

Moreover, if the four Greater Dhaka East projects are combined together and treated as one entity (the Greater Dhaka East Project), which is reasonable because of their geographical, economic and social connections and interrelations, then the project has the EIRR of 15.8, NPV of Tk. 1,501 million, B/C of 1.31 and NPVR (2) of 0.228.

These values are the highest among the three projects. Viewed in this way, the implementation of the DC-2 Project is justified.

### 3.2 Sensitivity Analysis

Sensitivity analysis was conducted to see whether the projects can maintain their viability and robustness, when placed under unfavorable circumstances during and after implementation.

In conducting sensitivity analysis, the "Guidelines" was referred to.

In Case A the 15% increase of capital costs compared with the base case was assumed. In Case B the 100% increase of O&M costs was assumed. In Cases C and D the 15% reduction of benefits and one and a half year delays in achieving benefits were respectively assumed.

The sensitivity analysis on the reduction of incremented net value of agricultural and fisheries production was not done because this is essentially not an agricultural development project and the sensitivity to such a variable is minimal.

In Case E the switching values of capital cost increase were estimated. Likewise, in Case F the switching values of benefit reduction were estimated.

The results of sensitivity analysis are shown below. The decision criterion employed is EIRR.

Case	Greater Dhaka East					Narayanganj	
	DC-1	DC-2	DC-3	DC-4	Combined	DND	West
Base Case	14.8	8.0	13.9	18.9	15.8	14.5	14.3
Case A	12.9	6.6	12.5	16.6	13.9	12.8	12.4
Case B	14.2	6.7	13.4	18.2	15.1	13.9	13.6
Case C	12.5	6.1	12.2	16.1	13.5	12.4	12.1
Case D	12.7	6.9	12.5	16.2	13.7	12.6	12.4
Case E	22.7	-28.0	20.0	58.6	33.5	22.1	18.7
Case F	17.7	-35.0	15.9	35.4	22.8	17.4	15.1

As the table shows, in all the cases of A, B, C and D all the five above - OCC projects maintain their viability.

When the four Greater Dhaka East projects are combined together and treated as one entity, then this project stay viable in all the cases of A, B, C and D.

In Case E the switching value of the DC-4 Project is calculated at 58.6%, that is to say, it may still stay viable, supposing the capital cost overrun reaches 58.6%. Likewise, the switching values of the DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects are calculated at 22.7%, 22.1%, 20.0% and 18.7%, respectively.

In Case F the switching value of the DC-4 Project works out at 35.4%, that is, it may still remain viable, supposing the benefits turn out to be less by 35.4%. Similarly, the switching values of the DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects work out at 17.7%, 17.4%, 15.9% and 15.1%, respectively.

The switching value of the combined Greater Dhaka East Project is 33.5% in Case E and 22.8% in Case F.

It follows from the above that the five above-OCC projects will all stay robust under any conceivable adverse circumstances. Also, the combined Greater Dhaka East Project will maintain its viability under any conceivable unfavorable conditions.

As regard the DC-2 Project, the 28% reduction of costs or the 35% addition of benefits will be necessary if it is to be feasible. It was found out also as a result of simulation that the implementation of the project should be started in 2015 (10 year postponement) if we are to make it feasible.

#### 4. Socio-Economic Impact Assessment

As negative social impacts of the project, one can cite people to be displaced from locations they have inhabited by the construction of flood protection facilities, people earning a livelihood by inland water fisheries and transportation to be affected by the depletion of flood water and farmers whose agricultural land will be acquired by the government for the sake of the project or be purchased by developers, thus their traditional form of earning being threatened.

On the other hand, as positive social impacts, one can quote the vast population and area to be saved from inundation, creation of employment and jobs during and after project implementation, reduction of water-borne diseases which are apt to break out especially accompanying a big and protracted flood, the removal of psychological burden people are habitually forced to bear and its beneficial effects on their attitude to life, and elevation of the use of flood protected land, thus accelerating its urbanization.

#### 4.1 Negative Impacts

##### 1) Displacement of People

It is estimated that the number of people to be displaced by the construction of embankments and khal improvement will reach 7,053. It is broken down to 1,337 for DC-1, 734 for DC-2, 433 for DC-3, 1,127 for DC-4, 1,783 for Narayanganj DND and 1,639 for Narayanganj West. Also, compensation for building demolition accompanying displacement is estimated to amount to Tk. 328.1 million. It is broken down to 34.4, 21.7, 13.6, 31.2, 61.7 and 165.5 in millions of Taka for the areas in the above order, respectively. (For detailed information on compensation refer to Table I.4).

The JICA Study Team conducted the sampling questionnaire survey to grasp socio-economic aspects of the people to be displaced. The survey was done in December, 1991 towards people to be affected by the construction of the embankments along the Balu River. The number of samples was 61 houses. (Refer to Table I.5).

The profile of the sampled subjects is that the average number of household members is 8.3; 62.3% are engaged in agriculture more or less, 11.5% in boating and 4.9% in fisheries; average monthly income is Tk. 6,266; 72.1% got either primary schooling or no schooling whatsoever.

As the results of the survey it was revealed that the average price of a house on demand basis is Tk. 210 thousand, the average area of land possessed by a house is .776 ha and the average price of land possessed by a house is Tk. 1,202 thousand.

It was also revealed that 70.5% of the respondents agree to be displaced and remove to other locations. The average compensation demanded per house is Tk. 882 thousand for land, Tk. 245 thousand for the house building, Tk. 39 thousand for removing and Tk. 39 thousand for life support and training, totaling Tk. 1,205 thousand. Concerning mental attitude toward displacement, 34.4% replied that resettlement was a good chance

to start a new life with compensation, topping other replies. Secondly placed was "If I get sufficient compensation, I agree to displacement." with 27.9%. But, the third with 21.3% was a negative reply saying that "It is difficult to change my occupation as a farmer". The attitude of resignation was expressed by 9.8% voicing "I cannot resist government order". There was none who appealed to difficulty in changing the present occupation as a fisherman/boatman.

As an overall assessment it can be said that the people concerned have on the whole positive mental attitudes towards resettlement, that proper amount of compensation is the central and crucial issue, and that proper job retraining/ reorientation is a "must". According to the surveys conducted on the people already displaced in such circumstances, the living standard of most of them deteriorated after the displacement. Systematic, detailed and long-term approach to this problem is, therefore, the most important and essential.

## 2) Adverse Effects on Boating and Fishing People

There are many people who are earning their livelihood by inland water fishing and boating in the Greater Dhaka East area. When embankments are constructed along the Balu River and other protective measures are taken, the vast areas which are now under water in the rainy season will be saved from inundation. Then, those people who are making their living by transportation and fisheries will be threatened to lose their trade.

The JICA Study Team carried out the interview survey towards boating people to know the extent and scale of this age-old, traditional occupation and the effects of the embankment on them.

The eleven (11) centers that are bazars, haats (weekly markets) or transshipment points were selected for the survey as shown under :

Tongi, Rampura Ghat, Madartek, Khilkhet, Shahjadpur, Mainertek, Kaskura, Kaetpara, Patira, Bora Beraid and Meradia.

The locations of the above terminals are shown in Fig. I.1. It was revealed as a result of the survey that the Greater Dhaka East area could be divided into three navigational zones as described below.

(1) Tongi and Balu River Zone

This area incorporates six (6) terminals, namely Tongi, Mainertek, Kaskura, Patira, Bora Beraid and Kaetpara. Navigational activities in this area will be little affected by the construction of the embankment.

(2) Begunbari and Madartek Zone

This area covers three (3) terminals of Rampura, Meradia and Madartek. This area will be most affected by the construction of embankment since it acts as a major transshipment point and both rural and urban produce are exchanged there. The Begunbari Khal along with the Naral River and the Naral Khal represents the only all season accessible waterway in the Greater Dhaka East area.

(3) Central Zone

This zone will be totally affected by the flood protection embankment. It includes Khilkhet and Shahjadpur. Once the embankment is put up, they will be completely isolated from the rest of the navigation network.

The total number of boats operating around the 11 terminals comes to 1,050. Since a boat is estimated to be owned/operated on average by 2.5 persons, the total number of people engaged in boating business works out at 2,625. The total sales earned by those boats and people are estimated at Tk. 53.3 million per year. (Refer to Table I.6).

The total number of people yearly transported by boats is calculated at 2.8 million. Also, the total value of the commodities transported by this navigational means would reach Tk. 573.7 million per annum. (Refer to Tables I.7 and I.8).

The total employment and household income in the Greater Dhaka East area in 1990 are estimated at 193,925 and Tk. 4,274.6 million, respectively. Therefore, the people and their earnings to be more or less affected by the construction of the embankment account for 1.4% and 1.2% of the total labor force and their earnings in the Greater Dhaka East area, respectively.

Actually, as mentioned above, only 5 terminals are directly affected by the embankment. The boating people and their earnings connected with those terminals are calculated at 573 and Tk. 18.1 million, respectively. They occupy 0.3% and 0.4% of the total labour force and their earnings in the Greater Dhaka East area, respectively.

It can be said from the above that the socio-economic impacts of the construction of the eastern embankment along the Balu River on the boating trade are not so much in comparative terms.

Moreover, although the boating business is an age-old, traditional occupation that has given employment to a substantial number of people and has benefited millions of customers, it is not an efficient service both for the suppliers and the customers compared with land transport. Although utmost care and measures should be taken so that the people to be directly affected can redirect their occupation or find a new locations for their trade, the transfer of the transport mode from inland water navigation to land transport is the demand of the modern times. Land transport is bound to be developed where boating was the sole transport means, which is more economic and more contributory to the socio-economic development of the Greater Dhaka East area in long terms.

It is said that over 756 households are involved with different intensity in fishing activities in the Study Area. More than 90% of them are occasional fishermen, the balance being constituted essentially by part-time fishermen. Full-time fishermen have proved to be scarce. Under these circumstances the impacts of the project on fishing people should not be exaggerated.

### 3) Loss of Farm Land and Occupation as Farmers

To make way for embankments many people living on the left bank of the Balu River will have to part with their farm land and be evacuated. Or, after the construction of the embankments farm land inside the embankments will be gradually bought up by the developers for residential and other uses. All this means that farmers will gradually lose their ancestral farm land and along with it they will lose their own traditional way of earning.

As Table C.1 shows, agricultural area in the Greater Dhaka East, Narayanganj DND and Narayanganj West was in 1990 8,814 ha, 3,173 ha and 464 ha, respectively. It is forecast that in 2010 agricultural area in the 3 project areas will be reduced to 1,310 ha, 532 ha and 8 ha in the above order, respectively.

The money they will get in return for their farm land will not necessarily make their new life easier. Rather past examples tend to depict the opposite picture. Farmers whose land is lost will usually fail to reorient their occupation to a higher plane, ending

up as squatters and so forth. Systematic, long-term approach and programs by the government are sought for to avoid or alleviate such a situation. One such approach is the provision of alternative farmlands, that remain unaffected in the surrounding flood plains of the priority area.

#### 4.2 Positive Impacts

##### 1) Population to be Saved from Inundation

In the "with" situation people living in the flood prone areas will be no longer affected by inundations.

It is estimated in the "without" situation that supposing the 1988-scale flood hit the Study Area in 2010, population to be affected would be 665,996 for DC-1, 261,856 for DC-2, 847,139 for DC-3, 1,218,397 for DC-4, 2,993,388 for Narayanganj DND and 981,873 for Narayanganj West, totaling 5,326,040. In the "with" situation the same number of people would be saved from inundation.

##### 2) Area to be Saved from Inundation

In the "with" case areas which are habitually or in time of big floods inundated will be free from such natural influences.

It is estimated in the "without" case that supposing the 1988-scale flood hit the Study area in 2010, built-up area to be affected would be 3,036 ha for DC-1, 1,146 ha for DC-2, 2,977 ha for DC-3, 2,635 ha for DC-4, 4,270 ha for Narayanganj DND and 1,720 ha for Narayanganj West, totaling 15,784 ha. In the "with" case the same area would be saved from inundation.

##### 3) Creation of Employment

The implementation of the project will accompany the recruitment of a great number of labour force.

The project will provide employment during construction works to 10,693 people for DC-1, 8,616 people for DC-2, 5,968 people for DC-3, 13,637 people for DC-4, 19,974 people for Narayanganj DND and 7,625 people for Narayanganj West, totaling 66,513 people on man-year basis.

After project implementation permanent jobs will be created for the operation and maintenance of equipment/facilities.

#### 4) Reduction of Water-Borne Diseases

Water-borne epidemics such as dysentery, diarrhoea, malaria, typhoid and cholera tend to break out following the visits of floods, especially, big and protracted ones. According to Statistical Yearbook of Bangladesh 1990, 144,521 more cases of dysentery, 8,930 more cases of diarrhoea and 25,533 more cases of malaria were recorded in 1988 compared with 1987 in the Region of Dhaka. Connection with the 1988 flood is suspected for this unusual happening.

The JICA Study Team conducted the field survey to know about the incidence of water-borne diseases as well as medical costs of those diseases in the Study Area.

According to the survey results the incidence of water-borne diseases in the Study Area abruptly went up in the two flood years of 1987 and 1988: in normal years the annual number of cases works out at 17,789 on average, while it was 31,955 and 41,607 in 1987 and 1988, respectively. It means that one witnessed 14,166 more cases in 1987 and 23,818 more cases in 1988. Such cases of water-borne diseases will increase with increasing population in future.

Medical costs of such diseases are calculated at Tk. 3,178 per case on average. It means the additional loss of Tk. 45.0 million and Tk. 75.7 million in 1987 and 1988 respectively to the economy of the Study Area. (Such a loss will increase with increasing population). These amounts correspond to 0.3% and 0.5% of the estimated GDP of the Study Area in 1987 and 1988, respectively.

Supposing the higher incidence of water-borne diseases in 1987 and 1988 was primarily due to floods, such economic losses as estimated above are likely to be avoided in the "with" situation.

#### 5) Removal of Psychological Burden

People of Bangladesh more or less suffer from psychological burden associated with the threats of floods. Once the flood protection and drainage project is realized in the Study Area, people there will be virtually freed from the inner load they are now forced to bear. It will surely affect their attitude toward life. They may get more positive and more active in their socio-economic activities.



6) Elevation of Land Use

After the project the existing low land mainly used for agriculture will be gradually developed and urbanized. It will be gradually converted into built-up areas. That is to say, houses, shops, factories and institutions will make their appearance, grow in number and finally get congested.

In the process more capital will be invested in the land for a higher use of it. It means that the value of the land will gradually go up, which will be reflected in a higher land price. This impact on the value of land can be enormous.

5. Environmental Impact Assessment

The project is aimed at protecting from flooding the existing and future urban area of Dhaka and Narayanganj. The population in the Study Area is projected to increase by 2.2 times from 3,068,927 in 1990 to 6,710,661 in 2010. It means a massive amount of wastewater, solid waste, etc. more than doubling the present level will be generated in future. (For more details refer to 3.3 of Supporting Report C). Unless proper vigilance and measures are taken most of the water courses crisscrossing the Study Area are going to be polluted as happened in so many other countries. In order that such things may not happen, regular monitoring of water quality in major water courses is recommended. (Refer to 4. of Supporting Report C).

Possible environmental impacts taken up and described hereunder except "possible change of river courses" and "possible breach of embankments" pertain to agriculture and related fields. As mentioned already, agricultural land in the Study Area is bound to be greatly reduced after the construction of embankments. Therefore, possible negative impacts on agriculture should be viewed against this background. In other words, such impacts should not be inordinately exaggerated.

Environmental factors to be considered for possible negative impacts on them by a flood protection and drainage project include quality of surface water, fauna and flora related to surface water, overall ecological balance, quality of soil, courses of rivers and possible breach of embankment.

1) Adverse Effect on Water Quality and Its Far-Reaching Implications

Water in canals and ponds will be depleted and its free intercourse with river water outside the embankment will be obstructed after the project. This may lead to the

stagnation of surface water. Besides, farmers will be encouraged to grow HYV more as there will be no floodings any more. But, HYV are more prone to pests and farmers will resort to more use of pesticide.

These things along with a more concentration of population are likely to pollute the water of canals and ponds and adversely affect fish and plant concerned. This can cause chain reactions in the overall ecological system in the Study Area.

## 2) Adverse Effects on Soil Quality

Annual floodings in the rainy season in the low land areas bring with them fertile soil made up of organic matters and crops in the dry season are benefited by them. This way of things has continued from the time immemorial. but, once the circumstances are created where there are no more such floodings crops may not grow as before unless farmers take remedial steps.

Farmers will be encouraged to grow HYV because there will be no floodings in the farm land any more. It will lead to a more use of chemical fertilizer as the growing of HYV and the use of fertilizer are inseparable. This situation may contribute to the deterioration of soil quality.

## 3) Possible Change of River Courses

Environmentalists argue about the possible change of river courses as a result of the empoldering of a certain area and its possible adverse effects on the natural and social environments concerned.

## 4) Possible Breach of Embankments

Should an embankment fail and the bulged water surge into the erstwhile protected area, the resultant damages to properties, human life and farm land would be enormous. This is a man-made disaster that is not allowed to happen.

## 6. Financial Analysis

### 6.1 General

The implementation of the flood protection and drainage project will save the vast Study Area from inundations by floods.

Those lands which are now flood plains will be no longer inundated and majority of them will be developed for urban uses. That is to say, they will be raised with additional soil and infrastructures such as roads, bridges, electric lines, telecommunication lines, water supply, gas and sewerage pipes will be constructed there so that they can be used for residential, commercial, industrial and institutional purposes. This land development will be basically public undertakings. The costs of land development will reach an enormous amount.

Those areas which are already built up will also be no longer inundated.

