

FAP24

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Bangladesh

Water Resources
Planning
Organization

European
Commission

Delft
Hydraulics



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Hydroland
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Osiris

Call - 913
PAP-24

(30)

**RIVER
SURVEY
PROJECT**

**Special
Report
No. 1**

**Validation of
staff gauge
bench marks**

October 1996

2

Special Report 1

**Validation of
Staff Gauge Bench Marks**

October 1996

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Acronyms and abbreviations

BM	: bench mark
BWDB	: Bangladesh Water Development Board
FAP	: Flood Action Plan
FMBM	: FINMAP bench mark
FPCO	: Flood Plan Coordination Organization (presently merged with WARPO)
ft	: feet (1 feet = 0.305 m)
JICA	: Japan International Cooperation Agency
PMU	: Project Management Unit (of the RSP)
RSP	: River Survey Project (= FAP24)
TBM	: temporary bench mark
WARPO	: Water Resources Planning Organisation

1 Introduction

The River Survey Project (RSP) was initiated on 9 June 1992. The project was executed by the Water Resources Planning Organization (WARPO) under the Ministry of Water Resources. Funding for the project was granted by the European Commission. The Consultant was DELFT-DHI Joint Venture in association with Osiris, Hydroland, and Approtech. The project was supervised by a Project Management Unit with participation by WARPO, a Project Advisor, and a Resident Project Advisor.

One of the objectives of the project was to supply detailed and accurate field data to FAP projects, as well as for other national planning, impact evaluation, and design activities within water resources and river engineering. Please refer to *RSP Final Report, Annex 1: 'Surveys'* for an over-all presentation of the survey component of the River Survey Project.

This report describes one activity within this programme, namely the validation of the bench marks of 47 BWDB staff gauges covering the main river system of Bangladesh. The work was executed in early 1993. The report was originally submitted to FPCO in June 1993 as *RSP Survey Report 2: 'Land survey, zero control water level stations'*. Following a consultation with PMU, it is hereby re-submitted in connection with the final reporting of the Project as *RSP Special Report 1*. In connection with the re-submission, minor editorial changes have been made, the title has been changed, one figure has been re-drafted, and the original Annex 1 (Proposal for complementary activities) has been omitted as outdated.

2 Background

This report deals with the verification of zero levels of 47 BWDB water level gauges as specified in ToR, Clause 4.2.a.1. The locations of the gauges are shown in Figure 1. The zero level of the gauges was determined by levelling the gauge to FPCO approved bench marks. The checking comprised a comparison between the thus obtained zero level and the zero level as used by the gauge reader.

Three stages can be distinguished for this checking:

- 1) Site visit to check if the information of the FPCO supplied bench marks corresponded with the situation in the field (Chapter 4).
- 2) If bench marks were found to be in accordance with the description supplied by FPCO and in a good condition, levelling between bench mark and gauge was carried out (Chapter 5).
- 3) In all other cases a proposal was sent to FPCO on how to improve the situation either by replacement, re-levelling or construction of new bench marks.

The results of the inspection of the stations are summarized in so-called inspection reports, having an agreed format. These reports are presented in Annex 1. Location maps of the gauging stations are presented in Annex 2.

The field work was executed in the period from January to August 1993.

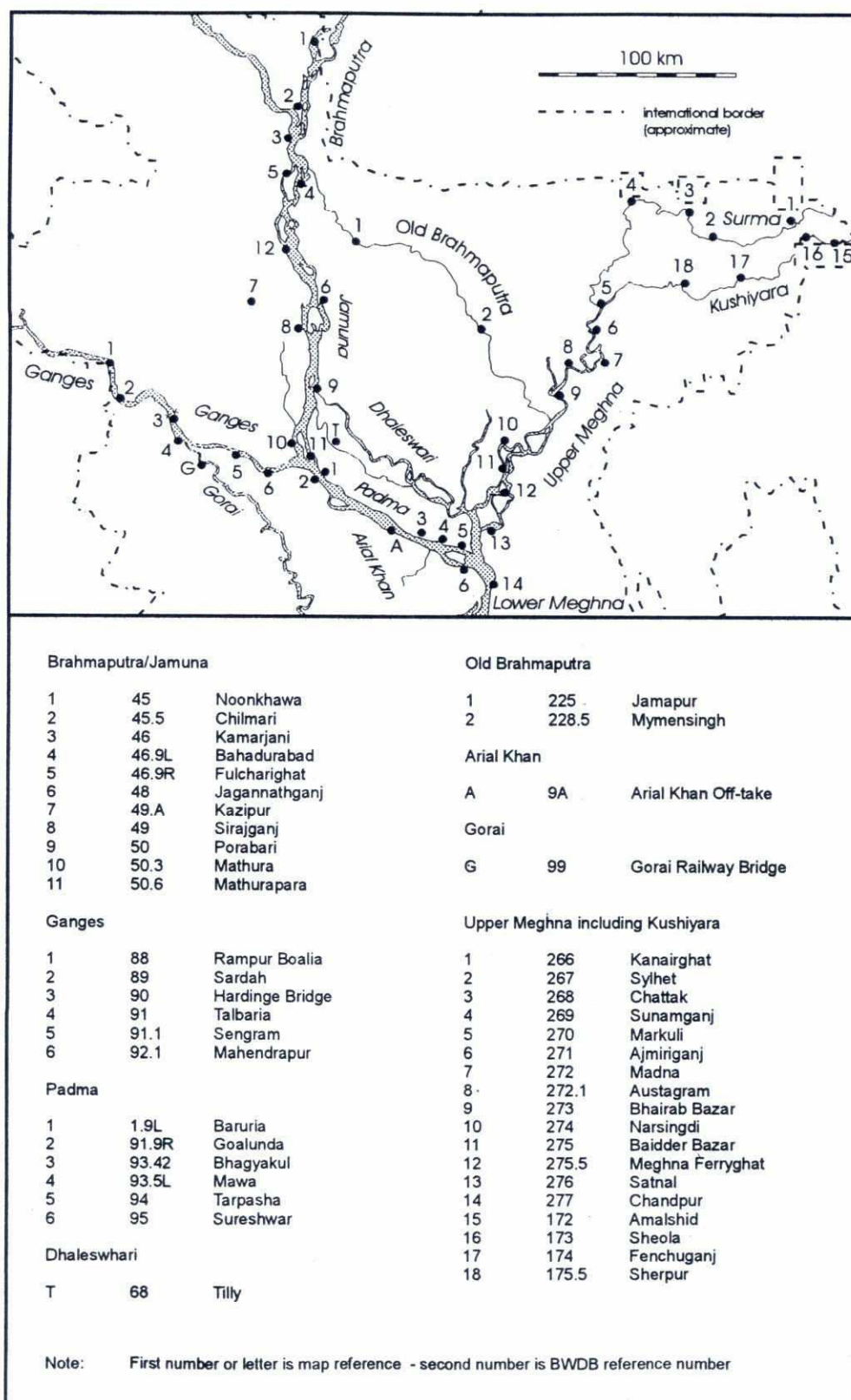


Figure 1: Locations of BWDB gauges

3 Bench mark networks

Survey of Bangladesh (SoB)

During site visits throughout the country SoB pillars were found which have been established under the Survey of Bangladesh project "Strengthening of Capability of Survey of Bangladesh in Geodesy" in cooperation with Japan (JICA). In many cases these bench marks and survey marks could be useful for the FAP24 project. Although nothing was known about the status and availability of data regarding these points when the site visits were made, survey crews were instructed to incorporate these points. This enables to make a check afterwards whenever data might become available.

BWDB

BWDB bench marks were officially supplied by the FPCO to the project. Distinction is made between Bench marks (BM) and Temporary Bench marks (TBM), the latter being of a lower order. As far as feasible the BWDB bench marks are used for the levelling of the staff gauges. Site visits have shown that in some cases BMs are in poor condition or not present anymore. In such cases the use of a bench mark from another network or the construction of a new bench mark is proposed. Another problem encountered that often the officially supplied data did not correspond with the data as supplied by the gauge readers or local concerned officials.

FINMAP

FINMAP established recently a network of bench marks (FMBMs). The node of points consists of two parts: A northern part roughly around the Jamuna/Brahmaputra and a coastal part along the Padma and to the south of the Padma. The northern part was officially supplied to the project by FPCO. For the southern part a request has been sent to the FPCO to supply the required data. All gauges connected to these BMs can be regarded as reliable. Whenever possible connection of BWDB BMs to this network was carried out.

FAP6

The FAP6 project is also involved in levelling water gauges in particular in the north eastern region of Bangladesh. They were consulted to avoid any duplication of work between FAP6 and FAP24.

Checking of water level stations will not be carried out by FAP6 before the establishment of a second order levelling network. The works for this network have only just started and would not be finished within one year. Consequently, checking of gauges would certainly not start within one year.

In order not to delay the works on the FAP24 project it was decided to check the zero level values of the gauges with the nearest available existing BWDB BMs or TBMs. After connection of BMs and TBMs to the second order levelling network by FAP6, corrections can be applied to the collected data whenever necessary.

Recommendation

It is recommended to use these networks as follows:

- Where possible, the BWDB network should be used.
- Next to that the FINMAP network can be used. The gauges along the Jamuna/Brahmaputra, Ganges and Padma can be connected to this network with relatively little effort. An exception to this are the gauges of Rampur, Boalia and Sardah.

- In the north eastern region along the Meghna and Kushiara the FAP6 is executing second order levelling to connect all gauges. Once this network is finished and gauges are connected, also these gauges can be used.
- Some isolated gauges throughout the country can easily be connected to the SoB/JICA network.
- The question remains, however, how these separate networks have been or will be connected to each other (BWDB, FINMAP north, FINMAP south, FAP6 network and SoB/JICA). As long as connection data between the networks are not readily available the use of more than one network should be limited as far as feasible.

For the checking of the 47 water level gauges the BWDB network was used, and whenever possible BWDB BMs were connected to the FINMAP network (FMBMs).

4 Site inspection

4.1 Elevation of bench marks

FPCO provided the elevations of BWDB bench marks located at each gauge station. During the field survey, it was observed that in some cases the elevations of BM/TBMs furnished by FPCO did not tally with the elevations of BM/TBMs located at the gauge stations. This is caused by the shifting of the BM/TBMs from its original position to some other place by the local BWDB office. In such cases the FAP24 field survey team had to collect the elevations of these BM/TBMs either from the local BWDB office or from the gauge reader posted at the gauge station.

The elevations of BM/TBMs which were obtained from the gauge reader are presented in Table 1.

Gauge Station	Elevations of BM/TBM in m PWD	
	Provided by FPCO	Obtained from gauge reader
45 Noonkhawa	28.066	27.688
45.5 Chilmari	23.536	25.310
46 Kamarjani	21.530	24.690
15J Mathurapara	16.515	16.760
91 Talbaria	14.076	13.840
91.1 Sengram	12.741	12.550
225 Jamalpur	17.861	18.530
269 Sunamganj	08.954	08.450

Table 1: BM/TBM levels obtained from gauge readers

4.2 Connection of bench marks

BWDB gauges were connected with the BWDB bench marks located at the gauge stations by second order levelling. In addition, the BWDB bench marks as well as the gauges were also connected with the FINMAP bench mark, wherever it was available near the gauge station, to have a check of the elevations of respective BM/TBM.

After connecting the FINMAP bench marks with the BWDB bench marks, the FAP24 field survey team observed some differences in elevations. Details of these differences are presented in Table 2.

Gauge station & number		Reference BM & their elevations (m PWD)		Elevations of BWDB bench mark (m PWD)	
		FMBM	Elevation	Existing BWDB	FAP24 survey
45	Noonkhawa	7626	28.056	27.688	27.874
45.5	Chilmari	7612	23.881	25.310	24.985
46	Kamarjani	7602 GPS	21.910	24.690	24.685
46.9L	Bahadurabad	764	20.309	21.785	21.768
48	Jagannathgonj	5114	15.791	16.732	16.358
49	Sirajganj	7201	13.975	13.870	13.536
50	Porabari	6205 GPS	12.934	12.270	12.265
50.3	Mathura	709	12.757	10.912	10.906
50.6	Teota	8122	10.202	10.135	9.947
15 J	Mathurapara	7215	16.763	16.760	16.426
90	Hardinge Bridge	8236	23.140	18.950	18.868
91	Talbaria	8230	14.494	13.840	14.136
91.1	Sengram	8216	11.921	12.550	12.473
91.2	Mahendrapur	8212	11.216	11.050	10.903
99	Gorai Railway Bridge	8225	20.690	13.728	13.755
225	Jamalpur	5243	16.947	18.530	18.302
228.5	Mymensingh	6024	14.164	14.338	14.057
68	Tilly	6223	9.523	9.409	9.216

Table 2: Difference in bench mark elevations

4.3 Location of bench marks

Present locations of BWDB BM/TBMs and FINMAP bench marks (FMBMs) which have been used as a reference bench mark are shown in sketch maps for each gauge station in Annex 2.

Descriptions of some of the BMs/TBMs, which have been shifted from their original location in the recent past, or are destroyed or found missing, are given in Table 3.

Gauge station & number	Description/location of BM/TBM	
	According to FPCO letter No.32/FPCO/A-024/90 dated 18.01.93/24.01.93	According to FAP24 inspection team
45 Noonkhawa	BM fixed in front of mosque in the village Noonkhawa, Kurigram	BM found but it was shifted from its original position
45.5 Chilmari	BM kept over R.C.C. pillar in front of Master's house near Youth Club, Chilmari	BM shifted from its original position. At present the BM is located on the footpath, north of Master's house at Chilmari
46 Kamarjani	BM situated at N-E corner of primary school & 1/4th mile south from gauge	TBM found at N-E corner of Primary school & 1/4th mile south from gauge
48 Jagannathganj	BM located 30 ft from the N-W corner of Jagannathganj P.O and 50 ft east from the upper class waiting room	Specified BM was reported by Gauge Reader to have been destroyed. Instead, 2 TBMs were found, one on telegraph post and another in plinth of passenger shed at Jagannathganj Railway Station
49A Kazipur	Located on the side of the N-E corner at Kazipur Hospital on the culvert distance 200 ft	BM destroyed. A new TBM has been established by FAP24 with ref.to FMBM 7209
15J Mathurapara	Near Deghulkandi village on platform of a school compound on the right bank of Jamuna River	BM destroyed as reported by Gauge Reader. Another TBM No.M-PCLP6 was found near the gauge
91 Talbaria	Located in the right bank back side of the house of Eman Pramanik	BM shifted from its original position to new site as reported by Gauge Reader
91.1 Sengram	Located in front of the house of Ali Sheikh, Sengram, Faridpur	BM is reported to be under 6 ft of earth, could not be recovered but found 2 BMs/TBMs in the house of Rustam Sarder & another TBM located west of mosque
94 Tarpasha	BM located in front of the Lohajang Cinema Hall	BM destroyed as reported by Gauge Reader
95 Sureswar	BM located near Chandipur P.O.	BM could not be ascertained which is under earth as reported by Gauge Reader
269 Sunamganj	Located on the north side of the compound of Ansar Training Camp present Police camp in village Shologhar & just near the N-E corner of rain gauging station	BM shifted and embedded in the N-W corner of Live Stock Hospital in front of shologhar Mosque and Ansar police camp
225 Jamalpur	BM located 50 ft N-W corner of Jute office Chapatola ghat and 120 ft apart from the right bank	BM destroyed as reported by Gauge Reader. TBM found at N-E corner of Bania Bazar High School
228.5 Mymensingh	BM located 30 ft east from Kayet Khali Railway Bridge	BM could not be located as per description. TBM located 100 ft S-E of University Hospital

Table 3: Description of bench mark deviations

4.4 Proposed improvement

During the inspection it was observed that certain improvements, in respect of present locations and existing conditions of bench marks were required at some gauge stations.

In this connection, a proposal was sent to FPCO in March, 1993 indicating the improvements to be made at a number of stations (for details see inspection reports, Annex 1). A summary of the proposed improvements is presented in Table 4.

Nos.	Station	Proposed improvements
45	Noonkhawa	BM 45 to be levelled with FMBM 7626
45.5	Chilmari	BM 45.5 to be levelled with FMBM 7612
46	Kamarjani	TBM to be levelled with FMBM 7602
48	Jagannathganj	TBMs to be levelled with FMBM 5114
49A	Kazipur	New TBM to be established and connected to FMBM 7209
91	Talbaria	BM 91 to be levelled with FMBM 8230
91.1	Sengram	New BM to be established and connected with FMBM 8216
93.4L	Bhagyakul	New TBM to be established and connected with BM 93.4L
94	Tarapasha	New TBM to be established and connected with FMBM 1716
95	Sureshwar	New BM to be established and connected with GPS 79
270	Markuli	New BM to be established and connected with BM 270
275.5	Meghna Ferryghat	New TBM to be established and connected with FM TBM 4103
4 A	Off-take of Arial Khan	New BM to be established and connected with nearby FMBM
99	Gorai Railway Bridge	New TBM to be established and connected with FMBM 8225

Table 4: Proposed improvements



5 Zero value of gauges

5.1 Variation of gauge zeros

For checking the zero values of staff gauges, FAP24 connected the gauges with BWDB bench marks located at the stations. Several differences were observed between the existing BWDB zero values and the zero of the gauges as determined by FAP24. Details are given in Table 5.

Gauge station	BWDB BM		Zero value of gauge (m PWD)				
	BWDB Height BM No.	(m PWD)	Date and Time		BWDB	FAP24 survey	Differ- ences
Noonkhawa	45	27.688	07.04.93	1440	19.60	19.65	+0.05
Chilmari	45.5	25.310	04.04.93	1025	17.30	17.32	+0.02
Kamarjani	46	24.690	02.04.93	1705	14.24	14.13	-0.11
Bahadurabad	46.9L	21.785	14.12.92	1620	13.00	12.98	-0.02
Fulchari	46.9R	19.330	13.12.92	1600	13.00	13.12	+0.12
Jagannathganj	48	16.732	22.02.93	1130	9.00	8.90	-0.10
Kazipur	49A	15.490	14.02.93	1045	8.00	8.00	0.00
Sirajganj	49	13.870	13.02.93	0940	6.53	6.48	-0.05
Porabari	50	12.270	12.02.93	1045	4.56	4.95	+0.39
Mathura	50.3	10.912	15.02.93	0935	2.65	2.61	-0.04
Teota	50.6	10.135	04.02.93	1340	2.17	2.24	-0.07
Mathurapara	15J	16.760	31.03.93	1550	10.30	10.35	+0.05
Hardinge Bridge	90	18.950	20.02.93	1240	3.24	3.27	+0.03
Talbaria	91	13.840	19.02.93	1200	2.51	2.59	+0.08
Sengram	91.1	12.550	20.04.93	1000	2.68	2.42	-0.26
Mahendrapur	91.2	11.050	11.02.93	1205	1.60	1.72	+0.12
Gorai Railway Bridge	99	13.728	18.02.93	1505	3.03	3.03	0.00
Goalundo	91.9R	10.300	08.02.93	1135	2.00	1.94	-0.06
Jamalpur	225	18.530	21.02.93	1500	11.00	11.00	0.00
Mymensingh	228.5	14.338	19.02.93	1125	5.90	5.90	0.00
Tilly	68	9.409	04.02.93	1000	3.00	3.00	0.00
Rampur Boalia	88	20.086	01.02.93	0945	8.95	8.70	-0.25
Sardah	89	18.836	02.02.93	0935	8.00	7.97	-0.03
Baruria	91.9L	7.790	09.02.93	1000	0.68	0.65	-0.03
Bhagyakul	93.4L	6.931	25.01.93	1650	0.17	0.17	0.00
Mawa	93.5L	6.325	24.01.93	1135	-0.21	-0.15	+0.06
Tarpasha	94	5.575	28.01.93	1120	0.80	0.79	-0.01
Sureswar	95	5.276	15.04.93	1820	0.22	0.11	-0.11
Arial Khan Off-take	4A	7.140	27.01.93	1625	-0.94	-0.83	+0.11
Kanaighat	266	14.308	03.03.93	1040	5.78	5.79	+0.01
Sylhet	267	12.090	07.03.93	1600	0.09	0.09	0.00
Chattak	268	10.300	02.03.93	0920	3.60	3.57	-0.03
Sunamganj	269	8.450	28.02.93	1135	4.00	3.93	-0.07
Markuli	270	8.162	17.03.93	1300	2.93	2.93	0.00
Ajmiriganj	271	8.085	16.03.93	1635	2.95	2.92	-0.03
Madna	272	7.698	18.03.93	0720	1.20	1.20	0.00
Austogram	272.1	8.864	19.03.93	0900	0.60	0.54	-0.06
Bhairab Bazar	273	7.371	08.02.93	1555	0.77	0.76	-0.01
Narsingdi	274	6.814	08.02.93	0920	0.55	0.52	-0.03
Baider Bazar	275	6.630	07.02.93	1455	1.46	1.42	-0.04
Meghna Ferryghat	275.5	6.985	12.04.93	1325	0.32	0.30	-0.02
Satnal	276	5.044	15.04.93	0805	-0.08	-0.08	0.00
Chandpur	277	5.410	14.04.93	0900	-0.28	-0.29	-0.01
Amalshid	172	17.590	05.03.93	1500	6.27	6.25	-0.02
Sheola	173	13.670	04.03.93	1040	6.80	6.83	+0.03
Fenchuganj	174	15.066	06.03.93	1215	5.00	5.03	+0.03
Sherpur	175.5	9.520	08.03.93	0930	3.00	3.00	0.00

Table 5: Zero values of gauges (BWDB bench marks)

Some of the BWDB bench marks and gauges were connected with the nearest FINMAP bench marks for double check.

Some differences in levels of BWDB bench marks and gauge zero have been observed in relation to the FINMAP bench marks. These differences are shown in Table 6.

Gauge station	FINMAP BM		BWDB BM			Zero value of gauge (m PWD)			
	No.	Height (m PWD)	No.	Height (m PWD)	FAP24 FMBM connection (mPWD)	Date & Time	BWDB	FAP24 w.r.t. FMBM	Differences
Noonkhawa	7626	28.057	45	27.688	27.874	07.04.93 1440	19.60	19.83	+0.23
Chilmari	7612	23.882	45.5	25.310	24.985	04.04.93 1025	17.30	17.32	+0.02
Kamarjani	7602	21.910	46	24.690	24.685	02.04.93 1705	14.24	14.12	-0.12
Bahadurabad	GPS764	20.309	46.9L	21.785	21.768	14.12.92 1620	13.00	12.96	-0.04
Fulchari	GPS7	21.970	46.9R	19.330	19.843	13.12.92 1600	13.00	13.63	+0.63
Jagannathganj	5114	15.791	48	16.732	16.358	22.02.93 1130	9.00	8.53	-0.47
Kazipur	7209	15.155	49A	15.490	15.396	14.02.93 1045	8.00	7.90	-0.10
Sirajganj	7201	13.975	49	13.870	13.536	13.02.93 0940	6.53	6.14	-0.39
Porabari	6205	12.934	50	12.270	12.265	12.02.93 1045	4.56	4.95	+0.39
Mathura	GPS709	12.757	50.3	10.912	10.906	15.02.93 0935	2.65	2.60	-0.05
Teota	8122	10.202	50.6	10.135	9.947	04.02.93 1340	2.17	2.05	-0.12
Mathurapara	7215	16.763	15J	16.760	16.426	31.03.93 1550	10.30	10.01	-0.29
Hardinge Bridge	8236	23.140	90	18.950	18.868	20.02.93 1240	3.24	3.18	-0.06
Talbaria	8230	14.494	91	13.840	14.136	19.02.93 1200	2.51	2.88	+0.37
Sengram	8216	11.921	91.1	12.550	12.473	20.04.93 1000	2.68	2.42	-0.26
Mahendrapur	8212	11.216	91.2	11.050	10.903	11.02.93 1205	1.60	1.58	-0.02
Gorai Railw. Br.	8225	20.690	99	13.728	13.755	18.02.93 1505	3.03	3.02	-0.01
Jamalpur	5243	16.947	225	18.530	18.302	21.02.93 1500	11.00	10.77	-0.23
Mymensingh	6024	14.164	228.5	14.338	14.057	19.02.93 1125	5.90	5.62	-0.28
Tilly	6223	9.529	68	9.409	9.216	04.02.93 1000	3.00	2.81	-0.19

Table 6: Zero values of gauges (FINMAP bench marks)

The differences in zero value of gauges shown in Tables 5 and 6 are to be added to the gauge zero levels obtained by the BWDB, which will give the actual zero values of the gauges.

5.2 Recommendations

For the 21 gauges that were connected to a FINMAP BM it is recommended to apply the connection indicated in Table 6, the FINMAP BMs being more recently established than the BWDB BMs.

Since FINMAP has established a network of bench marks for various projects in the country, it is recommended that the BWDB should also connect the other bench marks at different gauge stations to this levelling network.

The elevations of BWDB bench marks obtained by FAP24 with reference to FINMAP bench mark may be used by BWDB in the future.

Annex 1

Inspection Reports

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	:	45 Noonkhawa
Date of visit	:	02.03.93
Condition of gauge	:	Good
Remark	:	Gauge is located about 4Km downstream from Noonkhawa which creates confusion as to the naming of gauge station.

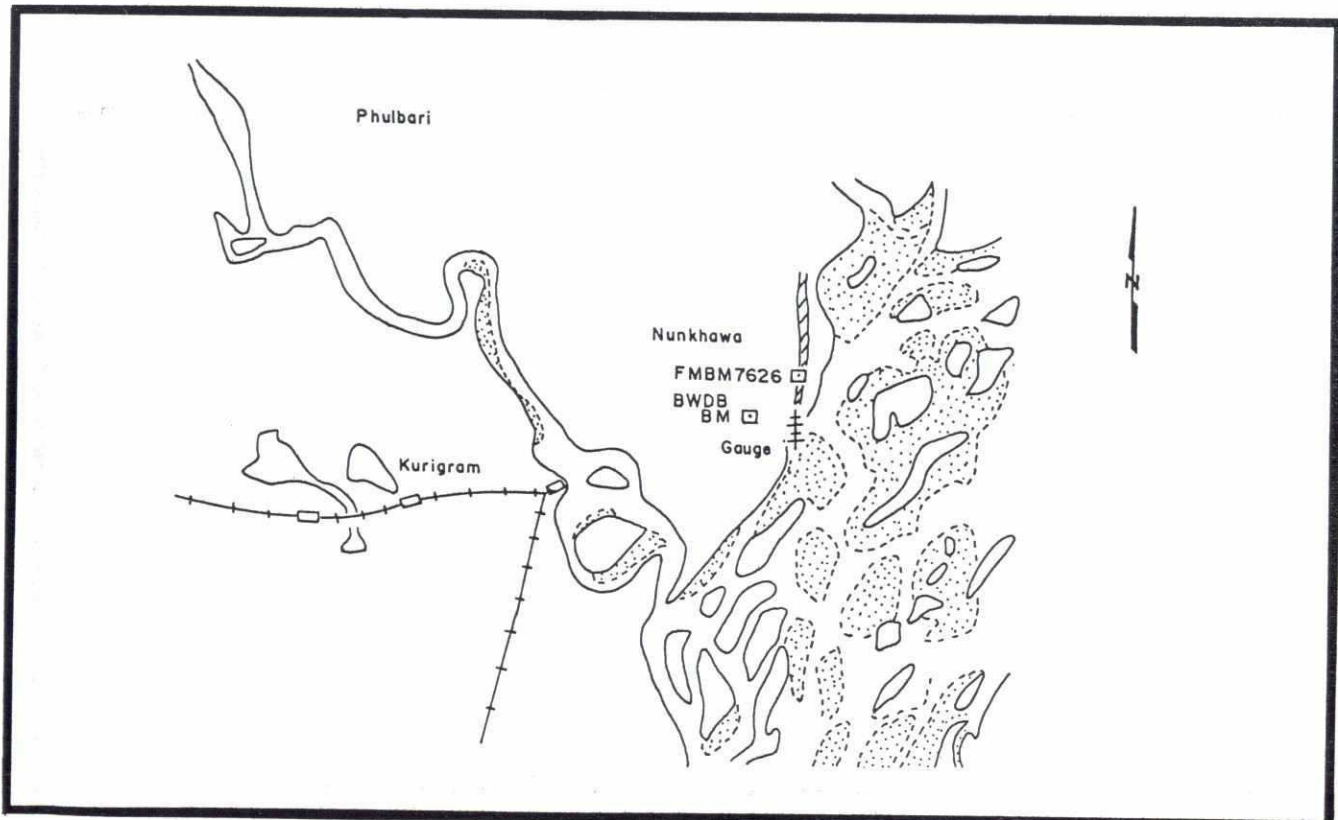
2. Bench mark

Calibration benchmark present	:	yes
Name	:	45 BM
Location	:	BM 45 located 3m west of Mosque in Gogidaha

Height	:	—
Condition	:	acceptable

3. If, not acceptable, give reasons : —
4. Distance of gauge to BM : 1.0 Km
5. Conclusion, recommendation : yes
 Improvements required, if yes, BM 45 be connected with FMBM 7626 which is located about 2.5 Km away.
 describe
 (Give recommended steps)

6. Sketch map of the area.
 (not to scale)



Annexure - B

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	: 45.5 Chilmari
Date of visit	: 11.01.93
Condition of gauge	: Good
Remark	: —

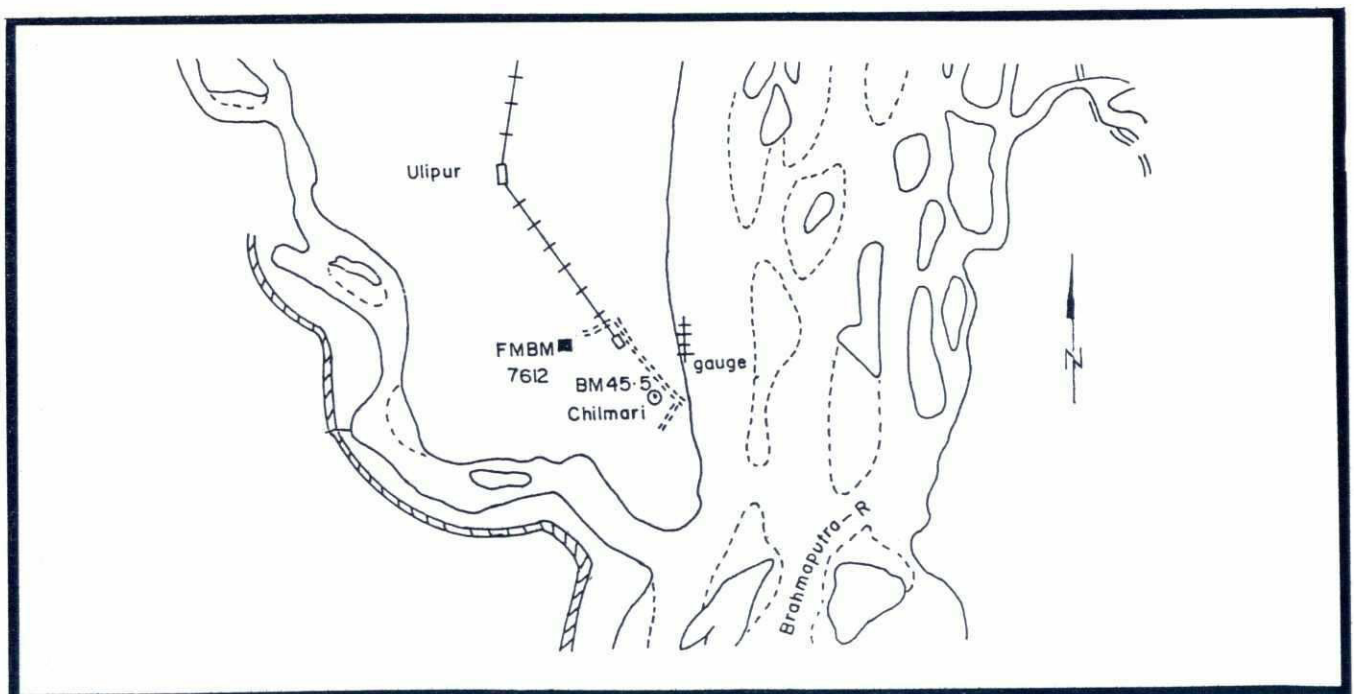
2. Bench mark

Calibration benchmark present	: yes
Name	: BM 45.5
Location	: BM 45.5 is located on the footpath north of Master's house at Chilmari and is about 150 meters west from the river bank.
Height	: —
Condition	: acceptable

3. If not acceptable, give reasons : —
4. Distance of gauge to BM : 0.5 Km
5. Conclusion, recommendation : yes

Improvements required, if yes, describe	BM 45.5 at Chilmari was shifted from its original position due to erosion of river bank.
(Give recommended steps)	Height of BM. 45.5 at new position be determined by levelling with FMBM 7612 located at a distance of about 4 Km from Chilmari.

6. Sketch map of the area.
(not to scale)



RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

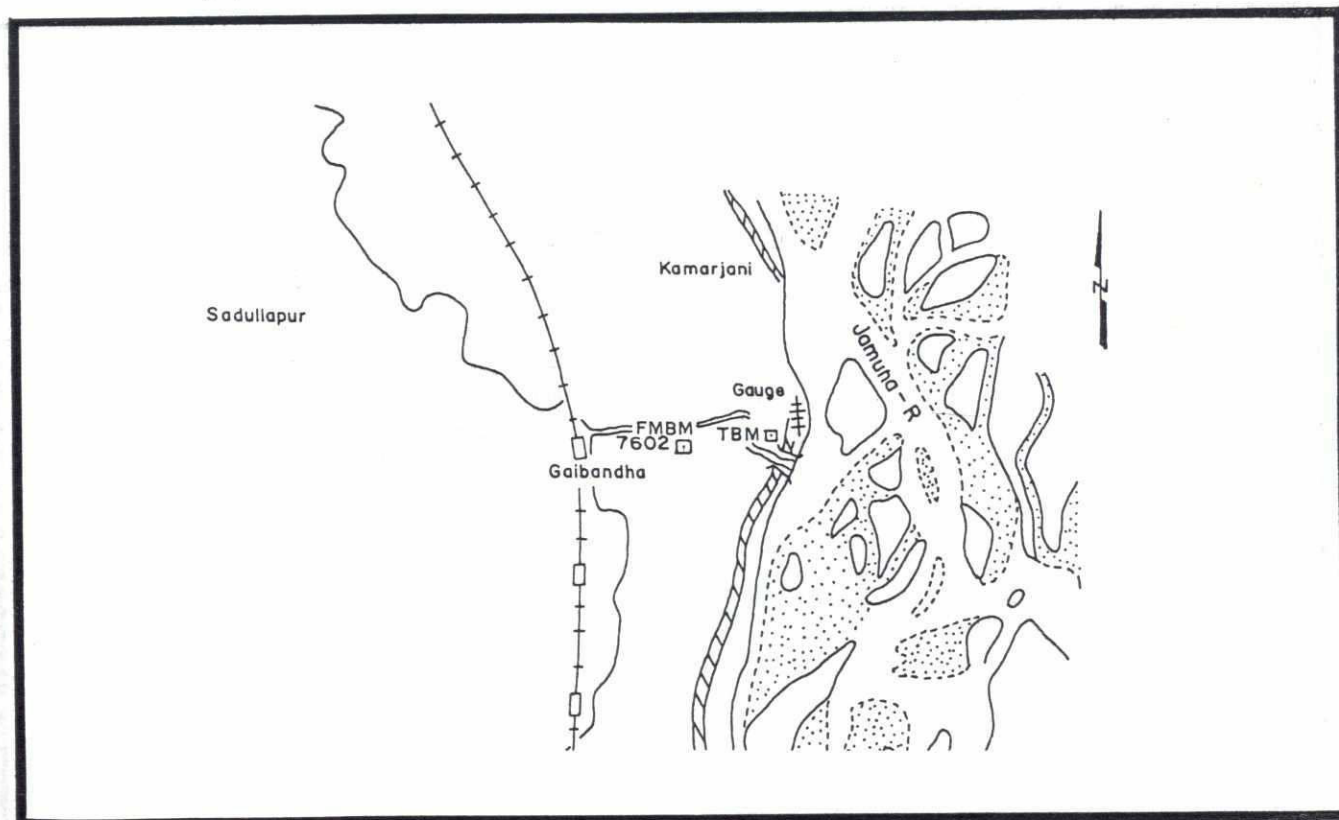
Name of gauge station	:	46 Kamarjani
Date of visit	:	03.03.93
Condition of gauge	:	Good
Remark	:	Gauge is located about 5 Km downstream from Kamarjani, which creates confusion as to the naming of gauge station.

 2. Bench mark

Calibration benchmark present	:	no
Name	:	TBM
Location	:	TBM located NE corner of primary school at Satarkandi.

