FRYS CREEK FLOOD STUDY

July 1994

PUBLIC WORKS

Coast and Flood Branch

FOREWORD

The State Government's Flood Policy is directed towards providing solutions to existing flood problems in developed areas and ensuring that new development is compatible with the flood hazard and does not create additional flooding problems in other areas. Under the policy, the management of flood liable land is the responsibility of local government.

This investigation was carried out for Great Lakes Council to determine flood behaviour in the lower reaches of Frys Creek which is a tributary of the Myall River.

INTRODUCTION

The township of Bulahdelah is located about 70 kilometres north of Newcastle where the Pacific Highway crosses the Myall River. The Frys Creek confluence with the Myall River is approximately 3 kilometres upstream from the Pacific Highway bridge. At this location the Myall River and Frys Creek have catchment areas of 240 and 18 square kilometres respectively.

Bulahdelah has a history of flooding with the largest floods on record occurring in 1897 and 1927. Smaller floods were recorded in 1947 and 1953, and less severe floods occurred more recently in 1985 and 1987. The "Bulahdelah Flood Appraisal", completed in October 1991, was prepared for Great Lakes Council to assess flood behaviour for the Myall River floodplain, in the vicinity of the Bulahdelah township. The data and models used in the flood appraisal were used to undertake the Frys Creek flood study. The locations of the study areas for the Bulahdelah Flood Appraisal and the Frys Creek study are shown on Figure 1.

The MIKE-11 hydraulic model set up for the "Bulahdelah Flood Appraisal" is an unsteady one-dimensional mathematical model that can be used to simulate flood routing, tidal exchange and flood storage effects. The model was used to determine design flood levels for the Myall River based on coincident flooding with the Crawford River. The flood flows were generated using the WBNM runoff routing model.

The aim of this investigation is to define the nature and extent of the flood problem in the lower reaches of the Frys Creek floodplain area under existing catchment conditions. The approach used to determine design flood levels for Frys Creek was based upon:

- application of the MIKE-11 and WBNM models used for the flood appraisal;
- review of hydrology to assess design flows in the Frys Creek catchment;
- setting up of a MIKE-11 hydraulic model extension to the existing model to include Frys Creek;
- calibration of the hydraulic model extension; and
- assessment of design floods for the Frys Creek catchment.

HYDROLOGIC MODELLING

The Watershed Bounded Network Model (WBNM, reference 1) used in the Bulahdelah Flood Appraisal Study (reference 2) was used to determine flood flows in the study area. The WBNM model is a runoff routing computer model capable of accepting rainfall data that varies across the catchment and over time.

The existing model included sub-areas based on watershed boundaries and existing drainage patterns for the Myall River and Frys Creek, as shown on Figure 2. The model was used to determine discharge hydrographs for the Myall River at Markwell Road Bridge, and for Frys Creek at the upstream boundary of the study area. There was no streamflow data and only limited flood level data available to calibrate the hydrologic model for Frys Creek. As a result, it was necessary to estimate flows using default model parameters recommended in Australian Rainfall and Runoff (AR&R, reference 3) for ungauged catchments.

Model Parameters

The model parameters used in the Bulahdelah Flood Appraisal were reviewed. The loss rate values were determined from the 1987 flood, and in the absence of other data, the default values for the storage delay and non-linearity coefficients are considered appropriate. The parameters as shown in Table 1, are considered satisfactory and were adopted.

Table 1 : WBNM Model Parameters

storage delay coefficient C	1.29
non-linearity coefficient n	-0.23
initial loss	21mm
continuing loss	2.5mm/hr

Discharge Hydrographs

The WBNM model routes the rainfall excess through the sub-areas identified for the study area. The critical rainfall duration for the Myall River is 36 hours (reference 2). Using the procedure in AR&R, storms of different durations were examined for the Frys Creek catchment. The critical rainfall duration for Frys Creek was determined to be 36 hours for the 1% and 5% Annual Exceedance Probability (AEP) flood events.

Discharge hydrographs are given on Figure 3 for the February 1987 flood, the 1% AEP flood and the 5% AEP flood.

HYDRAULIC MODELLING

Flood behaviour in the study area was determined for existing conditions using a MIKE-11 hydraulic model (reference 4). Both mainstream Myall River flooding and local flooding in Frys Creek were modelled.

The hydraulic model set up for the study area was established to the arrangement shown on Figure 4, with the floodplain areas discretized into branches, weirs and culverts to distribute flows across the floodplain as shown on Figure 5. Surveyed sections across the floodplain, bridge waterway areas and bridge deck levels were obtained from Calver, de Witt & Taylor Consulting Surveyors.

Discharge hydrographs into the study area from both the Myall River and Frys Creek were derived from the data used in Bulahdelah Flood Appraisal. The downstream tailwater levels used for calibration and design flood analyses were adopted from the existing MIKE-11 hydraulic model used in the Bulahdelah Flood Appraisal.

