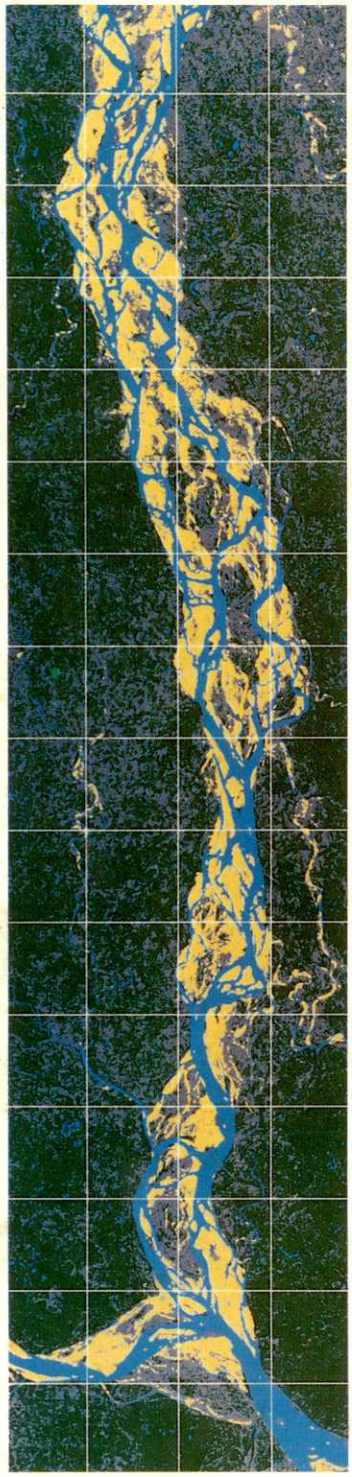
GOVERNMENT OF PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES
WATER RESOURCES PLANNING ORGANIZATION

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. 20

APRIL TO JUNE 1998

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

TEST AND IMPLEMENTATION PHASE

PROGRESS REPORT NO. 20

APRIL TO JUNE 1998

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

PROGRESS REPORT NO. 20

Table of Contents

8

List of Figures

List of Tables

List of Annexes

9

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.

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 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 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.

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.

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 1998. 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 1998.

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 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 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 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)
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 03.07.96	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 by Dr. Friedrich von Raumer on behalf of WARPO/KfW/CFD
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

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 1.2-1.1 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 1.2-3.2 presents the revised Staffing Schedule submitted along with the Progress Report No. 6 and adapted to the donors' comments, whereas Table 1.2-1.2 and Table 1.2-3.3 are showing the Work Plan and the Staffing Schedule as per proposal of July 1996, approved in March 1997. 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 of 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 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 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.

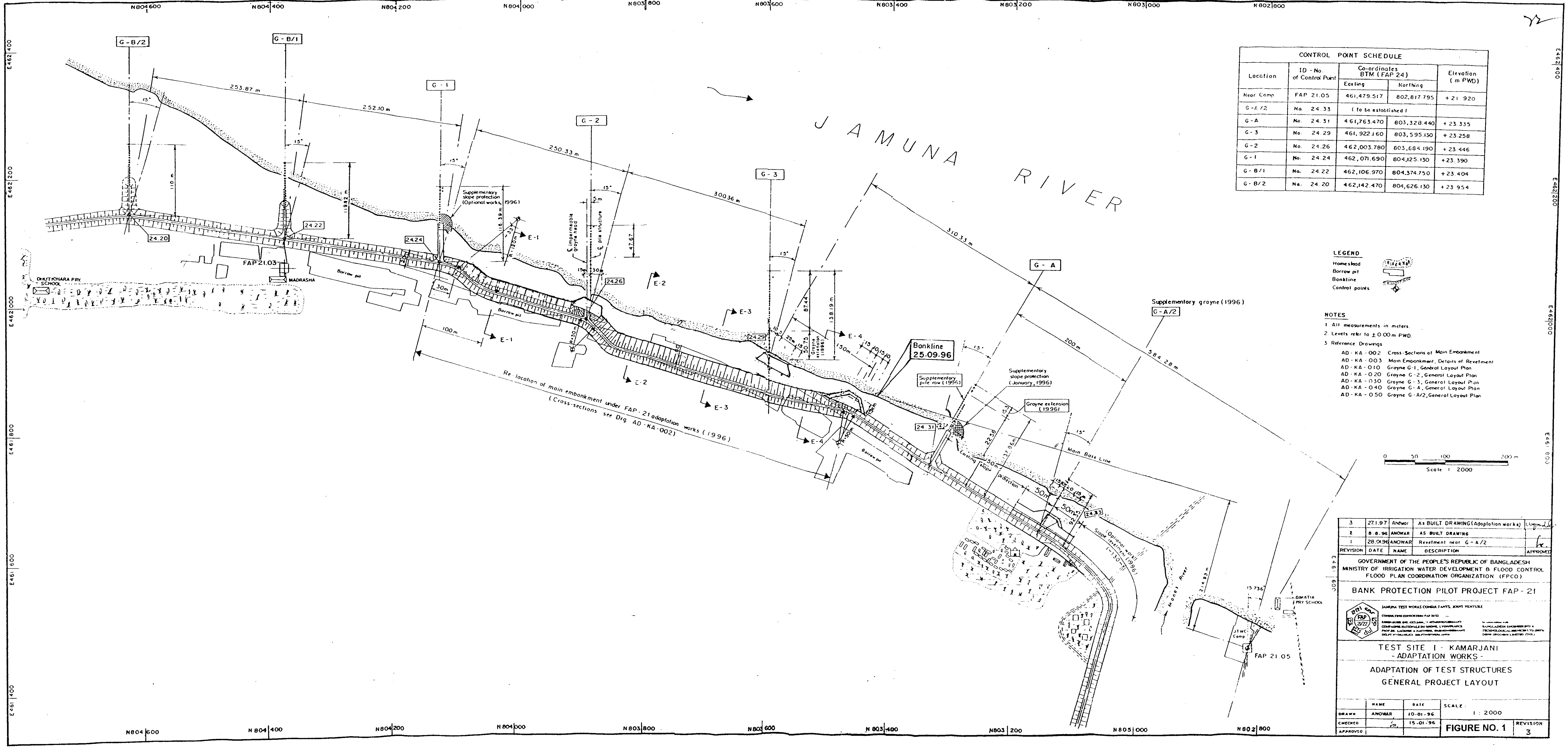
For the design of adaptation and repair measures, the design parameters as per original design of the groyne structure were being maintained. Only the downstream part of the impermeable groyne heads received substantially increased launching aprons.

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 are 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 was carried out by driving 23 steel piles ϕ 711 mm and 32 m length as well as by construction of 12 Nos of reinforced in-situ concrete piles 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.

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 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 1998 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 1998	May 1998	June 1998
01			
02			
03			
04			
05			
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19	main survey		
20	main survey	main survey	
21	main survey	main survey	
22	main survey	main survey	
23	main survey		main survey
24	main survey		main survey
25			main survey
26			main survey
27			main survey
28			main survey
29			main survey
30			main survey
31			

Table 1: Bathymetry surveys at Kamarjani Test Site from April to June 1998

(2) Topographic Measurements

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

20/04 - 25/04	bankline, waterline and charline
21/05 - 23/05	bankline, waterline and charline
19/06	position of new Manos Regulator

(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. Results are presented in the monthly reports on monitoring of the test structures.

Since mid of June additional current measurements were carried out by an engineer of "Labor für Wasserbau" of Hochschule Bremen with drifter buoys using DGPS.

(5) Observations

During the period under report the water level continued to rise with some minor fluctuations and the peak of the first half of the year of 21.59 m+PWD was reached on June 14. At the end of June the water level was recorded at 21.50 m+PWD.

During the months April and May slow bank erosion continued downstream from the groyne field up to Balashi Ghat. This erosion process slowed down when the Kundarapara cut-off channel continued to develop in June. No attack on the groyne field has been observed.

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 mobilize 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 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 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 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 15 the Client had been informed that the Revetment Test Structure was complete in all respects on June 12, 1997.

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 1998 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 F and G).

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

Village North-south connection

Consultants camp

LAND ACQUISITION
PHASE II (Site Survey 17.10.96)

FAP 21.28

SEE DETAIL
DRG. R-A-315

Market

Pond

FAP-770

GPS FM 764

BANKLINE ON
15TH MAY' 97

BANKLINE ON
15TH.OCTOBER'96

JAMUNA RIVER

179.40
224.40
45.0
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	
FAP21-8	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, Kacha, Footpath
High River Bank
House Pucca, Kacha & Tinshed
Traverse Station & Pillar
Home stead
Mosque

NOTES

1. The topography shown on this drawing is based on J T W C'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	Anowar	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

CONSULTING CONSORTIUM FAP 21/C

In association with:
BANGLADESH ENGINEERING & TECHNOLOGICAL SERVICES LTD. (BETS)

TEST SITE II - BAHADURABAD

GENERAL LAYOUT OF TEST STRUCTURE (1996/97)

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

SCALE : 1 : 2,000

FIGURE NO. 2

REVISION 1

REVETMENT TEST STRUCTURE
DEFINITION SKETCH

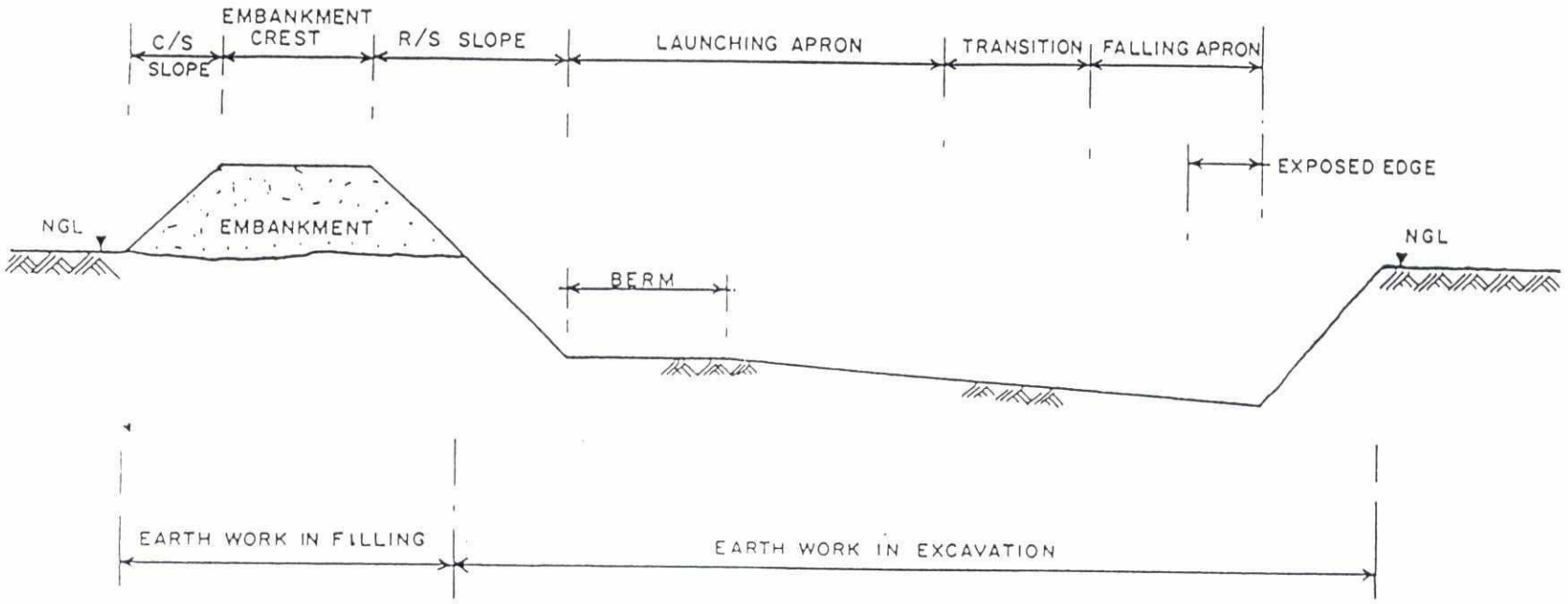


Figure 3: Definition Sketch of the Revetment Test Structure

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			CC-blocks D_n = 40 cm	Geo-sand container D	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 = 40/45 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 0221-4	BIDIM b 7	HaTe O 2214	BIDIM S 550			BIDIM S 550	DATEX AD1300	Hate J 9014	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 0221-4	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

Date	Survey Area		
	April 1998	May 1998	June 1998
01			
02			
03			
04	main and site survey		
05	main and site survey		
06			site survey
07			site survey
08		main and site survey	site survey
09		main and site survey	
10			
11			
12			
13			
14			site survey
15			site survey
16			main survey
17			main survey
18			main survey
19			
20			
21			
22			
23			
24			
25			main survey
26		main and site survey	main survey
27	main and site survey	main and site survey	main survey
28	main and site survey		
29			
30			
31			

Table 3: Bathymetry surveys at Bahadurabad Test Site from April to June 1998

Moreover, measurements have been carried out regularly 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

The following works were performed:

04/04	bankline survey
28/04	bankline survey
13/05	bankline survey
01/06	test site area

(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 Annex ?.

Additional current measurements were started mid of June by an engineer of "Labor für Wasserbau" of Hochschule Bremen with drifter buoys using DGPS.

(4) Observations

The first peak of the flood 1998 was recorded at 19.31 m+PWD on June 14 and at the end of the period under review 19.12 m+PWD were measured.

When the water level started to rise, the test structure came under attack again, but the falling aprons continued to function as expected. At about mid June, however, a sedimentation process started, when the char in front of the structure moved further downstream. Slow bank erosion was only observed downstream from the structure over a length of about 2 km.

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 workplan for the project continuation for the implementation of recurrent measures during the lean season 1996/97. The workplan 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 (see Fig. 4) 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 is located about 5 km east of the Groyne Test Structure of FAP 21 at Kamarjani.

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 the period under report 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 1998.

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

Monitoring of the structures started immediately after their completion. The valuable and good results were presented and explained in the previous progress reports.

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 only on January 07, 1998 another far and near field bathymetric survey was performed as well as bankline and topographic survey in the test site area. 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.

Recording of water levels was continued and maximum during the period under report was measured at 20.02 m+PWD on June 14.

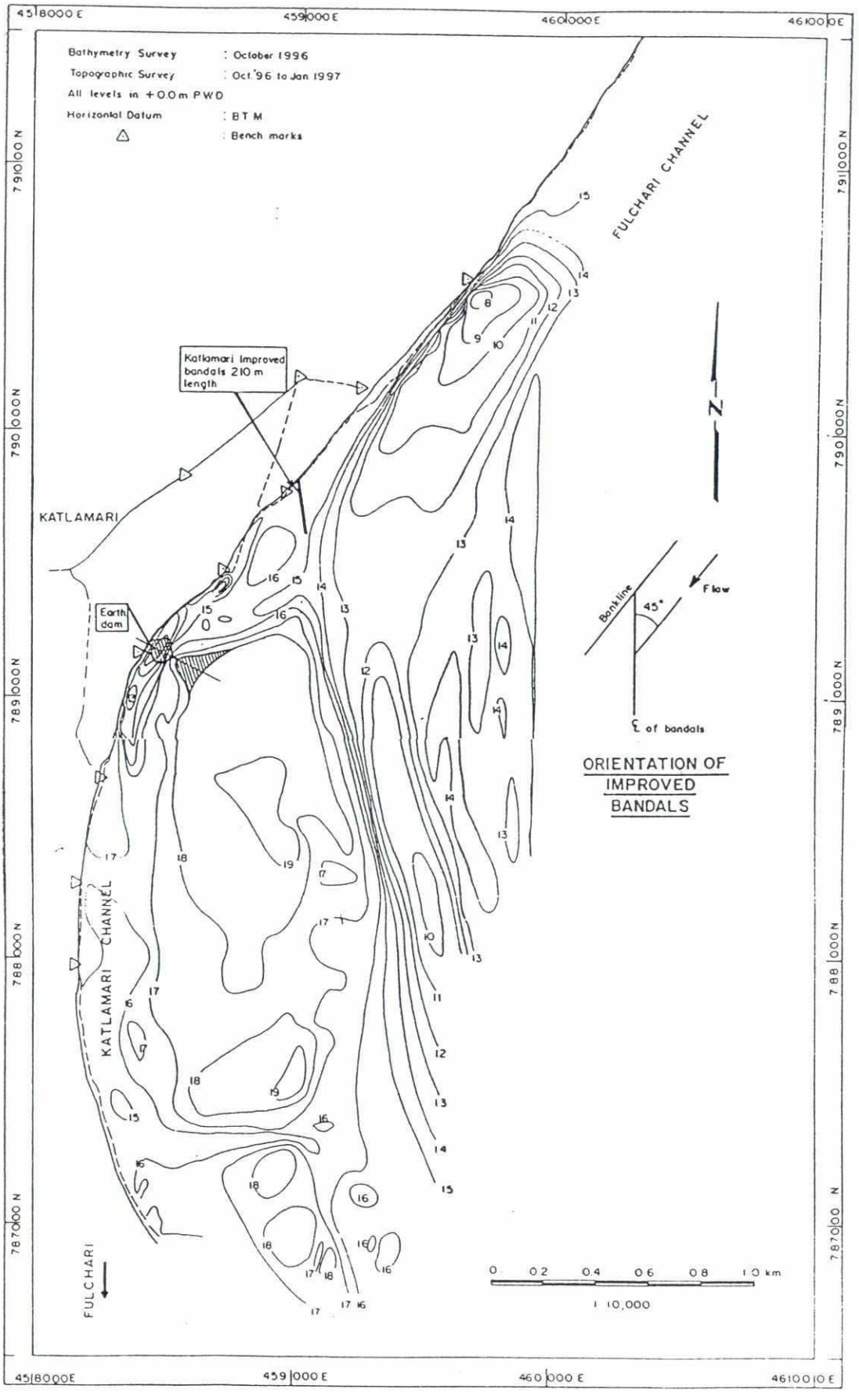


Fig. 4: Site Plan of Katlamari

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.

(b) Improved Bandals with adjustable Screens
The height of these bandals were planned to be 4.5 m only with 2 m high adjustable screens. Hence, they can only be installed in areas with a limited water depth or at such places which will fall dry during the lean season. Therefore, it was intended to build them as a connection between the bankline on the char and the deeper part of the Kundarapara channel where floating screens will be installed. The adjustability of the screens will increase the efficiency during the rising and falling limb of the hydrograph and contribute to the further development and improvement of bandals.

However, 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
The first promising tests with floating screens were carried out in July 1997 at Katlamari Test Site. These tests showed that it is possible to fix adjustable screens to floating elements and to handle and anchor these elements also at high water stages in deeper channels with higher flow velocities. For the new test site it was proposed to construct floating elements of about 5.7 x 11.3 m with a maximum screen depth of 4 m. Hence, even in 8 m deep channels a depth blockage ratio of 0.5 can be obtained. They were planned to be installed with a total length of 100 m as an extension of the improved bandals in the Kundarapara channel. Their main objective was to influence the flow in such a way that the development of the Kundarapara cut-off will be accelerated, but also to gain more experience in handling and anchoring of this type of recurrent measure. Since they are flexible and allow for use on repeated occasions in subsequent years, they are an ideal tool in the sense of recurrent measure.

Construction and assembling of the floating elements was started in February at Kamarjani Test Site. Since, however, the import of anchoring equipment was delayed, the elements with a total length of about 100 m could only be completed in June 1998. In the course of positioning and anchoring of the elements, local people sabotaged again 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. Results are given in Annex O to Q.

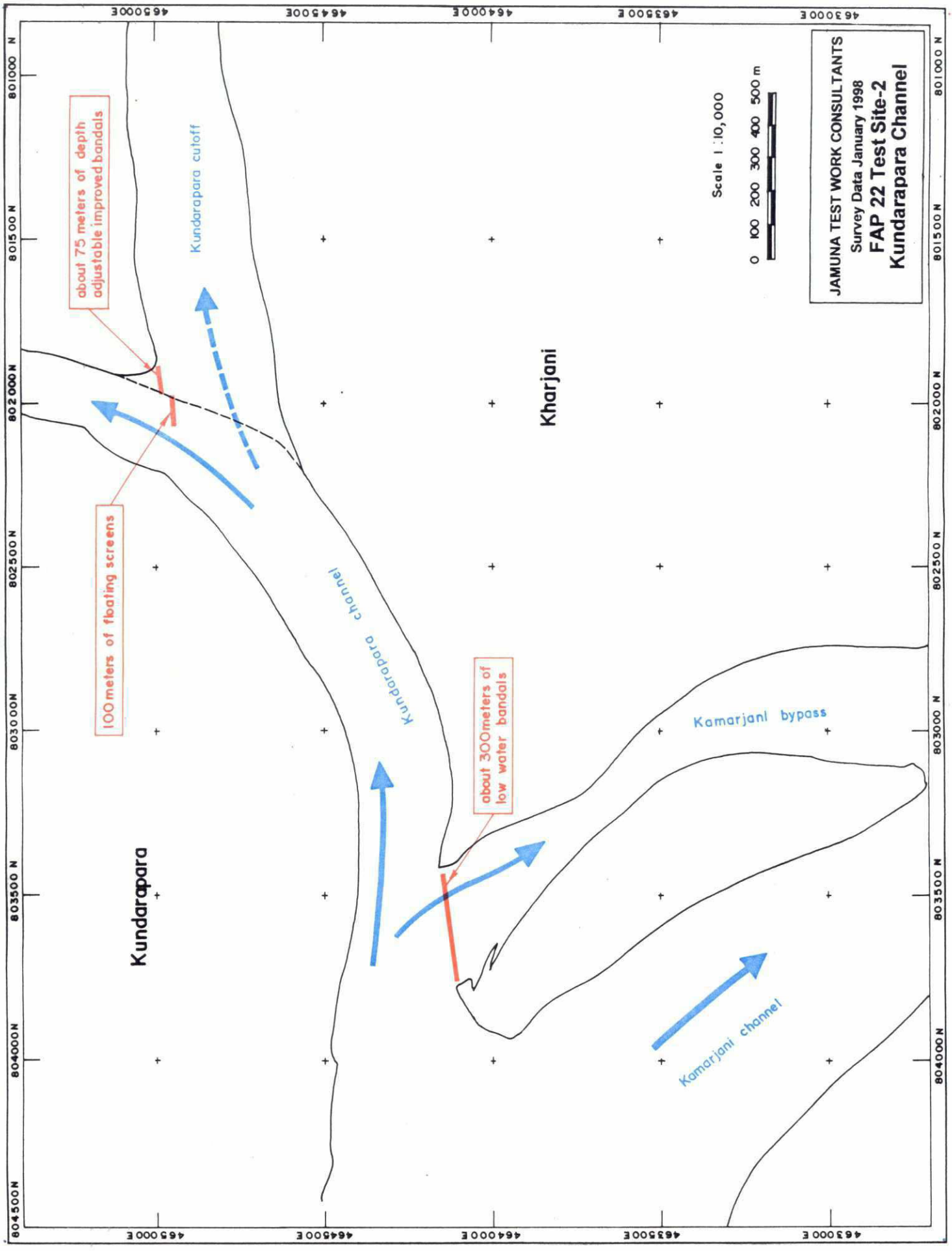


Fig. 5: Location of the Test Structures

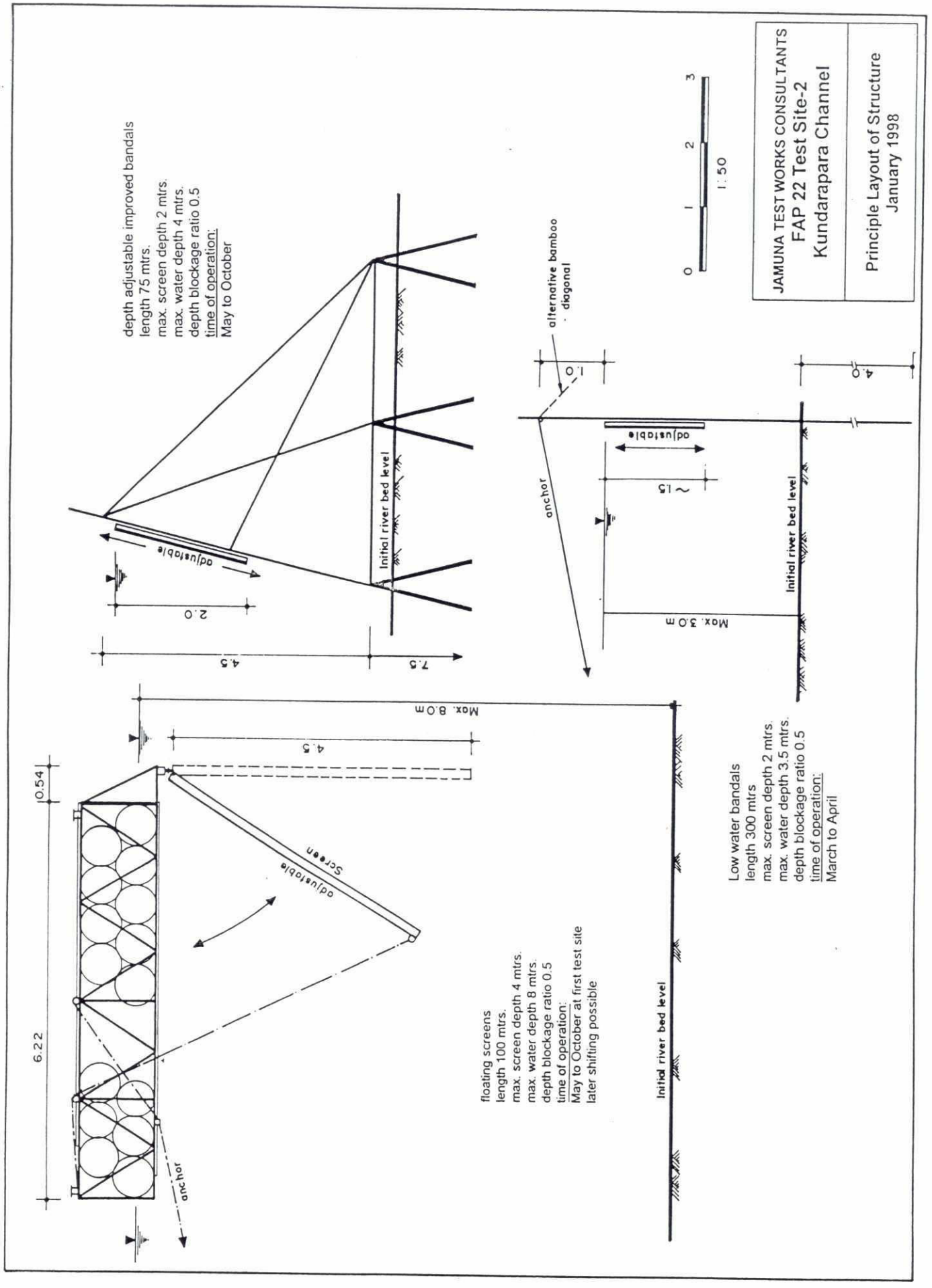


Fig. 6: Layout of the Structures

Table 1.1-1

BANK PROTECTION TEST STRUCTURES - FAP 21

EXPATRIATE PROFESSIONAL STAFF

Activities during the period of 04/98 to 06/98

VERSION : 09.06.98

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	30/06	
					09/05	18/05	Part time in Europe
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	-	-	
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	-	-	-	-	-	
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	10/06	30/06	
4.1.1	Morphologist	Dr. E. Mosselman	EM	DELFT	-	-	
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 1.1-2

BANK PROTECTION TEST STRUCTURES - FAP 21
LOCAL PROFESSIONAL STAFF
Activities during the period of 04/98 to 06/98

VERSION : 09.06.98

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 2	A. Q. Mohammed Ali	MA	BETS	-	-	
2.3.2	Mechanical Engineer 2	Masih-ur-Rahman	MR	DUL	-	-	
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	-	-	
3.4.2	Surveyor 2	-	-	-	-	-	
3.6.2/3/4	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	50 % for FAP 22
	Monitoring Data Processor	Yasmin Khayer	YK	FL	01/04	30/06	
4.1.2	Morphologist 2	M. H. Sarker	MHS	FL	-	-	
4.2.2	Modelling Expert 2	Monjur Kader	MoK	BETS	-	-	
4.3.2	Environmental Expert 2	Dr. A.K.M. Nazrul Islam	NI	BETS	-	-	
4.4	Socio-Economist	Tauhidun Nabi	TN	BETS	-	-	
4.5.2	Economist 2	NN	-	-	-	-	
4.6.2	Unallocated 2		-	-	-	-	

Table 1.1-3

BANK PROTECTION TEST STRUCTURES - FAP 21

LOCAL SUPPORT STAFF

Activities during the period of 04/98 to 06/98

VERSION : 09.06.98

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	

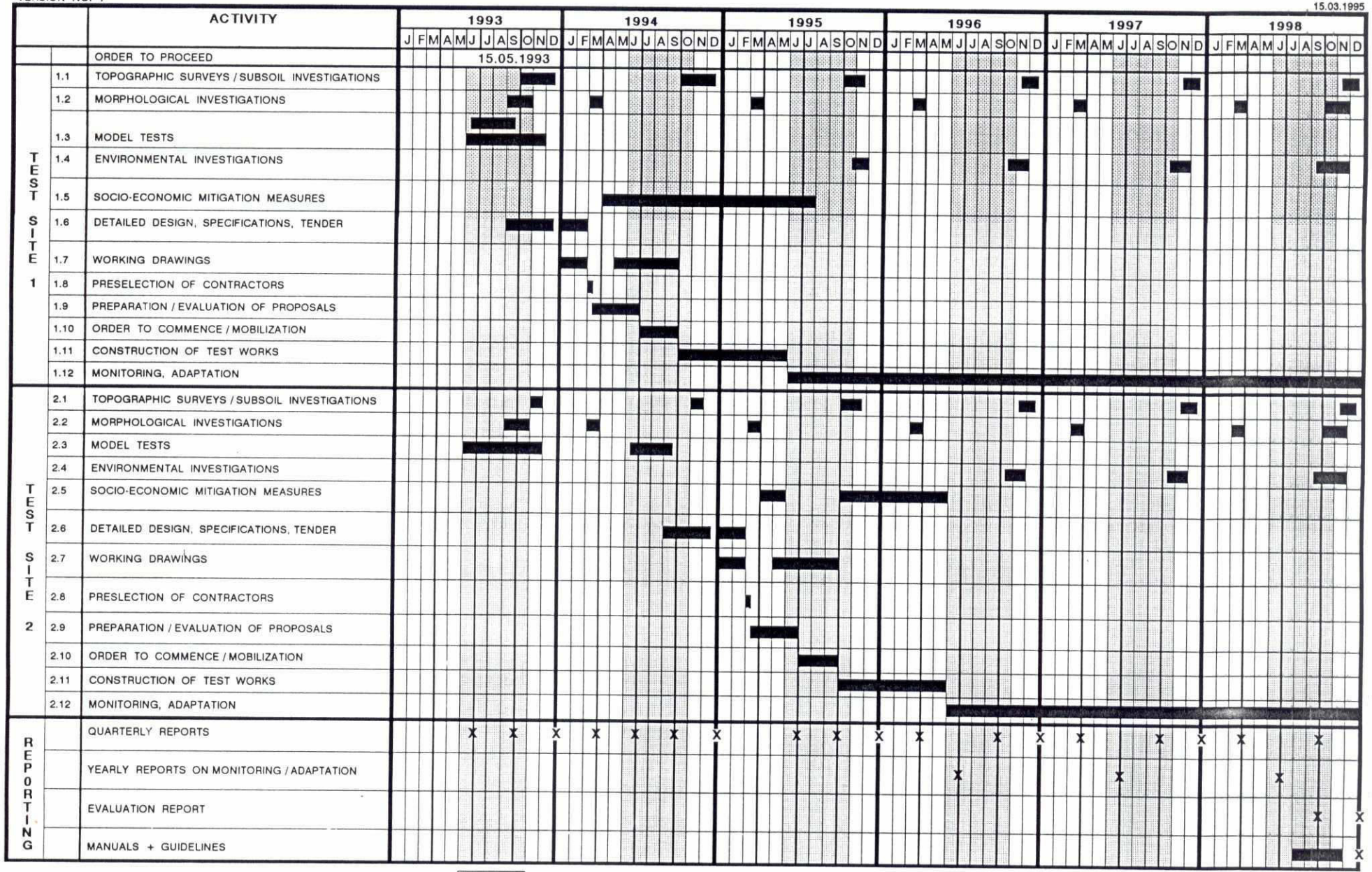
TABLE 1.2-1.1

BANK PROTECTION TEST STRUCTURES FAP 21

WORK PLAN *)

VERSION NO. 1

15.03.1995

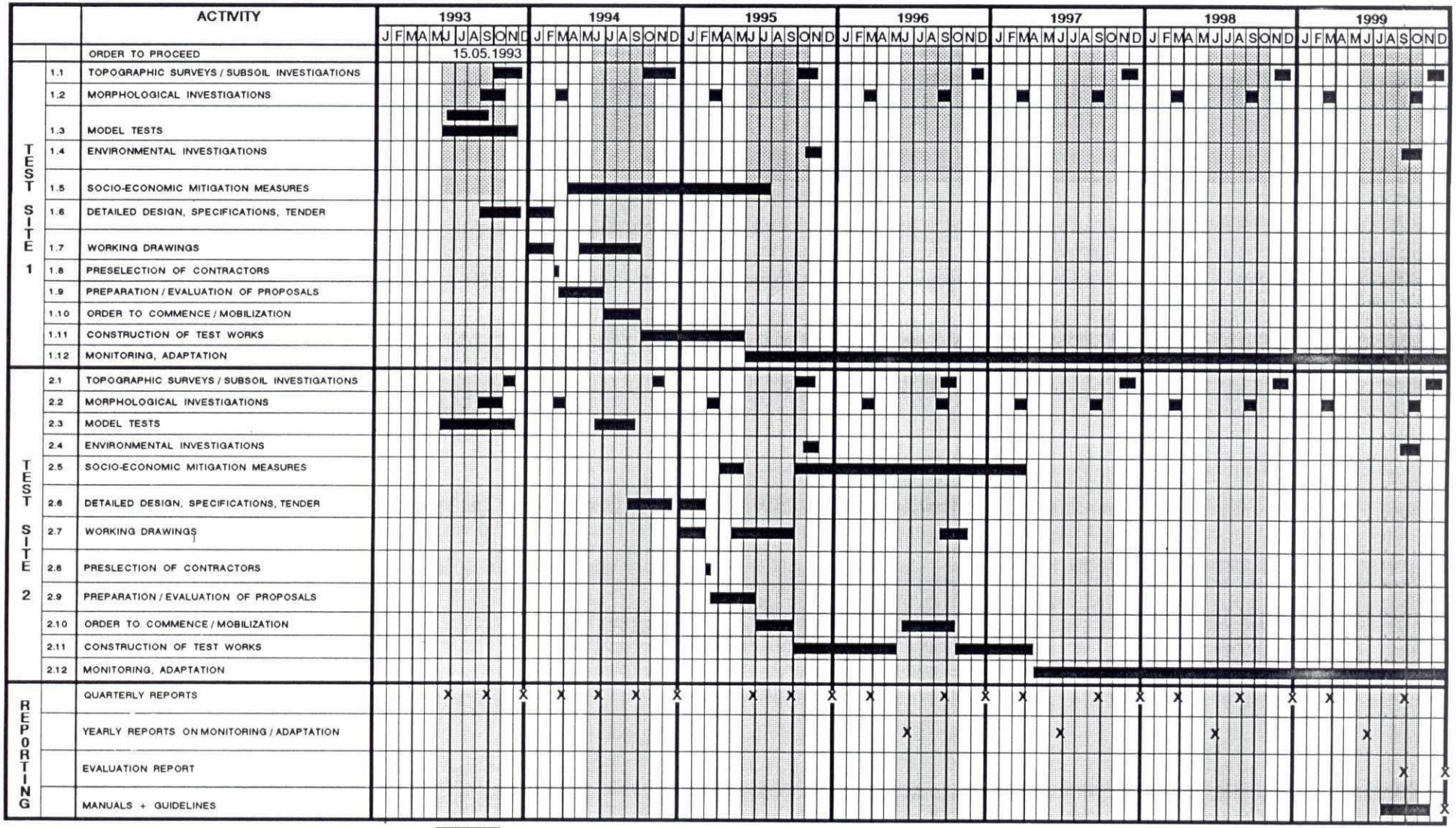


*) AS PER LETTER TO PROCEED OF MAY 1993

MONSOON

TABLE 1.2-1.2

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



*) AS PER PROPOSAL OF SEPTEMBER 1996

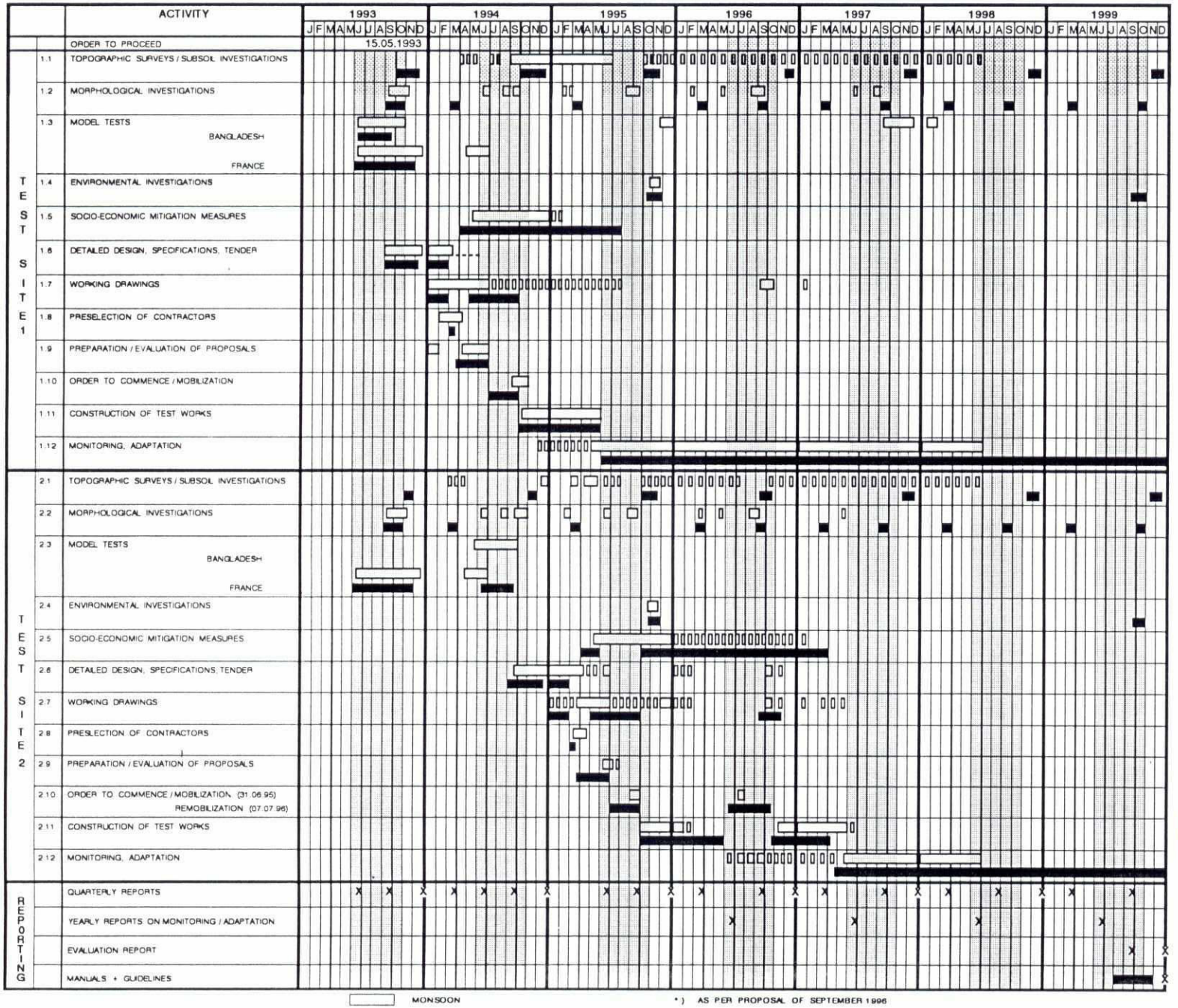
MONSOON

TABLE 1.2-2

BANK PROTECTION TEST STRUCTURES FAP 21

REVISION NO. 1 *)

WORK PLAN - FIELDED UP TO JUNE 30, 1998



*) AS PER PROPOSAL OF SEPTEMBER 1996

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

*) AS PER LETTER TO PROCEED OF MAY 1993

MONSOON — IN BANGLADESH — OUTSIDE BANGLADESH — LOCAL

62

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
	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	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	210	30	450	86