Height	:	21.530 m PWD
Condition	:	acceptable

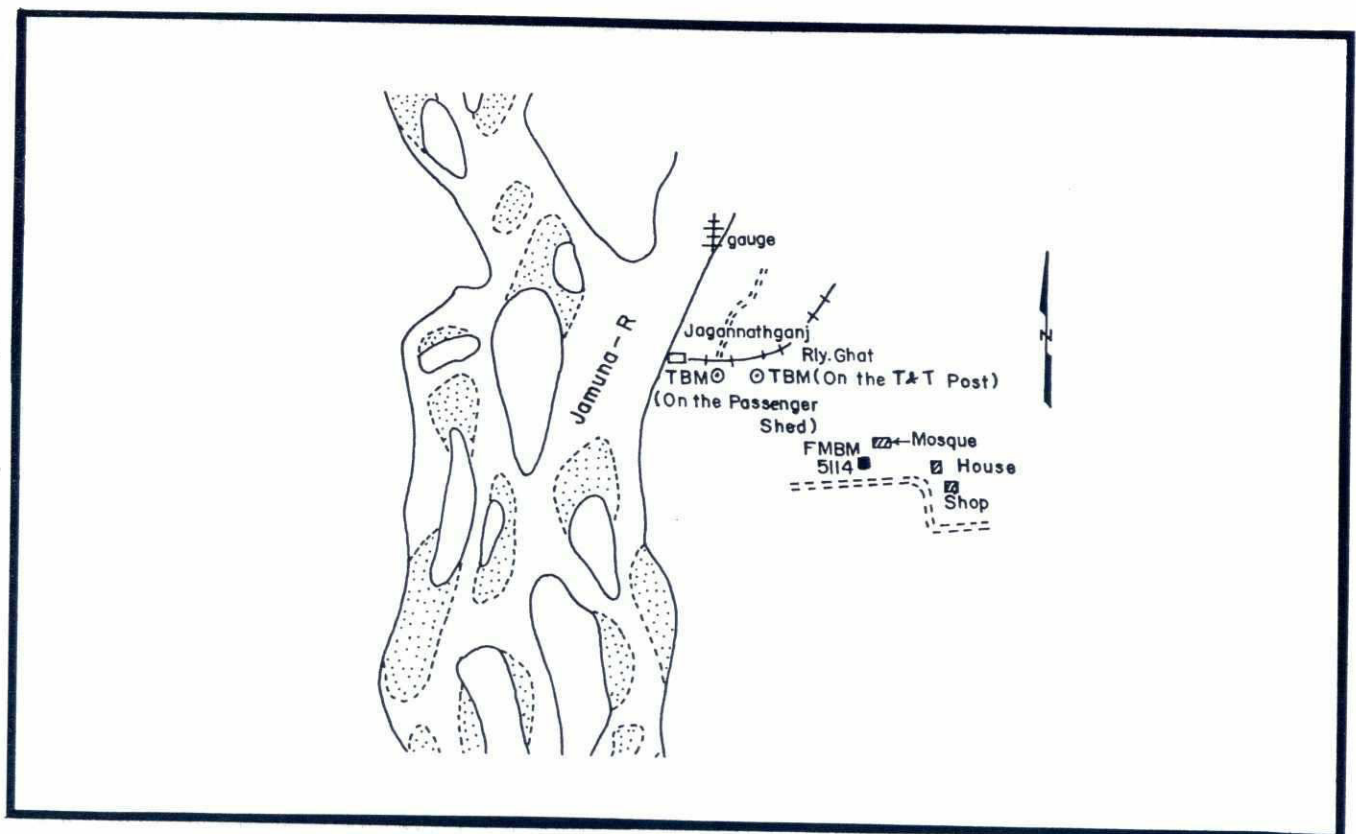
 3. If, not acceptable, give reasons : —
 4. Distance of gauge to BM : 0.2 Km
 5. Conclusion, recommendation : yes
 - Improvements required, if yes, TBM be connected with FM BM 7602, which is about 4 Km from the TBM.
- (Give recommended steps)
6. Sketch map of the area.
(not to scale)



Annexure - D

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

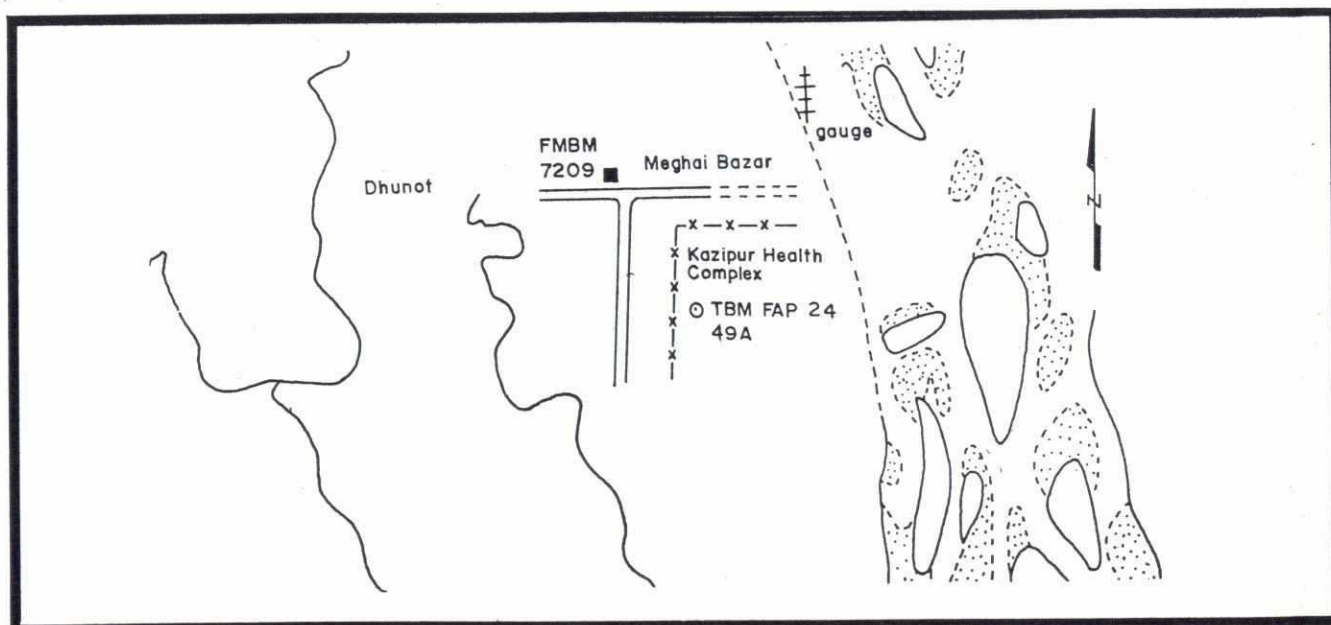
1. Gauge.
 Name of gauge station : 48 Jagannathganj
 Date of visit : 13.02.93
 Condition of gauge : Good
 Remark : —
2. Bench mark
 Calibration benchmark present : no
 Name : TBMs
 Location : One TBM located on passenger shed and the other on T & T post at jagannathganj ghat.
 Height : —
 Condition : acceptable
3. If, not acceptable, give reasons : —
4. Distance of gauge to BM : 0.2 Km
5. Conclusion, recommendation : yes
 Improvements required, if yes, TBMs at Jagannathganj ghat be levelled with FM BM 5114 located at a distance of about 2.5 Km from the Jagannathganj ghat.
 (Give recommended steps)
6. Sketch map of the area.
 (not to scale)



Annexure - E

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.
 Name of gauge station : 49A Kazipur
 Date of visit : 08.02.93
 Condition of gauge : Good
 Remark : —
2. Bench mark
 Calibration benchmark present : no
 Name : TBM
 Location : Kazipur
 Height :
 Condition : not acceptable
3. If, not acceptable, give reasons : Since BM 49A at Kazipur has been eroded by bank erosion, there should be one TBM located in a suitable position.
4. Distance of gauge to BM : 0.2 Km
5. Conclusion, recommendation : yes
 Improvements required, if yes, describe : One new TBM FAP 24 49A be established within the compound of Kazipur Health Complex and its height be determined by levelling with FMBM 7209 located at Meghai Bazar (1.5 Km from river bank)
 (Give recommended steps)
6. Sketch map of the area.
 (not to scale)



Annexure - F

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

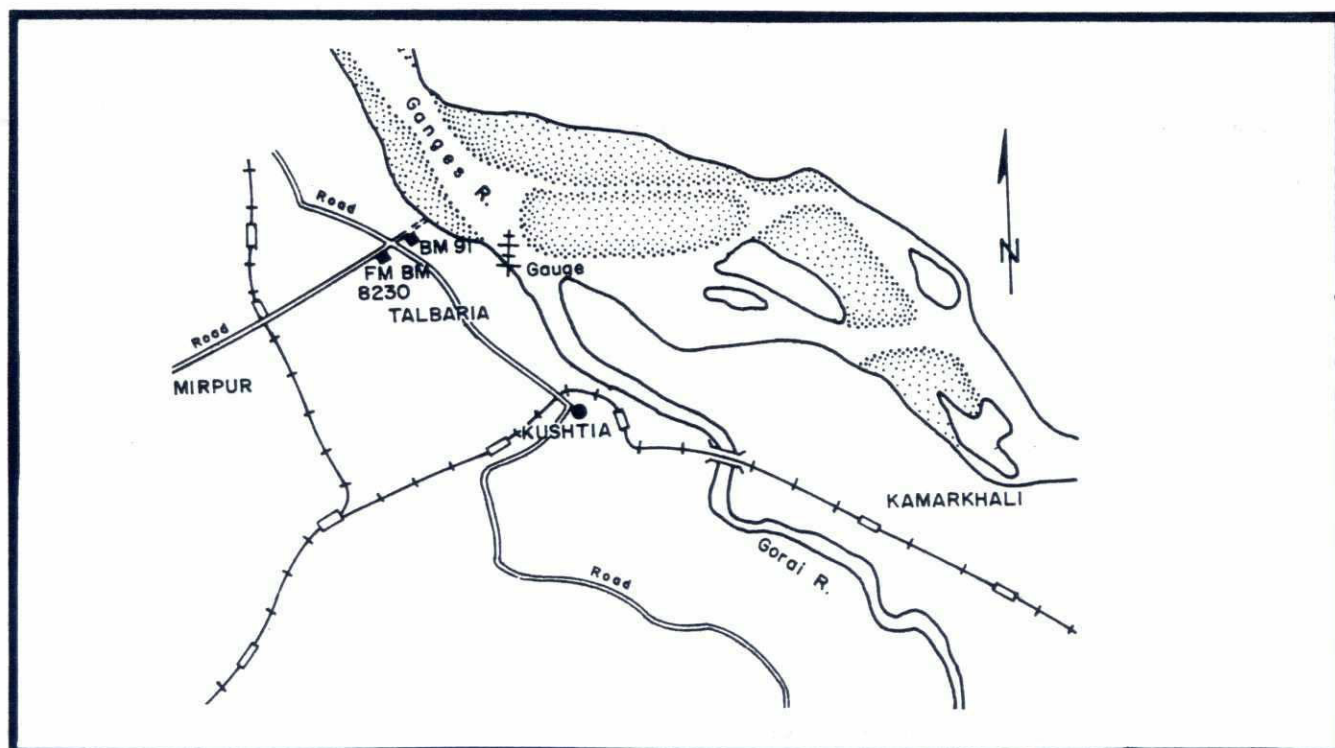
1. Gauge.
 Name of gauge station : 91 Talbaria
 Date of visit : 09.02.93
 Condition of gauge : Good
 Remark : —

2. Bench mark
 Calibration benchmark present : yes
 Name : BM 91
 Location : BM 91 is located on the eastside of the road leading to Mirpur from Talbaria.

 Height : —
 Condition : acceptable

3. If, not acceptable, give reasons : —
4. Distance of gauge to BM : 0.5 Km
5. Conclusion, recommendation : yes
 Improvements required, if yes, describe.
 (Give recommended steps)
 BM 91 Talbaria was shifted from its original position and placed at a new position. Height of BM 91 at new position be determined by levelling with FMBM 8230 located at a distance of about 3 Km from the gauge.

6. Sketch map of the area.
 (not to scale)



Annexure - G

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	:	91.1 Sengram
Date of visit	:	31.01.93
Condition of gauge	:	Good
Remark	:	—

2. Bench mark

Calibration benchmark present	:	no
Name	:	TBM
Location	:	Sengram
Height	:	—
Condition	:	not acceptable

3. If, not acceptable, give reasons

:	TBMs at Sengram considered to be not acceptable as their locations and heights are doubtful.
---	--

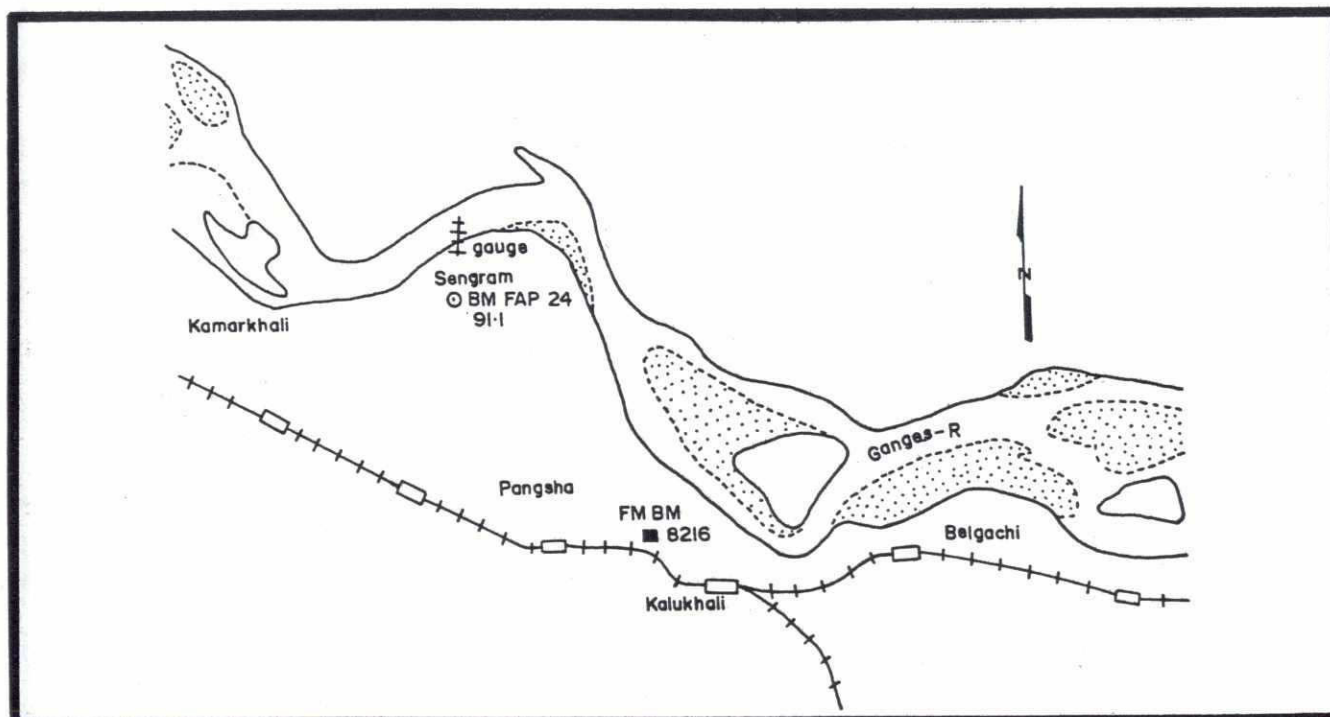
4. Distance of gauge to BM

:	0.5 Km
---	--------

5. Conclusion, recommendation

:	yes
Improvements required, if yes, describe. (Give recommended steps)	One B M FAP 24 91.1 be established at Sengram and its height be determined by levelling with nearest FMBM 8216, located at about 15 Km from Sengram.

6. Sketch map of the area.
(not to scale)



Annexure - H

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	: 93.4L Bhagyakul
Date of visit	: 23.01.93
Condition of gauge	: Good
Remark	: Gauge should be shifted near to Bhagyakul Bazar during flood period.
2. Bench mark

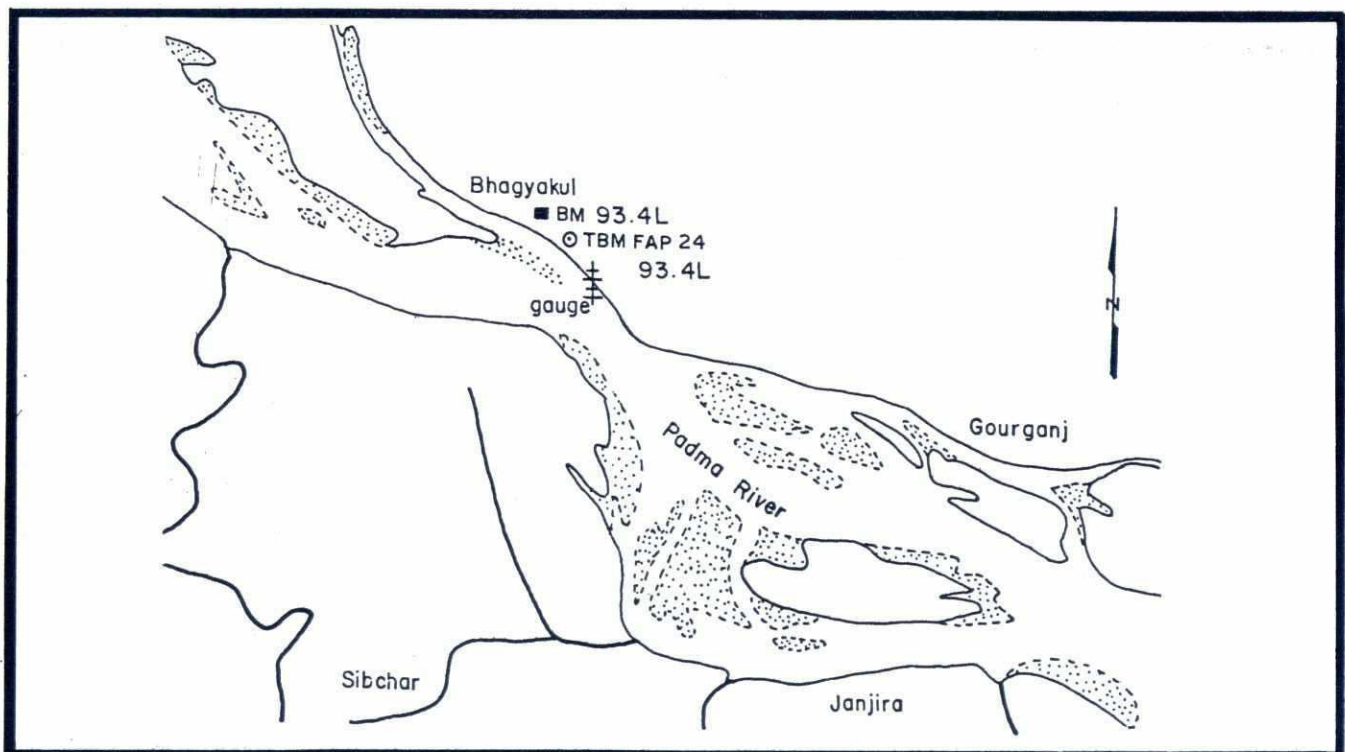
Calibration benchmark present	: yes
Name	: BM 93. 4L
Location	: Located within Bhagyakul meteorological station compound.
Height	: —
Condition	: acceptable
3. If, not acceptable, give reasons

: TBMs at Sengram considered to be not acceptable as their locations and heights are doubtful.
--
4. Distance of gauge to BM

: 3 Km

5. Conclusion, recommendation

: yes	
Improvements required, if yes, describe. (Give recommended steps)	Inter distance between BM 93. 4L and gauge being about 3 Km, one new TBM FAP 24 93. 4L be established at Bhagyakul Bazar. New TBM be levelled with BM. 93.4L, which will involve about 2 Km of levelling.
6. Sketch map of the area.
(not to scale)



Annexure - I

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

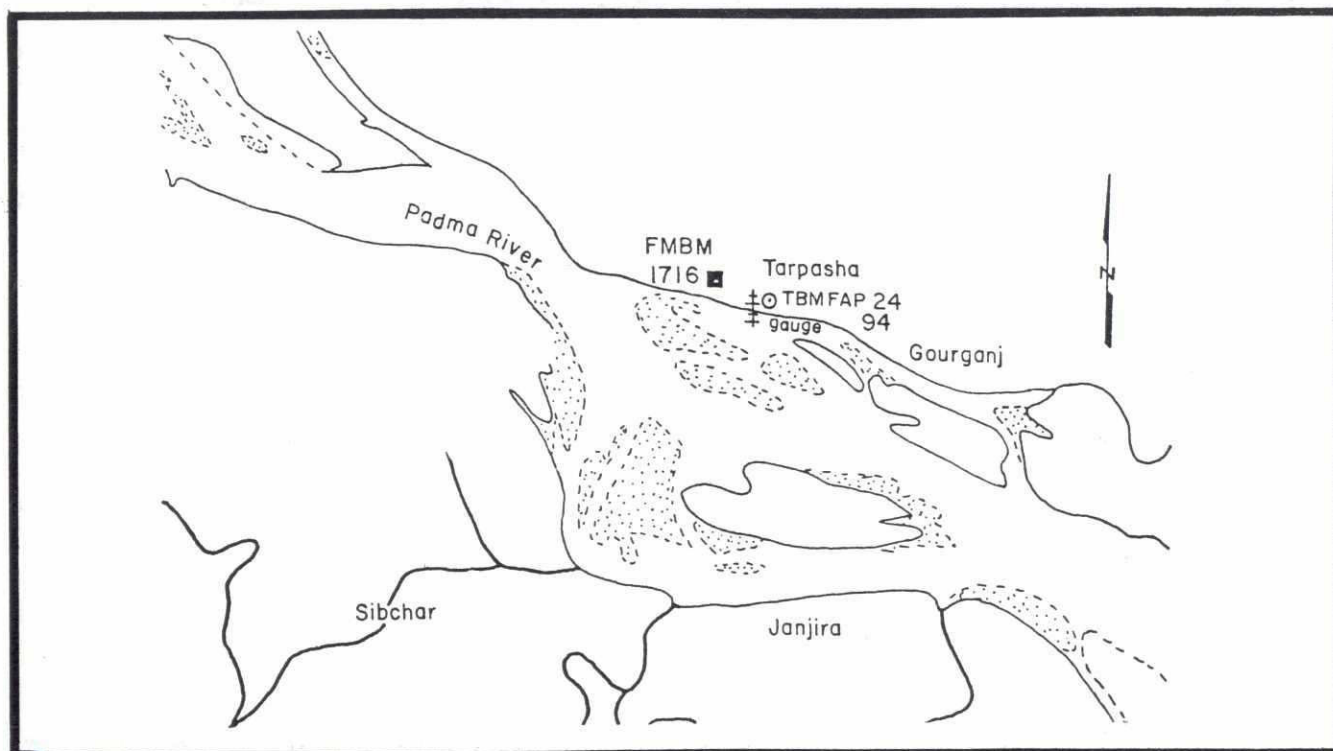
Name of gauge station	:	94 Tarpasha
Date of visit	:	23.01.93
Condition of gauge	:	Good
Remark	:	—
2. Bench mark

Calibration benchmark present	:	no
Name	:	TBM
Location	:	Located on the I.D. pillar near the house of Golam Hasan, retired Gauge Reader.
Height	:	5.575 meters PWD
Condition	:	not acceptable
3. If, not acceptable, give reasons

:	:	Top position of TBM pillar was found to be broken down.
---	---	---
4. Distance of gauge to BM

:	:	0.2 Km
---	---	--------
5. Conclusion, recommendation

:	:	yes
Improvements required, if yes, describe. (Give recommended steps)		One TBM FAP 24 94 be established at Tarpasha Bazar and its height be determined by levelling with nearest FMBM 1716, located at about 4 Km from Tarpasha Bazar.
6. Sketch map of the area.
(not to scale)



Annexure - J

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	: 95 Sureswar
Date of visit	: 27.01.93
Condition of gauge	: Good
Remark	: —

2. Bench mark

Calibration benchmark present	: no
Name	: TBM
Location	: Located at Sureswar Bazar.
Height	: 5.276 meters PWD
Condition	: not acceptable
3. If, not acceptable, give reasons

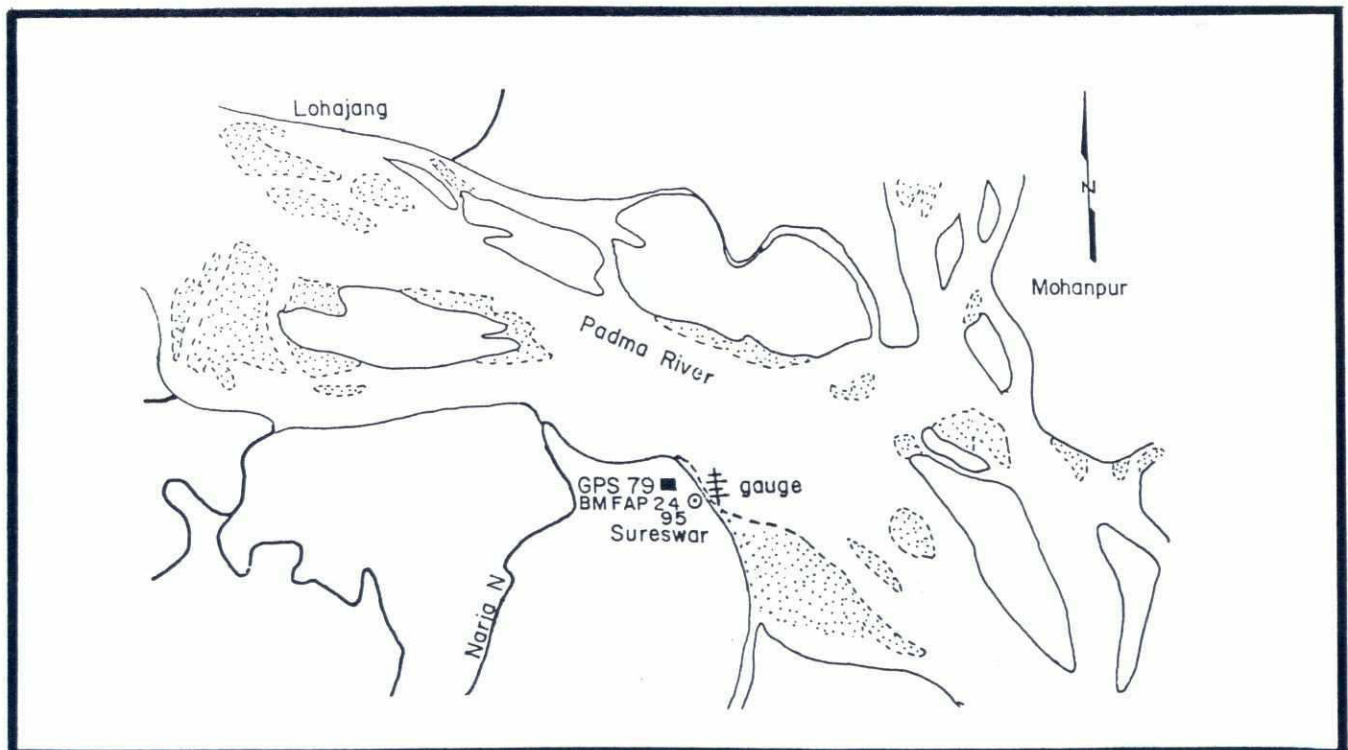
	: TBM kept on top of wooden peg was found to be in bad shape.
--	---

4. Distance of gauge to BM

	: 0.1 Km
--	----------
5. Conclusion, recommendation

Improvements required, if yes, describe. (Give recommended steps)	: yes One BM FAP 24 95 be established at Sureswar Bazar and its height be determined by levelling with GPS pillar No. 79 located at about 2.5 Km from Sureswar Bazar.
--	---

6. Sketch map of the area.
(not to scale)



Annexure - K

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

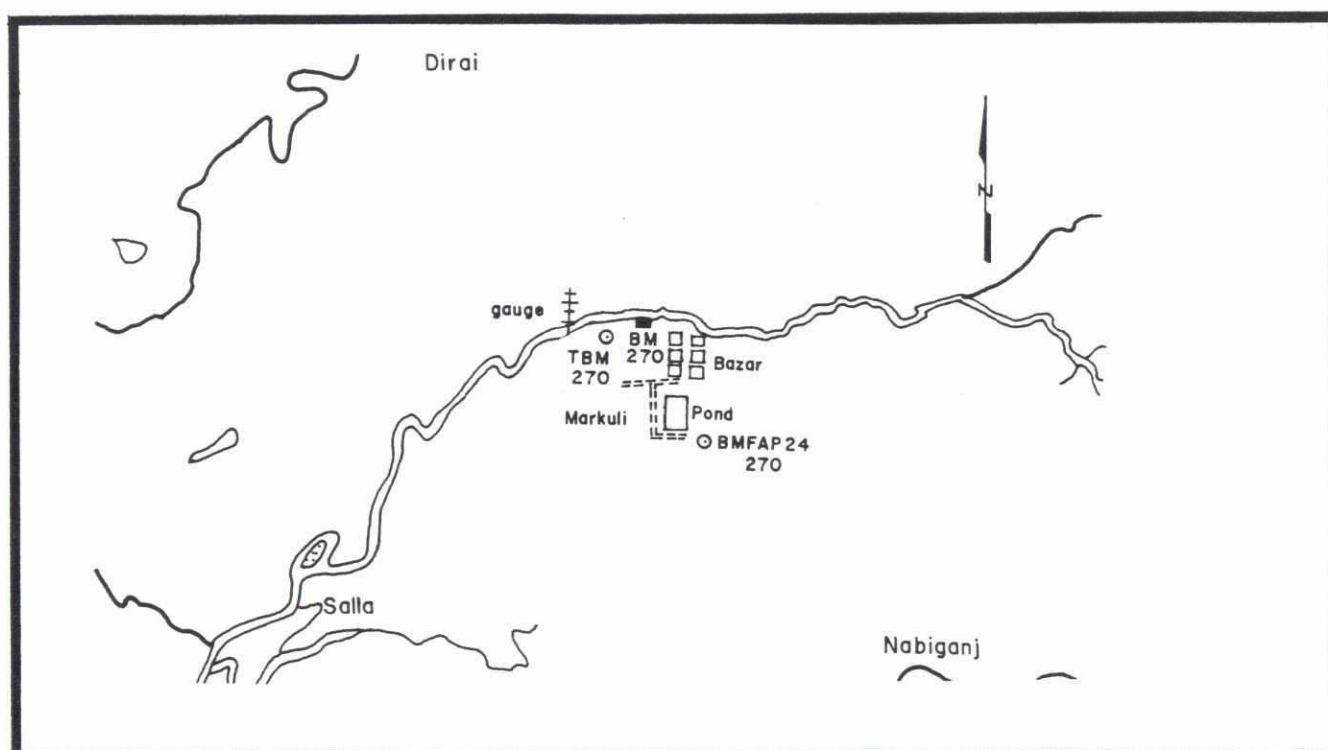
Name of gauge station	: 270 Markuli
Date of visit	: 18.02.93
Condition of gauge	: Good
Remark	: —
2. Bench mark

Calibration benchmark present	: yes
Name	: BM 270
Location	: BM located just on the bank of river Kushiyara at Markuli Bazar. TBM is only about 15 m from bank.
Height	: 8.162 meters PWD
Condition	: not acceptable
3. If, not acceptable, give reasons

	: BM 270 will no doubt be eroded during next flood period.
--	--
4. Distance of gauge to BM

	: 0.5 Km
--	----------
5. Conclusion, recommendation

	: yes
Improvements required, if yes, describe. (Give recommended steps)	One BM FAP 24 270 be established at suitable location at Markuli and be levelled with the BM/TBM at Markuli. Levelling length will approx. be 2.5 Km.
6. Sketch map of the area.
(not to scale)



Annexure - L

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	:	275.5 Meghna Ferry ghat
Date of visit	:	04.02.93
Condition of gauge	:	Good
Remark	:	—

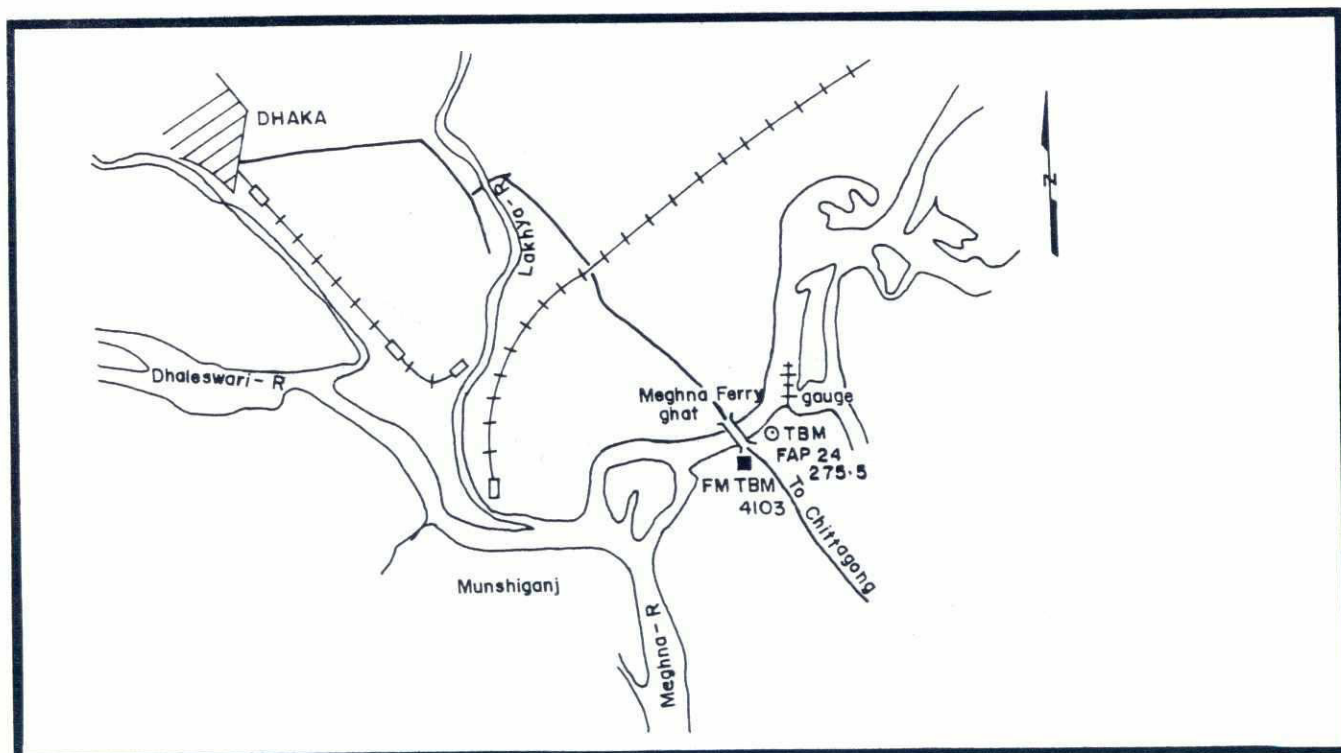
2. Bench mark

Calibration benchmark present	:	no
Name	:	TBM
Location	:	Located on the SE corner of Pucca bridge (Culvert) at old Ferryghat Bazar.
Height	:	6.985 meters PWD
Condition	:	not acceptable

3. If, not acceptable, give reasons :
4. Distance of gauge to BM : 0.25 Km
5. Conclusion, recommendation : yes
- Improvements required, if yes, describe.
(Give recommended steps)

One new TBM FAP 24 275.5 be established on the left bank at Meghna Ferry ghat in suitable place and its height be determined by levelling with FM TBM 4103 (length of levelling likely to be approx. 2 Km)

6. Sketch map of the area.
(not to scale)



Annexure - M

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	: 4 A Offtake of Arial Khan
Date of visit	: 24.01.93
Condition of gauge	: Good
Remark	: —

2. Bench mark

Calibration benchmark present	: no
Name	: TBM
Location	: TBM is located on the north east corner (of godown) plinth of Balihati Bazar.
Height	: 7.14 meters PWD
Condition	: not acceptable

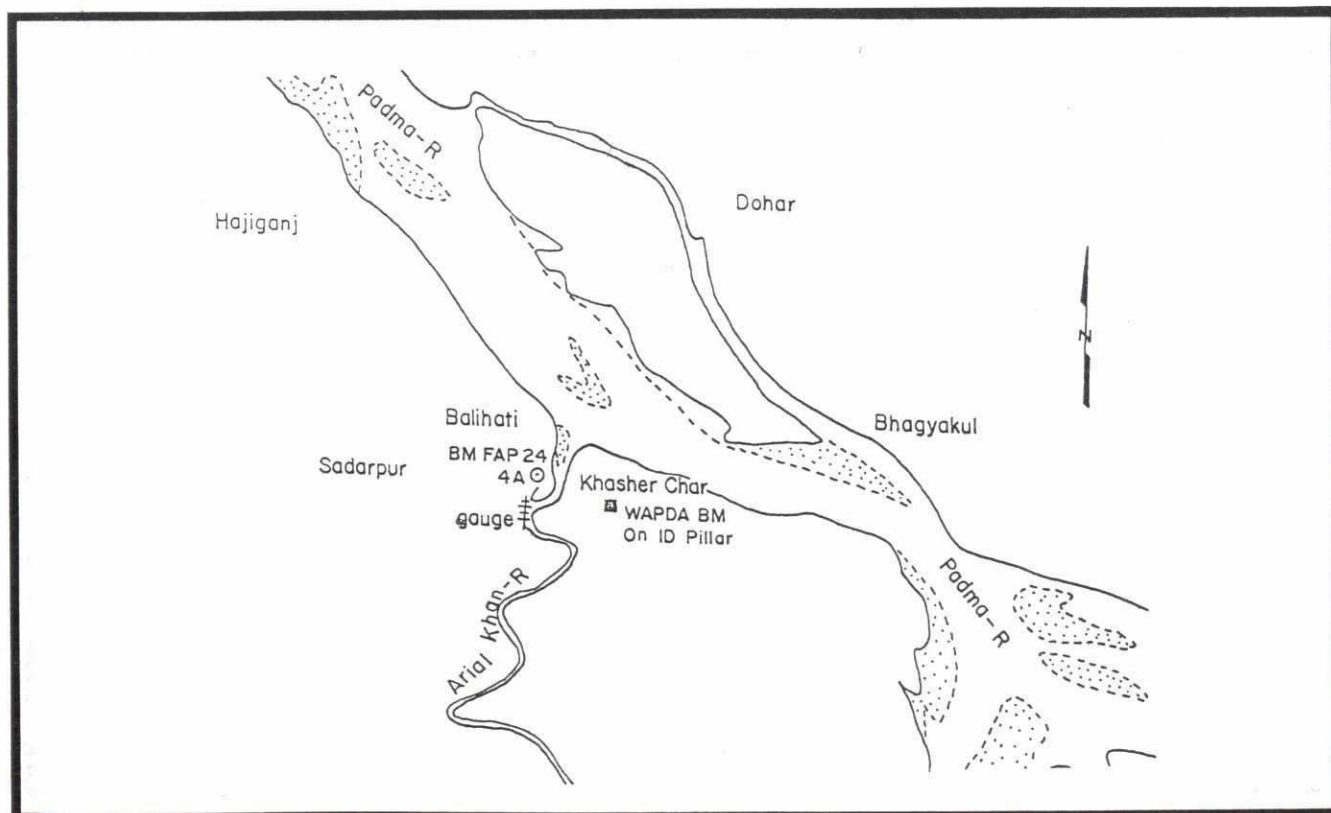
3. If, not acceptable, give reasons : Location of TBM not found suitable

4. Distance of gauge to BM : 1.5 Km

5. Conclusion, recommendation : yes

Improvements required, if yes, describe. (Give recommended steps)	One new BM FAP 24 4 A be established at Balihati Bazar and its height be determined by levelling with nearby FMBM (15 Km of levelling likely to be involved).
--	---

6. Sketch map of the area.
(not to scale)



Annexure - N

RIVER SURVEY PROJECT FAP-24 INSPECTION REPORT

1. Gauge.

Name of gauge station	:	99 Gorai Rly. Bridge
Date of visit	:	31.12.92
Condition of gauge	:	Good
Remark	:	—

2. Bench mark

Calibration benchmark present	:	no
Name	:	TBM
Location	:	Situated on the right bank of the Gorai river and 120ft. away from South-West abutment of Rly. Bridge.