Hydraulic Model Calibration

The 1987 flood event was used to calibrate the hydraulic model with the available flood level information from Public Works' maximum height recorders near Lee Street, Frys Creek Bridge and Markwell Road Bridge. In attempting to calibrate the model it became evident that the recorded peak water level at the Frys Creek Bridge was incorrect. However, calibration was achieved using a flood level at the Bridge that was obtained from the owner of the sawmill.

The main parameter adjusted in calibrating the hydraulic model was the Manning's roughness "n". Both the Myall River and Frys Creek have dense vegetation cover along the stream embankments and the major part of their floodplain areas have been cleared. To determine design flood level profiles in the study area for the existing development conditions, the "n" values given in Table 2 were adopted.

Table 2 : Manning's Roughness Coefficients

Stream	Stream Channel	Channel Embankments	Floodplain Areas
Myall River	0.040 - 0.075	0.080 - 0.240	0.040 - 0.080
Frys Creek	0.040 - 0.045	0.080 - 0.090	0.040 - 0.080

Design Flood Levels

Flood behaviour in the study area was determined by the MIKE-11 hydraulic model for the existing development conditions using the design 1% and 5% AEP flood discharges (see Figure 3).

An assessment of the sensitivity of flood behaviour resulting from the tailwater conditions adopted from the Bulahdelah Flood Appraisal was undertaken. The assessment indicated that the effect of different tailwater conditions on flood levels would not extend past the junction of Frys Creek and the Myall River.

The peak water level, velocity and discharge results for the 1% and 5% AEP floods are given in Table 3. Flood profiles are given on Figures 6 and 7.

Table 3 : FRYS CREEK FLOOD STUDY
SUMMARY OF RESULTS

WATER LEVEL (m AHD)

Branch	Chainage	1%	5%
MYALL	10.000	9.18	8.16
MYALL	10.010	9.12	8.11
MYALL	10.020	9.03	8.04
MYALL	10.200	8.31	7.44
MYALL	11.150	6.49	5.19
MYALL	11.650	6.36	5.19
MYALL	12.750	6.20	5.19
FRYS	10.000	7.42	7.19
FRYS	10.600	6.72	6.11
FRYS	11.000	6.62	5.75
FRYS	11.400	6.55	5.55
FRYS	11.410	6.54	5.26
FRYS	11.750	6.51	5.19
FRYS	12.310	6.48	5.19
FRYS	12.460	6.49	5.19

DISCHARGE (cu.m/sec)

Location	Chainage	1%	5%
MYALL	9.950	1219	839
MYALL	10.005	408	387
MYALL	10.015	1218	838
MYALL	10.110	1217	837
MYALL	10.675	1213	828
MYALL	11.400	1327	878
MYALL	12.200	1332	884
FRYS	10.300	149	107
FRYS	10.800	146	107
FRYS	11.200	143	106
FRYS	11.405	16	26
FRYS	11.580	140	105
FRYS	12.030	139	105
FRYS	12.385	137	104

VELOCITY (m/sec)

Branch	Chainage	1%	5%
MYALL	10.000	1.76	1.45
MYALL	10.005	1.51	2.06
MYALL	10.010	2.05	1.71
MYALL	10.015	2.21	1.87
MYALL	10.020	2.40	2.07
MYALL	10.110	2.59	2.23
MYALL	10.200	2.82	2.41
MYALL	10.675	2.11	2.33
MYALL	11.150	1.86	2.43
MYALL	11.400	1.59	1.67
MYALL	11.650	1.40	1.27
MYALL	12.200	1.99	1.87
MYALL	12.750	3.38	3.43
FRYS	10.000	1.67	1.49
FRYS	10.300	1.17	1.32
FRYS	10.600	0.89	1.17
FRYS	10.800	0.69	0.87
FRYS	11.000	0.56	0.78
FRYS	11.200	0.60	0.71
FRYS	11.400	0.64	0.74
FRYS	11.405	1.03	2.41
FRYS	11.410	0.71	1.11
FRYS	11.580	0.65	0.93
FRYS	11.750	0.61	0.80
FRYS	12.030	0.53	0.64
FRYS	12.310	0.47	0.53
FRYS	12.385	0.31	0.35
FRYS	12.460	0.23	0.26

