BOLTON RTC - A GLIMPSE AT THE FUTURE

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1. INTRODUCTION.

The Bolton Pilot project, part of the European Union's SPRINT programme, involves the application of Real Time Control to the Bolton town centre sewer system.

Started in December 1992, the project is now deep in the implementation stage of the two year programme. This has followed a construction programme involving the building of three large off-line storage tanks and the installation of sensors and a telemetry system. The aim of the project is to ensure a maximum reduction in pollution and flooding in the Bolton town centre area by controlling the use of these tanks in Real Time.

Real Time Control of the system will be achieved when sensors and controllers located throughout the sewer system are linked to a MOUSE ON-LINE model via a SCADA system. This will allow control of the system in response to fluctuating runoff quantities and the availability of storage at any time, with the aim of maximising the utilisation of this storage.

For an RTC system to work effectively, a strategy or set of rules is needed which specifies what actions to take in response to different conditions. The efficient development of such control strategies can be greatly aided by the use of simulation modelling techniques.

This paper describes how control strategies for the Bolton system have been developed and tested using the MOUSE PILOT software package. This work was carried out by WRc on behalf of North West Water Limited (NWW).

2. DESCRIPTION OF THE BOLTON SEWER SYSTEM

The Bolton town centre sewer system contains three large off-line sump style storage tanks with a combined volume of some 21,000 m^3. These are linked by the main trunk sewer which carries flows to the Wastewater Treatment Works (WwTW).

At present the tanks are filled by gravity with flows spilling from an internal overflow located on the upstream leg of the trunk sewer. This occurs when flows are throttled as they pass through various passive flow control devices. Return flows from the tanks to the trunk sewer are pumped. This offers the potential to control the emptying of each tank.

Each of the three storage tanks has an emergency overflow which spills to a small watercourse. The main spill point, however, is downstream where the trunk sewer crosses the River Croal on a pipe bridge. At this location a penstock throttles the continuation flow to the capacity of the pipe bridge and large spills occur via a syphon overflow.

Due to the storage provided by the three tanks, flooding is not a major problem in the town centre catchment although there are some known flood locations.

- Global Control - Without Gates.

  The Global Control strategy combined local flow based control at each of the tanks with set points at the spill levels into downstream tanks, the spill level at the syphon overflow, and the surcharge level at a known floodpoint (eg Bark Street). The control file was set up so that no tank could empty when;

  A. The flow in the local downstream sewer exceeded the set point, or

  B. There was spill into a downstream tank, or

  C. There was flooding downstream, or

  D. If the syphon overflow was spilling.

- Global Control - With Gates

  Two movable gates were then included in the model at Ladybridge and Spa Road tanks to investigate the effects of controlling the filling of the tanks. This involved the addition of rules for the control of these gates to the Global Control file described above.

  The two set points for the movement of these gates were selected as the spill level of the syphon overflow and a depth level in each tank near the maximum water level. A gate was allowed to be open, when the water level at the syphon overflow was below the set point, closed when this set point was exceeded and again opened if the set point in the tanks was exceeded. This latter condition overrode the syphon criteria as spill at the syphon was judged to be less harmful than spill at one of the tanks.

Each of these three control strategies was tested and debugged using the first storm of the annual time series (TSR1), prior to running the model with a long term simulation.

The three control strategies were then run through MOUSE-PILOT. MOUSE-PILOT enables the potential for RTC applications to be assessed through the use of a long term simulation of the pipe flow. From this simulation the Statistical effects of the applied control is calculated.

MOUSE-PILOT is a hybrid model which allows simulation in two states, a dry mode where dry weather flows are modelled using a simple steady state model and a wet mode where a dynamic simulation of storm derived flows is carried out at a relatively small timestep. The ability to represent these two scenarios allows the model to simulate a long rainfall record which contains periods of dry weather and storms by switching between the dry and wet modes as necessary.

The rainfall used in this assessment was a typical yearly record, generated using STORMPAC and comprised 74 events of varying duration and intensity in chronological order.

6. RESULTS

The results for the 1 year simulation under Local and Global Control (with and without gates) showed a small improvement in total spills for Global Control without gates over Local Control only. A greater reduction in total spills over Local Control is achieved by the

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Robert Tidswell	North West Water
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Question Martin Osborne Reid Crowther Consulting

Your approach looked at simple on/off control. Did you look at the effects of proportional speed control of the pumps?

Answer

we would expect to see some extra benefits from implementing proportional control although our task currently is adopt a broad-brush approach. The tanks are full for a long time before emptying so it is possible that proportional control could empty the tanks earlier.

Question John Blanksby Wilde and Partners

If there is such a long delay before the tanks were emptied what is the impact on quality ?

Answer

There is some concern about the effects of storage on quality and there are current plans within the SPRINT programme to look at this.