*) AS PER PROPOSAL OF 1995

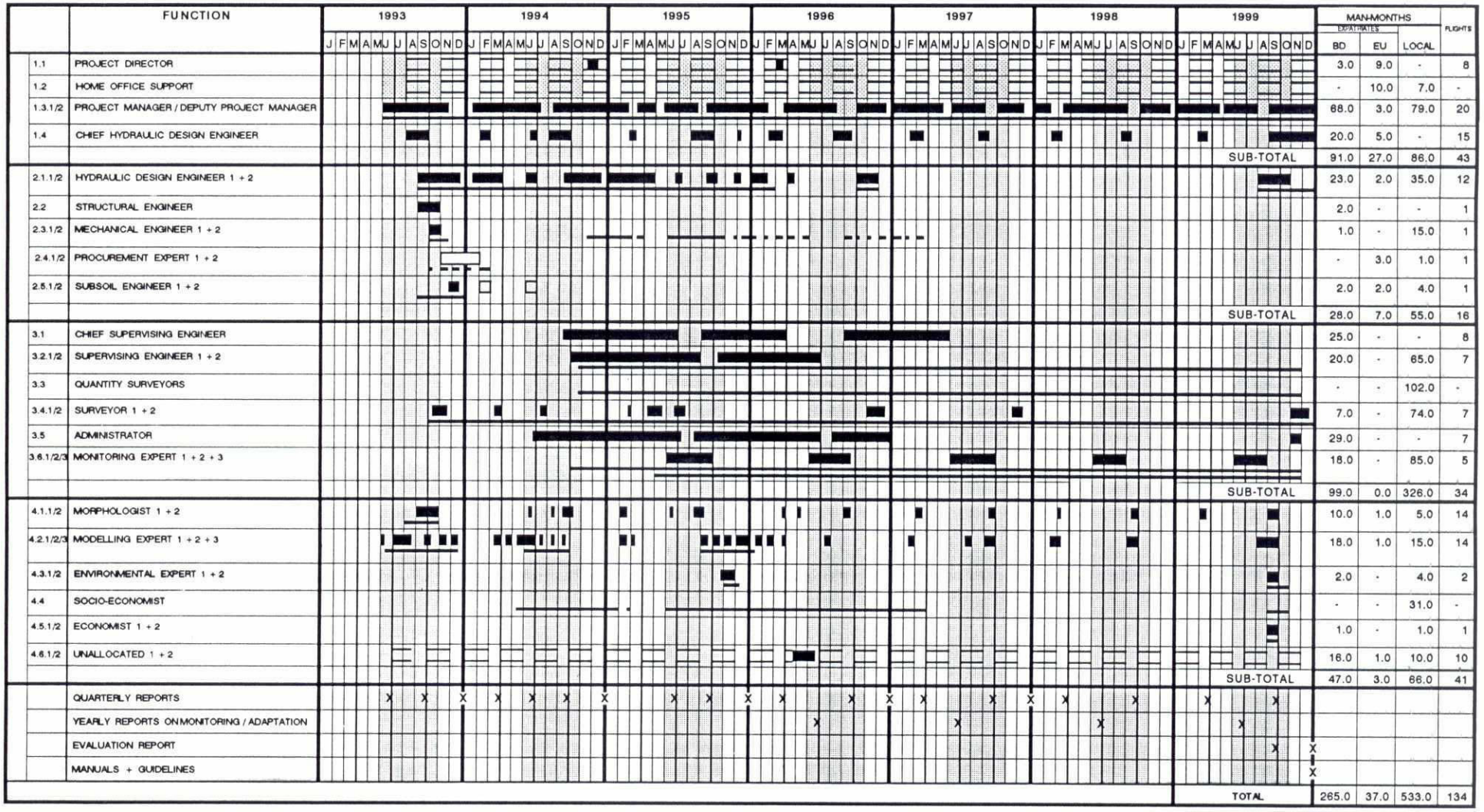
MONSOON | IN BANGLADESH | OUTSIDE BANGLADESH | LOCAL

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

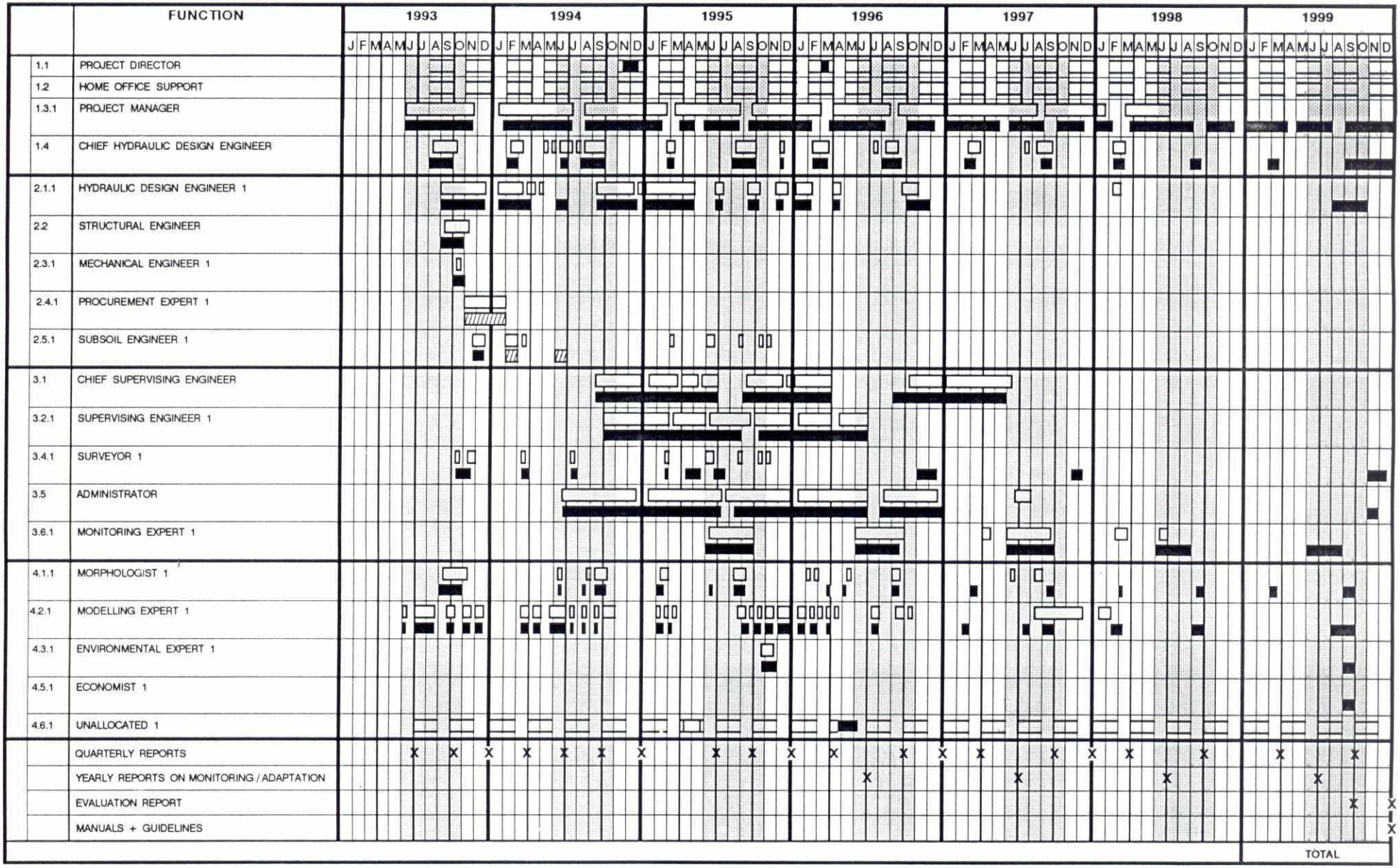
68

TABLE I . 2 - 4

BANK PROTECTION TEST STRUCTURES - FAP 21

REVISION NO. 2 *)

STAFFING SCHEDULE - EXPATRIATE PROFESSIONAL STAFF; FIELDED UP TO JUNE 30, 1998



*) AS PER PROPOSAL OF SEPTEMBER 1996

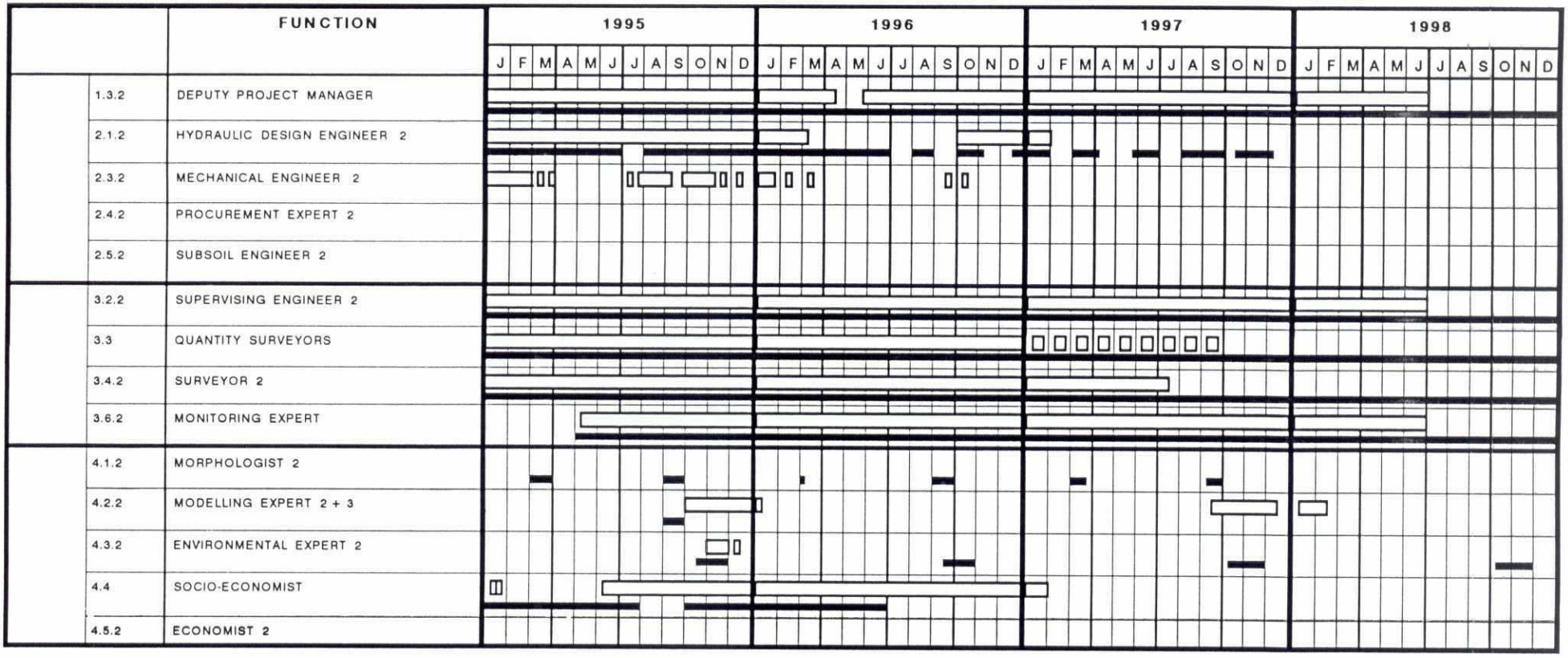
MONSOON IN BANGLADESH OUTSIDE BANGLADESH LOCAL PART TIME

TABLE 1. 2 - 5

BANK PROTECTION TEST STRUCTURES - FAP 21

REVISION NO. 2 *)

STAFFING SCHEDULE - LOCAL PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 1998



*) 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 04/98 to 06/98

VERSION : 09.06.98

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	01/04	18/04	
					29/05	20/06	
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 04/98 to 06/98

VERSION : 09.06.98

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	01/04	30/06	
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	01/04	30/06	50 % for FAP 21
	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

SL. NO.	ACTIVITY	1996				1997											
		Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	PRE-SELECTION	■	■														
2	VERIFICATION SURVEY		■														
3	FIELD CHECKS		■	■	■	■											
4	FIELD SELECTION		■	*	*	*											
5	DETAILED SURVEY		■	■													
6	FINAL DESIGN		■	■	■	■											
7	TENDERING			■	■												
8	CONSTRUCTION				■	■	■	■									
9	OPERATION AND MAINTENANCE							■	■	■	■	■	■	▮	▮	▮	▮
10	MONITORING AND EVALUATION							■	■	■	■	■	■	▮	▮	▮	▮

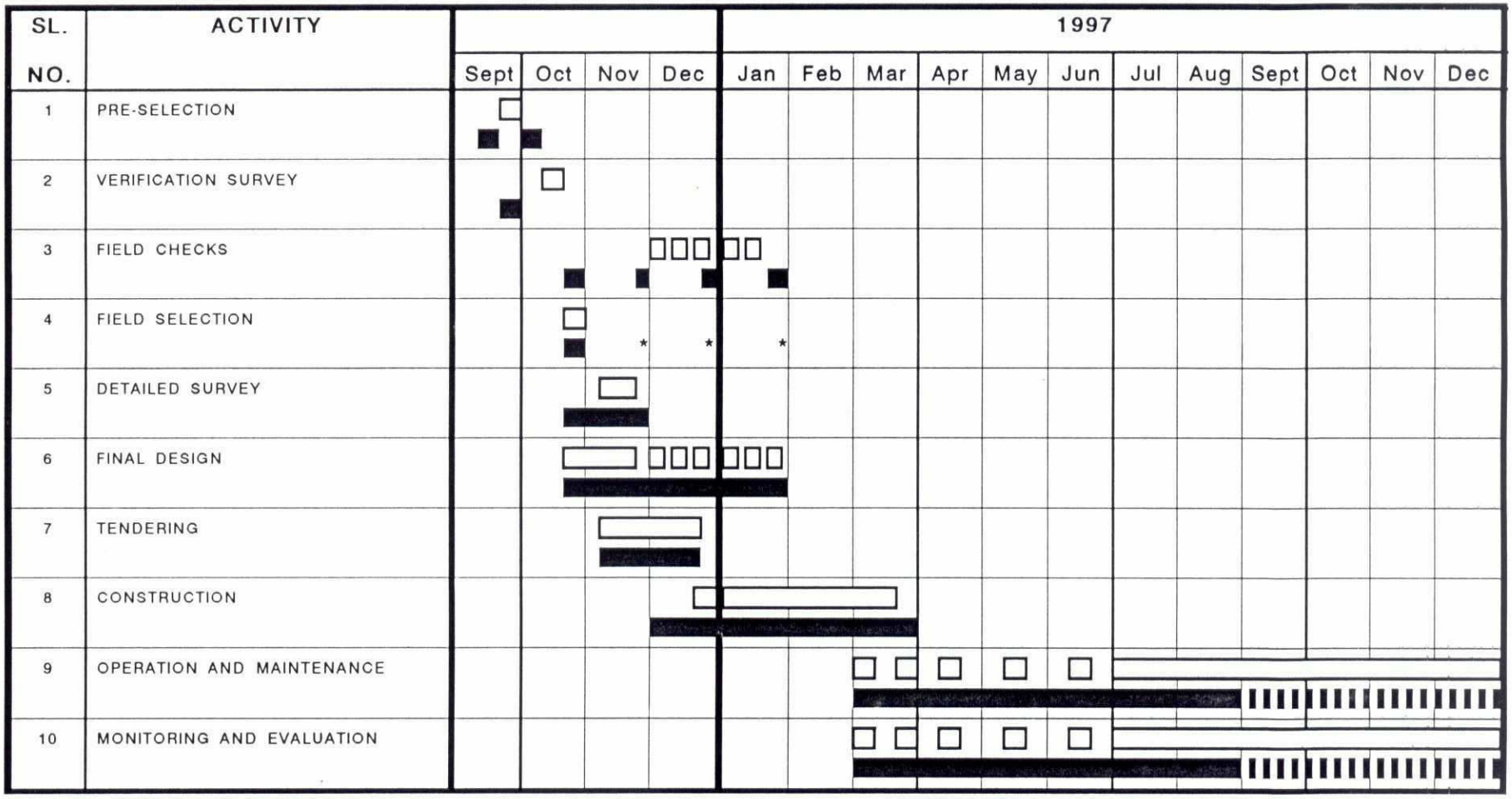
NOTE: * DENOTES REVIEW OF FINAL SELECTION

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 JUNE 30, 1998

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 2.2-5

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 1.3.2	PROJECT MANAGER * DEPUTY PROJECT MANAGER *	C. Netzeband 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 5.1.2	RIVER ENGINEER 1 RIVER ENGINEER 2	Pieter van Groen S. R. Khan				5.5		12.0	6
5.2	HYDRAULIC DESIGN ENGINEER	M. Schwarz				1.0	0.75		1
5.4.1 5.4.2	MORPHOLOGIST 1 * MORPHOLOGIST 2	Dr. E. Mosselman M. H. Sarker / NN				2.0		17.0	1
5.6.1	PROGRAMMER / MODELLING ENGINEER 1	J. Crebas				1.0			
5.8.1 5.8.2	SUPERVISING ENGINEER 1 SUPERVISING ENGINEER 2	K. Oberhagemann F. R. Khan				8.0	0.5	14.0	3
5.9.1 5.9.2	MONITORING EXPERT 1 MONITORING EXPERT 2	T. Döscher A. Haider / P.K. Maitra				2.0		14.0	2
5.11.1 5.11.2	UNALLOCATED 1 UNALLOCATED 2					3.0		2.0	3
					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

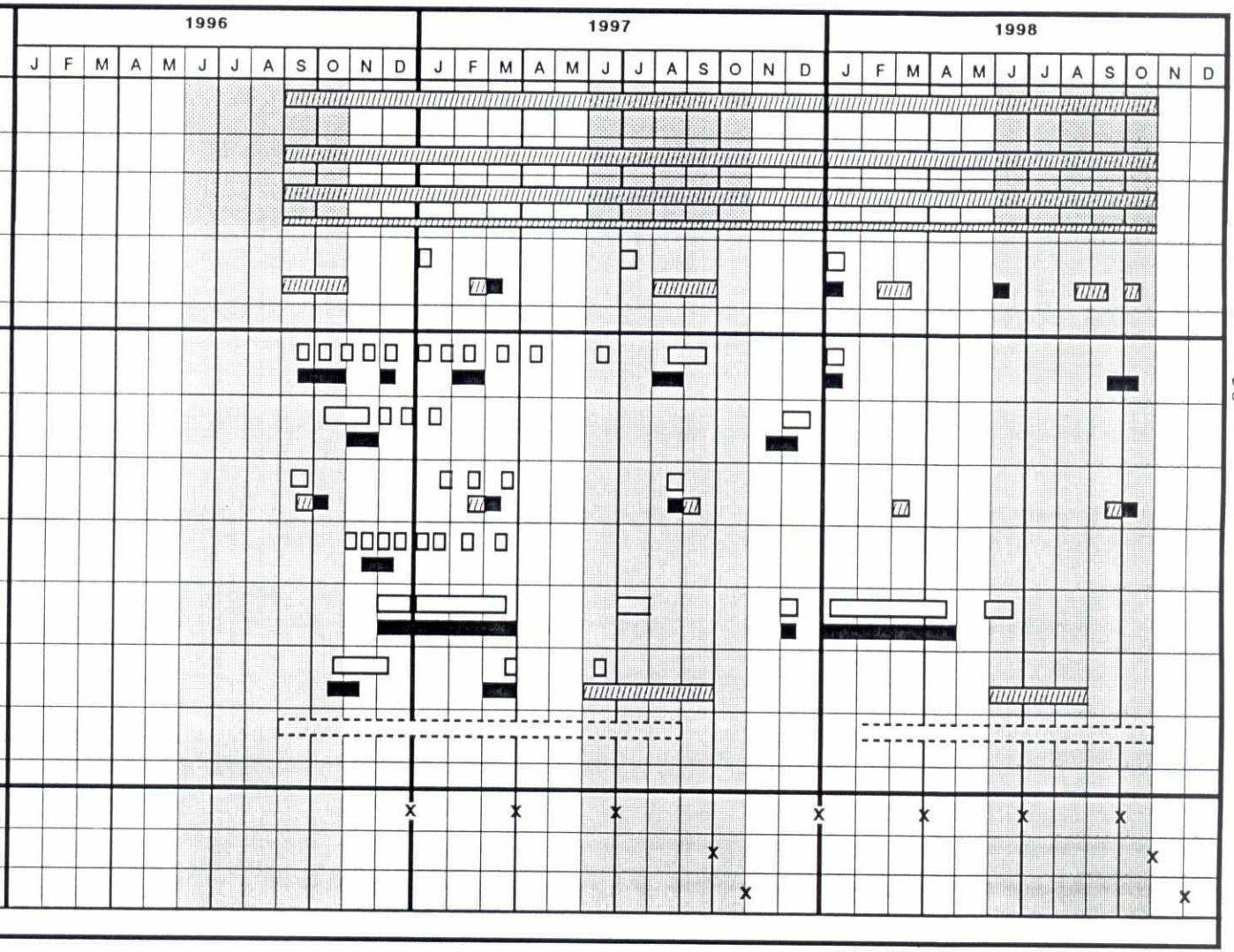
TABLE 2.2-6

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE *)

EXPATRIATE PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 1998

	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

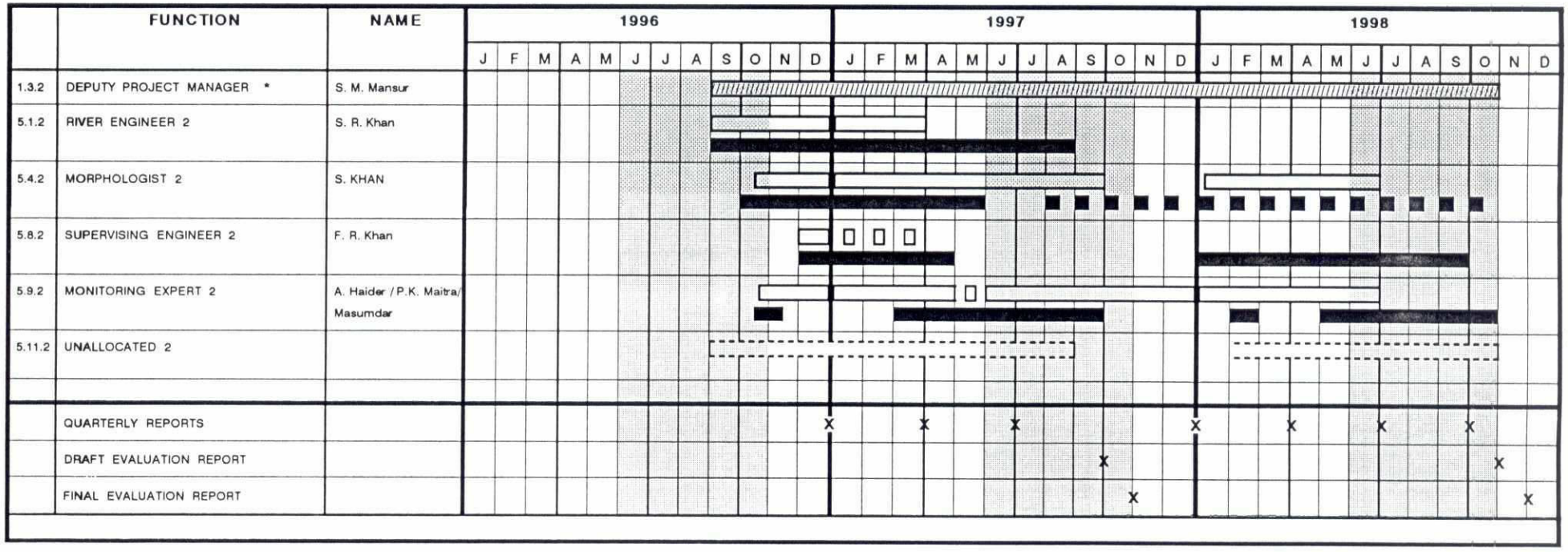
TABLE 2.2-7

STUDIES ON RECURRENT MEASURES - FAP 22

STAFFING SCHEDULE *)

LOCAL PROFESSIONAL STAFF - FIELDED UP TO JUNE 30, 1998

	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 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	16.280	16.330	16.370	
2	16.450	16.460	16.470	
3	16.430	16.410	16.400	
4	16.300	16.270	16.260	
5	16.190	16.160	16.140	
6	16.090	16.080	16.070	
7	16.060	16.060	16.050	
8	16.000	15.990	15.990	
9	15.890	15.880	15.860	
10	15.840	15.840	15.840	
11	15.840	15.840	15.840	
12	15.830	15.830	15.820	
13	15.800	15.800	15.790	
14	15.760	15.760	15.750	
15	15.750	15.760	15.760	
16	15.790	15.800	15.810	
17	15.850	15.870	15.890	
18	15.970	16.000	16.020	
19	16.090	16.110	16.130	
20	16.240	16.270	16.310	
21	16.440	16.480	16.510	
22	16.590	16.590	16.590	
23	16.590	16.570	16.550	
24	16.470	16.450	16.440	
25	16.410	16.400	16.390	
26	16.370	16.370	16.370	
27	16.380	16.390	16.400	
28	16.430	16.440	16.450	
29	16.500	16.520	16.540	
30	16.620	16.640	16.650	

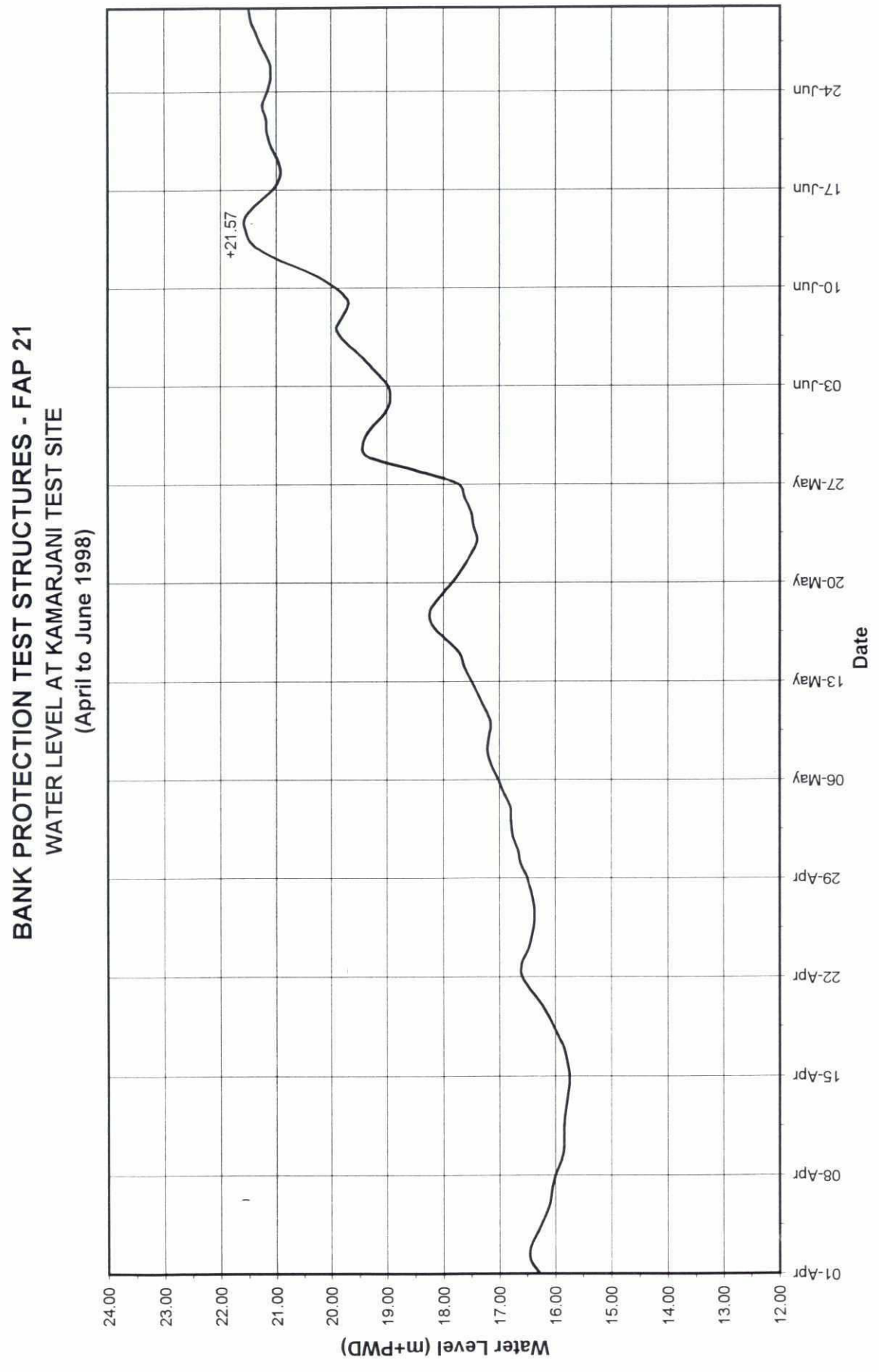
87

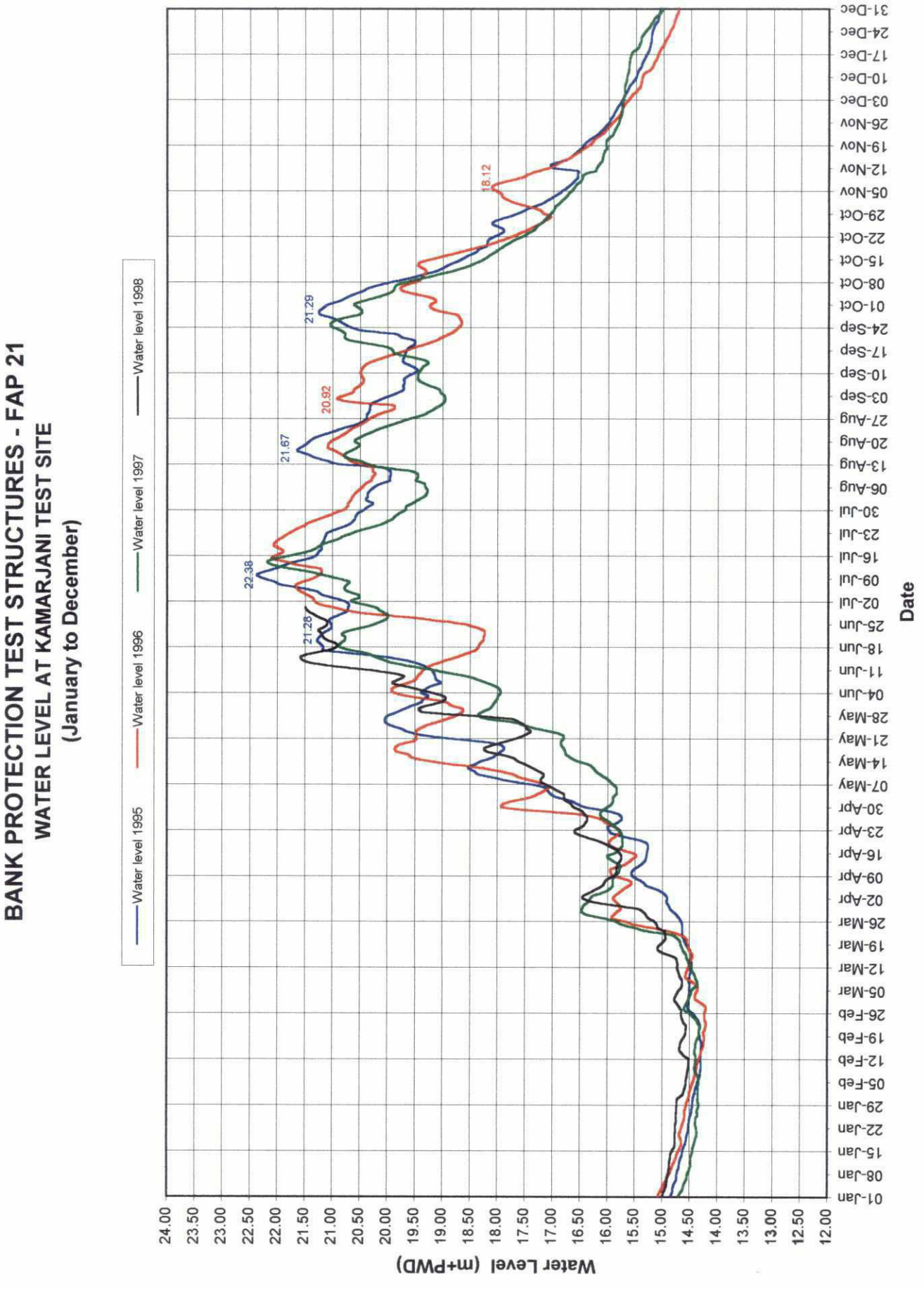
BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
MONTH : MAY 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	16.670	16.680	16.690	
2	16.770	16.780	16.790	
3	16.790	16.780	16.780	
4	16.800	16.820	16.830	
5	16.920	16.940	16.960	
6	17.030	17.050	17.070	
7	17.150	17.180	17.200	
8	17.220	17.220	17.210	
9	17.190	17.190	17.170	
10	17.160	17.160	17.170	
11	17.260	17.280	17.310	
12	17.380	17.400	17.410	
13	17.500	17.540	17.550	
14	17.630	17.640	17.660	
15	17.720	17.760	17.790	
16	17.970	18.020	18.070	
17	18.200	18.220	18.230	
18	18.240	18.200	18.170	
19	18.060	18.030	18.000	
20	17.840	17.820	17.780	
21	17.660	17.620	17.600	
22	17.510	17.480	17.450	
23	17.400	17.390	17.380	
24	17.470	17.490	17.490	
25	17.510	17.510	17.520	
26	17.620	17.630	17.640	
27	17.740	17.780	17.860	
28	18.520	18.740	18.930	
29	19.370	19.430	19.470	
30	19.430	19.410	19.390	
31	19.280	19.230	19.180	

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
MONTH : JUNE 1998

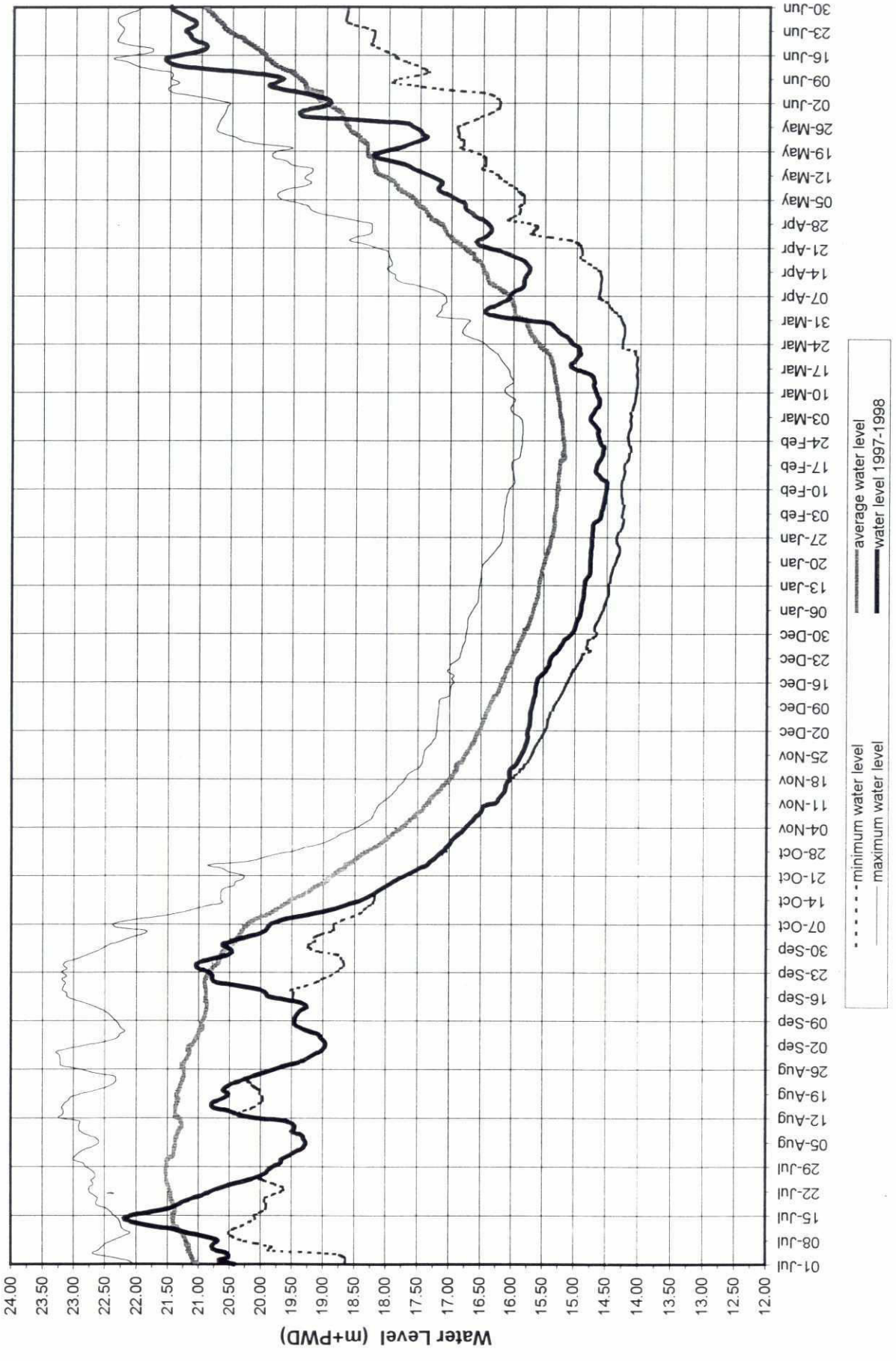
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	19.040	19.010	18.980	
2	18.940	18.930	18.930	
3	18.980	19.040	19.090	
4	19.210	19.260	19.300	
5	19.450	19.530	19.610	
6	19.730	19.750	19.790	
7	19.910	19.890	19.870	
8	19.790	19.760	19.730	
9	19.700	19.720	19.760	
10	19.930	19.990	20.080	
11	20.380	20.530	20.630	
12	20.980	21.080	21.180	
13	21.410	21.450	21.480	
14	21.550	21.590	21.690	
15	21.570	21.530	21.480	
16	21.340	21.290	21.240	
17	21.070	21.010	20.990	
18	20.930	20.940	20.960	
19	20.940	20.990	21.020	
20	21.090	21.120	21.160	
21	21.170	21.170	21.160	
22	21.190	21.220	21.240	
23	21.260	21.260	21.230	
24	21.160	21.140	21.140	
25	21.100	21.090	21.090	
26	21.120	21.150	21.180	
27	21.240	21.270	21.300	
28	21.350	21.370	21.390	
29	21.460	21.470	21.480	
30	21.500	21.490	21.510	


BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT KAMARJANI TEST SITE
(April to June 1998)
+21.57
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
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 (m+PWD)
Date
22.38
21.28
21.67
20.92
21.29
18.12

