205

GOSFORD CITY COUNCIL

TURO CREEK, PRETTY BEACH FLOOD STUDY

Final Report
DECEMBER 2003

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TABLE OF CONTENTS

Page No.

TABLE OF CONTENTS

FIGURES

APPENDICES

GLOSSARY

Annual Exceedance Probability (AEP)	Refers to the probability or risk of a flood of a given size occurring or being exceeded in any given year.
Average Recurrence Interval (ARI)	The expected or average frequency of a given storm event.
Australia Height Datum (AHD)	National survey datum corresponding approximately to mean sea level
Australian Rainfall and Runoff (AR&R)	A document produced by the Institution of Engineers, Australia which outlines methods to determine the hydrology and hydraulics of a system.
catchment	The catchment at a particular point is the area of land which drains to that point.
design flood / storm	A hypothetical flood / storm representing a specific likelihood of occurrence *(for example the 100 year ARI storm or 1% AEP flood).*
development	Existing or proposed works which may or may not impact upon flooding. Typical works are filling of land, and the construction of roads, floodways and buildings.
discharge	The rate of flow of water measured in terms of volume over time. It is not the velocity of flow, which is a measure of how fast the water is moving. Rather, it is a measure of how much water is moving. Discharge and flow are interchangeable terms.
flood	Above average river or creek flows which overtop banks and inundate floodplains.
flooding	The State Emergency Service uses the following definitions in flood warnings: ❒ **Minor flooding**: causes inconvenience such as closing of minor roads and the submergence of low level bridges. ❒ **Moderate flooding**: low-lying areas are inundated requiring removal of stock and/or evacuation of some houses. Main traffic bridges may be covered. ❒ **Major flooding**: extensive rural areas are flooded with properties, villages and towns isolated and/or appreciable urban areas flooded.
floodplain	Land adjacent to a river or creek which is periodically inundated due to floods up to the Probable Maximum Flood event. Floodplains are a natural formation created by the deposition of sediment during floods.
floodplain management	The coordinated management of the risks associated with human activities that occur on the floodplain.
flood storages	Floodplain areas which are important for the temporary storage of flood waters during a flood.
historical flood	A flood which has actually occurred.
hydraulic	The term given to the study of water flow in rivers, estuaries and coastal systems.
hydrograph	A graph showing how a river or creek's discharge changes with time.

hydrology	The term given to the study of the rainfall-runoff process in catchments.
IFD data	Intensity-Frequency-Duration data is based on historical data and provides average rainfall intensities for a range of average recurrence intervals and design storm durations.
management plan	A clear and concise document, normally containing diagrams and maps, describing a series of actions that will allow an area to be managed in a coordinated manner to achieve defined objectives.
MOUSE	A hydraulic computer model used to calculate water surface profiles.
peak flood level, flow or velocity	The maximum flood level, flow or velocity occurring during a flood event.
probable maximum flood (PMF)	An extreme flood deemed to be the maximum flood likely to occur.
probability	A statistical measure of the likely frequency or occurrence of flooding.
Rational Method	A statistical method for use in estimating design discharges.
RAFTS	A rainfall and runoff computer model used to generate discharge hydrographs and estimate flows from a catchment.
runoff	The amount of rainfall from a catchment which actually ends up as flowing water in the river or creek.
tailwater level	The level in a downstream water body or control structure which influences water levels in the upstream system.
velocity	The speed at which the flood waters are moving. Typically, modelled velocities in a river or creek are quoted as the depth and width averaged velocity, ie. the average velocity across the whole river or creek section.
water surface profile	Longitudinal plans showing the flood level at any given location along a watercourse or drainage system.

1 SUMMARY

Gosford City Council commissioned Patterson Britton and Partners to undertake a flood study for the Turo Creek catchment at Pretty Beach.

The *'Floodplain Development Manual' (1986)* outlines the steps involved in the floodplain management process shown in **Figure 1**. Since no detailed flood study has previously been undertaken for the Turo Creek catchment, the first step that needs to be carried out in the floodplain management process is the Flood Study. The flood study includes detailed flood modelling for the purposes of subsequently carrying out the Floodplain Management Study and Plan.

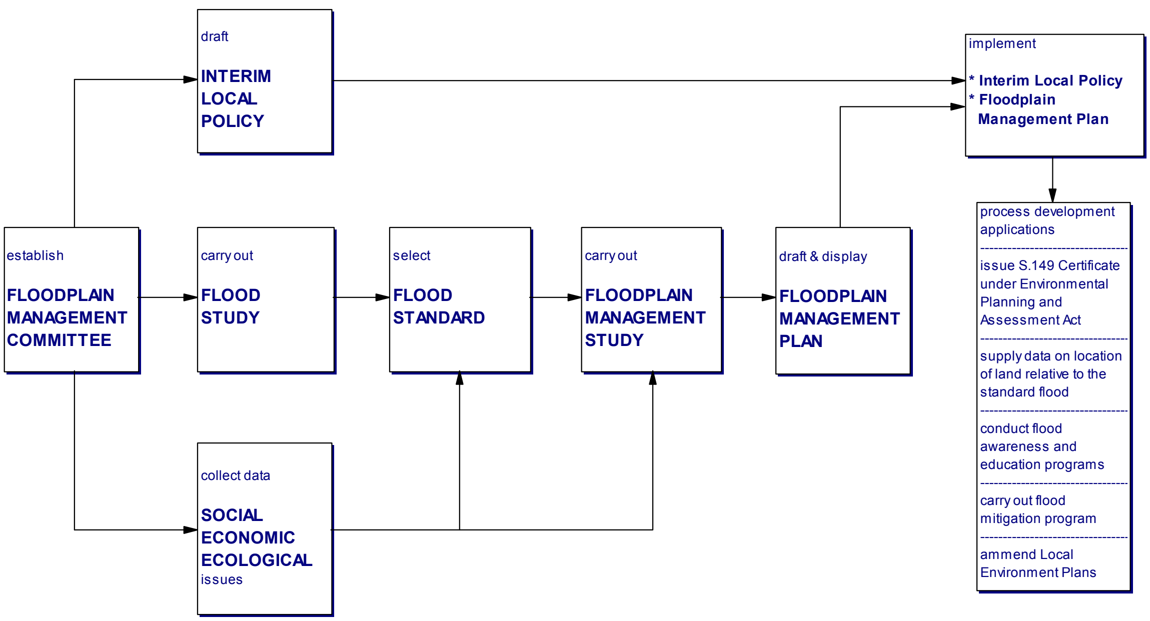


Figure 1 – *Floodplain Management Process*

The floodplain management plan for the study area will address the existing, future, and residual flood and environmental problems, in accordance with the NSW Government's Flood Policy as detailed in NSW Government's *Floodplain Development Manual (1986)* and the principles of the NSW Government's draft *Floodplain Management Manual (1999)*.

Specifically, the objectives of this flood study were to:

- define flood behaviour along Turo Creek for the 20%, 5% and 1% AEP events and the PMF using hydrologic and hydraulic models;
- present the flood behaviour for Turo Creek in a clear and concise manner, including flood flows, velocities and levels for the above events.

The approach adopted for this flood study was:

- issue the residents who are adjacent to the creek and/or could be effected by flooding of Turo Creek with a questionnaire (*refer **Appendix A***)
- collect and collate any relevant background information (*including questionnaires*);
- assemble and calibrate a hydrologic model of the catchment;
- undertake a detailed survey of Turo Creek;
- assemble and calibrate a hydraulic model, refine and calibrate as necessary;
- define flood flows and levels for the 20%, 5% and 1% AEP events and the Probable Maximum Flood (*PMF*);
- define flood velocities and flood extents for the 1% AEP event; and
- determine houses likely to be effected by the various flood events.

The flood study found that, especially during rarer events, flooding of the lower portions of Turo Creek is dominated by tidal influences and flooding in Brisbane Water. Floor levels of dwellings begin to become inundated in events with an average recurrence interval of 1 in 20 years (5% AEP). During the 1% AEP, it is estimated that up to 9 dwellings would be inundated above floor level. One dwelling near the outlet to Turo Creek did not have the floor level surveyed because of the refusal by the owner. It is likely that this dwelling would be adversely affected by flooding.

2 INTRODUCTION

2.1 STUDY AREA

The study area for this investigation is the Turo Creek channel from just upstream (south) of Como Parade to the outlet into Brisbane Water at Pretty Beach. Within the study area Turo Creek flows between Como Parade and Venice/High View Road, through private properties adjoining Venice Road. The study area is shown in **Figure 2**.

2.2 BACKGROUND

The catchment area of Turo Creek is approximately 44 hectares. The catchment is mostly undeveloped apart from residential developments and public reserves, which are located toward the outlet of the catchment.

The Turo Creek catchment is very steep with portions exceeding grades of 25%. Sub-vertical cliffs traverse the middle section of the catchment. During significant rainfall events water can be observed to sheet over these cliffs creating large waterfalls.

When Turo Creek passes though the residential area of Pretty Beach it divides the properties fronting Venice Road into two. To gain access to the rear of their properties residents have constructed foot bridges across the creek. It appears that many land owners have filled the overbank regions of Turo Creek to gain more useable land. However, filling the overbank regions and the construction of low pedestrian bridges and culverts , has reduced the conveyance of the creek.

This flood study will constitute the first of several steps that will be carried out in the floodplain management process to form the Floodplain Management Plan. The current flood study will define the degree of flooding, identify causes of flooding and define the existing extent and frequency of flooding within Turo Creek.

2.3 DATA

The following background data was used to undertake this study:

<u>*Topographic Maps*</u>

- **Broken Bay U2782-2** (1:4000) Orthophotomap – *Central Mapping Authority,* Dept of Lands, 1987

<u>*Historical Rainfall Records*</u> *(refer* ***Appendix B1****)*

- **Daily Rainfall Data, Woy Woy: 1974, 1988-2000** – *Climate and Consultancy Section,* Bureau of Meteorology, 2000.
- **Pluviometer Data, Kincumber: 1-5 Feb. 1990, 7-11 Feb. 1992, 5-9 Aug. 1998** – *Manly Hydraulics Laboratory,* NSW Department of Public Works and Services, 2000.
- **Pluviometer Data, Wyong: 15-18 Jan. 1988, 27 April – 1 May 1988** – *Manly Hydraulics Laboratory,* NSW Department of Public Works and Services, 2000.

<u>*Historical Tidal Records*</u> *(refer* ***Appendix B2****)*

- **Brisbane Waters, Koolewong: 1-4 Feb. 1990 –** *Manly Hydraulics Laboratory,* NSW Department of Public Works and Services, 2000.

<u>*Drainage Records*</u> *(refer* ***Appendix B3****)*

- **Drainage Records, Pretty Beach** – Gosford City Council, 1997.

2.4 ELEMENTS OF THE STUDY

The elements of this study include:

- *Liaison with residents*, via questionnaires and telephone communications to provide details of historic flooding and flood levels which could be used to calibrate the hydraulic model.
- *Detail field survey*, of Turo Creek, house floor levels, bridge structures and outlet structures to define the geometry of Turo Creek and create a hydraulic model.
- *Review of existing data*, to define catchment boundaries, slopes, flow lengths and other hydrologic characteristics required to develop an accurate hydrologic model.
- *Hydrologic Modelling*, establishment of RAFTS rainfall/runoff model of the Turo Creek catchment to estimate flows under existing catchment conditions for the 20%, 5% and 1% AEP events as well as the PMF event.
- *Hydraulic Modelling*, utilisation of field survey data to develop a calibrated MOUSE hydraulic model to identify flood behaviour for the 20%, 5% and 1% AEP events as well as the PMF event.
- Produce a bound report describing the methodology and results of the flood study, in accordance with the NSW Government Floodplain Development Manual and the headings outlined in the brief.

3 HYDROLOGIC MODELLING

3.1 RAFTS HYDROLOGIC MODEL

RAFTS is a non-linear rainfall/runoff program developed by WP Software, in Canberra. RAFTS can be used to estimate peak flows for catchments, using actual storm events, or design rainfall data derived from *Australian Rainfall and Runoff (AR&R)* (*IEAust, 1987*).

To undertake the hydrologic modelling, a RAFTS rainfall/runoff model was established for the Turo Creek catchment. The model was used to estimate design flows under existing catchment conditions for the 1%, 5% and 20% AEP events as well as the PMF event. The model was also used to estimate flows generated from historical rainfall events which were used in the calibration of the hydraulic model. All hydrologic analyses were undertaken in accordance with *AR&R*. PMF estimates were derived from Bulletin 53 (*Bureau of Meteorology, 1994)*.

RAFTS was chosen for this investigation because it has the following attributes:

- it can account for spatial and temporal variation in storm rainfall across a catchment;
- it can accommodate variations in catchment characteristics;
- it can be used to estimate discharge hydrographs at any location within the catchment; and
- it has successfully been widely used across NSW.

3.2 MODEL SET-UP

The catchment was divided into a number of subcatchments based on topography, land use, roads and the existing drainage system layout. Estimates of existing peak design and historic flows were derived for input into the hydraulic model.

Each subcatchment was analysed to determine parameters including area, weighted average catchment slope, the percentage of impervious area, and lag time to the next downstream sub-catchment. A summary of adopted subcatchment parameters is enclosed in **Appendix C** while **Figure 2** shows the adopted RAFTS sub-catchment plan.

A total of 8 major subcatchments were identified for the RAFTS model, with a total catchment area of approximately 44 ha. An area upstream of Pretty Beach Road, in the vicinity of the outlet culverts, was thought to retain stormwater and subsequently attenuate discharge into Brisbane Water. This ponding area upstream of the culverts was modelled in RAFTS to determine if flows were attenuated behind the culverts. The catchment breakdown is shown on **Figure 2** and includes the RAFTS model network layout.

3.3 CALIBRATION

As no stream gauge exists in the catchment, there was no possibility of a true storm calibration, however comparison was made with the Rational Formula calculations for "small to medium sized rural catchments", as outlined in ARR 1987 (*IEAust, 1987*). The results of this comparison are shown below in **Table 3.1**.

Table 3.1 : Comparison of Peak Flow Results between RAFTS and Rational Method

Average Recurrence Interval (AEP)	Peak discharge estimated using Rational Method (m^3/s)	Peak discharge estimated using RAFTS model (m^3/s)	
		Discharge Upstream of Culverts	Discharge to Brisbane Water
20%	4.5	4.5	4.4
5%	7.8	8.9	8.6
1%	13.6	14.1	11.8
PMF	*	66.4	64.3

Note: * : The Rational Method is only intended to be used up to and including the 100 year ARI event.

As can be seen from the results tabulated above, the RAFTS results are very similar to the results provided by the Rational Method. The RAFTS model results were adopted because the methodology is more comprehensive than the Rational Method, taking into account subcatchment slope, roughness, impervious percentage, lag times and storage effects.

Table 3.1 shows that the culverts beneath Pretty Beach Road attenuate discharges entering Brisbane Water, however, the magnitude of the reduction is not large.

To calibrate the hydraulic model (*refer* ***Section 4.2***) several historical rainfall events were modelled in RAFTS to estimate peak flows. Discharge estimates for historical events are shown in **Table 3.2**.

Table 3.2: Estimation of Historical Peak Flows

Date	Estimated peak discharge upstream of Pretty Beach Road culverts (m^3/s)
16/01/88 - 17/01/88	2.5
29/04/88 - 01/05/88	4.5
02/02/90 - 04/02/90	4.8
08/02/92 - 10/02/92	4.8
06/08/98	2.2

Questionnaires completed by residents adjacent to Turo Creek indicated that there was a large flow event in 1974. Unfortunately rainfall pluviometer records were not available for this event. **Table 3.2** shows that the storm event of February 1990 is likely to have generated the highest recent discharge in Turo Creek. It is also worth noting that this event, as well as the February 1992 and April 1988 events, are comparable with a 20% AEP event as defined in **Table 3.1**.

3.4 DESIGN STORM SIMULATION RESULTS

The RAFTS model, once "calibrated", was used to simulate runoff generated using design storm rainfall intensities and temporal patterns for the study area. Storm rainfall data was generated by applying the principals of rainfall intensity estimation and design temporal distributions outlined in AR&R (*IEAust, 1987*).

A range of storm durations were considered and modelled to establish the critical storm duration for the catchment. The critical storm duration corresponds to the maximum peak discharge generated by the hydrologic model for the most downstream node within the catchment.

A critical duration of 2 hours was determined for the catchment.

Using a critical duration of 2 hours and the corresponding rainfall intensities and design temporal patterns, peak discharges and discharge hydrographs were generated for the range of flood frequencies.

Estimated peak catchment discharges at the outlet to the catchment and at the entrance to the "basin" upstream of the Pretty Beach Road culverts for the design storms are listed in **Table 3.1**. **Table 3.4** displays the peak discharge at locations where the flow adopted in the hydraulic model of Turo Creek changed. Full RAFTS output files and hydrographs exported to the hydraulic model are contained in **Appendix D**.

Table 3.4: Peak Discharges Adopted for Hydraulic Modelling

Node	Estimated Peak Discharge (m^3/s)			
	PMF	**1% AEP**	**5% AEP**	**20% AEP**
10	33.3	7.1	4.5	2.2
8	50.5	10.6	6.9	3.4
GU	63.3	12.6	7.9	3.9
Outlet	66.4	14.1	8.9	4.5

Note: GU refers to Upstream side of crossing G.
Refer **Figure 3** for node locations.

4 HYDRAULIC MODELLING

4.1 MOUSE MODEL

MOUSE is a one dimensional, hydrodynamic program developed by the Danish Hydraulic Institute (*DHI*). It is a comprehensive model able to calculate surface runoff, open channel flow, pipe flow, water quality, and sediment transport for urban drainage systems. MOUSE solves the complete St. Venant (*dynamic flow*) equations which allows for the modelling of tidal tailwater conditions, flow reversal and storage effects.

For the current study, MOUSE was used solely as a hydraulic program (*RAFTS was used for hydrology*) to calculate pipe and channel flows in Turo Creek.

4.2 MODEL SET-UP

4.2.1 Detailed Survey

A survey was undertaken to define Turo Creek. The top and bottom of the channel, bridge and culvert structures within the channel and ten cross sections were surveyed along the length of the study area. Cross sections were analysed to ensure they accurately represented Turo Creek and overbank areas before they were entered into the hydraulic model. Nodes were defined at strategic positions between the cross sections and at bridge/culvert structures to define invert elevations and the bridges. Floor levels of dwellings in the vicinity of the creek were obtained except for No. 24 Pretty Beach Road where the owner refused entry for the survey. A plan of the survey, the location of the bridge and culvert structures, floor levels, sections and MOUSE nodes are contained in **Figure 3**. Diagrams of all bridge and culvert structures are contained in **Appendix E** while **Appendix F** shows the surveyed cross sections.

4.2.2 Hydrologic Data

Hydrologic data derived from RAFTS modelling (*refer* ***Section 3***) was input into the MOUSE model. Three hydrographs were imported for each of the 1% AEP, 5% AEP, 20% AEP, PMF and February 1990 events to account for an increase in flow from the top of the channel to the outlet. The hydrographs were exported from Catchments B, C and D in the RAFTS model and applied to nodes 10, 8 and GU of the MOUSE model (*refer* **Figure 3**). All hydrographs are contained in **Appendix D**.

4.2.3 Tidal Data

In order to accurately model the February 1990 event, tidal records that correlated to the pluviometer data, were used in the hydraulic model. The tidal record for the February 1990 event is contained in **Appendix B2**. Tidal levels for the 1% AEP, 5% AEP, 20% AEP and PMF events were supplied by Gosford City Council and are shown in **Table 4.1**.

The tidal records provided by Council (*refer **Table 4.1** below*) indicate tidal tailwater conditions of 1.60m AHD for the 1% AEP and PMF flood events. However, Council has suggested that it would be appropriate to adopt the estimated lagoon (*Brisbane Water*) 1% AEP flood level as a minimum inundation backwater within Turo Creek. Council has advised that the 1% AEP flood level for Brisbane Water at this location is 1.95m AHD. **Table 4.1** indicates adopted backwater flood levels for the 1% AEP and PMF events.

Table 4.1: Adopted Tidal Tailwater Control

Flow Event	Tidal Tailwater Control (m AHD) *	Brisbane Water Flood Levels (m AHD) *
20% AEP	0.45	-
5% AEP	0.80	-
1% AEP	1.60	1.95
PMF	1.60	1.95

Note: * : After Gosford City Council.

4.3 MODEL CALIBRATION

The hydraulic model was calibrated by running the model for the February 1990 event and comparing the results to actual levels observed by the residents of Pretty Beach. **Table 4.2** displays the difference between calculated water levels and the levels observed by residents. The model levels compared favourably with the observed levels.

Table 4.2: Results of Hydraulic Calibration

Node *	Calculated 1990 Water Level (m AHD)	Observed 1990 Water Level (m AHD)
JU	3.15	3.13
HU	2.51	2.48
GU	2.40	2.30
EU	2.15	2.16
CU	1.47	1.55

Note: * : JU refers to Upstream side of crossing J, similar for others.

4.4 HYDRAULIC MODELLING RESULTS

Once the hydraulic model was calibrated, the 1%, 5% and 20% AEP events and the PMF were modelled. The estimated peak flood levels for the four events are presented in **Table 4.3** while longitudinal profiles of the peak flood levels are shown in **Figure 4**. Flood extents for all events and peak flow velocities for the 1% AEP flood are shown in **Figure 5**. Peak water surface elevations are also displayed on the survey cross sections contained in **Appendix F**.

The results of modelling show that the banks of Turo Creek are overtopped during a flood event with an annual exceedance probability as high as 20% (*on average 1 in 5 years*). With reference to **Figure 4** it can be seen that the numerous crossings traversing Turo Creek create backwater effects which accumulate upstream. **Figure 5** shows that there are two main outbreak locations; a minor outbreak upstream of Section 6 most likely due to the presence of a retaining wall (*this outbreak is only noticed in the 20% AEP event*) and a major outbreak centred around sections 3 and 4 which is due to obstructions and filling of the creek and flattening of the overbank regions.

Table 4.3: Estimated Peak Flood Levels

Node *	Estimated Peak Flood Levels+ (m AHD)			
	PMF	**1% AEP**	**5% AEP**	**20% AEP**
10	6.23	5.10	4.79	4.51
9	5.91	4.75	4.50	4.29
8	5.92	4.76	4.51	4.13
7	4.58	3.66	3.48	3.16
KU	4.59	3.66	3.48	3.16
KD	4.44	3.57	3.43	3.13
6	4.31	3.55	3.42	3.13
JU	4.09	3.47	3.37	3.12
JD	3.95	3.33	3.05	2.49
HU	3.95	3.34	3.05	2.50
HD	3.50	2.83	2.67	2.39
GU	3.44	2.79	2.63	2.39
GD	3.34	2.72	2.57	2.34
FU	3.29	2.69	2.55	2.32
FD	3.11	2.53	2.37	2.18
EU	3.04	2.47	2.32	2.16
ED	2.77	2.16	1.99	1.76
DU	2.73	2.13	1.97	1.75
DD	2.53	*1.95*	1.75	1.52
2	2.22	*1.95*	1.66	1.49
CU	2.18	*1.95*	1.65	1.45
CD	2.09	*1.95*	1.53	1.08
1	2.00	*1.95*	1.15	0.82
B	*1.95*	*1.95*	1.08	0.77
A	*1.95*	*1.95*	0.80	0.45
OUT	*1.95*†	*1.95*†	0.80	0.45

Notes:
* JU refers to Upstream side of crossing J, JD refers to Downstream side of crossing J.
\+ Peak flood levels determined from Tailwater Levels provided in **Table 4.1**.
† Water levels shown in italics are estimated Brisbane Water flood levels provided in **Table 4.1**.

4.5 SENSITIVITY ANALYSIS

A sensitivity analysis was undertaken to assess the effect of tidal fluctuations on flood levels in Turo Creek. Results of the sensitivity analysis are contained in **Appendix G**. It was found that water levels towards the outlet of Turo Creek are greatly affected by high tailwater conditions. During the 1% AEP event a difference in tidal level of 1.45m (*1.95m AHD compared to 0.5m AHD*) resulted in a maximum water surface elevation increase of 0.58m near the upstream side of the Pretty Beach Road culverts.

The adopted tailwater levels in Brisbane Water in the design storms provide flood levels in Turo Creek at the upper end of the possible range. This is a conservative approach however without detailed joint event probability analyses (*beyond the scope of this study*) these levels are considered appropriate.

4.6 FLOOD PRONE PROPERTIES

Figure 6 shows the residences predicted to be inundated above floor level by the various design flood events. It can be seen that residences become inundated during an event with an annual exceedance probability of 5%. It is estimated that 2 houses are flooded above floor level during the 5% AEP event, 9 houses during the 1% AEP event and a total of 14 houses during a PMF event. It is likely that the dwelling at No. 24 Pretty Beach Road is also adversely affected by flooding however it was not possible to survey the floor level due to owner objection.

5 CONCLUSIONS

This study investigated flooding of the Turo Creek catchment at Pretty Beach. Results predict that the creeks' banks would be exceeded in flood events with an average recurrence interval of around 5 years (20% AEP).

The level of the tide adopted for use in the study had a significant effect on flood levels at the lower end of the catchment. Based on tidal levels recommended by Gosford City Council it was estimated that 2 houses would be flooded during the 5% AEP event, 9 houses during a 1% AEP event and up to a total of 14 houses during a PMF event. These figures do not include a house that was not surveyed due to resident objection. It is likely this house may be inundated, however this should be confirmed by survey.

