PRESENTATION TO THE WAPUG SPRING 1992 MEETINGS

URBAN POLLUTION MANAGEMENT - APPLICATION EXPERIENCE TO-DATE

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ABSTRACT

The Sewerage Rehabilitation Manual (SRM) is effective in presenting methodologies to manage the flooding and structural aspects of sewer performance, but in its initial form, offered little in the way of an objective control methodology for pollution arising from sewer discharges, because such techniques were simply not available. It was to fill this gap in technology that the Urban Pollution Management (UPM) programme was initiated. The SRM has subsequently been updated to include some initial sewerage orientated UPM developments (SRM-II).

The current emphasis of the UPM programme is directed towards the specific problem of wet weather discharges and, in particular, the control of combined sewer overflow (CSO) spills. The majority of UK urban drainage systems are combined to a greater or lesser degree. Investigation has established that there are some twenty one thousand CSO structures in England and Wales, with several thousand more in Scotland and Northern Ireland. Substantial lengths of watercourses are recognised to be seriously affected by CSO discharges and precluded from attaining their long term quality objectives (EQOs) by the impact of CSOs.

The main thrust of the immediate programme is in recognising that previous "setting" criteria for CSOs based on engineering considerations alone (e.g. multiples of dry weather flow or Formula A) are fundamentally flawed. The assimilative capacity of the receiving water is just as important as the transport capacity of the sewerage system and the treatment capacity of the sewage works. The UPM programme is designed to provide the tools to allow such a philosophy to be implemented effectively. Examining the integrated performance of the sewerage system and the sewage treatment works coupled with an assessment of their combined impact on the receiving environment will permit the optimisation of urban water pollution control planning and integrated wastewater management.

The UPM tools include:

i) Time Series Rainfall and Stochastic Rainfall Generator;

ii) MOSQITO sewer flow quality simulation model;

iii) MIKE 11 dynamic river impact simulation model;

iv) STOAT dynamic sewage treatment works model;

v) Biological Standards for the impact of intermittent discharges;

vi) Improved engineering designs for CSOs.

The UPM research programme is co-ordinated by WRc, who are the primary contractor. The programme is steered by the funders who include FWR, WS plcs, NRA, DoE and SERC.

These tools are now completed or available in interim form. A fundamental tenet of the UPM programme for the successful implementation of the modelling tools is to bring together the model developer and end-use at the earliest opportunity to verify and evaluate the performance of schemes designed using the new procedures. To this end a series of implementation pilot studies are being undertaken under the auspices of the WRc Sewerage Management Planning Club Research Contract. This involves a programme of work undertaken by the 5 WS plc club members (Anglian, North West, Severn Trent, Thames and Yorkshire) and WRc to evaluate the use of MOSQITO, MIKE 11 and STOAT within a framework of the integrated UPM approach. Additional MOSQITO support is provided via a subcontract from WRc to HRL.

The SMP contract has two main facets. These are:

i) To test individual models and management techniques on real problems, thereby

- developing experience and confidence in the use of the tools to solve other problems,
- providing feedback to model developers as to the appropriateness and effectiveness of models, and
- generating data and knowledge to enable models to be enhanced as necessary

ii) To develop a methodology for the integrated use of sewerage, sewage treatment works and river models for managing water quality in urban rivers in a rational and cost-effective manner.

In addition, data collected in the course of the pilot studies will permit the improved calibration of existing prototype models and will identify modelling areas which require further enhancement or development. Work on the contract commenced in April 1989 and is scheduled for completion in March 1993.

The SMP study programme has been broadly divided into five phases:

Identification of pilot study sites
Data collection
Model building, calibration and verification
Evaluation of proposed solutions
Assessment of model performance

Club members selected pilot study sites on the basis of real problems and where there was a perceived need to develop new schemes.

