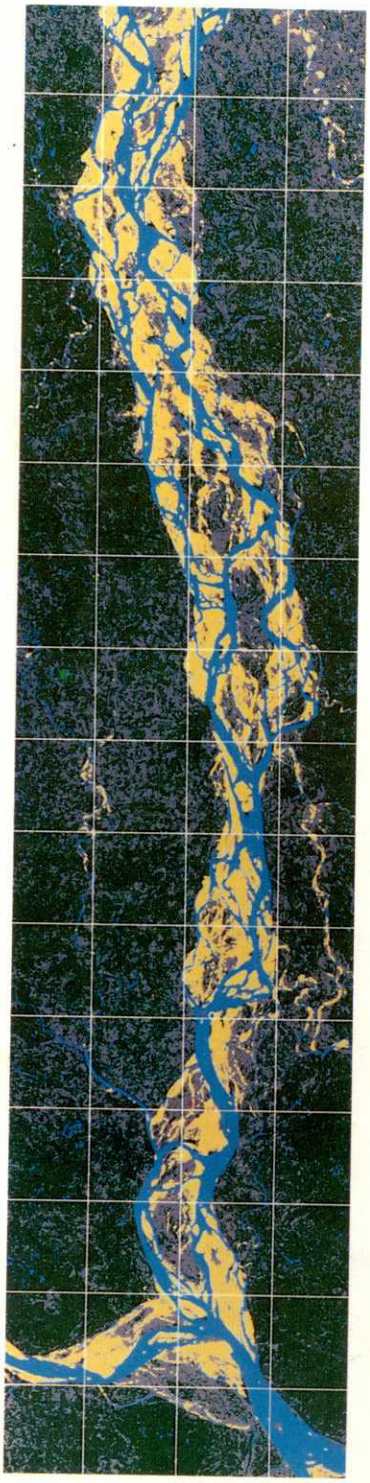
GOVERNMENT OF PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES
WATER RESOURCES PLANNING ORGANIZATION

FEDERAL REPUBLIC OF GERMANY

KREDITANSTALT FÜR
WIEDERAUFBAU (KfW)

FRENCH REPUBLIC

CAISSE FRANCAISE DE
DEVELOPPEMENT (CFD)



BANK PROTECTION AND RIVER TRAINING (AFPM) PILOT PROJECT FAP 21/22

TEST AND IMPLEMENTATION PHASE

PROGRESS REPORT NO. 28

APRIL TO JUNE 2000

JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE
CONSULTING CONSORTIUM FAP 21/22

RHEIN-RUHR ING.-GES.MBH, DORTMUND/GERMANY

COMPAGNIE NATIONALE DU RHONE, LYON/FRANCE
PROF.DR. LACKNER & PARTNERS, BREMEN/GERMANY
DELFT HYDRAULICS, DELFT/NETHERLANDS

In association with:

BANGLADESH ENGINEERING &
TECHNOLOGICAL SERVICES LTD. (BETS)
DESH UPODESH LIMITED (DUL)

BANK PROTECTION AND RIVER TRAINING
(AFPM) PILOT PROJECT
FAP 21/22

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1 GENERAL

1.1 THE PROJECT

The Project FAP 21/22 consisting of the two components

- Bank Protection Pilot Project (FAP 21) and
- River Training and Active Flood Plain Management Pilot Project (FAP 22)

was awarded by the Flood Plan Coordination Organization (FPCO) represented by the Kreditanstalt für Wiederaufbau (KfW) to the joint venture Rhein-Ruhr Ingenieur-Gesellschaft mbH as lead partner, Compagnie Nationale du Rhône, Prof. Dr. Lackner & Partners and Delft Hydraulics in association with Bangladesh Engineering and Technological Services Ltd. (BETS) and Desh Upodesh Ltd. (DUL).

As per Terms of Reference the Consultancy Services are to be performed in two phases, a Planning Study Phase (Phase I) followed by a Test and Implementation Phase (Phase II) for the FAP 21 component.

The Consultancy Agreement was signed on October 14, 1991. The date of commencement was fixed on December 01, 1991.

The Inception Report was issued on March 21, 1992 and the Interim Report on July 16, 1992. The Draft Final Planning Study Report for the FAP 22 component was presented on December 19, 1992 and that for the FAP 21 component on January 18, 1993.

A joint mission of KfW and Caisse Française de Developpement (CFD) carried out from January 26 to February 07, 1993 the Project appraisal of Phase II. The Mission together with FPCO agreed with the overall concept for the Test and Implementation Phase of the FAP 21 component, which started on June 01, 1993 after the "Letter to Proceed" had been issued by FPCO on May 15, 1993.

After a meeting held on June 21, 1993 the FAP Review Committee of the Ministry of Irrigation, Water Development and Flood Control recommended the Draft Final Planning Study Report of both the components for approval by the Technical Committee.

The Final Planning Study Report FAP 21/22 was presented on June 30, 1993 and approved by the FAP Technical Committee of the Ministry of Irrigation, Water Development & Flood Control on August 09, 1994.

With effect of January 01, 1996 the responsibilities of the client passed to the Water Resources Planning Organization (WARPO) of the in 1995 renamed Ministry of Water Resources.

The Bank Protection Pilot Project (FAP 21) consists of the construction of a Groyne Test Structure and a Revetment Test Structure at different test sites. The subcontract for the Groyne Test Structure at Kamarjani Test Site was awarded to the Consortium: The Engineers Limited and Corolla Corporation (BD) Ltd. on September 07, 1994. The actual construction works started on October 01, 1994 and were substantially completed end of April 1995. The groyne field was tested and permanently monitored by the Consultant for a period of 5 years and handed over to Bangladesh Water Development Board (BWDB) on April 15, 2000.

The subcontract for the construction of the Revetment Test Structure at Bahadurabad Test Site was awarded to the Joint Venture The Engineers Ltd.-Corolla Corporation (BD) Ltd. and Monico Ltd.-Boskalis International on September 30, 1995. The execution of works started in December 1995 but had to be suspended in January 1996 for various reasons. The construction works were resumed in

November 1996 and substantially completed end of May 1997.

With reference to the suspension of works on the Revetment Test Structure early 1996 and the incomplete adaptation / repair works at the Groyne Test Structure, the Consultant recommended in July 1996 an extension of the monitoring period of the FAP 21 component by one year up to end of 1999, which was approved by the Ministry of Water Resources in March 1997. Hence, work plan and staffing schedule were adapted accordingly up to December 31, 1999.

During the review mission of KfW and AFD (new name of the French donor agency with effect from April 1998) it was agreed between the donors, WARPO and BWDB in July 1998 to implement a third FAP 21 test site at Ghutail about 4 km downstream from Test Site II. Based on the Consultant's technical and financial proposal of December 1998 and its modification of May 1999 a subcontract was awarded to the Consortium: The Engineers Limited and Corolla Corporation (BD) Ltd. on June 23, 1999 for the construction of another Revetment Test Structure. The order to commence was issued the same day. The actual construction works started on December 17, 1999 and were completed end of May 2000. Necessary extension of Consultant's contract was approved by the Client and the Donors, and work plan and staffing schedule were adapted up to December 31, 2000.

The River Training and Active Flood Plain Management Pilot Project (FAP 22) was formally finalized by holding an international experts discussion from November 02 to 04, 1993 on the new concepts presented in the Final Planning Study Report. Based on the recommendations of the Experts a combination of two different recurrent measures was built in the dry season 1996/97 at Katlamari Test Site and monitored during the flood season 1997. Early January 1998, however, it emerged that the investigations at Katlamari could not be continued due to the morphological development in the test site area. Therefore, a new test site had to be selected, which was finally found at Kundarapara, about 5 km east of Kamarjani Test Site. However, all activities, in particular the development and investigation of floating elements, had to be stopped in March and June 1998 respectively due to permanent problems with the local population in that area. Finally, it was decided to resume the tests under FAP 22 in connection with the implementation of the third FAP 21 test site, but the actual situation at Ghutail early 2000 did not allow any tests with floating screens.

1.2 THE REPORT

As per Section 12.01 and Appendix 1 of the Consulting Agreement as well as according to the Work Plan of the Test and Implementation Phase (Table 1 of Attachment 1 to "Letter to Proceed") a Progress Report is due at the end of June 2000. This report is the Progress Report as indicated above and spells out the work progress of Consulting Services and Construction Works in the period from April to June 2000.

This report presents for the two components of the pilot project a description in brief of the activities performed during this period.

1.3 PERSONNEL DEPLOYMENT

After issue of the "Letter to Proceed" the expatriate Consultants and their local counterparts took up their assignment. The personnel deployment during the period under review is shown in Table 1.1-1, 1.1-2 and 1.1-3 for the FAP 21 component and in Table 2.1-1 and 2.1-2 for FAP 22.

1.4 IMPORTANT DATES AND EVENTS

15.05.1993	Letter to Proceed
01.06.1993	Start of Test and Implementation Phase

12.06.1993	Subcontract for the construction and installation of the Filter Test Rig
21.06.1993	Meeting of FAP Review Committee on Draft Final Study Report FAP 21/22
30.06.1993	Submission of Final Study Report FAP 21/22
14.07.1993	Subcontract for Physical Model Tests
23.07.1993	Collapse of Manos Regulator at Kamarjani Test Site
08. to 12.08.1993	Visit of Members of the German Parliament
18.09.1993	Submission of Final Invoice Phase I
28.09.1993	Subcontract for topographic and hydrographic survey at Kamarjani Test Site
31.10.1993	Subcontract for subsoil investigations at Kamarjani Test Site
02. to 04.11.1993	Experts Discussion FAP 22
10.02.1994	Coordination meeting for Kamarjani Test Site with FPCO and BWDB
23.02.1994	Issue of Tender Documents for Kamarjani Test Site
28.02.1994	Submission of Experts Recommendations FAP 22
20.03.1994	Pre-bid meeting for Test Site I
17.04.1994	Tender opening for Kamarjani Test Site
08. to 20.06.1994	Technical Assessment of Procurement Arrangements of the Consultant
14. to 20.06.1994	Review Mission of KfW/CFD
18.06.1994	Consultants Report on the results of the Experts Discussion FAP 22
09.08.1994	Approval of Consultants Final Study Report by the FAP Technical Committee
04.09.1994	Order to Commence construction works at Kamarjani Test Site
07.09.1994	Subcontract signed for construction works at Kamarjani Test Site
22.09.1994	Submission of Tech. Report No.1 on Physical Model Tests
22.09.1994	Submission of Tech. Report No.2 on Morphological Prediction for Test Areas
26.09.1994	Coordination meeting for Kamarjani Test Site with FPCO and BWDB
28. to 03.10.1994	KfW mission for definition of Kamarjani Test Site location
01.10.1994	Start of Construction Works at Kamarjani Test Site.
12. to 17.02.1995	Review Mission of KfW/CFD
26.02.1995	Submission of Technical Report No. 3 on Filter Stability Investigation
16.04.1995	Issue of Tender Documents for Test Site II
18.04.1995	Submission of Technical Report No. 4 on Falling Apron Investigation
15.05.1995	Pre-bid meeting for Test Site II
20. to 25.05.1995	Audit of the Project (Test Site I at Kamarjani)
30.05.1995	Completion of construction works at Kamarjani Test Site
11.06.1995	Tender opening for Test Site II
31.08.1995	Order to Commence construction works at Bahadurabad Test Site
10.09.1995	Coordination meeting for Bahadurabad Test Site with FPCO
20. to 26.09.1995	KfW mission for definition of Bahadurabad Test Site location
30.09.1995	Subcontract signed for construction works at Bahadurabad Test Site
01.12.1995	Start of construction Works at Bahadurabad Test Site
01.02.1996	Suspension of Construction Works at Bahadurabad Test Site
12.03.1996	Submission of Technical Report No. 5 on Additional Model Tests
20.03.1996	Submission of letters of FORCE MAJEURE to WARPO for both Test Sites
22.04.1996	Proposal for Final Implementation of Revetment Test Structure at Test Site II
26.06 to 03.07.1996	Review Mission of KfW/CFD
18.07.1996	Proposal for Modification of Consulting Services
05.09.1996	Submission of Report on Extended Studies on Recurrent Measures (FAP 22)
30.09.1996	Submission of Report on Monitoring and Adaptation 1995 at Test Site I
29.10.1996	Proposal for location of FAP 22 Test Site (Katlamari)
13. to 17.11.1996	Technical Review Mission of KfW/CFD
26.11.1996	Resumption of construction works at Bahadurabad Test Site
24.12.1996	Start of construction works at Katlamari Test Site (FAP 22)
02.03.1997	Approval of extension of the monitoring period up to December 31, 1999

20.03.1997	Completion of construction works at Katlamari Test Site (FAP 22)
31.05.1997	Completion of construction works at Bahadurabad Test Site
20. to 29.06.1997	Technical Assessment of Procurement Arrangements of the Consultant
11. to 19.07.1997	Audit of the Project (Test Site I and II)
14. to 21.07.1997	Technical Review Mission of KfW/CFD
14.09.1997	Submission of Technical and Financial Proposal for Consultancy Services and Construction of Low Cost and Recurrent Measures (FAP 22)
06.01.1998	Approval of modified Proposal of September 1997 for Consultancy Services and Construction of Low Cost and Recurrent Measures (FAP 22)
07.02.1998	Start of construction works at Kundarapara Test Site
05.05.1998	Submission of Technical Report No. 6 on Additional Model Tests
14. to 23.07.1998	Technical Review Mission of KfW/AFD
09.09.1998	Submission of Report on Monitoring and Adaptation 1996 at Test Site I
23.12.1998	Proposal for modification of Consulting Services for Test Site III
01. to 07.03.1999	Technical Review Mission of KfW/AFD
23.03.1999	Submission of Report on Monitoring and Adaptation 1997 at Test Site I
23.03.1999	Submission of Report on Monitoring and Adaptation 1997 at Test Site II
31.05.1999	Proposal for modification of Consulting Services for Test Site III (Revision 1)
23.06.1999	Subcontract signed for construction works at Test Site III
23.06.1999	Order to commence construction works at Ghutail Test Site
17.12.1999	Start of construction works at Ghutail Test Site
23.12.1999	Approval of extension of the construction and monitoring period up to December 31, 2000
05.02.2000	Submission of Report on Monitoring and Adaptation 1998 at Test Site I
05.02.2000	Submission of Report on Monitoring and Adaptation 1998 at Test Site II
26.02. to 06.03.2000	Technical Review Mission of KfW
15.04.2000	Handing over of the Groyne Test Structure at Kamarjani to BWDB
15.06.2000	Substantial completion of Third Test Site

2 BANK PROTECTION COMPONENT (FAP 21)

2.1 PRELIMINARY REMARK

The Consultant's services of the Test and Implementation Phase (Phase II) comprise all engineering and management tasks relating to the planning and execution of test structures, their monitoring, adaptation, repair measures during subsequent years and handing over to the Client at the end of the contract period.

After submission of the Draft Final Planning Study Report a joint mission of KfW and CFD has carried out the project appraisal to proceed into Phase II of the Project. The Mission agreed to the overall concept of Phase II proposed by the Consultant the essence of which was the construction of permeable groynes and of various types of revetments at two different test sites in two successive seasons.

However, the remaining lead time of the programme as presented in the Draft Final Planning Study Report for additional studies, final design, procurement, subcontracting and preparation of construction was found to be too short in view of the administrative and technical difficulties identified by the Consultant and the Mission. There seemed to be unacceptable risks that the construction of the test works at the first test site could not be completed successfully during the dry season 1993/94, which in turn would have led to major cost increases and endangered the achievement of meaningful test results.

A mutual understanding between all parties concerned had been reached on a postponement of the start of the construction period and of the end of the Project by one year. Moreover, it was decided to reduce the magnitude of the test works on the two selected test sites in order to reserve funds for further improvement of the test structures or, if necessary and possible, for the construction of new structures. Since in July 1998 remaining funds of about DM 8.4 million were estimated taking into account costs for monitoring and maintenance of the first two test structures until the end of the Project, all parties concerned came on request of the client to an agreement to utilise the contract amount up to 100 % and to implement a third test site.

Table 1.2-1.1 is showing the Work Plan and Table 1.2-3.1 the Staffing Schedule of the Test and Implementation Phase as per "Letter to Proceed" of May 15, 1993. Table 1.2-1.2 and 1.2-1.3 present revisions of the Work Plan of September 1996 and May 1999 respectively. Necessary modifications of the Staffing Schedule adjusted to the revised Work Plans and approved by the client and the donors are shown in Table 1.2-3.2 to 1.2-3.4. Table 1.2-2 is indicating the actual progress of works and Table 1.2-4 and Table 1.2-5 the actual deployment of the expatriate and local professional staff respectively during the period under review.

2.2 TEST SITE I AT KAMARJANI

2.2.1 General

Initially, the test structure comprised 6 groynes, each of them a combination of an impermeable and a permeable section with increasing permeability towards the river of which 3 groynes (G-1 to G-3) were partly constructed off-shore and on-shore while the other ones G-B1, G-B2 and G-A were built on the flood plain. All six structures launch from and were built against an embankment constructed under the authority of BWDB.

The main components of the groyne test field are the groynes G-1 to G-3, whereas G-B1, G-B2 and G-A, which were built upstream and downstream respectively from the main groynes, are intended to supplement the functioning and effects of the latter.

The "Order to Commence" the construction works was issued on September 04, 1994 and the works were substantially completed in April 1995.

The structure was "tested" by the river for the first time during the flood season 1995 which was marked by five flood peaks of which three represent events with more than 10 years re-occurrence and a maximum water level on July 10, 1995 corresponding to a situation of about 25 years re-occurrence.

The first four flood peaks contributed to three major damage events within the test site area:

- destruction of the impermeable groyne head of groyne G-2 and loss of piles of the permeable section;
- breach of the main embankment about 80 m downstream from groyne G-2, and
- collapsing of the impermeable part of groyne G-3 at the downstream side and destruction of the impermeable groyne head.

The initial findings of damage causes and the results of additional physical model tests performed in November/December 1995 at the River Research Institute at Faridpur had identified improvement and adaptation measures, which had to fulfil mainly the following conditions:

- to substantially reduce the magnitude of return currents and vortices within the groyne field, in particular along the main embankment, and

- to improve the transition between the permeable and impermeable part of the groynes with the aim to further limit the development of severe return currents, turbulences and vortices.

For the design of adaptation and repair measures, the design parameters as per original design of the groyne structure were being maintained. Only the downstream part of the impermeable groyne heads received substantially increased launching aprons.

Since the main river attack during the monsoon season 1996 was expected downstream from groyne G-A threatening the main embankment near the Manos river estuary, a new supplementary groyne G-A/2 was built 200 m downstream from G-A. However, the execution of the adaptation and repair works was hampered by the political situation in the country in 1995 and the first quarter 1996 with the result that the works could not be completed in time due to the rising water level. Especially, groyne G-2 remained incomplete because the gap between the remaining pile structure built in 1995 and the relocated main embankment could not be closed by driving further piles as per design.

During the flood season 1996 the river banks in the area of Kamarjani continued to be eroded and also the Groyne Test Structure came under attack again due to the attraction of the flow by the scour hole in front of the groynes. However, due to the adaptation of the structure and the morphological development in the test site area no damages to the structure occurred during the monsoon season 1996 except to the main embankment, which was slightly damaged by wave erosion in those areas where the upper part was only protected by grass sods. Repair works were carried out in November 1996 and the grass sod protection was replaced by brick mattressing. Further repair works of the pile structure of groyne G-2 were carried out by driving 23 Nos. steel piles ϕ 711 mm and 32 m length. Early 1998 twelve Nos. reinforced in-situ concrete piles were constructed between the toe of the relocated main embankment and the pile structure left over and intact after the monsoon 1995.

From September 1997 to end of January 1998 ten additional physical model tests were performed in the River Research Institute in Faridpur, the objective of which was

(1) to investigate the causes of damages observed in 1995 and
(2) to gain more information/knowledge of the behaviour of the groynes/groyne field

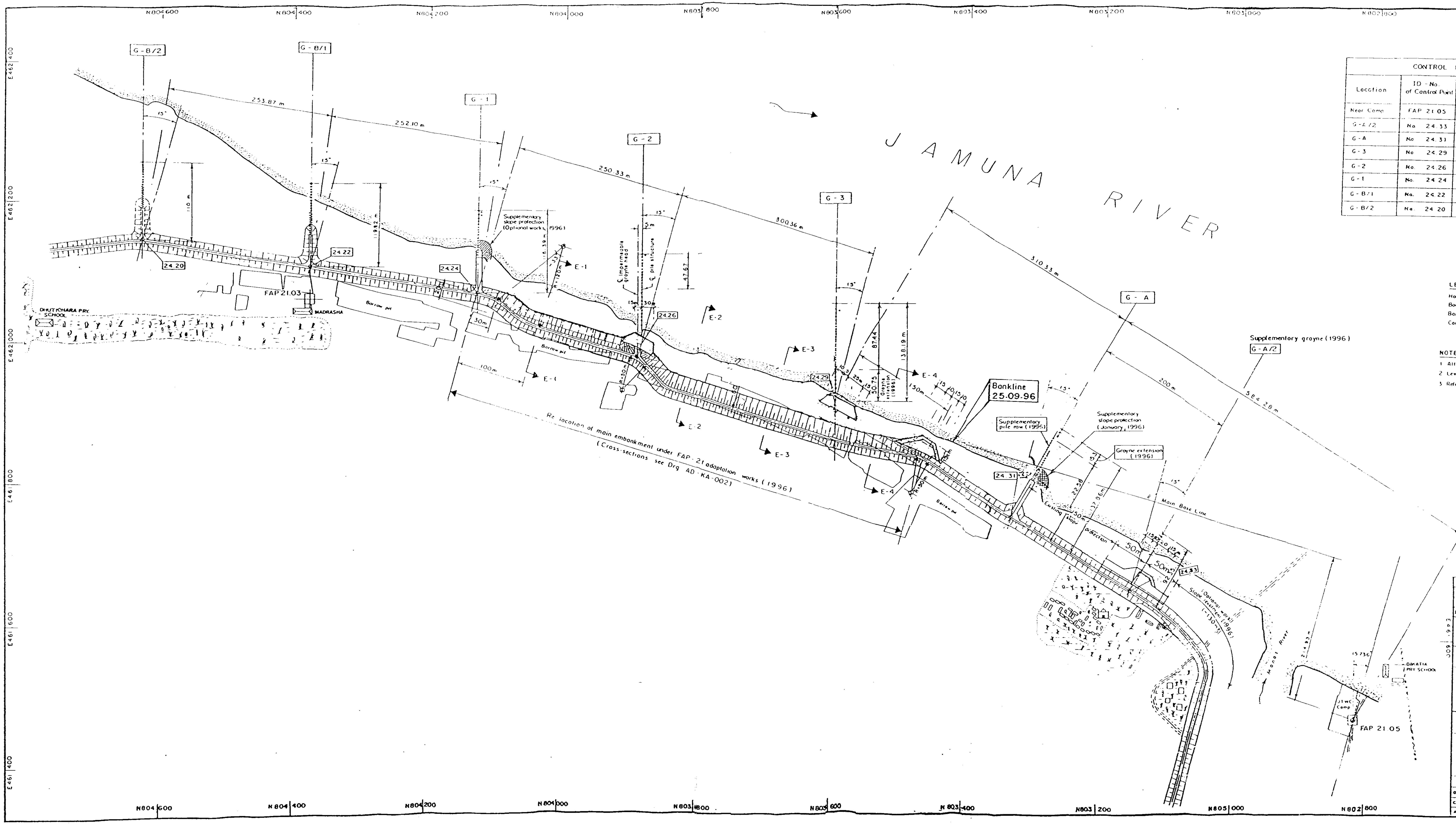
in order to be in a position to formulate design rules at the end of the Project in 1999 and to work out guidelines and manuals for their application.

During the monsoon seasons 1997 and 1998 no damages to the test structure occurred. Hence, no adaptation and repair works were necessary in the dry season 1998/99.

Also during the monsoon season 1999 no damages have been observed. Only more or less slow bank erosion continued downstream from the test structure in the area from Rasulpur to Balashi ghat as well as severe erosion at Kamarjani Bazar, about 4 km upstream from the groyne field. No adaptation and repair works were required.

In the course of the Technical Review Mission of KfW in February/March 2000 it was decided in agreement with all parties concerned to hand over the test structure to BWDB, which actually was done on April 15, 2000.

The general layout of the test structure after the execution of adaptation and repair works is shown in Fig. 1.



CONTROL POINT SCHEDULE				
Location	ID - No. of Control Point	Co-ordinates BTM (FAP 24)		Elevation (m PWD)
		Easting	Northing	
Near Camp	FAP 21.05	461,479.517	802,817.795	+ 21.920
G - A/2	No. 24.33	(to be established)		
G - A	No. 24.31	461,763.470	803,328.440	+ 23.335
G - 3	No. 24.29	461,922.160	803,595.130	+ 23.258
G - 2	No. 24.26	462,003.780	803,684.190	+ 23.446
G - 1	No. 24.24	462,071.690	804,125.130	+ 23.390
G - B/1	No. 24.22	462,106.970	804,374.750	+ 23.404
G - B/2	No. 24.20	462,142.470	804,626.130	+ 23.954

LEGEND

Homestead
Borrow pit
Bankline
Control points

NOTES

1. All measurements in meters
2. Levels refer to ± 0.00 m PWD
3. Reference Drawings

AD-KA-002 Cross-Sections of Main Embankment
AD-KA-003 Main Embankment, Details of Revetment
AD-KA-010 Groyne G-1, General Layout Plan
AD-KA-020 Groyne G-2, General Layout Plan
AD-KA-030 Groyne G-3, General Layout Plan
AD-KA-040 Groyne G-A, General Layout Plan
AD-KA-050 Groyne G-A/2, General Layout Plan

REVISION	DATE	NAME	DESCRIPTION	APPROVED
3	27.1.97	Anowar	As BUILT DRAWING (Adaptation works)	
2	8.8.96	ANOWAR	AS BUILT DRAWING	
1	28.01.96	ANOWAR	Revetment near G-A/2	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION WATER DEVELOPMENT & FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION (FPCO)

BANK PROTECTION PILOT PROJECT FAP-21

JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE

TEST SITE I - KAMARJANI
- ADAPTATION WORKS -

ADAPTATION OF TEST STRUCTURES
GENERAL PROJECT LAYOUT

	NAME	DATE
DRAWN	ANOWAR	10-01-96
CHECKED		15-01-96
APPROVED		

SCALE: 1 : 2000

FIGURE NO. 1 — REVISION 3

2.2.2 Monitoring of the Test Structures

Since the final objective of the bank protection pilot project is to develop and optimise design criteria, cost-effective construction and maintenance methods which, will serve as future standards appropriate for the prevailing conditions at the Jamuna and other rivers of Bangladesh, regular monitoring, preventive maintenance and adaptation of the works is a must after installation of the test structure. Hence, monitoring started immediately after completion of the works in 1995 and were continued even after handing over the structure to BWDB in April 2000. The following activities have been performed during the period under review:

(1) Bathymetry

Bathymetry surveys were done to detect and record planform and riverbed changes and their influence on the stability of the test structure. The activities during the months of April to June 2000 are shown in Table 1. All the surveys were finally processed in the office in Dhaka and the results are shown in contour charts.

The results of the main surveys during the period under review are given in Annex B.

Date	Survey Area		
	April 2000	May 2000	June 2000
01			
02			
03			
04			
05			
06			
07			
08			
09		main survey	
10		main survey	
11		main survey	
12		main survey	
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			

Table 1: Bathymetry surveys at Kamarjani Test Site from April to June 2000

(2) Topographic Measurements

The topographic measurements were done by using **E**lectronic **D**istance **M**easurement (EDM) equipment & levelling instrument. During the period under review the following works were performed:

08/05	char in front of the test structure
09/05	Kamarjani char and Kundarapara char
10/05	bankline from Syedpur to Balashi ghat
11/05	bankline from groyne G-A to Dhuchtichara

(3) Measurement by the Monitoring System

The monitoring system is located at groyne G-2 and recording water level information, wave heights and periods, test pile inclination and acceleration, wind speed and direction as well as other meteorological data like temperature, precipitation and relative humidity. Data are shown in the monthly reports on monitoring of the test structures.

(4) Measurement of Flow Velocity and Direction

Float track measurements were continued as well as measurements with the Valeport currentmeter in the Kamarjani main channel and Kundarapara cut-off channel. Results are presented in the monthly reports on monitoring of the test structures and in Annex B.

(5) Observations

The water level fluctuation in April and May is characterised by two sharp rises. The first one started on April 08 and within a period of 4 days only an increase of 1.09 m was observed. The second one followed from April 29 to May 03, again with a rise of 1,09 m. Although the test structure was handed over to BWDB on April 15, recording of the water levels was continued till end of May, when a level of 19,01 m+PWD was measured.

Bathymetric surveys, flow measurements as well as discharge measurements have only be performed during the month of May. No significant changes have been observed. The average flow velocity along the Kamarjani channel was 1.2 m/s. About 34 % of the total discharge ran along the latter, but about 66 % along the Kundarapara channel with a maximum flow velocity of 1.7 m/s.

2.3 TEST SITE II AT BAHADURABAD

2.3.1 Introduction

The construction of the Revetment Test Structure was originally planned about 4 km south of Bahadurabad Ghat based on the investigations during the Study Phase. Since, however, no substantial erosion occurred at the pre-selected test site, this area was abandoned and a more suitable one was selected in September/October 1995 at Kulkandi-village just downstream from Bahadurabad Ghat. The decision on the final location of the test structure was taken on October 11, 1995. However, end November 1995 it emerged that the Subcontractor could not mobilise the main construction equipment for dredging and underwater works in time. After he had admitted his inability to do so, the Consultant informed the Subcontractor on December 05, 1995 of his failure to comply with the contractual obligations in accordance with Sub-Clause 63.1 (b) of the Conditions of Contract. On January 20, 1996 the Subcontractor was notified in accordance with Sub-Clause 46.1 of the Conditions of Contract that the rate of progress of works was too slow to comply with the contractual Time of Completion and finally it was decided on January 31, 1996 to defer the final completion of the test structure until the dry season 1996/97.

Based on the experience in 1995 and January 1996, and after identification of the main constraints preventing the completion of Works as per original schedule, a proposal for the final implementation

of the Revetment Test Structure during the dry season 1996/97 was submitted in April 1996 taking into account the morphological analysis of the test area in March and May 1996 and the expected morphological development during the monsoon season 1996.

However, in August 1996 a deep channel shifted towards the bank of the selected test site and over the full length of the planned structure with severe erosion of the river bank resulting in a complete loss of the unprotected structure of 1995/96. Hence, another location of the Revetment Test Structure had to be determined and the design of the structure to be adapted accordingly. A proposal was presented to WARPO on October 19, 1996 which was discussed with the client and the donors during a review mission of the latter from November 13 to 17, 1996 with the final decision in favour of the location as shown in Fig. 2.

The start and the implementation of works was strongly affected by the land acquisition problem and the progress of works was already behind schedule at the end of 1996, because the subcontractor could only start the actual works on November 20, 1996 and concentrated till the end of the year mainly on earth works. Even after the client and the donors had decided during their meeting in November 1996 to proceed with the construction works, the concerned authorities of the Government of Bangladesh took almost another month for compensation payment to the local population after the donors had agreed to advance necessary funds.

Due to the above mentioned circumstances the delay of the actual construction works accumulated to almost 2.5 months. However, the Consultant and his Subcontractor made every effort to make up for lost time and on June 12, 1997 the Revetment Test Structure was complete in all respects.

During the construction phase the structure was protected by a natural earth dam. This was important for the completion of the falling aprons. It remained intact for a longer period than expected and was finally washed away only in the last week of June 1997. Hence, the test structure was subjected to flow and wave attack and the falling aprons started to function. During the monsoon 1997 the structure was strongly attacked by the river and severe erosion downstream from the structure was observed. In July flow velocities up to 3.9 m/s were measured and a scour hole developed in front of Section D and E the deepest level of which was at –7.0 m+PWD. The river attack continued also in August and September just as the severe erosion downstream from the test structure, which was about 100 m in September in an area about 1 km downstream from the structure.

Though the flow velocity decreased considerably in September, the depth of the scour hole in front of the structure increased and shifted to Section G and H. The deepest level was recorded at –14 m+PWD. In October 1997 a mid channel char continued to grow in front of the Railway ferry ghat. This resulted in a reduction of width and depth of the channel near the bank upstream from the Revetment Test Structure, whereas the western channel developed further and attacked the riverbank just downstream from the structure. Considerable erosion of some 50 m were recorded in October and this process continued till the end of the year. However, no damage to the structure was observed, the falling aprons functioned as expected and at the end of the year sedimentation in the area of the falling aprons of Section G and H and in the channel occurred. Hence, no adaptation and repair works were required. Only some rain-cuts, which had developed under the revetment of the main embankment in Section E, had to be filled.

Also during the first quarter of 1998 erosion has been observed downstream from the structure up to Ghutail Bazar. When the water level started to rise at about mid March, the test structure came under attack again, but the falling aprons continued to function as expected. In June and July sedimentation occurred in front of the structure with maximum deposition of about 17.5 m along Section H-2. In August, however, fresh erosion gave way to the sedimentation process and continued along the structure till end of the year affected in the last quarter by the formation of a new char in front of the

structure. During the whole year 1998 no damages to the structure caused by the river were observed and no adaptation and repair works were to be done.

At the beginning of 1999 a number of chars had developed in the vicinity of the test structure and a channel aimed at an angle of about 40° at Section B and C of the structure. After moderate changes of the river bed in front of the revetments and falling aprons during the first 5 months of the year, the erosion process started to increase in June and resulted in deep scour holes up to about –5 m+PWD in the downstream area. In July the oblique channel shifted further downstream and the parallel channel in front of the revetment structure started to silt up. During the last quarter of the year when the water level continued to fall a strip of land gradually surfaced, which had a width of about 100 m in front of the structure and which the local population started to cultivate. Their activities continued during the dry season 2000, when the water level further went down and no erosion occurred in front of the revetment structure.

Also after the third year of testing the structure no adaptation and repair works had to be executed.

N778 800 N778 600 N778 400 N778 200 N778 000 N777 800 N777 600 N777 400

E 471600 E 471400 E 471200 E 471000 E 470800 E 470600

To Schools
(Primary, Secondary, Madrasha)

FAP 21.B

LAND ACQUISITION
PHASE I (1995-96)

EC - MB Camp

pond

FAP 21 - X

A-2

B

Village North - south
connection

Consultants
camp

±10.0

LAND ACQUISITION
PHASE II (Site Survey 17.10.96)

FAP 21.28

SEE DETAIL
DRG. R-A-315

R=50

H-2

FAP 21-Y

H-1

Market

C

D

E

F

G

FAP-770

Pond

Pond

GPS FM 764

BANKLINE ON
15TH MAY' 97

BANKLINE ON
15TH.OCTOBER'96

179.40
224.40
45.0

JAMUNA RIVER

175.48
470.08
503.82

DRAWING PHOTOREDUCED BY 50%

CONTROL POINT SCHEDULE			
No. of Control Points	Co-ordinates BTM		Elevation (m PWD)
	Easting	Northing	
FAP21-B	471,548.482	778,800.937	+20.246
*) GPS FM764	471,086.185	778,478.880	—
FAP21.28	471,330.663	777,813.399	+ 20.139
FAP770	471,067.515	778,073.154	+ 20.248
FAP21-X	471,293.485	778,654.360	—
FAP21-Y	471,149.095	777,975.060	—

*) not existent anymore

0 50 100 200 m
SCALE 1 2000

LEGEND

- Embankment
- Road Pucca, Kaccha, Footpath
- High River Bank
- House Pucca, Kaccha & Tinshed
- Traverse Station & Pillar
- Home stead
- Mosque

NOTES

1. The topography shown on this drawing is based on J T WC"s survey of Oct '96 combined with topographical maps of Survey of Bangladesh
2. Levels refer to ±0.00 m PWD
3. Bank line and bathymetric survey as on 09/10/96
4. Reference Drawing :
   R - A - 302 Detailed Layout of Test Structure

REV	DATE	NAME	DESCRIPTION	APPROVED
1	01.6.97	Anwar	AS BUILT DRAWING	

GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES
WATER RESOURCES PLANNING ORGANISATION (WARPO)

BANK PROTECTION PILOT PROJECT FAP-21

JAMUNA TEST WORKS CONSULTANTS, JOINT VENTURE

TEST SITE II - BAHADURABAD

GENERAL LAYOUT OF TEST STRUCTURE
(1996/97)

	NAME	DATE
DRAWN	ANWAR	03-11-96
CHECKED		03-11-96
APPROVED		

SCALE : 1 : 2,000

FIGURE NO. 2

REVISION 1

REVETMENT TEST STRUCTURE
DEFINITION SKETCH

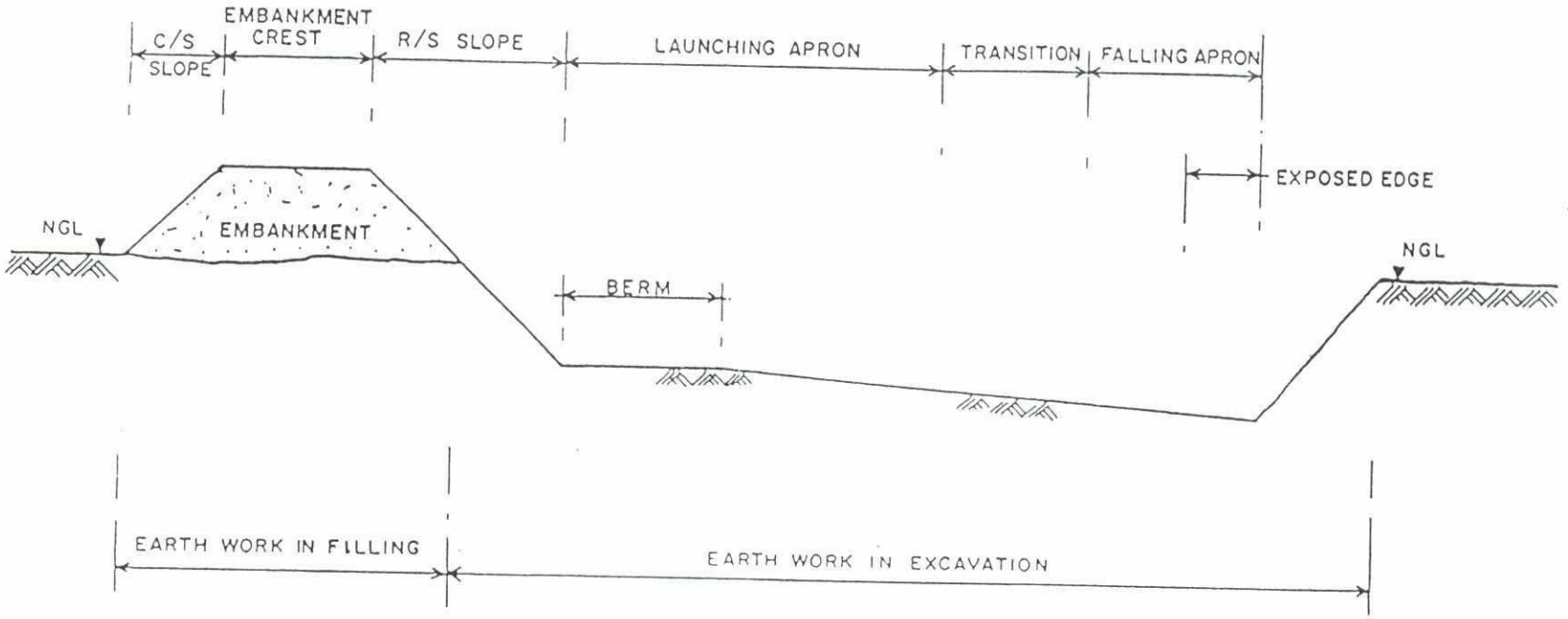


Figure 3: Definition Sketch of the Revetment Test Structure

DETAILS OF REVETMENT COMPOSITION

A. COVER LAYER

Test Structure		A-end	A-1	A-2	B	C	D	E		F	G	H-1	H-2
Land-sided slope		Brick mattress d = 15 cm	In all sections Durba grass sods laid on Geo-jute soil saver										
River side	Approximate length along toe of upper slope (at berm level)	~ 87.40	~ 74.70	~ 74.70	~ 99.10	~ 93.20	88.0	90.0		88.0	100.0	~ 82.75	~ 97.60
	Revetment above berm level (+15.3m to +22.0m PWD)	Brick mattress d = 15 cm	Brick mattress d = 15 cm	Wiremesh mattress d = 23/36 cm with stone fill Grade B (D_{50} = 15 cm)	Wiremesh mattress d = 23 cm with stone fill Grade B (D_{50} = 15 cm) on intermediate rubble layer (d = 25 cm)	CC-blocks D_n = 30 cm hand-laid in single, diagonal lines	CC-blocks D_n = 30 cm hand-laid in single, parallel lines	Interlocking CC-slabs (ship-lap type)		Wiremesh mattress d = 36 cm with brick fill	Interlocking CC-slabs (tongue-groove type) on intermediate layer	Rip-rap Grade C (D_{50} = 20 cm) Top 20 cm with stone pitching (d = 50 cm)	Rip-rap Grade C (D_{50} = 20 cm) Top 20 cm with stone pitching (d = 40 cm)
	Launching Apron at and below berm level (+14.5 m to +15.3 m PWD)		Dumped CC-blocks D_n = 30 cm	Dumped CC-blocks D_n = 35 cm	Dumped CC-blocks Edge us: D_n = 50 cm Center: D_n = 35 cm Edge ds: D_n = 40 cm	Articulated Rano-mattress d = 23/36 cm; stone fill grade B, C, D (D_{50} = 25 cm) with inter-connecting steel wire ropes and anchor piles at berm level	Articulated CC-block mattress with inter-connecting steel wire ropes and anchor pipes at berm level	FORESHORE-mattress (collapsible block mattress with cement grout fill)		PROFIX-mattress (tubular fabric mattress with sand and sand-bitumen fill)	INCOMAT-sandflex mattress (collapsible block mattress with sand fill)	Rip-rap Grade F (D_n = 25-35-45 cm)	CC-blocks D_n = 30 cm D_n = 35 cm (mixed)
	Transition between launching apron and falling apron		CC-blocks D_n = 30 cm	CC-blocks D_n = 30 cm	CC-blocks D_n = 35 cm					Rip-rap Grade E CC-blocks, D_n = 30 cm *1	CC-blocks D_n = 35 cm *2		
	Falling Apron (level +14.5 m PWD)	Dumped CC-blocks D_n = 30 cm	Dumped CC-blocks D_n = 35 cm D_n = 40 cm (mixed)	Rip-rap, Grade E (D_{50} = 30 cm)	Geo-sand-container Type C (180 kg/No.)	Geo-sand-container Type E (900 kg/No.)	CC-blocks D_n = 40 cm	CC-blocks D_n = 40 cm	Geo-sand container D	CC-blocks D_n = 40/45 cm (mixed)	CC-blocks D_n = 35/40 cm (mixed)		
	Exposed edge of falling apron			Rip-rap, Grade F (D_n = 25/35/45 cm)	Geo-sand-container Type D (250 kg/No.)		CC-blocks D_n = 45 cm	CC-blocks D_n = 45 cm	Geo-sand container E	Gabion socks with stone fill Grade B (D_{50} = 15 cm) (1,300 kg/No.)	CC-blocks D_n = 40 cm	Selected boulders D_n = 35-45 cm	

us : upstream
ds : downstream

B. FILTER LAYER

Test Structure			A-end	A-1	A-2	B	C		D	E		F	G	H-1	H-2
Land-sided slope			GF-1	In all sections Geo-jute Soil Saver											
River Side	Approximate length along toe of upper slope (at berm level)		~ 87.40	~ 74.70	~ 74.70	~ 99.10	~ 93.20		88.0	90.0		88.0	100.0	~ 82.75	~ 97.60
	Geotextile filter mats above berm level	Spec. Type	GF-1/-5	GF-1	GF-5	GF-2	Filter III on filter II	Khoa on filter II	GF-2	GF-1	GF-5	GF-1	GF-1	GF-4	GF-4/-2
		Brand Name	BIDIM b7 HaTe 02214	BIDIM b7	HaTe 0 2214	BIDIM S 550			BIDIM S 550	DATEX AD1300	Hate 39014	BIDIM S 390	DATEX AD1300	BIDIM S 700	HaTe E650/K251
	Geotextile filter mats at and below berm level	Spec. Type	GF-1/-5	GF-2	GF-2	GF-4	GF-2		GF-4	FORESHORE-mattres (collapsible fabric block mattress with cement grout fill)		PROFIX-mattress (tubular fabric mattress with sand and sand-bitumen fill)	GF-1 (sub-layer to INCOMAT-sand flex mattress)	GF-1	GF-1
		Brand Name	BIDIM b7 HaTe 02214	BIDIM S 550	BIDIM S 550	HaTe K 251	DATEX AD 1600		BIDIM S 700				BIDIM b 7	BIDIM S 390	BIDIM S 390

Table 2: Details of Revetment Composition

2.3.2 Monitoring of the Test Structures

Monitoring of the Revetment Test Structure started already during the construction phase in January 1997. During the period under report the following activities have been performed:

(1) Bathymetry

Bathymetry surveys are mainly done to record riverbed changes in front of the test structure and to detect their influence on the stability of the structure, in particular to find out the behaviour / functioning of the falling aprons and launching aprons, since this is decisive for the overall stability of the test structure.

The activities during the months of April to June 2000 are shown in Table 3. All the surveys were finally processed in the office in Dhaka and the results are shown in contour charts as well as differential models (see Annex G and H).

Date	Survey Area		
	April 2000	May 2000	June 2000
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			main survey
19			main survey
20	main survey		main survey
21	main survey		
22	main survey	main survey	
23	main survey	main survey	
24		main survey	
25		main survey	
26			
27			
28			
29			
30			
31			

Table 3: Bathymetry surveys at Bahadurabad Test Site from April to June 2000

More detailed surveys have been carried out in June in the individual sections of the structure. The aim of these activities is to get more information on erosion and sedimentation in the channel in front of the structure, in the area of the falling aprons and on the functioning of the falling/launching aprons. The results of these measurements are given as cross-sections in Annex I.

(2) Topographic Measurements

During the period under review the following works were performed:

04/05	bankline and waterline from Test Site II to Ghutail
25/05	bankline and waterline from Harindhara to Belgacha
27/05	char in front of Belgacha
28/05	bankline from Belgacha to Ghutail
18-19/06	bankline from Harindhara to 1.5 km d/s from Ghutail

(3) Measurement of Flow Velocity and Direction

Float track measurements were continued as well as measurements with the Valeport currentmeter. Results of flow measurements are presented in the monthly reports on monitoring and in Annex G.

(4) Observations

The sharp rise of the water level of more than 1 m within a few days in April and May as described in Subsection 2.2.2 for the area of the Groyne Test Structure were of course also observed at Bahadurabad. The same happened again during the period June 12 to 17, when a rise of 1.65 m was recorded. At the end of the period under report the water level was at 19.13 m+PWD.

During this second quarter of the year no significant morphological changes have been observed in the test site area. In front of the test structure small sedimentation was recorded, whereas the erosion process upstream from the structure in the area of Harindhara increased in June. The flow velocities in June were about 1.6 m/s along the structure and 2.7 m/s maximum in the main channel.

2.4 TEST SITE III AT GHUTAIL

2.4.1 Introduction

During the monsoon season 1997 and the following dry season severe erosion occurred further downstream from the Revetment Test Structure at Bahadurabad. Following the demand of the local population for suitable protection of their land and homesteads, WARPO requested the donors KfW and AFD during their review mission in July 1998 to agree to the implementation of a third test site at Ghutail, about 4 km downstream from the Revetment Test Structure. Since the test structures at Kamarjani and Bahadurabad had been implemented within the available budget and taking into account a cost estimate for their monitoring and maintenance until the completion of the Project by the end of December 1999, remaining funds of about DM 8.4 million were estimated. Taking further into account the intention to utilise the contract amount up to 100 %, it was agreed between the donors, WARPO and BWDB in July 1998 to implement a third FAP 21 test site at Ghutail.

Immediately after the decision had been taken in favour of a third test site, the Consultant started necessary investigations and surveys and arrived finally at the conviction that any test structure at any suitable test site on the Jamuna could not be completed before the monsoon season 1999. It was therefore suggested to the donors and the client on November 01, 1998 to start the actual construction of the third test structure after the monsoon season 1999 only.

In December 1998 a technical and financial proposal for the implementation of a third test structure along with a proposal for necessary modification of consulting services was submitted by the Consultant because the existing Contract was scheduled up to the end of 1999 only. The client and the donors approved the extension of the Contract up to end of 2000, but asked for some modifications of the financial proposal taking into account also the discussions and findings of the donors' review mission of March 1999. A revised proposal was submitted in May 1999, which was finally approved by the donors and the client as well.

2.4.2 Selection of Test Site

Within the feasible reach of the test sites of Kamarjani and Bahadurabad, six locations had been investigated and assessed with regard to their suitability for a third test structure. Basis of the analysis of the pre-selected sites were the site selection criteria already defined in the Final Planning Study Report FAP 21. Finally, Ghutail and the consolidation of the Revetment Test Structure at Test Site II were assessed to be most suitable for the implementation of a third test structure. Details of the assessment were presented in a revision of the "Proposal for Modification of Consulting Services for Test Site III" in May 1999.

Since small erosion in front of Ghutail continued more or less throughout the year, it was decided to build the third test structure in this area. The final location of the structure was determined mid November 1999 taking into account the something-to-defend criterion, the prevailing situation on site after the monsoon season 1999, in particular the actual bankline, and budget constraints as well. The final general layout of the structure is shown in Fig. 4.

2.4.3 The Structure

Based on the local situation and the investigations/observations since July 1998, when the general decision was taken to implement a third test site, it was decided to build another Revetment Test Structure taking into account the experience of Bahadurabad Test Site. A preliminary design was submitted with the "Proposal for Modification of Consulting Services for Test Site III" in May 1999, which had to be adapted to the actual situation on site at mid November of that year.

The revetment consists of an embankment and 2 different sections of launching/falling aprons. The crest of the embankment is at 21.50 m+PWD and the launching/falling aprons are built in the dry at 15.0 m+PWD, i.e. above Standard Low Water Level, which is at about 12.85 m+PWD. The total length of the aprons is 31 m in Section A and 28 m in Section B. They are designed to cope with scouring up to about –5 m+PWD. The 16 m long launching aprons are constructed of articulated RENO-mattresses with rubble-fill placed on geotextile filter. For the falling apron cc-blocks are used, the size of which is 40 and 45 cm in Section A and 35 and 40 cm in Section B. The water side slope of the embankment is protected by brick mattressing on geotextile filter.

A detailed layout and cross-sections were presented in Annex M of Progress Report No. 26. However, in January/February 2000 some modifications were required to adapt the design of the structure to the existing conditions in the test site area. This holds in particular for the downstream end of the structure. For details see Annex N of this report.

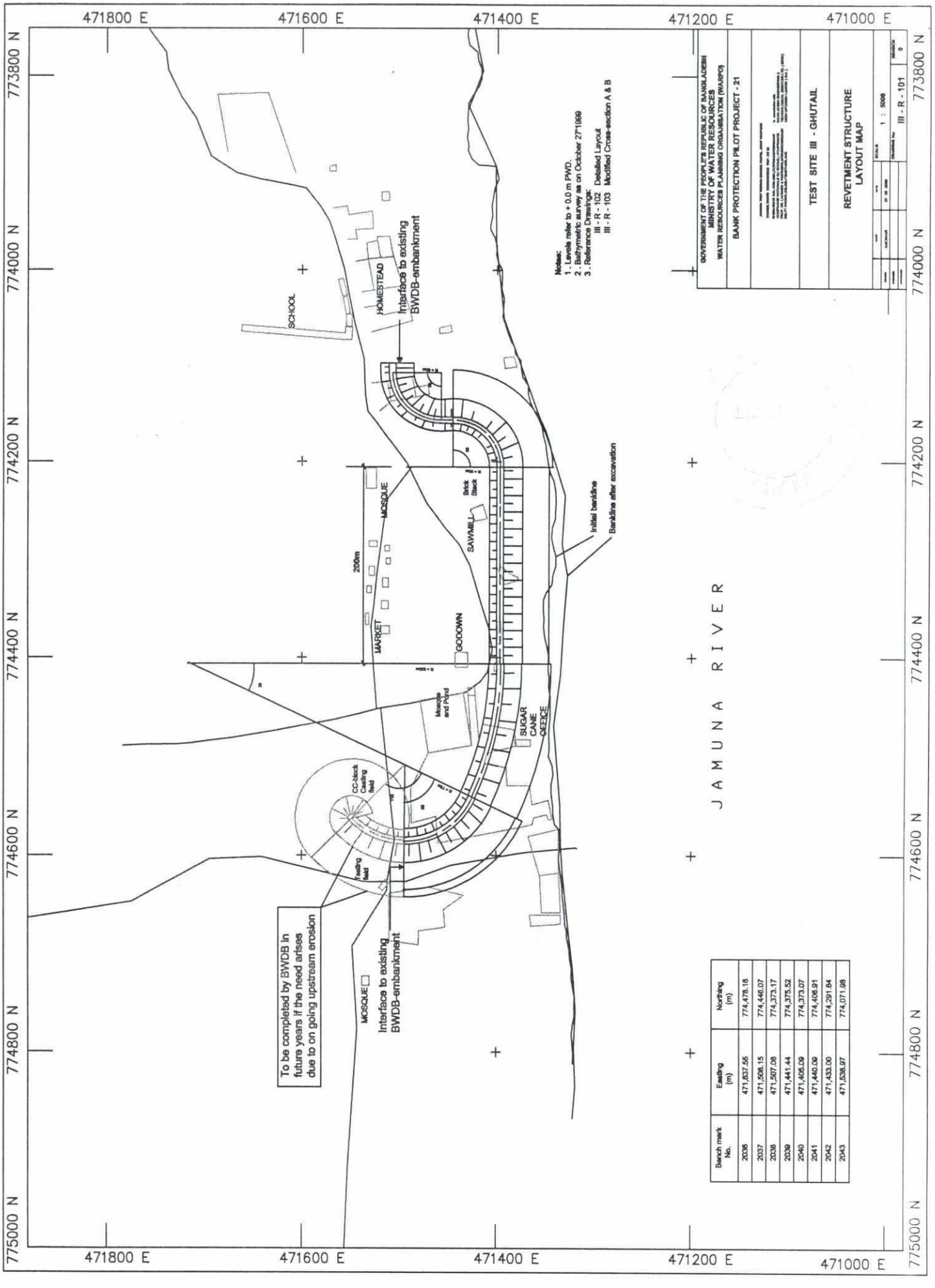
2.4.4 Execution of Works

The Contract with the Subcontractor for the execution of construction works was signed on June 23, 1999. The same day an order was placed for the supply of boulders. The Subcontractor started the site installation at Ghutail in July and the production of cc-blocks for the falling aprons on September 01, 1999.

The land acquisition procedure began in April 1999 and a first assessment followed in November after the final location of the structure and its dimensions were determined.

The major equipment for earth works arrived at site mid of November, but the actual construction works (earth works) could only be started on December 18, 1999 because of temporary problems with the local population in connection with compensation for crops and shifting of houses.

28


471800 E
471600 E
471400 E
471200 E
471000 E
773800 N
774000 N
774200 N
774400 N
774600 N
774800 N
775000 N
SCHOOL
HOMESTEAD
Interface to existing BWDB-embankment
MOSQUE
MARKET
200m
GODOWN
SAWMILL
Brick Stack
Mosque and Pond
SUGAR CANE QERCE
CC-block Casting field
Existing Field
To be completed by BWDB in future years if the need arises due to on going upstream erosion
MOSQUE
Interface to existing BWDB-embankment
Initial bankline
Bankline after excavation
J A M U N A R I V E R
Notes:
1. Levels refer to + 0.0 m PWD.
2. Bathymetric survey as on October 27'1999
3. Reference Drawings:
III - R - 102 Detailed Layout
III - R - 103 Modified Cross-section A & B
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES
WATER RESOURCES PLANNING ORGANISATION (WARPO)
BANK PROTECTION PILOT PROJECT - 21
TEST SITE III - GHUTAIL
REVETMENT STRUCTURE
LAYOUT MAP
SCALE 1 : 5000
III - R - 101
Bench mark No. | Easting (m) | Northing (m)
2036 | 471,837.55 | 774,478.18
2037 | 471,508.15 | 774,446.07
2038 | 471,507.06 | 774,373.17
2039 | 471,441.44 | 774,375.52
2040 | 471,405.09 | 774,373.07
2041 | 471,440.09 | 774,406.91
2042 | 471,433.00 | 774,291.84
2043 | 471,536.97 | 774,071.98

The most time consuming part of the works was the production of cc-blocks, for which more than 70% of the required funds were needed. On January 01, 2000 about 38% only of the total quantity of blocks had been cast, i.e. the production was behind schedule by about 4000 m^3. After improvement of the production procedure about 6500 m^3 could be made in February. At the end of March the production of 45 cm blocks was complete and that one of 35 cm and 40 cm cubes on April 04, 2000.

Filling of the trench in the transition area between the launching apron and the falling apron started on January 19, 2000. In order to obtain the maximum density of the cc-blocks and a plain surface, which serves as base for the wire mesh mattresses of the launching apron, the cubes were not dumped as specified, but carefully piled up one on top of the other. This work, which was started in the central section and continued to both ends of the structure was complete on April 21, 2000.

Placing of geotextile and Reno mattresses of the launching apron started on January 28 and was complete on May 02, 2000.

After the land acquisition problems in the central part of the embankment were resolved, the remaining earth works and placing of brick mattressing on its water side slope, which was started on February 05, was completed on May 05, 2000.

The road construction behind the embankment was strongly hampered by unusually early and heavy rainfall from about mid April. However, its pavement was completed on June 07, 2000.

The main construction equipment of the Contractor was moved from the site end of the period under report.

2.4.5 Monitoring of the Test Structures

After the decision had been taken to build a third test structure, the Consultant started necessary investigations, bathymetric surveys and flow measurements, in particular in the area of Ghutail Bazar. These activities were continued during the construction phase and after completion of the test structure. Since June 1998 the survey area in front of the Revetment Test Structure at Bahadurabad was extended to the south and the area in front of Ghutail Bazar included. During the period under report the following activities have been performed:

(1) Bathymetry

The activities during the months of April to June 2000 are the same as mentioned in Subsection 2.3.2 for Bahadurabad. Hence, for details see Annex G and H. In addition to the main surveys shown in Table 3, site surveys have been carried out on April 14, from May 19 to 20 and on June 06, 2000. The results are shown in contour charts in Annex O and as cross-sections in Annex P.

(2) Topographic Measurements

From April to June the following works were performed:

14/04	bankline
20/05	bankline
28/05	bankline from Belgacha to Ghutail
29/05	char in front of Ghutail
18-19/06	bankline

(3) Measurements of Flow Velocity and Direction

Additional float track measurements as well as measurements with the Valeport currentmeter were carried out at Ghutail Test Site on April 27, May 20 and June 17, 2000. Results are presented in the monthly reports on monitoring and in Annex O.

(4) Observations

The change of water levels during the period under report is more or less the same as recorded at Bahadurabad Test Site. Also at Ghutail a rise of 1.58 m was observed from June 12 to 17. At the end of June the water level was at 18.83 m+PWD.

In April and May the average flow velocity along the Revetment Test Structure was between 0.9 and 1.0 m/s, but increased in June up to 1.2 m/s. No significant erosion has been observed in front of the test structure, but only downstream from it and in June a sedimentation process started (see Annex P).

2.5 REPORTING

2.5.1 Introduction

In accordance with the Terms of Reference and the Consulting Agreement the Consultant has critically to assess the results of the test programme at the end of the Project and present a

Final Technical, Financial and Economical Project Evaluation Report

together with

Guidelines and Manuals for Planning, Design and Implementation of River Training and Bank Protection Works.

The latter are to be prepared on the basis of all available know-how and experience gained during the Project and should be applicable to more or less standard solutions for rivers in Bangladesh, in particular the Brahmaputra/Jamuna River.

On the occasion of the donors' review mission in July 1998 the Consultant presented in a work shop on July 20, 1998 his concept for the above mentioned reports. Tables of Content were elaborated and discussed with the donors and engineers of BWDB and WARPO. Finally, a time schedule was agreed upon in the workshop for the presentation of the Guidelines and Manuals. Since however, the project period was extended until end of 2000 due to the implementation of third test site, the schedule for elaborating the Guidelines and Manuals as well as the Final Project Evaluation Report needed to be modified. The programme of July 1998 was discussed with all parties concerned and updated during the donors' review missions of March 1999 and February/March 2000. The following updated programme was jointly agreed upon:

Date	Task	Action
December 1998	Determination of participants and composition of BWDB/WARPO working group; Definition of general concept and degree of Detailing	Finalized
December 1998	Determination of Table of Contents	Approved

Date	Task	Action
January to March 2000	Submission and presentation of draft chapters of the Guidelines	Consultant
July 2000	Submission of consolidated comments and suggestions of modification to draft Guidelines and Manual	BWDB / WARPO
October 2000	Inclusion of additional experiences from the monsoon 2000 season, if any	Consultant
December 2000	Submission of Final Document	Consultant

Since the basic contents of the Guidelines and the Manual are prepared before the construction and testing of the third test structure, all specific results and conclusions with respect to the Revetment Test Structure at Ghutail can only be added at the end of the project period.

2.5.2 Status of Works

(a) Final Project Evaluation Report

All information, experience and data gathered at the test sites with the different systems during the construction and monitoring period respectively have to be analysed in order to define the most suitable solutions for bank protection structures in Bangladesh with regard to their design, construction materials and construction methods. Hence, the results of and the experience with the test structures will be compiled for each of the structures in reports on

- design;
- procurement and construction;
- monitoring, and
- evaluation of hydraulic loads and river response

together with a report on the morphological behaviour of the river in the test site areas and relevant investigations respectively.

These reports will be presented as annexes to the technical part of the evaluation report. The latter will contain summaries of the annexes in a form as condensed as possible together with the conclusions and lessons learned.

This concept holds also for the other part of the final report viz. the financial and economical evaluation. The following annexes are under preparation and their status at the end of the period under report was as follows:

Annex 1	Morphological Investigations	100%
Annex 2	Socio-economic Investigations	60%
Annex 3	Ecological Assessment	50%
Annex 4	The Groyne Test Structure Design Report	95%
Annex 5	The Groyne Test Structure Procurement and Construction Report	70%
Annex 6	The Groyne Test Structure Monitoring Report	80%

Annex 7	The Groyne Test Structure Evaluation of Hydraulic Loads and River Response	60%
Annex 8	The Revetment Test Structure Design Report	90%
Annex 9	The Revetment Test Structure Procurement and Construction Report	20%
Annex 10	The Revetment Test Structure Monitoring Report	80%
Annex 11	The Revetment Test Structure Evaluation of Hydraulic Loads and River Response	80%
Annex 12	Financial and Economic Evaluation	40%

The status of relevant chapters of the main report correspond more or less to the above given figures.

(b) Guidelines and Manuals

The main topics of the Guidelines are **Planning, Design** and **Implementation** of river training and bank protection works. The structure of the documents has been discussed in the workshop in July 1998 and takes into account the existing guidelines and manuals of BWDB. In the course of preparation slight modifications of the Tables of Content were required, but the focal points of the documents are still:

- identification of priority protection sites;
- preparatory investigations and studies;
- general planning requirements;
- design principles for the individual bank protection and river training works;
- construction (materials, methods, equipment and implementation), and
- monitoring and maintenance.

The Table of Contents of the Guidelines is as follows:

Chapter 1	Introduction
Chapter 2	Objectives of River Training and Bank Protection Works
Chapter 3	Types of River Training and Bank Protection Works
Chapter 4	Identification of Priority Protection Sites
Chapter 5	General Approach
Chapter 6	Preparatory Investigations and Studies
Chapter 7	General Planning Requirements
Chapter 8	Design Principles for Embankments
Chapter 9	Design Principles for Cross Bars
Chapter 10	Design Principles for Revetments
Chapter 11	Design Principles for Groynes
Chapter 12	Design Principles for Guide Bunds
Chapter 13	Design Principles for Training Walls
Chapter 14	Design Principles for Bandals
Chapter 15	Design Principles for Floating Screens
Chapter 16	Design Principles for Artificial Cut-offs
Chapter 17	Design Principles for Closure dams
Chapter 18	Construction Materials
Chapter 19	Construction Methods
Chapter 20	Construction Equipment
Chapter 21	Implementation of Construction Works
Chapter 22	Monitoring and Maintenance of Works

At the end of June 2000 the first draft of the Guidelines is complete by about 95%. Only Chapter 11 and 20 are incomplete.

On January 30, 2000 a meeting was held with the working group of BWDB. As discussed and agreed upon during the meeting, the Consultant did not submit the Guidelines as a whole but in sections. The individual chapters were submitted to WARPO and BWDB as follows, each time with the request for comments and suggestions of modification:

Chapter 1 to 3	February 06, 2000
Chapter 4 to 7	March 06, 2000
Chapter 8 and 10	May 09, 2000
Chapter 14 to 19	May 31, 2000
Chapter 21 and 22	May 31, 2000.

It is mentioned that Chapter 9, 12 and 13 dealing with design principles for cross bars, guide bunds and training walls is not covered by the Consultant, but kept free for the experience of BWDB. In the meeting on January 30 and the letter of May 31, 2000 it was stressed, however, that the Consultant is prepared for discussions with BWDB engineers in this regard.

Unfortunately, even at the end of June 2000 the Consultant has not received any reply neither from WARPO nor BWDB.

The preparation of the Design Manual was not yet started.

3 RIVER TRAINING (AFPM) COMPONENT (FAP 22)

3.1 PRELIMINARY REMARK

After the activities under FAP 22 had been suspended in 1995, the Consultant was requested by WARPO on March 06, 1996 to take up recurrent measure activities. Therefore, the project works were resumed at the beginning of April 1996 and concentrated mainly on the completion of the desk study and a report on the activities in 1995/96, which was submitted on September 05, 1996 along with a proposal and work plan for the project continuation for the implementation of recurrent measures during the lean season 1996/97. The work plan covered the selection of suitable test sites as well as the design, implementation and testing of appropriate recurrent measures as Low Water Bandals, Improved Bandals and Sills.

Immediately after the positive comments of KfW on the Consultants programme of investigations in 1996/97 were received in September 1996, a suitable test site had been selected in the outflanking Katlamari channel just upstream from Fulchari where a combination of two measures viz. a 210 m long bandal structure and an earth dam about 600 m downstream from the bandals was built. Design and construction works started in the last quarter of 1996 and were completed mid March 1997. These measures were tested by the Jamuna river and monitored by the Consultants during the monsoon season 1997. It was intended to supplement/modify the test structures based on the experience of the first test season and to continue the investigations during the monsoon season 1998. A technical and financial proposal for further investigations was submitted to the client and the donors in the last quarter of 1997, but at the end of the flood season 1997 it emerged that the overall morphological development in the test site area and the Fulchari channel did not allow the continuation of the tests at Katlamari Test Site. Therefore, at the beginning of January 1998 a new test site was selected for testing of recurrent measures during the monsoon season 1998 which was located about 5 km east of the Groyne Test Structure of FAP 21 at Kamarjani. Unfortunately, the investigations had to be stopped because of the opposition of the population in that area.

Table 2.2-1 and Table 2.2-3 are showing the Work Plan as per proposal of August 1996 and December 1997 respectively whereas Table 2.2-5 the Staffing Schedule for the study period 1996 till 1998 including that one of the modified proposal of December 1997. Table 2.2-2 and 2.2-4 are showing the actual activities up to the end of 1997 and 1998 respectively and Table 2.2-6 and 2.2-7 the actual input of the expatriate and the local professional staff fielded up to end of June 2000.

3.2 TEST SITE I AT KATLAMARI

3.2.1 The Test Structures

Two different structures were built at Katlamari:

(a) improved bandals with a total length of 210 m and consisting of 4 main components at the off-take of the Katlamari channel with the aim to deflect the flow and to encourage siltation behind the structure;

(b) an earth dam 600 meters downstream from the bandal structure with the aim to close the Katlamari channel at the beginning of the flood season.

The idea behind these measures was to deflect the flow into the Fulchari channel, to decrease the size of the Katlamari channel and thus concentrate more flow in the Fulchari channel, to deepen the latter and to improve the ferry operations to Fulchari Ghat. In parallel it was expected that the size of the Katlamari channel would decrease, that bank erosion would diminish and agradable land could be won.

Both the structures were designed to support the effectiveness of each other and thus to increase their overall efficiency.

3.2.2 Monitoring of the Test Structures

After the Fulchari channel started to move westwards and finally washed away Section E of the bandal structure, it was decided to abandon this test site. In January/February 1998 dismantling of the remaining sections of the structure except Section A was started and the dismantled material of the bandal structure was transported to the new test site at Kundarapara and partly used for the construction of low water bandals. After the monsoon season also Section A was given up.

Hence, no monitoring activities are to be reported from the period under review.

3.3 TEST SITE II AT KUNDARAPARA

3.3.1 The Test Structures

In order to reduce the severe erosion in the outer bend of the Kamarjani channel between Syedpur and Balashi Ghat it was planned to promote the development of the Kundarapara cut-off channel. The following recurrent measures were planned to be constructed and investigated:

(a) Low Water Bandals

Low water bamboo bandals were installed in February / March 1998 at the entrance of the Kamarjani bypass channel in order to increase the inflow into the Kundarapara channel and at the same time to reduce the inflow into the Kamarjani bypass channel. The bandals were removed end of March 1998 when the water level started to rise.

(b) Improved Bandals with adjustable Screens

After permanent problems with the local population, it was decided on March 10, 1998 to stop the construction of the improved bandals when it became obvious that they could not be completed in time before the flood season 1998.

(c) Floating Screens

In the course of positioning and anchoring of the elements, local people sabotaged the activities so that the Consultant had no choice but to stop the investigations with floating screens for the flood season 1998.

3.3.2 Monitoring of the Test Structures

During the period under report bathymetric surveys and flow measurements were continued in the Kundarapara channel the results of which are presented in Annex B and C (FAP 21, Test Site I). However, testing of the floating elements remained suspended, since the morphological situation and channel configuration at the third FAP 21 test site did not allow any tests with floating screens.

3.4 REPORTING

Valuable results of the tests with recurrent measures gained at Katlamari and Kundarapara Test Sites will be included in the Guidelines for river training and bank protection works, which are under preparation (Section 2.5).

Table 1.1-1

BANK PROTECTION TEST STRUCTURES - FAP 21
EXPATRIATE PROFESSIONAL STAFF
Activities during the period of 04/2000 to 06/2000

VERSION : 09.07.00

Sl. No.	Function	Person	Code	Company	Period		Remarks
					From	To	
1.1	Project Director	Dr. D. Neuhaus / Dr. H. Kramer	DN / HK	RRI	01/04	30/06	Part time in Europe
1.2	Home Office Support						
1.3.1	Project Manager	C. Netzeband	CN	RRI	01/04	10/05	
					11/05	12/06	Home Office Work & Leave
					13/06	30/06	
1.4	Chief Hydraulic Design Engineer	Dr. H. Kramer	HK	L&P	01/04	30/06	Part time in Europe
2.1.1	Hydraulic Design Engineer	M. Schwarz	MS	L&P	01/04	30/06	Part time in Europe
2.2	Structural Engineer	-	-	-	-	-	
2.3	Mechanical Engineer	-	-	-	-	-	
2.4	Procurement Expert	-	-	-	-	-	
2.5.1	Subsoil Expert	H. Wessling	HW	L&P	-	-	
3.1.	Chief Supervising Engineer	-	-	-	-	-	
3.2.1	Supervising Engineer	K. Oberhagemann	KO	RRI	01/04	31/05	
3.4.1	Surveyor	J. Heise	JH	RRI	-	-	
3.5.1	Administrator	B. Thomas	BT	CNR	-	-	
3.6.1	Monitoring Expert	T. Döscher	TD	RRI	-	-	
4.1.1	Morphologist	Dr. E. Mosselman	EM	DELFT	01/05	31/05	Part time in Europe
4.2.1	Modelling Expert	M. v. d. Wal	MvdW	DELFT			
		D. Carrion	DC	CNR	-	-	
		E. Divet	ED	CNR	-	-	
4.3.1	Environmental Expert	C. Bertrand	CB	CNR	-	-	
4.5.1	Economist	--	-	-	-	-	
4.6.1	Unallocated	--	-	-	-	-	

TABLE 2.1-2

STUDIES ON RECURRENT MEASURES - FAP 22
LOCAL PROFESSIONAL STAFF
Activities during the period of 04/2000 to 06/2000

VERSION : 09.07.00

Sl. No.	Function	Person	Code	Company	Period		Remarks
					From	To	
1.2	Home Office Support	NN	-	-	-	-	
1.3.2	Deputy Project Manager	S. M. Mansur	SM	BETS	-	-	
5.1.2	River Engineer 2	S. R. Khan	SRK	BETS	-	-	
5.3.2	Surveyor 2	--	-	-	-	-	
5.4.2	Morphologist 2	Salahuddin Khan	SK	BETS	-	-	
5.8.2	Supervising Engineer 2	F. R. Khan	FRK	DUL	-	-	
5.9.2/3/4	Monitoring Expert 2	A.B.M. Anwar Haider	AH	BETS	-	-	
	Jr. Monitoring Expert	Pankaj K. Maitra	PKM	BETS	-	-	
	Monitoring Data Processor	Yasmin Khayer	YK	FL	-	-	
5.10.2	Economist 2	Dr. Lutfor Rahman	LR	BETS	01/04	30/04	

Table 1.1-3

BANK PROTECTION TEST STRUCTURES - FAP 21
LOCAL SUPPORT STAFF
Activities during the period of 04/2000 to 06/2000

VERSION : 09.07.00

Sl. No.	Function	Person	Company	Period		Remarks
				From	To	
1	Bilingual Secretary	Sk. Zakirul Islam	BETS	01/04	30/06	
2	Receptionist	Md. Razaul Karim	BETS	01/04	30/06	
3	Operator / Data Input	Md. Khorshed Alam	BETS	01/04	30/06	
4	Senior Draftsman	Anowarul Alam	BETS	01/04	30/06	
5	Draftsman	Md. Fazle Hossain Bhuiyan	BETS	01/04	30/06	
6	Photocopy Operator	Md. Q M Hussain (Babu)	BETS	01/04	30/06	
7	Accountant	A.B.M Bazlur Rashid	BETS	01/04	30/06	
8	Asstt. Acct. Purchase	Md. Shafiuddin	BETS	01/04	30/06	
9	Messenger	Md. Aziz	BETS	01/04	30/06	
10	Peon	Md. Habibur Rahman Hawladar	BETS	01/04	30/06	
11	Guards (8 hours shift)	Md. Farid Sikder /	BETS	01/04	30/06	
		Md. Moqbul Hossain /	BETS	01/04	30/06	
		Md. Shakawat Hossain	BETS	01/04	30/06	
12-19	Drivers	Eight Drivers	L&S	01/04	30/06	

TABLE 1.2-1.1

BANK PROTECTION TEST STRUCTURES FAP 21

WORK PLAN *)

VERSION NO. 1

15.03.1995

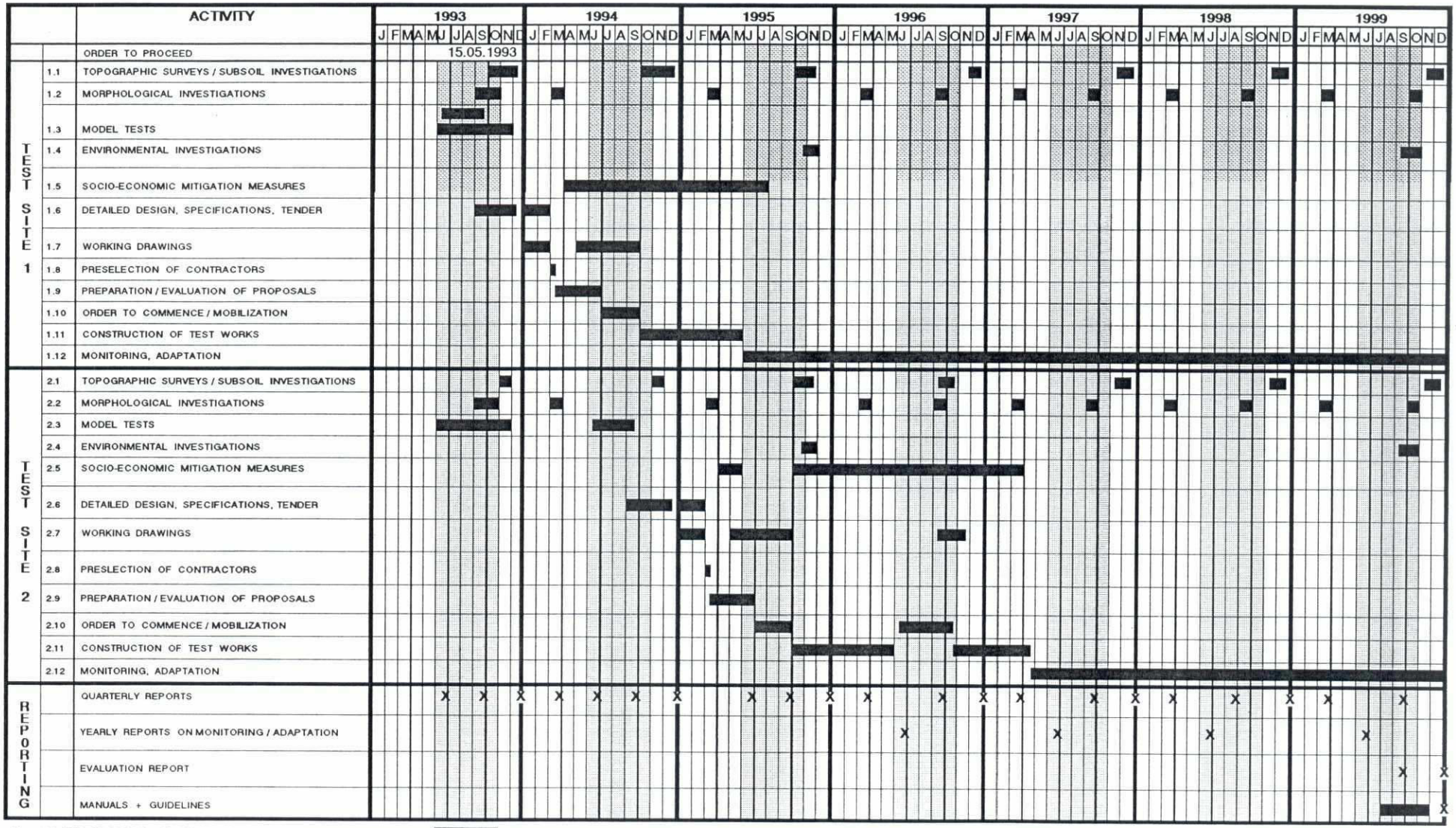
		ACTIVITY	1993	1994	1995	1996	1997	1998
			J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
		ORDER TO PROCEED	15.05.1993					
TEST SITE 1	1.1	TOPOGRAPHIC SURVEYS / SUBSOIL INVESTIGATIONS						
	1.2	MORPHOLOGICAL INVESTIGATIONS						
	1.3	MODEL TESTS						
	1.4	ENVIRONMENTAL INVESTIGATIONS						
	1.5	SOCIO-ECONOMIC MITIGATION MEASURES						
	1.6	DETAILED DESIGN, SPECIFICATIONS, TENDER						
	1.7	WORKING DRAWINGS						
	1.8	PRESELECTION OF CONTRACTORS						
	1.9	PREPARATION / EVALUATION OF PROPOSALS						
	1.10	ORDER TO COMMENCE / MOBILIZATION						
	1.11	CONSTRUCTION OF TEST WORKS						
	1.12	MONITORING, ADAPTATION						
TEST SITE 2	2.1	TOPOGRAPHIC SURVEYS / SUBSOIL INVESTIGATIONS						
	2.2	MORPHOLOGICAL INVESTIGATIONS						
	2.3	MODEL TESTS						
	2.4	ENVIRONMENTAL INVESTIGATIONS						
	2.5	SOCIO-ECONOMIC MITIGATION MEASURES						
	2.6	DETAILED DESIGN, SPECIFICATIONS, TENDER						
	2.7	WORKING DRAWINGS						
	2.8	PRESLECTION OF CONTRACTORS						
	2.9	PREPARATION / EVALUATION OF PROPOSALS						
	2.10	ORDER TO COMMENCE / MOBILIZATION						
	2.11	CONSTRUCTION OF TEST WORKS						
	2.12	MONITORING, ADAPTATION						
REPORTING		QUARTERLY REPORTS	X X X X X X X X X X X X X X X X X X X X X X X X					
		YEARLY REPORTS ON MONITORING / ADAPTATION	X X X X					
		EVALUATION REPORT	X X					
		MANUALS + GUIDELINES	X					

*) AS PER LETTER TO PROCEED OF MAY 1993

MONSOON

TABLE 1.2-1.2

BANK PROTECTION TEST STRUCTURES FAP 21
WORK PLAN
REVISION NO. 1 *)



*) AS PER PROPOSAL OF SEPTEMBER 1996

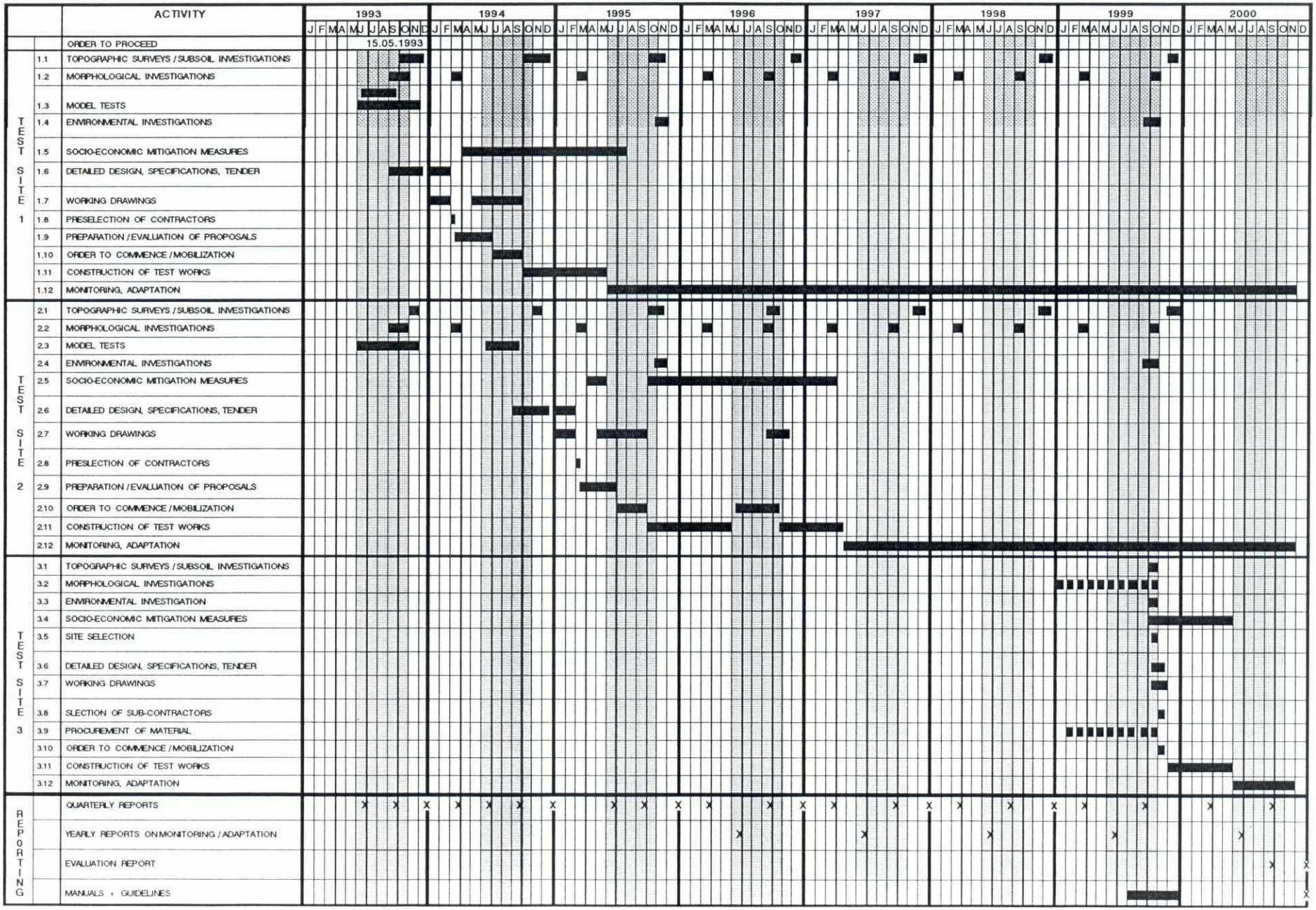
MONSOON

TABLE 1.2-1.3

BANK PROTECTION TEST STRUCTURES FAP 21

WORK PLAN

REVISION NO. 2 *)



*) AS PER PROPOSAL OF MAY 1999

MONSOON

TABLE 1.2-2

BANK PROTECTION TEST STRUCTURES FAP 21
REVISION NO. 2 *)
WORK PLAN - FIELDED UP TO JUNE 30, 2000

		ACTIVITY
		ORDER TO PROCEED 15.05.1993
TEST SITE 1	1.1	TOPOGRAPHIC SURVEYS / SUBSOIL INVESTIGATIONS
	1.2	MORPHOLOGICAL INVESTIGATIONS
	1.3	MODEL TESTS BANGLADESH / FRANCE
	1.4	ENVIRONMENTAL INVESTIGATIONS
	1.5	SOCIO-ECONOMIC MITIGATION MEASURES
	1.6	DETAILED DESIGN, SPECIFICATIONS, TENDER
	1.7	WORKING DRAWINGS
	1.8	PRESELECTION OF CONTRACTORS
	1.9	PREPARATION / EVALUATION OF PROPOSALS
	1.10	ORDER TO COMMENCE / MOBILIZATION
	1.11	CONSTRUCTION OF TEST WORKS
	1.12	MONITORING, ADAPTATION
TEST SITE 2	2.1	TOPOGRAPHIC SURVEYS / SUBSOIL INVESTIGATIONS
	2.2	MORPHOLOGICAL INVESTIGATIONS
	2.3	MODEL TESTS BANGLADESH / FRANCE
	2.4	ENVIRONMENTAL INVESTIGATIONS
	2.5	SOCIO-ECONOMIC MITIGATION MEASURES
	2.6	DETAILED DESIGN, SPECIFICATIONS, TENDER
	2.7	WORKING DRAWINGS
	2.8	PRESELECTION OF CONTRACTORS
	2.9	PREPARATION / EVALUATION OF PROPOSALS
	2.10	ORDER TO COMMENCE / MOBILIZATION REMOBILIZATION (07.07.97)
	2.11	CONSTRUCTION OF TEST WORKS
	2.12	MONITORING, ADAPTATION
TEST SITE 3	3.1	TOPOGRAPHIC SURVEYS / SUBSOIL INVESTIGATIONS
	3.2	MORPHOLOGICAL INVESTIGATIONS
	3.3	ENVIRONMENTAL INVESTIGATIONS
	3.4	SOCIO-ECONOMIC MITIGATION MEASURES
	3.5	SITE SELECTION
	3.6	DETAILED DESIGN, SPECIFICATIONS, TENDER
	3.7	WORKING DRAWINGS
	3.8	SELECTION OF SUB-CONTRACTORS
	3.9	PROCUREMENT OF MATERIAL
	3.10	ORDER TO COMMENCE / MOBILIZATION
	3.11	CONSTRUCTION OF TEST WORKS
	3.12	MONITORING, ADAPTATION

1993 1994 1995 1996 1997 1998 1999 2000

J F M A M J J A S O N D

*) AS PER PROPOSAL OF MAY 1999

MONSOON SCHEDULE REALIZATION

TABLE 1.2-3.1

BANK PROTECTION TEST STRUCTURES - FAP 21

STAFFING SCHEDULE *)

VERSION NO.1 — 15.03.1993

		FUNCTION	1993 J F M A M J J A S O N D	1994 J F M A M J J A S O N D	1995 J F M A M J J A S O N D	1996 J F M A M J J A S O N D	1997 J F M A M J J A S O N D	1998 J F M A M J J A S O N D	MAN-MONTHS EXPATRIATES BD	EU	LOCAL	
	1.1	PROJECT DIRECTOR							3	8		8
	1.2	HOME OFFICE SUPPORT								10	7	
	1.3.1/2	PROJECT MANAGER / DEPUTY PROJECT MANAGER							58	3	67	17
	1.4	CHIEF HYDRAULIC DESIGN ENGINEER							16	2		8
								SUB-TOTAL	77	23	74	33
	2.1.1/2	HYDRAULIC DESIGN ENGINEER 1 + 2							13		35	5
	2.2	STRUCTURAL ENGINEER							2			1
	2.3.1/2	MECHANICAL ENGINEER 1 + 2							2	1	3	2
	2.4.1/2	PROCUREMENT EXPERT 1 + 2							1	3	1	1
	2.5.1/2	SUBSOIL ENGINEER 1 + 2							2	2	6	2
								SUB-TOTAL	20	6	45	11
	3.1	CHIEF SUPERVISING ENGINEER							20			2
	3.2.1/2	SUPERVISING ENGINEER 1 + 2							20		53	2
	3.3	QUANTITY SURVEYORS									90	
	3.4.1/2	SURVERYOR 1 + 2							8		62	6
	3.5	ADMINISTRATOR							26			4
								SUB-TOTAL	74	0	205	14
	4.1.1/2	MORPHOLOGIST 1 + 2							8		9	7
	4.2.1/2	MODELLING EXPERT 1 + 2 + 3							7		16	2
	4.3.1/2	ENVIRONMENTAL EXPERT 1 + 2							4		7	4
	4.4	SOCIO-ECONOMIST									25	
	4.5.1/2	ECONOMIST 1 + 2							3		4	2
	4.6.1/2	UNALLOCATED 1 + 2							10		10	12
								SUB-TOTAL	32	0	71	27
		QUARTERLY REPORTS	X X X X X X X X X X X X X X X X X X X X X X X X									
		YEARLY REPORTS ON MONITORING / ADAPTATION				X	X	X				
		EVALUATION REPORT						X X				
		MANUALS + GUIDELINES						X				
								TOTAL	203	29	395	85

*) AS PER LETTER TO PROCEED OF MAY 1993

MONSOON — IN BANGLADESH — OUTSIDE BANGLADESH — LOCAL

TABLE 1.2-3.2

BANK PROTECTION TEST STRUCTURES - FAP 21

STAFFING SCHEDULE

REVISION NO. 1 *)

01.06.1995

		FUNCTION	1993	1994	1995	1996	1997	1998	MAN-MONTHS EXPATRIATES BD	EU	LOCAL	FLIGHTS
			J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D				
	1.1	PROJECT DIRECTOR							3	8		8
	1.2	HOME OFFICE SUPPORT								10	7	
	1.3.1/2	PROJECT MANAGER / DEPUTY PROJECT MANAGER							58	3	67	17
	1.4	CHIEF HYDRAULIC DESIGN ENGINEER							17	3		10
								SUB-TOTAL	78	24	74	35
	2.1.1/2	HYDRAULIC DESIGN ENGINEER 1 + 2							18		35	6
	2.2	STRUCTURAL ENGINEER							2			1
	2.3.1/2	MECHANICAL ENGINEER 1 + 2							2	1	3	2
	2.4.1/2	PROCUREMENT EXPERT 1 + 2							1	3	1	1
	2.5.1/2	SUBSOIL ENGINEER 1 + 2							2	2	6	2
								SUB-TOTAL	25	6	45	12
	3.1	CHIEF SUPERVISING ENGINEER							20			2
	3.2.1/2	SUPERVISING ENGINEER 1 + 2							20		53	2
	3.3	QUANTITY SURVEYORS									90	
	3.4.1/2	SURVERYOR 1 + 2							8		62	6
	3.5	ADMINISTRATOR							26			4
	3.6.1/2/3	MONITORING EXPERT 1 + 2 + 3							6		61	2
								SUB-TOTAL	80	0	266	16
	4.1.1/2	MORPHOLOGIST 1 + 2							9		9	10
	4.2.1/2/3	MODELLING EXPERT 1 + 2 + 3							9		18	4
	4.3.1/2	ENVIRONMENTAL EXPERT 1 + 2							4		7	4
	4.4	SOCIO-ECONOMIST									25	
	4.5.1/2	ECONOMIST 1 + 2							3		4	2
	4.6.1/2	UNALLOCATED 1 + 2							2		2	3
								SUB-TOTAL	27	0	65	23
		QUARTERLY REPORTS	X X X X X X X X X X X X X X X X X X X X X X X X									
		YEARLY REPORTS ON MONITORING / ADAPTATION				X	X	X				
		EVALUATION REPORT						X	X			
		MANUALS + GUIDELINES							X			
								TOTAL	210	30	450	86

*) AS PER PROPOSAL OF 1995

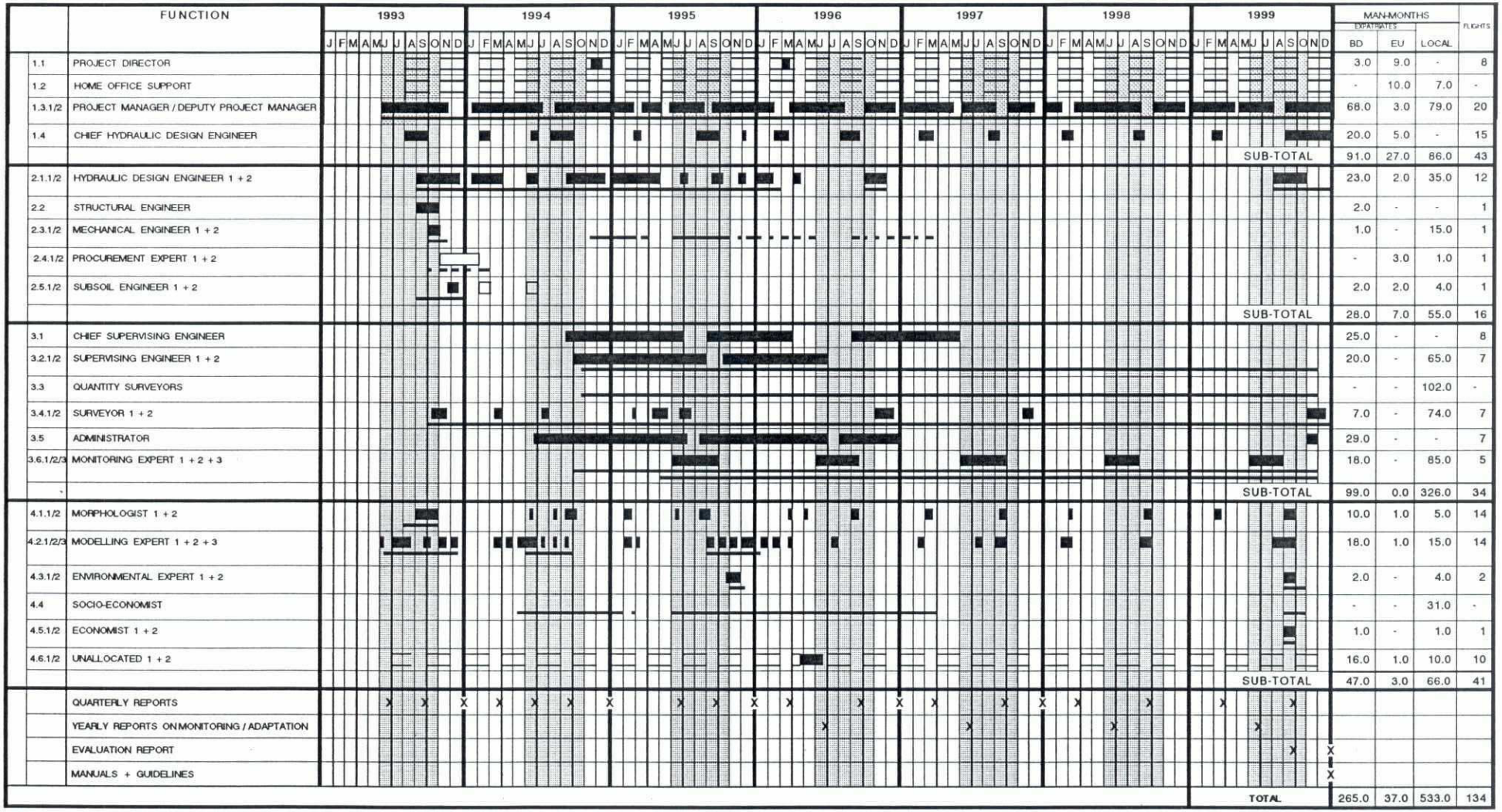
MONSOON IN BANGLADESH OUTSIDE BANGLADESH LOCAL

TABLE 1.2-3.3

BANK PROTECTION TEST STRUCTURES - FAP 21

STAFFING SCHEDULE

REVISION NO. 2 *)



	FUNCTION	MAN-MONTHS EXPATRIATES BD	EU	LOCAL	FLIGHTS
1.1	PROJECT DIRECTOR	3.0	9.0	-	8
1.2	HOME OFFICE SUPPORT	-	10.0	7.0	-
1.3.1/2	PROJECT MANAGER / DEPUTY PROJECT MANAGER	68.0	3.0	79.0	20
1.4	CHIEF HYDRAULIC DESIGN ENGINEER	20.0	5.0	-	15
	SUB-TOTAL	91.0	27.0	86.0	43
2.1.1/2	HYDRAULIC DESIGN ENGINEER 1 + 2	23.0	2.0	35.0	12
2.2	STRUCTURAL ENGINEER	2.0	-	-	1
2.3.1/2	MECHANICAL ENGINEER 1 + 2	1.0	-	15.0	1
2.4.1/2	PROCUREMENT EXPERT 1 + 2	-	3.0	1.0	1
2.5.1/2	SUBSOIL ENGINEER 1 + 2	2.0	2.0	4.0	1
	SUB-TOTAL	28.0	7.0	55.0	16
3.1	CHIEF SUPERVISING ENGINEER	25.0	-	-	8
3.2.1/2	SUPERVISING ENGINEER 1 + 2	20.0	-	65.0	7
3.3	QUANTITY SURVEYORS	-	-	102.0	-
3.4.1/2	SURVEYOR 1 + 2	7.0	-	74.0	7
3.5	ADMINISTRATOR	29.0	-	-	7
3.6.1/2/3	MONITORING EXPERT 1 + 2 + 3	18.0	-	85.0	5
	SUB-TOTAL	99.0	0.0	326.0	34
4.1.1/2	MORPHOLOGIST 1 + 2	10.0	1.0	5.0	14
4.2.1/2/3	MODELLING EXPERT 1 + 2 + 3	18.0	1.0	15.0	14
4.3.1/2	ENVIRONMENTAL EXPERT 1 + 2	2.0	-	4.0	2
4.4	SOCIO-ECONOMIST	-	-	31.0	-
4.5.1/2	ECONOMIST 1 + 2	1.0	-	1.0	1
4.6.1/2	UNALLOCATED 1 + 2	16.0	1.0	10.0	10
	SUB-TOTAL	47.0	3.0	66.0	41
	QUARTERLY REPORTS				
	YEARLY REPORTS ON MONITORING / ADAPTATION				
	EVALUATION REPORT				
	MANUALS + GUIDELINES				
	TOTAL	265.0	37.0	533.0	134

*) AS PER PROPOSAL OF SEPTEMBER 1996

MONSOON IN BANGLADESH OUTSIDE BANGLADESH LOCAL

TABLE 1.2-3.4

BANK PROTECTION TEST STRUCTURES - FAP 21

STAFFING SCHEDULE

REVISION NO. 3 *)

	FUNCTION	1993	1994	1995	1996	1997	1998	1999	2000	MAN-MONTHS EXPATRIATES BD	EU	LOCAL	FLIGHTS
		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D				
1.1	PROJECT DIRECTOR									3.00	9.00	-	5
1.2	HOME OFFICE SUPPORT									-	10.00	7.00	-
1.3.1/2	PROJECT MANAGER / DEPUTY PROJECT MANAGER									76.50	2.50	89.00	22
1.4	CHIEF HYDRAULIC DESIGN ENGINEER									24.00	6.00	-	17
									SUB-TOTAL	103.50	27.50	96.00	44
2.1.1/2	HYDRAULIC DESIGN ENGINEER 1 + 2									23.00	3.00	35.00	14
2.2	STRUCTURAL ENGINEER									2.13	-	-	1
2.3.1/2	MECHANICAL ENGINEER 1 + 2									1.00	-	12.21	1
2.4.1/2	PROCUREMENT EXPERT 1 + 2									-	3.00	1.00	-
2.5.1/2	SUBSOIL ENGINEER 1 + 2									1.20	2.06	3.11	1
									SUB-TOTAL	27.33	8.06	51.32	17
3.1	CHIEF SUPERVISING ENGINEER									29.27	-	-	8
3.2.1/2	SUPERVISING ENGINEER 1 + 2									18.96	-	71.00	7
3.3	QUANTITY SURVEYORS									-	-	95.00	-
3.4.1/2	SURVEYOR 1 + 2									4.44	-	44.00	6
3.5	ADMINISTRATOR									30.00	-	-	7
3.6.1/2/3	MONITORING EXPERT 1 + 2 + 3									23.00	-	98.00	9
									SUB-TOTAL	105.67	0.00	308.00	37
4.1.1/2	MORPHOLOGIST 1 + 2									9.00	2.00	5.08	14
4.2.1/2/3	MODELLING EXPERT 1 + 2 + 3									23.50	2.00	20.00	13
4.3.1/2	ENVIRONMENTAL EXPERT 1 + 2									2.00	-	2.50	2
4.4	SOCIO-ECONOMIST									-	-	33.00	-
4.5.1/2	ECONOMIST 1 + 2									1.00	-	1.00	1
4.6.1/2	UNALLOCATED 1 + 2									7.00	1.44	3.10	6
									SUB-TOTAL	42.50	5.44	64.68	36
	QUARTERLY REPORTS	X X X X X X X X X X X X X X X X X X X X X X X X											
	YEARLY REPORTS ON MONITORING / ADAPTATION	X X X X X											
	EVALUATION REPORT	X X											
	MANUALS + GUIDELINES	X X											
									TOTAL	279.00	41.00	520.00	134

*) AS PER PROPOSAL OF MAY 1999

MONSOON | IN BANGLADESH | OUTSIDE BANGLADESH | LOCAL

86

TABLE 1.2-4

BANK PROTECTION TEST STRUCTURES - FAP 21

REVISION NO. 3 *)

STAFFING SCHEDULE - EXPATRIATE PROFESSIONAL STAFF; FIELDED UP TO JUNE 30, 2000

	FUNCTION	1993	1994	1995	1996	1997	1998	1999	2000
		J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
1.1	PROJECT DIRECTOR								
1.2	HOME OFFICE SUPPORT								
1.3.1	PROJECT MANAGER								
1.4	CHIEF HYDRAULIC DESIGN ENGINEER								
2.1.1	HYDRAULIC DESIGN ENGINEER								
2.2	STRUCTURAL ENGINEER								
2.3.1	MECHANICAL ENGINEER 1								
2.4.1	PROCUREMENT EXPERT 1								
2.5.1	SUBSOIL ENGINEER 1								
3.1	CHIEF SUPERVISING ENGINEER								
3.2.1	SUPERVISING ENGINEER 1								
3.4.1	SURVEYOR 1								
3.5	ADMINISTRATOR								
3.6.1	MONITORING EXPERT 1								
4.1.1	MORPHOLOGIST 1								
4.2.1	MODELLING EXPERT 1								
4.3.2	ENVIRONMENTAL EXPERT 1								
4.5.1	ECONOMIST 1								
4.6.1	UNALLOCATED 1								
	QUARTERLY REPORTS	X X X X X X X X X X X X	X X X X X X X X X X X X	X X X X X X X X X X X X	X X X X X X X X X X X X	X X X X X X X X X X X X	X X X X X X X X X X X X	X X X X X X X X X X X X	X X X X X X X X X X X X
	YEARLY REPORTS ON MONITORING / ADAPTATION		X	X	X	X	X	X	X
	EVALUATION REPORT							X	X
	MANUALS + GUIDELINES								X

*) as per proposal of May 1999

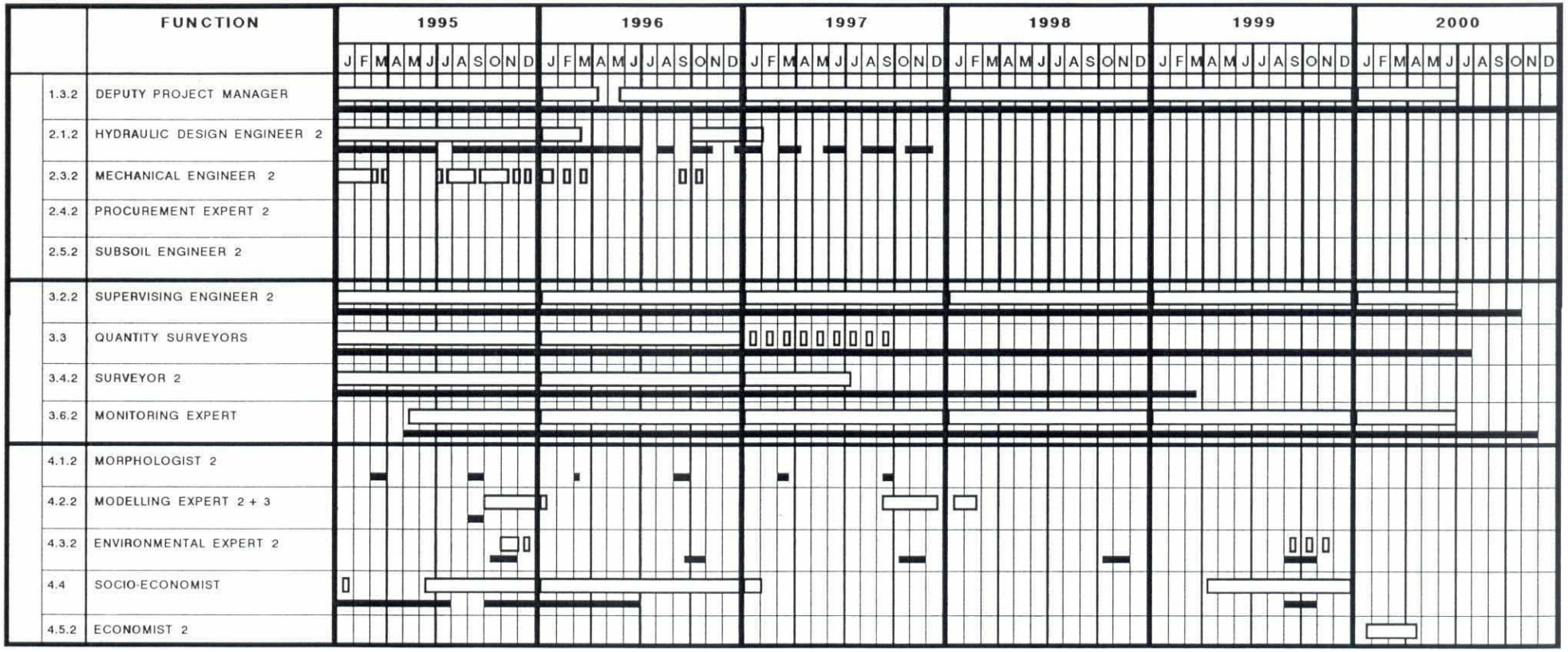
MONSOON — IN BANGLADESH — OUTSIDE BANGLADESH — REALIZATION

TABLE 1.2-5

BANK PROTECTION TEST STRUCTURES - FAP 21

REVISION NO. 3 *)

STAFFING SCHEDULE - LOCAL PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 2000



*) AS PER PROPOSAL OF SEPTEMBER 1996

SCHEDULE REALIZATION

TABLE 2.1-1

STUDIES ON RECURRENT MEASURES - FAP 22
EXPATRIATE PROFESSIONAL STAFF
Activities during the period of 04/2000 to 06/2000

VERSION : 09.07.00

Sl. No.	Function	Person	Code	Company	Period		Remarks
					From	To	
1.1	Project Director	Dr. D. Neuhaus	DN	RRI	-	-	
		Dr. H. Kramer	HK		-	-	
1.2	Home Office Support						
1.3.1	Project Manager	C. Netzeband	CN	RRI	-	-	
1.4	Chief Hydraulic Design Engineer	Dr. H. Kramer	HK	L&P	-	-	
5.1.1	River Engineer	P. van Groen	PvG	DELFT	-	-	
5.2	Hydraulic Design Engineer	M. Schwarz	MS	L&P	-	-	
5.3.1	Surveyor	-	-	-	-	-	
5.4.1	Morphologist	Dr. E. Mosselman	EM	DELFT	-	-	
5.5	System Analyst	R. H. Buijsrogge	RHB	DELFT	-	-	
5.6	Programmer	M. Witteveen	MW	DELFT	-	-	
5.6.A	Programmer / Modeller	J. I. Crebas	JIC	DELFT	-	-	
5.7	GIS Specialist	G.K.F.M.Hesselmans	GMH	DELFT	-	-	
5.8.1	Supervising Engineer	K. Oberhagemann	KO	RRI	-	-	
5.9.1	Monitoring Expert	T. Döscher	TD	L&P	-	-	
5.10	Economist	-	-	-	-	-	

TABLE 2.1-2

STUDIES ON RECURRENT MEASURES - FAP 22
LOCAL PROFESSIONAL STAFF
Activities during the period of 04/2000 to 06/2000

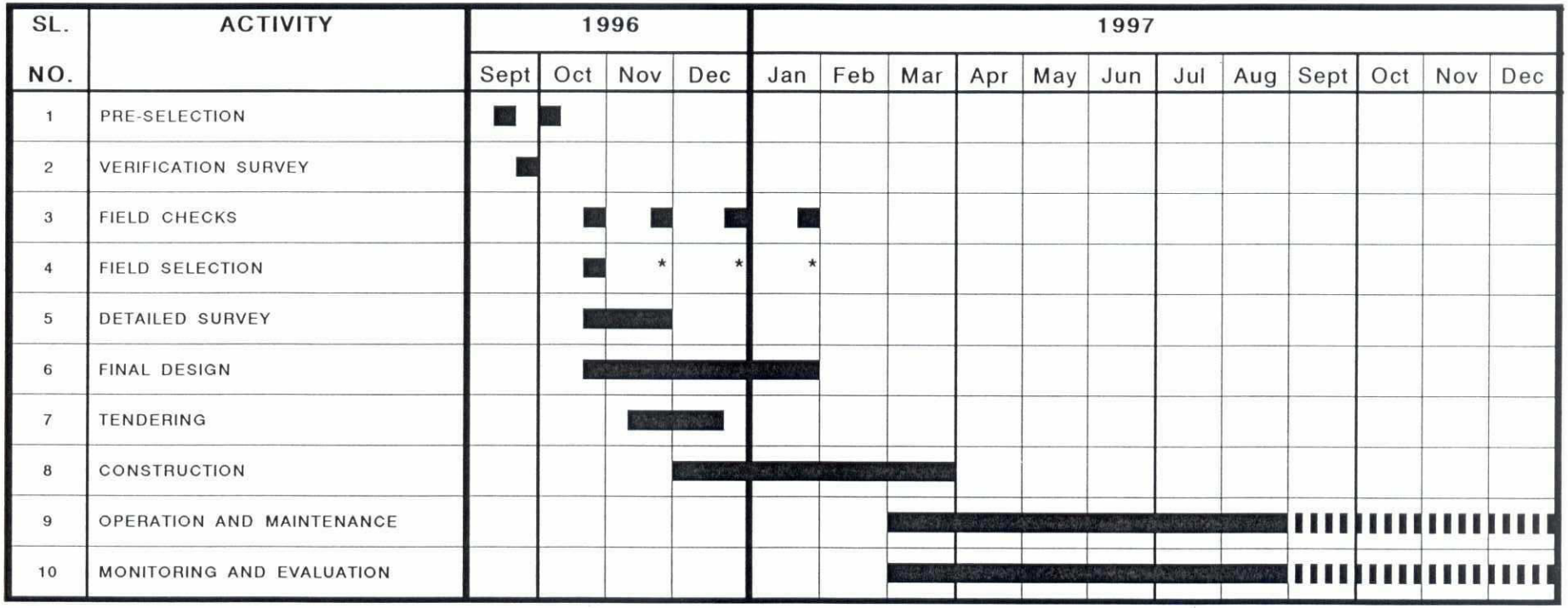
VERSION : 09.07.00

Sl. No.	Function	Person	Code	Company	Period		Remarks
					From	To	
1.2	Home Office Support	NN	-	-	-	-	
1.3.2	Deputy Project Manager	S. M. Mansur	SM	BETS	-	-	
5.1.2	River Engineer 2	S. R. Khan	SRK	BETS	-	-	
5.3.2	Surveyor 2	--	-	-	-	-	
5.4.2	Morphologist 2	Salahuddin Khan	SK	BETS	-	-	
5.8.2	Supervising Engineer 2	F. R. Khan	FRK	DUL	-	-	
5.9.2/3/4	Monitoring Expert 2	A.B.M. Anwar Haider	AH	BETS	-	-	
	Jr. Monitoring Expert	Pankaj K. Maitra	PKM	BETS	-	-	
	Monitoring Data Processor	Yasmin Khayer	YK	FL	-	-	
5.10.2	Economist 2	--	-	-	-	-	

TABLE 2.2-1

STUDIES ON RECURRENT MEASURES - FAP 22

WORK PLAN AS PER PROPOSAL OF AUGUST 1996



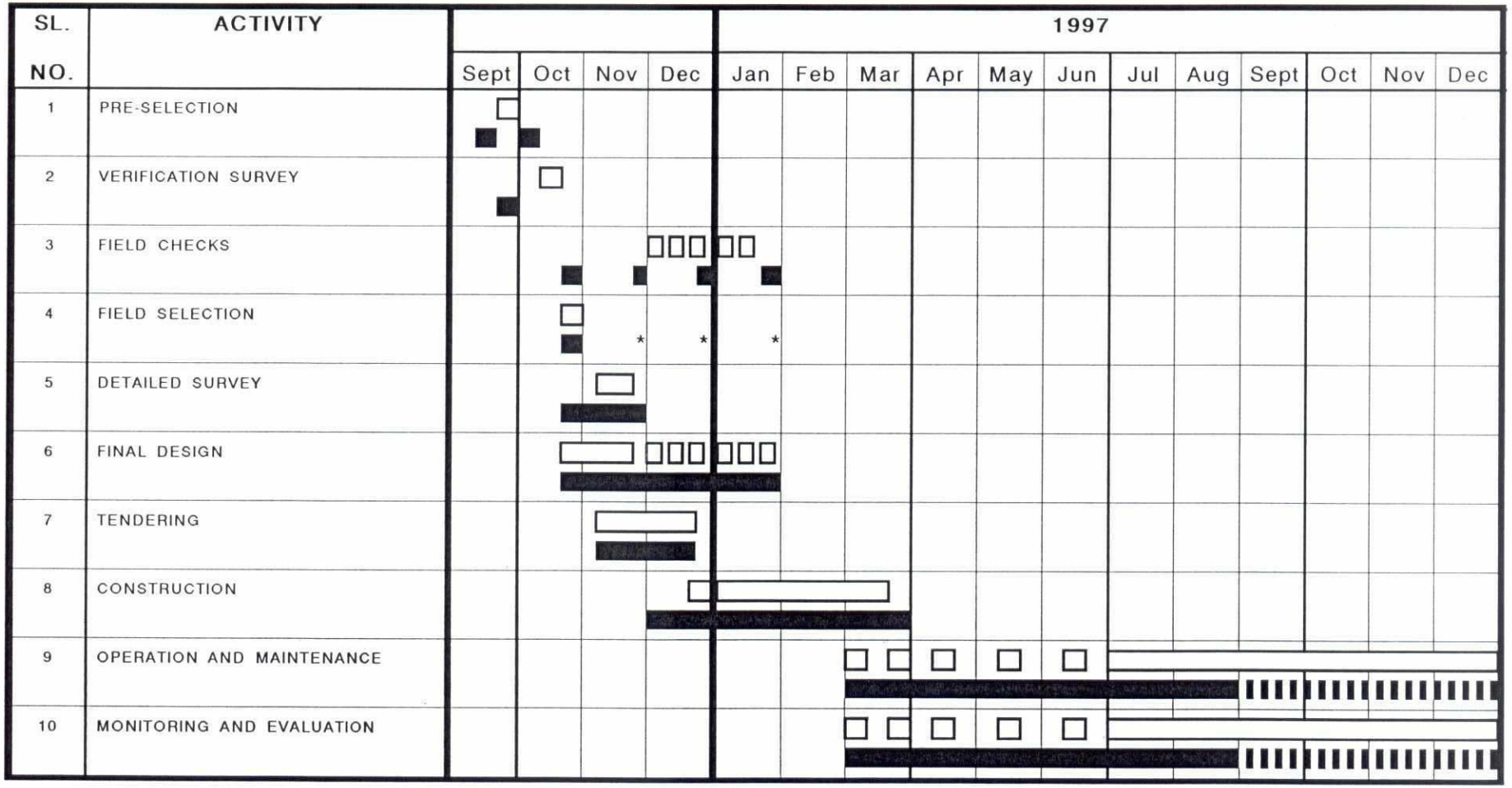
NOTE: * DENOTES REVIEW OF FINAL SELECTION

TABLE 2.2-2

STUDIES ON RECURRENT MEASURES - FAP 22

WORK PLAN AS PER PROPOSAL OF AUGUST 1996

ACTIVITIES FIELDED UP TO DECEMBER 31, 1997



NOTE: * DENOTES REVIEW OF FINAL SELECTION

TABLE 2.2-3

STUDIES ON RECURRENT MEASURES - FAP 22

WORK PLAN AS PER PROPOSAL OF DECEMBER 1997

SL. NO.	ACTIVITY	1997				1998											
		Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	PRE-SELECTION OF SITE																
2	VERIFICATION SURVEY / FIELD CHECK																
3	MAINTENANCE/ADAPTATION OF EXISTING BANDALS																
4	ELONGATION OF IMPROVED BANDALS																
5	DESIGN OF FLOATING SCREEN ELEMENTS																
6	CONSTRUCTION OF FLOATING SCREEN ELEMENTS																
7	FINAL SITE SELECTION																
8	DETAILED SURVEY																
9	POSITIONING AT TEST SITE																
10	OPERATION AND MAINTENANCE																
11	MONITORING																
12	EVALUATION																

TABLE 2.2-4

STUDIES ON RECURRENT MEASURES - FAP 22

WORK PLAN AS PER PROPOSAL OF DECEMBER 1997

FIELDED UP TO DECEMBER 31, 1998

SL. NO.	ACTIVITY
1	PRE-SELECTION OF SITE
2	VERIFICATION SURVEY / FIELD CHECK
3	MAINTENANCE/ADAPTATION OF EXISTING BANDALS
4	ELONGATION OF IMPROVED BANDALS
5	DESIGN OF FLOATING SCREEN ELEMENTS
6	CONSTRUCTION OF FLOATING SCREEN ELEMENTS
7	FINAL SITE SELECTION
8	DETAILED SURVEY
9	POSITIONING AT TEST SITE
10	OPERATION AND MAINTENANCE
11	MONITORING
12	EVALUATION

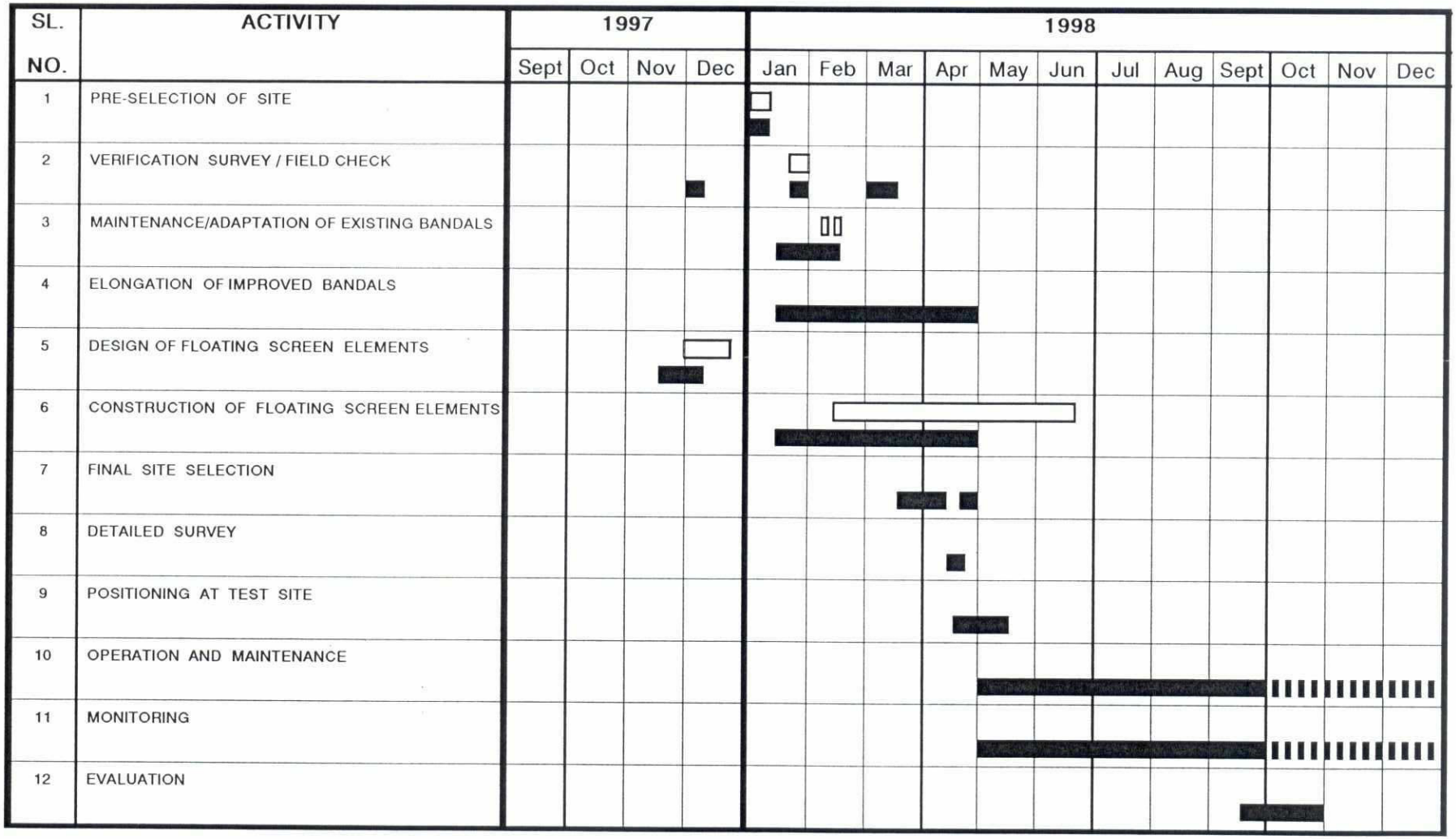


TABLE 2.2-5

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE *)

	FUNCTION	NAME	1996 J F M A M J J A S O N D	1997 J F M A M J J A S O N D	1998 J F M A M J J A S O N D	Man-Months EXPATRIATES BD	EU	LOCAL	FLIGHTS
1.1	PROJECT DIRECTOR	Dr. D. Neuhaus / Dr. H. Kramer							
1.2	HOME OFFICE SUPPORT						1.5		
1.3.1	PROJECT MANAGER *	C. Netzeband							
1.3.2	DEPUTY PROJECT MANAGER *	S. M. Mansur							
1.4	CHIEF HYDRAULIC DESIGN ENGINEER	Dr. H. Kramer				1.5	1.0		2
					SUB-TOTAL	1.5	2.5		2
5.1.1	RIVER ENGINEER 1	Pieter van Groen				5.5			6
5.1.2	RIVER ENGINEER 2	S. R. Khan						12.0	
5.2	HYDRAULIC DESIGN ENGINEER	M. Schwarz				1.0	0.75		1
5.4.1	MORPHOLOGIST 1 *	Dr. E. Mosselman				2.0			1
5.4.2	MORPHOLOGIST 2	M. H. Sarker / NN						17.0	
5.6.1	PROGRAMMER / MODELLING ENGINEER 1	J. Crebas				1.0			
5.8.1	SUPERVISING ENGINEER 1	K. Oberhagemann				8.0	0.5		3
5.8.2	SUPERVISING ENGINEER 2	F. R. Khan						14.0	
5.9.1	MONITORING EXPERT 1	T. Döscher				2.0			2
5.9.2	MONITORING EXPERT 2	A. Haider / P.K. Maitra						14.0	
5.11.1	UNALLOCATED 1					3.0			3
5.11.2	UNALLOCATED 2							2.0	
					SUB-TOTAL	22.5	1.25	59.0	16
	QUARTERLY REPORTS		X	X X X	X X X X				
	DRAFT EVALUATION REPORT			X	X				
	FINAL EVALUATION REPORT			X	X				
					TOTAL	24.0	3.75	59.0	18

NOTE : * Some of the working time of the Professionals will be charged to FAP 21 project

*) AS PER PROPOSAL OF AUGUST 1996 AND DECEMBER 1997 — MONSOON — EXPATRIATE — LOCAL — FAP 21

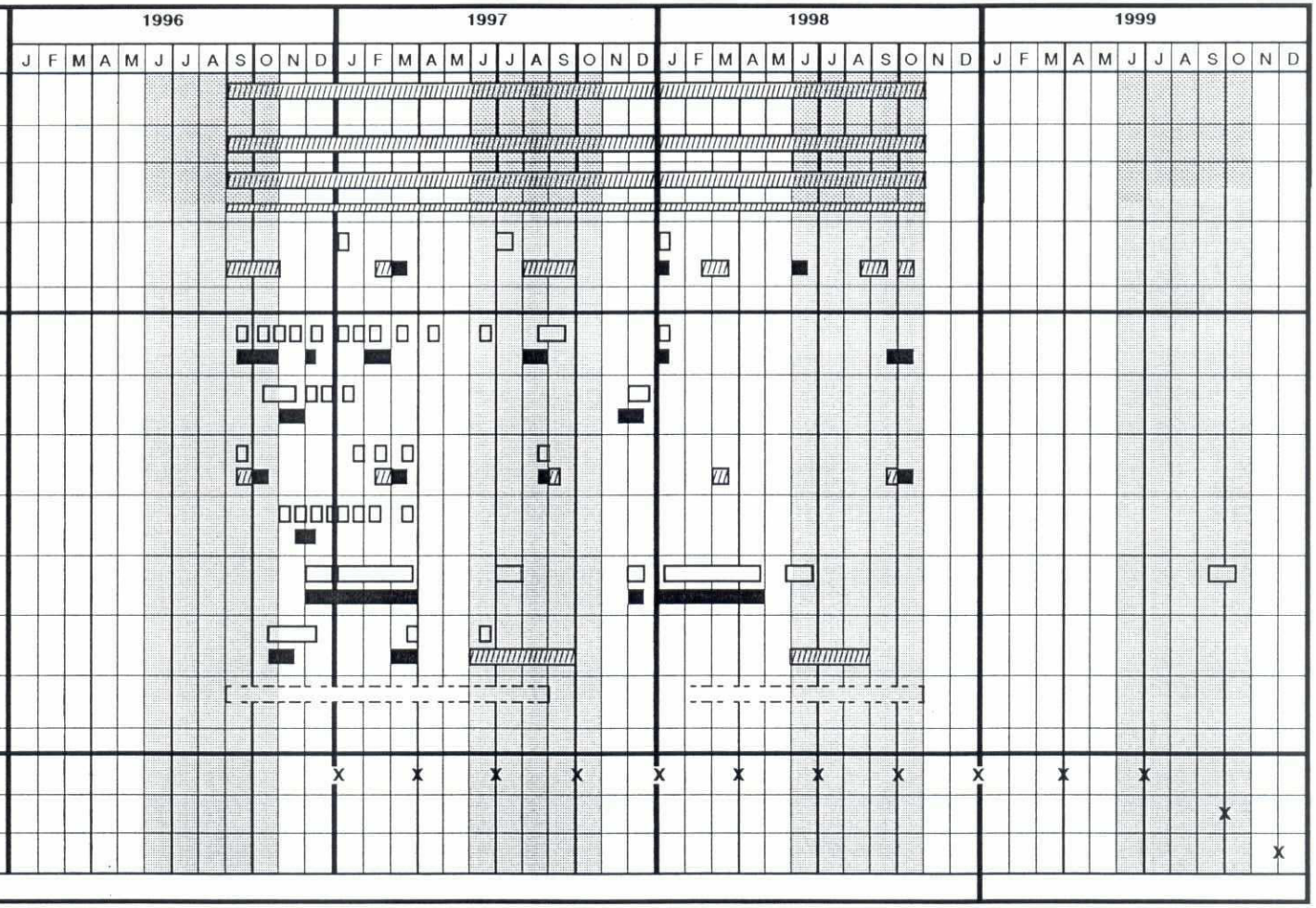
TABLE 2.2-6

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE *)

EXPATRIATE PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 2000

	FUNCTION	NAME
1.1	PROJECT DIRECTOR	Dr. D. Neuhaus / Dr. H. Kramer
1.2	HOME OFFICE SUPPORT	
1.3.1	PROJECT MANAGER *	C. Netzeband
1.4	CHIEF HYDRAULIC DESIGN ENGINEER *	Dr. H. Kramer
5.1.1	RIVER ENGINEER 1	Pieter van Groen
5.2	HYDRAULIC DESIGN ENGINEER	M. Schwarz
5.4.1	MORPHOLOGIST 1 *	Dr. E. Mosselman
5.6.1	PROGRAMMER / MODELLING ENGINEER 1	J. Crebas
5.8.1	SUPERVISING ENGINEER 1	K. Oberhagemann
5.9.1	MONITORING EXPERT 1	T. Döscher
5.11.1	UNALLOCATED 1	
	QUARTERLY REPORTS	
	DRAFT EVALUATION REPORT	
	FINAL EVALUATION REPORT	



NOTE : * Some of the working time of the Professionals will be charged to FAP 21 project

*) AS PER PROPOSAL OF AUGUST 1996 AND DECEMBER 1997

MONSOON EXPATRIATE FAP 21 RELIAZATION

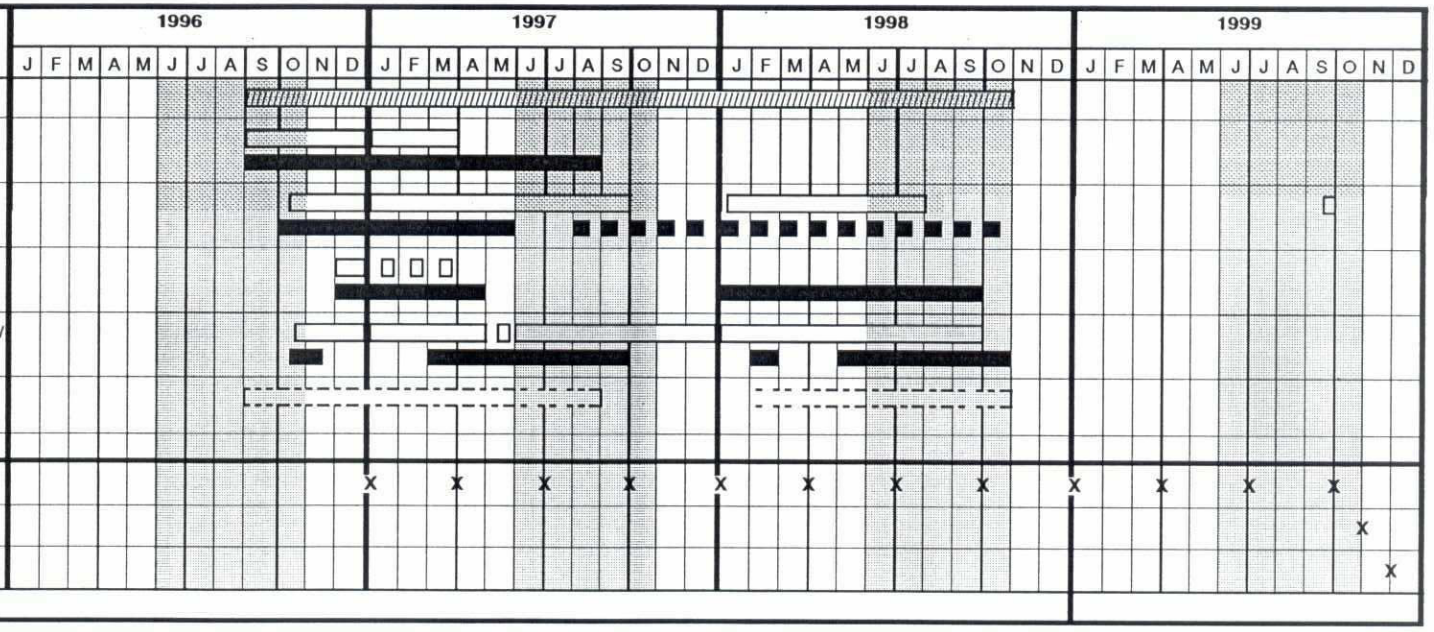
TABLE 2.2-7

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE *)

LOCAL PROFESSIONAL STAFF - FIELDED UP TO DECEMBER 31, 1999

	FUNCTION	NAME
1.3.2	DEPUTY PROJECT MANAGER *	S. M. Mansur
5.1.2	RIVER ENGINEER 2	S. R. Khan
5.4.2	MORPHOLOGIST 2	S. KHAN
5.8.2	SUPERVISING ENGINEER 2	F. R. Khan
5.9.2	MONITORING EXPERT 2	A. Haider / P.K. Maitra/ Masumdar
5.11.2	UNALLOCATED 2	
	QUARTERLY REPORTS	
	DRAFT EVALUATION REPORT	
	FINAL EVALUATION REPORT	



NOTE : * Some of the working time of the Professionals will be charged to FAP 21 project

*) AS PER PROPOSAL OF AUGUST 1996 AND DECEMBER 1997

MONSOON FAP 21 LOCAL RELIAZATION

ANNEX A

FAP 21 / Test Site I

- Water Level

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
MONTH : APRIL 2000

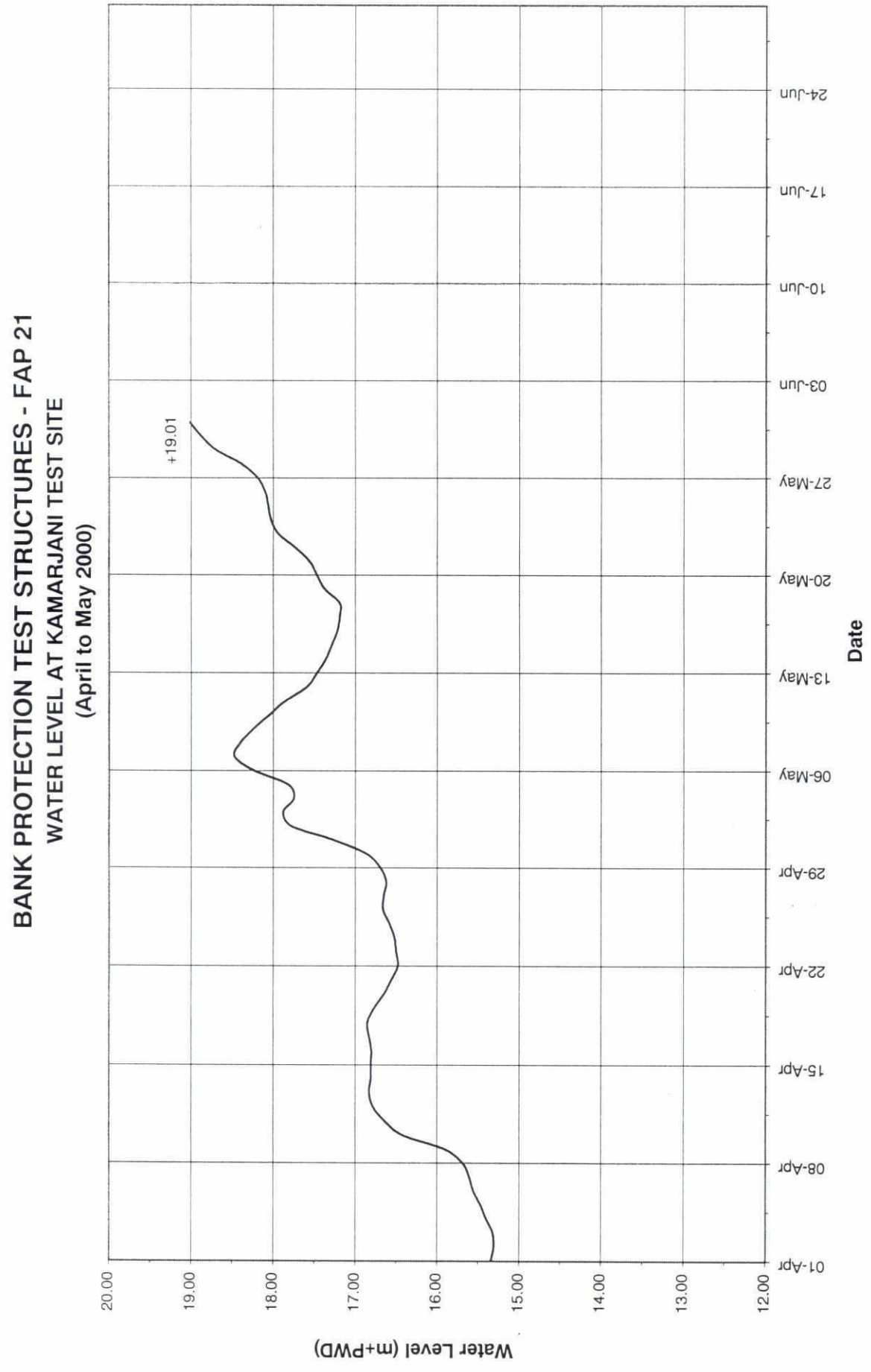
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	15.340	15.330	15.330	
2	15.310	15.310	15.310	
3	15.320	15.330	15.350	
4	15.400	15.420	15.430	
5	15.470	15.490	15.510	
6	15.560	15.580	15.590	
7	15.610	15.620	15.640	
8	15.690	15.710	15.740	
9	15.910	16.020	16.120	
10	16.420	16.500	16.540	
11	16.640	16.660	16.690	
12	16.780	16.790	16.800	
13	16.830	16.830	16.830	
14	16.810	16.820	16.820	
15	16.810	16.800	16.790	
16	16.800	16.800	16.800	
17	16.830	16.830	16.830	
18	16.850	16.840	16.830	
19	16.770	16.740	16.710	
20	16.650	16.620	16.600	
21	16.560	16.530	16.520	
22	16.480	16.480	16.470	
23	16.500	16.500	16.500	
24	16.520	16.530	16.540	
25	16.580	16.600	16.610	
26	16.660	16.670	16.670	
27	16.650	16.650	16.640	
28	16.620	16.647	16.660	
29	16.690	16.720	16.760	
30	16.860	16.910	17.000	

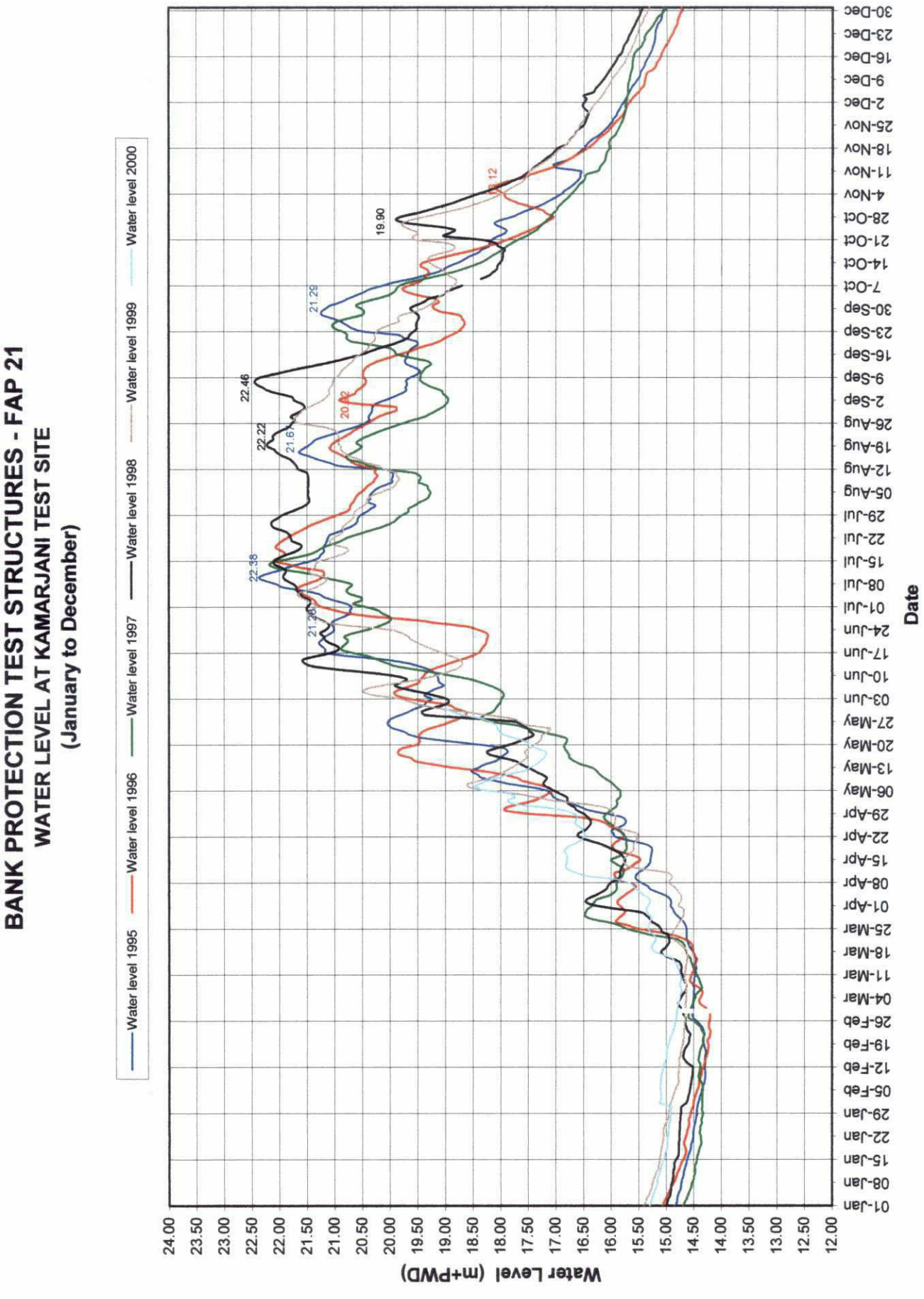
BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
MONTH : MAY 2000

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	17.260	17.350	17.450	
2	17.780	17.850	17.920	
3	17.880	17.850	17.820	
4	17.750	17.740	17.740	
5	17.820	17.880	17.950	
6	18.230	18.300	18.360	
7	18.470	18.470	18.450	
8	18.400	18.360	18.340	
9	18.240	18.200	18.170	
10	18.050	18.010	17.980	
11	17.860	17.810	17.740	
12	17.600	17.570	17.540	
13	17.470	17.450	17.430	
14	17.360	17.350	17.340	
15	17.290	17.270	17.250	
16	17.220	17.210	17.210	
17	17.190	17.190	17.180	
18	17.190	17.210	17.240	
19	17.370	17.400	17.420	
20	17.470	17.490	17.500	
21	17.560	17.590	17.610	
22	17.730	17.800	17.870	
23	17.940	17.960	17.990	
24	18.030	18.040	18.050	
25	18.060	18.060	18.060	
26	18.100	18.140	18.150	
27	18.190	18.210	18.240	
28	18.380	18.450	18.500	
29	18.690	18.720	18.770	
30	18.870	18.890	18.920	
31	19.010	19.040	19.060	

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
MONTH : JUNE 2000

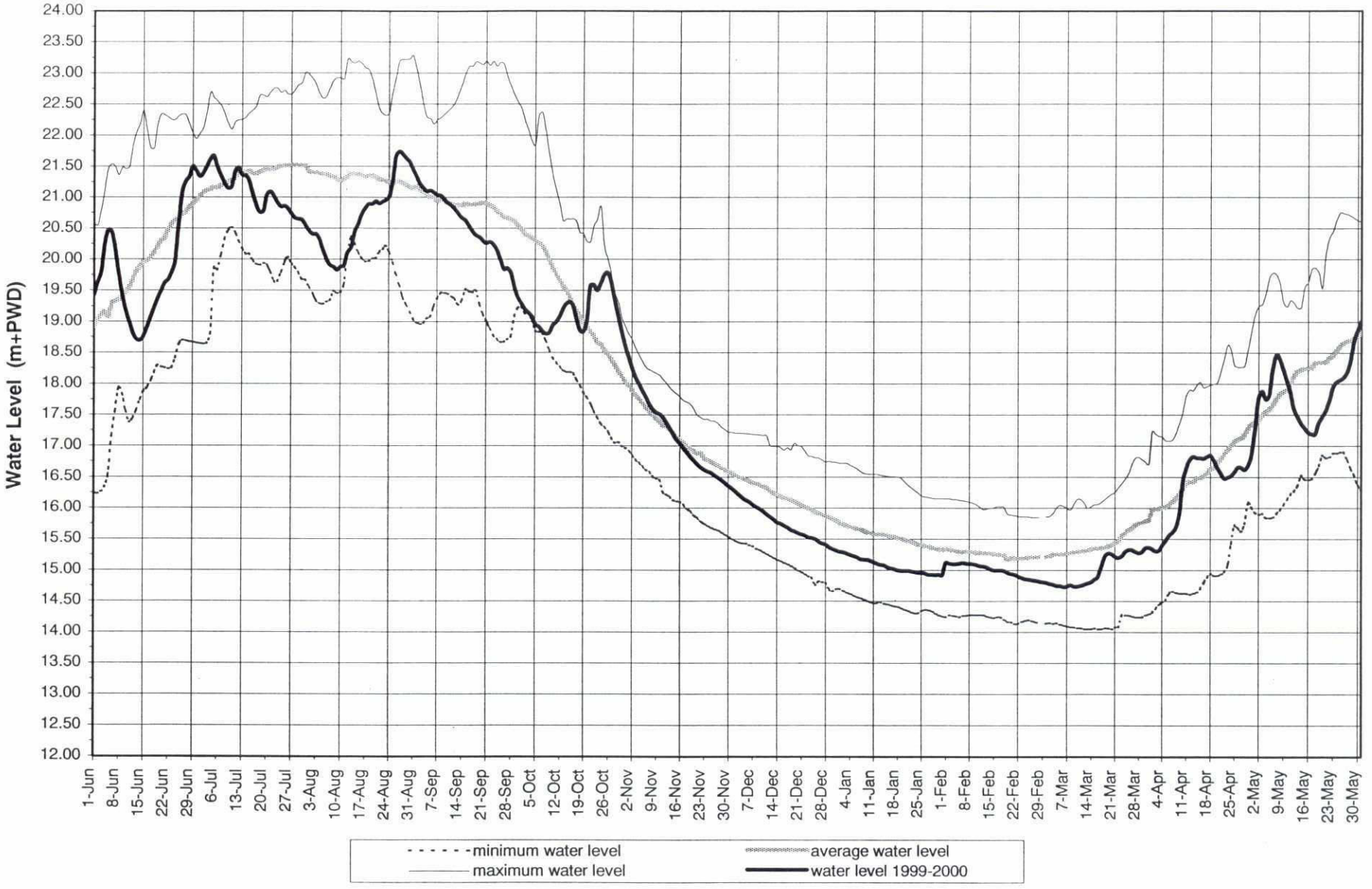
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12	**Water Level measurements at Test Site I - Kamarjani has been stopped from June 2000**			
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				


BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
(April to May 2000)
+19.01
Water Level (m+PWD)
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
01-Apr
08-Apr
15-Apr
22-Apr
29-Apr
06-May
13-May
20-May
27-May
03-Jun
10-Jun
17-Jun
24-Jun
Date


BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
(January to December)
Water level 1995
Water level 1996
Water level 1997
Water level 1998
Water level 1999
Water level 2000
Water Level (m+PWD)
Date
22.46
22.22
21.61
22.38
21.29
19.90
20 Apr
12

BANK PROTECTION TEST STRUCTURES - FAP 21

BWDB WATER LEVEL FREQUENCY CURVES VERSUS ACTUAL FAP 21 WATER LEVEL AT KAMARJANI TEST SITE UP TO MAY 2000

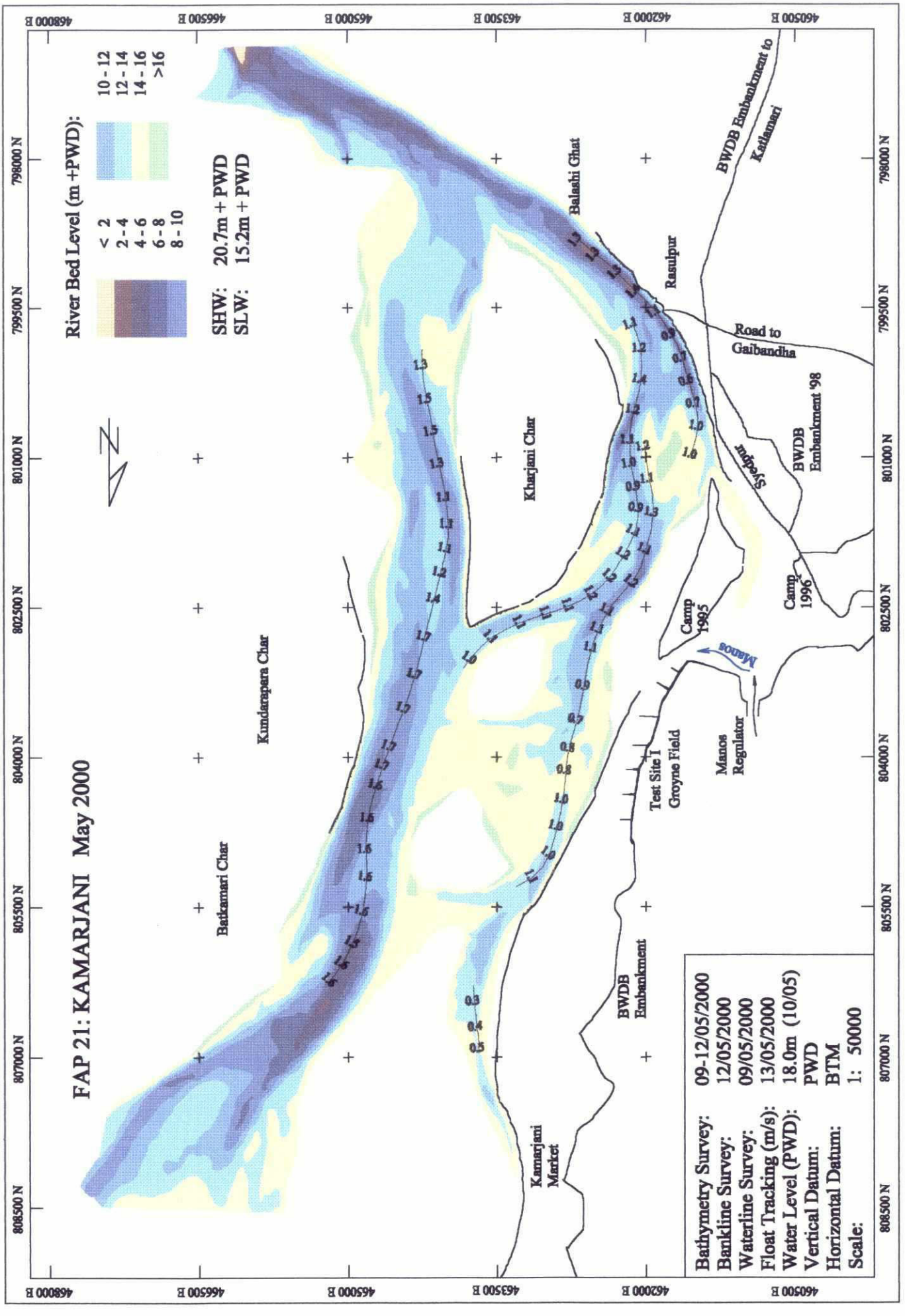


BWDB Data: Period of Record 1957 ~ 1997

ANNEX B

FAP 21 / Test Site I

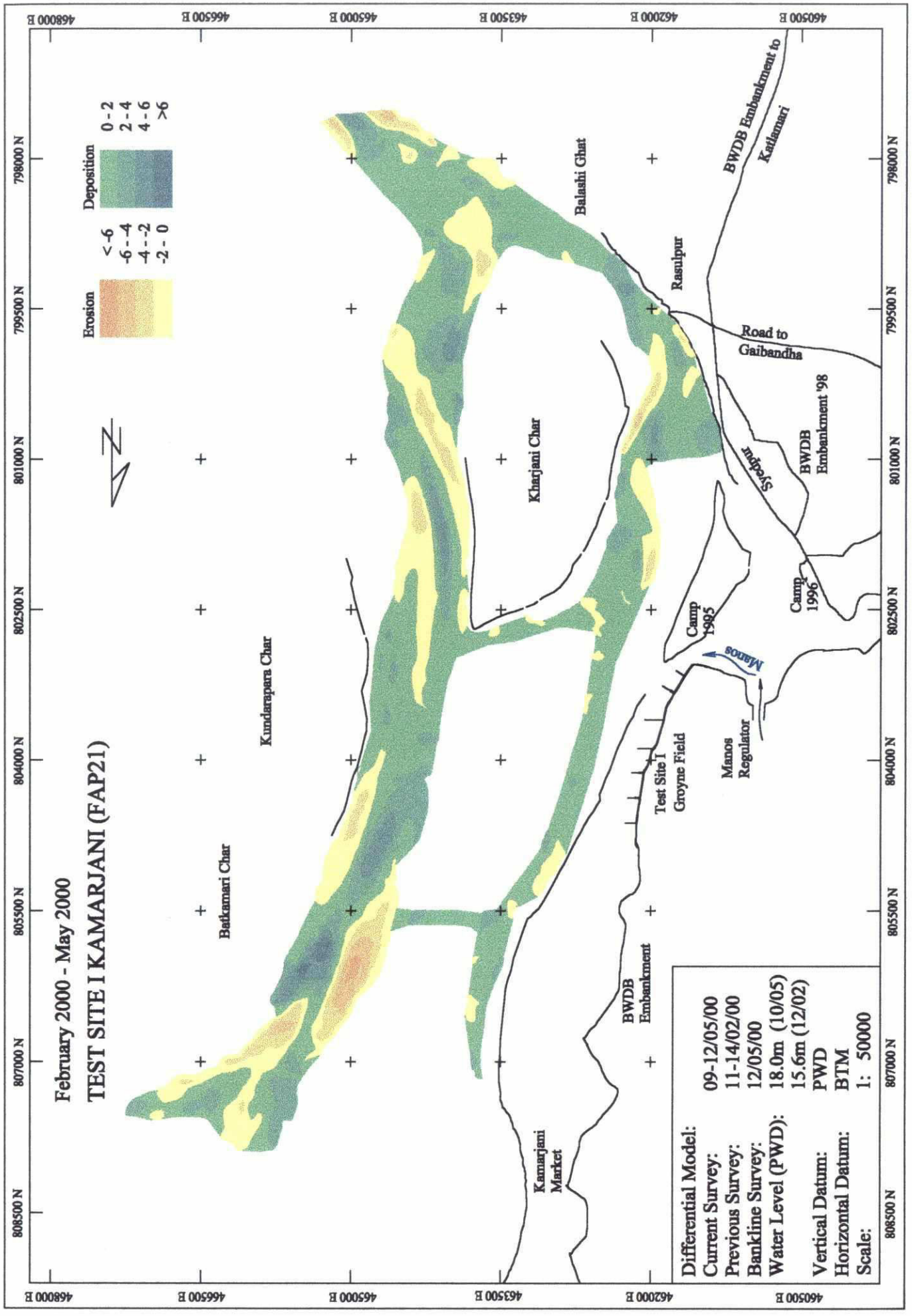
- Bathymetric Survey and Flow Velocities


FAP 21: KAMARJANI May 2000
River Bed Level (m +PWD):
< 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
>16
SHW: 20.7m + PWD
SLW: 15.2m + PWD
Batkamari Char
Kundarapara Char
Kharjani Char
Balashi Ghat
Rasulpur
BWDB Embankment to Kotkamari
Road to Gaibandha
BWDB Embankment '98
Camp 1995
Camp 1996
Manos
Manos Regulator
Test Site I
Groyne Field
BWDB Embankment
Kamarjani Market
Bathymetry Survey: 09-12/05/2000
Bankline Survey: 12/05/2000
Waterline Survey: 09/05/2000
Float Tracking (m/s): 13/05/2000
Water Level (PWD): 18.0m (10/05)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 50000

ANNEX C

FAP 21 / Test Site I

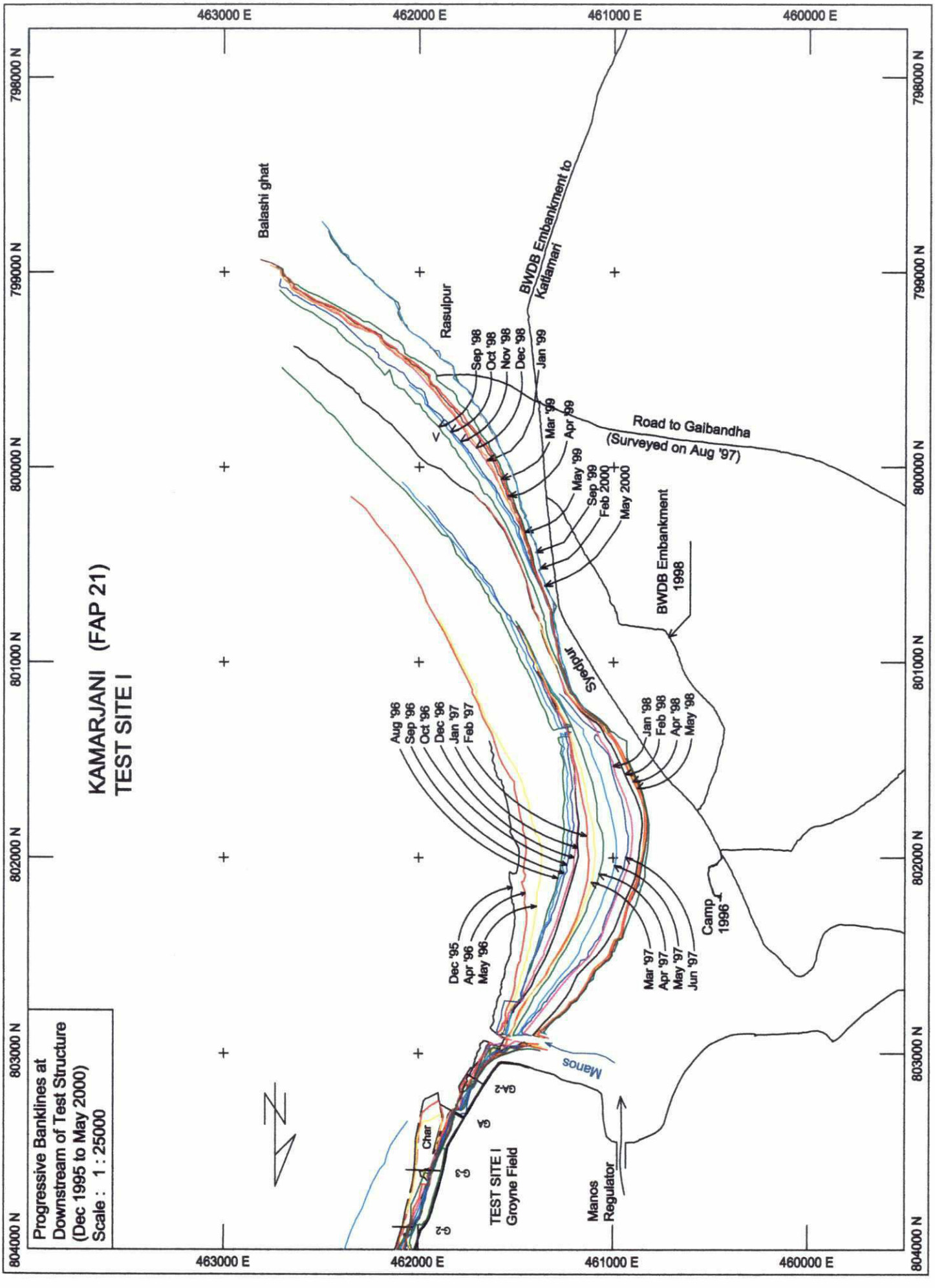
- Differential Models


February 2000 - May 2000
TEST SITE I KAMARJANI (FAP21)
Erosion
<-6
-6 - -4
-4 - -2
-2 - 0
Deposition
0 - 2
2 - 4
4 - 6
>6
Batkamari Char
Kundarapara Char
Kharjani Char
Balashi Ghat
Rasulpur
BWDB Embankment to Kellamari
Road to Gaibandha
BWDB Embankment '98
Camp 1995
Camp 1996
Manos
Manos Regulator
Test Site I Groyne Field
BWDB Embankment
Kamarjani Market
Differential Model:
Current Survey: 09-12/05/00
Previous Survey: 11-14/02/00
Bankline Survey: 12/05/00
Water Level (PWD): 18.0m (10/05)
15.6m (12/02)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 50000

ANNEX D

FAP 21 / Test Site I

- Change of Bankline


KAMARJANI (FAP 21)
TEST SITE I
Progressive Banklines at Downstream of Test Structure (Dec 1995 to May 2000)
Scale : 1 : 25000
463000 E
462000 E
461000 E
460000 E
798000 N
799000 N
800000 N
801000 N
802000 N
803000 N
804000 N
Balashi ghat
Rasulpur
BWDB Embankment to Katiamari
Sep '98
Oct '98
Nov '98
Dec '98
Jan '99
Mar '99
Apr '99
May '99
Sep '99
Feb 2000
May 2000
Road to Gaibandha (Surveyed on Aug '97)
BWDB Embankment 1998
Shyadpur
Aug '96
Sep '96
Oct '96
Dec '96
Jan '97
Feb '97
Jan '98
Feb '98
Apr '98
May '98
Dec '95
Apr '96
May '96
Mar '97
Apr '97
May '97
Jun '97
Camp 1996
Manos
Char
G-1
G-2
G-3
G-4
G-4-2
TEST SITE I
Groyne Field
Manos Regulator

ANNEX E

FAP 21 / Test Site I

- Photographs

There was no further development at the test site during the period under review.

Therefore, there are no photographs.

ANNEX F

FAP 21 / Test Site II

- Water Level

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BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
MONTH : APRIL 2000

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	13.680	13.670	13.660	
2	13.640	13.630	13.630	
3	13.650	13.660	13.680	
4	13.720	13.730	13.740	
5	13.780	13.790	13.800	
6	13.850	13.880	13.890	
7	13.900	13.920	13.930	
8	13.980	14.000	14.020	
9	14.140	14.220	14.300	
10	14.590	14.680	14.730	
11	14.890	14.920	15.020	
12	15.050	15.060	15.070	
13	15.110	15.130	15.130	
14	15.130	15.140	15.140	
15	15.130	15.130	15.140	
16	15.140	15.140	15.150	
17	15.150	15.150	15.160	
18	15.180	15.160	15.150	
19	15.110	15.080	15.060	
20	15.020	15.000	14.970	
21	14.930	14.900	14.880	
22	14.840	14.830	14.820	
23	14.860	14.860	14.858	
24	14.860	14.870	14.880	
25	14.900	14.920	14.930	
26	14.990	14.990	15.000	
27	15.000	14.990	14.970	
28	15.000	15.010	15.000	
29	15.030	15.030	15.040	
30	15.130	15.150	15.220	

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
MONTH : MAY 2000

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	15.480	15.520	15.570	
2	15.840	15.860	15.910	
3	15.950	15.950	15.930	
4	15.870	15.850	15.860	
5	15.870	15.900	15.950	
6	16.210	16.260	16.330	
7	16.450	16.460	16.470	
8	16.430	16.420	16.400	
9	16.310	16.270	16.250	
10	16.150	16.110	16.090	
11	16.000	15.960	15.940	
12	15.840	15.830	15.810	
13	15.730	15.720	15.700	
14	15.640	15.620	15.600	
15	15.540	15.530	15.490	
16	15.450	15.440	15.440	
17	15.410	15.410	15.410	
18	15.430	15.430	15.430	
19	15.560	15.570	15.580	
20	15.660	15.670	15.680	
21	15.720	15.740	15.770	
22	15.870	15.940	15.980	
23	16.070	16.080	16.090	
24	16.140	16.170	16.190	
25	16.200	16.210	16.220	
26	16.220	16.250	16.250	
27	16.290	16.290	16.290	
28	16.390	16.450	16.490	
29	16.680	16.720	16.750	
30	16.820	16.850	16.880	
31	16.920	16.980	17.000	

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BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
MONTH : JUNE 2000

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	17.150	17.240	17.310	
2	17.640	17.690	17.720	
3	17.790	17.810	17.830	
4	17.740	17.690	17.640	
5	17.460	17.420	17.360	
6	17.260	17.220	17.180	
7	17.140	17.130	17.110	
8	17.130	17.140	17.150	
9	17.210	17.240	17.270	
10	17.310	17.310	17.310	
11	17.330	17.330	17.330	
12	17.280	17.270	17.310	
13	17.570	17.670	17.710	
14	17.810	17.930	17.980	
15	18.510	18.580	18.660	
16	18.910	18.950	18.970	
17	18.930	18.900	18.880	
18	18.800	18.760	18.750	
19	18.620	18.590	18.550	
20	18.380	18.360	18.350	
21	18.240	18.210	18.190	
22	18.230	18.290	18.330	
23	18.650	18.820	18.930	
24	19.090	19.140	19.150	
25	19.010	19.000	18.990	
26	19.040	19.070	19.110	
27	19.230	19.260	19.310	
28	19.320	19.320	19.310	
29	19.250	19.230	19.180	
30	19.130	19.100	19.060	

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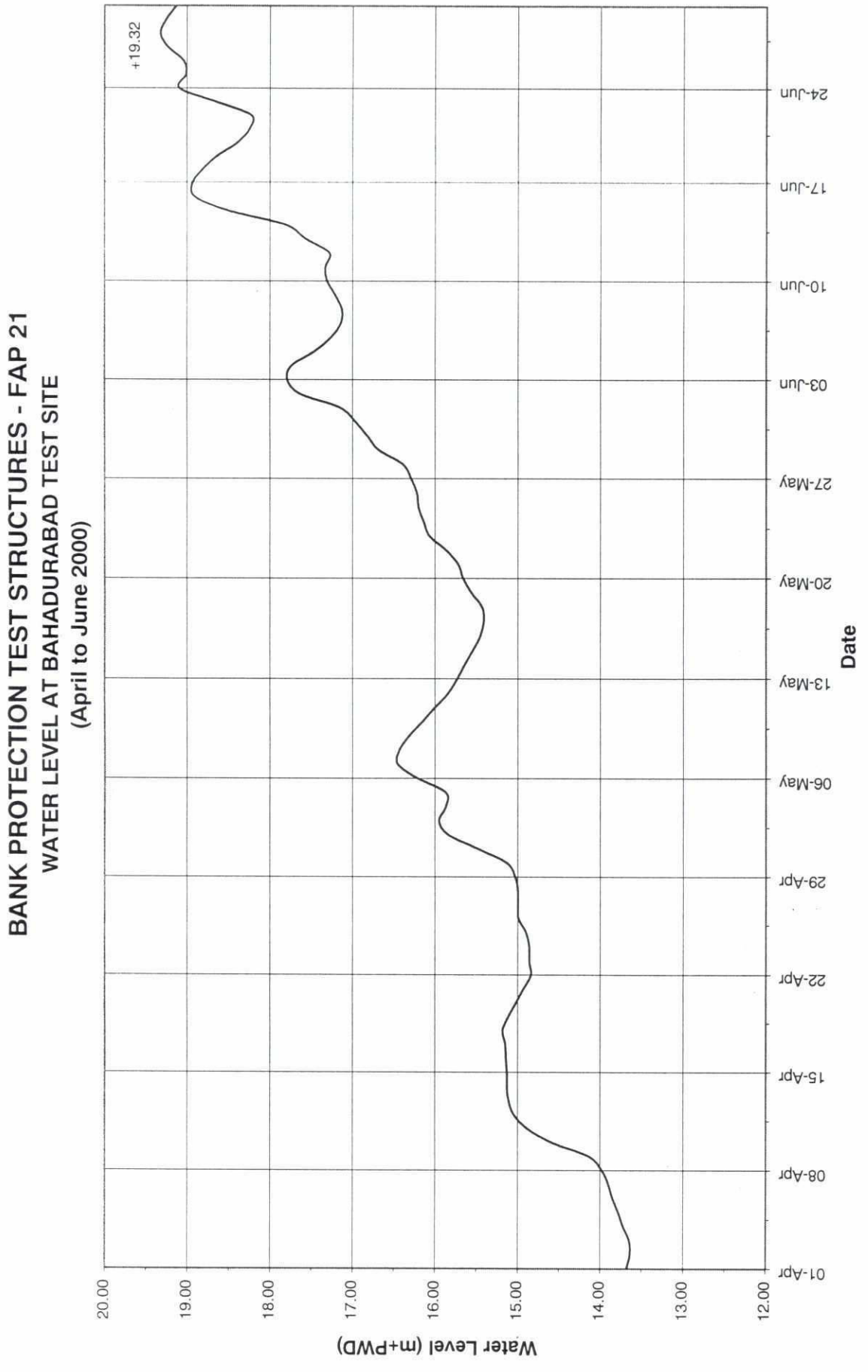
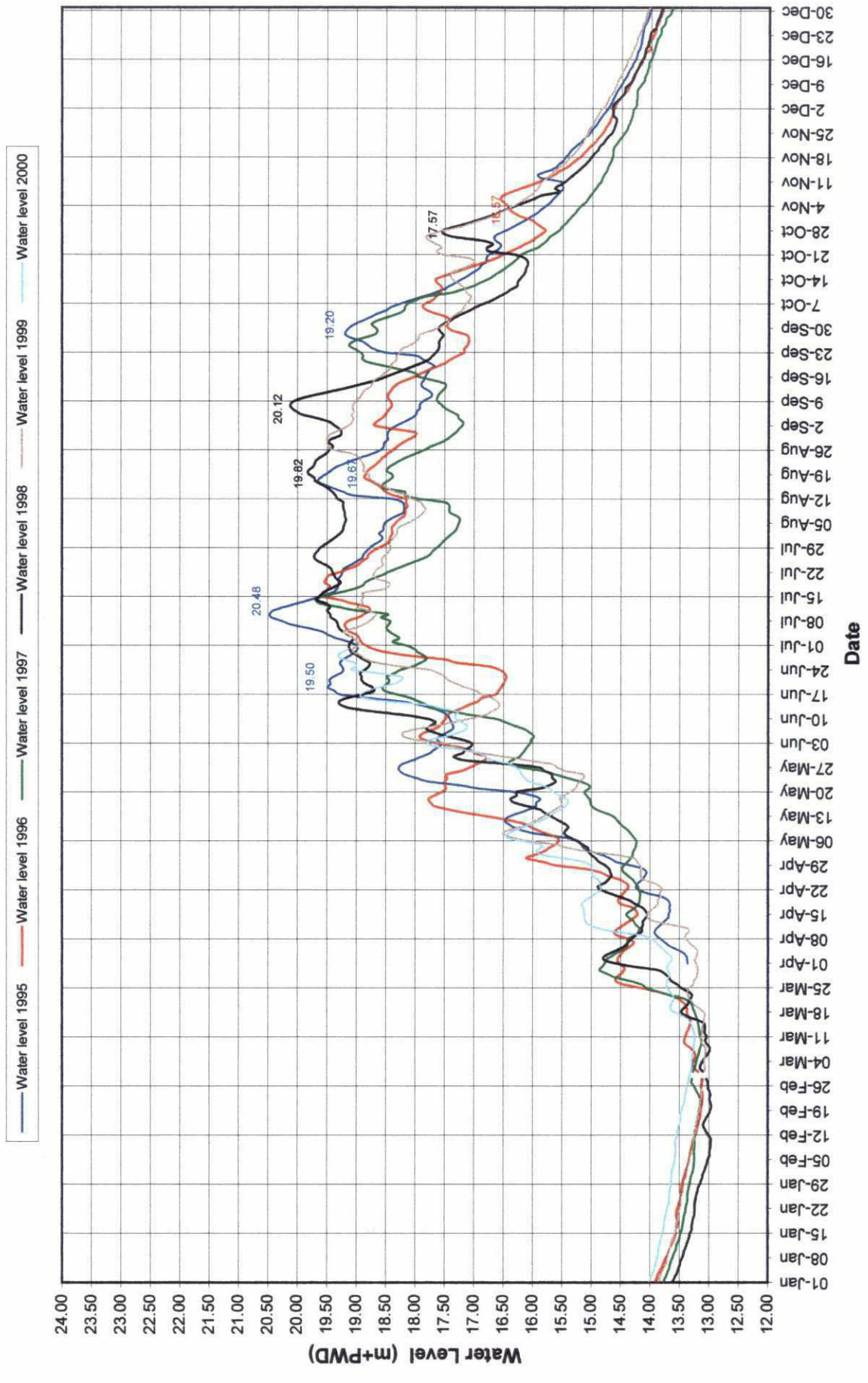

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
(April to June 2000)
+19.32
Water Level (m+PWD)
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
01-Apr
08-Apr
15-Apr
22-Apr
29-Apr
06-May
13-May
20-May
27-May
03-Jun
10-Jun
17-Jun
24-Jun
Date

98

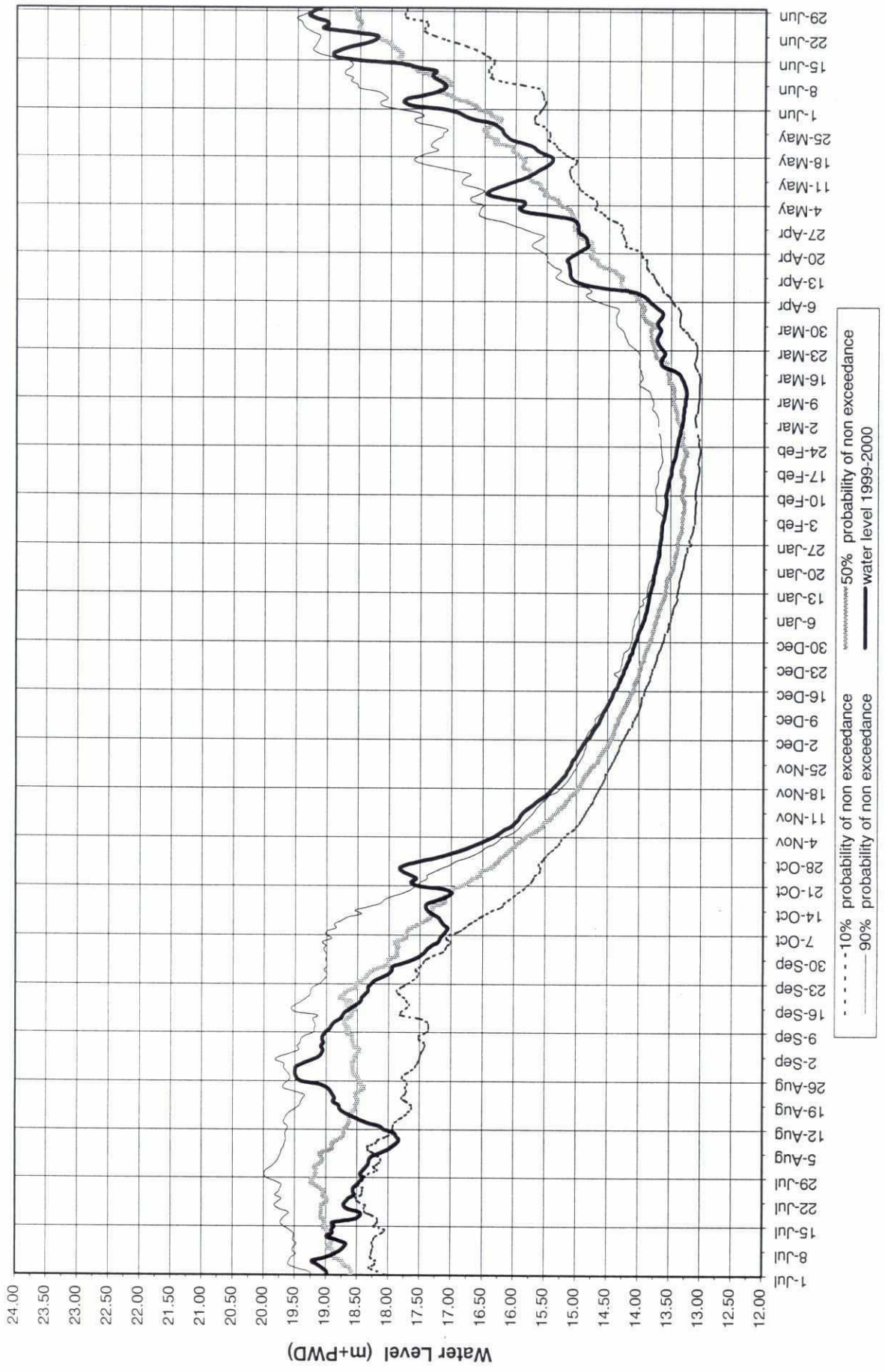
BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
(January to December)