Height	:	13.728 meters PWD
Condition	:	not acceptable
3. If, not acceptable, give reasons

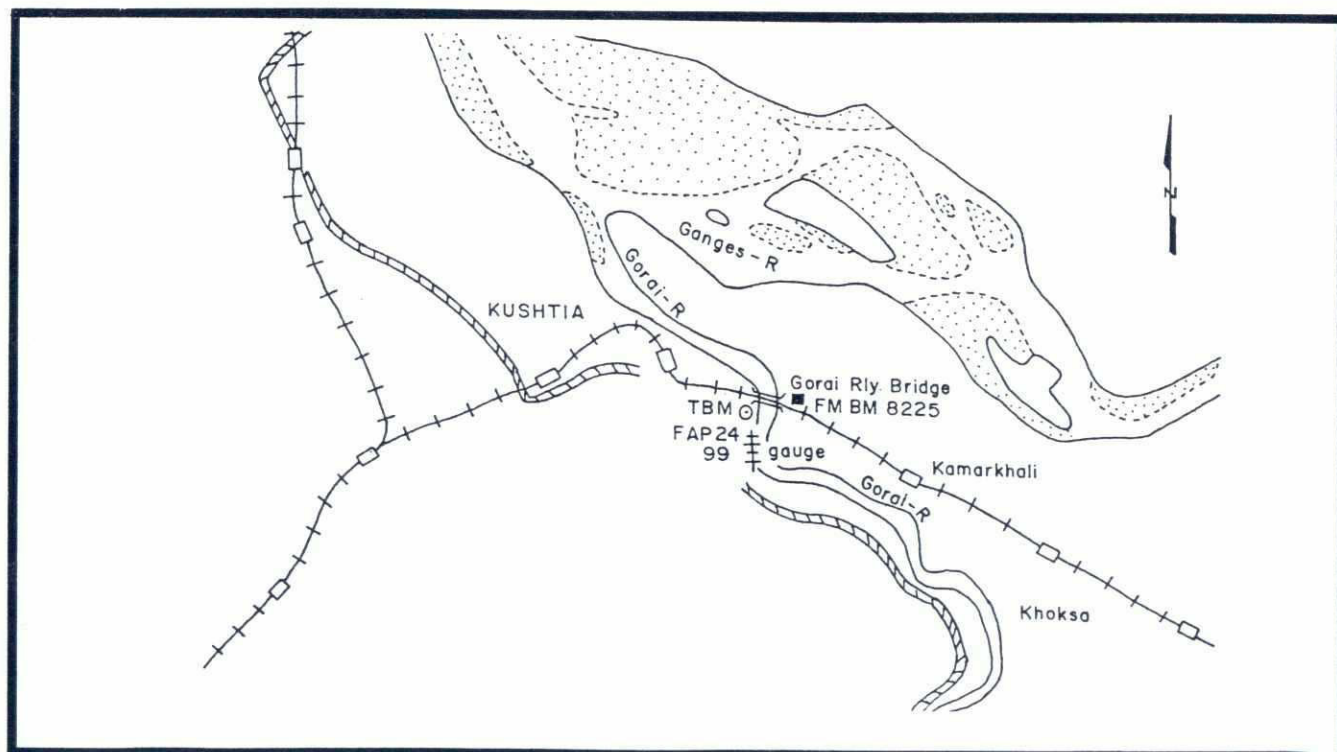
:	Existing TBM on the abutment of Gori Rly. Bridge considered to be not acceptable in view of its location.
---	---
4. Distance of gauge to BM

:	0.5 Km
---	--------
5. Conclusion, recommendation

:	yes
---	-----

Improvements required, if yes, describe.
(Give recommended steps)

One TBM FAP 24 99 be established on the right bank near the Gorai Rly. bridge and its height be determined by levelling with FM BM 8225 (length of levelling likely to be involved approx. 3 Km).
6. Sketch map of the area.
(not to scale)



Annex 2

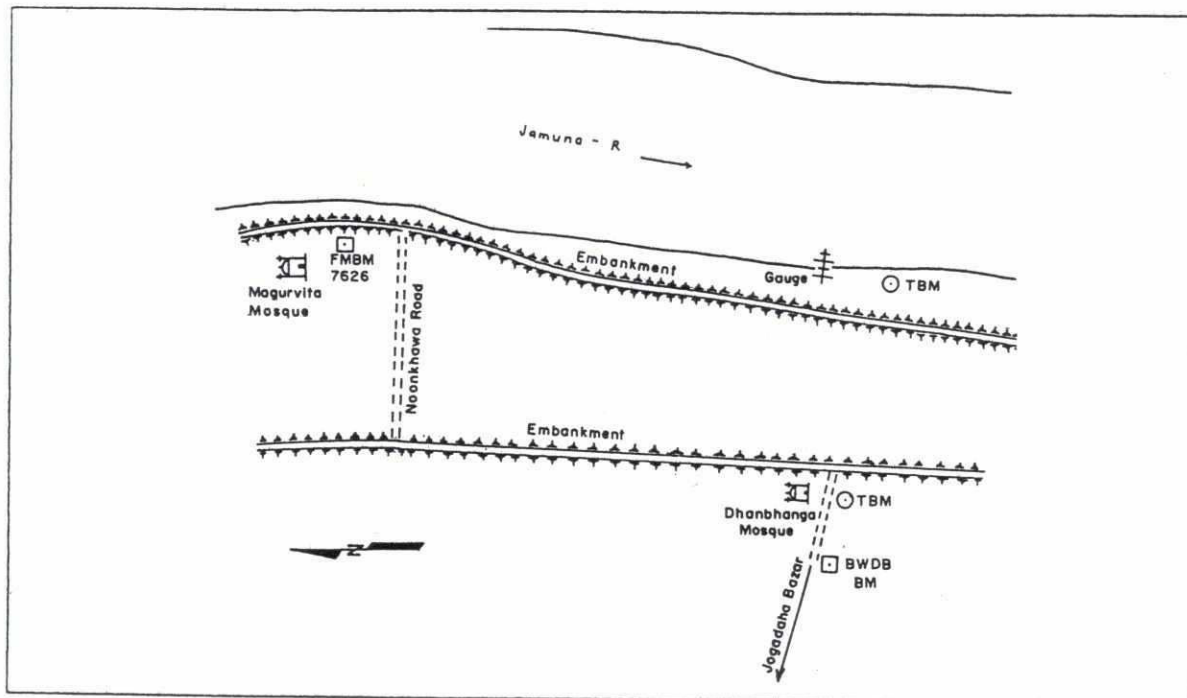
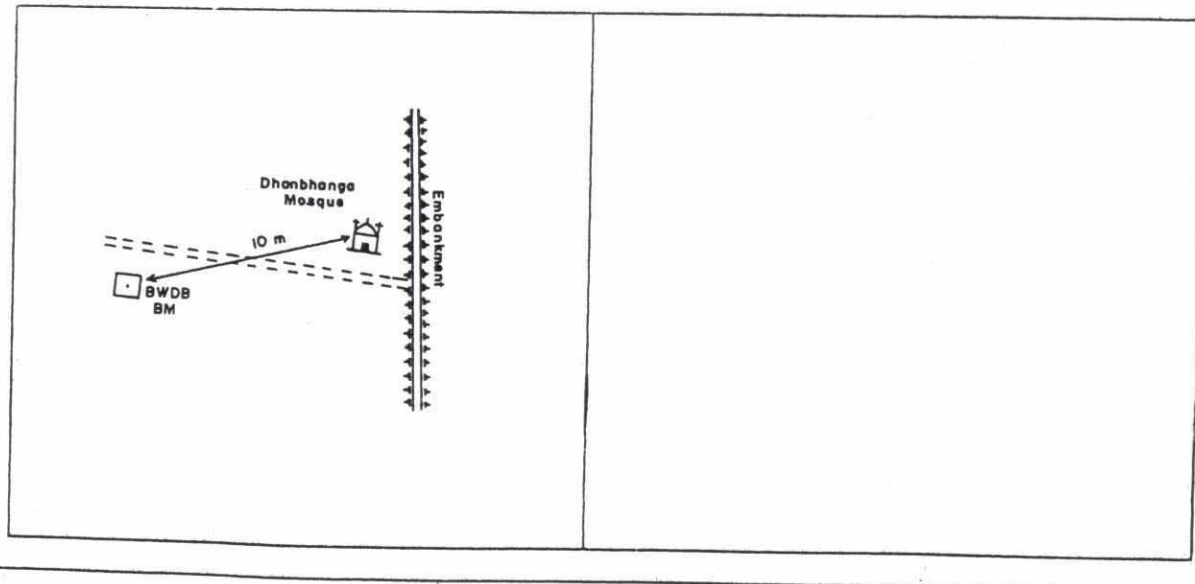
Location of Gauging Stations



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Brahmaputra-Jamuna

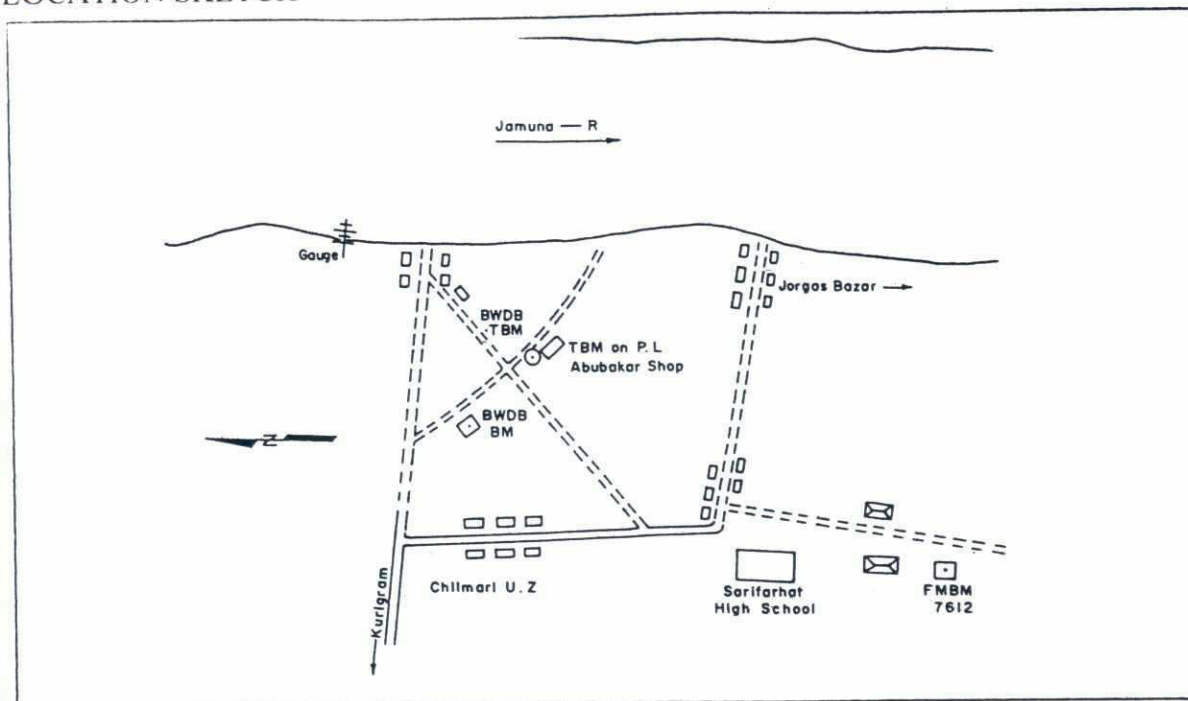
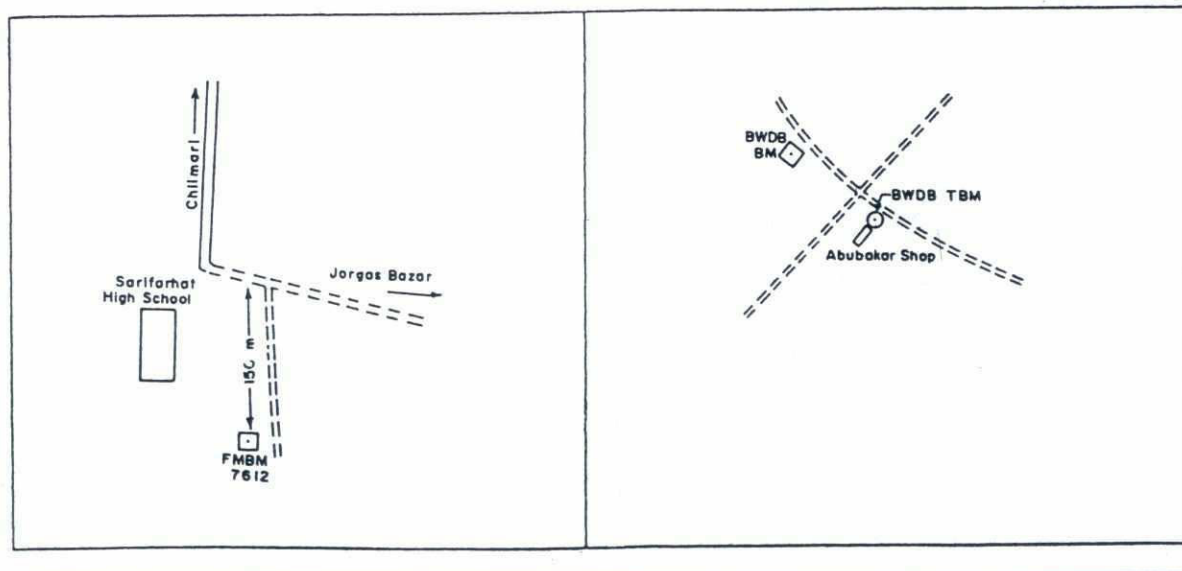
GAUGE STATION : 45 Noonkhawa

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Brahmaputra-Jamuna

GAUGE STATION : 45.5 Chilmari

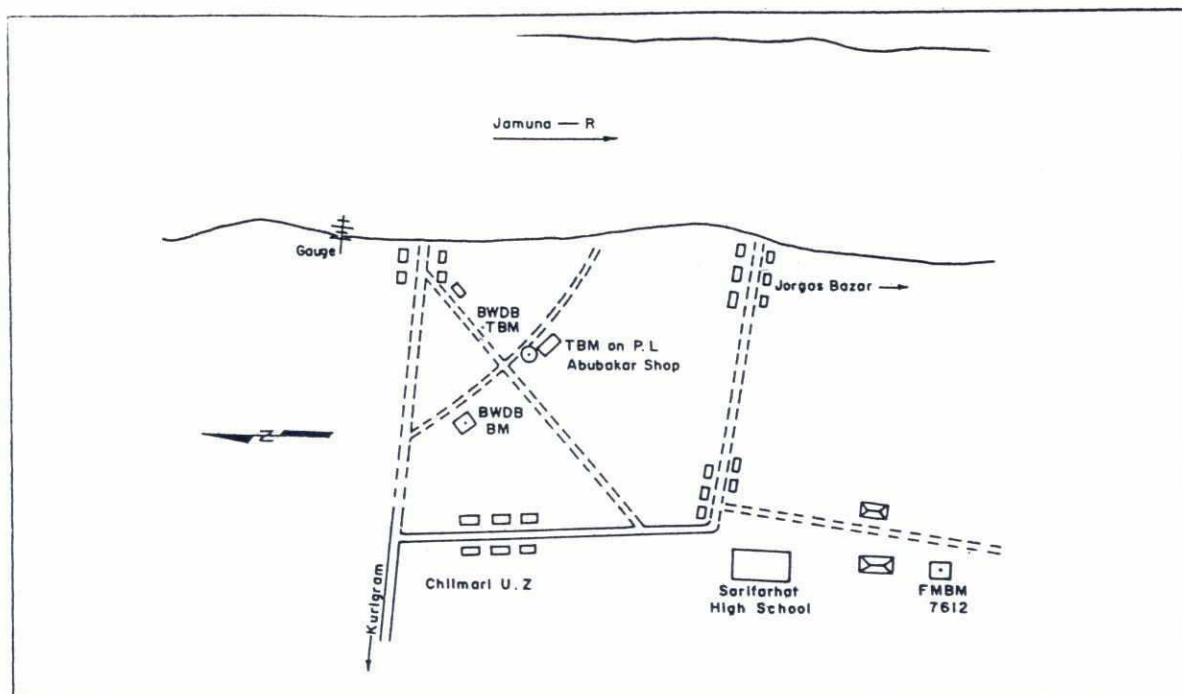
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

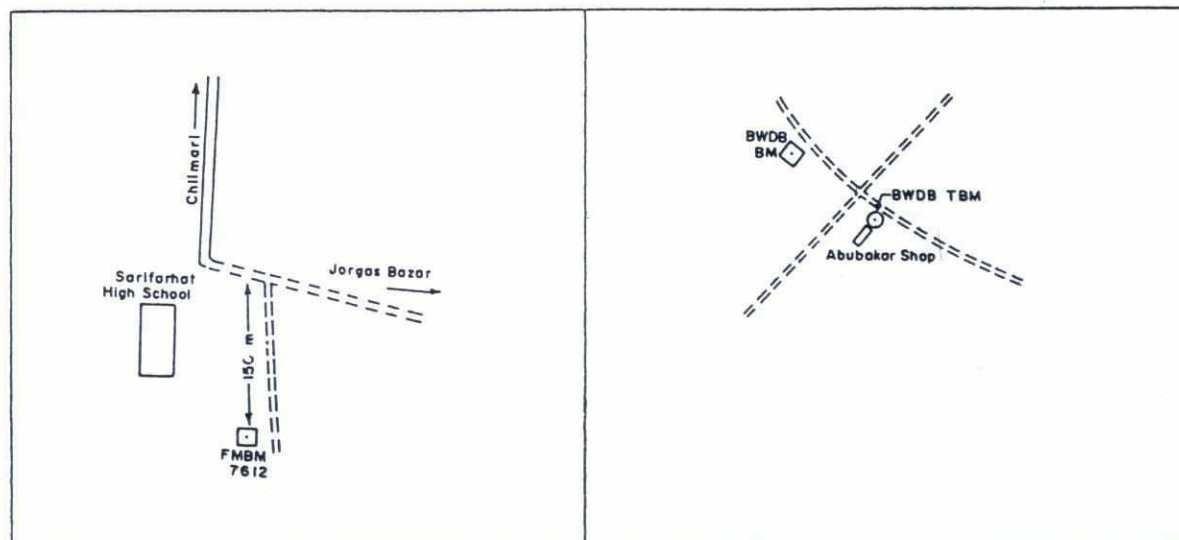
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 45.5 Chilmari

LOCATION SKETCH



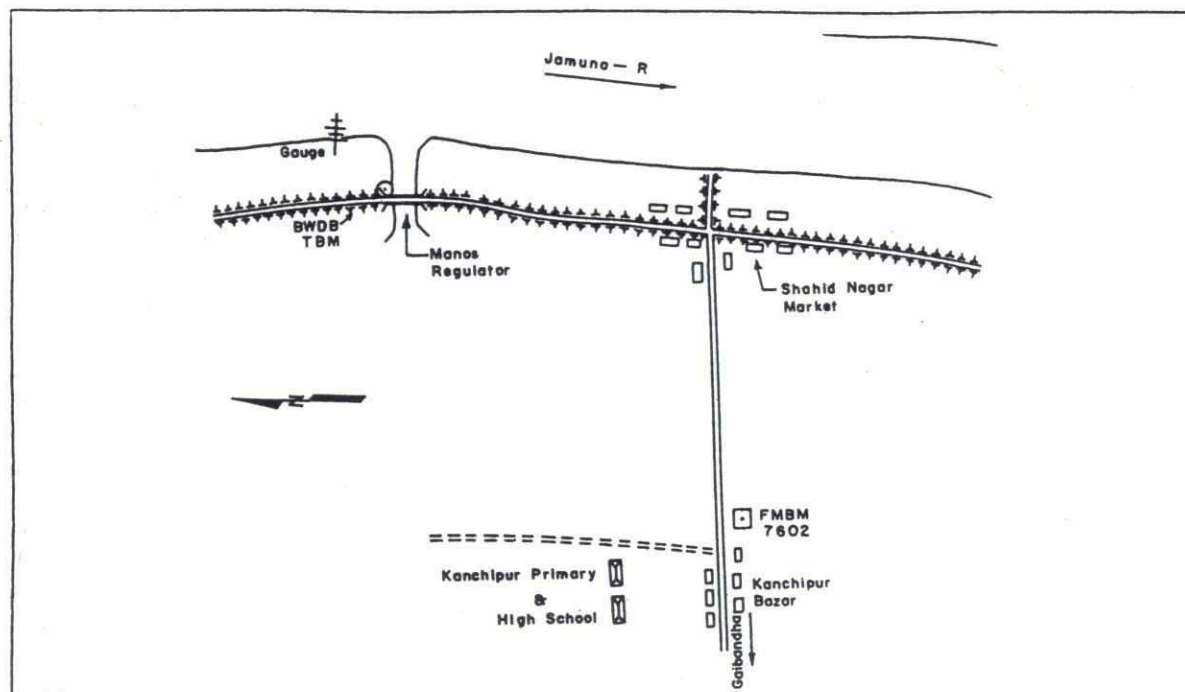
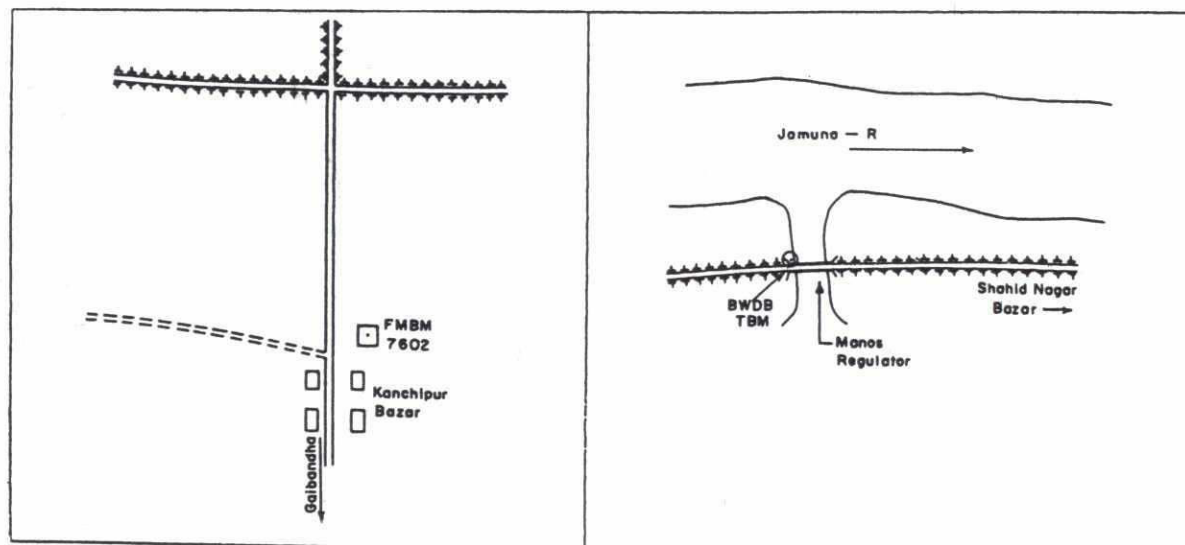
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Old Brahmaputra

GAUGE STATION : 46 Kamarjani

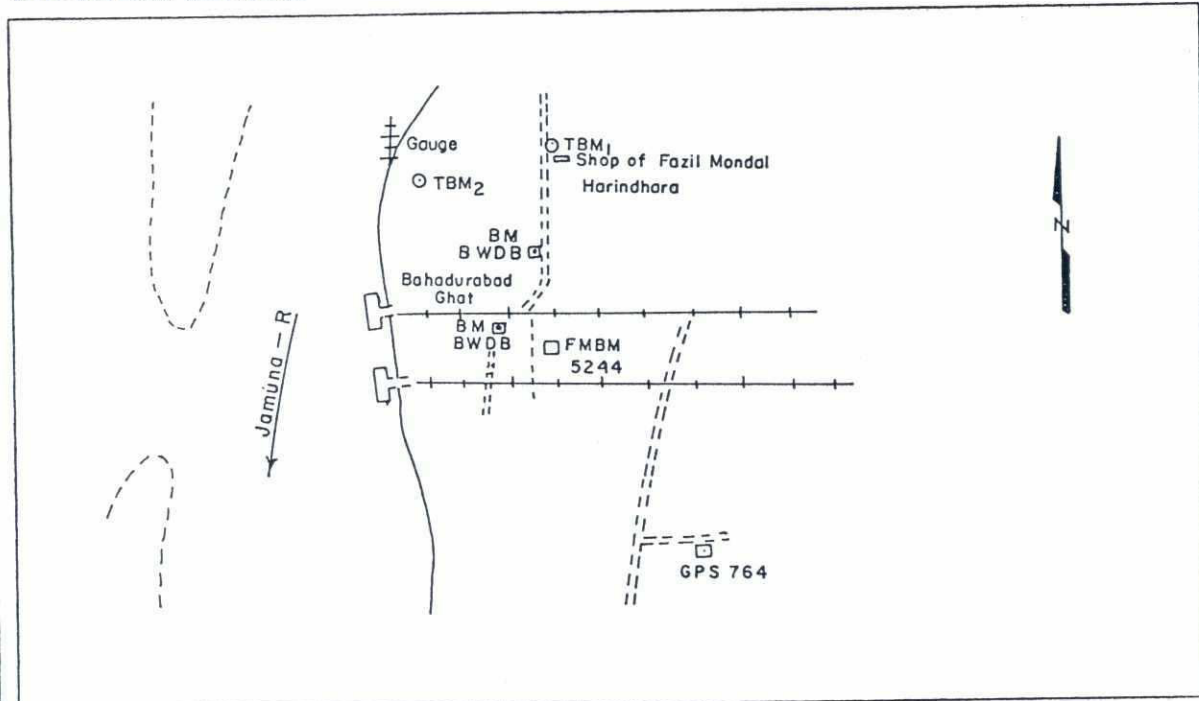
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

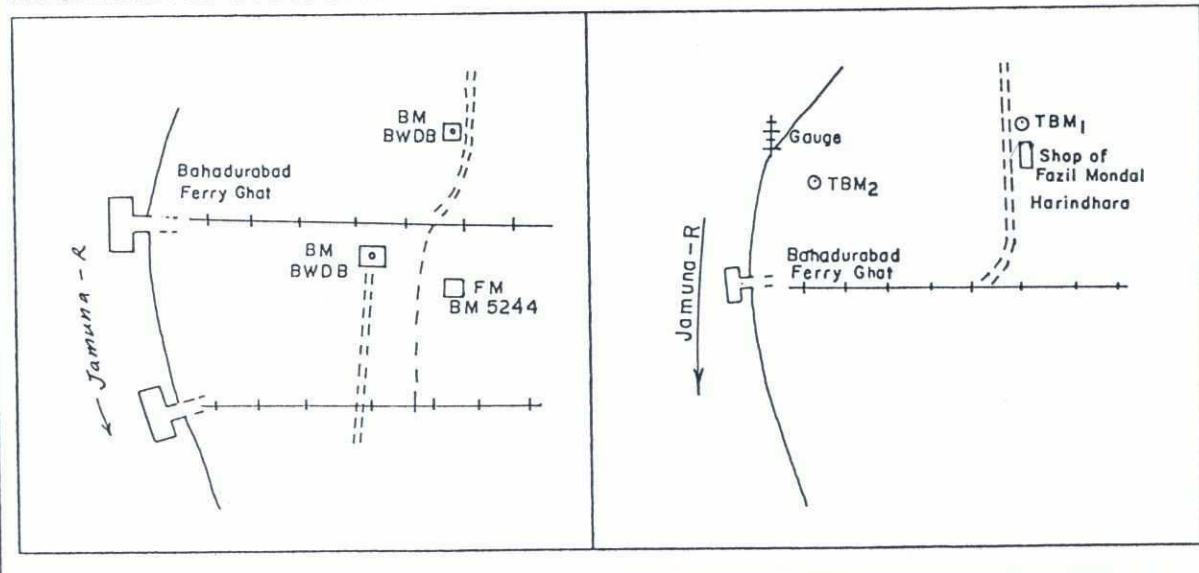
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 46.9L Bahadurabad transit

LOCATION SKETCH



LOCATION OF BM & TBM

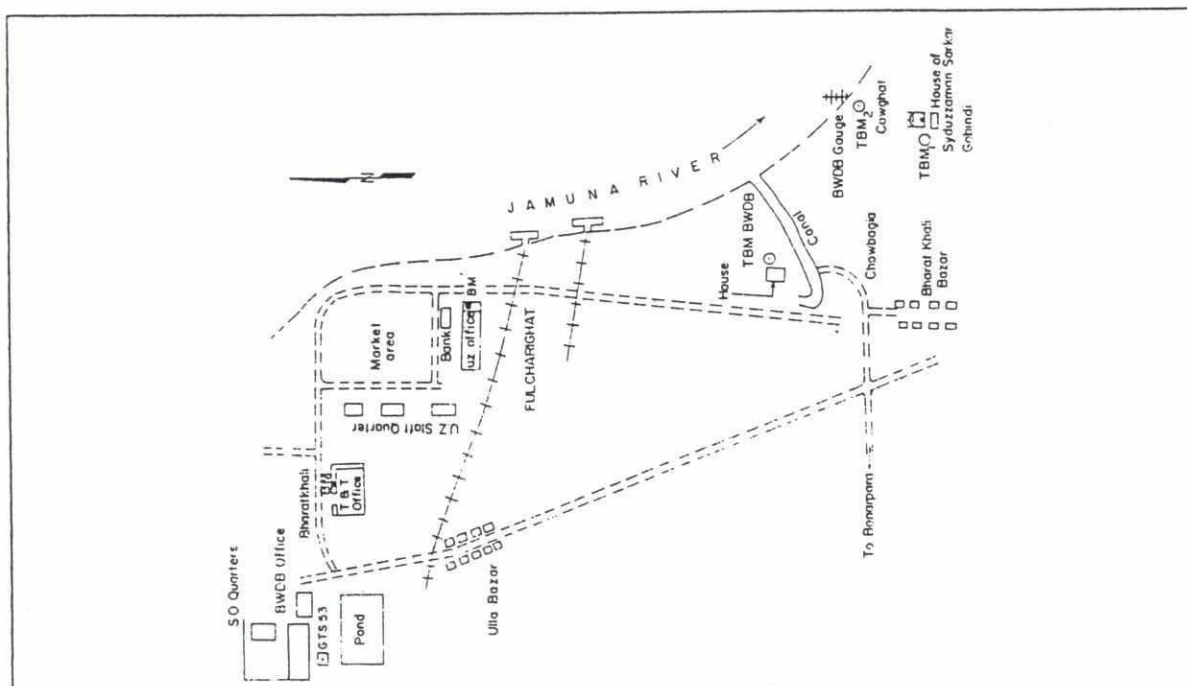


PROJECT : FAP 24 RIVER SURVEY PROJECT

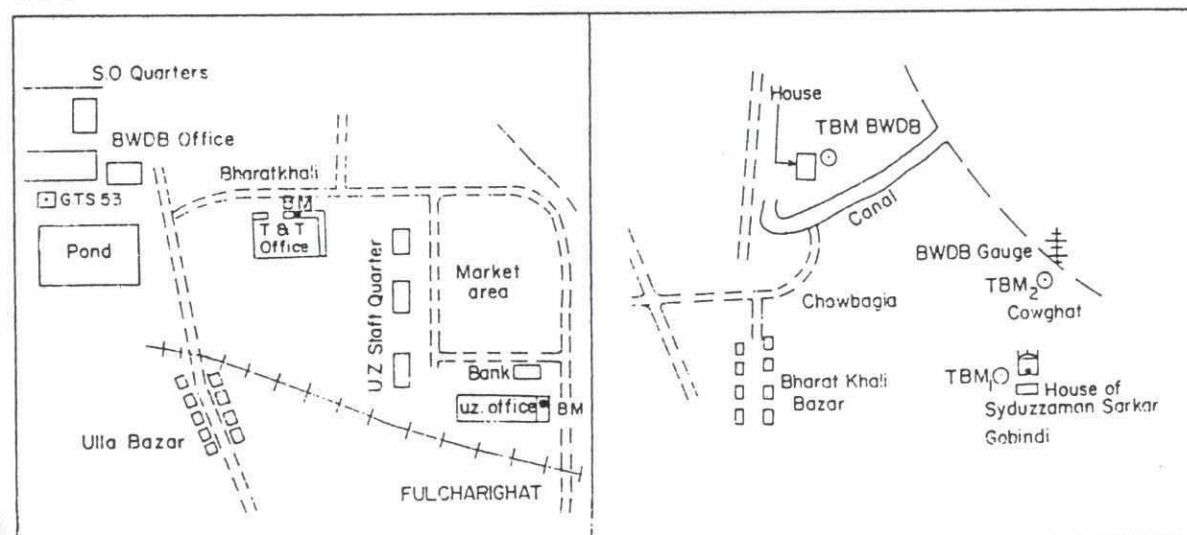
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 46.9 R Fulchari transit

LOCATION SKETCH



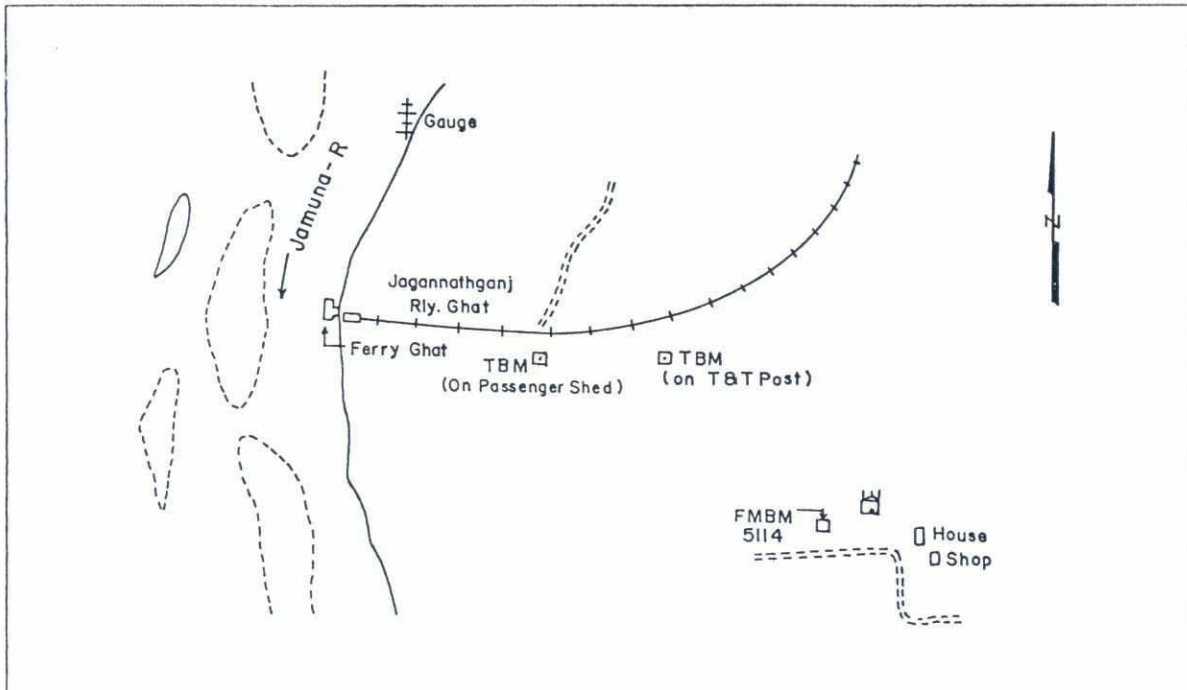
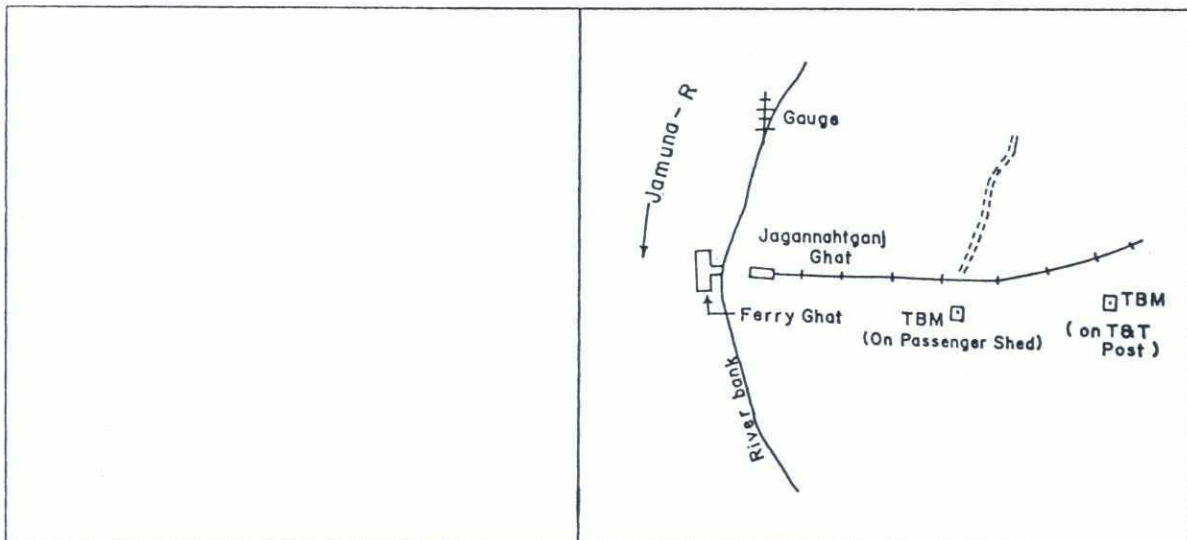
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Brahmaputra-Jamuna

GAUGE STATION : 48 Jagannathganj

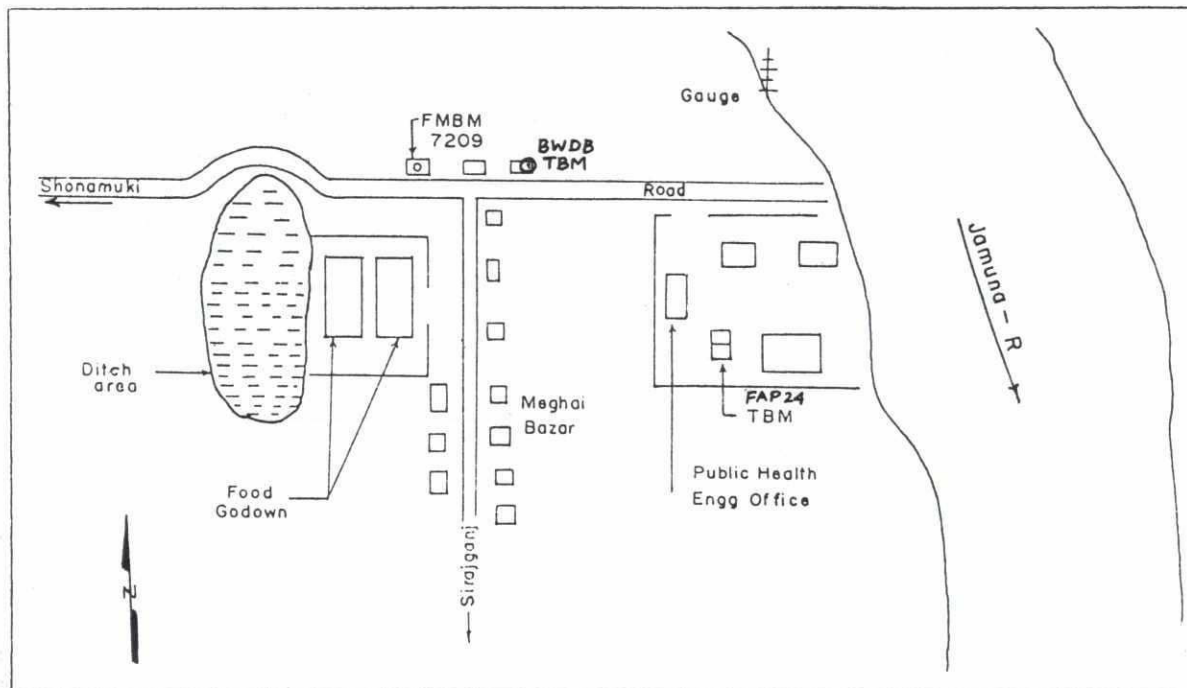
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