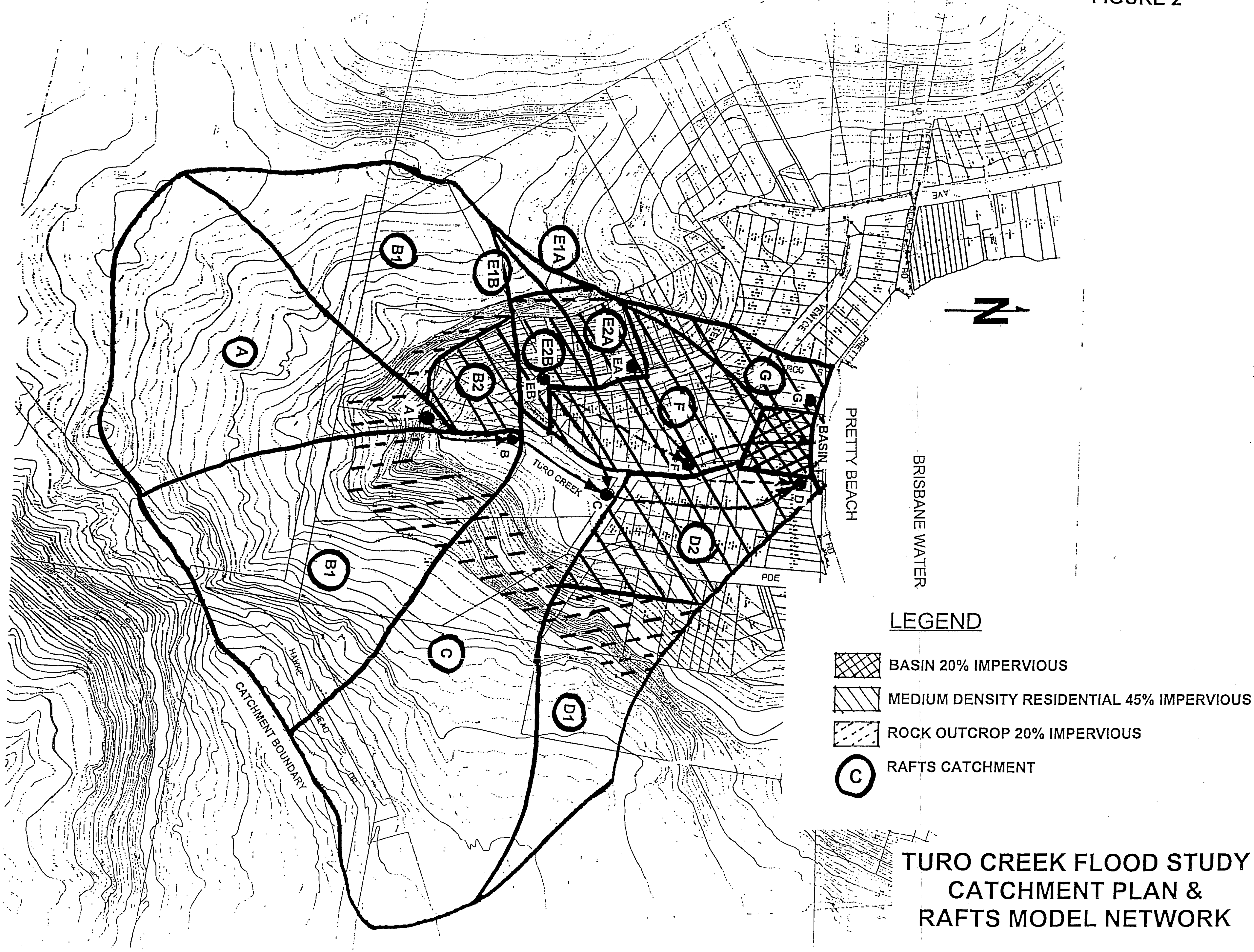
The effects of the existing storage within the park adjacent to Pretty Beach Road was to slightly attenuate flood discharges through the culvert outlet to Brisbane Water. The effects of the attenuation of peak flood flows is limited by the overtopping of Pretty Beach Road during events in excess of the 5% AEP event.

6 REFERENCES

- **Australian Rainfall and Runoff (AR&R)**, *Institute of Engineers Australia, 1987.*
- **Bulletin 53 – The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method**, *Bureau of Meteorology, 1994.*
- **Draft NSW Floodplain Management Manual**, *NSW Government, 1999*.
- **Floodplain Development Manual,** *NSW Government, December 1986. brochure*
- **Runoff and Flow Simulation (RAFTS)**, *User Manual v2.8, WP Software, June 1992*

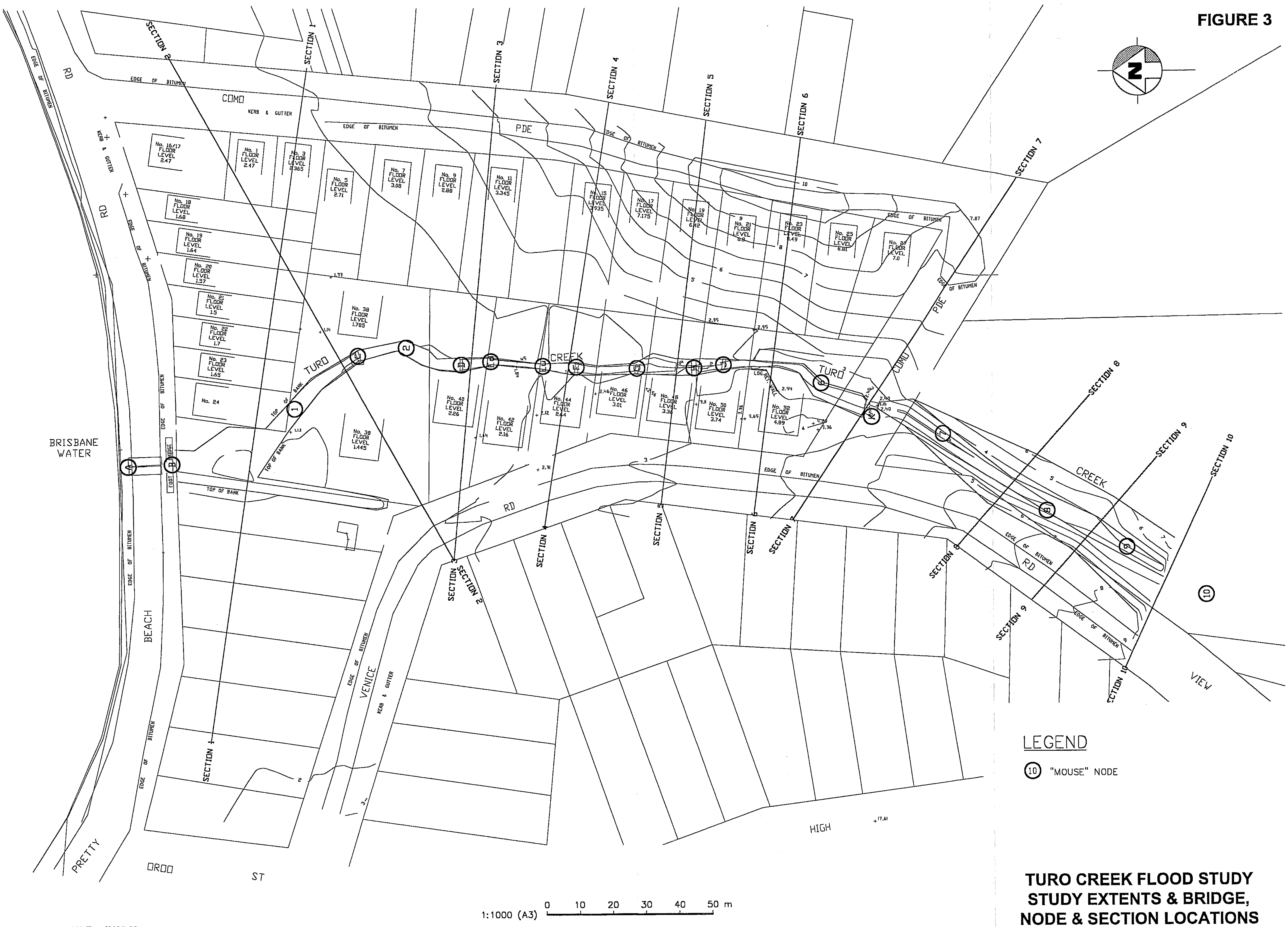
FIGURES

FIGURE 2



TURO CREEK FLOOD STUDY
CATCHMENT PLAN &
RAFTS MODEL NETWORK

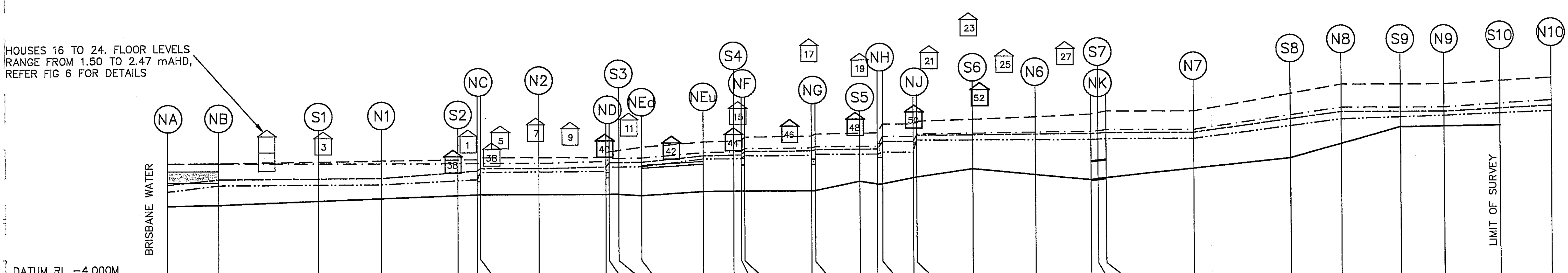
FIGURE 3



TURO CREEK FLOOD STUDY
STUDY EXTENTS & BRIDGE, NODE & SECTION LOCATIONS

3680-Turo/3680-03

FIGURE 4



CHAINAGE (M)	PMF FLOOD LEVEL	1% AEP FLOOD LEVEL	5% AEP FLOOD LEVEL	20% AEP FLOOD LEVEL	EXISTING CHANNEL INVERT
0.00	1.95	1.95	0.80	0.45	-0.29
13.24	1.95	1.95	1.08	0.77	-0.25
38.91					-0.03
55.31	2.00	1.95	1.15	0.82	
75.16					0.26
80.15	2.09	1.95	1.53	1.08	0.30
80.95	2.18	1.95	1.65	1.45	
95.83	2.22	1.95	1.66	1.49	
113.28	2.53	1.95	1.75	1.52	0.33
114.08	2.73	2.13	1.97	1.75	
116.62					0.33
122.46	2.77	2.16	1.99	1.76	0.27
138.34	3.04	2.47	2.32	2.16	0.48
146.18					0.50
148.11	3.11	2.53	2.37	2.18	0.51
149.01	3.29	2.69	2.55	2.32	
166.47	3.34	2.72	2.57	2.34	0.50
167.47	3.44	2.79	2.63	2.39	
178.96					1.00
183.54	3.50	2.83	2.67	2.39	0.83
184.84	3.95	3.34	3.05	2.50	
192.70	3.95	3.33	3.05	2.49	1.20
193.60	4.09	3.47	3.37	3.12	
208.00					1.64
224.14	4.31	3.55	3.42	3.13	
238.41	4.44	3.57	3.43	3.13	
240.25					2.41
242.31	4.59	3.66	3.48	3.16	1.16
265.18	4.58	3.66	3.48	3.16	
290.29					2.14
303.36	5.92	4.76	4.51	4.13	
330.45					3.71
330.05	5.91	4.75	4.50	4.29	
344.78					3.78
357.86	6.23	5.10	4.79	4.51	

HORIZONTAL 1:1000 (A3) 0 10 20 30 40 50 m

VERTICAL 1:200 (A3) 0 2 4 6 8 10 m

NOTES

1. FLOOD PROFILES ARE APPROXIMATE ONLY. NO ACCOUNT OF LOCALISED BLOCKING OF EXISTING STRUCTURES HAS BEEN MADE.
2. ALL HEIGHTS ARE IN METRES AND RELATIVE TO THE AUSTRALIAN HEIGHT DATUM (AHD)
3. THE BASE OF THE HOUSES SHOWN IS SET AT THE SURVEYED FLOOR LEVEL.

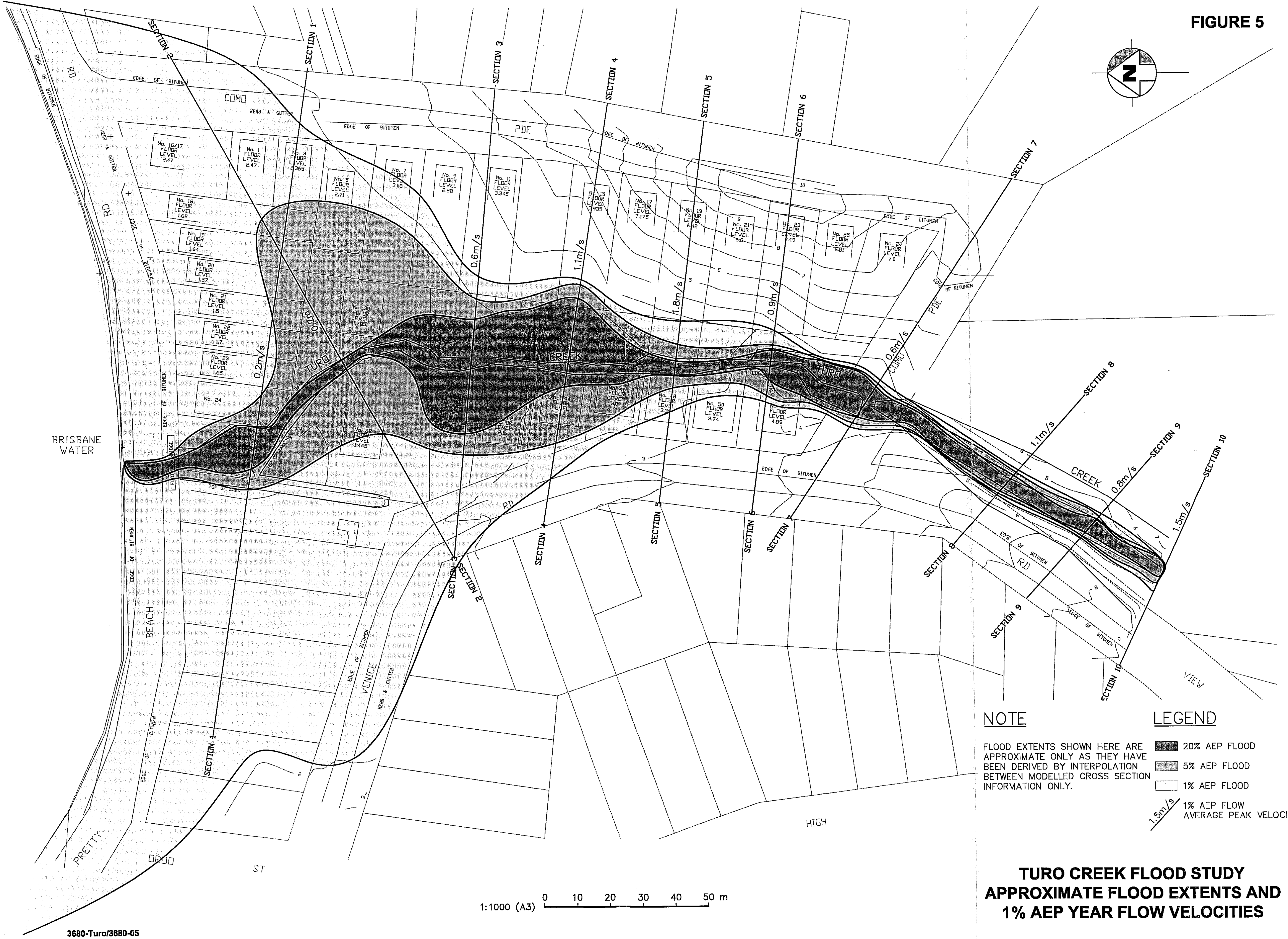
LEGEND

- (NB) "MOUSE" NODES
- (S1) SURVEYED SECTION
- [21] EXISTING HOUSE EAST OF CREEK
- [46] EXISTING HOUSE WEST OF CREEK

TURO CREEK FLOOD STUDY
LONGITUDINAL SECTION
FLOOD PROFILES

3680-Turo/3680-04

FIGURE 5



NOTE

FLOOD EXTENTS SHOWN HERE ARE APPROXIMATE ONLY AS THEY HAVE BEEN DERIVED BY INTERPOLATION BETWEEN MODELLED CROSS SECTION INFORMATION ONLY.

LEGEND

- 20% AEP FLOOD
- 5% AEP FLOOD
- 1% AEP FLOOD
- 1.5m/s — 1% AEP FLOW AVERAGE PEAK VELOCIT

1:1000 (A3) 0 10 20 30 40 50 m

TURO CREEK FLOOD STUDY APPROXIMATE FLOOD EXTENTS AND 1% AEP YEAR FLOW VELOCITIES

3680-Turo/3680-05

FIGURE 6

NOTES

1. HOUSE FLOOR LEVEL INUNDATION IS NOT COMPREHENSIVE. NO ACCOUNT HAS BEEN MADE FOR OVERLAND FLOW INUNDATING PROPERTIES, OR INUNDATION CAUSED BY LOCAL BACKING UP OF FLOOD WATERS DUE TO BLOCKAGE OR PARTIAL BLOCKAGE OF ANY CULVERTS/BRIDGES OR OTHER STRUCTURES.
2. HOUSE FLOOR LEVEL INUNDATION PLAN DOES NOT ALLOW FOR ANY FREEBOARD.

LEGEND

- HOUSE FLOOR LEVEL INUNDATED DURING 5% & 1% AEP & PMF EVENTS
- HOUSE FLOOR LEVEL INUNDATED DURING 1% AEP & PMF EVENTS
- HOUSE FLOOR LEVEL INUNDATED DURING PMF EVENT

1:1000 (A3) 0 10 20 30 40 50 m

TURO CREEK FLOOD STUDY
HOUSE FLOOR LEVEL INUNDATION PLAN

3680-Turo/3680-06

APPENDIX A

RESIDENT QUESTIONNAIRE

Please return to:
Gosford City Coucil
PO BOX 21
Gosford NSW 2250
Att: Mr. Senthil Myl

GOSFORD CITY COUNCIL

QUESTIONNAIRE - TURO CREEK FLOOD STUDY AND PRETTY BEACH DRAINAGE INVESTIGATION

Your response to this questionnaire will help Council in its investigation of the drainage system and flooding problems in your area. Please tick ☐ box where requested.

1. **Please provide your address details below.**

   Address: ....

   ....

   .... Postcode ....

   Name (optional): ....

   Name of Business/Organisation (if applicable): ....

2. **How long have you been at this address (or owned this property)?**

   ________ years (if less than one year please state number of months)

   ________ months

3. **Type of development**

   ☐ Business. Please indicate type: ....
   ☐ House
   ☐ Residential units.
   ☐ Other. Please specify: ....

4. **Your status with regard to this property**

   ☐ Owner residing or conducting business at property.
   ☐ Tenant only.
   ☐ Owner not residing nor conducting business at property.
   ☐ Secretary of Body Corporate.
   ☐ Other. Please specify: ....

Please return to:
Gosford City Coucil
PO BOX 21
Gosford NSW 2250
Att: Mr. Senthil Myl

5. **Have you ever experienced any flooding or drainage problems at this address?**

- ☐ No
- ☐ Yes

6. **A number of flooding and drainage problems have been reported to Council in the area. If you can remember the dates of storms which produced flooding, please indicate these below *(the following storm dates may be of some help in assisting your memory: (1988, January 1999).* Please rank the storms with the worst storm placed first in the list.**

Dates of worst storms: 1. ....
2. ....
3. ....
Others ....

7. **If possible please draw a sketch map of your property and show on it where the floodwater comes from and where it goes. If possible, show depths of floodwaters. Show any other relevant details and return it with this questionnaire. It may be of assistance to state whether the floodwaters have risen from a channel or natural creek system (eg. Turo Creek, or have come from overland flow entering your property from the adjoining street or roadway).**

8. **What parts of your property are flooded?** (you may tick more than one box)

Worst Storm

- ☐ no flooding
- ☐ grounds or yard
- ☐ garage/covered parking area
- ☐ shop/office/house (above floor)
- ☐ shop/office/house (below floor)
- ☐ other

Other Storms

- ☐ no flooding
- ☐ grounds or yard
- ☐ garage/covered parking area
- ☐ shop/office/house (above floor)
- ☐ shop/office/house (below floor)
- ☐ other

9. **During severe storms, what is the approximate cost of damage caused by flood or drainage water on your property?**

Worst Storm

- ☐ no damage
- ☐ 0-$500
- ☐ $500-$1000
- ☐ $1000-$2000
- ☐ $2000-$5000
- ☐ $5000-10000
- ☐ approx $____________

Other Storms

- ☐ no damage
- ☐ 0-$500
- ☐ $500-$1000
- ☐ $1000-$2000
- ☐ $2000-$5000
- ☐ $5000-10000
- ☐ approx $______

Please return to:
Gosford City Coucil
PO BOX 21
Gosford NSW 2250
Att: Mr. Senthil Myl

10. If you think you know the cause or source of flooding in the general area please indicate this below. Also if you have any other comments about flooding in your area, please make these in the space below.

....
....
....
....
....
....
....
....
....

11. If you have any suggestions for resolving the drainage problems in your area, indicate these below or on a separate sketch.

....
....
....
....
....
....
....
....
....

12. Do you have any photographs, videos or other information about flooding in your area which you would be prepared to make available to the Consultant or Council?

- ☐ No
- ☐ Yes (if 'yes' please provide your telephone number in Question 15 below so that we may contact you)

Please return to:
Gosford City Coucil
PO BOX 21
Gosford NSW 2250
Att: Mr. Senthil Myl

13. **Would you like to be interviewed by Council's Consultant to discuss your particular drainage problems and the information provided in this questionnaire?**

- ☐ No
- ☐ Yes (if 'yes' please provide your telephone number in Question 15 below so that we may contact you)

Please note that due to time constraints, not all respondents will receive a phone call.

14. **Have you previously written to Council in connection with flooding and drainage problems in your area?**

- ☐ No
- ☐ Yes

If 'yes' please attach copies of your correspondence (if available) and provide a list of the dates of the correspondence below.

Date of correspondence: ....

....

15. **If you have answered 'yes' in Questions 12 or 13, or if you have any other information which you think would be relevant please provide your telephone number below so that we may contact you.**

Work Phone: .... (Ask for ....)

Best time to call is ....

Home Phone:.. (Ask for ....)

Best time to call is ....

16. **In the future we will need to come back to survey the creek and any flood levels indicated by your sketch. May we enter your property at that time to undertake the survey?**

- ☐ No
- ☐ Yes

After completing the questionnaire please check that you have answered every question. Put the completed questionnaire in the attached freepost envelope and post it within seven days. Thank you for your assistance.

APPENDIX B1

HISTORICAL RECORDS - RAINFALL

Data for Woy Woy (Chun Chiu)

r 061318 • Locality: Woy Woy • Opened Dec 1964 • Still Open • Latitude 33°29'22"S • Longitude 151°19'58"E • Elevation 3m

tation to 9am (mm)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Avg	Max	Min	Total	Nbr
6.4	22.8	15.0	15.2	10.0	10.2	1.6	0.0	0.0	0.0	0.0	0.0	1.2	53.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	4.4	0.0	0.0	0.0	0.0	4.6	53.2	0.0	142.2	31
0.0	0.0	0.0	12.4	7.2	0.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	10.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	12.4	0.0	31.4	31
5.2	7.2	5.2	0.0	1.4	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	7.0	4.2	3.6	6.0	4.0	2.2	1.0	34.0	23.0	0.0	0.0	0.0	0.4	0.0		3.6	34.0	0.0	109.0	30
0.0	0.0	2.8	0.0	0.0	0.0	5.6	57.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.8	0.0	2.3	57.0	0.0	70.6	31
2.6	0.0	0.0	0.0	11.2	0.0	0.0	0.0	0.0	0.2	4.2	0.0	3.8	0.0	6.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.0	1.4		1.1	11.2	0.0	31.8	30
0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	2.4	1.2	0.0	0.0	0.0	0.2	4.0	0.0	4.6	1.6	0.0	0.0	0.0	0.7	4.6	0.0	20.8	31
0.0	0.0	0.0	5.2	0.0	11.8	2.0	0.0	5.4	3.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	2.2	1.0	1.2	0.0	0.0	0.0	62.4	26.2	0.0	0.0	0.0	0.0	0.0	3.9	62.4	0.0	122.2	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.6	2.0	4.0	7.6	0.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.2	0.0	0.0	0.0	7.8				1.8	20.0	0.0	50.2	28
1.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	4.8	8.6	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.7	8.6	0.0	21.6	31
0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.6	61.4	1.0	0.0	0.0	0.0	25.8	6.4	11.4	0.0	0.0	0.2	3.4	56.4	0.0	34.2	0.0	0.0	0.0	0.0	0.0		7.4	61.4	0.0	223.0	30
0.0	32.2	38.2	14.4	62.2	33.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.4	8.0	58.8	76.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.7	76.8	0.0	330.6	31
0.0	4.0	21.0	27.4	1.6	0.0	0.6	0.6	0.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	0.0	0.0	0.0	0.6	16.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0		3.2	27.4	0.0	95.4	30
6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0		11.0	16.2	0.0	17.4	7.2		25.0	8.0	9.0	0.0	0.0	3.5	25.0	0.0	102.8	29
0.0	0.0	0.0	0.0	1.0	86.6	104.8	65.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	23.0	48.2	16.8	0.0	20.6	1.0	3.0	1.8	0.0	1.2	2.0	1.6	0.0	0.0	0.0	0.0	12.2	104.8	0.0	376.8	31
0.0	0.0	0.0	0.0	2.0	12.0	1.0	1.8	0.0	0.0	0.0	3.8	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	1.0	0.0	4.2	3.2	0.0	0.0	0.0		1.6	14.0	0.0	47.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.2	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		21.0	0.0	0.0	0.0	0.0	0.0	19.0	2.6	0.0	0.0	0.4	2.1	21.0	0.0	62.4	30
1.0	3.2	1.0	0.0	0.0	0.0	1.0	1.0	13.0	0.0	0.0	0.0	12.2	1.0	0.0	1.2	18.0	2.6	1.2	14.0	0.0	0.0	0.0	0.0	0.0	43.6	0.0	0.0	0.0	0.0		3.8	43.6	0.0	114.0	30
14.0	0.0	0.0	0.0	2.2	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	18.0	1.0	2.0	1.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	18.0	0.0	58.6	31
7.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	24.6	37.0	13.2	0.0	1.4	0.0	2.0	2.0	4.2	5.0	0.0	3.3	37.0	0.0	103.8	31
8.2	0.0	22.0	0.0	1.8	0.0	3.0	8.2	56.0	7.0	0.0	0.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.4	0.2	80.6	27.0	1.2	2.0				8.0	80.6	0.0	223.8	28
6.2	1.2	1.2	0.0	0.0	3.0	0.0	15.0	3.4	0.0	0.0	0.0	0.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	15.0	0.0	42.2	31
0.0	42.0	54.6		74.0	31.2	10.0	10.0	1.0	0.0	0.0	0.0	17.0	19.2	0.0	5.0	22.0	0.0	0.0	0.0	0.0	5.2	1.2	0.0	0.0	0.0	0.0	8.0	3.0	0.0		10.5	74.0	0.0	303.4	29
1.0	0.0	3.0	0.0	0.0	0.0	1.8	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	5.4	5.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.9	5.4	0.0	27.4	31
0.0	0.0	16.8	0.0	0.2	0.0	0.4	47.0	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	25.0	0.0	9.0	18.0	12.2	4.0	2.2	0.0		5.3	47.0	0.0	160.2	30
0.0	4.8	15.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	21.0	34.0	32.0	50.0	16.0	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	4.0	0.0	0.0	0.0	0.0	6.3	50.0	0.0	195.0	31
0.0	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	15.2	0.0	0.8	18.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	0.0	0.2	0.0	1.2	0.0	23.0	4.0	0.0	3.3	30.0	0.0	103.4	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.8	0.0	5.2	0.0	0.0	0.0	11.8	0.0	12.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	0.0	0.0	0.0		1.3	12.0	0.0	38.8	30
0.0	0.0	0.0	0.0	1.8	6.2	5.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0		55.0	5.4	0.0	0.0	0.0	0.0	0.0	13.4	4.4	55.0	0.0	131.0	30
13.0	8.0	0.0	5.0	4.0	0.0	0.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	9.0	1.0	0.0	0.0	3.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		2.5	24.0	0.0	76.0	30
0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	9.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	12.0	0.0	0.0	0.0	7.0	10.0	11.0	1.0	3.0	40.0	0.0	0.0	1.5	3.2	40.0	0.0	99.0	31
0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	3.0	4.5	0.0	1.5	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	1.0	8.0	4.5	1.0	0.0	0.0	1.0	8.0	0.0	30.5	31

