USE OF RAINFALL DATA FROM FLOW SURVEYS

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1. INTRODUCTION

Often when undertaking a flow survey of a sewer system the objective is to gather data for verifying a model of the system (see Code of Practice for Hydraulic Modelling).

However, the survey may form a significant proportion of the total cost of the investigation of a system and can be as much as 20%. It is therefore necessary to make effective use of the recorded rainfall data by careful selection of those measured storm events which produce an adequate flow response in the sewer system. The response to a storm event will depend upon rainfall depth, rainfall duration, catchment size and wetness, and the characteristics of the system itself. The following criteria are suggested when inspecting the data:

2. SELECTION OF STORM EVENTS

This should be done from a minimum of three measured storm events (if available) (see Code of Practice for Hydraulic Modelling). It is advisable to use at least two storms with differing characteristics:

(i) a high intensity, short duration storm where initial storage in the catchment is minimal (as characterised by summer storms); and

(ii) a low intensity, long duration storm.

3. FLOW RESPONSE

WRc suggest a ratio of peak to base flow of five, provided that the depth at peak is greater than 150 mm.

4. RARE STORM EVENTS

Although such a storm may produce a good response in the system care must be taken to ensure that loss of flow from the system through flooding does not make the data unreliable.

5. ADDITIONAL FACTORS

Consider:

(i) hyetograph profile, i.e. the degree of ‘peakedness’;

(ii) spatial distribution of the rainfall; and

(iii) catchment size, location and topographical features.

6. RECOMMENDATIONS

Recommended minimum values of rainfall intensity and duration for various catchment sizes are shown in the Table 1. It must be emphasized that these are recommended values only and that in certain circumstances it may be necessary to use data with values less than those recommended. Also, see Code of Practice for Hydraulic Modelling.

Table 1

CATCHMENT	RAINFALL	
	TOTAL	AVERAGE MINIMUM INTENSITY AND DURATION
Small paved catchment <20 ha	5 mm	5 mm/hr for 15 minutes minimum
Large catchments 20 – 300 ha		5 mm/hr for 30 minutes

(N.B. For rural areas WRc suggest total rainfall of 25 mm)

7. EXAMPLES

The following three examples show some typical problems experienced by the author in selecting storms.

(i) <u>Use of a local storm</u>

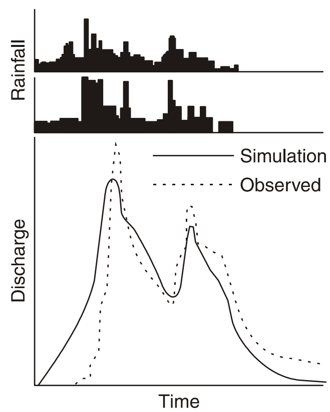

Figure 1

(ii) <u>Long Duration Storms</u>

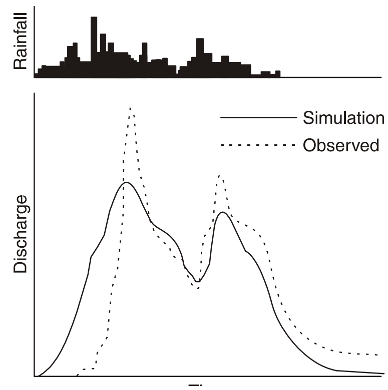

Figure 2

When measuring storm events over a large catchment, spatial distribution of the rainfall may be significant. Consider a surface water system with 5.5 km of pipes draining 34 ha and modelled as an 84 pipe system. Figure 1 shows the comparison between actual and simulated flows for the hyetograph averaged over the whole catchment (360 ha). When data from the geographically closest rain gauge is used for the sub-catchment there is an increase in peak flow by 10%; see Figure 2. Such an increase could be significant and could lead to an increase in the size of the pipework.

A critical factor using long duration, low intensity storms may be the initial wetness of the catchment and thus the UCWI value used in Wallingford Percentage Runoff Model.

Figure 3 shows an under-estimate of flows using a complete 1 hour storm with UCWI = 102. If, alternatively, the more significant part of the storm is modelled separately for 25 mins duration and UCWI = 170, the model provides a better fit with measured flows; see Figure 4.