The total capital costs of the flood protection and drainage project are estimated at Tk. 26,987 million. In addition, to maintain and operate the flood protection and drainage facilities recurrent costs amounting to Tk. 177 million will be annually required.

Through flood protection, drainage and land development majority of lands in the Study Area will turn into urban areas. In parallel with it the value, that is, price of land will go up to a great extent.

It follows from the above that land owners in the Study Area will be a major beneficiary of the project. However, the degree of benefits they will get will be different between those who now own flood plains and those who own already built-up areas. Also, it will be different between those who own commercial areas with high population density and those who own residential areas with low population density.

The JICA Study Team proposes that the authorities impose Land Development Tax on landowners to recover O&M costs.

### 6.2 Land Development Tax

As Table I.9 shows, the built-up area in Greater Dhaka East is estimated to increase from 6,675 ha in 1990 by 98.4% to 13,245 ha in the target year of 2010. Likewise, the

built-up area in Narayanganj is estimated to increase from 3,487 ha in 1990 by 71.8% to 5,990 ha in 2010. In total, the built-up area in the Study Area will go up from 10,162 ha in 1990 by 89.3% to 19,235 ha in 2010.

It is assumed that Dhaka and Narayanganj have their own, separate jurisdictions for the collection of Land Development Tax rates. It implies that the tariff will be different between the two areas.

As mentioned above, the built-up area in Greater Dhaka East and Narayanganj is estimated in 2010 to reach 13,245 ha and 5,990 ha, respectively, while annual O&M costs of the project for the two areas in the same years are estimated at Tk. 128 million and Tk. 49 million, respectively. That is to say, to recover O&M costs annual rates of Tk. 9,664 and Tk. 8,180 per ha will be levied on landowners in Greater Dhaka East and Narayanganj, respectively. Supposing collection efficiency is 70%, their respective annual rates will be Tk. 13,806 and Tk. 11,686 per ha.

Using the local measure, Tk. 39 and Tk. 33 per decimal will be annually levied in Greater Dhaka East and Narayanganj, respectively. Supposing collection efficiency is 70%, their respective annual rates will be Tk. 56 and Tk. 47 per decimal.

Table I.10 shows the amount of Land Development Tax, O&M costs, cash flow and cumulative cash flow by year and by project area. As it presents, cumulative cash flow is mostly negative in DC-1 and DC-2, but mostly positive in DC-3 and DC-4, combinedly showing a certain positiveness in the long run. Also, cumulative cash flow is positive in Narayanganj DND, but negative in Narayanganj West, combinedly showing a certain positiveness.

As already mentioned, actually the tariff should be structured in such a way that rates will be different depending on various factors. For instance, they will be different between the land which is now agricultural and the land which is now already urban, and also between the highly built-up area and the built-up area with low population density. Rates will be determined partly in accordance with the level/intensity of infrastructural investments per unit area of land and partly in accordance with the convenience/utility of locations. They will all be reflected in the price of land.

If a uniform tariff is applied in both Greater Dhaka East and Narayanganj, average annual rates work out at Tk. 9,202 per ha or Tk. 37 per decimal. Supposing collection efficiency is 70%, the rates come to Tk. 13,146 per ha or Tk. 53 per decimal.

## 7. Conclusions

As already mentioned, the DC-4, DC-1, Narayanganj DND, Narayanganj West and DC-3 Projects with their respective EIRR's of 18.9%, 14.8%, 14.5%, 14.3% and 13.9% can be judged to be economically feasible .

Regarding this kind of project with a strong social nature, the EIRR's of over 7% have proved to be on the high side. In this light the DC-2 Project with the EIRR of 8.0% can also be judged to be feasible. Moreover, the 4 compartments of the Greater Dhaka East area are geographically, socially and economically interdependent and inseparable. In this meaning the EIRR of 15.8% for the 4 Dhaka projects combined justifies the implementation of the DC-2 Project.

Values of other decision criteria and results of sensitivity analysis support the above evaluation.

In terms of socio-economic impacts of the projects, supposing the 1988-scale flood hit the Study Area in 2010, 5,660,700 people or 84.4% of the total population and 15,784 ha or 82.1% of the total built-up area would be saved from inundation. The projects will provide employment opportunities reaching 66,513 man-years. (Refer to Table I.11).

They will surely reduce the breakout of water-borne diseases by tens of thousands of cases, saving the economic losses running into Tk. fifty to one hundred million. They will remove psychological burden and stresses from people's mind, nurturing positive attitude to life. Most importantly, the enormous and vast area of land will be set free from inundation, enabling it to be developed and used for human habitation and economic activity.

The resettlement and boating trade issues must be treated with the utmost care as the livelihood of people is involved. However, they are transitory in nature and an inescapable friction from the standpoint of overall economic development.

Regarding environmental issues, it is indispensable and essential to concentrate all the human efforts to prevent, stop and lessen the negative environmental impacts of the project. The prime targets are living environment improvement and water pollution control measures as illustrated in Supporting Report C.

8. Supplementary Study

8.1 Economic Analysis of Integrated Narayananj Project

Economic analysis was performed on the assumptions that the Narayananj DND Project and the Narayananj West Project are integrated into one entity. In this case the two projects will start simultaneously and also, the rehabilitation costs of flood walls in the Narayananj DND Project will become unnecessary.

Subsequently, the results of economic analysis was compared between this integrated case and the separated case.

1) Implementation Schedule

The implementation schedule of this case is as follows:

Item	1996	1997	1998	1999	2000	2001	2001
1. Narayananj DND							
A. Project Preparation	_____						
B. Storm Water Drainage		_____					
2. Narayananj West							
A. Project Preparation	_____						
B. Flood Mitigation		_____					
C. Storm Water Drainage			_____				

Item	2003	2004	2005	2006	2007	2008	2009
1. Narayananj DND							
A. Project Preparation						_____	
B. Storm Water Drainage							_____
2. Narayananj West							
A. Project Preparation							
B. Flood Mitigation							
C. Storm Water Drainage							

## 2) Results of Economic Analysis

### (1) Cost Benefit Streams

Based on the implementation schedule the cost benefit streams were prepared as shown in Table I.12.

### (2) Calculation of Decision Criteria

Based on the cost benefit streams economic analysis was performed. The results are shown and compared with the separated case below.

Case	EIRR (%)	NPV (Tk.Mln.)	B/C	NPVR(2)
Combined Case	14.0	473	1.16	0.109
Separated Case				
1. Narayanganj DND	14.5	371	1.21	0.151
2. Narayanganj West	14.3	152	1.18	0.110

It is apparent from the above that the separated case is better in economic viability than the combined case.

## 8.2 SCF Based Economic Analysis

Additional economic analysis including sensitivity analysis was performed, applying the standard conversion factor (SCF) of 0.87 to the benefits excluding those related to agriculture.

The SCF value of 0.87 is based on the final report of "Estimation of Economic Prices of Selected Commodities for Use in FAP Planning Studies" by Q. Shahabuddin and K. Mustahidur Rahman dated April 15, 1992.

Agricultural benefits have already been converted in economic terms in accordance with the "Guidelines".

1) Project Benefits

Annual, 1987 - scale and 1988 - scale external flood damages and annual and worst internal damages were recalculated for each of the 6 areas and for both 1990 and 2010 conforming the SCF as above. The results are shown in Table I.13.

Based on Table I.13 average annual flood damages were calculated as presented in Table I.14. The below table summarises Table I.14.

Project Benefits

Project	(Unit: Tk. Million)	
	1990	2010
DC-1	39.8	564.3
DC-2	25.1	154.4
DC-3	171.2	546.8
DC-4	260.2	688.4
Greater Dhaka East	496.3	1,953.9
Narayanganj DND	135.0	556.8
Narayanganj West	99.2	343.8
Total	730.5	2,854.5

2) Calculation of EIRR and Other Decision Criteria

Employing the project benefits in Table I.14, economic analysis was newly conducted. The results are tabulated below.

Project	EIRR (%)	NPV (Tk. Min.)	B/C	NPVR(2)
DC-1	12.8	74	1.06	0.044
DC-2	6.4	-134	0.65	-0.212
DC-3	12.5	55	1.04	0.031
DC-4	16.6	660	1.35	0.266
Greater Dhaka East	13.8	685	1.14	0.104
Narayanganj DND	12.7	96	1.05	0.039
Narayanganj West	12.4	21	1.02	0.015



As the above table shows, the DC-4 Project has the highest EIRR of 16.6%. The EIRR's of the DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects are almost the same, being 12.8%, 12.7%, 12.5% and 12.4%, respectively. All these five projects have the EIRR's exceeding the OCC of 12.0%

The EIRR of the DC-2 Project is 6.4%, which is low compared with OCC.

With regard to NPV, the DC-4 Project has the biggest value of Tk. 660 million. The second place goes to the Narayanganj DND Project with Tk. 96 million, followed by the DC-1, DC-3 and Narayanganj West Projects with Tk. 74 million, Tk. 55 million and Tk. 21 million, respectively. The DC-2 Project has the negative NPV of Tk. -134 million.

In terms of B/C, the DC-4 Project leads others with 1.35. The B/C's of the DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects are not much different, being 1.06, 1.05, 1.04 and 1.02, respectively. The B/C of the DC-2 Project is 0.65, which is less than one (1).

Turning to NPVR (2), the DC-4 Project has the highest value of 0.266. The DC-1, Narayanganj DND and DC-3 Projects have similar values of 0.044, 0.039 and 0.031, respectively. The Narayanganj West Project is placed fifth with 0.015. The DC-2 Project has the negative NPVR (2) of -0.212.

It is to be noted that regarding priority order the DC-4 Project is placed first in all the decision criteria. The DC-1 Project is placed second except in NPV where it is the third. The Narayanganj DND Project is placed third except in NPV where it is the second. The DC-3 Project is placed fourth. The Narayanganj West Project is placed fifth and the DC-2 Project is placed sixth.

As seen in the above, the five projects, namely the DC-4, DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects are judged to be economically feasible, while the DC-2 Project appears problematic so far as economic evaluation is concerned.

However, one thing to be noted and remembered is that in a project with a strongly social nature such as this one the EIRR of 7% has proved to be on a high side.

Furthermore, the DC-2 Project is an integral part of the Greater Dhaka East Project combining the four compartments, which has the EIRR of 13.8%, NPV of Tk. 685 million, B/C of 1.14 and NPVR (2) of 0.104. These values are the highest among the three projects. Because of these reasons the implementation of the DC-2 Project is justified.

### 3) Sensitivity Analysis

Sensitivity analysis was conducted to see whether the projects can maintain their viability, when placed under unfavorable circumstances during and after implementation. In conducting sensitivity analysis, GPA was referred to.

In case A the 15% increase of capital costs compared with the base case was assumed. In Case B the 100% increase of O&M costs was assumed. In Cases C and D the 15% reduction of benefits and one and a half year delays in achieving benefits were respectively assumed.

The sensitivity analysis on the reduction of incremented net value of agricultural and fisheries production was not done because this is not an agricultural development project and the sensitivity to such a variable is minimal.

In Case E the switching values of capital cost increase were estimated. Likewise, in Case F the switching values of benefit reduction were estimated.

The results of sensitivity analysis are shown below. The decision criteria employed is EIRR.

Case	Greater Dhaka East					Narayanganj	
	DC-1	DC-2	DC-3	DC-4	Combined	DND	West
Base Case	12.8	6.4	12.5	16.6	13.8	12.7	12.4
Case A	11.1	5.0	11.1	14.4	12.0	11.1	10.7
Case B	12.1	5.0	11.9	15.8	13.1	12.1	11.7
Case C	10.7	4.6	10.8	14.0	11.6	10.7	10.3
Case D	11.0	5.4	11.2	14.3	12.0	11.0	10.8
Case E	6.1	-38.5	4.2	37.5	15.7	5.7	2.6
Case F	5.5	-55.0	3.8	26.0	11.6	5.2	2.4

As the table shows, in Case A out of the five above-OCC projects only the DC-4 Project stays viable. In Case B the DC-4, DC-1 and Narayanganj DND Projects stay viable. In cases C and D only the DC-4 Project stays viable as in Case A.

When the four Greater Dhaka East projects are combined together and treated as one entity, then this project maintain its viability in case A, B and D.

In case E the switching value of the DC-4 Project is calculated at 37.5%, that is to say, it may stay viable, supposing the capital cost overrun reaches 37.5%. Likewise, the switching values of the DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects are calculated at 6.1%, 5.7%, 4.2% and 2.6%, respectively.

In Case F the switching value of the DC-4 Project works out at 26.0%, that is to say, it may remain viable, supposing the benefits turn out to be less by 26%. Similarly, the switching values of the DC-1, Narayanganj DND, DC-3 and Narayanganj West Projects work out at 5.5%, 5.2%, 3.8% and 2.4%.

The switching value of the combined Greater Dhaka East Project is 15.7% in Case E and 11.6% in Case F.

It follows from the above that the DC-4 Project will keep its robustness under any conceivable adverse circumstances, that the other four above-OCC projects will be vulnerable to unfavorable circumstances in one way or another and also that the combined Greater Dhaka East Project will virtually stay viable under any adverse circumstances.

As regard the DC-2 Project, the 38.5% reduction of costs or the 55% addition of benefits will be required if it is to be feasible.

It might be added that the EIRR's of all the five above-OCC projects stay above the 10% line in all the cases of A, B, C and D.

Table I.1 Average Annual Flood Damages by Area by Year

(Unit : Tk. Million)

Area	Average Annual Flood Damages		
	External Flood	Internal Flood	Total
1. 1990			
Dhaka East - 1	40.7	2.5	43.2
Dhaka East - 2	25.4	1.0	26.4
Dhaka East - 3	121.0	74.1	195.1
Dhaka East - 4	195.5	97.5	293.0
Dhaka East (Sub-Total)	382.6	175.1	557.7
Narayanganj DND	116.0	37.4	153.4
Narayanganj West	88.5	24.9	113.4
Total	587.1	237.4	824.5
2. 2010			
Dhaka East - 1	634.5	13.9	648.4
Dhaka East - 2	169.3	7.4	176.7
Dhaka East - 3	480.4	148.1	628.5
Dhaka East - 4	631.9	159.4	791.3
Dhaka East (Sub-Total)	1,916.1	328.8	2,244.9
Narayanganj DND	483.8	156.1	639.9
Narayanganj West	318.8	76.5	395.3
Total	2,718.7	561.4	3,280.1

Source : JICA

Table I.2 (1) Economic Costs by Project

## 1. Capital Cost

(Unit : Tk. Million)

Item	Greater Dhaka East					Narayanganj		Total
	DC-1	DC-2	DC-3	DC-4	Sub-Total	DND	West	
<b>A. Project Preparation</b>								
1) Administration	85	59	57	67	268	66	51	385
2) Engineering	326	226	220	258	1,030	250	194	1,474
3) Compensation	34	22	14	31	101	62	166	329
<b>Sub-Total</b>	<b>445</b>	<b>307</b>	<b>291</b>	<b>356</b>	<b>1,399</b>	<b>378</b>	<b>411</b>	<b>2,188</b>
<b>B. Flood Mitigation</b>								
1) Embankment	2,101	813	835	910	4,659	0	616	5,275
2) Flood Wall	19	20	14	25	78	43	180	301
3) Sluice Gate	160	89	78	79	406	60	157	623
4) Related Struc.etc.	0	0	0	0	0	3	1	4
<b>Sub-Total</b>	<b>2,280</b>	<b>922</b>	<b>927</b>	<b>1,014</b>	<b>5,143</b>	<b>106</b>	<b>954</b>	<b>6,203</b>
<b>C. Storm Water Drainage</b>								
1) Pump Station	1,156	553	1,077	1,066	3,852	1,296	510	5,658
2) Khal Improvement	246	183	150	426	1,005	932	386	2,323
3) Bridge etc.	14	0	0	8	22	101	16	139
<b>Sub-Total</b>	<b>1,416</b>	<b>736</b>	<b>1,227</b>	<b>1,500</b>	<b>4,879</b>	<b>2,329</b>	<b>912</b>	<b>8,120</b>
<b>D. Physical Contingency</b>	<b>425</b>	<b>294</b>	<b>285</b>	<b>337</b>	<b>1,341</b>	<b>326</b>	<b>253</b>	<b>1,920</b>
<b>E. Replacement</b>	<b>389</b>	<b>732</b>	<b>727</b>	<b>713</b>	<b>2,561</b>	<b>949</b>	<b>328</b>	<b>3,838</b>
<b>Total</b>	<b>4,955</b>	<b>2,991</b>	<b>3,457</b>	<b>3,920</b>	<b>15,323</b>	<b>4,088</b>	<b>2,858</b>	<b>22,269</b>

Table I.2 (2) Economic Costs by Project

2. Annual Net Benefits of Production Foregone

(Unit : Tk. Million)

Item	Greater Dhaka East					Narayanganj		Total
	DC-1	DC-2	DC-3	DC-4	Sub-Total	DND	West	
Land Acquisition (ha)	197.9	96.2	83.1	146.3	523.5	107.1	121.2	751.8
Annual Net Benefits of Production Foregone	2.28	1.11	0.96	1.68	6.02	1.23	1.39	8.65

3. Annual Operating and Maintenance Cost

(Unit : Tk. Million)

Item	Greater Dhaka East					Narayanganj		Total
	DC-1	DC-2	DC-3	DC-4	Sub-Total	DND	West	
O & M Cost	37	30	29	32	128	28	21	177