BANK PROTECTION TEST STRUCTURES - FAP 21

BWDB WATER LEVEL FREQUENCY CURVES VERSUS ACTUAL FAP 21 WATER LEVEL AT KAMARJANI TEST SITE UP TO JUNE '98

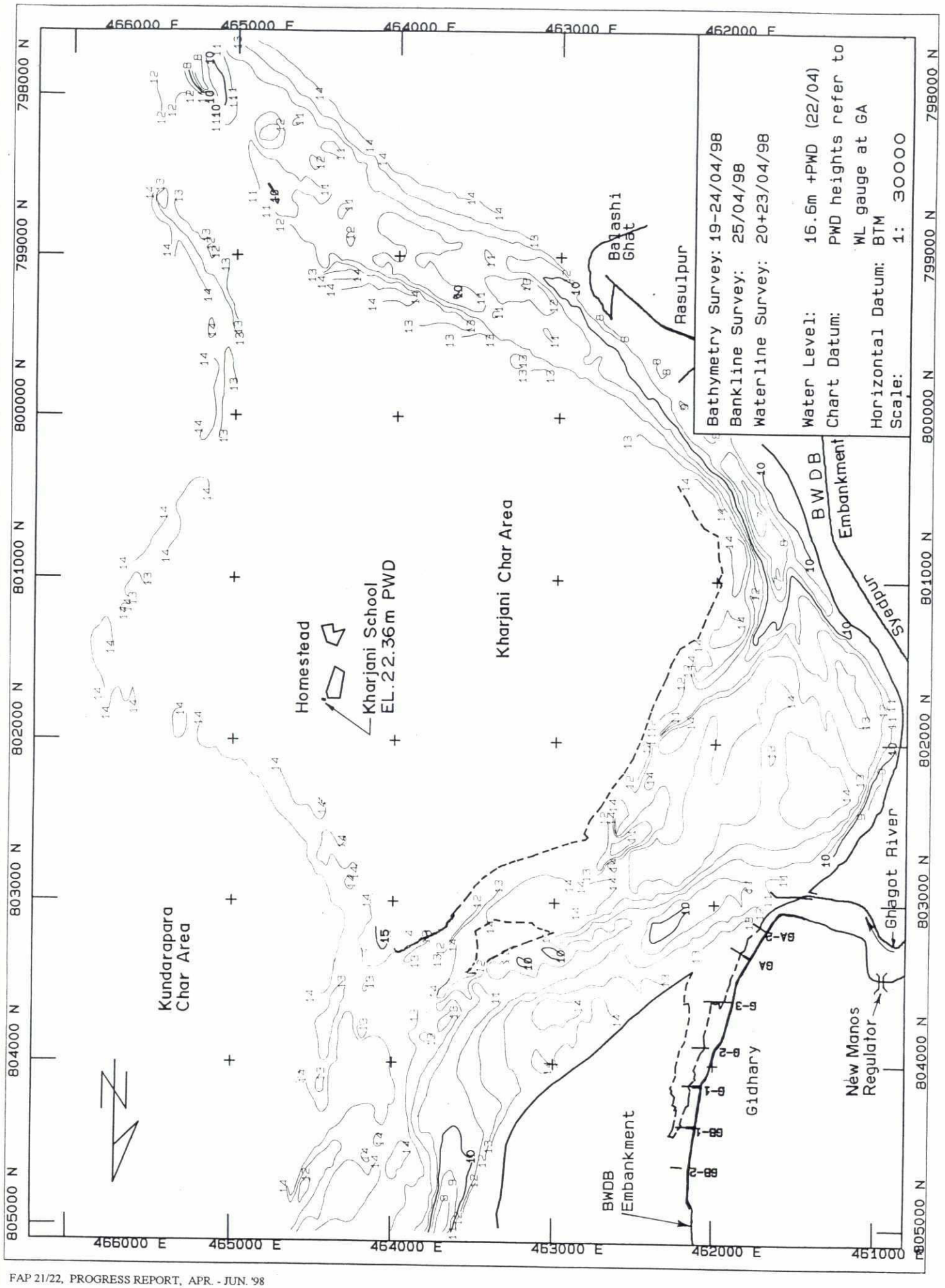


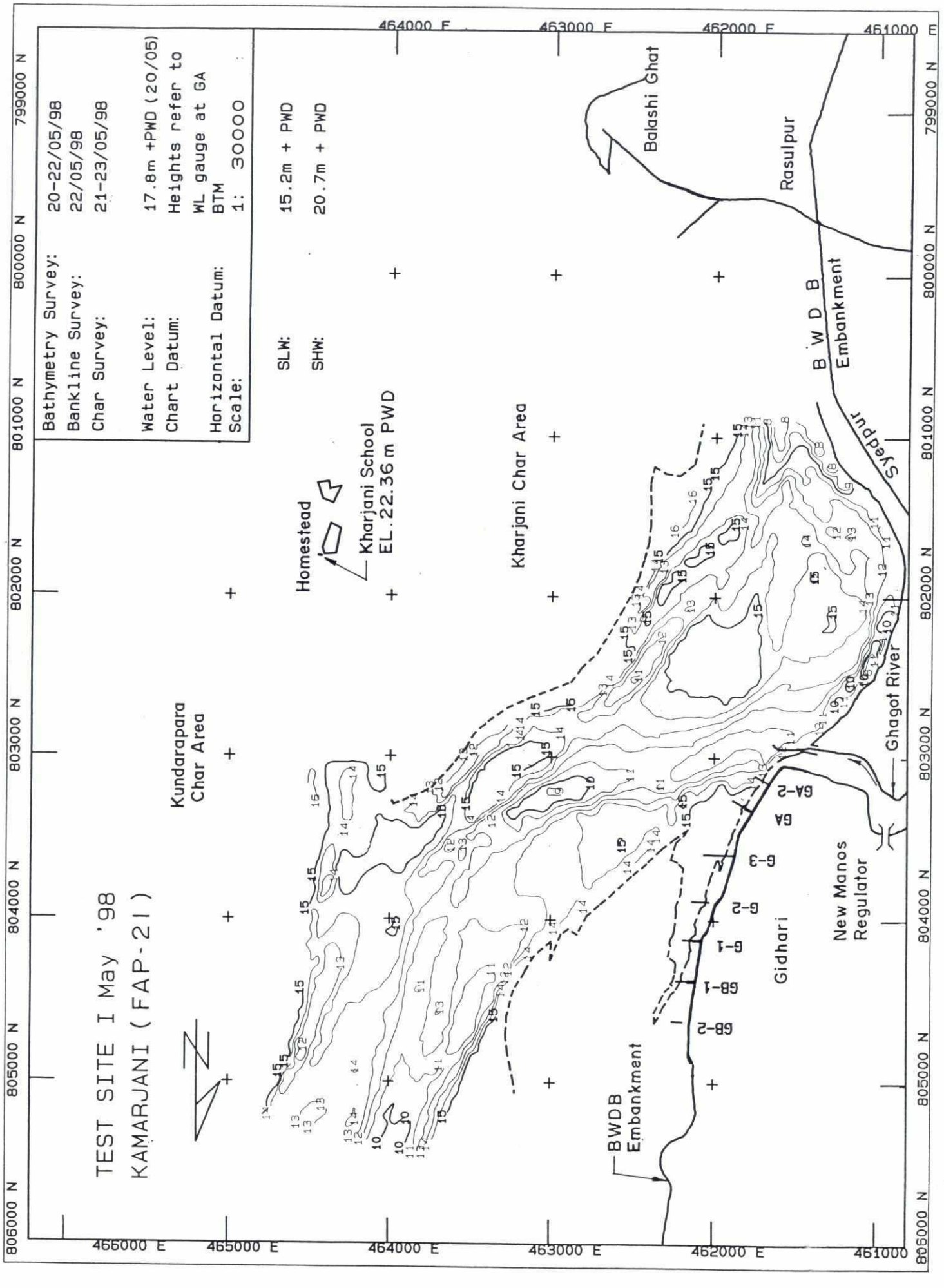
BWDB Data: Period of Record 1957 ~ 1997

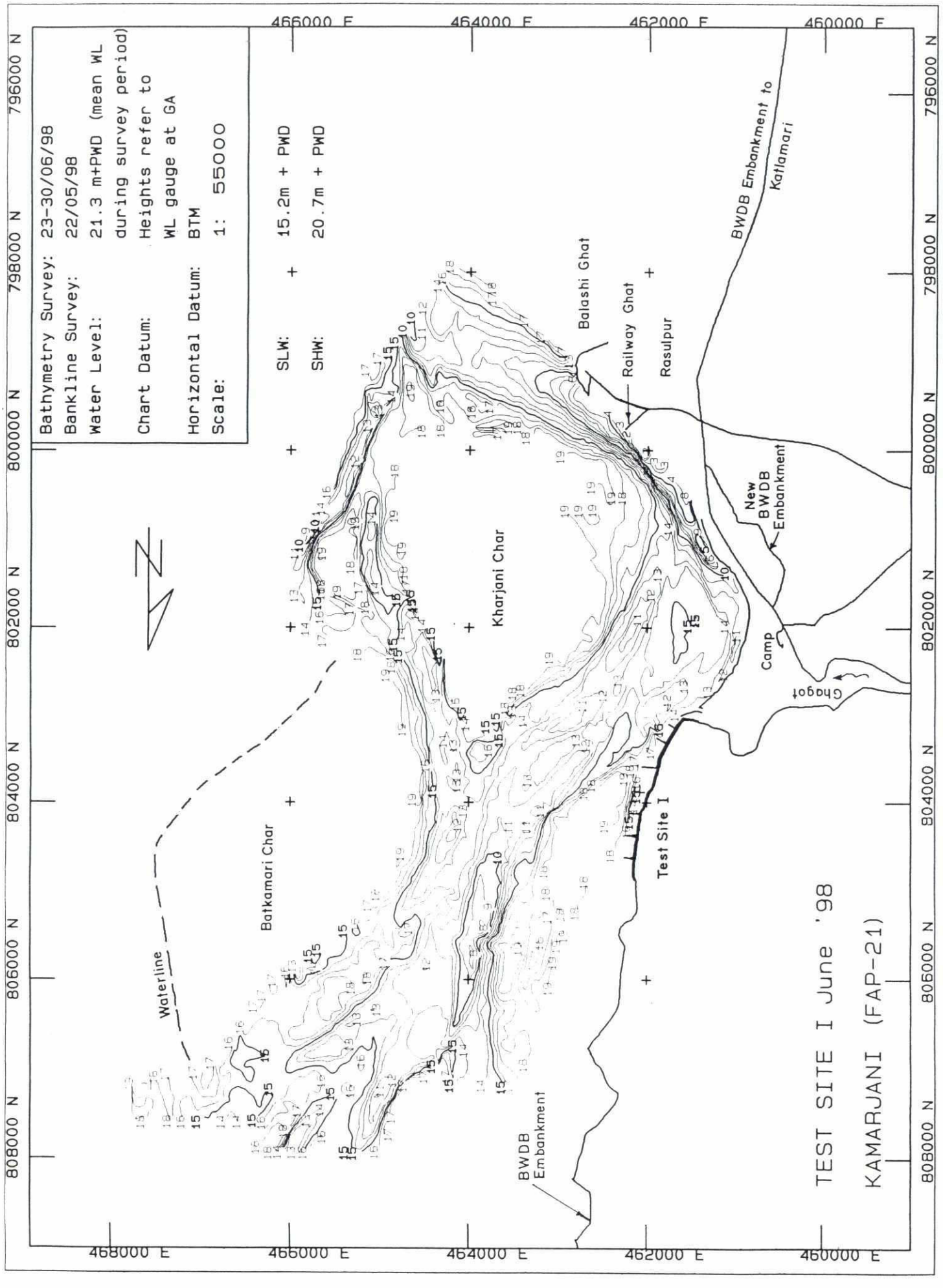
ANNEX B

FAP 21 / Test Site I

- Bathymetric Survey


Bathymetry Survey: 19-24/04/98
Bankline Survey: 25/04/98
Waterline Survey: 20+23/04/98
Water Level: 16.6m +PWD (22/04)
Chart Datum: PWD heights refer to WL gauge at GA
Horizontal Datum: BTM
Scale: 1: 30000
Kundarapara Char Area
Kharjani Char Area
Homestead
Kharjani School EL.22.36m PWD
Balashi Ghat
Rasulpur
BWDB Embankment
Syedpur
Ghagot River
New Manos Regulator
Gidhary
BWDB Embankment
466000 E
465000 E
464000 E
463000 E
462000 E
461000 E
805000 N
804000 N
803000 N
802000 N
801000 N
800000 N
799000 N
798000 N

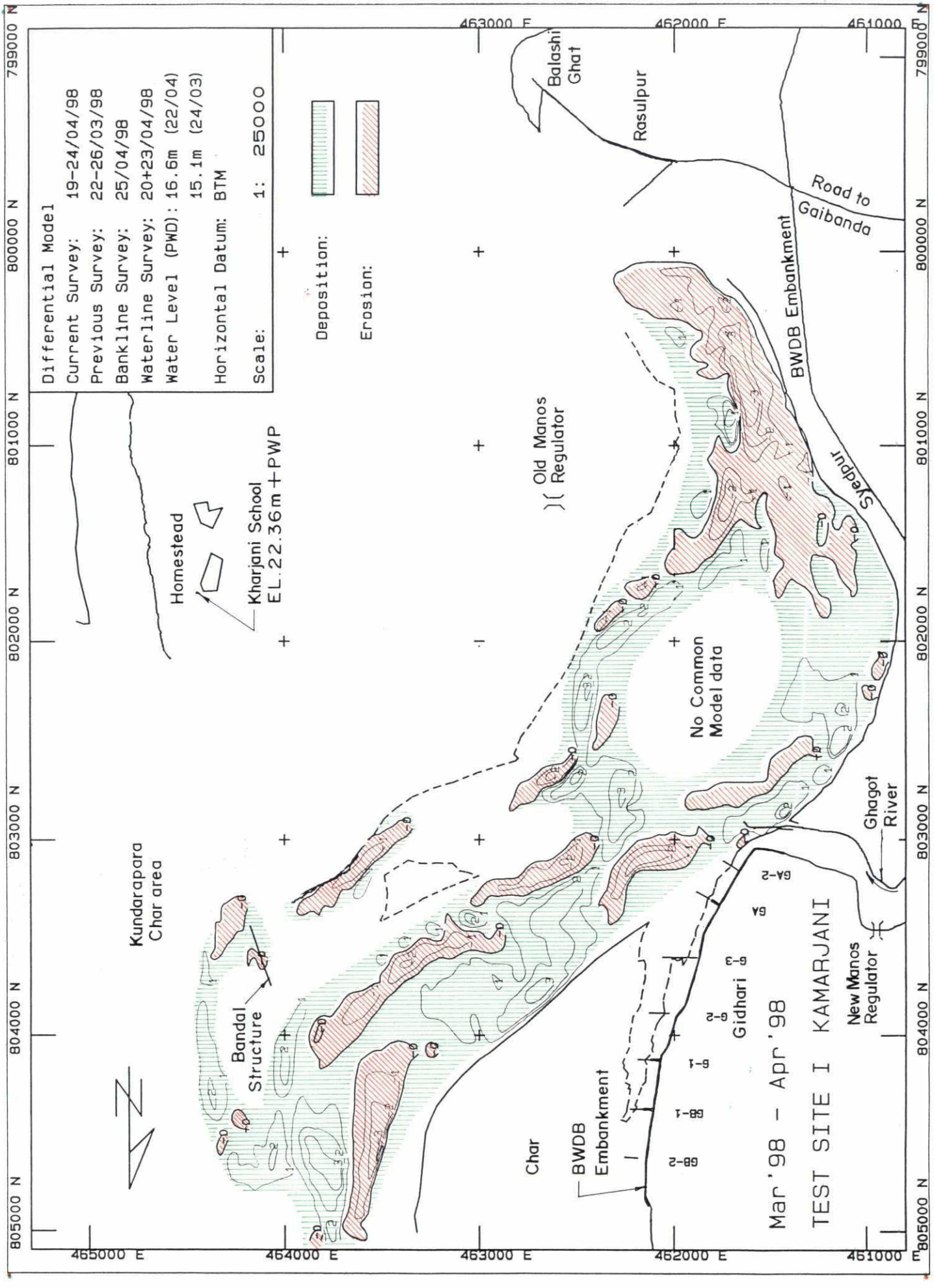

TEST SITE I May '98
KAMARJANI (FAP-21)
Bathymetry Survey: 20-22/05/98
Bankline Survey: 22/05/98
Char Survey: 21-23/05/98
Water Level: 17.8m +PWD (20/05)
Chart Datum: Heights refer to WL gauge at GA
Horizontal Datum: BTM
Scale: 1: 30000
SLW: 15.2m + PWD
SHW: 20.7m + PWD
Kundarapara Char Area
Kharjani Char Area
Homestead
Kharjani School EL.22.36 m PWD
Balashi Ghat
Rasulpur
B W D B Embankment
Syedpur
Ghagot River
New Manos Regulator
Gidhari
GA-2
GA
G-3
G-2
G-1
GB-1
GB-2
BWDB Embankment
799000 N
800000 N
801000 N
802000 N
803000 N
804000 N
805000 N
806000 N
464000 E
463000 E
462000 E
461000 E
466000 E
465000 E

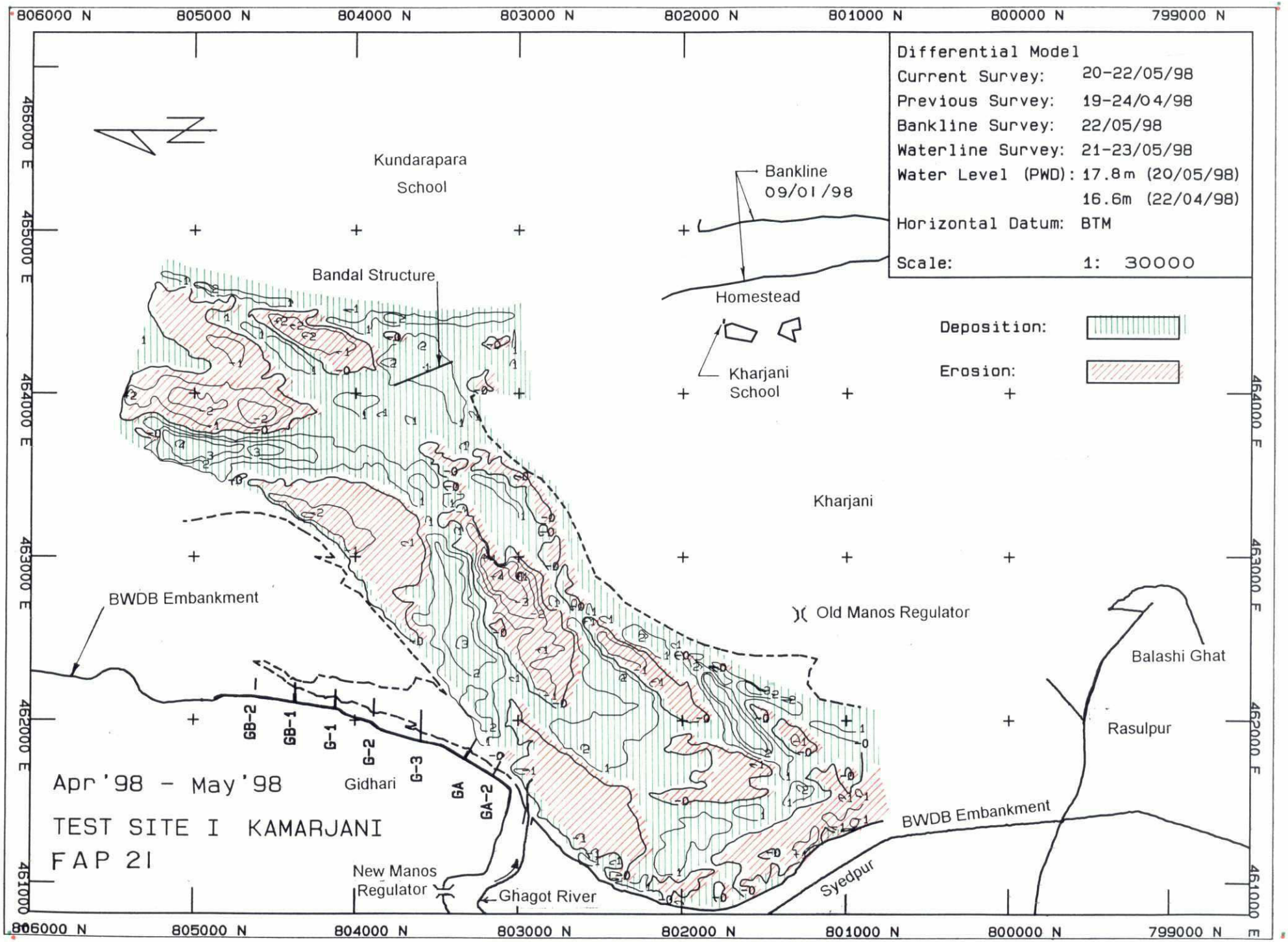

Bathymetry Survey: 23-30/06/98
Bankline Survey: 22/05/98
Water Level: 21.3 m+PWD (mean WL during survey period)
Chart Datum: Heights refer to WL gauge at GA
Horizontal Datum: BTM
Scale: 1: 55000
SLW: 15.2m + PWD
SHW: 20.7m + PWD
466000 E
464000 E
462000 E
460000 E
796000 N
798000 N
800000 N
802000 N
804000 N
806000 N
808000 N
Waterline
Batkamari Char
Kharjani Char
Balashi Ghat
Railway Ghat
Rasulpur
BWDB Embankment to Katlamari
New BWDB Embankment
Camp
Ghagot
Test Site I
BWDB Embankment
TEST SITE I June '98
KAMARJANI (FAP-21)

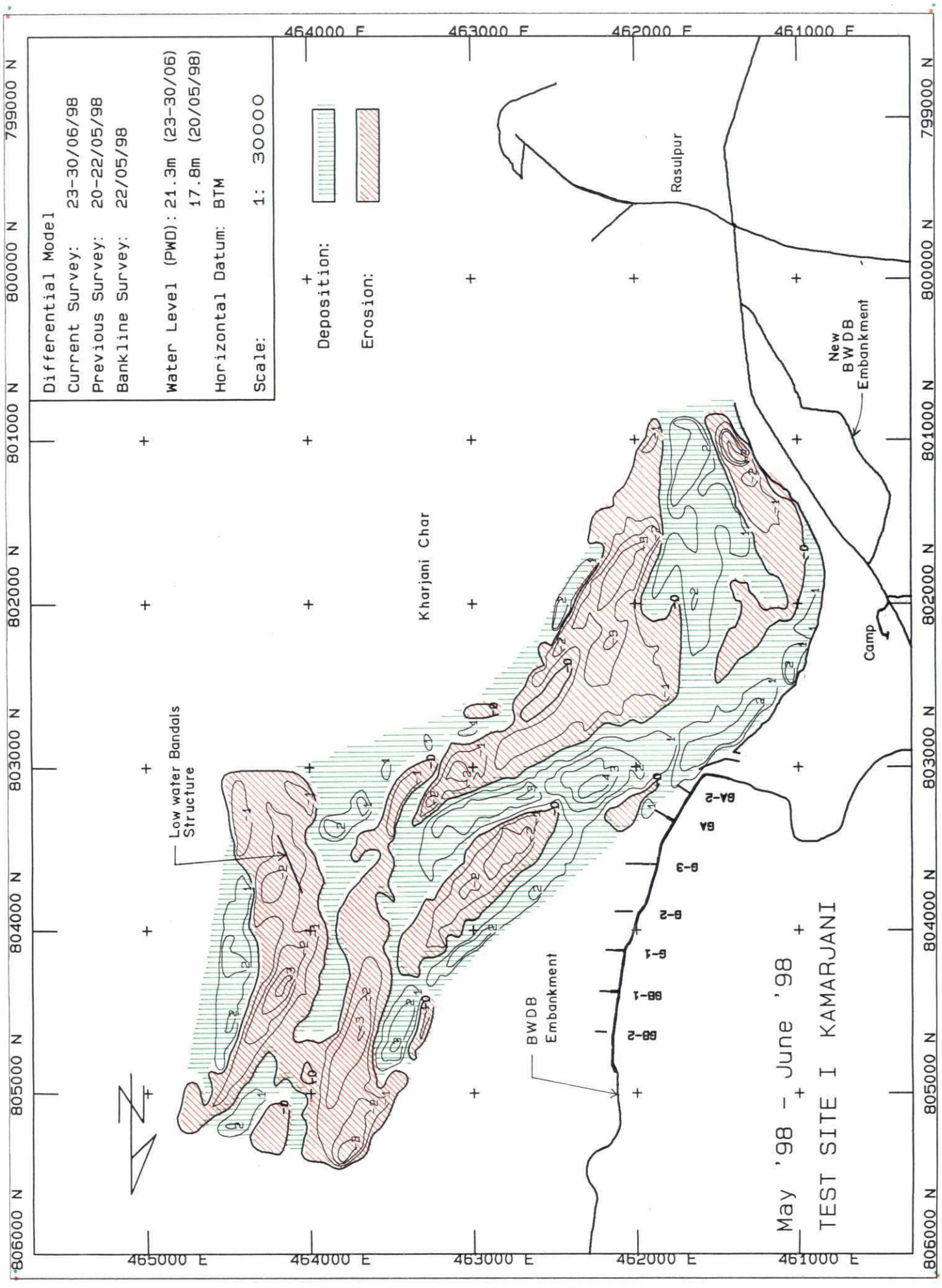
ANNEX C

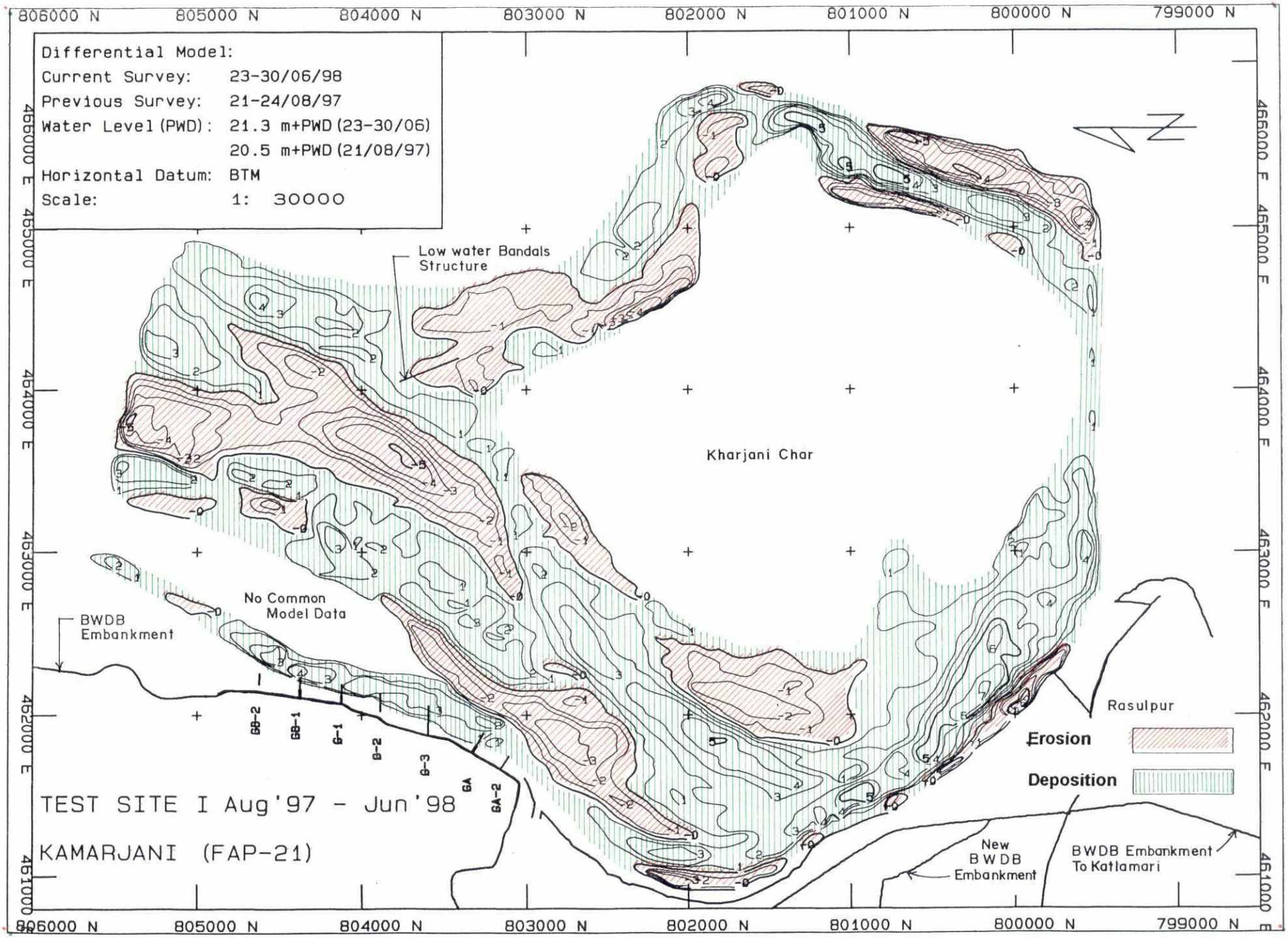
FAP 21 / Test Site I

- Differential Model


Differential Model
Current Survey: 19-24/04/98
Previous Survey: 22-26/03/98
Bankline Survey: 25/04/98
Waterline Survey: 20+23/04/98
Water Level (PWD): 16.6m (22/04)
15.1m (24/03)
Horizontal Datum: BTM
Scale: 1: 25000
Deposition:
Erosion:
Balashi Ghat
Rasulpur
Road to Gaibanda
BWDB Embankment
Shyadpur
Old Manos Regulator
Homestead
Kharjani School EL.22.36m+PWP
No Common Model data
Kundarapara Char area
Bandal Structure
Char
BWDB Embankment
Gidhari
Ghagot River
New Manos Regulator
TEST SITE I KAMARJANI
Mar'98 - Apr'98
GA-2
GA
G-3
G-2
G-1
GB-1
GB-2
799000 N
800000 N
801000 N
802000 N
803000 N
804000 N
805000 N
465000 E
464000 E
463000 E
462000 E
461000 E


806000 N
805000 N
804000 N
803000 N
802000 N
801000 N
800000 N
799000 N
466000 E
465000 E
464000 E
463000 E
462000 E
461000 E
Differential Model
Current Survey: 20-22/05/98
Previous Survey: 19-24/04/98
Bankline Survey: 22/05/98
Waterline Survey: 21-23/05/98
Water Level (PWD): 17.8m (20/05/98)
16.6m (22/04/98)
Horizontal Datum: BTM
Scale: 1: 30000
Deposition:
Erosion:
Kundarapara School
Bankline 09/01/98
Homestead
Bandal Structure
Kharjani School
Kharjani
BWDB Embankment
Old Manos Regulator
Balashi Ghat
Rasulpur
GB-2
GB-1
G-1
G-2
G-3
GA
GA-2
Gidhari
Apr'98 - May'98
TEST SITE I KAMARJANI
FAP 21
New Manos Regulator
Ghagot River
Syedpur
BWDB Embankment

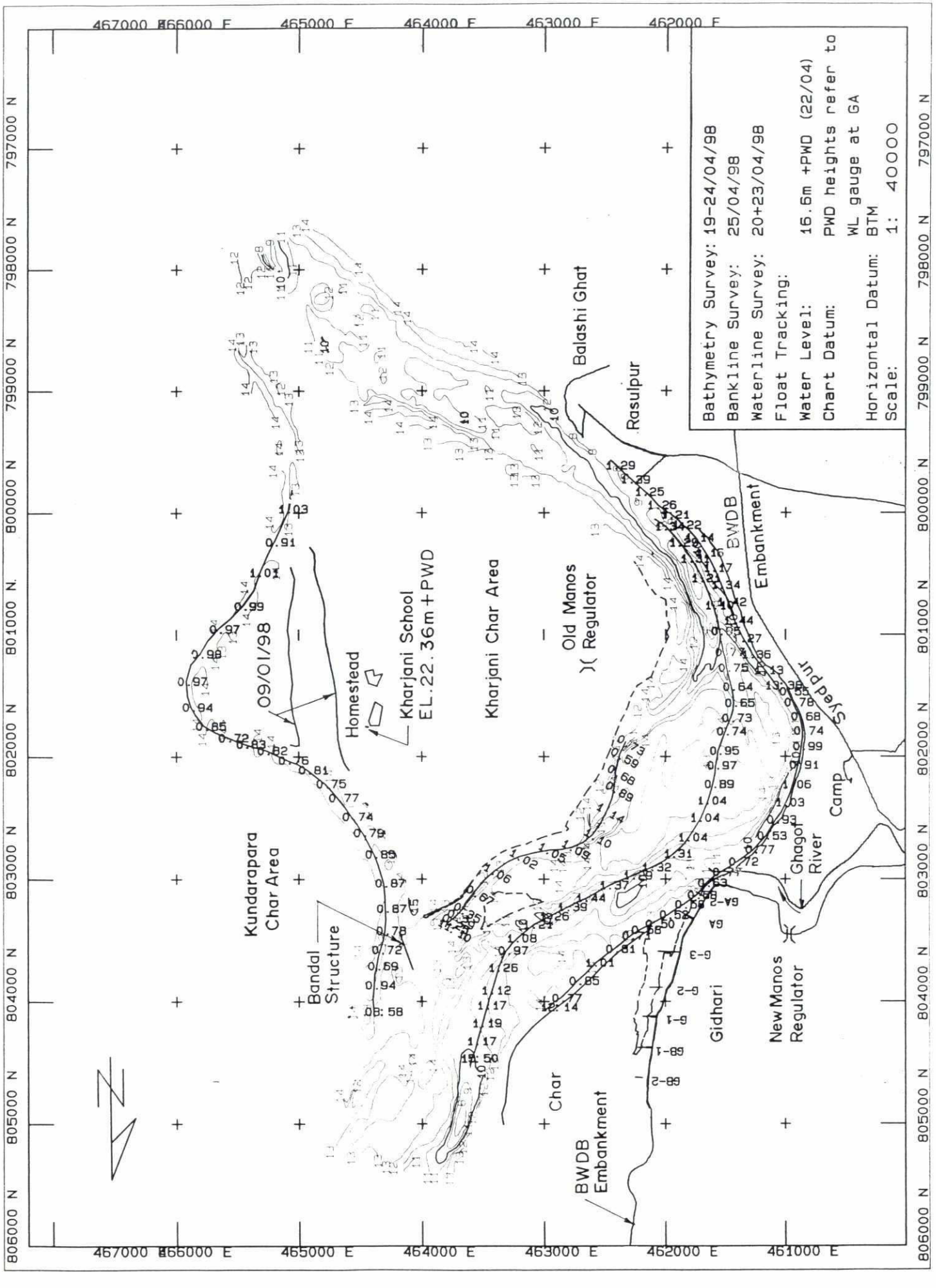

Differential Model
Current Survey: 23-30/06/98
Previous Survey: 20-22/05/98
Bankline Survey: 22/05/98
Water Level (PWD): 21.3m (23-30/06)
17.8m (20/05/98)
Horizontal Datum: BTM
Scale: 1: 30000
Deposition:
Erosion:
Rasulpur
New BWDB Embankment
Khorjani Char
Low water Bandals Structure
BWDB Embankment
Camp
BA-2
BA
B-3
B-2
B-1
BB-1
BB-2
May '98 - June '98
TEST SITE I KAMARJANI
464000 E
463000 E
462000 E
461000 E
465000 E
806000 N
805000 N
804000 N
803000 N
802000 N
801000 N
800000 N
799000 N

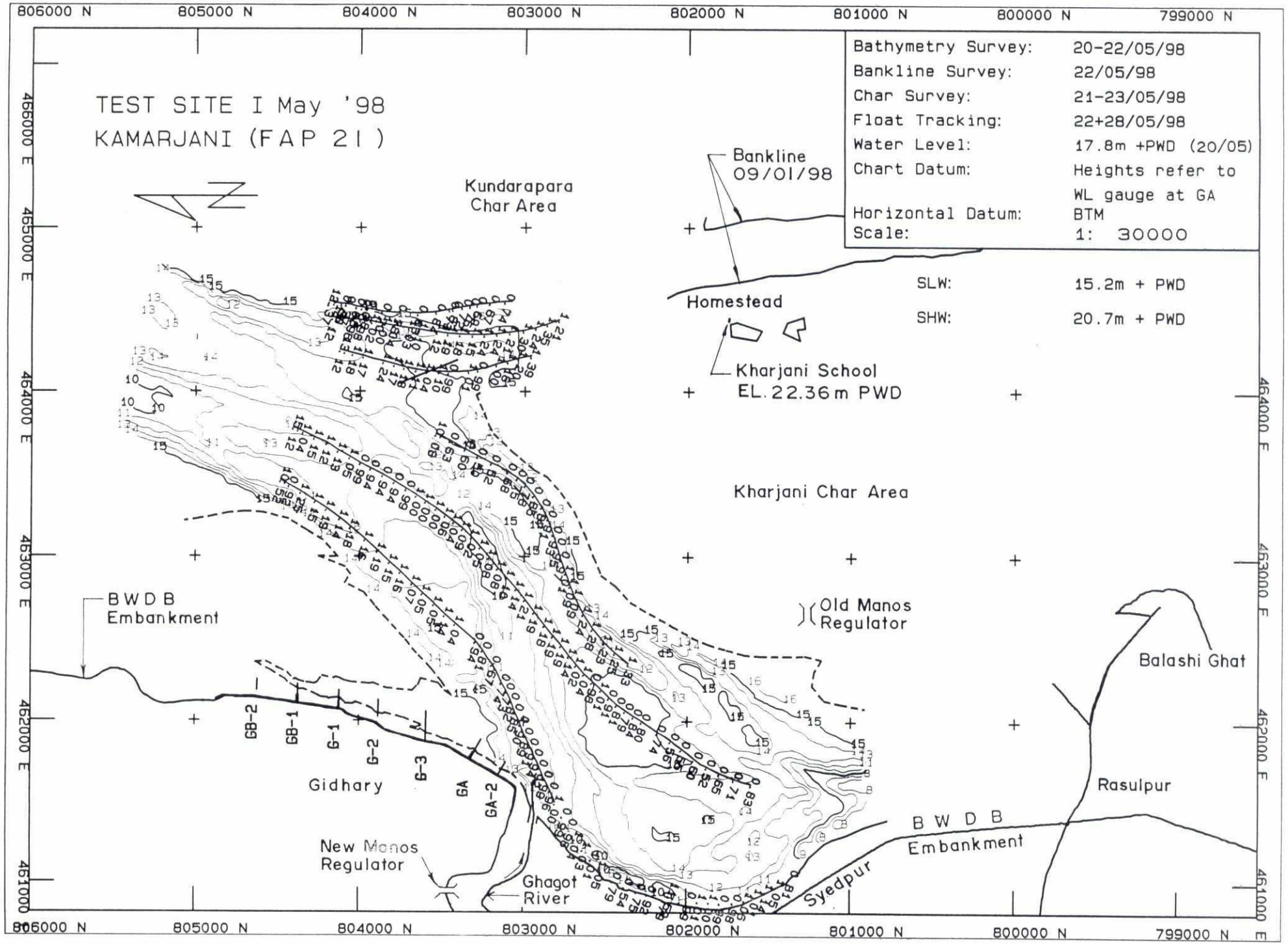

Differential Model:
Current Survey: 23-30/06/98
Previous Survey: 21-24/08/97
Water Level (PWD): 21.3 m+PWD (23-30/06)
20.5 m+PWD (21/08/97)
Horizontal Datum: BTM
Scale: 1: 30000
806000 N
805000 N
804000 N
803000 N
802000 N
801000 N
800000 N
799000 N
465000 E
464000 E
463000 E
462000 E
461000 E
466000 E
465000 E
464000 E
463000 E
462000 E
461000 E
Low water Bandals Structure
Kharjani Char
No Common Model Data
BWDB Embankment
GB-2
GB-1
G-1
G-2
G-3
GA
GA-2
Rasulpur
Erosion
Deposition
New BWDB Embankment
BWDB Embankment To Katlamari
TEST SITE I Aug'97 - Jun'98
KAMARJANI (FAP-21)

ANNEX D

FAP 21 / Test Site I

- Flow Velocities


Bathymetry Survey: 19-24/04/98
Bankline Survey: 25/04/98
Waterline Survey: 20+23/04/98
Float Tracking:
Water Level: 16.6m +PWD (22/04)
Chart Datum: PWD heights refer to WL gauge at GA
Horizontal Datum: BTM
Scale: 1: 40000
09/01/98
Homestead
Kharjani School EL.22.36m+PWD
Kharjani Char Area
Old Manos)(Regulator
BWDB Embankment
Balashi Ghat
Rasulpur
Syedpur
Camp
Ghagor River
Kundarapara Char Area
Bandal Structure
Gidhari
New Manos Regulator
Char
BWDB Embankment
467000 E
466000 E
465000 E
464000 E
463000 E
462000 E
461000 E
797000 N
798000 N
799000 N
800000 N
801000 N
802000 N
803000 N
804000 N
805000 N
806000 N


TEST SITE I May '98
KAMARJANI (FAP 21)
Bathymetry Survey: 20-22/05/98
Bankline Survey: 22/05/98
Char Survey: 21-23/05/98
Float Tracking: 22+28/05/98
Water Level: 17.8m +PWD (20/05)
Chart Datum: Heights refer to WL gauge at GA
Horizontal Datum: BTM
Scale: 1: 30000
SLW: 15.2m + PWD
SHW: 20.7m + PWD
Bankline 09/01/98
Kundarapara Char Area
Homestead
Kharjani School EL. 22.36 m PWD
Kharjani Char Area
BWDB Embankment
Old Manos Regulator
Balashi Ghat
Rasulpur
BWDB Embankment
Syedpur
Gidhary
GB-2
GB-1
G-1
G-2
G-3
GA
GA-2
New Manos Regulator
Ghagot River
806000 N
805000 N
804000 N
803000 N
802000 N
801000 N
800000 N
799000 N
466000 E
465000 E
464000 E
463000 E
462000 E
461000 E