ACKNOWLEDGMENTS

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REFERENCES

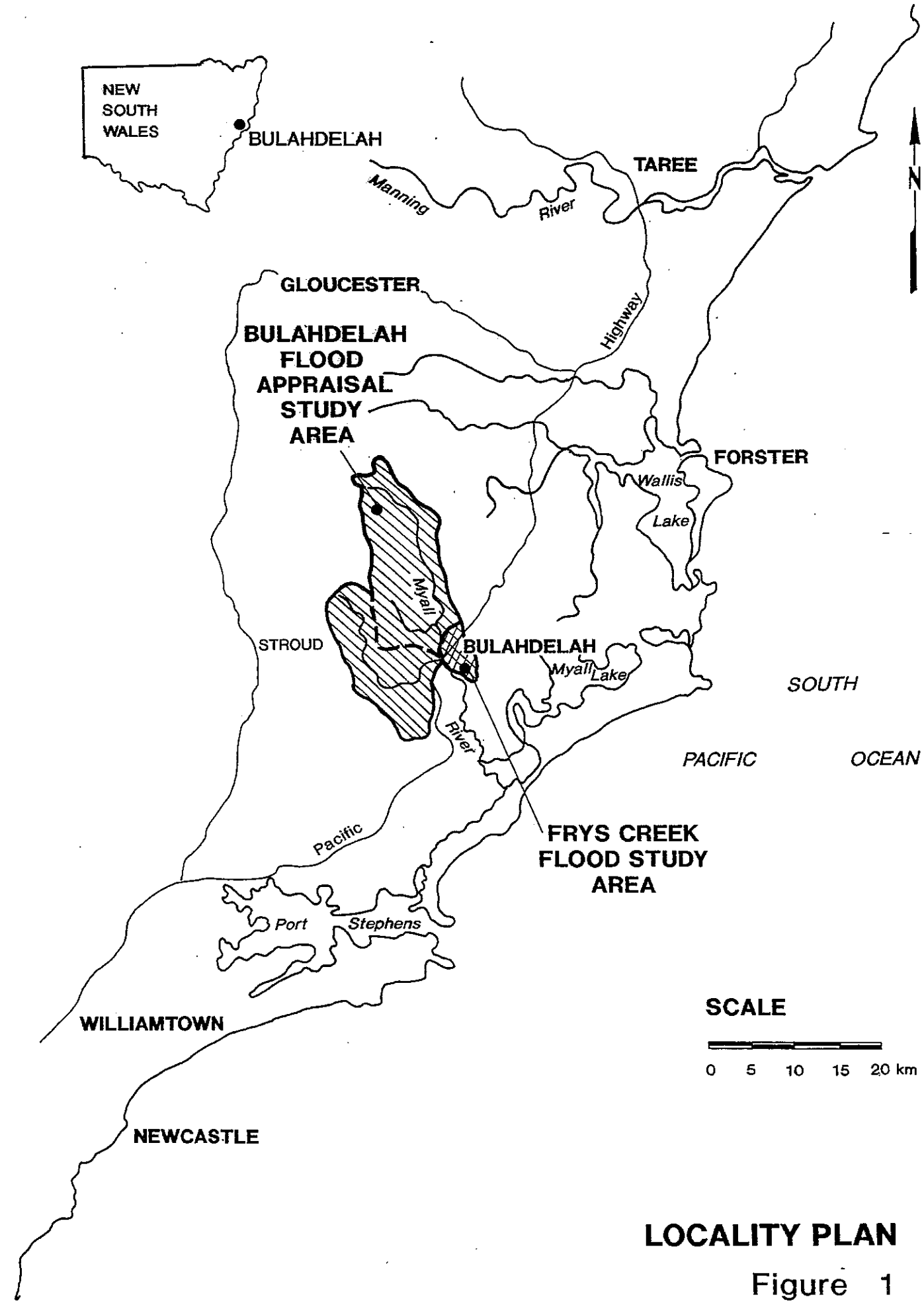
1. "WBNM - A General Runoff Routing Model - Computer Program and User Guide", Boyd M.J., Bates B.C., Pilgrim D.H., and Cordery I., (1987), University of New South Wales.

2. "Bulahdelah Flood Appraisal", Public Works, October 1991

3. "Australian Rainfall and Runoff - A Guide to Flood Estimation", The Institution of Engineers Australia, Revised Edition, 1987