Source : JICA

Table I.3(1) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

1. Greater Dhaka East - 1 Project

(Unit:Tk Million)						
NO. YEAR	CC	OM	CS	BF	CF	
1 1992	0	0	0	0	0	
2 1993	0	0	0	0	0	
3 1994	0	0	0	0	0	
4 1995	0	0	0	0	0	
5 1996	0	0	0	0	0	
6 1997	0	0	0	0	0	
7 1998	0	0	0	0	0	
8 1999	195	0	195	0	-195	
9 2000	196	0	196	0	-196	
10 2001	692	0	692	73	-619	
11 2002	952	0	952	188	-764	
12 2003	952	0	952	320	-632	
13 2004	948	0	948	467	-481	
14 2005	2	36	38	497	459	
15 2006	2	36	38	527	489	
16 2007	2	36	38	558	519	
17 2008	157	36	193	588	395	
18 2009	157	36	193	618	425	
19 2010	247	36	283	648	366	
20 2011	2	37	39	679	639	
21 2012	90	37	127	709	582	
22 2013	2	37	39	739	700	
23 2014	2	37	39	769	730	
24 2015	2	37	39	800	760	
25 2016	2	37	39	830	791	
26 2017	2	37	39	860	821	
27 2018	2	37	39	890	851	
28 2019	299	37	336	921	584	
29 2020	2	37	39	951	912	
30 2021	2	37	39	981	942	
31 2022	2	37	39	1012	972	
32 2023	2	37	39	1042	1003	
33 2024	2	37	39	1072	1033	
34 2025	94	37	131	1102	971	
35 2026	2	37	39	1133	1093	
36 2027	2	37	39	1163	1124	
37 2028	2	37	39	1193	1154	
38 2029	2	37	39	1223	1184	
39 2030	2	37	39	1394	1355	

Table I.3(2) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

2. Greater Dhaka East - 2 Project

(Unit:Tk Million)						
NO. YEAR	CC	OM	CS	BF	CF	
1 1992	0	0	0	0	0	
2 1993	0	0	0	0	0	
3 1994	0	0	0	0	0	
4 1995	0	0	0	0	0	
5 1996	0	0	0	0	0	
6 1997	0	0	0	0	0	
7 1998	0	0	0	0	0	
8 1999	0	0	0	0	0	
9 2000	0	0	0	0	0	
10 2001	0	0	0	0	0	
11 2002	0	0	0	0	0	
12 2003	0	0	0	0	0	
13 2004	0	0	0	0	0	
14 2005	132	0	132	0	-132	
15 2006	134	0	134	0	-134	
16 2007	544	0	544	44	-500	
17 2008	760	0	760	111	-649	
18 2009	299	13	312	142	-169	
19 2010	301	15	316	177	-140	
20 2011	1	25	26	184	158	
21 2012	88	25	113	192	78	
22 2013	1	30	31	199	168	
23 2014	1	30	31	207	175	
24 2015	1	30	31	214	183	
25 2016	1	30	31	222	191	
26 2017	1	30	31	229	198	
27 2018	1	30	31	237	206	
28 2019	1	30	31	244	213	
29 2020	1	30	31	252	221	
30 2021	1	30	31	259	228	
31 2022	1	30	31	267	236	
32 2023	1	30	31	274	243	
33 2024	1	30	31	282	251	
34 2025	549	30	579	289	-289	
35 2026	1	30	31	297	266	
36 2027	185	30	215	304	90	
37 2028	1	30	31	312	281	
38 2029	1	30	31	319	289	
39 2030	1	30	31	327	296	
40 2031	1	30	31	335	304	
41 2032	1	30	31	342	311	
42 2033	1	30	31	350	319	
43 2034	1	30	31	357	326	
44 2035	1	30	31	365	334	
45 2036	1	30	31	592	561	

Table I.3(3) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

3. Greater Dhaka East - 3 Project

(Unit:Tk Million)						
NO. YEAR	CC	OM	CS	BF	CF	
1 1992	439	0	439	19	-420	
2 1993	180	0	180	28	-152	
3 1994	82	0	82	34	-49	
4 1995	1	4	5	35	30	
5 1996	0	4	4	36	32	
6 1997	0	4	4	38	33	
7 1998	0	4	4	39	35	
8 1999	0	4	4	41	36	
9 2000	125	4	130	42	-88	
10 2001	126	4	130	43	-87	
11 2002	544	4	548	183	-365	
12 2003	894	4	898	337	-562	
13 2004	432	17	449	425	-24	
14 2005	436	17	453	520	67	
15 2006	6	29	35	542	507	
16 2007	175	29	204	563	359	
17 2008	1	33	34	551	551	
18 2009	1	33	34	607	573	
19 2010	1	33	34	629	594	
20 2011	1	33	34	650	616	
21 2012	1	33	34	672	638	
22 2013	1	33	34	694	659	
23 2014	1	33	34	715	681	
24 2015	1	33	34	737	703	
25 2016	1	33	34	759	724	
26 2017	1	33	34	780	746	
27 2018	1	33	34	802	768	
28 2019	1	33	34	824	789	
29 2020	545	33	578	845	267	
30 2021	1	33	34	867	833	
31 2022	184	33	217	889	571	
32 2023	1	33	34	910	876	
33 2024	1	33	34	932	898	
34 2025	1	33	34	954	919	
35 2026	1	33	34	975	941	
36 2027	1	33	34	997	963	
37 2028	1	33	34	1019	984	
38 2029	1	33	34	1040	1006	
39 2030	1	33	34	1062	1028	
40 2031	1	33	34	1302	1268	

Table I.3(4) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

4. Greater Dhaka East - 4 Project

(Unit:Tk Million)						
NO. YEAR	CC	OM	CS	BF	CF	
1 1992	163	0	163	9	-154	
2 1993	167	0	167	19	-148	
3 1994	8	3	11	20	10	
4 1995	158	3	160	21	-140	
5 1996	434	3	436	108	-329	
6 1997	877	3	879	249	-631	
7 1998	880	3	882	405	-478	
8 1999	539	20	558	517	-41	
9 2000	2	32	33	542	509	
10 2001	2	32	33	567	534	
11 2002	2	31	32	592	559	
12 2003	2	31	32	617	594	
13 2004	2	31	32	642	609	
14 2005	2	31	32	667	634	
15 2006	2	31	32	692	659	
16 2007	2	31	32	717	684	
17 2008	7	31	37	741	704	
18 2009	172	31	202	766	564	
19 2010	2	35	36	791	755	
20 2011	2	35	36	816	780	
21 2012	2	35	36	841	805	
22 2013	2	35	36	866	830	
23 2014	536	35	570	891	320	
24 2015	2	35	36	916	879	
25 2016	2	35	36	941	904	
26 2017	2	35	36	966	929	
27 2018	2	35	36	991	954	
28 2019	2	35	36	1016	979	
29 2020	2	35	36	1040	1004	
30 2021	2	35	36	1065	1029	
31 2022	2	35	36	1090	1054	
32 2023	2	35	36	1115	1079	
33 2024	181	35	215	1140	925	
34 2025	2	35	36	1474	1438	



Table I.3(5) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

## 5. Greater Dhaka East Project

NO. YEAR	(Unit:Tk Million)			
	CC	OM	CS	CF
1 1992	602	0	602	-574
2 1993	347	0	347	-300
3 1994	90	3	93	-39
4 1995	158	7	166	-110
5 1996	434	7	441	-297
6 1997	877	7	884	-597
7 1998	880	7	887	-443
8 1999	734	24	758	-200
9 2000	323	36	360	584
10 2001	820	35	856	684
11 2002	1498	35	1533	964
12 2003	1848	35	1883	1273
13 2004	1382	48	1430	103
14 2005	572	84	656	1684
15 2006	144	96	240	1761
16 2007	723	96	819	1882
17 2008	925	100	1025	1000
18 2009	629	113	742	1392
19 2010	551	119	670	2245
20 2011	6	130	136	2329
21 2012	181	130	311	2414
22 2013	6	135	141	2498
23 2014	540	135	675	2582
24 2015	6	135	141	2667
25 2016	6	135	141	2751
26 2017	6	135	141	2835
27 2018	6	135	141	2920
28 2019	303	135	438	2566
29 2020	550	135	685	3089
30 2021	6	135	141	3173
31 2022	189	135	324	3257
32 2023	6	135	141	3342
33 2024	185	135	320	3426
34 2025	646	135	781	3820
35 2026	4	100	104	2405
36 2027	188	100	288	2464
37 2028	4	100	104	2524
38 2029	4	100	104	2583
39 2030	4	100	104	2679
40 2031	2	63	65	1636
41 2032	2	63	65	1442
42 2033	2	63	65	1471
43 2034	2	63	65	1718
44 2035	1	30	31	365
45 2036	1	30	31	592

Table I.3(6) Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
CF=Cash Flow (=BF - CS)

## 6. Narayanganj DND Project

NO. YEAR	(Unit:Tk Million)			
	CC	OM	CS	CF
1 1992	234	0	234	0
2 1993	0	0	0	0
3 1994	0	0	0	0
4 1995	0	0	0	0
5 1996	328	0	328	0
6 1997	895	0	895	110
7 1998	896	0	896	235
8 1999	850	14	864	372
9 2000	1	25	26	397
10 2001	1	25	26	421
11 2002	1	25	26	445
12 2003	1	25	26	470
13 2004	1	25	26	494
14 2005	1	25	26	518
15 2006	1	25	26	543
16 2007	1	24	25	567
17 2008	5	24	29	591
18 2009	171	24	195	616
19 2010	1	28	29	640
20 2011	1	28	29	664
21 2012	1	28	29	689
22 2013	1	28	29	713
23 2014	1	28	29	737
24 2015	771	28	799	762
25 2016	1	28	29	786
26 2017	1	28	29	810
27 2018	1	28	29	835
28 2019	1	28	29	859
29 2020	1	28	29	883
30 2021	1	28	29	907
31 2022	1	28	29	932
32 2023	1	28	29	956
33 2024	180	28	208	980
34 2025	1	28	29	1005
35 2026	1	28	29	1390

Table I.3(7) Cost Benefit Streams  
 CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits  
 CF=Cash Flow (=BF - CS)

7. Narayananj West Project

(Unit: Tk Million)

NO. YEAR	CC	OM	CS	BF	CF
1 1992	0	0	0	0	0
2 1993	0	0	0	0	0
3 1994	0	0	0	0	0
4 1995	0	0	0	0	0
5 1996	0	0	0	0	0
6 1997	0	0	0	0	0
7 1998	0	0	0	0	0
8 1999	369	0	369	0	-369
9 2000	376	0	376	44	-332
10 2001	603	0	603	121	-482
11 2002	606	0	606	207	-400
12 2003	286	16	302	256	-46
13 2004	295	16	311	311	-1
14 2005	1	21	22	302	302
15 2006	1	21	22	339	317
16 2007	1	21	22	353	331
17 2008	1	21	22	367	345
18 2009	1	21	22	381	359
19 2010	1	21	22	395	373
20 2011	1	21	22	409	387
21 2012	1	21	22	423	401
22 2013	1	21	22	438	415
23 2014	1	21	22	452	429
24 2015	1	21	22	466	443
25 2016	1	21	22	480	457
26 2017	1	21	22	494	472
27 2018	1	21	22	508	486
28 2019	329	21	350	522	172
29 2020	1	21	22	536	514
30 2021	1	21	22	550	528
31 2022	1	21	22	564	542
32 2023	1	21	22	579	556
33 2024	1	21	22	593	570
34 2025	1	21	22	607	584
35 2026	1	21	22	621	598
36 2027	1	21	22	635	613
37 2028	1	21	22	649	627
38 2029	1	21	22	772	750

Table I.4 Resettlement Compensation Cost for Buildings

(Unit : Tk. Million)

Project Area	Embankment		Compensation Cost	Drainage		Total Compensation Cost
	No. of House Buildings (units)	Floor Area of Other Bldgs (sq.m)		No. of House Buildings (units)	Floor Area of Other Bldgs (sq.m)	
Dhaka East - 1	310	2,800	26.4	0	8.0	34.4
Dhaka East - 2	230	2,100	19.7	0	2.0	21.7
Dhaka East - 3	70	700	6.3	700	7.3	13.6
Dhaka East - 4	230	1,400	16.2	1,400	15.0	31.2
Dhaka East (Sub-Total)	840	7,000	68.6	2,100	32.3	100.9
Narayanganj DND	0	0	0.0	6,900	61.7	61.7
Narayanganj West	195	23,700	126.3	4,400	39.2	165.5
Total	1,035	30,700	194.9	13,400	133.2	328.1

Notes : 1) The unit cost of compensation for house buildings is Tk. 40,000/ building. (Source : WDB and JICA)

2) The unit cost of compensation for other buildings is Tk. 5,000 / sq.m of floor area. (Source : PWD)

Source : JICA

Table I.5 Summary of Questionnaire Survey on People to be Displaced

1. Average No. of Household Members : 8.33
5. Average House Price : Tk. 209,980
6. Average Land Area : 0.776 ha
7. Average Land Price : Tk. 1,202,110
8. Agree to Remove ? : Yes = 70.5%, No = 29.5%

Occupation	Share (%)
1) Business & Agriculture	29.50
2) Agriculture	16.39
3) Service & Agriculture	11.48
4) Boating	11.48
5) Service	11.47
6) Business	6.56
7) Fishing	4.92
8) Agriculture & Fishing	4.92
9) Service & Business	3.28
Total	100.00

9. Average Compensation Demanded

(Unit : Tk.)				
Land	House	Remove	Others	Total
881,540	245,340	39,030	39,330	1,205,240

3. Average Monthly Income : Tk. 6,266
- 10.

Education	Share (%)
1) Primary	37.70
2) No Schooling	34.43
3) Secondary	24.59
4) College	3.28
5) University	-
6) Others	-
Total	100.00

Mental Attitude toward Displacement	Share (%)
1) Good chance to start a new life with compensation	34.42
2) If I get sufficient compensation, I agree to displacement.	27.87
3) Difficult to change my occupation as a farmer	21.31
4) I can not resist government order.	9.84
5) Others	6.56
6) Difficult to change my occupation as a fisherman / boatman	-
Total	100.00

Source : JICA

Table I.6 Sales by Boating in Dhaka East Area

(Unit : Tk.)

Boat Terminals	Boat - Days										Average Sales per Boat per Day E	Sales by Boating			Share (%)
	Wet Season					Dry Season						Wet Season F1=D1xE	Dry Season F2=D2xE	Total G=F1+F2	
	No. of Boats A1	No. of Months B1	No. of Operating Days per Month C1	Boat-Days D1=A1xB1xC1	No. of Boats A2	No. of Months B2	No. of Operating Days per Month C2	Boat-Days D2=A2xB2xC2	F1=D1xE	F2=D2xE					
Rampura	85	7	30	17,850	18	5	30	2,700	350	6,247,500	945,000	7,192,500	13.50		
Meradia	11	7	4	308					350	107,800	0	107,800	0.20		
	3	7	26	546					350	191,100	0	191,100	0.36		
Madartek	60	7	30	12,600	18	5	30	2,700	350	4,410,000	945,000	5,355,000	10.06		
Shahjadpur	23	7	30	4,830					325	1,569,750	0	1,569,750	2.95		
Khilkhet	47	7	30	9,870					375	3,701,250	0	3,701,250	6.95		
Tongi	275	7	30	57,750	75	5	30	11,250	375	21,656,250	4,218,750	25,875,000	48.57		
Mainer Tek	11	7	30	2,310	6	5	30	900	250	577,500	225,000	802,500	1.51		
Kaskura	8	7	30	1,680					175	294,000	0	294,000	0.55		
Paibra	75	7	8	4,200	35	5	8	1,400	350	1,470,000	490,000	1,960,000	3.68		
	8	7	22	1,232	8	5	22	880	350	431,200	308,000	739,200	1.39		
Bora Beraid	75	7	4	2,100	60	5	4	1,200	350	735,000	420,000	1,155,000	2.17		
	8	7	26	1,456	8	5	26	1,040	350	509,600	364,000	873,600	1.64		
Kaetpara	350	7	4	9,800	125	5	4	2,500	225	2,205,000	562,500	2,767,500	5.20		
	11	7	26	2,002	8	5	26	1,040	225	450,450	234,000	684,450	1.28		
Total	1,050			128,534	361			25,610		44,556,400	8,712,250	53,268,650	100.00		

Note : Results of the interview survey towards boatmen.

Source : JICA

Table I.7 No. of Passengers Transported by Boats

Boat Terminals	Boat - Days per Year		Average No. of Trips per Day	Share of Passenger Terminal Services	Average No. of Passengers per Trip	No. of Passengers			Share (%)
	Wet Season	Dry Season				Wet Season	Dry Season	Total	
	A1	A2	B	C	D	E1 = A1xBxCxD	E2 = A2xBxCxD	F = E1+E2	
Rampura	17,850	2,700	1.5	50%	20	267,750	40,500	308,250	10.94
Meradia	308	0	11.0	80%	10	27,104	0	27,104	0.96
	546	0	11.0	80%	10	48,048	0	48,048	1.71
Madartek	12,600	2,700	2.5	50%	20	315,000	67,500	382,500	13.57
Shahjadpur	4,830	0	3.0	90%	20	260,820	0	260,820	9.25
Khilkhet	9,870	0	2.0	90%	20	355,320	0	355,320	12.60
Tongi	57,750	11,250	1.0	40%	20	462,000	90,000	552,000	19.58
Mainer Tek	2,310	900	11.0	90%	10	228,690	89,100	317,790	11.27
Kaskura	1,680	0	1.0	90%	20	30,240	0	30,240	1.07
Patira	4,200	1,400	3.5	30%	20	88,200	29,400	117,600	4.17
	1,232	880	3.5	30%	20	25,872	18,480	44,352	1.57
Bora Beraid	2,100	1,200	2.5	50%	20	52,500	30,000	82,500	2.93
	1,456	1,040	2.5	50%	20	36,400	26,000	62,400	2.21
Kaetpara	9,800	2,500	1.5	50%	20	147,000	37,500	184,500	6.55
	2,002	1,040	1.5	50%	20	30,030	15,600	45,630	1.62
Total	128,534	25,610				2,374,974	444,080	2,819,054	100.00

Note : Results of the interview survey towards boatmen.