ANNEX E

FAP 21 / Test Site II

- Water Level

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
MONTH : APRIL 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	14.600	14.600	14.720	
2	14.790	14.800	14.800	
3	14.780	14.780	14.730	
4	14.660	14.660	14.660	
5	14.530	14.530	14.490	
6	14.430	14.390	14.390	
7	14.370	14.370	14.370	
8	14.320	14.280	14.280	
9	14.240	14.240	14.240	
10	14.140	14.140	14.140	
11	14.140	14.140	14.140	
12	14.120	14.120	14.120	
13	14.120	14.120	14.120	
14	14.070	14.070	14.070	
15	14.050	14.050	14.050	
16	14.080	14.080	14.080	
17	14.140	14.140	14.140	
18	14.260	14.260	14.260	
19	14.360	14.360	14.360	
20	14.520	14.520	14.520	
21	14.700	14.700	14.700	
22	14.840	14.850	14.870	
23	14.890	14.870	14.850	
24	14.770	14.730	14.730	
25	14.710	14.700	14.690	
26	14.660	14.660	14.650	
27	14.680	14.690	14.690	
28	14.700	14.720	14.720	
29	14.770	14.770	14.800	
30	14.870	14.890	14.910	

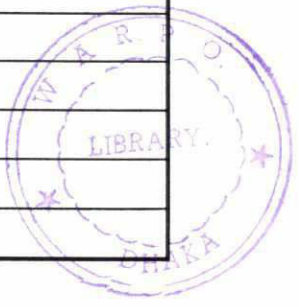
29

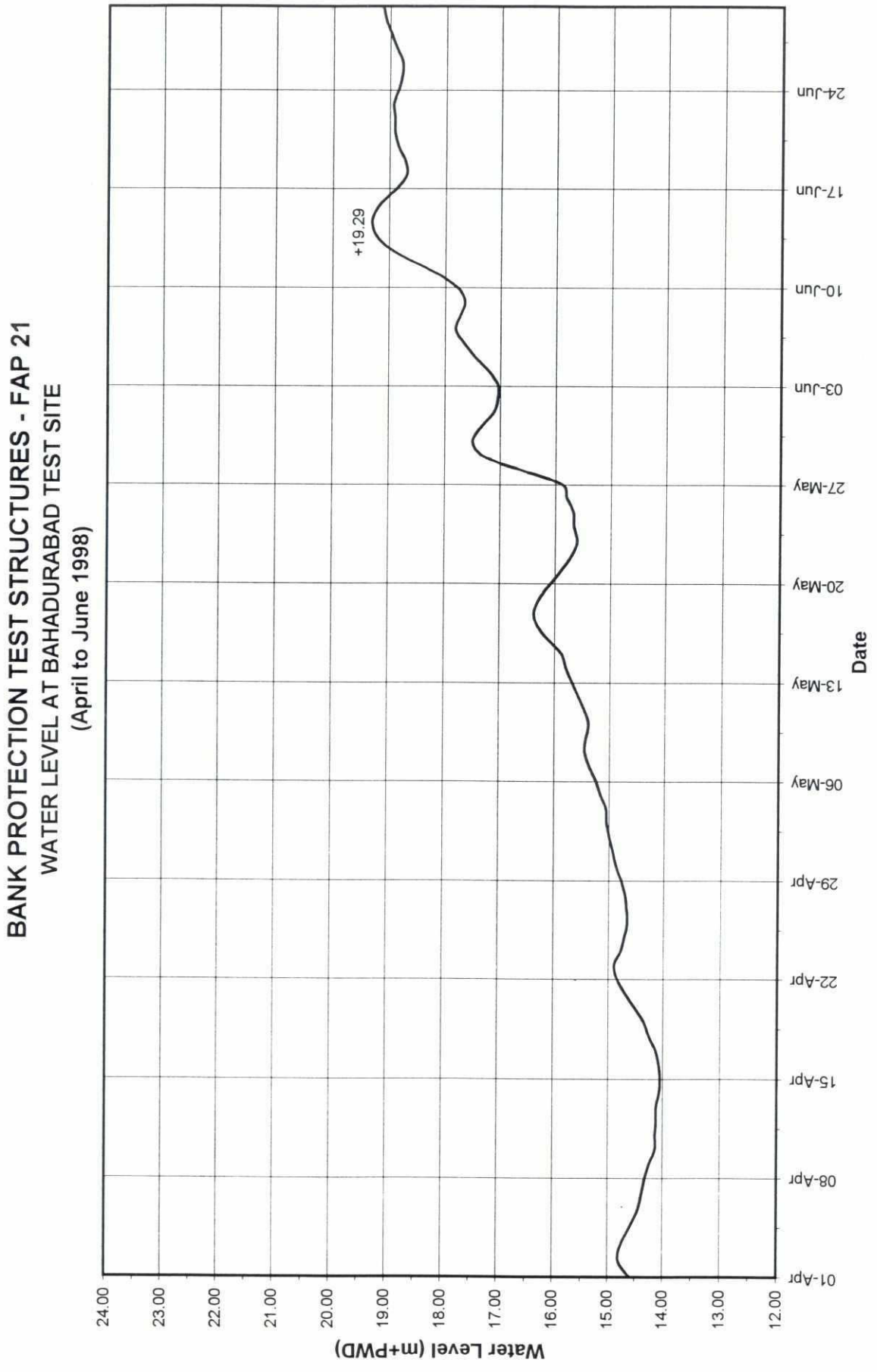
BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
MONTH : MAY 1998

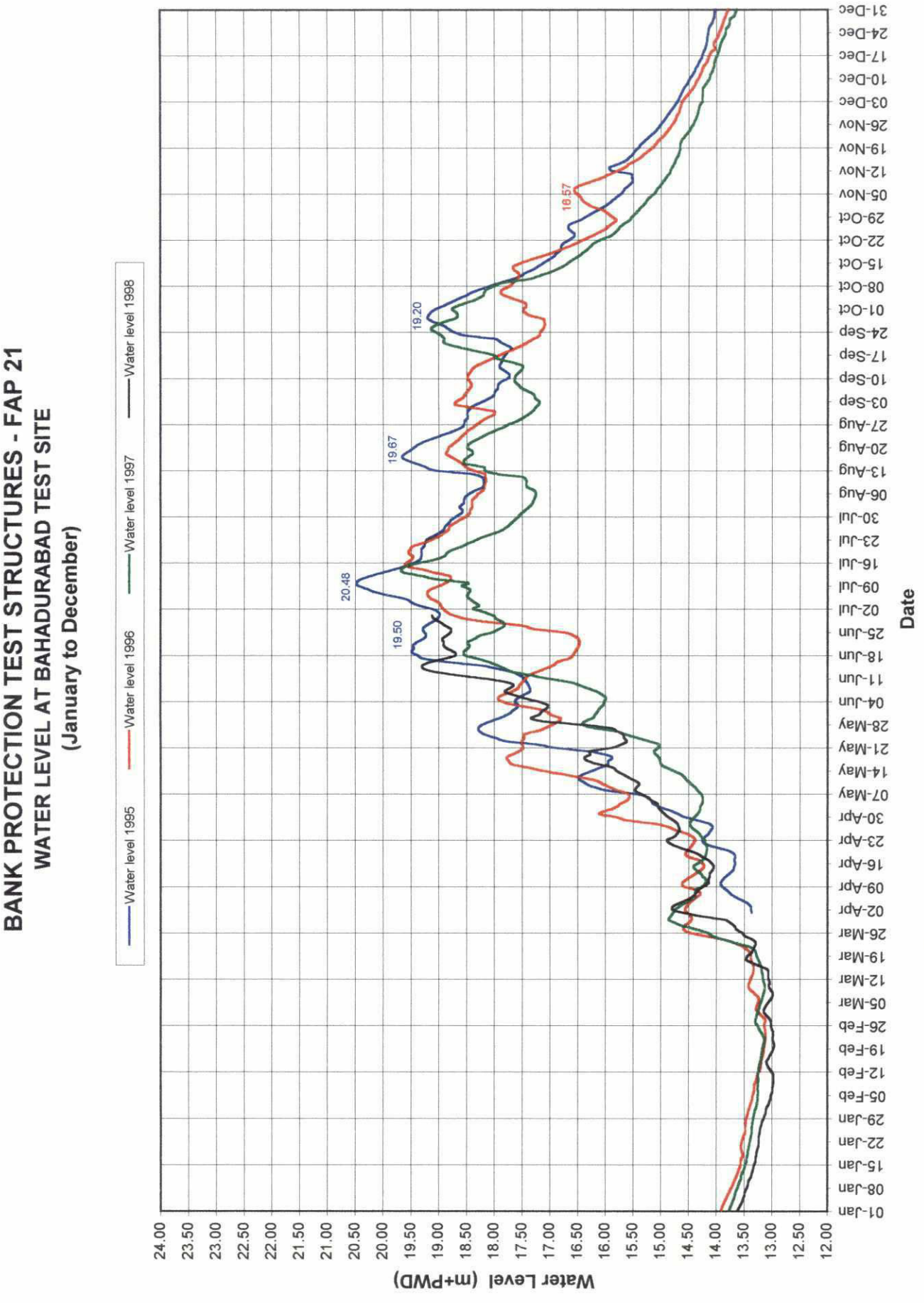
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	14.930	14.930	14.950	
2	15.000	15.000	15.030	
3	15.050	15.050	15.050	
4	15.060	15.070	15.070	
5	15.160	15.180	15.190	
6	15.250	15.270	15.300	
7	15.370	15.390	15.390	
8	15.460	15.460	15.460	
9	15.440	15.430	15.420	
10	15.390	15.390	15.390	
11	15.470	15.520	15.520	
12	15.580	15.610	15.610	
13	15.690	15.710	15.750	
14	15.800	15.820	15.850	
15	15.880	15.910	15.940	
16	16.120	16.160	16.200	
17	16.320	16.350	16.350	
18	16.380	16.370	16.360	
19	16.270	16.260	16.210	
20	16.280	16.050	16.050	
21	15.880	15.860	15.830	
22	15.710	15.700	15.680	
23	15.610	15.610	15.610	
24	15.670	15.660	15.660	
25	15.680	15.680	15.690	
26	15.800	15.810	15.810	
27	15.890	15.920	15.980	
28	16.450	16.710	16.870	
29	17.140	17.240	17.310	
30	17.340	17.300	17.260	
31	17.200	17.160	17.110	

BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
MONTH : JUNE 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	17.140	17.110	17.080	
2	17.050	17.010	17.000	
3	17.040	17.060	17.090	
4	17.210	17.240	17.410	
5	17.470	17.500	17.520	
6	17.670	17.690	17.720	
7	17.810	17.820	17.820	
8	17.730	17.720	17.670	
9	17.650	17.630	17.630	
10	17.800	17.810	17.910	
11	18.190	18.260	18.420	
12	18.700	18.790	18.930	
13	19.100	19.160	19.210	
14	19.280	19.310	19.310	
15	19.290	19.280	19.250	
16	19.130	19.120	19.050	
17	18.870	18.840	18.790	
18	18.700	18.690	18.710	
19	18.730	18.770	18.800	
20	18.850	18.860	18.880	
21	18.910	18.910	18.910	
22	18.910	18.960	18.960	
23	18.940	18.940	18.940	
24	18.850	18.850	18.840	
25	18.790	18.780	18.780	
26	18.780	18.780	18.770	
27	18.890	18.890	18.900	
28	18.980	18.990	19.010	
29	19.080	19.090	19.110	
30	19.120	19.120	19.130	

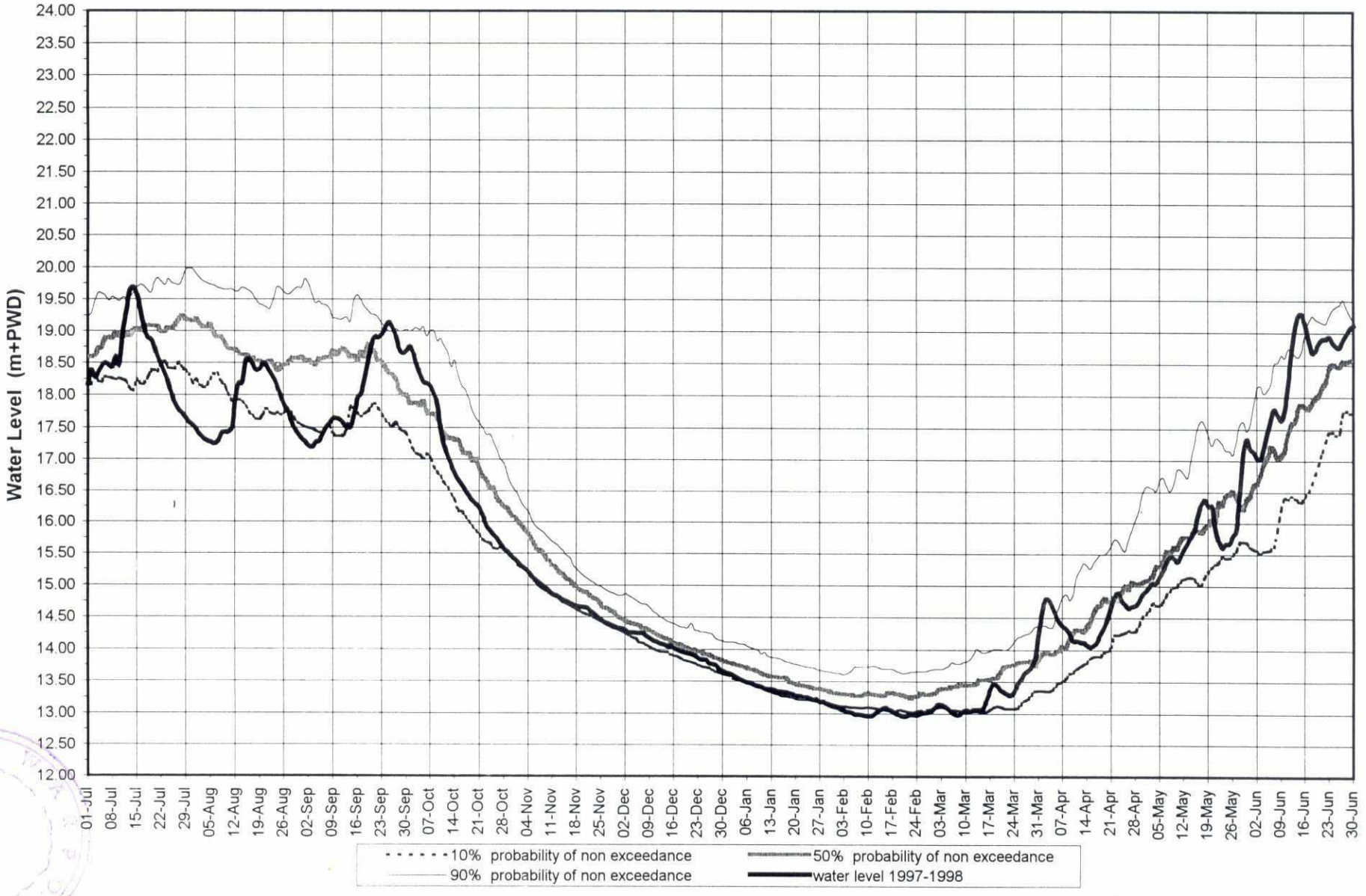



BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
(April to June 1998)
+19.29
Water Level (m+PWD)
24.00
23.00
22.00
21.00
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
Date
01-Apr
08-Apr
15-Apr
22-Apr
29-Apr
06-May
13-May
20-May
27-May
03-Jun
10-Jun
17-Jun
24-Jun


BANK PROTECTION TEST STRUCTURES - FAP 21
WATER LEVEL AT BAHADURABAD TEST SITE
(January to December)
Water level 1995
Water level 1996
Water level 1997
Water level 1998
Water Level (m+PWD)
Date
20.48
19.50
19.67
19.20
18.57

BANK PROTECTION TEST STRUCTURES - FAP 21

BWDB WATER LEVEL FREQUENCY CURVES VERSUS ACTUAL FAP 21 WATER LEVEL AT BAHADURABAD TEST SITE UP TO JUNE '98

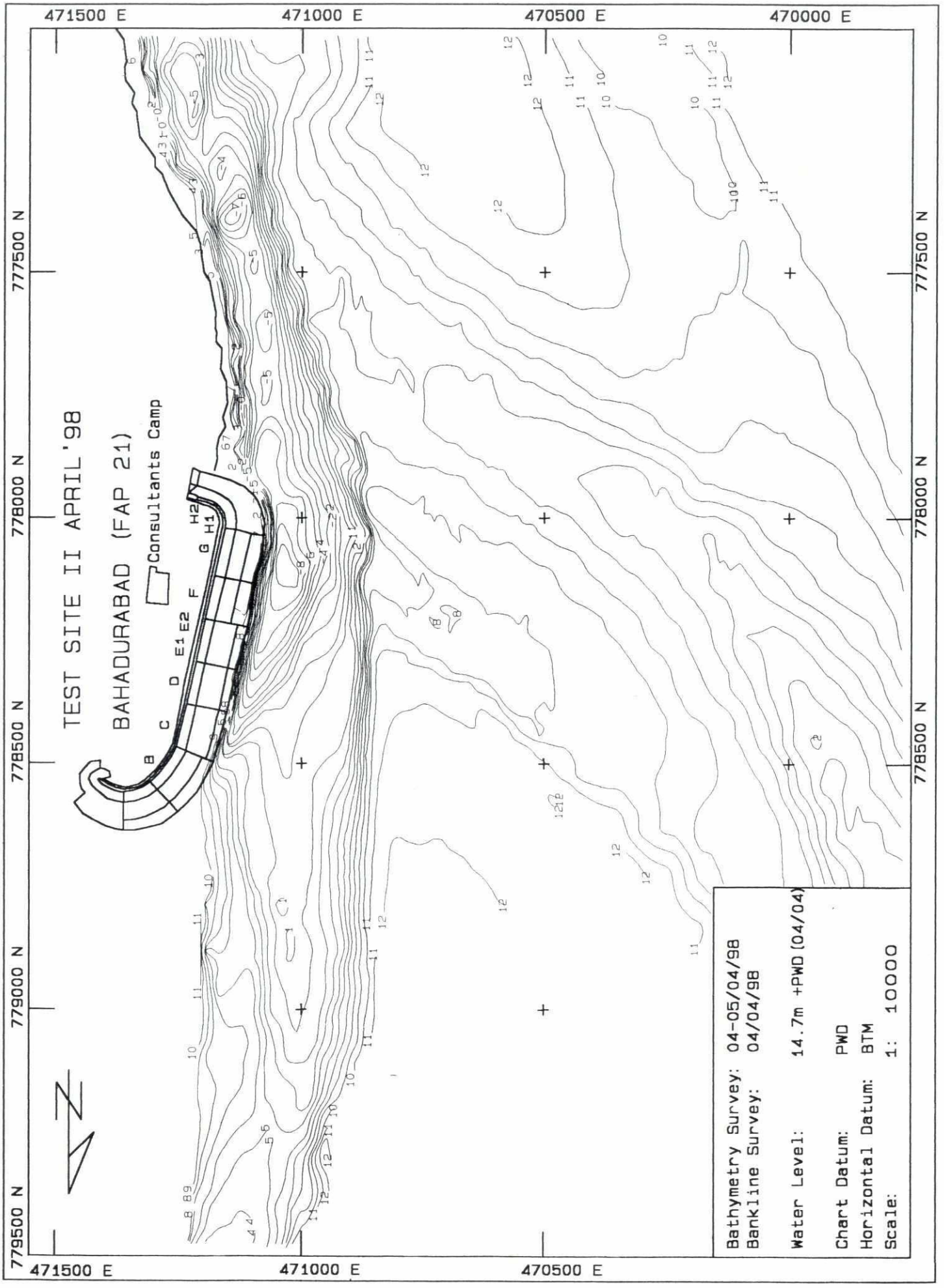


BWDB Data: Period of Record 1962 ~ 1994

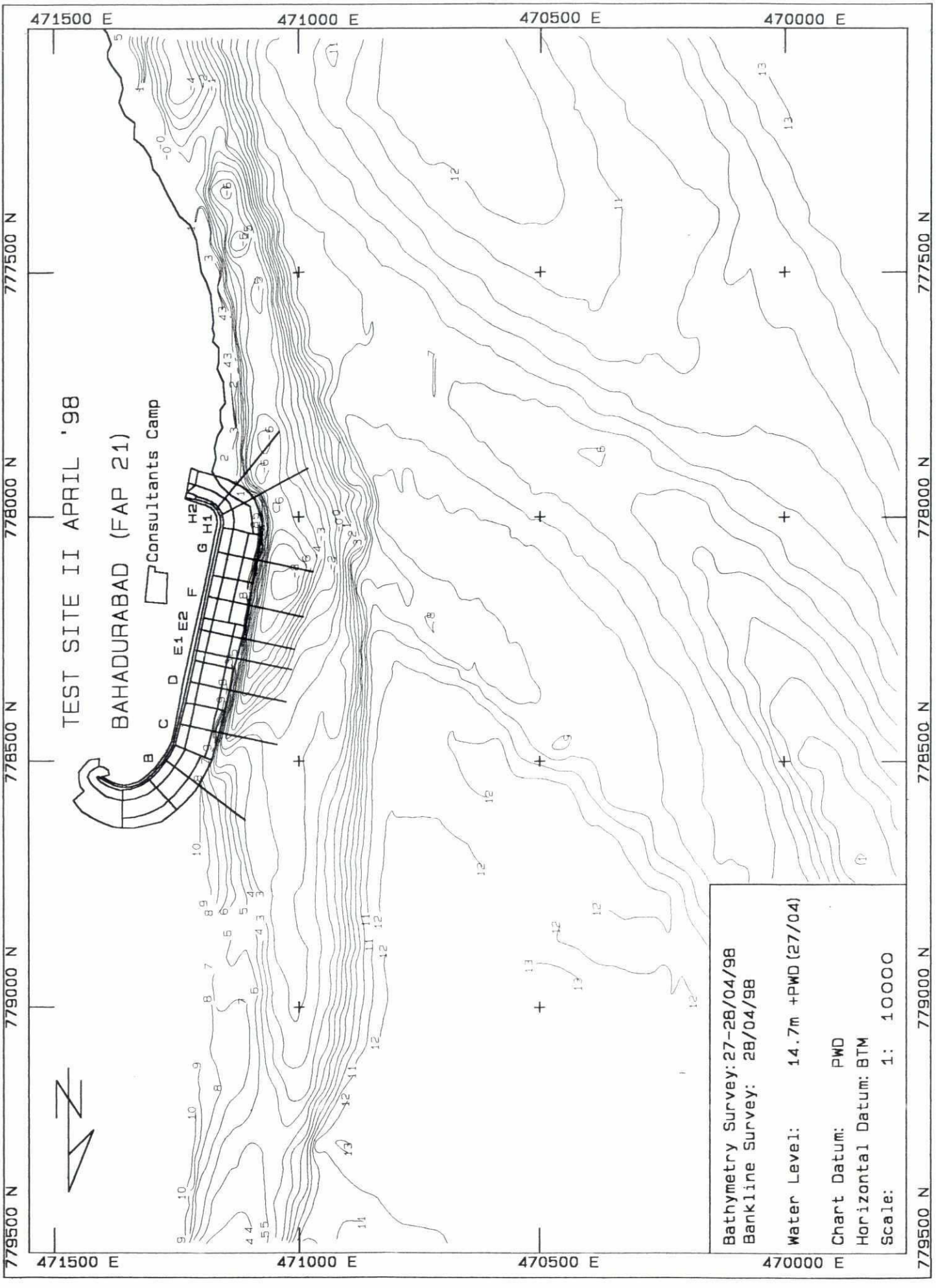
ANNEX F

FAP 21 / Test Site II

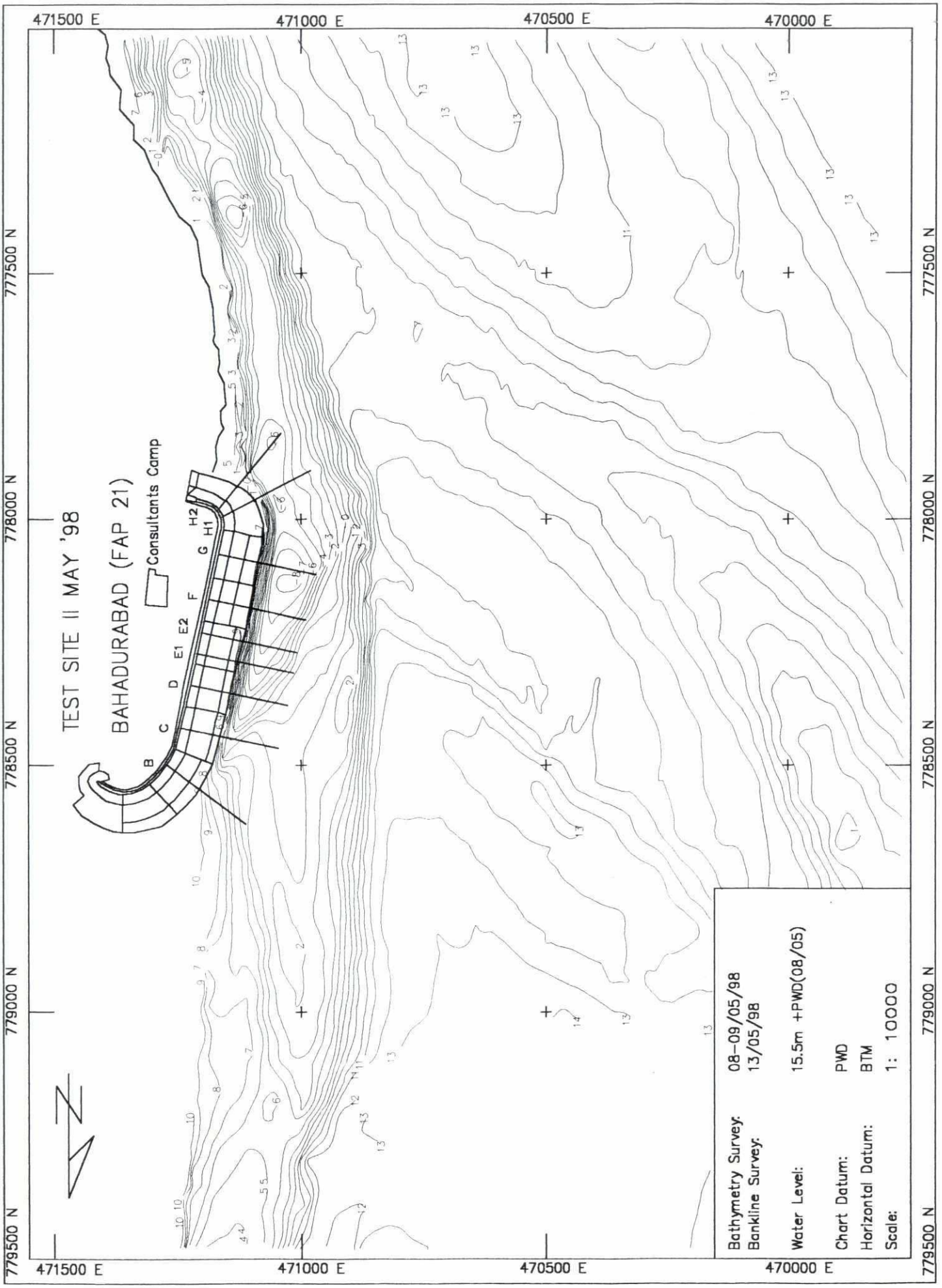
- Bathymetric Survey

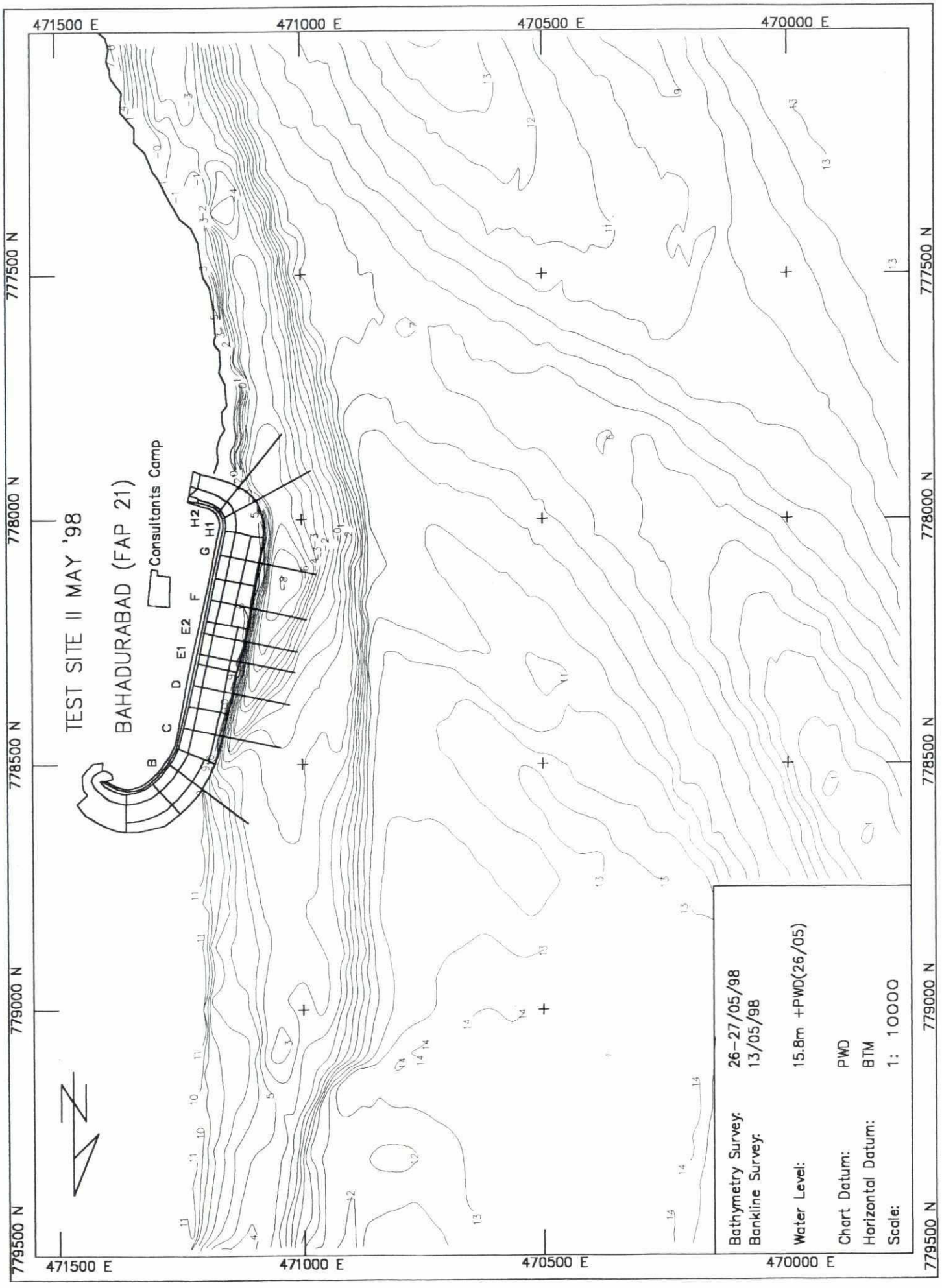

TEST SITE II APRIL '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N
Bathymetry Survey: 04-05/04/98
Bankline Survey: 04/04/98
Water Level: 14.7m +PWD (04/04)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000

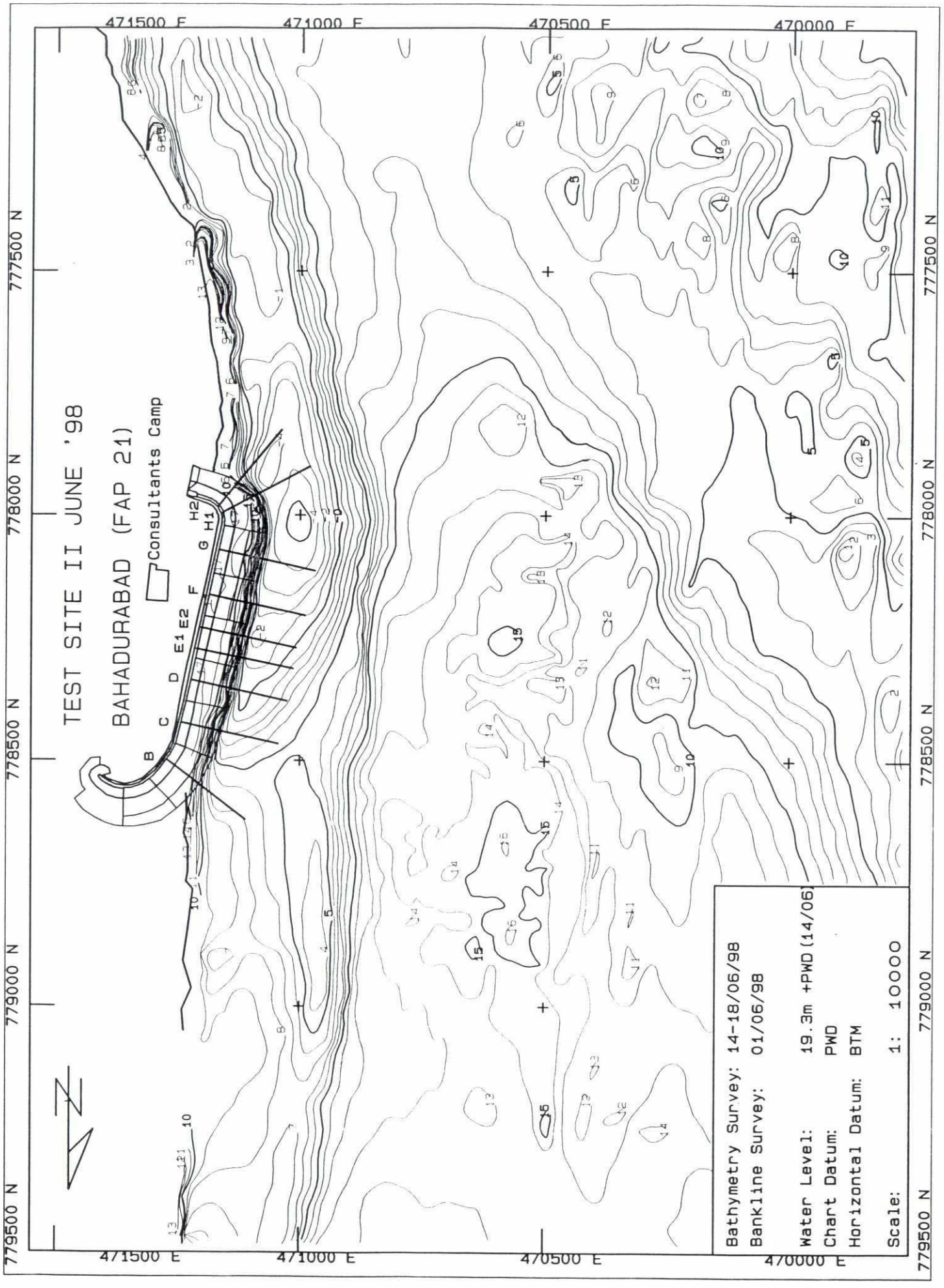
98

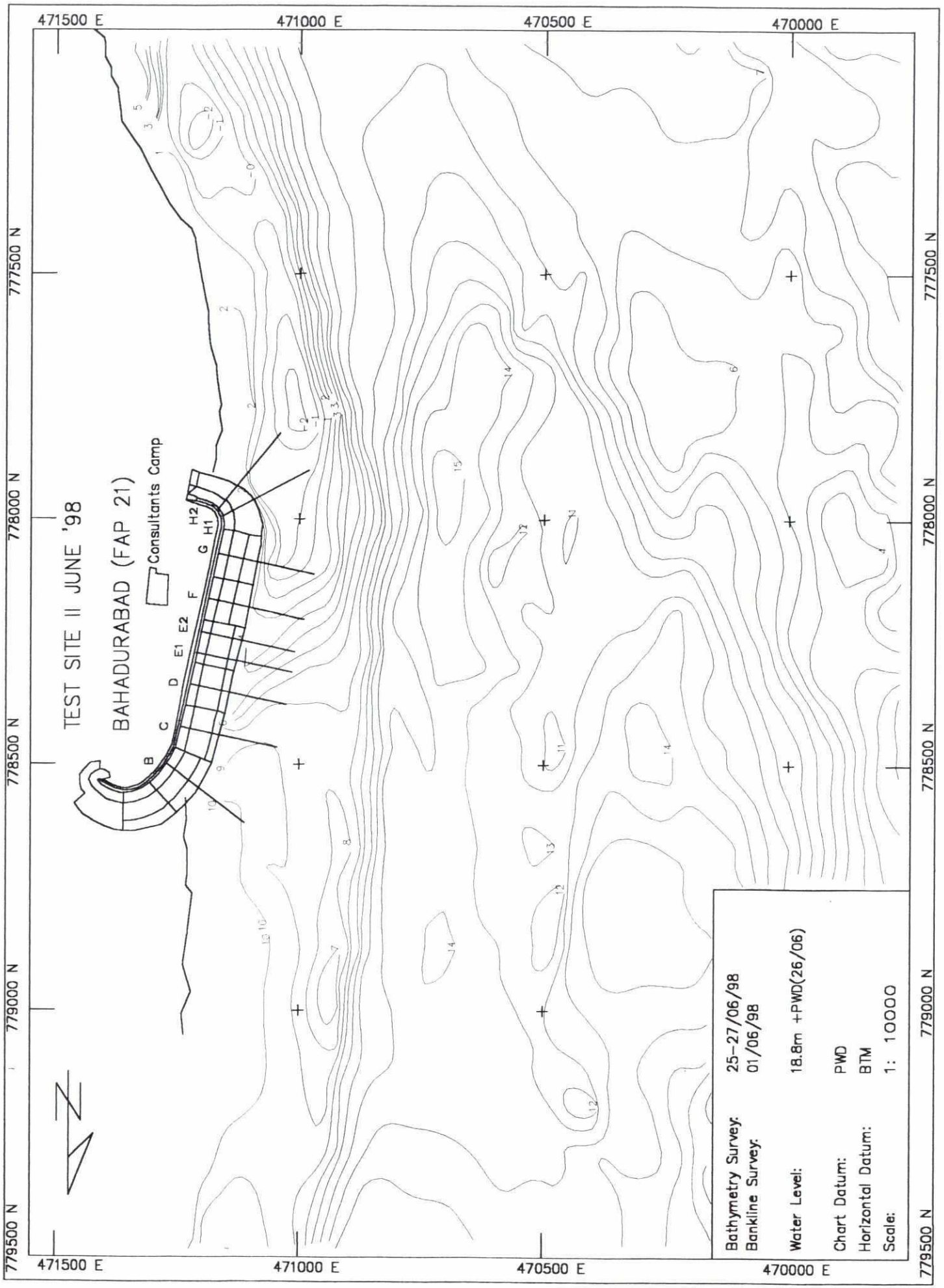

TEST SITE II APRIL '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N
Bathymetry Survey: 27-28/04/98
Bankline Survey: 28/04/98
Water Level: 14.7m +PWD (27/04)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000

90


TEST SITE II MAY '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N
Bathymetry Survey: 08-09/05/98
Bankline Survey: 13/05/98
Water Level: 15.5m +PWD(08/05)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000


471500 E
471000 E
470500 E
470000 E
777500 N
778000 N
778500 N
779000 N
779500 N
TEST SITE II MAY '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Bathymetry Survey: 26-27/05/98
Bankline Survey: 13/05/98
Water Level: 15.8m +PWD(26/05)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000