This example demonstrates that the catchment wetness changes with time. Although the predicted and measured flows compare favourably at the beginning of the 10 hour storm, at the end of the storm they differ by 37%. In contrast by modelling the main part of the storm the mismatch is less than 2%. Clearly, to obtain a good fit for the whole of this type of storm UCWI would have to vary with time, or an average appropriate value should be used to reduce the overall variance.

(iii) <u>Flat Catchment – Low Intensity Storm</u>

Due to inadequacy of rainfall data a low intensity storm of average intensity 3 mm/hr over 2 hours and a total rainfall of 3.8 mm had to be used to verify a flat sub-catchment (slope 1:200) of 16 ha drained by a system of 166 pipes with a total length of 11.5 km.

Figure 5 shows that the predicted flow hydrograph profile and peak compare favourably with measured flows but there is a significant time lag of approximately 1 hour.

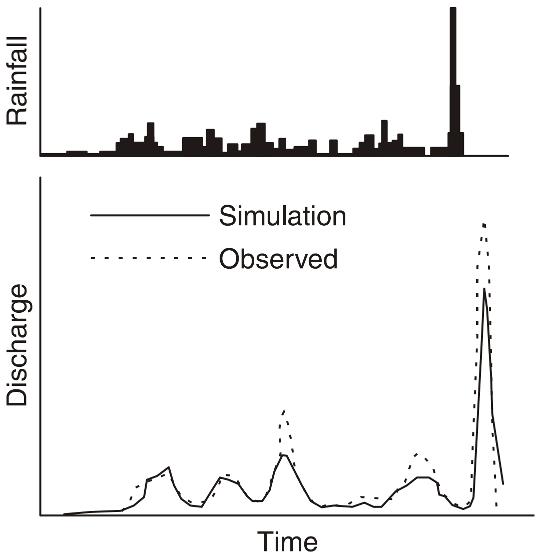

Figure 3

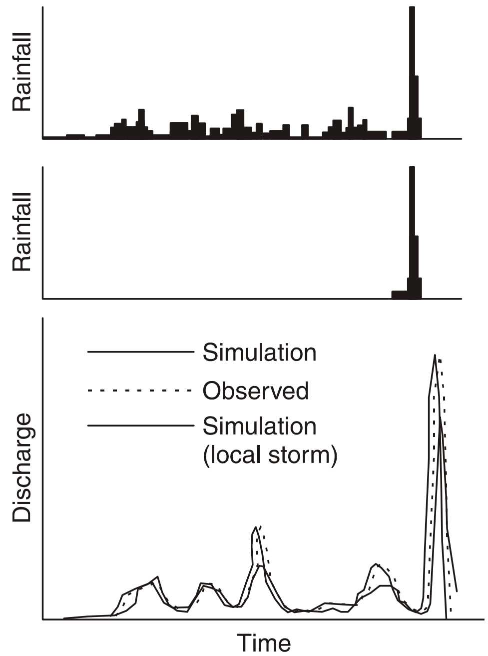

Figure 4

In this instance it is evident that the model is predicting that flows are entering the sewer system too early. There are a number of model parameters which may cause such a mismatch. They include:

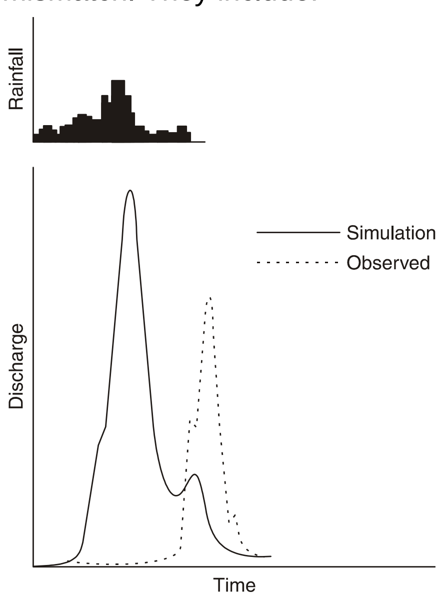

Figure 5

(a) using the minimum slope index of 1 in 50 – Mild slope (whereas the catchment is much flatter – 1 in 200)

(b) adopting a low value of UCWI (34) which indicates catchment condition was dry – this would cause measured flows to be attenuated before reaching the sewer system, and

(c) being limited by ANTEC which only allows catchment storage to be either fully taken up or not.

AMENDMENTS

Ver	Description	Date
1.	First Published	May 1987
2.	Editorial Amendments	March 2009