Source : JICA

Table I.8 Amount of Commodities Transported by Boats

Boat Terminals	Boat - Days per Year		Average No. of Trips per Day	Share of Commodity Transport Services	Total No. of Trips for Commodity Transport Services		Share by Size of Boats						Value of Commodities per Trip			Value of Commodities			Share (%)
	Wet Season	Dry Season			Wet Season	Dry Season	Wet Season		Dry Season		Small Boat	Big Boat	Small Boat	Big Boat	F1	F2	Wet Season	Dry Season	
			E11	E12			E21	E22	D1x(E11xF1)+E12xF2	D2x(E21xF1)+E22xF2									H = G1+G2
	A1	A2	B	C	D1=A1xBxC	D2=A2xBxC	E11	E12	E21	E22	F1	F2	G1 = D1x(E11xF1)+E12xF2	G2 = D2x(E21xF1)+E22xF2	H = G1+G2				
Rampura	17,850	2,700	1.5	50%	13,388	2,025	0.65	0.35	0.25	0.75	1,000	10,000	55,558,125	15,693,750	71,251,875	12.42			
Meradia	308	0	11.0	20%	678	0	0.33	0.67	0.25	0.75	1,000	10,000	4,743,200	0	4,743,200	0.83			
	546	0	11.0	20%	1,201	0	0.33	0.67	0.25	0.75	1,000	10,000	8,408,400	0	8,408,400	1.47			
Madartek	12,600	2,700	2.5	50%	15,750	3,375	1.00	0.00	1.00	0.00	1,000	10,000	15,750,000	3,375,000	19,125,000	3.33			
Shahjadpur	4,830	0	3.0	10%	1,449	0	0.00	1.00	1.00	0.00	1,000	10,000	14,490,000	0	14,490,000	2.53			
Khilkhet	9,870	0	2.0	10%	1,974	0	0.00	1.00	1.00	0.00	1,000	10,000	19,740,000	0	19,740,000	3.44			
Tongi	57,750	11,250	1.0	60%	34,650	6,750	0.45	0.55	0.00	1.00	1,000	10,000	204,750,000	39,150,000	243,900,000	42.50			
Mainer Tek	2,310	900	11.0	10%	2,541	990	1.00	0.00	1.00	0.00	1,000	10,000	2,541,000	990,000	3,531,000	0.62			
Kaskura	1,680	0	1.0	10%	168	0	1.00	0.00	1.00	0.00	1,000	10,000	168,000	0	168,000	0.03			
Patira	4,200	1,400	3.5	70%	10,290	3,430	0.53	0.47	1.00	0.00	1,000	10,000	53,508,000	18,865,000	72,373,000	12.61			
	1,232	880	3.5	70%	3,018	2,156	0.53	0.47	1.00	0.00	1,000	10,000	15,695,680	11,858,000	27,553,680	4.80			
Bora Beraid	2,100	1,200	2.5	50%	2,625	1,500	0.53	0.47	1.00	0.00	1,000	10,000	13,650,000	8,250,000	21,900,000	3.82			
	1,456	1,040	2.5	50%	1,820	1,300	0.53	0.47	1.00	0.00	1,000	10,000	9,464,000	7,150,000	16,614,000	2.90			
Kaerpara	9,800	2,500	1.5	50%	7,350	1,875	0.64	0.36	1.00	0.00	1,000	10,000	30,975,000	8,906,250	39,881,250	6.95			
	2,022	1,040	1.5	50%	1,517	780	0.64	0.36	1.00	0.00	1,000	10,000	6,327,750	3,705,000	10,032,750	1.75			
Total	128,554	25,610											455,769,155	117,943,000	573,712,155	100.00			

Note : Results of the interview survey towards boatmen.

Source : JICA

Table I.9 Built-up Area by Year and by Project Area

(Unit: ha)

Year	Greater Dhaka East					Narayanganj	
	DC-1	DC-2	DC-3	DC-4	Combined	DND	West
1990	1,253	341	3,164	1,917	6,675	2,175	1,312
1991	1,339	380	3,197	1,979	6,894	2,288	1,348
1992	1,430	423	3,229	2,043	7,125	2,407	1,385
1993	1,528	470	3,263	2,109	7,370	2,533	1,423
1994	1,632	524	3,296	2,177	7,630	2,665	1,462
1995	1,744	583	3,330	2,248	7,905	2,804	1,502
1996	1,863	649	3,364	2,321	8,197	2,950	1,543
1997	1,990	723	3,399	2,396	8,508	3,103	1,586
1998	2,126	804	3,434	2,473	8,838	3,265	1,629
1999	2,272	896	3,469	2,553	9,190	3,435	1,674
2000	2,427	997	3,505	2,636	9,565	3,614	1,720
2001	2,558	1,042	3,553	2,717	9,870	3,675	1,720
2002	2,697	1,089	3,602	2,801	10,188	3,737	1,720
2003	2,843	1,139	3,651	2,887	10,518	3,799	1,720
2004	2,996	1,190	3,701	2,975	10,862	3,863	1,720
2005	3,158	1,244	3,751	3,067	11,220	3,928	1,720
2006	3,329	1,300	3,803	3,161	11,593	3,994	1,720
2007	3,509	1,359	3,855	3,258	11,981	4,062	1,720
2008	3,699	1,421	3,907	3,358	12,385	4,130	1,720
2009	3,899	1,485	3,961	3,462	12,806	4,199	1,720
2010	4,110	1,552	4,015	3,568	13,245	4,270	1,720



Table I.10(1) O&amp;M Cost Recovery Cash Flow

## 1. DC-1

(Unit: Tk. Million)

Year	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow
1998	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0
2004	29.0	36.0	-7.0	-7.0
2005	30.5	36.0	-5.5	-12.5
2006	32.2	36.0	-3.8	-16.3
2007	33.9	36.0	-2.1	-18.4
2008	35.7	36.0	-0.3	-18.7
2009	37.7	36.0	1.7	-17.0
2010	39.7	37.0	2.7	-14.3
2011	39.7	37.0	2.7	-11.6
2012	39.7	37.0	2.7	-8.8
2013	39.7	37.0	2.7	-6.1
2014	39.7	37.0	2.7	-3.4
2015	39.7	37.0	2.7	-0.7
2016	39.7	37.0	2.7	2.0
2017	39.7	37.0	2.7	4.7

Table I.10(2) O&amp;M Cost Recovery Cash Flow

## 2. DC-2

(Unit: Tk. Million)

Year	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow
1998	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0
2007	13.1	13.0	0.1	0.1
2008	13.7	15.0	-1.3	-1.1
2009	14.3	25.0	-10.7	-11.8
2010	15.0	25.0	-10.0	-21.8
2011	15.0	30.0	-15.0	-36.8
2012	15.0	30.0	-15.0	-51.8
2013	15.0	30.0	-15.0	-66.8
2014	15.0	30.0	-15.0	-81.8
2015	15.0	30.0	-15.0	-96.8
2016	15.0	30.0	-15.0	-111.8
2017	15.0	30.0	-15.0	-126.8

Table I.10(3) O&M Cost Recovery Cash Flow

3. DC-3

(Unit: Tk. Million)					
Year	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow	
1998		0.0	0.0	0.0	0.0
1999		0.0	0.0	0.0	0.0
2000		0.0	0.0	0.0	0.0
2001		0.0	0.0	0.0	0.0
2002		0.0	0.0	0.0	0.0
2003		0.0	0.0	0.0	0.0
2004		0.0	0.0	0.0	0.0
2005		0.0	0.0	0.0	0.0
2006		36.7	13.0	23.7	23.7
2007		37.3	13.0	24.3	48.0
2008		37.8	25.0	12.8	60.8
2009		38.3	25.0	13.3	74.0
2010		38.8	29.0	9.8	83.8
2011		38.8	29.0	9.8	93.6
2012		38.8	29.0	9.8	103.4
2013		38.8	29.0	9.8	113.2
2014		38.8	29.0	9.8	123.0
2015		38.8	29.0	9.8	132.8
2016		38.8	29.0	9.8	142.6
2017		38.8	29.0	9.8	152.4

Table I.10(4) O&M Cost Recovery Cash Flow

4. DC-4

(Unit: Tk. Million)					
Year	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow	
1998		23.9	17.0	6.9	6.9
1999		24.7	29.0	-4.3	2.6
2000		25.5	29.0	-3.5	-0.9
2001		26.3	28.0	-1.7	-2.7
2002		27.1	28.0	-0.9	-3.6
2003		27.9	28.0	-0.1	-3.7
2004		28.8	28.0	0.8	-3.0
2005		29.6	28.0	1.6	-1.3
2006		30.5	28.0	2.5	1.2
2007		31.5	28.0	3.5	4.7
2008		32.5	28.0	4.5	9.2
2009		33.5	32.0	1.5	10.6
2010		34.5	32.0	2.5	13.1
2011		34.5	32.0	2.5	15.6
2012		34.5	32.0	2.5	18.1
2013		34.5	32.0	2.5	20.5
2014		34.5	32.0	2.5	23.0
2015		34.5	32.0	2.5	25.5
2016		34.5	32.0	2.5	28.0
2017		34.5	32.0	2.5	30.5

Table I.10(5) O&amp;M Cost Recovery Cash Flow

## 5. Narayananj DND

(Unit: Tk. Million)

Year	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow
1998	26.7	14.0	12.7	12.7
1999	28.1	25.0	3.1	15.8
2000	29.6	25.0	4.6	20.4
2001	30.1	25.0	5.1	25.4
2002	30.6	25.0	5.6	31.0
2003	31.1	25.0	6.1	37.1
2004	31.6	25.0	6.6	43.7
2005	32.1	25.0	7.1	50.8
2006	32.7	24.0	8.7	59.5
2007	33.2	24.0	9.2	68.7
2008	33.8	24.0	9.8	78.5
2009	34.4	28.0	6.4	84.9
2010	34.9	28.0	6.9	91.8
2011	34.9	28.0	6.9	98.7
2012	34.9	28.0	6.9	105.6
2013	34.9	28.0	6.9	112.6
2014	34.9	28.0	6.9	119.5
2015	34.9	28.0	6.9	126.4
2016	34.9	28.0	6.9	133.4
2017	34.9	28.0	6.9	140.3

Table I.10(6) O&amp;M Cost Recovery Cash Flow

## 6. Narayananj West

(Unit: Tk. Million)

Year	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow
1998	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0
2001	14.1	16.0	-1.9	-1.9
2002	14.1	16.0	-1.9	-3.9
2003	14.1	21.0	-6.9	-10.8
2004	14.1	21.0	-6.9	-17.7
2005	14.1	21.0	-6.9	-24.6
2006	14.1	21.0	-6.9	-31.6
2007	14.1	21.0	-6.9	-38.5
2008	14.1	21.0	-6.9	-45.4
2009	14.1	21.0	-6.9	-52.4
2010	14.1	21.0	-6.9	-59.3
2011	14.1	21.0	-6.9	-66.2
2012	14.1	21.0	-6.9	-73.2
2013	14.1	21.0	-6.9	-80.1
2014	14.1	21.0	-6.9	-87.0
2015	14.1	21.0	-6.9	-93.9
2016	14.1	21.0	-6.9	-100.9
2017	14.1	21.0	-6.9	-107.8

Table I.10(7) O&amp;M Cost Recovery Cash Flow

## 7. Greater Dhaka East Combined

Year	(Unit: Tk. Million)			
	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow
1998	23.9	17.0	6.9	6.9
1999	24.7	29.0	-4.3	2.6
2000	25.5	29.0	-3.5	-0.9
2001	26.3	28.0	-1.7	-2.7
2002	27.1	28.0	-0.9	-3.6
2003	27.9	28.0	-0.1	-3.7
2004	57.7	64.0	-6.3	-10.0
2005	60.2	64.0	-3.8	-13.9
2006	99.5	77.0	22.5	8.6
2007	115.8	90.0	25.8	34.4
2008	119.7	104.0	15.7	50.1
2009	123.8	118.0	5.8	55.8
2010	128.0	123.0	5.0	60.8
2011	128.0	128.0	0.0	60.8
2012	128.0	128.0	0.0	60.8
2013	128.0	128.0	0.0	60.8
2014	128.0	128.0	0.0	60.8
2015	128.0	128.0	0.0	60.8
2016	128.0	128.0	0.0	60.8
2017	128.0	128.0	0.0	60.8

Table I.10(8) O&amp;M Cost Recovery Cash Flow

## 8. Narayanganj Combined

Year	(Unit: Tk. Million)			
	Land Development Tax	O&M Costs	Cash Flow	Cumulative Cash Flow
1998	26.7	14.0	12.7	12.7
1999	28.1	25.0	3.1	15.8
2000	29.6	25.0	4.6	20.4
2001	44.1	41.0	3.1	23.5
2002	44.6	41.0	3.6	27.1
2003	45.2	46.0	-0.8	26.3
2004	45.7	46.0	-0.3	26.0
2005	46.2	46.0	0.2	26.2
2006	46.7	45.0	1.7	27.9
2007	47.3	45.0	2.3	30.2
2008	47.9	45.0	2.9	33.1
2009	48.4	49.0	-0.6	32.5
2010	49.0	49.0	0.0	32.5
2011	49.0	49.0	0.0	32.5
2012	49.0	49.0	0.0	32.5
2013	49.0	49.0	0.0	32.5
2014	49.0	49.0	0.0	32.5
2015	49.0	49.0	0.0	32.5
2016	49.0	49.0	0.0	32.5
2017	49.0	49.0	0.0	32.5

Table I. 11 Project Evaluation

Item	Greater Dhaka East					Narayanganj		Remarks
	DC-1	DC-2	DC-3	DC-4	Combined	DND	West	
<b>1. Economic Evaluation</b>								
1) EIRR (%)	14.8	8.0	13.9	18.9	15.8	14.5	14.3	
2) NPV (Tk. million)	274	-98	263	1,032	1,501	371	152	
3) B/C	1.22	0.74	1.19	1.55	1.31	1.21	1.18	
4) NPVR (2)	0.162	-0.155	0.147	0.416	0.228	0.151	0.110	
<b>2. Socio - Economic Impacts</b>								
1) Population to be Saved from Inundation by 1988 - Scale Flood in 2010	665,996	261,856	847,139	1,218,397	2,993,388	1,685,439	981,873	
2) Area to be Saved from Inundation by 1988 - Scale Flood in 2010 (ha)	3,036	1,146	2,977	2,635	9,794	4,270	1,720	
3) Labour Force to be Employed during Construction (man-years)	10,693	8,616	5,968	13,637	38,914	19,974	7,625	
4) Resettlement								
(1) No. of People to be Displaced	1,337	734	433	1,127	3,631	1,783	1,639	
(2) Compensation (Tk. million)	34.4	21.7	13.6	31.2	100.9	61.7	165.5	
5) Boating Trade to be Affected								
(1) No. of Boatmen to be Affected	853 118	415	1,207 305	150 150	2,625 573	- -	- -	....Seriously
(2) Annual Sales to be Affected (Tk.)	30,675,750 3,701,250	4,727,800	12,513,100 9,061,150	5,355,000 5,355,000	53,268,650 18,117,400	- -	- -	....Seriously

Source : JICA

Table I.12 Cost Benefit Streams of Integrated Narayanganj DND  
and West Projects

CC=Capital Costs; OM=O/M Costs; CS=Costs  
BF=Benefits; CF=Cash Flow (=BF - CS)

(Unit: Tk Million)

NO.	YEAR	CC	OM	CS	BF	CF
1	1992	234	0	234	0	-234
2	1993	0	0	0	0	0
3	1994	0	0	0	0	0
4	1995	0	0	0	0	0
5	1996	698	0	698	0	-698
6	1997	1220	0	1220	144	-1075
7	1998	1447	0	1447	334	-1113
8	1999	1457	14	1471	548	-922
9	2000	288	41	329	616	288
10	2001	297	41	338	689	352
11	2002	3	46	49	728	679
12	2003	3	46	49	766	718
13	2004	3	46	49	805	756
14	2005	3	46	49	843	794
15	2006	3	46	49	882	833
16	2007	3	45	48	920	872
17	2008	7	45	52	958	907
18	2009	173	45	218	997	779
19	2010	3	49	52	1035	984
20	2011	3	49	52	1074	1022
21	2012	3	49	52	1112	1060
22	2013	3	49	52	1150	1099
23	2014	3	49	52	1189	1137
24	2015	773	49	822	1227	406
25	2016	331	49	380	1266	886
26	2017	3	49	52	1304	1253
27	2018	3	49	52	1343	1291
28	2019	3	49	52	1381	1329
29	2020	3	49	52	1419	1368
30	2021	3	49	52	1458	1406
31	2022	3	49	52	1496	1445
32	2023	3	49	52	1535	1483
33	2024	182	49	231	1573	1342
34	2025	3	49	52	1612	1560
35	2026	3	49	52	2120	2068

Table I.13 Summary of Flood Damages with SCF Applied

(Unit: Tk. Million)

Area	External Flood			Internal Flood	
	Annual	1987-Scale	1988-Scale	Annual	Worst
1. 1990					
DC-1	2.4	84.2	262.8	1.6	5.8
DC-2	1.2	52.1	209.6	0.6	2.4
DC-3	18.5	194.8	1,103.6	57.9	145.3
DC-4	18.1	324.3	2,071.2	77.7	186.7
Dhaka East	40.2	655.4	3,647.2	137.8	340.2
Narayanganj DND	1.3	162.4	1,862.2	33.6	61.1
Narayanganj West	5.3	113.9	1,441.3	19.1	49.9
Total	46.8	931.7	6,950.7	190.5	451.2
2. 2010					
DC-1	65.9	1,232.2	3,060.0	8.7	33.5
DC-2	29.4	282.7	1,242.1	4.4	18.3
DC-3	87.0	750.9	4,129.4	112.1	300.6
DC-4	97.9	973.4	6,079.6	123.4	316.0
Dhaka East	280.2	3,239.2	14,511.1	248.6	668.4
Narayanganj DND	13.1	601.0	8,478.4	139.7	255.3
Narayanganj West	22.5	344.3	6,011.2	59.6	150.3
Total	315.8	4,184.5	29,000.7	447.9	1,074.0

Note: SCF of 0.87 was applied to the flood damages excluding agricultural damages.