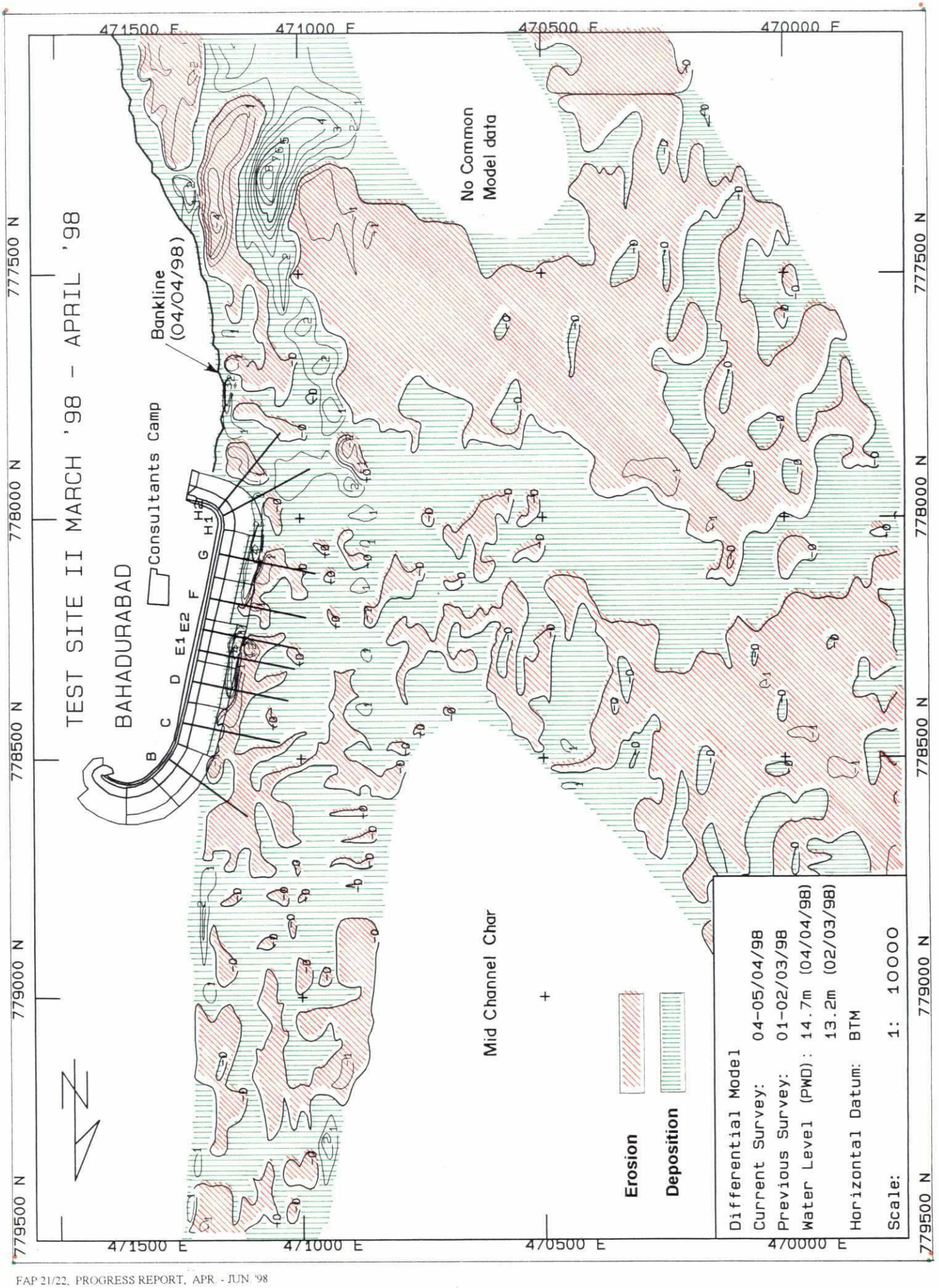

TEST SITE II JUNE '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N
Bathymetry Survey: 14-18/06/98
Bankline Survey: 01/06/98
Water Level: 19.3m +PWD (14/06)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000

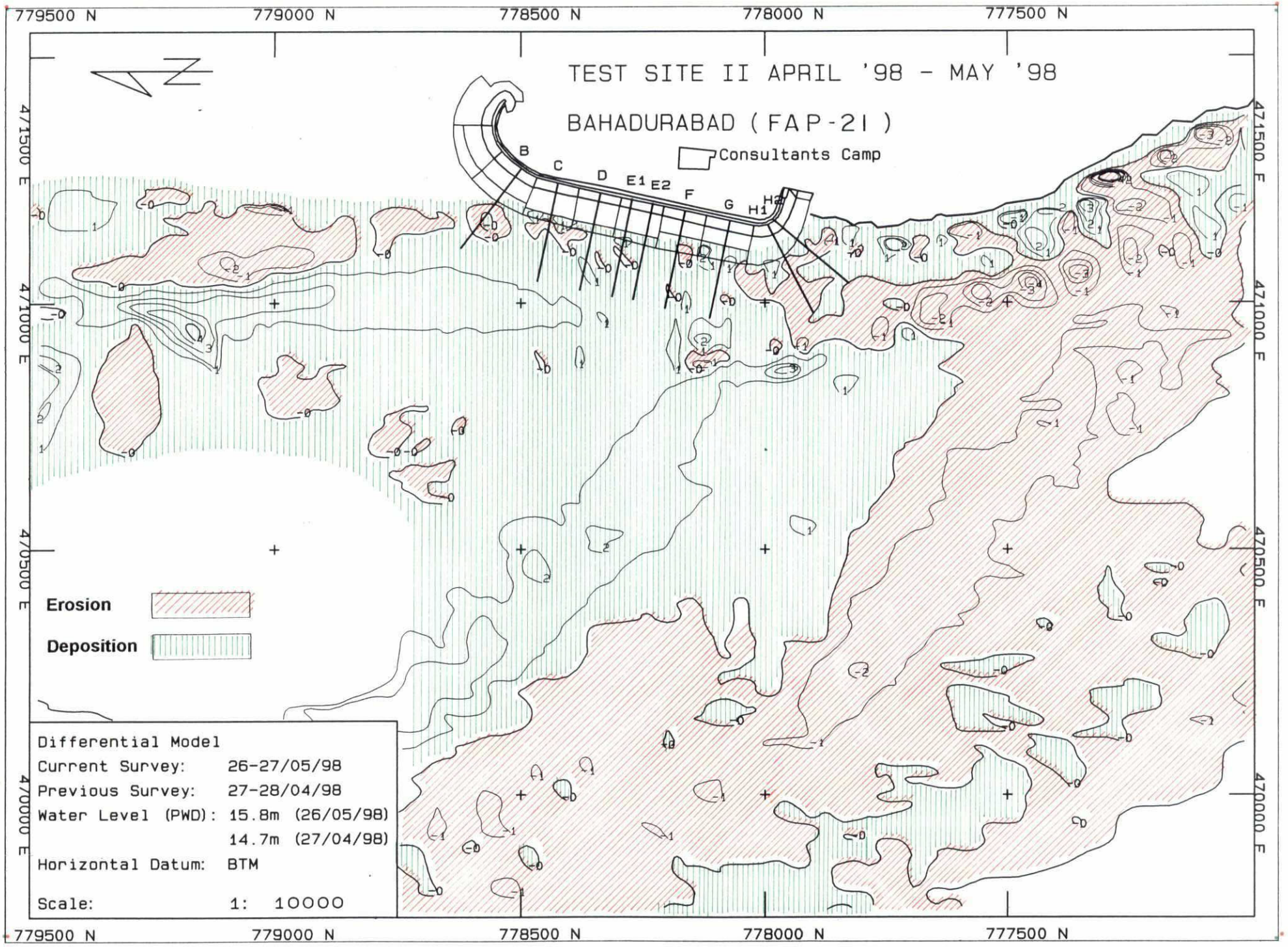

471500 E
471000 E
470500 E
470000 E
777500 N
778000 N
778500 N
779000 N
779500 N
TEST SITE II JUNE '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Bathymetry Survey: 25-27/06/98
Bankline Survey: 01/06/98
Water Level: 18.8m +PWD(26/06)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000

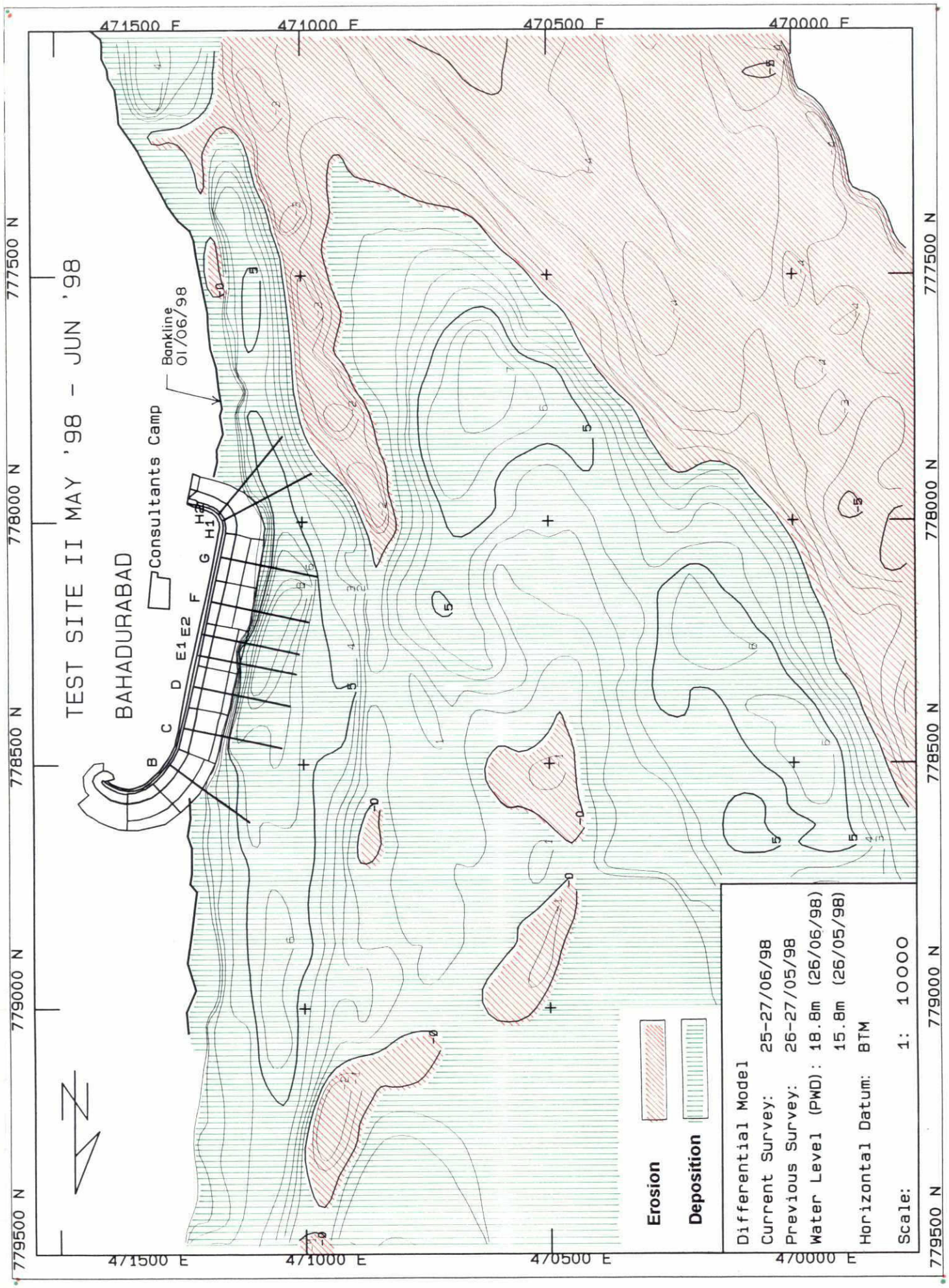
ANNEX G

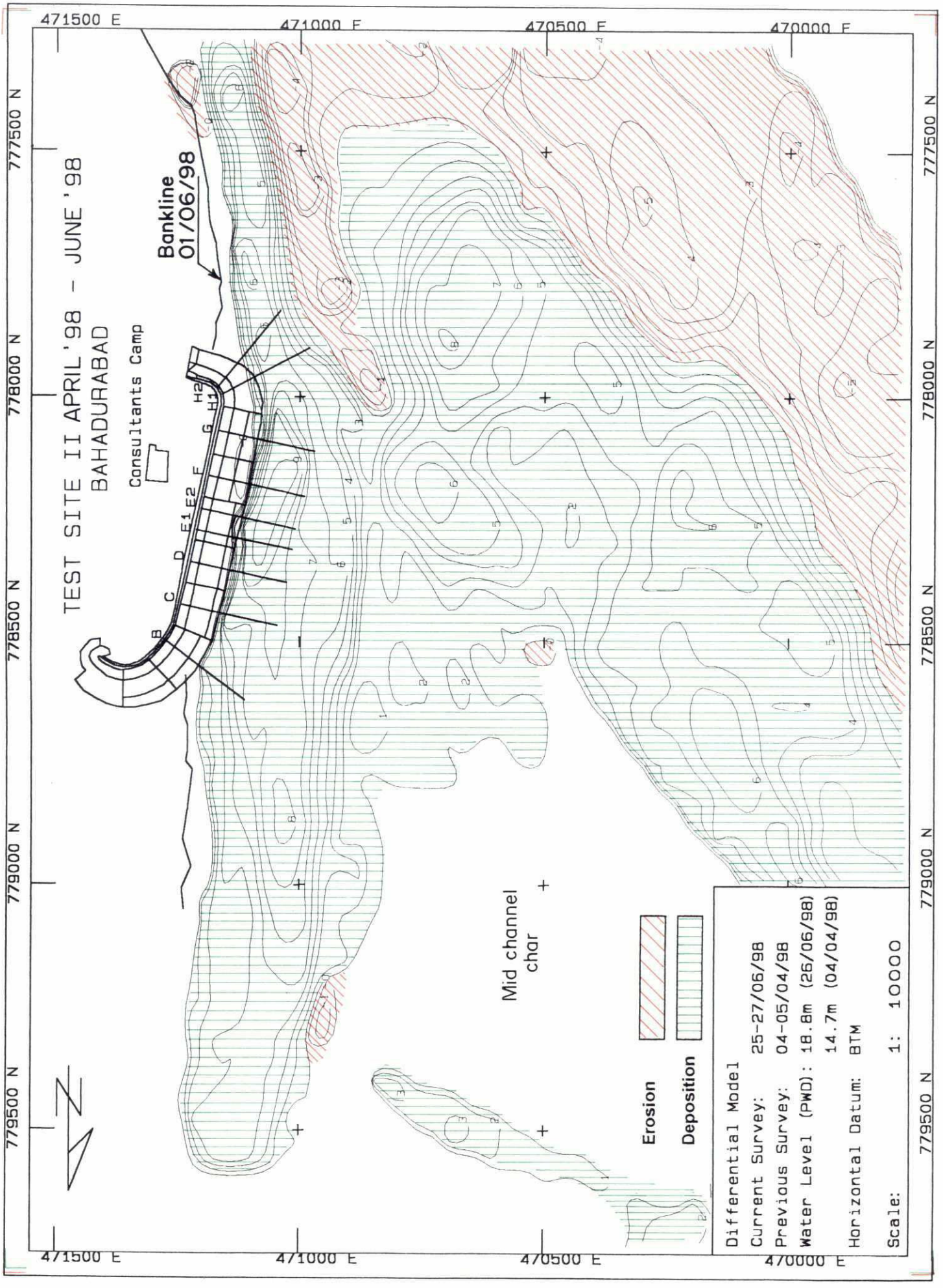
FAP 21 / Test Site II

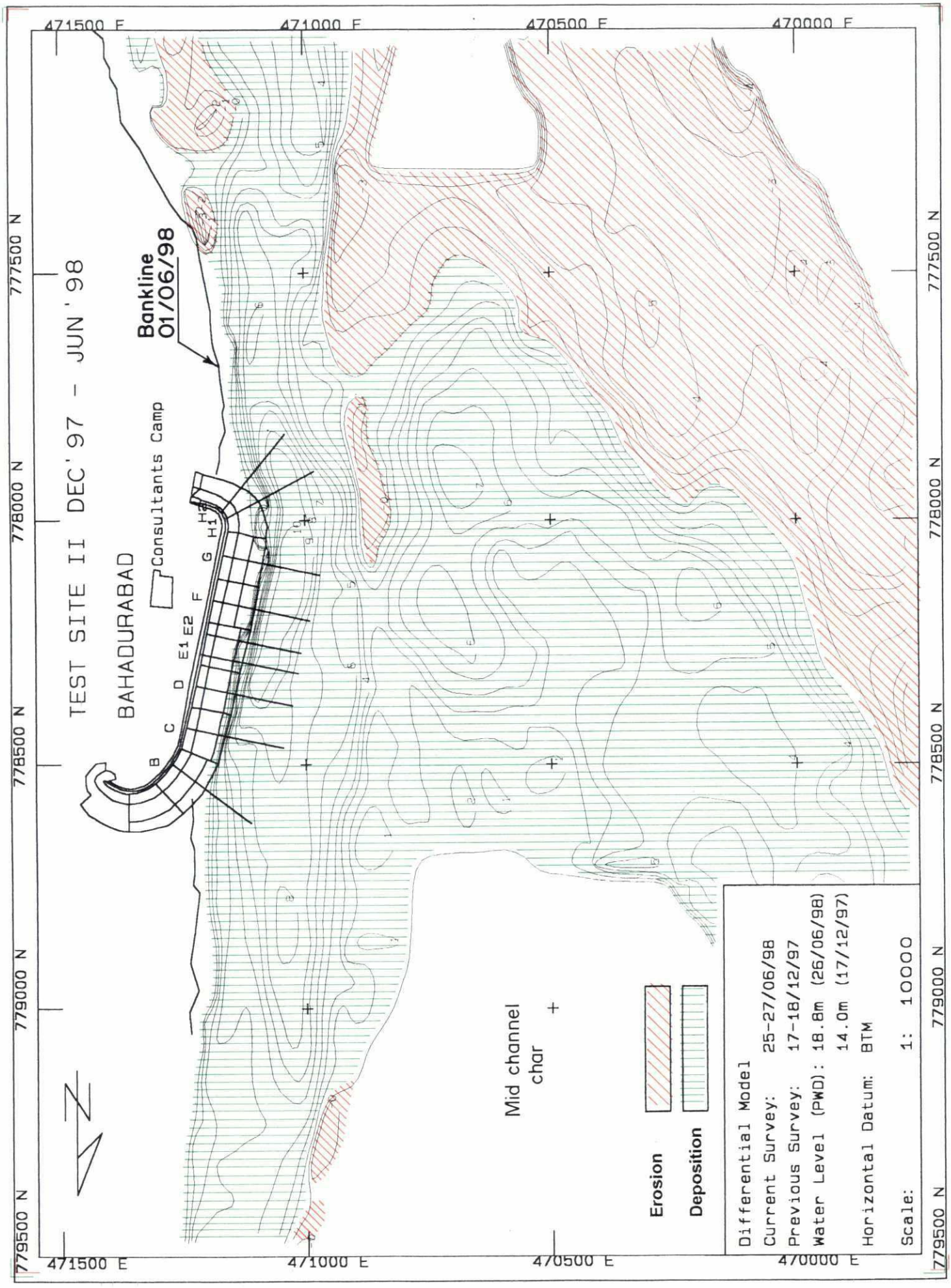
- Differential Model


TEST SITE II MARCH '98 - APRIL '98
BAHADURABAD
Bankline (04/04/98)
Consultants Camp
B C D E1 E2 F G H1 H2
No Common Model data
Mid Channel Char
Erosion
Deposition
Differential Model
Current Survey: 04-05/04/98
Previous Survey: 01-02/03/98
Water Level (PWD): 14.7m (04/04/98)
13.2m (02/03/98)
Horizontal Datum: BTM
Scale: 1: 10000
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N


779500 N
779000 N
778500 N
778000 N
777500 N
471500 E
471000 E
470500 E
470000 E
TEST SITE II APRIL '98 - MAY '98
BAHADURABAD (FAP-21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Erosion
Deposition
Differential Model
Current Survey: 26-27/05/98
Previous Survey: 27-28/04/98
Water Level (PWD): 15.8m (26/05/98)
14.7m (27/04/98)
Horizontal Datum: BTM
Scale: 1: 10000


TEST SITE II MAY '98 - JUN '98
BAHADURABAD
Consultants Camp
Bankline 01/06/98
B C D E1 E2 F G H1 H2
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N
Erosion
Deposition
Differential Model
Current Survey: 25-27/06/98
Previous Survey: 26-27/05/98
Water Level (PWD): 18.8m (26/06/98)
15.8m (26/05/98)
Horizontal Datum: BTM
Scale: 1: 10000

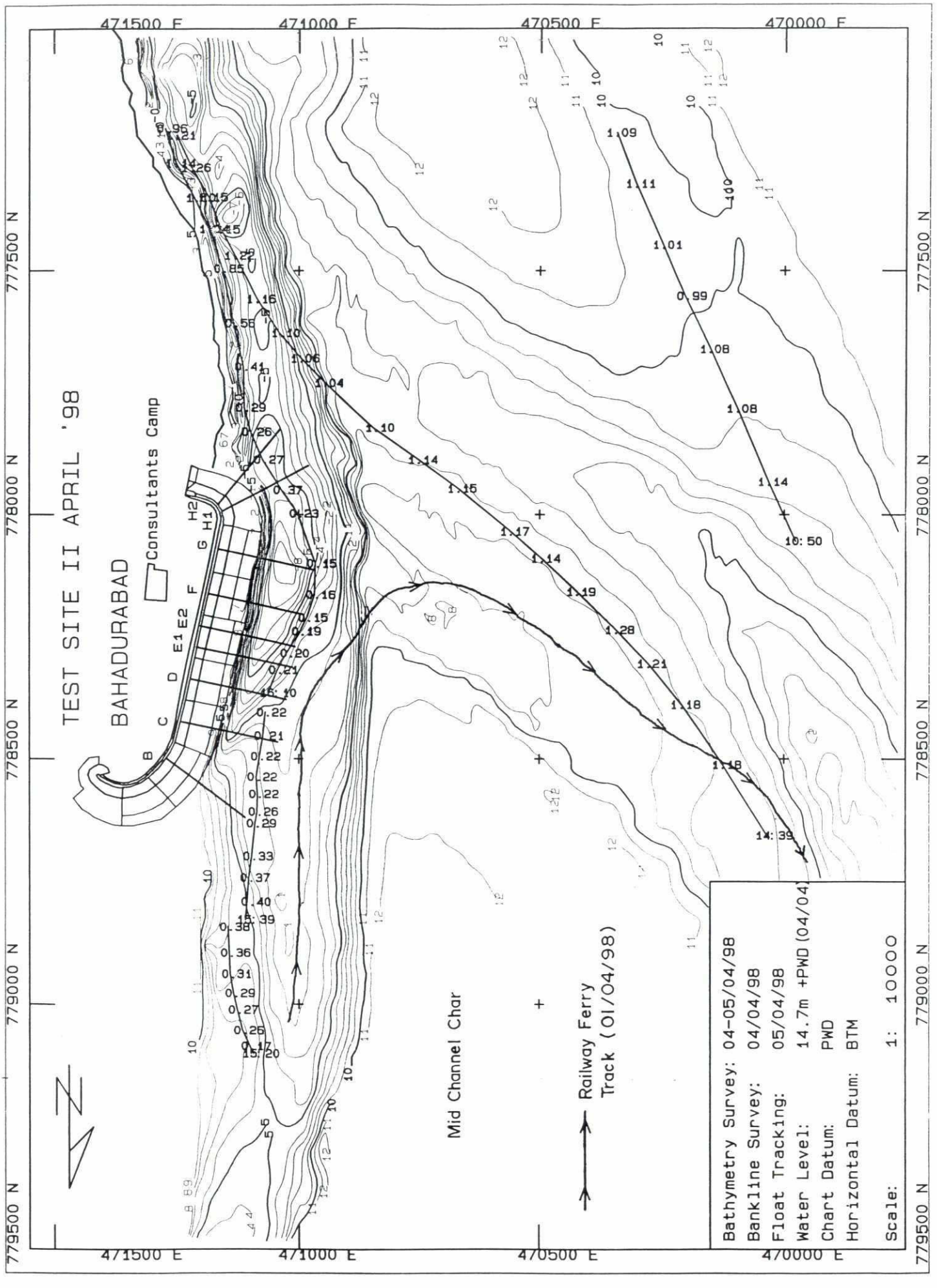

471500 E
471000 E
470500 E
470000 E
777500 N
778000 N
778500 N
779000 N
779500 N
TEST SITE II APRIL '98 - JUNE '98
BAHADURABAD
Bankline
01/06/98
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Mid channel
char
Erosion
Deposition
Differential Model
Current Survey: 25-27/06/98
Previous Survey: 04-05/04/98
Water Level (PWD): 18.8m (26/06/98)
14.7m (04/04/98)
Horizontal Datum: BTM
Scale: 1: 10000

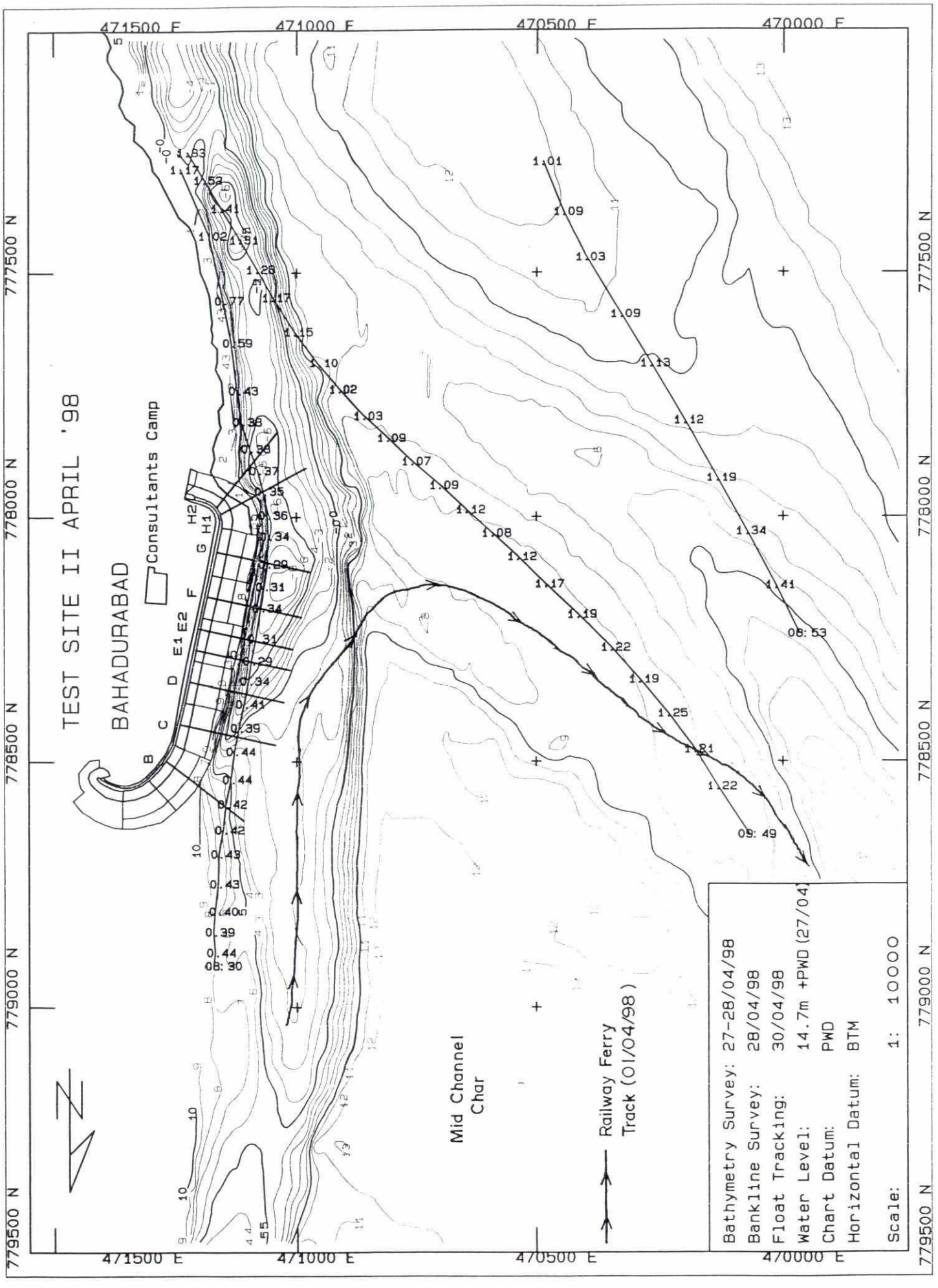

471500 E
471000 E
470500 E
470000 E
777500 N
778000 N
778500 N
779000 N
779500 N
TEST SITE II DEC'97 - JUN'98
BAHADURABAD
Bankline
01/06/98
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Mid channel
char
Erosion
Deposition
Differential Model
Current Survey: 25-27/06/98
Previous Survey: 17-18/12/97
Water Level (PWD): 18.8m (26/06/98)
14.0m (17/12/97)
Horizontal Datum: BTM
Scale: 1: 10000

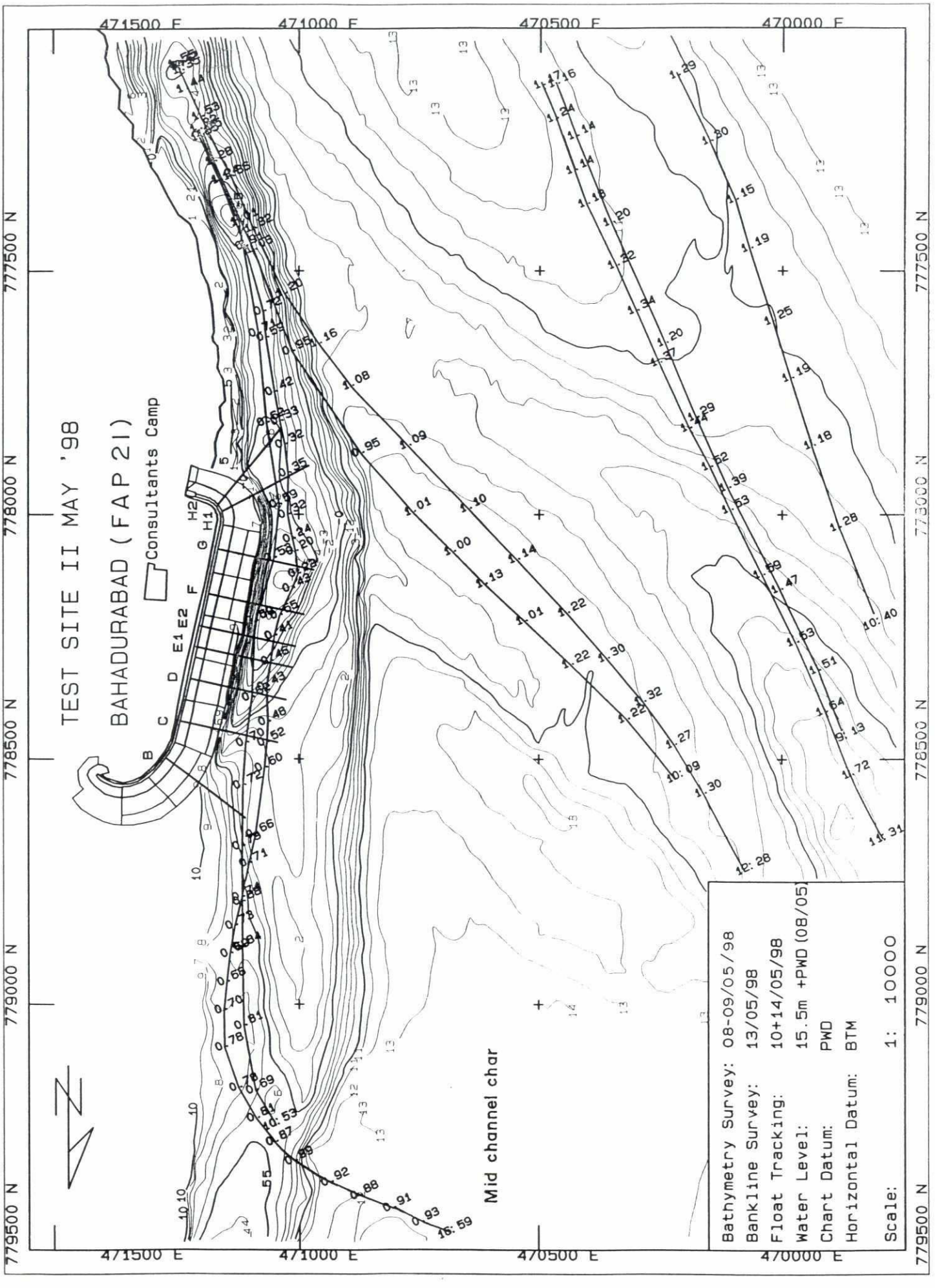
ANNEX H

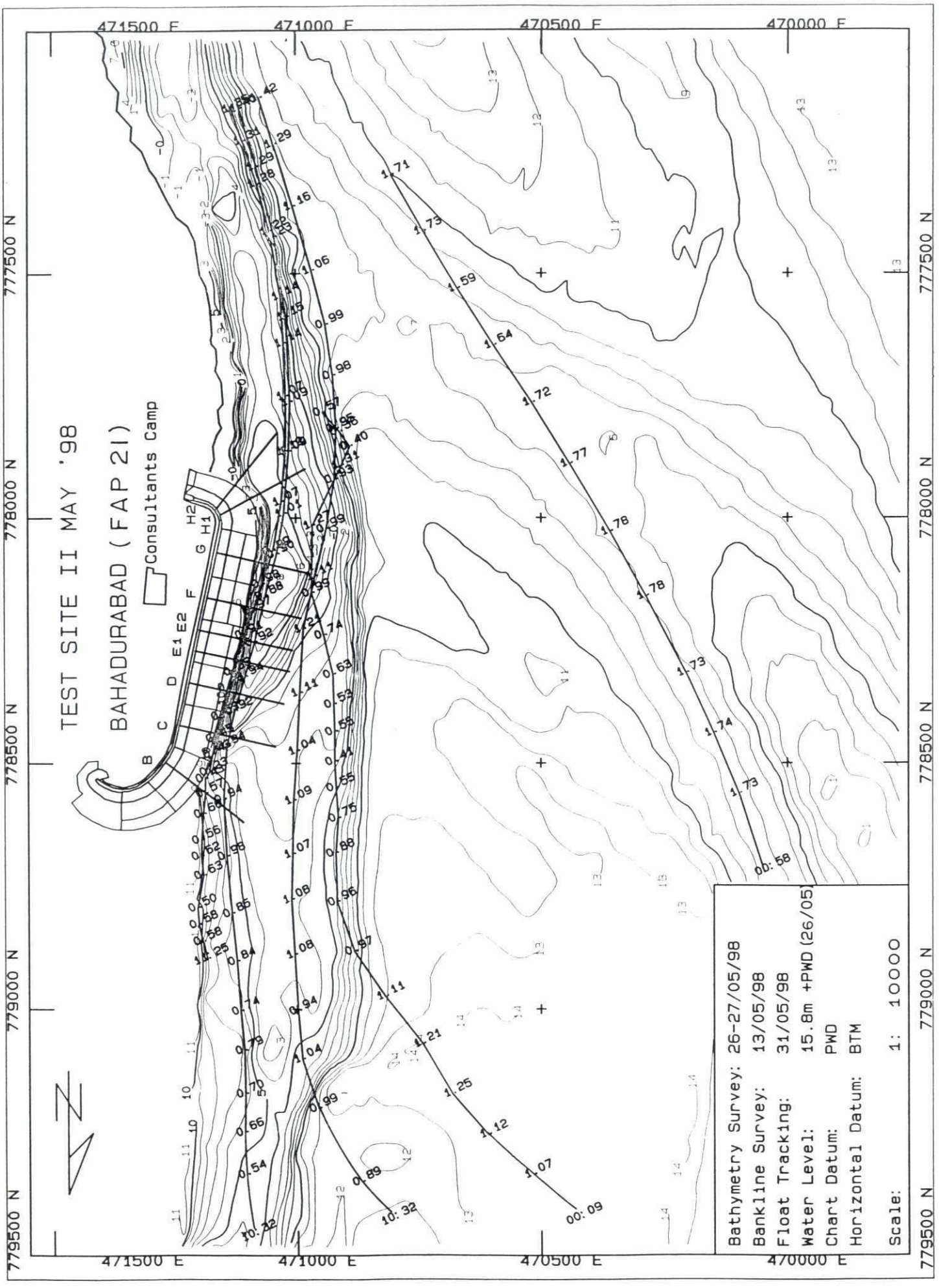
FAP 21 / Test Site II

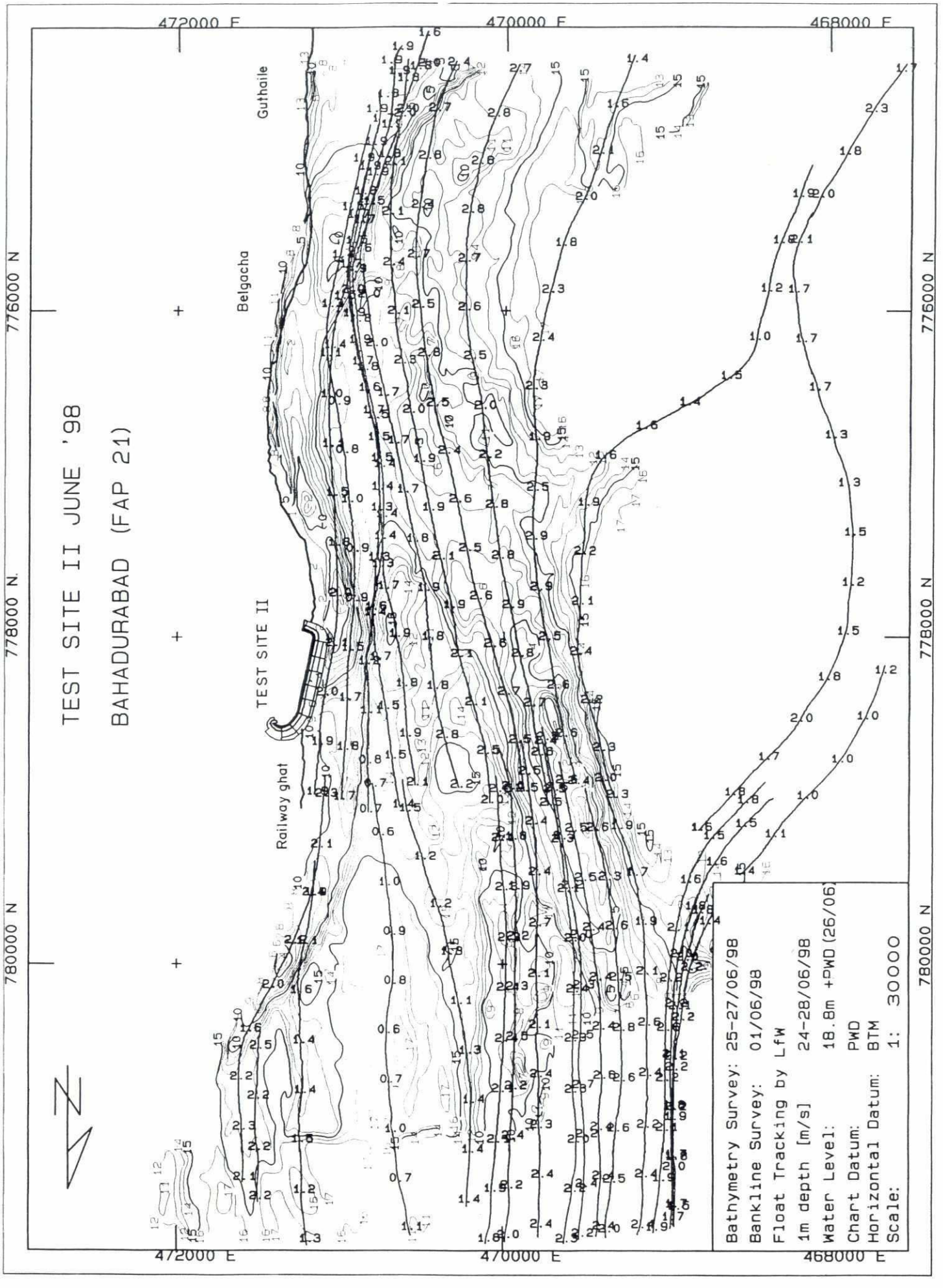
- Flow Velocities


TEST SITE II APRIL '98
BAHADURABAD
Consultants Camp
Mid Channel Char
Railway Ferry
Track (01/04/98)
Bathymetry Survey: 04-05/04/98
Bankline Survey: 04/04/98
Float Tracking: 05/04/98
Water Level: 14.7m +PWD (04/04)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N


471500 E
471000 E
470500 E
470000 E
777500 N
778000 N
778500 N
779000 N
779500 N
TEST SITE II APRIL '98
BAHADURABAD
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Mid Channel
Char
Railway Ferry
Track (01/04/98)
08: 53
09: 49
08: 30
Bathymetry Survey: 27-28/04/98
Bankline Survey: 28/04/98
Float Tracking: 30/04/98
Water Level: 14.7m +PWD (27/04
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000


TEST SITE II MAY '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
Mid channel char
Bathymetry Survey: 08-09/05/98
Bankline Survey: 13/05/98
Float Tracking: 10+14/05/98
Water Level: 15.5m +PWD (08/05)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N


