

- (7) Record of Discussion of the First Meeting of the Joint Committee for Joint Inspection and Monitoring of the Sharing of the Ganga/Ganges Waters at Farakka under the Treaty of December 1996





**542. Record of Discussion of the first meeting of the Joint Committee for Joint Inspection and Monitoring of the sharing of the Ganga/Ganges Waters at Farakka under the Treaty of December 1996.**

**Dhaka, December 24, 1996**

1. The Joint Committee for the Joint Inspection and Monitoring of the sharing of the Ganga/Ganges waters at Farakka constituted by the Governments of Bangladesh and India in pursuance of the Treaty on sharing of the Ganga/Ganges waters at Farakka signed on 12th December, 1996 (Appendix-I)<sup>2</sup> for the first meeting on 24th December, 1996 at Dhaka.
  2. The meeting was attended by Mr. N.V.V. Char, Commissioner (ER) and Chairman, Joint Committee, Indian side and Mr. Md. Lutfur Rahman, Member Indo-Bangladesh Joint Rivers Commission and Chairman, Joint Committee Bangladesh side, Mr. Khalilur Rahman, Director, Joint Rivers Commission Bangladesh side, and Mr. Tauhidul Anwar Khan, Joint Commissioner JRC Bangladesh and Members, Joint Committee Bangladesh side, Mr. Debashis Chakravarti, Counsellor (Political), High Commission of India and Dr. Air. Nishat, Professor, Water Resources, Engineering Department, BUET and Member, Indo-Bangladesh Joint Rivers Commission attended the meeting on special invitation.
  3. The following Agenda of the Meeting was adopted:
    - i) Procedures and method of functioning of the Joint Committee.
    - ii) Procedures for sharing of the Ganga/Ganges waters at Farakka.
    - iii) Setting up of the teams at Farakka and Hardinge Bridge.
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1. Meanwhile, welcoming the Treaty, a statement issued by the Official Spokesman of the United States Department of State on December 13 said: "The United States welcomes the signing of the agreement on sharing the water of the Ganges river between India and Bangladesh on December 12 in New Delhi. The accord, signed by the Prime Ministers of the two countries was a fine example of amicable resolution of a formerly contentious issue between the neighbours. Besides the immediate benefits to the two signatories, we believe the agreement augurs well for greater bilateral and regional cooperation among all the nations of South Asia. This is a positive step forward".
  2. Document No. 533.

- iv) Guidelines of functioning of the observation team at Farakka(India).
  - v) Guidelines for functioning of the observation team at Hardinge Bridge (Bangladesh).
  - vi) Selection of sites and procedures for location of verticals for discharge observations.
  - vii) Programme for next meeting.
  - viii) Any other item.
- 4. Procedure and method of functioning of the Joint Committee:**
- 4.1 the Joint Committee discussed the matter and decided to adopt the procedure and method of functioning as given in Appendix-II.
- 5. Procedure for Sharing of the Ganga/Ganges Waters at Farakka:**
- 5.1 The Joint Committee discussed various aspects and decided to adopt the procedure for sharing of the water of the Ganga/Ganges at Farakka as given in Appendix-III.
- 6. Setting up of Teams at Farakka and Hardinge Bridge:**
- 6.1 The Joint Committee decided to set up teams at Farakka and Hardinge Bridge to observe and record the daily flows below Farakka Barrage in the river Ganga/Ganges, in the Feeder Canal and in the Navigation Lock as and when it is operated as well as at Hardinge Bridge as given in Appendix-IV.<sup>1</sup>
- 6.2 The Bangladesh side proposed that four of their official should be stationed at Farakka to observe and record at Farakka the daily flows below Farakka Barrage, in the Feeder Canal and in the Navigation Lock whenever it is operated. The Indian side proposed that two of their officials be stationed at Hardinge Bridge to observe and record at Hardinge Bridge the daily flows of Ganga / Ganges river.
- 7. Guidelines for Functioning of the Observation team at Farakka (India):**
- 7.1 The Joint Committee discussed and decided to adopt the guidelines for functioning of the observation team at Farakka (India) as given in Appendix-V.<sup>1</sup>
- 8. Guidelines for Functioning of the Observation Team at Hardinge Bridge (Bangladesh):**
- 8.1 The Joint Committee discussed and decided to adopt the guidelines for functioning of the observation team at Hardinge Bridge (Bangladesh) as given in Appendix-VI.<sup>1</sup>

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1. Not reproduced here.

## 9. Selection of Sites

- 9.1 The Joint Committee decided unanimously that joint observations at the permanent site 1030m downstream of Farakka Barrage may continue till such time the Indian side placed before the Joint Committee the cross section, H.V.D., V.V.D. and mass curves for observation sites at 1030m 1230m 1430m and 1804m downstream of barrage, L.C.T. Ghat and an index plan of the Farakka reach on the Ganga/Ganges for their Consideration. The Joint Committee also agreed that discharge observation in the Feeder Canal may be carried out at the permanent site 535m downstream of the Head Regulator till the need for an alternate site arises.
- 9.2 The Joint Committee decided that Joint Observation may continue at the permanent site 2500ft. upstream of the Hardinge Bridge where the river is flowing in one channel till such time the Bangladesh side placed before the Joint Committee in the next meeting the cross-sections survey data at the permanent site, 2500ft. upstream of Hardinge Bridge, at two more sites 6000 ft. and 8000 ft. upstream of the bridge, mass curves, V.V.D., and H.V.D. along with an index map of the Ganga/Ganges of the reach upstream of the Hardinge Bridge for their consideration.
- 9.3 It was decided in the meeting that the Indian side would consider installation of automatic gauges at Farakka in the Feeder Canal and in the Ganga/Ganges. It was also decided that Bangladesh side would consider installing an automatic gauge in the Ganga/Ganges at Hardinge Bridge.
10. The site at the Navigation Lock and method of observing discharge or accounting the water drawn for Navigation Lock shall be decided by site inspection by the joint teams.

## 11. Annual Report

The contents of the yearly report to be submitted by the Joint Committee to the two Governments was discussed and it was agreed that:

- (a) The Report should be a joint one and would include all the data collected by the Joint Committee.
- (b) The Report should include a table showing the flows recorded during various ten-day periods from January 1-10 to May 21-31, the flows reaching Farakka withdrawal by India at Farakka and release to Bangladesh.
- (c) The Report should include a table showing the flows recorded at Hardinge Bridge during various ten-day periods from January 1-10 to May 21-31.

- (d) The Records of Discussions of the various meetings of the Committee held during the year under review would also be included as Annexures to the Report.

**12. Programme for Next Meetings:**

The Joint Committee decided that the next meeting and visit of the Committee would be held at Dhaka/Hardinge bridge in January, 1997. The Bangladesh side of the Joint Committee would also visit Farakka in end January, 1997.

Dated Dhaka, the 24th December, 1996.

(Md. Lutfur Rahman)

(N.V.V. Char)

**Appendix-II**

**Procedure and Method of Functioning of the Joint Committee for Joint Inspection and Monitoring of the Sharing of the Ganga/Ganges Waters at Farakka under the Treaty of 12th December, 1996**

The meetings of the Joint Committee shall generally take place thrice a year around December/January, March and July. The Joint Committee shall also inspect the observation sites in India and Bangladesh at least once during each dry season according to the convenience of both the Governments.

2. The meetings may generally take place alternately in the two countries subject to the convenience of both the Governments.
3. The meetings of the Joint Committee shall be closed meetings.
4. The decisions and/or recommendations of the Joint Committee shall be unanimous.
5. The record of discussions shall be drawn up at the end of each meeting/visit.
6. The Joint Committee shall discuss and finalise its Annual Report for submission to the two Governments in its meeting in July each year.
7. The Joint Committee shall review and finalise arrangements for implementation of the provisions on the sharing between India and Bangladesh of the Ganga/Ganges waters at Farakka by ten-day periods from the 1st January to the 31st May every year with reference to the formula at Annexure-I and an indicative schedule giving the implications of the sharing arrangements under Annexure-1 at Annexure-2 of Appendix-I, before the start of Joint observation every year. The Joint Committee shall examine the river surveys conducted after the monsoon for deciding the most suitable observation sites both at Farakka (India) and Hardinge bridge (Bangladesh).

8. All correspondence between the two sides on the implementation of the arrangements contained in the Indo-Bangladesh Treaty of December, 1974 and in examining any difficulty arising out of the implementation of sharing arrangements and of the operations of the Farakka Barrage shall be carried out by the two Chairmen and Members designated by them.
9. The Joint Committee may co-opt or invite officials of either country mutually agreed upon to assist it on any specific issue(s).
10. The Joint Committee shall establish teams to be stationed at Farakka and Hardinge Bridge to observe and record at Farakka the daily flows below Farakka Barrage, in the Feeder Canal and at the Navigation Lock as well as at Hardinge Bridge. One of the officials from Indian team and one from the Bangladesh team at each of the two-observation sites—Farakka and Hardinge Bridge, would be designated as Team Leaders.
11. On receipt of any complaint/complaints from the Leader of the Teams of either country stationed at Farakka and at Hardinge Bridge, the Joint Committee on being requested by the Chairman of either country shall hold a meeting within 10 days of receipt of such request at the station of the origin of complaint/complaints, examine and settle them in an expeditious manner.
12. Pending settlement of the differences or disputes, the Joint observation shall continue at the respective stations. However, objections raised by the Team Leader shall be simply noted in the remarks column of the Daily Discharge/Stream flows observation sheet.
13. On receipt of report from the Team Leaders at Farakka in any event of Ganges flow at Farakka falling below 50,000 cusecs in any 10-day period, the Joint Committee would immediately report to the two Governments for entering into immediate consultations to make adjustments on an emergency basis.
14. If there are any difficulties in holding such meetings by any Chairman, the member of the Joint Committee designated by the respective Chairman shall carry out his functions and settle the differences. If the differences are not resolved, the Chairman of the two sides shall meet within 10-days of receipt of notice from either of them. If the difference or dispute remains still unresolved these shall be referred to the Indo-Bangladesh Joint Rivers Commission. If the difference or dispute still remains unsolved, it shall be referred to the two Governments which shall meet urgently at the appropriate level to resolve it by mutual discussions.
15. The Joint Committee may from time to time review its procedure and method of functioning and modify them as may be mutually agreed upon.

### Appendix-III

#### Procedure for Sharing of the Ganga/Ganges Waters At Farakka (India)

The sharing of the flows of the Ganga/Ganges actually available at Farakka between Bangladesh and India will be effected by releases through the Farakka Barrage, the Feeder Canal Head Regulators and the Navigation Lock by adjustment of the gates of the Barrage and the Head Regulator and operation of the Navigation Lock by the Farakka Project Authorities. The Engineer-in-charge of the head works (hereinafter called the Engineer) will inform the Indian side of the Team in writing, in duplicate, of the estimated flows through the Feeder Canal Head Regulator, the Barrage and the Navigation Lock, whenever he makes adjustments in the discharges to the Feeder Canal, operates the Navigation Lock and to the Ganga/Ganges. If, however, no adjustments and operations are made, it shall also be so indicated in writing, in duplicate. The teams of the Joint Committee stationed at Farakka will conduct discharge observations in the Feeder Canal and the Ganga/Ganges below the Farakka Barrage and compute the daily mean flows by using such observed data and the information on adjustments in estimated discharges and operation of the Navigation Lock (whenever operated) sent by the Engineer-in-charge of the headworks to the Indian side of the team. Performa for the use of the team and of the Engineer are given in the Annexure "A", "B", "C" and "D".

2. The team shall conduct discharge observations everyday between 0800 hours and 1400 hours (which may be advanced by an hour or so as mutually convenient) and compute the discharge at Farakka through the Feeder Canal and in the Ganga/Ganges below the Barrage and at the Navigation Lock whenever operated. The observed data of the sites thus computed will be added and presented in the form of a table (Annexure "A") showing therein the total flow reaching Farakka, measured flows in the Feeder Canal, and in the Navigation Lock whenever operated and the measured flow in the Ganga/Ganges, the shares of the two countries according to the Treaty, December, 1996. The share for each day is provisionally derived by applying the share applicable to each country in that 10-day period, and then the adjustments of the respective discharge could be suggested taking also into account the discharges during the proceeding 24 hours calculated as indicated in the Annexure "A". The tabulated information will be sent by the Indian side of the Team to the Engineer, who will check up the computation for the shares, and make adjustments aimed at releasing the due shares in the Ganga/Ganges and the Feeder Canal and send to the Indian side of the Team the information on the estimated discharges in the form indicated in Annexure "B".
3. The Engineer shall also send to the Indian side of the team at 0800 hours every day the estimated releases made by him incorporating adjustments in



the respective discharges during the period beyond 1400 hours of the previous day and 0800 hours of the day, in writing, in duplicate, in the form indicated in Annexure "C".

4. The team shall integrate the daily mean flows by using the observed data and data on adjustments of respective discharges received by the Indian side of the team from the Engineer. It will compute any excesses over or shortages from the due shares during the previous 24 hours and suggest the needed adjustments of releases during the remaining period of the day before the observations starts the next day, in the appropriate columns in Annexure "A".
5. The team will observe gauges at Farakka in the Feeder Canal and in the Ganga/Ganges below the Farakka Barrage at 0800 hours, 1200 hours, 1600 hours., 2000 hours and 2400 hours., regularly and copies of these data will be furnished by the Indian side of the team to the Engineer at 1400 hours every day, in the form specified in Annexure "D".
6. The team shall furnish, in duplicate, to the Joint Committee the statements of observed flows, and the information on estimated releases received from the Engineer by the Indian side every day and other observed water level data and the computed daily mean flows. One copy shall be sent to Dhaka and the other to New Delhi. It shall also submit a statement, in duplicate, of mean flows for each 10-day period on the expiry of each 10-day period, and one copy of this shall be sent to Dhaka and the other to New Delhi. All such statements should be signed by the two officials of Bangladesh and India comprising the team at Farakka designated for the purpose.
7. On Sundays and Holidays, no discharge observations will be conducted at Farakka. However, water level gauges will be recorded by the Team at the hours mentioned in Para 5 above at Farakka in the Feeder Canal and the Ganga/Ganges below the Farakka barrage. The Engineer shall also inform, in writing in duplicate, to the Indian side of the team the estimated releases made by him to the Feeder Canal and through the Navigation Lock whenever operations and Ganga/Ganges river below Farakka Barrage by operations with times noted therein on those days. The Engineer on non-observation days should make his own estimate of the releases in the Feeder Canal and the Ganga/Ganges below the Farakka Barrage between 0800 hours and 1400 hours and this should be considered as the observed discharge and used for computational purposes on the next day.
8. All initial records shall be made in quadruplicate and signed by the two designated officials from the countries and be preserved by these officials (one with each) of the team as part of the Joint Committee.
9. One copy of each official communication from the Engineer to the India

member of the team shall be furnished to the Bangladesh side of the Team as official record.

- D.** Nothing stated herein shall be deemed to restrict in anyway judgment and liberty of the Farakka Barrage Authority to take such actions as are appropriate in the interest of the safety of the Barrage, Canal and ancillary structures and extraordinary situation, as also for construction and maintenance purpose.

(8) The Helsinki Rules on the Use of the Waters of  
International Rivers



## The Helsinki Rules on the Uses of the Waters of International Rivers

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### CHAPTER 1. GENERAL

#### Article I

The general rules of international law as set forth in these chapters are applicable to the use of the waters of an international drainage basin except as may be provided otherwise by convention, agreement or binding custom among the basin States.

#### Article II

*An international drainage basin is a geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus.*

#### Article III

A "basin State" is a State the territory of which includes a portion of an international drainage basin.

### CHAPTER 2. EQUITABLE UTILIZATION OF THE WATERS OF AN INTERNATIONAL DRAINAGE BASIN

#### Article IV

Each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.

#### Article V

I. What is a reasonable and equitable share within the meaning of article IV to be determined in the light of all the relevant factors in each particular case.

II. Relevant factors which are to be considered include, but are not limited to:

1. The geography of the basin, including in particular the extent of the drainage area in the territory of each basin State;
2. The hydrology of the basin, including in particular the contribution of water by each basin State;
3. The climate affecting the basin;
4. The past utilization of the waters of the basin, including in particular existing utilization;
5. The economic and social needs of each basin State;
6. The population dependent on the waters of the basin in each basin State;
7. The comparative costs of alternative means of satisfying the economic and social needs of each basin State;
8. The availability of other resources;
9. The avoidance of unnecessary waste in the utilization of waters of the basin;
10. The practicability of compensation to one or more of the co-basin States as a means of adjusting conflicts among uses; and

11. The degree to which the needs of a basin State may be satisfied, without causing substantial injury to a co-basin State.

III. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is reasonable and equitable share, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

#### Article VI

A use or category of uses is not entitled to any inherent preference over any other use or category of uses.

#### Article VII

A basin State may not be denied the present reasonable use of the waters of an international drainage basin to reserve for a co-basin State a future use of such waters.

#### Article VIII

1. An existing reasonable use may continue in operation unless the factors justifying its continuance are outweighed by other factors leading to the conclusion that it be modified or terminated so as to accommodate a competing incompatible use.
2. (a) A use that is in fact operational is deemed to have been an existing use from the time of the initiation of construction directly related to the use or, where such construction is not required, the undertaking of comparable acts of actual implementation.  
(b) Such a use continues to be an existing use until such time as it is discontinued with the intention that it be abandoned.
3. A use will not be deemed an existing use if at the time of becoming operational it is incompatible with an already existing reasonable use.

### CHAPTER 3. POLLUTION

#### Article IX

As used in this chapter, the term "water pollution" refers to any detrimental change resulting from human conduct in the natural composition, content, or quality of the waters of an international drainage basin.

#### Article X

1. Consistent with the principle of equitable utilization of the waters of an international drainage basin, a State:
  - (a) Must prevent any new form of water pollution or any increase in the degree of existing water pollution in an international drainage basin which would cause substantial injury in the territory of a co-basin State;
  - (b) Should take all reasonable measures to abate existing water pollution in an international drainage basin to such an extent that no substantial damage is caused in the territory of a co-basin State.
2. The rule stated in paragraph 1 of this article applies to water pollution originating:
  - (a) Within a territory of the State, or

(b) Outside the territory of the State, if it is caused by the State's conduct.

#### Article XI

1. In the case of a violation of the rule stated in paragraph 1 (a) of article X of this chapter, the State responsible shall be required to cease the wrongful conduct and compensate the injured co-basin State for the injury that has been caused to it.
2. In a case falling under the rule stated in paragraph 1 (b) of article X, if a State fails to take reasonable measures, it shall be required promptly to enter into negotiations with the injured State with a view towards reaching a settlement equitable under the circumstances.

#### CHAPTER 4 . NAVIGATION (Articles XII-XX)

#### CHAPTER 5. TIMBER FLOATING (ArticlesXXI-XXV)

#### CHAPTER 6. PROCEDURES FOR THE PREVENTION AND SETTLEMENT OF DISPUTES

#### Article XXVI

This chapter relates to procedures for the prevention and settlement of international disputes as to the legal rights or other interests of basin States and of other States in the waters of an international drainage basin.

#### Article XXVII

Consistently with the Charter of the United Nations, States are under an obligation to settle international disputes as to their legal rights or other interests by peaceful means in such a manner that international peace and security and justice are not endangered.

It is recommended that States resort progressively to the means of prevention and settlement of disputes stipulated in articles XXIX to XXXIV of this chapter.

#### Article XXVIII

1. States are under a primary obligation to resort to means of prevention and settlement of disputes stipulated in the applicable treaties binding upon them.
2. States are limited to the means of prevention and settlement of disputes stipulated in treaties binding upon them only to the extent provided by the applicable treaties.

#### Article XXIX

1. With a view to preventing disputes from arising between basin States as to their legal rights or other interest, it is recommended that each basin State furnish relevant and reasonably available information to the other basin States concerning the waters of a drainage basin within its territory and its use of, and activities with respect to, such waters.
2. A State, regardless of its location in a drainage basin, should in particular furnish to any other basin State, the interests of which may be substantially affected, notice of any proposed construction or installation which would alter the regime of the basin in a way which might give rise to a dispute as defined in article XXVI. The notice should include such essential facts as will permit the recipient to make an assessment of the probable effect of the proposed alteration.
3. A State providing the notice referred to in paragraph 2 of this article should afford the recipient a reasonable period of time to make an assessment of the probable effect of the proposed construction or installation and to submit its views thereon to the State furnishing the notice.
4. If a State has failed to give the notice referred to in paragraph 2 of this article, the alteration by

the State in the regime of the drainage basin shall not be given the weight normally accorded to temporal priority in use in the event of a determination of what is a reasonable and equitable share of the waters of the basin.

#### Article XXX

In case of a dispute between States as to their legal rights or other interests, as defined in article XXVI, they should seek a solution by negotiation..

#### Article XXXI

1. If a question or dispute arises which relates to the present or future utilization of the waters of an international drainage basin, it is recommended that the basin States refer the question or dispute to a joint agency and that they request the agency to survey the international drainage basin and to formulate plans or recommendations for the fullest and most efficient use thereof in the interests of all such States.
2. It is recommended that the joint agency be instructed to submit reports on all matters within its competence to the appropriate authorities of the member States concerned.
3. It is recommended that the member States of the joint agency in appropriate cases invite non-basin States which by treaty enjoy a right in the use of the waters of an international drainage basin to associate themselves with the work of the joint agency or that they be permitted to appear before the agency.

#### Article XXXII

If a question or a dispute is one which is considered by the States concerned to be incapable of resolution in the manner set forth in article XXXI, it is recommended that they seek the good offices, or jointly request the mediation of a third State, of a qualified international organization or of a qualified person.

#### Article XXXIII

1. If the States concerned have not been able to resolve their dispute through negotiation or have been unable to agree on the measures described in articles XXXI and XXXII, it is recommended that they form a commission of inquiry or an ad hoc conciliation commission, which shall endeavor to find a solution, likely to be accepted by the States concerned, of any dispute as to their legal rights.
2. It is recommended that the conciliation commission be constituted in the manner set forth in the annex.

#### Article XXXIV

It is recommended that the States concerned agree to submit their legal disputes to an ad hoc arbitral tribunal, to a permanent arbitral tribunal or to the International Court of Justice if:

- (a) A commission has not been formed as provided in article XXXIII, or
- (b) The commission has not been able to find a solution to be recommended, or
- (c) A solution recommended has not been accepted by the States concerned, and
- (d) An agreement has not been otherwise arrived at.

#### Article XXXV



It is recommended that in the event of arbitration the States concerned have recourse to the Model Rules on Arbitral Procedure prepared by the International Law Commission of the United Nations at its tenth session b/in 1958.

Article XXXVI

*Recourse to arbitration implies the undertaking by the States concerned to consider the award to be given as final and to submit in good faith to its execution.*

Article XXXVII

The means of settlement referred to in the preceding articles of this chapter are without prejudice to the utilization of means of settlement recommended to, or required of, members of regional arrangements or agencies and of other international organizations.

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*a/ Adopted by the International Law Association at the fifty-second conference, held at Helsinki in August 1966. Report of the Committee on the Uses of the Waters of International Rivers (London, International Law Association, 1967).*

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- (9) Convention on the Law of the Non-Navigational Uses of International Watercourses (21 May 1997, New York)



**Convention on the Law of the Non-Navigational Uses of International Watercourses (21 May 1997, New York).**

*Text*

The Parties to the present Convention,

Conscious of the importance of international watercourses and the non-navigational uses thereof in many regions of the world,

Having in mind Article 13, paragraph 1 (a), of the Charter of the United Nations, which provides that the General Assembly shall initiate studies and make recommendations for the purpose of encouraging the progressive development of international law and its codification,

Considering that successful codification and progressive development of rules of international law regarding non-navigational uses of international watercourses would assist in promoting and implementing the purposes and principles set forth in Articles 1 and 2 of the Charter of the United Nations,

Taking into account the problems affecting many international watercourses resulting from, among other things, increasing demands and pollution,

Expressing the conviction that a framework convention will ensure the utilization, development, conservation, management and protection of international watercourses and the promotion of the optimal and sustainable utilization thereof for present and future generations,

Affirming the importance of international cooperation and good-neighbourliness in this field,

Aware of the special situation and needs of developing countries, Recalling the principles and recommendations adopted by the United Nations Conference on Environment and Development of 1992 in the Rio Declaration and Agenda 21,

Recalling also the existing bilateral and multilateral agreements regarding the non-navigational uses of international watercourses,

Mindful of the valuable contribution of international organizations, both governmental and non-governmental, to the codification and progressive development of international law in this field,

Appreciative of the work carried out by the International Law Commission on the law of the non-navigational uses of international watercourses,

Bearing in mind United Nations General Assembly resolution 49/52 of 9 December 1994,

Have agreed as follows:

## PART I. INTRODUCTION

### Article 1 Scope of the present Convention

1. The present Convention applies to uses of international watercourses and of their waters for purposes other than navigation and to measures of protection, preservation and management related to the uses of those watercourses and their waters.
2. The uses of international watercourses for navigation is not within the scope of the present Convention except insofar as other uses affect navigation or are affected by navigation.