90

BANK PROTECTION TEST STRUCTURES - FAP 21

BWDB WATER LEVEL FREQUENCY CURVES VERSES ACTUAL FAP 21 WATER LEVEL AT BAHADURABAD TEST SITE UP TO JUNE 2000

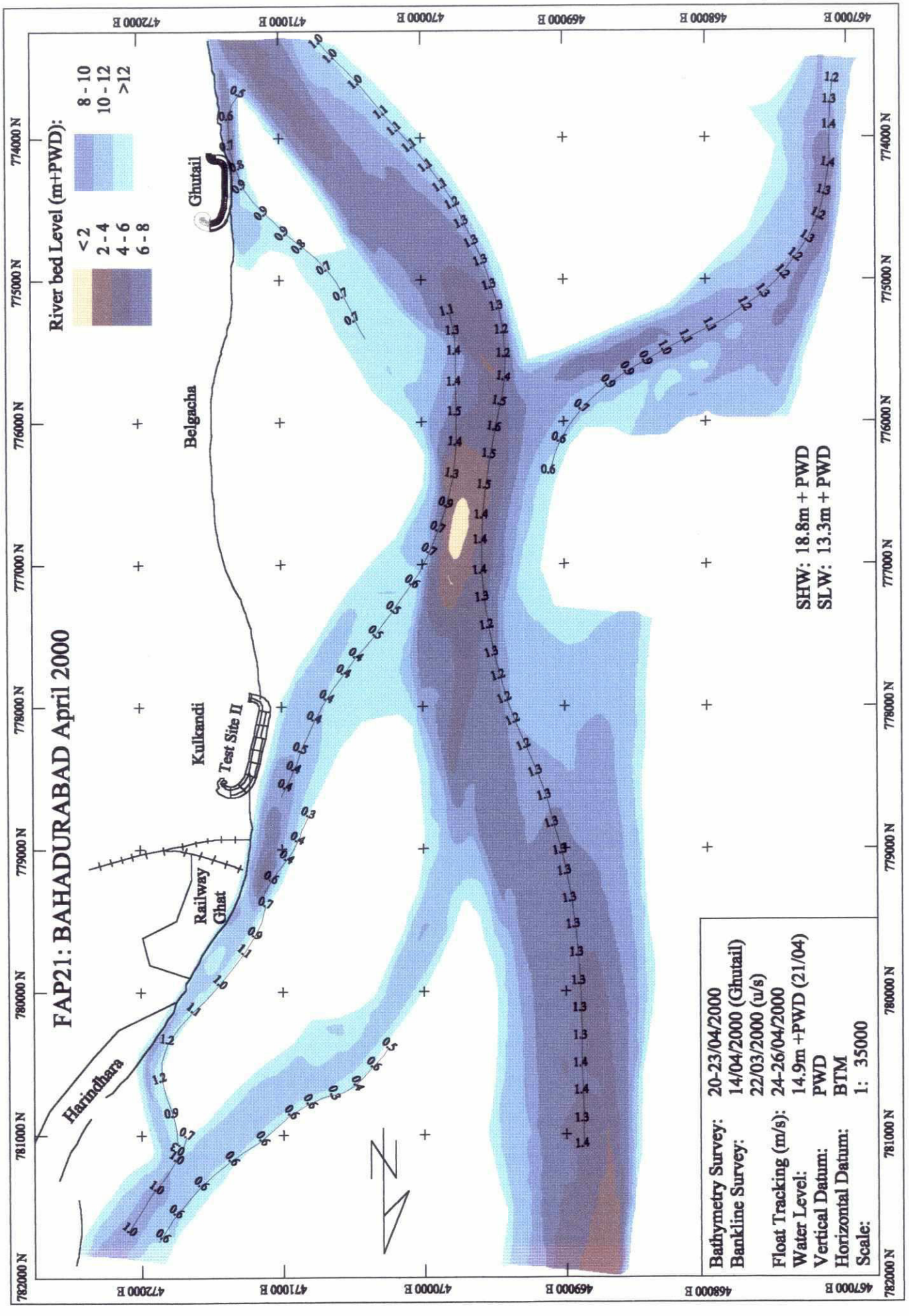


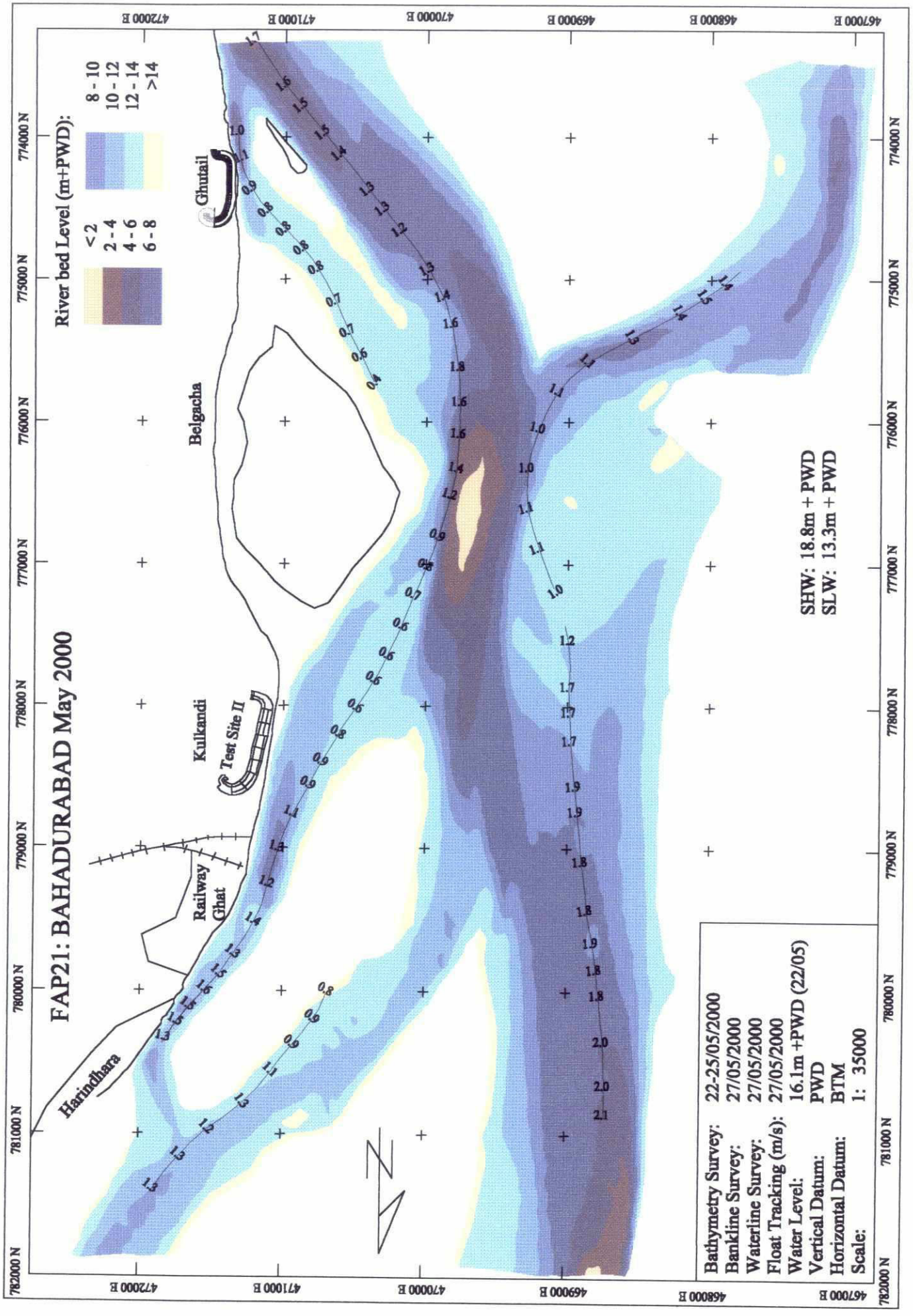
BWDB Data: Period of Record 1962 ~ 1994

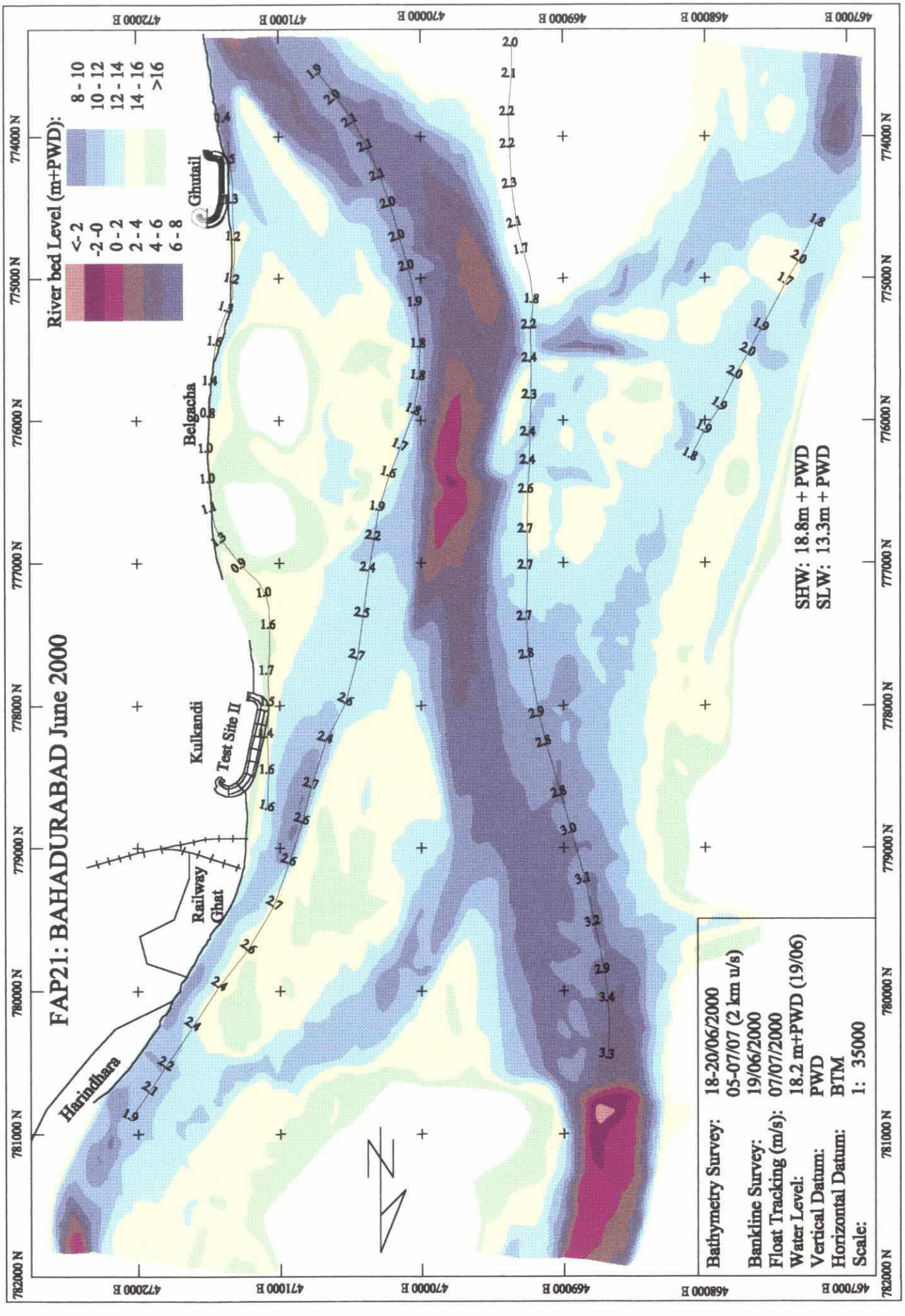
ANNEX G

FAP 21 / Test Site II

- Bathymetric Survey and Flow Velocities


FAP21: BAHADURABAD April 2000
River bed Level (m+PWD):
<2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
>12
Ghutail
Belgacha
Kulkandi
Test Site II
Railway Ghat
Harindhara
SHW: 18.8m + PWD
SLW: 13.3m + PWD
Bathymetry Survey: 20-23/04/2000
Bankline Survey: 14/04/2000 (Ghutail)
22/03/2000 (u/s)
Float Tracking (m/s): 24-26/04/2000
Water Level: 14.9m +PWD (21/04)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 35000
472000 E
471000 E
470000 E
469000 E
468000 E
467000 E
782000 N
781000 N
780000 N
779000 N
778000 N
777000 N
776000 N
775000 N
774000 N

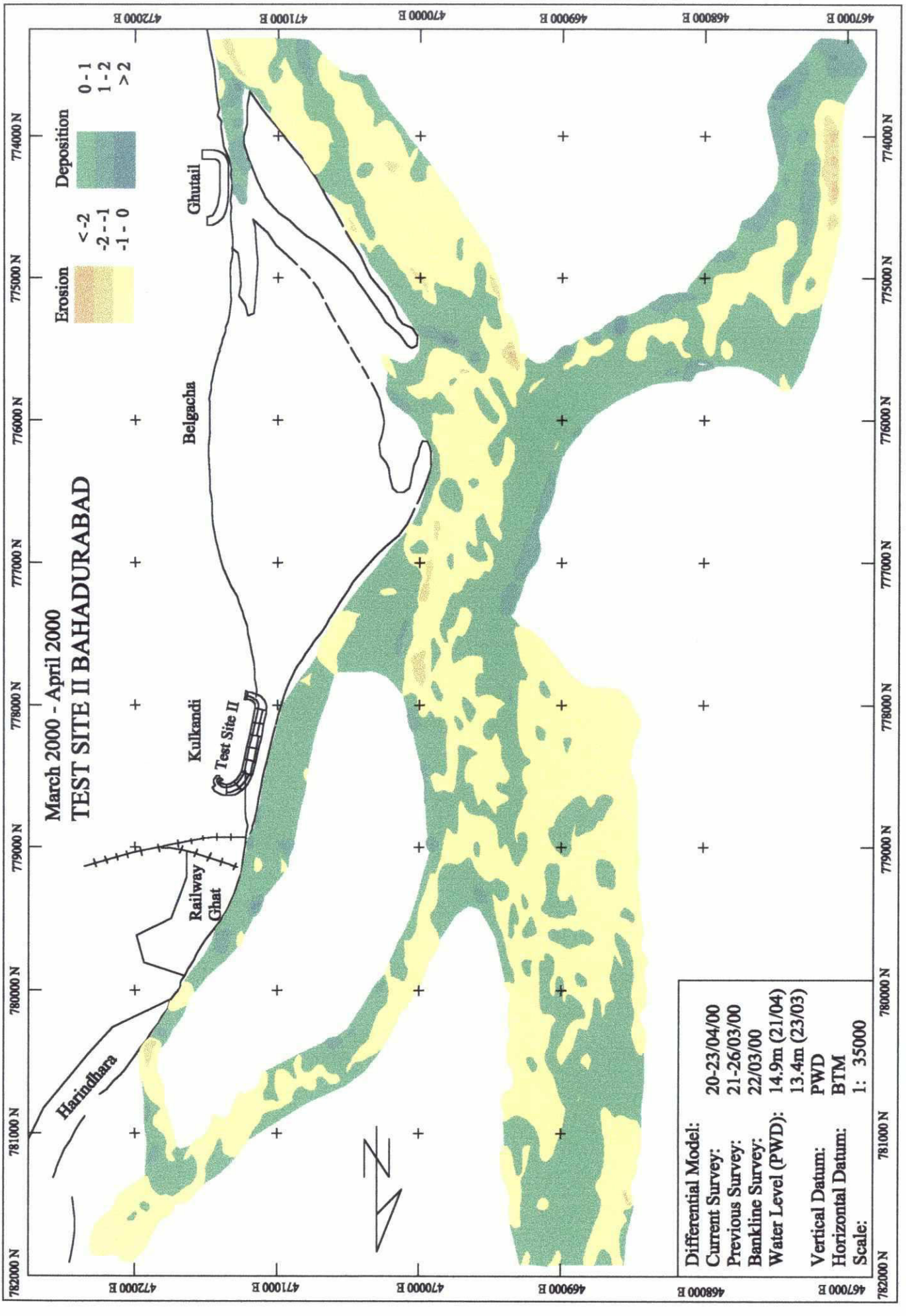

FAP21: BAHADURABAD May 2000
River bed Level (m+PWD):
<2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
>14
Ghutail
Belgacha
Kulkandi
Test Site II
Railway Ghat
Harindhara
SHW: 18.8m + PWD
SLW: 13.3m + PWD
Bathymetry Survey: 22-25/05/2000
Bankline Survey: 27/05/2000
Waterline Survey: 27/05/2000
Float Tracking (m/s): 27/05/2000
Water Level: 16.1m +PWD (22/05)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 35000
N
467000 E
468000 E
469000 E
470000 E
471000 E
472000 E
782000 N
781000 N
780000 N
779000 N
778000 N
777000 N
776000 N
775000 N
774000 N

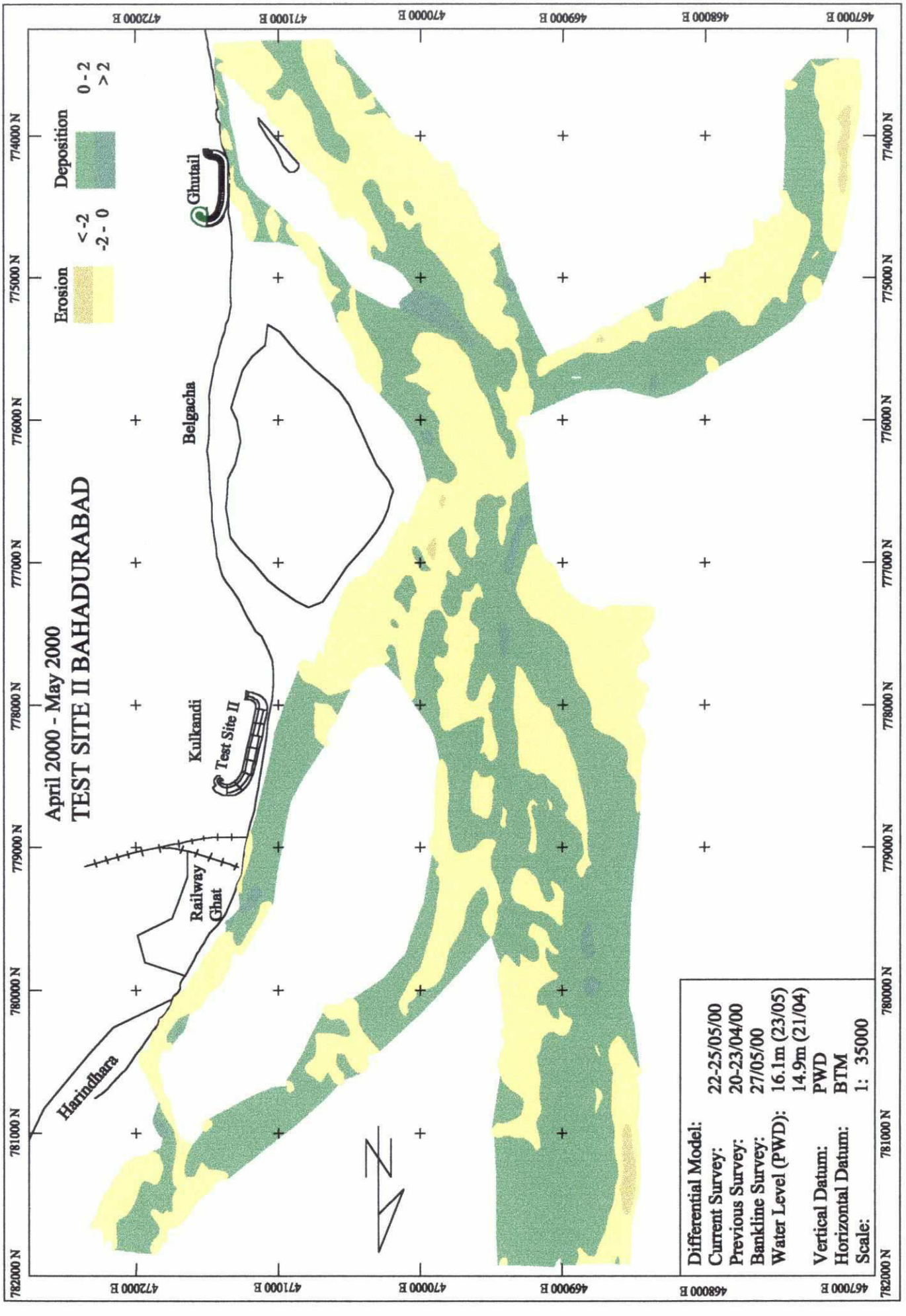

FAP21: BAHADURABAD June 2000
River bed Level (m+PWD):
<-2
-2 -0
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
>16
Ghutail
Belgacha
Kulkandi
Test Site II
Railway Ghat
Harindhara
SHW: 18.8m + PWD
SLW: 13.3m + PWD
Bathymetry Survey: 18-20/06/2000
05-07/07 (2 km u/s)
Bankline Survey: 19/06/2000
Float Tracking (m/s): 07/07/2000
Water Level: 18.2 m+PWD (19/06)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 35000

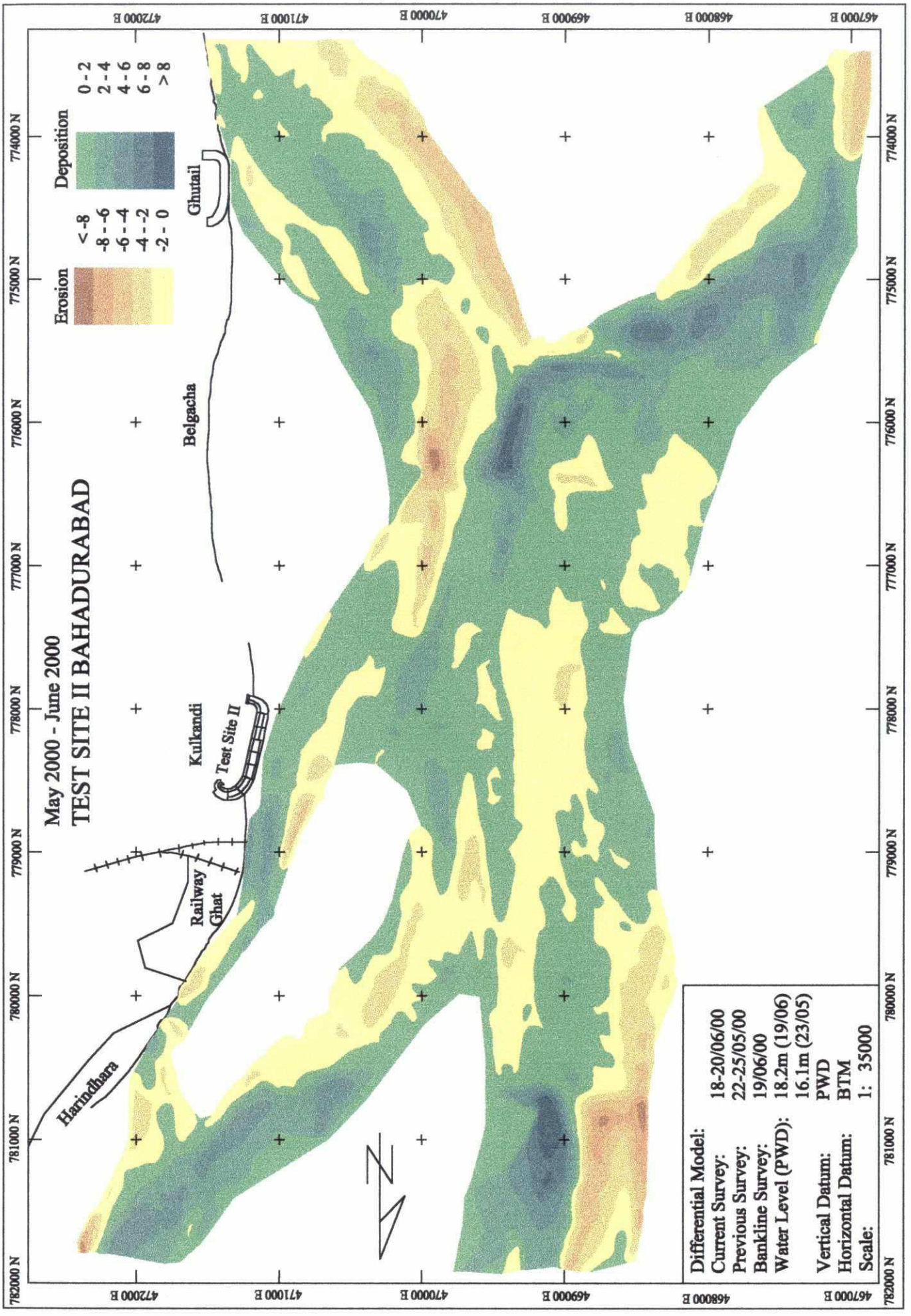
ANNEX H

FAP 21 / Test Site II

- Differential Models


March 2000 - April 2000
TEST SITE II BAHADURABAD
Erosion
< -2
-2 - -1
-1 - 0
Deposition
0 - 1
1 - 2
> 2
Ghutail
Belgacha
Kulkandi
Test Site II
Railway Ghat
Harindhara
Differential Model:
Current Survey: 20-23/04/00
Previous Survey: 21-26/03/00
Bankline Survey: 22/03/00
Water Level (PWD): 14.9m (21/04)
13.4m (23/03)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 35000
472000 E
471000 E
470000 E
469000 E
468000 E
467000 E
774000 N
775000 N
776000 N
777000 N
778000 N
779000 N
780000 N
781000 N
782000 N


April 2000 - May 2000
TEST SITE II BAHADURABAD
Erosion
< -2
-2 - 0
Deposition
0 - 2
> 2
Ghutail
Belgacha
Kulkandi
Test Site II
Railway Ghat
Harindhara
Differential Model:
Current Survey: 22-25/05/00
Previous Survey: 20-23/04/00
Bankline Survey: 27/05/00
Water Level (PWD): 16.1m (23/05)
14.9m (21/04)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 35000
782000 N
781000 N
780000 N
779000 N
778000 N
777000 N
776000 N
775000 N
774000 E
472000 E
471000 E
470000 E
469000 E
468000 E
467000 E

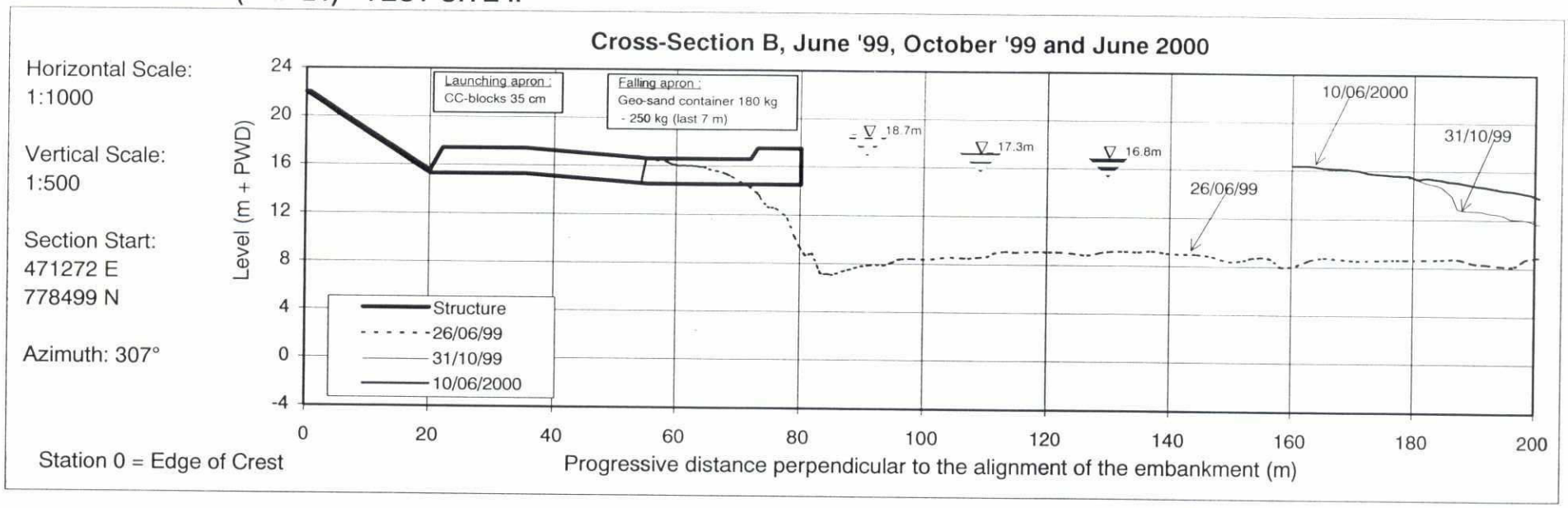

May 2000 - June 2000
TEST SITE II BAHADURABAD
Erosion
< -8
-8 - -6
-6 - -4
-4 - -2
-2 - 0
Deposition
0 - 2
2 - 4
4 - 6
6 - 8
> 8
Ghutail
Belgacha
Kulkandi
Test Site II
Railway Ghat
Harindhara
Differential Model:
Current Survey: 18-20/06/00
Previous Survey: 22-25/05/00
Bankline Survey: 19/06/00
Water Level (PWD): 18.2m (19/06)
16.1m (23/05)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 35000
N
472000 E
471000 E
470000 E
469000 E
468000 E
467000 E
782000 N
781000 N
780000 N
779000 N
778000 N
777000 N
776000 N
775000 N
774000 N

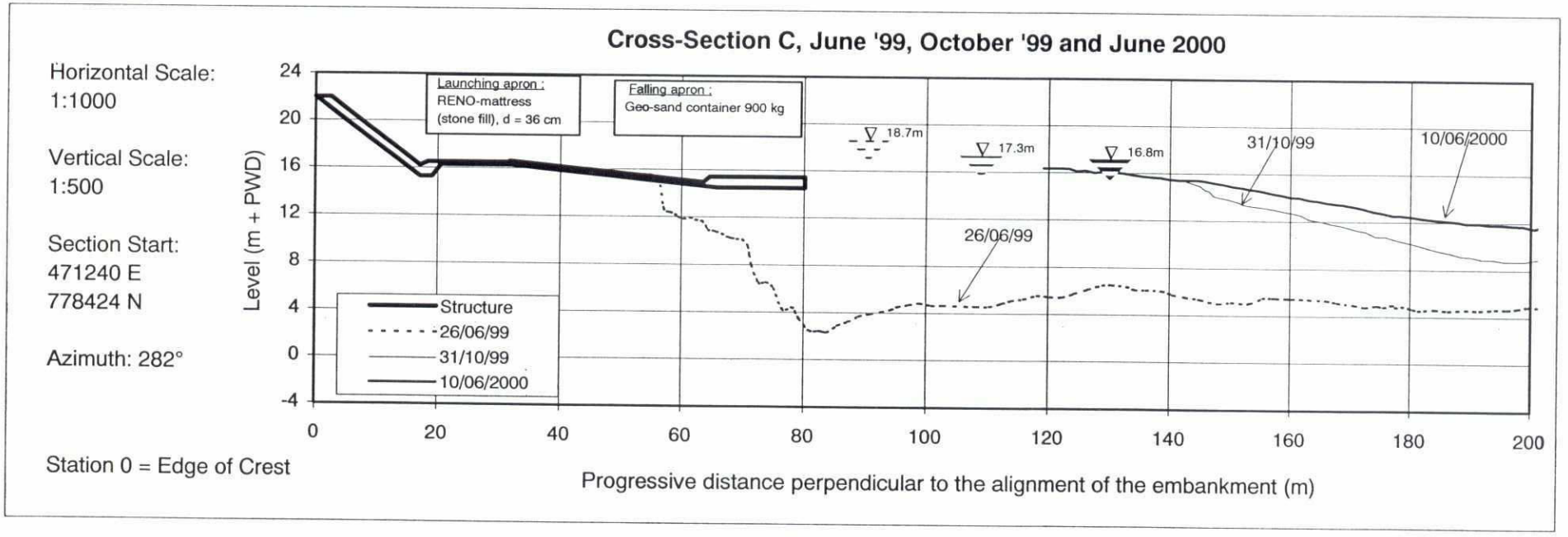
ANNEX I

FAP 21 / Test Site II

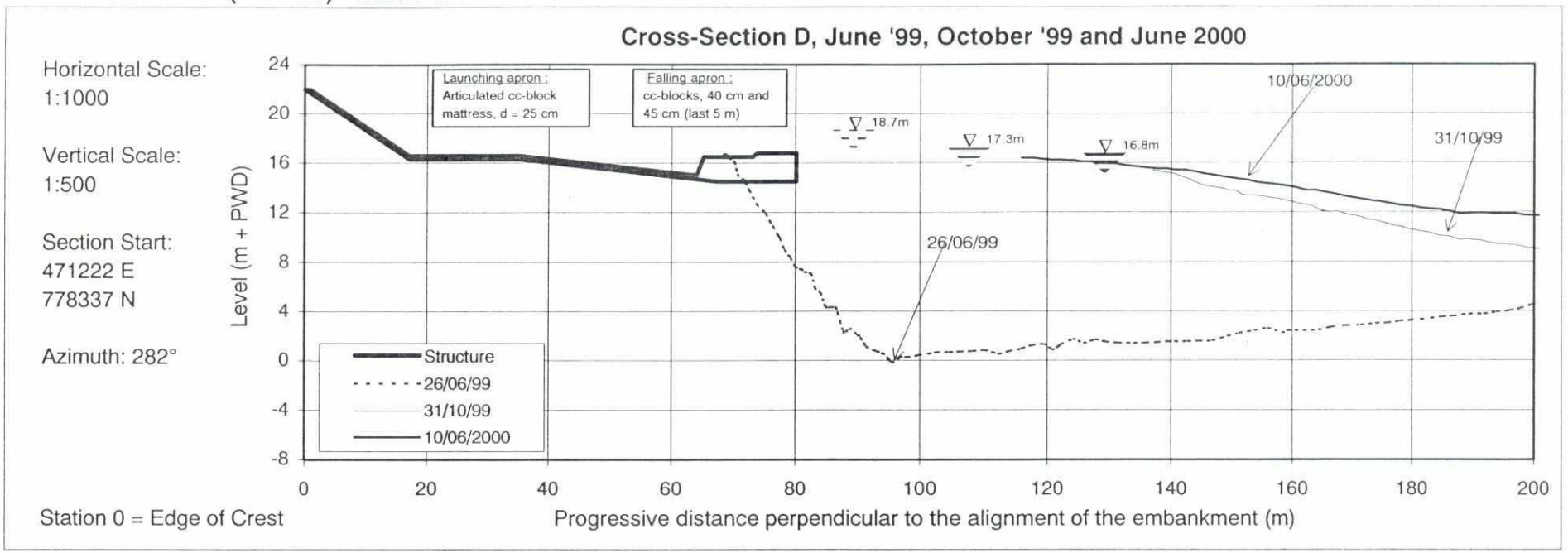
- Cross-Sections end of June 2000

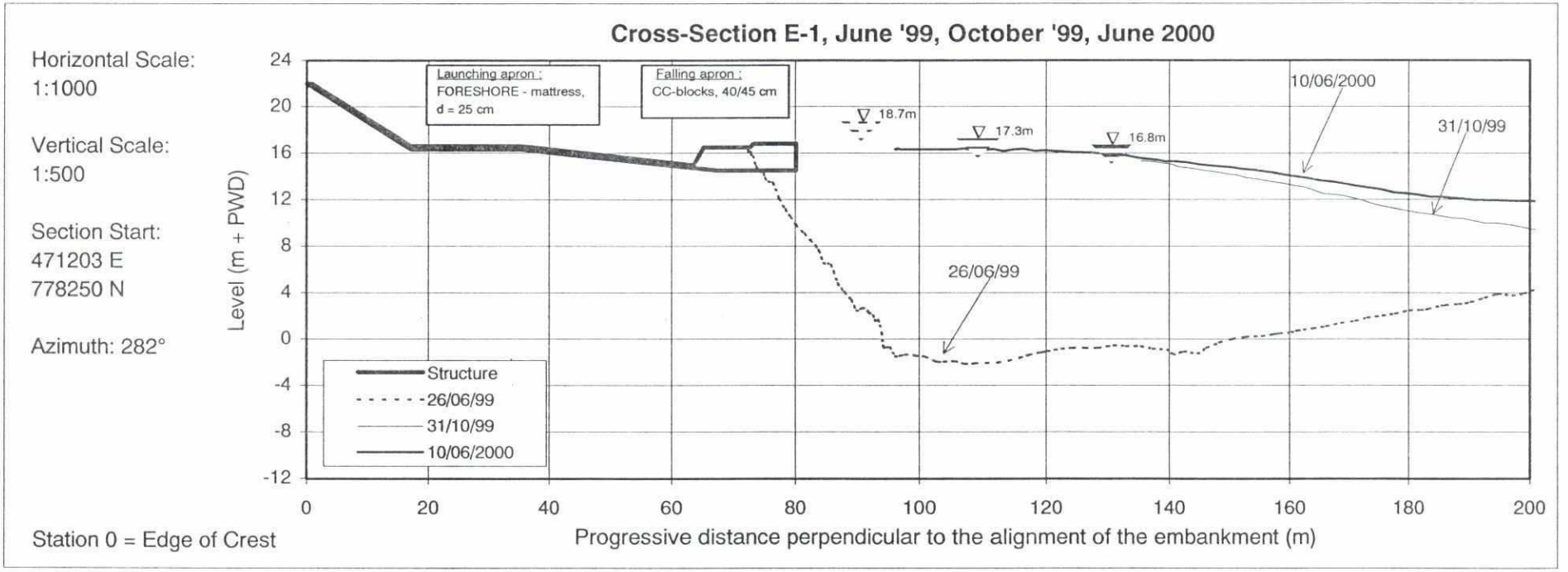
BAHADURABAD (FAP 21) - TEST SITE II





BAHADURABAD (FAP 21) - TEST SITE II





BAHADURABAD (FAP 21) - TEST SITE II

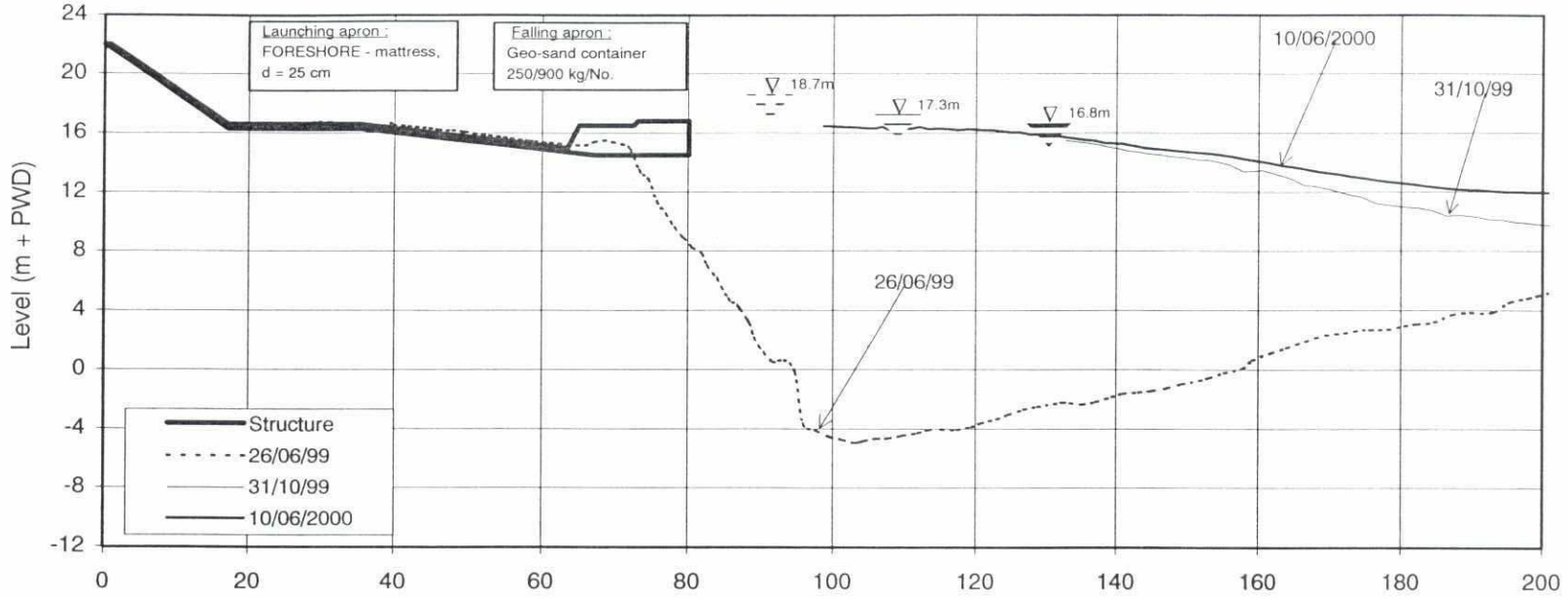
Cross-Section E-2, June '99, October '99 and June 2000

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471201 E
778229 N

Azimuth: 282°



Station 0 = Edge of Crest

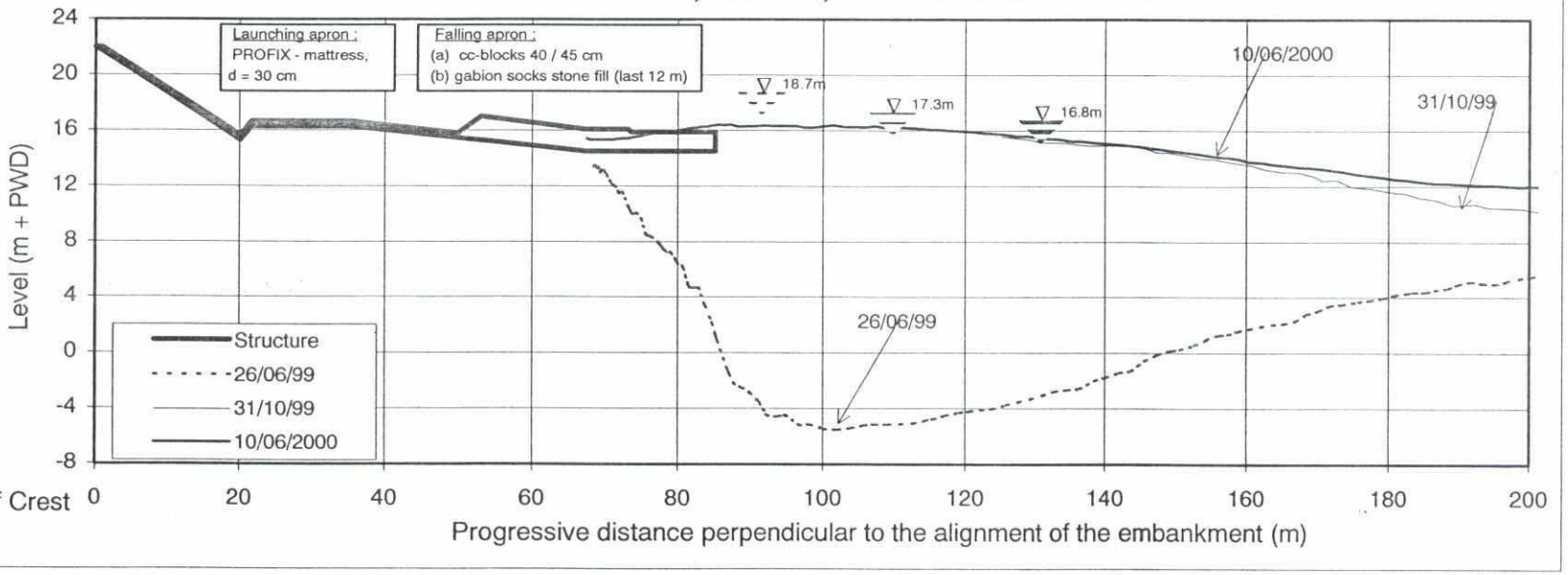
Cross-Section F, June '99, October '99 and June 2000

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471185 E
778162 N

Azimuth: 282°



Station 0 = Edge of Crest

BAHADURABAD (FAP 21) - TEST SITE II

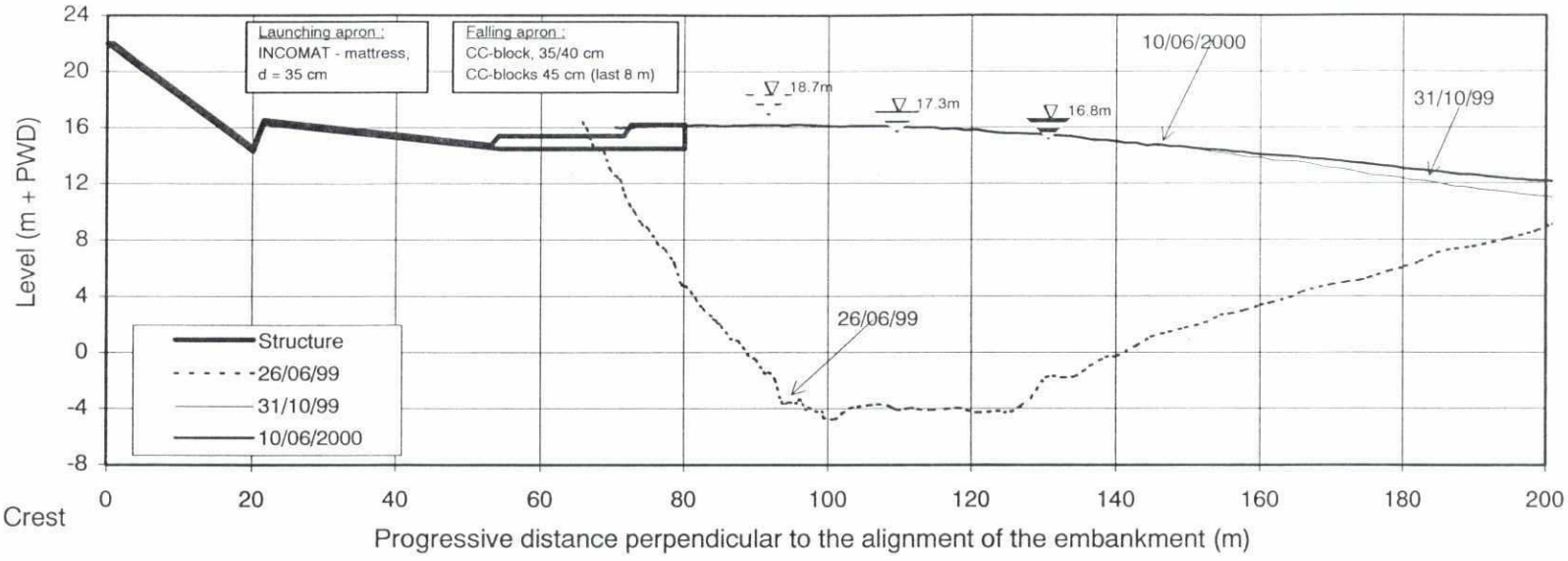
Cross-Section G, June '99, October '99 and June 2000

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471165 E
778071 N

Azimuth: 282°



Station 0 = Edge of Crest

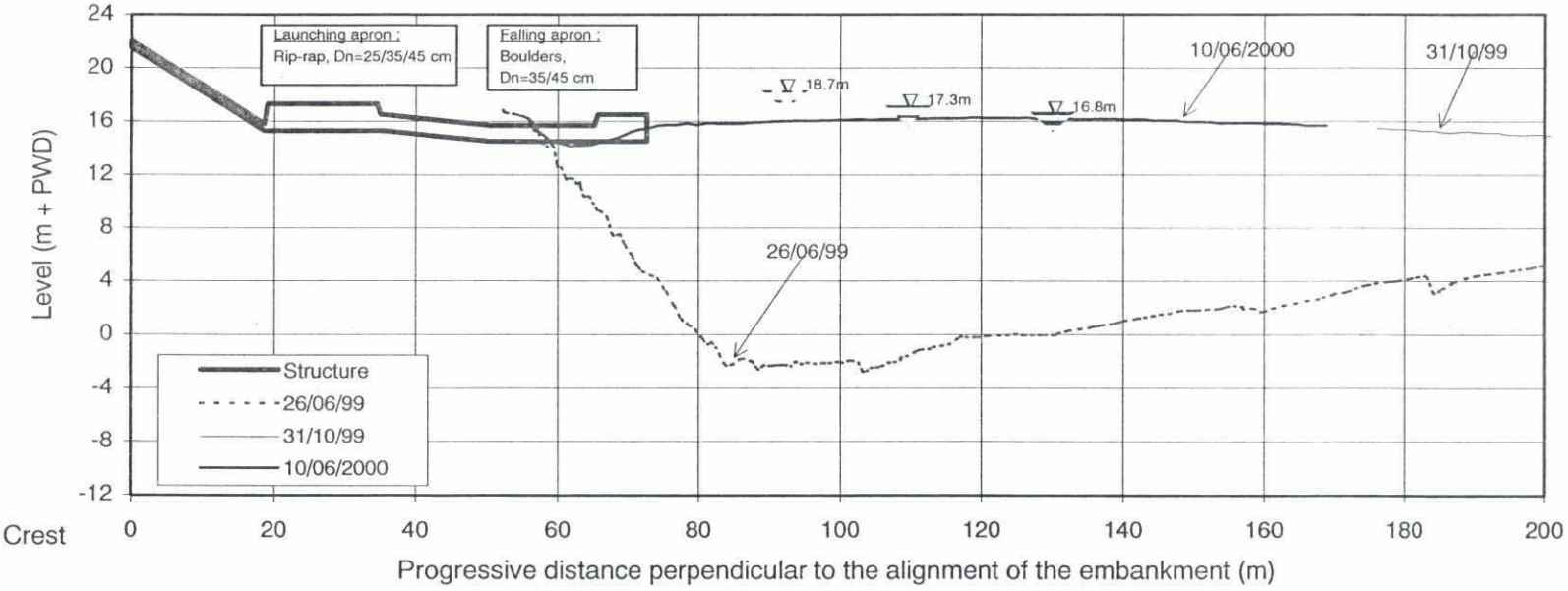
Cross-Section H-1, June '99, October '99, June 2000

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471158 E
777994 N

Azimuth: 242°

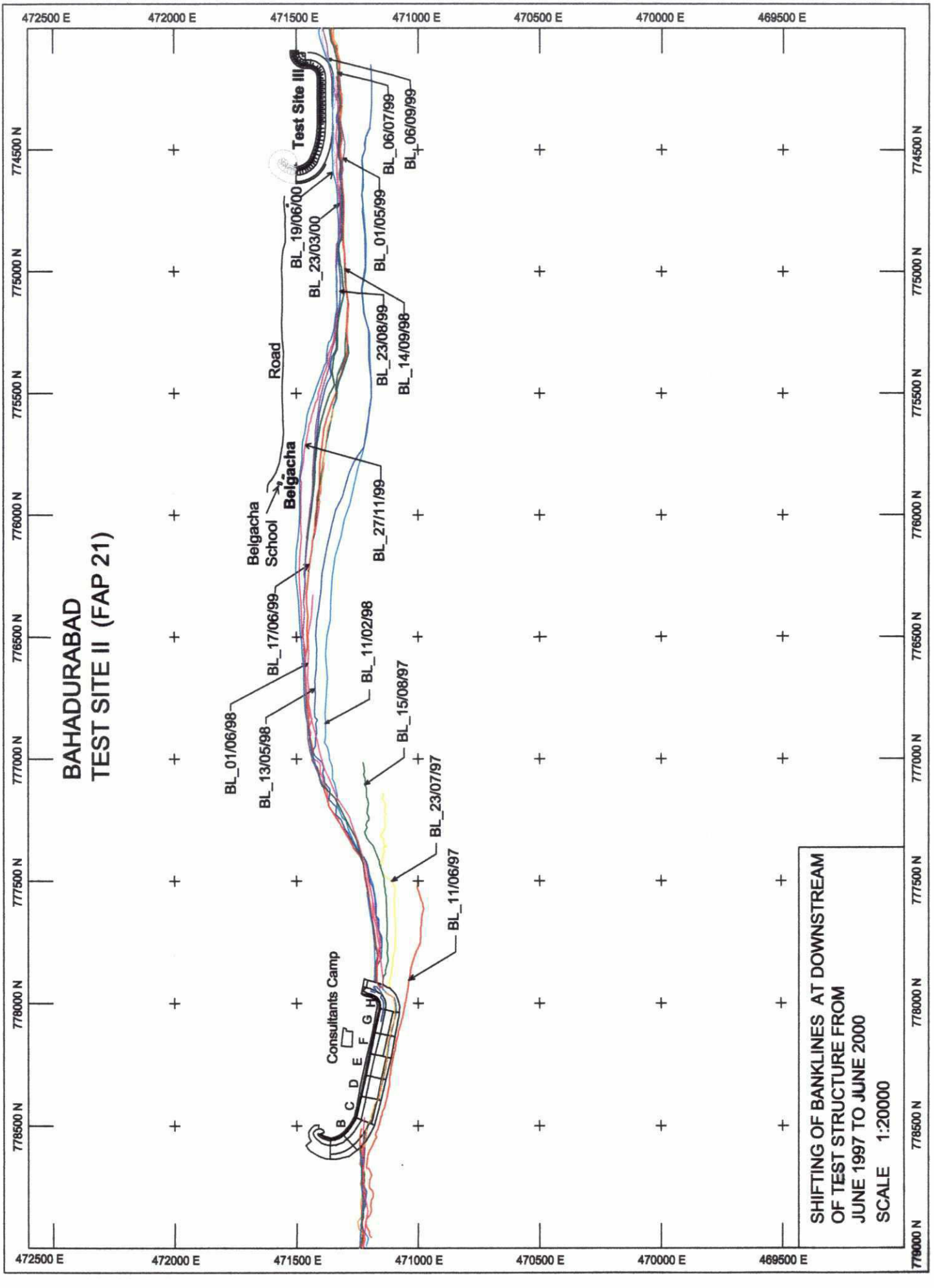


Station 0 = Edge of Crest

ANNEX K

FAP 21 / Test Site II

- Change of Bankline


BAHADURABAD
TEST SITE II (FAP 21)
Test Site III
Road
Belgacha
Belgacha School
Consultants Camp
BL_01/06/98
BL_13/05/98
BL_17/06/99
BL_11/02/98
BL_15/08/97
BL_23/07/97
BL_11/06/97
BL_27/11/99
BL_14/09/98
BL_23/08/99
BL_23/03/00
BL_19/06/00
BL_01/05/99
BL_06/07/99
BL_06/09/99
SHIFTING OF BANKLINES AT DOWNSTREAM OF TEST STRUCTURE FROM JUNE 1997 TO JUNE 2000
SCALE 1:20000
472500 E
472000 E
471500 E
471000 E
470500 E
470000 E
469500 E
774500 N
775000 N
775500 N
776000 N
776500 N
777000 N
777500 N
778000 N
778500 N
779000 N

ANNEX L

FAP 21 / Test Site II

- Photographs

There was no further development at the test site during the period under review.

Therefore, there are no photographs.

ANNEX M

FAP 21 / Test Site III

- Water Level

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT GHUTAIL TEST SITE
MONTH : APRIL 2000

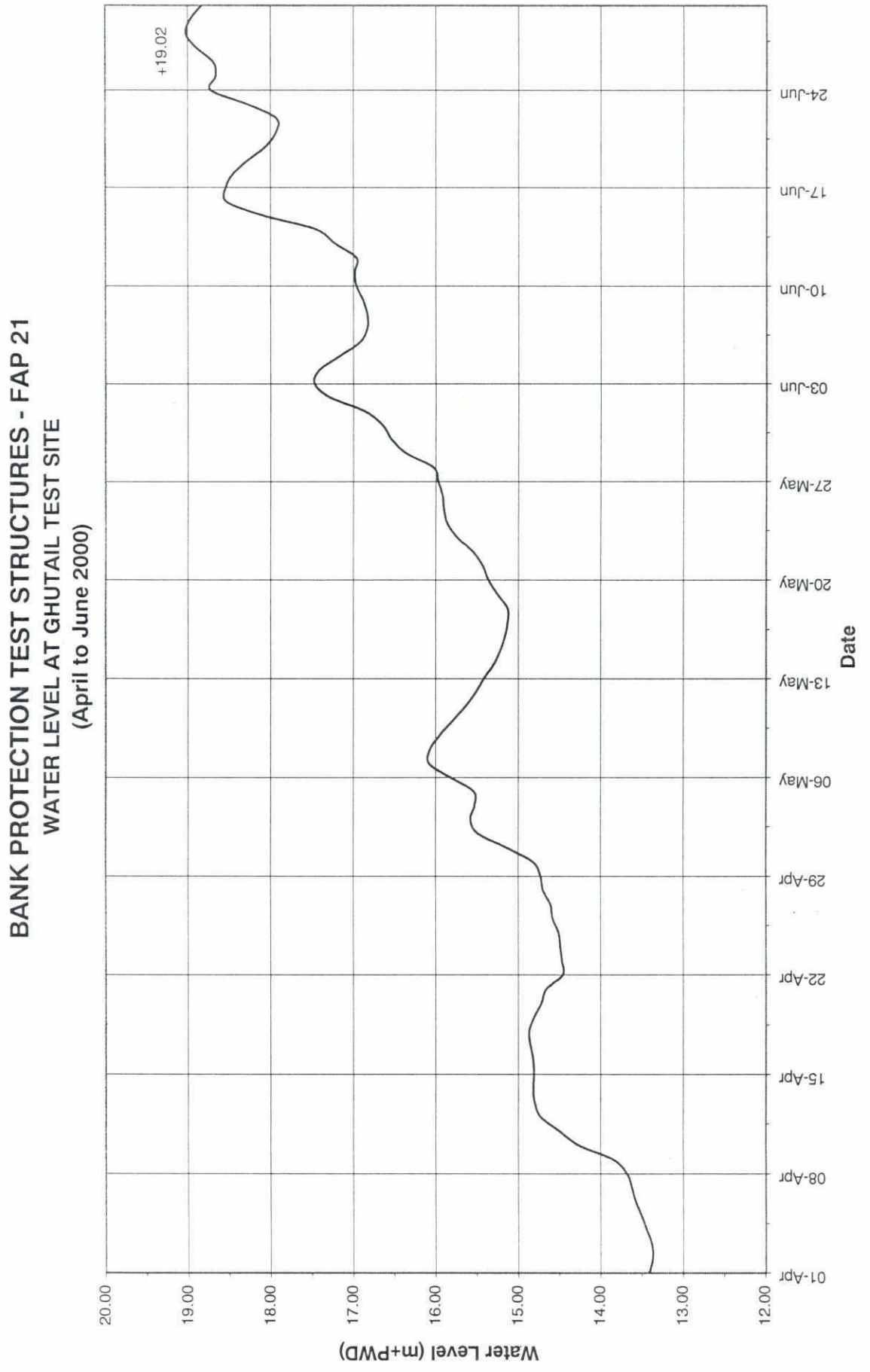
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	13.410	13.400	13.380	
2	13.370	13.360	13.360	
3	13.380	13.400	13.400	
4	13.440	13.450	13.470	
5	13.500	13.510	13.520	
6	13.570	13.590	13.600	
7	13.620	13.640	13.650	
8	13.680	13.700	13.720	
9	13.850	13.930	14.000	
10	14.260	14.310	14.400	
11	14.500	14.620	14.660	
12	14.730	14.750	14.770	
13	14.800	14.810	14.820	
14	14.820	14.820	14.830	
15	14.810	14.820	14.830	
16	14.820	14.820	14.830	
17	14.850	14.860	14.870	
18	14.870	14.870	14.860	
19	14.810	14.790	14.780	
20	14.720	14.710	14.690	
21	14.669	14.550	14.490	
22	14.460	14.450	14.450	
23	14.470	14.480	14.480	
24	14.430	14.490	14.500	
25	14.510	14.520	14.540	
26	14.580	14.590	14.600	
27	14.610	14.610	14.610	
28	14.700	14.710	14.700	
29	14.730	14.740	14.750	
30	14.820	14.850	14.900	

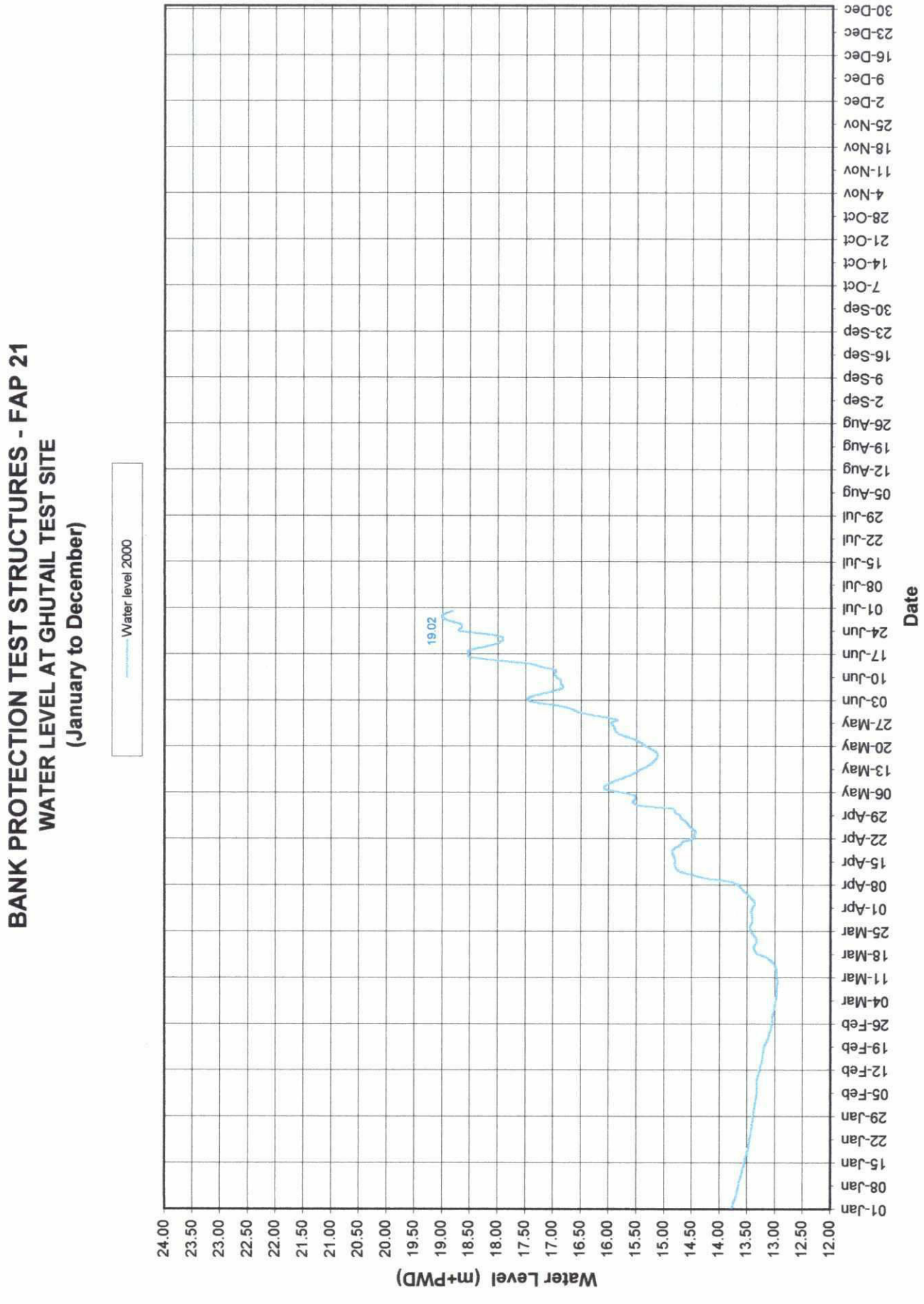
BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT GHUTAIL TEST SITE
MONTH : MAY 2000

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	14.840	15.190	15.240	
2	15.490	15.550	15.570	
3	15.580	15.580	15.570	
4	15.530	15.500	15.490	
5	15.540	15.560	15.580	
6	15.820	15.900	15.950	
7	16.080	16.120	16.130	
8	16.070	16.060	16.040	
9	15.950	15.940	16.930	
10	15.800	15.770	16.760	
11	15.650	15.620	15.590	
12	15.520	15.510	15.490	
13	15.420	15.390	15.370	
14	15.300	15.280	13.270	
15	15.220	15.210	13.200	
16	15.160	15.160	15.150	
17	15.130	15.120	15.120	
18	15.130	15.130	15.130	
19	15.250	15.280	15.290	
20	15.360	15.380	15.390	
21	15.430	15.450	15.470	
22	15.550	15.640	15.660	
23	15.740	15.790	15.810	
24	15.860	15.890	15.900	
25	15.900	15.910	15.910	
26	15.920	15.940	15.950	
27	15.970	15.970	15.970	
28	15.860	15.870	15.870	
29	16.180	16.250	16.280	
30	16.530	16.550	16.560	
31	16.640	16.660	16.680	

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT GHUTAIL TEST SITE
MONTH : JUNE 2000

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	16.850	16.910	16.960	
2	17.270	17.340	17.380	
3	17.470	17.480	17.480	
4	17.410	17.360	17.340	
5	17.160	17.110	17.070	
6	16.920	16.900	16.880	
7	16.830	16.840	16.840	
8	16.880	16.900	16.940	
9	16.880	16.900	16.940	
10	16.960	16.960	17.000	
11	16.980	16.970	16.970	
12	16.960	16.970	17.000	
13	17.220	17.290	17.320	
14	17.450	17.540	17.590	
15	18.090	18.190	18.280	
16	18.530	18.590	18.590	
17	18.540	18.530	18.520	
18	18.540	18.530	18.400	
19	18.260	18.230	18.110	
20	18.050	18.030	18.020	
21	17.930	17.910	17.910	
22	17.930	17.950	17.990	
23	18.280	18.410	18.600	
24	18.720	18.730	18.730	
25	18.660	18.630	18.610	
26	18.690	18.730	18.760	
27	18.890	18.940	19.000	
28	19.020	19.010	18.990	
29	18.970	18.920	18.910	
30	18.830	18.770	18.730	

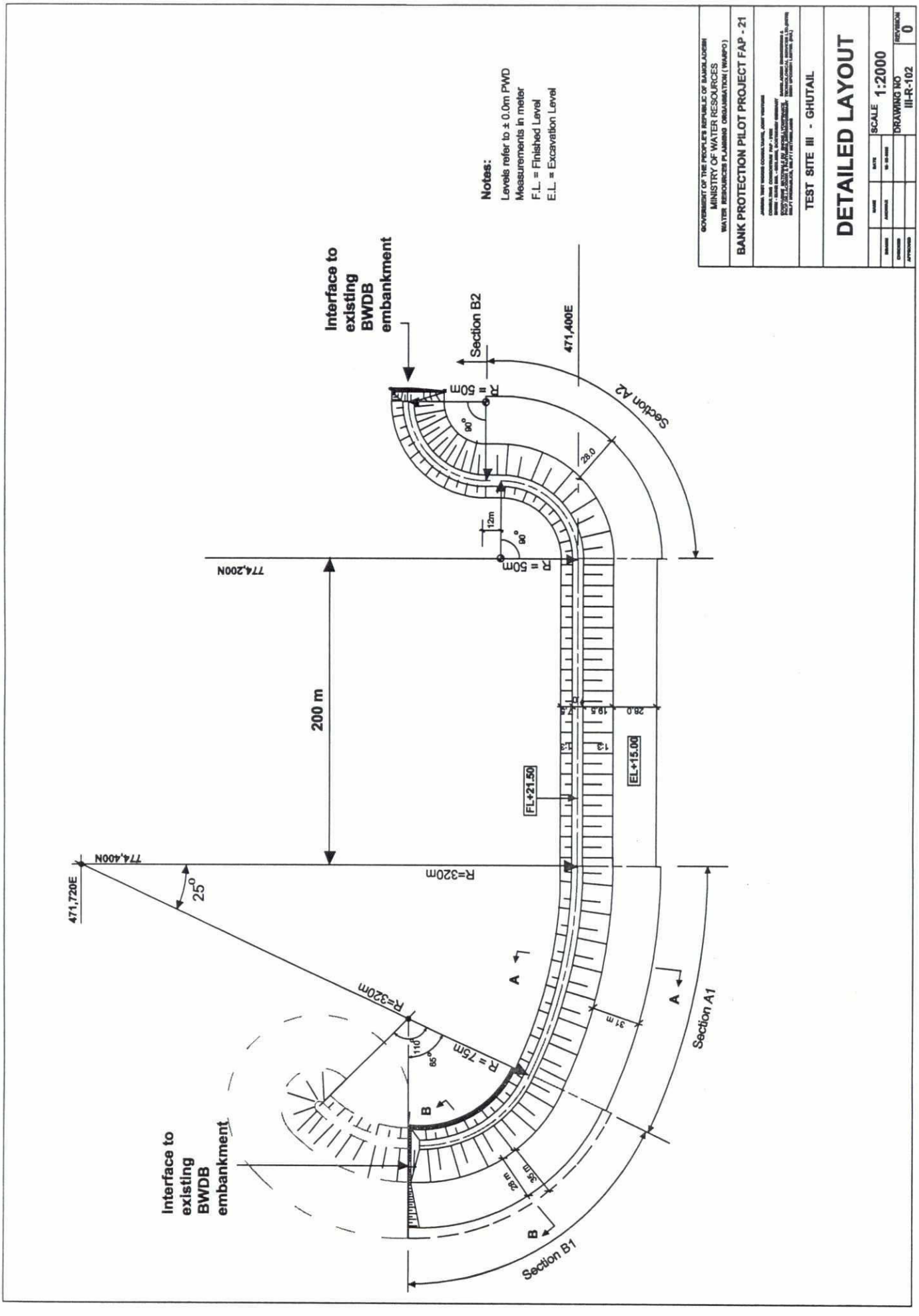

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT GHUTAIL TEST SITE
(April to June 2000)
+19.02
Water Level (m+PWD)
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
Date
01-Apr
08-Apr
15-Apr
22-Apr
29-Apr
06-May
13-May
20-May
27-May
03-Jun
10-Jun
17-Jun
24-Jun

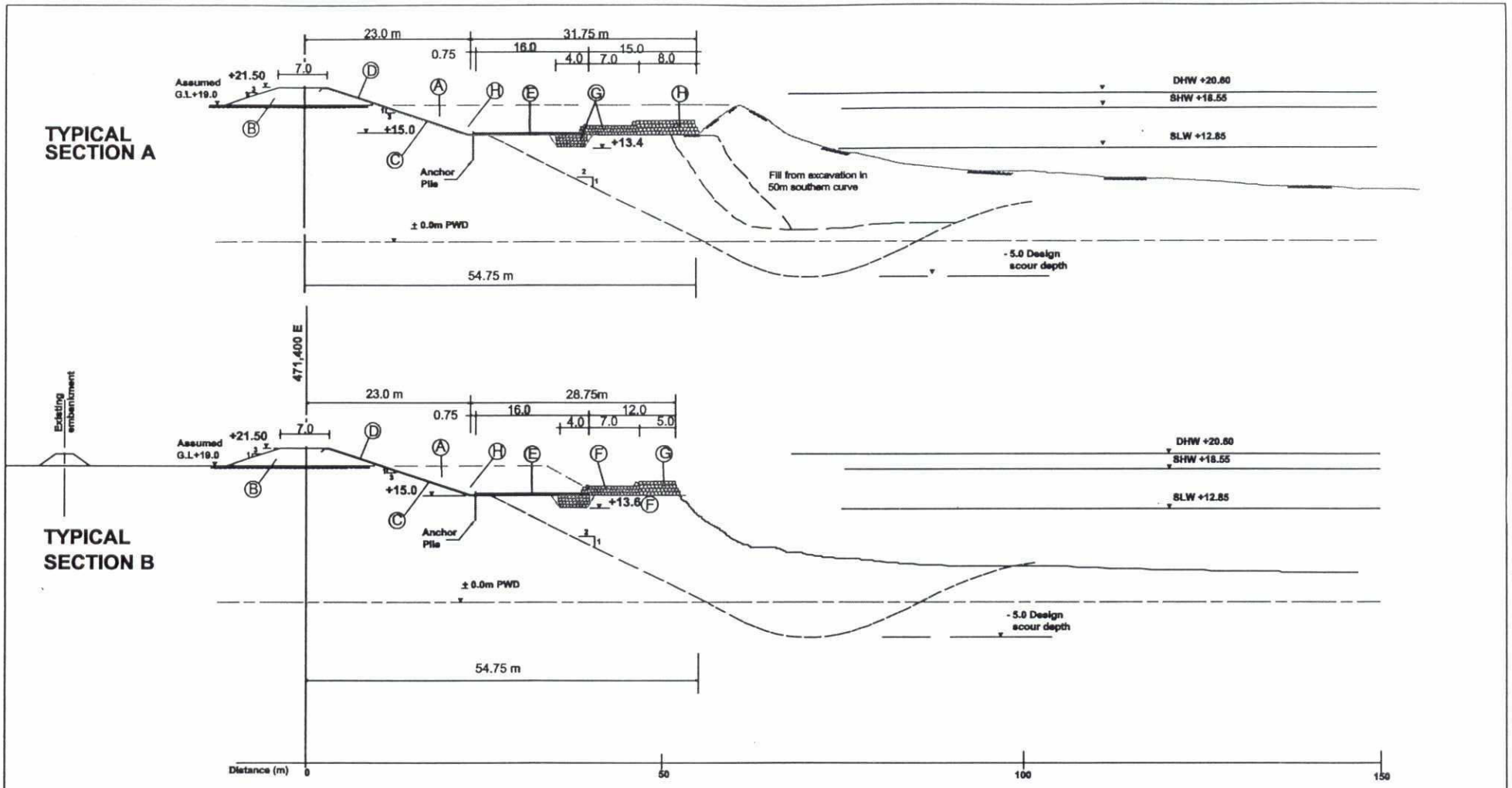

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT GHUTAIL TEST SITE
(January to December)
Water level 2000
19.02
Water Level (m+PWD)
24.00
23.50
23.00
22.50
22.00
21.50
21.00
20.50
20.00
19.50
19.00
18.50
18.00
17.50
17.00
16.50
16.00
15.50
15.00
14.50
14.00
13.50
13.00
12.50
12.00
Date
01-Jan
08-Jan
15-Jan
22-Jan
29-Jan
05-Feb
12-Feb
19-Feb
26-Feb
04-Mar
11-Mar
18-Mar
25-Mar
01-Apr
08-Apr
15-Apr
22-Apr
29-Apr
06-May
13-May
20-May
27-May
03-Jun
10-Jun
17-Jun
24-Jun
01-Jul
08-Jul
15-Jul
22-Jul
29-Jul
05-Aug
12-Aug
19-Aug
26-Aug
2-Sep
9-Sep
16-Sep
23-Sep
30-Sep
7-Oct
14-Oct
21-Oct
28-Oct
4-Nov
11-Nov
18-Nov
25-Nov
2-Dec
9-Dec
16-Dec
23-Dec
30-Dec

