10 Years Experience of the Urban Pollution Management Procedure

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Introduction

At the WaPUG 10 Conference in November 1994 to celebrate the first decade of WaPUG's existence, a paper entitled *"Sewerage – the Next 10 Years"* was presented by Ian Clifforde and Ron Chapman of WRc. This paper looked back at the revolutionary changes that had occurred in UK water industry sewerage practice in the preceding 10 years and noted the new opportunities that were beginning to open up for the industry with the then recently published Urban Pollution Management (UPM) Manual. The paper also looked ahead to the next 10 years, making some predictions about what was anticipated to happen in that period.

At the end of the second decade of WaPUG's existence, it is opportune and appropriate both to review how accurate the earlier predictions have proved to be and also to repeat the crystal ball gazing exercise for the coming decade. To this end, this paper briefly summarises the predictions of the previous paper. It then looks at what the industry has achieved in the field of sewerage management over the last decade with particular reference to the application of UPM and how technology has developed to support it. Finally, the paper looks forward to the future and considers what might, or perhaps what should, occur in the coming 10 years.

Summary of "Sewerage – the Next 10 Years"

The 10 years from 1984 to 1994 had seen a transformation in the sewerage management practices of the UK water industry. Drainage Area Planning, and in particular the science (or 'black art'?) of hydraulic simulation modelling, had become established practice during that period and had allowed the industry to develop a level of understanding about its underground assets that was far better than had ever previously been possible. This, in turn, had led to major savings in the capital expenditure which was necessary to meet required levels of service. The objections that had been put forward by the more conservative parts of the industry about the complexity and sophistication of the technology associated with the Sewerage Rehabilitation Manual (SRM) and the Wallingford Procedure had been shown to be largely unfounded.

The 10th anniversary of WaPUG in 1994 coincided with the publication of first edition of the Urban Pollution Management Manual (UPM1). This was the culmination of the industry's 10 year research programme to address the recognised major shortcoming of the SRM; that of effective methods of pollution control. Hence, the industry was seen to be at the dawn of a new era in which ALL aspects of sewerage performance could be adressed cost effectively for the first time. At the same time, it was recognised that, whilst privatisation of the industry had freed it of many of the constraints previously experienced under public ownership, the new status had brought about a whole new set of pressures, both financial, through Ofwat, and environmental, as a result of increased public expectation and environmental regulation. UPM, together with the earlier technology in SRM, was seen to be an objective way forward to help the industry to meet these challenges.

Looking ahead to what was then the coming 10 years; i.e. the period that we have now experienced, several trends and one or two specific changes were predicted. Environmental standards were anticipated to become even tighter, as were financial constraints (no prizes for guessing those!!). From the technology point of view, computing capabilities, both in terms of the practically available hardware and specialist water industry software, were confidently expected to improve dramatically. Data collection and management were also seen as areas due for big improvement. In terms of the way in which the industry actually implemented improvements to its assets, the next big thing was expected to be the Real Time (or Active) control of urban drainage systems. The inherent difficulties associated with the technology were recognised, but these were expected to have been largely overcome by the end of the decade.

Review of the Last 10 Years (as it really happened!)

So how have the last 10 years actually worked out? How much of what was predicted in 1994 has turned out to be right and how much turned out to be wrong?

Certainly Urban Pollution Management, as a concept, has proved to be invaluable to the industry. In 1994 it was known that there were some 7-8,000 unsatisfactory combined sewer overflows (uCSOs) in England and Wales, plus a good few more in Scotland and Northern Ireland (but without the privatisation process, the actual numbers were rather more uncertain). What wasn't appreciated at the time was the timescales over which improvement was going to be required. As illustrated in Figure 1, very few CSOs were improved in the first years after privatisation. Effort was being concentrated on improving under-performing sewage treatment works.

Period	**No. of CSOs Improved**
Before 1989	8,000 uCSOs created
1989 - 1994	0
1994 – 1996	525
1996 - 2000	1,726
2000 – 2005	4,625

2005 – 2010	> 2,000

Source : Environment Agency

Figure 1 – Schedule of UID Improvements

However, as sewage treatment works performance was brought under better control, intermittent pollution from CSOs achieved a higher profile and the required rate of improvement accelerated, culminating in the AMP 3 programme that necessitated the oft quoted statistic of 18 CSO to be improved each week throughout the 5 year programme period. UPM has undoubtedly played a valuable role in enabling the demands of such an ambitious programme to be met. Without UPM, much money would have been wasted through the construction of schemes that either failed to meet the required environmental targets or, conversely, were designed unknowingly to incorporate excessive factors of safety. However, the short timescale and sheer size of the programme also brought some problems in allowing the industry to get best value for money in the way that UPM potentially provided. Five years may sound like a long time in most contexts, but it is a very short period in which to identify supply chain partners for a multi- million pound programme, plan investigative studies, undertake the associated data collection and analysis programmes, develop solutions involving several iterations to arrive at the optimal configurations, and then design and construct the schemes. Given that not all schemes can start on Day 1 of the AMP period, compromises are, and were, inevitable. It is enlightening to consider what some of those compromises have been.