### Article 2 Use of terms

For the purposes of the present Convention:

- (a) "Watercourse" means a system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus;
- (b) "International watercourse" means a watercourse, parts of which are situated in different States;
- (c) "Watercourse State" means a State Party to the present Convention in whose territory part of an international watercourse is situated, or a Party that is a regional economic integration organization, in the territory of one or more of whose Member States part of an international watercourse is situated;
- (d) "Regional economic integration organization" means an organization constituted by sovereign States of a given region, to which its member States have transferred competence in respect of matters governed by this Convention and which has been duly authorized in accordance with its internal procedures, to sign, ratify, accept, approve or accede to it.

### Article 3 Watercourse agreements

1. In the absence of an agreement to the contrary, nothing in the present Convention shall affect the rights or obligations of a watercourse State arising from agreements in force for it on the date on which it became a party to the present Convention.

2. Notwithstanding the provisions of paragraph 1, parties to agreements referred to in paragraph 1 may, where necessary, consider harmonizing such agreements with the basic principles of the present Convention.

3. Watercourse States may enter into one or more agreements, hereinafter referred to as "watercourse agreements", which apply and adjust the provisions of the present Convention to the characteristics and uses of a particular international watercourse or part thereof.

4. Where a watercourse agreement is concluded between two or more watercourse States, it shall define the waters to which it applies. Such an agreement may be entered into with respect to an entire international watercourse or any part thereof or a particular project, programme or use except insofar as the agreement adversely affects, to a significant extent, the use by one or more other watercourse States of the waters of the watercourse, without their express consent.

5. Where a watercourse State considers that adjustment and application of the provisions of the present Convention is required because of the characteristics and uses of a particular international watercourse, watercourse States shall consult with a view to negotiating in good faith for the purpose of concluding a watercourse agreement or agreements.

6. Where some but not all watercourse States to a particular international watercourse are parties to an agreement, nothing in such agreement shall affect the rights or obligations under the present Convention of watercourse States that are not parties to such an agreement.

#### Article 4 Parties to watercourse agreements

1. Every watercourse State is entitled to participate in the negotiation of and to become a party to any watercourse agreement that applies to the entire international watercourse, as well as to participate in any relevant consultations.

2. A watercourse State whose use of an international watercourse may be affected to a significant extent by the implementation of a proposed watercourse agreement that applies only to a part of the watercourse or to a particular project, programme or use is entitled to participate in consultations on such an agreement and, where appropriate, in the negotiation thereof in good faith with a view to becoming a party thereto, to the extent that its use is thereby affected.

## PART II. GENERAL PRINCIPLES

#### Article 5 Equitable and reasonable utilization and participation

1. Watercourse States shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse States with a view to

attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse.

2. Watercourse States shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.

#### Article 6 Factors relevant to equitable and reasonable utilization

1. Utilization of an international watercourse in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including:

(a) Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;

(b) The social and economic needs of the watercourse States concerned;

(c) The population dependent on the watercourse in each watercourse State;

(d) The effects of the use or uses of the watercourses in one watercourse State on other watercourse States;

(e) Existing and potential uses of the watercourse;

(f) Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect;

(g) The availability of alternatives, of comparable value, to a particular planned or existing use.

2. In the application of article 5 or paragraph 1 of this article, watercourse States concerned shall, when the need arises, enter into consultations in a spirit of cooperation.

3. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

#### Article 7 Obligation not to cause significant harm

1. Watercourse States shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse States.



2. Where significant harm nevertheless is caused to another watercourse State, the States whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures, having due regard for the provisions of articles 5 and 6, in consultation with the affected State, to eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation.

#### Article 8 General obligation to cooperate

1. Watercourse States shall cooperate on the basis of sovereign equality, territorial integrity, mutual benefit and good faith in order to attain optimal utilization and adequate protection of an international watercourse.

2. In determining the manner of such cooperation, watercourse States may consider the establishment of joint mechanisms or commissions, as deemed necessary by them, to facilitate cooperation on relevant measures and procedures in the light of experience gained through cooperation in existing joint mechanisms and commissions in various regions.

#### Article 9 Regular exchange of data and information

1. Pursuant to article 8, watercourse States shall on a regular basis exchange readily available data and information on the condition of the watercourse, in particular that of a hydrological, meteorological, hydrogeological and ecological nature and related to the water quality as well as related forecasts.

2. If a watercourse State is requested by another watercourse State to provide data or information that is not readily available, it shall employ its best efforts to comply with the request but may condition its compliance upon payment by the requesting State of the reasonable costs of collecting and, where appropriate, processing such data or information.

3. Watercourse States shall employ their best efforts to collect and, where appropriate, to process data and information in a manner which facilitates its utilization by the other watercourse States to which it is communicated.

#### Article 10 Relationship between different kinds of uses

1. In the absence of agreement or custom to the contrary, no use of an international watercourse enjoys inherent priority over other uses.

2. In the event of a conflict between uses of an international watercourse, it shall be resolved with reference to articles 5 to 7, with special regard being given to the requirements of vital human needs.

### PART III. PLANNED MEASURES

#### Article 11 Information concerning planned measures

Watercourse States shall exchange information and consult each other and, if necessary, negotiate on the possible effects of planned measures on the condition of an international watercourse.

#### Article 12 Notification concerning planned measures with possible adverse effects

Before a watercourse State implements or permits the implementation of planned measures which may have a significant adverse effect upon other watercourse States, it shall provide those States with timely notification thereof. Such notification shall be accompanied by available technical data and information, including the results of any environmental impact assessment, in order to enable the notified States to evaluate the possible effects of the planned measures.

#### Article 13 Period for reply to notification

Unless otherwise agreed:

(a) A watercourse State providing a notification under article 12 shall allow the notified States a period of six months within which to study and evaluate the possible effects of the planned measures and to communicate the findings to it;

(b) This period shall, at the request of a notified State for which the evaluation of the planned measures poses special difficulty, be extended for a period of six months.

#### Article 14 Obligations of the notifying State during the period for reply

During the period referred to in article 13, the notifying State:

(a) Shall cooperate with the notified States by providing them, on request, with any additional data and information that is available and necessary for an accurate evaluation; and

(b) Shall not implement or permit the implementation of the planned measures without the consent of the notified States.

#### Article 15 Reply to notification

The notified States shall communicate their findings to the notifying State as early as possible within the period applicable pursuant to article 13. If a notified State finds that implementation of the planned measures would be inconsistent with the provisions of articles 5 or 7, it shall attach to its finding a documented explanation setting forth the reasons for the finding.

#### Article 16 Absence of reply to notification

1. If, within the period applicable pursuant to article 13, the notifying State receives no communication under article 15, it may, subject to its obligations under articles 5 and 7, proceed with the implementation of the planned measures, in accordance with the notification and any other data and information provided to the notified States.
2. Any claim to compensation by a notified State which has failed to reply within the period applicable pursuant to article 13 may be offset by the costs incurred by the notifying State for action undertaken after the expiration of the time for a reply which would not have been undertaken if the notified State had objected within that period.

#### Article 17 Consultations and negotiations concerning planned measures

1. If a communication is made under article 15 that implementation of the planned measures would be inconsistent with the provisions of articles 5 or 7, the notifying State and the State making the communication shall enter into consultations and, if necessary, negotiations with a view to arriving at an equitable resolution of the situation.
2. The consultations and negotiations shall be conducted on the basis that each State must in good faith pay reasonable regard to the rights and legitimate interests of the other State.
3. During the course of the consultations and negotiations, the notifying State shall, if so requested by the notified State at the time it makes the communication, refrain from implementing or permitting the implementation of the planned measures for a period of six months unless otherwise agreed.

#### Article 18 Procedures in the absence of notification

1. If a watercourse State has reasonable grounds to believe that another watercourse State is planning measures that may have a significant adverse effect upon it, the former State may request the latter to apply the provisions of article 12. The request shall be accompanied by a documented explanation setting forth its grounds.
2. In the event that the State planning the measures nevertheless finds that it is not under an obligation to provide a notification under article 12, it shall so inform the other State, providing a documented explanation setting forth the reasons for such finding. If this finding does not satisfy the other State, the two States shall, at the request of that other State, promptly enter into consultations and negotiations in the manner indicated in paragraphs 1 and 2 of article 17.
3. During the course of the consultations and negotiations, the State planning the measures shall, if so requested by the other State at the time it requests the initiation of consultations and negotiations, refrain from implementing or permitting the implementation of those measures for a period of six months unless otherwise agreed.

#### Article 19 Urgent implementation of planned measures

1. In the event that the implementation of planned measures is of the utmost urgency in order to protect public health, public safety or other equally important interests, the State planning the measures may, subject to articles 5 and 7, immediately proceed to implementation, notwithstanding the provisions of article 14 and paragraph 3 of article 17.

2. In such case, a formal declaration of the urgency of the measures shall be communicated without delay to the other watercourse States referred to in article 12 together with the relevant data and information.

3. The State planning the measures shall, at the request of any of the States referred to in paragraph 2, promptly enter into consultations and negotiations with it in the manner indicated in paragraphs 1 and 2 of article 17.

#### PART IV. PROTECTION, PRESERVATION AND MANAGEMENT

##### Article 20 Protection and preservation of ecosystems

Watercourse States shall, individually and, where appropriate, jointly, protect and preserve the ecosystems of international watercourses.

##### Article 21 Prevention, reduction and control of pollution

1. For the purpose of this article, "pollution of an international watercourse" means any detrimental alteration in the composition or quality of the waters of an international watercourse which results directly or indirectly from human conduct.

2. Watercourse States shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution of an international watercourse that may cause significant harm to other watercourse States or to their environment, including harm to human health or safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse. Watercourse States shall take steps to harmonize their policies in this connection.

3. Watercourse States shall, at the request of any of them, consult with a view to arriving at mutually agreeable measures and methods to prevent, reduce and control pollution of an international watercourse, such as:

(a) Setting joint water quality objectives and criteria;

(b) Establishing techniques and practices to address pollution from point and non-point sources;

(c) Establishing lists of substances the introduction of which into the waters of an international watercourse is to be prohibited, limited, investigated or monitored.

#### Article 22 Introduction of alien or new species

Watercourse States shall take all measures necessary to prevent the introduction of species, alien or new, into an international watercourse which may have effects detrimental to the ecosystem of the watercourse resulting in significant harm to other watercourse States.

#### Article 23 Protection and preservation of the marine environment

Watercourse States shall, individually and, where appropriate, in cooperation with other States, take all measures with respect to an international watercourse that are necessary to protect and preserve the marine environment, including estuaries, taking into account generally accepted international rules and standards.

#### Article 24 Management

1. Watercourse States shall, at the request of any of them, enter into consultations concerning the management of an international watercourse, which may include the establishment of a joint management mechanism.
2. For the purposes of this article, "management" refers, in particular, to:
  - (a) Planning the sustainable development of an international watercourse and providing for the implementation of any plans adopted; and
  - (b) Otherwise promoting the rational and optimal utilization, protection and control of the watercourse.

#### Article 25 Regulation

1. Watercourse States shall cooperate, where appropriate, to respond to needs or opportunities for regulation of the flow of the waters of an international watercourse.
2. Unless otherwise agreed, watercourse States shall participate on an equitable basis in the construction and maintenance or defrayal of the costs of such regulation works as they may have agreed to undertake.
3. For the purposes of this article, "regulation" means the use of hydraulic works or any other continuing measure to alter, vary or otherwise control the flow of the waters of an international watercourse.

#### Article 26 Installations

1. Watercourse States shall, within their respective territories, employ their best efforts to maintain and protect installations, facilities and other works related to an international watercourse.

2. Watercourse States shall, at the request of any of them which has reasonable grounds to believe that it may suffer significant adverse effects, enter into consultations with regard to:

(a) The safe operation and maintenance of installations, facilities or other works related to an international watercourse; and

(b) The protection of installations, facilities or other works from wilful or negligent acts or the forces of nature.

## PART V. HARMFUL CONDITIONS AND EMERGENCY SITUATIONS

### Article 27 Prevention and mitigation of harmful conditions

Watercourse States shall, individually and, where appropriate, jointly, take all appropriate measures to prevent or mitigate conditions related to an international watercourse that may be harmful to other watercourse States, whether resulting from natural causes or human conduct, such as flood or ice conditions, water-borne diseases, siltation, erosion, salt-water intrusion, drought or desertification.

### Article 28 Emergency situations

1. For the purposes of this article, "emergency" means a situation that causes, or poses an imminent threat of causing, serious harm to watercourse States or other States and that results suddenly from natural causes, such as floods, the breaking up of ice, landslides or earthquakes, or from human conduct, such as industrial accidents.

2. A watercourse State shall, without delay and by the most expeditious means available, notify other potentially affected States and competent international organizations of any emergency originating within its territory.

3. A watercourse State within whose territory an emergency originates shall, in cooperation with potentially affected States and, where appropriate, competent international organizations, immediately take all practicable measures necessitated by the circumstances to prevent, mitigate and eliminate harmful effects of the emergency.

4. When necessary, watercourse States shall jointly develop contingency plans for responding to emergencies, in cooperation, where appropriate, with other potentially affected States and competent international organizations.

## PART VI. MISCELLANEOUS PROVISIONS

#### Article 29 International watercourses and installations in time of armed conflict

International watercourses and related installations, facilities and other works shall enjoy the protection accorded by the principles and rules of international law applicable in international and non-international armed conflict and shall not be used in violation of those principles and rules.

#### Article 30 Indirect procedures

In cases where there are serious obstacles to direct contacts between watercourse States, the States concerned shall fulfil their obligations of cooperation provided for in the present Convention, including exchange of data and information, notification, communication, consultations and negotiations, through any indirect procedure accepted by them.

#### Article 31 Data and information vital to national defence or security

Nothing in the present Convention obliges a watercourse State to provide data or information vital to its national defence or security. Nevertheless, that State shall cooperate in good faith with the other watercourse States with a view to providing as much information as possible under the circumstances.

#### Article 32 Non-discrimination

Unless the watercourse States concerned have agreed otherwise for the protection of the interests of persons, natural or juridical, who have suffered or are under a serious threat of suffering significant transboundary harm as a result of activities related to an international watercourse, a watercourse State shall not discriminate on the basis of nationality or residence or place where the injury occurred, in granting to such persons, in accordance with its legal system, access to judicial or other procedures, or a right to claim compensation or other relief in respect of significant harm caused by such activities carried on in its territory.

#### Article 33 Settlement of disputes

1. In the event of a dispute between two or more Parties concerning the interpretation or application of the present Convention, the Parties concerned shall, in the absence of an applicable agreement between them, seek a settlement of the dispute by peaceful means in accordance with the following provisions.

2. If the Parties concerned cannot reach agreement by negotiation requested by one of them, they may jointly seek the good offices of, or request mediation or conciliation by, a third party, or make use, as appropriate, of any joint watercourse institutions that may have been established by them or agree to submit the dispute to arbitration or to the International Court of Justice.

3. Subject to the operation of paragraph 10, if after six months from the time of the request for negotiations referred to in paragraph 2, the Parties concerned have not been able to settle their dispute through negotiation or any other means referred to in paragraph 2, the dispute shall be submitted, at the request of any of the parties to the dispute, to impartial fact-finding in accordance with paragraphs 4 to 9, unless the Parties otherwise agree.

4. A Fact-finding Commission shall be established, composed of one member nominated by each Party concerned and in addition a member not having the nationality of any of the Parties concerned chosen by the nominated members who shall serve as Chairman.

5. If the members nominated by the Parties are unable to agree on a Chairman within three months of the request for the establishment of the Commission, any Party concerned may request the Secretary-General of the United Nations to appoint the Chairman who shall not have the nationality of any of the parties to the dispute or of any riparian State of the watercourse concerned. If one of the Parties fails to nominate a member within three months of the initial request pursuant to paragraph 3, any other Party concerned may request the Secretary-General of the United Nations to appoint a person who shall not have the nationality of any of the parties to the dispute or of any riparian State of the watercourse concerned. The person so appointed shall constitute a single-member Commission.

6. The Commission shall determine its own procedure.

7. The Parties concerned have the obligation to provide the Commission with such information as it may require and, on request, to permit the Commission to have access to their respective territory and to inspect any facilities, plant, equipment, construction or natural feature relevant for the purpose of its inquiry.

8. The Commission shall adopt its report by a majority vote, unless it is a single-member Commission, and shall submit that report to the Parties concerned setting forth its findings and the reasons therefor and such recommendations as it deems appropriate for an equitable solution of the dispute, which the Parties concerned shall consider in good faith.

9. The expenses of the Commission shall be borne equally by the Parties concerned.

10. When ratifying, accepting, approving or acceding to the present Convention, or at any time thereafter, a Party which is not a regional economic integration organization may declare in a written instrument submitted to the Depositary that, in respect of any dispute not resolved in accordance with paragraph 2, it recognizes as compulsory ipso facto and without special agreement in relation to any Party accepting the same obligation:

(a) Submission of the dispute to the International Court of Justice; and/or

(b) Arbitration by an arbitral tribunal established and operating, unless the parties to the dispute otherwise agreed, in accordance with the procedure laid down in the annex to the present Convention.



A Party which is a regional economic integration organization may make a declaration with like effect in relation to arbitration in accordance with subparagraph (b).

## PART VII. FINAL CLAUSES

### Article 34 Signature

The present Convention shall be open for signature by all States and by regional economic integration organizations from ...until ... at United Nations Headquarters in New York.

### Article 35 Ratification, acceptance, approval or accession

1. The present Convention is subject to ratification, acceptance, approval or accession by States and by regional economic integration organizations. The instruments of ratification, acceptance, approval or accession shall be deposited with the Secretary-General of the United Nations.

2. Any regional economic integration organization which becomes a Party to this Convention without any of its member States being a Party shall be bound by all the obligations under the Convention. In the case of such organizations, one or more of whose member States is a Party to this Convention, the organization and its member States shall decide on their respective responsibilities for the performance of their obligations under the Convention. In such cases, the organization and the member States shall not be entitled to exercise rights under the Convention concurrently.

3. In their instruments of ratification, acceptance, approval or accession, the regional economic integration organizations shall declare the extent of their competence with respect to the matters governed by the Convention. These organizations shall also inform the Secretary-General of the United Nations of any substantial modification in the extent of their competence.

### Article 36 Entry into force

1. The present Convention shall enter into force on the ninetieth day following the date of deposit of the thirty-fifth instrument of ratification, acceptance, approval or accession with the Secretary-General of the United Nations.

2. For each State or regional economic integration organization that ratifies, accepts or approves the Convention or accedes thereto after the deposit of the thirty-fifth instrument of ratification, acceptance, approval or accession, the Convention shall enter into force on the ninetieth day after the deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession.

3. For the purposes of paragraphs 1 and 2, any instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by States.

Article 37 Authentic texts

The original of the present Convention, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations.

IN WITNESS WHEREOF the undersigned plenipotentiaries, being duly authorized thereto, have signed this Convention.

Done at New York, this 21 day May of of one thousand nine hundred and ninety-seven.

## Annex Arbitration

### Article 1

Unless the parties to the dispute otherwise agree, the arbitration pursuant to article 33 of the Convention shall take place in accordance with articles 2 to 14 of the present annex.

### Article 2

The claimant party shall notify the respondent party that it is referring a dispute to arbitration pursuant to article 33 of the Convention. The notification shall state the subject matter of arbitration and include, in particular, the articles of the Convention, the interpretation or application of which are at issue. If the parties do not agree on the subject matter of the dispute, the arbitral tribunal shall determine the subject matter.

### Article 3

1. In disputes between two parties, the arbitral tribunal shall consist of three members. Each of the parties to the dispute shall appoint an arbitrator and the two arbitrators so appointed shall designate by common agreement the third arbitrator, who shall be the Chairman of the tribunal. The latter shall not be a national of one of the parties to the dispute or of any riparian State of the watercourse concerned, nor have his or her usual place of residence in the territory of one of these parties or such riparian State, nor have dealt with the case in any other capacity.
2. In disputes between more than two parties, parties in the same interest shall appoint one arbitrator jointly by agreement.
3. Any vacancy shall be filled in the manner prescribed for the initial appointment.

### Article 4

1. If the Chairman of the arbitral tribunal has not been designated within two months of the appointment of the second arbitrator, the President of the International Court of Justice shall, at the request of a party, designate the Chairman within a further two-month period.
2. If one of the parties to the dispute does not appoint an arbitrator within two months of receipt of the request, the other party may inform the President of the International Court of Justice, who shall make the designation within a further two-month period.

### Article 5

The arbitral tribunal shall render its decisions in accordance with the provisions of this Convention and international law.

### Article 6

Unless the parties to the dispute otherwise agree, the arbitral tribunal shall determine its own rules of procedure.

#### Article 7

The arbitral tribunal may, at the request of one of the Parties, recommend essential interim measures of protection.

#### Article 8

1. The parties to the dispute shall facilitate the work of the arbitral tribunal and, in particular, using all means at their disposal, shall:

(a) Provide it with all relevant documents, information and facilities; and

(b) Enable it, when necessary, to call witnesses or experts and receive their evidence.

2. The parties and the arbitrators are under an obligation to protect the confidentiality of any information they receive in confidence during the proceedings of the arbitral tribunal.

#### Article 9

Unless the arbitral tribunal determines otherwise because of the particular circumstances of the case, the costs of the tribunal shall be borne by the parties to the dispute in equal shares. The tribunal shall keep a record of all its costs, and shall furnish a final statement thereof to the parties.

#### Article 10

Any Party that has an interest of a legal nature in the subject matter of the dispute which may be affected by the decision in the case, may intervene in the proceedings with the consent of the tribunal.

#### Article 11

The tribunal may hear and determine counterclaims arising directly out of the subject matter of the dispute.

#### Article 12

Decisions both on procedure and substance of the arbitral tribunal shall be taken by a majority of its members.

#### Article 13

If one of the parties to the dispute does not appear before the arbitral tribunal or fails to defend its case, the other party may request the tribunal to continue the proceedings and to make its award. Absence of a party or a failure of a party to defend its case shall not constitute a bar to the proceedings. Before rendering its final decision, the arbitral tribunal must satisfy itself that the claim is well founded in fact and law.

#### Article 14

1. The tribunal shall render its final decision within five months of the date on which it is fully constituted unless it finds it necessary to extend the time limit for a period which should not exceed five more months.

2. The final decision of the arbitral tribunal shall be confined to the subject matter of the dispute and shall state the reasons on which it is based. It shall contain the names of the members who have participated and the date of the final decision. Any member of the tribunal may attach a separate or dissenting opinion to the final decision.

3. The award shall be binding on the parties to the dispute. It shall be without appeal unless the parties to the dispute have agreed in advance to an appellate procedure.

4. Any controversy which may arise between the parties to the dispute as regards the interpretation or manner of implementation of the final decision may be submitted by either party for decision to the arbitral tribunal which rendered it.