TEST SITE II MAY '98
BAHADURABAD (FAP 21)
Consultants Camp
B
C
D
E1
E2
F
G
H1
H2
471500 E
471000 E
470500 E
470000 E
779500 N
779000 N
778500 N
778000 N
777500 N
Bathymetry Survey: 26-27/05/98
Bankline Survey: 13/05/98
Float Tracking: 31/05/98
Water Level: 15.8m +PWD (26/05)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 10000


TEST SITE II JUNE '98
BAHADURABAD (FAP 21)
472000 E
470000 E
468000 E
776000 N
778000 N
780000 N
Guthaile
Belgacha
TEST SITE II
Railway ghat
Bathymetry Survey: 25-27/06/98
Bankline Survey: 01/06/98
Float Tracking by LfW
1m depth [m/s] 24-28/06/98
Water Level: 18.8m +PWD (26/06)
Chart Datum: PWD
Horizontal Datum: BTM
Scale: 1: 30000

ANNEX I

FAP 21 / Test Site II

- Cross Section end of June 1998

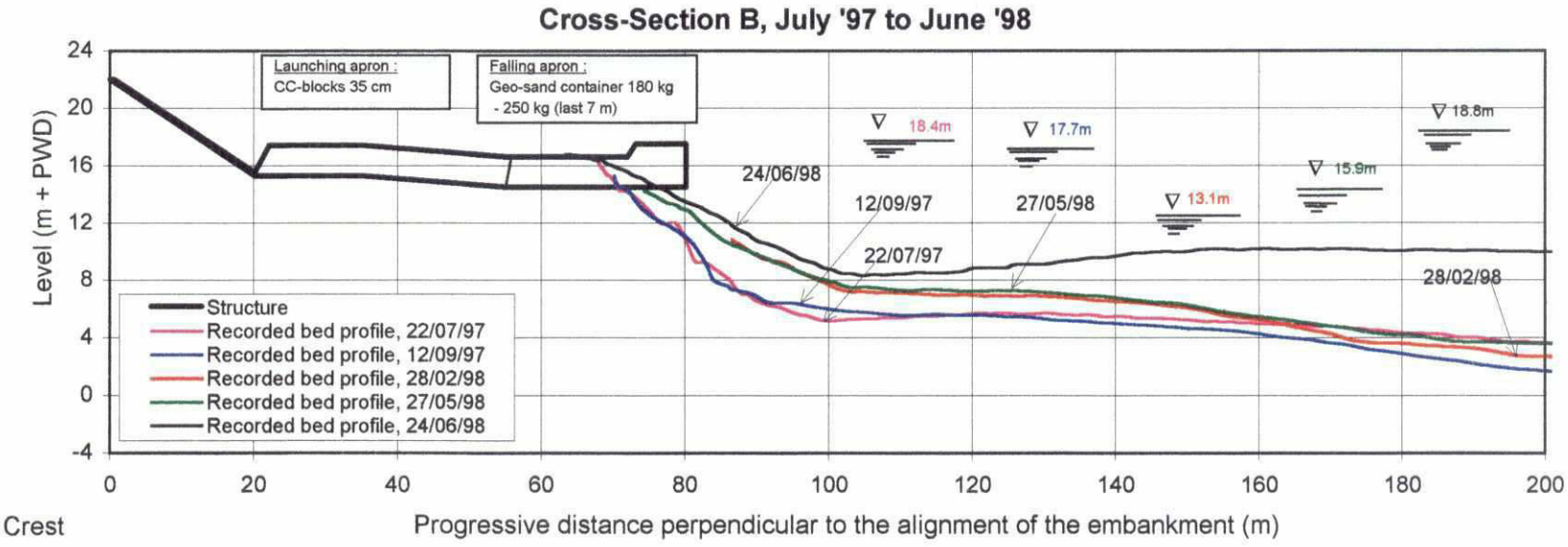
BAHADURABAD (FAP 21) - TEST SITE II

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471272 E
778499 N

Azimuth: 307°



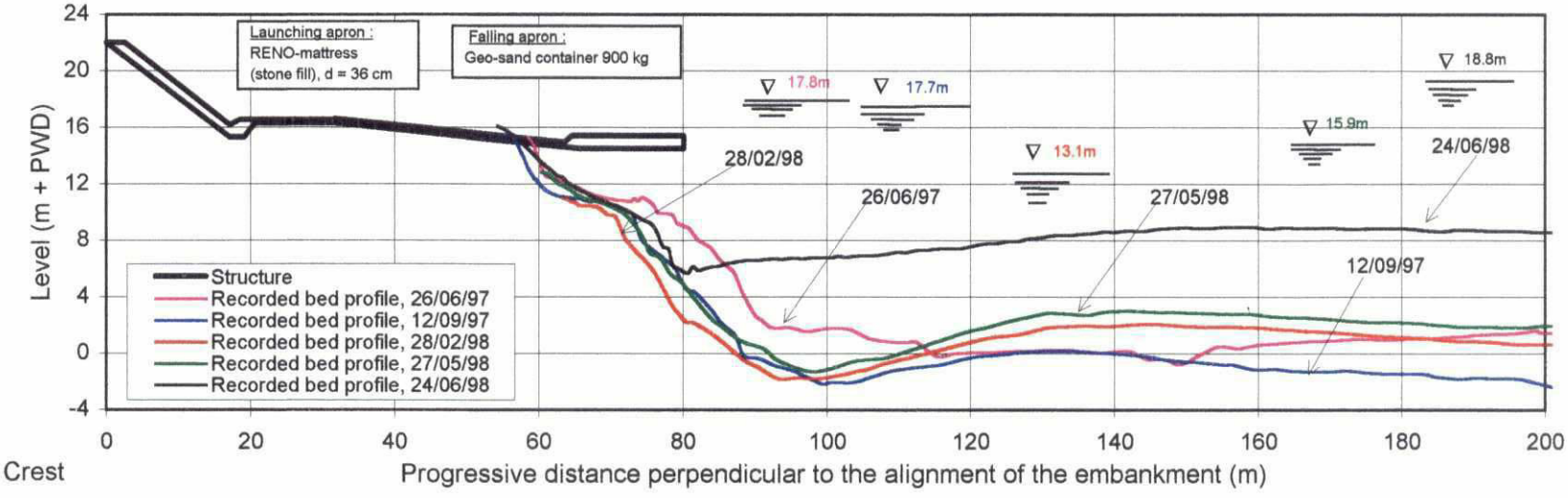
Station 0 = Edge of Crest

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471240 E
778424 N

Azimuth: 282°



Station 0 = Edge of Crest

BAHADURABAD (FAP 21) - TEST SITE II

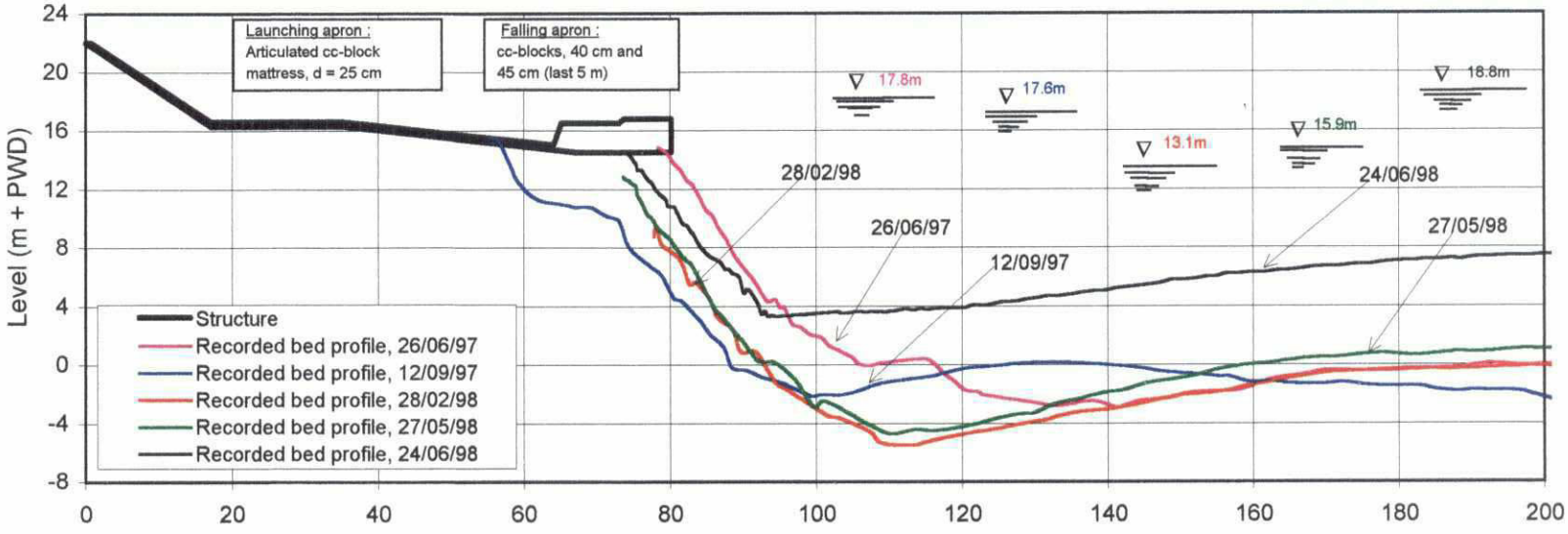
Cross-Section D, June '97 to June '98

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471222 E
778337 N

Azimuth: 282°



Station 0 = Edge of Crest

Progressive distance perpendicular to the alignment of the embankment (m)

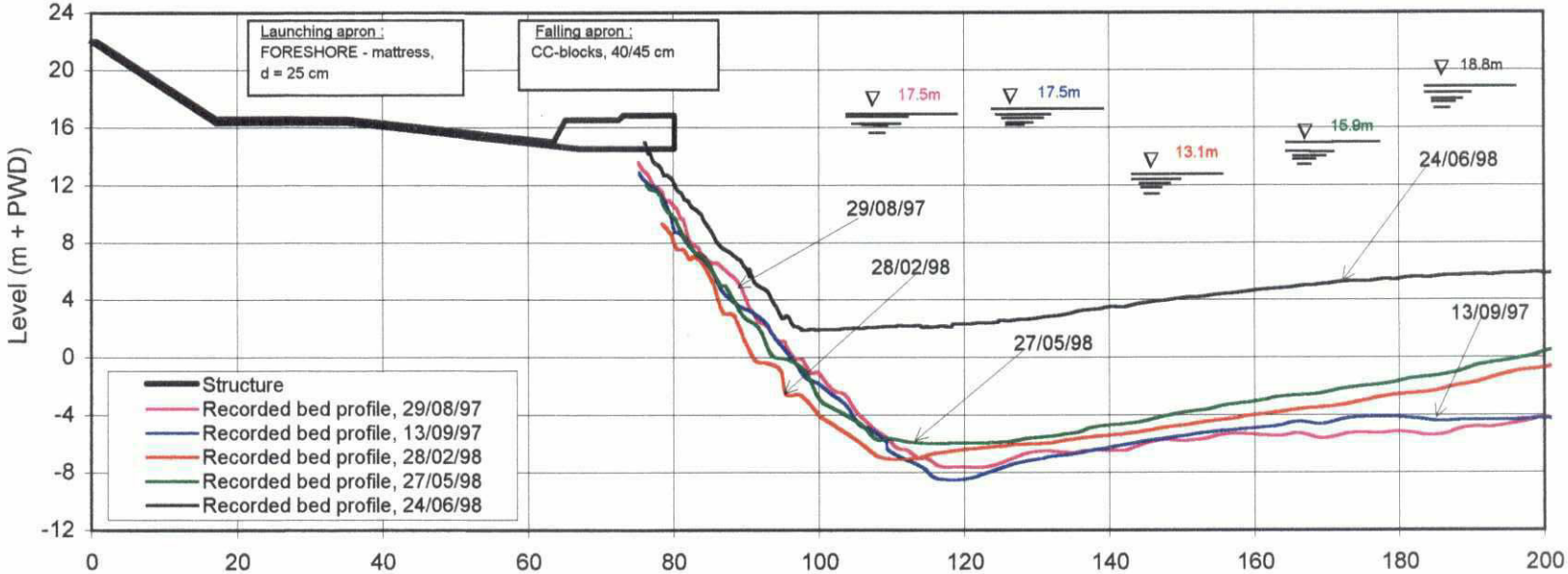
Cross-Section E-1, August '97 to June '98

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471203 E
778250 N

Azimuth: 282°



Station 0 = Edge of Crest

Progressive distance perpendicular to the alignment of the embankment (m)

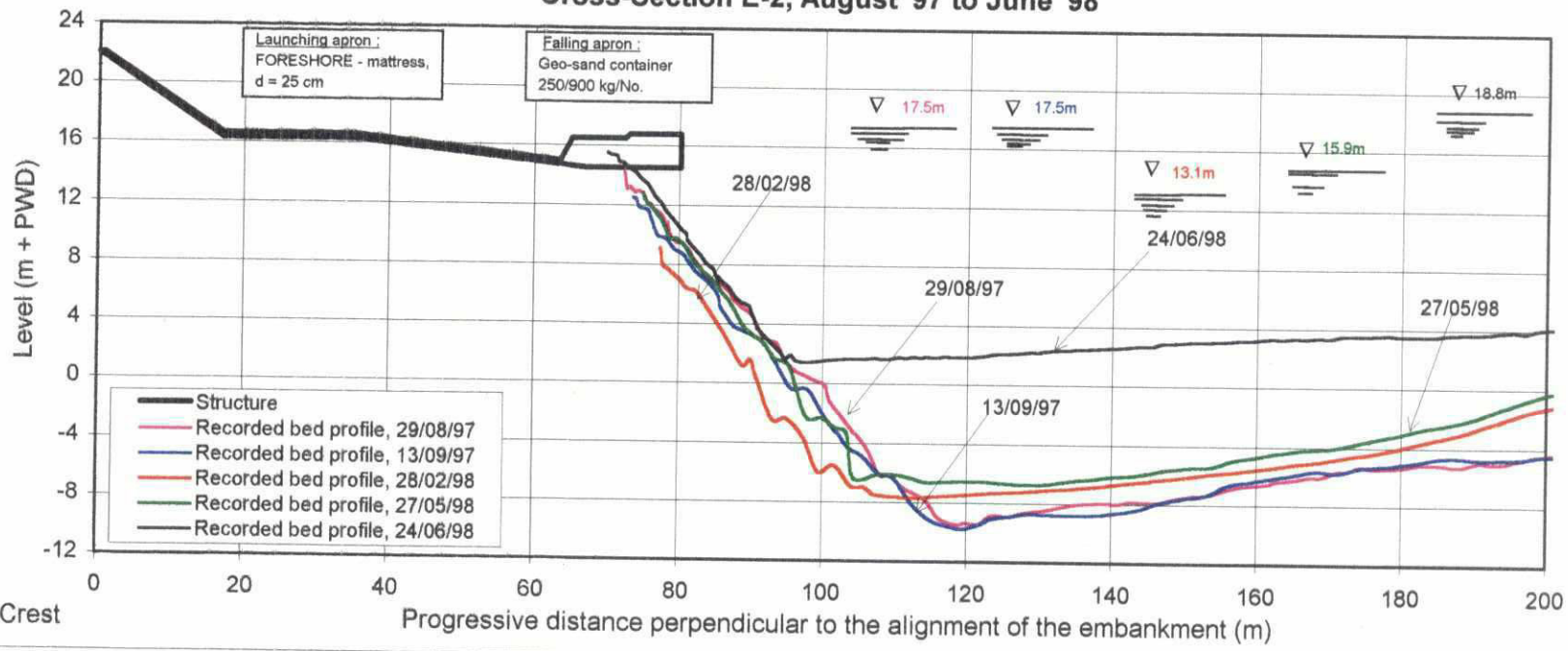
Cross-Section E-2, August '97 to June '98

Horizontal Scale:
1:1000

Vertical Scale:
1:500

Section Start:
471201 E
778229 N

Azimuth: 282°



Station 0 = Edge of Crest

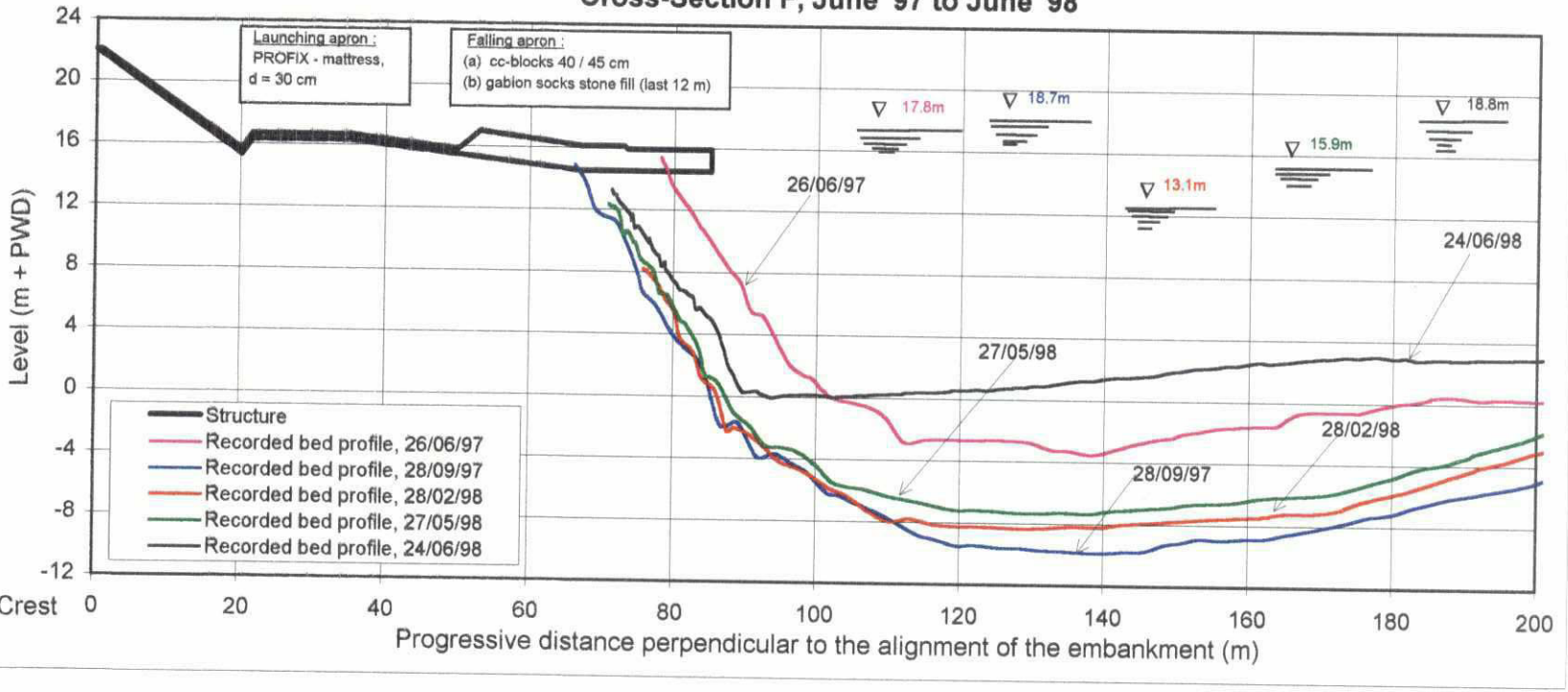
Cross-Section F, June '97 to June '98

Horizontal Scale:
1:1000

Vertical Scale:
1:500

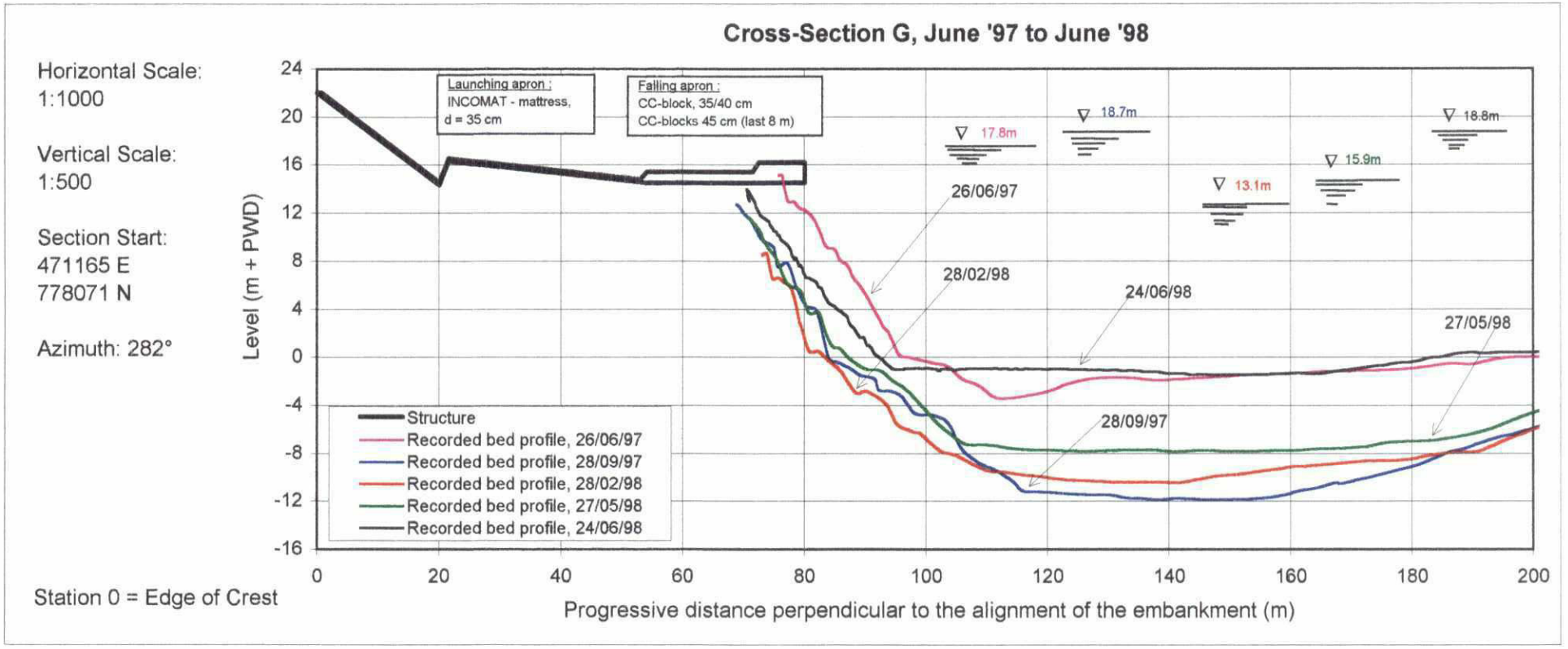
Section Start:
471185 E
778162 N

Azimuth: 282°

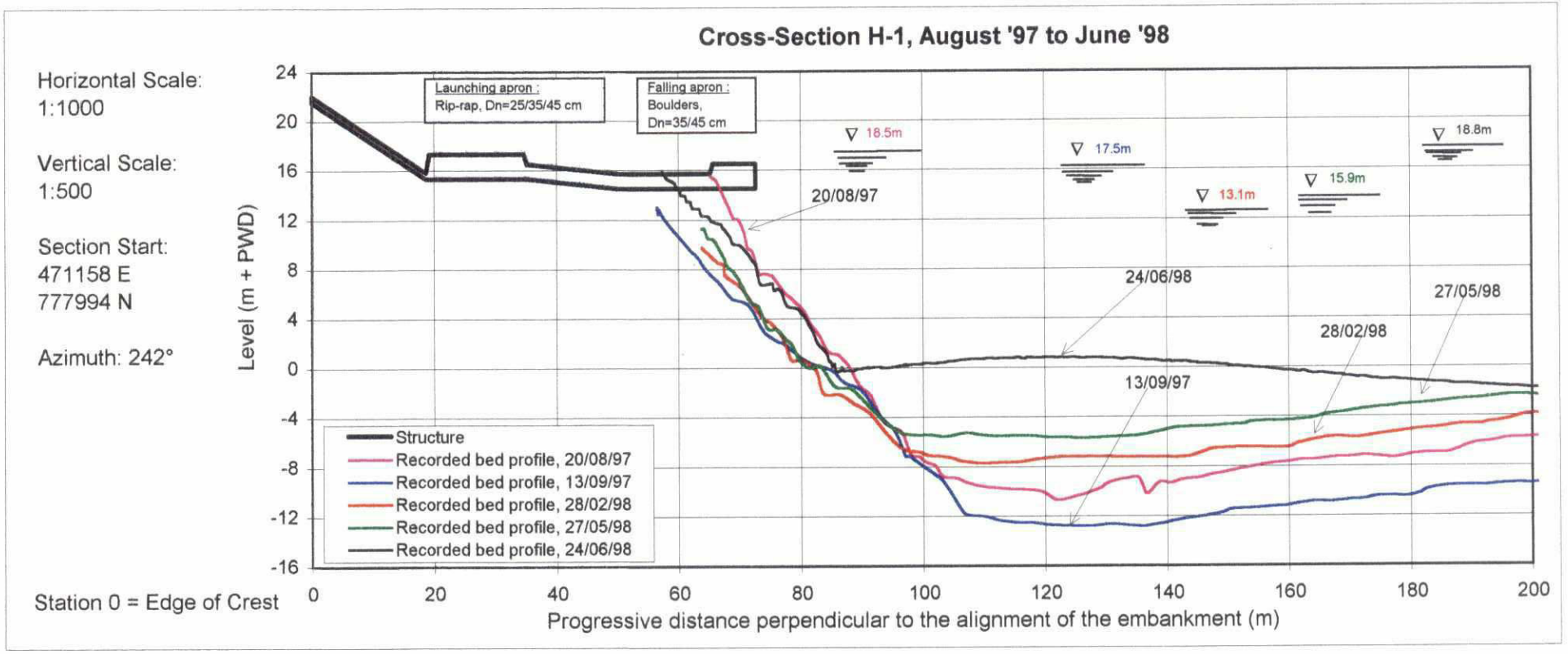


Station 0 = Edge of Crest

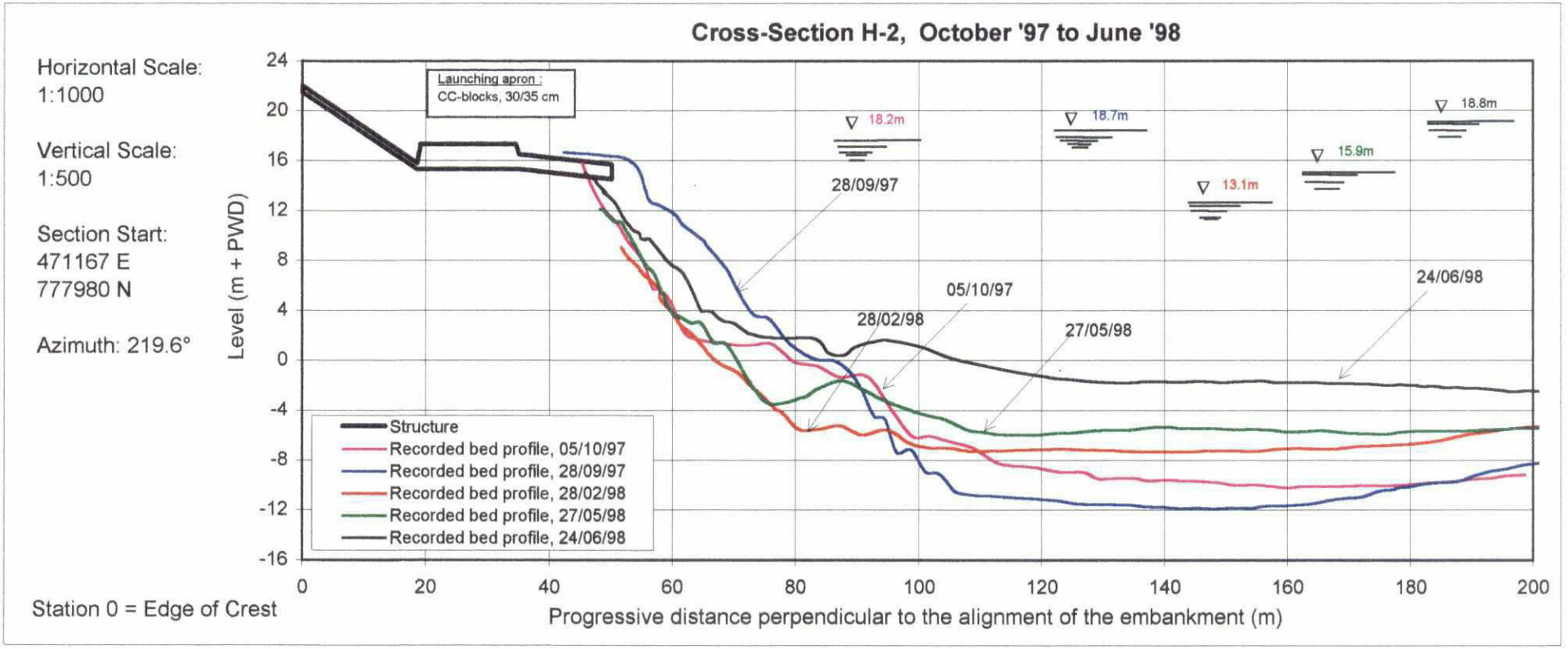
BAHADURABAD (FAP 21) - TEST SITE II



BAHADURABAD (FAP 21) - TEST SITE II



BAHADURABAD (FAP 21) - TEST SITE II



ANNEX K

FAP 21 / Test Site II

- Photographs

Photo 1: Adaptation works in Section H in progress end of April 1998

Photo 2: Section H after completion of adaptation works on May 05, 1998

ANNEX L

FAP 22 / Test Site I

- Water Level

RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KATLAMARI TEST SITE
MONTH : APRIL 1998

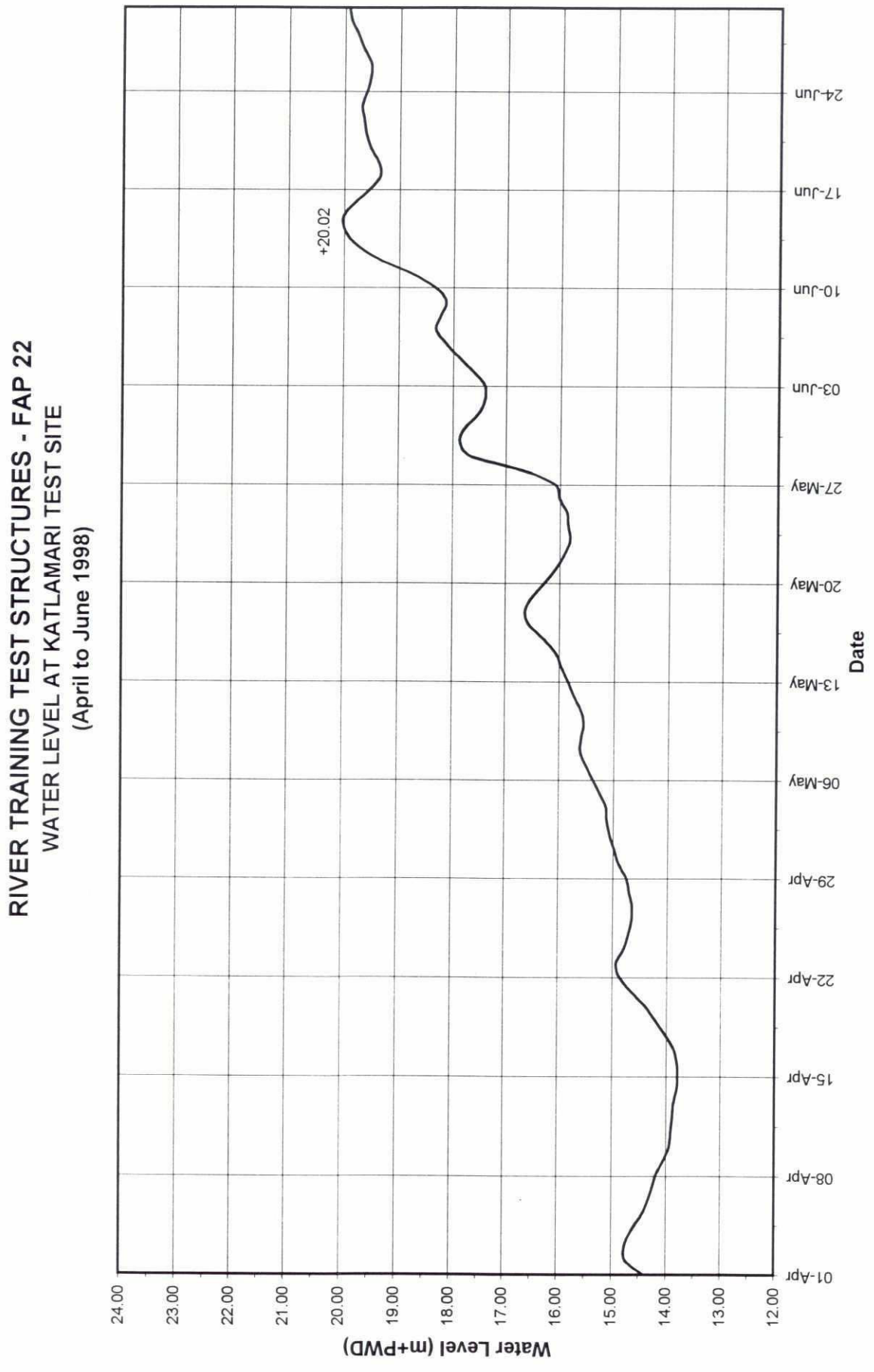
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	14.410	14.510	14.570	
2	14.740	14.760	14.770	
3	14.760	14.750	14.730	
4	14.640	14.610	14.580	
5	14.470	14.460	14.430	
6	14.350	14.330	14.310	
7	14.260	14.250	14.240	
8	14.190	14.170	14.150	
9	14.060	14.040	14.020	
10	13.940	13.920	13.900	
11	13.920	13.910	13.910	
12	13.890	13.890	13.880	
13	13.870	13.860	13.850	
14	13.810	13.800	13.790	
15	13.790	13.790	13.790	
16	13.810	13.820	13.830	
17	13.880	13.910	13.930	
18	14.040	14.070	14.100	
19	14.220	14.250	14.270	
20	14.400	14.440	14.470	
21	14.650	14.700	14.730	
22	14.870	14.880	14.890	
23	14.930	14.910	14.900	
24	14.790	14.780	14.770	
25	14.710	14.710	14.760	
26	14.650	14.650	14.640	
27	14.640	14.650	14.660	
28	14.700	14.710	14.720	
29	14.760	14.780	14.800	
30	14.900	14.940	14.950	

RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KATLAMARI TEST SITE
MONTH : MAY 1998

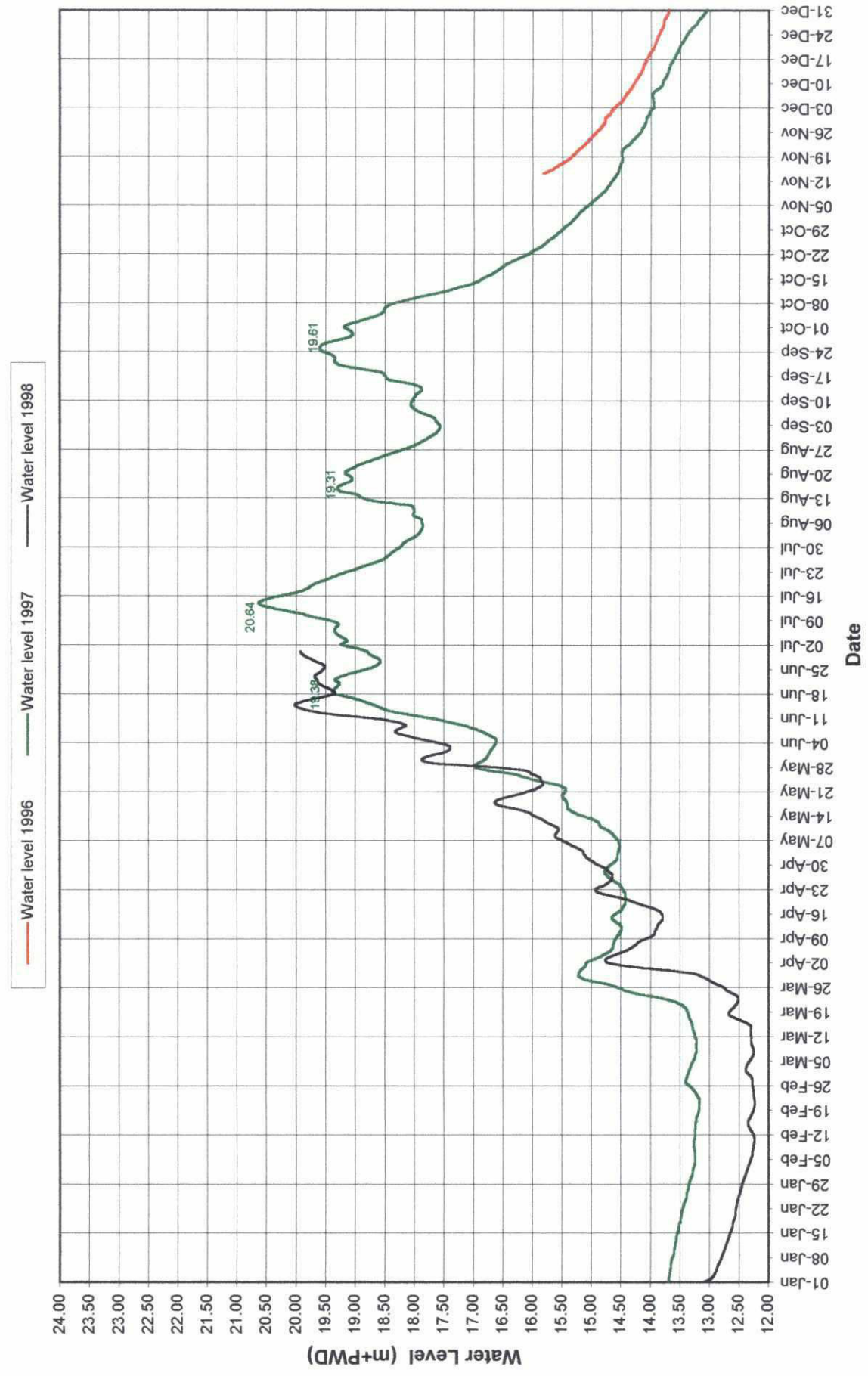
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	14.980	14.990	15.010	
2	15.070	15.090	15.090	
3	15.120	15.120	15.120	
4	15.140	15.150	15.160	
5	15.250	15.270	15.290	
6	15.380	15.400	15.420	
7	15.510	15.530	15.550	
8	15.610	15.600	15.600	
9	15.600	15.590	15.580	
10	15.550	15.550	15.550	
11	15.610	15.640	15.660	
12	15.740	15.750	15.760	
13	15.840	15.880	15.900	
14	15.970	15.990	16.010	
15	16.070	16.100	16.150	
16	16.300	16.360	16.410	
17	16.570	16.600	16.620	
18	16.640	16.630	16.610	
19	16.510	16.480	16.460	
20	16.290	16.250	16.220	
21	16.080	16.050	16.020	
22	15.920	15.900	15.880	
23	15.820	15.810	15.800	
24	15.850	15.860	15.860	
25	15.880	15.890	15.900	
26	16.020	16.030	16.020	
27	16.110	16.140	16.170	
28	16.730	16.970	17.160	
29	17.680	17.780	17.840	
30	17.880	17.880	17.870	
31	17.780	17.730	17.680	