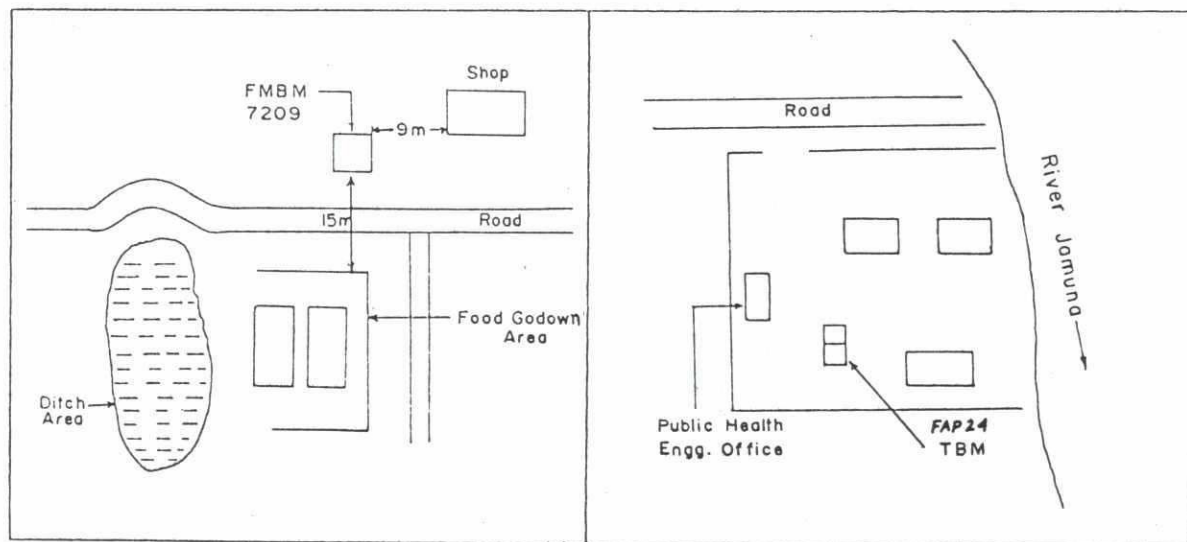
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 49A Kazipur

LOCATION SKETCH



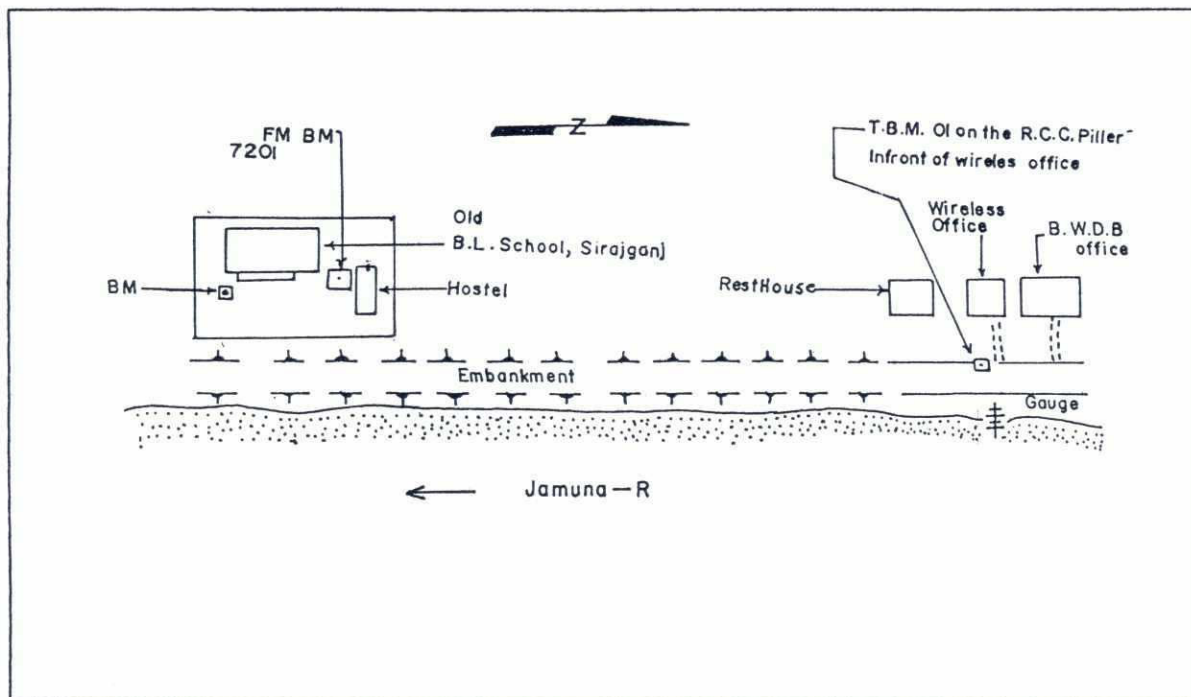
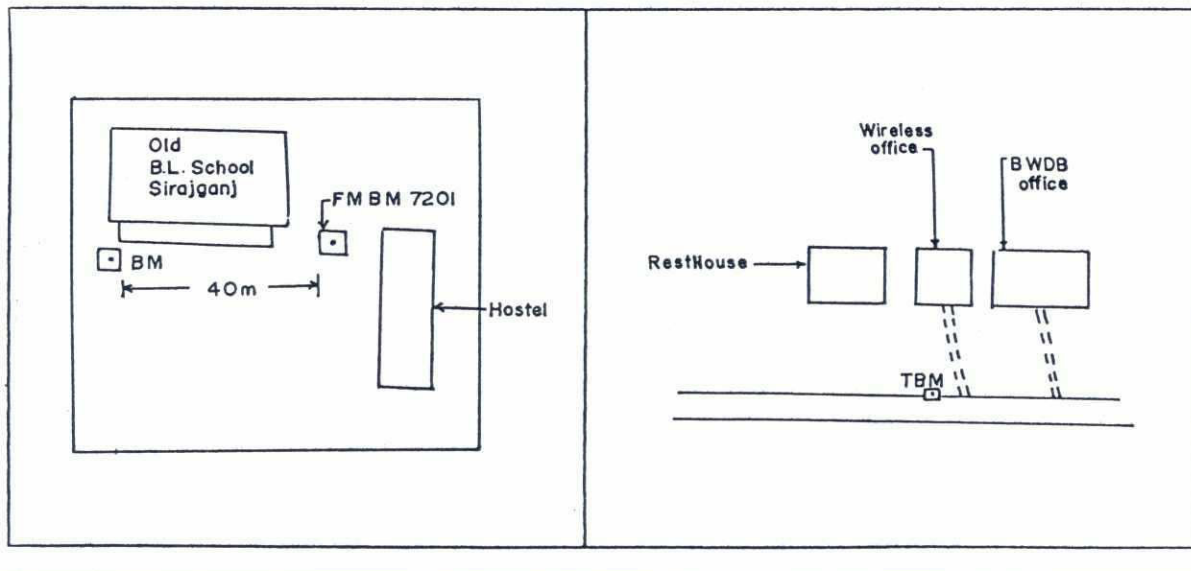
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Brahmaputra-Jamuna

GAUGE STATION : 49 Serajganj

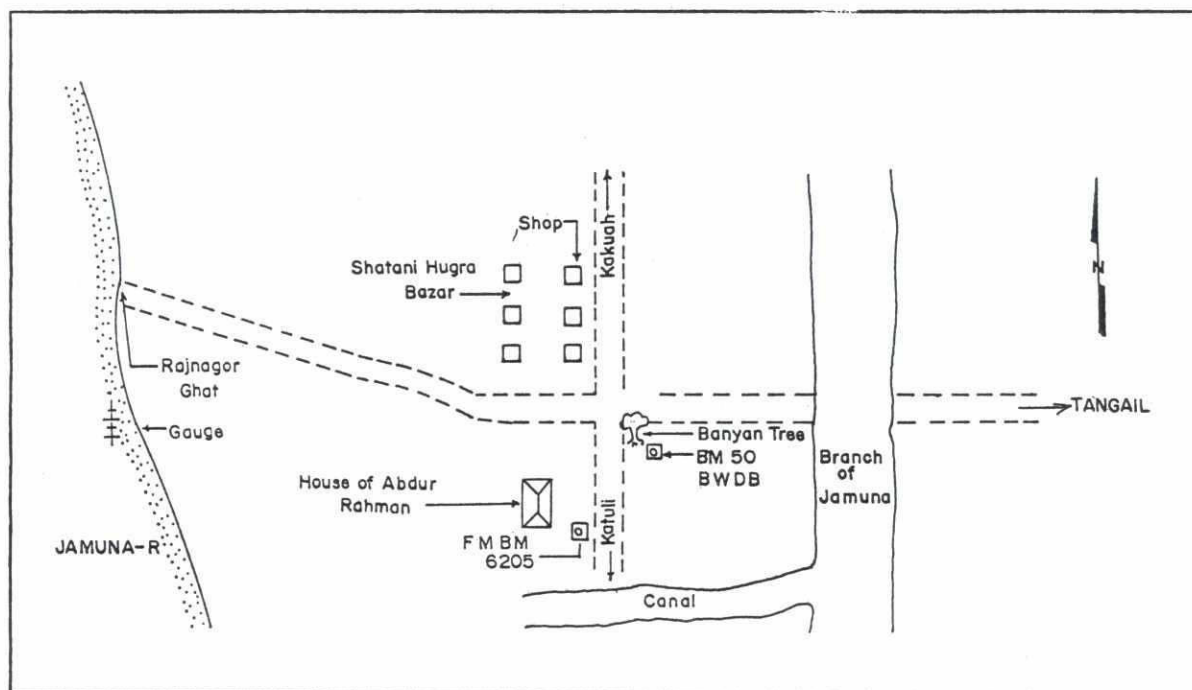
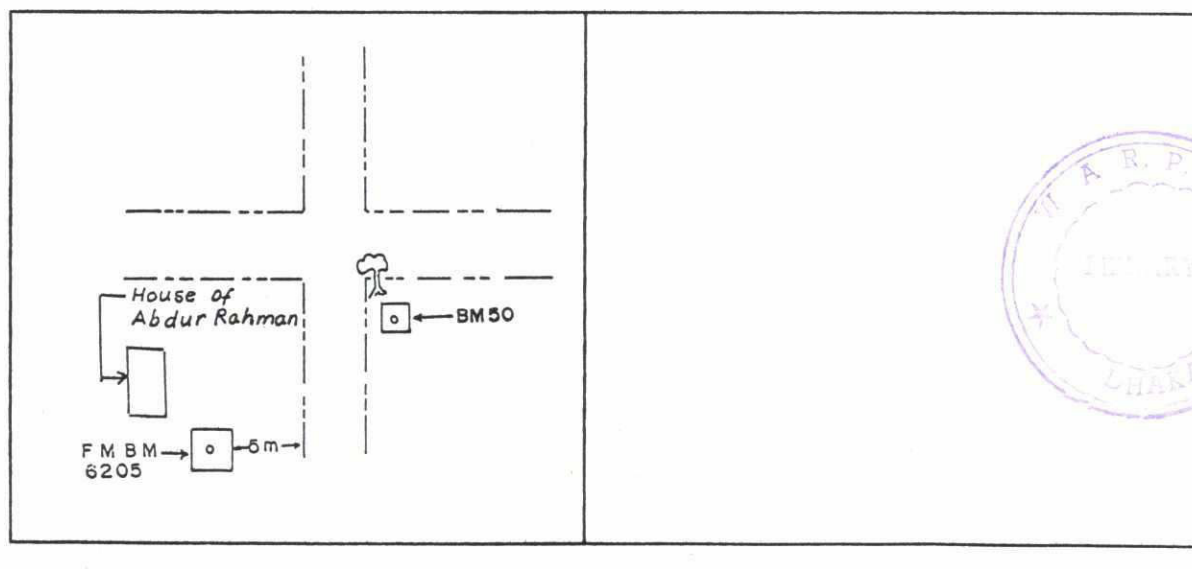
LOCATION SKETCH**LOCATION OF BM & TBM**

6b

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Brahmaputra-Jamuna

GAUGE STATION : 50 Porabari

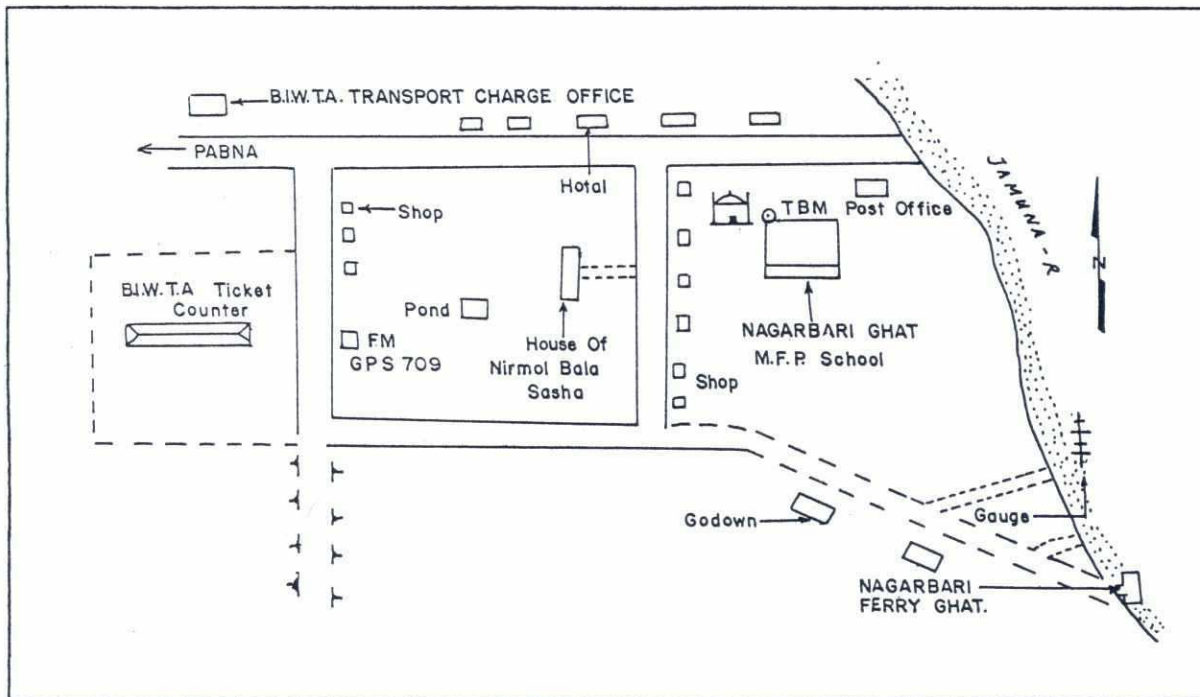
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

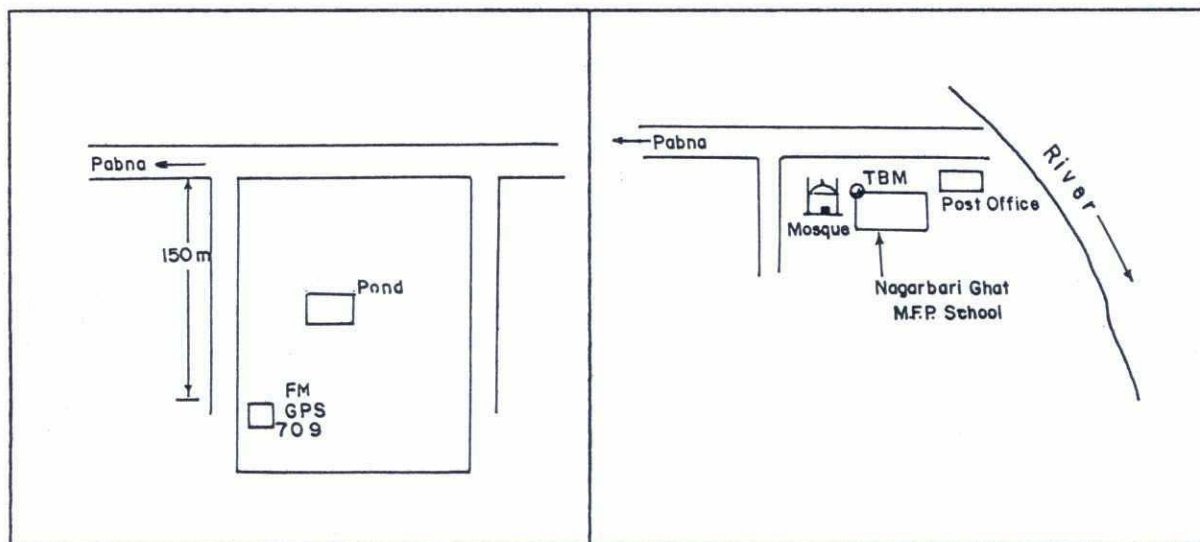
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 50.3 Mathura

LOCATION SKETCH



LOCATION OF BM & TBM

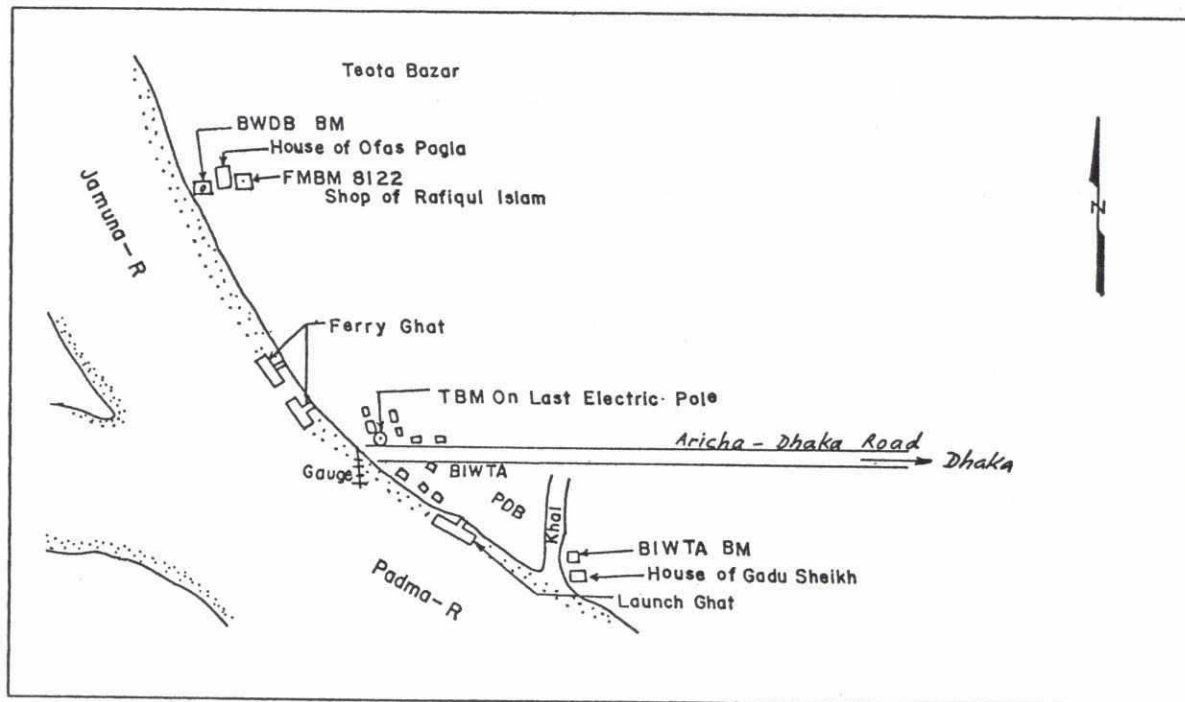


PROJECT : FAP 24 RIVER SURVEY PROJECT

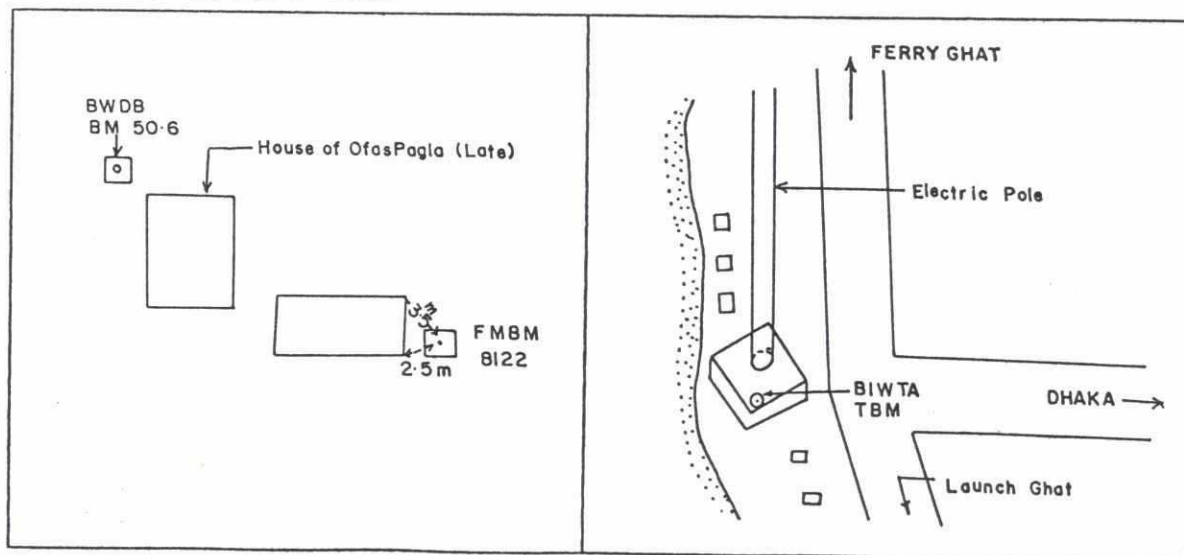
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 50.6 Teota

LOCATION SKETCH



LOCATION OF BM & TBM

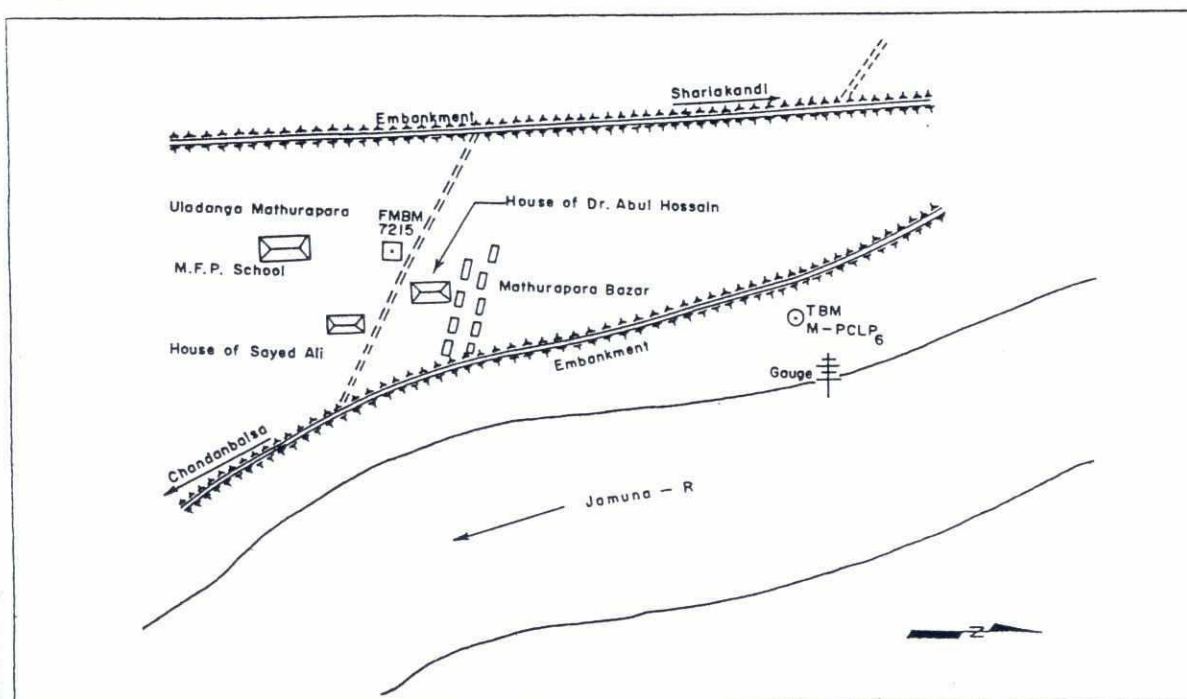


PROJECT : FAP 24 RIVER SURVEY PROJECT

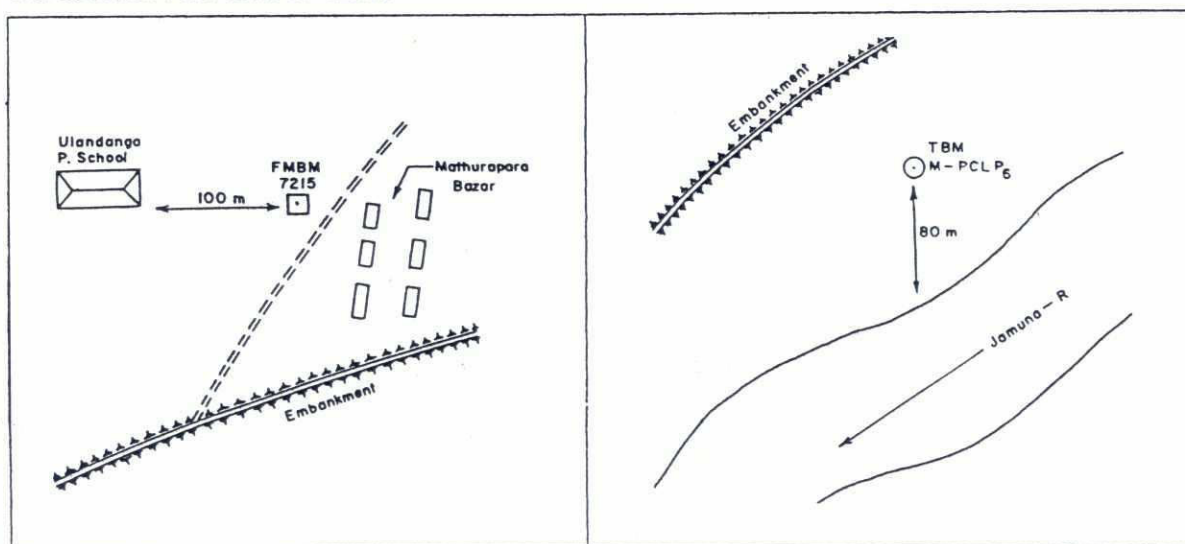
RIVER : Brahmaputra-Jamuna

GAUGE STATION : 15.J Mathurapara

LOCATION SKETCH



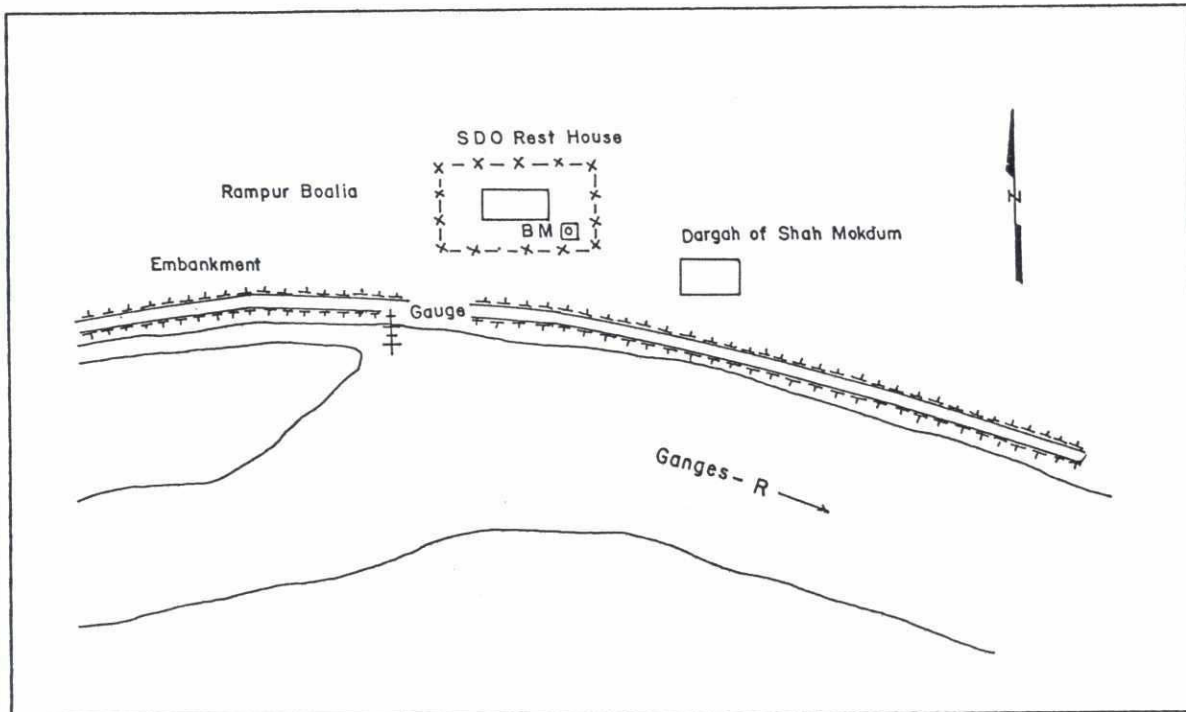
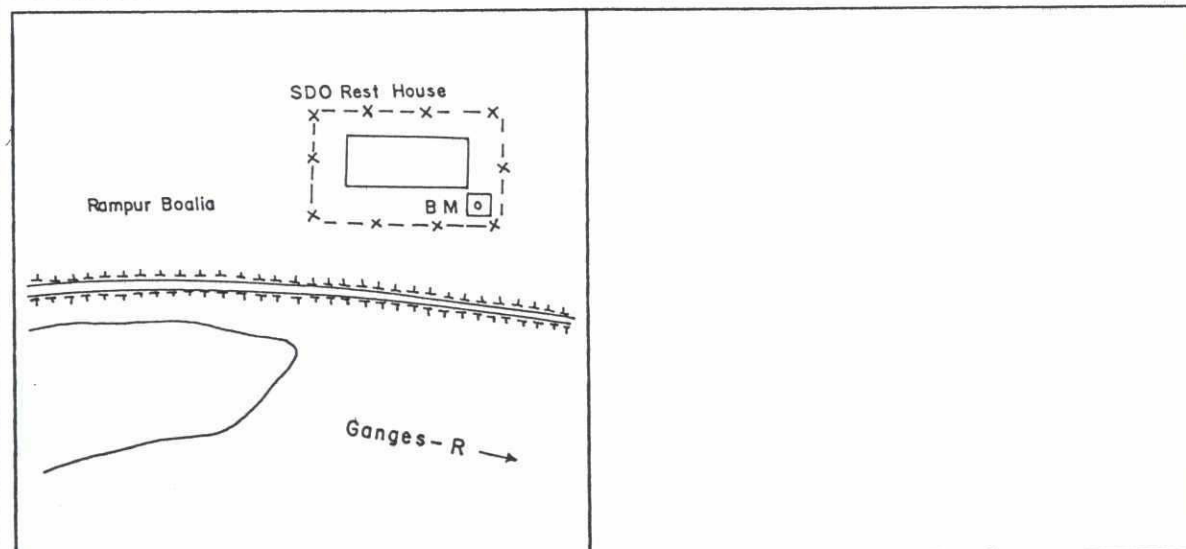
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Ganges

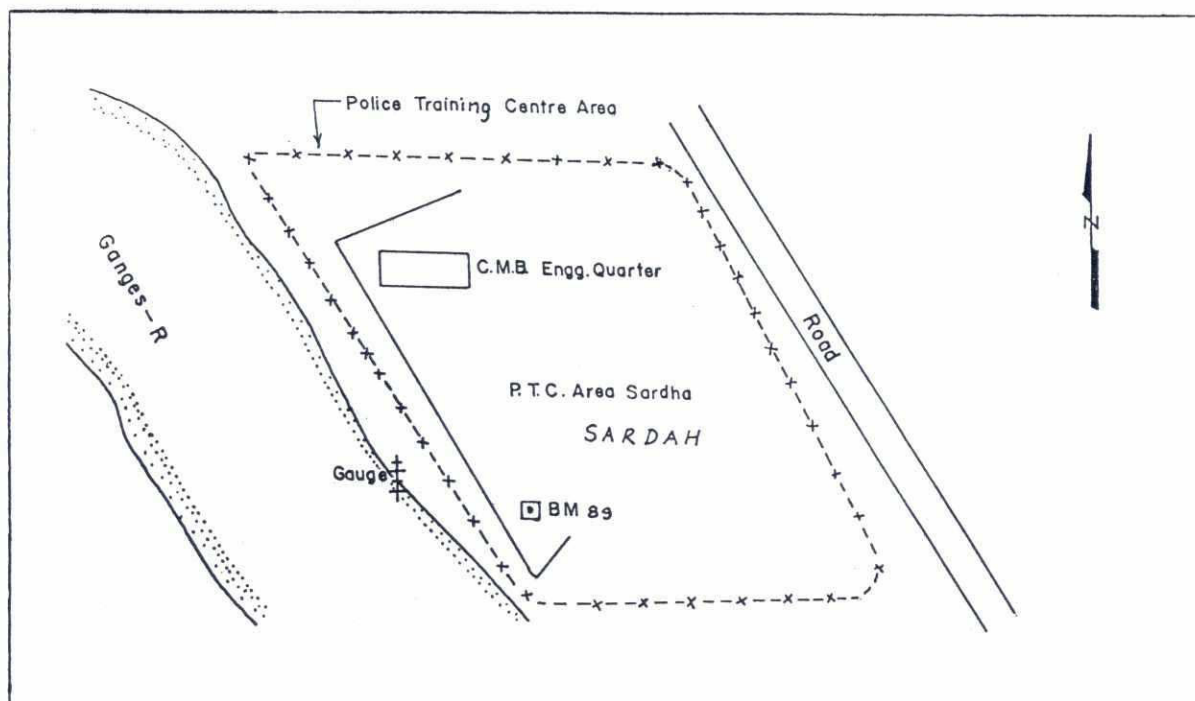
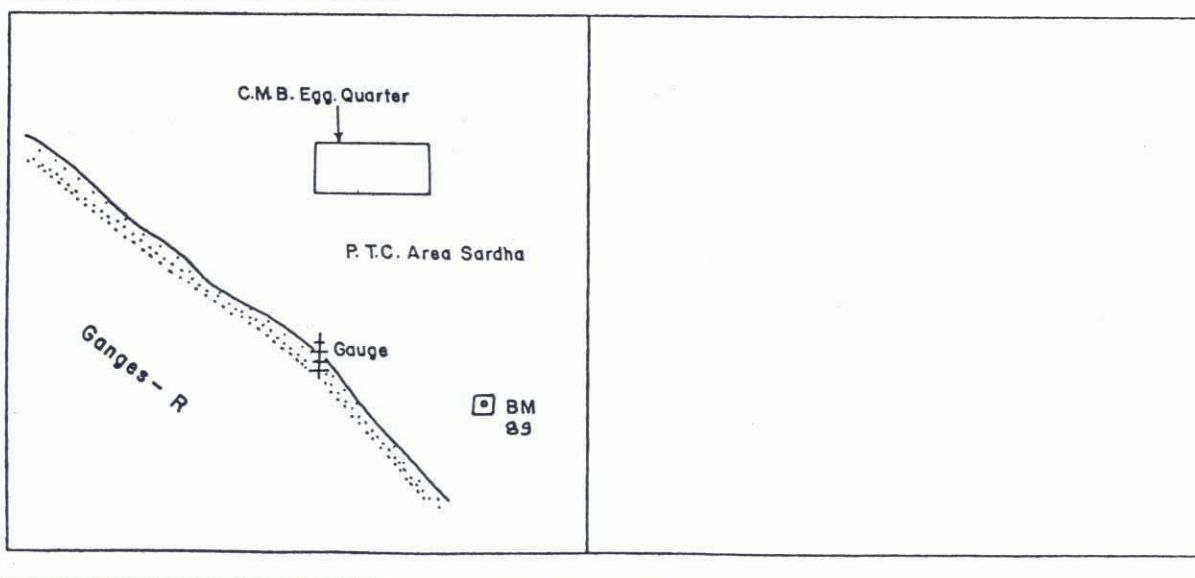
GAUGE STATION : 88 Rampur Boalia