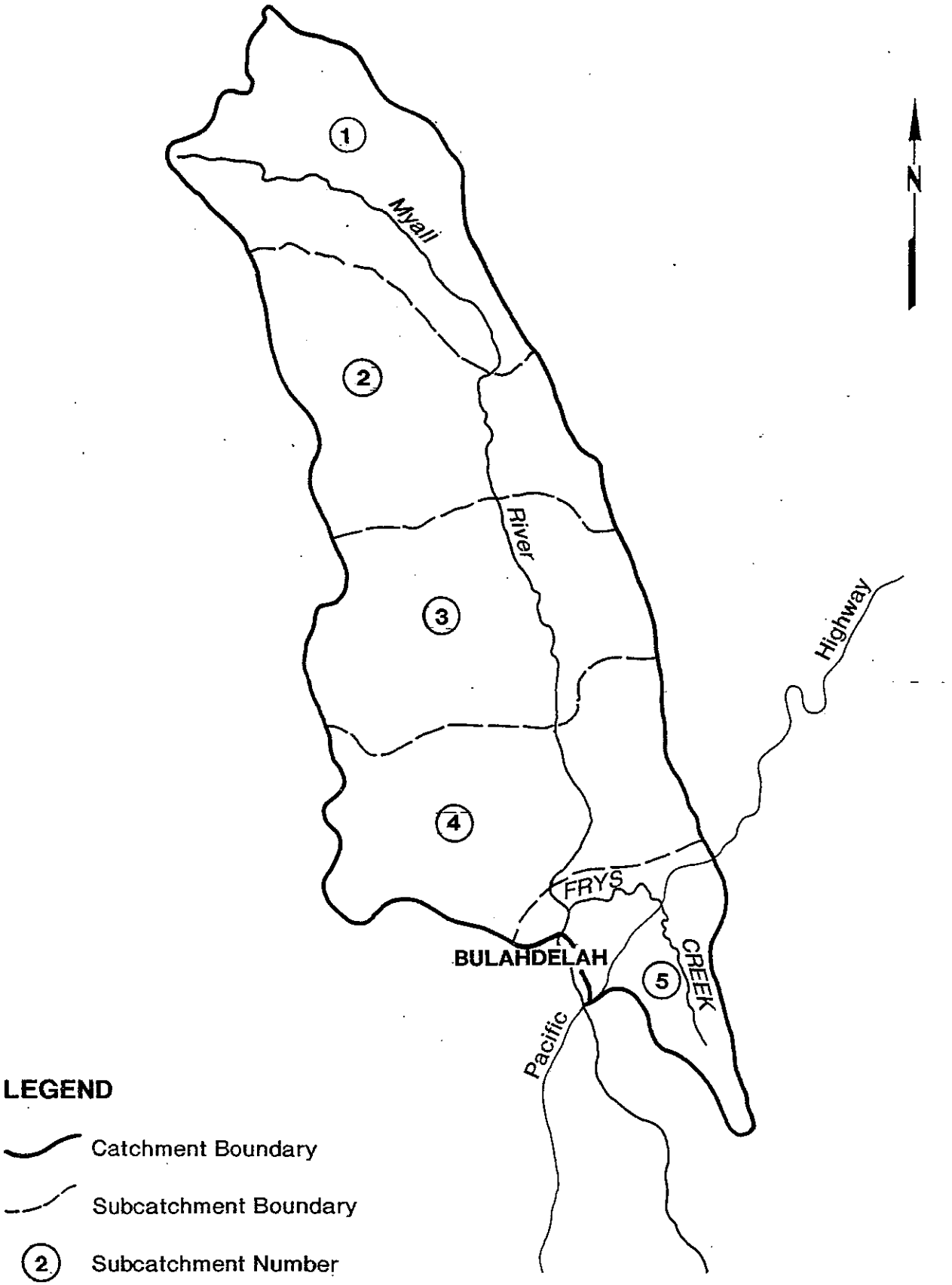
4. "MIKE-11 V3.01 Technical Reference Manual", Danish Hydraulic Institute, November 1992