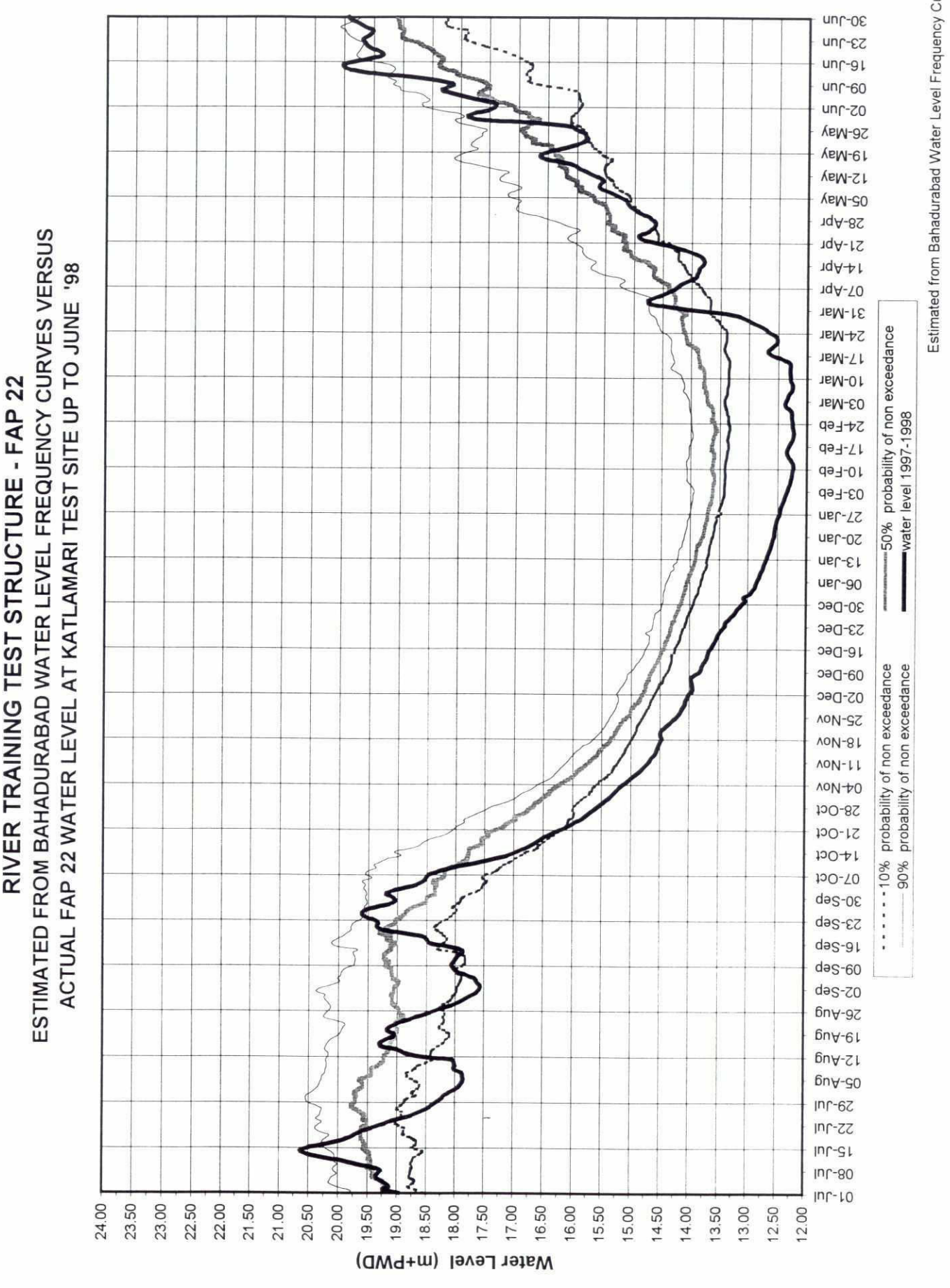
RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KATLAMARI TEST SITE
MONTH : JUNE 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	17.530	17.490	17.470	
2	17.410	17.410	17.400	
3	17.410	17.470	17.520	
4	17.630	17.680	17.720	
5	17.890	17.940	17.980	
6	18.140	18.190	18.220	
7	18.330	18.330	18.330	
8	18.240	18.220	18.200	
9	18.140	18.170	18.200	
10	18.350	18.430	18.480	
11	18.790	18.920	18.990	
12	19.370	19.460	19.560	
13	19.770	19.840	19.890	
14	19.980	20.020	20.020	
15	20.020	20.000	19.970	
16	19.820	19.770	19.720	
17	19.550	19.480	19.430	
18	19.350	19.330	19.340	
19	19.400	19.440	19.470	
20	19.540	19.570	19.600	
21	19.620	19.620	19.620	
22	19.650	19.680	19.680	
23	19.690	19.680	19.670	
24	19.600	19.570	19.570	
25	19.540	19.520	19.530	
26	19.530	19.550	19.570	
27	19.660	19.680	19.720	
28	19.760	19.780	19.810	
29	19.880	19.890	19.900	
30	19.930	19.930	19.930	


RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KATLAMARI TEST SITE
(April to June 1998)
+20.02
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
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

RIVER TRAINING TEST STRUCTURE - FAP 22
WATER LEVEL AT KATLAMARI TEST SITE
(January to December)

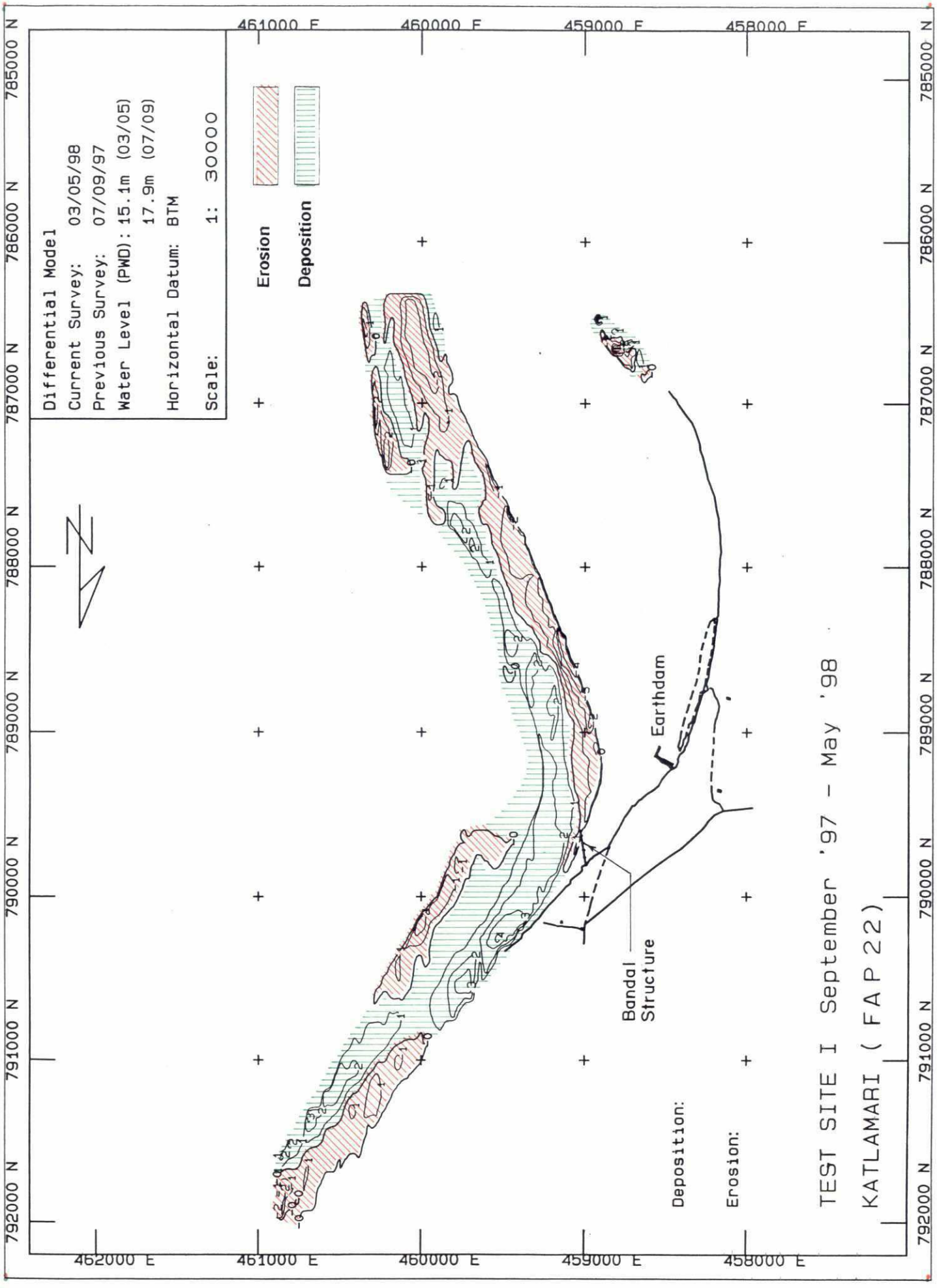



RIVER TRAINING TEST STRUCTURE - FAP 22
ESTIMATED FROM BAHADURABAD WATER LEVEL FREQUENCY CURVES VERSUS
ACTUAL FAP 22 WATER LEVEL AT KATLAMARI TEST SITE UP TO JUNE '98
Water Level (m+PWD)
24.00
23.50
23.00
22.50
22.00
21.50
21.00
20.50
20.00
19.50
19.00
18.50
18.00
17.50
17.00
16.50
16.00
15.50
15.00
14.50
14.00
13.50
13.00
12.50
12.00
01-Jul
08-Jul
15-Jul
22-Jul
29-Jul
05-Aug
12-Aug
19-Aug
26-Aug
02-Sep
09-Sep
16-Sep
23-Sep
30-Sep
07-Oct
14-Oct
21-Oct
28-Oct
04-Nov
11-Nov
18-Nov
25-Nov
02-Dec
09-Dec
16-Dec
23-Dec
30-Dec
06-Jan
13-Jan
20-Jan
27-Jan
03-Feb
10-Feb
17-Feb
24-Feb
03-Mar
10-Mar
17-Mar
24-Mar
31-Mar
07-Apr
14-Apr
21-Apr
28-Apr
05-May
12-May
19-May
26-May
02-Jun
09-Jun
16-Jun
23-Jun
30-Jun
10% probability of non exceedance
50% probability of non exceedance
90% probability of non exceedance
water level 1997-1998
Estimated from Bahadurabad Water Level Frequency Curves

ANNEX M

FAP 22 / Test Site II

- Differential Model


Differential Model
Current Survey: 03/05/98
Previous Survey: 07/09/97
Water Level (PWD): 15.1m (03/05)
17.9m (07/09)
Horizontal Datum: BTM
Scale: 1: 30000
Erosion
Deposition
461000 E
460000 E
459000 E
458000 E
462000 E
792000 N
791000 N
790000 N
789000 N
788000 N
787000 N
786000 N
785000 N
Earthdam
Bandal Structure
Deposition:
Erosion:
TEST SITE I September '97 - May '98
KATLAMARI (FAP 22)

ANNEX N

FAP 22 / Test Site II

- Water Level

RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KUNDARAPARA TEST SITE
MONTH : APRIL 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	16.470	16.520	16.550	
2	16.630	16.630	16.630	
3	16.600	16.570	16.560	
4	16.470	16.460	16.410	
5	16.330	16.310	16.280	
6	16.230	16.220	16.210	
7	16.190	16.180	16.170	
8	16.130	16.120	16.100	
9	16.030	16.010	15.990	
10	15.970	15.970	15.970	
11	15.980	15.980	15.970	
12	15.960	15.960	15.950	
13	15.930	15.930	15.920	
14	15.900	15.900	15.890	
15	15.890	15.890	15.900	
16	15.920	15.920	15.920	
17	15.990	16.010	16.030	
18	16.100	16.130	16.150	
19	16.220	16.240	16.280	
20	16.380	16.430	16.450	
21	16.570	16.620	16.640	
22	16.730	16.730	16.710	
23	16.710	16.680	16.670	
24	16.590	16.580	16.570	
25	16.540	16.530	16.520	
26	16.490	16.480	16.490	
27	16.510	16.520	16.520	
28	16.540	16.550	16.560	
29	16.610	16.620	16.640	
30	16.720	16.730	16.740	

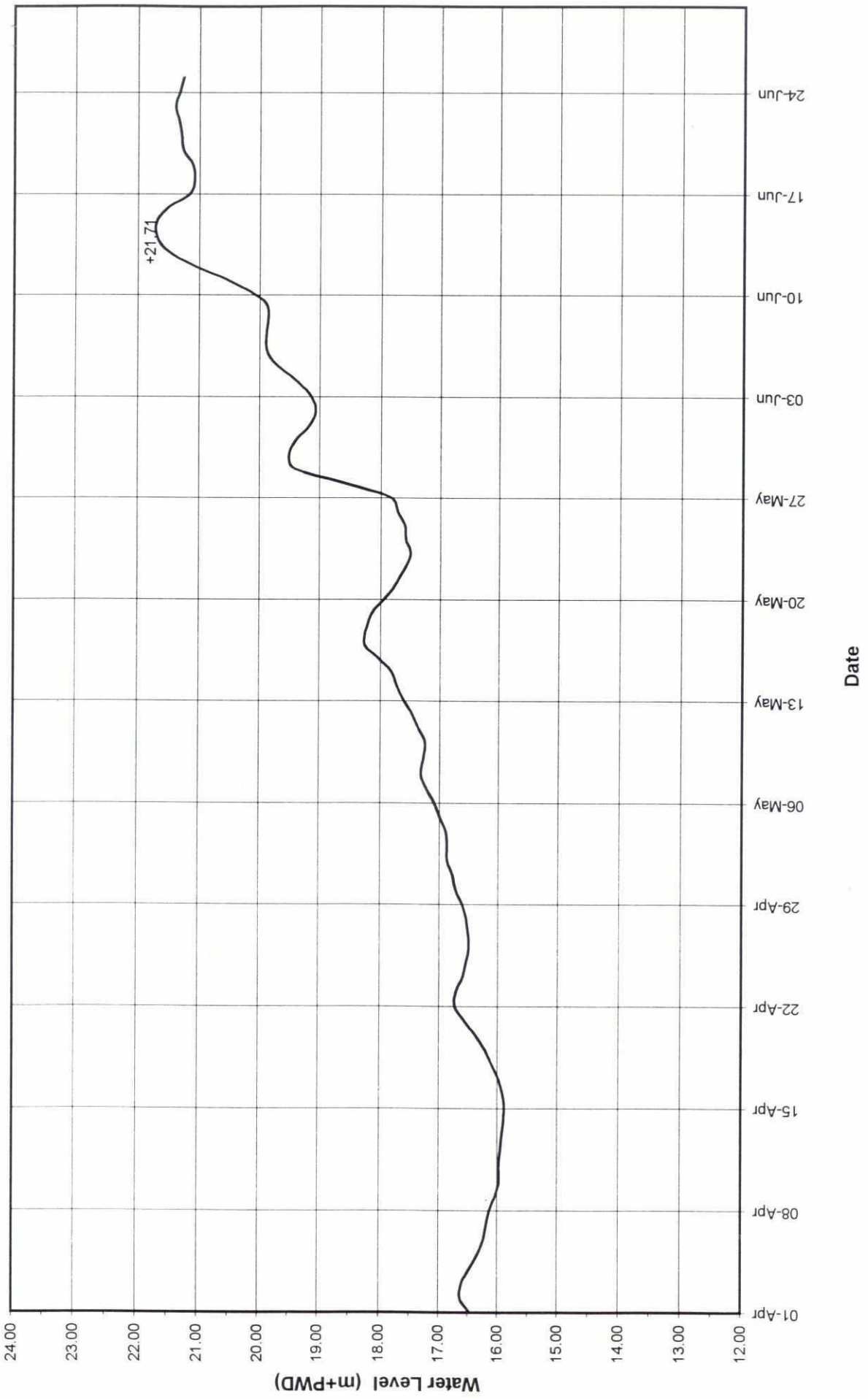
RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KUNDARAPARA TEST SITE
MONTH : MAY 1998

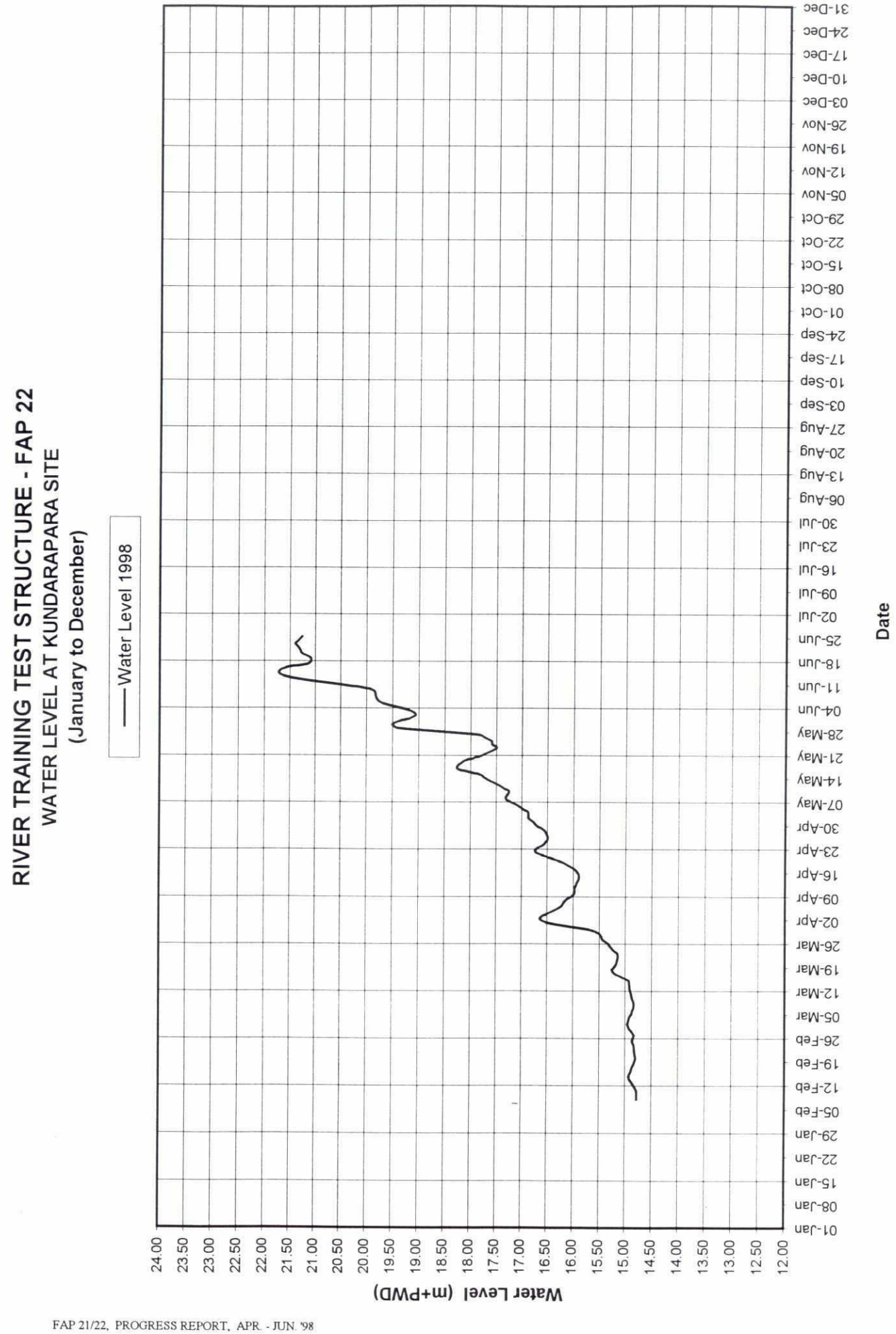
DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	16.780	16.780	16.790	
2	16.870	16.880	16.880	
3	16.870	16.870	16.870	
4	16.890	16.910	16.930	
5	17.000	17.020	17.040	
6	17.100	17.130	17.150	
7	17.240	17.270	17.280	
8	17.320	17.320	17.320	
9		17.280	17.270	
10	17.250	17.250	17.260	
11	17.360	17.390	17.410	
12	17.470	17.500	17.530	
13	17.610	17.630	17.660	
14	17.730	17.750	17.770	
15	17.820	17.850	17.880	
16	18.060	18.120	18.170	
17	18.270	18.300	18.310	
18		18.280	18.260	
19	18.150	18.110	18.080	
20	17.940	17.900	17.870	
21	17.760	17.760	17.690	
22		17.570	17.550	
23	17.510	17.500	17.490	
24	17.580	17.580	17.570	
25	17.600	17.600	17.610	
26	17.720	17.730	17.740	
27	17.840	17.880	17.960	
28	18.620		18.940	
29	19.420	19.490	19.540	
30	19.510	19.490	19.470	
31	19.390	19.350	19.310	

RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KUNDARAPARA TEST SITE
MONTH : JUNE 1998

DAYS	TIME			REMARKS
	8.00	13.00	17.00	
1	19.170	19.130	19.100	
2	19.070	19.070	19.060	
3	19.150	19.190	19.220	
4	19.370	19.420	19.460	
5		19.690	19.630	
6	19.770	19.900	19.840	
7				
8		19.910	19.890	
9	19.860	19.880	19.930	
10	20.090	20.140	20.260	
11	20.540	21.220	20.680	
12	21.100	21.590	21.320	
13	21.520	21.730	21.630	
14	21.700	21.680	21.740	
15	21.690	21.440	21.600	
16	21.530	21.170	21.400	
17	21.160	21.100	21.150	
18	21.090	21.160	21.110	
19	21.120	21.280	21.180	
20	21.270	21.390	21.290	
21	21.300	21.330	21.330	
22	21.340	21.390	21.390	
23	21.400	21.430	21.420	
24	21.330	21.320	21.320	
25	21.270	21.260	21.260	
26				
27				
28				
29				
30				

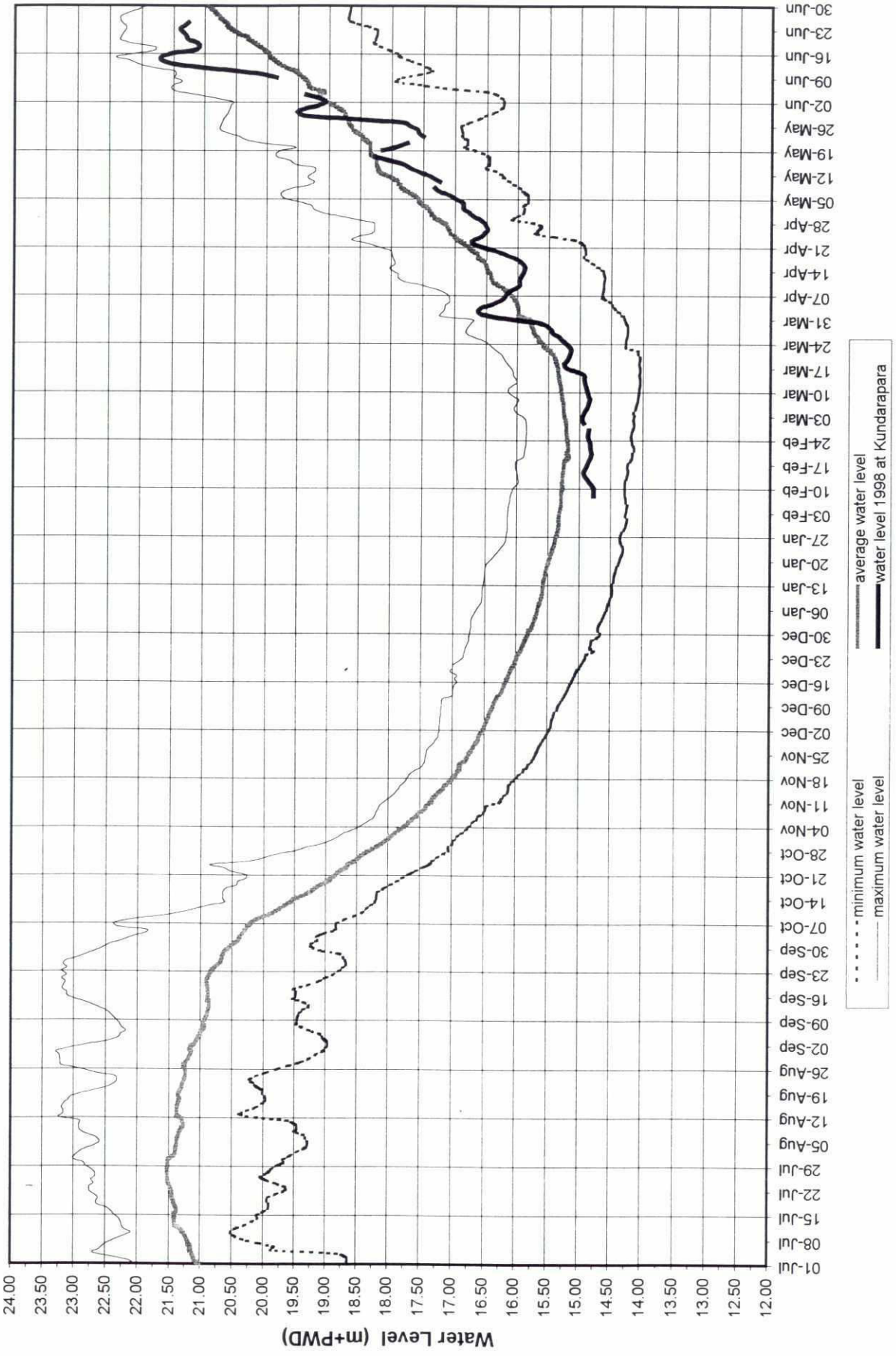
RIVER TRAINING TEST STRUCTURES - FAP 22
WATER LEVEL AT KUNDARAPARA TEST SITE
(April to June 1998)




RIVER TRAINING TEST STRUCTURE - FAP 22
WATER LEVEL AT KUNDARAPARA SITE
(January to December)
Water Level 1998
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
01-Jan
08-Jan
15-Jan
22-Jan
29-Jan
05-Feb
12-Feb
19-Feb
26-Feb
05-Mar
12-Mar
19-Mar
26-Mar
02-Apr
09-Apr
16-Apr
23-Apr
30-Apr
07-May
14-May
21-May
28-May
04-Jun
11-Jun
18-Jun
25-Jun
02-Jul
09-Jul
16-Jul
23-Jul
30-Jul
06-Aug
13-Aug
20-Aug
27-Aug
03-Sep
10-Sep
17-Sep
24-Sep
01-Oct
08-Oct
15-Oct
22-Oct
29-Oct
05-Nov
12-Nov
19-Nov
26-Nov
03-Dec
10-Dec
17-Dec
24-Dec
31-Dec
Date

RIVER TRAINING TEST STRUCTURES - FAP 22

BWDB WATER LEVEL FREQUENCY CURVES VERSUS ACTUAL FAP 22 WATER LEVEL AT KAMARJANI TEST SITE UP TO JUNE '98

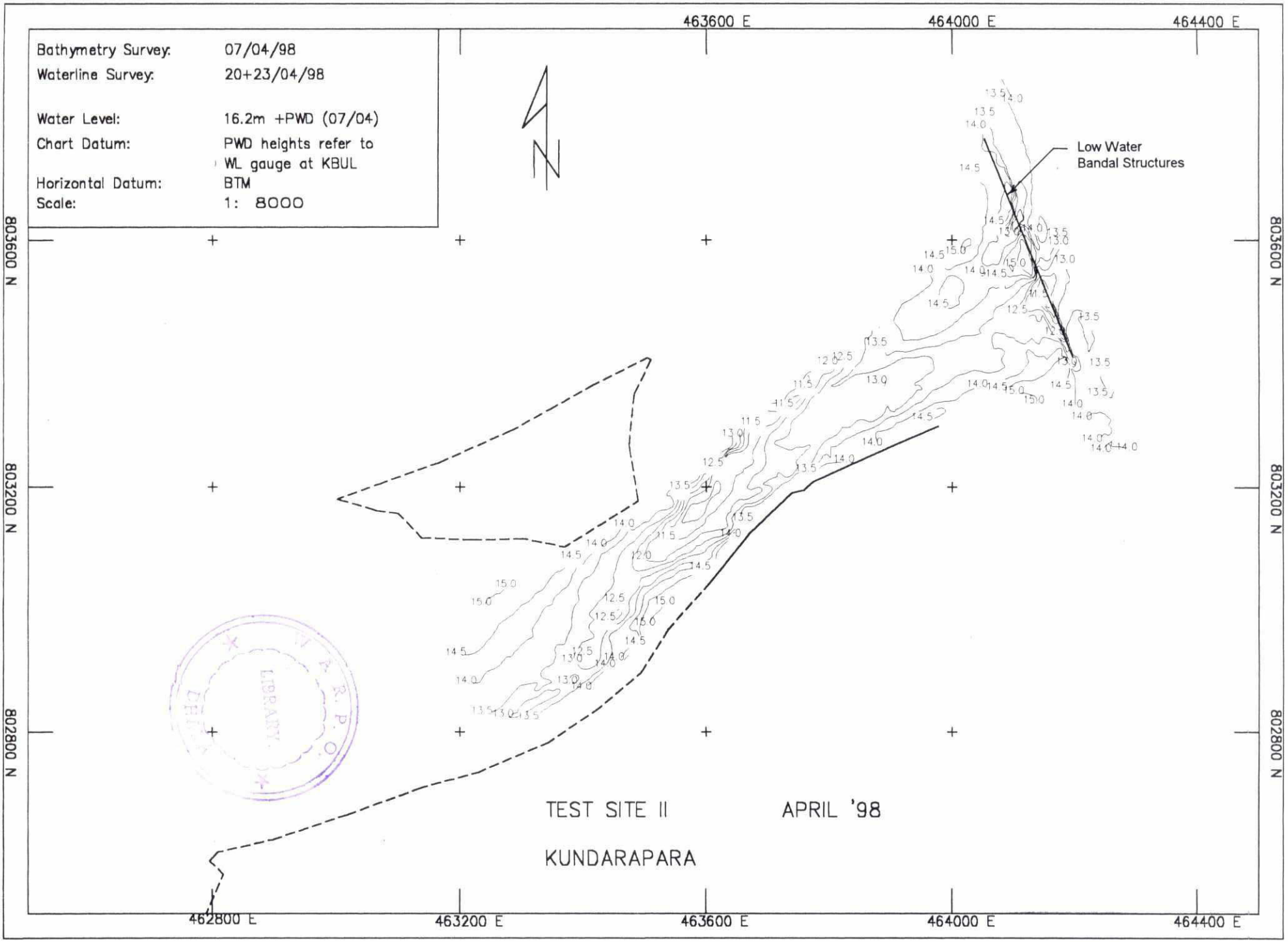


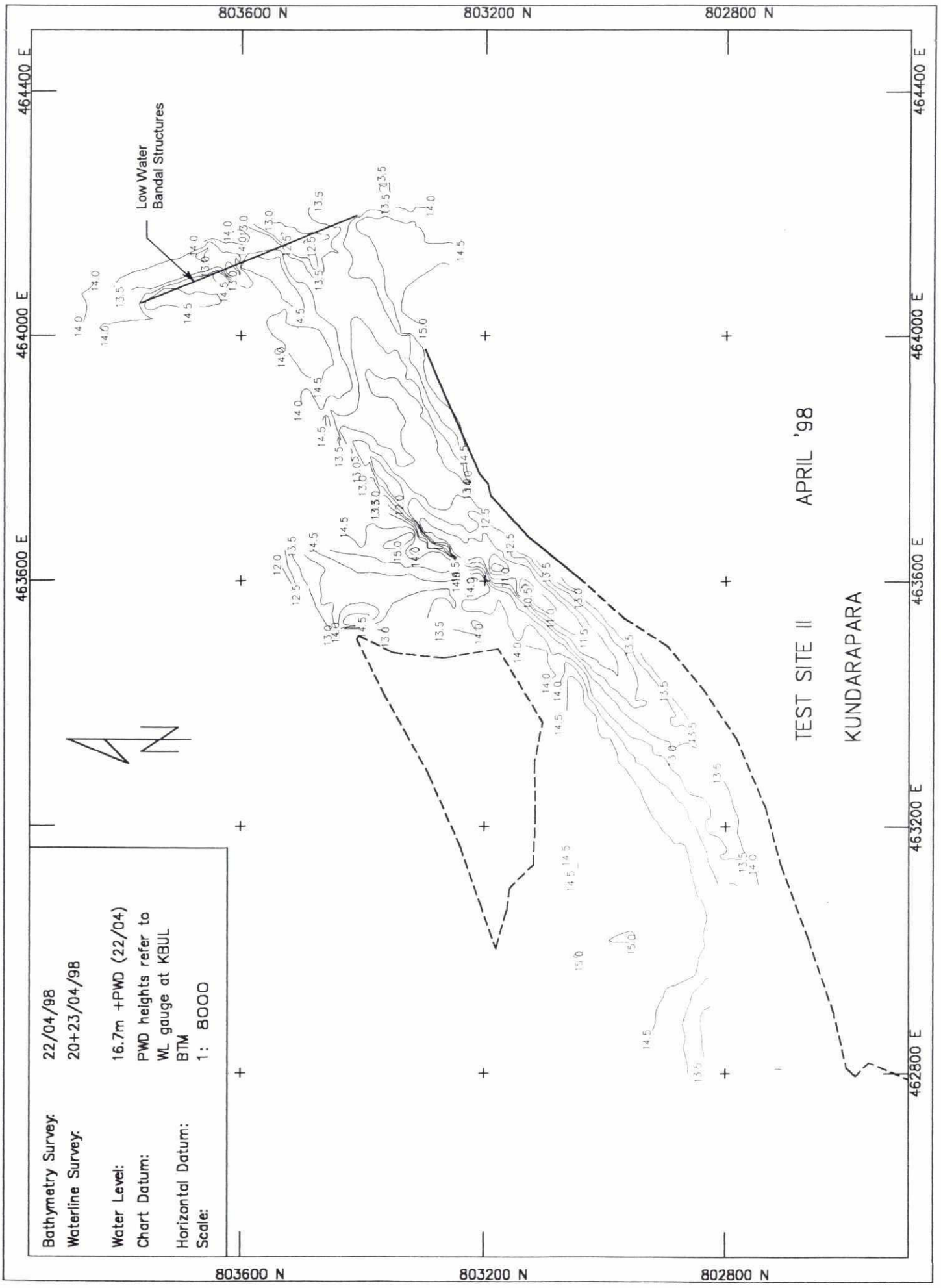
BWDB Data: Period of Record 1957 ~ 1997

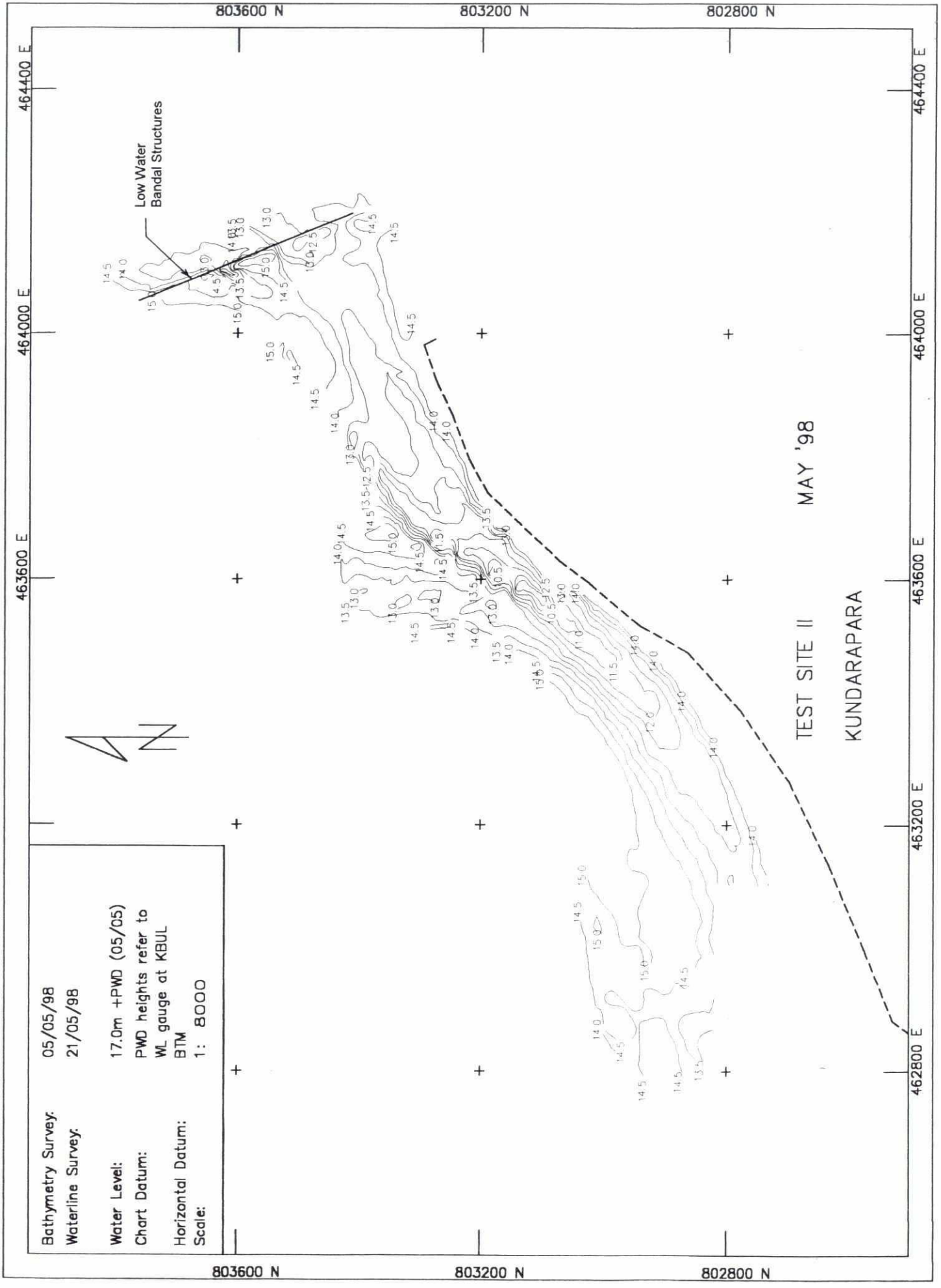
ANNEX O

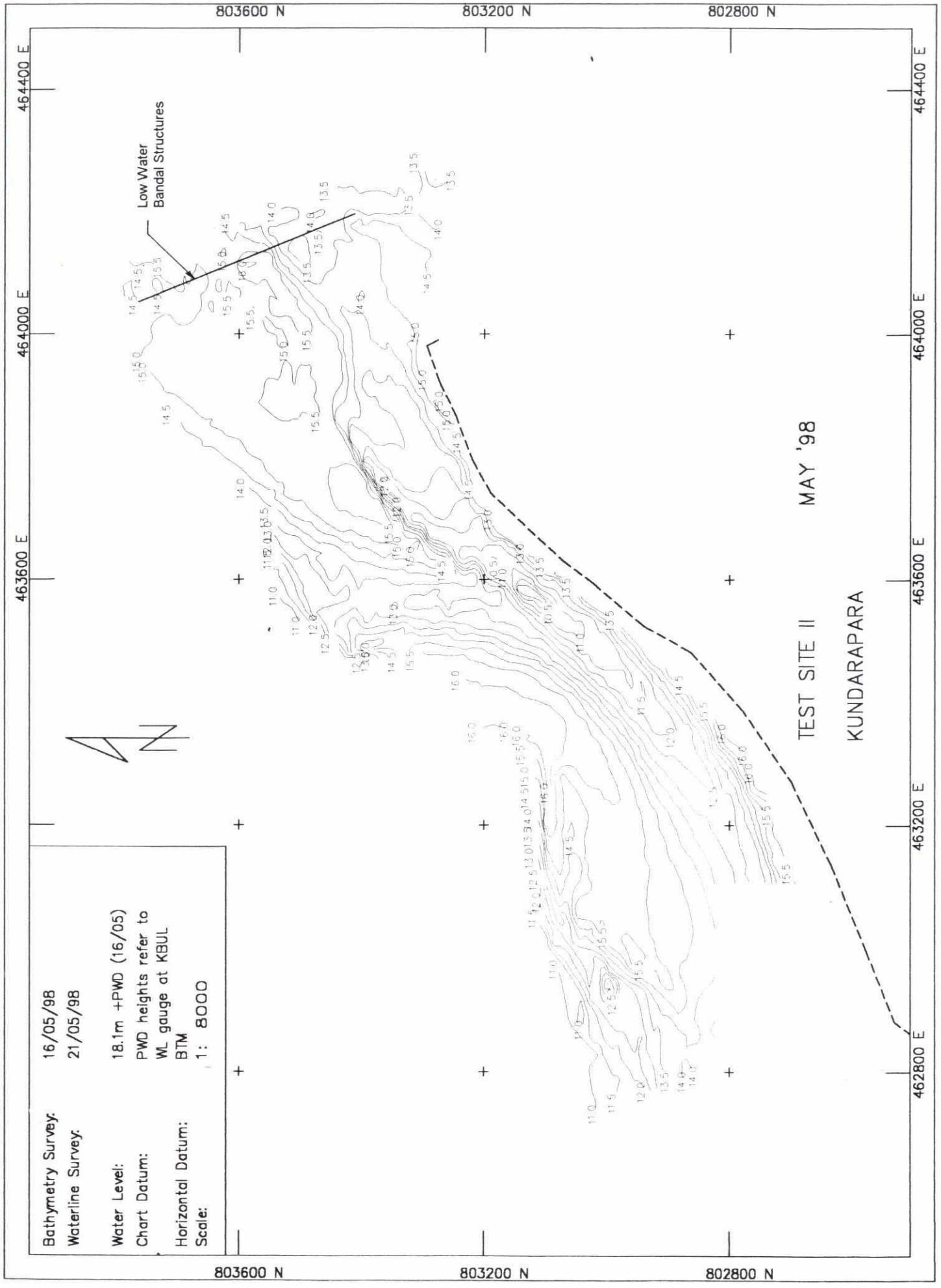
FAP 22 / Test Site II

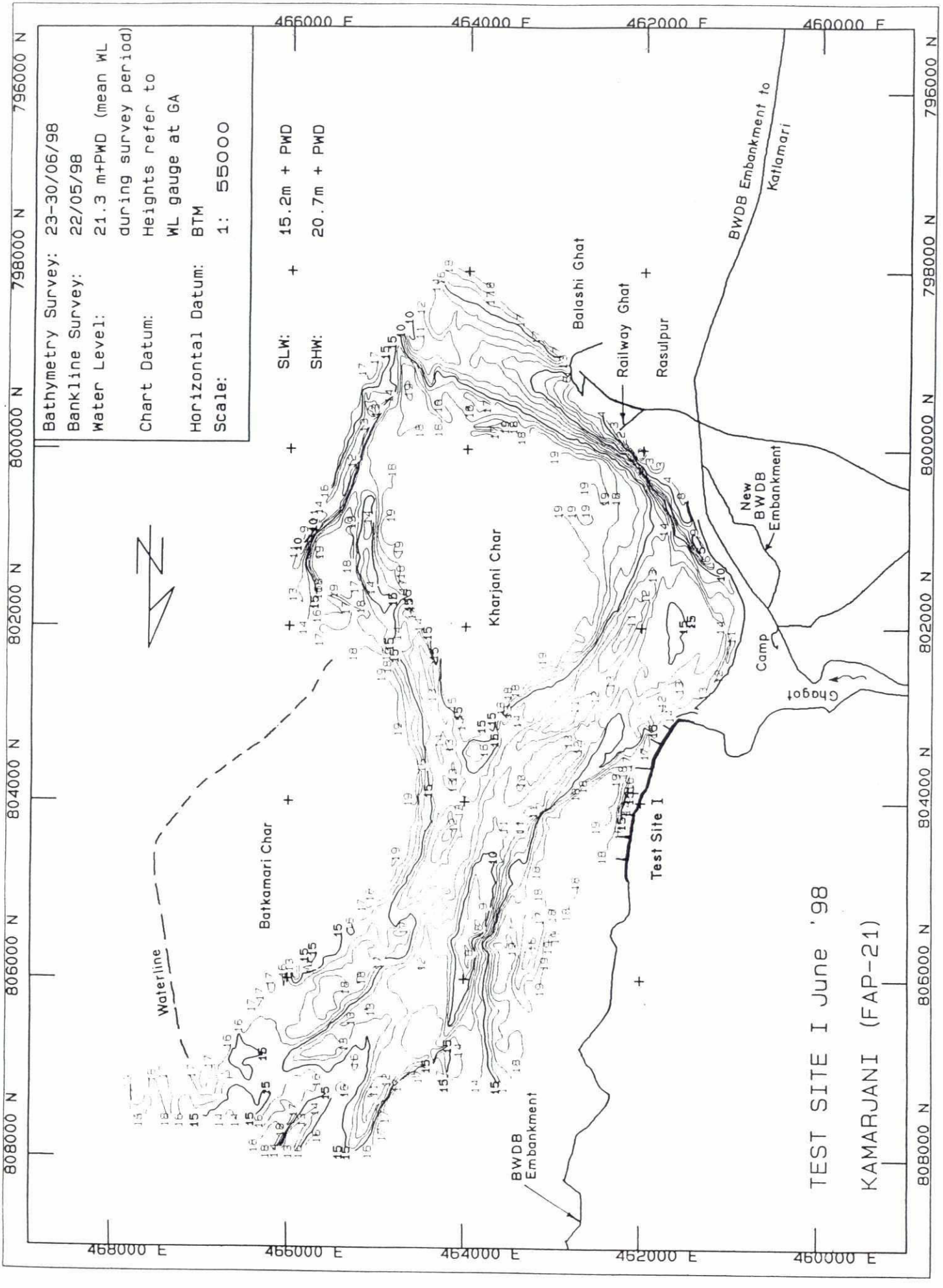
- Bathymetric Survey


Bathymetry Survey: 07/04/98
Waterline Survey: 20+23/04/98
Water Level: 16.2m +PWD (07/04)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 8000
463600 E
464000 E
464400 E
462800 E
463200 E
803600 N
803200 N
802800 N
Low Water
Bandal Structures
TEST SITE II APRIL '98
KUNDARAPARA
LIBRARY