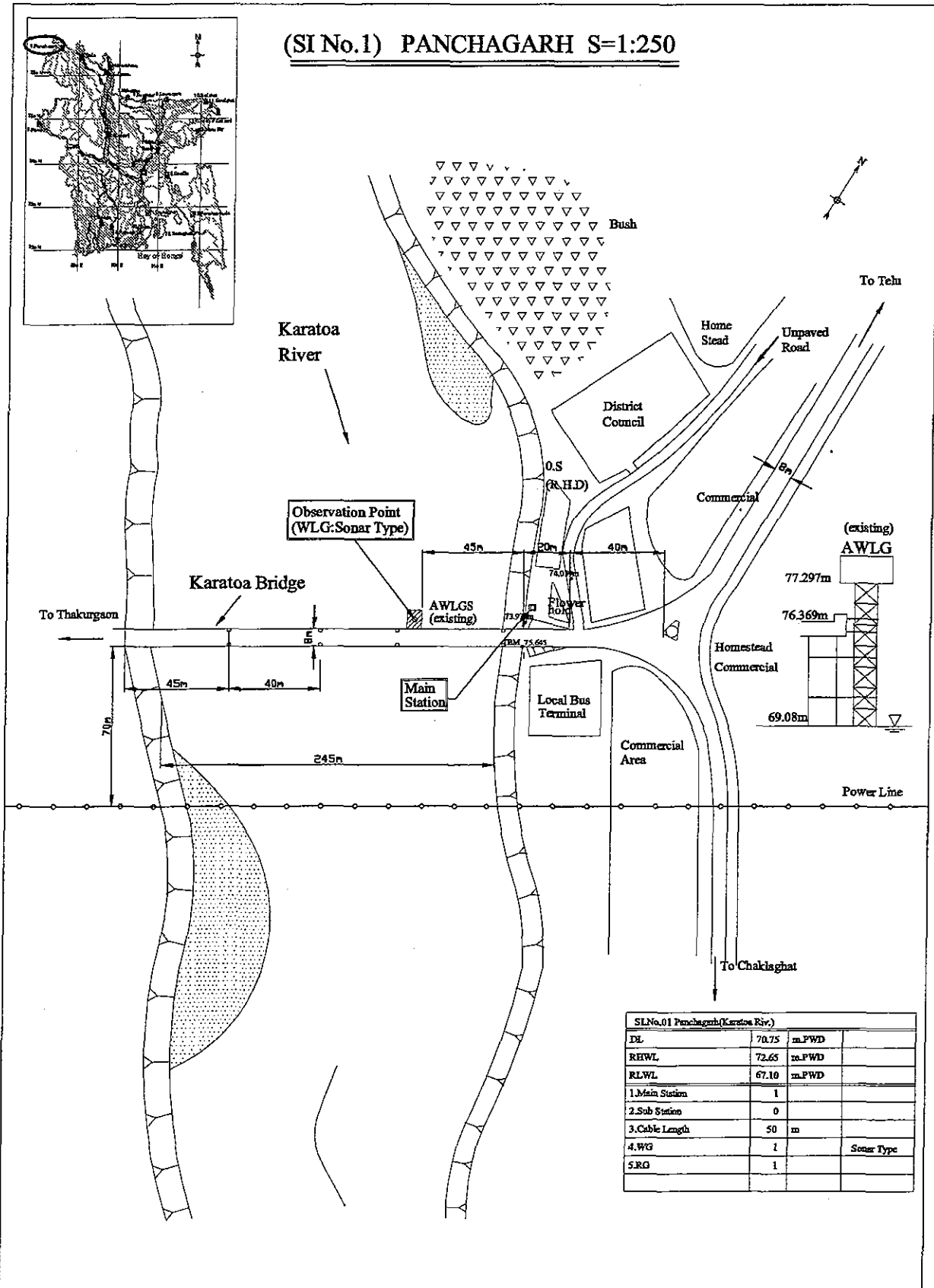
## ***ANNEX-V***

SKETCH DRAWING OF THE LAYOUT PLAN OF PROPOSED  
TELEMETRIC GAUGING STATIONS





(SI No.1) PANCHAGARH S=1:250

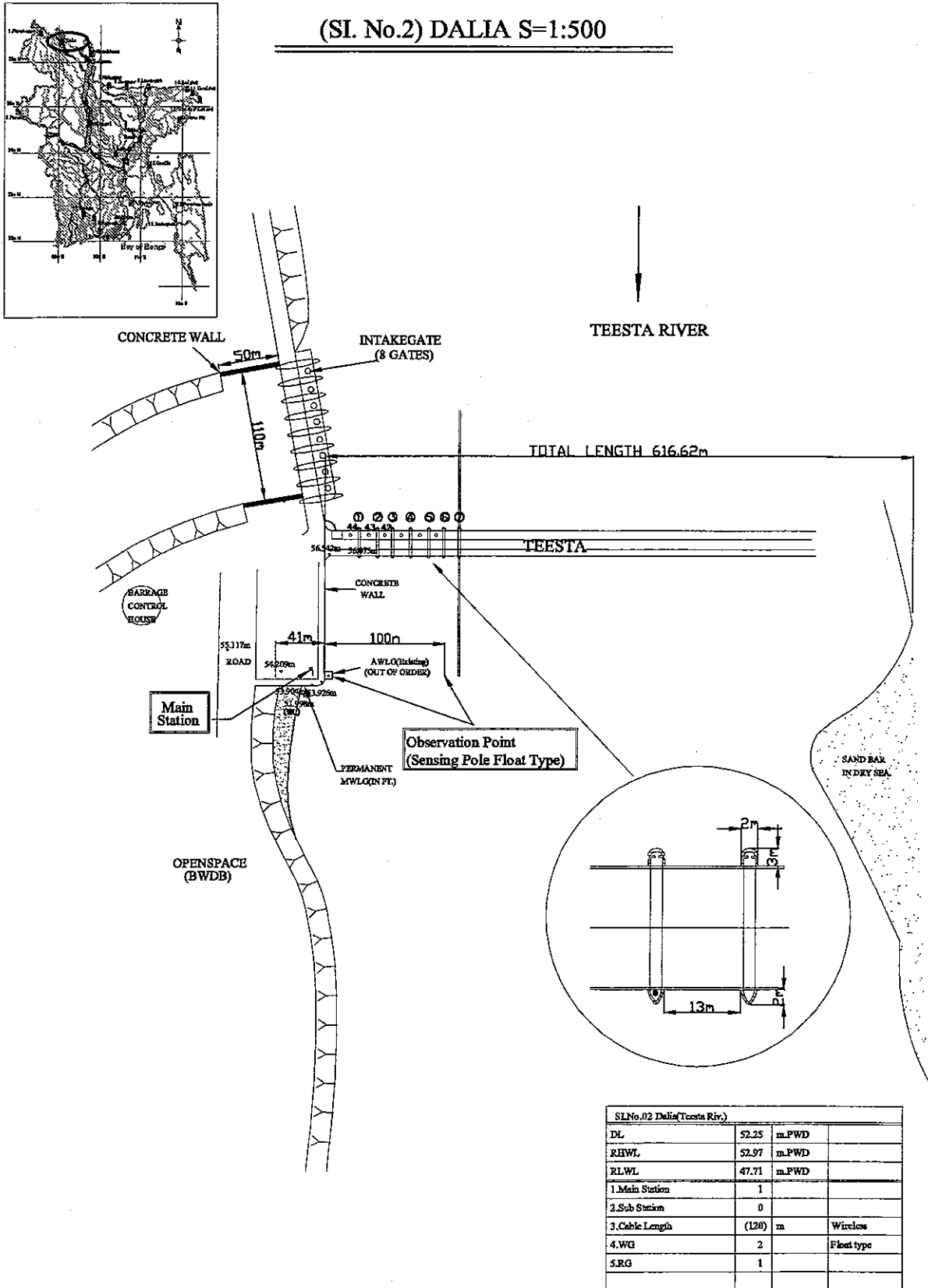


Feasibility Study for Improvement  
of Flood Forecasting and Warning Services  
in the People's Republic of Bangladesh

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Figure 1  
Layout Plan Sketch (1.Panchagarh)

(Sl. No.2) DALIA S=1:500

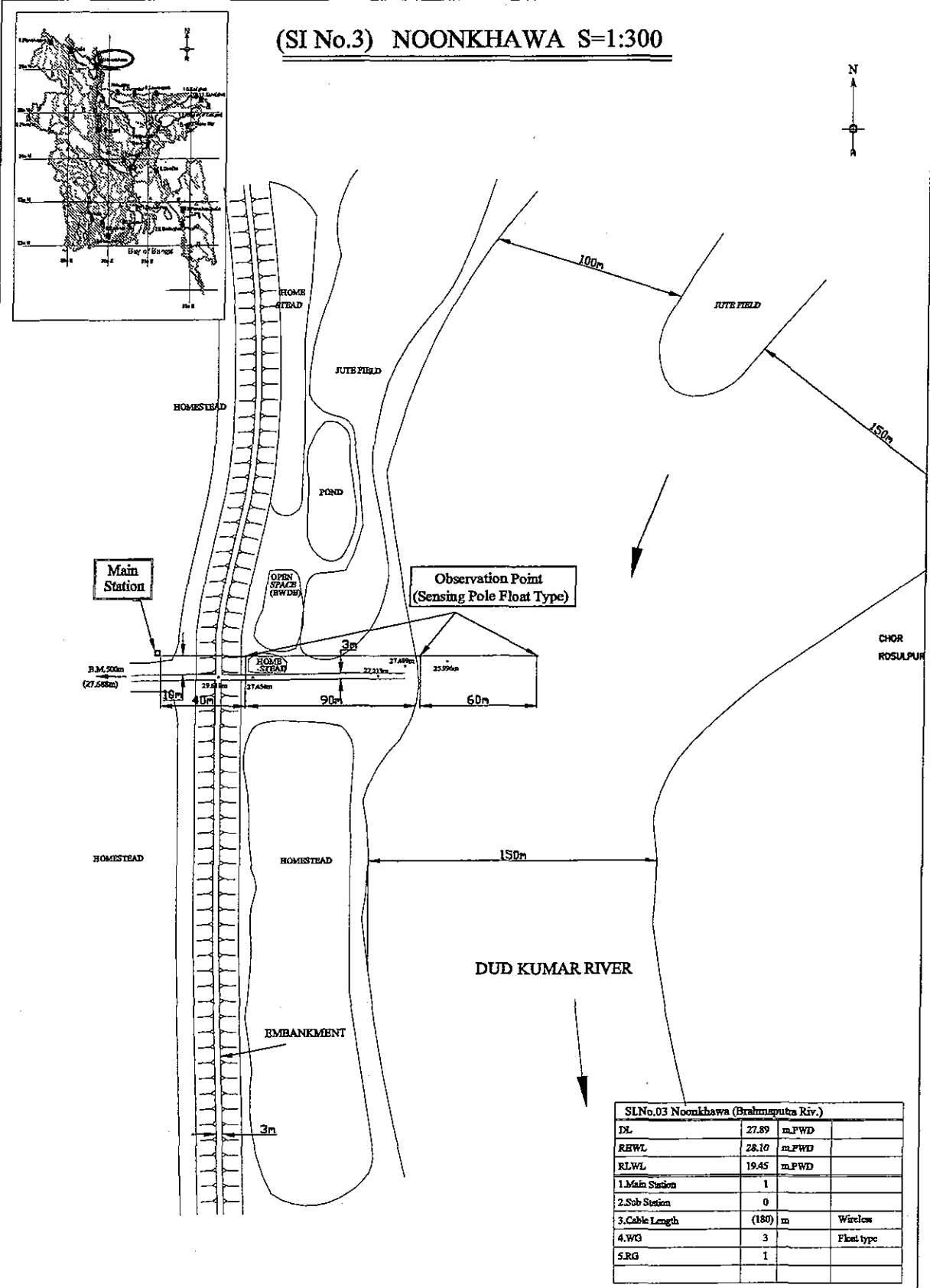


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Figure 2  
Layout Plan Sketch (2.Dalia)

(SI No.3) NOONKHAWA S=1:300

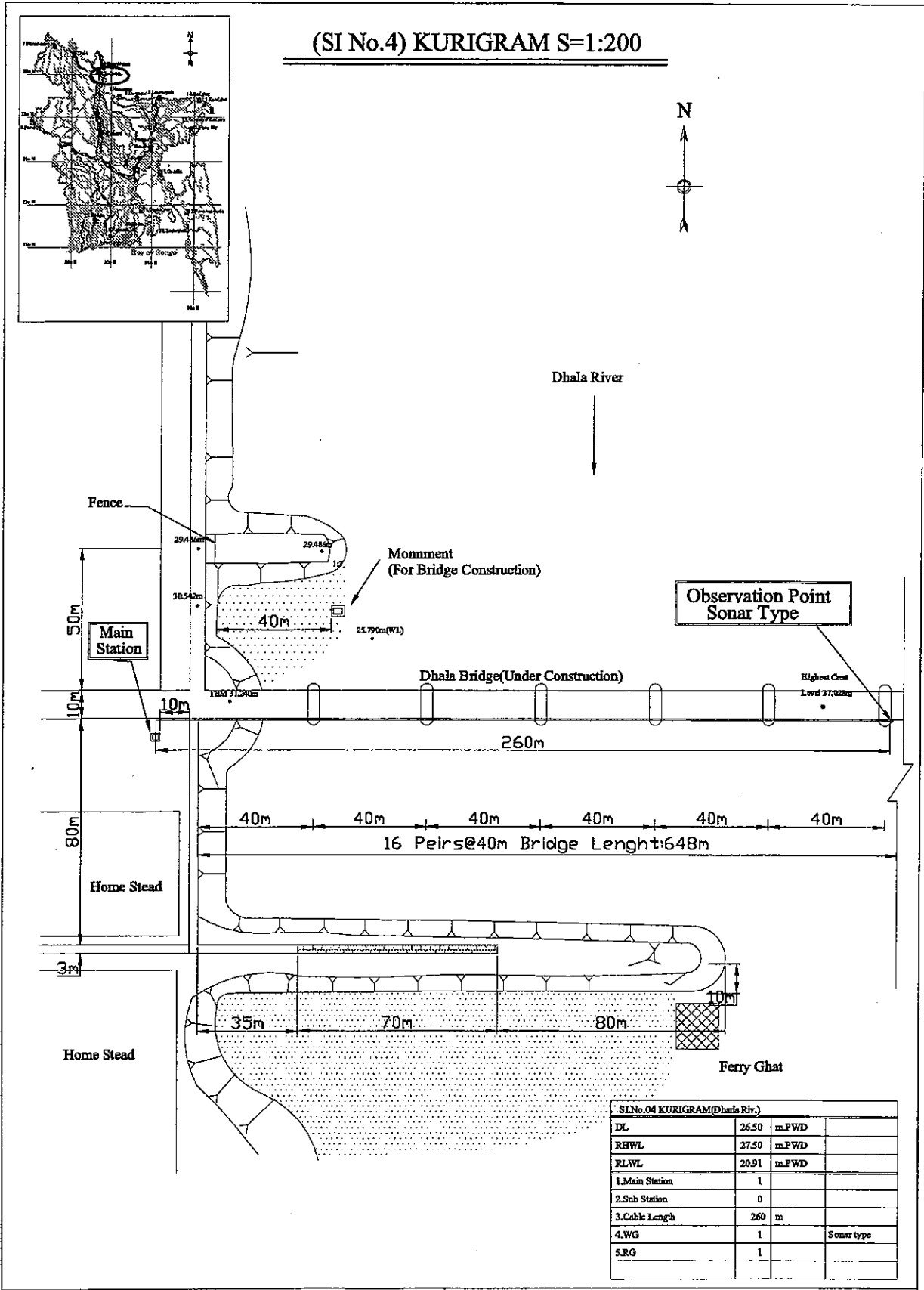


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Figure 3  
Layout Plan Sketch (3.Noonkhawa)

(SI No.4) KURIGRAM S=1:200



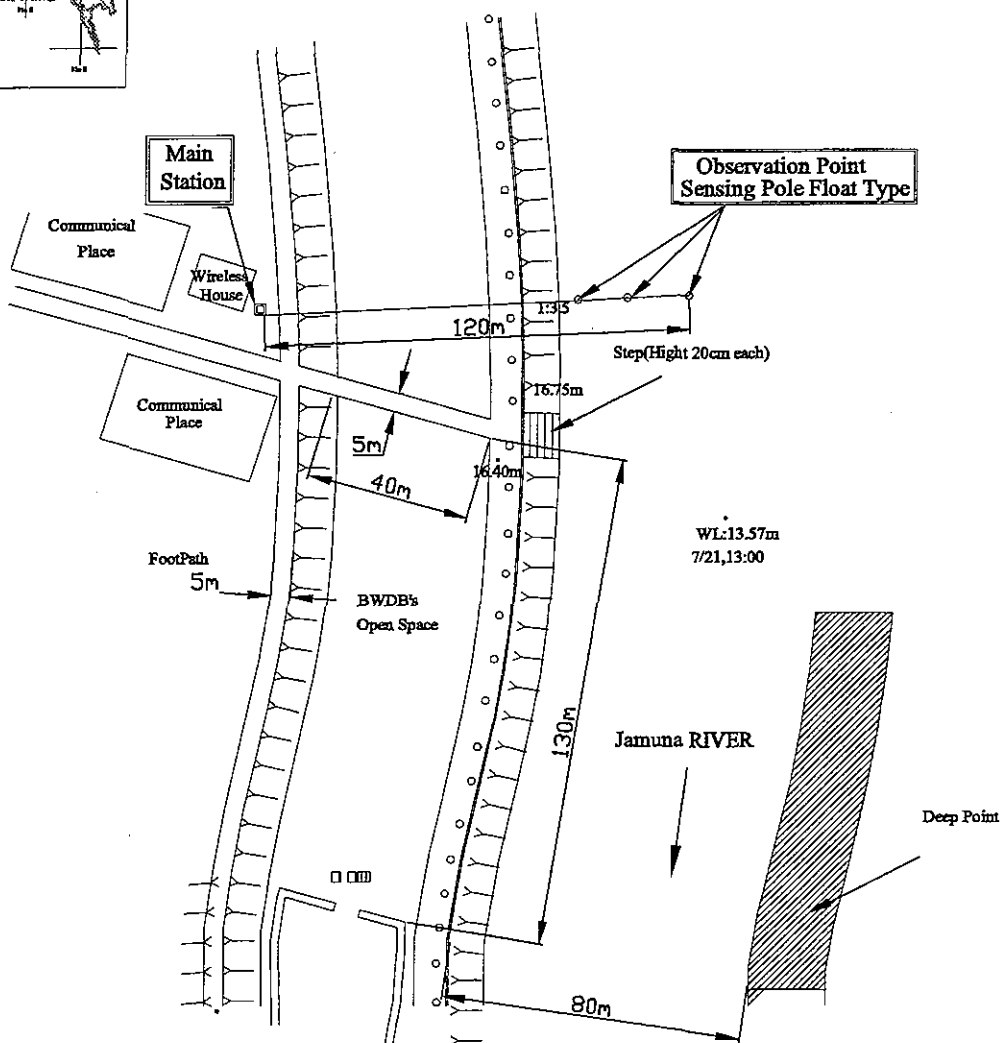
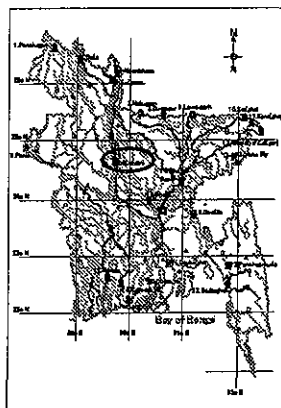
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Figure 4

Layout Plan Sketch (4.Kurigram)

(SI No.5) SIRAJGANJ S=1:200



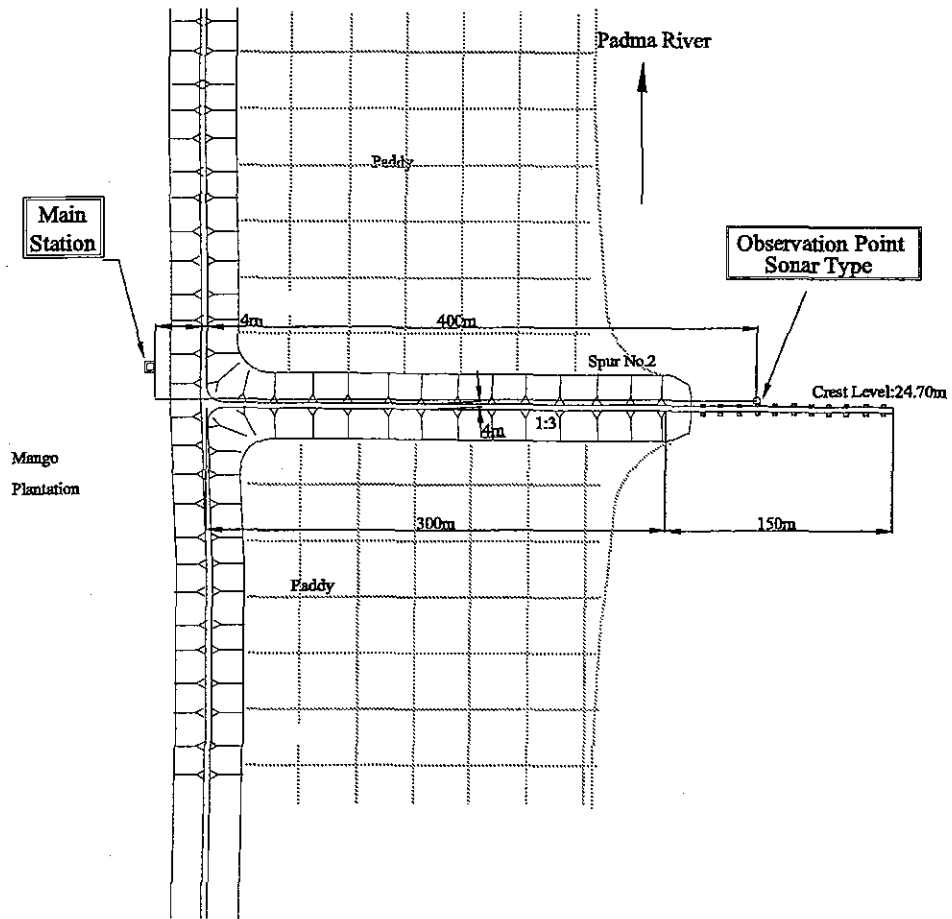
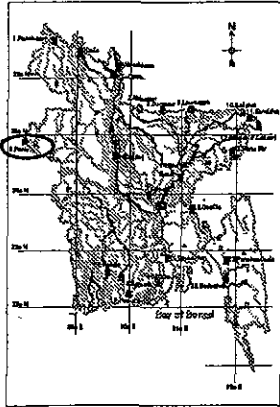
SINo.03 Sirajganj(Jamuna Riv.)			
DL	13.75	m.PWD	
RHWL	15.12	m.PWD	
RLWL	6.35	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(120)	m	Wireless
4.WG	3		Float type
5.RG	1		

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Figure 5  
Layout Plan Sketch (5.Sirajganj)

(SI No.6) PANKHA S=1:500



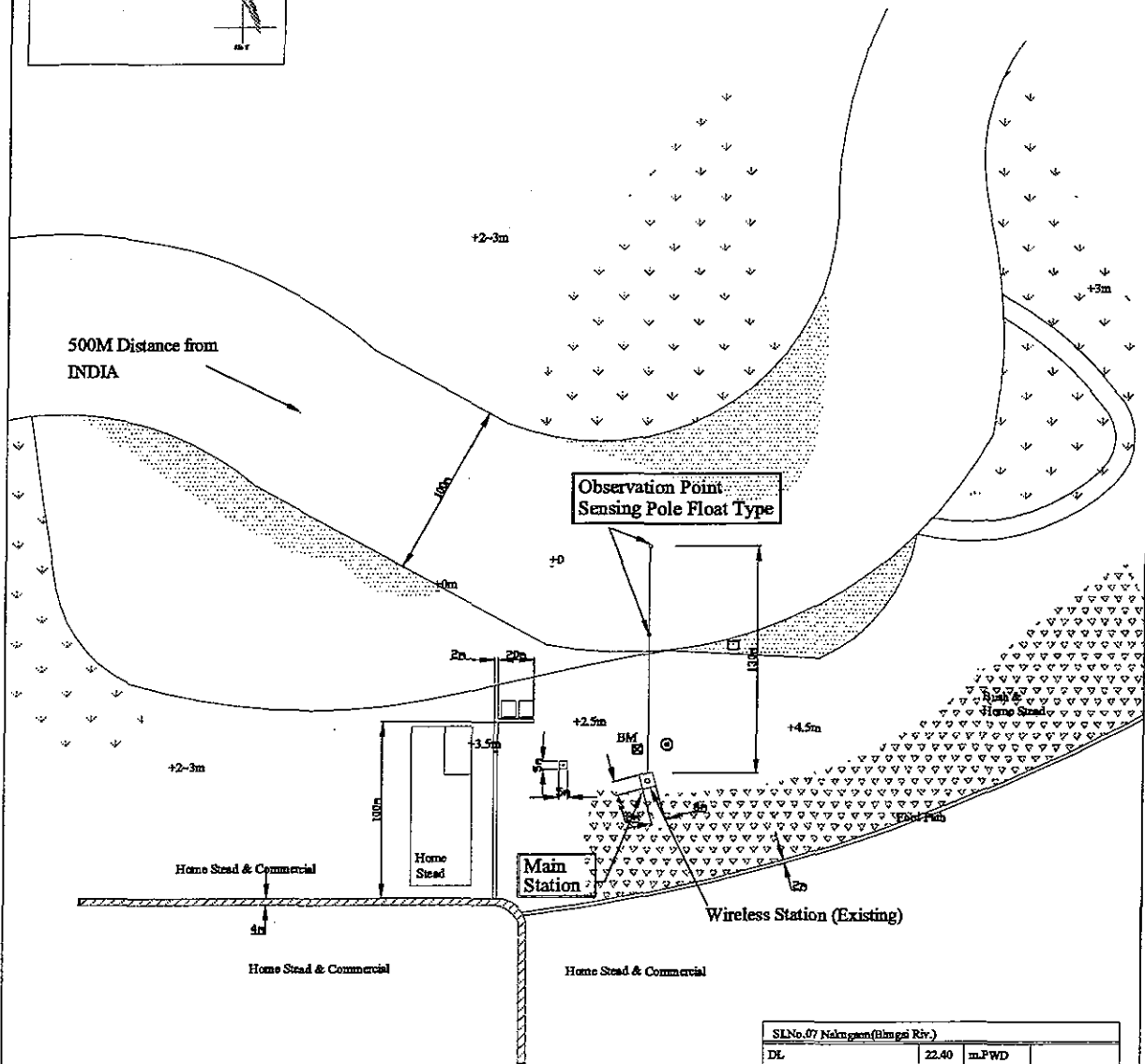
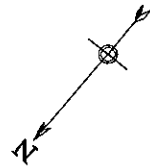
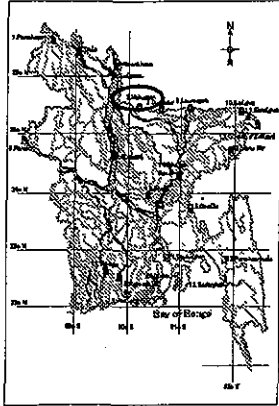
SI No. 06 Pankha (Upper Padma Riv.)			
DL	21.50	m.PWD	
RHWL	24.14	m.PWD	
RLWL	12.88	m.PWD	
1. Main Station	1		
2. Sub Station	0		
3. Cable Length	400	m	
4. WG	1		Sonar Type
5. RG	1		

