Workshop 4: Effectiveness and Accuracy of Model Verification

Chairman - A R Eadon, Severn Trent Water

Mini-paper - N Simmonds, Consultant

The Chairman's introduction, together with the mini-paper, was intended to provide a stimulus to the workshop discussion. Reference was made by the Chairman to a long term study undertaken in the Severn Trent area, which showed wide variations between measured flow and model predictions over a large range of storm events.

The paper discussed results from a flow survey undertaken to provide detailed verification of two WASSP models, one being a surface water system and the other a partially combined system. These models had been generally verified on data from flow monitors placed on the outfall points of each system. Both models were indicating severe surcharging and extensive flooding on a 1 year design event, for which no corroborative evidence could be found.

A 15 monitor flow survey was carried out in the two catchments over a five week period during which four exceptionally good rainfall events occurred, two of these being almost equivalent to a 1 year design storm. However, when full evaluation of the survey data was completed, it was apparent that there were major problems with data accuracy as the following summary indicates:

Satisfactory data	38%
No data - equipment failure	10%
Suspect data - inaccurate velocity	30%
Suspect data - depth or other problems	22%

Various illustrations of the problems encountered were presented. Those relating to intermittent data losses could be identified and corrected without difficultly. Errors in depth could be identified, but it was impossible to determine whether site conditions or equipment faults were responsible. Neither of these two problem categories were misleading in terms of model verification, but inaccuracies in velocity cast serious doubts on previous assumptions regarding connected areas.

Velocity errors were extremely difficult to identify because flow/depth characteristics as shown on scattergraphs appeared perfectly normal. It was necessary to undertake a detailed analysis of the system data changes, required in theory, to achieve comparison with measured flows at each site. This showed conclusively that the measured flows were totally impractical and that the only source of error was the velocity element of data. Two particular problems were identified:-

A. Velocity Overprediction

This is a site dependent phenomenon related to deficiencies in the doppler measurement principle. It can occur over the full depth range within a sewer, but is more likely to influence flows exceeding 25% pipe capacity. Errors were in the range of +20% to +100% and there was no evidence of unsatisfactory flow conditions during site inspections.

B. Velocity Reduction in clean water

This is a fluid condition phenomenon again related to doppler measurement deficiencies. It occurred at sites on the surface water system shortly after pipe surcharge, when steady clean water was presumably flowing past the sensor. Errors were in the range of -50% to -90%, but there was no evidence of inaccuracies in non surcharge conditions.

These problems made it impossible to verify the WASSP models by flow comparison methods. However, the excellent range of storms which occurred during the flow survey and the relative reliability of depth measurement, provided clear evidence of the severe surcharge conditions predicted by the models.

Workshop Discussion

It was confirmed that short term flow surveys were being used by the majority of engineers to verify WASSP/WALLRUS models. The discussions concentrated on the following three topics:-

1. The effectiveness of short term flow surveys

There was considerable support for the previously expressed concern about accuracy of flow survey data, particularly on velocity measurement. However, there were many delegates who had in the past been willing to accept all data as presented without question. It was agreed that the interpretation of data required a specialist understanding which could not be easily obtained.

Many delegates considered that flow data was more meaningful when a model had been prepared prior to the survey. It is then possible to check data quality by model calibration at an early stage. Flow surveys often highlighted major errors in the assumptions made when compiling sewer system data for models.

There was concern that short term surveys often did not capture a sufficient number of suitable rainfall events during the normal five week period. Many did not consider three events to be adequate and there were numerous occasions where surveys had to be extended. Even extensions did not always produce satisfactory data. Some delegates questioned the need to always undertake a flow survey.

2. Possible Improvements

There was unanimous support for research into improved flow monitoring equipment, concentrating on velocity measurement.

However, the present equipment will inevitably continue in use for some time and it is necessary to achieve the best possible performance. Better quality control of data by contractors was widely supported, but those contractor's representatives present, were concerned about achieving this within current prices. It was suggested that a good client/contractor relationship was beneficial to the production of satisfactory results.

Many delegates agreed that with depth measurement being far more reliable than velocity, more emphasis could be placed on its use for verification of models. In the past there has been reluctance to rely on level correlation because of the limitations of WASSP, but with the increasing use of WALLRUS, an improvement in level prediction is anticipated.

3. Other Methods of Verification

The use of historical data was discussed, but few delegates had found adequate records available to provide a reliable basis for verification. There was little support for sending out questionnaires to obtain information, because of the lack of reliability and political implications.

Many delegates agreed that long term level measurement of surcharge conditions in all major sewers would provide a valuable database, especially if linked with a more limited short term flow survey, but there seemed to be very few authorities prepared to implement such as policy.

Conclusions

Short term flow surveys remain the most viable option for model verification.

These surveys can provide much useful information, but the accuracy of results must be carefully assessed before proceeding with verification.

There is an urgent need to improve the present survey equipment, particularly velocity measurement.