Table I.14 Average Annual Flood Damages with SCF Applied

(Unit: Tk. Million)

Area	Average Annual Flood Damages		Total
	External Flood	Internal Flood	
<b>1. 1990</b>			
DC-1	37.7	2.1	39.8
DC-2	24.2	0.9	25.1
DC-3	106.7	64.5	171.2
DC-4	175.4	84.8	260.2
Dhaka East	344.0	152.3	496.3
Narayanganj DND	102.4	32.6	135.0
Narayanganj West	77.6	21.6	99.2
<b>Total</b>	<b>524.0</b>	<b>206.5</b>	<b>730.5</b>
<b>2. 2010</b>			
DC-1	552.2	12.1	564.3
DC-2	148.0	6.4	154.4
DC-3	418.0	128.8	546.8
DC-4	549.7	138.7	688.4
Dhaka East	1,667.9	286.0	1,953.9
Narayanganj DND	421.0	135.8	556.8
Narayanganj West	277.3	66.5	343.8
<b>Total</b>	<b>2,366.2</b>	<b>488.3</b>	<b>2,854.5</b>



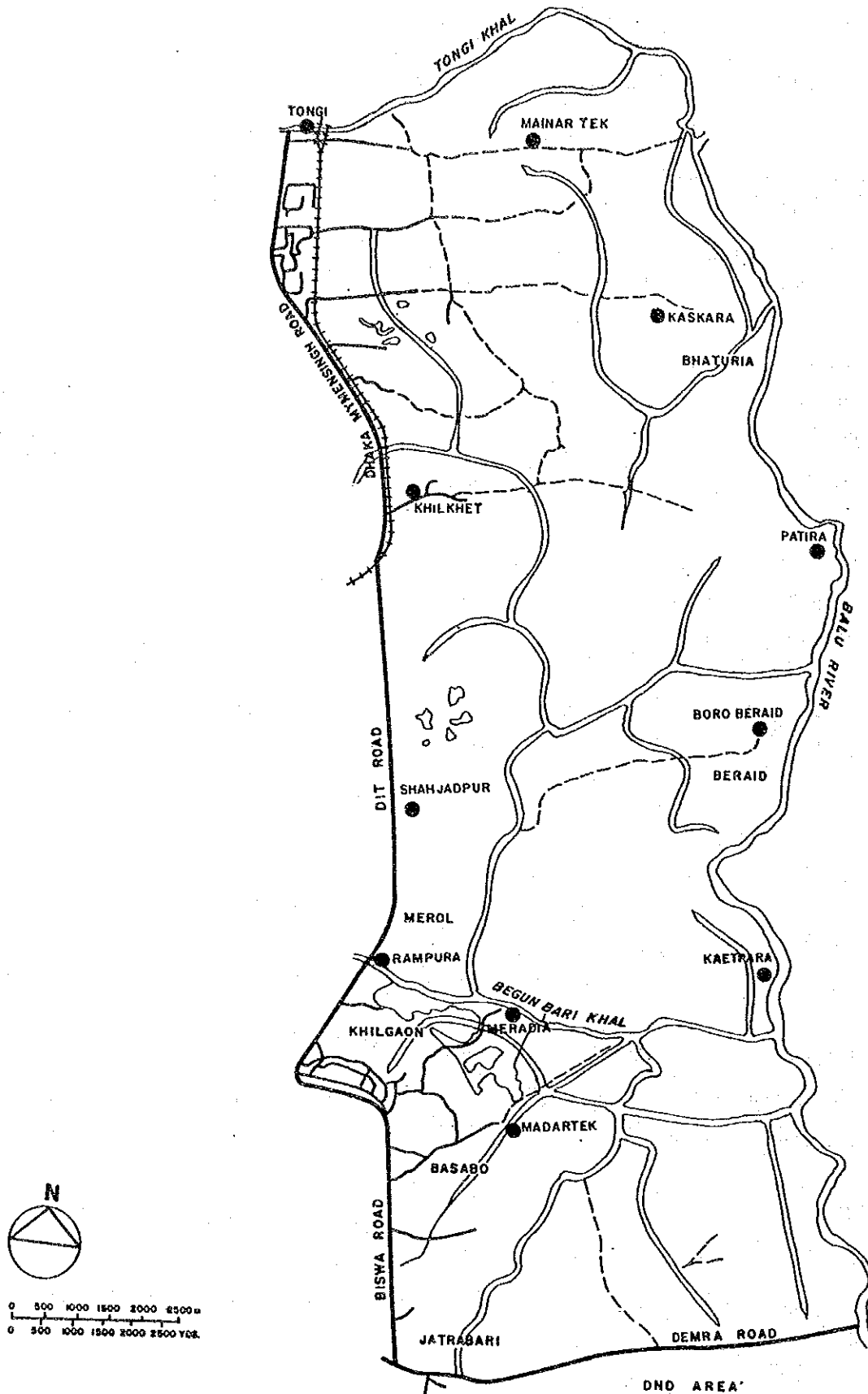


FIG. I.1

LOCATIONS OF MAJOR EXISTING BOATING CENTERS

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

**SUPPORTING REPORT J**  
**SUPPLEMENTAL SURVEYS AND**  
**WATER LEVEL GAUGE INSTALLATION**



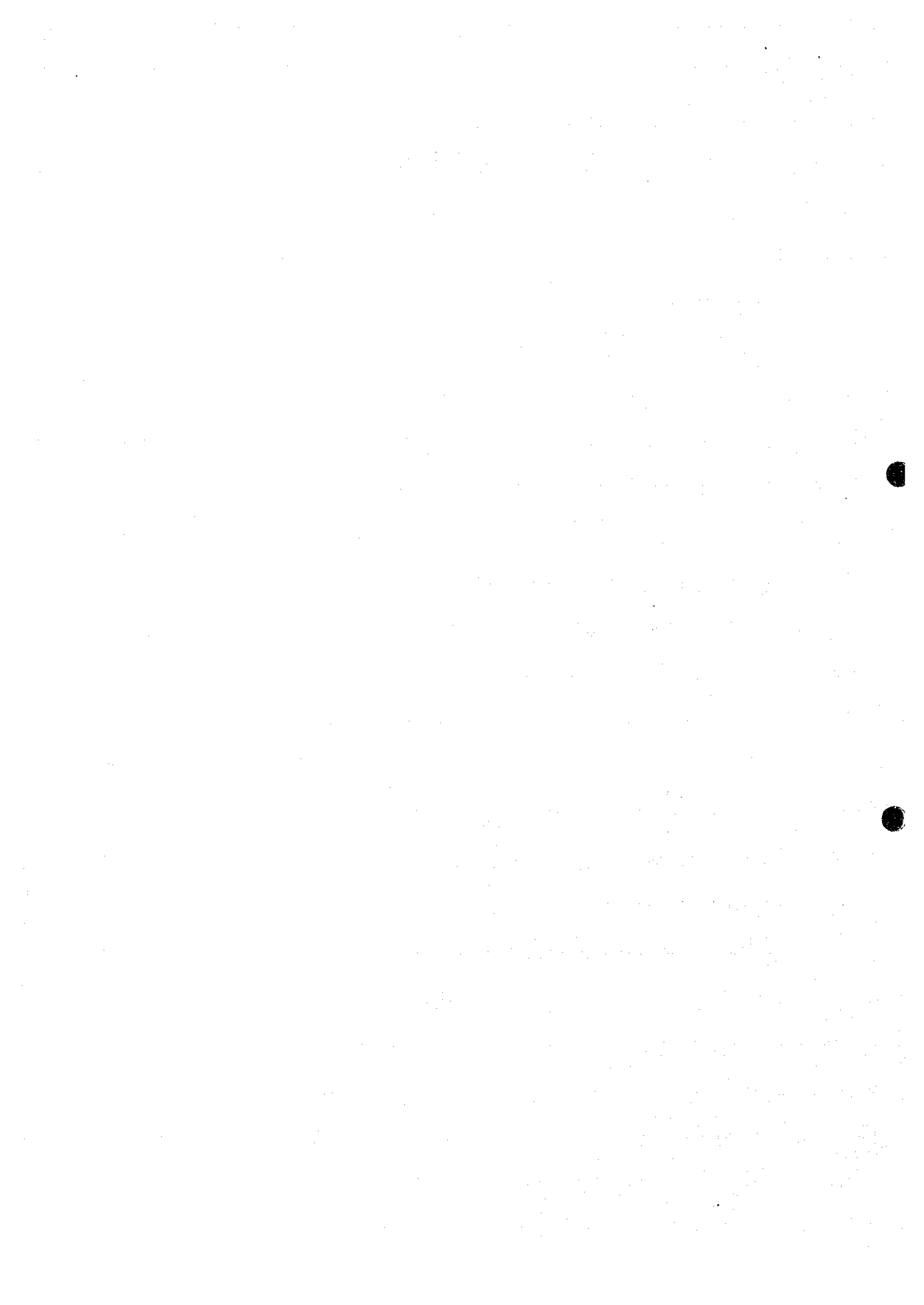
SUPPORTING REPORT J : SUPPLEMENTARY SURVEY  
AND WATER LEVEL GAUGE INSTALLATION

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SUPPORTING REPORT J : SUPPLEMENTARY SURVEY  
AND WATER LEVEL GAUGE INSTALLATION

1. General

Supplementary surveys and investigations have been carried out for the identified priority areas. The surveys for Greater Dhaka and DND were conducted from May 1991, and but for Narayanganj West from September 1991. They are explained as follows :

- (1) Ground survey on the existing embankment, the proposed flood mitigation and stormwater drainage improvement facilities
- (2) Soil investigation on the proposed facilities
- (3) Environmental survey
- (4) Installation of two water-level gauges

2. Ground Survey

2.1 Greater Dhaka

1) Longitudinal and Cross Sectional Survey

The survey was conducted for the following flood mitigation and stormwater drainage improvement facilities :

- (1) Embankment and Flood Wall
  - Existing west embankment and flood wall : L = 38.5 km.
  - Existing road-cum-embankment : L = 21.0 km
  - Proposed east embankment : L = 30.0 km
  - Proposed sub-embankment : L = 10.0 km

Total : L = 99.5 km

(2) River and Khal

-	Dhaleswari River	: L = 13.0 km
-	Buriganga River	: L = 3.0 km
-	Turag River	: L = 12.0 km
-	Lakhya River	: L = 7.0 km
-	Balu River	: L = 1.0 km
-	Khal	: L = 103.5 km

---

Total : L = 139.5 km

2) Topographic Survey

Topographic surveys were conducted at the proposed pumping stations

Each survey location is shown in Fig. 3.1

2.2 DND

Longitudinal and cross sectional surveys, and topographical surveys were conducted for the following flood mitigation and stormwater drainage improvement facilities:

-	Existing DND embankment	: L = 31.0 Km
-	Khal	: L = 37.5Km
-	Topographic survey at the proposed pumping stations	

Each survey location is shown in Fig. 3.2

### 2.3 Narayanganj West

Longitudinal and cross sectional surveys, and topographical surveys were conducted for the following flood mitigation and stormwater drainage improvement facilities :

- Proposed embankment and road-cum embankment : L=13.0 km
- Proposed concrete flood wall : L=14.0 km
- Proposed Khal improvement : L=7.5 km

Each survey location is shown in Fig. 3.2.

### 3. Soil Investigation

#### 3.1 Greater Dhaka

Soil investigations were carried out for the existing embankment of Greater Dhaka West, the proposed east embankment and flood wall of Greater Dhaka East. The main items of the work are as follows :

(1) Machine boring

- Existing west embankment : 4 sites
- Proposed east embankment : 4 sites
- Proposed pumping station : 3 sites

(2) Standard penetration test with spril-barrel sampling in order to obtain N-values of all foundations and for soil classification, laboratory test and unconfined compression test.

(3) Thin walled tube sampling ( undisturbed core sampling for foundation sub-soil)

(4) Sampling for embankment material test.

Each location is shown in Fig. 3.3.



### 3.2 Narayananj

The soil investigation was carried out for the proposed embankment, flood wall and pumping stations of Narayananj DND and West.

- (1) Machine boring at six sites, in order to get subsoil conditions for proposed facilities,
- (2) Standard penetration test with split-barrel sampling in order to obtain N-values of sub-soil and split-barrel sampling for soil classification, laboratory test and unconfined compression test.
- (3) Thin-walled tube sampling ( undisturbed core sampling ) for foundation sub-soil, and
- (4) Sampling for embankment material test.

The locations of soil investigation are shown in Figs. 3.4.

### 4. Environmental Survey

The survey is consisting of the followings :

- (1) Comprehensive ecological survey

A comprehensive ecological survey is carried out aiming at facilitating comprehensive environmental assessment by the implementation of flood control and drainage works and subsequent urbanization on the ecological elements of fauna and flora, and agricultural and aquacultural resources.

- (2) Water Quality Survey

Water quality sampling and analysis at fifteen (15) sites specified in the proposed retarding areas of the F/S area was carried out in flood season (September to October, 1991) and will be done in dry season ( January to February to February, 1991).

(3) **Supplementary Living Environmental Survey**

The survey consists of additional data collection of living environmental parameters at water supply, sewerage/sanitation and solid waste management. In addition determination of resettlement population due to embankment / Khal construction/ improvement and the survey to determine necessity of navigational provision be carried out.

5 **Installation of Water Level Gauges**

Automatic water level gauges are installed at Demra (BWDB St. 179) of the Lakhya River and Kalagachia ( BWDB St. 71) near the confluence of the Meghna River to the Dhaleswari River, shown in Fig. 3.5. The gauges are designed to obtain data through year.