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Ganges

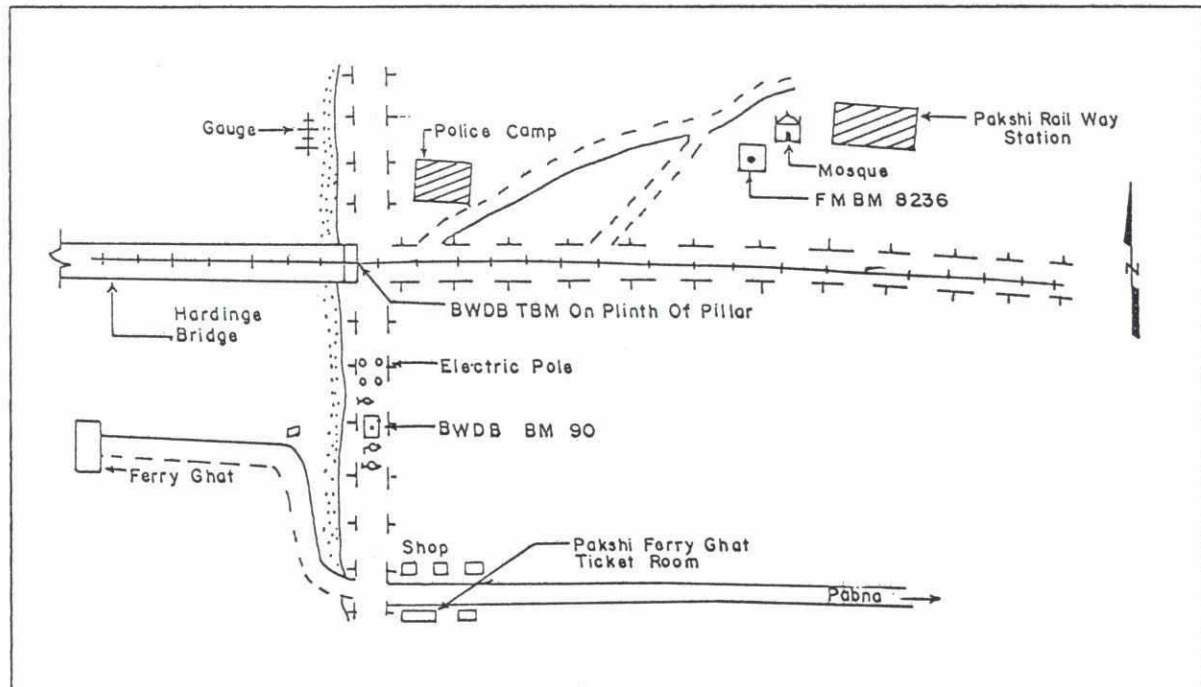
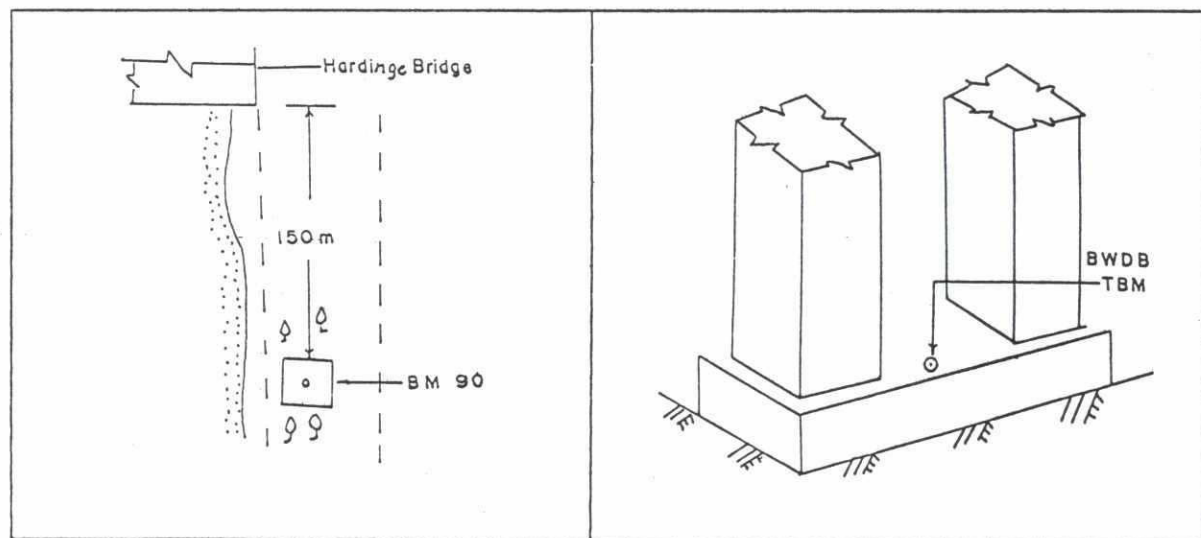
GAUGE STATION : 89 Sardah

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Ganges

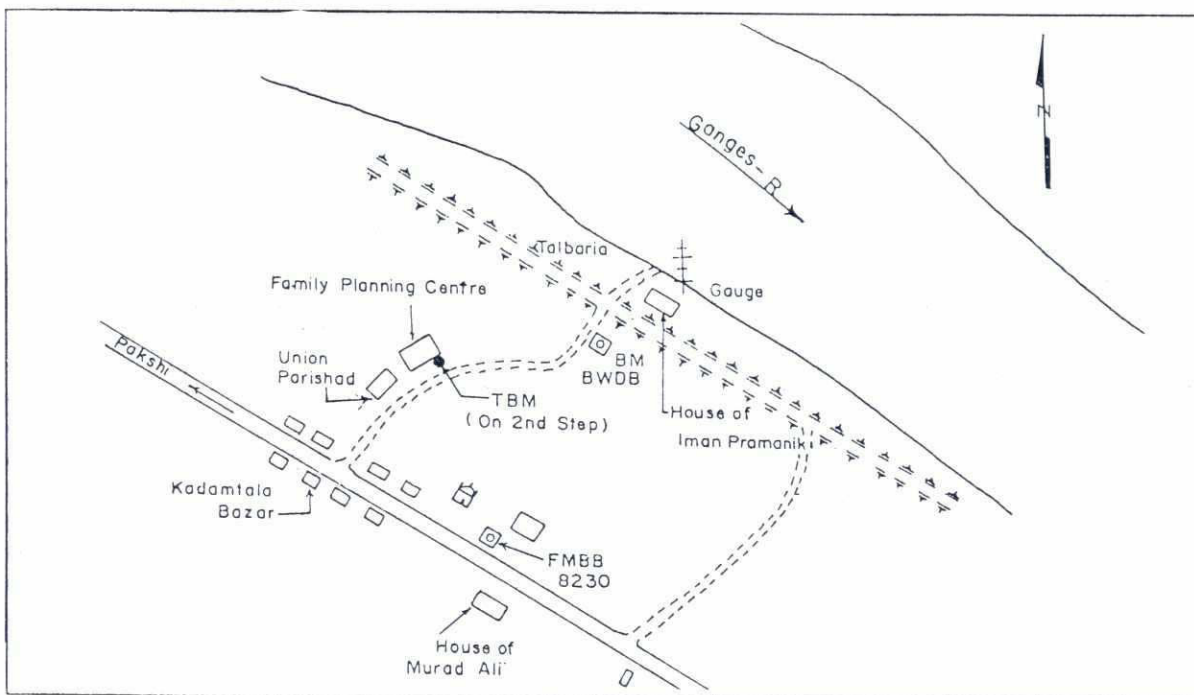
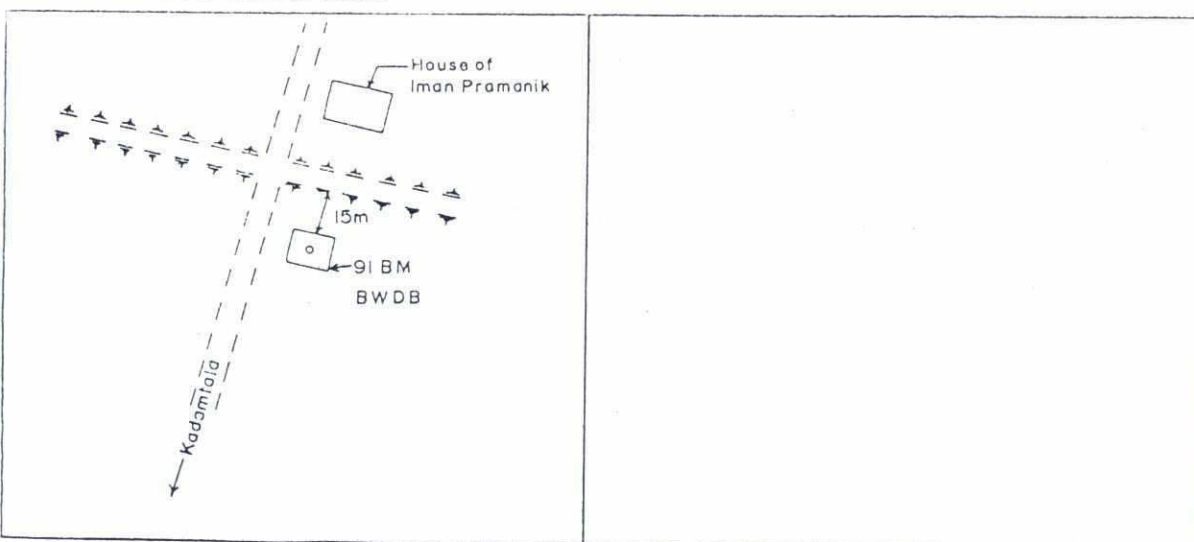
GAUGE STATION : 90 Hardinge Bridge

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Ganges

GAUGE STATION : 91 Talbaria

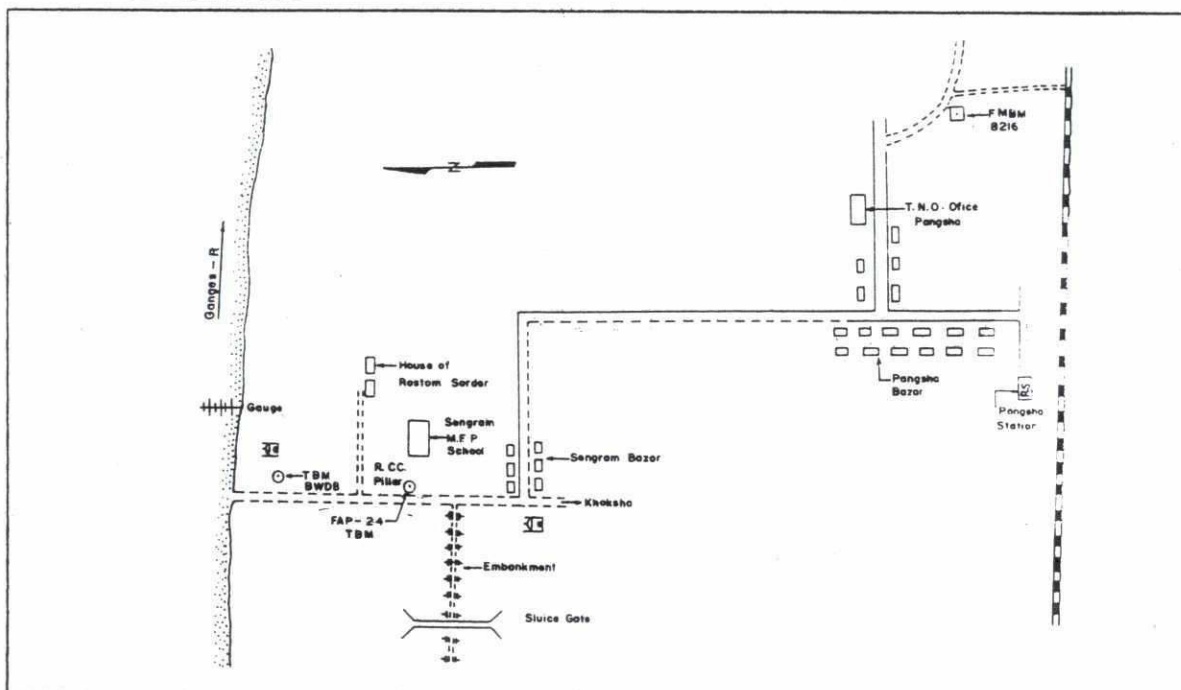
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

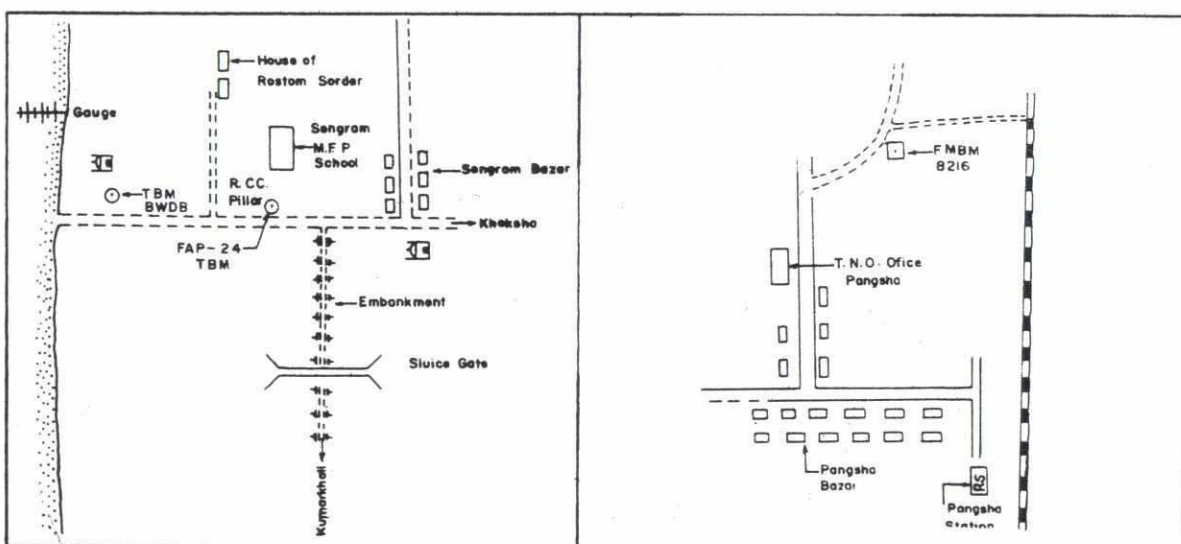
RIVER : Ganges

GAUGE STATION : 91.1 Sengram

LOCATION SKETCH



LOCATION OF BM & TBM

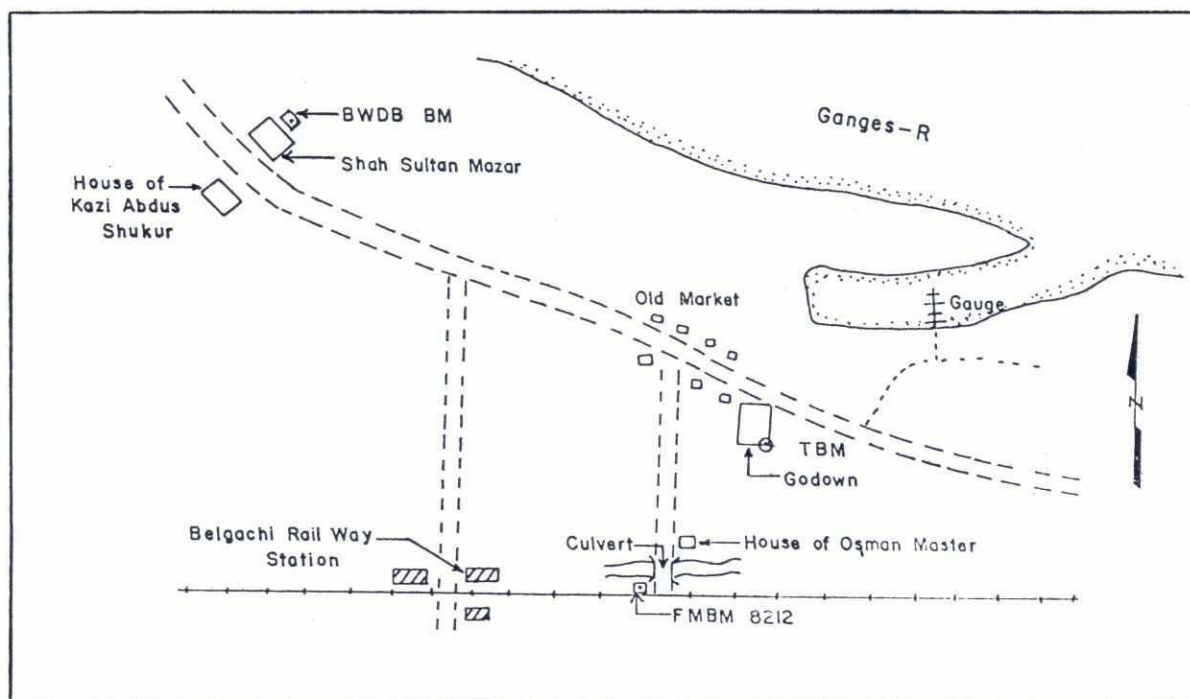


PROJECT : FAP 24 RIVER SURVEY PROJECT

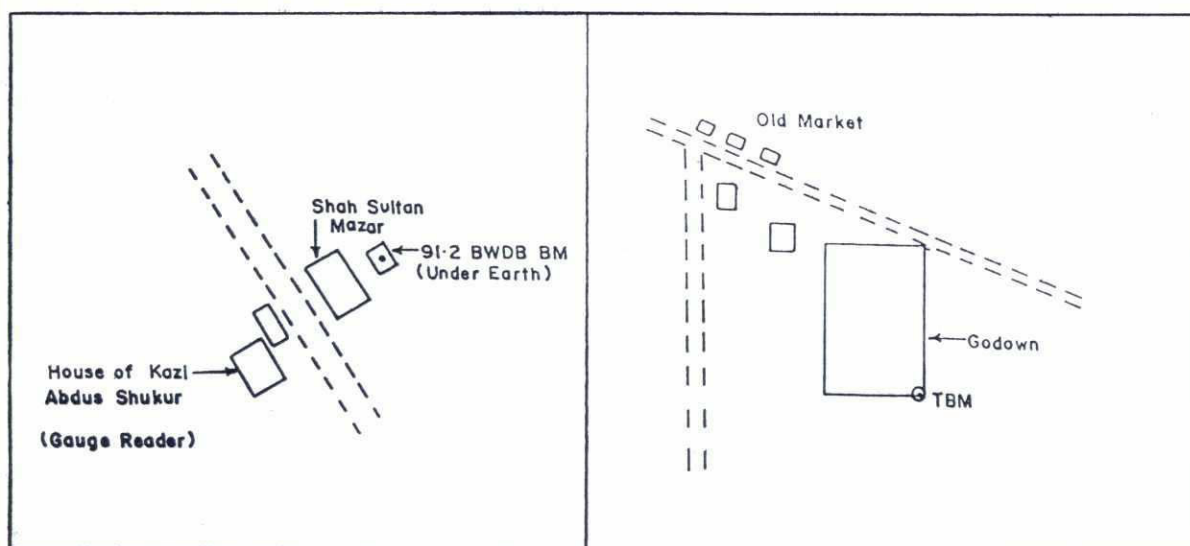
RIVER : Ganges

GAUGE STATION : 91.2 Mahendrapur

LOCATION SKETCH



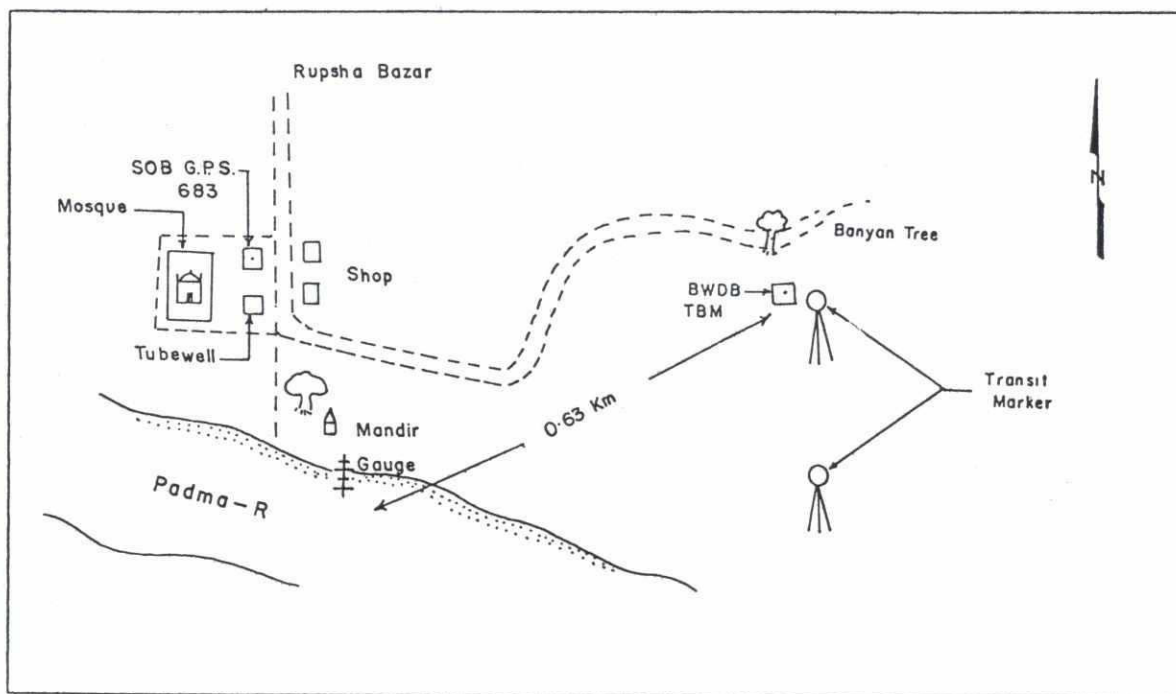
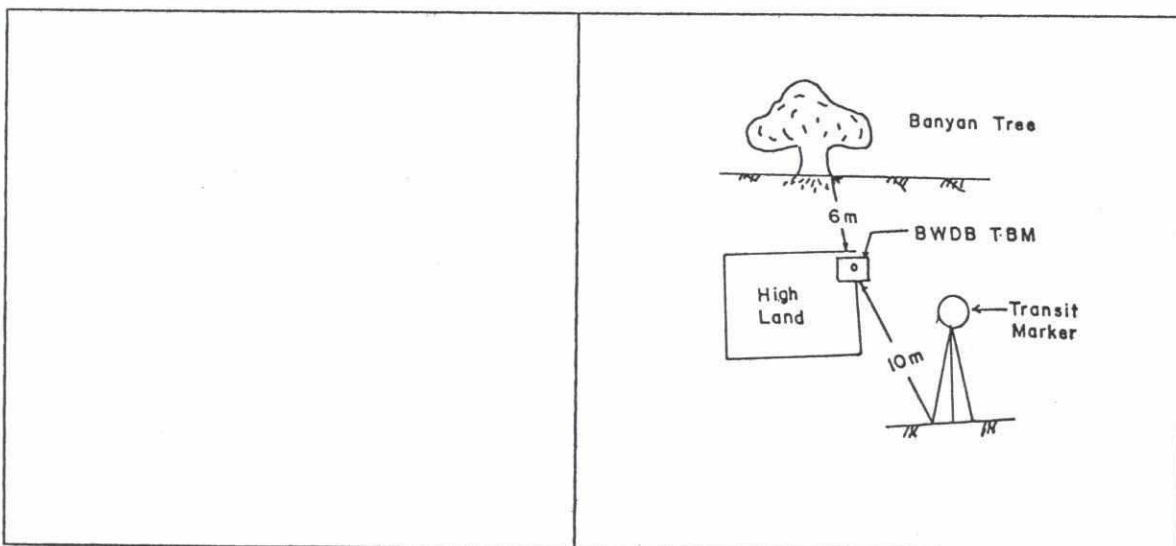
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Padma

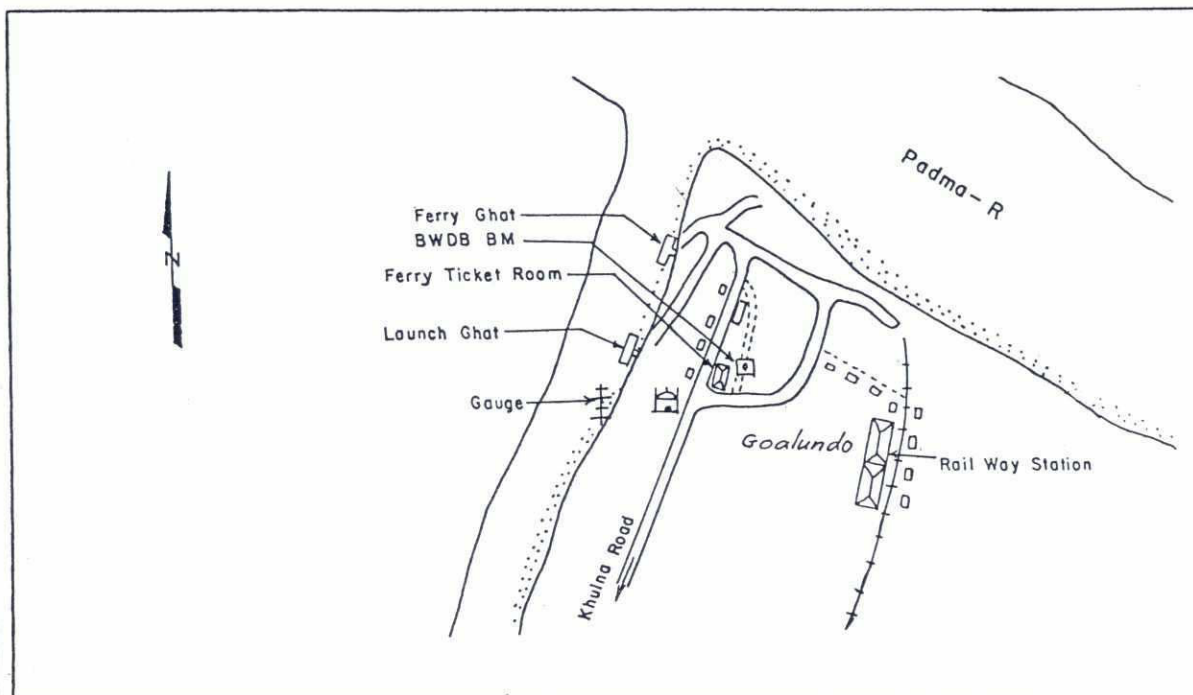
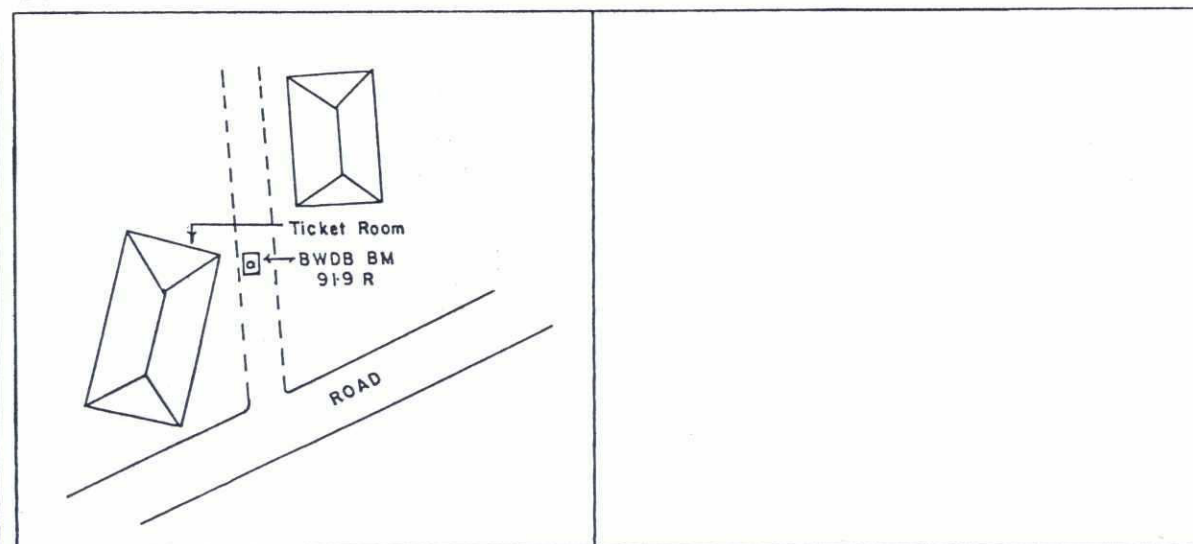
GAUGE STATION : 91.9L Baruria

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Padma

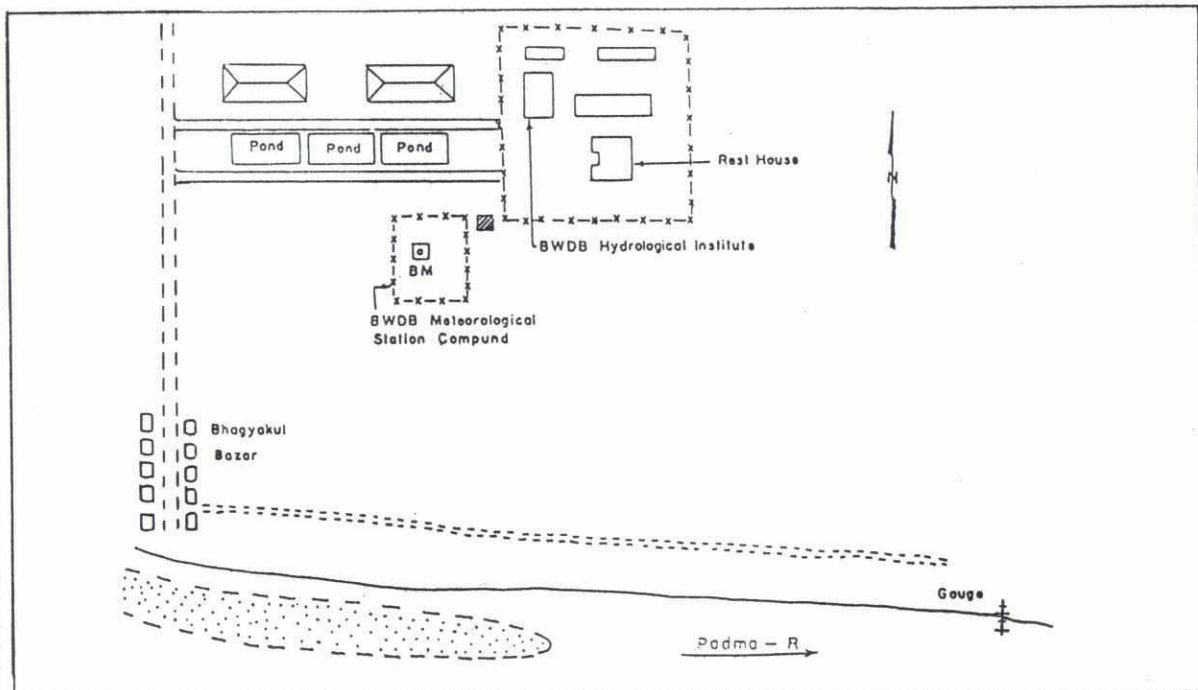
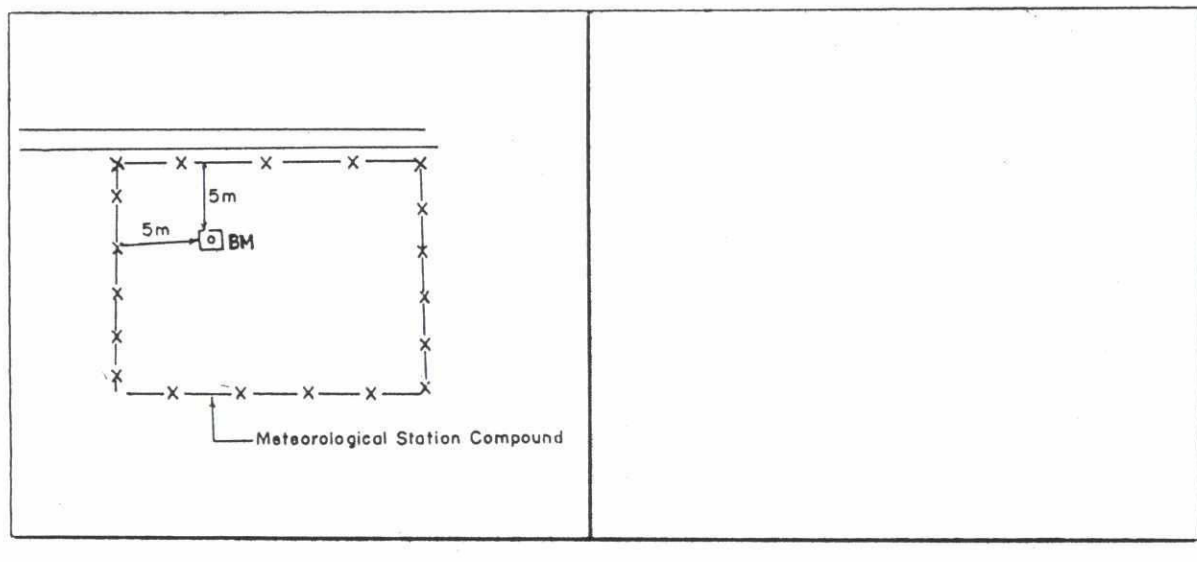
GAUGE STATION : 91.9R Goalunda

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Padma

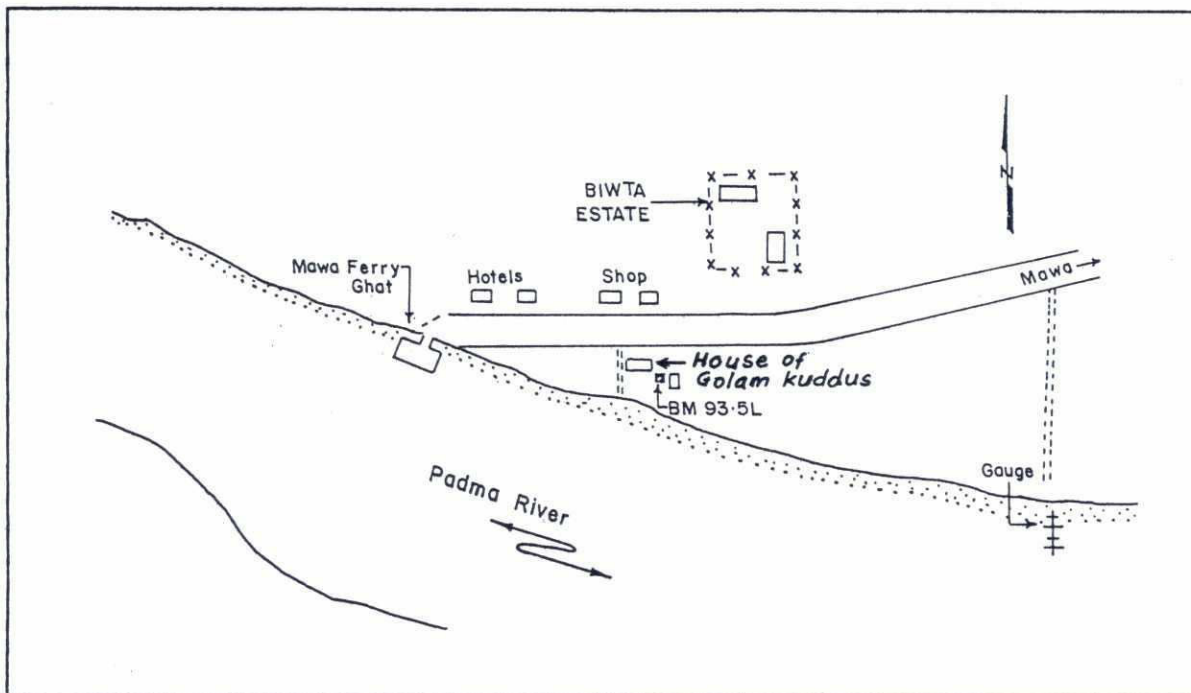
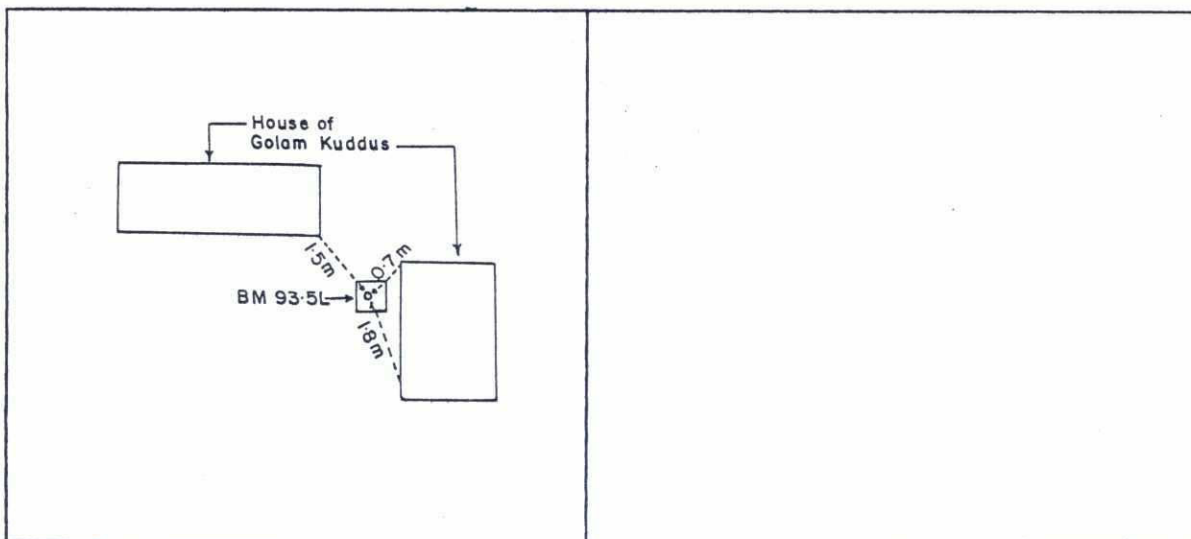
GAUGE STATION : 93.4L Bhagyakul