Prepared by Climate and Consultancy Section in the New South Wales Regional Office of the Bureau of Meteorology
Contact us by phone on (02) 9296 1555, by fax on (02) 9296 1567, or by email on reqnsw@bom.gov.au

Data for Woy Woy (Chun Chiu)

r 061318 • Locality: Woy Woy • Opened Dec 1964 • Still Open • Latitude 33°29'22"S • Longitude 151°19'58"E • Elevation 3m

tation to 9am (mm)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Avg	Max	Min	Total	Nbr
0.0	0.0	19.6	4.2	6.4	14.6	0.0	4.0	4.8	1.2	1.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	19.6	0.0	64.4	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.4	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2	7.4	16.4		2.2	19.2	0.0	65.2	30
37.2	9.2	1.8	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.8	2.4	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.6	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.2	37.2	0.0	69.4	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.4	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	3.8	0.5	5.6	0.0	14.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0		0.0	0.6	0.0	0.6	30
0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	6.8	16.4	4.2	1.0	0.8	0.0	0.0	0.0	0.0	1.8	0.0	0.0	1.3	16.4	0.0	41.8	31
0.0	8.2	0.4	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	1.8	0.0	3.8	0.0	0.0	0.8	1.0	1.8	0.0	0.0	1.8	5.8	0.0	0.0	9.8	11.2		1.8	11.2	0.0	52.6	30
8.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	26.4	14.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	6.8	19.2	8.8	0.6	0.0	0.0	0.0	0.0	2.9	26.4	0.0	91.4	31
0.0	12.8	22.8	17.6	0.4	1.6	9.8	0.0	1.8	1.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	16.8	21.8	0.4	1.0	0.0	0.0	0.0	0.0	0.0	4.6	1.0	0.0	3.8	22.8	0.0	119.0	31
0.0	0.0	0.0	0.0	0.0	11.8	1.8	0.0	0.0	0.0	2.0	3.8	0.0	2.8	2.2	10.2	31.0	3.4	0.0	0.2	4.4	1.2	1.6	0.0	0.0	0.0	0.0	0.0				2.7	31.0	0.0	76.4	28
7.2	11.6	32.2	11.4	61.8	22.6	7.6	20.6	0.2	13.4	10.8	0.4	0.2	0.0	0.0	25.2	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.4	0.0	0.0	7.5	61.8	0.0	231.8	31
0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	9.6	26.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		1.3	26.8	0.0	39.8	30
0.0	2.8	1.6	0.6	0.6	31.2	20.4	1.2	0.4	3.2	0.0	0.0	0.0	15.8	0.0	0.0	20.8	21.2	2.2	0.0	0.0	16.2	14.6	0.0	0.0	0.2	0.0	0.0	0.2	0.0	0.0	4.9	31.2	0.0	153.2	31
0.0	1.8	1.8	27.8	7.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	27.2	30.6	0.0	0.0	0.0	0.0	17.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0		4.0	30.6	0.0	120.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	0.0	1.8	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.2	31
0.0	1.2	23.6	0.0	0.0	1.8	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	4.0	18.0	14.8	0.0	0.0	5.0	0.0	0.0	0.0	33.6	43.8	0.2	0.0	0.0	0.0		4.9	43.8	0.0	147.6	30
0.0	0.0	3.2	3.2	0.2	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.8	5.0	7.6	0.0	0.0	0.0	0.0	0.0	3.6	0.0	1.2	0.9	7.6	0.0	27.4	31
0.0	0.0	2.6	0.0	0.2	1.8	0.0	0.0	0.0	0.0	0.0	1.8	30.6	0.0	0.0	1.8	0.0	0.0	12.2	30.6	24.8	25.4	12.2	0.4	1.0	3.2	1.0	0.0	3.8	4.2		5.2	30.6	0.0	157.4	30
4.0	2.2	1.0	0.0	8.4	26.8	0.0	0.0	0.0	1.0	5.2	0.0	4.2	0.0	0.0	0.0	0.8	12.8	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	9.8	6.6	0.0	0.0	0.4	2.7	26.8	0.0	84.2	31
0.0	2.2	17.2	4.8	0.0	7.4	33.2	0.2	7.8	1.0	6.0	0.0	0.0	0.0	0.0	1.0	6.4	1.2	0.0	1.2	21.2	4.6	3.2	20.0	0.0	2.0	0.0	0.0	0.0	0.2	0.0	4.5	33.2	0.0	140.8	31
1.2	0.0	0.0	0.0	0.0	9.2	1.2	0.0	6.0	0.0	0.0	0.0	0.0	11.2	3.6	2.8	6.8	0.0	0.0	0.0	5.2	0.6	0.6	0.0	4.0	0.0	0.0	0.0	5.0			2.0	11.2	0.0	57.4	29
10.0	0.0	0.0	0.0	6.0	0.0	0.0	10.2	7.4	8.0	9.2	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.4	0.0	0.0	0.8	0.0	1.0	0.0	1.2	2.0	10.2	0.0	62.2	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	1.6	0.0	13.8	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	1.0	0.0		1.0	13.8	0.0	30.2	30
3.8	35.8	12.8	13.0	14.6	17.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	12.6	4.8	4.2	25.2	1.8	3.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	35.8	0.0	151.4	31
0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.8	16.2	12.8	25.0	6.2	2.2	35.2	10.4	0.0	0.0	0.0	0.0	5.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0		6.0	64.8	0.0	179.0	30
0.0	0.0	0.0	0.0	0.0	2.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.8	3.8	0.0	0.0	1.4	29.8	0.0	42.8	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.2	32.8	118.2	5.1	118.2	0.0	158.0	31
11.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.6	15.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.2	15.2		4.1	46.2	0.0	122.0	30
2.8	0.0	0.0	0.0	0.0	0.0	1.0	11.8	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	2.6	2.4	4.8	1.2	0.0	0.0	0.0	0.0	0.0	5.2	2.4	0.0	0.0	0.0	1.1	11.8	0.0	35.4	31
0.0	1.2	0.0	0.0	14.8	11.4	0.0	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.4	6.0	13.6	0.0	0.0	6.4	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0		3.0	16.8	0.0	89.4	30
0.0	0.0	0.0	0.0	0.0	0.0	19.6	9.6	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	1.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	8.8	1.7	19.6	0.0	52.6	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	1.0	1.2	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.8	2.0	0.0	33.8	48.2	8.2	3.3	48.2	0.0	103.0	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2		136.8	48.0	6.2	2.4	3.6	1.2	0.0	0.0	0.0	0.0	0.0	0.0	9.0	10.4	0.0	3.8				8.3	136.8	0.0	224.6	27
0.0	0.0	0.0	0.0	0.6	11.6	3.0	0.0	5.6	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	11.6	0.0	27.6	31
0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	2.4	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	14.2	2.2	0.0	0.0	0.0	0.0		0.8	14.2	0.0	24.2	30
0.0	0.0	0.0	0.4	0.0	13.8	0.2	4.8	6.2	33.8	14.6	1.2	0.0	0.0	0.0	0.2	28.2	1.6	0.6	7.0	5.8	4.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	33.8	0.0	125.2	31
4.8	0.8	0.0	0.0	1.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	5.6	4.2	1.0	3.4	0.2	31.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	6.8	30.6		3.1	31.2	0.0	94.2	30

ata for Woy Woy (Chun Chiu)

061318 • Locality: Woy Woy • Opened Dec 1964 • Still Open • Latitude 33°29'22"S • Longitude 151°19'58"E • Elevation 3m

ation to 9am (mm)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Avg	Max	Min	Total	Nbr
0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	15.6	1.1	15.6	0.0	35.2	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	1.6	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	0.0	0.0	0.0		0.2	1.6	0.0	5.0	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	20.0	4.6	0.0	0.8	16.2	4.0	8.2	0.6	9.2	2.0	2.2	17.8	0.0	0.0	0.4	0.0	0.0	0.0	8.0	5.2	25.8	0.0	4.4	25.8	0.0	137.4	31
0.0	0.0	0.0	0.0	0.0	4.2	11.4	28.0	4.2	81.2	96.2	17.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		8.3	96.2	0.0	248.6	30
0.0	0.6	4.6	0.0	0.0	0.0	0.0	0.0	10.6	7.6	9.8	2.4	0.2	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	10.8	0.0	50.2	31
0.8	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.2	3.8	0.0	6.2	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.4	0.0	0.0	0.0		0.3	5.8	0.0	9.8	30
0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	2.6	0.0	0.6	0.0	0.0	0.0	0.2	2.6	0.0	6.4	31
1.6	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.2	0.0	1.2	17.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	4.8	6.8	0.0	3.2		2.5	36.2	0.0	75.2	30
0.6	0.0	0.0	1.4	0.8	0.0	0.0	0.0	0.0	0.0	20.4	62.4	22.6	48.4	13.6	0.0	0.0	0.0	0.0	0.0	0.0	23.4	7.8	0.0	0.0	0.0	0.0	2.8	0.8	6.2	9.6	7.1	62.4	0.0	220.8	31
6.2	0.0	0.0	0.0	8.0	4.2	0.0	6.8	109.2	1.4	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.2	10.6	0.0	0.0	0.0	0.4	0.0	0.0	4.8	109.2	0.0	149.6	31
0.0	0.0	0.0	3.8	17.6	3.6	6.8	13.6	196.8	153.6	0.0	6.2	1.6	0.0	3.2	0.0	0.0	0.0	0.0	0.0	1.0	7.8	6.8	28.8	32.4	3.6	0.0	0.0	0.0			16.8	196.8	0.0	487.2	29
0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	16.6	0.0	0.0	6.2	59.6	6.2	0.0	0.0	1.8	0.0	3.0	59.6	0.0	93.4	31
0.0	6.2	90.2	33.0	1.0	0.0	0.0	9.2	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	18.2	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	25.6	0.0	0.0		6.6	90.2	0.0	199.2	30
0.0	0.0	0.0	1.0	0.0	0.0	5.8	0.8	0.0	0.8	0.0	0.0	1.8	0.0	0.0	0.0	0.6	20.4	0.0	0.0	8.0	1.8	7.8	0.0	0.0	0.0	0.0	0.0	3.8	20.2	1.8	2.4	20.4	0.0	74.6	31
0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	1.0	0.0	6.0	3.8	0.0	0.0	0.0	16.8	14.0	22.8	16.8	3.8		3.0	22.8	0.0	90.2	30
0.0	0.0	0.0	0.0	0.0	0.0	0.8	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.4	0.6	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.4	0.0	12.4	31
0.6	0.6	0.0	0.2	3.6	0.0	2.6	6.2	12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.0	0.0	0.0	0.0	2.0	0.4	1.2	12.8	0.0	38.6	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.6	2.8		0.6	8.8	0.0	16.8	30
0.0	0.0	0.0	0.0	11.8	0.0	10.6	8.6	0.0	0.2	0.0	2.4	0.0	0.0	0.0	0.0	2.2	1.4	1.0	0.0	1.6	0.2	0.0	0.0	0.0	0.0	3.0	0.0	0.0	1.2	0.0	1.4	11.8	0.0	44.2	31
10.0	4.2	3.8	0.0	1.2	17.0	5.6	0.0	0.0	0.0	0.8	9.8	16.4	0.0	0.0	0.0	0.6	11.0	4.4	0.4	0.0	8.6	0.0	0.0	0.6	0.0	0.0	0.0	0.0	14.8		3.6	17.0	0.0	109.2	30
13.6	0.6	0.0	9.2	38.0	7.6	24.8	3.0	0.6	0.0	0.0	0.0	0.0	14.4	5.2	1.2	9.0	11.0	0.0	0.0	0.0	22.0	0.0	0.0	1.0	7.2	8.0	0.0	0.0	0.0	0.0	5.7	38.0	0.0	176.4	31
0.0	0.0	0.0	1.2	1.0	0.0	15.8	5.8	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4	10.6	11.8	14.8	0.4	1.4	0.0	0.0	0.0	0.0	2.4	15.8	0.0	73.6	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	1.8	6.8	0.0	0.0	0.8	9.6	6.0	0.0	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0				1.8	16.2	0.0	51.2	28
0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	13.2	0.0	0.0	13.8	0.0	0.0	3.8	1.0	0.0	2.2	0.0	0.0	0.0	14.2	0.0	0.8	0.0	7.0	0.8	0.0	1.2	0.6	0.0	2.4	14.6	0.0	73.2	31
0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.6	3.0	25.6	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8	2.6		1.8	25.6	0.0	54.4	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	2.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.2	2.0	0.0	7.2	31
1.0	27.4	0.0	0.0	21.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.4	1.0		2.0	27.4	0.0	59.2	30
0.0	0.0	0.0	0.0	6.8	6.2	0.0	0.2	31.8	3.8	0.4	17.8	0.0	0.0	0.0	0.0	8.0	0.0	0.0	1.6	0.6	0.0	0.0	0.0	0.0	2.8	0.0	0.0	10.0	25.2	0.8	3.7	31.8	0.0	116.0	31
1.4	0.0	6.8	10.8	25.6	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	3.6	3.8	7.8	31.6	5.8	10.6	0.0	4.1	31.6	0.0	125.6	31
0.4	3.8	0.0	0.0	1.4	0.0	0.0	0.0	2.8	28.6	0.0	0.0	23.8	21.2	1.4	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		2.9	28.6	0.0	85.6	30
0.0	9.6	1.6	8.2	4.2	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	18.8	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	6.2	0.0	0.0	0.0	2.0	0.0	2.1	18.8	0.0	64.8	31
0.0	0.0	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	4.8	4.6	2.4	0.0	0.0	10.4	1.6	17.0	11.2	0.0	3.6	0.0	0.0	1.2	0.0	0.0	0.0	0.0		2.3	17.0	0.0	69.4	30
0.0	0.0	2.4	6.8	15.6	2.4	2.2	11.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0	0.0	0.6	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	17.8	0.0	62.2	31
0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.0	16.4	7.6	0.4	5.6	0.0	2.8	0.0	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.5	16.4	0.0	46.2	31
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	49.2	0.0	0.0	1.6	0.4	0.0	40.4	7.8	7.2	0.8	0.0	0.0	0.0	0.0	0.0	27.4				5.2	49.2	0.0	145.4	28
7.0	0.0	0.0	0.0	0.0	0.0	66.4	7.0	8.6	11.6	0.0	11.8	0.0	0.0	0.0	0.0	0.0	0.6	2.0	1.8	0.0	0.0	0.0	13.0	0.6	28.2	1.0	35.8	31.4	7.6	0.4	7.6	66.4	0.0	234.8	31
0.0	2.2	4.2	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.2	3.6	34.6	41.2	0.2	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		3.0	41.2	0.0	88.8	30

Data for Woy Woy (Chun Chiu)

per 061318 • Locality: Woy Woy • Opened Dec 1964 • Still Open • Latitude 33°29'22"S • Longitude 151°19'58"E • Elevation 3m

pitation to 9am (mm)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Avg	Max	Min	Total	Nbr
3	0.0	10.2	1.2	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	168.2	9.8	0.0	0.0	0.4	6.8	1.8	10.8	4.6	0.0	0.0	0.0	0.0	0.6	0.0	7.0	168.2	0.0	216.6	31
8	0.0	3.2	0.0	0.0	0.0	0.0	6.2	28.8	0.0	0.0	0.0	0.0	3.8	68.2	8.6	7.8	7.8	0.0	0.0	7.2	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			4.9	68.2	0.0	143.4	29
8	0.0	0.0	3.6	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	16.8	23.8	9.8	2.8	62.6	13.2	11.2	14.8	3.6	0.0	0.0	0.0	2.8	5.5	62.6	0.0	172.0	31
8	37.8	12.8	61.8	58.2	3.8	17.6	20.2	13.4	84.6	23.4	13.6	20.2	23.4	0.0	0.0	0.0	10.2	1.4	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.2	62.2	146.4		20.8	146.4	0.0	625.4	30
8	102.2	0.0	0.2	0.0	0.2	1.4	0.6	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	5.8	0.0	0.0	0.0	0.0	0.0	2.6	17.2	0.0	0.0	0.8	1.8	2.8	8.2	4.8	102.2	0.0	148.8	31
8	1.6	2.0	2.2	7.4	6.2	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4	32.0	7.2	0.0	0.0	0.0	0.0	2.8	3.8	0.6	0.2	0.0	0.0	0.0	0.0		3.0	32.0	0.0	91.2	30
8	0.0	0.0	1.0	0.2	60.6	127.4	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	127.4	0.0	190.4	31
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.8	11.8	26.2	0.4	0.0	0.0	2.4	0.0	0.0	0.0	1.8	26.2	0.0	56.4	31
8	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	0.4	57.8	69.8	1.8	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	17.4	13.8	0.0	0.0		5.9	69.8	0.0	176.8	30
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.0	31
8	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	5.2	0.0	0.2	0.0	0.0	0.0	44.2	17.2	0.8	0.0	0.0	1.4	6.8	0.0	1.8	0.8	1.6	2.0	6.2	1.0	0.0		3.1	44.2	0.0	92.2	30
8	0.0	0.0	0.0	0.0	0.0	0.0	1.4	3.6	0.8	5.4	14.6	14.8	0.0	0.4	2.0	8.2	2.2	0.0	1.6	0.0	0.4	0.0	3.8	3.8	0.0	0.0	25.2	0.0	0.0	0.0	0.0	2.8	25.2	0.0	88.2	31
9	1.2	104.6	46.4	7.2	0.0	30.6	158.0	2.8	0.0	1.6	0.0	0.0	1.2	3.2	0.0	0.0	0.0	0.0	7.0	0.0	9.4	8.8	11.8	0.4	0.0	8.4	2.4	0.0	0.8	15.4	0.0	13.6	158.0	0.0	421.2	31
9	3.8	0.0	0.0	3.6	13.2	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	25.6	76.8	0.0	0.0	0.0	0.0	0.0	5.8	0.0				5.1	76.8	0.0	142.6	28
9	0.8	0.0	0.0	8.2	12.2	0.0	0.0	0.0	0.0	4.0	2.6	4.8	0.8	32.8	10.8	12.8	0.4	2.6	0.8	6.4	0.0	0.0	0.0	0.0	10.8	2.8	55.2	15.8	0.2	2.4	3.4	6.1	55.2	0.0	190.6	31
9	44.4	58.6	17.0	0.0	0.0	0.0	0.0	12.8	15.2	0.8	0.0	0.0	18.6	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	25.4	11.8	13.2	14.8	32.2	12.4	15.8	0.8	17.2		10.4	58.6	0.0	313.4	30
89	0.8	1.8	5.6	5.8	0.0	0.0	0.0	3.4	0.0	0.8	5.6	0.2	15.8	0.4	0.0	2.6	24.6	0.4	0.2	18.6	3.0	0.2	0.6	4.2	0.0	0.0	4.8	15.2	0.0	0.0	0.8	3.7	24.6	0.0	115.4	31
89	0.8	0.0	8.4	38.6	39.2	13.4	2.2	0.0	3.2	0.0	0.8	15.2	3.2	0.0	0.0	9.0	0.0	1.2	0.0	42.8	57.8	6.2	2.2	1.0	0.0	0.0	2.0	18.2	40.2	0.6		10.2	57.8	0.0	306.2	30
89	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	11.6	6.0	1.6	0.4	0.0	0.0	0.0	0.7	11.6	0.0	22.4	31
89	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0	1.0	28.6	4.8	0.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	1.3	28.6	0.0	39.4	31
89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	30
89	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	10.6	5.4	0.0	0.0	0.0	0.0	0.0	0.6	10.6	0.0	17.6	31
89	0.6	0.6	0.0	0.0	0.0	0.0	6.8	2.8	0.0	0.0	18.8	28.6	0.0	0.0	0.0	0.0	0.0	1.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0		2.1	28.6	0.0	64.4	30
89	0.0	0.0	0.0	7.0	31.2	89.8	9.2	9.2	2.0	0.2	1.6	1.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.2	0.0	0.0	5.1	89.8	0.0	156.6	31
990	0.0	4.0	0.0	0.0	0.0	0.0	10.2	10.4	9.8	37.6	5.2	2.4	0.0	1.8	3.2	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	3.0	37.6	0.0	91.8	31
990	1.0	29.2	309.8	187.8	5.2	3.8	67.8	13.8	31.4	7.4	42.0	1.8	0.0	0.0	0.0	0.0	0.0	16.4	0.0	0.0	0.0	4.8	0.0	14.8	14.2	2.2	0.0	0.0				26.9	309.8	0.0	753.4	28
990	0.0	0.0	0.0	0.0	0.0	4.0	12.2	22.2	0.0	0.0	0.0	3.6	4.8	1.0	0.0	35.4	36.0	0.0	46.8	5.8	9.6	2.4	6.2	4.2	2.2	1.2	6.4	0.0	13.8	20.2	6.0	7.9	46.8	0.0	244.0	31
990	0.0	0.0	20.6	15.2	33.0	18.4	0.0	0.4	7.4	2.6	18.2	0.2	0.8	0.0	2.3	46.6	19.0	0.8	11.8	80.2	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		9.8	80.2	0.0	295.3	30
990	0.0	0.0	0.0	0.0	0.0	0.0	0.8	77.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	6.4	0.2	16.2	3.8	23.8	3.2	0.0	4.0	38.6	8.2	7.2	6.2	77.0	0.0	192.4	31
990	0.0	0.0	0.0	0.0	0.0	2.8	8.2	8.6	0.2	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	5.2	10.8	4.2	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.0	0.0	0.0		1.4	10.8	0.0	42.2	30
990	0.6	1.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	1.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	0.0	0.0	3.4	47.4	0.0	5.4	22.0	0.0	0.0	10.8	3.5	47.4	0.0	109.2	31
990	38.0	68.8	25.8	5.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	4.6	0.0	0.0	0.0	1.8	0.2	0.0	0.0	0.0	0.0	0.0	0.4	9.2	0.0	3.2	24.2	6.1	68.8	0.0	187.6	31
990	0.4	0.0	2.8	0.0	0.0	0.0	0.0	0.4	0.0	0.0	2.4	0.0	2.0	15.8	36.2	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0	3.4		2.9	36.2	0.0	85.6	30
990	0.0	4.0	0.4	0.0	0.0	0.6	8.8	0.0	6.0	0.0	0.4	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	3.8	4.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	1.2	8.8	0.0	36.4	31
990	0.0	0.4	0.0	1.8	2.2	0.0	0.0	0.0	0.0	11.8	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0		0.8	11.8	0.0	25.0	30
990	0.0	0.0	11.2	9.8	0.0	0.0	0.0	0.0	2.0	8.6	14.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	14.8	0.0	56.6	31
991	0.0	0.0	0.0	0.0	0.0	22.8	0.0	0.0	0.0	2.8	4.6	0.0	0.8	0.0	5.8	0.8	0.0	0.0	0.0	0.0	6.6	12.2	0.0	0.8	0.0	0.0	44.8	0.0	0.0	0.0	0.0	3.3	44.8	0.0	102.0	31
991	0.0	0.0	0.0	0.0	0.0	0.0	15.8	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	7.2	1.8	0.2	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	3.0				1.1	15.8	0.0	29.4	28

Prepared by Climate and Consultancy Section in the New South Wales Regional Office of the Bureau of Meteorology
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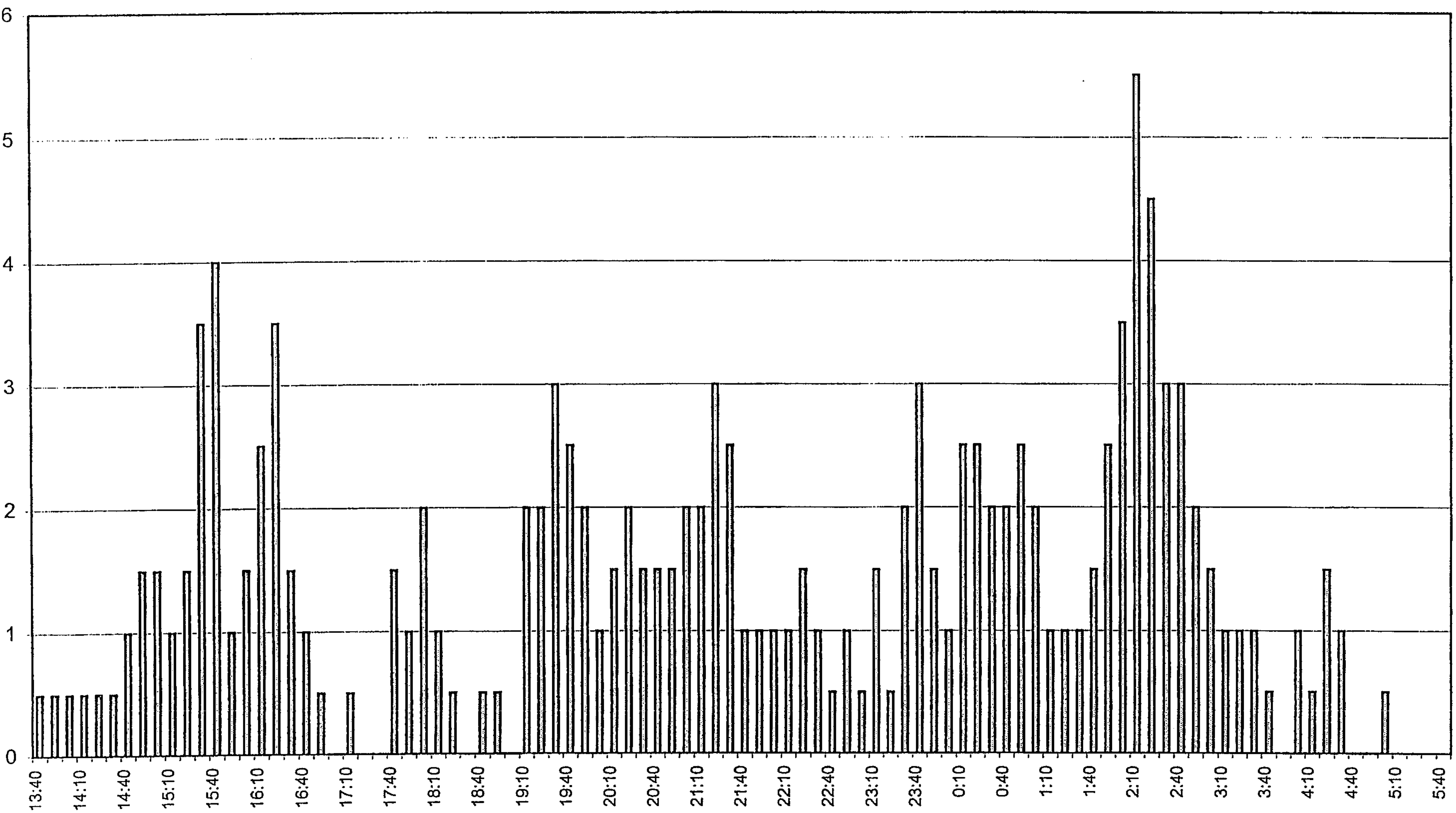
Data for Woy Woy (Chun Chiu)

r.061318 • Locality: Woy Woy • Opened Dec 1964 • Still Open • Latitude 33°29'22"S • Longitude 151°19'58"E • Elevation 3m