FIGURES



LOCALITY PLAN

Figure 1



LEGEND

Catchment Boundary

Subcatchment Boundary

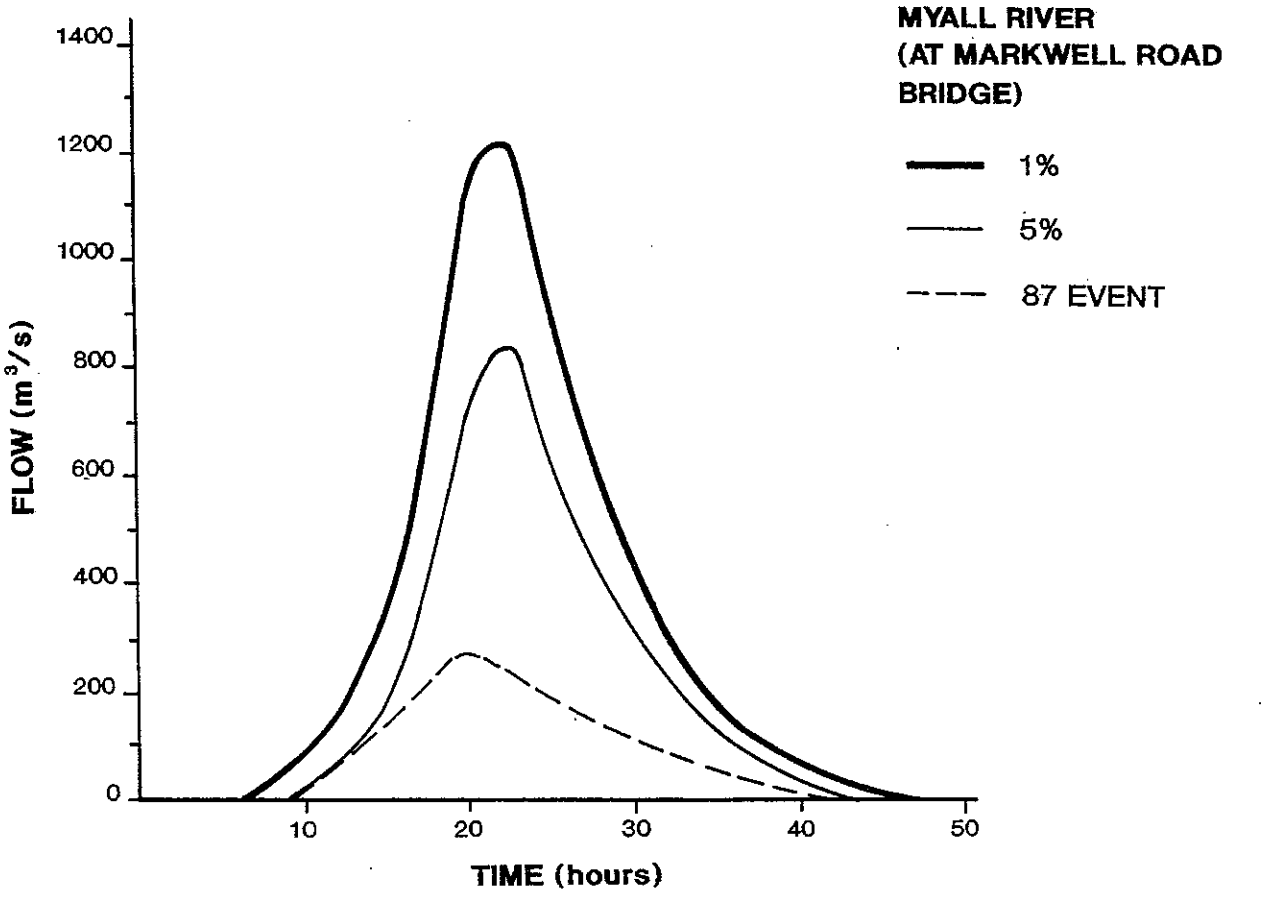
(2) Subcatchment Number

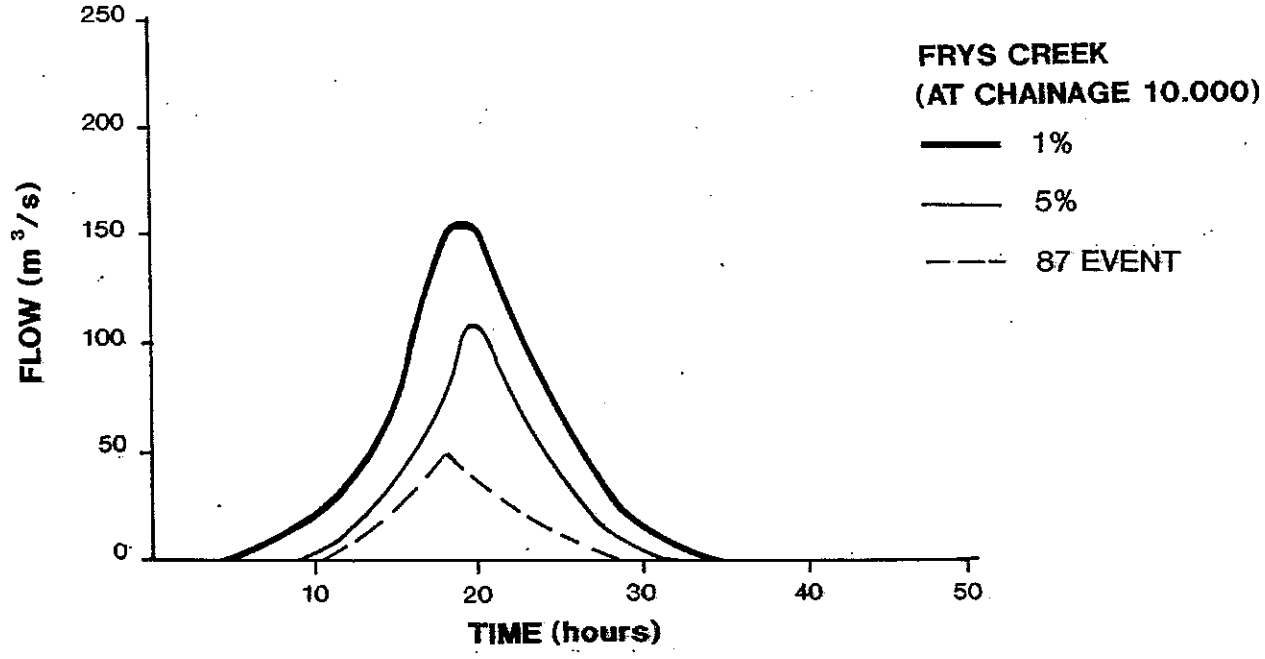
SCALE

0 2 4 6 8 km

WBNM MODEL LAYOUT

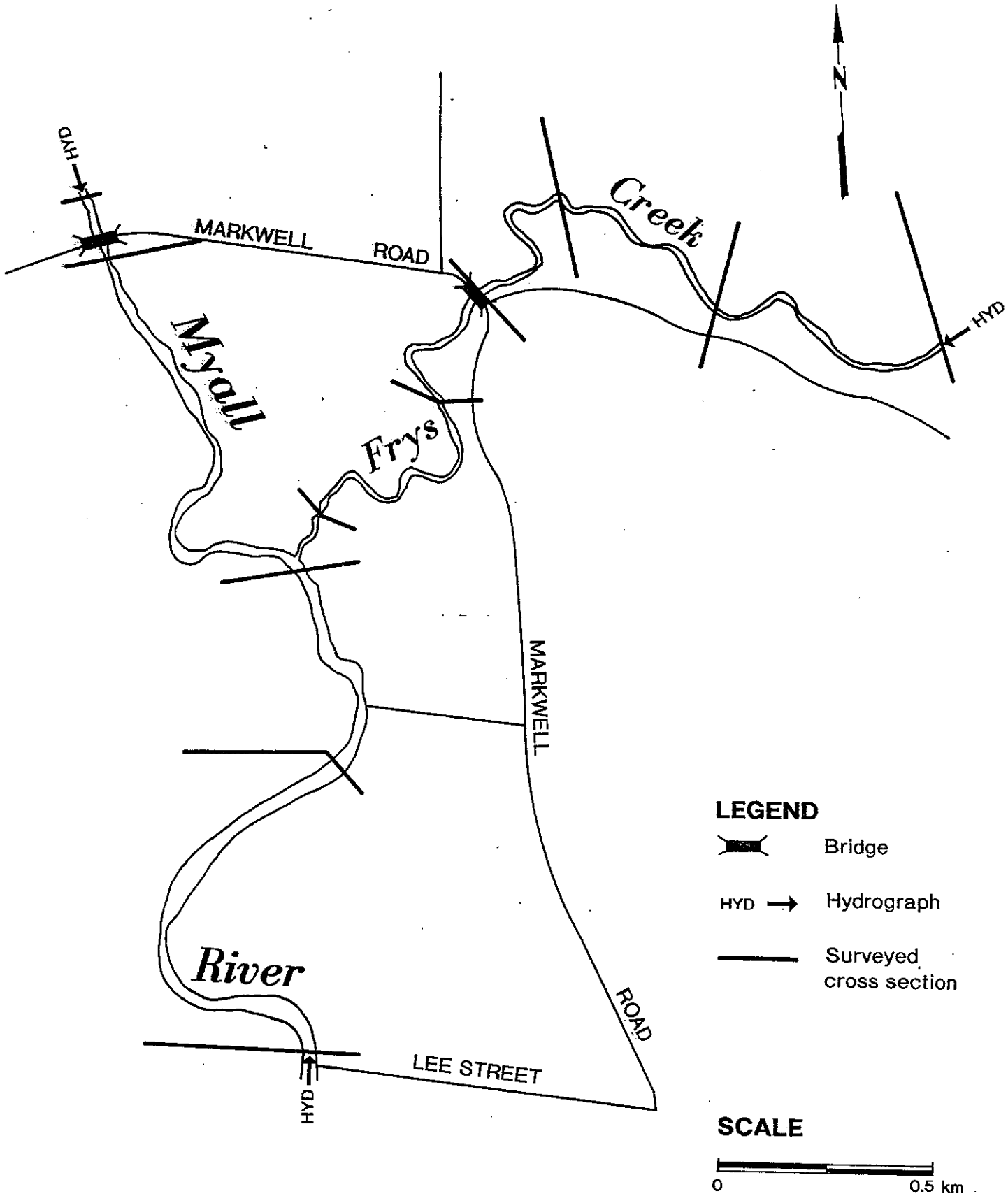