803600 N
803200 N
802800 N
464400 E
464000 E
463600 E
463200 E
462800 E
Low Water
Bandal Structures
TEST SITE II
APRIL '98
KUNDARAPARA
Bathymetry Survey: 22/04/98
Waterline Survey: 20+23/04/98
Water Level: 16.7m +PWD (22/04)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 8000


803600 N
803200 N
802800 N
464400 E
464000 E
463600 E
463200 E
462800 E
Low Water
Bandal Structures
TEST SITE II
KUNDARAPARA
MAY '98
Bathymetry Survey: 05/05/98
Waterline Survey: 21/05/98
Water Level: 17.0m +PWD (05/05)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 8000

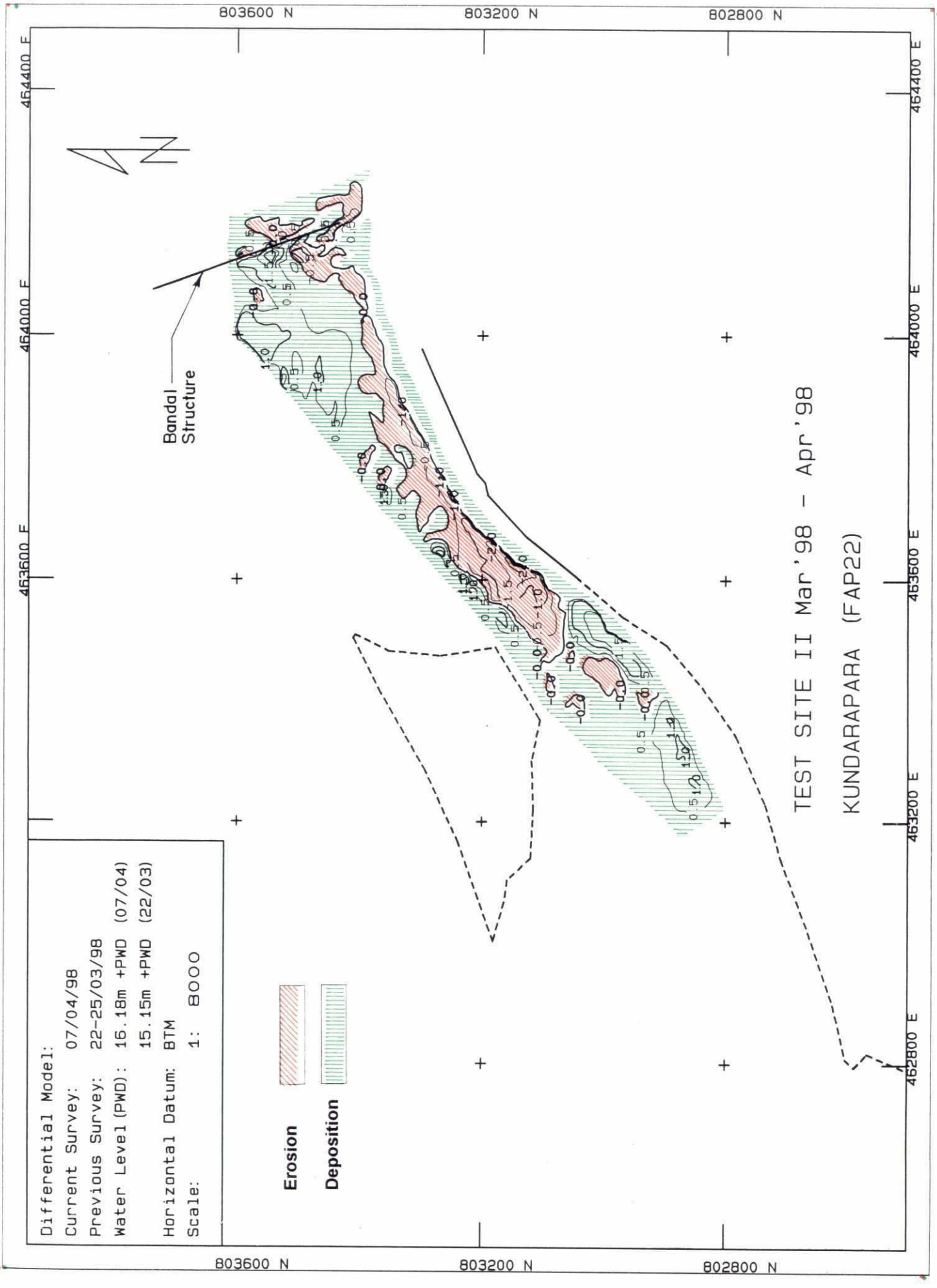

803600 N
803200 N
802800 N
464400 E
464000 E
463600 E
463200 E
462800 E
Low Water
Bandal Structures
TEST SITE II
KUNDARAPARA
MAY '98
Bathymetry Survey: 16/05/98
Waterline Survey: 21/05/98
Water Level: 18.1m +PWD (16/05)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 8000

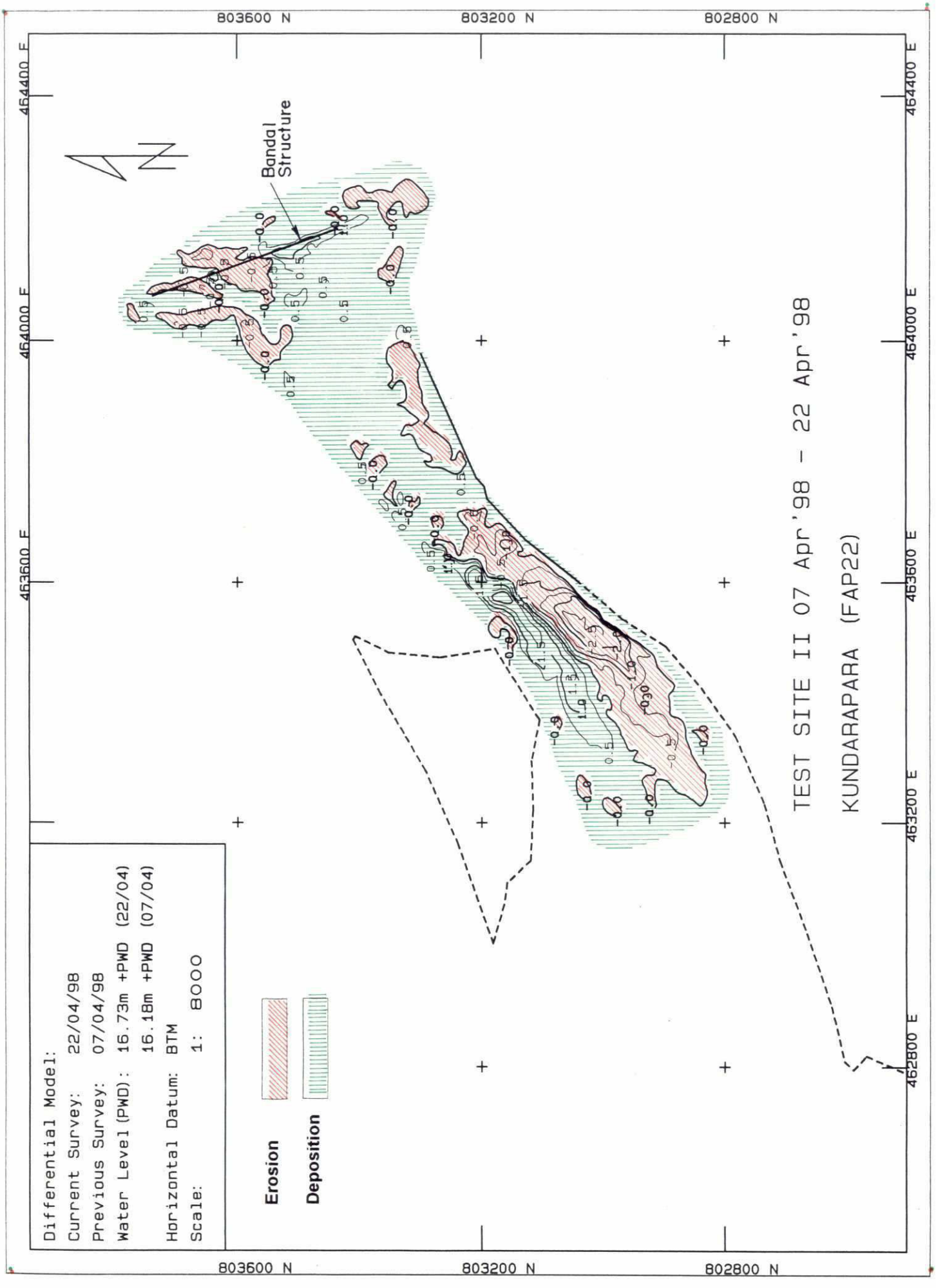

Bathymetry Survey: 23-30/06/98
Bankline Survey: 22/05/98
Water Level: 21.3 m+PWD (mean WL during survey period)
Chart Datum: Heights refer to WL gauge at GA
Horizontal Datum: BTM
Scale: 1: 55000
SLW: 15.2m + PWD
SHW: 20.7m + PWD
466000 E
464000 E
462000 E
460000 E
796000 N
798000 N
800000 N
802000 N
804000 N
806000 N
808000 N
468000 E
Waterline
Batkamari Char
Kharjani Char
Balashi Ghat
Railway Ghat
Rasulpur
BWDB Embankment to Katlamari
New BWDB Embankment
Camp
Ghagot
Test Site I
BWDB Embankment
TEST SITE I June '98
KAMARJANI (FAP-21)

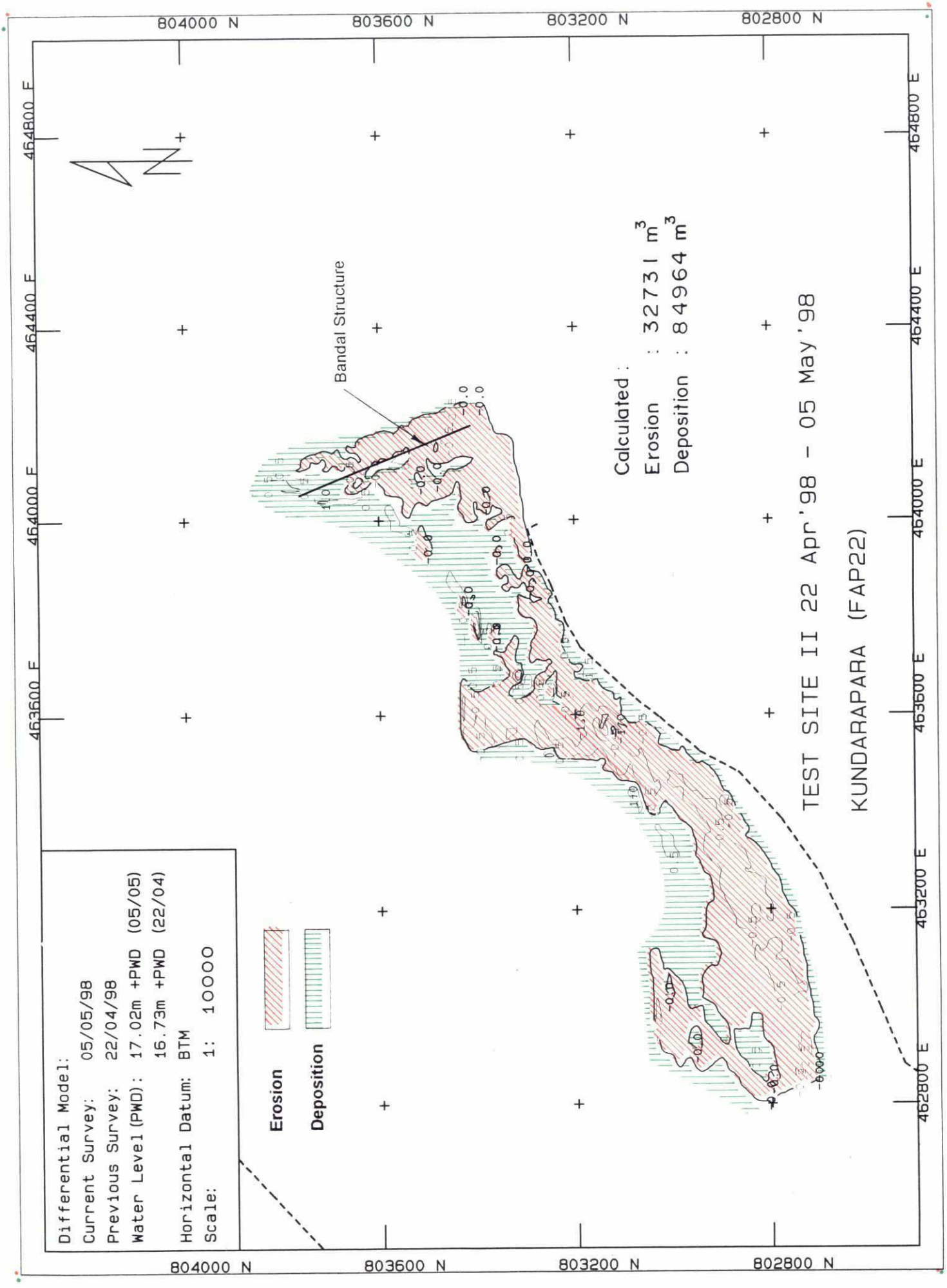
ANNEX P

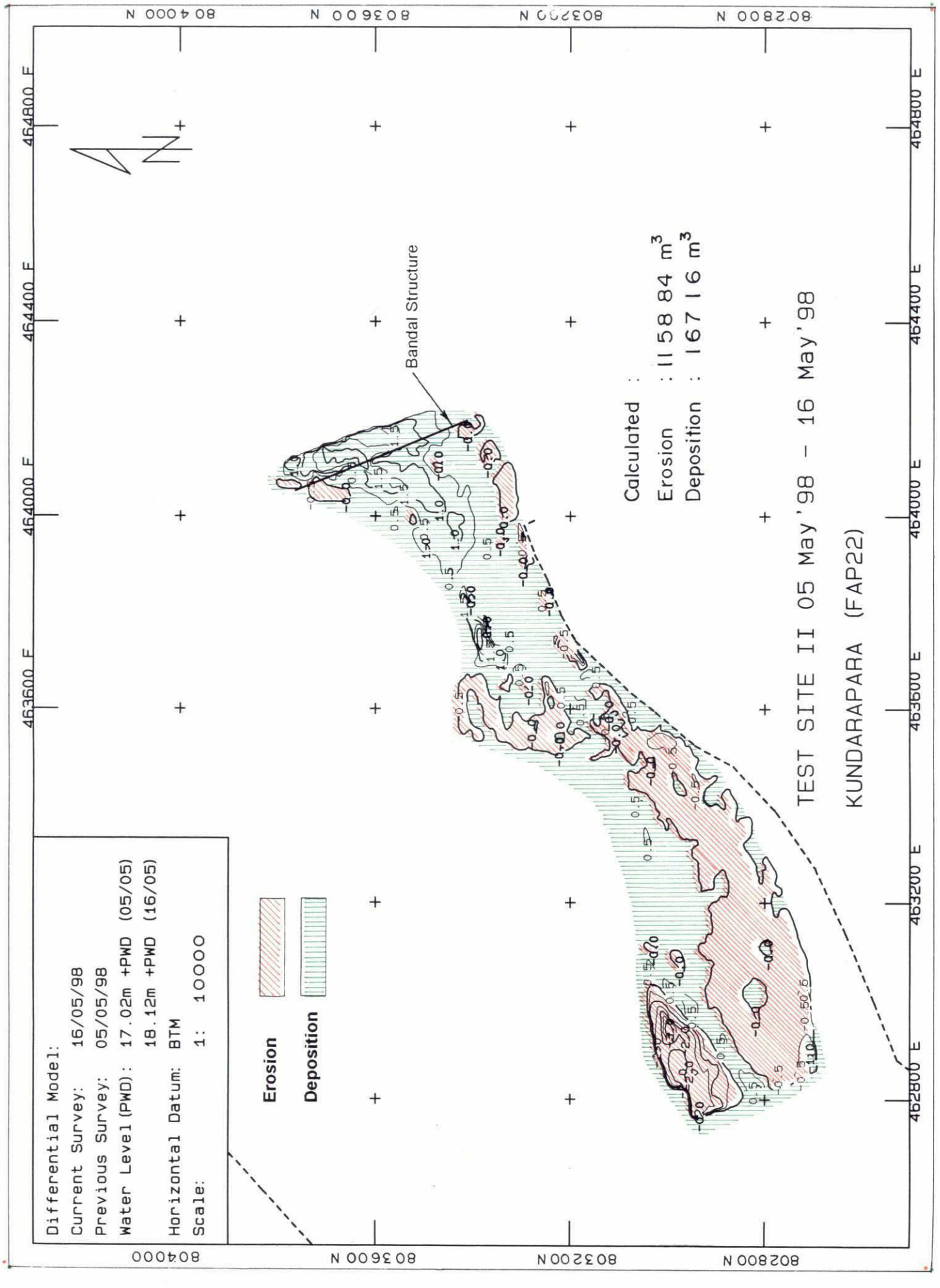
FAP 22 / Test Site II

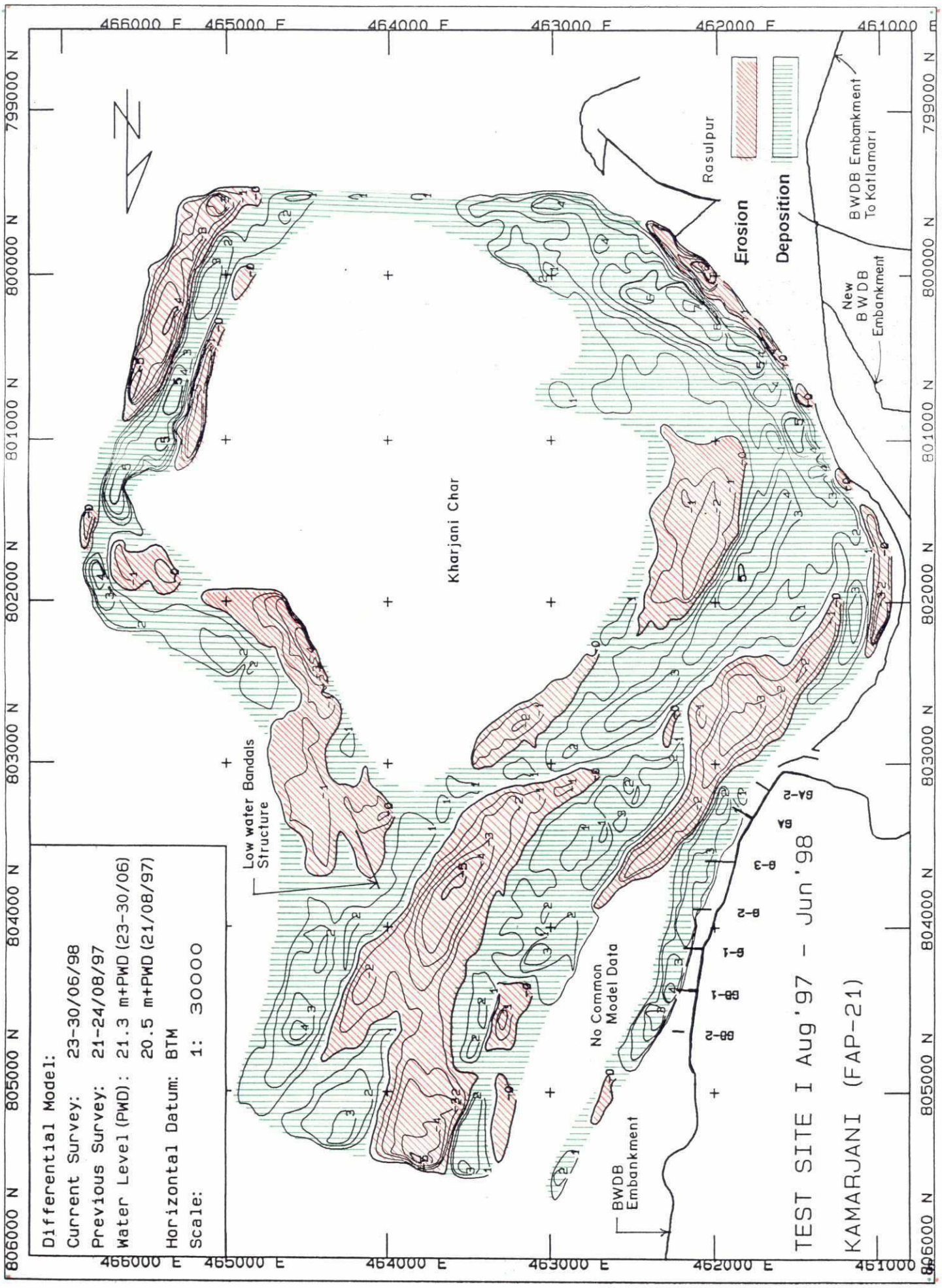
- Differential Model


803600 N
803200 N
802800 N
464400 E
464000 E
463600 E
463200 E
462800 E
Bandal Structure
TEST SITE II Mar'98 - Apr'98
KUNDARAPARA (FAP22)
Differential Model:
Current Survey: 07/04/98
Previous Survey: 22-25/03/98
Water Level (PWD): 16.18m +PWD (07/04)
15.15m +PWD (22/03)
Horizontal Datum: BTM
Scale: 1: 8000
Erosion
Deposition


803600 N
803200 N
802800 N
464400 E
464000 E
463600 E
463200 E
462800 E
Bandal Structure
TEST SITE II 07 Apr '98 - 22 Apr '98
KUNDARAPARA (FAP22)
Differential Model:
Current Survey: 22/04/98
Previous Survey: 07/04/98
Water Level (PWD): 16.73m +PWD (22/04)
16.18m +PWD (07/04)
Horizontal Datum: BTM
Scale: 1: 8000
Erosion
Deposition


804000 N
803600 N
803200 N
802800 N
464800 E
464400 E
464000 E
463600 E
463200 E
462800 E
Bandal Structure
Calculated :
Erosion : 32731 m3
Deposition : 84964 m3
TEST SITE II 22 Apr'98 - 05 May'98
KUNDARAPARA (FAP22)
Differential Model:
Current Survey: 05/05/98
Previous Survey: 22/04/98
Water Level(PWD): 17.02m +PWD (05/05)
16.73m +PWD (22/04)
Horizontal Datum: BTM
Scale: 1: 10000
Erosion
Deposition

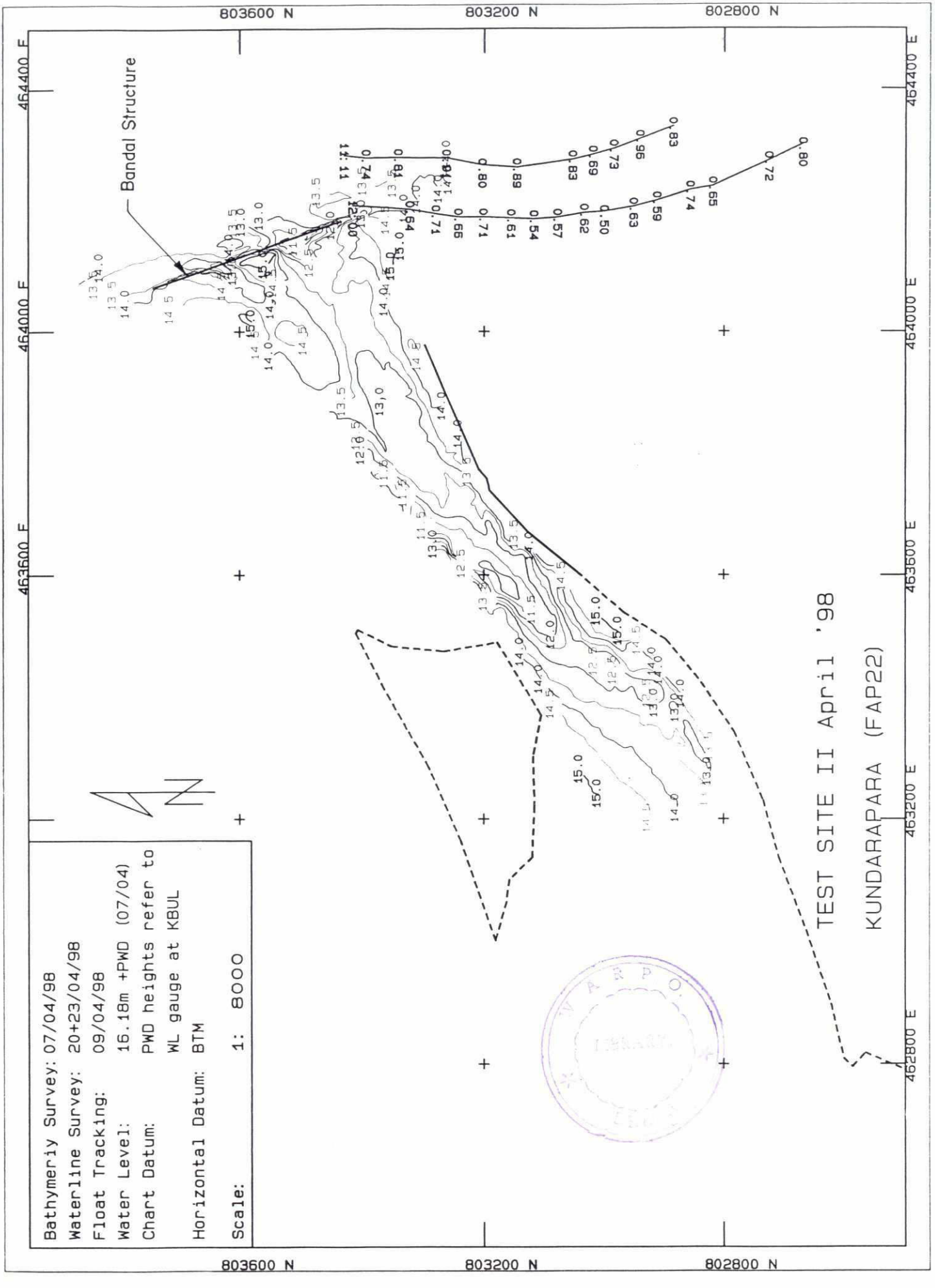

Differential Model:
Current Survey: 16/05/98
Previous Survey: 05/05/98
Water Level (PWD): 17.02m +PWD (05/05)
18.12m +PWD (16/05)
Horizontal Datum: BTM
Scale: 1: 10000
Erosion
Deposition
Bandal Structure
Calculated :
Erosion : 11584 m3
Deposition : 16716 m3
TEST SITE II 05 May'98 - 16 May'98
KUNDARAPARA (FAP22)
804000 N
803600 N
803200 N
802800 N
462800 E
463200 E
463600 E
464000 E
464400 E
464800 E

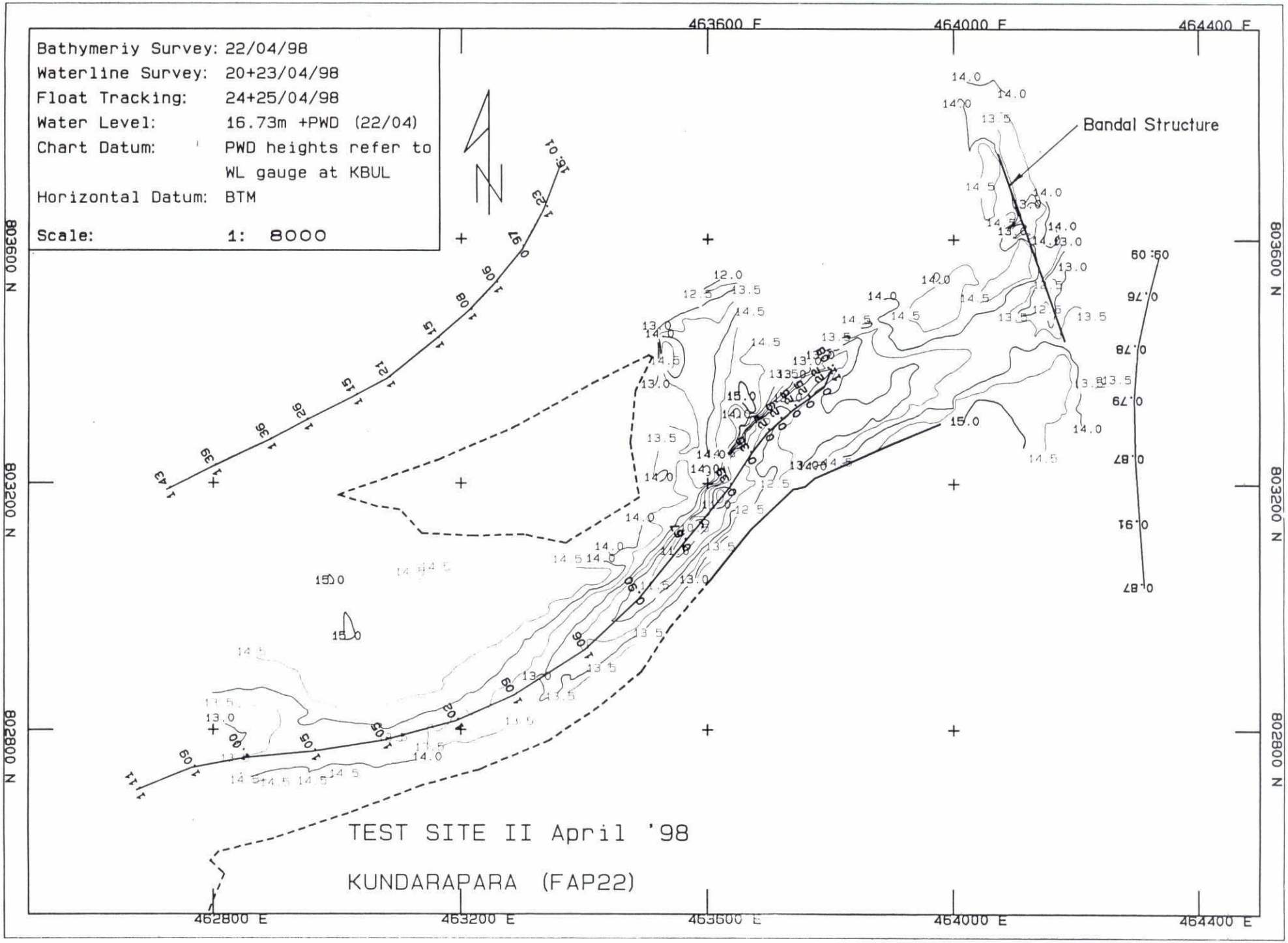

TEST SITE I Aug '97 - Jun '98
KAMARJANI (FAP-21)
Differential Model:
Current Survey: 23-30/06/98
Previous Survey: 21-24/08/97
Water Level (PWD): 21.3 m+PWD (23-30/06)
20.5 m+PWD (21/08/97)
Horizontal Datum: BTM
Scale: 1: 30000
Erosion
Deposition
Rasulpur
Kharjani Char
Low water Bandals Structure
No Common Model Data
BWDB Embankment
BWDB Embankment To Katiamari
New BWDB Embankment
466000 E
465000 E
464000 E
463000 E
462000 E
461000 E
806000 N
805000 N
804000 N
803000 N
802000 N
801000 N
800000 N
799000 N

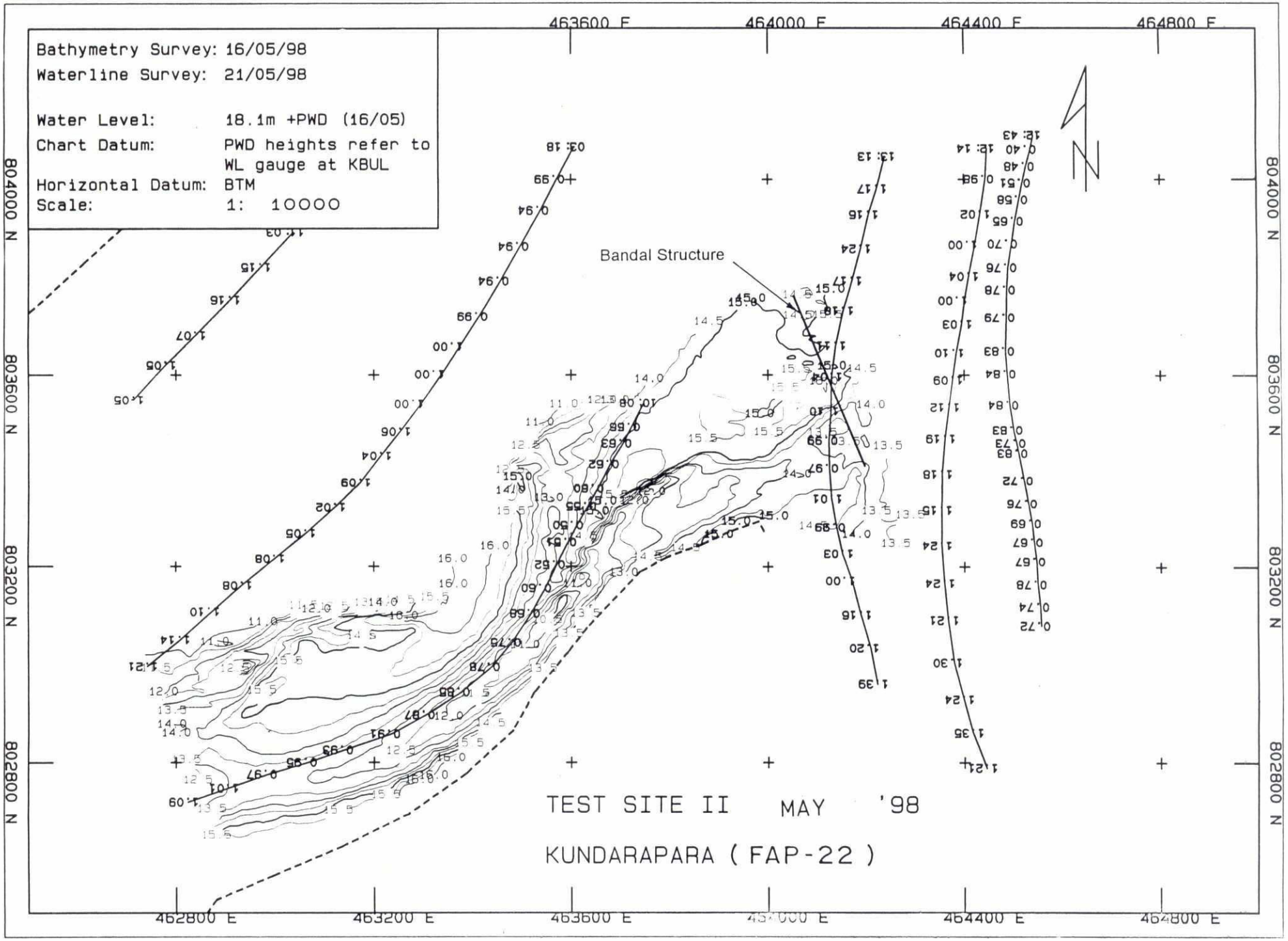
ANNEX Q

FAP 22 / Test Site II

- Flow Velocities


803600 N
803200 N
802800 N
464400 E
464000 E
463600 E
463200 E
462800 E
Bandal Structure
TEST SITE II April '98
KUNDARAPARA (FAP22)
Bathymeriy Survey: 07/04/98
Waterline Survey: 20+23/04/98
Float Tracking: 09/04/98
Water Level: 16.18m +PWD (07/04)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 8000


Bathymeriy Survey: 22/04/98
Waterline Survey: 20+23/04/98
Float Tracking: 24+25/04/98
Water Level: 16.73m +PWD (22/04)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 8000
Bandal Structure
TEST SITE II April '98
KUNDARAPARA (FAP22)
463600 E
464000 E
464400 E
803600 N
803200 N
802800 N
462800 E
463200 E
463600 E
464000 E
464400 E


Bathymetry Survey: 16/05/98
Waterline Survey: 21/05/98
Water Level: 18.1m +PWD (16/05)
Chart Datum: PWD heights refer to WL gauge at KBUL
Horizontal Datum: BTM
Scale: 1: 10000
Bandal Structure
463600 E
464000 E
464400 E
464800 E
804000 N
803600 N
803200 N
802800 N
462800 E
463200 E
463600 E
464400 E
464800 E
TEST SITE II MAY '98
KUNDARAPARA (FAP-22)

JG2

ANNEX R

FAP 22 / Test Site II

- Photographs

Photo 1: Low Water Bandals on April 25, 1998

Photo 2: Floating Elements at construction site at Kamarjani end of May 1998