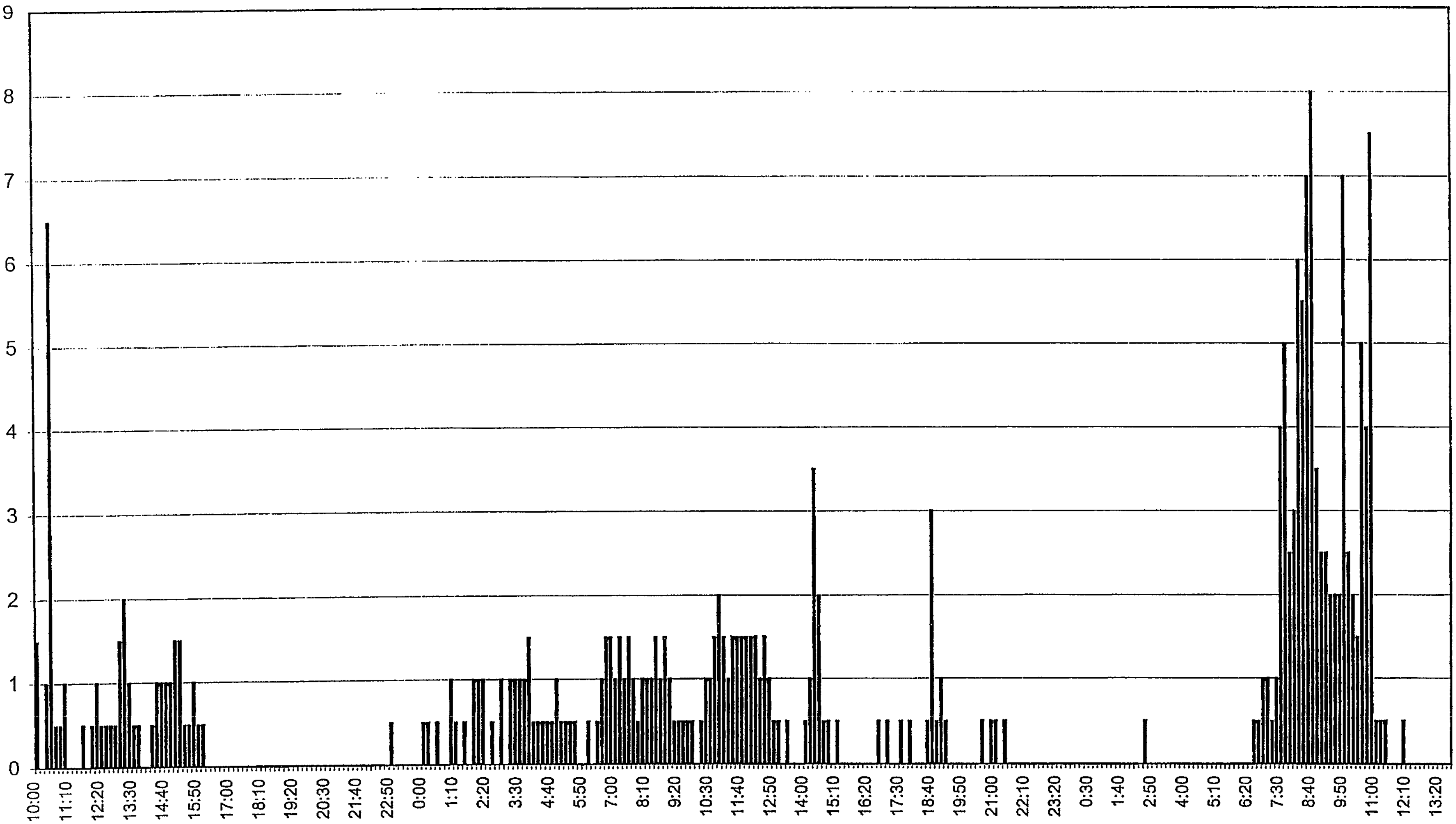
tation to 9am (mm)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Avg	Max	Min	Total	Nbr
0.0	0.0	3.2	0.0	0.0	2.6	12.0	20.0	0.0	6.4	53.8	42.4	0.2	0.0	0.0	0.0	0.0	0.0	20.6	3.2	0.0	0.0	0.0	0.0	8.2	5.2	2.2	0.0	0.0	0.0	0.0	5.8	53.8	0.0	180.0	31
0.0	0.0	0.4	0.0	0.0	0.0	0.6	0.6	0.2	5.2	6.2	0.0	0.0	8.4	23.0	0.2	0.8	0.0	12.2	38.4	1.4	0.0	0.0	0.0	14.4	2.4	1.4	0.0				4.1	38.4	0.0	115.8	28
0.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6		48.0	72.4	1.6	0.0	2.2	4.2	7.8	12.6	2.0	0.0	1.0	52.2	69.2	1.0	0.4	3.2	1.8	0.0	0.2	0.0	9.6	72.4	0.0	289.2	30
0.0	1.0	1.2	0.0	17.0	0.6	0.0	0.6	0.8	18.8	36.8	29.4	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	70.4	5.4	0.0	2.8	0.4	0.0	0.8	2.4	0.0	0.0		6.4	70.4	0.0	190.8	30
0.0	0.0	2.0	4.2	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	103.4	5.2	0.8	0.0	0.0	0.0	0.0	0.4	68.8	24.8	20.6	7.4	0.0	0.0	8.0	103.4	0.0	247.0	31
10.2	49.2	4.3	28.8	60.4	1.8	0.0	1.8	0.0	0.0	18.0	13.0	5.4	0.0	0.0	25.2	6.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6		7.6	60.4	0.0	226.5	30
0.0	2.0	2.2	0.2	0.2	0.2	0.2	0.4	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.3	2.2	0.0	10.8	31
0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	4.8	0.0	19.6	0.0	0.0	8.2	28.8	12.2	0.0	0.0	0.0	2.4	28.8	0.0	75.0	31
0.0	4.6	0.0	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0	2.0	3.4	0.0	0.0	0.4	6.4	0.0	0.0		0.9	6.4	0.0	26.8	30
0.0	0.0	0.0	2.4	7.2	0.0	0.0	5.2	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	1.4	9.0	0.0	0.0	0.0	0.0	4.4	0.0	0.0	1.4	0.0	0.8	0.2	30.0	0.0	2.1	30.0	0.0	64.0	31
4.4	20.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.2	3.8	0.0	0.4	9.8	3.0	26.6	0.0	0.0	0.0	5.8	1.8	0.0	12.8	14.8	0.8	0.0		3.6	26.6	0.0	108.4	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	18.0	0.0	19.8	31

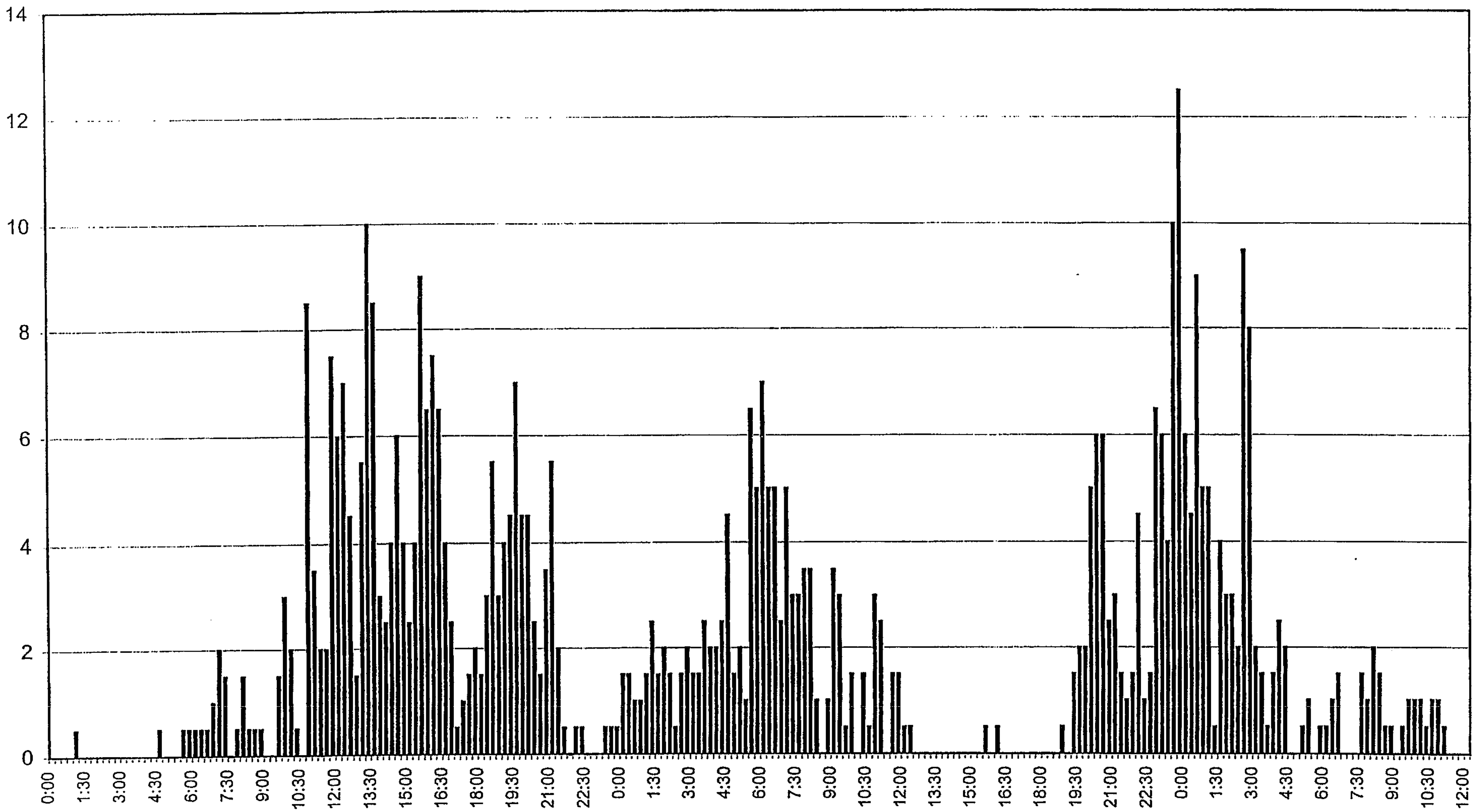
16-17 January 1988 10min Pluviograph



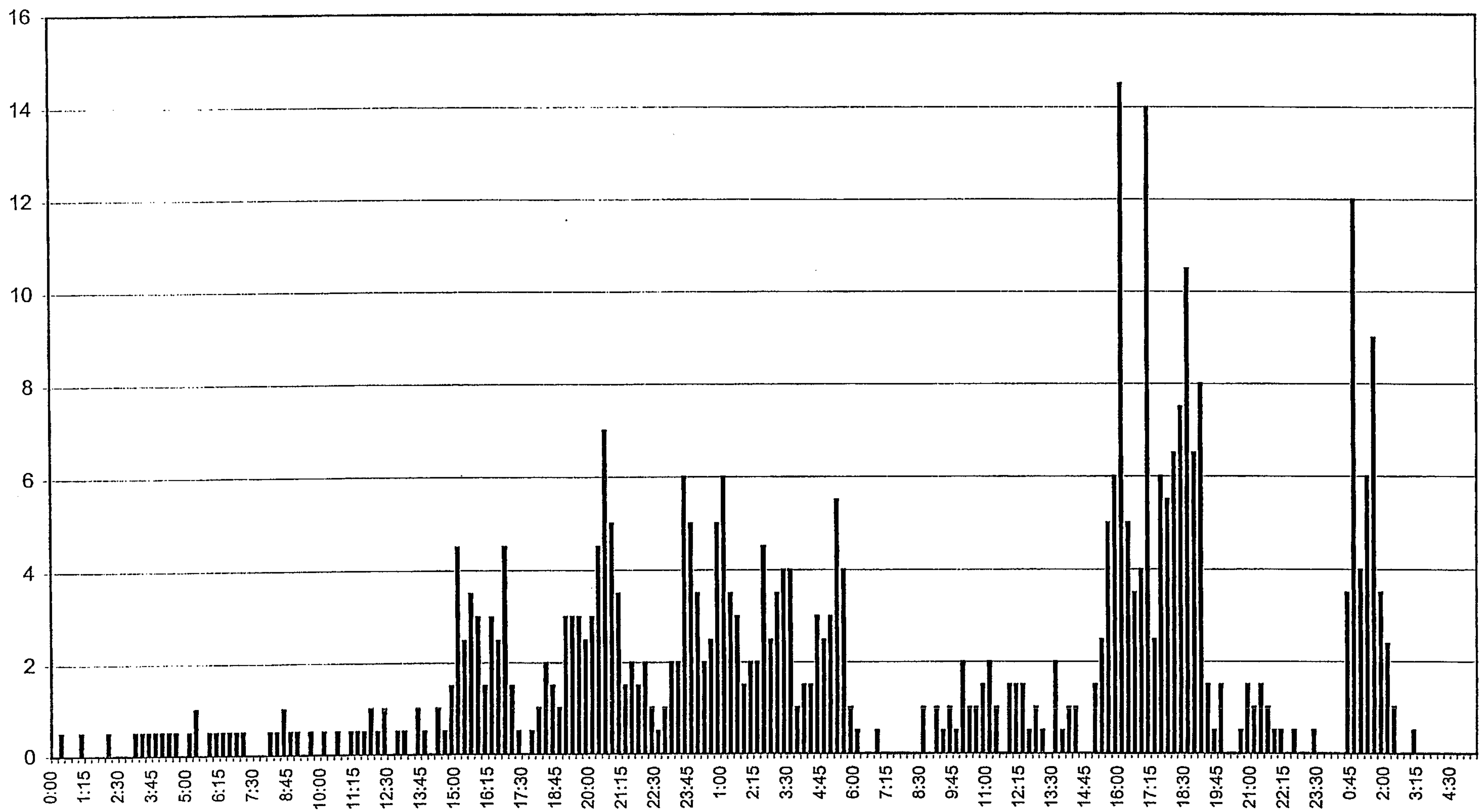
29/4 - 1/5 1988 - 10min Pluviograph



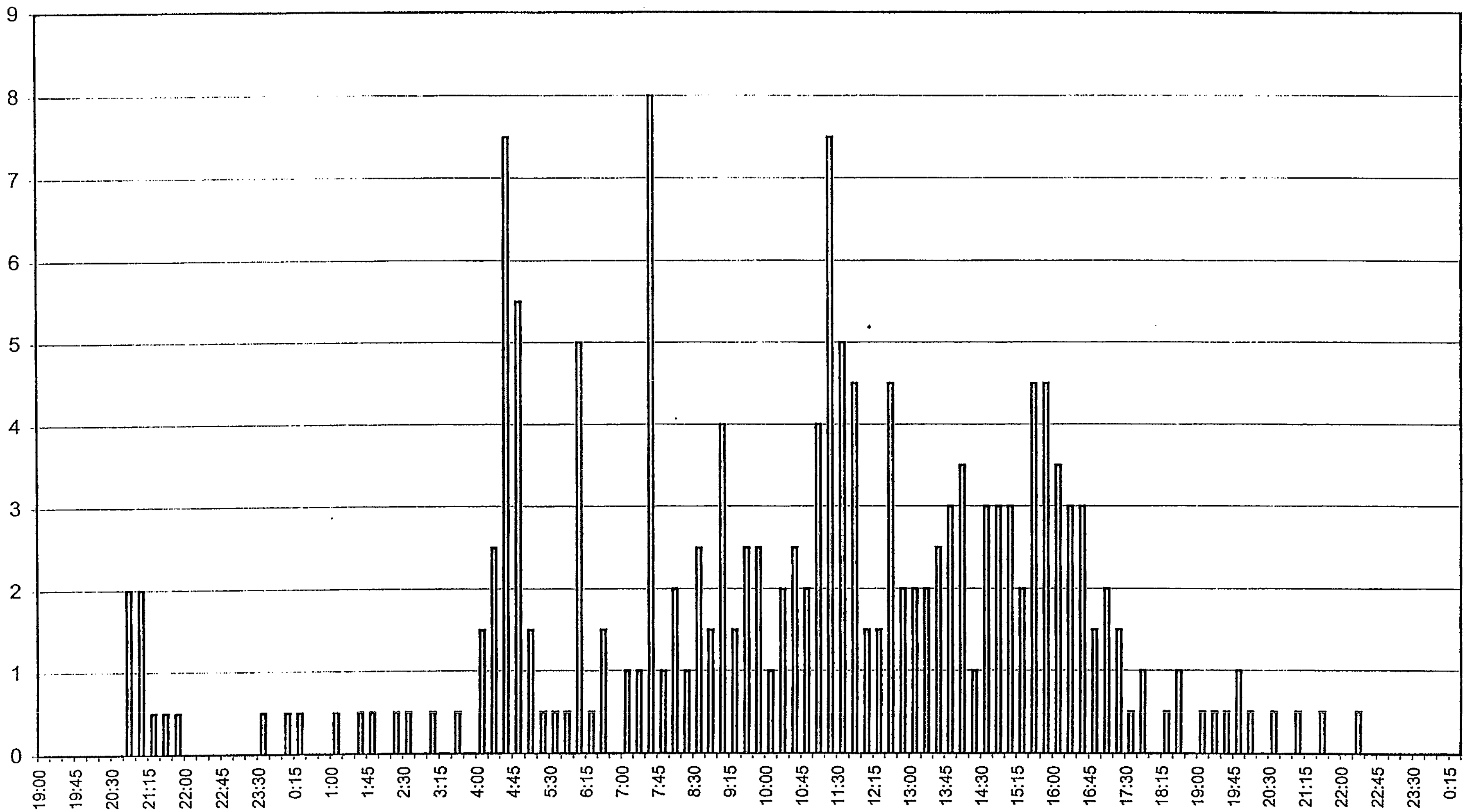
2-4 Feb 1990 - 15min Pluviograph



8-10 Feb 1992 - 15min Pluviograph



5-6 Aug 1998 - 15min Pluviograph



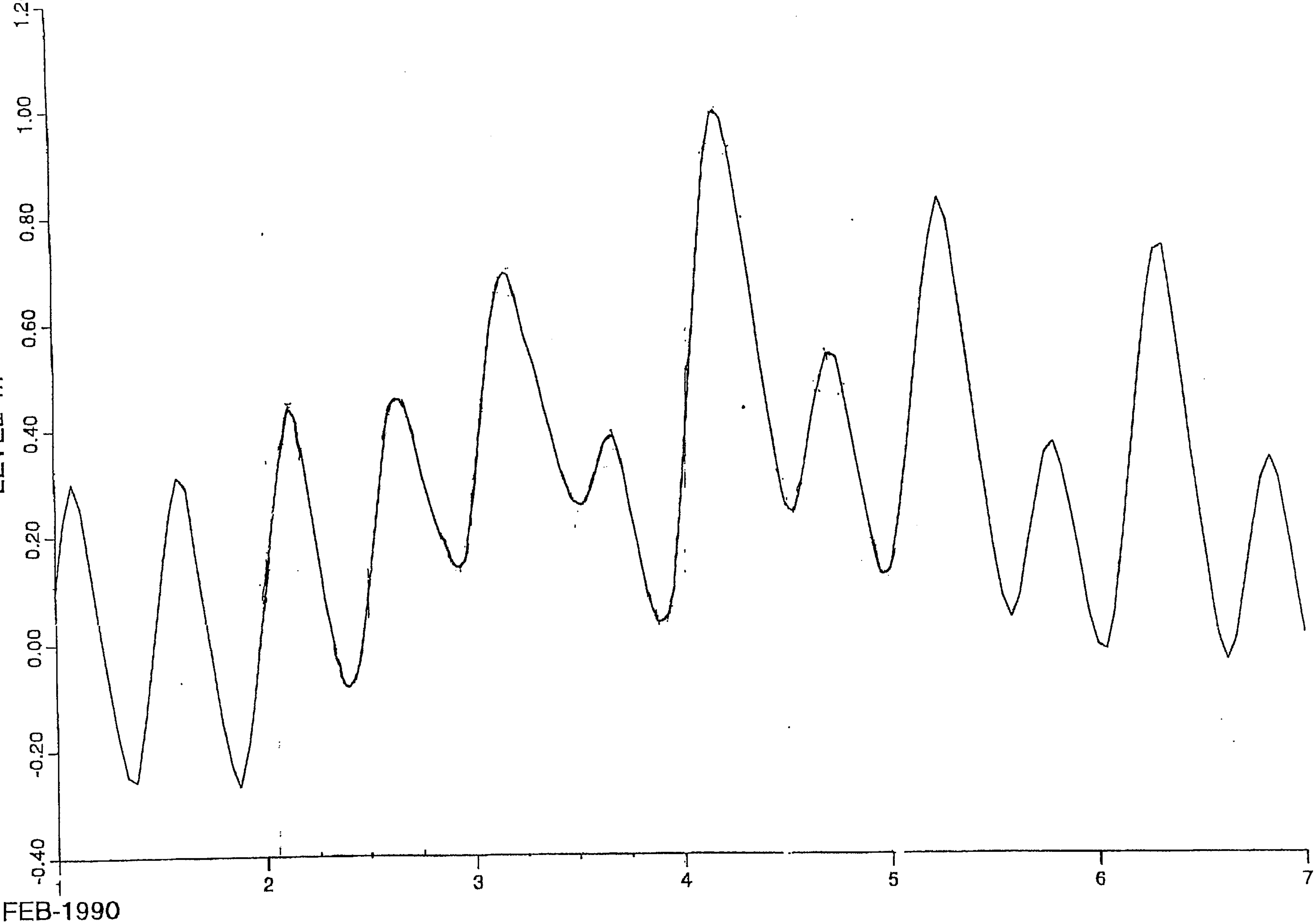
APPENDIX B2

HISTORICAL RECORDS - TIDE

S ATION: BRISBANE WATERS, KOG EWONG

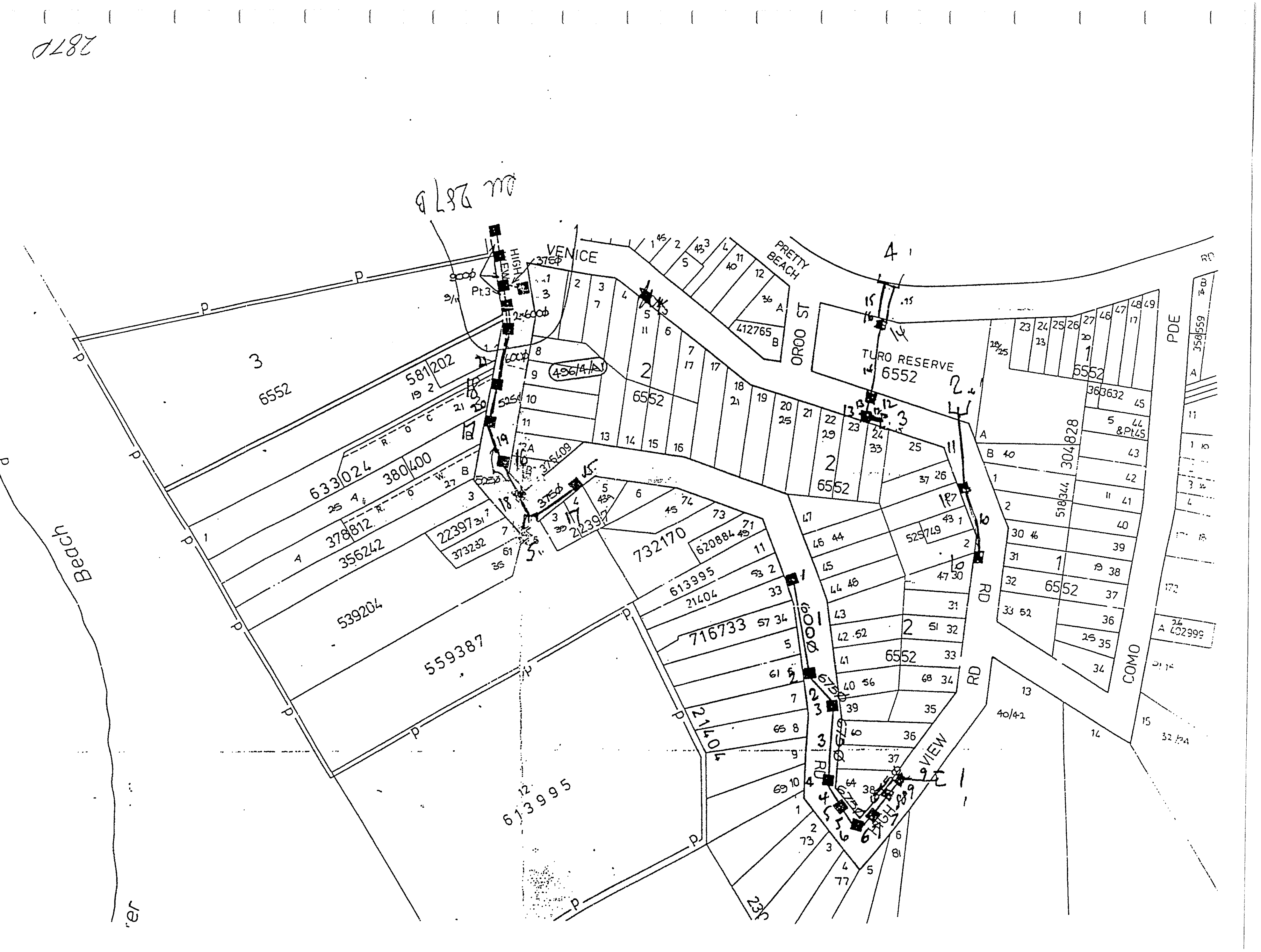
DATUM: AUSTRALIAN HEIGHT DATUM

Max. = 1.00 at 0400:04/02/1990 Min. = -0.27 at 2100:01/02/1990

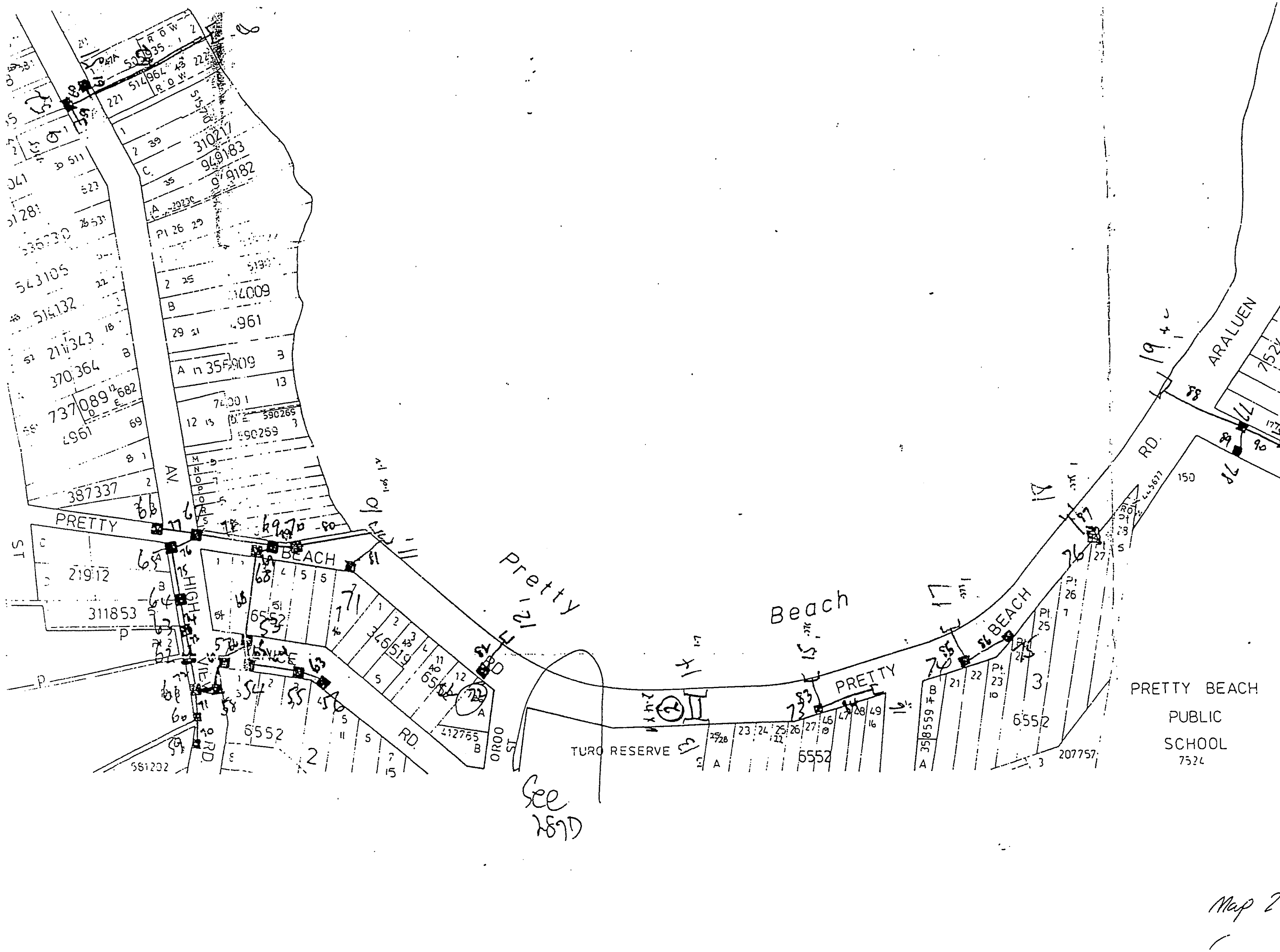


APPENDIX B3

HISTORICAL RECORDS - DRAINAGE



VENICE
HIGH VIEW
PRETTY BEACH
OROO ST
TURO RESERVE
6552
COMO
PDE
RD
VIEW
RD
Beach


PRETTY BEACH RD.
HIGH VIEW RD.
PRETTY AV.
ST
OROO ST
TURO RESERVE
Pretty Beach
ARALUEN
PRETTY BEACH PUBLIC SCHOOL
See 289D
Map 2

28-2-97 MAP No 287 B

PITS

BLUE PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .900

NEW_ASSETID	SIZE	DEPTH	INLETSIZE	INLETTYPE	OPENSIZE	CONDITION		COMMENTS
51	1.2	.8		L/Box	.8	3	.375	
52	1.2	1.3		L/Box(2)	.8	3	.600	
53	1.2	1.3		L/Box(4)	.8	3	.450	
54	1.2	1.1		L/Box(4)	.8	3	.375	
55	1.2	1.3		Sump		3	.375	
56	1.2	1.3		L/Box(4)	.7	3	.375	
57	1.2	.9		L/Box(4)	.8	3	.375	
58	1.1	1		L/Box	.7	5	.375	
59	1.1	2.1		L/Box	.7	5	.450	
60	1.1	1.6		L/Box	.7	5	.450	
61	1.1	1.5		L/Box	.7	5	.450	
62	1.1	1.5		L/Box	.7	5	.450	
63	1.1	1.5		L/Box	.7	5	.450	
64	1.2	1.7		L/Box(3)	.7	3	.450	
65	1.2	2		L/Box(3)	.7	3	.450	
66	1.2	1.6		L/Box(2)	.7	3	.600	
67	1.2	1.6		Sump		3	1.200	
68	1.5	1.3		L/Box	1	3	.450	
69	2.4	1.5	.9	DGCP	2	4	1.2	
70	1.5	1.5		Sump		3	1.2	
71	1.2	1		L/Box(4)	.7	3	.375	
72	.8	1		L/Box	.3	3	.375	
73	1.1	.8		L/Box(2)	.3	3	.375	
74	1.5	1.1		L/Box(3)	.8	3	.375	

12/97 MAP No 287B

PIPES

GREEN PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .900

NEW_ASSETID	DIAMETER	DEPTH UP	DEPTH DOWN	CONDITION	COMMENTS
✓76	.45	2	1.6	3	
✓77	.6	1.6	1.6	3	
✓78	1.2	1.6	1.5	3	
✓79	1.2	1.5	1.5	3	
✓80	1.05	1.5	1.2	3	
✓81	.375	1	1	3	
✓82	.375	1	1	3	
✓83	.375	.8	1	3	
✓84	.375	.5	.8	3	
✓85	.375	1.1	1	3	
✓86	.375	1.2	1.1	3	
✓87	.375	1	1	3	
✓88	.6	1.4	1	5	
✓89	.375	1.4	1.4	5	
✓90	.6	1.3	1.4	5	
✓91	.6	1.4	1.3	5	
✓92	.6	1.3	1.4	5	
✓93	.6	1.5	1.3	5	
✓94	.45	1	1.5	5	
✓95	.45	1.7	1	5	
✓96	.45	1.3	1.7	5	
✓97	.45	1.2	1.3	5	
✓98	.375 ~~.45~~	1.2	1.5	5	
✓99	.375	1	1.2	5	
✓100	.375	.8	1	5	

28|2|97 MAP No 287B

PIPES

GREEN PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .900

NEW_ASSETID	DIAMETER	DEPTH UP	DEPTH DOWN	CONDITION	COMMENTS
51	.375	1	1	3	
52	.375	1	1	3	
53	.45	1	1	3	
54	.45	1.3	1	3	
55	.45	.9	1.3	3	
56	.45	1	.9	3	
57	.45	1	1	3	
58	.375	.7	1	3	
59	.375	.5	1.3	3	
60	.6	1.3	1.2	3	
61	.375	.8	1	3	
62	.6	1.2	1	3	
63	.375	1.3	1.3	3	
64	.375	1.3	1.1	3	
65	.375	1.1	1.3	3	
66	.375	.9	1.3	3	
67	.375	1	.9	3	
68	.45	1.3	1.3	3	
69	.45	1.3	1.5	3	
70	.45	2.1	1.6	5	
71	.45	1.6	1.5	5	
72	.45	1.5	1.5	3	
73	.45	1.5	1.5	3	
74	.45	1.5	1.7	3	
75	.45	1.7	2	3	

E: 27/2/97 MAP No 28'1B

HEAD WALLS

RED PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .900

ID	NEW_ASSETID	PIPE DIAMETER	MATERIAL	NO OF PIPES	DEPTH	CONDITION	COMMENTS
	✓ 1	.6	C	3	.9	~~4~~ 5	
97							
	✓ 2	.45	C	1	.8	3	
	✓ 3	.45	C	1	1	3	
	✓ 4	.375	C	1	1	3	
	✓ 5	.375	C	1	1	3	
	✓ 6	.45	C	1	1	3	
	✓ 7	.375	C	1	1	3	
	✓ 8	.6	STONE	1	1	3	
	✓ 9	.375	C	1	.5	3	
	✓ 10	1.05	STONE	1	1.2	3	
	✓ 11	.375	STONE	1	1	3	
	✓ 12	.375	STONE	1	1	3	
	✓ 13	1.5 2.4 x 1 RCBC		1	1.7	5	
	✓ 14	〃	〃	1	1.7	5	
	✓ 15	.375	STONE	1	1	3	
	✓ 16	.375	STONE	1	.5	3	
	✓ 17	.375	STONE	1	1	3	
	✓ 18	.375	STONE	1	1	3	
	✓ 19	.6	C	1	1	5	
	✓ 20	.375	C	1	1	5	NF
	✓ 21	.6	C	1	.9	3	
	✓ 22	.375	C	1	.5	3	
	✓ 23	.375	C	1	.5	3	
	✓ 24	.6	C	1	1	3	

DATE [illegible] MAP No [illegible]

BOX CULVERTS

RED PEN
ALL MESUERMENTS IN METERS EG: 1.2 C

ASSETID	NEW_ASSETID	WIDTH	HEIGHT	DEPTH_UP	DEPTH_DOWN	CONDITION	COMMENTS
	1	.5	.8	2.3	1.2	3	
	2	2.4	1	1.7	1.7	5	
	2a	2.4	1	1.7	1.7	5	

18.297 MAP No 287D

PITS

BLUE PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .900

NEW_ASSETID	SIZE	DEPTH	INLETSIZE	INLETTYPE	OPENSIZE	CONDITION	Diameter	COMMENTS
✓ 1	1.2	.9		L/Box (3)	.7	3	.600	
✓ 2	1.2	1.1		L/Box (2)	.4	3	.675	
✓ 3	1.2	1.4		L/Box (2)	.4	3	.675	
✓ 4	1.2	2.1		L/Box	.5	3	.675	
✓ 5	1.5	1.1		L/Box	1	3	.675	
✓ 6	1.4	1.1?		~~L/Box~~ Sump		3	.675	
✓ 7	1.4	1.4?		Sump		3	.675	
✓ 8	1.2	1.1?		Sump		5	.675	
✓ 9	1.2	1		L/Box (2)	.7	5	.525	
✓ 10	1.2	1.3		L/Box (2)	.6	3	.600	
✓ 11	1.2	1.1		L/Box	.6	4	.600	
✓ 12	.8	.7	.8	GRATE		4	.600	
✓ 13	1.2	.9		L/Box	.6	4	.600	
✓ 14	2	.8		L/Box	1	4	.750	
✓ 15	1.2	1.4		L/Box	.5	~~4~~ 5	.375	
✓ 16	1.2	1.4		L/Box	.5	5	.525	
✓ 17	1.1	2		L/Box	.5	5	.525	
✓ 18	1.1	1.6		L/Box	.5	5	.600	

TE 28/7/[illegible] MAP No [illegible]

HEAD WALLS

RED PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .

ETID	NEW_ASSETID	PIPE DIAMETER	MATERIAL	NO OF PIPES	DEPTH	CONDITION	COMMENTS
	✓1	·525	STONE	1	1	5	
	✓2	·6	4	1	1	4	
	✓3	·45	C	1	·5	4	
	✓4	·75	C	2	1	4	
	✓5	·525	C	2	1.5	5	

ATE 28/2/97 MAP No 287D

PIPES

GREEN PEN
ALL MESUERMENTS IN METERS EG: 1.2 OR .

SETID	DIAMETER	OFFSET	DEPTH UP	DEPTH DOWN	CONDITION	STREET OFF	LOT NO	BNDRY OFF	LOTS NO	1ST TIE	1TIE LOTS	2ND TIE	2 TIE LOTS	LI
1	.6		.9	1.1	3									
2	.675		1.1	1.4	3									
3	.675		1.4	2.1	3									
4	.675		2.1	1.1	3									
5	.675		1.1	1.1	3									
6	.675		1.1	1.1	3									
7	.675		1.1	1.1	3									
8	.525		1.1	1	5									
9	.525		1	1	5									
10	.6		1.3	1.1	3									
11	.6		1.1	1	3									
12	.45		.5	.9	4									
13	~~.75~~ .6		.9	.7	4									
14	.6		.9	.8	4									
15	.75		.8	1	4									
16	.75		.8	1	4									
17	.375		1.4	1.5	5									
18	.525		1.5	1.4	5									
19	.525		1.4	2	5									
20	.525		2	1.6	5									
21	.6		1.6	2.1	5									

APPENDIX C

RAFTS SUB-CATCHMENT PARAMETERS

Catchment	Pervious Area (ha)	Impervious Area (ha)	Slope (%)	Pervious Roughness	Impervious Roughness	Lag Time (min)
A	7.99	0.11	20.9	0.08	0.015	0.4
B2	0.43	0.35	23.1	0.025	0.015	0
B1	12.5	0.33	23.1	0.08	0.015	0.7
E2B	0.43	0.35	20.7	0.025	0.015	0
E1B	0.35	0.02	20.7	0.08	0.015	0.7
C1	10.12	0.2	20	0.08	0.015	0
C	N/A	N/A	20	0.08	N/A	1.3
D2	1.44	1.18	17	0.025	0.015	0
E2A	0.43	0.35	20.7	0.025	0.015	0
E1A	0.35	0.02	20.7	0.08	0.015	1.5
F	1.51	1.24	19.5	0.025	0.015	0
D1	2.97	0.17	17	0.08	0.015	0
D	N/A	N/A	17	0.08	N/A	0
G	0.51	0.42	24	0.025	0.015	0
Basin	0.39	0.1	1.7	0.025	0.015	0

APPENDIX D

RAFTS OUTPUT FILES AND EXPORT HYDROGRAPHS

Sheet 1

##

RUNTIME RESULTS

##

Max. no. of links allowed = 280

Max. no. of routng increments allowed = 600

Max. no. of rating curve points = 200

Max. no. of storm temporal points = 2000

Max. no. of channel subreaches = 55

Max link stack level = 20

Input Version number = 400

##

Turo Creek Flood Study - 100 Year Average Recurrence Interval

Results for period from 0: .0 1/ 1/1990
to 8:20.0 1/ 1/1990

##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 90.
RETURN PERIOD (YRS) = 100.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (hectares)	Catch. Area #2 (hectares)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
A	7.990	.1100	20.90	20.90	.1000	99.90	.080	.015	.0413	.0001	1.000
B2	.4300	.3500	23.10	23.10	.1000	99.90	.025	.015	.0035	.0002	2.000
B1	12.500	.3300	23.10	23.10	.1000	99.90	.080	.015	.0495	.0002	1.001
E2B	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	3.000
E1B	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	3.001
C1	10.120	.2000	20.00	20.00	.1000	99.90	.080	.015	.0477	.0001	3.002
C	.00100	.000	20.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.002
D2	1.440	1.180	17.00	17.00	.1000	99.90	.025	.015	.0076	.0004	4.000
E2A	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	5.000
E1A	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	5.001
F	1.510	1.240	19.50	19.50	.1000	99.90	.025	.015	.0073	.0004	5.002
D1	2.970	.1700	17.00	17.00	.1000	99.90	.080	.015	.0273	.0001	4.001
D	.00100	.000	17.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.003
G	.5100	.4200	24.00	24.00	.1000	99.90	.025	.015	.0037	.0002	6.000
BASIN	.3900	.1000	1.700	1.700	.1000	99.90	.025	.015	.0122	.0003	1.004

Sheet 3

##
Turo Creek Flood Study - 100 Year Average Recurrence Interval

Results for period from 0: .0 1/ 1/1990
to 8:20.0 1/ 1/1990
##

ROUTING INCREMENT (MINS)	=	1.00
STORM DURATION (MINS)	=	120.
RETURN PERIOD (YRS)	=	100.
BX	=	1.0000
TOTAL OF FIRST SUB-AREAS (HA)	=	39.42
TOTAL OF SECOND SUB-AREAS (HA)	=	4.84
TOTAL OF ALL SUB-AREAS (HA)	=	44.26

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	57.200	25.00	5.000	5.000	2.500	81.317	104.65	2.749	43.00	.4000
B2	57.200	25.00	5.000	5.000	2.500	81.317	104.65	.4860	34.00	.0000
B1	57.200	25.00	5.000	5.000	2.500	81.317	104.65	7.046	43.00	.7000
E2B	57.200	25.00	5.000	5.000	2.500	81.317	104.65	.4814	34.00	.0000
E1B	57.200	25.00	5.000	5.000	2.500	81.317	104.65	.6440	35.00	.7000
C1	57.200	25.00	5.000	5.000	2.500	81.317	104.65	3.674	41.00	.0000
C	57.200	25.00	.0000	5.000	.0000	81.317	.000	10.611	44.00	1.300
D2	57.200	25.00	5.000	5.000	2.500	81.317	104.65	1.544	35.00	.0000
E2A	57.200	25.00	5.000	5.000	2.500	81.317	104.65	.4814	34.00	.0000
E1A	57.200	25.00	5.000	5.000	2.500	81.317	104.65	.6440	35.00	1.500
F	57.200	25.00	5.000	5.000	2.500	81.317	104.65	2.189	35.00	.0000
D1	57.200	25.00	5.000	5.000	2.500	81.317	104.65	3.397	35.00	.0000
D	57.200	25.00	.0000	5.000	.0000	81.317	.000	12.550	42.00	.0000
G	57.200	25.00	5.000	5.000	2.500	81.317	104.65	.5776	34.00	.0000
BASIN	57.200	25.00	5.000	5.000	2.500	81.317	104.65	14.064	42.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
BASIN	42.00	14.06	49.00	11.81	37064.7	.0000	2738.8	1.4006

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 5

```
##################################################################################
                       RUNTIME            RESULTS
##################################################################################

Max. no. of links allowed =    280

Max. no. of routng increments allowed =    600

Max. no. of rating curve points =   200

Max. no. of storm temporal points =  2000

Max. no. of channel subreaches =    55

Max link stack level =     20

Input Version number =           400

##################################################################################
Turo Creek Flood Study - 20 Year Average Recurrence Inverval

Results for period from  0:  .0  1/ 1/1990
                     to  8:20.0  1/ 1/1990
##################################################################################
```

```
ROUTING INCREMENT (MINS) =        1.00
STORM DURATION (MINS)    =        120.
RETURN PERIOD (YRS)      =         20.
BX                       =      1.0000
TOTAL OF FIRST SUB-AREAS  (HA) =       39.42
TOTAL OF SECOND SUB-AREAS (HA) =        4.84
TOTAL OF ALL SUB-AREAS (HA)    =       44.26
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (hectares)	Catch. Area #2 (hectares)	Slope #1 (%)	Slope #2 (%)	% Impervious #1 (%)	% Impervious #2 (%)	Pern #1	Pern #2	B #1	B #2	Link No.
A	7.990	.1100	20.90	20.90	.1000	99.90	.080	.015	.0413	.0001	1.000
B2	.4300	.3500	23.10	23.10	.1000	99.90	.025	.015	.0035	.0002	2.000
B1	12.500	.3300	23.10	23.10	.1000	99.90	.080	.015	.0495	.0002	1.001
E2B	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	3.000
E1B	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	3.001
C1	10.120	.2000	20.00	20.00	.1000	99.90	.080	.015	.0477	.0001	3.002
C	.00100	.000	20.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.002
D2	1.440	1.180	17.00	17.00	.1000	99.90	.025	.015	.0076	.0004	4.000
E2A	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	5.000
E1A	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	5.001
F	1.510	1.240	19.50	19.50	.1000	99.90	.025	.015	.0073	.0004	5.002
D1	2.970	.1700	17.00	17.00	.1000	99.90	.080	.015	.0273	.0001	4.001
D	.00100	.000	17.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.003
G	.5100	.4200	24.00	24.00	.1000	99.90	.025	.015	.0037	.0002	6.000
BASIN	.3900	.1000	1.700	1.700	.1000	99.90	.025	.015	.0122	.0003	1.004

Sheet 7

##

RUNTIME RESULTS

##

Max. no. of links allowed = 280

Max. no. of routng increments allowed = 600

Max. no. of rating curve points = 200

Max. no. of storm temporal points = 2000

Max. no. of channel subreaches = 55

Max link stack level = 20

Input Version number = 400

##

Turo Creek Flood Study - 5 Year Average Recurrence Inverval

Results for period from 0: .0 1/ 1/1990
to 8:20.0 1/ 1/1990

##

ROUTING INCREMENT (MINS)	=	1.00
STORM DURATION (MINS)	=	120.
RETURN PERIOD (YRS)	=	5.
BX	=	1.0000
TOTAL OF FIRST SUB-AREAS (HA)	=	39.42
TOTAL OF SECOND SUB-AREAS (HA)	=	4.84
TOTAL OF ALL SUB-AREAS (HA)	=	44.26

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (hectares)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
A	7.990	.1100	20.90	20.90	.1000	99.90	.080	.015	.0413	.0001	1.000
B2	.4300	.3500	23.10	23.10	.1000	99.90	.025	.015	.0035	.0002	2.000
B1	12.500	.3300	23.10	23.10	.1000	99.90	.080	.015	.0495	.0002	1.001
E2B	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	3.000
E1B	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	3.001
C1	10.120	.2000	20.00	20.00	.1000	99.90	.080	.015	.0477	.0001	3.002
C	.00100	.000	20.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.002
D2	1.440	1.180	17.00	17.00	.1000	99.90	.025	.015	.0076	.0004	4.000
E2A	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	5.000
E1A	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	5.001
F	1.510	1.240	19.50	19.50	.1000	99.90	.025	.015	.0073	.0004	5.002
D1	2.970	.1700	17.00	17.00	.1000	99.90	.080	.015	.0273	.0001	4.001
D	.00100	.000	17.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.003
G	.5100	.4200	24.00	24.00	.1000	99.90	.025	.015	.0037	.0002	6.000
BASIN	.3900	.1000	1.700	1.700	.1000	99.90	.025	.015	.0122	.0003	1.004

Sheet 9

```
################################################################################
                    RUNTIME            RESULTS
################################################################################
```

Max. no. of links allowed = 280

Max. no. of routng increments allowed = 600

Max. no. of rating curve points = 200

Max. no. of storm temporal points = 2000

Max. no. of channel subreaches = 55

Max link stack level = 20

Input Version number = 400

```
################################################################################
Turo Creek Flood Study - PMF

Results for period from  0:  .0   1/ 1/1990
                    to   8:20.0   1/ 1/1990
################################################################################
```

```
                              ROUTING INCREMENT (MINS)  =      1.00
                              STORM DURATION (MINS)     =       15.
                              RETURN PERIOD (YRS)       =     1015.
                              BX                        =    1.0000
                              TOTAL OF FIRST SUB-AREAS  (HA) =     39.42
                              TOTAL OF SECOND SUB-AREAS (HA) =      4.84
                              TOTAL OF ALL SUB-AREAS (HA)    =     44.26
```

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area (hectares) #1	#2	Slope (%) #1	#2	% Impervious (%) #1	#2	Pern #1	#2	B #1	#2	Link No.
A	7.990	.1100	20.90	20.90	.1000	99.90	.080	.015	.0413	.0001	1.000
B2	.4300	.3500	23.10	23.10	.1000	99.90	.025	.015	.0035	.0002	2.000
B1	12.500	.3300	23.10	23.10	.1000	99.90	.080	.015	.0495	.0002	1.001
E2B	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	3.000
E1B	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	3.001
C1	10.120	.2000	20.00	20.00	.1000	99.90	.080	.015	.0477	.0001	3.002
C	.00100	.000	20.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.002
D2	1.440	1.180	17.00	17.00	.1000	99.90	.025	.015	.0076	.0004	4.000
E2A	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	5.000
E1A	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	5.001
F	1.510	1.240	19.50	19.50	.1000	99.90	.025	.015	.0073	.0004	5.002
D1	2.970	.1700	17.00	17.00	.1000	99.90	.080	.015	.0273	.0001	4.001
D	.00100	.000	17.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.003
G	.5100	.4200	24.00	24.00	.1000	99.90	.025	.015	.0037	.0002	6.000
BASIN	.3900	.1000	1.700	1.700	.1000	99.90	.025	.015	.0122	.0003	1.004

Sheet 11

G	480.00	25.00	5.000	5.000	2.500	212.75	233.75	1.815	7.000	.0000
BASIN	480.00	25.00	5.000	5.000	2.500	212.75	233.75	66.352	19.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	---------- Basin ---------- Vol. Avail	Vol. Used	Stage Used
BASIN	19.00	66.35	22.00	64.33	94960.2	.0000	22175.1	3.0331

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

##
Turo Creek Flood Study - PMF

Results for period from 0: .0 1/ 1/1990
to 8:20.0 1/ 1/1990
##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 45.
RETURN PERIOD (YRS) = 1045.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	413.00	25.00	5.000	5.000	2.500	281.25	302.88	12.094	20.00	.4000
B2	413.00	25.00	5.000	5.000	2.500	281.25	302.88	1.323	8.000	.0000
B1	413.00	25.00	5.000	5.000	2.500	281.25	302.88	32.278	20.00	.7000
E2B	413.00	25.00	5.000	5.000	2.500	281.25	302.88	1.317	8.000	.0000
E1B	413.00	25.00	5.000	5.000	2.500	281.25	302.88	1.836	13.00	.7000
C1	413.00	25.00	5.000	5.000	2.500	281.25	302.88	16.739	21.00	.0000
C	413.00	25.00	.0000	5.000	.0000	281.25	.000	49.019	21.00	1.300
D2	413.00	25.00	5.000	5.000	2.500	281.25	302.88	4.251	10.00	.0000
E2A	413.00	25.00	5.000	5.000	2.500	281.25	302.88	1.317	8.000	.0000
E1A	413.00	25.00	5.000	5.000	2.500	281.25	302.88	1.836	13.00	1.500
F	413.00	25.00	5.000	5.000	2.500	281.25	302.88	6.452	15.00	.0000
D1	413.00	25.00	5.000	5.000	2.500	281.25	302.88	13.907	16.00	.0000
D	413.00	25.00	.0000	5.000	.0000	281.25	.000	61.024	22.00	.0000
G	413.00	25.00	5.000	5.000	2.500	281.25	302.88	1.572	8.000	.0000
BASIN	413.00	25.00	5.000	5.000	2.500	281.25	302.88	64.136	21.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	---------- Basin ---------- Vol. Avail	Vol. Used	Stage Used
BASIN	21.00	64.14	24.00	62.58	125421.	.0000	22035.6	3.0214

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 13

##
Turo Creek Flood Study - PMF

Results for period from 0: .0 1/ 1/1990
to 5: .0 1/ 1/1990
##

ROUTING INCREMENT (MINS)	=	1.00
STORM DURATION (MINS)	=	90.
RETURN PERIOD (YRS)	=	1090.
BX	=	1.0000
TOTAL OF FIRST SUB-AREAS (HA)	=	39.42
TOTAL OF SECOND SUB-AREAS (HA)	=	4.84
TOTAL OF ALL SUB-AREAS (HA)	=	44.26

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	313.00	25.00	5.000	5.000	2.500	437.42	460.79	9.756	28.00	.4000
B2	313.00	25.00	5.000	5.000	2.500	437.42	460.79	1.085	13.00	.0000
B1	313.00	25.00	5.000	5.000	2.500	437.42	460.79	26.138	30.00	.7000
E2B	313.00	25.00	5.000	5.000	2.500	437.42	460.79	1.083	13.00	.0000
E1B	313.00	25.00	5.000	5.000	2.500	437.42	460.79	1.496	13.00	.7000
C1	313.00	25.00	5.000	5.000	2.500	437.42	460.79	13.806	31.00	.0000
C	313.00	25.00	.0000	5.000	.0000	437.42	.000	39.945	31.00	1.300
D2	313.00	25.00	5.000	5.000	2.500	437.42	460.79	3.591	13.00	.0000
E2A	313.00	25.00	5.000	5.000	2.500	437.42	460.79	1.083	13.00	.0000
E1A	313.00	25.00	5.000	5.000	2.500	437.42	460.79	1.496	13.00	1.500
F	313.00	25.00	5.000	5.000	2.500	437.42	460.79	5.096	13.00	.0000
D1	313.00	25.00	5.000	5.000	2.500	437.42	460.79	10.558	24.00	.0000
D	313.00	25.00	.0000	5.000	.0000	437.42	.000	50.485	31.00	.0000
G	313.00	25.00	5.000	5.000	2.500	437.42	460.79	1.293	13.00	.0000
BASIN	313.00	25.00	5.000	5.000	2.500	437.42	460.79	53.297	31.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	31.00	53.30	32.00	53.11	194698.	.0000	21281.3	2.9580

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 15

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.4648	772.5	.4000
B2	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.0640	760.0	.0000
B1	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	1.231	770.0	.7000
E2B	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.0638	760.0	.0000
E1B	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.0878	760.0	.7000
C1	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.6442	770.0	.0000
C	-1.000	25.00	.0000	5.000	.0000	57.292	.000	1.876	770.0	1.300
D2	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.2127	760.0	.0000
E2A	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.0638	760.0	.0000
E1A	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.0878	760.0	1.500
F	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.3058	760.0	.0000
D1	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.3726	760.0	.0000
D	-1.000	25.00	.0000	5.000	.0000	57.292	.000	2.197	772.5	.0000
G	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	.0763	760.0	.0000
BASIN	-1.000	25.00	5.000	5.000	2.500	57.292	98.208	2.507	770.0	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	--------- Basin --------- Vol. Avail	Vol. Used	Stage Used
BASIN	770.0	2.507	772.5	2.484	27252.4	.0000	252.07	.4900

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

##
Turo Creek Flood Study - Historical Floods (April 1988)

Results for period from 0: .0 1/ 1/1990
to 11:20.0 4/ 1/1990
##

ROUTING INCREMENT (MINS) = 10.00
STORM DURATION (MINS) = 3110.
RETURN PERIOD (YRS) = 8805.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

Sheet 17

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.8517	2880.	.4000
B2	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.1024	2880.	.0000
B1	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	2.271	2880.	.7000
E2B	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.1021	2880.	.0000
E1B	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.1468	2880.	.7000
C1	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	1.204	2880.	.0000
C	-1.000	25.00	.0000	5.000	.0000	288.38	.000	3.474	2880.	1.300
D2	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.3377	2880.	.0000
E2A	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.1021	2880.	.0000
E1A	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.1468	2880.	1.500
F	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.5003	2880.	.0000
D1	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.6802	2880.	.0000
D	-1.000	25.00	.0000	5.000	.0000	288.38	.000	4.155	2880.	.0000
G	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	.1218	2880.	.0000
BASIN	-1.000	25.00	5.000	5.000	2.500	288.38	379.38	4.834	2880.	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	2880.	4.834	2880.	4.661	131889.	.0000	471.62	.7422

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

###
Turo Creek Flood Study - Historical Floods (Feb 1992)

Results for period from 0: .0 1/ 1/1990
to 3: .0 4/ 1/1990
###

ROUTING INCREMENT (MINS) = 7.50
STORM DURATION (MINS) = 3210.
RETURN PERIOD (YRS) = 9202.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

Sheet 19

##
Turo Creek Flood Study - Historical Floods (Aug 1998)

Results for period from 0: .0 1/ 1/1990
to 21:50.0 2/ 1/1990
##

ROUTING INCREMENT (MINS) = 5.00
STORM DURATION (MINS) = 1770.
RETURN PERIOD (YRS) = 9808.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

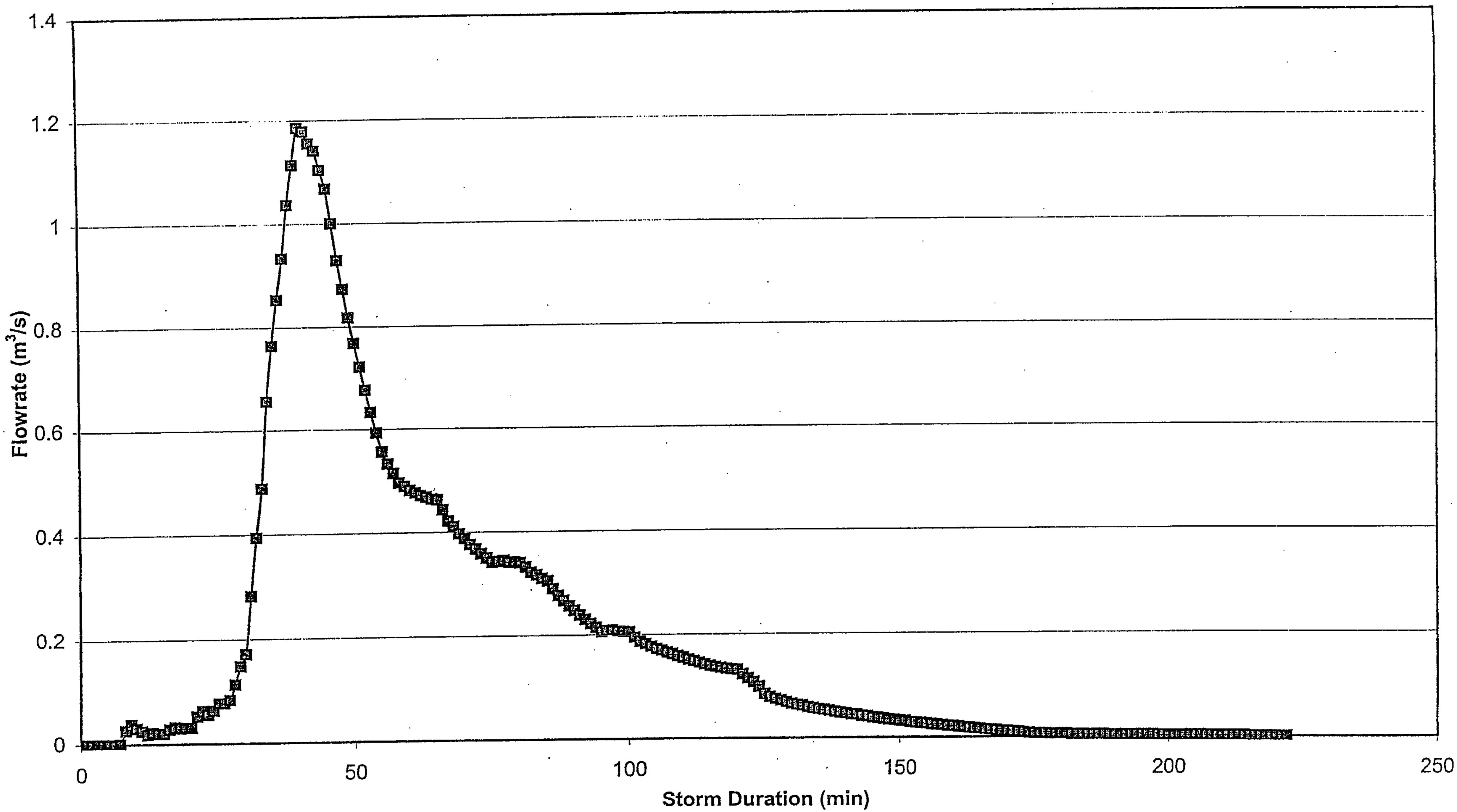
Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.4007	990.0	.4000
B2	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.0624	765.0	.0000
B1	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	1.064	990.0	.7000
E2B	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.0621	765.0	.0000
E1B	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.0810	765.0	.7000
C1	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.5539	990.0	.0000
C	-1.000	25.00	.0000	5.000	.0000	68.667	.000	1.618	990.0	1.300
D2	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.2043	765.0	.0000
E2A	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.0621	765.0	.0000
E1A	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.0810	765.0	1.500
F	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.2976	765.0	.0000
D1	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.3437	975.0	.0000
D	-1.000	25.00	.0000	5.000	.0000	68.667	.000	1.900	990.0	.0000
G	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	.0744	765.0	.0000
BASIN	-1.000	25.00	5.000	5.000	2.500	68.667	108.62	2.174	980.0	.0000

SUMMARY OF BASIN RESULTS

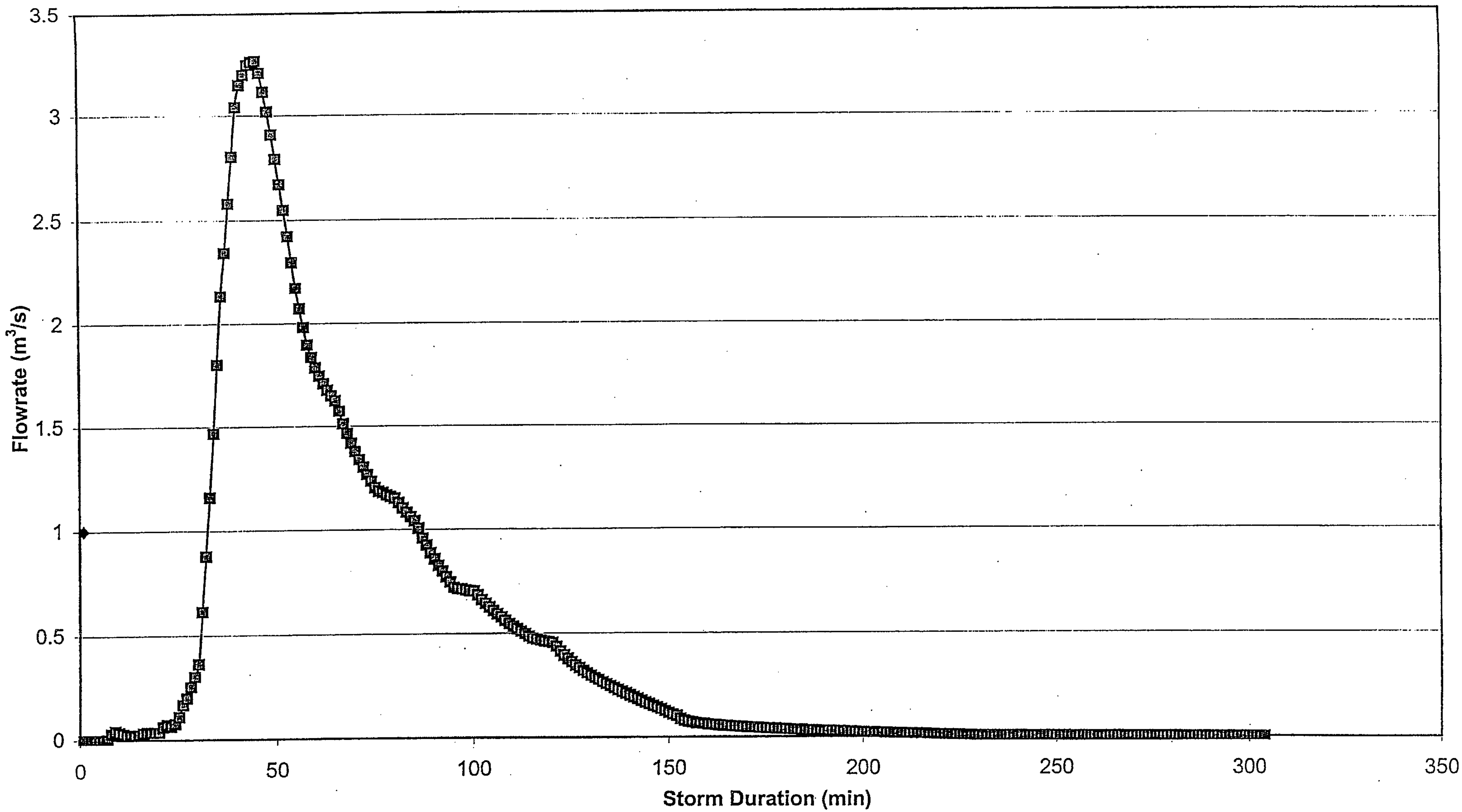
Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	980.0	2.174	980.0	2.192	32260.5	.0000	220.17	.4502

SUMMARY OF BASIN OUTLET RESULTS

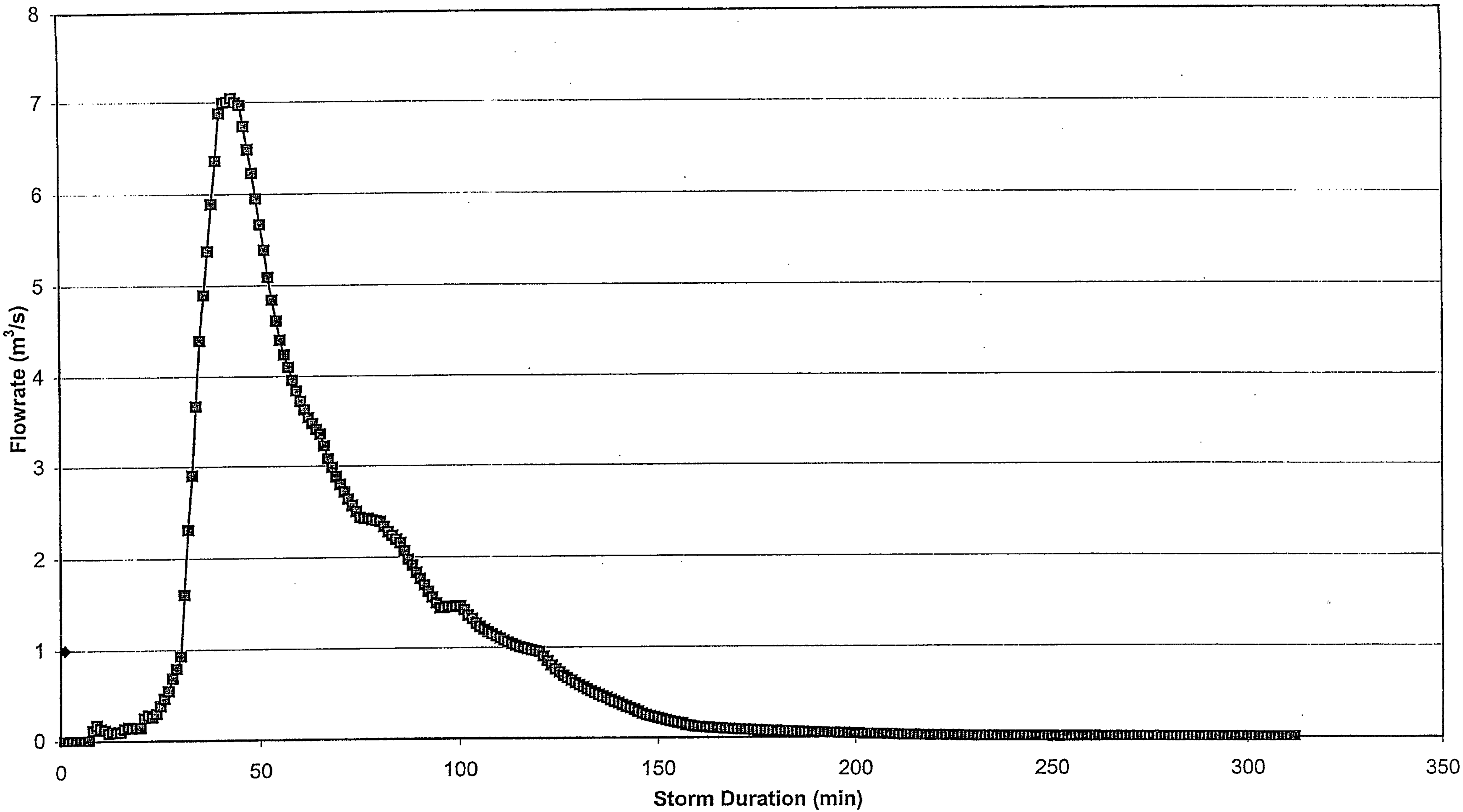
Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000



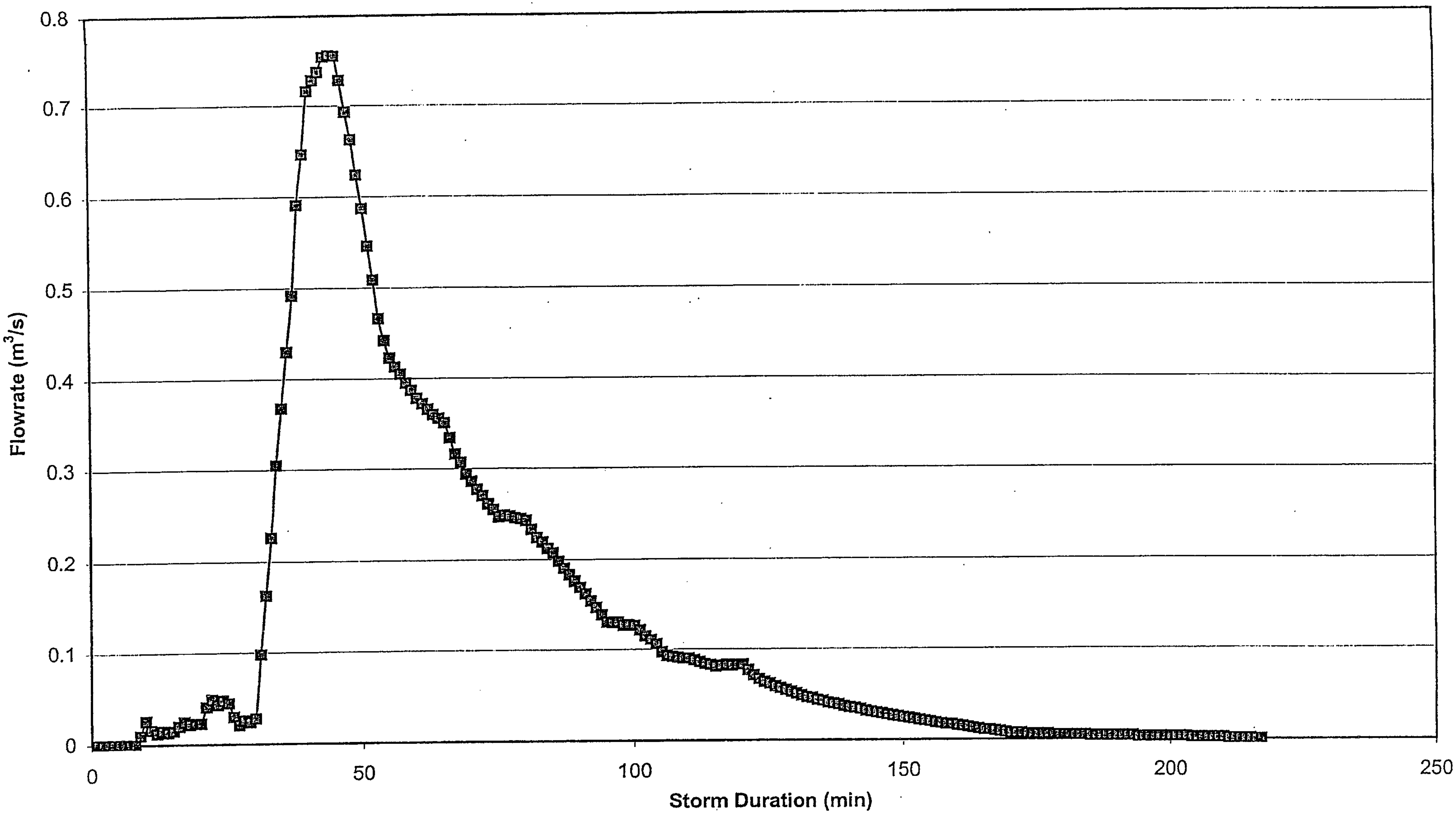
Hydrograph - 1% AEP: Node D



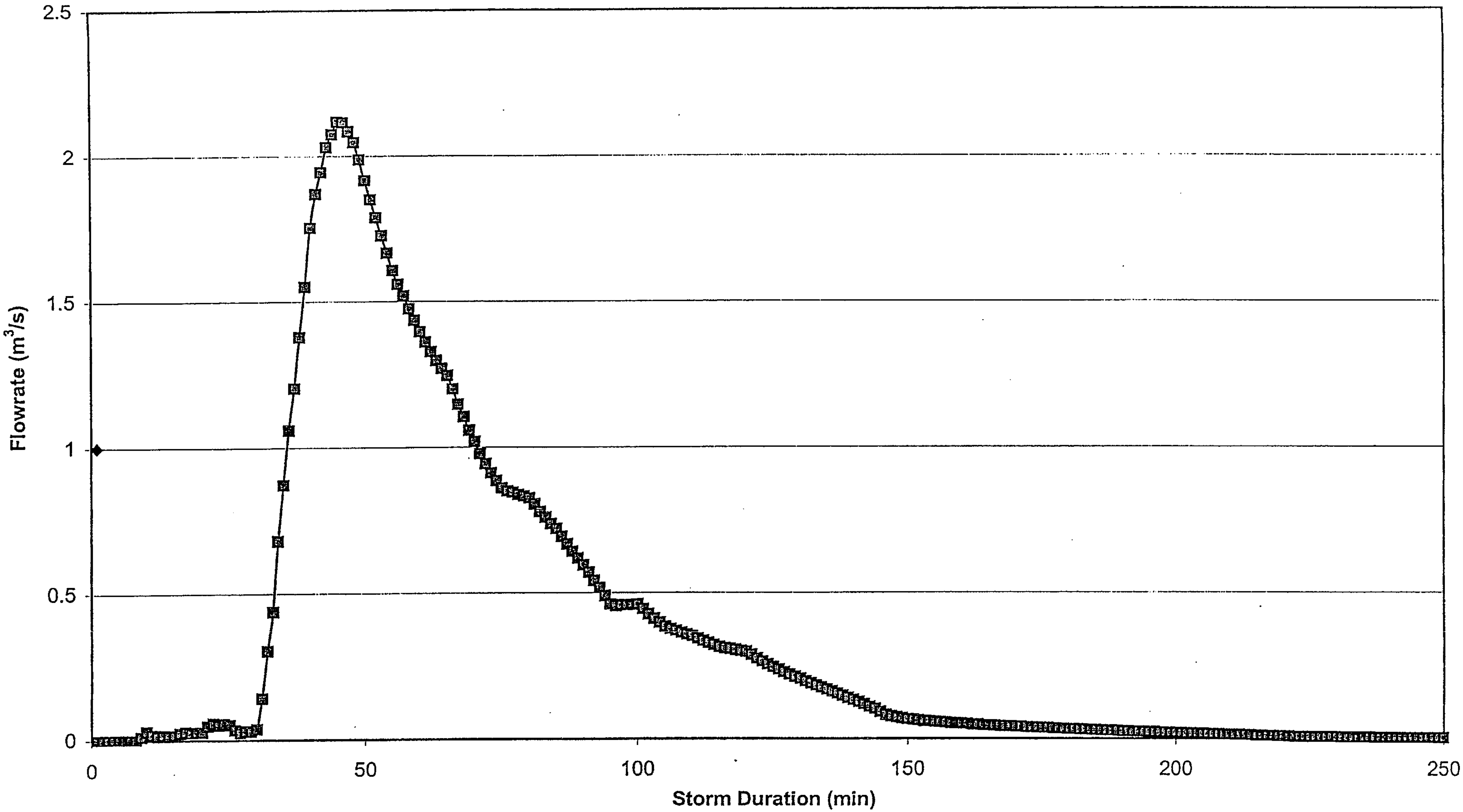
Hydrograph - 1% AEP: Node C



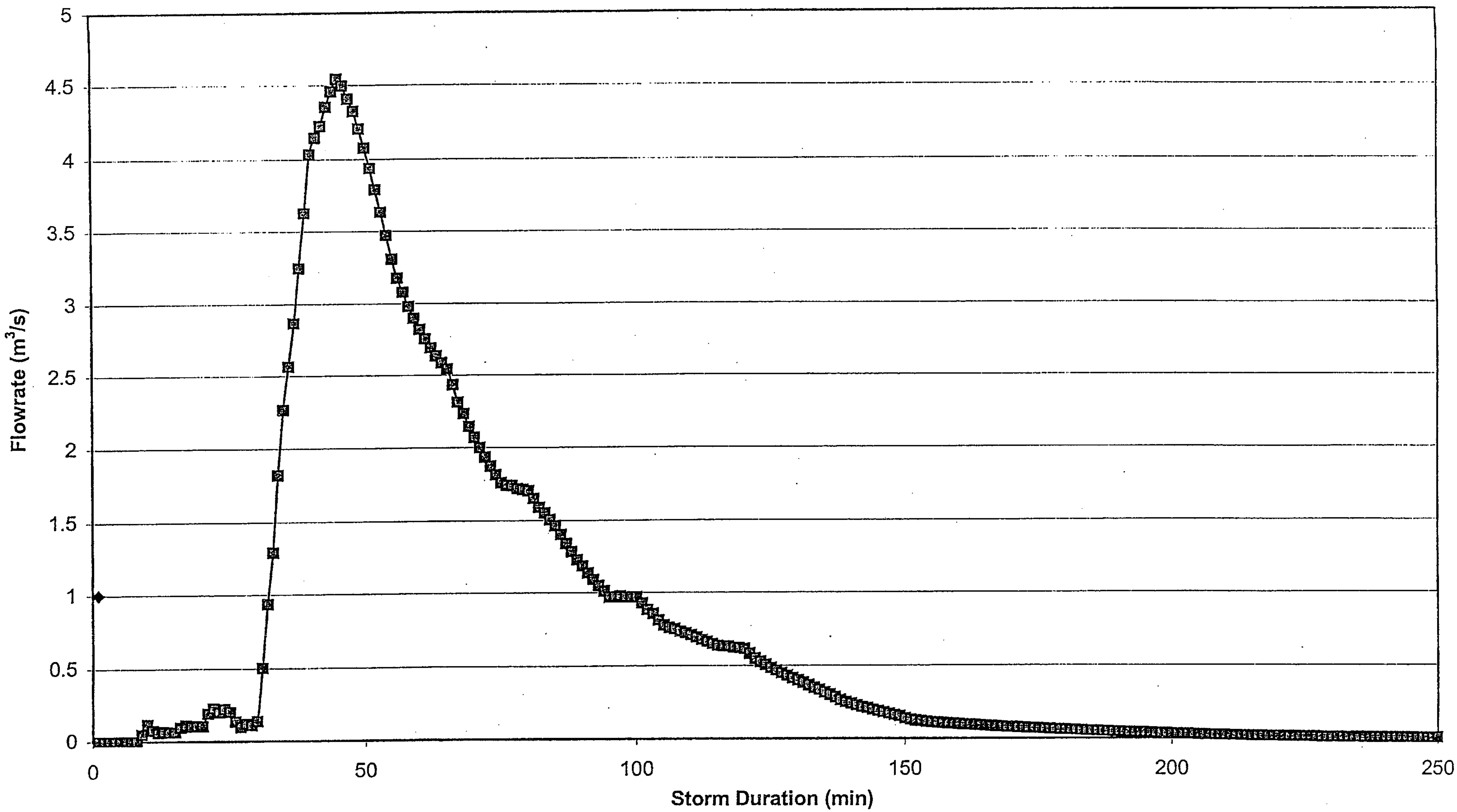
Hydrograph - 1% AEP: Node B



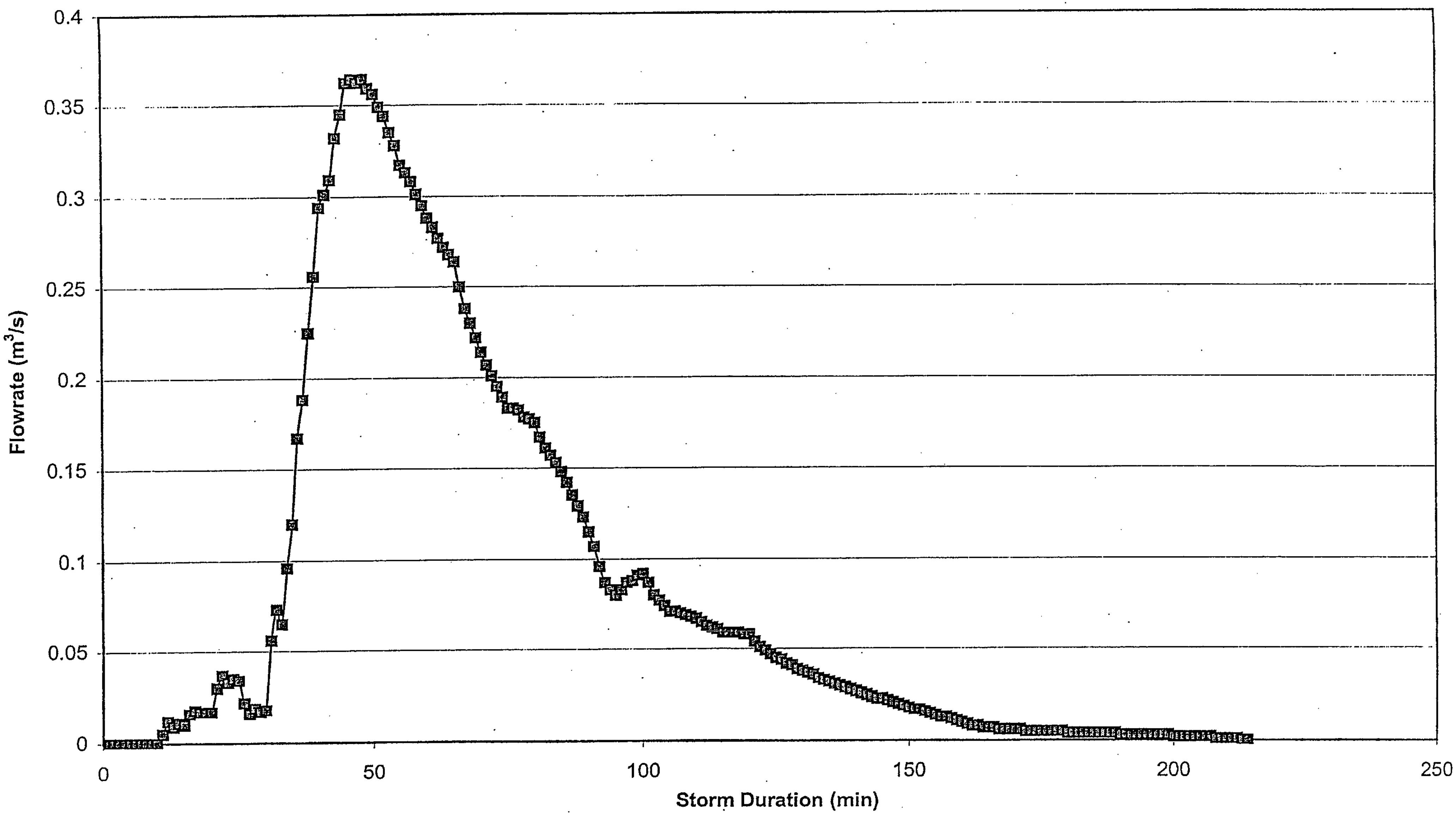
Hydrograph - 5% AEP: Node D



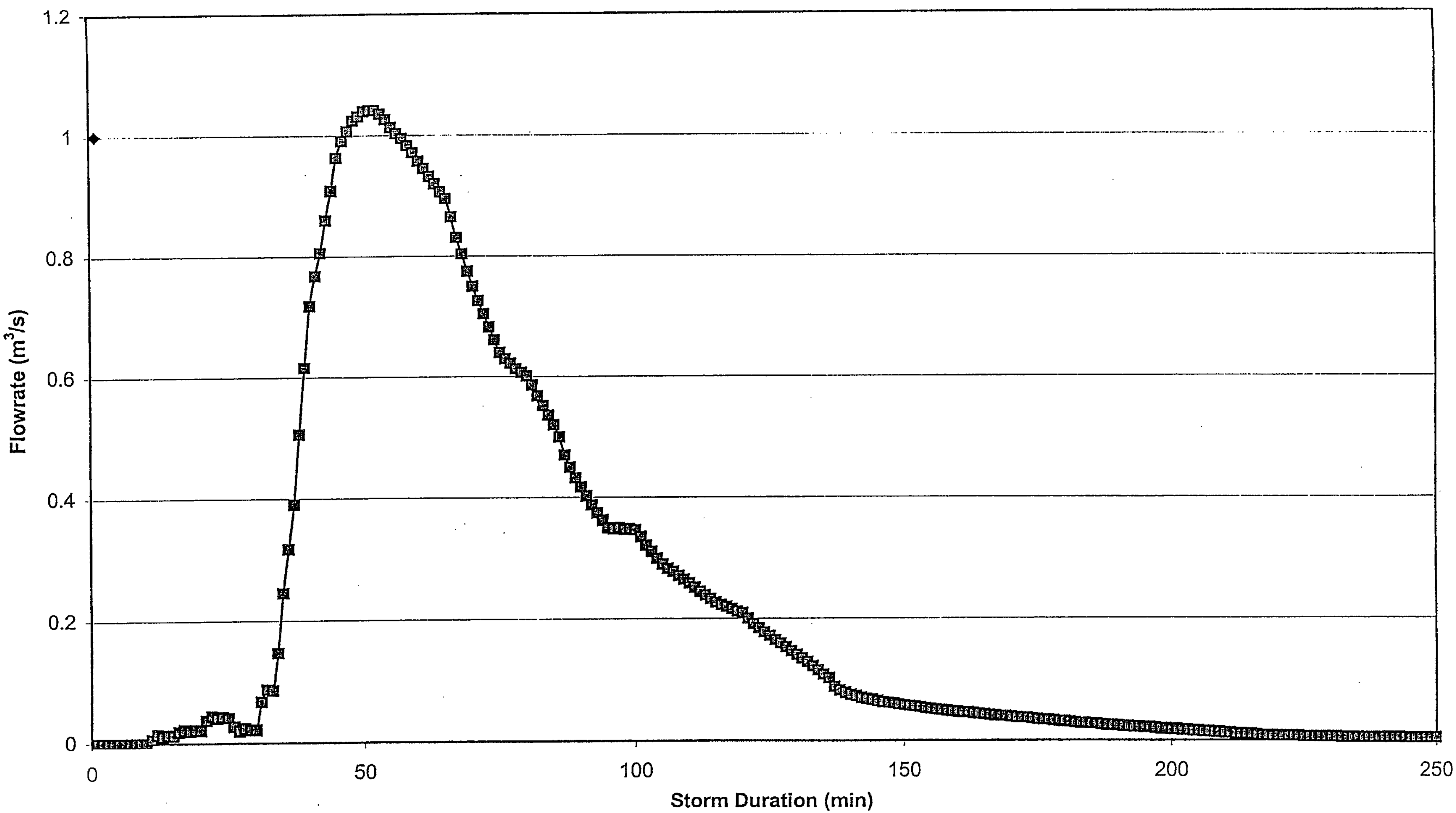
Hydrograph - 5% AEP: Node C



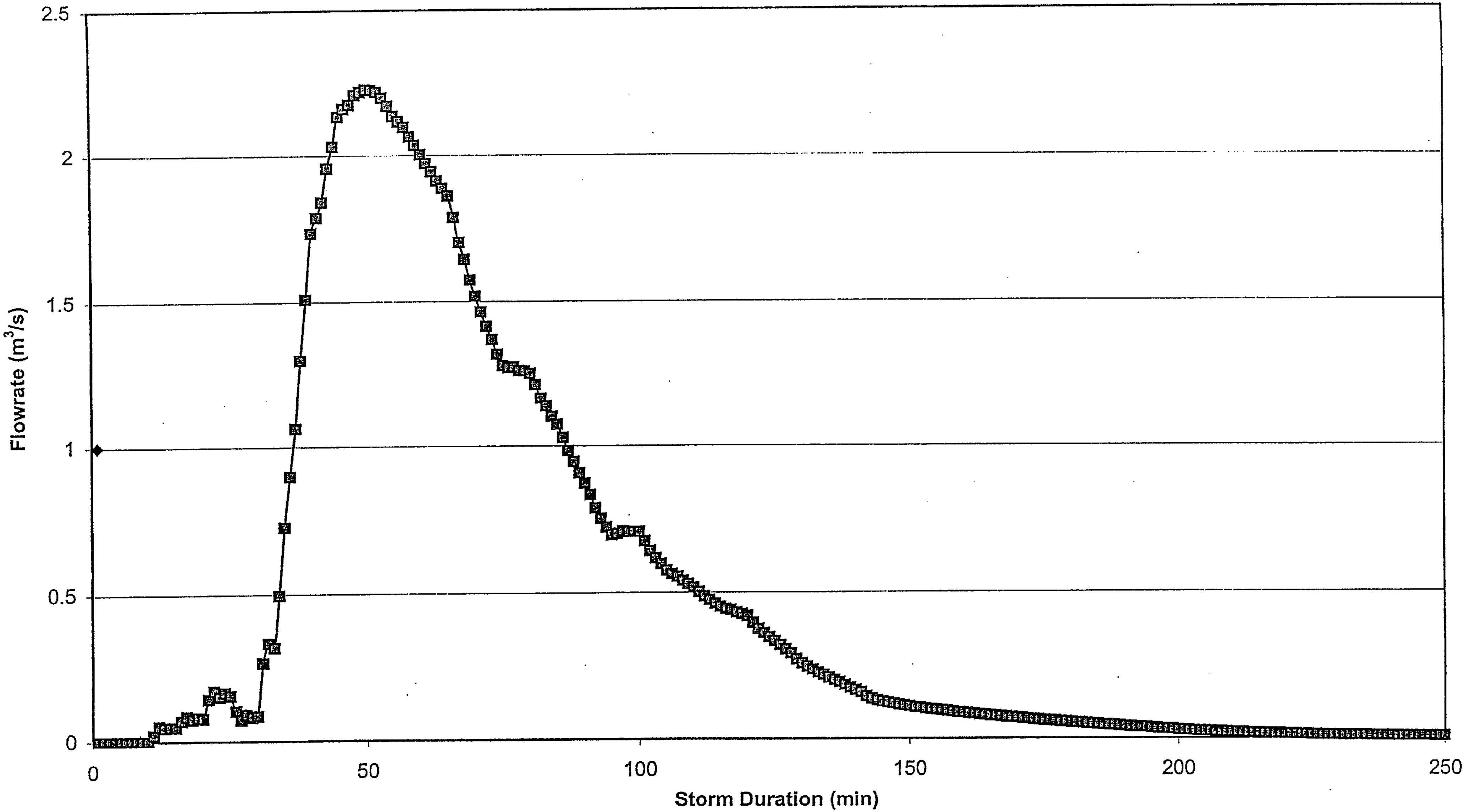
Hydrograph - 5% AEP: Node B



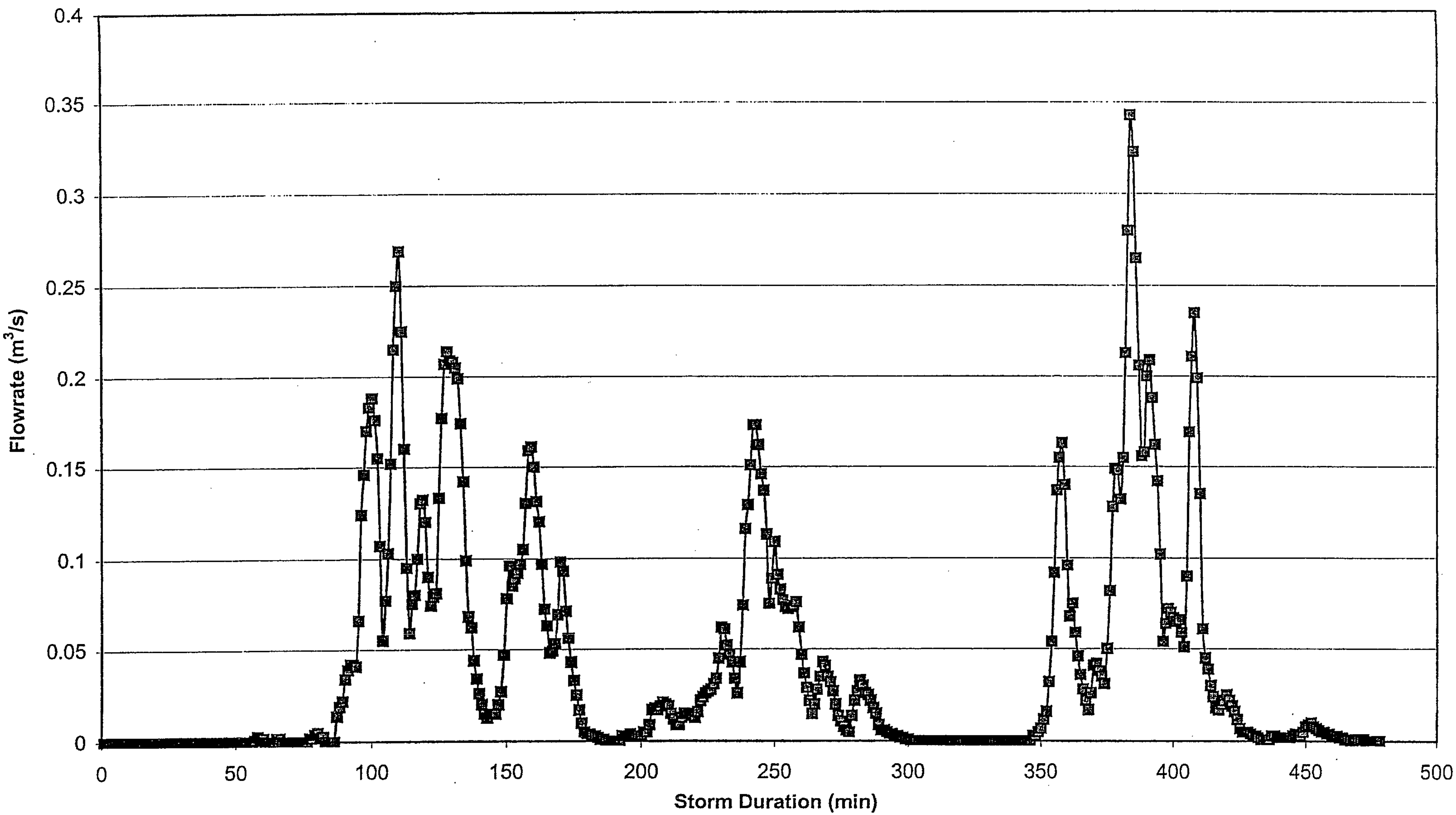
Hydrograph - 20% AEP: Node D



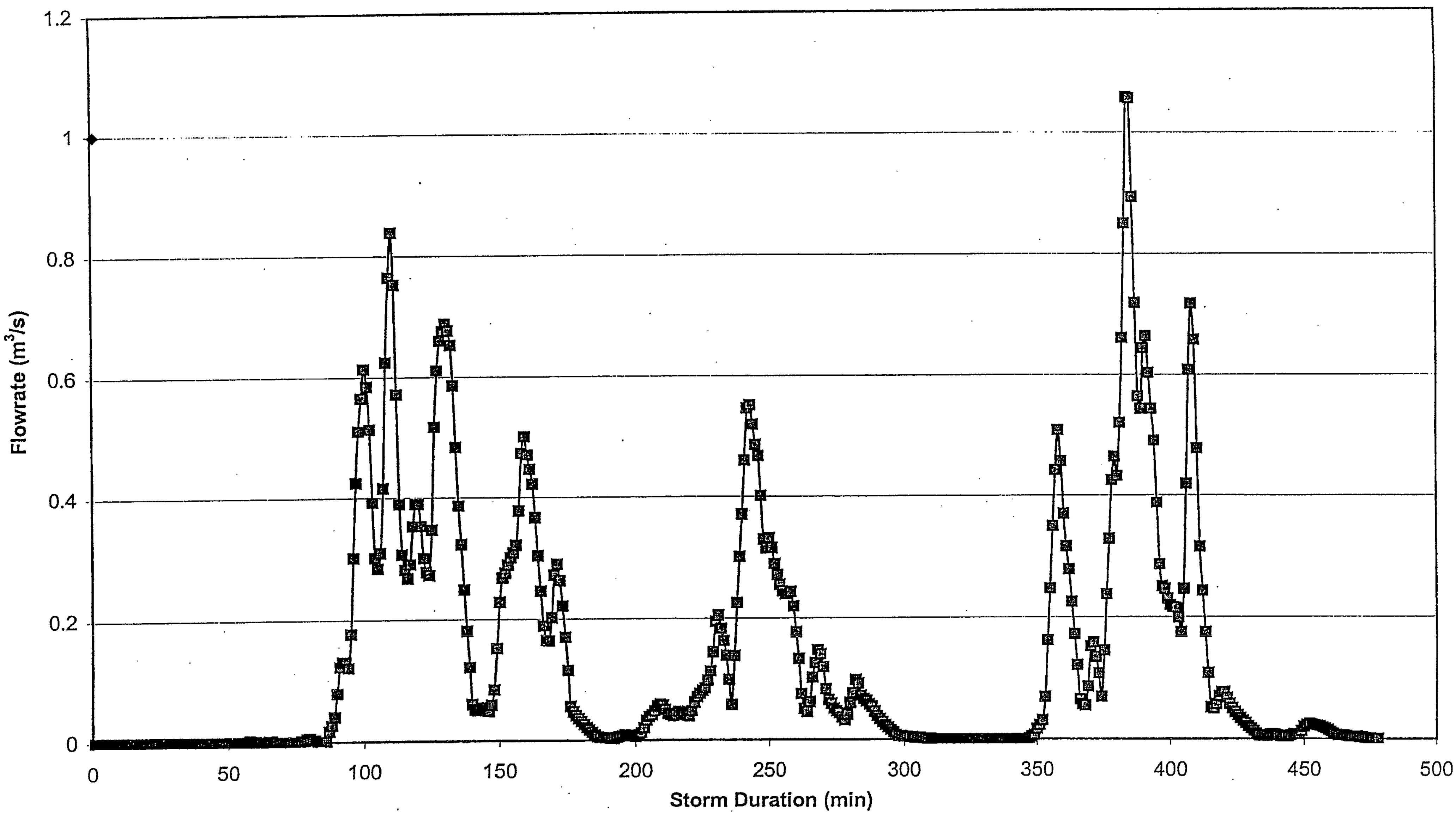
Hydrograph - 20% AEP: Node C



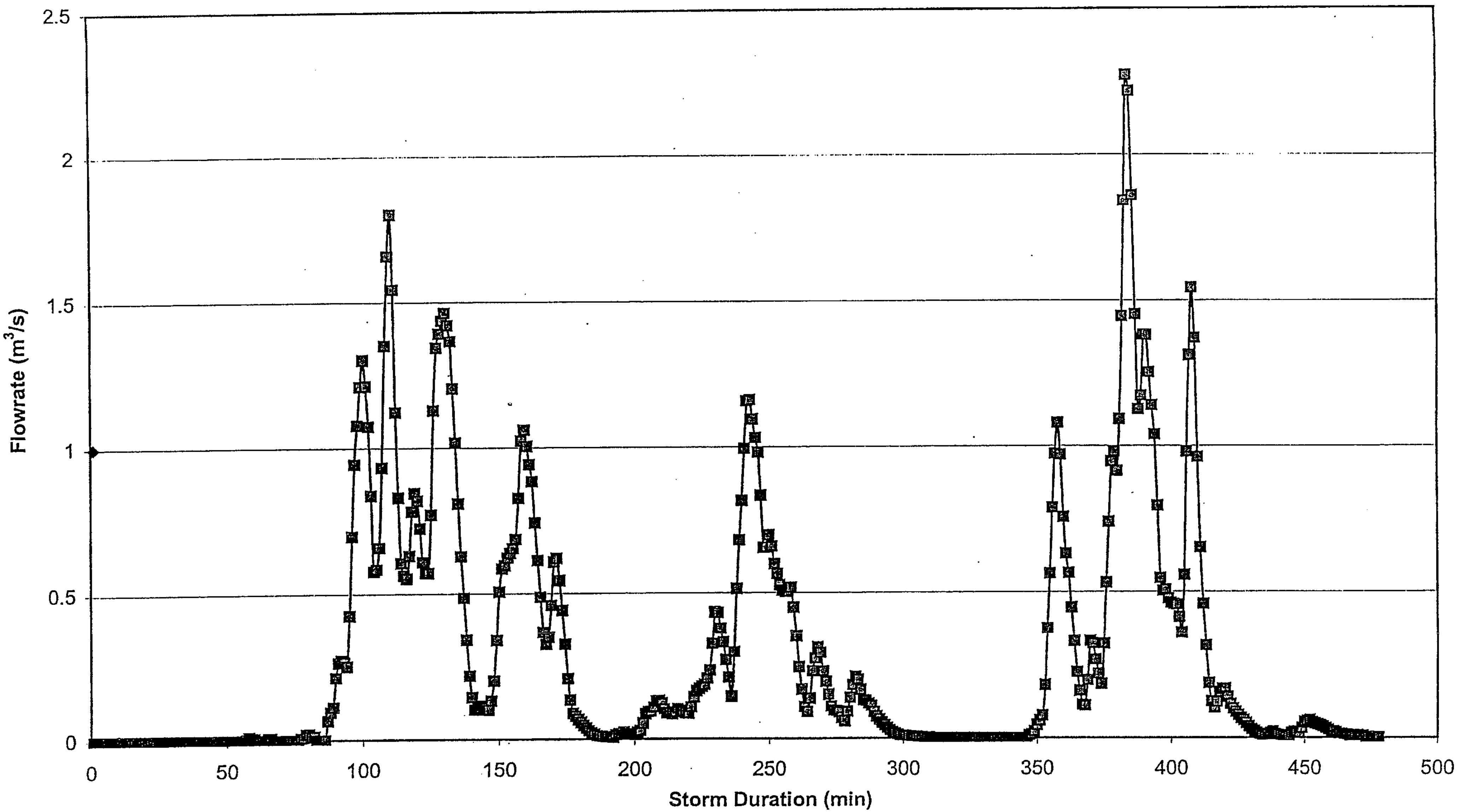
Hydrograph - 20% AEP: Node B



Hydrograph - Feb. 1990: Node D



Hydrograph - Feb. 1990: Node C



Hydrograph - Feb. 1990: Node B

Sheet 2

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	68.100	25.00	5.000	5.000	2.500	70.900	93.650	2.546	35.00	.4000
B2	68.100	25.00	5.000	5.000	2.500	70.900	93.650	.5093	29.00	.0000
B1	68.100	25.00	5.000	5.000	2.500	70.900	93.650	6.455	35.00	.7000
E2B	68.100	25.00	5.000	5.000	2.500	70.900	93.650	.5066	29.00	.0000
E1B	68.100	25.00	5.000	5.000	2.500	70.900	93.650	.7007	30.00	.7000
C1	68.100	25.00	5.000	5.000	2.500	70.900	93.650	3.469	31.00	.0000
C	68.100	25.00	.0000	5.000	.0000	70.900	.000	9.727	36.00	1.300
D2	68.100	25.00	5.000	5.000	2.500	70.900	93.650	1.649	30.00	.0000
E2A	68.100	25.00	5.000	5.000	2.500	70.900	93.650	.5066	29.00	.0000
E1A	68.100	25.00	5.000	5.000	2.500	70.900	93.650	.7007	30.00	1.500
F	68.100	25.00	5.000	5.000	2.500	70.900	93.650	2.371	30.00	.0000
D1	68.100	25.00	5.000	5.000	2.500	70.900	93.650	3.990	30.00	.0000
D	68.100	25.00	.0000	5.000	.0000	70.900	.000	11.911	32.00	.0000
G	68.100	25.00	5.000	5.000	2.500	70.900	93.650	.6082	29.00	.0000
BASIN	68.100	25.00	5.000	5.000	2.500	70.900	93.650	13.450	32.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	32.00	13.45	41.00	11.38	32479.0	.0000	2312.5	1.3543

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 4

```
##################################################################################
Turo Creek Flood Study - 100 Year Average Recurrence Interval

Results for period from  0:   .0  1/ 1/1990
                    to   8:20.0  1/ 1/1990
##################################################################################
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```
ROUTING INCREMENT (MINS)  =        1.00
STORM DURATION (MINS)     =        180.
RETURN PERIOD (YRS)       =        100.
BX                        =      1.0000
TOTAL OF FIRST SUB-AREAS  (HA) =        39.42
TOTAL OF SECOND SUB-AREAS (HA) =         4.84
TOTAL OF ALL SUB-AREAS (HA)    =        44.26
```

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	44.500	25.00	5.000	5.000	2.500	95.667	121.37	2.110	46.00	.4000
B2	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.2629	43.00	.0000
B1	44.500	25.00	5.000	5.000	2.500	95.667	121.37	5.414	45.00	.7000
E2B	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.2629	43.00	.0000
E1B	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.3860	45.00	.7000
C1	44.500	25.00	5.000	5.000	2.500	95.667	121.37	2.868	46.00	.0000
C	44.500	25.00	.0000	5.000	.0000	95.667	.000	8.282	46.00	1.300
D2	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.8817	41.00	.0000
E2A	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.2629	43.00	.0000
E1A	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.3860	45.00	1.500
F	44.500	25.00	5.000	5.000	2.500	95.667	121.37	1.310	45.00	.0000
D1	44.500	25.00	5.000	5.000	2.500	95.667	121.37	1.985	45.00	.0000
D	44.500	25.00	.0000	5.000	.0000	95.667	.000	9.595	47.00	.0000
G	44.500	25.00	5.000	5.000	2.500	95.667	121.37	.3139	36.00	.0000
BASIN	44.500	25.00	5.000	5.000	2.500	95.667	121.37	10.986	45.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	45.00	10.99	51.00	9.708	43575.8	.0000	1491.1	1.2058

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 6

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	43.300	25.00	5.000	5.000	2.500	53.933	76.933	1.777	45.00	.4000
B2	43.300	25.00	5.000	5.000	2.500	53.933	76.933	.3933	35.00	.0000
B1	43.300	25.00	5.000	5.000	2.500	53.933	76.933	4.543	45.00	.7000
E2B	43.300	25.00	5.000	5.000	2.500	53.933	76.933	.3909	35.00	.0000
E1B	43.300	25.00	5.000	5.000	2.500	53.933	76.933	.4720	35.00	.7000
C1	43.300	25.00	5.000	5.000	2.500	53.933	76.933	2.333	45.00	.0000
C	43.300	25.00	.0000	5.000	.0000	53.933	.000	6.864	46.00	1.300
D2	43.300	25.00	5.000	5.000	2.500	53.933	76.933	1.189	35.00	.0000
E2A	43.300	25.00	5.000	5.000	2.500	53.933	76.933	.3909	35.00	.0000
E1A	43.300	25.00	5.000	5.000	2.500	53.933	76.933	.4720	35.00	1.500
F	43.300	25.00	5.000	5.000	2.500	53.933	76.933	1.632	35.00	.0000
D1	43.300	25.00	5.000	5.000	2.500	53.933	76.933	2.089	35.00	.0000
D	43.300	25.00	.0000	5.000	.0000	53.933	.000	7.895	46.00	.0000
G	43.300	25.00	5.000	5.000	2.500	53.933	76.933	.4668	35.00	.0000
BASIN	43.300	25.00	5.000	5.000	2.500	53.933	76.933	8.904	43.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	43.00	8.904	47.00	8.562	24952.0	.0000	1017.0	1.1098

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 8

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.8727	49.00	.4000
B2	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.2249	36.00	.0000
B1	32.700	25.00	5.000	5.000	2.500	33.067	55.817	2.222	50.00	.7000
E2B	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.2199	36.00	.0000
E1B	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.2690	40.00	.7000
C1	32.700	25.00	5.000	5.000	2.500	33.067	55.817	1.150	46.00	.0000
C	32.700	25.00	.0000	5.000	.0000	33.067	.000	3.358	51.00	1.300
D2	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.6908	40.00	.0000
E2A	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.2199	36.00	.0000
E1A	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.2690	40.00	1.500
F	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.9904	40.00	.0000
D1	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.9844	40.00	.0000
D	32.700	25.00	.0000	5.000	.0000	33.067	.000	3.882	48.00	.0000
G	32.700	25.00	5.000	5.000	2.500	33.067	55.817	.2619	38.00	.0000
BASIN	32.700	25.00	5.000	5.000	2.500	33.067	55.817	4.490	45.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	45.00	4.489	46.00	4.405	15687.4	.0000	446.59	.7155

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Run completed at: 4th August 2000 10:29:25

Sheet 10

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	680.00	25.00	5.000	5.000	2.500	143.83	164.37	13.121	13.00	.4000
B2	680.00	25.00	5.000	5.000	2.500	143.83	164.37	2.029	5.000	.0000
B1	680.00	25.00	5.000	5.000	2.500	143.83	164.37	33.952	13.00	.7000
E2B	680.00	25.00	5.000	5.000	2.500	143.83	164.37	1.995	5.000	.0000
E1B	680.00	25.00	5.000	5.000	2.500	143.83	164.37	2.646	7.000	.7000
C1	680.00	25.00	5.000	5.000	2.500	143.83	164.37	17.309	13.00	.0000
C	680.00	25.00	.0000	5.000	.0000	143.83	.000	51.095	13.00	1.300
D2	680.00	25.00	5.000	5.000	2.500	143.83	164.37	6.464	7.000	.0000
E2A	680.00	25.00	5.000	5.000	2.500	143.83	164.37	1.995	5.000	.0000
E1A	680.00	25.00	5.000	5.000	2.500	143.83	164.37	2.646	7.000	1.500
F	680.00	25.00	5.000	5.000	2.500	143.83	164.37	10.244	7.000	.0000
D1	680.00	25.00	5.000	5.000	2.500	143.83	164.37	18.724	7.000	.0000
D	680.00	25.00	.0000	5.000	.0000	143.83	.000	62.199	14.00	.0000
G	680.00	25.00	5.000	5.000	2.500	143.83	164.37	2.407	5.000	.0000
BASIN	680.00	25.00	5.000	5.000	2.500	143.83	164.37	65.182	13.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	13.00	65.18	16.00	55.66	64326.1	.0000	21485.1	2.9751

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

##
Turo Creek Flood Study - PMF

Results for period from 0: .0 1/ 1/1990
to 8:20.0 1/ 1/1990
##

ROUTING INCREMENT (MINS) = 1.00
STORM DURATION (MINS) = 30.
RETURN PERIOD (YRS) = 1030.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2	Cont. Loss #1 (mm/h)	Cont. Loss #2	Excess Rain #1 (mm)	Excess Rain #2	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	480.00	25.00	5.000	5.000	2.500	212.75	233.75	12.573	17.00	.4000
B2	480.00	25.00	5.000	5.000	2.500	212.75	233.75	1.523	7.000	.0000
B1	480.00	25.00	5.000	5.000	2.500	212.75	233.75	33.280	17.00	.7000
E2B	480.00	25.00	5.000	5.000	2.500	212.75	233.75	1.516	7.000	.0000
E1B	480.00	25.00	5.000	5.000	2.500	212.75	233.75	2.083	10.00	.7000
C1	480.00	25.00	5.000	5.000	2.500	212.75	233.75	17.217	18.00	.0000
C	480.00	25.00	.0000	5.000	.0000	212.75	.000	50.498	18.00	1.300
D2	480.00	25.00	5.000	5.000	2.500	212.75	233.75	4.917	9.000	.0000
E2A	480.00	25.00	5.000	5.000	2.500	212.75	233.75	1.516	7.000	.0000
E1A	480.00	25.00	5.000	5.000	2.500	212.75	233.75	2.083	10.00	1.500
F	480.00	25.00	5.000	5.000	2.500	212.75	233.75	7.472	10.00	.0000
D1	480.00	25.00	5.000	5.000	2.500	212.75	233.75	15.456	13.00	.0000
D	480.00	25.00	.0000	5.000	.0000	212.75	.000	63.270	19.00	.0000

Sheet 12

##
Turo Creek Flood Study - PMF

Results for period from 0: .0 1/ 1/1990
to 8:20.0 1/ 1/1990
##

ROUTING INCREMENT (MINS)	=	1.00
STORM DURATION (MINS)	=	60.
RETURN PERIOD (YRS)	=	1060.
BX	=	1.0000
TOTAL OF FIRST SUB-AREAS (HA)	=	39.42
TOTAL OF SECOND SUB-AREAS (HA)	=	4.84
TOTAL OF ALL SUB-AREAS (HA)	=	44.26

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	370.00	25.00	5.000	5.000	2.500	340.33	362.54	11.224	22.00	.4000
B2	370.00	25.00	5.000	5.000	2.500	340.33	362.54	1.281	9.000	.0000
B1	370.00	25.00	5.000	5.000	2.500	340.33	362.54	29.824	22.00	.7000
E2B	370.00	25.00	5.000	5.000	2.500	340.33	362.54	1.272	9.000	.0000
E1B	370.00	25.00	5.000	5.000	2.500	340.33	362.54	1.650	14.00	.7000
C1	370.00	25.00	5.000	5.000	2.500	340.33	362.54	15.688	27.00	.0000
C	370.00	25.00	.0000	5.000	.0000	340.33	.000	45.469	22.00	1.300
D2	370.00	25.00	5.000	5.000	2.500	340.33	362.54	3.958	10.00	.0000
E2A	370.00	25.00	5.000	5.000	2.500	340.33	362.54	1.272	9.000	.0000
E1A	370.00	25.00	5.000	5.000	2.500	340.33	362.54	1.650	14.00	1.500
F	370.00	25.00	5.000	5.000	2.500	340.33	362.54	5.649	12.00	.0000
D1	370.00	25.00	5.000	5.000	2.500	340.33	362.54	12.672	21.00	.0000
D	370.00	25.00	.0000	5.000	.0000	340.33	.000	57.162	27.00	.0000
G	370.00	25.00	5.000	5.000	2.500	340.33	362.54	1.531	9.000	.0000
BASIN	370.00	25.00	5.000	5.000	2.500	340.33	362.54	60.243	27.00	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	27.00	60.24	28.00	59.77	151603.	.0000	21812.1	3.0026

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 14

##
RUNTIME RESULTS
##

Max. no. of links allowed = 280

Max. no. of routng increments allowed = 600

Max. no. of rating curve points = 200

Max. no. of storm temporal points = 2000

Max. no. of channel subreaches = 55

Max link stack level = 20

Input Version number = 400

##
Turo Creek Flood Study - Historical Floods (Jan 1988)

Results for period from 0: .0 1/ 1/1990
to 1: .0 2/ 1/1990
##

ROUTING INCREMENT (MINS) = 2.50
STORM DURATION (MINS) = 970.
RETURN PERIOD (YRS) = 8801.
BX = 1.0000
TOTAL OF FIRST SUB-AREAS (HA) = 39.42
TOTAL OF SECOND SUB-AREAS (HA) = 4.84
TOTAL OF ALL SUB-AREAS (HA) = 44.26

SUMMARY OF CATCHMENT AND RAINFALL DATA

Link Label	Catch. Area #1 (hectares)	Catch. Area #2	Slope #1 (%)	Slope #2	% Impervious #1 (%)	% Impervious #2	Pern #1	Pern #2	B #1	B #2	Link No.
A	7.990	.1100	20.90	20.90	.1000	99.90	.080	.015	.0413	.0001	1.000
B2	.4300	.3500	23.10	23.10	.1000	99.90	.025	.015	.0035	.0002	2.000
B1	12.500	.3300	23.10	23.10	.1000	99.90	.080	.015	.0495	.0002	1.001
E2B	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	3.000
E1B	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	3.001
C1	10.120	.2000	20.00	20.00	.1000	99.90	.080	.015	.0477	.0001	3.002
C	.00100	.000	20.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.002
D2	1.440	1.180	17.00	17.00	.1000	99.90	.025	.015	.0076	.0004	4.000
E2A	.4300	.3500	20.70	20.70	.1000	99.90	.025	.015	.0037	.0002	5.000
E1A	.3500	.0200	20.70	20.70	.1000	99.90	.080	.015	.0082	0.000	5.001
F	1.510	1.240	19.50	19.50	.1000	99.90	.025	.015	.0073	.0004	5.002
D1	2.970	.1700	17.00	17.00	.1000	99.90	.080	.015	.0273	.0001	4.001
D	.00100	.000	17.00	.0000	.1000	.0000	.080	.00	.0004	.0000	1.003
G	.5100	.4200	24.00	24.00	.1000	99.90	.025	.015	.0037	.0002	6.000
BASIN	.3900	.1000	1.700	1.700	.1000	99.90	.025	.015	.0122	.0003	1.004

Sheet 16

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.8508	2423.	.4000
B2	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.1249	2415.	.0000
B1	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	2.202	2423.	.7000
E2B	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.1246	2415.	.0000
E1B	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.1707	2415.	.7000
C1	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	1.134	2423.	.0000
C	-1.000	25.00	.0000	5.000	.0000	216.65	.000	3.336	2423.	1.300
D2	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.4024	2415.	.0000
E2A	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.1246	2415.	.0000
E1A	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.1707	2415.	1.500
F	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.5959	2415.	.0000
D1	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.7251	2415.	.0000
D	-1.000	25.00	.0000	5.000	.0000	216.65	.000	3.984	2415.	.0000
G	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	.1502	2415.	.0000
BASIN	-1.000	25.00	5.000	5.000	2.500	216.65	281.15	4.787	2415.	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	---------- Basin ---------- Vol. Avail	Vol. Used	Stage Used
BASIN	2415.	4.786	2423.	4.553	98859.4	.0000	461.09	.7309

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

Sheet 18

Link Label	Average Intensity (mm/h)	Init. Loss #1 (mm)	Init. Loss #2 (mm)	Cont. Loss #1 (mm/h)	Cont. Loss #2 (mm/h)	Excess Rain #1 (mm)	Excess Rain #2 (mm)	Peak Inflow (m^3/s)	Time to Peak	Link Lag (mins)
A	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.7967	2810.	.4000
B2	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.0956	2810.	.0000
B1	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	2.136	2810.	.7000
E2B	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.0953	2810.	.0000
E1B	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.1347	2810.	.7000
C1	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	1.129	2810.	.0000
C	-1.000	25.00	.0000	5.000	.0000	91.667	.000	3.265	2810.	1.300
D2	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.3123	2810.	.0000
E2A	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.0953	2810.	.0000
E1A	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.1347	2810.	1.500
F	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.4628	2810.	.0000
D1	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.6266	2810.	.0000
D	-1.000	25.00	.0000	5.000	.0000	91.667	.000	3.891	2810.	.0000
G	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	.1141	2810.	.0000
BASIN	-1.000	25.00	5.000	5.000	2.500	91.667	137.92	4.521	2810.	.0000

SUMMARY OF BASIN RESULTS

Link Label	Time to Peak	Peak Inflow (m^3/s)	Time to Peak	Peak Outflow (m^3/s)	Total Inflow (m^3)	Basin Vol. Avail	Basin Vol. Used	Basin Stage Used
BASIN	2810.	4.520	2810.	4.366	42705.3	.0000	442.77	.7114

SUMMARY OF BASIN OUTLET RESULTS

Link Label	No. of	S/D Factor (m)	Dia (m)	Width (m)	Pipe Length (m)	Pipe Slope (%)
BASIN	2.0	2.000		.000	20.000	.2000

```
################################################################################
Turo Creek Flood Study - Historical Floods (Feb 1990)

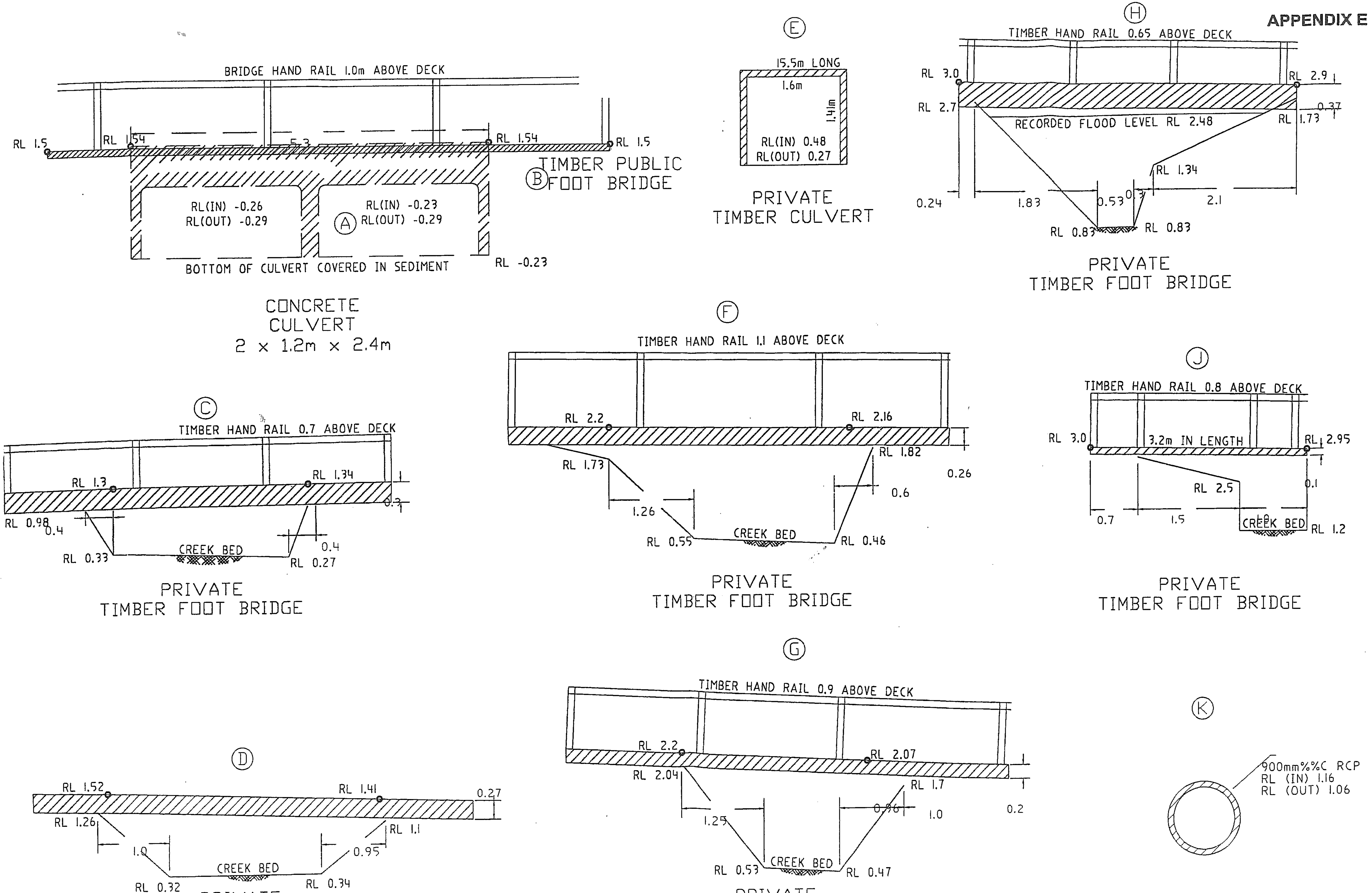
Results for period from  0:   .0  1/ 1/1990
                     to  3:   .0  4/ 1/1990
################################################################################
```

```
ROUTING INCREMENT (MINS)  =       7.50
STORM DURATION (MINS)     =      3615.
RETURN PERIOD (YRS)       =      9002.
BX                        =     1.0000
TOTAL OF FIRST SUB-AREAS  (HA)  =      39.42
TOTAL OF SECOND SUB-AREAS (HA)  =       4.84
TOTAL OF ALL SUB-AREAS (HA)     =      44.26
```

APPENDIX E

BRIDGE AND CULVERT STRUCTURES

APPENDIX E



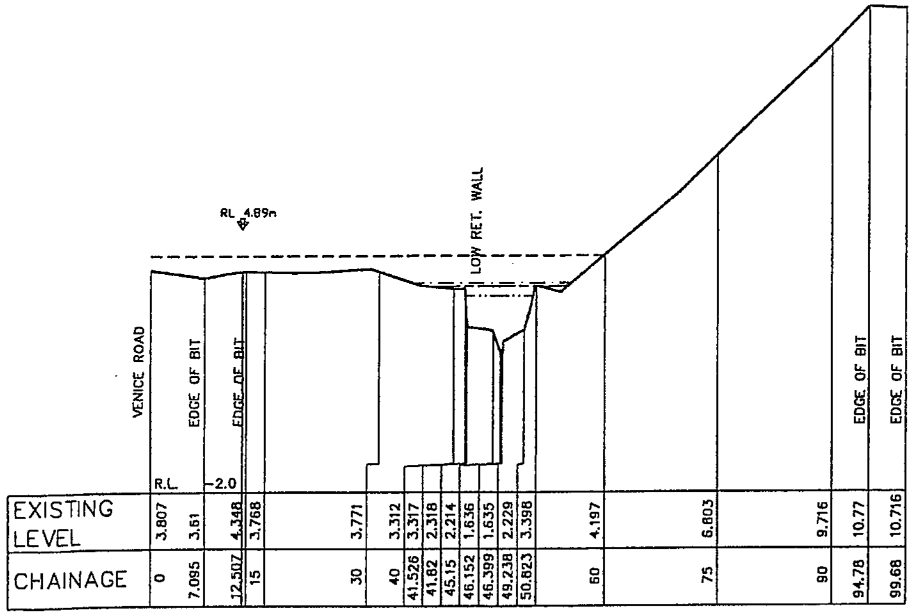
TURO CREEK FLOOD STUDY
BRIDGE & CULVERT STRUCTURES

3680-Turo/APPENDIX-E

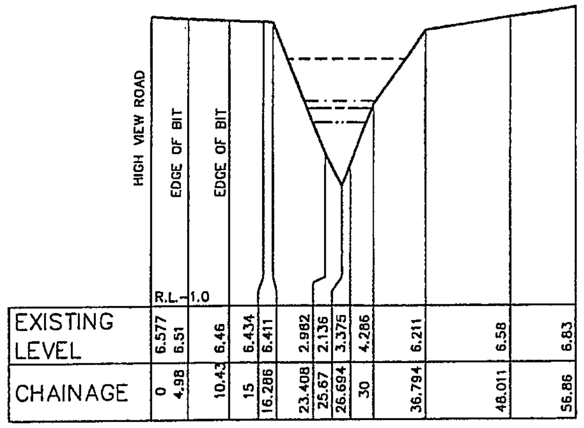
1:50 (A3) 0 1 2 3 4 5 M

APPENDIX F

SURVEYED CROSS SECTIONS AND FLOOD ELEVATIONS



SECTION No.6



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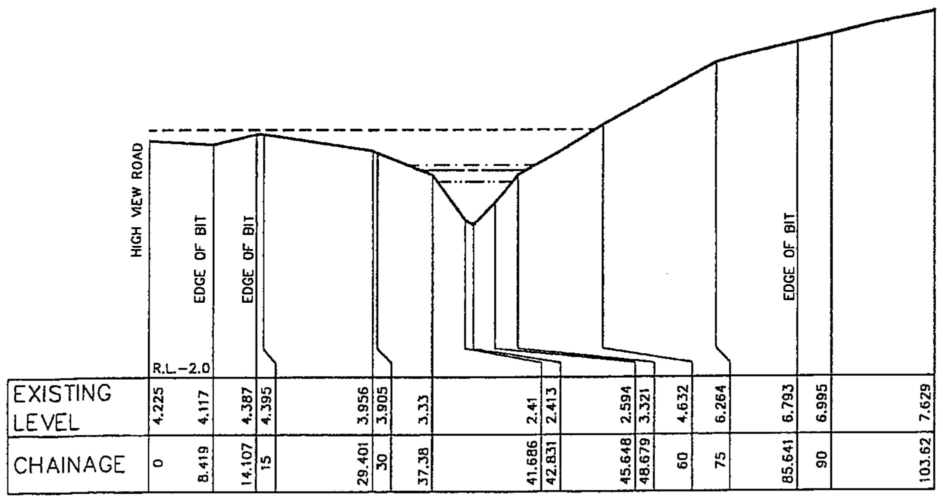

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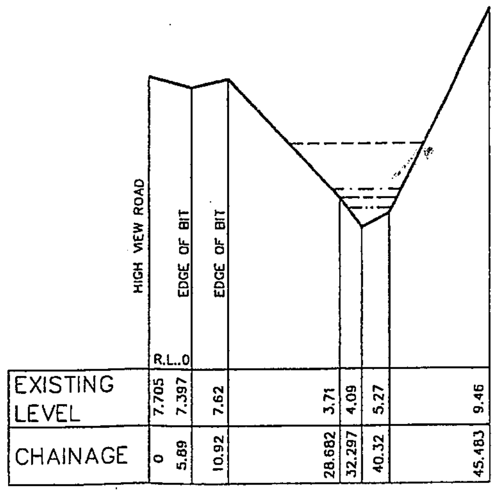
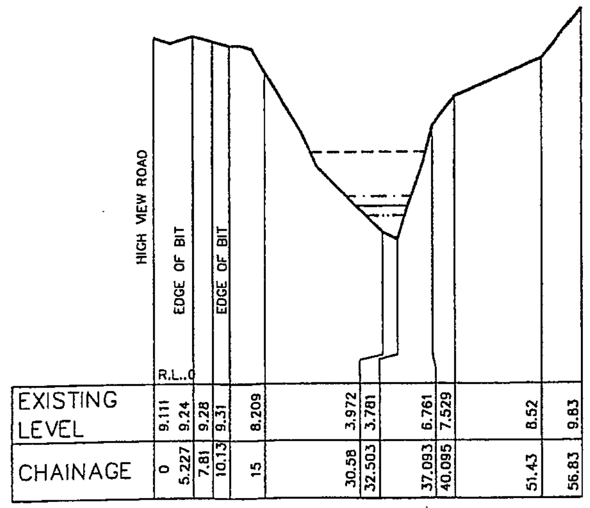


SECTION No.9



SECTION No.10

NOTE

FLOOD EXTENTS ARE APPROXIMATE ONLY. NO ACCOUNT OF LOCALISED BLOCKING OF EXISTING STRUCTURES HAS BEEN MADE.

LEGEND

—··—·· 20% AEP TAILWATER
——— 5% AEP TAILWATER
—·—·— 1% AEP TAILWATER
----- PMF TAILWATER
RL 3.36m SURVEYED HOUSE FLOOR LEVEL

HORIZONTAL 1:1000 (A3) 0 10 20 30 40 50 m

VERTICAL 1:200 (A3) 0 2 4 6 8 10 m

TURO CREEK FLOOD STUDY
SURVEYED CROSS SECTIONS & ESTIMATED FLOOD ELEVATIONS
sheet 2 of 2

APPENDIX G

TIDAL SENSITIVITY ANALYSIS

APPENDIX G

Node	PMF with 1.95m Tailwater	PMF with 1.60m Tailwater	PMF with 1.25m Tailwater	1% AEP with 1.95m Tailwater	1% AEP with 1.60m Tailwater	1% AEP with 1.25m Tailwater	1% AEP with 0.5m Tailwater	5% AEP with 0.80m Tailwater	5% AEP with 0.50m Tailwater	20% AEP with 0.50m Tailwater	20% AEP with 0.45m Tailwater
10	6.23	6.23	6.23	5.10	5.10	5.10	5.10	4.79	4.79	4.51	4.51
9	5.91	5.91	5.91	4.75	4.75	4.75	4.75	4.50	4.51	4.29	4.29
8	5.92	5.92	5.92	4.76	4.76	4.76	4.76	4.51	4.52	4.13	4.13
7	4.58	4.58	4.58	3.66	3.66	3.66	3.66	3.48	3.49	3.16	3.16
KU	4.59	4.59	4.59	3.66	3.66	3.66	3.66	3.48	3.49	3.16	3.16
KD	4.44	4.44	4.44	3.57	3.57	3.57	3.57	3.43	3.43	3.14	3.13
6	4.31	4.31	4.31	3.55	3.55	3.55	3.55	3.42	3.42	3.13	3.13
JU	4.09	4.09	4.09	3.47	3.47	3.47	3.47	3.37	3.37	3.12	3.12
JD	3.95	3.95	3.95	3.33	3.33	3.33	3.33	3.05	3.05	2.50	2.49
HU	3.95	3.95	3.95	3.34	3.34	3.34	3.34	3.05	3.06	2.50	2.50
HD	3.50	3.50	3.50	2.83	2.83	2.83	2.83	2.67	2.67	2.39	2.39
GU	3.44	3.44	3.44	2.79	2.79	2.79	2.79	2.63	2.64	2.39	2.39
GD	3.34	3.34	3.34	2.72	2.72	2.72	2.72	2.57	2.57	2.34	2.34
FU	3.29	3.29	3.29	2.70	2.69	2.69	2.69	2.55	2.55	2.32	2.32
FD	3.11	3.11	3.11	2.55	2.53	2.53	2.52	2.37	2.37	2.18	2.18
EU	3.04	3.04	3.04	2.50	2.47	2.47	2.46	2.32	2.32	2.16	2.16
ED	2.77	2.77	2.77	2.23	2.16	2.16	2.15	1.99	1.99	1.76	1.76
DU	2.73	2.73	2.73	2.21	2.13	2.12	2.12	1.97	1.97	1.75	1.75
DD	2.54	2.53	2.53	2.07	1.95	1.93	1.93	1.75	1.75	1.50	1.52
2	2.26	2.22	2.22	1.97	1.78	1.75	1.74	1.66	1.66	1.47	1.49
CU	2.22	2.18	2.18	1.97	1.76	1.73	1.72	1.65	1.64	1.43	1.45
CD	2.14	2.09	2.09	1.96	1.70	1.64	1.61	1.53	1.51	1.05	1.08
1	2.07	2.00	2.00	1.95	1.67	1.59	1.51	1.15	1.11	0.78	0.82
B	1.95	1.70	1.69	1.95	1.61	1.47	1.37	1.08	1.03	0.72	0.77
A	1.95	1.60	1.25	1.95	1.60	1.25	0.52	0.80	0.50	0.50	0.45
OUT	1.95	1.60	1.25	1.95	1.60	1.25	0.50	0.80	0.50	0.50	0.45

THE END