Figure 2





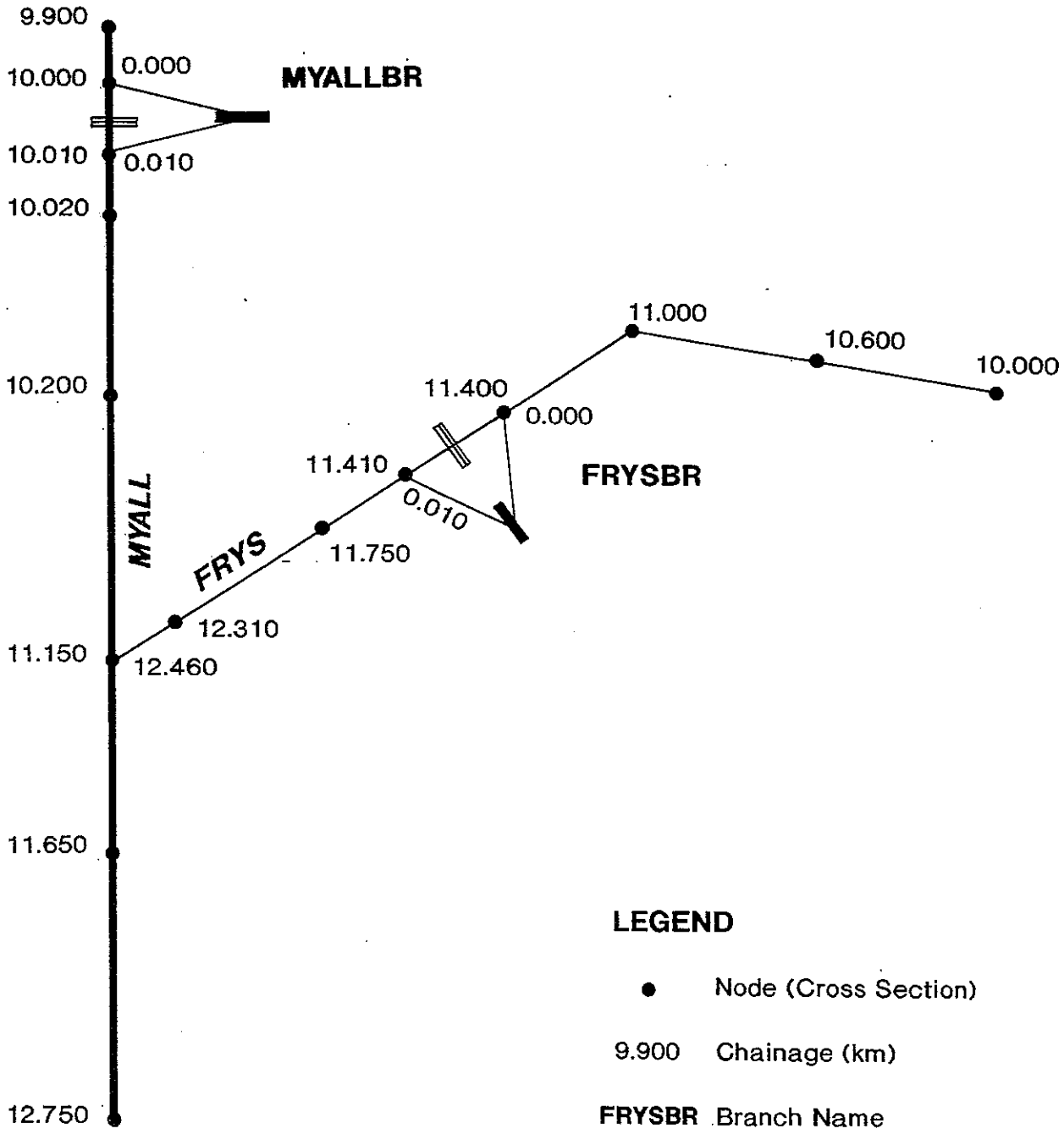
DISCHARGE HYDROGRAPHS

Figure 3



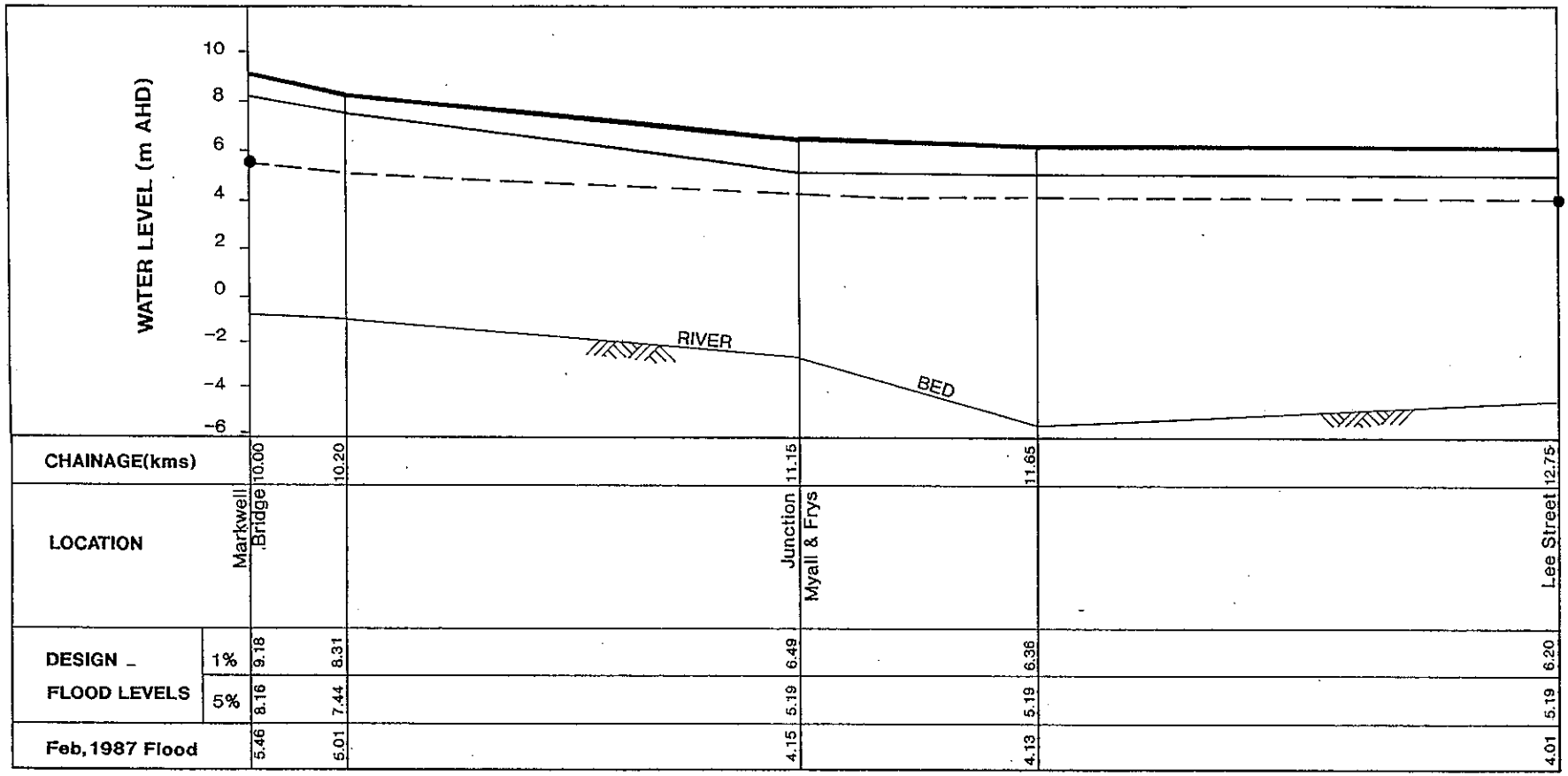
ARRANGEMENT FOR MIKE –11 MODEL

Figure 4



MODEL DISCRETIZATION

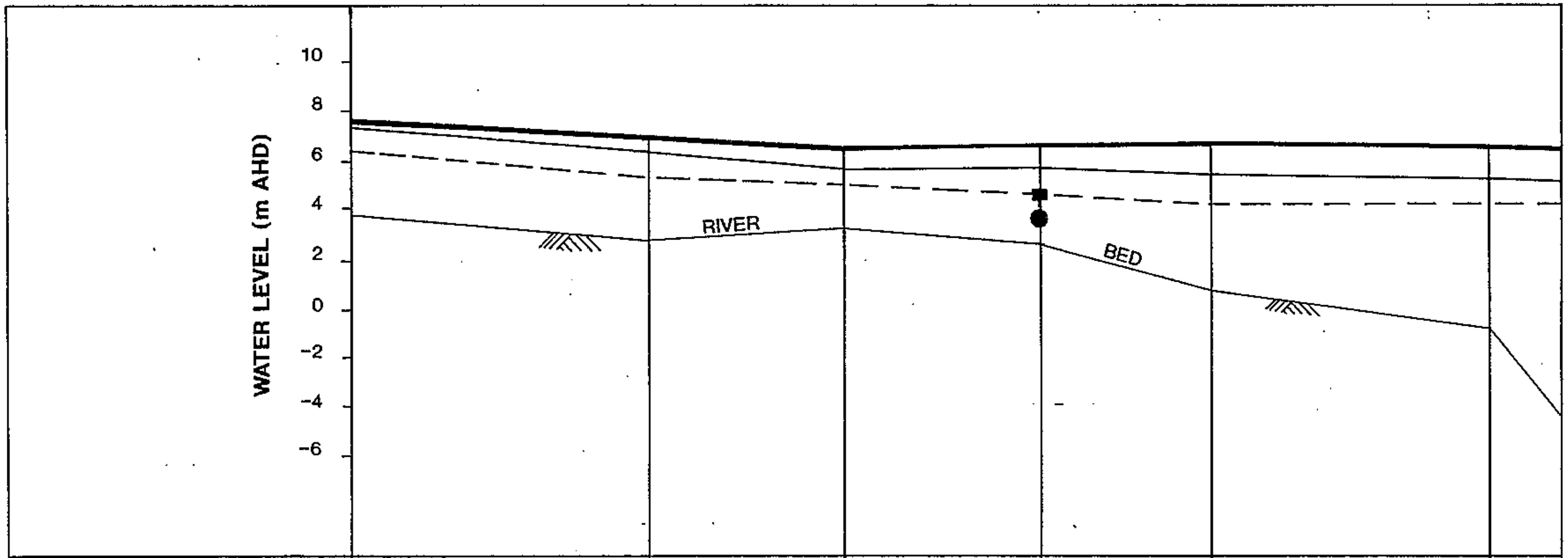
Figure 5



LEGEND

- 1% AEP
- 5% AEP
- 1987 FLOOD
- RECORDED FLOOD LEVEL

MYALL RIVER
FLOOD PROFILES
Figure 6



CHAINAGE (kms)		10.00	10.60	11.00	11.40	11.75	12.31	12.46
LOCATION		Upstream Boundary			Frys Creek Bridge			Junction Myall & Frys
DESIGN FLOOD LEVELS	1%	7.42	6.72	6.62	6.55	6.51	6.48	6.49
	5%	7.19	6.11	5.75	5.55	5.19	5.19	5.19
Feb, 1987 Flood		6.37	5.42	4.90	4.58	4.17	4.15	4.15

LEGEND

- 1% AEP (thick solid line)
- 5% AEP (thin solid line)
- 1987 FLOOD (dashed line)
- ■ OBSERVED FLOOD LEVEL
- ● RECORDED FLOOD LEVEL

FRYS CREEK
FLOOD PROFILES

Figure 7