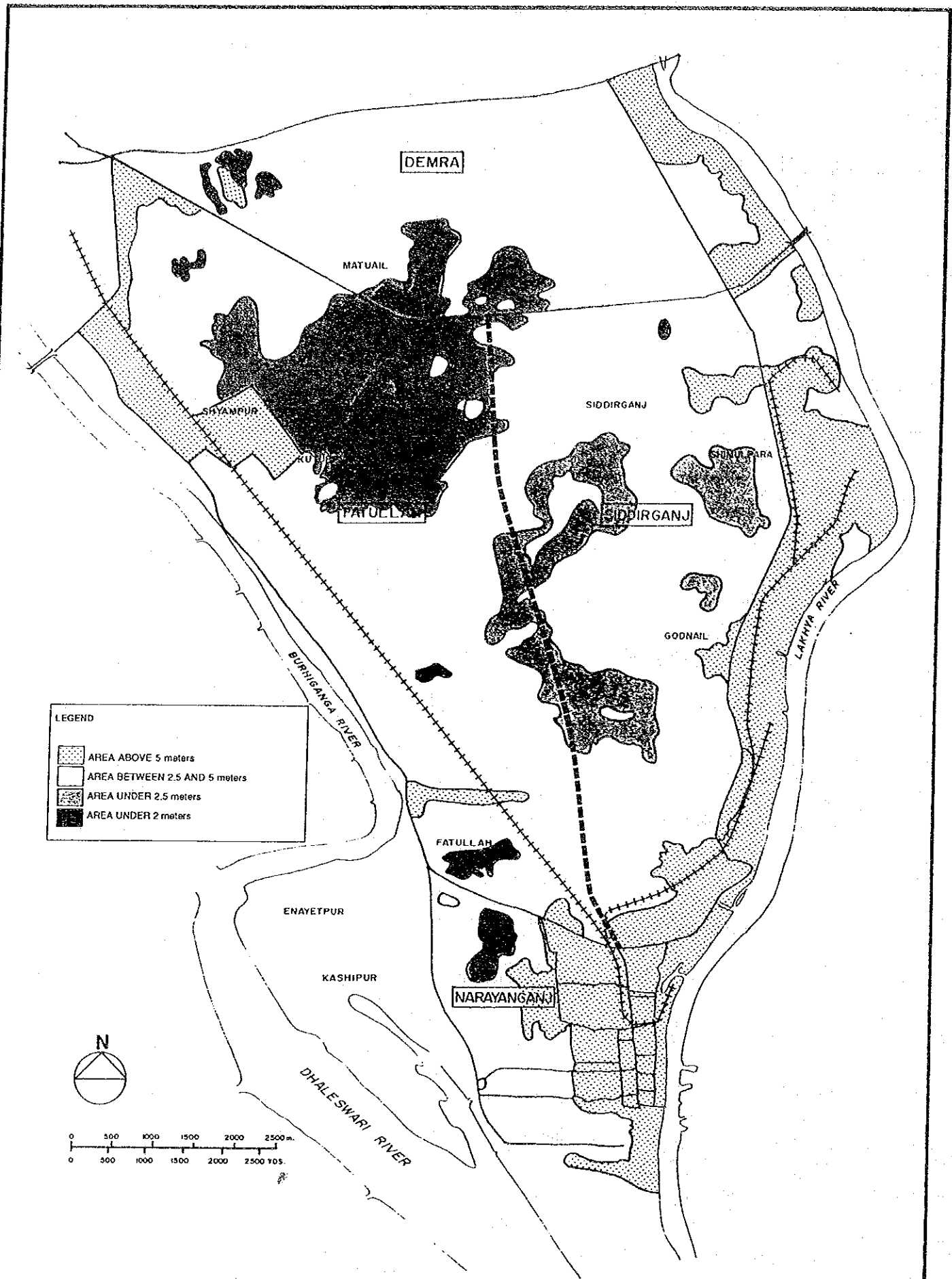


FIG. A.11

EXISTING LAND HEIGHT : DND/NARAYANGANJ WEST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH

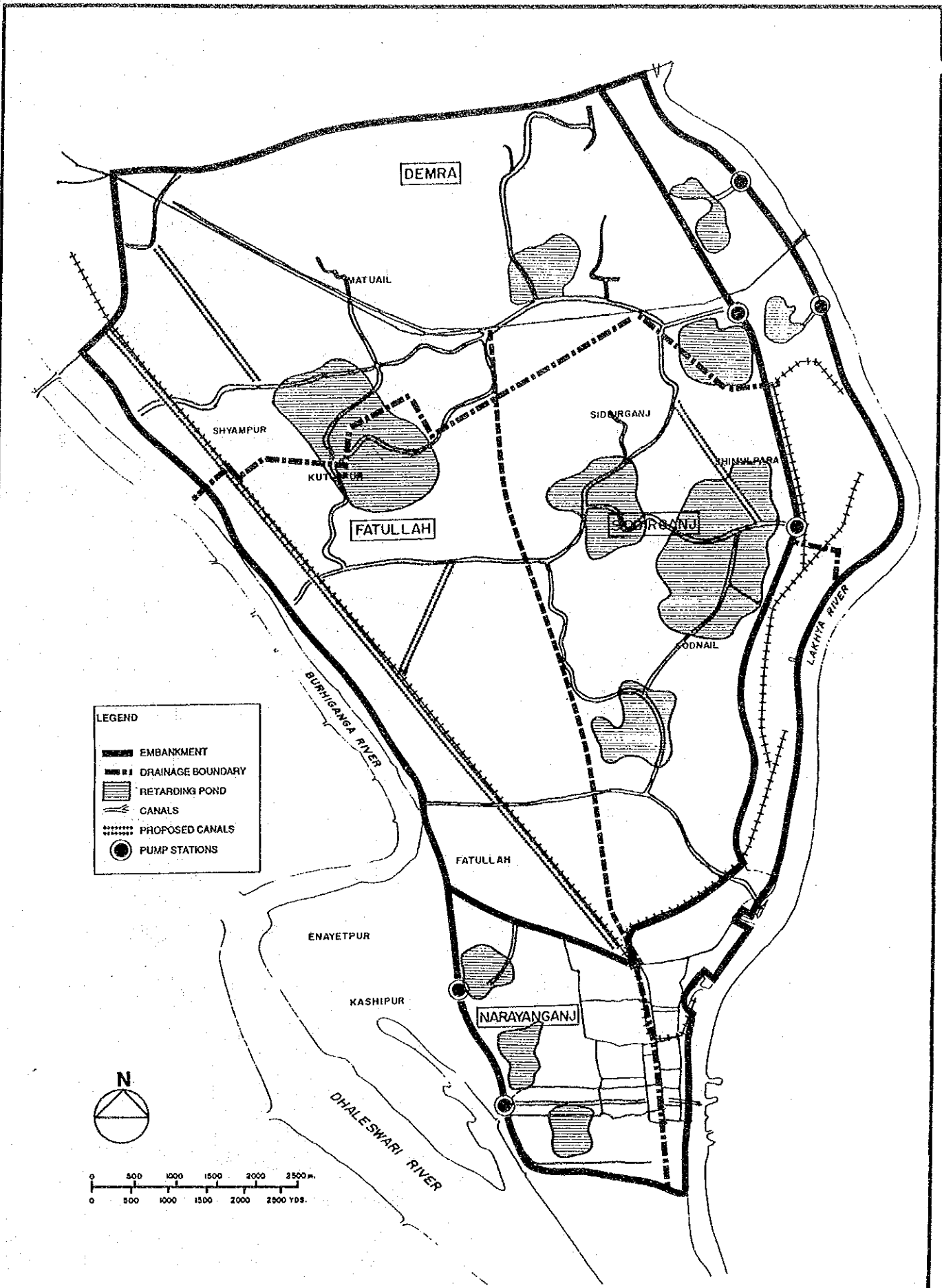


FIG. A.12

FLOOD PROTECTION PROPOSAL : DND/NARAYANGANJ WEST

GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROLOLITAN AREA) OF BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH