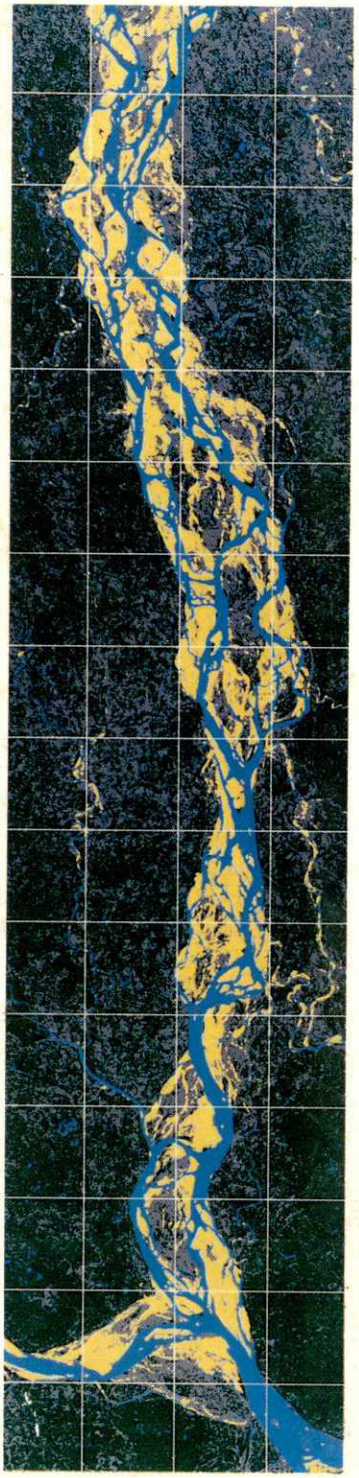
GOVERNMENT OF PEOPLES REPUBLIC OF BANGLADESH
MINISTRY OF IRRIGATION, WATER DEVELOPMENT AND FLOOD CONTROL
FLOOD PLAN COORDINATION ORGANIZATION

KREDITANSTALT FÜR
WIEDERAUFBAU (KfW)

CAISSE FRANCAISE DE
DEVELOPPEMENT (CFD)



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

TEST AND IMPLEMENTATION PHASE

PROGRESS REPORT NO. 12

APRIL TO JUNE 1996

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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FAP 21/22

PROGRESS REPORT NO. 12

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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) had 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.

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 on site started on October 01, 1994 and were substantially completed end of April 1995. 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 progress of works, which started in December 1995 only, was however, too slow and in January 1996 it emerged that the Subcontractor could not complete the test structure in time before the monsoon season 1996. Hence, it was decided to defer the final completion of the revetment test structure until the dry season 1996/97.

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. Following the request of FPCO and the donors during the

donors' mission of June 1994, the Consultant submitted on July 10, 1995 a proposal for extended studies on recurrent measures under FAP 22 and their application in assisting FAP 21 to reach its objective. The activities started in July 1995.

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, 1996. 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 1996.

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 the 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 by Dr. Friedrich von Raumer on behalf of FPCO/KfW/CFD
14. to 20.06.1994	Review Mission of KfW/CFD
18.06.1994	Submission of the 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 Technical Report No.1 on Physical Model Tests

22.09.1994	Submission of Technical 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 and discussions on import of geotextile material
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)
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
20.03.1996	Submission of letters of FORCE MAJEURE to WARPO for both Test Sites
26.06 to 03.07.96	Review Mission of KfW/CFD

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 at two test sites, 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 is 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.

The Table 1.2-1 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, whereas Table 1.2-3.2 presents the

revised Staffing Schedule submitted along with the Progress Report No. 6 and adapted to the donors' comments. Table 1.2-2 and Table 1.2-4 are showing the actual progress of works and the actual deployment of the expatriate professional staff respectively during the period under review.

2.2 TEST SITE I AT KAMARJANI

2.2.1 General

The test structure comprises of 6 permeable groynes 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 the Bangladesh Water Development Board (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 of 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 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.

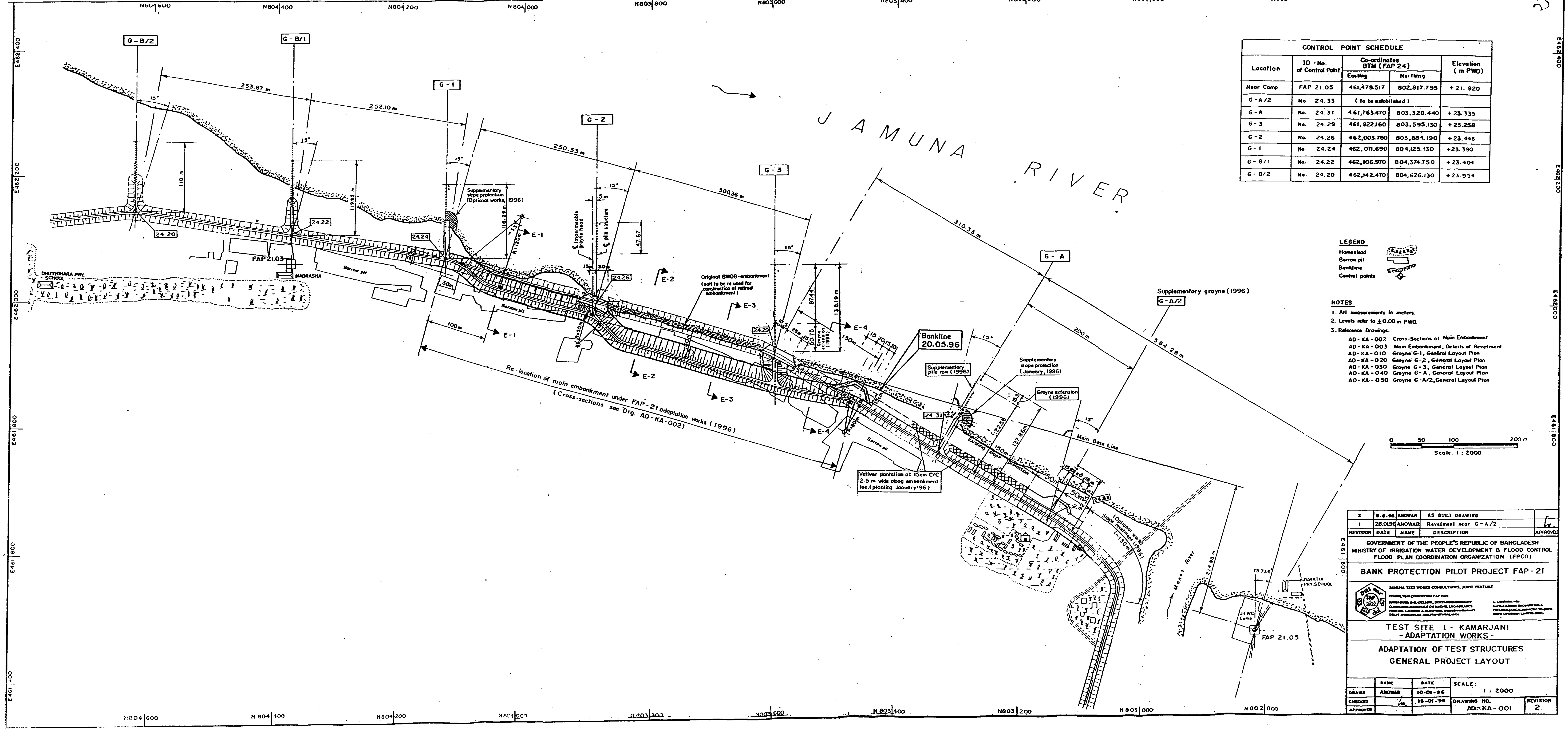
The initial findings of damage causes and the results of additional physical model tests performed in November/December 1995 at the River Research Institute at Faridpur had identified improvement and adaptation measures which have to fulfill mainly the following conditions:

- 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.

2.2.2 Adaptation Measures

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 is expected downstream of groyne G-A threatening the main embankment near the Manos river estuary, it was decided to provide a new supplementary groyne G-A/2 about 200 m downstream of G-A.


JAMUNA RIVER
Manos River
G-B/2
G-B/1
G-1
G-2
G-3
G-A
G-A/2
Supplementary groyne (1996)
253.87 m
252.10 m
250.33 m
300.36 m
310.33 m
200 m
384.28 m
214.93 m
110 m
119.82 m
116.39 m
47.67
87.44
50.75
138.19 m
137.86m
122.58
100m
30m
150m
50m
15.736
R=120m
R=50m
R=50m
15°
24.20
24.22
24.24
24.26
24.29
24.31
24.33
FAP 21.03
FAP 21.05
DHUTICHARA PRY. SCHOOL
MADRASHA
DAKATIA PRY. SCHOOL
JTWC Comp
Borrow pit
Supplementary slope protection (Optional works, 1996)
℄ impermeable groyne head
℄ pile structure
Original BWDB-embankment (soil to be re used for construction of retired embankment)
Groyne extension (1996)
Bankline 20.05.96
Supplementary pile row (1996)
Supplementary slope protection (January, 1996)
Groyne extension (1996)
Main Base Line
Existing slope protection
Slope revetment (Optional works 1996) (~130m)
Vetiver plantation at 15cm C/C 2.5 m wide along embankment toe. (planting January '96)
Re-location of main embankment under FAP-21 adaptation works (1996)
(Cross-sections see Drg. AD-KA-002)
E-1
E-2
E-3
E-4
N804|600
N804|400
N804|200
N804|000
N803|800
N803|600
N803|400
N803|200
N803|000
N802|800
E462|400
E462|200
E462|000
E461|800
E461|600
E461|400

CONTROL POINT SCHEDULE

Location	ID - No. of Control Point	Co-ordinates BTM (FAP 24) Easting	Co-ordinates BTM (FAP 24) Northing	Elevation (m PWD)
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	803,884.190	+ 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

0 50 100 200 m
Scale. 1 : 2000

REVISION	DATE	NAME	DESCRIPTION	APPROVED
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		18-01-96
APPROVED		

SCALE: 1 : 2000
DRAWING NO. AD-KA-001
REVISION 2.

The supply of material and the execution of the adaptation and repair measures, however, was delayed due to the political situation in the country with frequent hartals and non-cooperation movements since September 1995 and in particular during the first quarter 1996. Hence, the actual construction works on site started only end of March 1996 and could not be completed in time in accordance with the design 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.

The main adaptation and repair measures are as follows (see Fig. 1):

- relocation of the main embankment starting about 30 m downstream of groyne G-1 up to about 150 m downstream of groyne G-3. The retired embankment is now 20 m behind the original one between groyne G-1 and G-2 and 50 m between groyne G-2 and G-3;
- slope protection by cc-blocks/boulders at the head of the steel sheet pile cofferdam of groyne G-1;
- driving of 44 Nos. tubular steel piles dia. 711 mm between the existing pile structure of groyne G-3 and the retired main embankment after removal of the remaining part of the impermeable groyne section;
- toe-protection of the retired embankment by cc-blocks upstream and downstream of the pile structure of groyne G-3;
- pile Nos. 21 to 24 (tubular steel piles ϕ 711 m) of groyne G-A were extended by 4.5 m and re-driven. Moreover, the pile structure was extended to the river side by 3 additional tubular steel piles ϕ 1016 m. Since 5 Nos. of totally 12 Nos. bored piles ϕ 914 mm got lost during and after the monsoon season 1995 a row of additional 9 tubular steel piles ϕ 711 mm have been installed 2.5 m upstream of the bored piles. The total length of the pile structure is now about 78 m;
- the new groyne G-A/2 consists of 20 Nos. bored piles ϕ 914 mm and 14 Nos. tubular steel piles ϕ 711 mm. The total length of the groyne is about 92 m from the center of the main embankment;
- the river-sided slope of the retired embankment is protected between groyne G-1 and G-2 up to a level of 21.0 m PWD by brick-mattresses and above up to the crest at 23.50 m PWD by Durba grass sods on Geo-jute soil saver. The same holds for the section between groyne G-2 and G-3. Downstream of groyne G-3, between groyne G-A and G-A/2 as well as downstream of groyne G-A/2 the brick-mattresses are up to the crest of the embankment.

2.2.3 Monitoring of the Test Structures

Since the final objective of the bank protection pilot project is to develop and optimize 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. 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, 1996 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 (2.5 km upstream of G-2 to 2.5 km downstream of G-2) during the period under review are given in Annex B.

Date	Survey Area		
	April 1996	May 1996	June 1996
01	main survey	main survey	main survey
02	main survey	main survey	main survey
03	main survey		main survey
04			
05			
06			100 m u/s of G1 to 150 m d/s of G-A2
07		G-1 to 200 m d/s of G-A	100 m u/s of G1 to 150 m d/s of G-A2
08		G-1 to 200 m d/s of G-A	100 m u/s of G1 to 150 m d/s of G-A2
09			
10			
11			
12			
13			
14			G1 to 500 m d/s of G-A2
15		100 m u/s of G-1 to 200 m d/s of G-A	G1 to 500 m d/s of G-A2
16		100 m u/s of G-1 to 200 m d/s of G-A	G1 to 500 m d/s of G-A2
17			
18			
19	50 m u/s of G-1 to G-A2		
20			
21			
22			
23			
24			
25			G-B2 to 150 m d/s of G-A2
26		100 m u/s of G-1 to 200 m d/s of G-A	G-B2 to 150 m d/s of G-A2
27			G-B2 to 150 m d/s of G-A2
28			main survey
29			main survey
30			main survey
31			

Table 1: Bathymetry survey at Kamarjani Test Site from April to June 1996

(2) Topographic Measurements

The topographic measurements were done by using Electronic Distance Measurement (EDM) equipment and leveling instrument. During the period under review the following works were performed:

18/04	pile positioning of G-A and G-A/2
19/04	bankline survey from G-B2 to Rasulpur
05/05 - 06/05	bankline survey from G-B2 to 2 km d/s of old FAP 21 camp
13/05 - 14/05	bankline survey from 150 m u/s of G-B2 to 1 km d/s of old FAP 21 camp
20/05	bankline survey from 250 m u/s of G-B2 to 1 km d/s of old FAP 21 camp
11/06	set up benchmark pillars along the embankment
12/06 - 24/06	polygone survey to coordinate benchmarks
25/06	as built survey of embankment and bankline survey
26/06	survey of cc-block areas
27/06	pile positioning of G-3 and bankline survey

(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 which, however, is out of order since beginning of June 1996 and under repair.

Results of float tracking are also presented in the monthly reports on monitoring of the test structures.

(5) Observations

The variation of water level during the period under report is characterized by 3 sharp rises: 1.8 m within 5 days at the end of April, 2.5 m within 10 days during the first half of May and 2.7 m within one week at the end of June. The man attack of the river concentrated on the area from groyne G-A to Rasulpur (south of the old camp) resulting in loss of 3 more bored piles of groyne G-A and continuous bank erosion. However, there were no damages of the test structure till end of June 1996. The following observations have been recorded:

05-08/04	Bank erosion from G-A to Rasulpur
11/04	Loss of three bored piles at G-A
13/04	Return current d/s of G-A; Bank erosion from G-A to Rasulpur
16-17/04	Bank erosion from G-A to Rasulpur
19/04	Bank erosion from G-A to Rasulpur; strong current at the damaged toe area of G-2
20/04	Bank erosion from G-A to Rasulpur; heavy wind and wave
21/04	Heavy wind and wave
23/04	Bank erosion from the camp to Rasulpur
01-08/05	Bank erosion from old camp to Rasulpur
10/05	Bank erosion from G-A2 to Rasulpur
11/05	Bank erosion due to wind, wave and flow (mainly d/s of site)
12/05	Bank erosion at the whole test site due to wind and wave
13/05	Erosion at the toe of the damaged impermeable part of G-2
14/05	Bank erosion d/s of old camp to Rasulpur
17-25/05	Severe erosion due to current from old camp to Rasulpur
29/05	Small erosion occurred along the bankline in groyne field area due to wind and wave. Severe erosion along Rasulpur.

01-07/06	Bank erosion d/s of groyne field area to Rasulpur
01, 04, 20/06	Insignificant bank erosion along groyne field area
11/06	Bank erosion at Rasulpur
19/06/	Storm condition (8 Bft) (11:30 - 12:30)
20-22/06	Severe bank erosion from 1.2 km d/s of G-2 to Rasulpur, less erosion at groyne field area; Strong wind (6-8 Bft), wave height 0.4 m
22/06	Bank erosion at GA-2
23/06	Bank erosion at G-3
27-30/06	Floating debris at G-2, G-3, G-A and G-A2 (grass, banana trees)
29/06	Bankline under water.

2.2.4 Morphological Investigations

A morphological analysis of the area of Kamarjani has been carried out in February/March 1996 and was finalised in May 1996. This update on the morphological developments had among other things the following purposes:

- to predict whether the attack on the groynes at the test site will continue, and
- to assess the risk that the FAP 21 camp will be washed away during the flood of 1996.

The following probabilities of attack had been estimated:

- 70 % for the groyne test structure;
- 20 % for the old FAP 21 camp, and
- 90 % for the area of Rasulpur.

This means that the certainty of attack of the groynes are decreasing compared to previous years, whereas erosion is threatening the FAP 21 camp more and more. The above values for the probabilities of attack have been strongly influenced by the expectation of a strong attraction of the flow by the scour hole in front of the groynes. Previously this effect was underestimated. If it now turns out to be overestimated, however, the actual probability of attack of the groynes will be lower and the actual probability of attack of the FAP 21 camp will be higher.

Three possible morphological developments might end the attack on the test structure:

- abandonment of Kamarjani Branch;
- downstream migration of the upper Kamarjani Branch, and
- cut-off through inlet along the left bank of Kamarjani Branch.

Of these, the downstream migration of the upper Kamarjani Branch has the highest probability.

The results of the morphological investigations are compiled in a separate report of July 1996.

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 of Bahadurabad Ghat. The decision on the final location of the test structure was taken on October 11, 1995 and the Subcontractor was provided with the detailed layout drawings for setting out the structure the same day, followed by a

complete set of Working Drawings on October 14, 1995. However, end November 1995 it emerged that the Subcontractor could not mobilise the main construction equipment for dredging and under water 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 Sub-contractor 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 next dry season.

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 of the current year.

2.3.2 Morphological Investigations

To verify that the location of the test site selected in September/October 1995 is still suitable for the revetment test structure, a morphological analysis has been carried out in February/March 1996. This update on the morphological developments which was finalized in May 1996 indicate that continued attack on Test Site II in 1996 has a high probability estimated to be 90 %. However, the attack in 1997 and 1998 is less certain because the absence of a clear bend makes that capricious planform changes easily occur.

The results of the morphological investigations are compiled in a separate report of July 1996.

2.3.3 Proposal for Final Implementation

(1) Preliminary Remarks

The final implementation of the test structure depends on various factors which are among other things

- the general morphological development within the test site area, and
- the local bank erosion at the test site which could be
  - (a) moderate, say up to 30 m, corresponding to a year long average for the area except the year 1995, or
  - (b) severe, say up to 80 m to 100 m (or even more).

For the two assumed morphological developments, (a) and (b) (see Figure 2) the following Implementation Options emerge.

At the time of partial suspension of Works end January 1996 the excavation within the area of launching aprons had reached an average level of about +13.50m to +14.50m PWD.

(a) Options A and B

The local bank erosion is of such moderate nature that the presently built (but unprotected) embankment can be completed and the slope protections and launching aprons can yet be arranged between the embankment and the river. These options may include shifting of the present embankment within reasonable limits, say up to 25m.

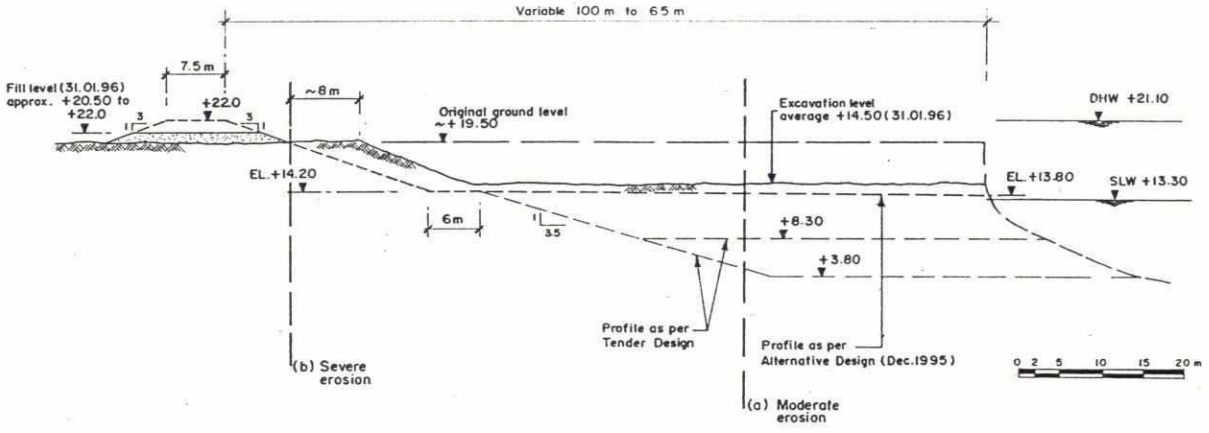


Fig. 2 : Test Site II - Bahadurabad; Typical cross-section of construction pit (01/96) with assumed morphological developments

(b) Options C and D

The local bank erosion has extended so much that the presently done work can not anymore be integrated into the final implementation scheme. This leaves the option to either implement the original Tender Design or the Revised Design of December 1995.

The options and related pros and cons are being discussed in more detail in the following sub-items.

(2) Option A

With only moderate bank erosion within the test structure area, a good chance exists to utilize to the maximum extent earth work already done. The present alignment of the embankment could be maintained, or be realigned slightly towards East to gain adequate space to the then prevailing bankline.

The berm and a short slope below berm shall receive proper cover layers on geotextile filters. All material originally designed for slope revetment and falling aprons would be arranged in relatively short but thick (3m and more) launching aprons.

To extend the available construction window a temporary dyke could be arranged along the bankline, to protect the construction area against early rise of river water level. The general principle is depicted in ANNEX F, Figure F-1.

The advantages of this Option A are:

- the opportunity of maximum use of work already done;
- least requirements for occupying additional land in the area;
- earth works would be limited and thus manageable, and
- no dredging or other underwater works.

As disadvantage is to be mentioned:

- placing of launching apron material to more than 3m height can not any more be carried out by manual labour, but has to be supported by suitable mechanical equipment. This will incur higher cost for placing the respective materials.

(3) Option B

The basic principle is to dredge a gentle slope from berm level towards existing river bed profile, up to a limited water depth, and to place the materials directly on the river bed, always provided that the then prevailing river bed profile is not to steep. A typical cross-section is shown in Figure F-2 of ANNEX F.

This Option B could be applied also in case of only moderate bank erosion and appears suitable to supplement Option A for those test sections (E, F and G) where geotextile mattress systems are to be installed, but could be applied also for test sections which are planned with cover layers and launching aprons of cc-blocks, boulders, gabions, etc.

The advantages are:

- least requirements for occupying additional land in the area;
- earth works would be limited and thus manageable, and
- slope protection on geotextile filter mats below berm and long launching aprons may protect the bank more efficiently against expected scouring, as compared to only horizontally arranged launching aprons.

The disadvantages are:

- limited dredging works are required in shallow water condition. Presently available crawler cranes for dredging would be unsuitable due to limited reach. Repair and upgrade of Manitowoc 3900 with adequately long boom will incur unreasonably high cost, and
- installation of geotextile filter mats and geotextile mattress systems under water require specialised equipment and working methods, which the Subcontractor could not materialise in 1995 and January 1996.

(4) Option C

Option C represents the Tender Design, but with some adjustments to recent experience. The under water slopes are planned at about 1:5 or 1:6, while the design water depth should be limited to max. 5m below SLW. A typical cross-section is presented in Figure F-3 of ANNEX F.

The advantages of this option are:

- compliance with the approved principles of the Final Planning Study Report FAP 21, and
- efficiency with regard to bank protection possibly superior to other options, in particular for large scour depths.

The disadvantages are:

- latest experience at the Jamuna Bridge Site (April 1996) indicate that even slopes of 1:6, partially protected, suffered from major slope slides. Test Sections F to J at Bahadurabad are to be profiled in sand without noticeable cohesive additives and are comparable to Jamuna Bridge Site conditions. Executional problems may arise, which could not be managed with the available means;
- dredging equipment of suitable capacity and standard is not available within Bangladesh according to a research carried out by the Subcontractor during February / March 1996, and
- implementation cost would raise by about Tk. 65 million on account of mobilising dredging equipment from abroad, a magnitude which can not reasonably be justified for the present pilot project.

(5) Option D

This Option D is based on the Revised Design of December 1995 with recommended alterations, as are:

- berm excavation level should be raised to about 2m above SLW, and

- a natural cofferdam, if necessary supplemented by a temporary dyke with a crest level at +21.5m PWD, shall be maintained between the river bank and the construction pit. If required for reasons of land availability the width of the planned construction pit could be reduced by choosing short but thick launching aprons.

A typical cross-section for Option D is presented in Figure F-4 of ANNEX F.

The advantages of this option are :

- maximum utilisation of construction window by protecting the construction pit against continuing erosion and rising river water. If required, seepage through the natural cofferdam or dyke can be discharged by pumps;
- no dredging equipment required;
- no specialised floating equipment for installation of filters and mattresses below water level, and
- earth works, though of large quantity, can be managed, if the Subcontractor alters the originally planned labour intensive working method to more mechanised working sequences.

The disadvantage is :

- more land will be occupied as compared to Options A, B and C which is, however, already covered by Consultant's request to WARPO.

(6) Recommended Implementation Option

The morphological changes in the test site area will only be known in its ultimate consequences by mid September or even only early October 1996, dependent on the season. It is a must that all equipment has to be on stand-by, ready for operation by mid September 1996. Consequently, it will be recommended to mobilise equipment suitably covering more than one implementation option.

Option C (adapted original Tender Design) should not be given further consideration since

- implementation proved impossible under the condition of utilising locally available equipment;
- executional risks in constructing safe under water slopes and subsequent filter and protection materials can not be eliminated by means reasonable and justifiable within the Pilot Project, and
- implementation cost are too high due to the requirement of hiring main construction equipment from outside Bangladesh.

The same argumentation holds good for Option B, although to a limited extent. However, with past experience in mind, the executional risks do not call to favour Option B.

Under the assumption of an only moderate bank erosion within the test structure area, Option A is recommended under the aspect that only limited additional land areas would have to be occupied.

Otherwise, Option D will suit all requirements resulting from morphological changes and presents an option fully suitable for local construction capacity.

It was therefore recommended to start preparation, modification and upgrading of the equipment for implementation of Option A as well as Option D latest by June 1996, to be ready for operation mid September 1996 the latest. This recommendation appears not to be the most economical measure, but is a way to ensure timely availability of the required equipment resources.

The layout for final implementation is proposed to be reduced in its overall length of the test structure by about 100m, mainly for two reasons

- hard rock supply of Grading Range E (100kg - 200kg/No.) can not be materialised from quarries in India, eliminating one alternative of originally chosen revetments, and
- volume of works is being reduced to be more suitable for local construction capacity.

It is a side effect that the overall construction cost are being reduced, but not substantially.

The tentatively proposed implementation layout is presented in Figure F-5 of ANNEX F, which also depicts the altered arrangement of revetment and falling apron alternatives for Option D. The final decision and detailed design for the implementation of the test structures has to be deferred until the end of monsoon period 1996.

(7) Implementation Time Schedule

The important milestones of the implementation time schedule are

• Subcontractor's equipment to be ready for transport to Site	September 15, 1996
• Detailed bathymetric and bankline survey	September 15, 1996
• Handing over land for Permanent Structures	October 01, 1996
• Determination of test structure location, as soon as possible after monsoon, but latest scheduled date	October 01, 1996
• Preparation of revised layout and working drawings	within 6 weeks of determination of location
• Subcontractor's equipment to be set up at Site	October 01-15, 1996
• Commencement of earth works	October 15, 1996
• Completion of Works	April 15, 1997

(8) Final Recommendation

The review of constraints experienced during the dry season 1995/96 has identified the following criteria to be fulfilled for successful final implementation of the test structures :

- The land for Permanent Structures must be made available by end September 1996;
- Subcontractor's main equipment must be mobilised mid June 1996 so as to ensure its upgrading, repair and modification and to be ready for operation by September 15, 1996;
- Those works which commonly are being carried out by man power have to be supported by mechanised means to ensure the required production rates, and
- Subcontractor has to be provided with additional expatriate support for construction planning and methodologies.

The analysis of various implementation options has resulted in the recommendation to wave any solution dependent on dredging works and under water works. Options A and D represent alternatives suitable for the local construction capability and as such are more realistic towards finding future standard construction methods for the rivers of Bangladesh.

As to the estimated cost for the final implementation reference is made to "Proposal for Final Implementation during Dry Season 1996/97" of April 1996 according to which the construction works for the project can be completed within the approved budget.

The final design for the revetment test structures must be carried out during September/October 1996, to comply with Item (7).

Due to the postponement of the completion of the revetment test structures it may be required to extend the monitoring period of the Project by one year, so as to study the behaviour of the test structures, and to implement adaptations if required, in accordance with the basic principles of the FAP 21 Pilot Project, provided the morphological developments in the test area justify such additional monitoring period.

2.3.4 Activities During the Period under Review

After it had been decided on January 31, 1996 to suspend the construction works until dry season 1996/97, the following activities have been performed only: earth works for the protection of the already built components of the structure, production of cc-blocks, sewing of geotextile bags and boulder supply. At the end of the period under review, the following quantities were available/done:

• Earth works (excavation)	260,000 m^3	(61 %)
• CC-block production	26,230 m^3	(98 %)
• Boulder supply	9,000 m^3	(41 %)
• Hard-rock supply	15 m^3	(3.6 %)
• Container bags	22,000 pcs	(78 %)
• Interlocking cc-blocks	21,500 pcs	(77 %)

2.3.5 Socio-Economic Activities

The socio-economic activities during the period under report concentrated mainly on the land acquisition process and stimulating the interest of the local population in the Project. After several group meetings with the local people, a joint meeting was held between them and WARPO officials on April 25, 1996. They consented to provide additional land upon request from WARPO if required for the construction of the revetments. The land-schedule was completed in early May and formally submitted to the office of the Deputy Commissioner.

3 RIVER TRAINING (AFPM) COMPONENT (FAP 22)

3.1 PRELIMINARY REMARK

On the occasion of the donors' Review Mission of June 1994 the Consultant had been requested to consider as part of FAP 22 the possibility of low cost intervention to stabilize the morphological evolution on the first test site of FAP 21 by short-term activities taking into account comments on the report on the Expert Discussion of November 1993.

The FAP 22 study indicated that a river training scenario, with recurrent measures and permanent structures complementary to each other, is attractive from a socio-economic and environmental point of view. As a result of the investigations on recurrent measures, surface screens and artificial channel cut-offs were recommended as most promising measures. The Experts unanimously agreed with the application of recurrent measures. However, they strongly recommended further studies and early testing of the methods, not limited to laboratory investigations only, but including prototype tests in the

river at an early stage in order to come to a better assessment of costs and operation aspects. The investigation and application or different techniques like bandalling, low cost earthworks and intelligent dredging including a study of combination of different measures were recommended. Based on these recommendations, the Consultant had developed a schedule of works for extended studies on recurrent measures which had been presented in the report on the Expert Discussion and which was the basis for a proposal of technical and financial details for consultancy services and construction of recurrent measures, submitted to the client and the donors at the beginning of July 1995.

The Consultants proposal was commented by FPCO and KfW. The latter recommended the client to give the approval to the preliminary measures to be carried out in Phase 1 of the proposal as this would allow their integration into FAP 21 activities in the 1995/96 season already.

On the basis of the above mentioned comments, the Consultant started the activities in July 1995. Table 2.2-1 is showing the Work Plan and Table 2.2-3 the Staffing Schedule of Phase 1 as per proposal of July 1995, whereas Table 2.2-2 is showing the actual activities fielded up to the end of the period under report and the Tables 2.2-4 and 2.2-5 the actual input of the expatriate and the local staff fielded up to end December 1995.

Since the Consultant could not get an official instruction in writing in 1995 to start the activities, although necessary funds for the execution of activities within phase 1 of the proposal are shown in the "Letter to Proceed" it was decided, to complete the desk study as shown in the work plan, but to suspend the other works under phase 1 until the approval from FPCO has been obtained.

On March 06, 1996 only the Consultant was requested by WARPO to take up recurrent measure activities under Phase I. Therefore, the project works were resumed at the beginning of April 1996.

3.2 ACTIVITIES DURING THE PERIOD UNDER REPORT

The activities mainly concentrated on the completion of the desk study. Data analyses were completed including analysis of water level data , study of information on effects of bandalling over different stretches of the Jamuna river during the period 1984/85 to 1991/92 collected from Bangladesh Inland Water Transport Authority (BIWTA). The same holds for information on bandalling received from Bangladesh Railway.

The desk study report will be presented in the 3rd quarter of the current year along with a revised Work Plan, revised Staffing Schedule and Cost Estimates for the proposed measures.

Table 1.1-1

BANK PROTECTION TEST STRUCTURES - FAP 21
EXPATRIATE PROFESSIONAL STAFF
Activities during the period of 04/96 to 06/96

VERSION : 05.08.96

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 7 days
1.2	Home Office Support						
1.3.1	Project Manager	C. Netzeband	CN	RRI	01/04	30/06	
					13/05	17/05	In Europe
1.4	Chief Hydraulic Design Engineer	Dr. H. Kramer	HK	L&P	01/04	30/06	Part time in Europe 9 days
2.1.1	Hydraulic Design Engineer	M. Schwarz	MS	L&P	01/04	24/04	In Bangladesh
					01/05	30/06	Part time in Europe 7 days
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	G. Hourseau	GH	CNR	20/04	30/06	
		J.C. Thiesson	JCT	CNR	08/05	22/06	
3.4.1	Surveyor	J. Heise	JH	RRI	-	-	
3.5.1	Administrator	B. Thomas	BT	CNR	01/04	30/06	
3.6.1	Monitoring Expert	T. Döscher	TD	L&P	02/06	30/06	
4.1.1	Morphologist	Dr. E. Mosselman	EM	DELFT	01/04	30/06	Part time 8 days in Europe
							Part time 3 days in Bangladesh
4.2.1	Modelling Expert	M v d Wal	MvdW	DELFT	01/04	30/04	Part time 3 days
4.3.1	Environmental Expert	C. Bertrand	CB	CNR	-	-	
4.5.1	Economist	--	-	-	-	-	
4.6.1	Unallocated	--	-	-	-	-	

Table 1.1-2

BANK PROTECTION TEST STRUCTURES - FAP 21

LOCAL PROFESSIONAL STAFF

Activities during the period of 04/96 to 06/96

VERSION : 22.08.96

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	01/04	30/06	
2.1.2	Hydraulic Design Engineer	A. Q. Mohammed Ali	MA	BETS	-	-	
2.3.2	Mechanical Engineer 2	Masih-ur-Rahman	MR	DUL	01/04	30/06	
2.4.2	Procurement Expert 2	Masih-ur-Rahman	MR	DUL	-	-	
2.5.2	Subsoil Expert 2	-	-	-	-	-	
3.2.2	Supervising Engineer 2	Fazlur Rahman	FR	BETS	01/04	30/06	
3.3	Quantity Surveyor	Faizur Rahman Khan	FRK	DUL	01/04	30/06	
3.4.2	Surveyor 2	A. H. M. Kamal	MK	DUL	01/04	30/06	
3.6.2/3	Monitoring Expert 2	A.B.M. Anwar Haider	AH	BETS	01/04	30/06	
	Jr. Monitoring Expert	Pankaj K. Maitra	PKM	BETS	01/04	30/06	
4.1.2	Morphologist 2	-	-	-	-	-	
4.2.2	Modelling Expert 2	Jahangir Islam	JI	BETS	-	-	
4.3.2	Environmental Expert 2	Dr. A.K.M. Nazrul Islam	NI	BETS	-	-	
4.4	Socio-Economist	Tauhidun Nabi	TN	BETS	01/04	30/06	
4.5.2	Economist 2	NN	-	-	-	-	
4.6.2	Unallocated 2	NN	-	-	-	-	

Table 1.1-3

BANK PROTECTION TEST STRUCTURES - FAP 21

LOCAL SUPPORT STAFF

Activities during the period of 04/96 to 06/96

VERSION : 22.08.96

Sl. No.	Function	Person	Company	Period		Remarks
				From	To	
1	Bilingual Secretary	Sk. Zakirul Islam	BETS	01/04	30/06	
2	Receptionist / Word Processor Typist	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

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	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
		EVALUATION REPORT	X	X	X	X	X	X
		MANUALS + GUIDELINES	X	X	X	X	X	X

MONSOON

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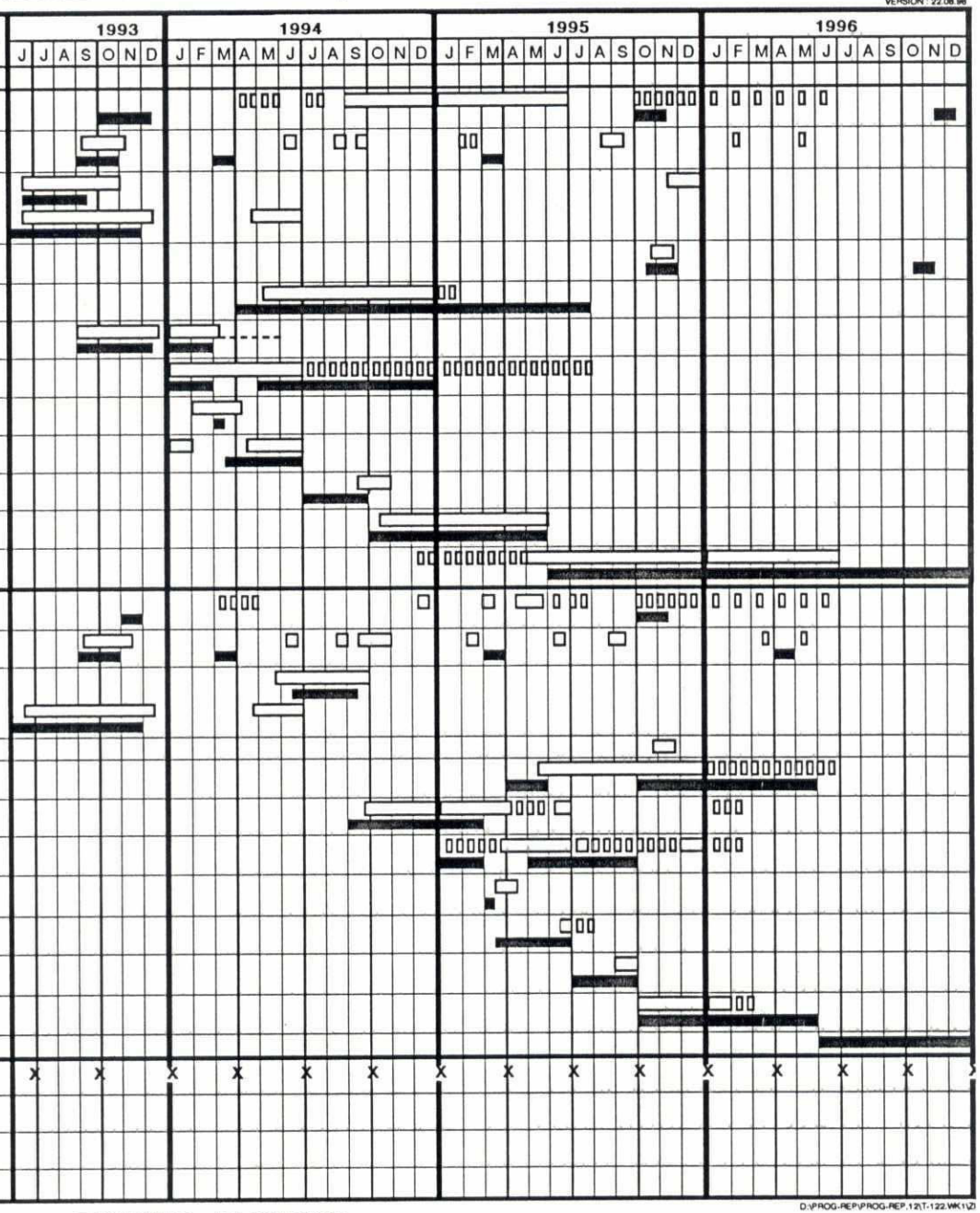
Table 1 . 2 - 2

BANK PROTECTION TEST STRUCTURES - FAP 21
WORK PLAN
FIELDED UP TO JUNE 30, 1996

VERSION : 22.06.96

		ACTIVITY
		ORDER TO PROCEED 15.05.93
TESTSITE 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, AS BUILT DRAWINGS
	1.8	PRESELECTION OF CONTRACTORS
	1.9	PREPARATION / EVALUATION OF PROPOSALS
	1.10	ORDER TO COMMENCE (04.09.94) / MOBILIZATION
	1.11	CONSTRUCTION OF TEST WORKS
	1.12	MONITORING, ADAPTATION
TESTSITE 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	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
		YEARLY REPORTS ON MONITORING / ADAPTATION
		EVALUATION REPORT
		MANUALS + GUIDELINES



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SCHEDULED 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 X X X X	X X X X X X X	X X X X X X X				
		YEARLY REPORTS ON MONITORING / ADAPTATION										
		EVALUATION REPORT										
		MANUALS + GUIDELINES										
								TOTAL	203	29	395	85

MONSOON IN BANGLADESH OUTSIDE BANGLADESH LOCAL

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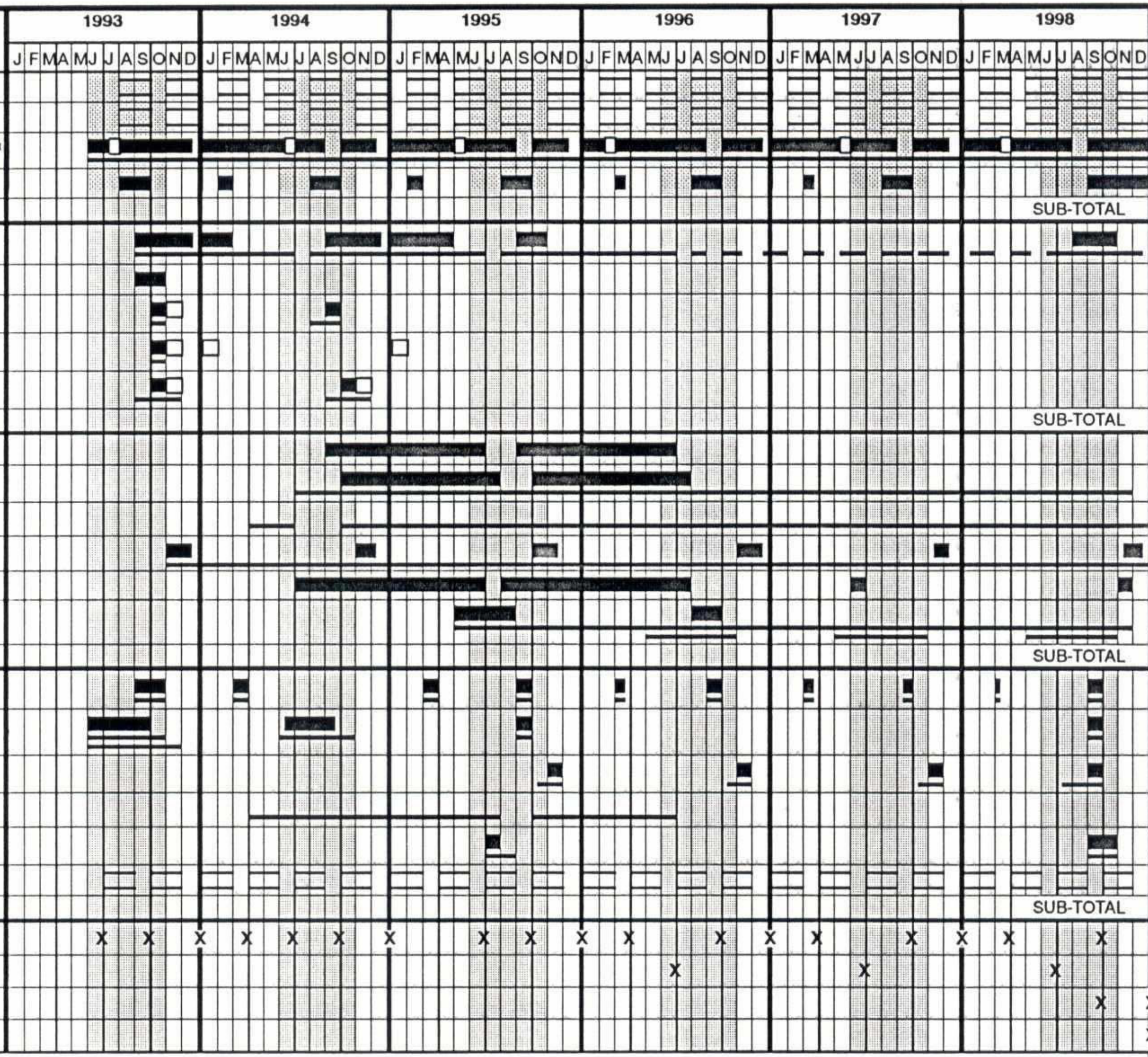
TABLE 1.2-3.2

BANK PROTECTION TEST STRUCTURES - FAP 21

STAFFING SCHEDULE

REVISION NO. 1

01.06.1995



	FUNCTION	MAN-MONTHS EXPATRIATES BD	EU	LOCAL	FLIGHTS
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	SURVEYOR 1 + 2	6		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				
	YEARLY REPORTS ON MONITORING / ADAPTATION				
	EVALUATION REPORT				
	MANUALS + GUIDELINES				
	TOTAL	210	30	450	86

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MONSOON — IN BANGLADESH — OUTSIDE BANGLADESH — LOCAL

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Table 1.2-4

BANK PROTECTION TEST STRUCTURES - FAP 21

STAFFING SCHEDULE

EXPATRIATE PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 1996

VERSION : 22.08.96

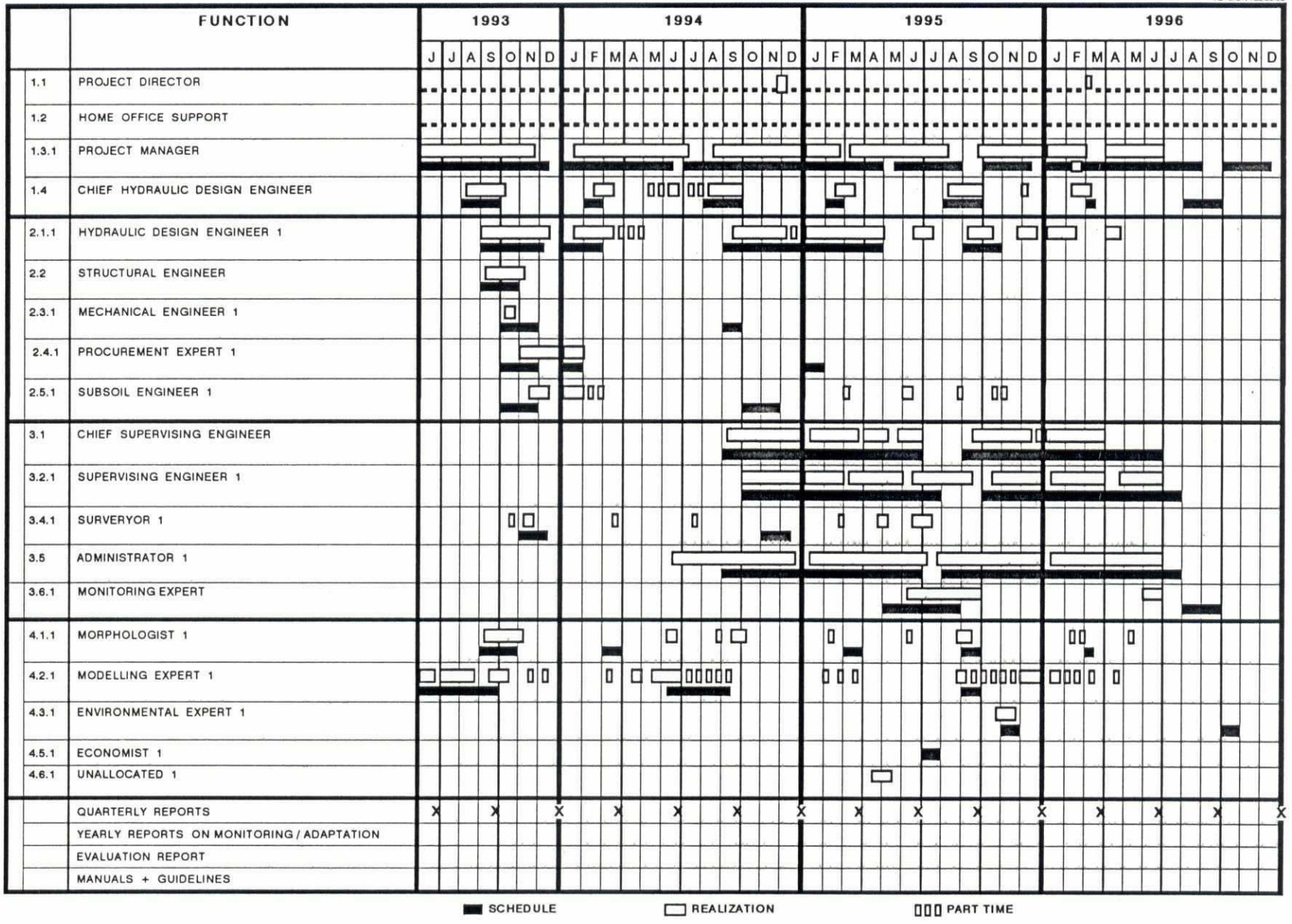

TABLE 2.1-1

STUDIES ON RECURRENT MEASURES - FAP 22

EXPATRIATE PROFESSIONAL STAFF

Activities during the period 04/96 to 06/96

VERSION :05.08.96

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	22/05	18/06	Part time 8days
5.2	Hydraulic Design Engineer	M. Schwarz	MS	L&P	-	-	
5.3.1	Surveyor	C. Beil	CB	RRI	-	-	
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	-	-	
5.7	GIS Specialist	G.K.F.M.Hesselmans	GMH	DELFT	-	-	
5.8.1	Supervising Engineer	--	-	-	-	-	
5.9.1	Monitoring Expert	T. Döscher	TD	L&P	-	-	
5.10	Economist	F. de Cock	FC	CNR	-	-	

TABLE 2.1-2

STUDIES ON RECURRENT MEASURES - FAP 22

LOCAL PROFESSIONAL STAFF

Activities during the period 04/96 to 06/96

VERSION : 05.08.96

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	12/05	30/06	
5.3.2	Surveyor 2	--	-	-	-	-	
5.4.2	Morphologist 2	--	-	-	-	-	
5.8.2	Supervising Engineer 2	--	-	-	-	-	
5.9.2	Monitoring Expert 2	A.B.M. Anwar Haider	AH	BETS	-	-	
5.10.2	Economist 2	--	-	-	-	-	

GD

TABLE 2.2-1

STUDIES ON RECURRENT MEASURES - FAP 22

WORK PLAN

AS PER PROPOSAL OF JULY 1995

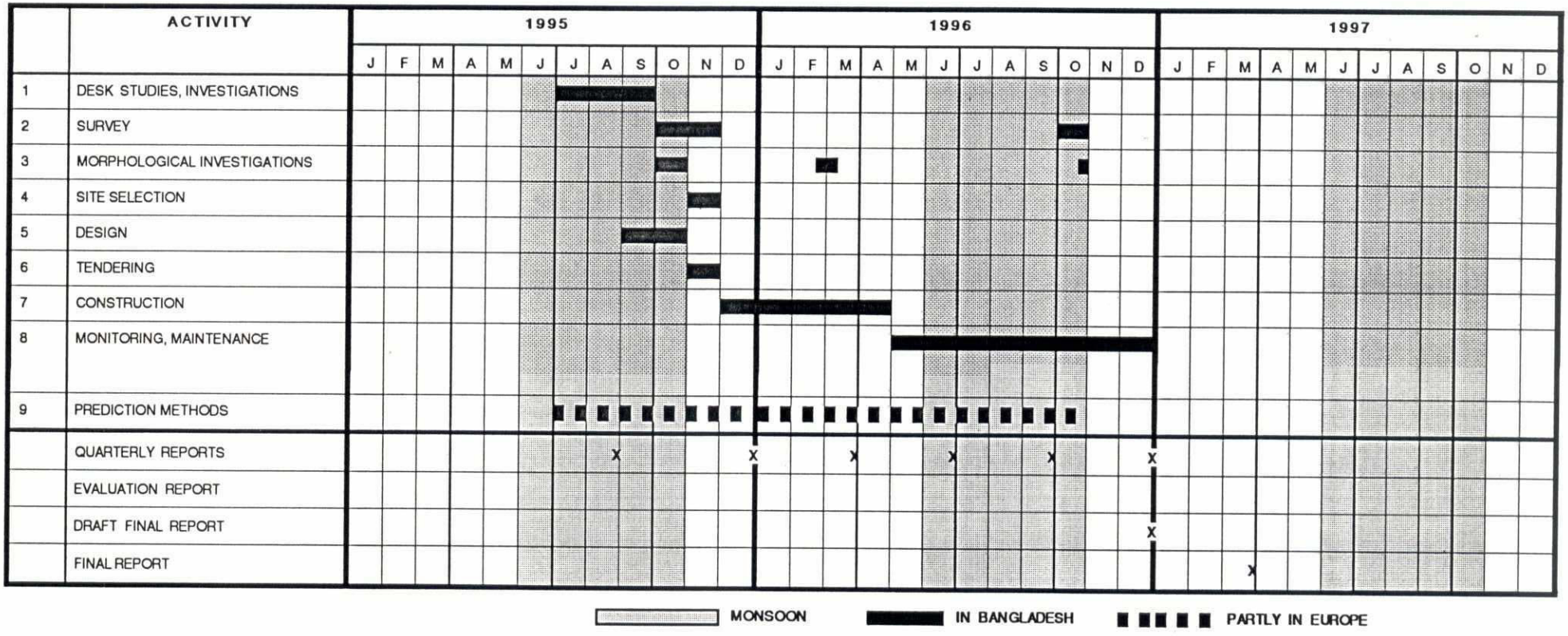

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TABLE 2.2-2

STUDIES ON RECURRENT MEASURES - FAP 22

WORK PLAN

ACTIVITIES FIELDED UP TO JUNE 30, 1996

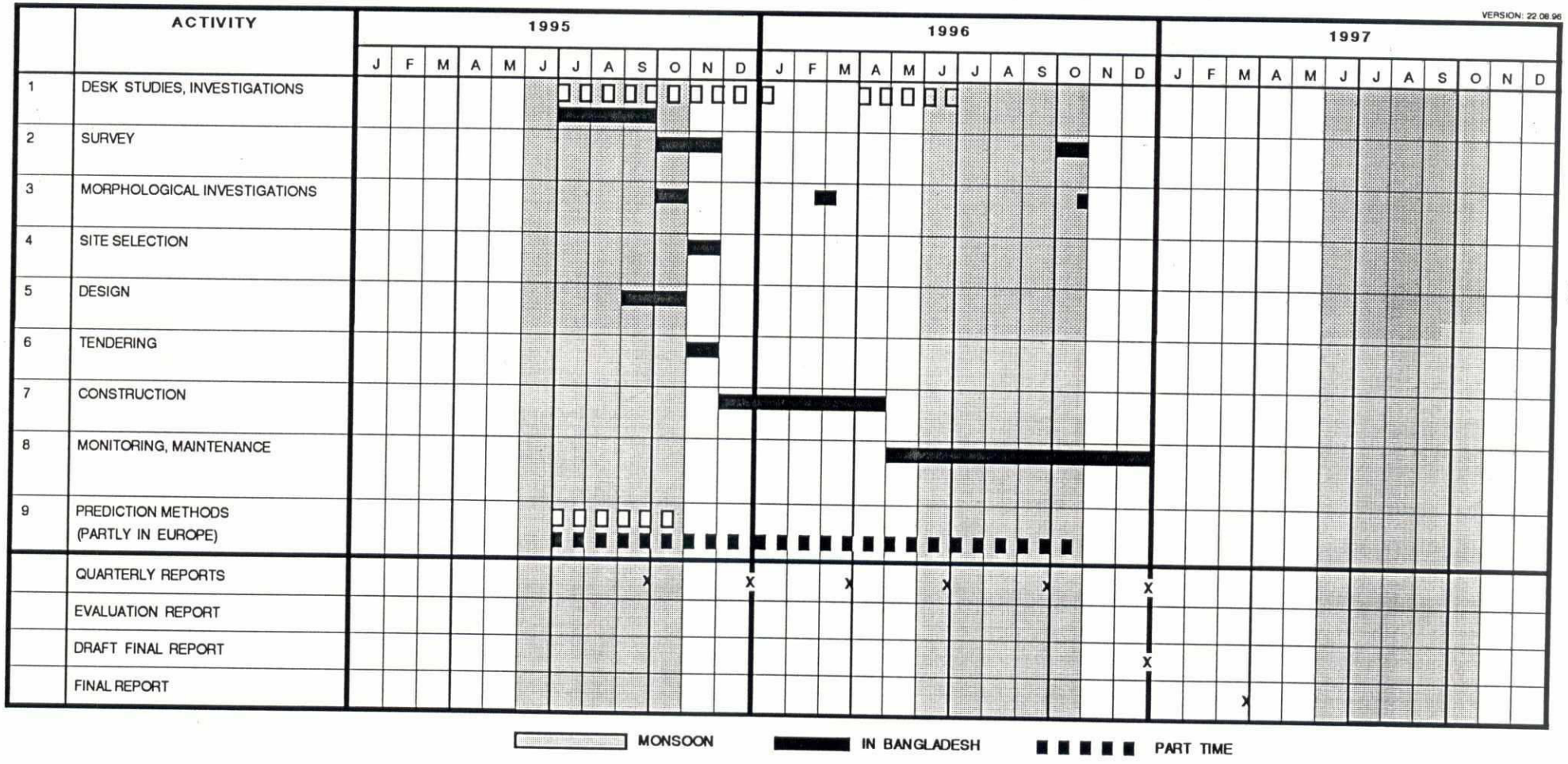

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TABLE 2.2-3

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE

AS PER PROPOSAL OF JULY 1995

	FUNCTION	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	Man-Months EXPATRIATES BD	EU	LOCAL	FLIGHTS
1.1	PROJECT DIRECTOR																																					0.5	1.5		1
1.2	HOME OFFICE SUPPORT																																						2.0	2.0	
1.3.1/2	PROJECT MANAGER / DEPUTY PROJECT MANAGER																																					AS PER FAP 21 COMPONENT			
1.4	CHIEF HYDRAULIC DESIGN ENGINEER																																					1.0	1.0		
																																					SUB-TOTAL	1.5	4.5	2.0	1
5.1.1/2	RIVER ENGINEER 1 + 2																																					7.0		18.0	3
5.2	HYDRAULIC DESIGN ENGINEER																																					2.0			
5.3.1/2	SURVERYOR 1 + 2																																					3.0		3.0	
5.4.1/2	MORPHOLOGIST 1 + 2																																					2.0	2.0	2.0	
5.5	SYSTEM ANALYST																																						3.0		
5.6	PROGRAMMER																																						1.5		
5.7	GIS SPECIALIST																																						1.5		
5.8.1/2	SUPERVISING ENGINEER																																					5.0		5.0	1
5.9.1/2	MONITORING EXPERT 1 + 2																																					2.0		7.0	
5.10	ECONOMIST 1 + 2																																					1.0		2.0	1
																																				SUB-TOTAL	22.0	8.0	37.0	5
	QUARTERLY REPORTS									X		X				X		X		X		X		X																	
	EVALUATION REPORT																																									
	DRAFT FINAL REPORT																									X																
	FINAL REPORT																										X														
																																				TOTAL	23.5	12.5	39.0	6

MONSOON IN BANGLADESH OUTSIDE BANGLADESH PART TIME LOCAL

D:\PROG-REP\PROG-REP.12\WK1-FILE\TAB-223.WK1\Z1

TABLE 2.2-4

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE

EXPATRIATE PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 1996

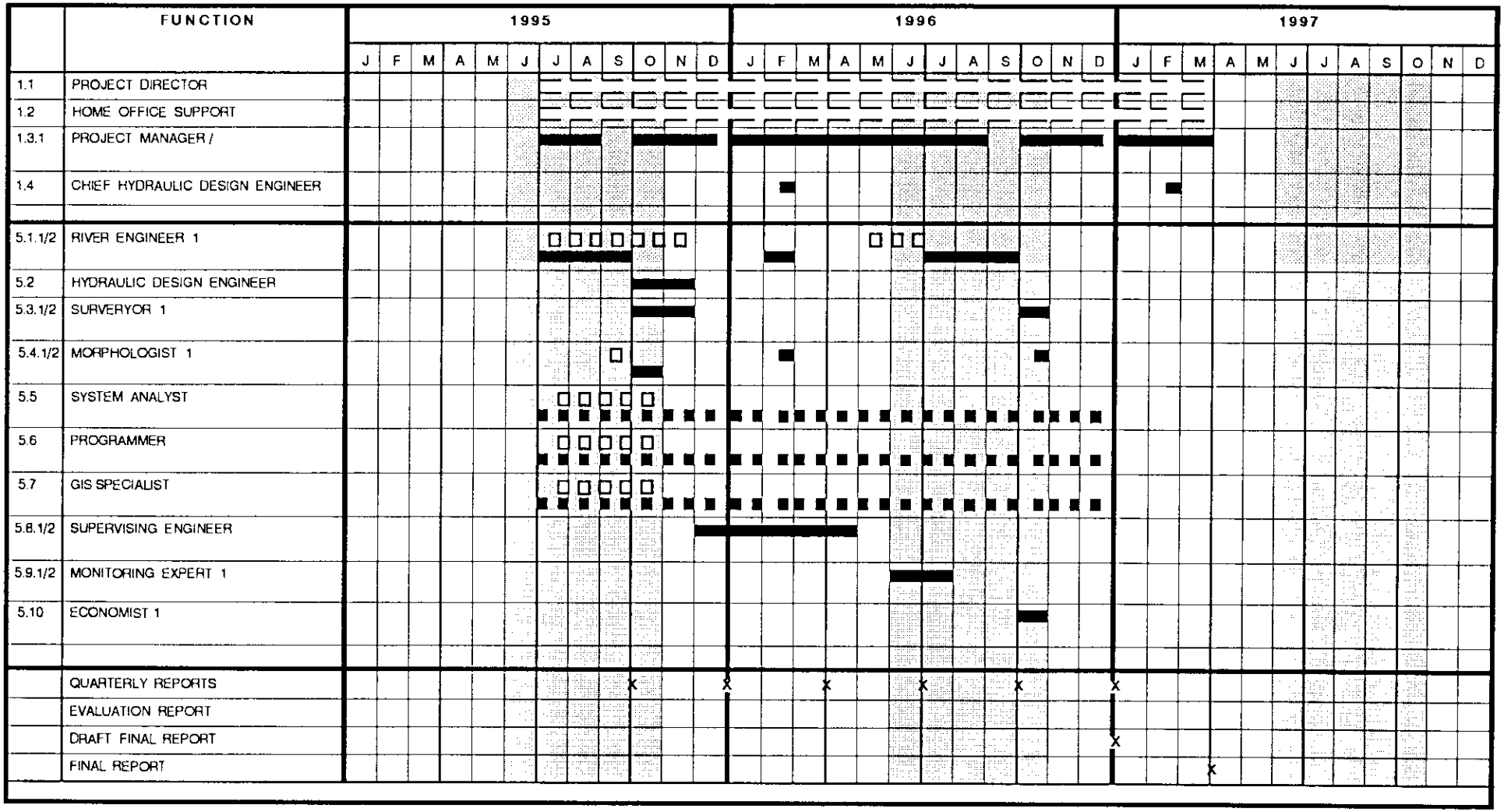

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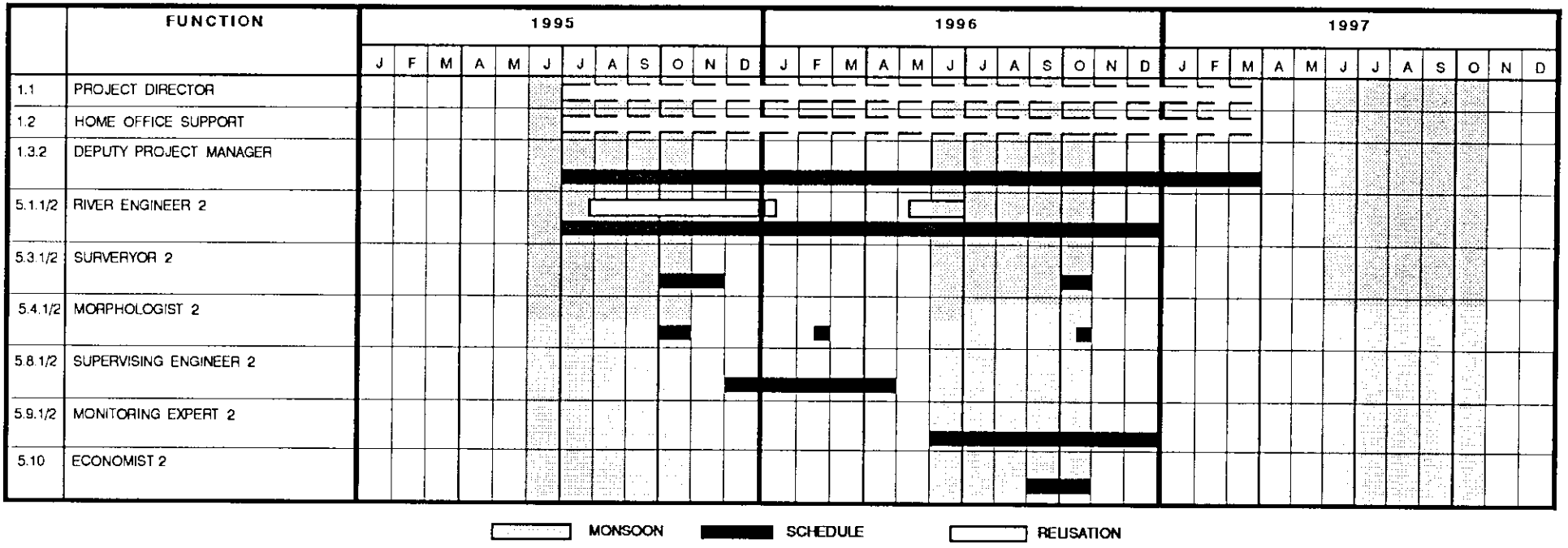
TABLE 2.2-5

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE

LOCAL PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 1996



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2.2-5

ANNEX A

Test Site I

- Water Level

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BANK PROTECTION TEST STRUCTURES - FAP 21

WATER LEVEL AT KAMARJANI TEST SITE

MONTH : APRIL, 1996

DAYS	TIME			REMARKS
	8.00	12.00	17.00	
1	15.850		15.870	
2	15.900		15.880	
3	15.860		15.820	
4	15.780		15.750	
5	15.700		15.660	
6	15.610		15.570	
7	15.560		15.580	
8	15.700		15.790	
9	15.910		15.940	
10	15.940		15.900	
11	15.940		15.800	
12	15.740		15.690	
13	15.640		15.600	
14	15.560		15.520	
15	15.480		15.470	
16	15.550		15.590	
17	15.770		15.840	
18	15.940		15.970	
19	15.980		15.980	
20	15.950		15.850	
21	15.860		15.800	
22	15.790		15.790	
23	15.790		15.800	
24	15.890		15.900	
25	16.020		16.440	
26	16.100		16.140	
27	16.260		16.380	
28	16.650		16.900	
29	17.470		17.790	
30	17.930		17.970	

BANK PROTECTION TEST STRUCTURES - FAP 21

WATER LEVEL AT KAMARJANI TEST SITE

MONTH : MAY, 1996

DAYS	TIME			REMARKS
	8.00	12.00	17.00	
1	17.890		17.850	
2	17.650		17.560	
3	17.400		17.330	
4	17.270		17.200	
5	17.150		17.130	
6	17.080		17.090	
7	17.130		17.240	
8	17.370		17.410	
9	17.610		17.670	
10	17.720		17.810	
11	17.990		18.040	
12	18.340		18.480	
13	18.860		18.920	
14	19.230		19.340	
15	19.550		19.510	
16	19.630		19.710	
17	19.840		19.870	
18	19.860		19.820	
19	19.730		19.660	
20	19.540		19.510	
21	19.470		19.460	
22	19.490		19.520	
23	19.480		19.450	
24	19.420		19.370	
25	19.280		19.220	
26	19.080		19.020	
27	18.910		18.830	
28	18.760		18.730	
29	18.650		18.650	
30	18.640		18.770	
31	18.830		18.860	

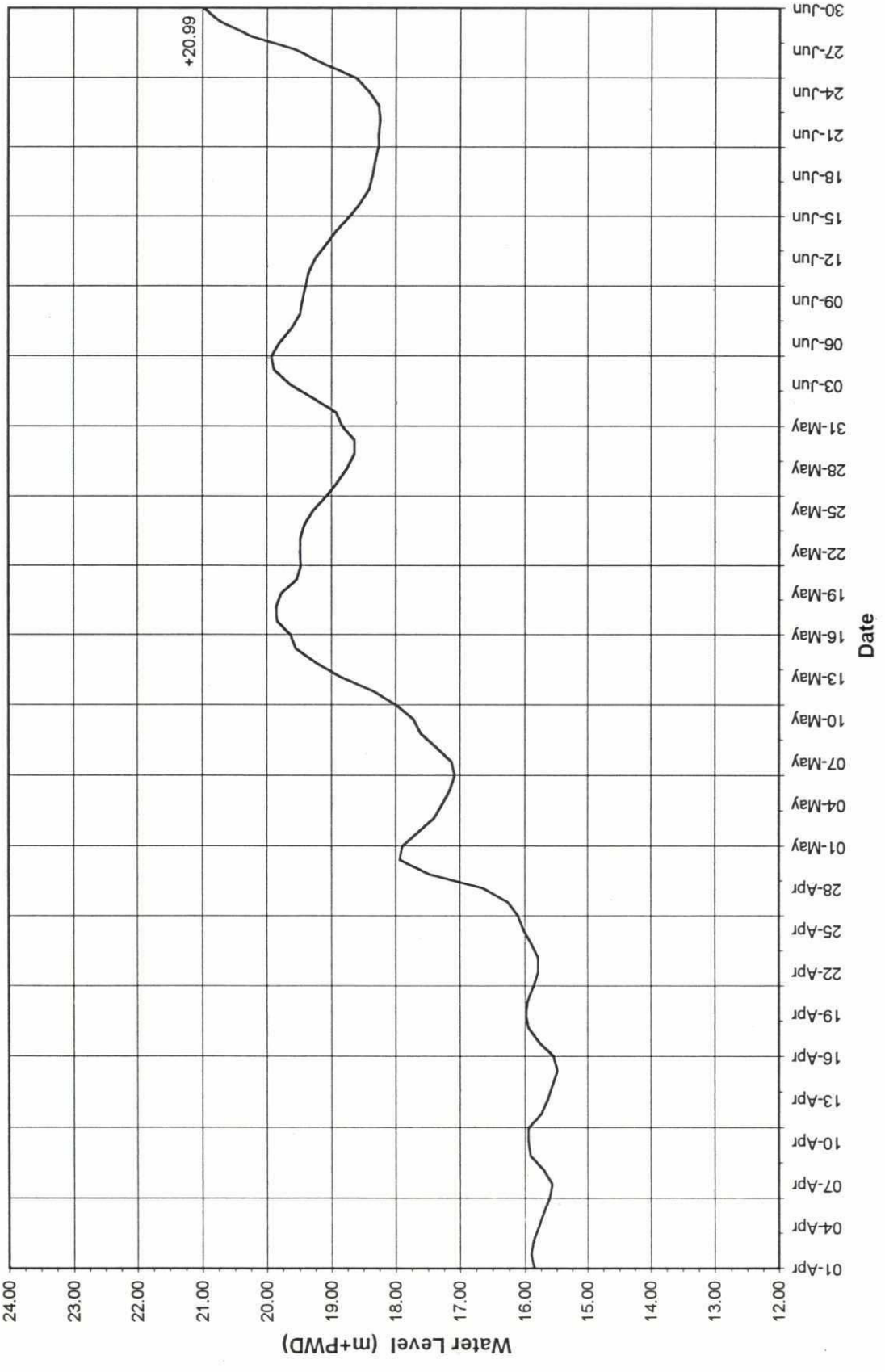
BANK PROTECTION TEST STRUCTURES - FAP 21

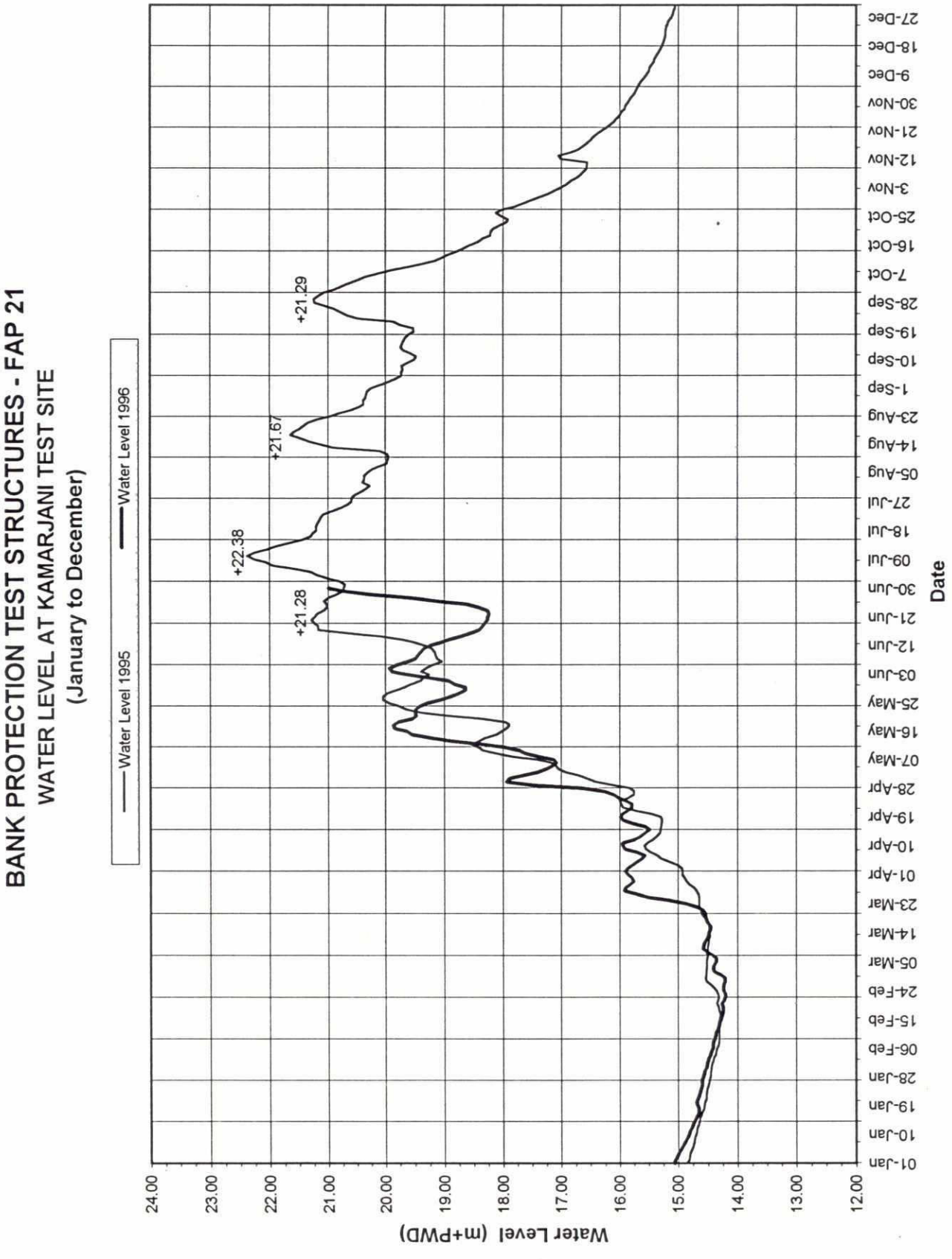
WATER LEVEL AT KAMARJANI TEST SITE

MONTH : JUNE, 1996

DAYS	TIME			REMARKS
	8.00	12.00	17.00	
1	18.930		19.050	
2	19.290		19.440	
3	19.650		19.760	
4	19.890		19.950	
5	19.930		19.920	
6	19.800		19.730	
7	19.620		19.580	
8	19.490		19.470	
9	19.450		19.440	
10	19.400		19.400	
11	19.350		19.330	
12	19.250		19.180	
13	19.080		19.010	
14	18.920		18.840	
15	18.720		18.650	
16	18.550		18.490	
17	18.410		18.390	
18	18.360		18.350	
19	18.320		18.290	
20	18.270		18.290	
21	18.260		18.260	
22	18.240		18.240	
23	18.260		18.310	
24	18.410		18.500	
25	18.620		18.750	
26	19.120		19.230	
27	19.550		19.880	
28	20.260		20.520	
29	20.730		20.890	
30	20.990		21.150	

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
(April to June '96)




BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
(January to December)
Water Level 1995
Water Level 1996
+22.38
+21.28
+21.67
+21.29
Water Level (m+PWD)
24.00
23.00
22.00
21.00
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
Date
01-Jan
10-Jan
19-Jan
28-Jan
06-Feb
15-Feb
24-Feb
05-Mar
14-Mar
23-Mar
01-Apr
10-Apr
19-Apr
28-Apr
07-May
16-May
25-May
03-Jun
12-Jun
21-Jun
30-Jun
09-Jul
18-Jul
27-Jul
05-Aug
14-Aug
23-Aug
1-Sep
10-Sep
19-Sep
28-Sep
7-Oct
16-Oct
25-Oct
3-Nov
12-Nov
21-Nov
30-Nov
9-Dec
18-Dec
27-Dec

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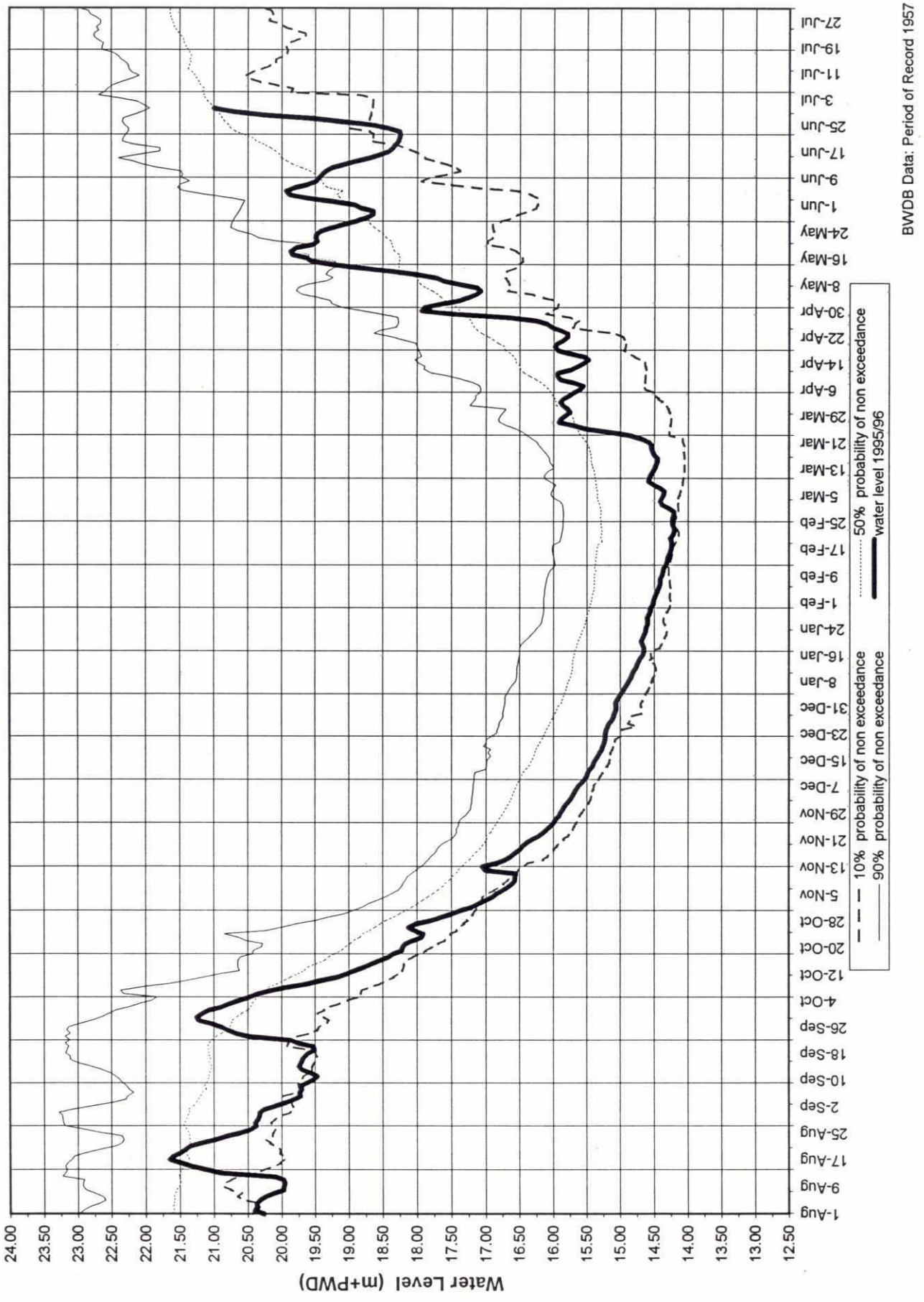
BANK PROTECTION TEST STRUCTURES - FAP 21

BWDB WATER LEVEL FREQUENCY CURVES VERSUS ACTUAL FAP 21 WATER LEVEL AT KAMARJANI TEST SITE UP TO JUNE '96



BWDB Data: Period of Record 1957 - 1989

ANNEX B

Test Site I

- Bathymetric Survey

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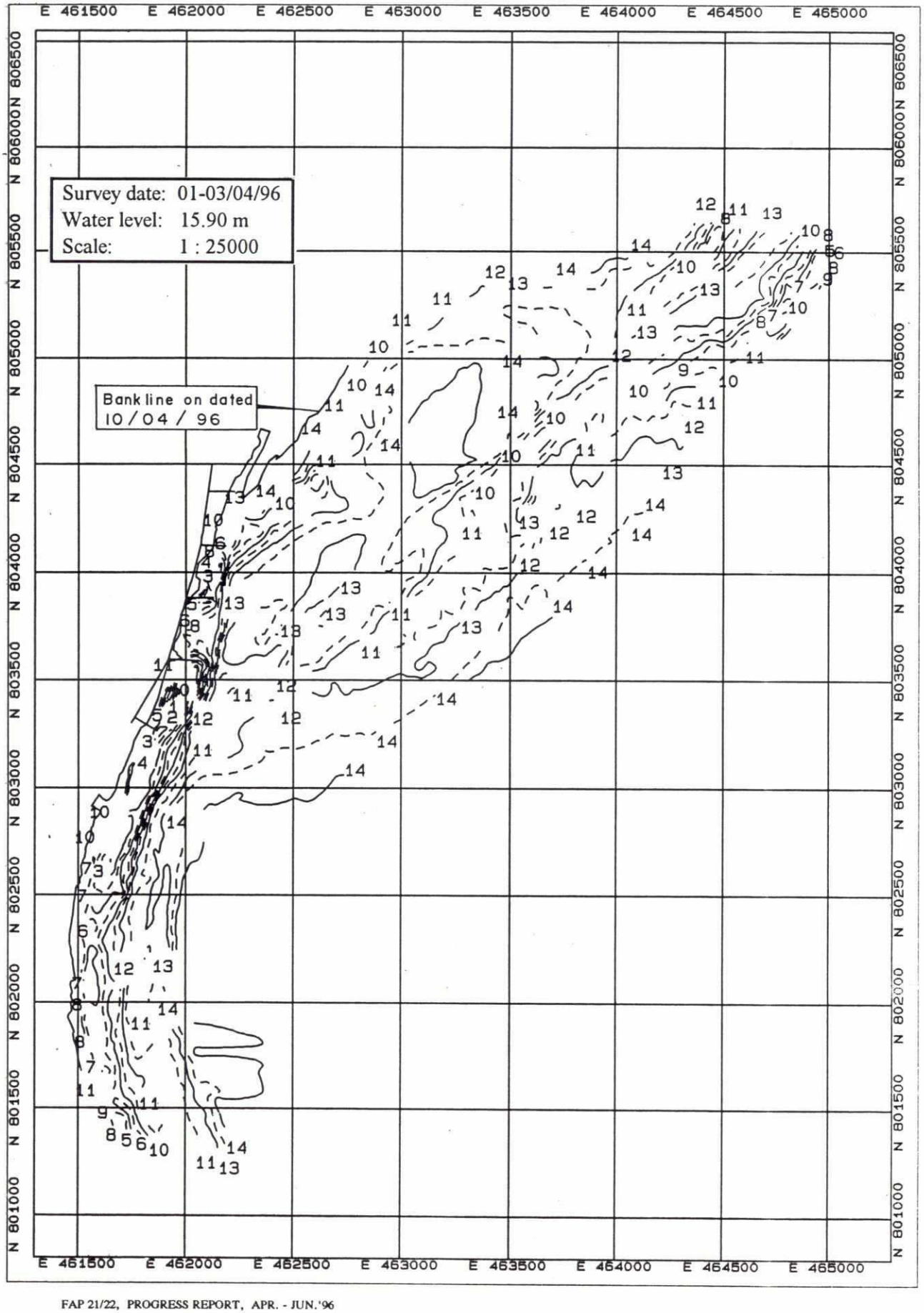
BANK PROTECTION TEST STURCUTRES - FAP 21

CONTOUR LINES AT KAMARJANI TEST SITE



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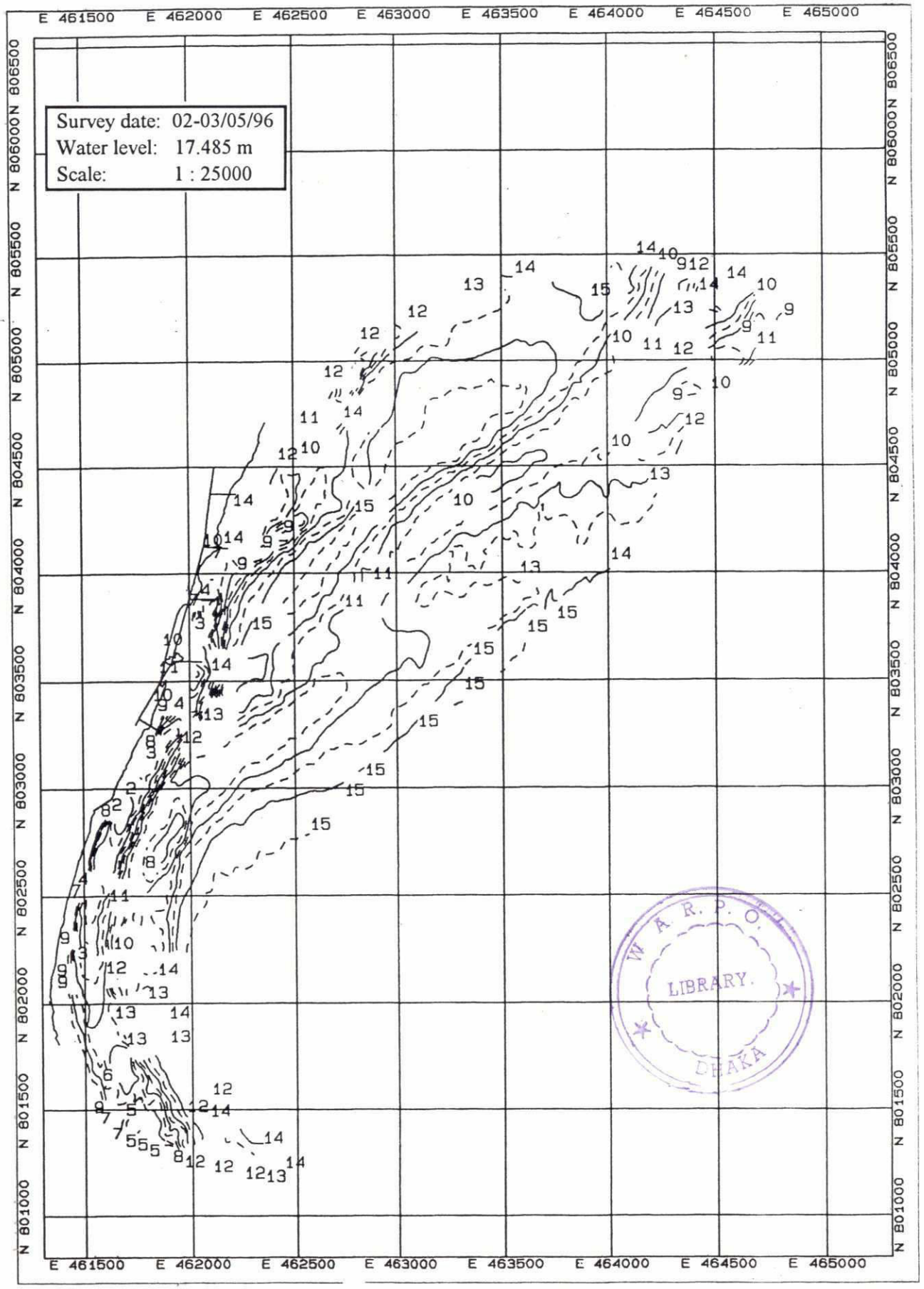
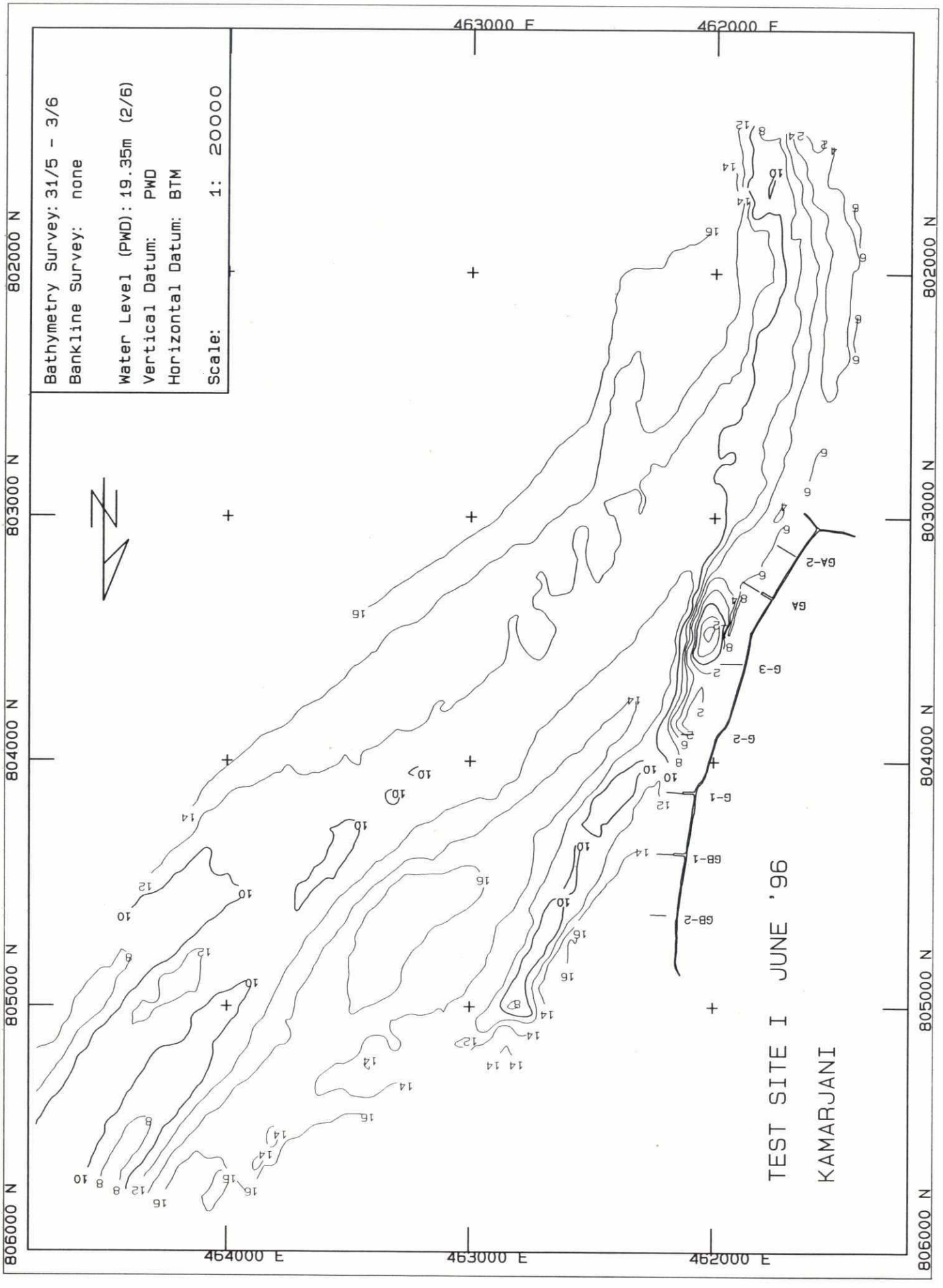
BANK PROTECTION TEST STURCUTRES - FAP 21

CONTOUR LINES AT KAMARJANI TEST SITE




Bathymetry Survey: 31/5 - 3/6
Bankline Survey: none
Water Level (PWD): 19.35m (2/6)
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 20000
463000 E
462000 E
802000 N
803000 N
804000 N
805000 N
806000 N
464000 E
463000 E
462000 E
TEST SITE I JUNE '96
KAMARJANI
GA-2
GA
G-3
G-2
G-1
GB-1
GB-2

ANNEX C

Test Site I

- Photographs

Photo 1: Groyne G-B1 on 30.05.96
(water level at 18.70 m PWD)

Photo 2: Welding of tubular steel piles u/s of groyne G-1

Photo 3: Relocated main embankment south of groyne G-1 on 16.04.96

Photo 4: Profiling and placing of brick-mattresses on the relocated main embankment south of groyne G-2 on 16.04.96

Photo 5: Relocated main embankment between groyne G-2 and G-3 on 08.05.96 (water level at 17.39 m PWD)

Photo 6: Relocated main embankment between groyne G-2 and G-3 on 30.05.96. Above 21.1 m PWD protected by grass-sods, below by brick-mattresses (water level at 18.70 m PWD)

Photo 7: Groyne G-3; Driving of additional tubular steel piles on 27.05.96 (water level at 18.87 m PWD)

Photo 8: Groyne G-3; Driving of additional tubular steel piles in progress on 04.06.96 (water level at 19.92 m PWD)

Photo 9: Floating debris in the groyne field on 15.05.96
(water level at 19.52 m PWD)

Photo 10: Groyne G-2 on 28.06.96
(water level at 20.39 m PWD)

Photo 11: Preparation for current measurements with the Valeport current meter between groyne G-2 and G-3 on 03.06.96 (water level at 19.70 m PWD)

Photo 12: Groyne G-3 on 28.06.96 (water level at 20.39 m PWD)

Photo 13: Groyne G-A; tubular steel piles u/s of remaining 7 bored piles on 27.05.96 (water level at 18.87 m PWD)

Photo 14: Groyne G-A; tubular steel piles u/s of remaining 7 bored piles on 27.05.96 (water level at 18.87 m PWD)

Photo 15: Groyne G-A/2; driving of tubular steel piles on 27.05.96 (water level at 18.87 m PWD)

Photo 16: Groyne G-A/2 after completion on 29.05.96 (water level at 18.65 m PWD)

Photo 17: Main embankment at groyne G-A/2 on 28.06.96
(water level at 20.39 m PWD)

Photo 18: Old FAP 21 camp after vacation on 08.05.96

Photo 19: New FAP 21 camp under construction on 06.06.96

Photo 20: New FAP 21 camp on 29.06.96

ANNEX D

Test Site II

- Water Level

BANK PROTECTION TEST STRUCTURES - FAP 21

WATER LEVEL AT BAHADURABAD TEST SITE

MONTH : APRIL, 1996

DAYS	TIME			REMARKS
	8.00	12.00	17.00	
1	14.534		14.554	
2	14.566		14.560	
3	14.538		14.528	
4	14.486		14.464	
5	14.422		14.396	
6	14.338		14.306	
7	14.286		14.301	
8	14.378		14.471	
9	14.578		14.616	
10	14.618		14.603	
11	14.541		14.516	
12	14.451		14.418	
13	14.369		14.346	
14	14.280		14.250	
15	14.216		14.214	
16	14.244		14.299	
17	14.316		14.416	
18	14.511		14.547	
19	14.556		14.544	
20	14.518		14.488	
21	14.462		14.542	
22	14.413		14.403	
23	14.379		14.385	
24	14.425		14.477	
25	14.535		14.609	
26	14.734		14.764	
27	14.858		14.922	
28	15.104		15.314	
29	15.614		15.804	
30	15.824		15.834	

(D

BANK PROTECTION TEST STRUCTURES - FAP 21

WATER LEVEL AT BAHADURABAD TEST SITE

MONTH : MAY, 1996

DAYS	TIME			REMARKS
	8.00	12.00	17.00	
1	16.114		16.082	
2	15.974		15.922	
3	15.812		15.752	
4	15.730		15.665	
5	15.620		15.615	
6	15.570		15.570	
7	15.592		15.655	
8	15.765		15.820	
9	15.920		16.000	
10	16.045		16.115	
11	16.173		16.227	
12	16.435		16.565	
13	16.775		16.880	
14	17.135		17.276	
15	17.425		17.500	
16	17.680		17.657	
17	17.739		17.783	
18	17.778		17.761	
19	17.680		17.641	
20	17.551		17.501	
21	17.481		17.489	
22	17.501		17.503	
23	17.501		17.497	
24	17.461		17.437	
25	17.476		17.338	
26	17.231		17.181	
27	17.081		17.046	
28	16.961		16.906	
29	16.841		16.786	
30	16.811		16.881	
31	16.986		17.006	

BANK PROTECTION TEST STRUCTURES - FAP 21

WATER LEVEL AT BAHADURABAD TEST SITE

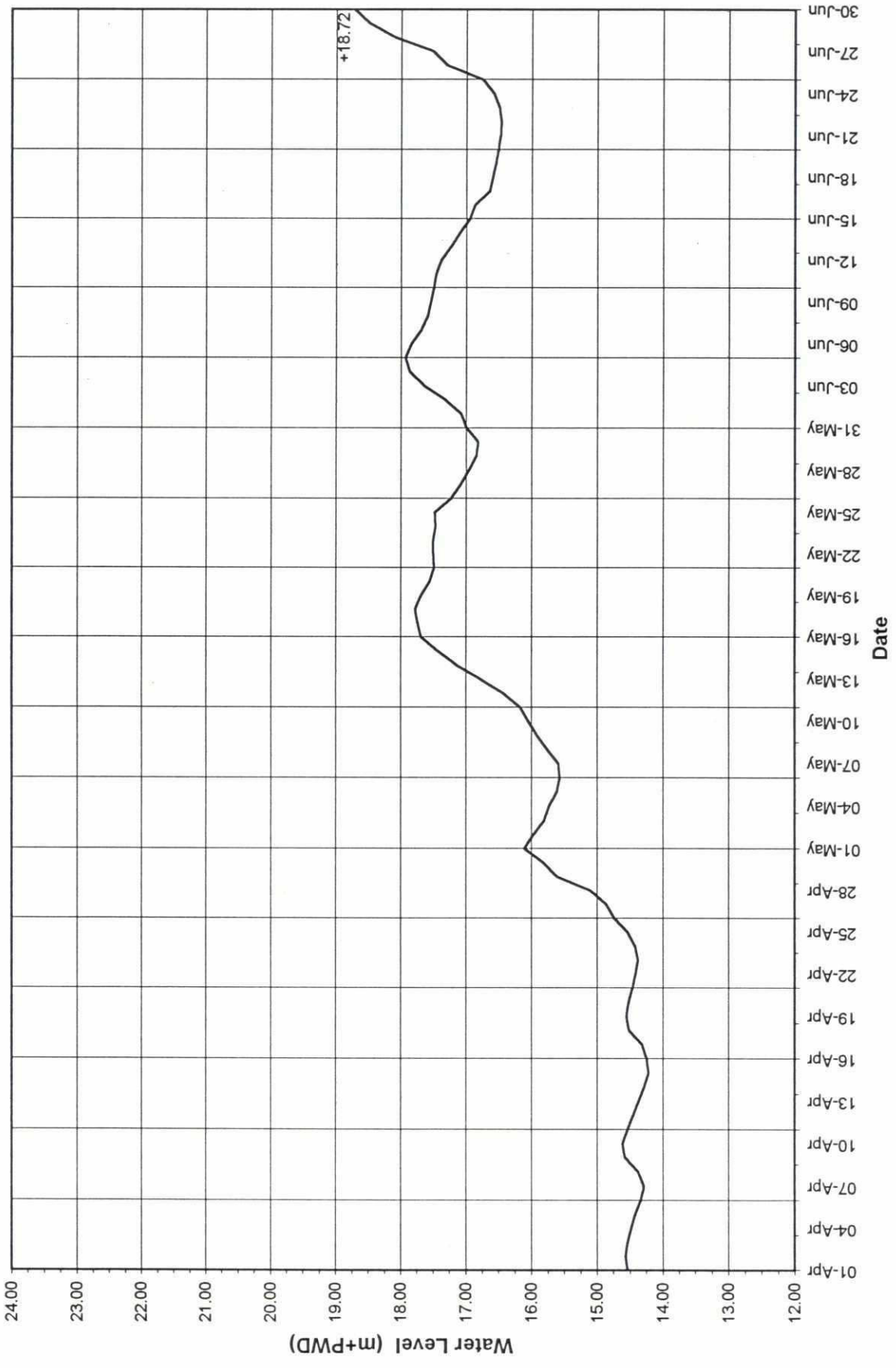
MONTH : JUNE, 1996

DAYS	TIME			REMARKS
	8.00	12.00	17.00	
1	17.071		17.146	
2	17.311		17.461	
3	17.641		17.731	
4	17.861		17.921	
5	17.931		17.909	
6	17.839		17.781	
7	17.686		17.651	
8	17.581		17.561	
9	17.541		17.531	
10	17.491		17.471	
11	17.451		17.423	
12	17.373		17.324	
13	17.221		17.176	
14	17.091		17.041	
15	16.941		16.881	
16	16.866		16.836	
17	16.643		16.613	
18	16.593		16.576	
19	16.553		16.543	
20	16.513		16.494	
21	16.483		16.473	
22	16.463		16.471	
23	16.493		16.525	
24	16.578		16.578	
25	16.748		16.816	
26	17.293		17.243	
27	17.503		17.723	
28	18.103		18.293	
29	18.493		18.613	
30	18.723		18.773	

BANK PROTECTION TEST STRUCTURES - FAP 21

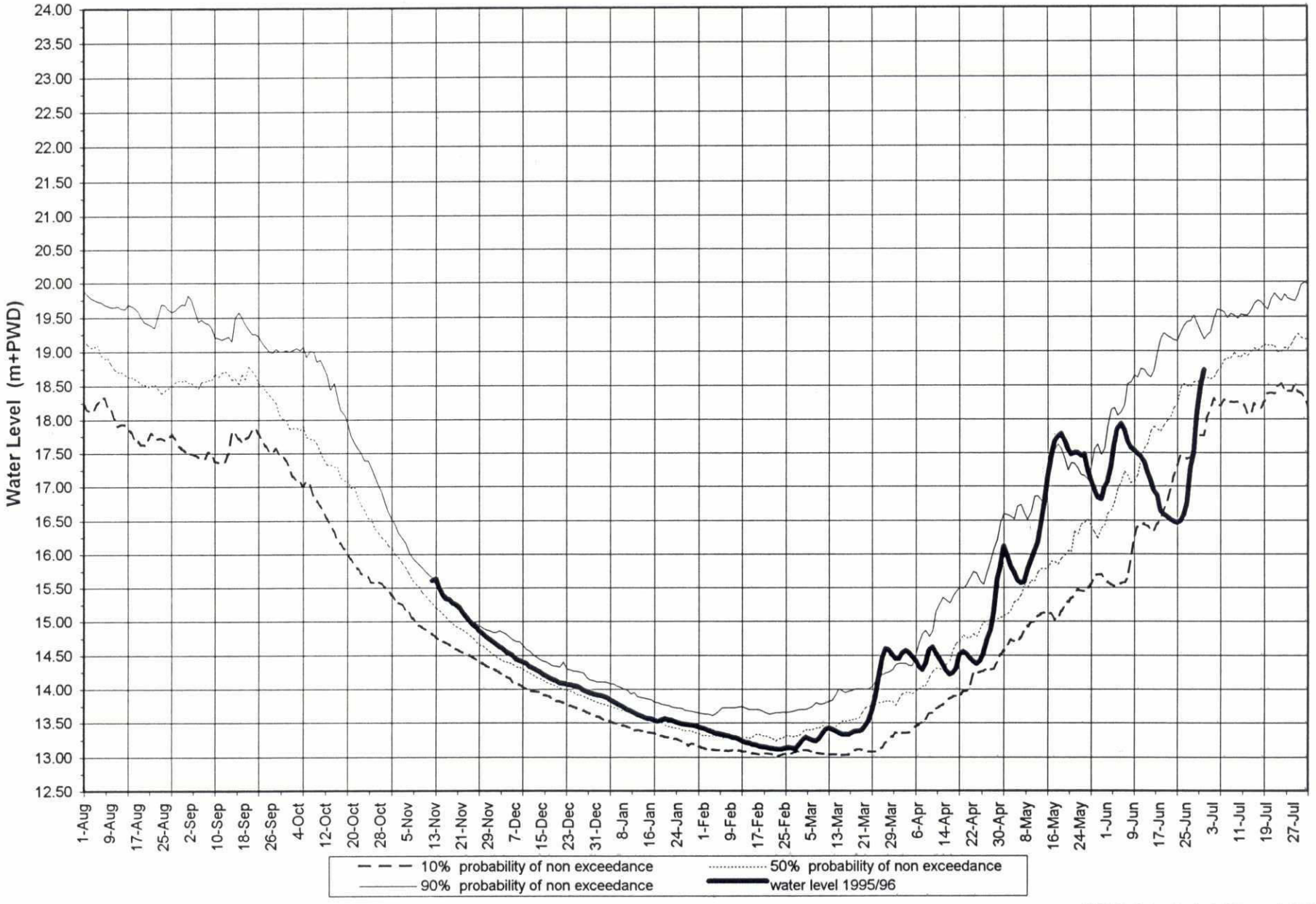
WATER LEVEL AT BAHADURABAD TEST SITE

(April to June '96)



BANK PROTECTION TEST STRUCTURES - FAP 21

BWDB WATER LEVEL FREQUENCY CURVES VERSUS ACTUAL FAP 21 WATER LEVEL AT BAHADURABAD TEST SITE UP TO JUNE '96

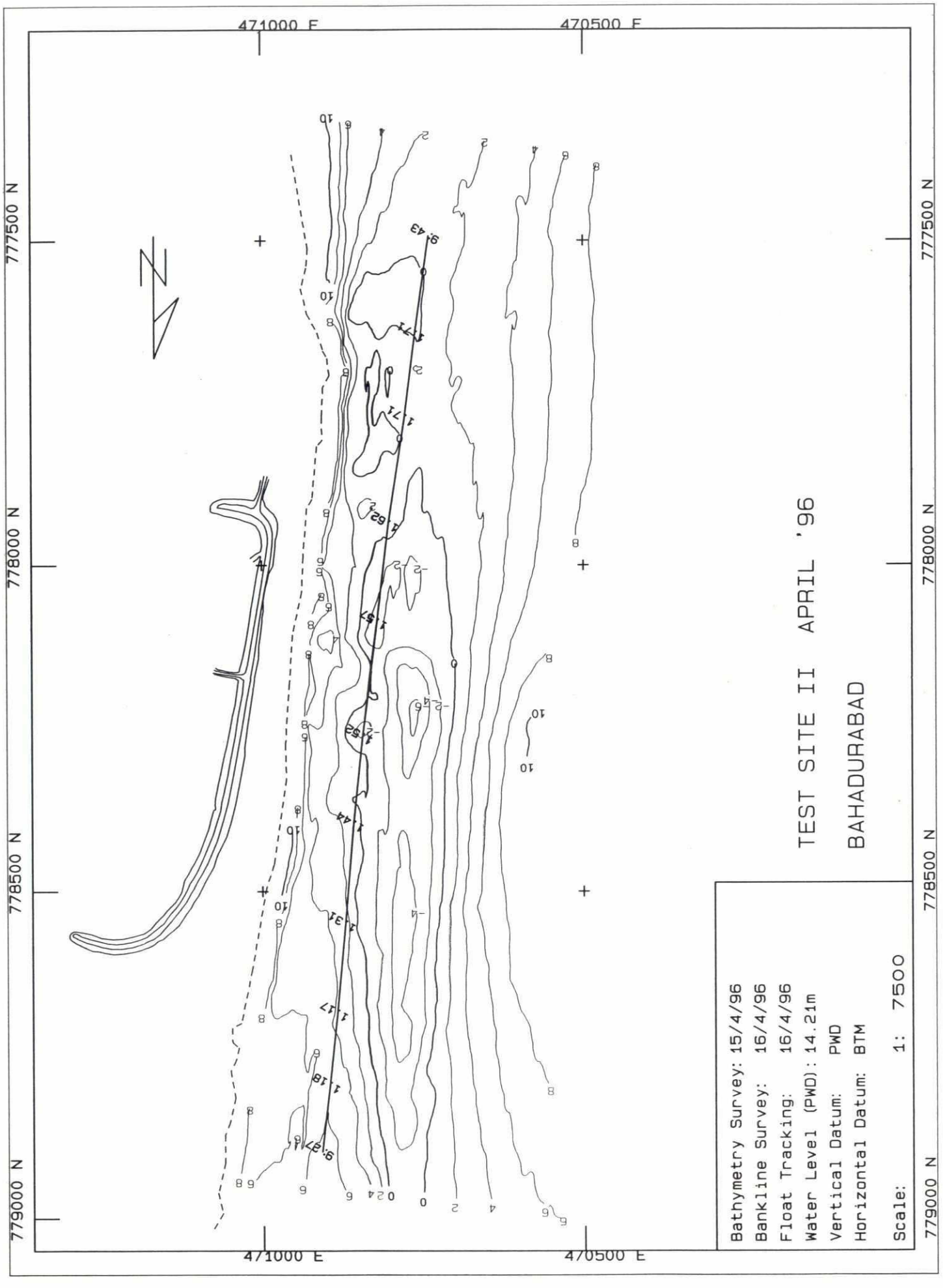


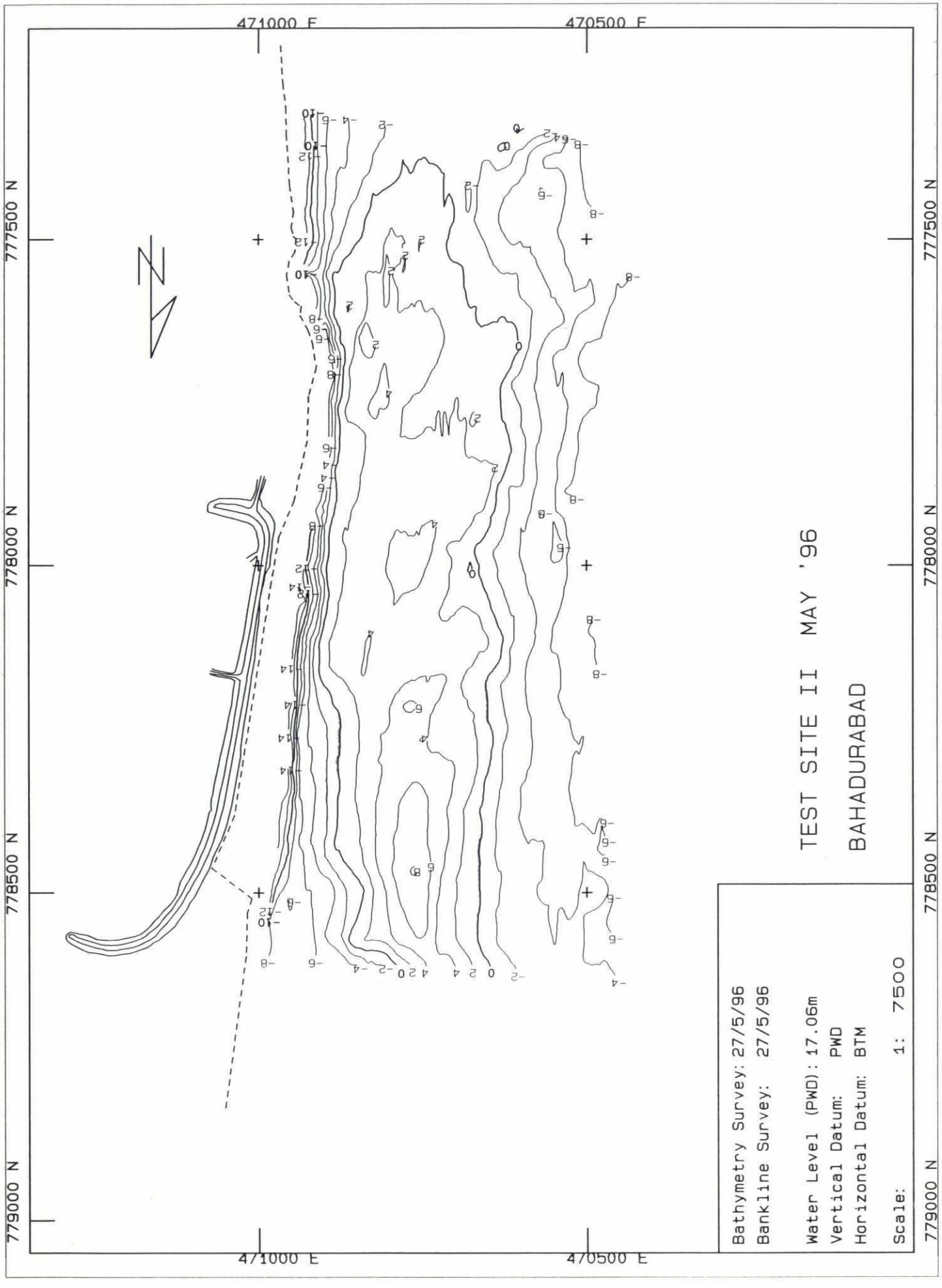
BWDB Data: Period of Record 1962 - 1994

ANNEX E

Test Site II

- Bathymetric Survey


471000 E
470500 E
777500 N
778000 N
778500 N
779000 N
TEST SITE II APRIL '96
BAHADURABAD
Bathymetry Survey: 15/4/96
Bankline Survey: 16/4/96
Float Tracking: 16/4/96
Water Level (PWD): 14.21m
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 7500


471000 E
470500 E
777500 N
778000 N
778500 N
779000 N
TEST SITE II MAY '96
BAHADURABAD
Bathymetry Survey: 27/5/96
Bankline Survey: 27/5/96
Water Level (PWD): 17.06m
Vertical Datum: PWD
Horizontal Datum: BTM
Scale: 1: 7500

ANNEX F

Test Site II

- Implementation Options

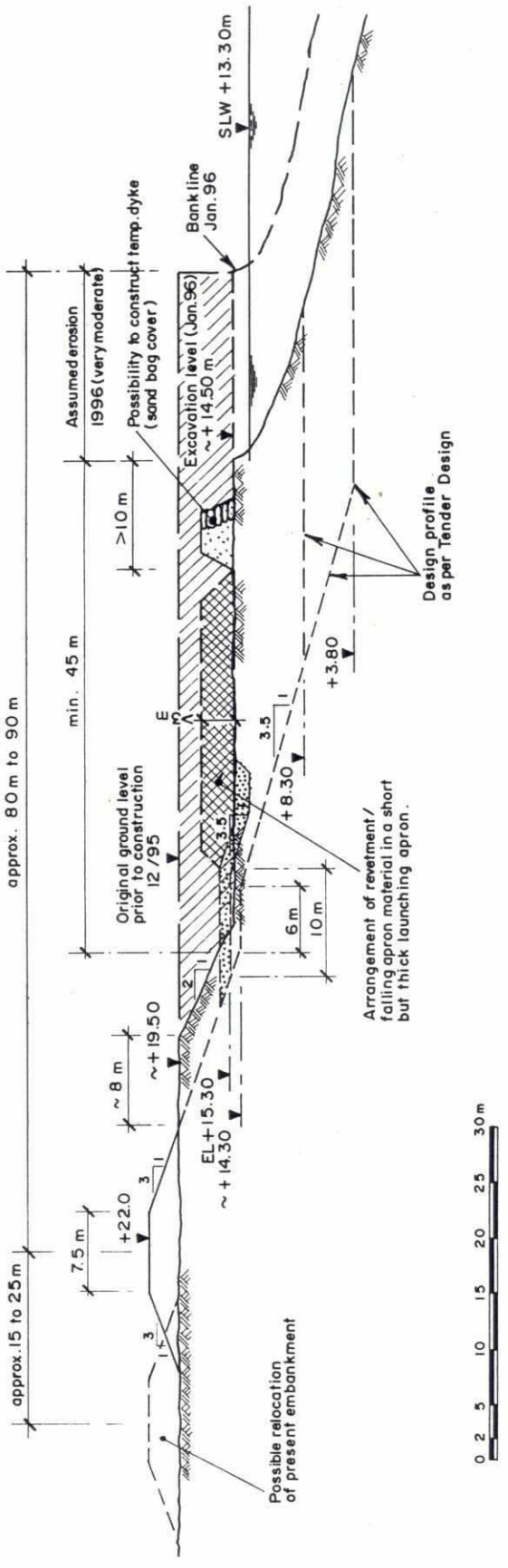


Fig. F-1: **Implementation Option A**
Typical Cross-Section

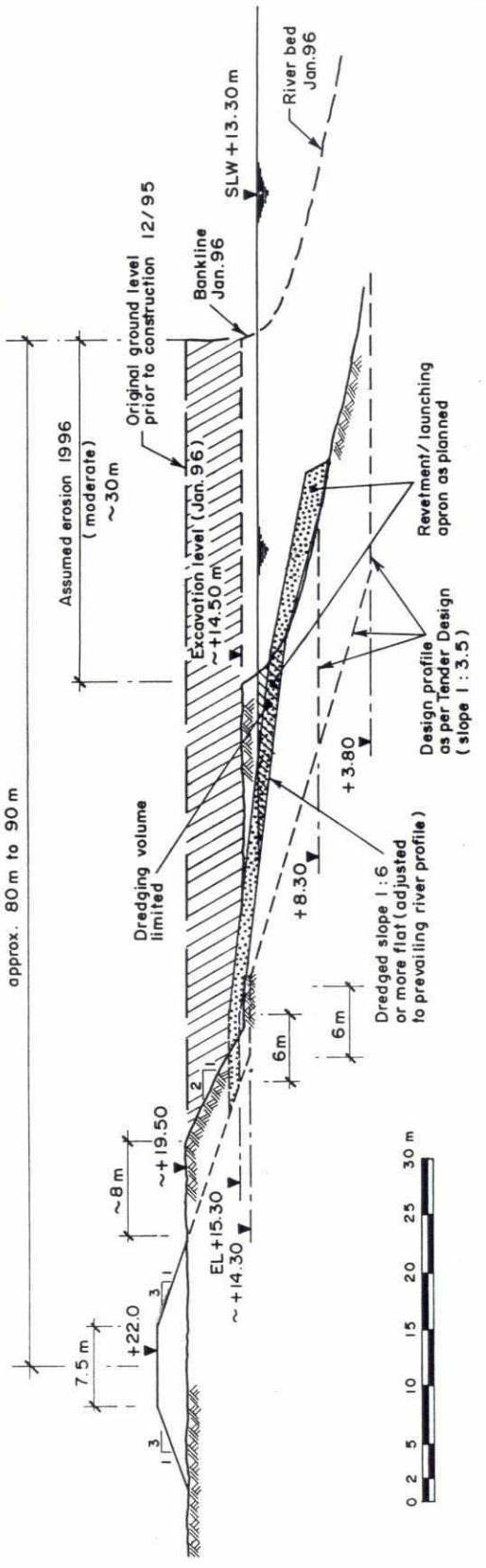


Fig. F-2: **Implementation Option B**
Typical Cross-Section

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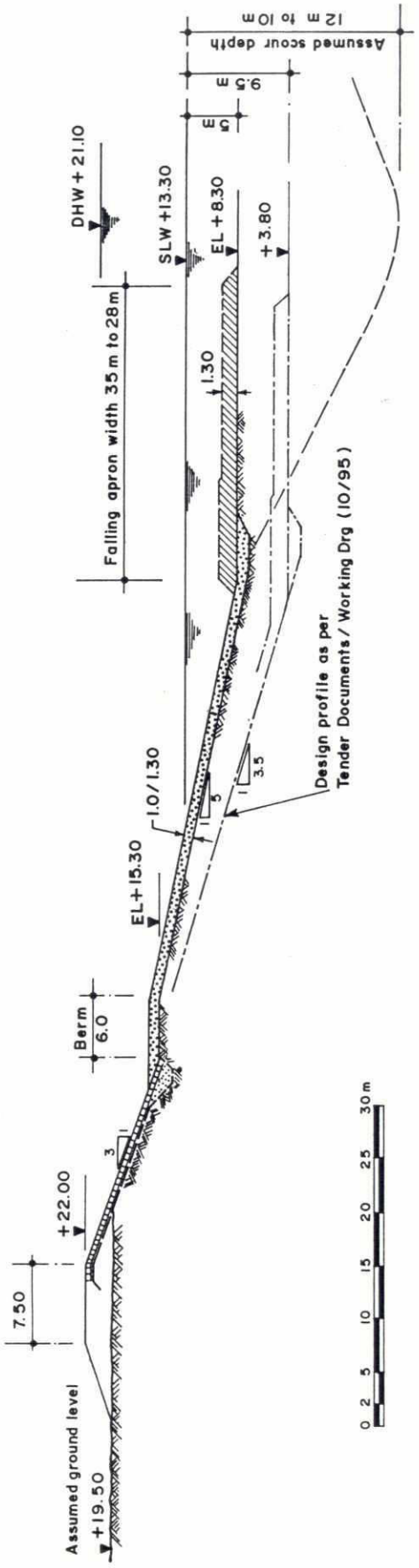


Fig. F-3: Implementation Option C
Typical Cross-Section

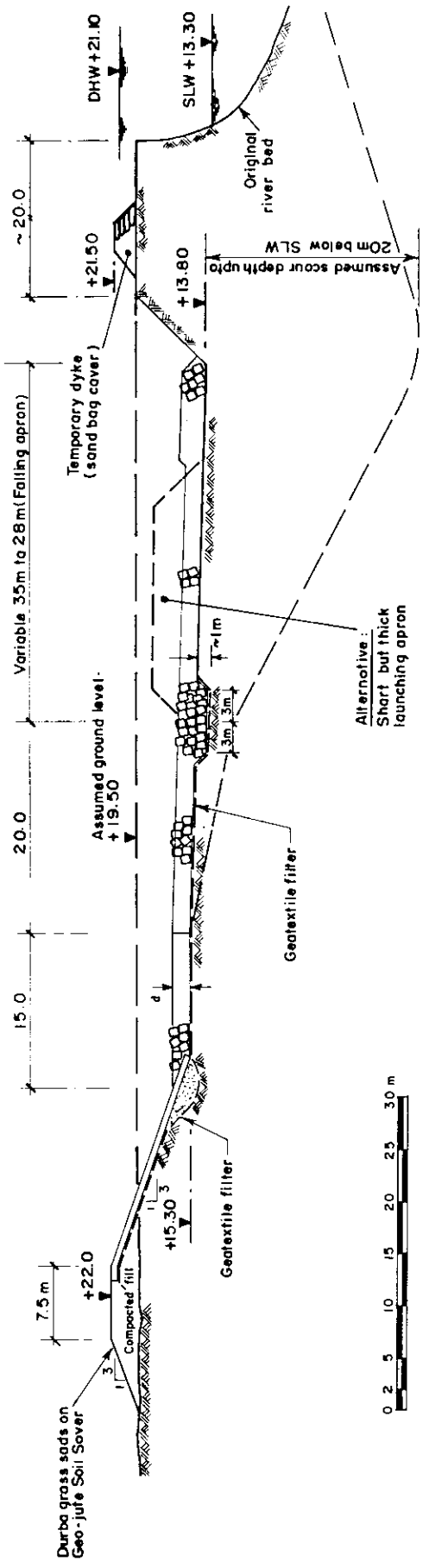
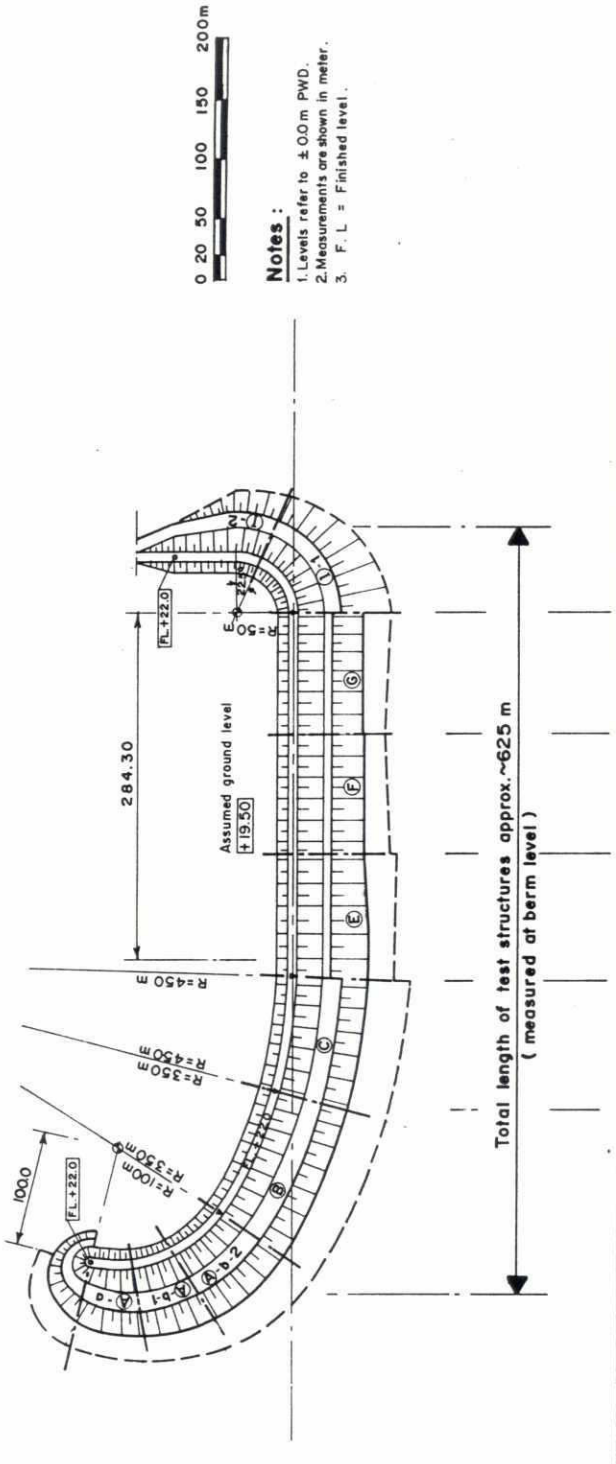


Fig. F-4: Implementation Option D
Typical Cross-Section



River side slope	DESIGN SECTION	A-a-1	A-a-2	A-b-1	A-b-2	B	C	E	F	G	1 - 1	1 - 2
	Land-sided slope	In all section Durba grass sods laid on Geo-jute soil saver										
	Approx. length along berm	110 m		112 m		118 m	108 m	100 m	100 m	100 m	90 m	110 m
	Revetment protection above berm level	Brick-mattress d = 15 cm	Brick-mattress d = 20 cm	Reno-mattresses d = 36 cm (brick fill) on intermediate rubble layer		Wire mesh-mattresses d = 23 cm (stone fill D_{50} = 15 cm) on intermediate rubble layer	CC-blocks, d = 30 cm single layer, hand laid in parallel rows	Inter locking CC-slabs tongue and grove type	Wire mesh-mattresses d = 36 m (brick fill)	Interlocking CC-slabs ship-lap type on intermediate rubble layer	Hard-rock, D_{50} = 20 cm surface bonding by cement grout, d = 50 cm	Hard-rock, D_{50} = 20 cm with bitumen pattern grouting, d = 40 cm
	Revetment protection below berm level	Reno-mattresses d = 23 cm, with stone fill D_{50} = 15 cm on rubble layer		Dumped CC-blocks D_n = 30 cm		Dumped CC-blocks transition (us): D_n = 50 cm Centre part: D_n = 35 cm transition (ds): D_n = 40 cm	Dumped CC-blocks transition (us): D_n = 35 cm D_n = 45 cm transition (ds): D_n = 40 cm	Collapsable block mattress (FORE-SHORE) d = 25 cm with cement mortar grout fill, in the launching part with additional filter points in the mattress system. Exposed edge of apron: Geo-sand container Type D (250 kg/No.)	Tubular fabric mattress (PROFIX) ; sand filled respect. sand-bitumen filled d = 30 cm d = 40 cm (transitions)	Collapsable block mattress (INCOMAT - Sand Flex) d = 35 cm d = 45 cm (transitions)	Rip-rap, D_{50} = 35 cm (stone/boulder size ranging d = 25 cm to d = 45 cm) (Range F)	Dumped CC-blocks, D_n = 30 cm and 35 cm
	Transition layer between revetment and launching apron	—	—	CC-blocks, D_n = 30 cm		CC-blocks, D_n = 30 cm	CC-blocks, D_n = 30 cm		CC-blocks, D_n = 35 cm	CC-blocks, D_n = 40 cm		
	Launching apron (falling apron)	Dumped CC-blocks D_n = 40 cm (30 cm)	Rip-rap D_{50} = 25/30 cm	Rip-rap D_{50} = 30/35 cm	Rip-rap D_{50} = 30/35 cm	Geo-sand container Type C (180 kg/No.) Type D (250 kg/No.) for exposed edge	Geo-sand container Type E (900 kg/No.)		Gabion-socks with stone fill (D_{50} = 15 cm) Volume 0.65 m³/No Weight 1300 kg/No	Dumped CC-blocks, D_n = 40 cm D_n = 45 cm for exposed edge		

Fig. F-5: **Proposed Implementation Layout (Tentative)**
Designation of Design Sections and Materials (Option D)

ANNEX G

Test Site II

- Photographs

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Photo 1: Earth works as on 12.04.96 in Sections E, F, G
(water level at 14.44 m PWD)

Photo 2: Test Site on 27.05.96
(water level at 17.06 m PWD)

Photo 3: Earth works as on 12.04.96 in Section B
(water level at 14.44 m PWD)

Photo 4: Section A (on the right-hand side) on 27.05.96
(water level at 17.06 m PWD)

Photo 5: Geotextile filter material stored in Subcontractors camp in May 1996

Photo 6: Sewing of geotextile bags

Photo 7: FAP 21 camp after whirlwind of 01.05.96

Photo 8: FAP 21 camp after whirlwind of 01.05.96