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**Figure 6**  
Layout Plan Sketch (6.Pankha)

(SI No.07) NAKUAGAON S=1:400



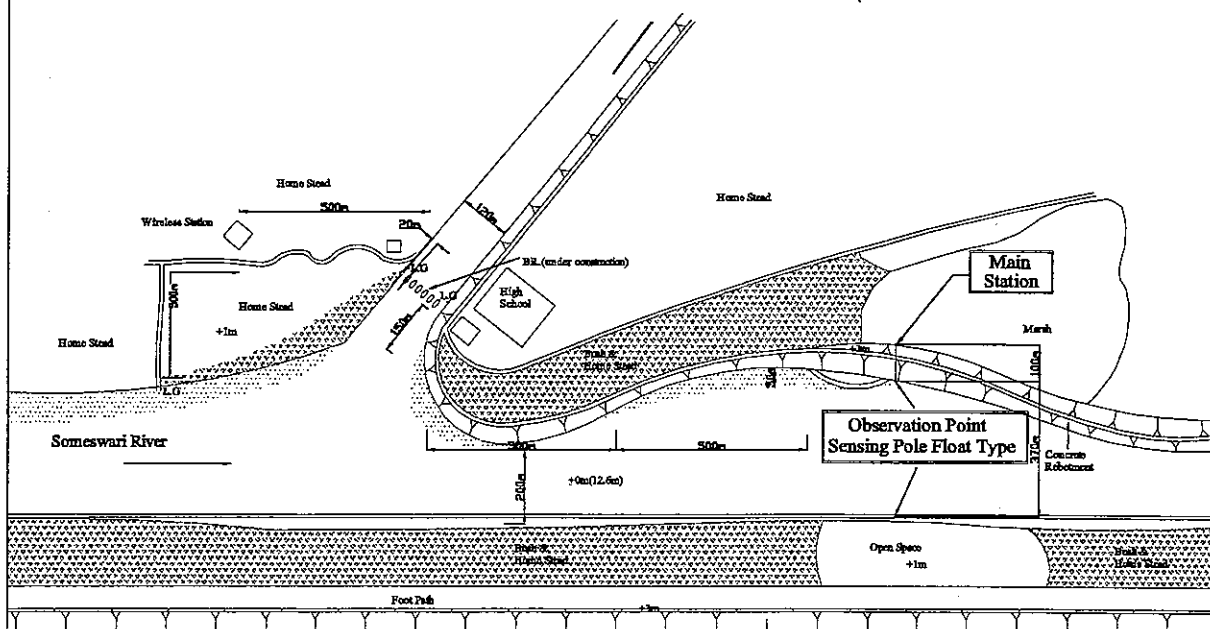
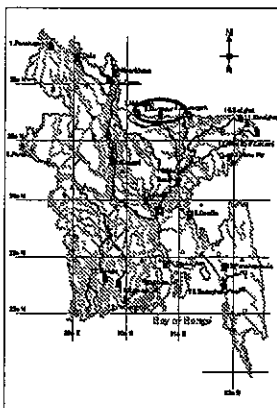
SI No.07 Nakuagaon (Jamgi Riv.)			
DL	22.40	m.PWD	
RHWL	26.01	m.PWD	
RLWL	-	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(130)	m	Wireless
4.WG	2		Float type
5.RG	1		

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Figure 7  
Layout Plan Sketch (7.Nakuagaon)

(SI No.8) DURGAPUR S=1:2,000



SI No.08 Durgapur(Someswari Riv.)			
DL	13.00	m.PWD	
REWL	15.15	m.PWD	
RLWL	6.99	m.PWD	
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2.Sub Station	0		
3.Cable Length	(460)	m	Wireless
4.WG	2		Float type
5.RG	1		

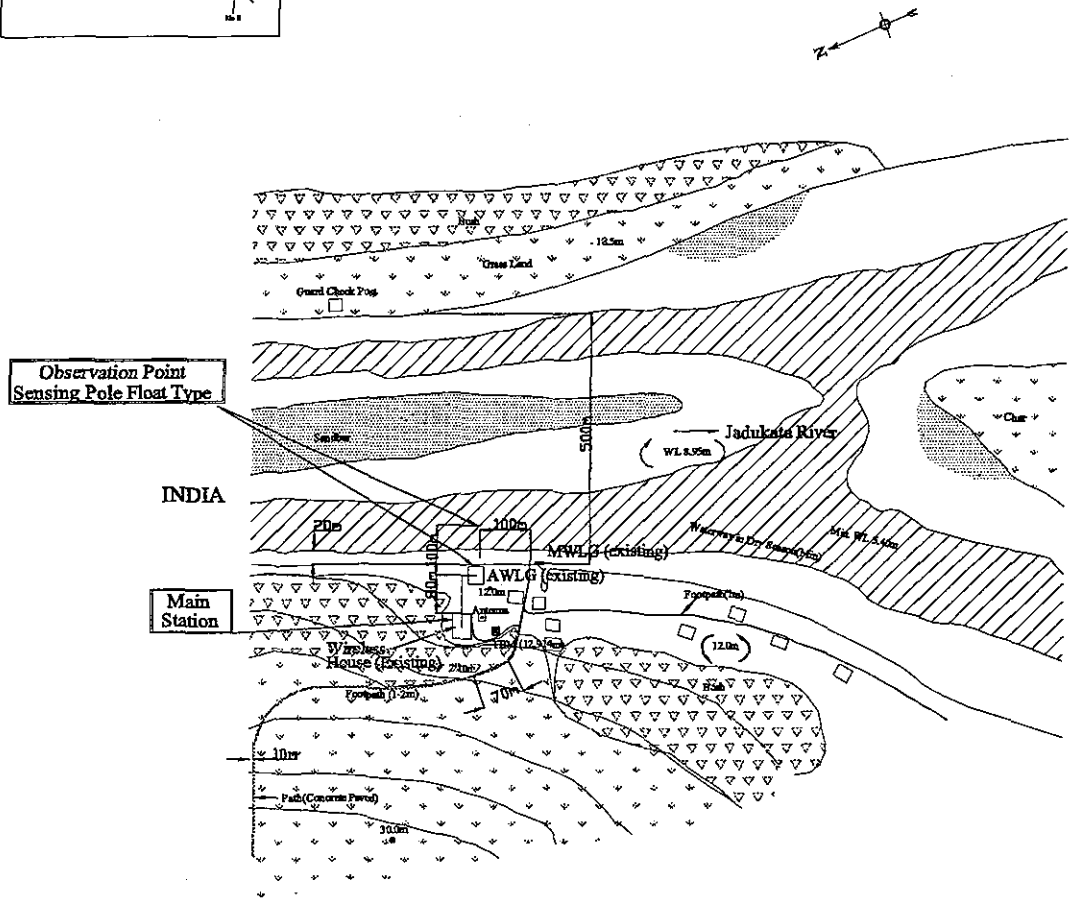
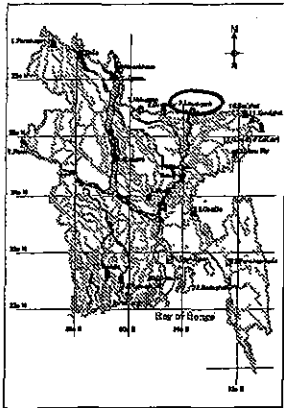
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Figure 8  
Layout Plan Sketch (8.Durgapur)



(SI No.09) LAURERGARH S=1:1,500



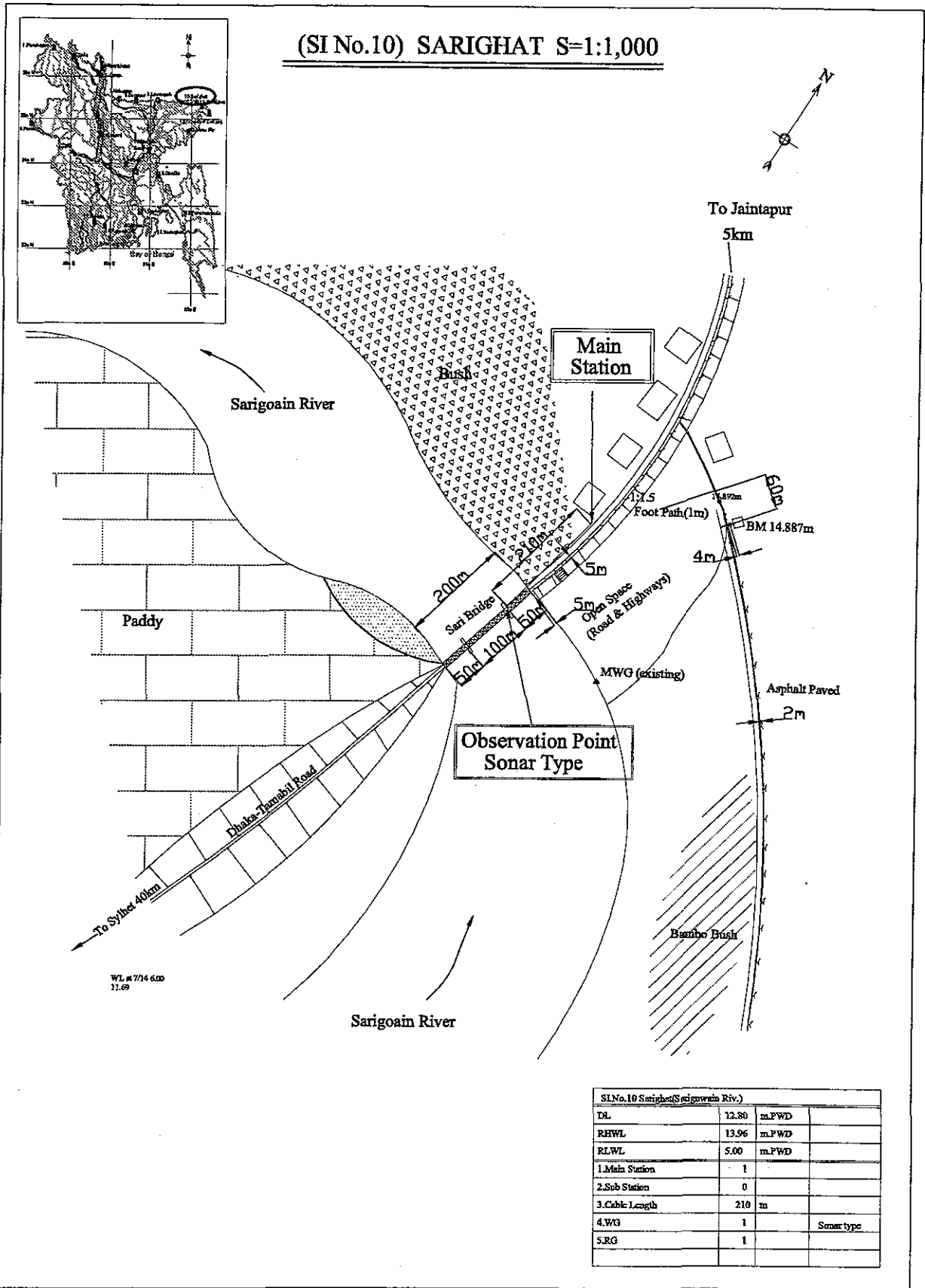
SI No.09 Laurergarh (Jadukata Riv.)		
DL	8.53	m.PWD
RHWL	11.85	m.PWD
RLWL	5.44	m.PWD
1.Main Station	1	
2.Sub Station	0	
3.Cable Length	(180)	m Wireless
4.WG	2	Float type
5.RG	1	

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Figure 9  
Layout Plan Sketch (9.Laurergarh)

(SI No.10) SARIGHAT S=1:1,000



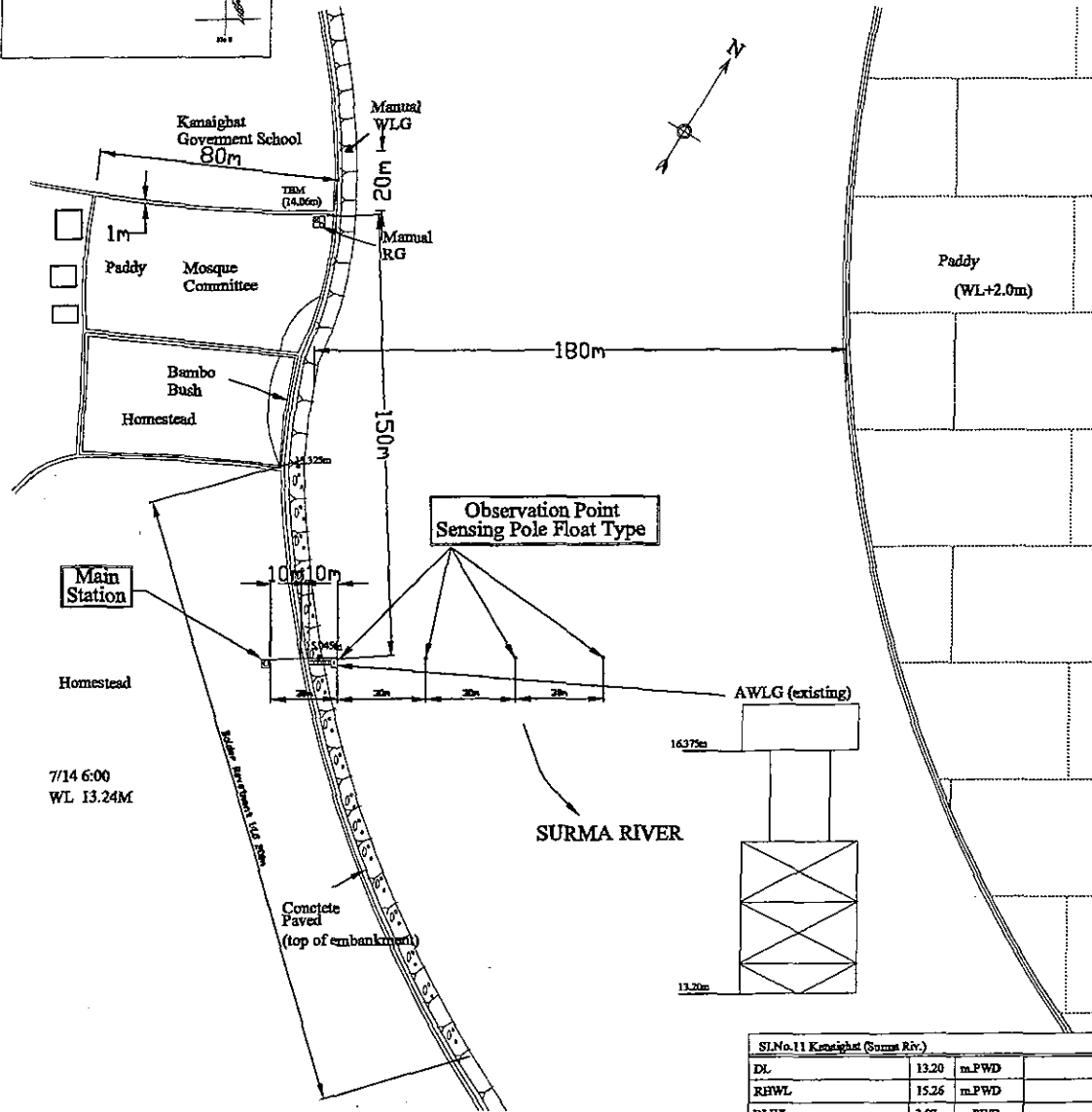
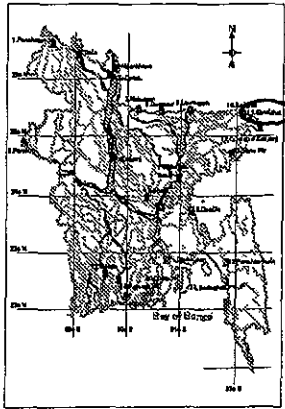
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Figure10

Layout Plan Sketch (10.Sarighat)

(SI No.11) KANAIGHAT S=1:250



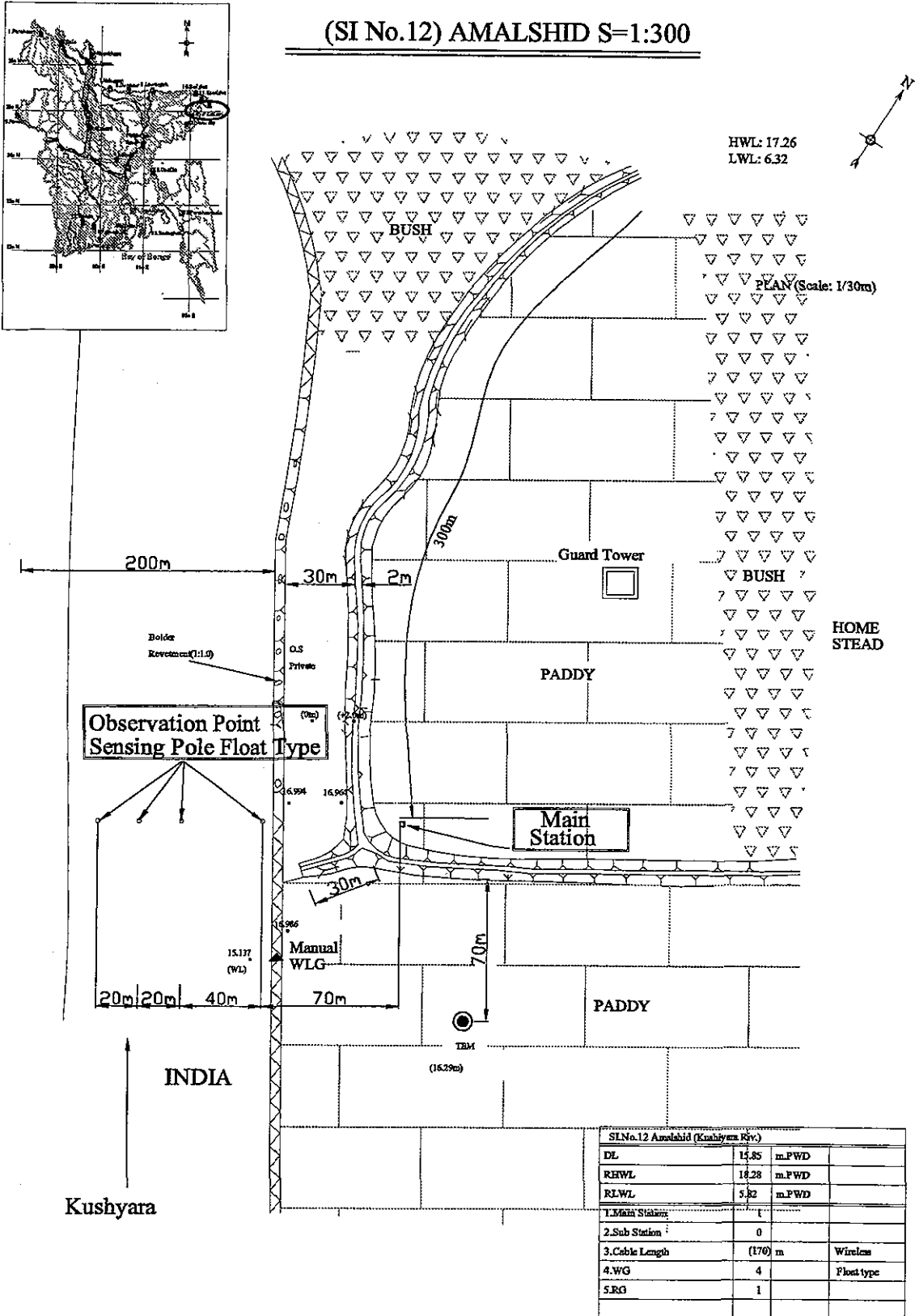
SI.No.11 Kanaighat (Surma Riv.)			
DL	13.20	m.PWD	
RHWL	15.26	m.PWD	
RLWL	3.67	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(120)	m	Wireless
4.WG	4		Float type
5.RG	1		

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Figure 11  
Layout Plan Sketch (11.Kanaighat)

(SI No.12) AMALSHID S=1:300

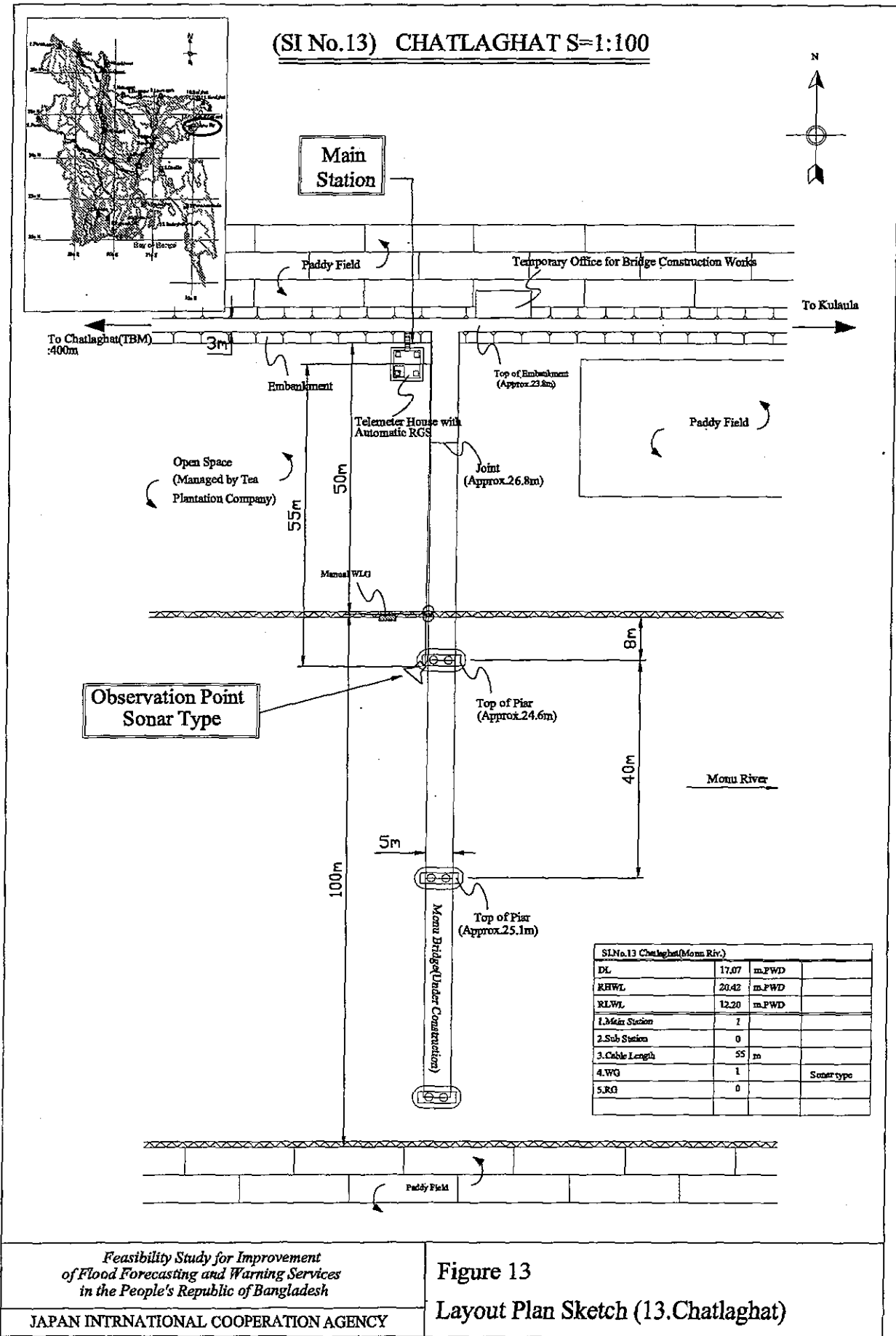


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Figure 12

Layout Plan Sketch (12.Amalshid)