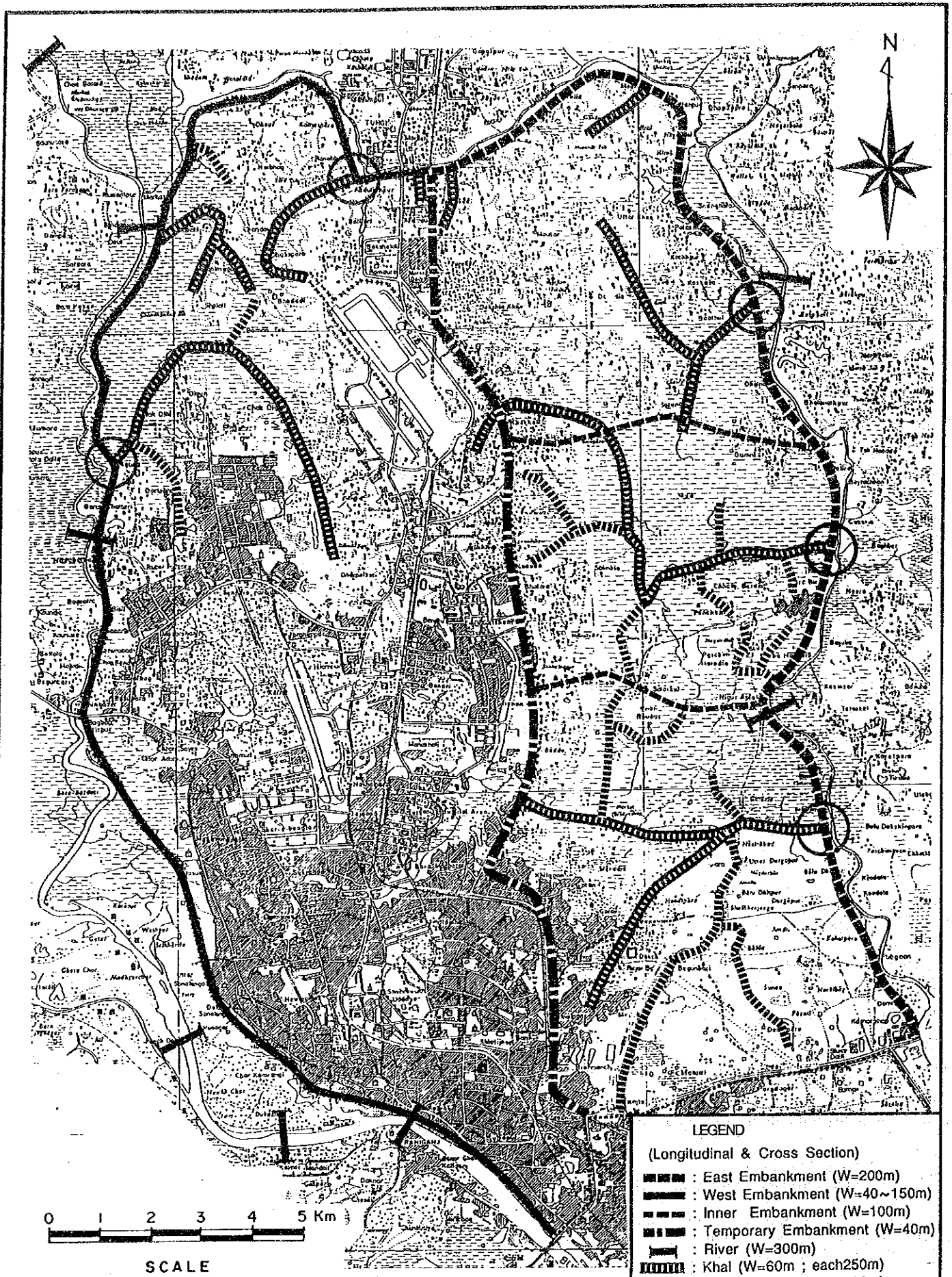
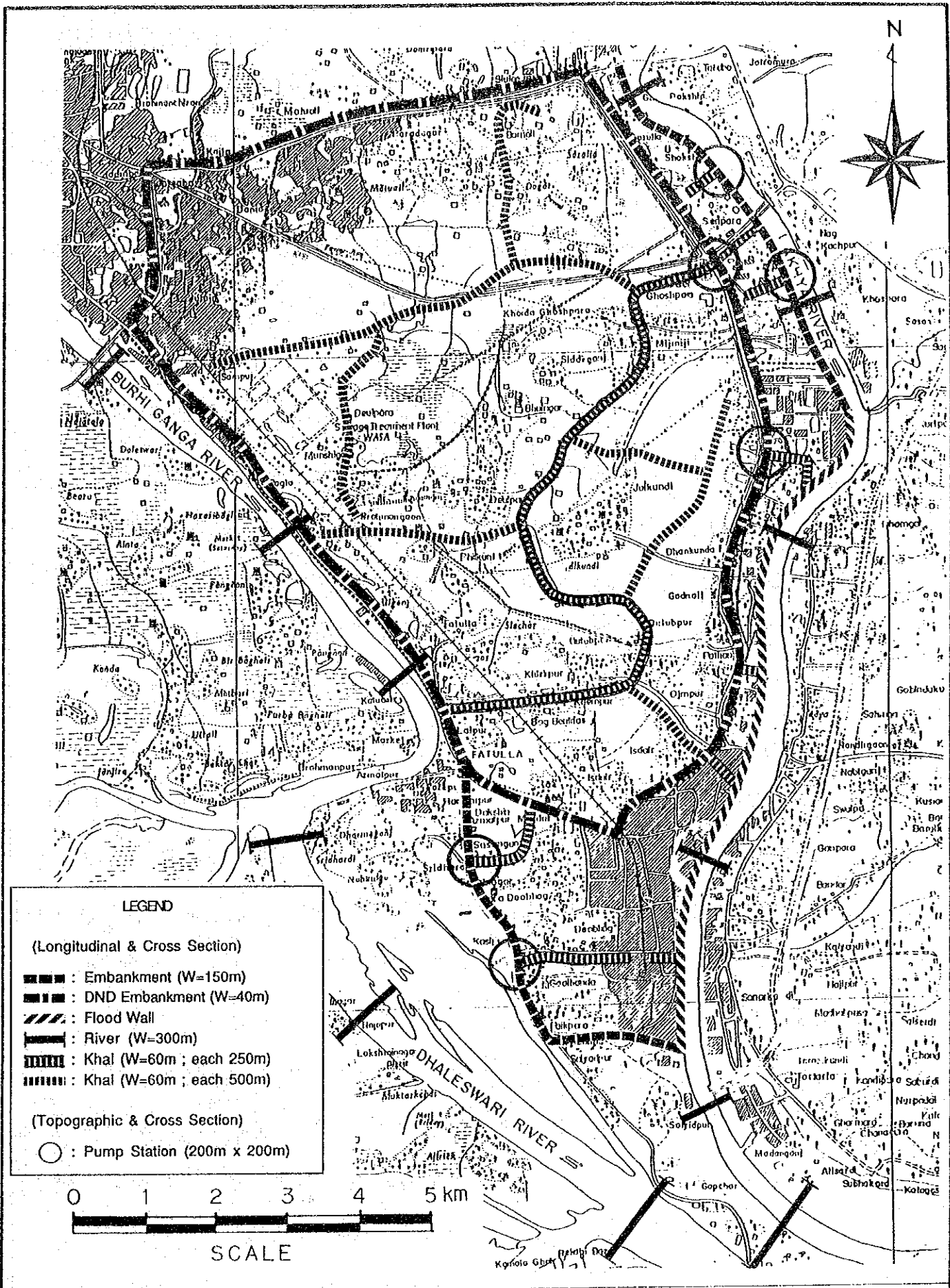


FIG. J.1

LOCATION OF GROUND SURVEY  
: GREATER DHAKA

- LEGEND**
- (Longitudinal & Cross Section)
- ▬ : East Embankment (W=200m)
  - ▬ : West Embankment (W=40~150m)
  - ▬ : Inner Embankment (W=100m)
  - ▬ : Temporary Embankment (W=40m)
  - ▬ : River (W=300m)
  - ▬ : Khal (W=60m ; each250m)
  - ▬ : Khal (W=60m ; each500m)
- (Topographic & Cross Section)
- : Pump Station (200m x 200m)

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



**FIG. J.2**

**LOCATION OF GROUND SURVEY : NARAYANGANJ**

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

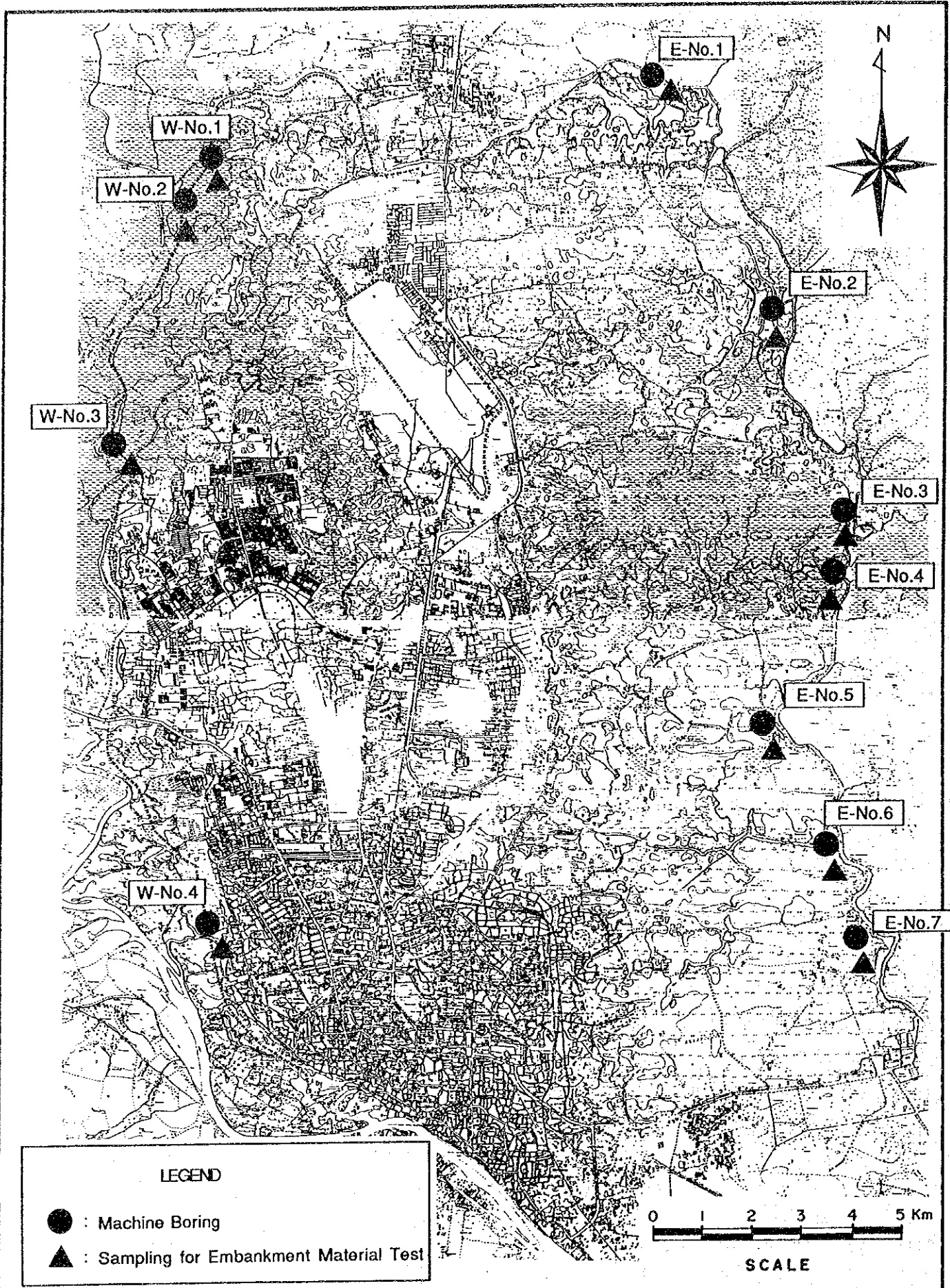
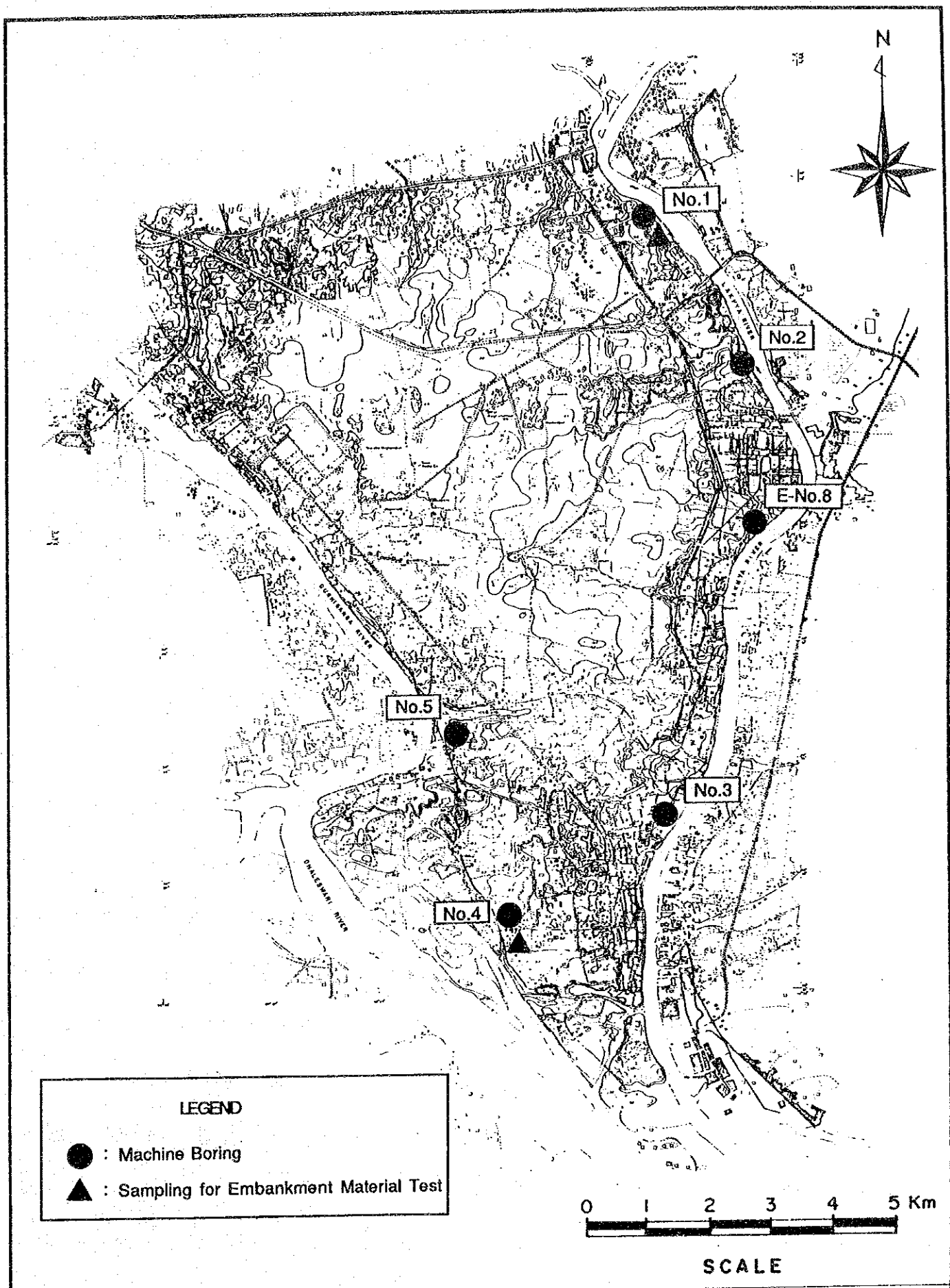


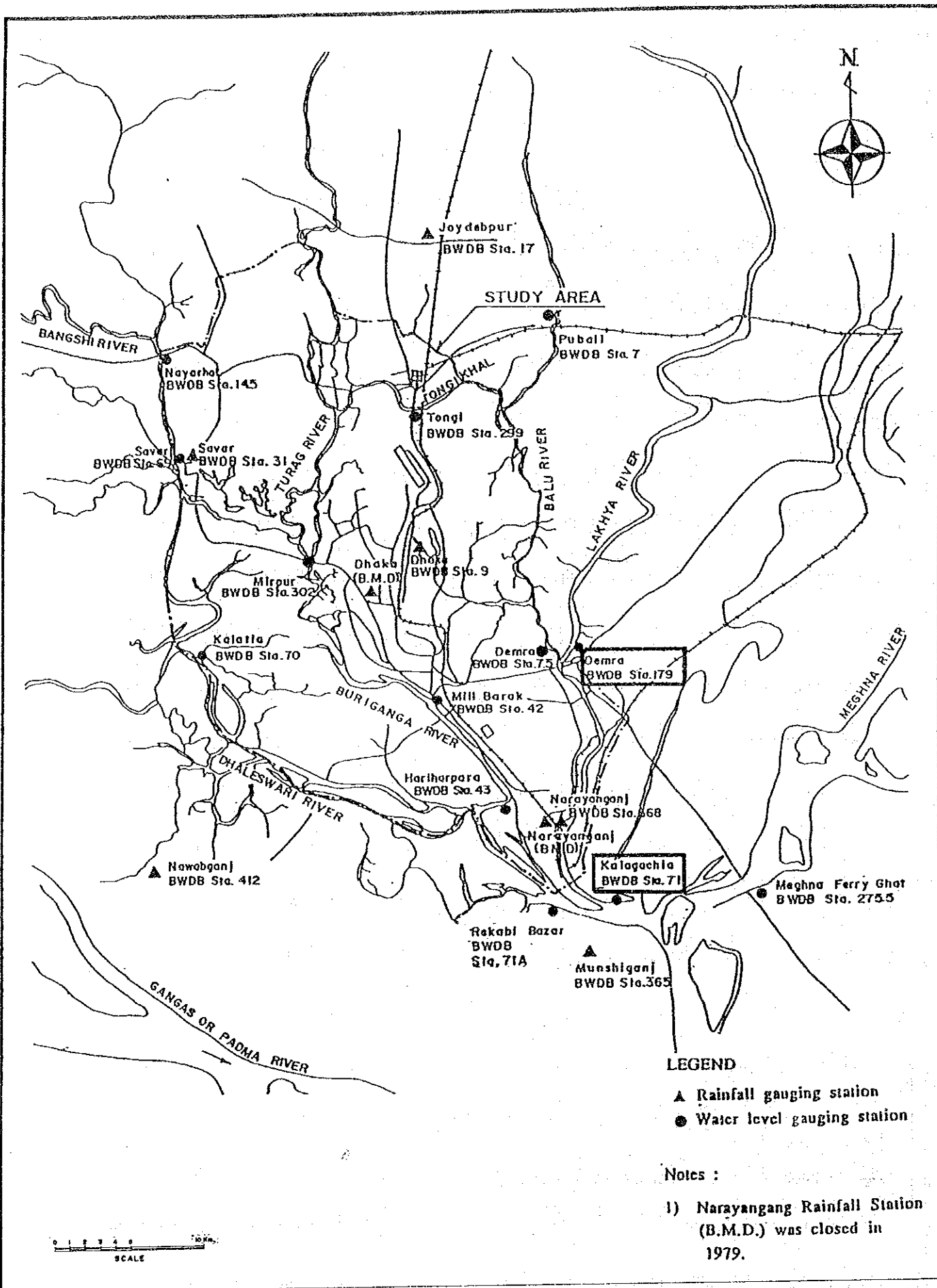
FIG. J.3

LOCATION OF SOIL INVESTIGATION : GREATER DHAKA

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



**FIG. J.4** LOCATION OF SOIL INVESTIGATION : NARAYANGANJ  
 GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA) OF  
 BANGLADESH FLOOD ACTION PLAN NO.8A IN THE PEOPLE'S REPUBLIC OF BANGLADESH



**FIG. J.5**

**LOCATION OF DEMRA AND KALAGACHIA WATER LEVEL GAGING STATIONS NEWLY INSTALLED BY JICA STUDY TEAM**

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

**SUPPORTING REPORT K**  
**SCOPE OF WORK AND MINUTES OF MEETING**

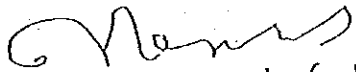




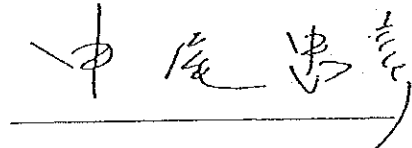
SCOPE OF WORK  
FOR  
GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA)  
OF  
BANGLADESH FLOOD ACTION PLAN NO. 8A  
IN  
THE PEOPLE'S REPUBLIC OF BANGLADESH

AGREED UPON BETWEEN  
JAPAN INTERNATIONAL COOPERATION AGENCY  
AND  
FLOOD PLAN COORDINATION ORGANIZATION

DHAKA, BANGLADESH, JUNE 21, 1990

  
21 21.6.90

HR. A. H. H. NURUL HUQ  
CHIEF ENGINEER  
FLOOD PLAN  
COORDINATION ORGANIZATION  
THE PEOPLE'S REPUBLIC  
OF BANGLADESH



HR. TADAHIKO NAKAO  
LEADER OF  
PRELIMINARY SURVEY TEAM,  
JAPAN INTERNATIONAL  
COOPERATION AGENCY

## I. INTRODUCTION

In response to the request of the Government of the People's Republic of Bangladesh (hereinafter referred to as "the Government of Bangladesh") the Government of Japan decided to conduct the Study on Greater Dhaka Protection Project for Dhaka Metropolitan Area in the People's Republic of Bangladesh of Flood Action Plan No. 8A (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Bangladesh.