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Padma

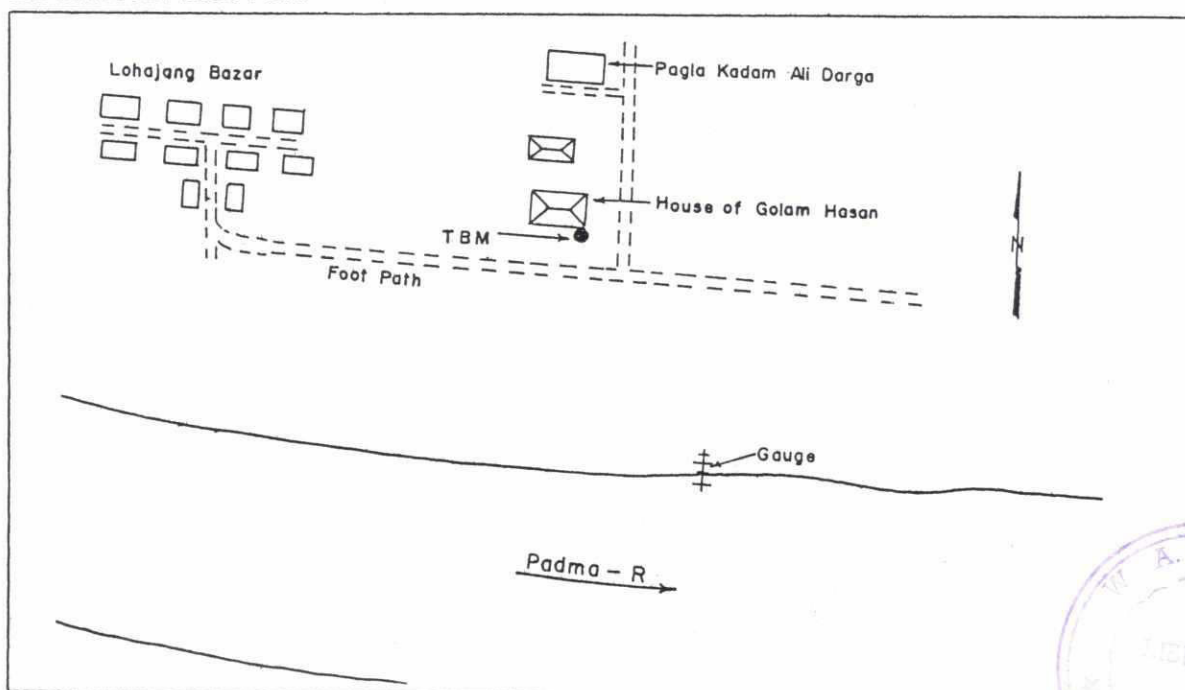
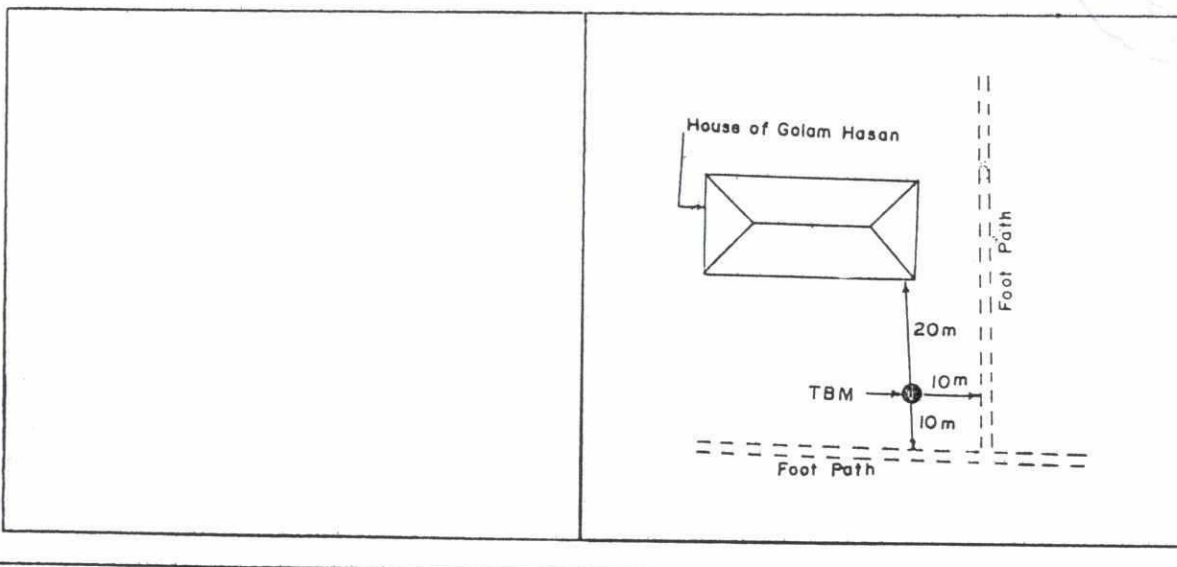
GAUGE STATION : 93.5L Mawa

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Padma

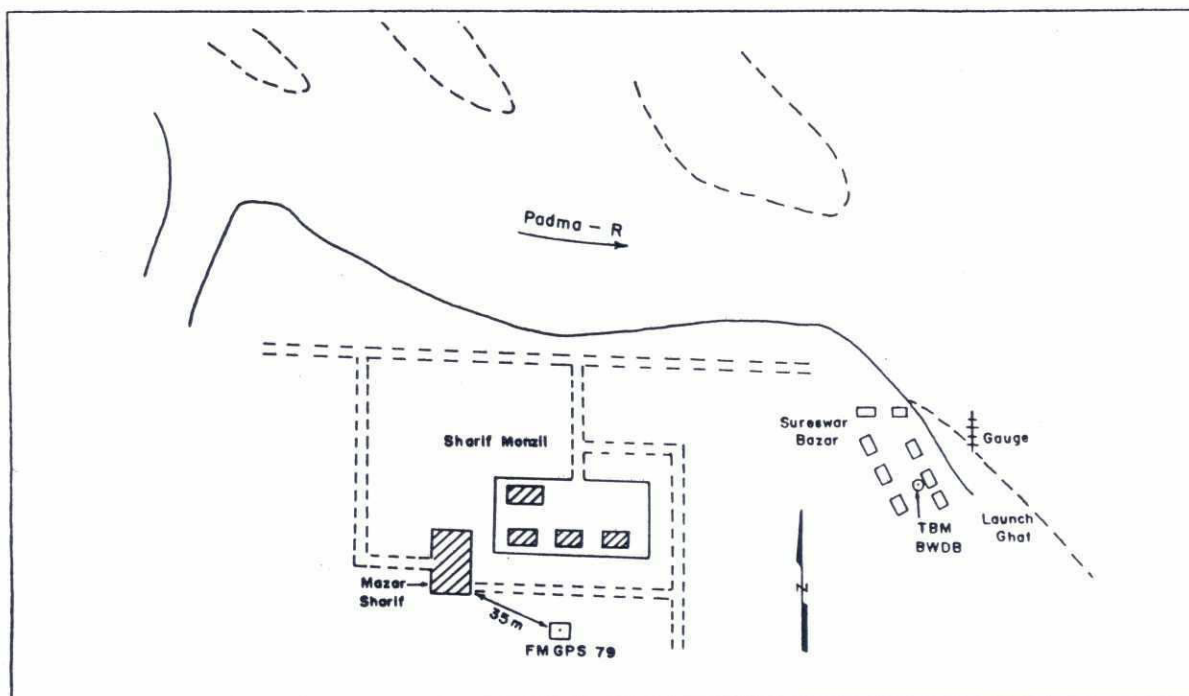
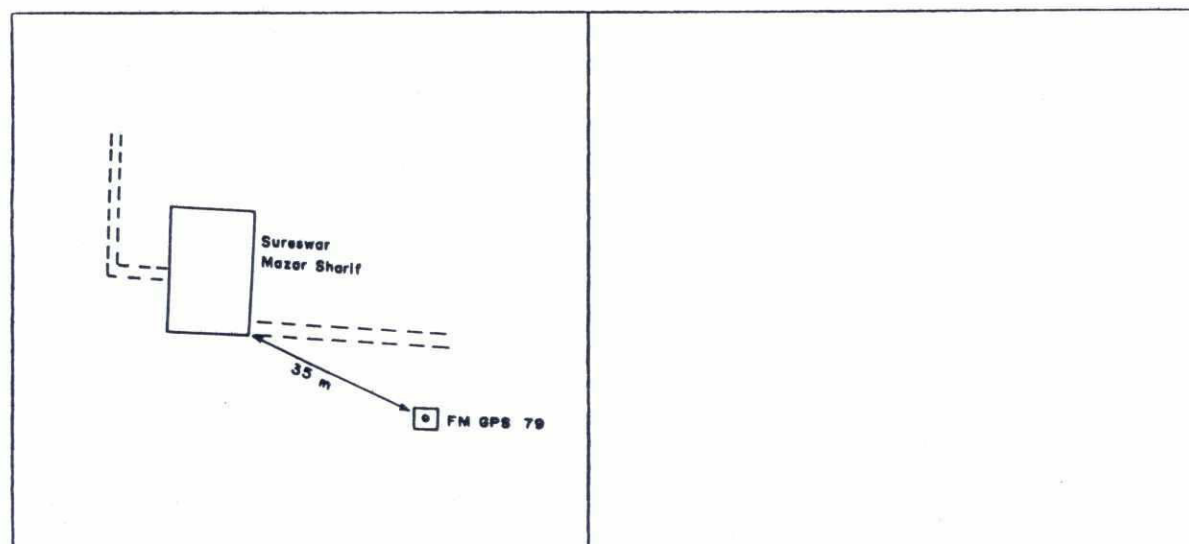
GAUGE STATION : 94 Tarpasha

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Padma

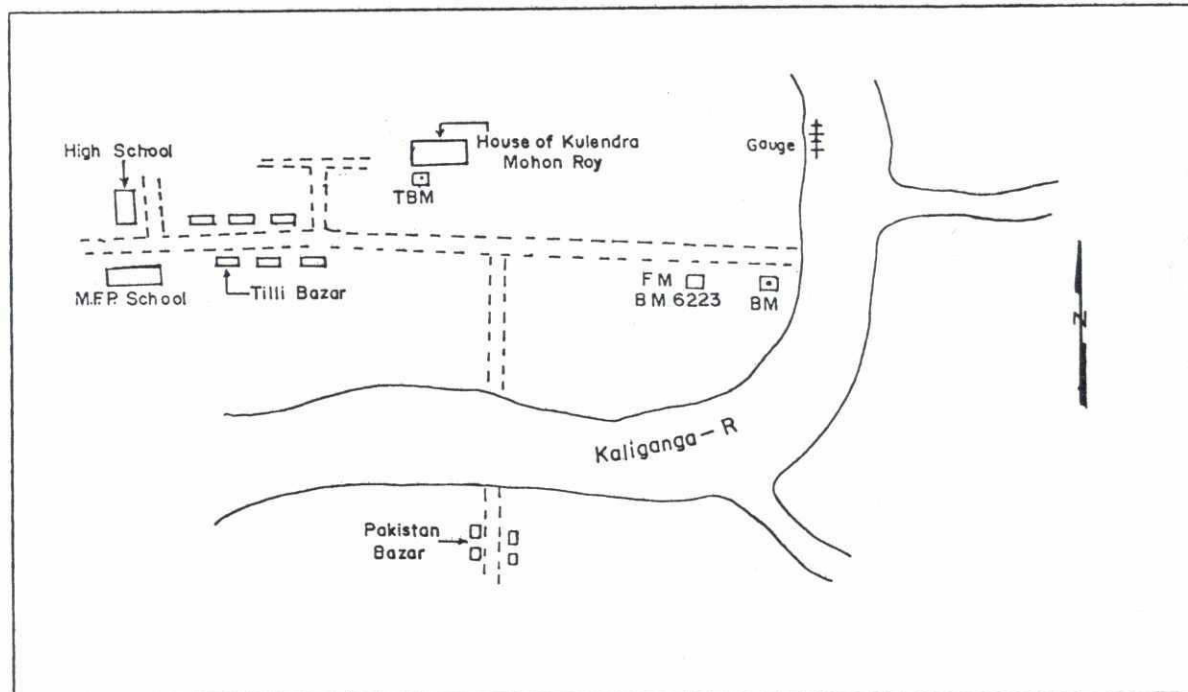
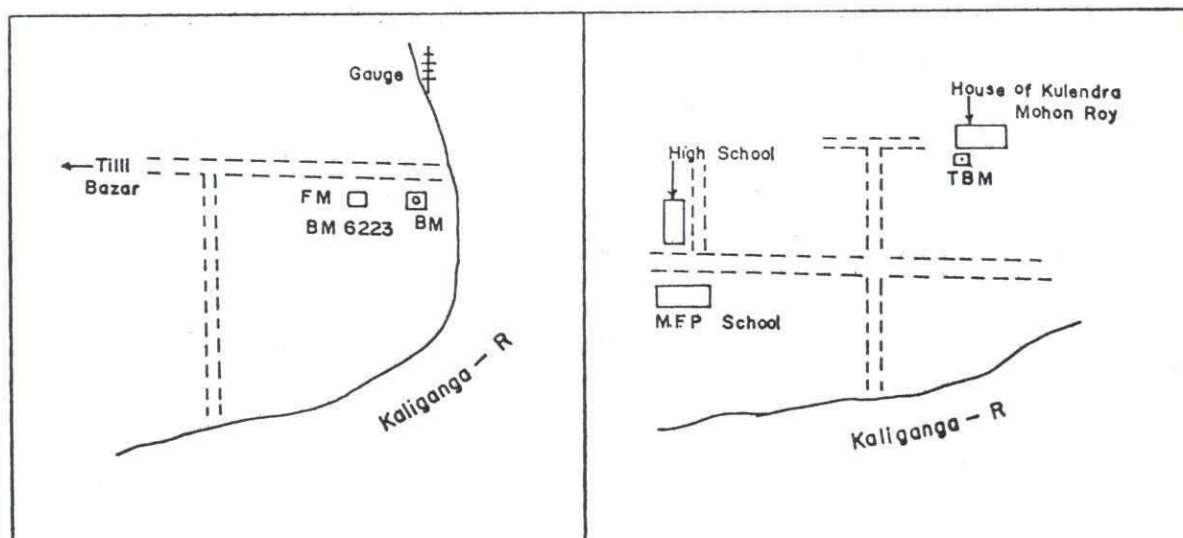
GAUGE STATION : 95 Sureswar

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Dhaleswari

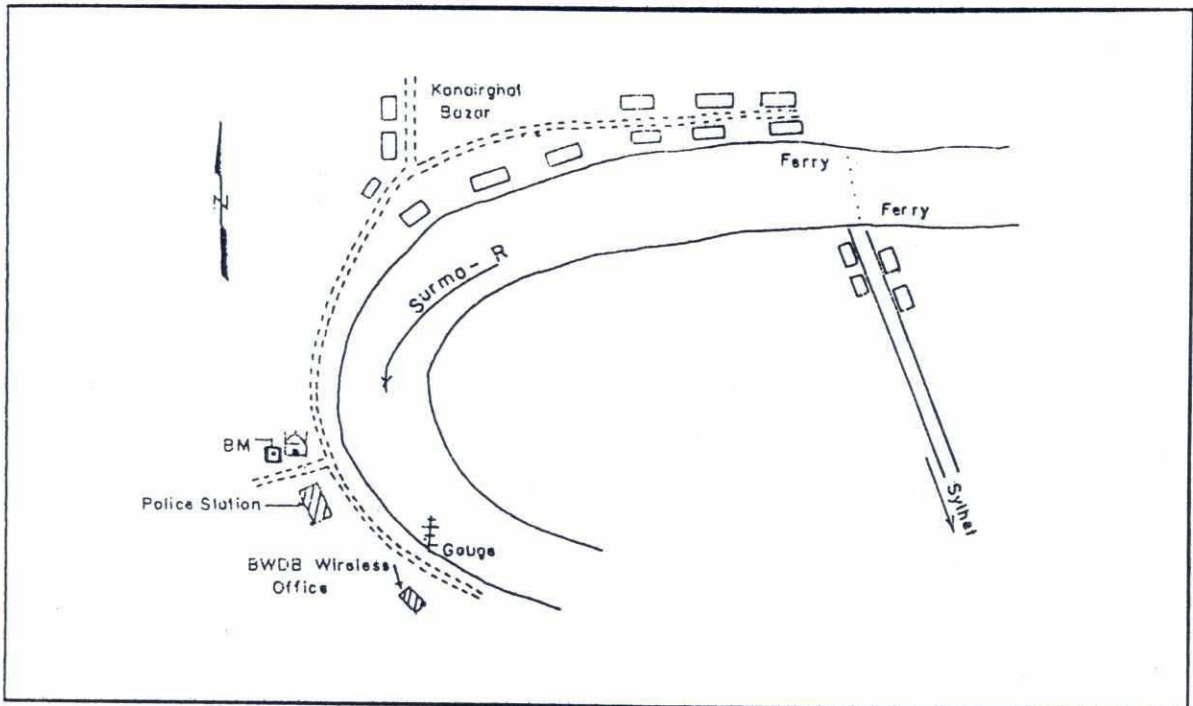
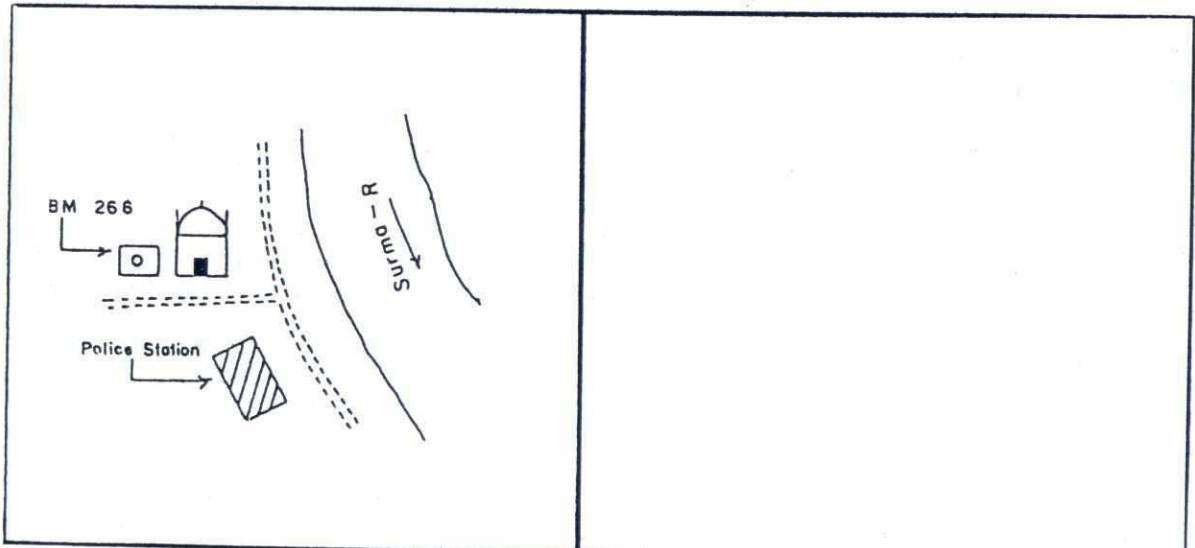
GAUGE STATION : 68 Tilli

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Surma

GAUGE STATION : 266 Kanairghat

LOCATION SKETCH**LOCATION OF BM & TBM**

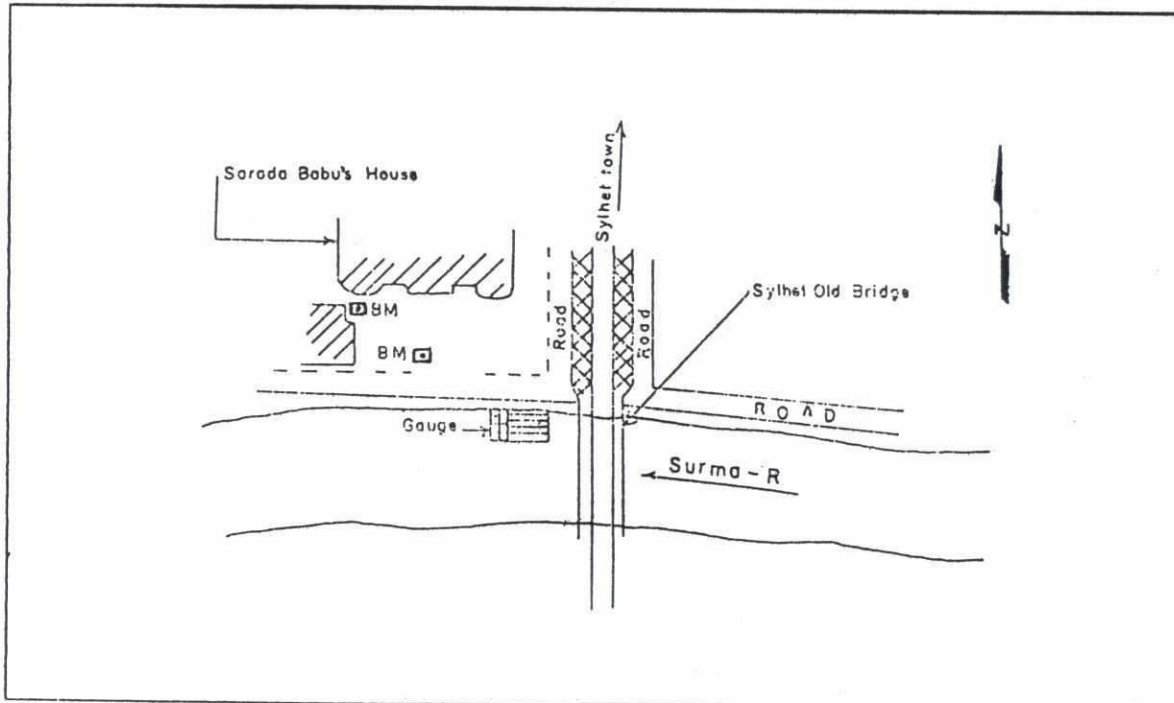


PROJECT : FAP 24 RIVER SURVEY PROJECT

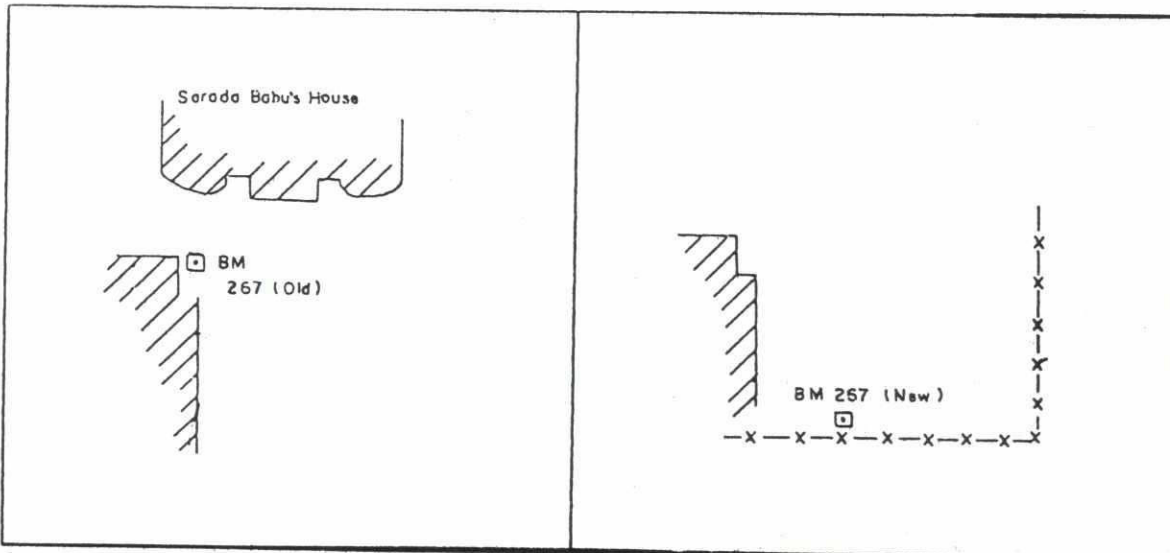
RIVER : Surma

GAUGE STATION : 267 Sylhet

LOCATION SKETCH



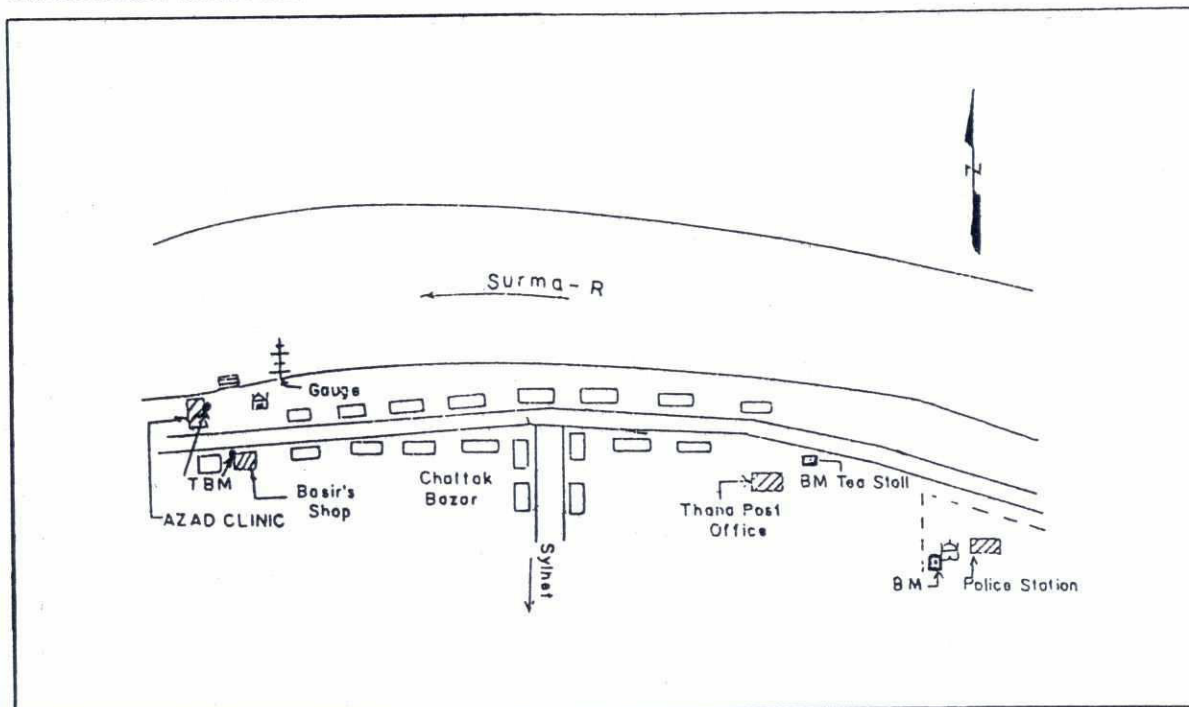
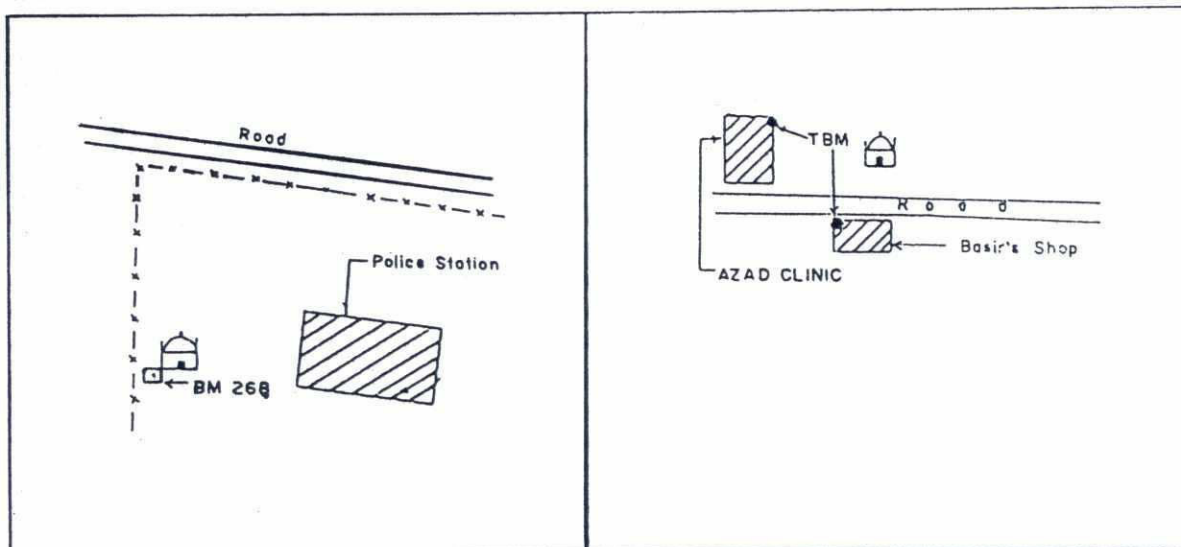
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Surma

GAUGE STATION : 268 Chattak

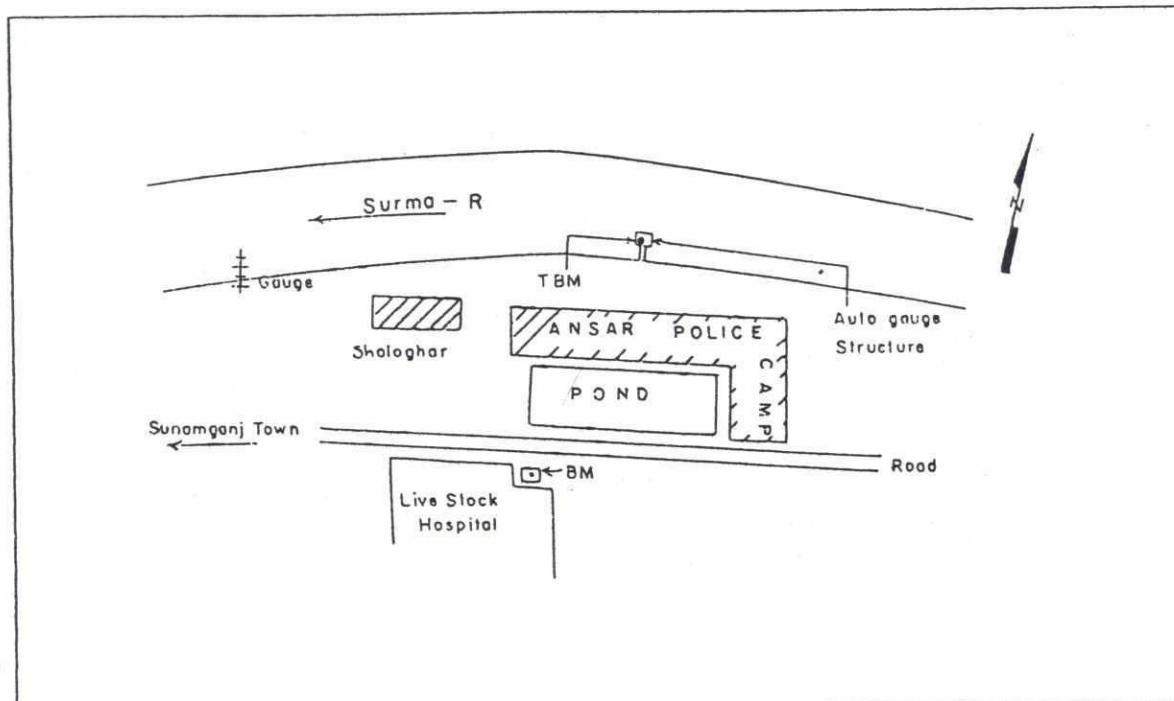
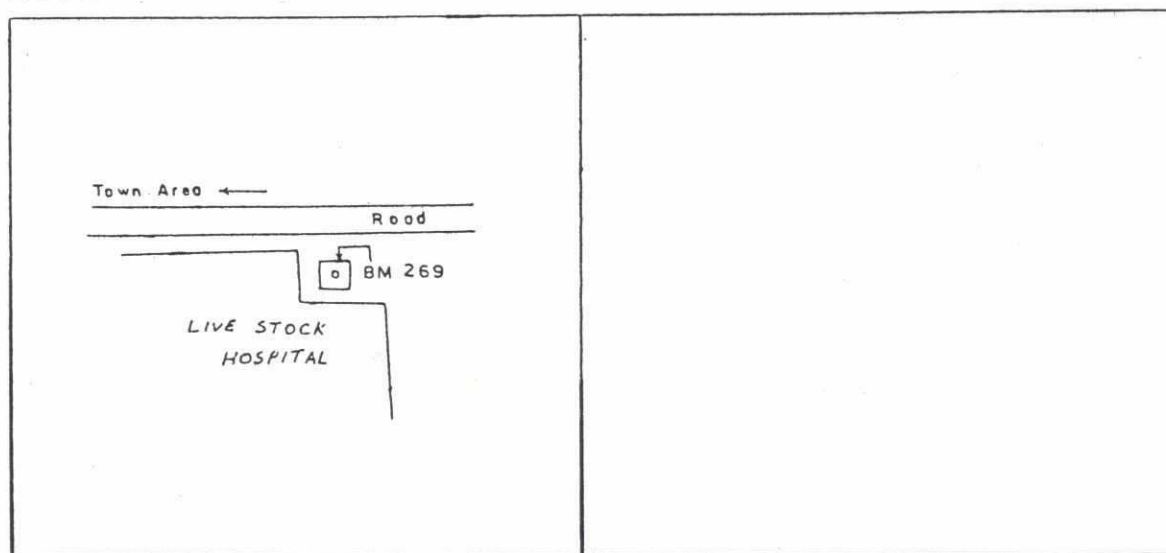
LOCATION SKETCH**LOCATION OF BM & TBM**

86

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Surma

GAUGE STATION : 269 Sunamganj

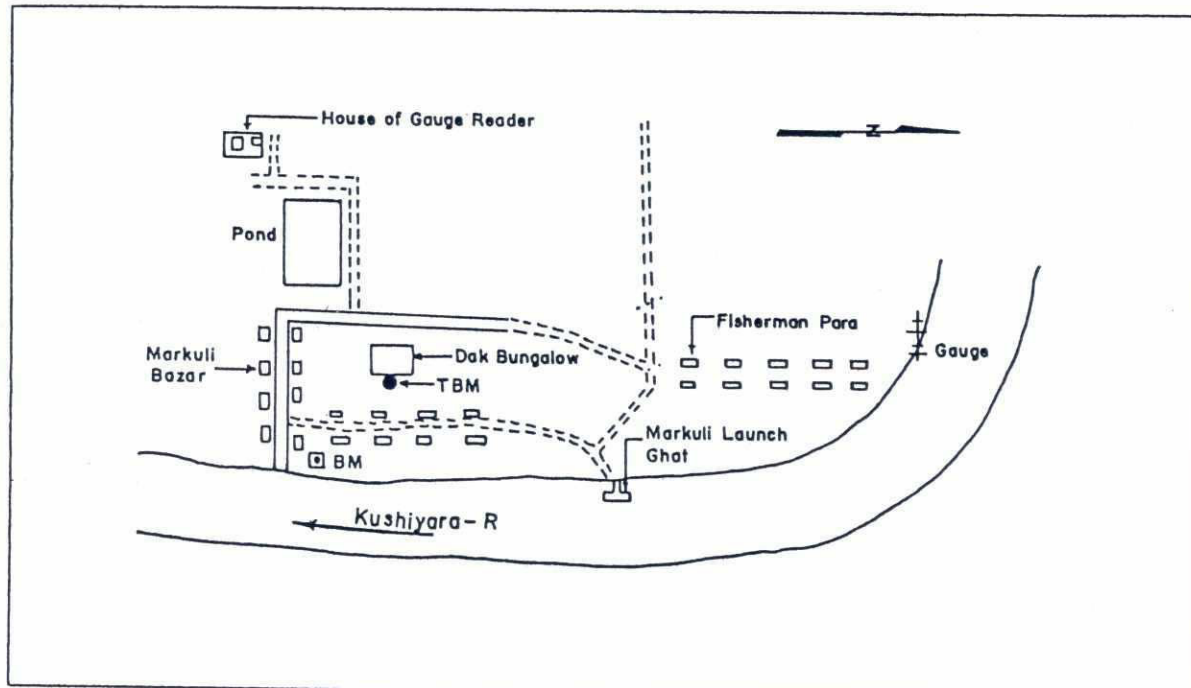
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

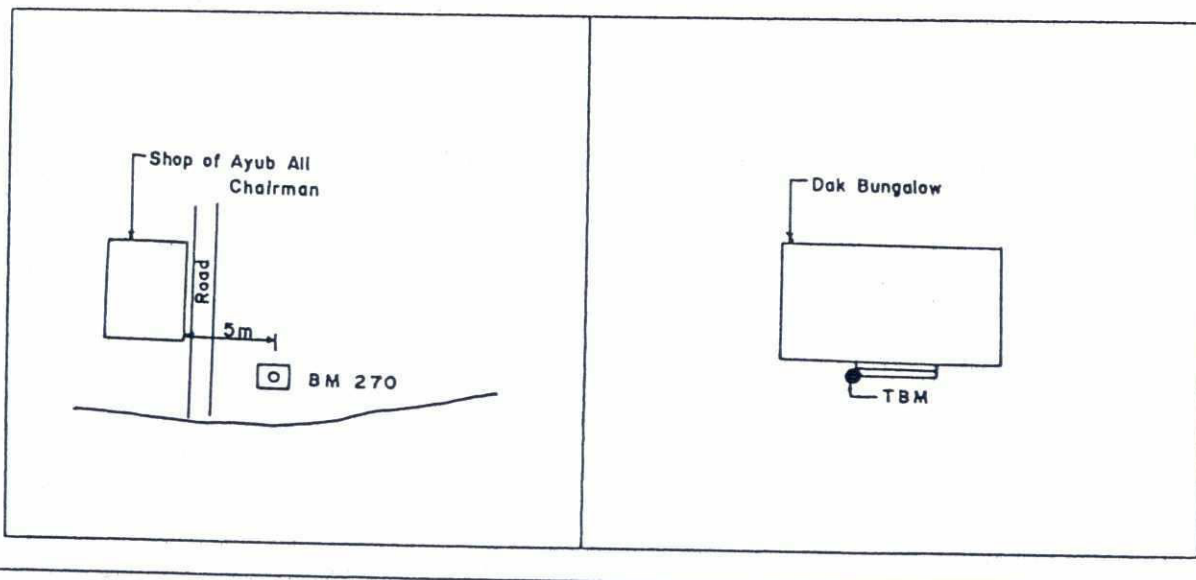
RIVER : Kushiya

GAUGE STATION : 270 Markuli

LOCATION SKETCH



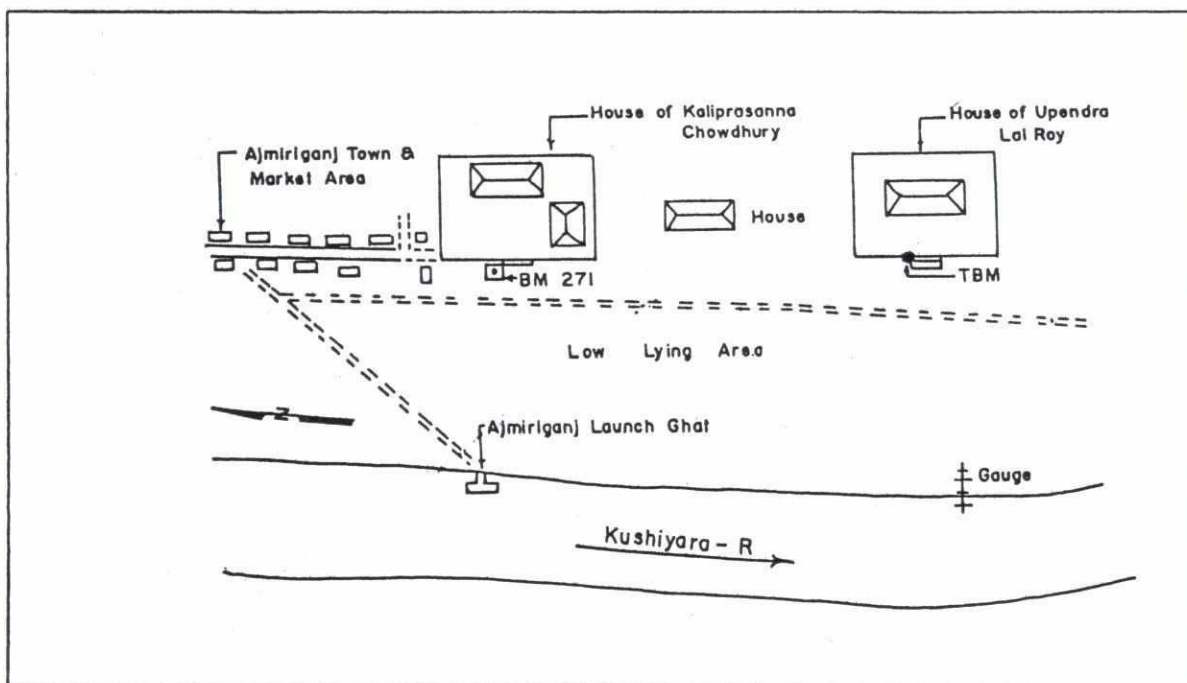
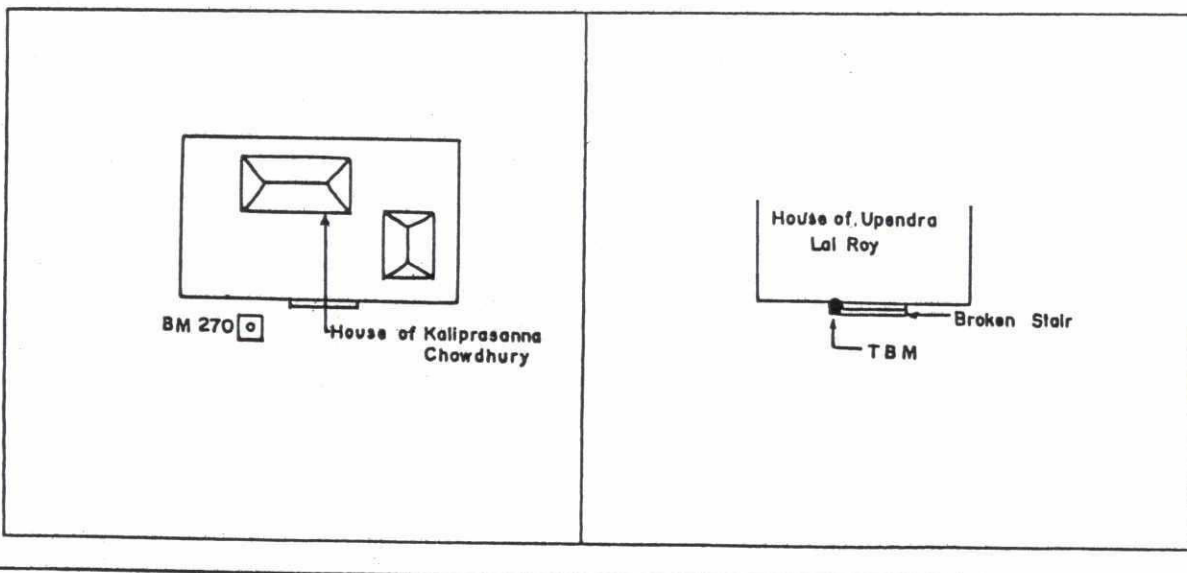
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Kushiya