ANNEX N

FAP 21 / Test Site III

- Detailed Layout and Cross-Section


GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES
WATER RESOURCES PLANNING ORGANISATION (WARPO)
BANK PROTECTION PILOT PROJECT FAP - 21
TEST SITE III - GHUTAIL
DETAILED LAYOUT
SCALE 1:2000
DRAWING NO III-R-102
REVISION 0
Notes:
Levels refer to ± 0.0m PWD
Measurements in meter
F.L. = Finished Level
E.L. = Excavation Level
Interface to existing BWDB embankment
Section B2
471,400E
Section A2
R = 50m
28.0
12m
774,200N
200 m
FL+21.50
EL+15.00
774,400N
471,720E
25°
R=320m
R = 75m
110°
65°
31 m
Section A1
Section B1
Interface to existing BWDB embankment



Ⓐ Excavation
Ⓑ Fill, Compact + Profile
Ⓒ Geotextile filter POLYFELT TS-70
Ⓓ Brick mattressing (d=15cm)
Ⓔ Articulated RENO-mattresses
d-30cm,rubble-fill Grade B/C
(D_{50} =15/20cm)
Geotextile filter BIDIM S-82
Ⓕ CC-Blocks 35° (45 Nos/m²)
Ⓖ CC-Blocks 40° (32 Nos/m²)
Ⓗ CC-Blocks 45° (25 Nos/m)

Notes:
1. All measurements in meter.
2. Levels refer to ± 0.0 m PWD.
3. SLW = Standard Low Water
SHW = Standard High Water
DHW = Design High Water

GOVERMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES
WATER RESOURCES PLANNING ORGANISATION (WARPO)

BANK PROTECTION PILOT PROJECT FAP - 21

TEST SITE III - GHUTAIL

MODIFIED CROSS-SECTION A & B

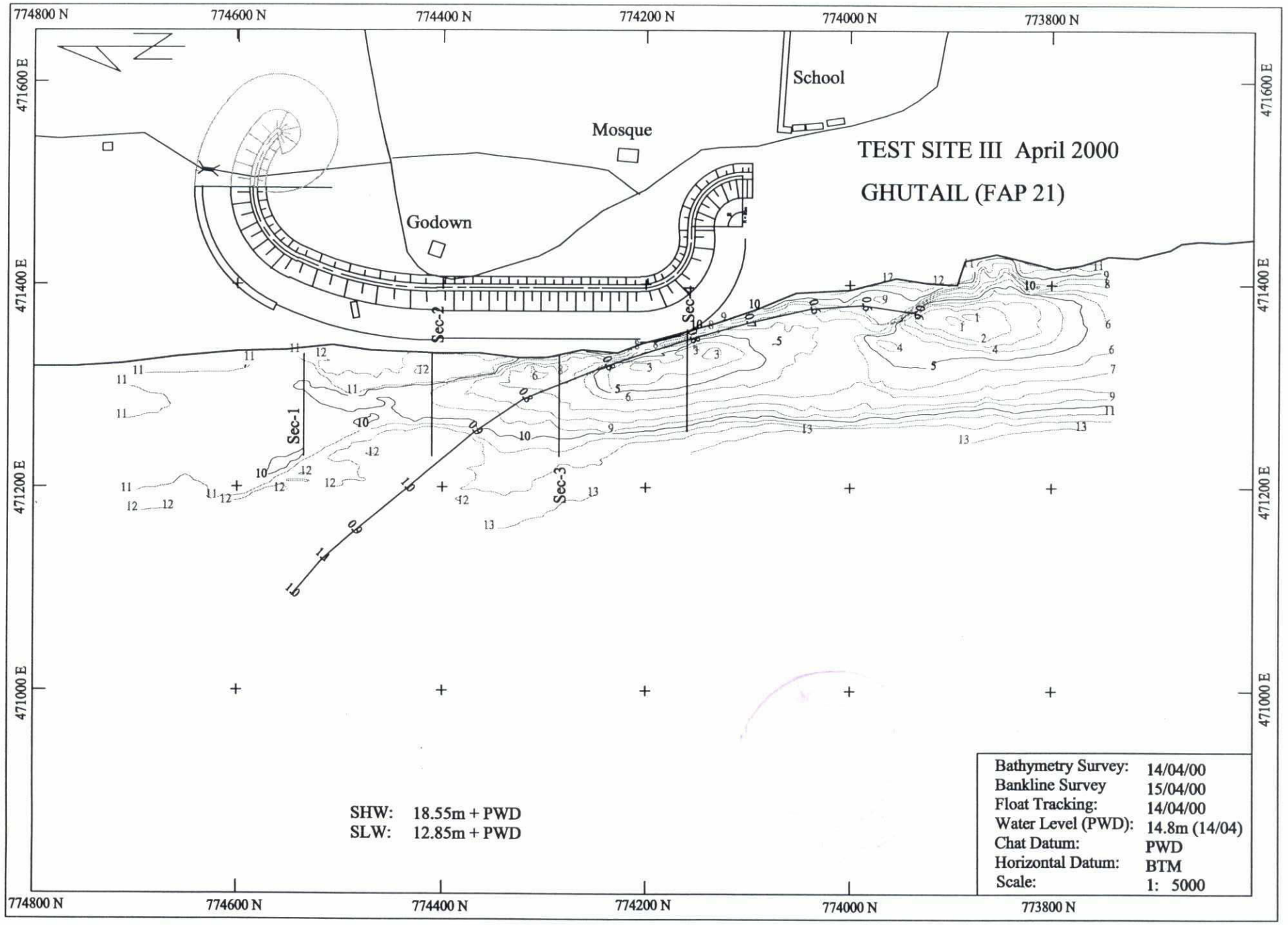
	NAME	DATE	SCALE
DRAWN	ANOWAR	07-05-2000	1:500
CHECKED			DRAWING NO: III-R-103
APPROVED			REVISION: 0

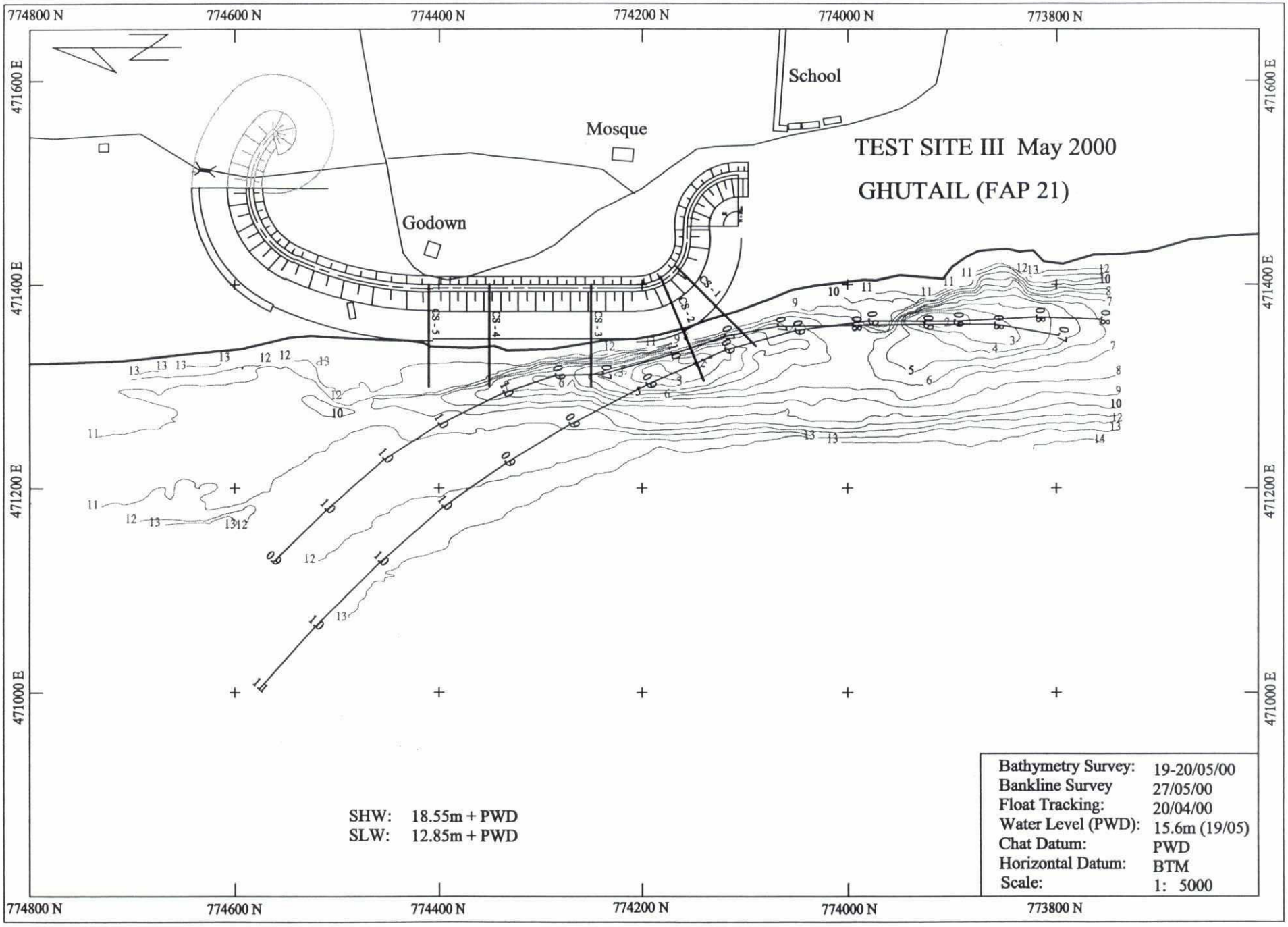
302

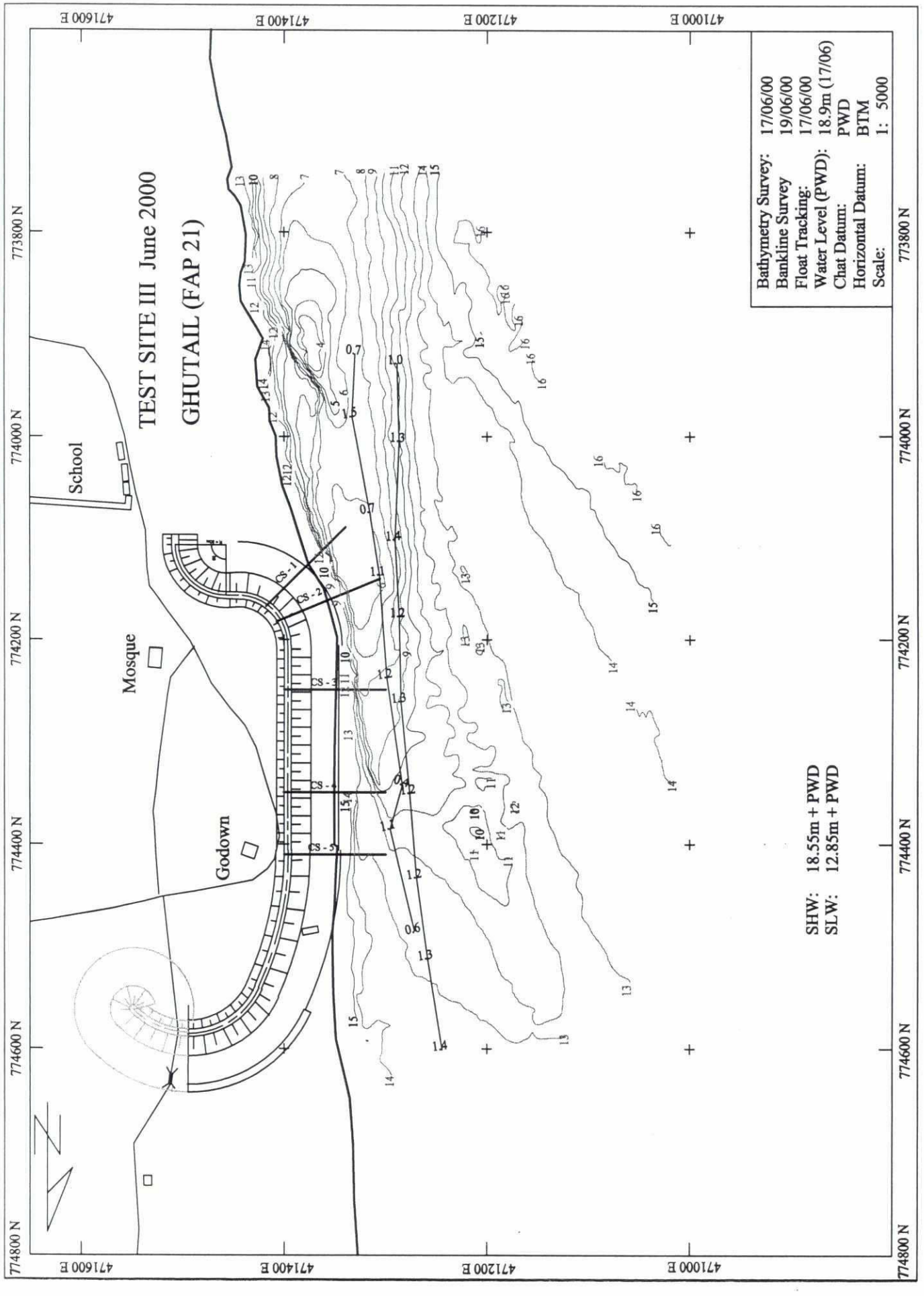
ANNEX O

FAP 21 / Test Site III

- Bathymetric Survey and Flow Velocities


774800 N
774600 N
774400 N
774200 N
774000 N
773800 N
471600 E
471400 E
471200 E
471000 E
School
Mosque
Godown
TEST SITE III April 2000
GHUTAIL (FAP 21)
Sec-1
Sec-2
Sec-3
Sec-4
SHW: 18.55m + PWD
SLW: 12.85m + PWD
Bathymetry Survey: 14/04/00
Bankline Survey 15/04/00
Float Tracking: 14/04/00
Water Level (PWD): 14.8m (14/04)
Chat Datum: PWD
Horizontal Datum: BTM
Scale: 1: 5000


774800 N
774600 N
774400 N
774200 N
774000 N
773800 N
471600 E
471400 E
471200 E
471000 E
School
Mosque
Godown
TEST SITE III May 2000
GHUTAIL (FAP 21)
CS - 1
CS - 2
CS - 3
CS - 4
CS - 5
SHW: 18.55m + PWD
SLW: 12.85m + PWD
Bathymetry Survey: 19-20/05/00
Bankline Survey 27/05/00
Float Tracking: 20/04/00
Water Level (PWD): 15.6m (19/05)
Chat Datum: PWD
Horizontal Datum: BTM
Scale: 1: 5000


TEST SITE III June 2000
GHUTAIL (FAP 21)
School
Mosque
Godown
CS-1
CS-2
CS-3
CS-4
CS-5
Bathymetry Survey: 17/06/00
Bankline Survey 19/06/00
Float Tracking: 17/06/00
Water Level (PWD): 18.9m (17/06)
Chat Datum: PWD
Horizontal Datum: BTM
Scale: 1: 5000
SHW: 18.55m + PWD
SLW: 12.85m + PWD
471600 E
471400 E
471200 E
471000 E
773800 N
774000 N
774200 N
774400 N
774600 N
774800 N

ANNEX P

FAP 21 / Test Site III

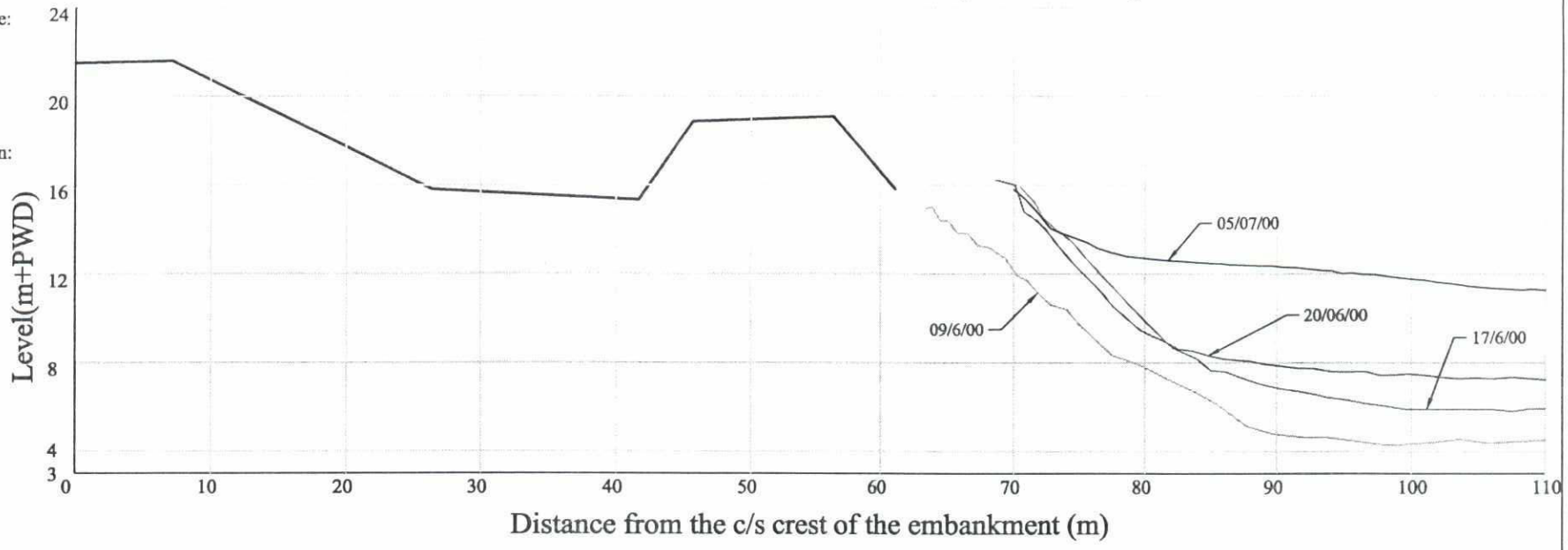
- Cross-Sections

Test Site III: Cross Section - 1[June 2000]

Horizontal Scale:
1: 500
Vertical Scale:
1: 300

Starting Position:
471416.8 E
774166.8 N

Section Angle:
225°

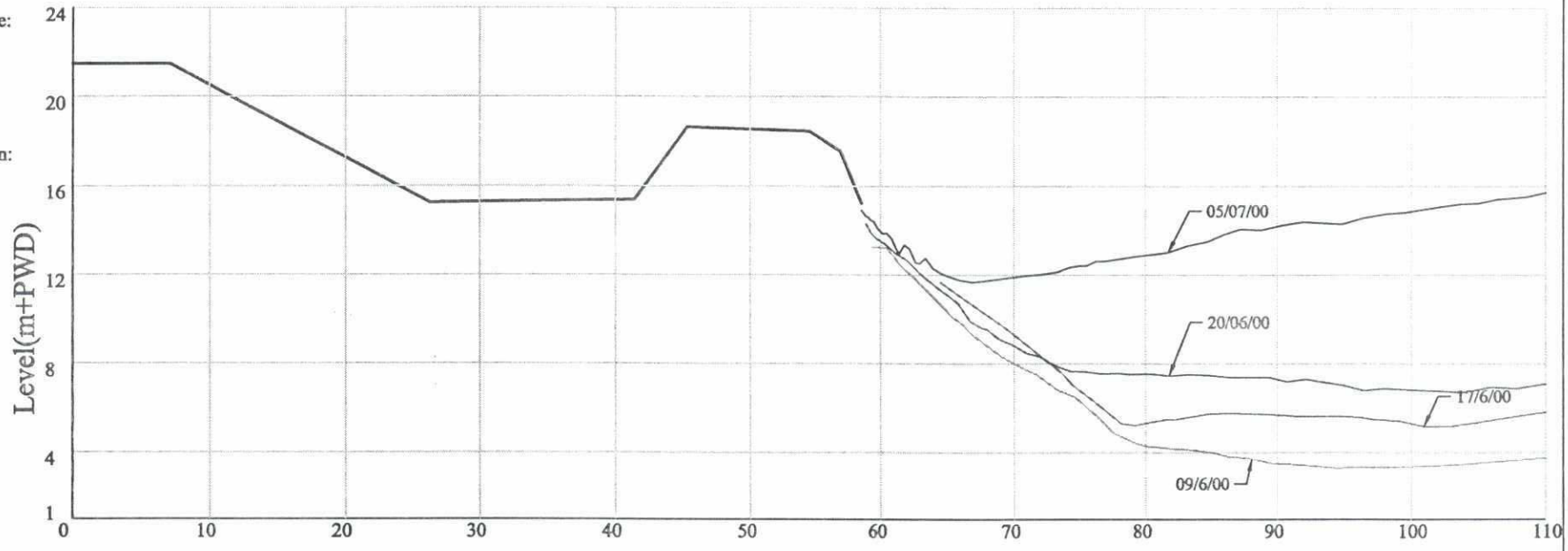


Test Site III: Cross Section - 2[June 2000]

Horizontal Scale:
1: 500
Vertical Scale:
1: 300

Starting Position:
471406.8 E
774182.1 N

Section Angle:
247.5°



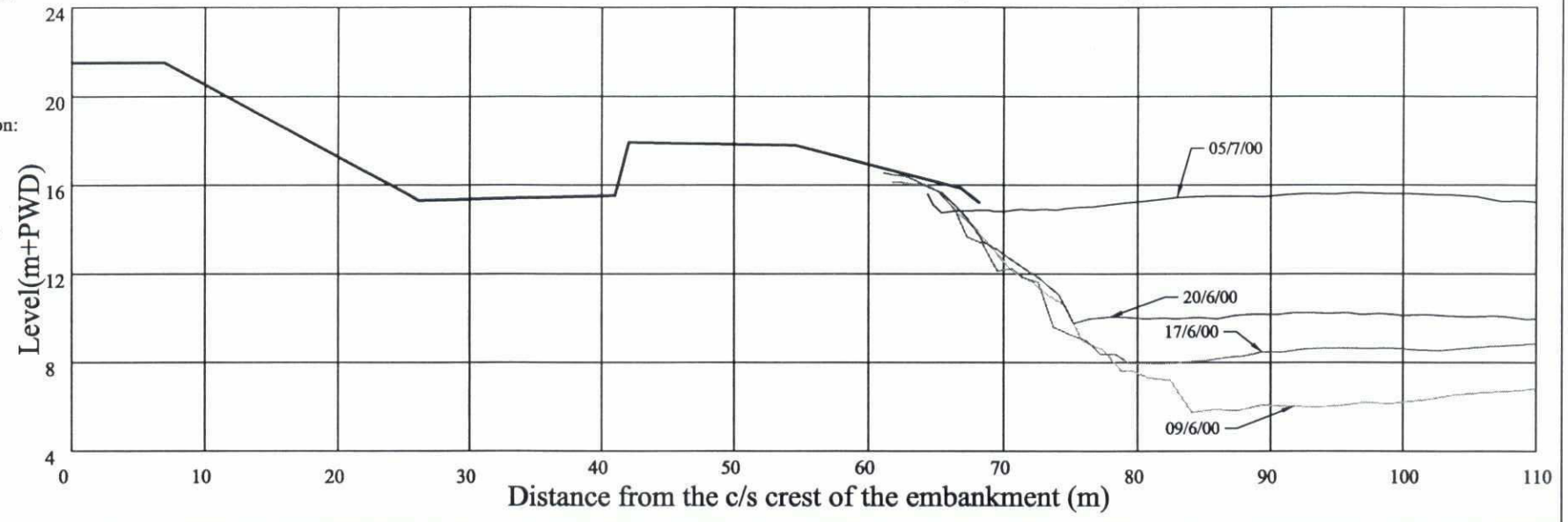
Note: For location see Appendix B-7

Test Site III: Cross Section - 3[June 2000]

Horizontal Scale:
1: 500
Vertical Scale:
1: 300

Starting Position:
471403.2 E
774249.5 N

Section Angle:
270°

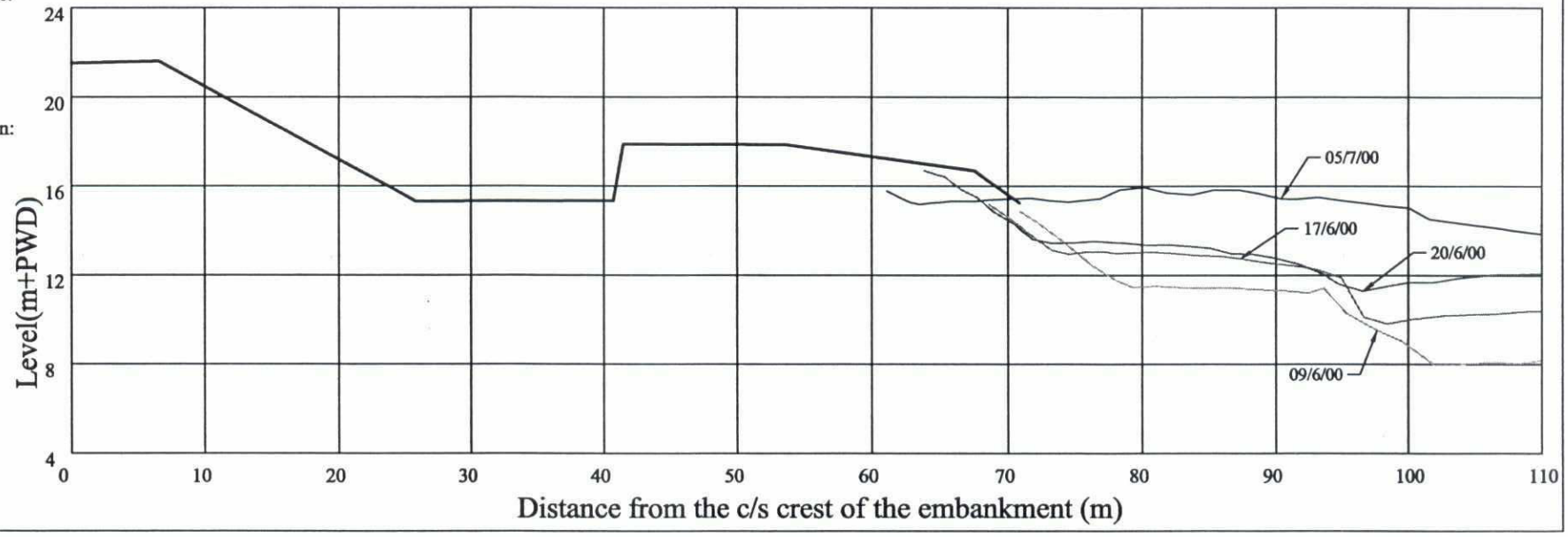


Test Site III: Cross Section - 4[June 2000]

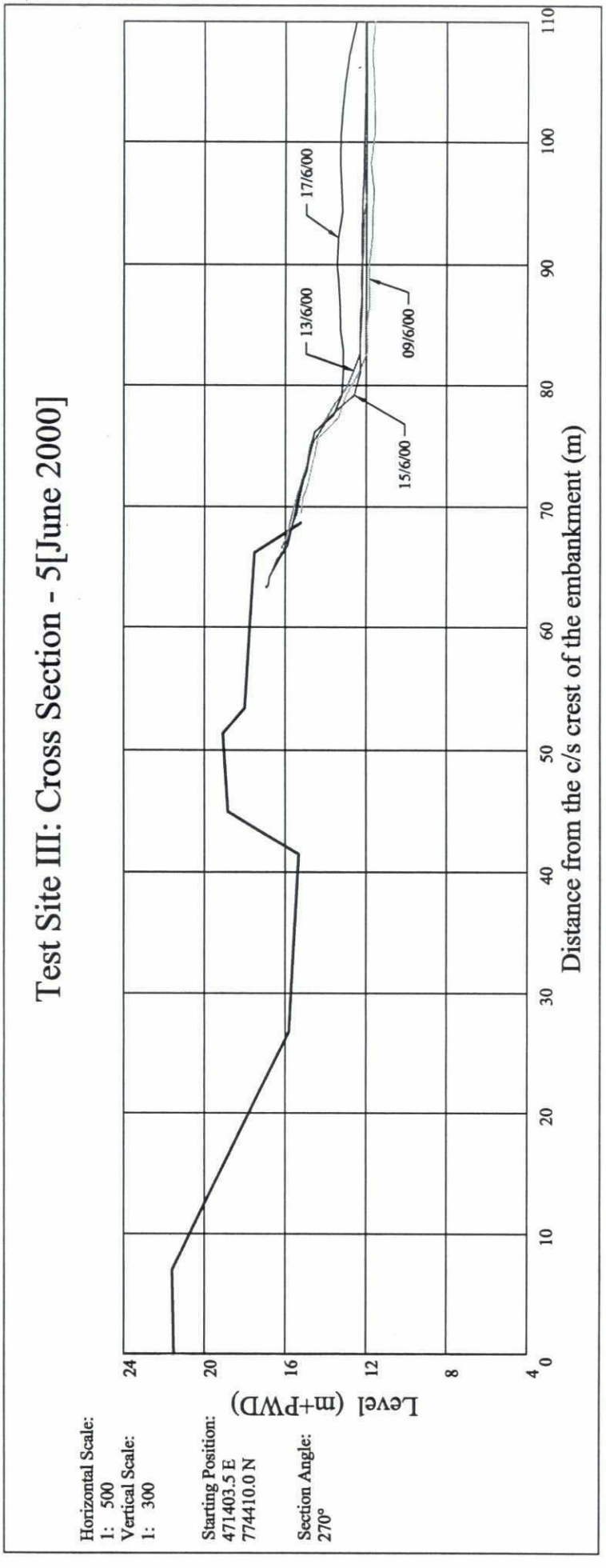
Horizontal Scale:
1: 500
Vertical Scale:
1: 300

Starting Position:
471403.1 E
774349.3 N

Section Angle:
270°



Note: For location see Appendix B-7



Note: For location see Appendix B-7

220'

ANNEX Q

FAP 21 / Test Site III

- Photographs

Photo 1: Test Site III – Ghutail;
View upstream on 14.06.2000;
Water level at 17.45 m+PWD

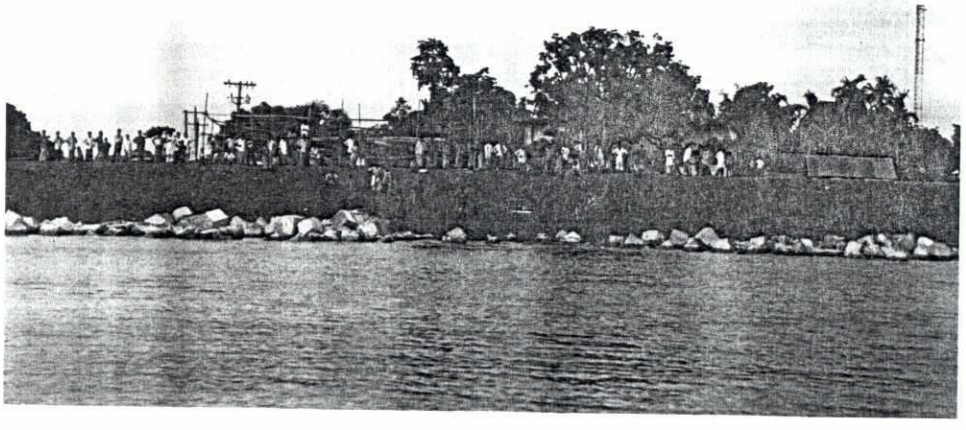


Photo 2: Test Site III – Ghutail;
View of middle section on 30.06.2000
Water level at 18.83 m+PWD

Photo 3: Test Site III – Ghutail;
View downstream on 30.06.2000;
Water level at 18.83 m+PWD

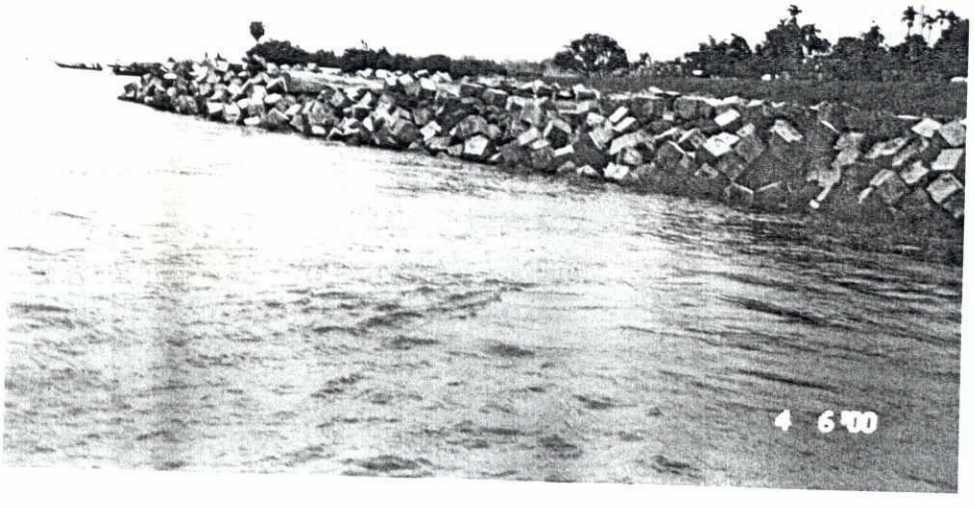


Photo 4: Test Site III – Ghutail;
View of falling apron of downstream;
Water level as 17.41 m+PWD

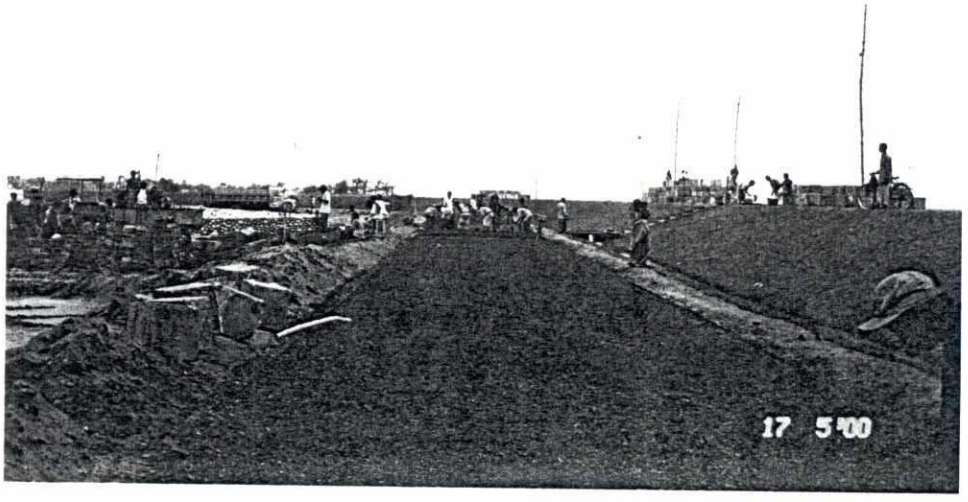


Photo 5: Test Site III – Ghutail;
Road construction behind embankment

Photo 6: Test Site III – Ghutail;
Road construction behind embankment