The present document sets forth the Scope of Work with regard to the Study.

## II. OBJECTIVES OF THE STUDY

The objectives of the Study are as follows;

1. to formulate a Master Plan on a comprehensive flood control and stormwater drainage for Dhaka Metropolitan Area.
2. to conduct a feasibility study on a flood control and stormwater drainage for the priority area identified in the Master Plan.

## III. STUDY AREA

The Study area will cover Dhaka Metropolitan area (approximately 850 km<sup>2</sup>), consisting of Greater Dhaka area (approximately 260km<sup>2</sup>), Tongi, Savar, Keraniganj and Narayanganj.

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#### IV. OUTLINE OF THE STUDY

##### 1. Study Framework

The Study Comprises of the following three (3) phases

Phase 1: Preliminary Review

Phase 2: Master Plan Study on a comprehensive flood control and stormwater drainage in the Dhaka Metropolitan area

Phase 3: Feasibility study for priority area identified in the Master Plan

##### 2. Study Items

###### 2-1 Phase 1: Preliminary Review

2-1-1 Collection, collation and updating of available data and informations as described below:

- a. topographic map, aerial photograph and related drawings,
- b. soil, geological and geographical data,
- c. population, land use and regional development plans,
- d. existing road network,
- e. hydrological and hydraulic conditions,
- f. existing flood control and stormwater drainage facilities,
- g. past floods and flood damages,
- h. related institutions, and
- i. other related data and information.

2-1-2 Review of the relevant previous studies, reports and plans including ongoing projects

2-1-3 Carrying out of the following field surveys and investigations:

- a. field reconnaissance,
- b. supplemental topographic survey for preparation of accurate base map,
- c. longitudinal and cross sectional survey for drainage channels and rivers,
- d. supplemental geo-technical survey for proposed major flood control and drainage facilities,
- e. flood and flood damage survey, and
- f. water quality test.

2-1-4 Review of existing urban development plans and projections of population distribution and land use pattern/distribution, in order to assess the future flood control and stormwater drainage requirement.

2-2 Phase 2: A Master Plan Study on a comprehensive flood control and stormwater drainage in the Dhaka Metropolitan area  
for this purpose, the following studies and analysis shall be conducted:

- a. assessment of the present conditions for the existing flood control and stormwater drainage works,
- b. target year, design rainfall and flood water level,
- c. hydraulic simulation with mathematical modelling using Hike 11 of the Surface Water Modelling Centre for the 850 km<sup>2</sup> area with a view to formulate and optimise planning and design aspects at the Master Plan and its priority projects considering various options for flood control and drainage,
- d. alternative studies for external flood protection and internal drainage improvement plans, and recommendation of optimum plan in consideration to capital cost, operation/maintenance, environmental and financial aspects, and
- e. preparation of phased implementation programme and identification of priority projects.

2-3 Phase 3: A feasibility study for the priority projects identified in the Master Plan Study

A feasibility study for the identified priority projects shall incorporate, the following aspects;

- a. the necessary supplementary data collection, field surveys and analysis,
- b. alternative project concepts and selection of the optimum ones considering technical, economic and operational aspects,
- c. preliminary designs of the proposed facilities, with due attention to appropriate technology and taking into account prevailing conditions in Bangladesh,
- d. time schedules for subsequent detailed design, tendering and construction, with estimated dates for putting the proposed facilities into service.

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- e. approximate land acquisition plans.
- f. cost estimates for construction, operation and maintenance of the proposed projects.
- g. economic and financial evaluation of the proposed projects, including their social and environmental impacts.
- h. proposals for institutional arrangements for operation and maintenance.

## V. SCHEDULE OF THE STUDY

The Study will be performed in accordance with the tentative study schedule shown in the appendix.

## VI. REPORTS

JICA will prepare and submit the following reports in English to the Government of Bangladesh.

### 1. Inception Report (50 copies)

This report is to be submitted at the commencement of the first field survey in Bangladesh and to describe the overall approach and implementation programme of the Study.

### 2. Preliminary Review Report (50 copies)

This report is to be submitted at the end of the Preliminary Review phase. It shall present a compilation and analysis of all collected relevant data on the basis of which a precise description of the required Master Plan Study and of the related details of study programme

It will include a proposal for the development of the project area that will form the basis for the desired master plan. The Government of Bangladesh will offer his decision on this proposal within 1 month after submission of the Report; agreed development plan will be the basis of the Master Plan to be prepared.

### 3. Interim Report (50 copies)

This report is to be submitted four (4) months after the commencement of the Master Plan Study.

It shall present all findings in field survey, preliminary results of analysis and confirmation of basic idea, criteria and standard for formulation of the Master Plan.

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4. Draft Master Plan Report (50 copies)

This report is to be submitted seven (7) months after the commencement of the Master plan Study.

It shall review all options assessed and propose the preferred Master Plan for flood control and drainage for the Dhaka Metropolitan Area.

The report shall make firm recommendation for the priority project(s) to be taken up for the subsequent feasibility study. Final proposals for detailed terms of reference for the feasibility study will be submitted separately.

The Government of Bangladesh will offer his decision and give its comments on this report within one (1) month after submission of the Report.

5. Master Plan Report (100 copies)

This report is to be submitted within two (2) months after receipt of the comments from the Government of Bangladesh on the Draft Master Plan Report.

6. Draft Final Report (50 copies)

This report is to be submitted six (6) months after the commencement of the Feasibility Study.

It will confirm viability of priority projects.

The Government of Bangladesh shall provide JICA with its comments within one (1) month after the receipt of the Draft Final Report.

7. Final Report (100 copies)

This report is to be submitted within one (1) month after receipt of the comments from the Government of Bangladesh on the Draft Final Report.

V. UNDERTAKINGS OF THE GOVERNMENT OF BANGLADESH

1. To facilitate smooth conduct of the Study, the Government of Bangladesh shall take necessary measures:

(1) to secure the safety of the Japanese Study Team for the Study (hereinafter referred to as "the Team").

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- (2) to permit the members of the Team to enter, leave and stay in Bangladesh for the duration of their assignment therein, and exempt them from alien registration requirements and consular fees,
  - (3) to exempt the members of the Team from taxes, duties and other charges on equipment, machinery and other materials brought into and out of Bangladesh for the implementation of the Study,
  - (4) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study,
  - (5) to provide necessary facilities to the Team for the remittance as well as the utilization of the funds introduced into Bangladesh from Japan in connection with the implementation of the Study,
  - (6) to secure permission for entry into private properties or restricted areas for the conduct of the Study,
  - (7) to provide and to secure permission for the Team to take all data and documents (including photographs and maps) related to the Study to Japan,
  - (8) to provide medical services as needed. Its expenses will be chargeable on members of the Team.
2. The Government of Bangladesh shall bear claims, if any arises against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.
  3. Flood Plan Coordination Organization (hereinafter referred to as "FPCO"), Ministry of Irrigation, Water Development and Flood Control, shall be the executing agency of the Study and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study. FPCO will review and monitor the Study.



4. FPCO shall, at its own expense, provide the Team with the followings, in cooperation with other relevant organizations concerned :

- (1) counterpart personnel necessary for the Study,
- (2) credentials or identification cards.

#### VII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

1. to dispatch, at its own expense, the Team to Bangladesh,
2. to perform technology transfer to the Bangladesh counterpart personnel in the course of the Study.

#### IX. CONSULTATION

JICA and FPCO shall consult each other in respect of any matter that may arise from or in connection with the Study.

#### X. VALIDITY OF THIS SCOPE OF WORK

This Scope of Work comes into effect as of the date when a formal request with Technical Assistance Project Proposal would be made through the diplomatic channel.

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Appendix I

TENTATIVE WORK SCHEDULE

Phase	Phase 1			Phase 2							Phase 3									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Month in Order																				
Works in Bangladesh	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Works in Japan	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Reports	Δ			Δ				Δ			Δ			Δ				Δ		Δ
	Ic/R		PR/R					It/R			DMP/R			MP/R				DF/R		F/R

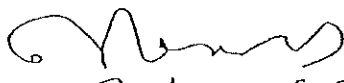
(Remarks)

- Ic/R : Inception Report
- PR/R : Preliminary Review Report
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- F/R : Final Report

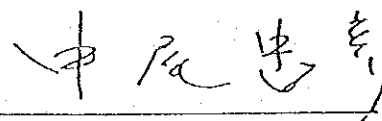
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MINUTES OF MEETING  
FOR  
GREATER DHAKA PROTECTION PROJECT (STUDY IN DHAKA METROPOLITAN AREA)  
OF  
BANGLADESH FLOOD ACTION PLAN NO. 8A  
IN  
THE PEOPLE'S REPUBLIC OF BANGLADESH

DHAKA, BANGLADESH, JUNE 21, 1990

  
21.6.90

MR. A. K. H. KURUL HUQ  
CHIEF ENGINEER  
FLOOD PLAN  
COORDINATION ORGANIZATION  
THE PEOPLE'S REPUBLIC  
OF BANGLADESH



MR. TADAINIKO NAKAO  
LEADER OF  
PRELIMINARY SURVEY TEAM,  
JAPAN INTERNATIONAL  
COOPERATION AGENCY

A Preliminary Survey Team (the Team) of Japan International Cooperation Agency (JICA), headed by Mr. Tadahiko, Nakao visited Bangladesh from June 15 to June 22, 1990 to discuss the Scope of Work for the study on Greater Dhaka Protection Project for Dhaka Metropolitan Area in the People's Republic of Bangladesh of Flood Action Plan No. 8A (the Study).

The team carried out field surveys of the study area and held series of discussions with officials of Flood Plan Coordination Organization (FPCO) and the authorities concerned of the Government of Bangladesh (GOB). A list of those who attended the meetings is shown in the attached sheet.

A final meeting was held on June 21, 1990 at the Conference Room of FPCO, in Dhaka. Mr. A. K. H. Nurul Haq, Chief Engineer of FPCO, presided over the meeting on behalf of FPCO. Main issues discussed on the Scope of Work are as follows:

1. It was confirmed that the Terms of Reference (T/R) for the Study was approved by the Technical Committee for FAP and GOB will request technical cooperation on the above Study to the Government of Japan through diplomatic channel, as soon as the Technical Assistance Project Proposal (TAPP) be approved, for the formality.

2. GOB understood that the responsibility of consultants as specified in Section 9 of T/R was primarily to JICA, therefore, provisions under section 9 were not applicable to the Study to be carried out under the Technical Cooperation Scheme of JICA.

3. In reference to II., III., and IV. in S/W, it was confirmed that further details and clarification should be referred to relevant section in the said T/R as guideline of the Study.

4. In reference to V. SCHEDULE OF THE STUDY in S/W, although it was agreed that part of work is done in Japan in accordance with normal procedure under JICA, GOB requested the Team to consider further that work be done in Bangladesh as much as possible, for keeping continuous consultation and coordination with FPCO, Panel of Experts and other FAP activities.

2

N.T.

5. In reference to VI. of REPORT in S/W, it was confirmed that progress report will be prepared and submitted quaterly to GOB.

6. In reference to VI. of UNDERTAKING OF THE GOVERNMENT OF BANGLADESH in S/W, the following points were raised and confirmed:

- 1) Implementation arrangement for the study should be the same as for the Dhaka Integrated Flood Protection Project of FAP No.8B, otherwise agreed in S/W
- 2) GOB agreed to assign Bangladesh counterpart personnel as project director (full time), engineers from BWDB, DHC, RRD, DWASA, RAJUK, DOE, SOB and other organizations concerned, for the smooth execution of the Study.

7. In reference to VII. of UNDERTAKING OF JICA in S/W, GOB requested the team;

- 1) to respect the policy of GOB to utilize availability of local consultant as much as possible for the Study.
- 2) to provide survey equipment and vehicles for the Study and donate them with customs and other duties borne by FPCO, after the completion of the Study.
- 3) to accept Bangladesh counterpart personnel for technical training in Japan.
- 4) to secure intimate communication among the Study team and organizations concerned.
- 5) to provide office with equipment borne by JICA, due to the budgetary constraint of FPCO.

8. For the smooth and effective implementation of the Study, it was agreed;

- 1) GOB should provide all data and information required in the initial stage of the Study.
- 2) GOB should make decision and give it's comments on provisional Preliminary Review Report and Draft Master Plan Report on schedule in accordance with the work schedule.

2

N.T.

attendants list

Bangladesh Side

1.Mr.Md. Nurul Huda	Chairman, Local Panel of Experts, FPCO
2.Mr.A.M.M. Nurul Huq	Chief Engineer, FPCO
3.Mr.K.B.M.Shafiuddin	Superintending Engineer, FPCO
4.Mr.Emaduddin Ahmad	Executive Engineer, FPCO
5.Mr.Md.M.Delwar Hossain	Chief Engineer, RAJUK
6.Mr.Zakir Hossain	Dhaka Town Planner, RAJUK
7.Mr.Emdadul Islam	Executive Engineer
8.Mr.R. Nurul Hasan	Superintending Engineer, LGEB
9.Mr.Md. Morsed Alam	Senior Water Resources Specialist, LGEB
10.Mr.A.Quader Chondhuy	Superintending Engineer of Drainage, DWASA
11.Mr.Shafiul Islam	Additional Chief Engineer, DMC
12.Mr.Md. Afazuddin	Chief Engineer, NEZ, WDB

Japanese Side

1.Mr.Tadahiko Nakao	Team Leader
2.Mr.Tomoki Sato	Member(Cooperation Policy)
3.Mr.Muneo Sato	Member(Cooperation Planning)
4.Mr.Ryosuke Kikuchi	Member(River Planning)
5.Mr.Motoharu Sekizawa	Member(River Protection & Drainage)
6.Mr.Mitsuru Suemori	Member(Project Planning)
7.Mr.Itsu Adachi	Member(Coordinator)
8.Mr.Hitoshi Baba	Embassy of Japan
9.Mr.Takeshi Naruse	JICA Bangladesh Office

Panel of Experts

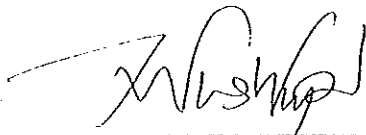
1.Mr.W.Van Allen	Panel of Expert
2.Mr.Hidetomi OI	Panel of Expert

2

N.T.

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

DHAKA, BANGLADESH, OCTOBER 25, 1990

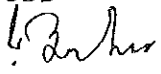


K. B. M. SHAFIUDDIN  
SUPERINTENDING ENGINEER  
FLOOD PLAN  
COORDINATION ORGANIZATION  
THE PEOPLE'S REPUBLIC  
OF BANGLADESH

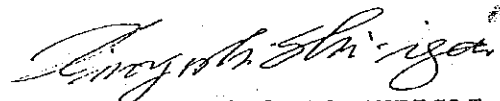


HAJIME TANAKA  
TEAM LEADER  
JICA STUDY TEAM  
JAPAN INTERNATIONAL  
COOPERATION AGENCY

Witness



EMADUDDIN AHMAD  
EXECUTIVE ENGINEER  
FPCO



DR. HIROYOSHI SHIIGAI  
CHAIRMAN  
ADVISORY COMMITTEE, JICA

Minutes of the Meeting for Greater Dhaka Protection Project  
(Study in Dhaka Metropolitan Area) of Bangladesh Flood Action  
Plan No. 8A. between JICA and FPCO on 25th October, 1990.

An Advisory Committee of Japan International Cooperation Agency headed by Dr. Hiroyoshi Shiigai and the members of the Study Team on Greater Dhaka Protection Project : FAP 8A discussed with the officials of Flood Plan Coordination Organization, (FPCO) BWDB, DMC, RAJUK, DOE, DWASA, LGEB on the draft Inception Report of the study from 23rd Oct. 90 to 25th Oct. 90 in Dhaka, Bangladesh. A list of the personnel attended the discussions are shown in annexure I. During discussions, the following points were raised and confirmed.

- 1) Agreed comments on the draft Inception report for incorporating changes at places are shown in Annexure II. The revised Inception Report will be prepared by JICA Study Team before 31st Oct. 1990 in the light of the discussion.
- 2) FPCO requested JICA to modify the tentative study schedule (shown in Fig. 3) to accommodate the important activities to be performed in Bangladesh in the spirit of sl. 4 of the minutes of the meeting on 21st June between FPCO & JICA. JICA agreed to consider the issue.
- 3) FPCO agreed to provide GOB personnel as per TAPP at the shortest possible time.
- 4) FPCO recalled the article 7 (1) of the minutes of meeting of 21st June '90 between FPCO and JICA and requested JICA study team to engage local Consultant. JICA agreed to engage local consultants and the consolidated assignment schedule will be submitted to FPCO at the earliest.
- 5) FPCO requested JICA to initiate the process of procurement of vehicles and equipment (as per list shown in TOR) under temporary importation policy through Project Pass Book (as per clause 7/2 of 21st June, 1990 minutes of the study) and keep FPCO informed. At the end of the Study JICA will donate the vehicles and equipments and GOB will make necessary arrangement of payment of Custom duty and Sales-Tax. JICA will inform on the procurement of vehicles and equipment after discussion with JICA headquarter.
- 6) FPCO & JICA jointly reconfirmed to abide by the clauses of Scope of Works and Minutes of Meeting signed on 21st June, 1990 of the study.