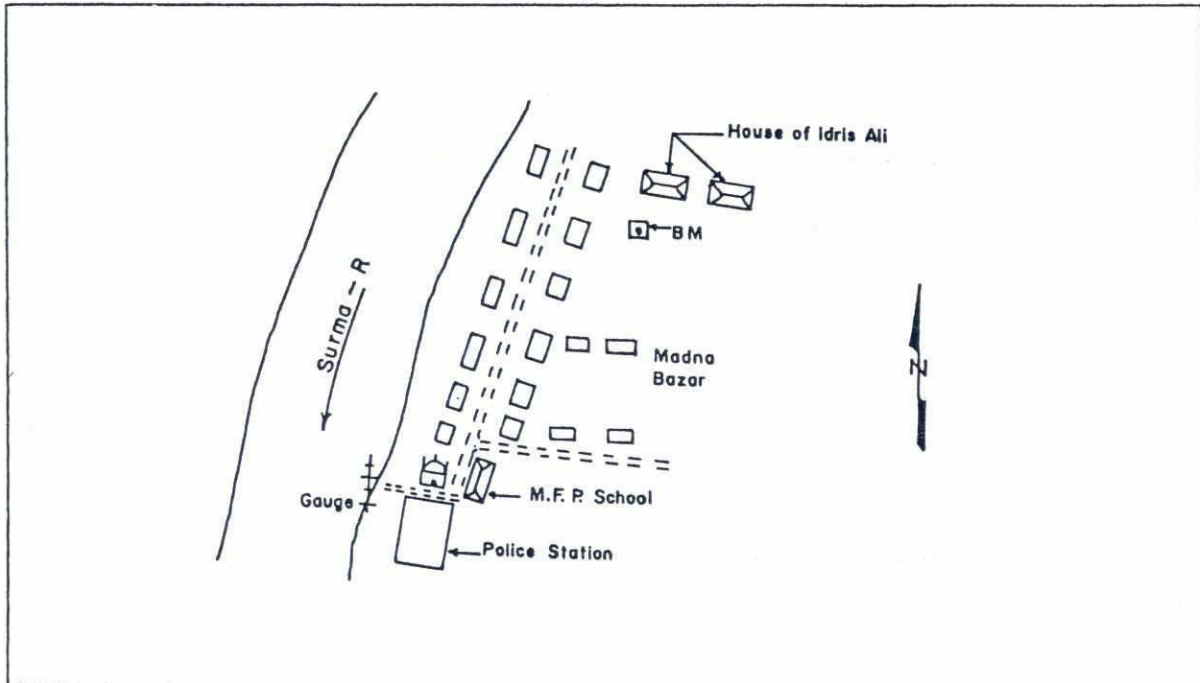
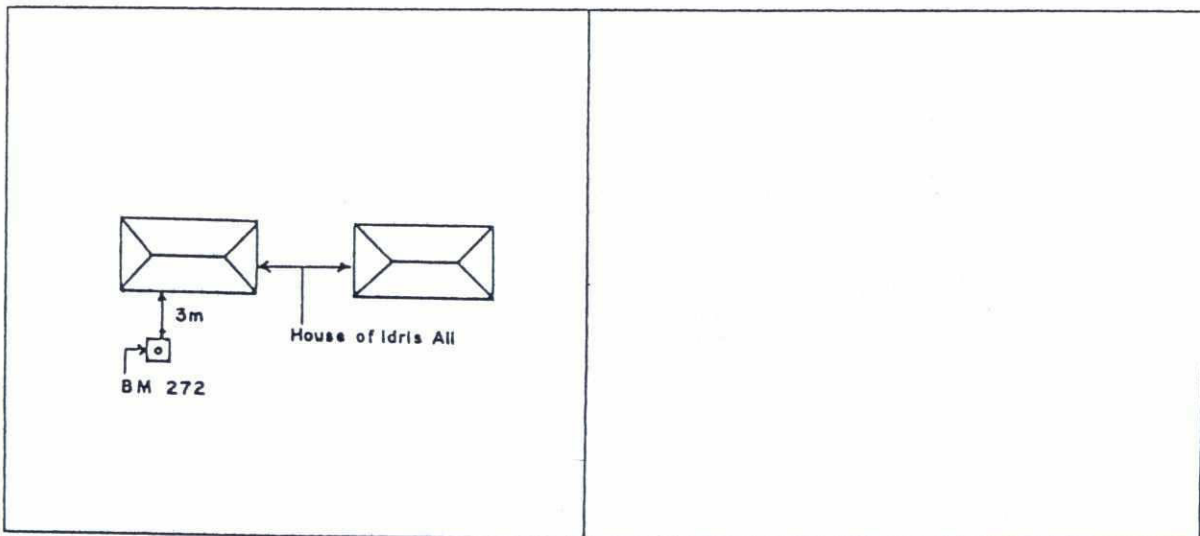
GAUGE STATION : 271 Ajmiriganj

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

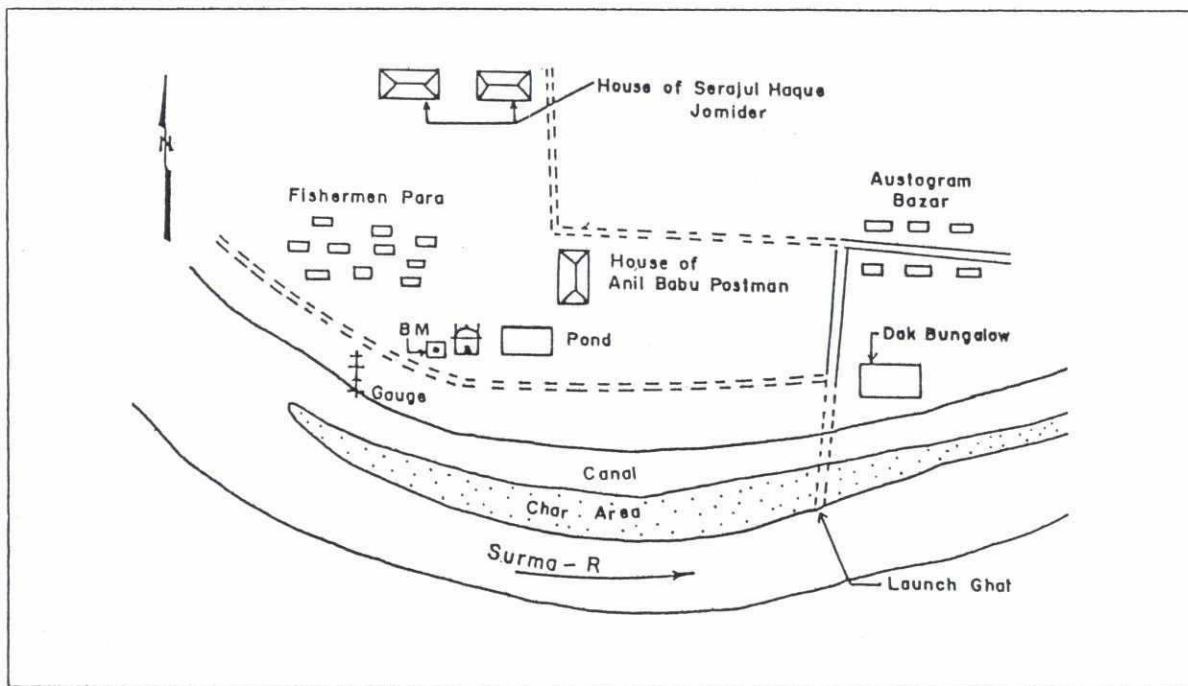
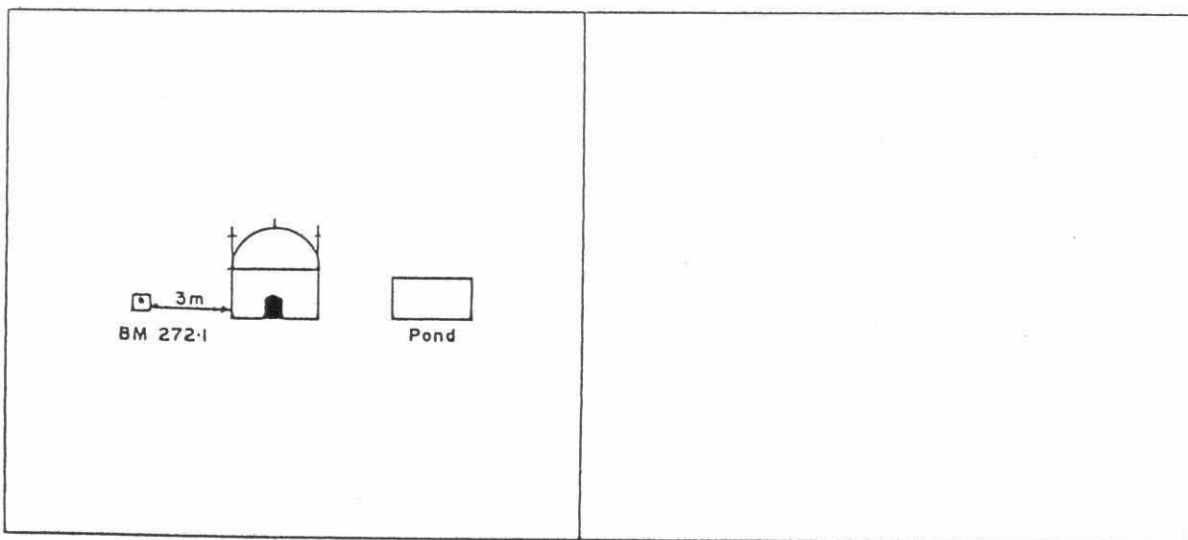
GAUGE STATION : 272 Madna

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

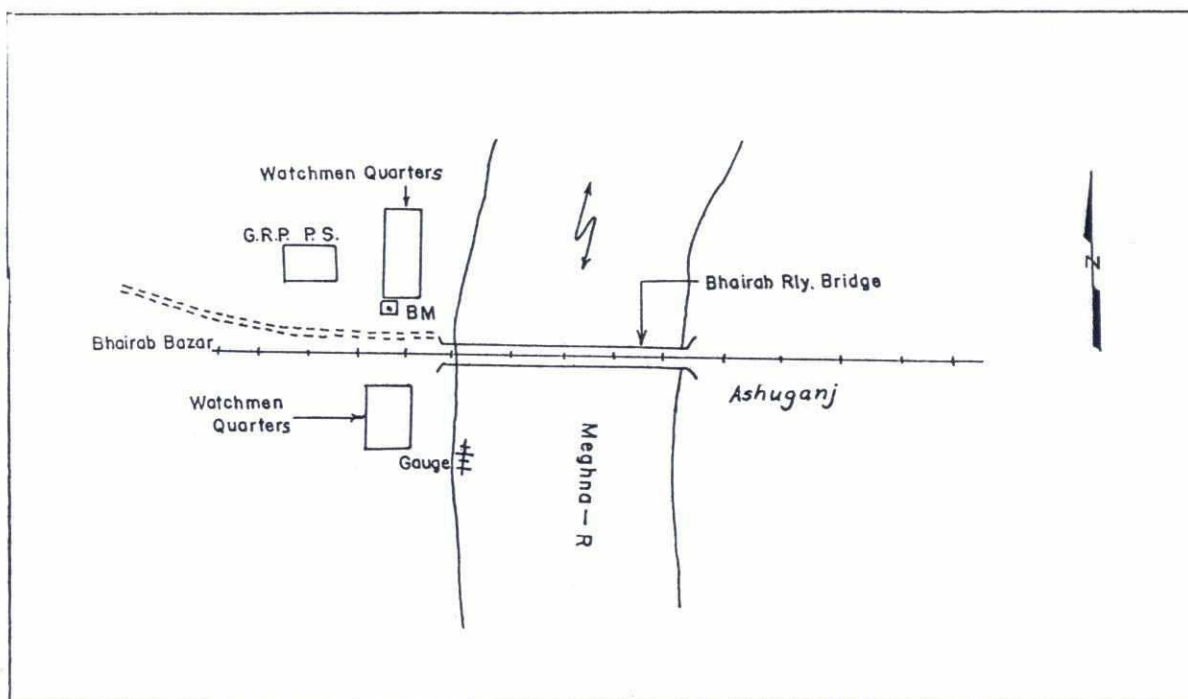
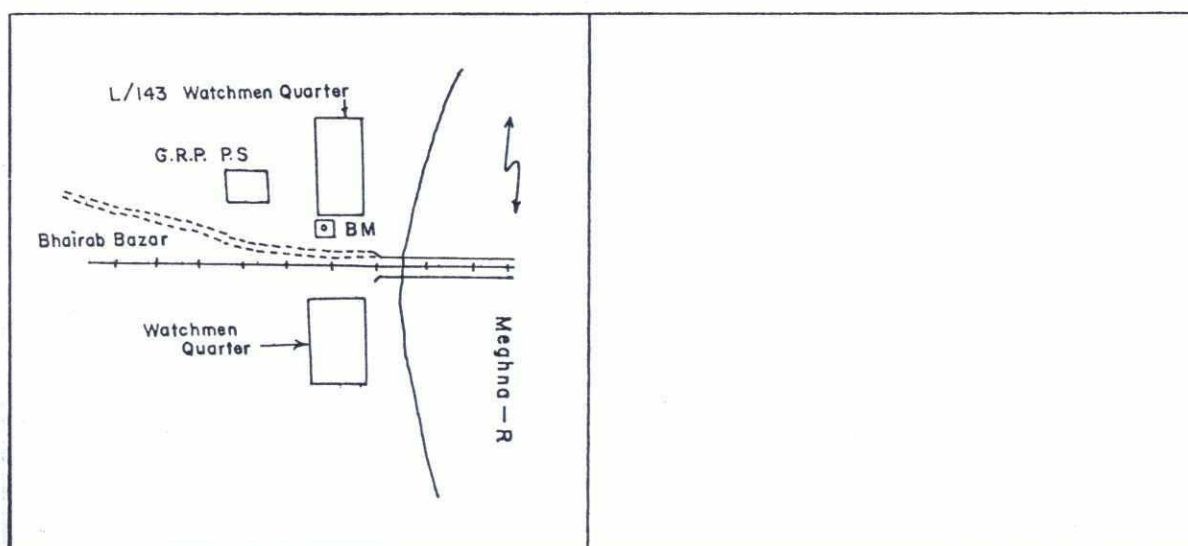
GAUGE STATION : 272.1 Austagram

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

GAUGE STATION : 273 Bhairab Bazar

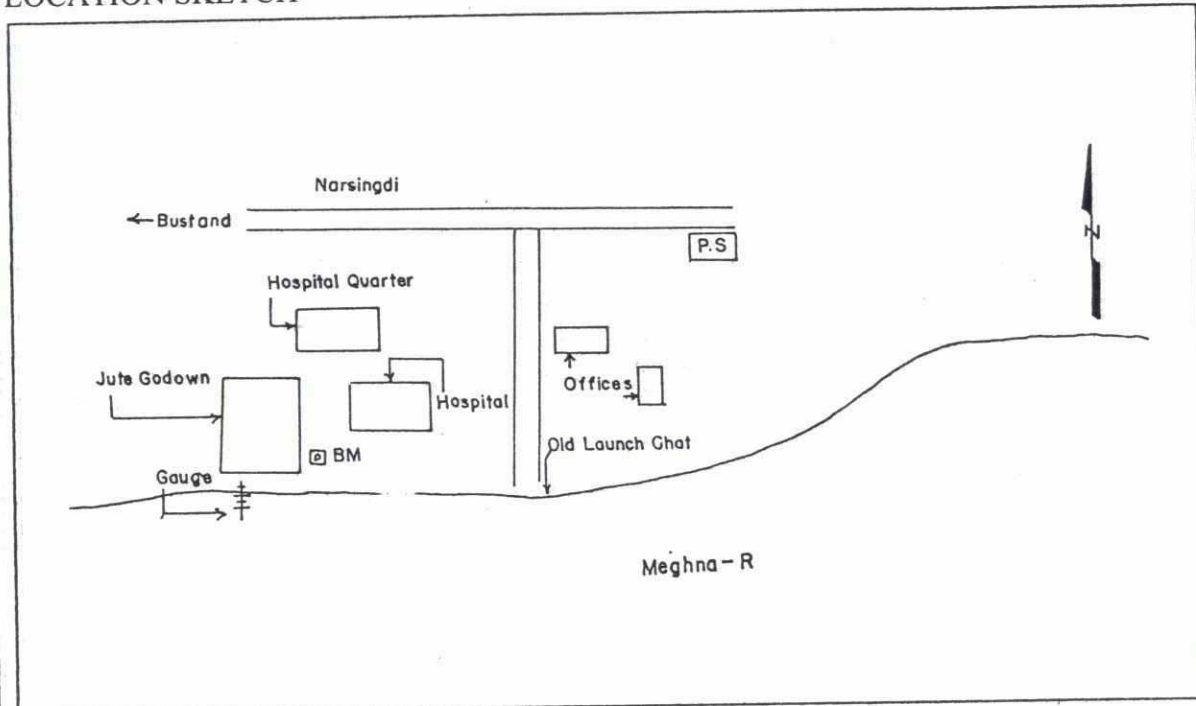
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

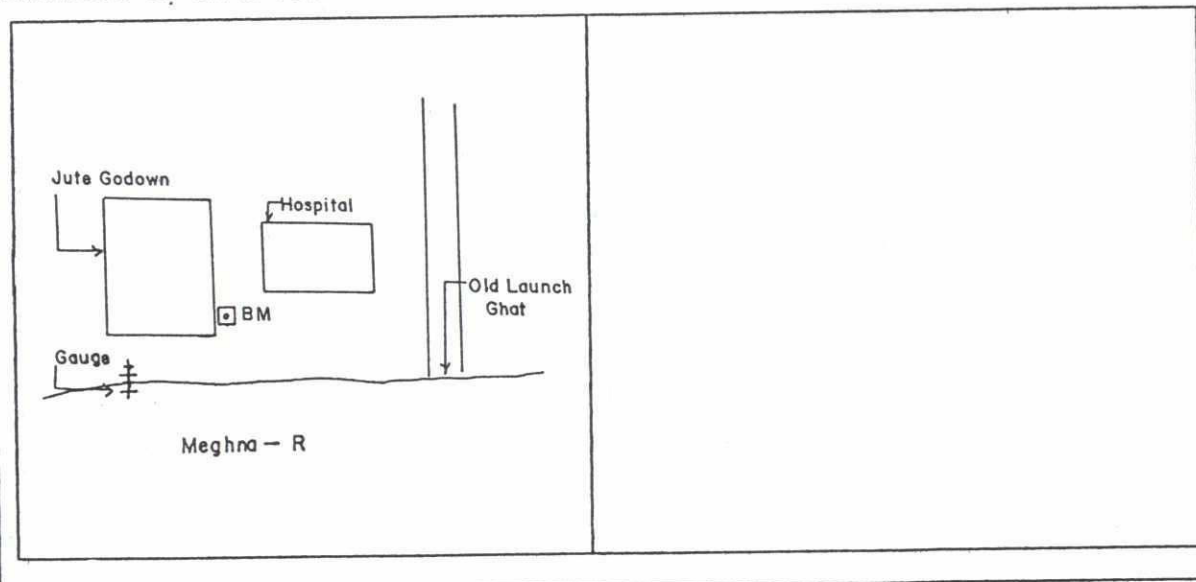
RIVER : Upper Meghna

GAUGE STATION : 274 Narsingdi

LOCATION SKETCH



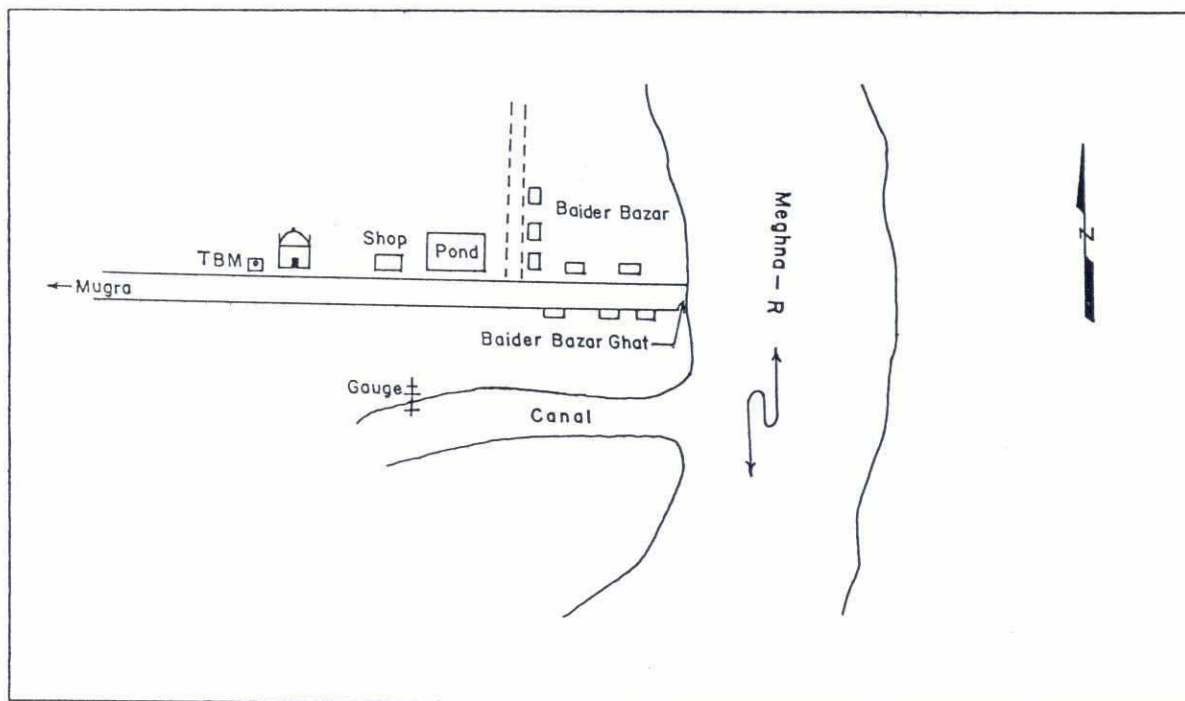
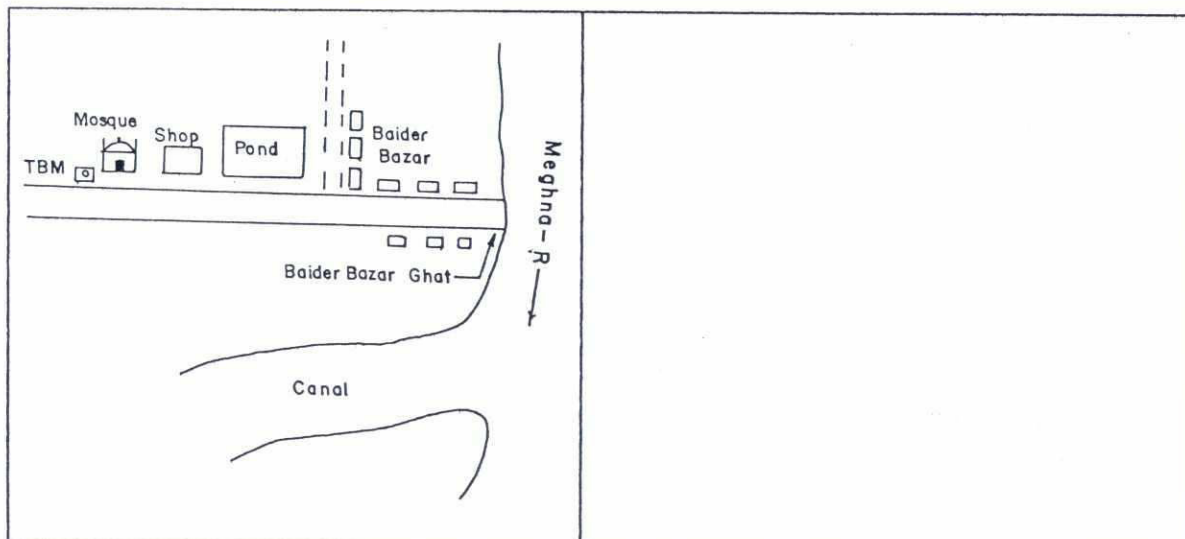
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

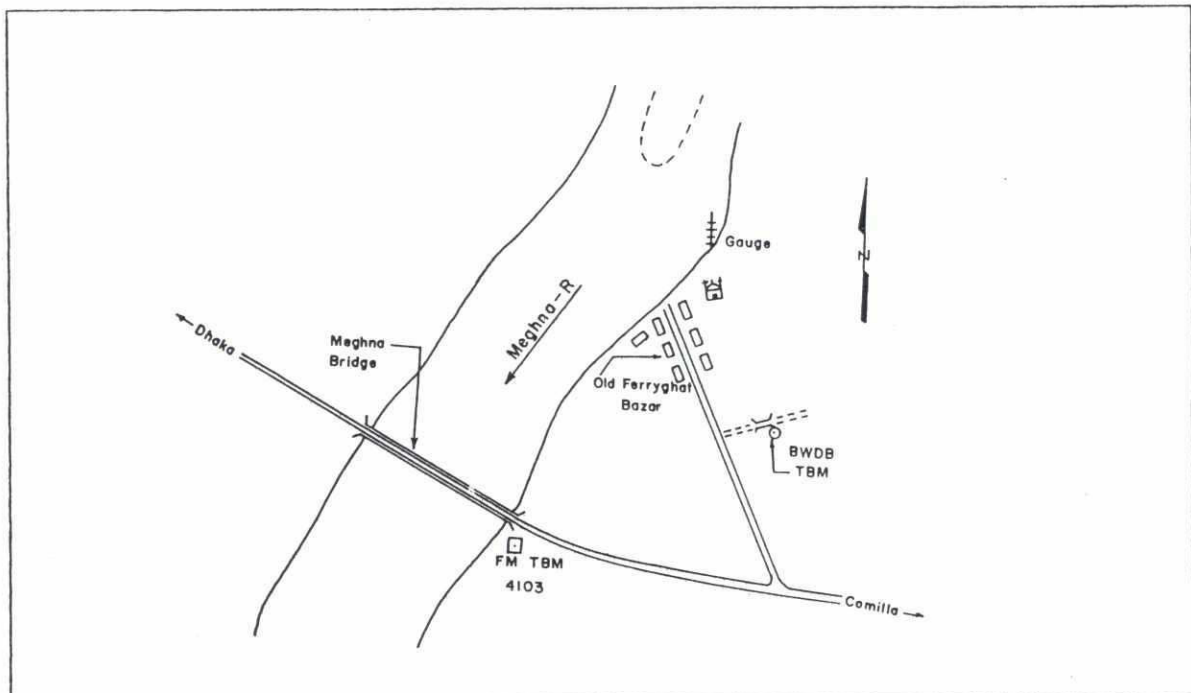
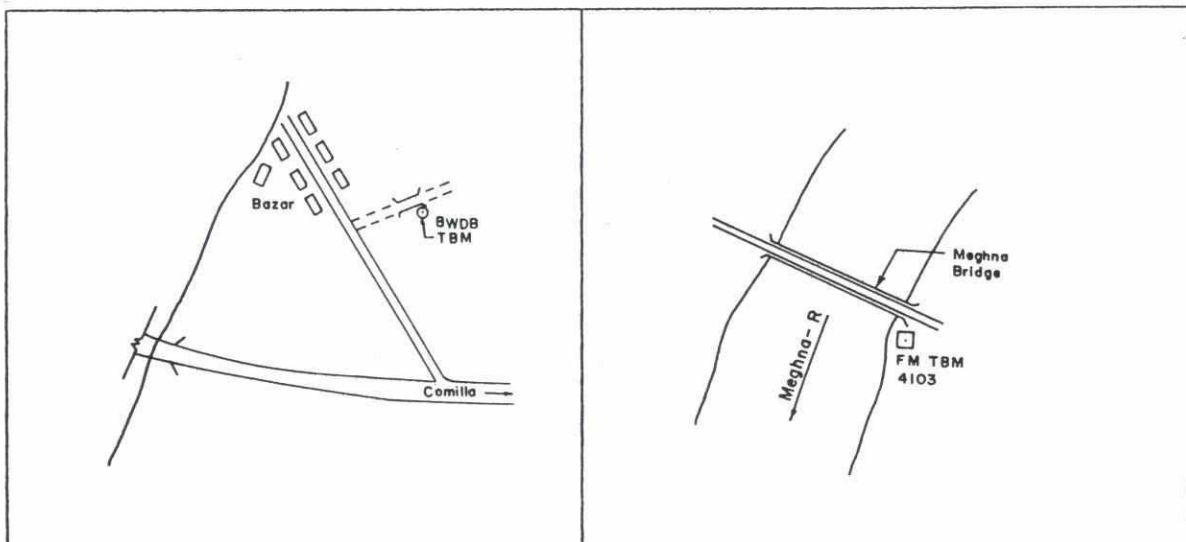
GAUGE STATION : 275 Baider Bazar

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

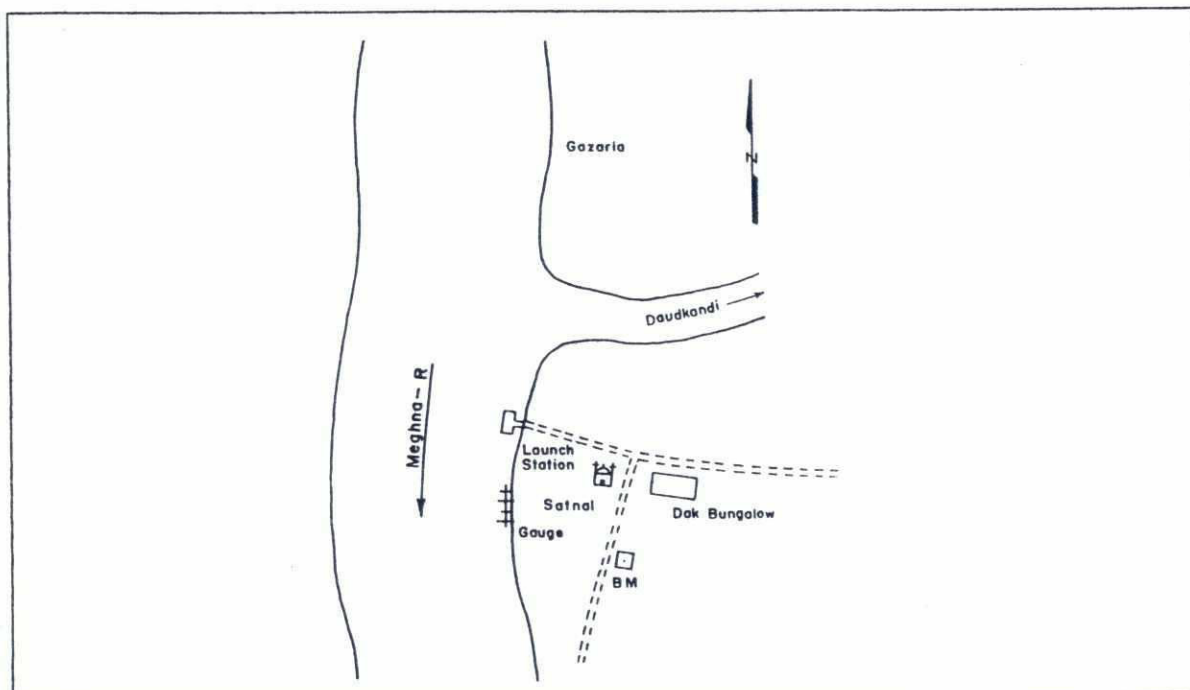
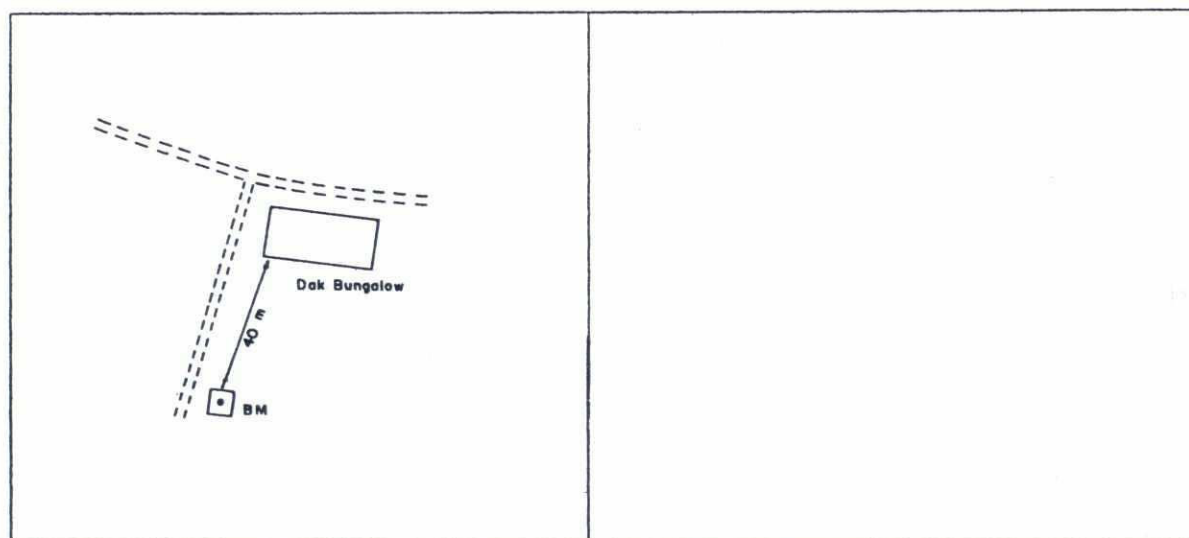
GAUGE STATION : 275.5 Meghna ferry ghat

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

GAUGE STATION : 276 Satnal

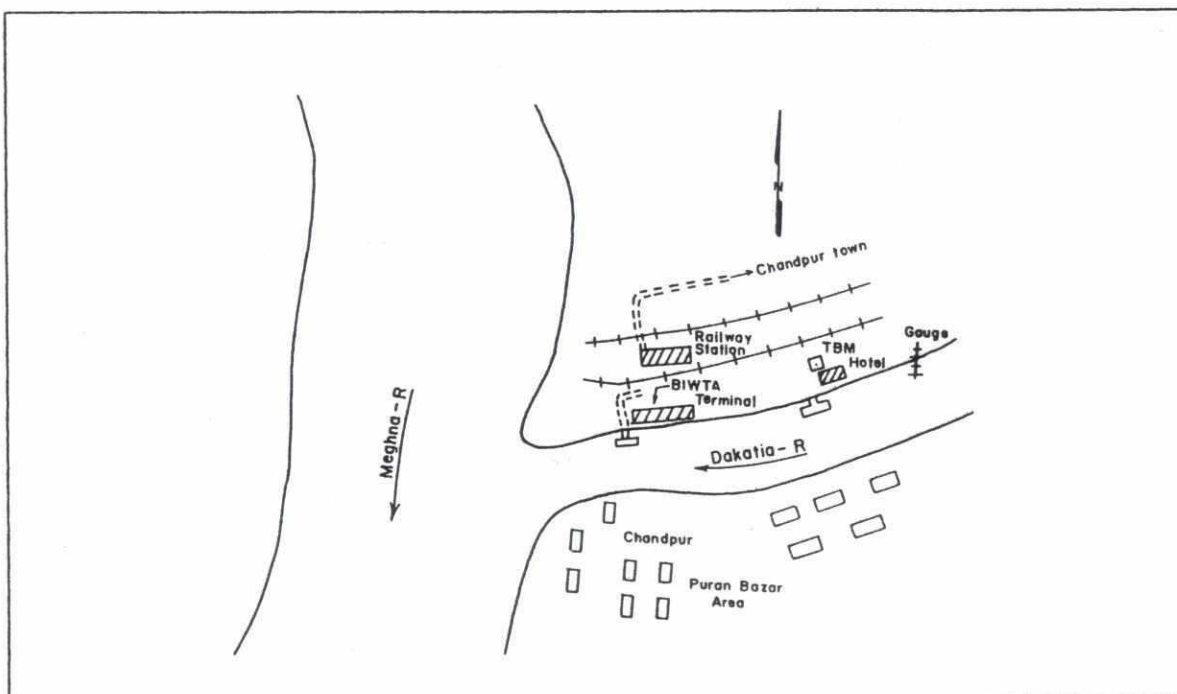
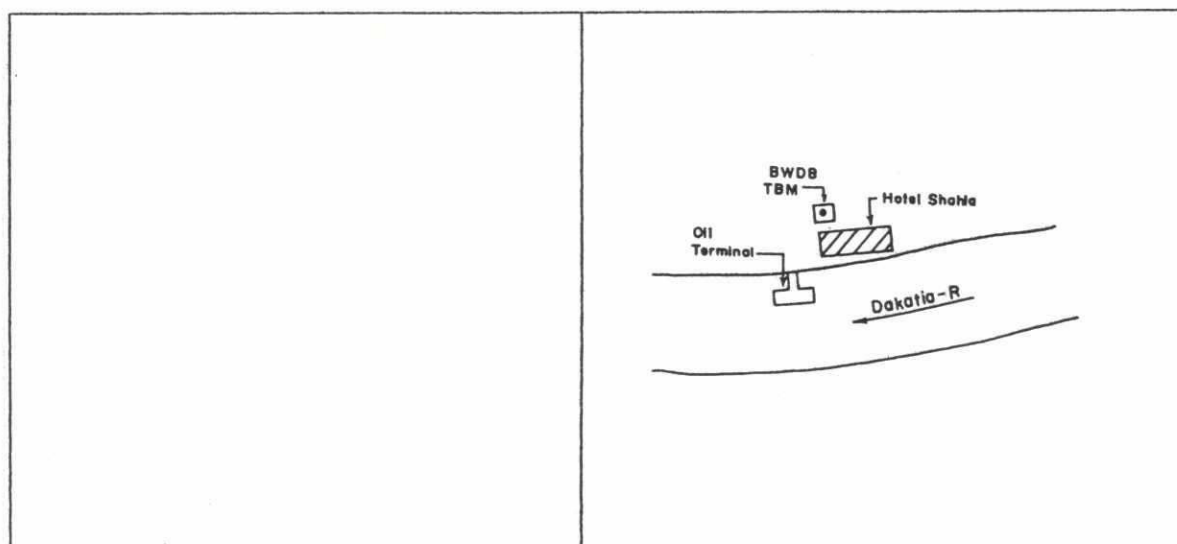
LOCATION SKETCH**LOCATION OF BM & TBM**