Data collection has now been completed at all the study sites. Model building has commenced for 4 of the pilot studies. The sites can be broadly categorised into:

1. Small town - small upland urban river
2. Small town - large lowland river
3. Medium town - medium upland rural river
4. Large town - small lowland urban river
5. Small town - small lowland rural river

The data collection programmes for the SMP studies were devised by WRc and HR. They represented the best initial advice as to the most suitable form in which data could be collected to allow reliable use of the models. In this respect, the data collection requirements were viewed as 'ideal' or 'maximum' levels. In addition, the requirements of the collection programmes were varied during the study as practical experience was gained from the first few completed studies and as local situations and requirements dictated.

The principal aim of the data collection was to assemble accurate local data to allow for the building, calibration and verification of MOSQITO, STOAT and MIKE 11 models. This was to be achieved through an extensive short term (5 weeks) data collection period similar to that used in hydraulic sewer flow surveys. During this period data were to be collected for dry weather and wet weather periods. For the sewerage and river systems five 24 hour dry periods were sampled and up to 5 storms were captured. STOAT data requirements are somewhat different and involve long term background and short term intensive process monitoring based around dry weather and storm event flows.

The extent of successful data capture is indicated below:

SITE	SAMPLED PERIODS DRY WEATHER	STORM EVENTS
1	3	2
2	5	0
3	5	3
4	3	0
5	4	2

It is clear that for building the models local background information is of great importance in allowing good models to be produced. For the river system this might include cross-sectional data and historical stage/discharge relationship, time of travel and water quality data. For the sewerage system a reliable verified WALLRUS model is a vital factor. In a number of pilot studies a 'verified' WALLRUS model was provided for the MOSQITO study which then had to be substantially modified to improve its performance before it could be used. This shortcoming in the basic hydraulic model has been shown to be due partly to the allowable errors in typical WALLRUS verification and partly because WALLRUS models are typically verified for high flow conditions only, whereas MOSQITO models require verification at both high and low flows.

In some pilot studies the failure to collect storm event data (for many reasons, such as weather factors, equipment failure and resourcing) will limit model development to calibration only. One clear lesson that has been learnt to date is that in subsequent applications the need for storm event quality data must be greatly reduced.

Quality data collection by sampling and continuous monitoring is expensive, labour intensive and unpredictable. The full evaluation of model capabilities and requirements in the SMP pilot studies will identify the extent to which significant reductions can be made to data collection requirements without significant loss in the reliability of model predictions and user confidence.

Paper 3 : Urban Pollution Management (Chris Hutchings/Bob Crabtree WRc, Brian Wilkinson Yorkshire Water)

Gary Moys, Integrated Hydro Systems : offered the opinion that for some catchments WALLRUS was not capable of modelling high flows accurately let alone the problem with dry weather flows mentioned in the lecture. He also said that SPIDA/WALLRUS could not represent low flows (DWFs) from different areas. He understood that MIKE 11 was better suited to modelling flatter catchments and had noted that some of the test catchments were steep.

Answer : One of the biggest problems was collecting accurate dry weather flow data, especially in the upstream reaches of a catchment and better methods for doing this needed to be investigated. MIKE 11 had been modified for UK conditions and a decision had been taken that it was suitable for steeper catchments.

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Brian Sharman, North West Water : Could STOAT model high technology treatment works?

Answer : STOAT is a modular program with different modules for different processes. The existing modules were for the more standard processes of sedimentation etc but it was planned to develop further modules to represent the high tech processes.

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George Hare, Northumbrian Water : How accurate are river models, and how successful do you envisage verification to be ?

Answer : Data collection is as extensive for a sewer system. There are problems at low flows, when the models are unstable.

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G Moys, IHS : Is MIKE 11 able to represent small rivers adequately? Many overflows discharge to a small river which subsequently discharges to a larger river. MIKE 11 does not work in such situations.

Answer : We will know at the end of the Study, the purpose of which is to assess suitability. Small rivers can be treated as point discharges to large rivers, but the beneficial effects of "in-river" storage/treatment are then lost.

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G Edwards, Northumbrian Water : Will the Study identify simpler methods of appraising overflows?

Answer : We have discussed the "state of the art" tools today. Other aspects of the UPM programme consider "lesser" tools and may identify the scenarios appropriate to each tool.

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Paper 4 : SFT Data Logger to monitor CSOs (Michael Merrick, Solutions from Technology Ltd)

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