  
FPCO

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JICA

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## APPENDIX - I

## MEMBERS ATTENDED IN THE MEETING:

## GOB TEAM

	Name	Designation	Organization
1.	M. N. Huda	Chairman Local Specialist Panel	FPCO
2.	Prof. Ainun Nishat	Member PoE	FPCO
3.	K. B. M. Shafiuddin	SE	FPCO
4.	Abdul Quader Choudhury	SE	DWASA
5.	Md. Mehedi Ali Khan	SE	DMC
6.	Emaduddin Ahmad	EE	FPCO
7.	Emdadul Islam	EE	RAJUK
8.	A.K.M. Halimur Rahman	EE	BWDB
9.	Md. Moksed Alam	EE	LGEB
10.	Abu Taleb Khandaker	DD	DOE

## JICA TEAM

1.	Dr. Hiroyoshi Shiigai	Chairman Advisory Committee	JICA
2.	Itsu Adachi	Member	JICA
3.	Atsushi Suzuki	Member	JICA
4.	Takeshi Naruse	Deputy Rep.	JICA Dhaka
5.	Hajime Tanaka	Team Leader	JICA Study team
6.	Toshiaki Tokumasu	Deputy Team Leader	-do-
7.	Isao Misono	Member	-do-
8.	Takashi Furukawa	Member	-do-
7.	J. R. Jones	Member	-do-

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ANNEXURE II

Comments on the Draft Inception Report of Greater  
Dhaka Protection Project, FAP-8A.

- Page 1 2nd line from bottom  
Insert "in general" after "area"
- Page 2 3rd para, 2nd line  
May be rephrased as "several plans were prepared until  
1987"
- Page 2 last para 4th line  
Add after 'disaster'.  
  
Government of Bangladesh established a "Committee for  
Flood Control and Drainage of Greater Dhaka" and approved  
a major flood protection scheme in March 1989. Pending  
assistance from donors and in view of the urgent need for  
flood protection, the Government has undertaken some  
flood protection works in the western part of the  
metropolis (some 155 sq. km) involving construction of  
embankment/flood wall, regulators, road raising etc. from  
internal resources.
- Page 2 last para 4th line after "studies" add "of the  
International agencies"
- Page 3 5th line from top  
add after 'January 1990'  
  
The ADB financed "Dhaka City Integrated Flood Protection  
Project" (FAP-8B) includes 260 sqkm area covering current  
DMA area and the area in its immediate vicinity  
undergoing fast urbanization. It involves in the  
preparation of a feasibility for priority investments not  
covered under ongoing flood protection program comprising  
embankment roads, pumping station/sluices and improvement  
of drainage, slum areas, solid waste management and  
sanitation. ADB study will take into account the  
recommendations and conclusions of JICA master planning  
for flood control and drainage as well as pilot  
investment projects.  
  
It is thus necessary that JICA assisted study will  
maintain close contact with ADB study and vice versa and  
the two teams will keep access for each other in their  
findings through FPCO.
- Page 7 2.2 1st line  
add 'available' after 'All'  
Sl.(1) 'Aerial, photographs in 1:50,000'

- Page 8 bottom  
Add sl (10) Any other relevant studies
- Page 10  
Add above the last three lines  
long term effect of the flood damage both  
quantifiable and unquantifiable
- Page 11 (3) preparation of Topo Maps, 8th line delete the  
remaining after "carried out"  
4th para delete
- Page 11 (5) Survey for Environmental Aspects EIA based on mainly  
secondary data  
Add after environmental aspects "including slums"
- Page 13 (1) Target year  
target year will be 2020
- Page 13 4th & 3rd line from bottom rephrase as  
"peak level of 1988 or storm with 100 year return period  
or any other appropriate return period.
- Page 20 Sl.(3) delete 'living' and insert 'impact' after  
'Environmental'
- Page 20 End of Economic evaluation Para  
Add "The study team will also consider the proposed  
special Economic Evaluation guide lines if available."
- Page 24  
concerned agency may be replaced by 'GOB Study Team' with  
note on the compositions.
- Page 25 last para 2nd line delete 'together'  
3rd and 4th line  
delete and replace by "The GOB counterpart team will  
supervise, review, monitor and coordinate the study while  
the JICA expatriate and local consultants will implement  
the study as per agreed documents of scope of work and  
TOR. The schedule of GOB input is shown in Fig.5.
- Page 26 Final printing of Feasibility Report will be done in  
May'92 in Japan.
- Page 34  
List of data to be collected (Add as may be available)
- Page 36 Sl.(8)  
Add after "(O&M)" "flood protection and" delete "of"

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4.7 *[Handwritten initials]*

Minutes of the Meeting  
for  
Greater Dhaka Protection Project  
(Study in Dhaka Metropolitan Area)  
of Bangladesh Flood Action Plan No. 8A  
between JICA and FPCO on 20th December, 1990

The Advisory Committee of Japan International Cooperation Agency headed by Dr. Hiroyoshi Shiigai and the members of the Study Team on Greater Dhaka Protection Project: FAP 8A, discussed with the officials of Flood Plan Coordination Organization (FPCO), BWDB, DMC, FAJUK, DOE, DWASA, LGEB and SOB on a Draft Copy of Preliminary Review Report of the study from 19th Dec. 1990 to 20th Dec. 1990 in Dhaka, Bangladesh. A list of the personnel attended the discussion, are shown in Annex I.

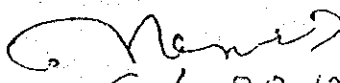
Draft copy of Preliminary Review Report was submitted by the JICA Study Team to the meeting. Mr. H. TANAKA, the Team leader of JICA study Team, explained the outline of the report and stressed the importance on timely selection of master plan study area.

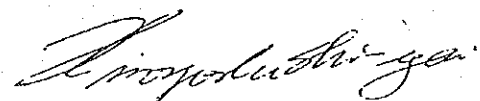
After discussions and comments, the draft report was received by FPCO. It was agreed by GOB counterpart team to furnish comments on the report by 23.12.90.

JICA will submit the final copy which will be made shortly with some changes incorporating the comments.

FPCO will send comments on this report to JICA collecting opinions of various Ministries and Agencies of GOB by the end of January, 1991.

This minutes of meeting has been signed on 20th December, 1990

  
5 / 20, 12, 90  
A.M.M. NURUL HUQ  
Chief Engineer  
Flood Plan  
Coordination Organisation

  
Dr. HIROYOSHI SHIIGAI  
Chairman  
Advisory Committee  
Japan International  
Cooperation Agency

## MEMBERS ATTENDED IN THE MEETING :

## GOB TEAM

Name	Designation	Organization.
1. M.N.Huda	Chairman, Local Specialist Panel.	FPCO
2. Prof. M.A.Hannan.	Member, PoE	FPCO
3. Prof. Ainun Nishat	Member PoE	FPCO
4. Mr. A.M.M.Nurul Huq	Chief Engineer.	FPCO
5. Mr. K.B.M.Shafiuddin	S.E.	FPCO
6. Mr. Farhad Hussain.	Executive Engineer.	RHD
7. Mr. Emaduddin Ahmad	Executive Engineer	FPCO
8. Mr. Emdadul Islam	Executive Engineer	RAJUK
9. Mr. A.K.M.Halimur Rahman.	Executive Engineer.	BWDB.
10. Md. Harun	Executive Engineer.	BWDB
11. Mr. Abu Taleb Khandaker	Dy. Director.	DOE
JICA TEAM :		
1. Dr. Hiroyoshi Shiigai	Chairman Advisory Committee	JICA
2. Mr. Hidetomi Ol	Panel of Expert.	
3. Hiroshi Enomoto	Coordinator	JICA.
4. Mr. Hitoshi Baba	Embassy of Japan.	
5. Takeshi Naruse	Deputy Rep.	JICA Dhaka.
6. Mr. Hajime Tanaka	Team Leader	JICA Study Team
7. Toshiaki Tokumasu	Deputy Team Leader	-do-
8. Isao Misono	Member	-do-
9. J.R.Jones	Member	-do-

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20.12.90

20.12.1990

Minutes of the meeting for Greater Dhaka Protection Project of Bangladesh Flood Action Plan No.8A between JICA and FPCO on 21st March, 1991.

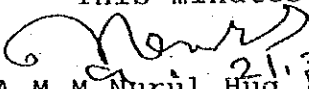
The Advisory Team of Japan International Co-operation Agency headed by Mr.HIDETOMI OI and the members of the Study Team on Greater Dhaka Protection Project: FAP-8A, discussed with the officials of Flood Plan Co-ordination Organisation (FPCO) PoE(L&E), BWDB, RAJUK, UDD, DoE, RHD, HSD and consultants of FAP-8B on the Interim Report (summary and main report) of the study on 20th March and 21st March, 1991 in Dhaka, Bangladesh. A list of personnel attended the discussion meeting are shown in Annex-I.

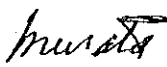
Interim Report was presented by Mr.Naohito MURATA, the Team Leader of JICA Study Team. He explained the main part of the report and pointed out the basic idea, standard and criteria for formulation of the Master Plan of the study area.

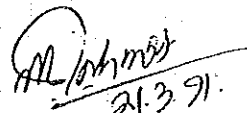
During discussions various points were raised on Interim report from representatives of various organisations, PoE(L&E) and consultants of FAP-8B. Finally it was agreed that comments from different Ministries & Agencies will be collected very soon. JICA Study Team will submit the final copy within a short time incorporating the comments received from GOB side.


GOB side pointed out that some of the members of the JICA Study Team should work in Bangladesh during April & May, 91. JICA Advisory Team informed that they will take up the matter with Head office in Tokyo.

This minutes of the meeting has been signed on 21st March, 1991.

  
( A.M.M. Nurul Haq )  
Chief Engineer  
Flood Plan Co-ordination  
Organisation.

  
( N. MURATA )  
Team Leader  
JICA Study Team  
Greater Dhaka Protection Project-

  
Witness : (A.K.M. Halimur Rahman)  
Superintending Engineer,  
Flood Plan Co-ordination  
Organisation.

  
Witness : (HIDETOMI OI )  
Member  
JICA Advisory Team.

## MEMBERS ATTENDED IN THE MEETING

<u>Name</u>	<u>Designation</u>	<u>Organisation</u>
1. M.N.Huda	Chairman, Local Specialist Panel	FPCO
2. A.M.M.Nurul Hug	Chief Engineer	FPCO
3. A.K.M.Halimur Rahman	Superintending Engineer	FPCO
4. Md.Abdur Rahman	Superintending Engineer	BWDB
5. Md.forhad Hussain	Executive Engineer	Roads & Highways Deptt.
6. Md.Emdadul Islam	Executive Engineer	RAJUK
7. Joynul Abedin Khan	Executive Engineer	Housing & Settlement Directorate.
8. M.Anwarul Islam	Deputy Director	Deptt.of Environment
9. Alauddin Ahmed	Deputy Director	URBAN DEV.DTE.
10. J.Dempster	Chairman, Panel of Experts(expatriate)	FPCO
11. Van Ellen	Panel of Experts(E)	FPCO
12. Dr.Ainun Nishat	Panel of Experts(L)	FPCO
13. Dr.M.S.Zaman	Institutional Specialist	FPCO/UNDP
14. Mr.Emdad Ali	Local Consultant	FPCO
15. Nurul Absar	Local Consultant	FPCO
16. Md.Badiuzzaman	Morphological Engineer Local Consultant	FPCO
17. Dr.Asad Ali Shah	Sr.Urban Dev.Specialist	Asian Dev.Bank
18. R.D.Berlin	Team Leader, FAP-8B	Louis berger International Inc.
19. Max Williams	Hydraulic Engineer, FAP-8B	"
20. Shaheedul Islam	Flood Control, Planning Engineer FAP-8B.	"

## JICA TEAM

1. HIDETOMI OI	Advisory Team	JICA
2. HIROSHI ENOMOTO	Coordinator	JICA
3. TAKESHI NARUSE	Deputy Representative	JICA Dhaka office
4. N.MURATA	Team Leader	JICA STUDY Team, FAP-8A
5. T.Tokumasu	deputy Team Leader	do
6. I.MISONO	Flood Prevention Engr.	do
7. N.Ishibashi	Socio-Economist	do
8. Dr.S.Jayamohon	Environmental Engineer	do

Minutes of the Meeting  
for  
Greater Dhaka Protection Project  
(Study in Dhaka Metropolitan Area)  
Of Bangladesh Flood Action Plan No. 8A  
Between JICA and FPCO on 28th July, 1991.

The Advisory Committee of Japan International Cooperation Agency, headed by Dr. Hiroyoshi Shiigai and the members of the study team on Greater Dhaka Protection Project, FAP 8A, discussed with the officials of Flood Plan Co-ordination Organization (FPCO), POE(L), BWDB, RAJUK, DCC, DOE, HSD, RHD, LGEB, WORLD BANK AND Consultants of FAP-8B, Dhaka Integrated Flood Protection Project, the copy of Draft Master Plan (summary, main report and supporting report) of the study on 28th July 1991 in FPCO office, Dhaka, Bangladesh. A list of the personnel attended the discussion are shown in Annex I.

A draft copy of the draft Master Plan Report was submitted by the JICA study team to the meeting. Mr. Hajime Tanaka, the team leader of the JICA study team, explained the outline of the Master Plan and priority areas for the Feasibility Study. During the discussion some observation were made by the participants. The JICA study team will submit the Draft Master Plan by the 1st week of August, 1991 after incorporating the comments made during the discussion.

FPCO will collect the additional comments of various ministries and agencies of GOB and send them to JICA by the end of August, 1991.

During the discussion GOB expressed its satisfaction to Draft Master Plan in principle and the following points were raised:

1. The JICA study team have proposed the priority areas as follows:

1st Priority Area:

- Greater Dhaka West
- Greater Dhaka East
- Narayanganj DND
- Narayanganj West.

2nd Priority Area:

- Tongi
- Keranigonj

3rd Priority Area:

- Narayanganj East
- Savar



The JICA study team recommended Greater Dhaka East and DND for the F/S areas, as the priority area of Dhaka West has been taken by ADB financed consultants, FAP 8B.

GOB, however, requested the inclusion of Narayanganj West and Kamrangir Char for the F/S areas instead of DND.

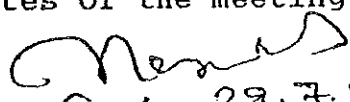
The JICA study team expressed their opinion that Kamrangir Char belongs to the side of Greater Dhaka West area, and that appropriate data on both Narayanganj West and Kamrangir Char are not fully available for feasibility study. The JICA study team still recommends DND instead of Narayanganj West and Kamrangir Char for the F/S area. However this will be finalised after August, 1991.

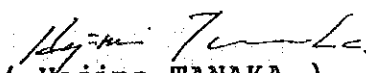
2. Although DOE requested a full scale EIA in the F/S, the JICA study team expressed its difficulties to prepare a full scale EIA for the F/S, because it is beyond the scope of works agreed upon between GOB and JICA, and also not planned in the Inception Report (FAP 8A).

The JICA study team, however, expressed that the F/S will cover assessment of environmental impacts based on the secondary data.


3. The necessity of more detailed information supplied from FAP 8B to FAP 8A was confirmed. The Plan proposed by FAP 8B in its Interim Report No.-I is confirmed in the draft Master Plan.
4. Importance of continuous presence of the JICA study team in Dhaka was stressed by GOB side.
5. Possibility of more intensive use of local consultants was also stressed by GOB side.

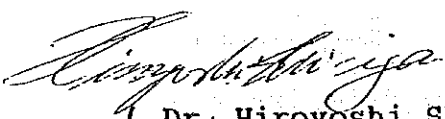
The minutes of the meeting was signed on 29th July, 1991.

  
( A. M. M. Nurul Haq )  
Chief Engineer,  
Flood Plan Coordination  
Organization.

  
( Hajime TANAKA )  
Team Leader,  
JICA Study Team  
Greater Dhaka Protection Project

Witness

  
( A. K. M. Hafimur Rahman )  
Superintending Engineer  
Flood Plan Coordination  
Organization

  
( Dr. Hiroyoshi SHIIGAI )  
Chairman  
Advisory Committee  
Japan International  
Cooperation Agency.

## MEMBERS ATTENDED IN THE MEETING

Sl. No.	Name	Designation	Organisation
1.	M. N. Huda	Chairman, Local Specialist Panel	FPCO
2.	A. M. M. Nurul Huq	Chief Engineer	FPCO
3.	A. K. M. Halimur Rahman	Superintending Engineer	FPCO
4.	Md. Masud Ahmed	Sub-Divisional Engineer	FPCO
5.	Md. Abdur Rahman	Superintending Engineer	BWDB
6.	Md. Yusuf Harun	Executive Engineer	BWDB
7.	Md. Mehdi Ali Khan	Superintending Engineer	D.C.C
8.	Emdadul Islam	Executive Engineer	RAJUK
9.	Md. Forhad Hussain	Executive Engineer	RHD
10.	M. Anwarul Islam	Deputy Director	DOE
11.	Joynul Abedin Khan	Executive Engineer	HSD
12.	Abdullah	Sub-Divisional Engineer	HSD
13.	Ross Wallace	Co-ordinator	World Bank
14.	Max Williams	Acting Project Manager FAP-8B	Louis Berger International Inc.
<b>JICA TEAM</b>			
1.	Dr. Hiroyoshi Shiigai	Chairman, Advisory Committee	JICA, Tokeyo
2.	Motohauce Sekizawa	Advisory Committee	JICA, Tokyo
3.	Hiroshi Enomoto	Co-ordinator	JICA, Tokyo
4.	Hajime Tanaka	Team Leader	JICA StudyTeam
5.	Toshiaki Tokamasu	Deputy Team Leader	JICA StudyTeam
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