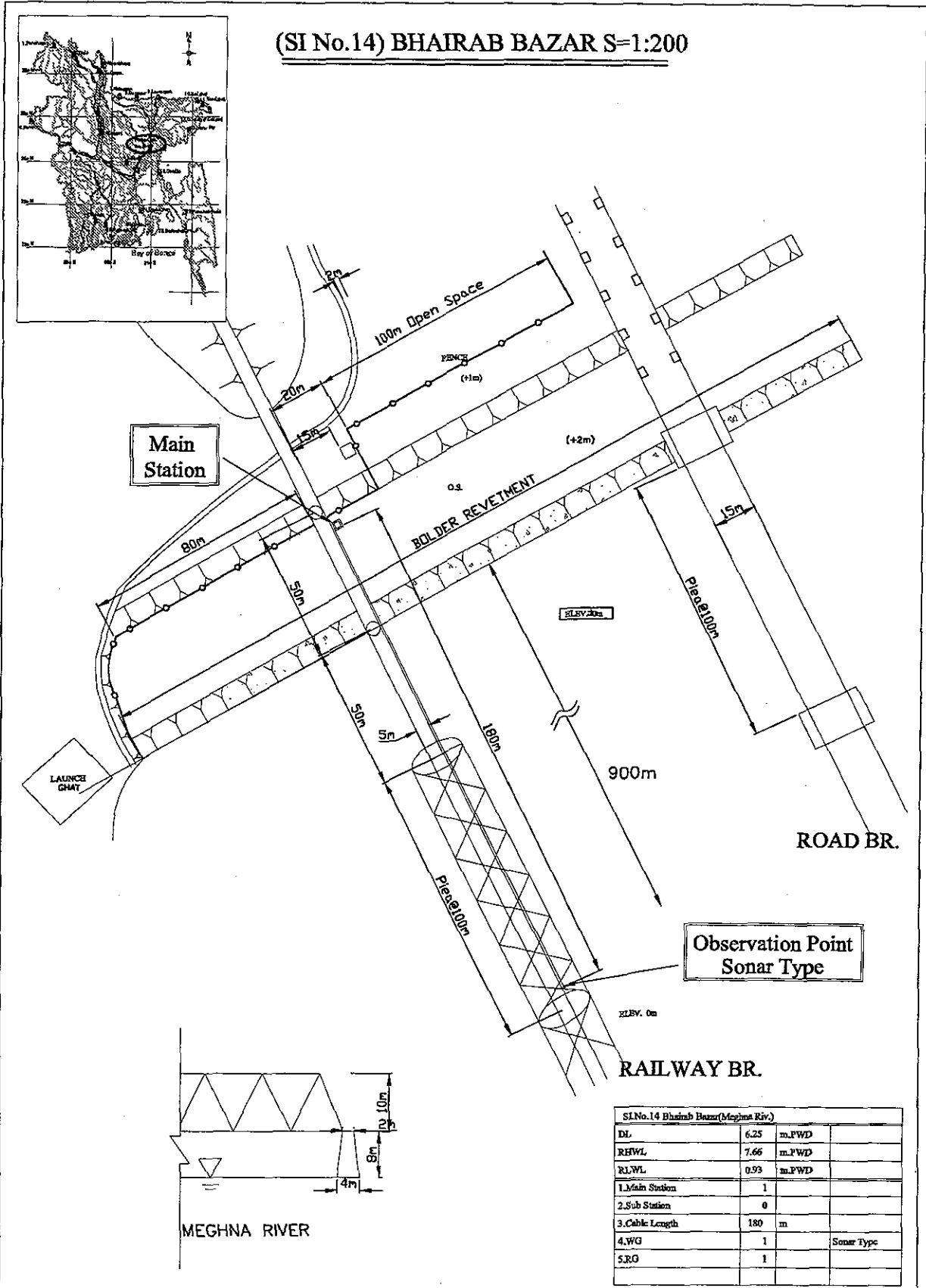


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**Figure 13  
Layout Plan Sketch (13.Chatlaghat)**

(SI No.14) BHAIKAB BAZAR S=1:200



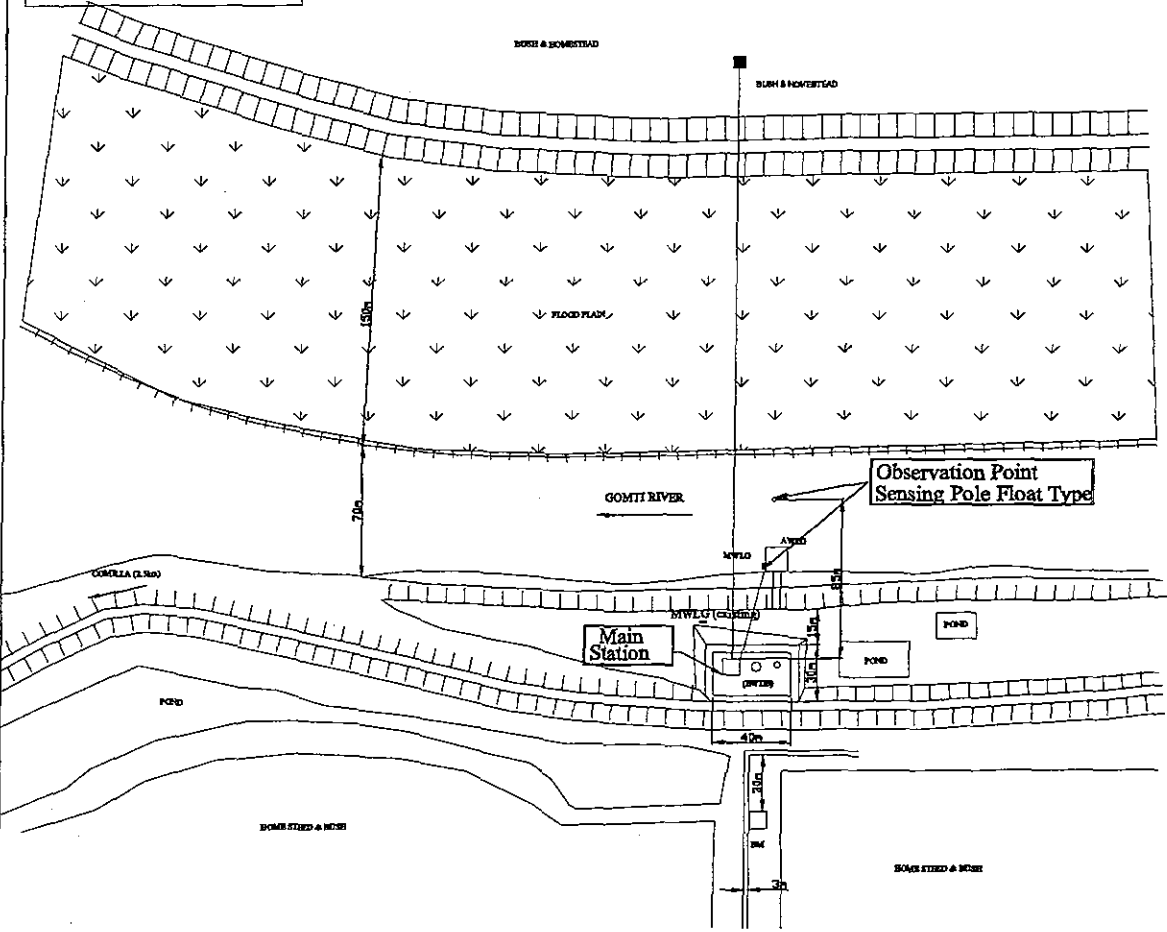
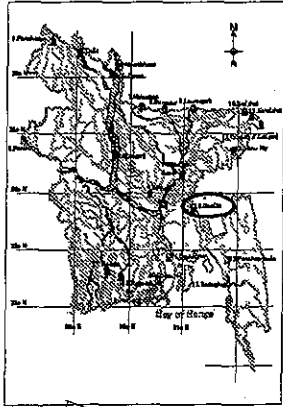
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Figure 14

Layout Plan Sketch (14.Bhairab bazar)

(SI No.15) COMILLA=1:400



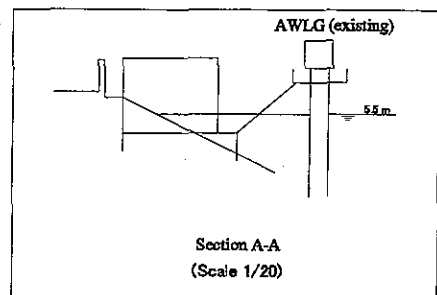
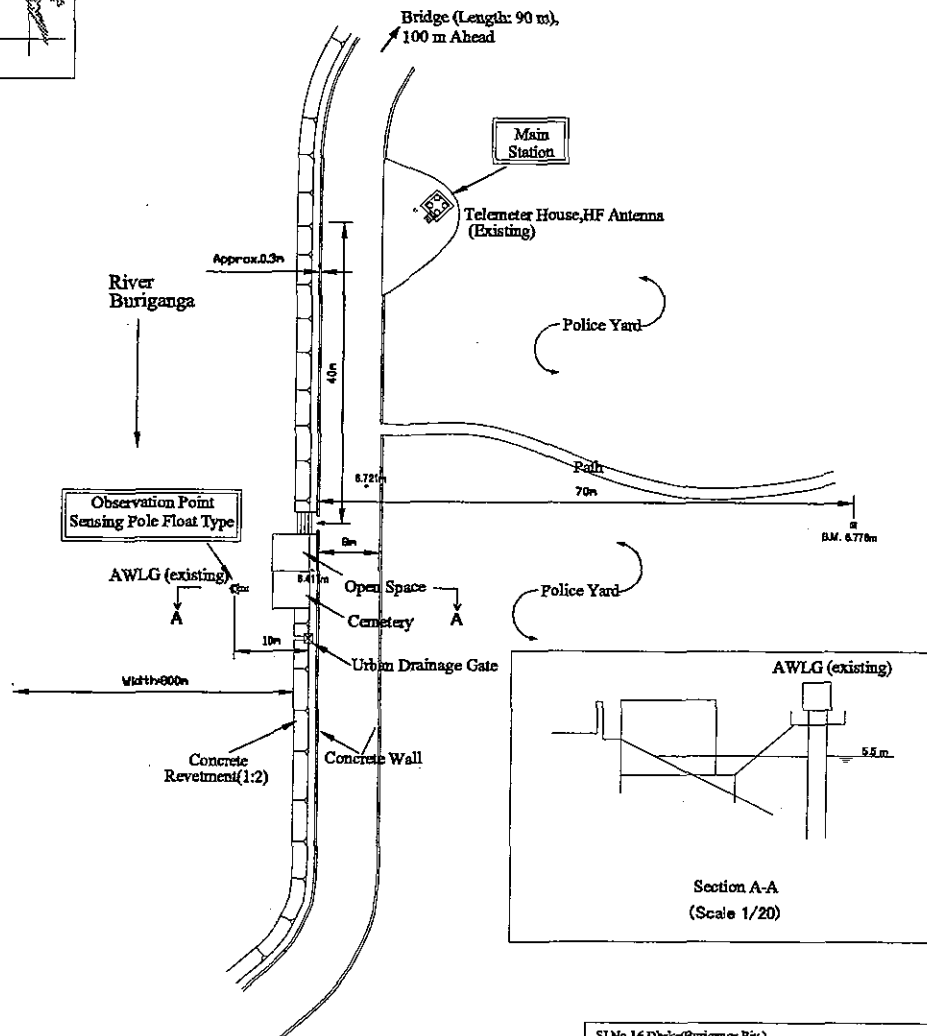
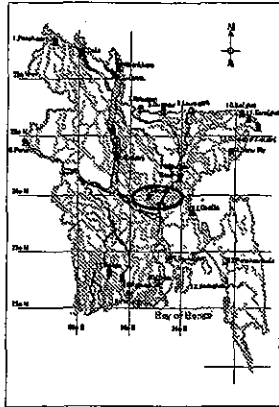
SI.No.15 Comilla(Gomti Riv.)			
DL	11.75	m.PWD	
R.H.W.L.	13.56	m.PWD	
R.L.W.L.	6.70	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(85)	m	Wireless
4.WG	2		Float type
5.RG	1		

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Figure 15  
Layout Plan Sketch (15.Comilla)

(SI No.16) DHAKA S=1:100



SI No.16 Dhaka(Buriganga Riv.)			
DL	6.00	m.PWD	
RHWL	7.58	m.PWD	
RLWL	0.52	m.PWD	
1.Main Station	0		Existing
2.Sub Station	0		Existing
3.Cable Length	0 m		Existing
4.WG	0		Existing
5.RG	0		

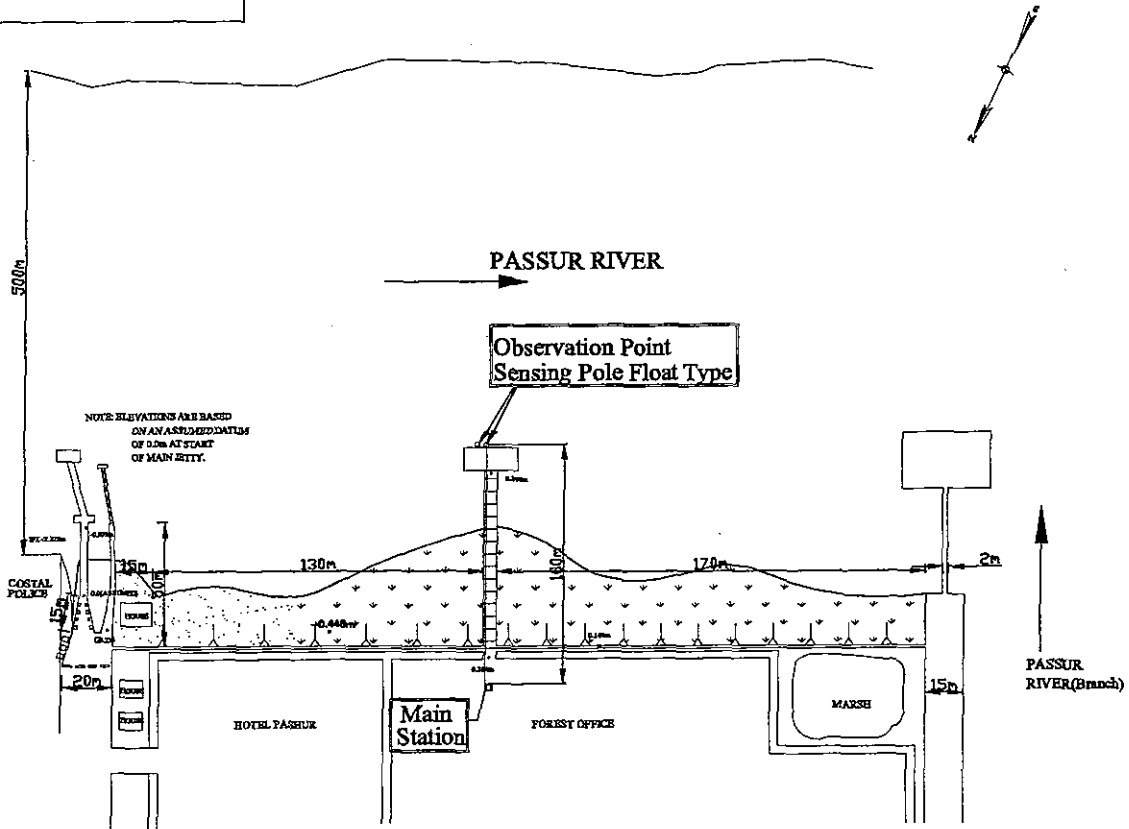
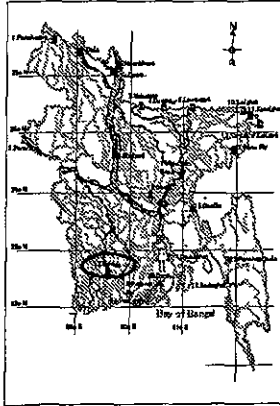
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Figure 16  
Layout Plan Sketch (16.Dhaka)



(SI No.17) MONGLA S=1:300



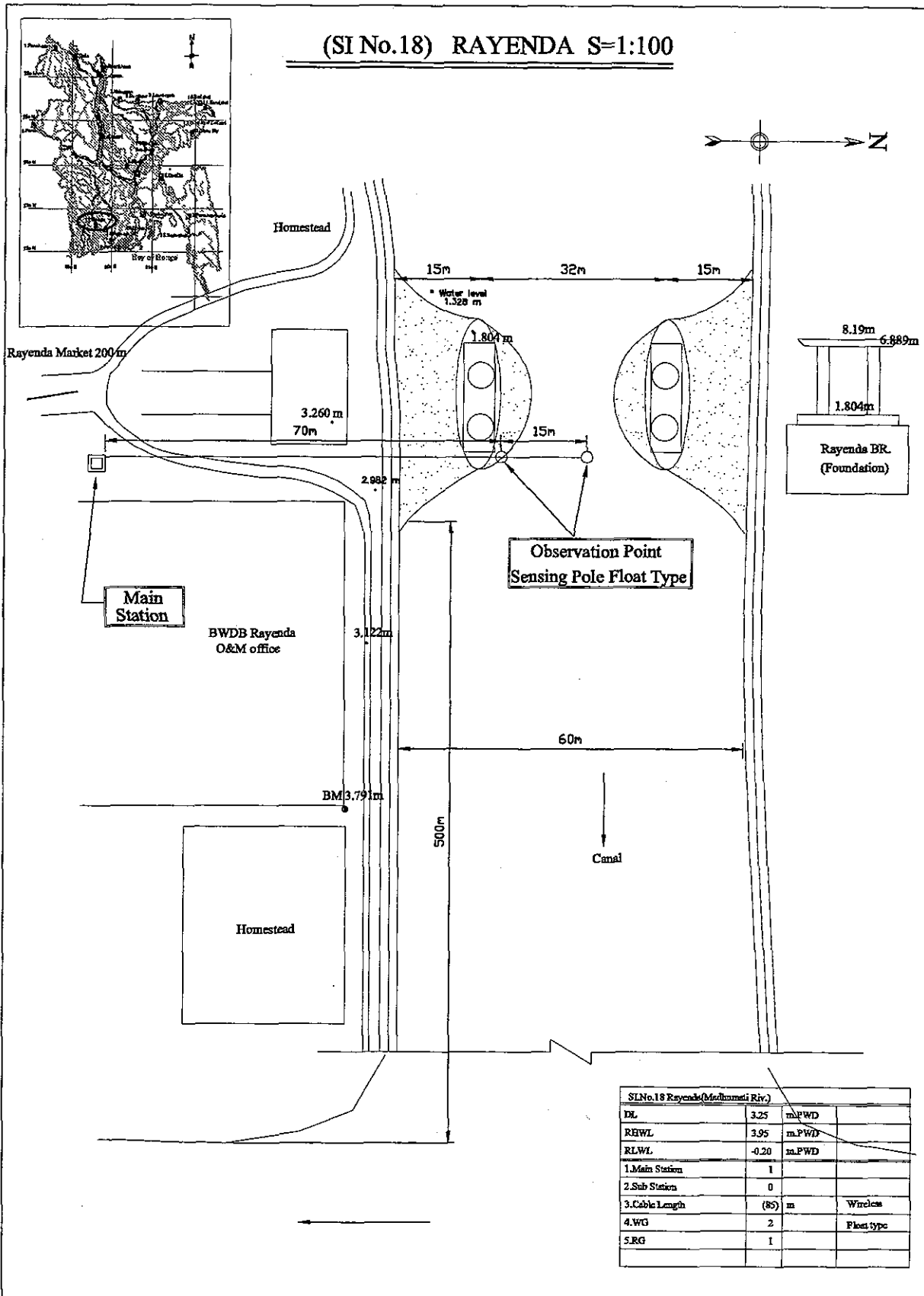
SI No. 17 Mongla (Rupai-Passar Riv.)		
DL		m.PWD
RHWL	3.28	m.PWD
RLWL	-1.77	m.PWD
1. Main Station	1	
2. Sub Station	0	
3. Cable Length	(100) m	Wireless
4. WG	2	Float
5. RG	1	

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Figure 17  
Layout Plan Sketch (17.Mongla)

(SI No.18) RAYENDA S=1:100

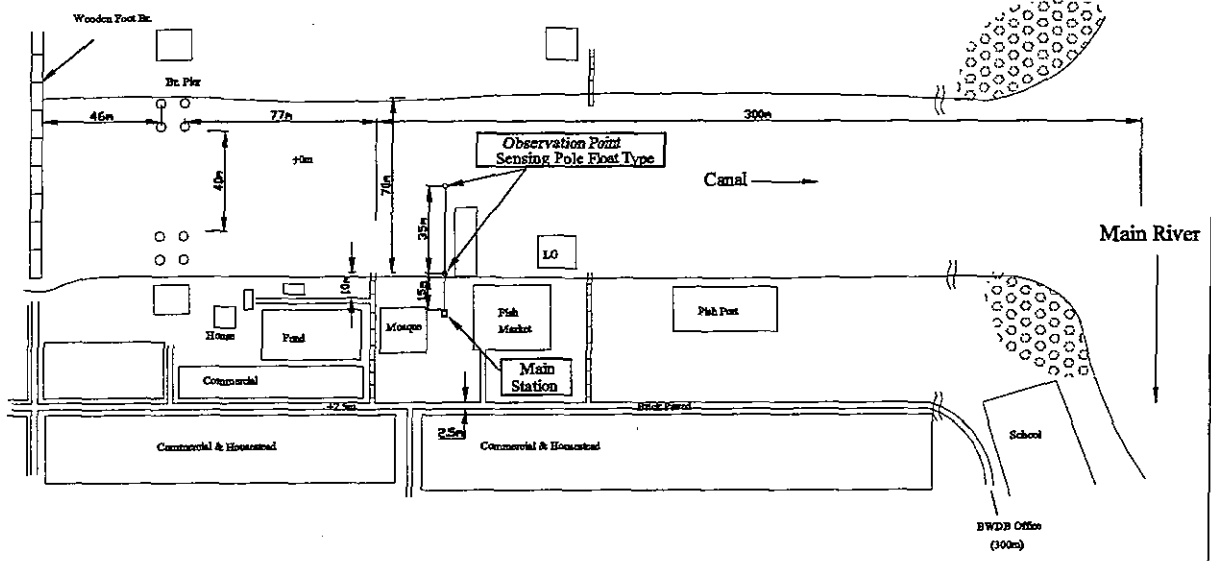
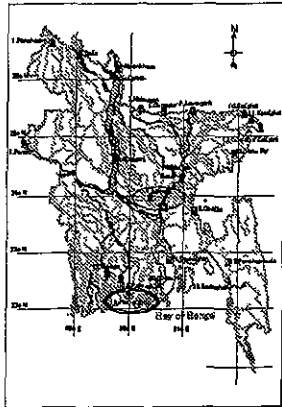


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Figure 18  
Layout Plan Sketch (18.Rayenda)

(SI No.19) PATHARGHATA S=1:250



SI.No.19 Patharghata(Bishelchi Riv.)			
DL	-	m.PWD	
RHWL	3.80	m.PWD	
RLWL	-1.17	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(50) m	Wireless	
4.WG	2	Float type	
5.RG	1		

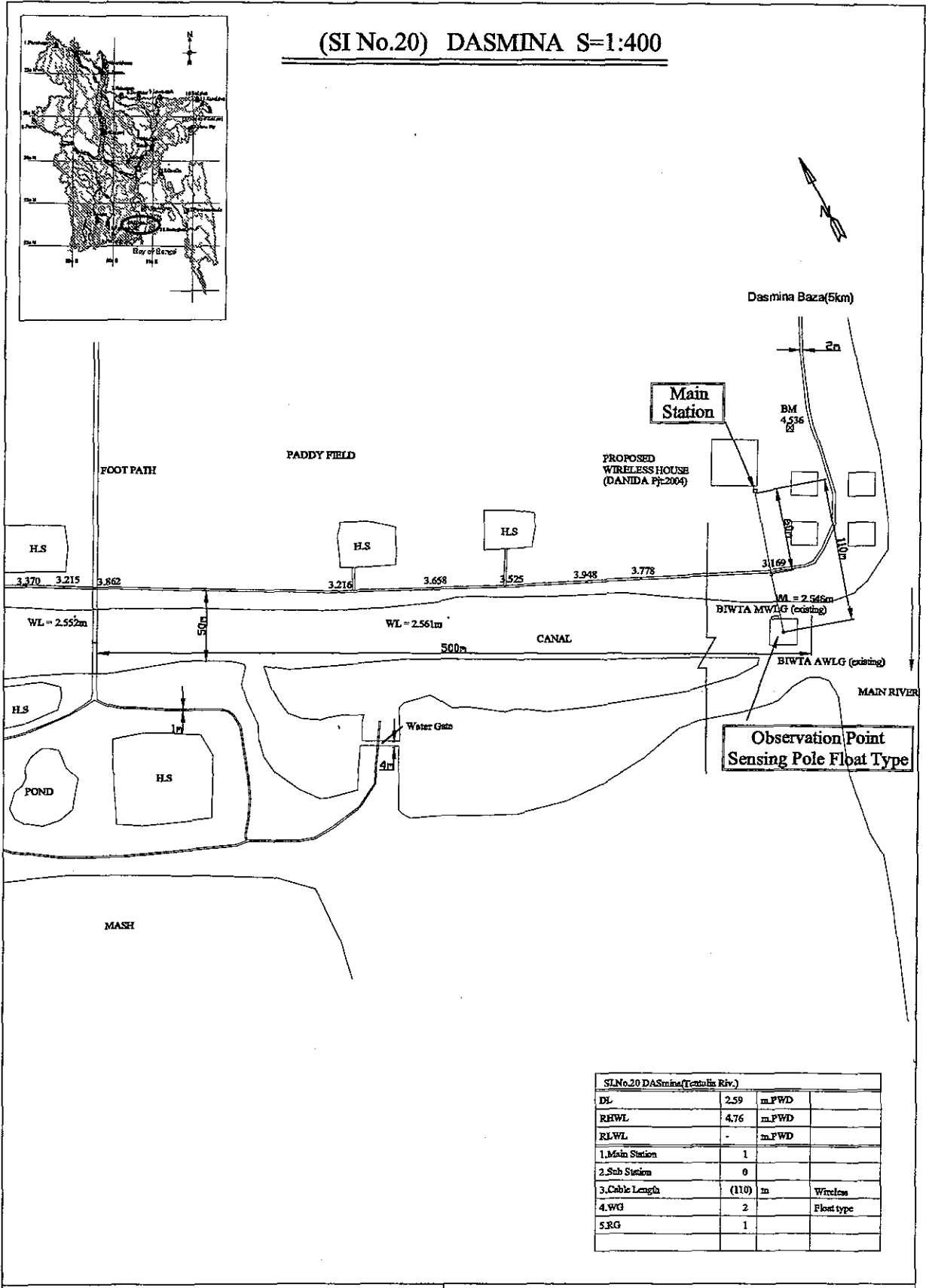
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Figure 19