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PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Upper Meghna

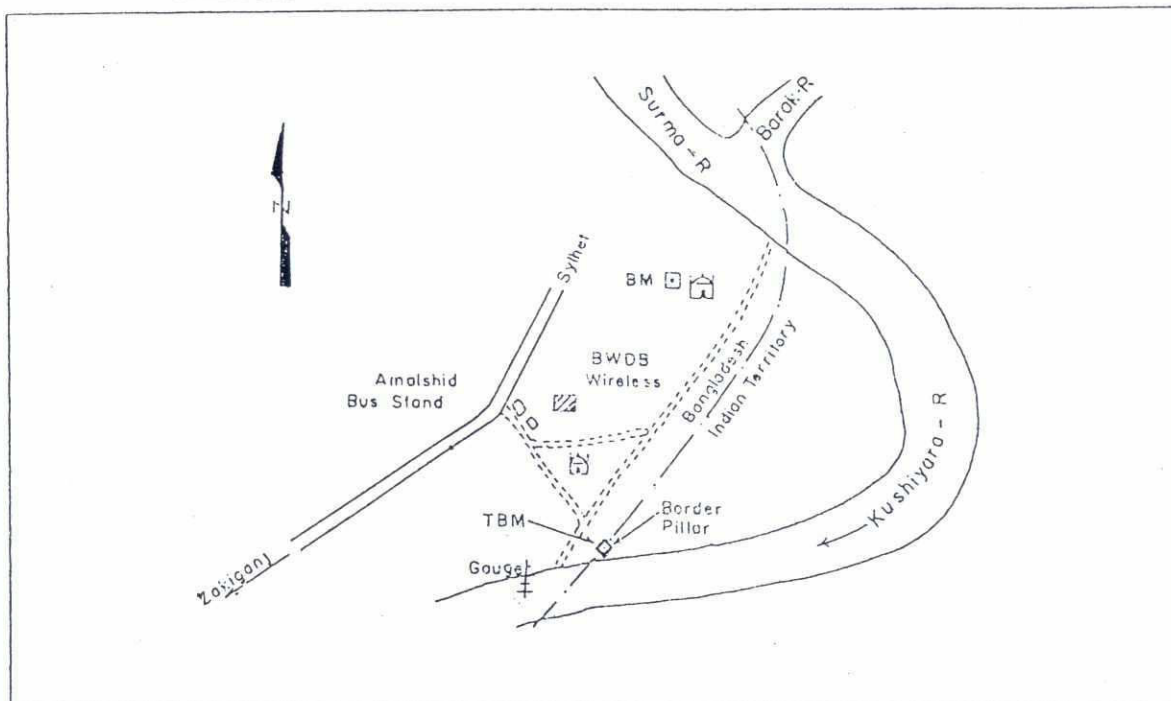
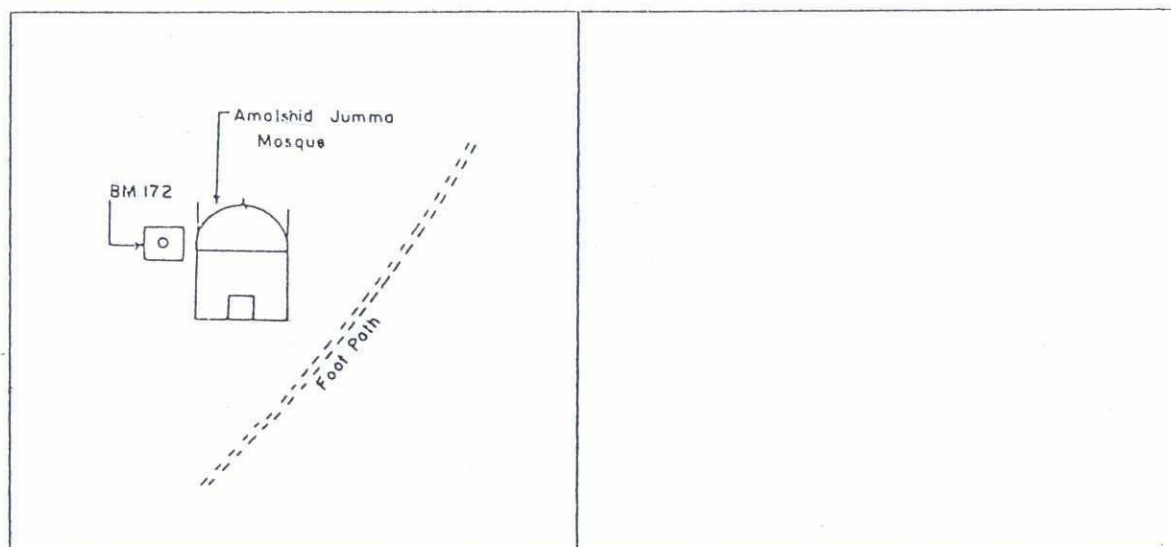
GAUGE STATION : 277 Chandpur

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Kushiya

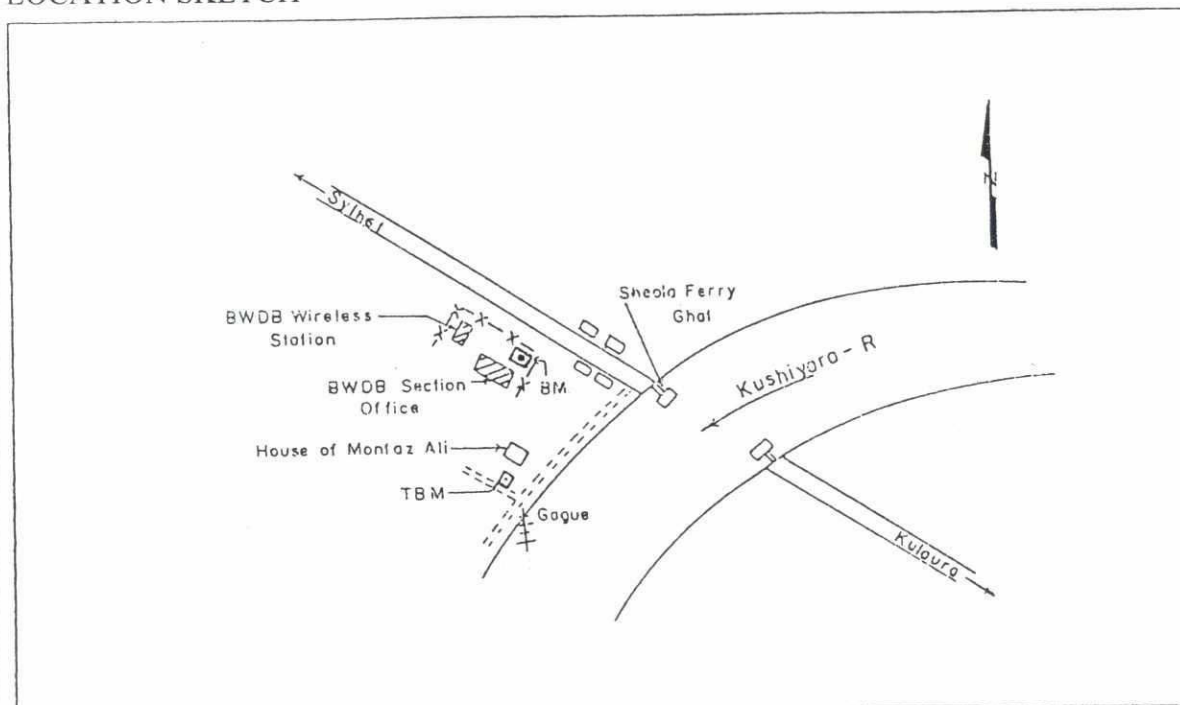
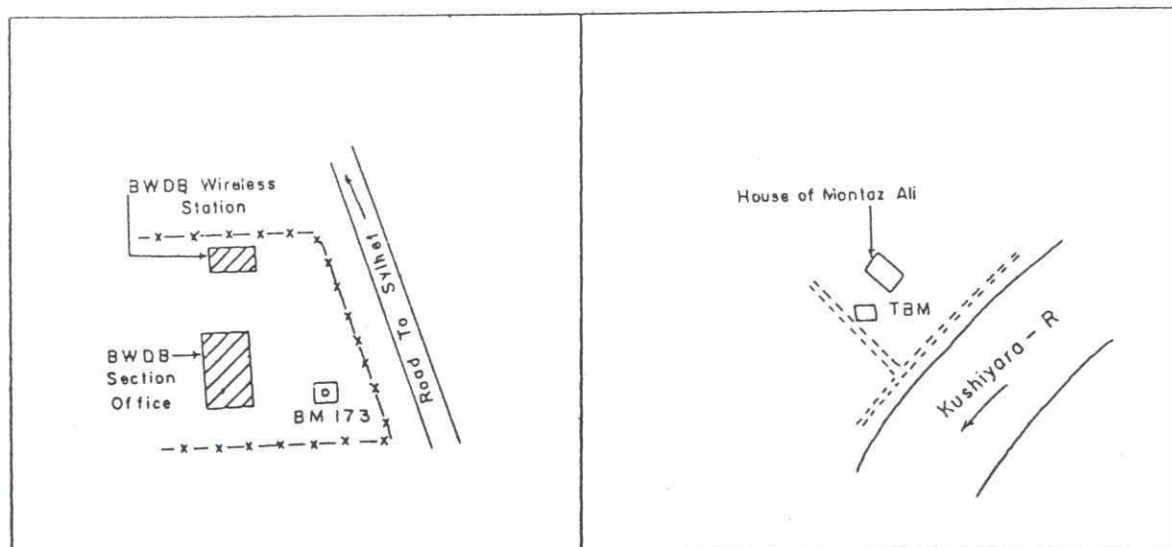
GAUGE STATION : 172 Amalshid

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Kushiyara

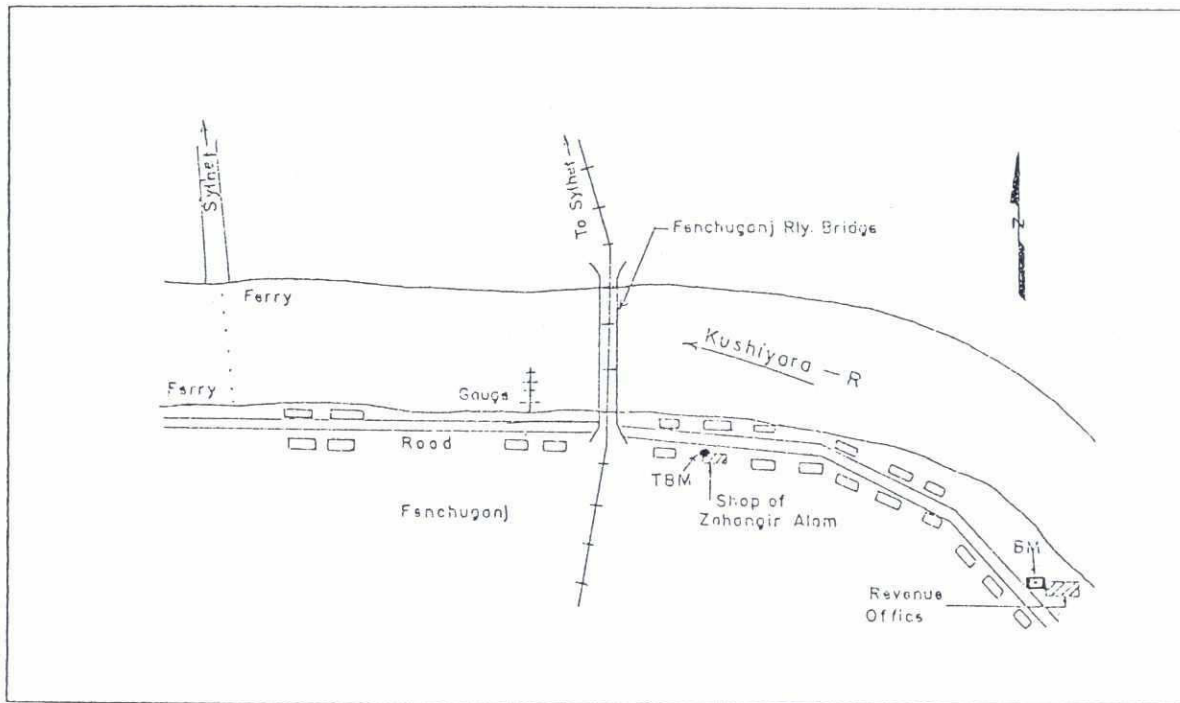
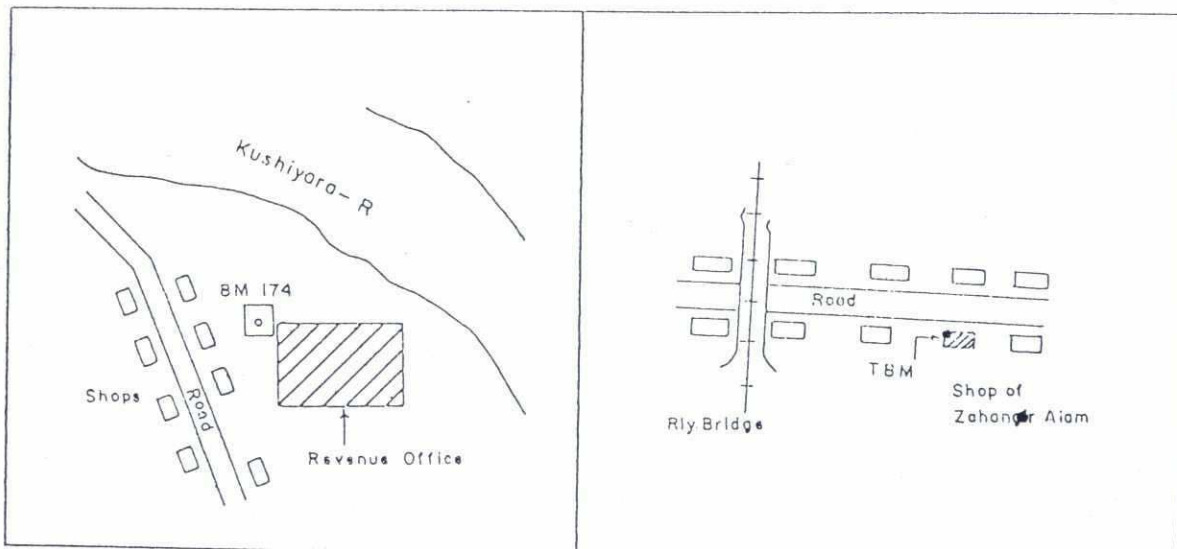
GAUGE STATION : 173 Sheola

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Kushiya

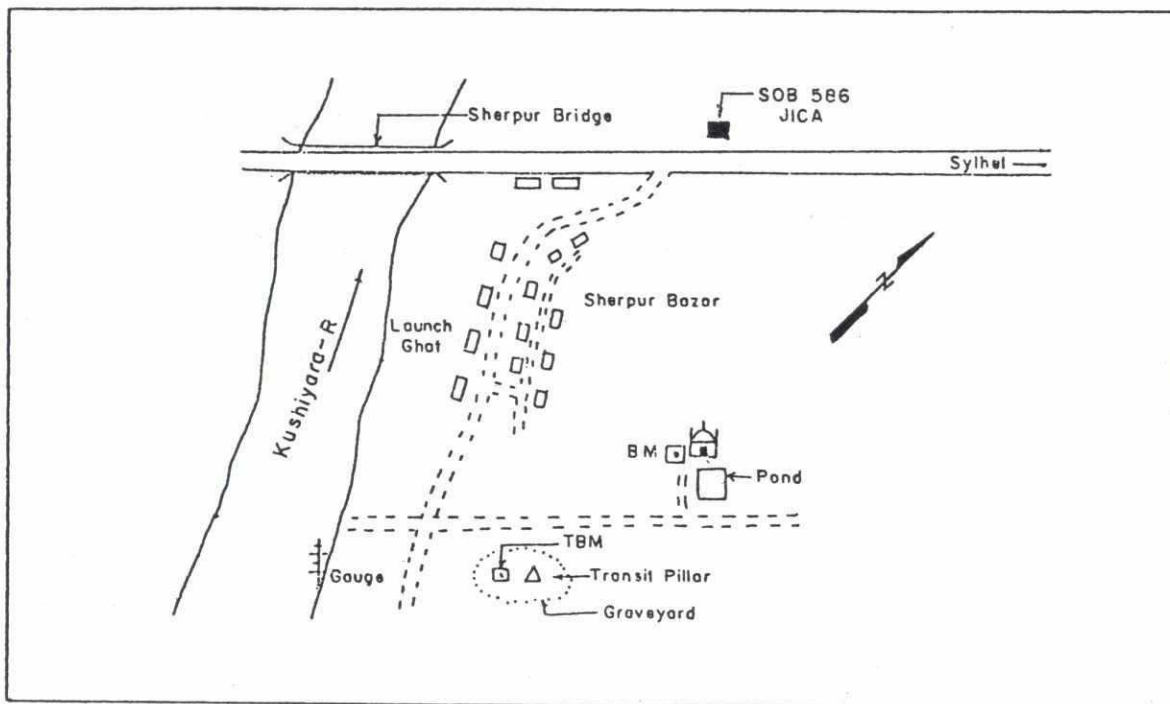
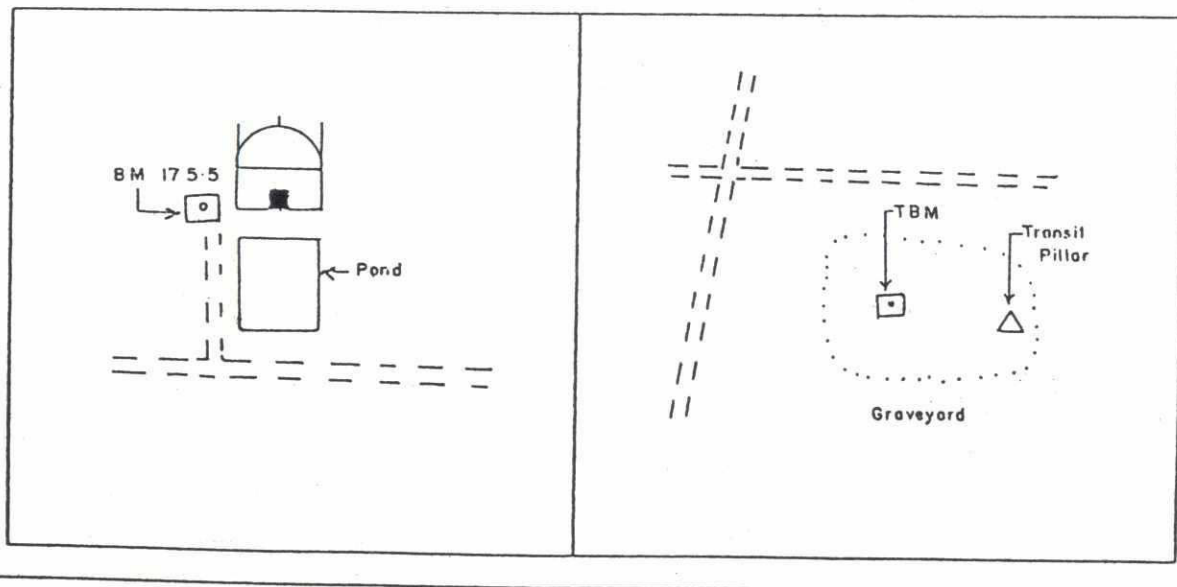
GAUGE STATION : 174 Fenchuganj

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Kushiya

GAUGE STATION : 175.5 Sherpur

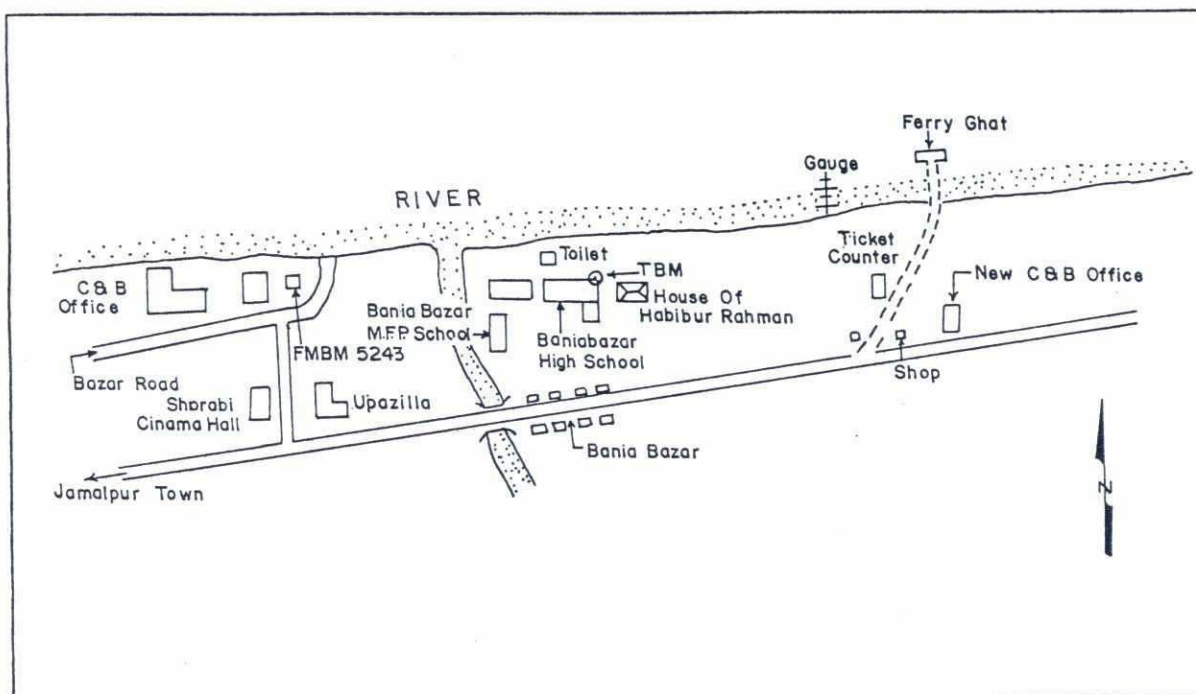
LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

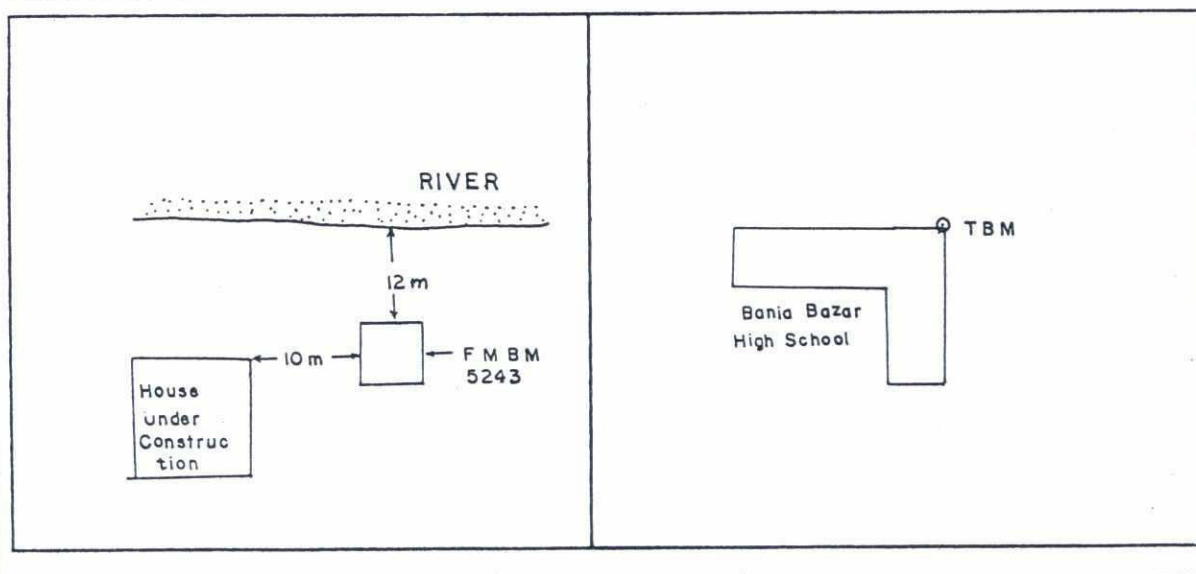
RIVER : Old Brahmaputra

GAUGE STATION : 225 Jamalpur

LOCATION SKETCH



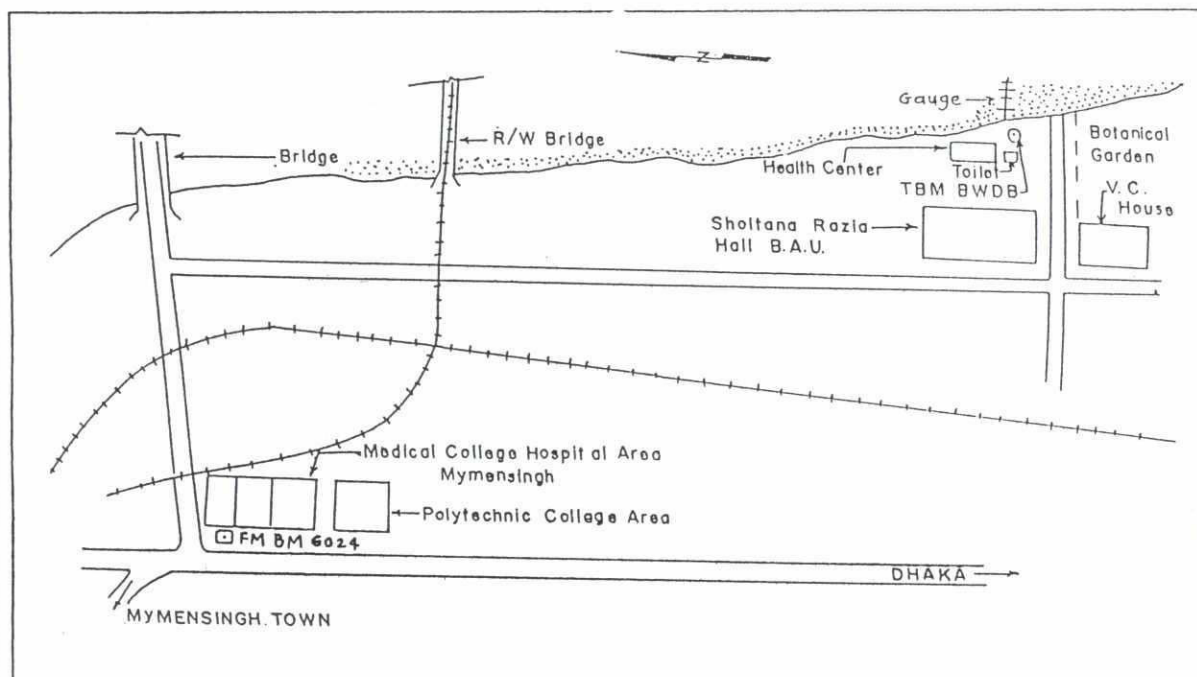
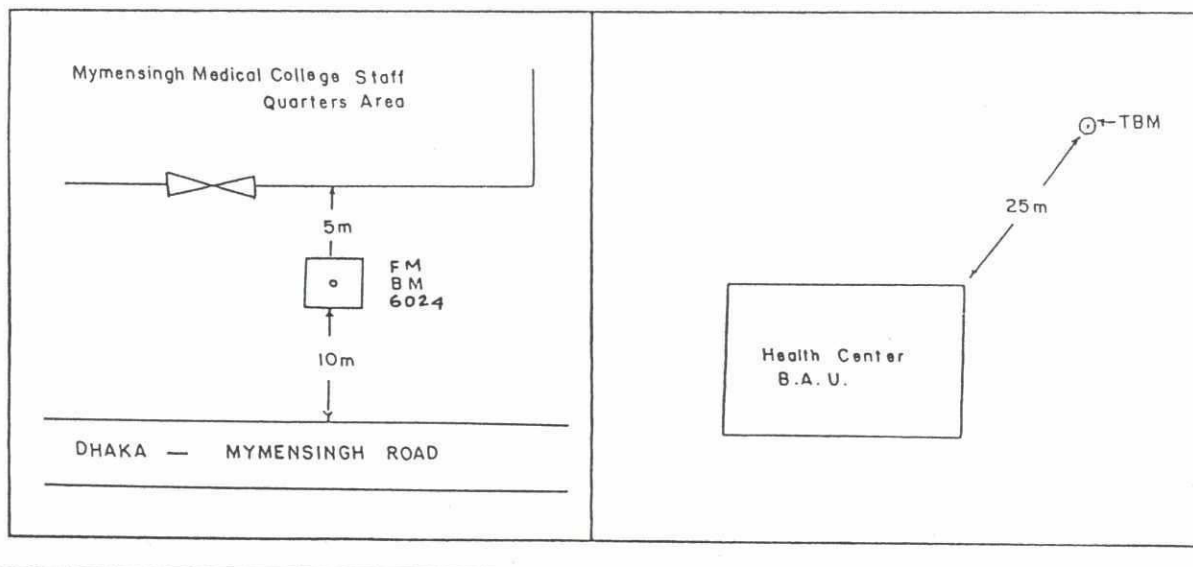
LOCATION OF BM & TBM



PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Old Brahmaputra

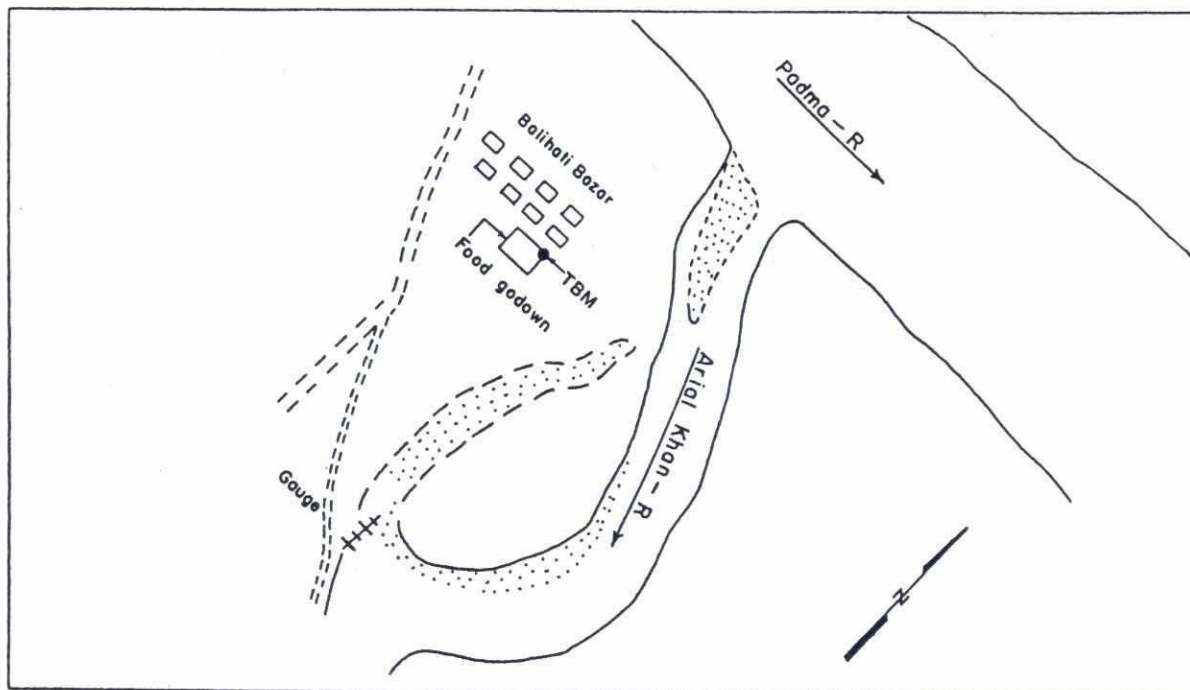
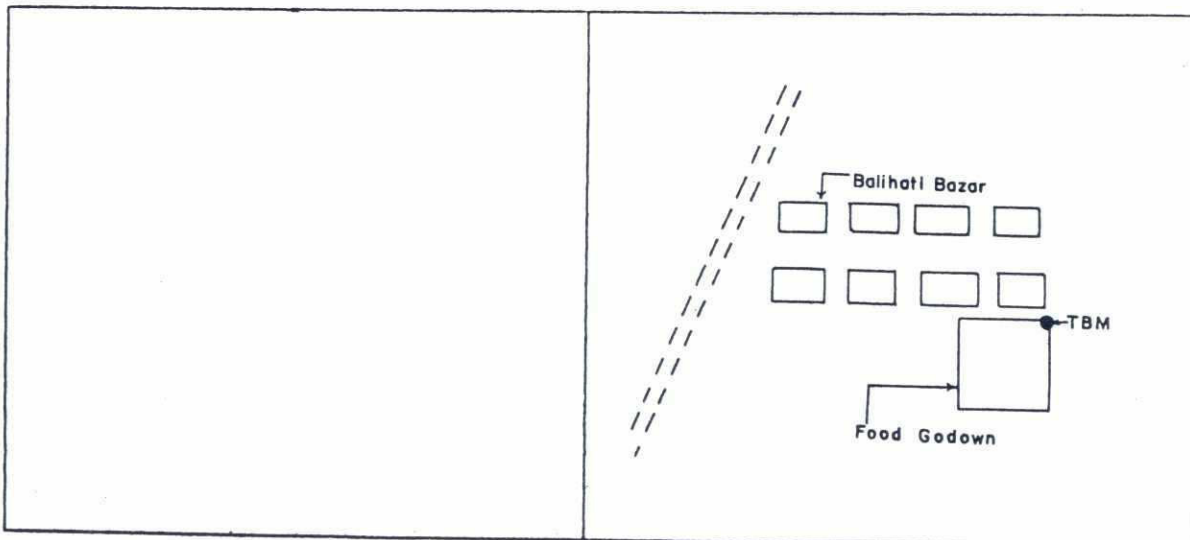
GAUGE STATION : 228.5 Mymensingh

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Arial Khan

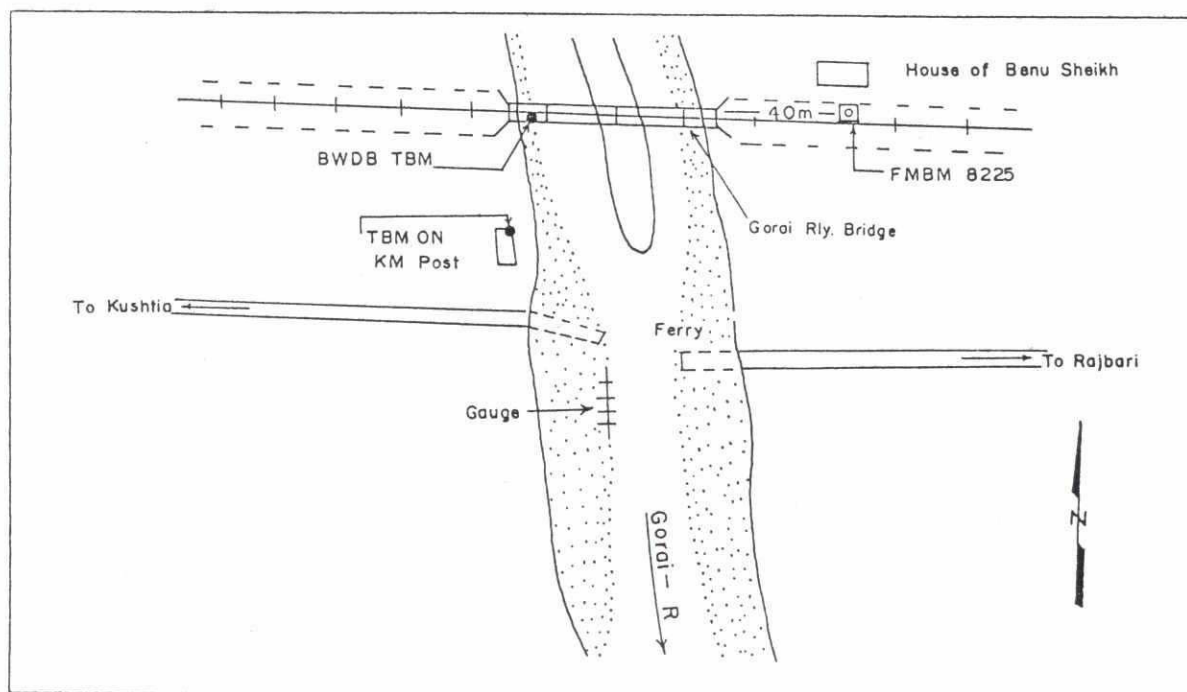
GAUGE STATION : 4A Off-take of Arial Khan

LOCATION SKETCH**LOCATION OF BM & TBM**

PROJECT : FAP 24 RIVER SURVEY PROJECT

RIVER : Gorai

GAUGE STATION : 99 Gorai Railway Bridge

LOCATION SKETCH**LOCATION OF BM & TBM**