Layout Plan Sketch (19.Patharghata)

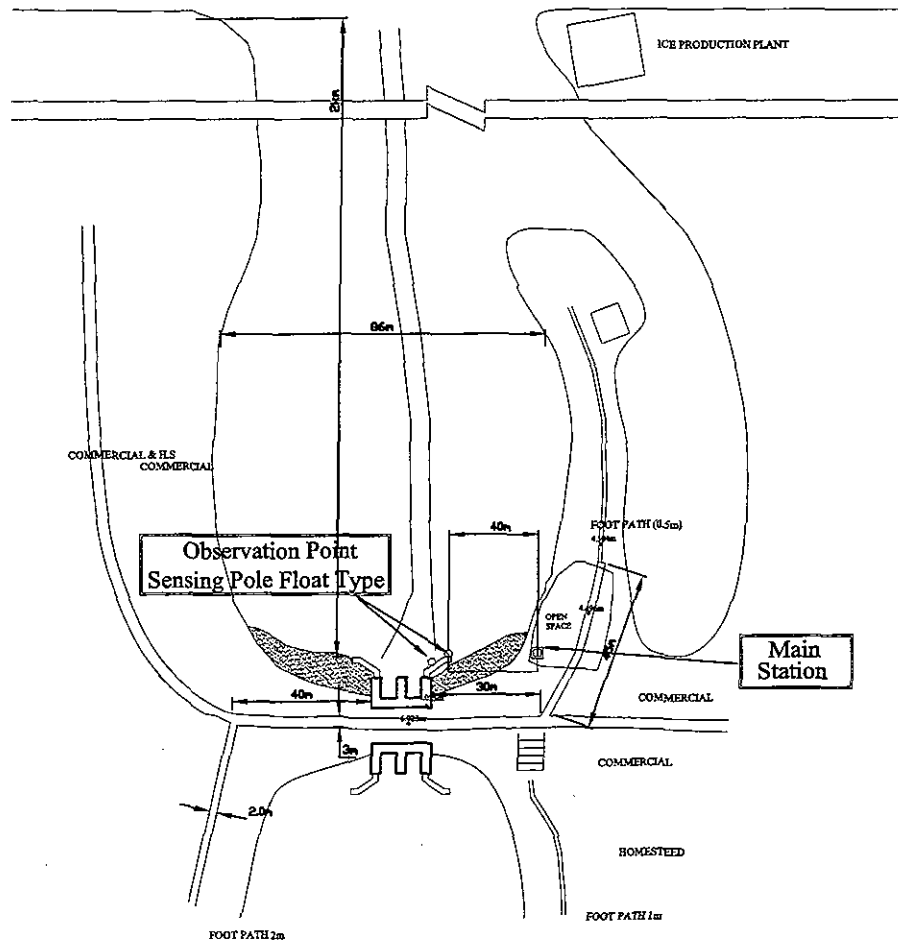
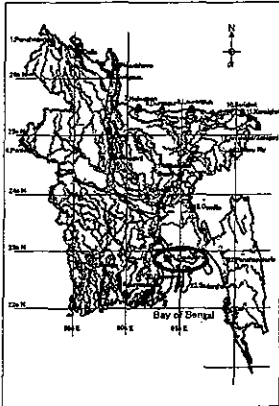
(SI No.20) DASMINA S=1:400



SI.No.20 DASmina(Tetulia Riv.)			
DL	2.59	m.PWD	
RRLWL	4.76	m.PWD	
RLWL	-	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(110)	m	Wireless
4.WG	2		Float type
5.RG	1		

Figure 20  
Layout Plan Sketch (20.Dasmina)

(SI No.21) DAULATKHAN S=1:200



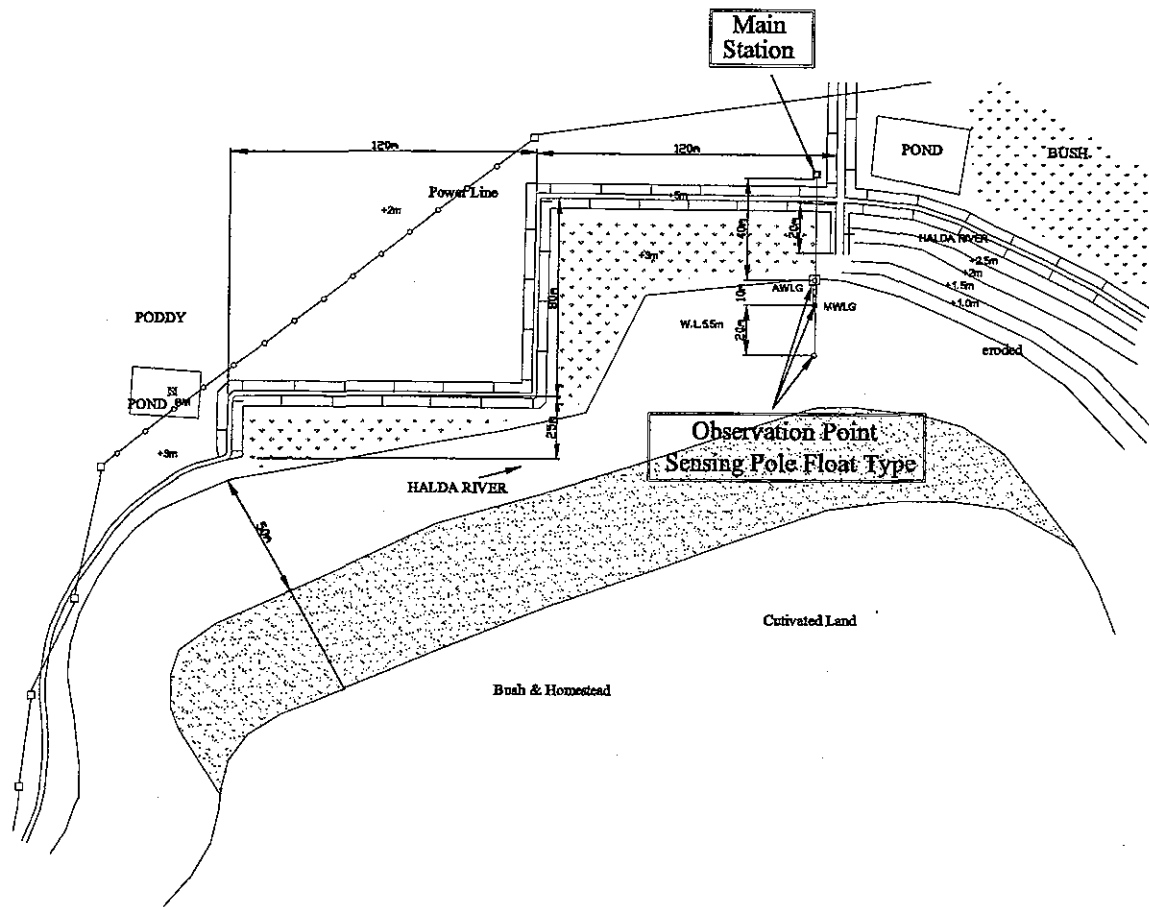
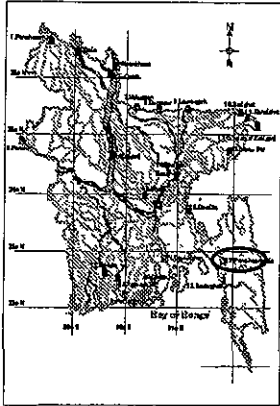
SI No.20 Daulatkhán (L. Meghna Riv.)			
DL	3.43	m.PWD	
RHWL	5.11	m.PWD	
RLWL	-0.54	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(40)	m	Wireless
4.WG	2		Float type
5.RG	1		

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Figure 21  
Layout Plan Sketch (21.Daulatkhán)

(SI No.22) PANCHAPUKURIA S=1:300



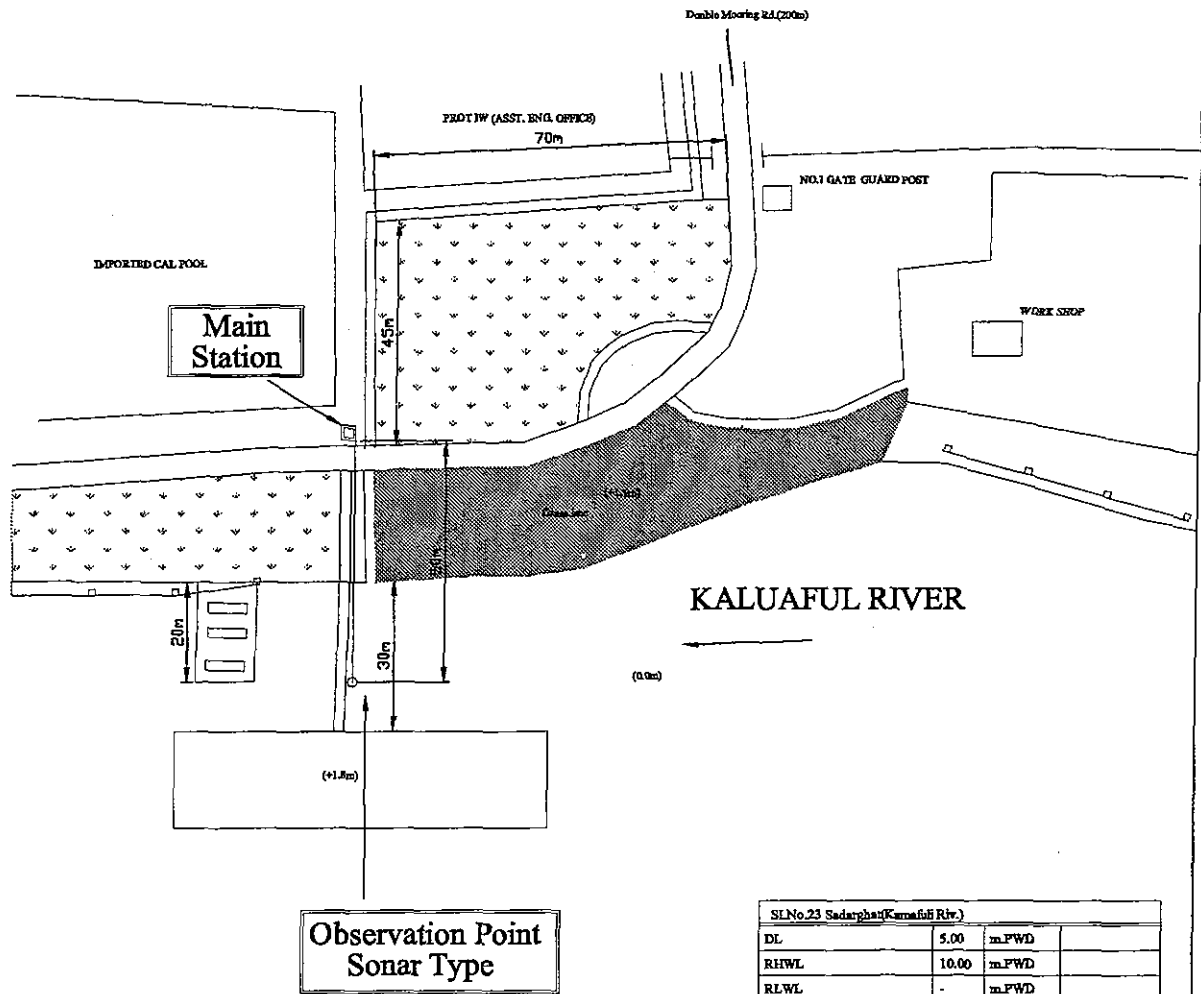
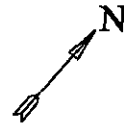
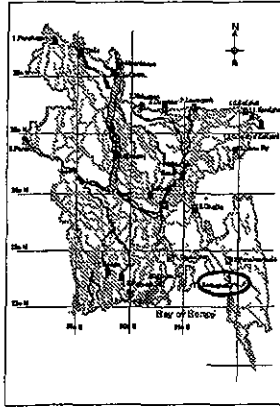
SI No.22 Panchapukuria (Halda Riv.)			
DL	9.50	m.PWD	
REWL	11.55	m.PWD	
RLWL	1.84	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	(70) m	Wireless	
4.WG	3	Float type	
5.RG	1		

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Figure 22  
Layout Plan Sketch (22.Panchapukuria)

(SI No.23) SADARGHAT S=1:150



SI No.23 Sadarghat(Karnafuli Riv.)			
DL	5.00	m.PWD	
RHWL	10.00	m.PWD	
RLWL	-	m.PWD	
1.Main Station	1		
2.Sub Station	0		
3.Cable Length	50	m	
4.WG	1		Sonar Type
5.RG	1		

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Figure 23  
Layout Plan Sketch (23.Sadarghat)





## *ANNEX-VI*

RESULT OF THE ASSESSMENT OF FLOOD FORECASTING  
ANALYSIS MODEL



**Table 1 Summary of Errors at Forecast Stations Applied in Modelling by FFWC (1/6)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
<b>Flash Flood Areas</b>									
Bhusirbandar	24hr	2001	0.08	0.11	0.18	0.29	0.41	0.17	1.23
		2002	0.10	0.13	0.16	0.21	0.30	0.16	1.28
		2003	0.15	0.21	0.24	0.38	0.48	0.22	1.34
	48hr	2001	0.14	0.20	0.26	0.45	0.70	0.29	2.24
		2002	0.19	0.24	0.32	0.45	0.63	0.29	1.79
		2003	0.31	0.36	0.47	0.69	0.94	0.43	2.26
	72hr	2001	0.16	0.25	0.36	0.55	1.08	0.40	3.00
		2002	0.32	0.39	0.48	0.69	0.94	0.45	2.09
		2003	0.50	0.57	0.74	0.95	1.31	0.63	3.44
Harbiganj	24hr	2002	0.27	0.37	0.44	0.56	0.80	0.37	1.18
		2003	0.14	0.21	0.30	0.50	0.80	0.33	1.93
		2002	0.55	0.67	0.80	0.92	1.02	0.58	1.64
	48hr	2003	0.29	0.45	0.54	0.84	1.09	0.51	2.31
		2002	0.45	0.66	0.85	0.99	1.16	0.61	2.04
	2003	0.38	0.51	0.68	1.07	1.48	0.64	2.40	
Jariajanjail	24hr	2001	0.11	0.15	0.19	0.30	0.39	0.18	0.89
		2002	0.15	0.19	0.22	0.30	0.37	0.18	0.85
		2003	0.13	0.20	0.28	0.36	0.43	0.22	2.29
	48hr	2001	0.21	0.26	0.32	0.43	0.76	0.30	1.42
		2002	0.21	0.23	0.29	0.32	0.42	0.24	1.09
		2003	0.29	0.36	0.47	0.54	0.74	0.36	1.74
	72hr	2001	0.31	0.36	0.46	0.61	0.94	0.42	1.62
		2002	0.23	0.28	0.30	0.43	0.53	0.28	1.18
		2003	0.39	0.47	0.55	0.77	0.91	0.47	2.39
Kanaighat	24hr	2001	0.15	0.23	0.26	0.35	0.51	0.27	2.29
		2002	0.11	0.16	0.20	0.25	0.44	0.22	2.12
		2003	0.15	0.20	0.25	0.35	0.45	0.25	2.97
	48hr	2001	0.26	0.36	0.50	0.58	0.90	0.42	2.89
		2002	0.29	0.34	0.42	0.55	0.99	0.43	3.04
		2003	0.38	0.43	0.59	0.73	0.94	0.53	5.13
	72hr	2001	0.39	0.50	0.69	0.82	1.04	0.54	3.61
		2002	0.38	0.50	0.62	0.93	1.35	0.58	2.38
		2003	0.45	0.68	0.76	0.99	1.32	0.72	5.96
Mohadevpur	24hr	2001	0.10	0.11	0.20	0.32	0.57	0.24	2.14
		2002	0.14	0.16	0.21	0.28	0.41	0.19	0.86
		2003	0.23	0.29	0.38	0.61	0.88	0.36	1.92
	48hr	2001	0.23	0.29	0.52	0.71	0.89	0.39	2.19
		2002	0.26	0.33	0.43	0.55	0.80	0.35	1.61
		2003	0.34	0.48	0.77	0.92	1.31	0.58	2.71
	72hr	2001	0.31	0.41	0.60	0.92	1.26	0.52	2.40
		2002	0.30	0.39	0.51	0.76	1.01	0.48	2.48
		2003	0.40	0.52	0.96	1.18	1.46	0.69	3.01
Moulvi Bazar	24hr	2001	0.14	0.21	0.30	0.42	0.59	0.24	1.26
		2002	0.16	0.19	0.24	0.35	0.48	0.24	1.43
		2003	0.17	0.20	0.30	0.49	0.98	0.35	2.27
	48hr	2001	0.27	0.45	0.59	0.75	1.08	0.44	2.11
		2002	0.30	0.43	0.50	0.59	0.86	0.45	2.25
		2003	0.30	0.42	0.64	0.98	1.55	0.58	2.74
	72hr	2001	0.43	0.56	0.68	0.89	1.40	0.57	2.01
		2002	0.39	0.58	0.74	1.03	1.31	0.59	3.04
		2003	0.36	0.57	1.14	1.46	1.74	0.74	3.27

**Table 1 Summary of Errors at Forecast Stations Applied in Modelling by FFWC (2/6)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
<b>Monsoonal Flood Areas</b>									
Bahadurabad	24hr	2001	0.04	0.05	0.06	0.08	0.11	0.06	0.66
		2002	0.04	0.04	0.05	0.07	0.10	0.05	0.30
		2003	0.04	0.05	0.06	0.08	0.10	0.05	0.19
	48hr	2001	0.07	0.10	0.13	0.18	0.24	0.11	0.44
		2002	0.07	0.08	0.10	0.13	0.20	0.10	0.49
		2003	0.10	0.13	0.15	0.19	0.22	0.12	0.50
	72hr	2001	0.12	0.16	0.21	0.27	0.42	0.19	1.11
		2002	0.11	0.13	0.17	0.23	0.31	0.16	1.34
		2003	0.18	0.24	0.29	0.32	0.37	0.21	0.63
Bagayakul	24hr	2001	0.04	0.06	0.07	0.09	0.11	0.06	0.26
		2002	0.04	0.05	0.06	0.08	0.10	0.05	0.27
		2003	0.04	0.05	0.06	0.08	0.09	0.05	0.31
	48hr	2001	0.07	0.10	0.14	0.16	0.20	0.10	0.47
		2002	0.07	0.08	0.10	0.13	0.17	0.09	0.35
		2003	0.06	0.07	0.10	0.14	0.19	0.09	0.53
	72hr	2001	0.09	0.13	0.15	0.21	0.25	0.13	0.68
		2002	0.09	0.11	0.14	0.17	0.25	0.12	0.41
		2003	0.08	0.11	0.14	0.18	0.27	0.12	0.69
Bairab Bazar	24hr	2001	0.03	0.04	0.05	0.07	0.07	0.04	0.18
		2002	0.02	0.02	0.02	0.03	0.04	0.02	0.10
		2003	0.02	0.03	0.04	0.04	0.05	0.03	0.17
	48hr	2001	0.04	0.05	0.06	0.08	0.11	0.06	0.30
		2002	0.03	0.04	0.04	0.06	0.11	0.04	0.19
		2003	0.03	0.04	0.06	0.10	0.12	0.05	0.22
	72hr	2001	0.06	0.07	0.09	0.11	0.14	0.07	0.40
		2002	0.04	0.06	0.07	0.10	0.15	0.06	0.26
		2003	0.04	0.06	0.10	0.13	0.18	0.07	0.25
Chakrahimpur	24hr	2001	0.06	0.08	0.10	0.14	0.25	0.11	0.99
		2002	0.06	0.07	0.11	0.14	0.24	0.13	2.04
		2003	0.08	0.10	0.15	0.30	0.37	0.16	0.88
	48hr	2001	0.13	0.17	0.22	0.27	0.35	0.21	1.76
		2002	0.13	0.16	0.20	0.25	0.33	0.19	2.01
		2003	0.15	0.19	0.24	0.30	0.50	0.21	0.98
	72hr	2001	0.20	0.25	0.30	0.37	0.60	0.29	1.54
		2002	0.18	0.22	0.29	0.38	0.52	0.26	1.98
		2003	0.20	0.28	0.33	0.35	0.51	0.27	1.28
Chandpur	24hr	2001	0.20	0.28	0.32	0.41	0.49	0.25	1.33
		2002	0.18	0.20	0.30	0.39	0.47	0.23	1.05
		2003	0.12	0.17	0.22	0.27	0.41	0.22	1.08
	48hr	2001	0.24	0.30	0.35	0.41	0.52	0.27	1.16
		2002	0.22	0.25	0.33	0.41	0.54	0.27	1.03
		2003	0.17	0.22	0.30	0.33	0.52	0.27	1.14
	72hr	2001	0.27	0.30	0.37	0.43	0.54	0.30	1.02
		2002	0.26	0.30	0.38	0.43	0.59	0.29	1.10
		2003	0.30	0.32	0.33	0.42	0.48	0.31	1.23
Chapai-Nawabganj	24hr	2001	0.04	0.05	0.06	0.10	0.16	0.07	0.59
		2002	0.06	0.07	0.08	0.11	0.15	0.07	0.34
		2003	0.04	0.05	0.07	0.08	0.11	0.06	0.21
	48hr	2001	0.09	0.12	0.14	0.21	0.40	0.15	0.73
		2002	0.10	0.13	0.18	0.23	0.32	0.15	0.69
		2003	0.07	0.10	0.10	0.17	0.21	0.12	0.46
	72hr	2001	0.16	0.19	0.30	0.37	0.49	0.23	1.10
		2002	0.16	0.21	0.30	0.37	0.51	0.22	0.91
		2003	0.11	0.14	0.15	0.28	0.34	0.17	0.65

**Table 1 Summary of Errors at Forecast Stations Applied in Modelling by FFWC (3/6)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
Chilmari	24hr	2001	0.08	0.11	0.18	0.23	0.27	0.12	0.42
		2002	0.04	0.05	0.06	0.08	0.13	0.06	0.31
		2003	0.05	0.06	0.08	0.11	0.13	0.07	0.20
	48hr	2001	0.14	0.18	0.25	0.29	0.40	0.18	0.81
		2002	0.08	0.11	0.13	0.17	0.30	0.13	1.02
		2003	0.15	0.17	0.19	0.22	0.28	0.16	0.57
	72hr	2001	0.18	0.24	0.29	0.39	0.53	0.26	1.35
		2002	0.13	0.17	0.21	0.29	0.43	0.21	1.63
		2003	0.23	0.27	0.31	0.37	0.50	0.25	0.69
Demra	24hr	2001	0.06	0.09	0.14	0.17	0.31	0.12	0.56
		2002	0.03	0.04	0.04	0.06	0.09	0.04	0.28
		2003	0.02	0.03	0.03	0.05	0.07	0.04	0.44
	48hr	2001	0.09	0.11	0.16	0.23	0.40	0.15	0.74
		2002	0.04	0.05	0.07	0.08	0.12	0.06	0.26
		2003	0.04	0.05	0.06	0.08	0.10	0.06	0.42
	72hr	2001	0.11	0.15	0.21	0.34	0.45	0.18	0.86
		2002	0.06	0.07	0.08	0.10	0.13	0.07	0.40
		2003	0.05	0.07	0.08	0.10	0.14	0.08	0.43
Dhaka	24hr	2001	0.03	0.04	0.06	0.07	0.11	0.05	0.25
		2002	0.03	0.03	0.04	0.05	0.08	0.03	0.13
		2003	0.03	0.04	0.04	0.05	0.07	0.04	0.28
	48hr	2001	0.06	0.08	0.09	0.12	0.17	0.08	0.35
		2002	0.05	0.06	0.08	0.10	0.12	0.06	0.22
		2003	0.06	0.07	0.08	0.11	0.14	0.07	0.36
	72hr	2001	0.09	0.11	0.12	0.16	0.22	0.10	0.41
		2002	0.06	0.08	0.10	0.13	0.16	0.08	0.35
		2003	0.07	0.10	0.11	0.14	0.21	0.10	0.47
Goalondo	24hr	2001	0.04	0.04	0.05	0.07	0.11	0.05	0.41
		2002	0.04	0.05	0.06	0.07	0.09	0.05	0.28
		2003	0.04	0.05	0.05	0.06	0.09	0.05	0.18
	48hr	2001	0.08	0.10	0.12	0.16	0.19	0.12	0.76
		2002	0.06	0.07	0.10	0.13	0.16	0.08	0.64
		2003	0.08	0.09	0.11	0.14	0.18	0.09	0.36
	72hr	2001	0.14	0.17	0.20	0.24	0.31	0.18	0.97
		2002	0.10	0.12	0.13	0.17	0.23	0.12	0.82
		2003	0.12	0.16	0.19	0.22	0.27	0.15	0.44
Gorai Rly Br.	24hr	2001	0.03	0.04	0.06	0.08	0.14	0.05	0.28
		2002	0.04	0.05	0.07	0.08	0.11	0.06	0.42
		2003	0.03	0.03	0.04	0.06	0.11	0.04	0.26
	48hr	2001	0.07	0.09	0.14	0.17	0.23	0.11	0.51
		2002	0.09	0.10	0.14	0.17	0.24	0.12	0.65
		2003	0.07	0.08	0.10	0.13	0.20	0.09	0.44
	72hr	2001	0.12	0.17	0.23	0.28	0.36	0.18	0.77
		2002	0.15	0.20	0.24	0.27	0.36	0.19	0.92
		2003	0.10	0.14	0.19	0.24	0.33	0.15	0.48
Hardinge Br.	24hr	2001	0.04	0.05	0.06	0.09	0.11	0.06	0.30
		2002	0.04	0.04	0.05	0.07	0.10	0.05	0.28
		2003	0.03	0.04	0.05	0.07	0.10	0.04	0.17
	48hr	2001	0.09	0.11	0.13	0.19	0.28	0.12	0.62
		2002	0.10	0.11	0.13	0.17	0.26	0.12	0.58
		2003	0.06	0.08	0.11	0.16	0.20	0.09	0.36
	72hr	2001	0.13	0.17	0.21	0.31	0.44	0.19	0.90
		2002	0.18	0.20	0.25	0.29	0.40	0.21	0.87
		2003	0.12	0.15	0.20	0.25	0.33	0.15	0.53

**Table 1 Summary of Errors at Forecast Stations Applied in Modelling by FFWC (4/6)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
Jagir	24hr	2002	0.04	0.06	0.07	0.09	0.13	0.11	1.54
		2003	0.04	0.05	0.09	0.11	0.16	0.11	1.39
	48hr	2002	0.07	0.09	0.11	0.14	0.24	0.17	1.59
		2003	0.11	0.13	0.16	0.20	0.36	0.19	1.45
	72hr	2002	0.09	0.12	0.16	0.22	0.38	0.23	1.88
		2003	0.15	0.21	0.26	0.38	0.62	0.28	1.60
Jamalpur	24hr	2001	0.03	0.05	0.06	0.10	0.16	0.07	0.78
		2002	0.05	0.05	0.09	0.11	0.13	0.06	0.30
		2003	0.06	0.07	0.09	0.12	0.17	0.10	0.75
	48hr	2001	0.07	0.10	0.14	0.23	0.35	0.13	0.84
		2002	0.08	0.10	0.14	0.18	0.27	0.11	0.43
		2003	0.10	0.13	0.16	0.21	0.30	0.15	0.81
	72hr	2001	0.12	0.15	0.24	0.36	0.46	0.21	1.31
		2002	0.14	0.18	0.22	0.27	0.33	0.17	0.60
		2003	0.18	0.19	0.24	0.32	0.45	0.21	0.80
Kamakarli	24hr	2001	0.06	0.08	0.10	0.17	0.26	0.12	0.89
		2002	0.07	0.08	0.11	0.14	0.19	0.09	0.60
		2003	0.05	0.08	0.09	0.15	0.26	0.14	1.50
	48hr	2001	0.09	0.12	0.16	0.22	0.33	0.15	0.80
		2002	0.09	0.11	0.13	0.18	0.25	0.13	0.80
		2003	0.08	0.11	0.14	0.34	0.58	0.20	1.03
	72hr	2001	0.13	0.19	0.23	0.31	0.38	0.19	1.08
		2002	0.13	0.18	0.22	0.26	0.36	0.19	0.88
		2003	0.10	0.14	0.21	0.39	0.74	0.29	2.13
Madaripur	24hr	2001	0.02	0.03	0.04	0.07	0.13	0.06	0.76
		2002	0.03	0.04	0.04	0.06	0.07	0.04	0.40
		2003	0.02	0.03	0.04	0.05	0.07	0.03	0.15
	48hr	2001	0.05	0.06	0.08	0.12	0.14	0.08	0.78
		2002	0.05	0.06	0.07	0.10	0.15	0.07	0.40
		2003	0.05	0.06	0.07	0.09	0.17	0.07	0.28
	72hr	2001	0.06	0.07	0.10	0.13	0.16	0.10	0.75
		2002	0.07	0.08	0.10	0.13	0.19	0.09	0.42
		2003	0.06	0.09	0.11	0.16	0.23	0.10	0.37
Mirpur	24hr	2001	0.03	0.03	0.04	0.05	0.08	0.04	0.24
		2002	0.02	0.02	0.03	0.04	0.05	0.03	0.23
		2003	0.02	0.03	0.04	0.05	0.08	0.04	0.41
	48hr	2001	0.05	0.06	0.07	0.09	0.12	0.06	0.44
		2002	0.04	0.05	0.06	0.07	0.09	0.05	0.32
		2003	0.04	0.05	0.07	0.09	0.13	0.07	0.46
	72hr	2001	0.07	0.08	0.10	0.12	0.18	0.09	0.77
		2002	0.05	0.06	0.08	0.11	0.15	0.07	0.37
		2003	0.05	0.07	0.09	0.14	0.21	0.09	0.58
Mymensingh	24hr	2001	0.04	0.05	0.06	0.09	0.12	0.06	0.46
		2002	0.03	0.04	0.05	0.07	0.08	0.05	0.30
		2003	0.04	0.05	0.06	0.08	0.11	0.06	0.42
	48hr	2001	0.09	0.10	0.12	0.16	0.27	0.13	0.79
		2002	0.07	0.09	0.12	0.15	0.18	0.10	0.92
		2003	0.07	0.09	0.12	0.16	0.19	0.11	0.74
	72hr	2001	0.12	0.15	0.20	0.25	0.44	0.19	1.18
		2002	0.11	0.13	0.16	0.20	0.28	0.15	1.66
		2003	0.12	0.15	0.22	0.24	0.32	0.16	0.87

**Table 1 Summary of Errors at Forecast Stations Applied in Modelling by FFWC (5/6)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
Naogan	24hr	2001	0.08	0.10	0.17	0.22	0.32	0.14	0.65
		2002	0.10	0.12	0.14	0.17	0.26	0.12	0.97
		2003	0.11	0.14	0.15	0.18	0.25	0.13	0.34
	48hr	2001	0.13	0.17	0.28	0.43	0.55	0.25	1.19
		2002	0.18	0.23	0.27	0.34	0.45	0.23	1.68
		2003	0.24	0.27	0.30	0.38	0.43	0.25	0.82
	72hr	2001	0.21	0.29	0.37	0.65	1.03	0.39	1.57
		2002	0.27	0.32	0.38	0.44	0.65	0.34	2.07
		2003	0.30	0.39	0.45	0.49	0.73	0.36	1.44
Rajshahi	24hr	2001	0.04	0.05	0.07	0.10	0.12	0.06	0.62
		2002	0.05	0.06	0.07	0.11	0.13	0.07	0.52
		2003	0.02	0.03	0.04	0.07	0.10	0.05	0.58
	48hr	2001	0.09	0.12	0.15	0.20	0.30	0.13	0.62
		2002	0.11	0.15	0.19	0.22	0.31	0.15	0.80
		2003	0.08	0.10	0.12	0.16	0.22	0.12	0.93
	72hr	2001	0.16	0.20	0.25	0.35	0.42	0.21	1.03
		2002	0.21	0.26	0.31	0.35	0.47	0.26	0.83
		2003	0.15	0.19	0.22	0.30	0.43	0.21	1.21
Sirajganj	24hr	2001	0.04	0.07	0.11	0.31	0.36	0.13	0.74
		2002	0.03	0.04	0.05	0.06	0.08	0.05	0.63
		2003	0.04	0.06	0.08	0.09	0.13	0.07	0.42
	48hr	2001	0.11	0.15	0.20	0.32	0.42	0.18	1.22
		2002	0.07	0.08	0.10	0.13	0.17	0.10	0.93
		2003	0.10	0.12	0.16	0.18	0.27	0.13	0.65
	72hr	2001	0.16	0.21	0.25	0.39	0.50	0.23	1.34
		2002	0.12	0.15	0.18	0.23	0.33	0.16	1.03
		2003	0.15	0.20	0.25	0.31	0.43	0.21	0.64
Sheola	24hr	2001	0.09	0.11	0.15	0.19	0.28	0.12	0.69
		2002	0.08	0.12	0.16	0.21	0.28	0.12	0.59
		2003	0.11	0.13	0.16	0.24	0.44	0.17	1.37
	48hr	2001	0.19	0.23	0.29	0.36	0.62	0.26	1.57
		2002	0.20	0.26	0.32	0.39	0.55	0.26	0.94
		2003	0.24	0.30	0.41	0.51	0.73	0.35	2.89
	72hr	2001	0.29	0.34	0.43	0.57	0.75	0.36	1.95
		2002	0.28	0.37	0.44	0.53	0.83	0.36	1.19
		2003	0.36	0.46	0.61	0.80	1.02	0.54	3.60
Sunamganj	24hr	2001	0.04	0.06	0.08	0.11	0.16	0.07	0.39
		2002	0.06	0.07	0.09	0.13	0.20	0.08	0.43
		2003	0.06	0.08	0.12	0.15	0.23	0.10	0.50
	48hr	2001	0.08	0.11	0.15	0.22	0.32	0.14	0.87
		2002	0.08	0.15	0.18	0.28	0.41	0.16	0.76
		2003	0.13	0.15	0.23	0.32	0.45	0.21	1.39
	72hr	2001	0.13	0.17	0.24	0.30	0.49	0.21	1.26
		2002	0.17	0.23	0.27	0.39	0.59	0.25	1.14
		2003	0.23	0.28	0.37	0.46	0.59	0.31	1.81
Sylhet	24hr	2001	0.04	0.06	0.09	0.13	0.22	0.10	1.38
		2002	0.06	0.08	0.09	0.14	0.21	0.11	0.84
		2003	0.05	0.05	0.08	0.10	0.13	0.06	0.30
	48hr	2001	0.11	0.14	0.17	0.25	0.41	0.18	1.90
		2002	0.13	0.17	0.22	0.33	0.63	0.24	1.51
		2003	0.14	0.19	0.23	0.28	0.36	0.17	0.50
	72hr	2001	0.16	0.20	0.28	0.37	0.55	0.26	2.64
		2002	0.21	0.26	0.34	0.53	0.99	0.37	2.00
		2003	0.23	0.31	0.38	0.45	0.59	0.27	0.84

**Table 1 Summary of Errors at Forecast Stations Applied in Modelling by FFWC (6/6)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
Taraghat	24hr	2001	0.05	0.07	0.09	0.11	0.18	0.08	0.48
		2002	0.05	0.06	0.07	0.09	0.13	0.06	0.24
		2003	0.05	0.08	0.11	0.15	0.26	0.10	0.44
	48hr	2001	0.08	0.12	0.16	0.20	0.31	0.14	0.81
		2002	0.09	0.10	0.13	0.16	0.21	0.11	0.74
		2003	0.13	0.21	0.23	0.34	0.41	0.21	1.08
	72hr	2001	0.14	0.18	0.23	0.31	0.39	0.19	1.16
		2002	0.12	0.15	0.17	0.22	0.29	0.16	1.21
		2003	0.20	0.25	0.39	0.42	0.64	0.30	1.46
Tongi	24hr	2001	0.03	0.04	0.04	0.05	0.09	0.04	0.20
		2002	0.02	0.03	0.04	0.05	0.07	0.03	0.15
		2003	0.03	0.04	0.07	0.08	0.12	0.05	0.34
	48hr	2001	0.05	0.07	0.08	0.10	0.13	0.07	0.68
		2002	0.04	0.05	0.06	0.07	0.11	0.05	0.20
		2003	0.05	0.08	0.10	0.15	0.23	0.10	0.44
	72hr	2001	0.07	0.09	0.11	0.14	0.18	0.10	1.04
		2002	0.05	0.06	0.08	0.09	0.15	0.07	0.28
		2003	0.07	0.10	0.14	0.24	0.33	0.13	0.55



**Table 2 Summary of Errors at Boundary Stations Applied in Modelling by FFWC (1/4)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
<b>Flash Flood Areas</b>									
Manu Rly Br	24hr	2002	0.37	0.42	0.50	0.70	0.98	0.47	1.97
		2003	0.32	0.44	0.54	0.65	1.42	0.55	2.74
	48hr	2002	0.40	0.48	0.79	1.15	1.35	0.66	3.25
		2003	0.45	0.64	0.90	1.25	2.11	0.76	2.78
	72hr	2002	0.55	0.74	1.06	1.43	1.68	0.82	3.38
		2003	0.51	0.74	1.05	1.55	2.43	0.91	2.95
Amalshid	24hr	2002	0.14	0.17	0.20	0.28	0.38	0.19	0.66
		2003	0.18	0.22	0.28	0.35	0.47	0.24	1.49
	48hr	2002	0.28	0.32	0.39	0.51	0.64	0.37	1.43
		2003	0.38	0.48	0.58	0.72	0.86	0.47	1.52
	72hr	2002	0.46	0.53	0.58	0.73	1.04	0.52	1.56
		2003	0.53	0.69	0.80	1.01	1.23	0.62	2.07
Sarighat	24hr	2002	0.37	0.39	0.45	0.49	0.62	0.42	1.50
		2003	0.44	0.51	0.56	0.63	0.75	0.44	0.94
	48hr	2002	0.34	0.37	0.45	0.60	0.84	0.46	1.73
		2003	0.40	0.48	0.56	0.70	0.83	0.47	1.44
	72hr	2002	0.28	0.32	0.42	0.79	1.00	0.50	1.69
		2003	0.34	0.45	0.56	0.70	0.93	0.46	1.63
Lourergorh	24hr	2002	0.18	0.25	0.32	0.41	0.52	0.25	1.04
		2003	0.41	0.50	0.71	0.90	1.30	0.67	3.76
	48hr	2002	0.21	0.27	0.35	0.50	0.63	0.30	1.23
		2003	0.60	0.82	1.02	1.26	1.62	0.88	4.29
	72hr	2002	0.28	0.30	0.41	0.54	0.69	0.34	1.31
		2003	0.60	0.76	1.05	1.65	2.25	0.97	4.63
Durgapur	24hr	2001	0.25	0.26	0.38	0.43	0.60	0.32	0.86
		2002	0.20	0.23	0.30	0.37	0.63	0.28	1.39
		2003	0.24	0.28	0.41	0.54	0.97	0.40	1.94
	48hr	2001	0.25	0.31	0.44	0.51	0.71	0.34	1.05
		2002	0.21	0.26	0.38	0.49	0.82	0.34	1.94
		2003	0.26	0.39	0.60	0.94	1.15	0.48	2.02
	72hr	2001	0.29	0.38	0.51	0.59	0.77	0.39	0.96
		2002	0.23	0.30	0.44	0.68	0.96	0.40	2.04
		2003	0.35	0.54	0.71	0.98	1.19	0.54	2.64
Nakuagaon	24hr	2002	0.15	0.22	0.25	0.35	0.46	0.24	1.82
		2003	0.17	0.22	0.28	0.50	0.75	0.42	3.90
	48hr	2002	0.20	0.25	0.33	0.38	0.65	0.33	2.67
		2003	0.23	0.30	0.40	0.65	1.57	0.52	3.55
	72hr	2002	0.27	0.35	0.42	0.53	0.56	0.39	2.67
		2003	0.30	0.35	0.50	0.82	1.37	0.64	3.82
Comilla	24hr	2002	0.12	0.15	0.18	0.23	0.34	0.17	0.69
		2003	0.12	0.18	0.27	0.39	0.61	0.27	1.84
	48hr	2002	0.20	0.28	0.37	0.45	0.55	0.29	1.29
		2003	0.29	0.37	0.50	0.80	1.05	0.50	3.09
	72hr	2002	0.28	0.32	0.38	0.53	0.79	0.38	1.51
		2003	0.39	0.50	0.70	0.95	1.35	0.63	3.03



**Table 2 Summary of Errors at Boundary Stations Applied in Modelling by FFWC (3/4)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
<b>Monsoonal Flood Areas</b>									
Noonkhawa	24hr	2001	0.07	0.09	0.13	0.16	0.23	0.10	0.33
		2002	0.05	0.06	0.07	0.10	0.16	0.07	0.40
		2003	0.05	0.07	0.08	0.11	0.14	0.08	0.32
	48hr	2001	0.14	0.24	0.33	0.42	0.49	0.25	0.58
		2002	0.10	0.14	0.18	0.22	0.32	0.15	1.30
		2003	0.15	0.18	0.20	0.26	0.32	0.17	0.62
	72hr	2001	0.24	0.36	0.40	0.58	0.69	0.37	1.08
		2002	0.17	0.23	0.27	0.37	0.52	0.22	1.37
		2003	0.20	0.26	0.31	0.43	0.56	0.26	0.88
Gaibandha	24hr	2001	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
		2002	0.06	0.07	0.10	0.14	0.19	0.09	0.51
	48hr	2001	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
		2002	0.10	0.14	0.17	0.23	0.32	0.15	0.61
	72hr	2001	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
		2002	0.14	0.18	0.22	0.32	0.45	0.20	0.85
Rohanpur	24hr	2001	0.06	0.10	0.14	0.18	0.38	0.19	1.32
		2002	0.06	0.08	0.12	0.16	0.30	0.12	1.12
	48hr	2001	0.09	0.20	0.20	0.26	0.52	0.24	1.55
		2002	0.12	0.16	0.22	0.29	0.45	0.19	1.13
	72hr	2001	0.21	0.32	0.37	0.39	0.77	0.33	1.63
		2002	0.21	0.27	0.35	0.45	0.59	0.28	1.13
Pankha	24hr	2001	0.07	0.08	0.15	0.30	0.49	0.20	1.17
		2002	0.06	0.09	0.10	0.15	0.24	0.10	0.94
		2003	0.05	0.07	0.09	0.11	0.15	0.08	0.50
	48hr	2001	0.21	0.27	0.33	0.46	0.63	0.29	0.86
		2002	0.13	0.17	0.21	0.26	0.40	0.18	0.94
		2003	0.12	0.16	0.19	0.23	0.32	0.16	0.73
	72hr	2001	0.32	0.48	0.49	0.57	0.65	0.38	1.17
		2002	0.23	0.27	0.32	0.40	0.51	0.28	0.96
		2003	0.20	0.23	0.29	0.36	0.47	0.25	1.00
<b>Tidal Flood Areas</b>									
Mongla	24hr	2002	0.37	0.44	0.53	0.58	0.72	0.40	1.19
		2003	0.14	0.23	0.29	0.42	0.62	0.27	1.89
	48hr	2002	0.37	0.49	0.54	0.75	0.91	0.46	1.39
		2003	0.24	0.32	0.36	0.48	0.64	0.32	1.12
	72hr	2002	0.36	0.54	0.68	0.84	0.96	0.49	1.39
2003		0.33	0.39	0.50	0.59	0.70	0.42	3.14	
Daulatkhan	24hr	2002	0.17	0.21	0.25	0.36	0.47	0.26	0.99
		2003	0.18	0.23	0.27	0.33	0.48	0.23	0.96
	48hr	2002	0.21	0.36	0.40	0.50	0.57	0.30	0.88
		2003	0.21	0.28	0.33	0.40	0.68	0.28	1.09
	72hr	2002	0.35	0.39	0.47	0.56	0.73	0.37	1.05
		2003	0.23	0.28	0.35	0.50	0.60	0.31	1.40
Rayenda	24hr	2002	0.13	0.20	0.23	0.26	0.38	0.18	0.80
		2003	0.10	0.13	0.19	0.24	0.33	0.15	0.45
	48hr	2002	0.18	0.23	0.31	0.41	0.53	0.24	0.88
		2003	0.10	0.15	0.21	0.32	0.39	0.17	0.60
	72hr	2002	0.27	0.32	0.42	0.45	0.70	0.32	1.08
		2003	0.14	0.16	0.24	0.30	0.45	0.20	0.89

**Table 2 Summary of Errors at Boundary Stations Applied in Modelling by FFWC (4/4)**

Location	Forecast Period (hr)	Year	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
			50%	40%	30%	20%	10%		
Dasmina	24hr	2002	0.19	0.23	0.27	0.31	0.38	0.21	0.98
		2003	0.11	0.16	0.20	0.23	0.32	0.17	1.06
	48hr	2002	0.23	0.30	0.34	0.45	0.49	0.27	1.40
		2003	0.17	0.20	0.22	0.29	0.40	0.21	1.22
	72hr	2002	0.24	0.33	0.38	0.51	0.61	0.31	1.45
		2003	0.16	0.21	0.23	0.33	0.49	0.22	1.28
Pathargata	24hr	2002	0.09	0.14	0.20	0.30	0.31	0.15	0.55
		2003	0.17	0.20	0.24	0.31	0.55	0.23	0.85
	48hr	2002	0.20	0.23	0.28	0.32	0.40	0.21	0.71
		2003	0.22	0.30	0.34	0.44	0.57	0.27	0.85
	72hr	2002	0.22	0.27	0.33	0.41	0.51	0.26	0.92
		2003	0.27	0.33	0.39	0.52	0.61	0.31	0.83

Note: -99.9 Data of poor quality or unavailable.  
 MAE Mean absolute error

**Table 3 Errors in 24 Hour Flood Forecasts Based on Period from June 30 to August 22, 2003 (1/2)**

Location	Case	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
		50%	40%	30%	20%	10%		
<b>Flash Flood Areas</b>								
Bhusirbandar	27 Update Stn, Obs. Bound.	0.16	0.17	0.21	0.29	0.42	0.22	1.65
	No Updating, Obs. Bound.	0.14	0.16	0.22	0.28	0.39	0.21	1.64
	27 Update Stn, FFWC Bound.	0.12	0.18	0.22	0.38	0.47	0.21	1.34
Harbiganj	27 Update Stn, Obs. Bound.	0.16	0.20	0.31	0.39	0.54	0.27	2.26
	No Updating, Obs. Bound.	0.17	0.23	0.27	0.44	0.65	0.28	1.48
	27 Update Stn, FFWC Bound.	0.13	0.19	0.28	0.43	0.64	0.28	1.93
Jariajangail	27 Update Stn, Obs. Bound.	0.05	0.06	0.10	0.14	0.17	0.08	0.42
	No Updating, Obs. Bound.	0.06	0.07	0.08	0.14	0.19	0.08	0.37
	27 Update Stn, FFWC Bound.	0.13	0.16	0.24	0.36	0.39	0.18	0.63
Kanaighat	27 Update Stn, Obs. Bound.	0.08	0.11	0.15	0.20	0.25	0.12	0.57
	No Updating, Obs. Bound.	0.10	0.14	0.16	0.22	0.26	0.13	0.40
	27 Update Stn, FFWC Bound.	0.11	0.13	0.18	0.24	0.32	0.15	0.46
Mohadevpur	27 Update Stn, Obs. Bound.	0.22	0.32	0.36	0.39	0.51	0.29	1.10
	No Updating, Obs. Bound.	0.31	0.35	0.45	0.62	0.74	0.37	1.36
	27 Update Stn, FFWC Bound.	0.21	0.28	0.38	0.54	0.86	0.33	1.17
Moulvi Bazaar	27 Update Stn, Obs. Bound.	0.11	0.13	0.17	0.25	0.50	0.24	1.50
	No Updating, Obs. Bound.	0.12	0.16	0.20	0.33	0.47	0.25	1.54
	27 Update Stn, FFWC Bound.	0.14	0.18	0.23	0.34	0.54	0.26	1.41
<b>Monsoonal Flood Areas</b>								
Bahadurabad	27 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.07	0.09	0.05	0.19
	No Updating, Obs. Bound.	0.04	0.06	0.07	0.07	0.12	0.05	0.15
	27 Update Stn, FFWC Bound.	0.04	0.05	0.06	0.08	0.10	0.05	0.19
Bagayakul	27 Update Stn, Obs. Bound.	0.03	0.03	0.04	0.06	0.08	0.04	0.11
	No Updating, Obs. Bound.	0.03	0.03	0.04	0.05	0.06	0.04	0.10
	27 Update Stn, FFWC Bound.	0.03	0.04	0.04	0.06	0.08	0.04	0.11
Bairab Bazaar	27 Update Stn, Obs. Bound.	0.03	0.03	0.05	0.07	0.10	0.05	0.21
	No Updating, Obs. Bound.	0.02	0.02	0.03	0.05	0.05	0.03	0.09
	27 Update Stn, FFWC Bound.	0.01	0.02	0.03	0.04	0.04	0.02	0.17
Chakrahimpur	27 Update Stn, Obs. Bound.	0.10	0.11	0.16	0.22	0.26	0.14	0.60
	No Updating, Obs. Bound.	0.09	0.10	0.14	0.16	0.31	0.12	0.61
	27 Update Stn, FFWC Bound.	0.09	0.10	0.13	0.26	0.35	0.15	0.88
Chandpur	27 Update Stn, Obs. Bound.	0.14	0.16	0.23	0.28	0.42	0.22	1.07
	No Updating, Obs. Bound.	0.14	0.16	0.22	0.29	0.39	0.22	1.07
	27 Update Stn, FFWC Bound.	0.12	0.17	0.22	0.27	0.41	0.22	1.08
Chapai-Nawabganj	27 Update Stn, Obs. Bound.	0.03	0.04	0.06	0.08	0.11	0.05	0.17
	No Updating, Obs. Bound.	0.03	0.04	0.07	0.09	0.12	0.05	0.16
	27 Update Stn, FFWC Bound.	0.04	0.06	0.08	0.11	0.19	0.21	2.25
Chilmari	27 Update Stn, Obs. Bound.	0.03	0.04	0.06	0.08	0.10	0.04	0.15
	No Updating, Obs. Bound.	0.03	0.04	0.05	0.07	0.09	0.04	0.15
	27 Update Stn, FFWC Bound.	0.05	0.06	0.07	0.11	0.12	0.07	0.20
Demra	27 Update Stn, Obs. Bound.	0.02	0.03	0.03	0.04	0.06	0.03	0.08
	No Updating, Obs. Bound.	0.02	0.02	0.03	0.04	0.05	0.02	0.07
	27 Update Stn, FFWC Bound.	0.02	0.03	0.03	0.03	0.05	0.03	0.10
Dhaka	27 Update Stn, Obs. Bound.	0.03	0.04	0.05	0.06	0.07	0.03	0.09
	No Updating, Obs. Bound.	0.02	0.03	0.04	0.05	0.07	0.03	0.10
	27 Update Stn, FFWC Bound.	0.03	0.03	0.04	0.05	0.06	0.03	0.09
Goalondo	27 Update Stn, Obs. Bound.	0.03	0.04	0.05	0.06	0.07	0.04	0.14
	No Updating, Obs. Bound.	0.03	0.04	0.04	0.05	0.07	0.04	0.14
	27 Update Stn, FFWC Bound.	0.04	0.04	0.05	0.06	0.07	0.04	0.13
Gorai Rly Br.	27 Update Stn, Obs. Bound.	0.03	0.03	0.04	0.04	0.07	0.04	0.23
	No Updating, Obs. Bound.	0.04	0.05	0.06	0.06	0.07	0.04	0.17
	27 Update Stn, FFWC Bound.	0.03	0.03	0.04	0.05	0.09	0.04	0.26

**Table 3 Errors in 24 Hour Flood Forecasts Based on Period from June 30 to August 22, 2003 (2/2)**

Location	Case	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
		50%	40%	30%	20%	10%		
Hardinge Br.	27 Update Stn, Obs. Bound.	0.02	0.03	0.04	0.05	0.06	0.03	0.17
	No Updating, Obs. Bound.	0.02	0.03	0.04	0.04	0.06	0.03	0.10
	27 Update Stn, FFWC Bound.	0.03	0.03	0.04	0.06	0.08	0.04	0.17
Jagir	27 Update Stn, Obs. Bound.	0.04	0.06	0.08	0.10	0.15	0.07	0.27
	No Updating, Obs. Bound.	0.05	0.07	0.08	0.10	0.16	0.07	0.33
	27 Update Stn, FFWC Bound.	0.04	0.05	0.09	0.11	0.14	0.07	0.43
Jamalpur	27 Update Stn, Obs. Bound.	0.06	0.07	0.08	0.11	0.13	0.07	0.21
	No Updating, Obs. Bound.	0.04	0.06	0.08	0.09	0.13	0.06	0.24
	27 Update Stn, FFWC Bound.	0.06	0.06	0.09	0.12	0.17	0.10	0.75
Kamakarii	27 Update Stn, Obs. Bound.	0.05	0.07	0.08	0.09	0.18	0.09	0.62
	No Updating, Obs. Bound.	0.04	0.05	0.07	0.09	0.18	0.08	0.47
	27 Update Stn, FFWC Bound.	0.04	0.06	0.08	0.11	0.16	0.09	0.63
Madaripur	27 Update Stn, Obs. Bound.	0.02	0.03	0.03	0.04	0.05	0.02	0.13
	No Updating, Obs. Bound.	0.03	0.03	0.04	0.04	0.05	0.03	0.11
	27 Update Stn, FFWC Bound.	0.02	0.02	0.03	0.04	0.05	0.02	0.13
Mirpur	27 Update Stn, Obs. Bound.	0.01	0.02	0.02	0.03	0.05	0.02	0.10
	No Updating, Obs. Bound.	0.02	0.03	0.03	0.04	0.05	0.03	0.07
	27 Update Stn, FFWC Bound.	0.02	0.02	0.03	0.04	0.06	0.03	0.24
Mymensingh	27 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.07	0.08	0.04	0.13
	No Updating, Obs. Bound.	0.04	0.05	0.07	0.09	0.12	0.06	0.16
	27 Update Stn, FFWC Bound.	0.04	0.05	0.06	0.07	0.08	0.05	0.19
Naogan	27 Update Stn, Obs. Bound.	0.14	0.17	0.18	0.19	0.23	0.14	0.29
	No Updating, Obs. Bound.	0.10	0.12	0.16	0.19	0.24	0.12	0.31
	27 Update Stn, FFWC Bound.	0.11	0.13	0.15	0.18	0.19	0.12	0.34
Rajshahi	27 Update Stn, Obs. Bound.	0.02	0.03	0.03	0.04	0.05	0.02	0.10
	No Updating, Obs. Bound.	0.02	0.03	0.03	0.04	0.05	0.02	0.09
	27 Update Stn, FFWC Bound.	0.02	0.02	0.04	0.05	0.09	0.03	0.15
Sirajganj	27 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.09	0.12	0.06	0.22
	No Updating, Obs. Bound.	0.03	0.04	0.05	0.07	0.08	0.04	0.18
	27 Update Stn, FFWC Bound.	0.05	0.06	0.08	0.09	0.13	0.06	0.24
Sheola	27 Update Stn, Obs. Bound.	0.05	0.07	0.08	0.11	0.16	0.08	0.62
	No Updating, Obs. Bound.	0.06	0.07	0.10	0.11	0.15	0.08	0.38
	27 Update Stn, FFWC Bound.	0.09	0.11	0.12	0.14	0.20	0.11	0.62
Sunamganj	27 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.07	0.11	0.06	0.30
	No Updating, Obs. Bound.	0.05	0.06	0.08	0.10	0.14	0.07	0.30
	27 Update Stn, FFWC Bound.	0.04	0.06	0.08	0.11	0.19	0.08	0.41
Sylhet	27 Update Stn, Obs. Bound.	0.05	0.06	0.07	0.08	0.11	0.06	0.17
	No Updating, Obs. Bound.	0.05	0.07	0.07	0.09	0.11	0.06	0.18
	27 Update Stn, FFWC Bound.	0.04	0.05	0.06	0.09	0.11	0.06	0.19
Taraghat	27 Update Stn, Obs. Bound.	0.05	0.07	0.09	0.12	0.17	0.09	0.44
	No Updating, Obs. Bound.	0.06	0.08	0.10	0.12	0.15	0.08	0.48
	27 Update Stn, FFWC Bound.	0.05	0.08	0.10	0.13	0.16	0.09	0.44
Tongi	27 Update Stn, Obs. Bound.	0.04	0.04	0.08	0.09	0.12	0.06	0.34
	No Updating, Obs. Bound.	0.04	0.05	0.07	0.09	0.11	0.06	0.35
	27 Update Stn, FFWC Bound.	0.03	0.05	0.08	0.09	0.13	0.06	0.34
<b>Averages</b>								
Flash Flood Areas	27 Update Stn, Obs. Bound.	0.13	0.17	0.22	0.28	0.40	0.20	1.25
	No Updating, Obs. Bound.	0.15	0.19	0.23	0.34	0.45	0.22	1.13
	27 Update Stn, FFWC Bound.	0.14	0.19	0.26	0.38	0.54	0.24	1.16
Monsoonal Flood Areas	27 Update Stn, Obs. Bound.	0.05	0.06	0.07	0.09	0.12	0.06	0.28
	No Updating, Obs. Bound.	0.04	0.06	0.07	0.09	0.12	0.06	0.25
	27 Update Stn, FFWC Bound.	0.05	0.06	0.07	0.10	0.13	0.07	0.41

Note: Obs. Bound.: Observed water levels at boundary condition  
 FFWC Bound.: Boundary Conditions as estimated by FFWC

**Table 4 Errors in 24 Hour Flood Forecasts Based on Period from June 30 to July 22, 2003 (1/3)**

Location	Case (No. Model Update Points and Adopted Boundary Condition)	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
		50%	40%	30%	20%	10%		
<b>Flash Flood Areas</b>								
Bhusirbandar	27 Update Stn, Obs. Bound.	0.12	0.16	0.21	0.48	0.54	0.29	1.65
	3 Update Stn, Obs. Bound.	0.13	0.16	0.19	0.46	0.55	0.29	1.65
	No Updating, Obs. Bound.	0.13	0.14	0.15	0.47	0.54	0.28	1.64
	27 Update Stn, FFWC Bound.	0.13	0.22	0.24	0.48	0.51	0.29	1.34
Harbiganj	27 Update Stn, Obs. Bound.	0.21	0.29	0.33	0.39	0.65	0.37	2.26
	3 Update Stn, Obs. Bound.	0.20	0.22	0.27	0.65	0.86	0.37	1.40
	No Updating, Obs. Bound.	0.19	0.22	0.28	0.65	0.79	0.37	1.48
	27 Update Stn, FFWC Bound.	0.13	0.19	0.30	0.43	0.64	0.34	1.93
Jariajanjail	27 Update Stn, Obs. Bound.	0.04	0.06	0.10	0.13	0.17	0.10	0.42
	3 Update Stn, Obs. Bound.	0.03	0.06	0.08	0.09	0.16	0.08	0.37
	No Updating, Obs. Bound.	0.04	0.07	0.08	0.13	0.15	0.08	0.37
	27 Update Stn, FFWC Bound.	0.10	0.13	0.16	0.24	0.28	0.14	0.46
Kanaighat	27 Update Stn, Obs. Bound.	0.05	0.07	0.10	0.11	0.16	0.09	0.32
	3 Update Stn, Obs. Bound.	0.05	0.08	0.09	0.10	0.17	0.09	0.34
	No Updating, Obs. Bound.	0.05	0.08	0.10	0.12	0.17	0.10	0.35
	27 Update Stn, FFWC Bound.	0.11	0.12	0.13	0.16	0.18	0.12	0.46
Mohadevpur	27 Update Stn, Obs. Bound.	0.19	0.32	0.37	0.39	0.68	0.33	1.10
	3 Update Stn, Obs. Bound.	0.28	0.42	0.58	0.75	0.82	0.45	1.32
	No Updating, Obs. Bound.	0.42	0.44	0.71	0.74	0.76	0.45	1.36
	27 Update Stn, FFWC Bound.	0.22	0.23	0.34	0.39	0.61	0.31	1.13
Moulvi Bazar	27 Update Stn, Obs. Bound.	0.12	0.12	0.17	0.32	0.40	0.21	0.82
	3 Update Stn, Obs. Bound.	0.11	0.15	0.19	0.30	0.44	0.19	0.76
	No Updating, Obs. Bound.	0.11	0.14	0.19	0.30	0.44	0.20	0.76
	27 Update Stn, FFWC Bound.	0.16	0.18	0.21	0.34	0.49	0.27	1.27
<b>Monsoonal Flood Areas</b>								
Bahadurabad	27 Update Stn, Obs. Bound.	0.04	0.04	0.05	0.07	0.09	0.05	0.19
	3 Update Stn, Obs. Bound.	0.03	0.06	0.07	0.09	0.12	0.06	0.15
	No Updating, Obs. Bound.	0.04	0.06	0.07	0.09	0.12	0.06	0.15
	27 Update Stn, FFWC Bound.	0.03	0.05	0.06	0.10	0.11	0.06	0.19
Bagayakul	27 Update Stn, Obs. Bound.	0.01	0.02	0.04	0.04	0.06	0.03	0.10
	3 Update Stn, Obs. Bound.	0.02	0.03	0.04	0.05	0.05	0.03	0.11
	No Updating, Obs. Bound.	0.03	0.03	0.03	0.05	0.06	0.03	0.08
	27 Update Stn, FFWC Bound.	0.02	0.02	0.03	0.05	0.06	0.03	0.08
Bairab Bazar	27 Update Stn, Obs. Bound.	0.03	0.05	0.07	0.09	0.10	0.07	0.21
	3 Update Stn, Obs. Bound.	0.02	0.02	0.03	0.03	0.04	0.03	0.11
	No Updating, Obs. Bound.	0.04	0.05	0.05	0.05	0.06	0.04	0.09
	27 Update Stn, FFWC Bound.	0.03	0.04	0.04	0.04	0.05	0.04	0.17
Chakrahimpur	27 Update Stn, Obs. Bound.	0.08	0.09	0.10	0.13	0.14	0.11	0.60
	3 Update Stn, Obs. Bound.	0.08	0.08	0.09	0.16	0.25	0.12	0.36
	No Updating, Obs. Bound.	0.05	0.09	0.09	0.11	0.15	0.09	0.33
	27 Update Stn, FFWC Bound.	0.08	0.10	0.11	0.13	0.26	0.11	0.37
Chandpur	27 Update Stn, Obs. Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	3 Update Stn, Obs. Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	No Updating, Obs. Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	27 Update Stn, FFWC Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
Chapai-Nawabganj	27 Update Stn, Obs. Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	3 Update Stn, Obs. Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	No Updating, Obs. Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
	27 Update Stn, FFWC Bound.	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9	-99.9
Chilmari	27 Update Stn, Obs. Bound.	0.03	0.04	0.06	0.07	0.10	0.05	0.12
	3 Update Stn, Obs. Bound.	0.03	0.04	0.06	0.08	0.08	0.05	0.15
	No Updating, Obs. Bound.	0.03	0.04	0.06	0.08	0.08	0.05	0.15
	27 Update Stn, FFWC Bound.	0.04	0.06	0.07	0.11	0.12	0.07	0.20
Demra	27 Update Stn, Obs. Bound.	0.02	0.03	0.03	0.04	0.06	0.03	0.08
	3 Update Stn, Obs. Bound.	0.02	0.02	0.03	0.04	0.04	0.03	0.11
	No Updating, Obs. Bound.	0.02	0.02	0.02	0.03	0.05	0.02	0.07
	27 Update Stn, FFWC Bound.	0.02	0.02	0.03	0.03	0.04	0.03	0.10

**Table 4 Errors in 24 Hour Flood Forecasts Based on Period from June 30 to July 22, 2003 (2/3)**

Location	Case (No. Model Update Points and Adopted Boundary Condition)	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
		50%	40%	30%	20%	10%		
Dhaka	27 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.06	0.08	0.05	0.09
	3 Update Stn, Obs. Bound.	0.03	0.05	0.05	0.06	0.07	0.04	0.08
	No Updating, Obs. Bound.	0.03	0.03	0.05	0.07	0.07	0.04	0.10
	27 Update Stn, FFWC Bound.	0.04	0.05	0.05	0.06	0.07	0.05	0.09
Goalondo	27 Update Stn, Obs. Bound.	0.03	0.04	0.04	0.05	0.06	0.04	0.14
	3 Update Stn, Obs. Bound.	0.02	0.03	0.04	0.06	0.10	0.04	0.14
	No Updating, Obs. Bound.	0.03	0.04	0.05	0.07	0.09	0.04	0.14
	27 Update Stn, FFWC Bound.	0.02	0.04	0.05	0.05	0.07	0.04	0.13
Gorai Rly Br.	27 Update Stn, Obs. Bound.	0.03	0.03	0.03	0.04	0.07	0.05	0.23
	3 Update Stn, Obs. Bound.	0.03	0.04	0.05	0.05	0.06	0.04	0.15
	No Updating, Obs. Bound.	0.03	0.04	0.06	0.06	0.07	0.04	0.14
	27 Update Stn, FFWC Bound.	0.03	0.04	0.04	0.04	0.09	0.05	0.26
Hardinge Br.	27 Update Stn, Obs. Bound.	0.02	0.02	0.04	0.04	0.07	0.04	0.17
	3 Update Stn, Obs. Bound.	0.03	0.03	0.05	0.05	0.05	0.03	0.08
	No Updating, Obs. Bound.	0.03	0.04	0.04	0.05	0.06	0.03	0.08
	27 Update Stn, FFWC Bound.	0.03	0.03	0.04	0.07	0.08	0.05	0.17
Jagir	27 Update Stn, Obs. Bound.	0.07	0.08	0.10	0.16	0.16	0.10	0.27
	3 Update Stn, Obs. Bound.	0.05	0.08	0.11	0.14	0.19	0.10	0.31
	No Updating, Obs. Bound.	0.06	0.09	0.10	0.18	0.20	0.11	0.33
	27 Update Stn, FFWC Bound.	0.06	0.09	0.10	0.16	0.16	0.10	0.43
Jamalpur	27 Update Stn, Obs. Bound.	0.06	0.06	0.06	0.08	0.11	0.06	0.18
	3 Update Stn, Obs. Bound.	0.04	0.07	0.08	0.09	0.10	0.06	0.16
	No Updating, Obs. Bound.	0.04	0.06	0.08	0.09	0.10	0.06	0.15
	27 Update Stn, FFWC Bound.	0.04	0.05	0.06	0.06	0.11	0.05	0.17
Kamakarli	27 Update Stn, Obs. Bound.	0.08	0.09	0.12	0.17	0.25	0.14	0.62
	3 Update Stn, Obs. Bound.	0.04	0.07	0.08	0.18	0.26	0.11	0.46
	No Updating, Obs. Bound.	0.04	0.07	0.08	0.18	0.25	0.12	0.47
	27 Update Stn, FFWC Bound.	0.08	0.11	0.13	0.16	0.26	0.14	0.63
Madaripur	27 Update Stn, Obs. Bound.	0.03	0.03	0.04	0.05	0.05	0.03	0.13
	3 Update Stn, Obs. Bound.	0.03	0.04	0.04	0.05	0.08	0.04	0.15
	No Updating, Obs. Bound.	0.04	0.04	0.05	0.06	0.07	0.04	0.11
	27 Update Stn, FFWC Bound.	0.02	0.02	0.04	0.05	0.06	0.04	0.13
Mirpur	27 Update Stn, Obs. Bound.	0.01	0.01	0.02	0.02	0.03	0.02	0.09
	3 Update Stn, Obs. Bound.	0.02	0.03	0.03	0.03	0.04	0.03	0.09
	No Updating, Obs. Bound.	0.02	0.03	0.03	0.03	0.04	0.03	0.06
	27 Update Stn, FFWC Bound.	0.02	0.02	0.03	0.04	0.04	0.03	0.16
Mymensingh	27 Update Stn, Obs. Bound.	0.03	0.04	0.06	0.07	0.07	0.04	0.10
	3 Update Stn, Obs. Bound.	0.05	0.05	0.07	0.09	0.14	0.07	0.18
	No Updating, Obs. Bound.	0.04	0.05	0.05	0.07	0.11	0.06	0.15
	27 Update Stn, FFWC Bound.	0.04	0.05	0.05	0.06	0.07	0.04	0.09
Naogan	27 Update Stn, Obs. Bound.	0.12	0.15	0.17	0.18	0.21	0.13	0.24
	3 Update Stn, Obs. Bound.	0.14	0.15	0.16	0.17	0.22	0.13	0.29
	No Updating, Obs. Bound.	0.12	0.12	0.14	0.16	0.23	0.13	0.31
	27 Update Stn, FFWC Bound.	0.10	0.10	0.13	0.14	0.18	0.11	0.22
Rajshahi	27 Update Stn, Obs. Bound.	0.03	0.03	0.03	0.03	0.06	0.03	0.10
	3 Update Stn, Obs. Bound.	0.02	0.03	0.03	0.04	0.04	0.03	0.09
	No Updating, Obs. Bound.	0.02	0.03	0.03	0.04	0.04	0.03	0.09
	27 Update Stn, FFWC Bound.	0.02	0.02	0.04	0.05	0.10	0.04	0.14
Sirajganj	27 Update Stn, Obs. Bound.	0.03	0.04	0.05	0.06	0.06	0.05	0.22
	3 Update Stn, Obs. Bound.	0.04	0.04	0.05	0.05	0.06	0.04	0.15
	No Updating, Obs. Bound.	0.03	0.04	0.05	0.07	0.08	0.05	0.14
	27 Update Stn, FFWC Bound.	0.03	0.05	0.06	0.06	0.09	0.06	0.22
Sheola	27 Update Stn, Obs. Bound.	0.03	0.04	0.07	0.09	0.11	0.06	0.20
	3 Update Stn, Obs. Bound.	0.03	0.04	0.07	0.10	0.11	0.06	0.15
	No Updating, Obs. Bound.	0.03	0.04	0.07	0.10	0.11	0.06	0.15
	27 Update Stn, FFWC Bound.	0.07	0.08	0.09	0.10	0.13	0.07	0.20
Sunamganj	27 Update Stn, Obs. Bound.	0.05	0.05	0.07	0.08	0.11	0.07	0.30
	3 Update Stn, Obs. Bound.	0.05	0.06	0.07	0.09	0.12	0.07	0.30
	No Updating, Obs. Bound.	0.05	0.06	0.09	0.11	0.12	0.08	0.30
	27 Update Stn, FFWC Bound.	0.06	0.09	0.10	0.11	0.14	0.10	0.41



**Table 4 Errors in 24 Hour Flood Forecasts Based on Period from June 30 to July 22, 2003 (3/3)**

Location	Case (No. Model Update Points and Adopted Boundary Condition)	Error (m) Exceeded for Given Percentage of Time					MAE (m)	Max. Error (m)
		50%	40%	30%	20%	10%		
Sylhet	27 Update Stn, Obs. Bound.	0.03	0.03	0.06	0.08	0.10	0.05	0.17
	3 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.08	0.09	0.05	0.18
	No Updating, Obs. Bound.	0.05	0.05	0.07	0.07	0.11	0.06	0.18
	27 Update Stn, FFWC Bound.	0.04	0.05	0.05	0.06	0.09	0.05	0.19
Taraghat	27 Update Stn, Obs. Bound.	0.10	0.12	0.13	0.16	0.26	0.13	0.44
	3 Update Stn, Obs. Bound.	0.06	0.08	0.10	0.14	0.14	0.10	0.48
	No Updating, Obs. Bound.	0.09	0.10	0.12	0.15	0.17	0.11	0.48
	27 Update Stn, FFWC Bound.	0.09	0.12	0.14	0.25	0.26	0.13	0.44
Tongi	27 Update Stn, Obs. Bound.	0.03	0.04	0.09	0.12	0.14	0.07	0.21
	3 Update Stn, Obs. Bound.	0.03	0.03	0.05	0.11	0.12	0.06	0.23
	No Updating, Obs. Bound.	0.03	0.04	0.06	0.10	0.15	0.07	0.21
	27 Update Stn, FFWC Bound.	0.02	0.03	0.09	0.12	0.15	0.06	0.22
<b>Averages</b>								
Flash Flood Areas	27 Update Stn, Obs. Bound.	0.12	0.17	0.21	0.30	0.43	0.23	1.10
	3 Update Stn, Obs. Bound.	0.13	0.18	0.23	0.39	0.50	0.25	0.97
	No Updating, Obs. Bound.	0.16	0.18	0.25	0.40	0.48	0.25	0.99
	27 Update Stn, FFWC Bound.	0.14	0.18	0.23	0.34	0.45	0.25	1.10
Monsoonal Flood Areas	27 Update Stn, Obs. Bound.	0.04	0.05	0.07	0.08	0.11	0.06	0.22
	3 Update Stn, Obs. Bound.	0.04	0.05	0.06	0.08	0.11	0.06	0.19
	No Updating, Obs. Bound.	0.04	0.05	0.06	0.09	0.11	0.06	0.19
	27 Update Stn, FFWC Bound.	0.04	0.06	0.07	0.09	0.12	0.06	0.23

Note: -99.9: Data not available or unreliable.

Obs. Bound.: Observed water levels as boundary condition

FFWC Bound.: Boundary condition as estimated by FFWC