The policy of the Environment Agency, in common with its sister environmental regulation organisations in Scotland and Northern Ireland, is to strongly encourage, if not to absolutely require, the use of UPM to support applications for new consents for intermittent discharges. In practice, the level of practical understanding, and consequently acceptance, of UPM in its widest sense is still limited at the working level within the regulatory community. This has sometimes had a constraining effect on the specification of standards required for compliance and, consequently, on the form of UPM studies and, ultimately, on the cost effectiveness of solutions.

However, a more significant factor in influencing the utilisation of UPM has been the attitude of the water utilities. At the very least, this can be said to have been variable. In reality, attitudes to UPM have run the gamut from whole-hearted and enthusiastic recognition of the opportunities and benefits offered by the approach, to 'head-in-the-sand' attempts to ignore it completely. The reasons for this are sometimes difficult to fully understand for anybody outside of the organisations in question. However, there are certain 'threads' that perhaps can be drawn together. As a starting point, it must be recognised that not all water utilities faced (or indeed face in the present day) the same scale of problems in regard of intermittent discharges and, in particular, CSOs. Figure 2 illustrates the spatial variability in the numbers of Unsatisfactory Intermittent Discharges (UIDs) in the AMP3 programme for England and Wales. On the one hand, for the areas with really big programmes, the issue was clearly of importance and using the best available technology to derive the optimal solutions was, or should have been, a key issue. North-west, North-east, South-west and Wales come under this heading. Whilst for Anglian, Thames and Southern, the scale of the problem was much smaller and, consequently, it might have been considered to be less important to use cutting-edge technology. However, these bald numbers conceal a lot of other factors.

It is probably not politic to attempt to take the analysis of individual water companies utilisation and performance in respect of UPM too much further on an attributable basis. Better to offer some more generalised thoughts on how the uptake of UPM has been implemented.

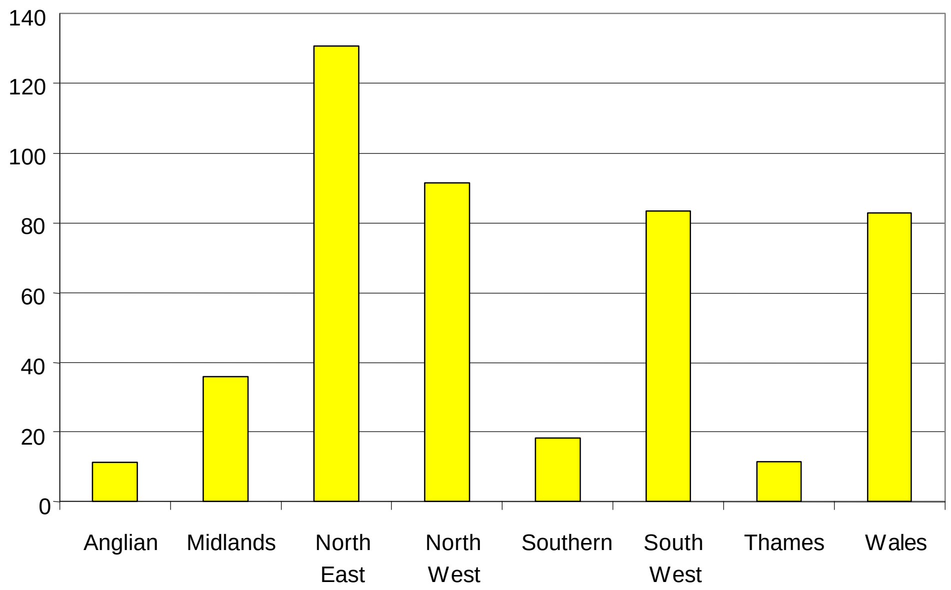

Figure 2 – Unsatisfactory Intermittent Discharges to be addresses in AMP3

Some of the utilities with very large programmes have, for very understandable reasons, felt it necessary to make the application of UPM a very procedural activity – to establish a production line of UPM studies, using the same tools in a repetitive manner. Such an approach is very much at odds with the fundamental ethos of UPM, which is all about the development of specific solutions to specific problems using the most appropriate tools. However, it must be recognised that the demands of AMP3 in terms of timescales and delivery may make such compromises almost essential.

Other companies have only considered UPM to be applicable to large scale problems, preferring to adhere to outmoded, more traditional techniques such as Formula A and the Scottish Development Department (SDD) elsewhere. This approach harks back to a common misunderstanding about what UPM really is – that UPM inherently involves the use of detailed, sophisticated models that require extensive and expensive data to calibrate and verify. In reality, of course, UPM is a concept that can be applied using relatively simple tools if that is what is appropriate to the scale and cost of the issue.

Perhaps the most common interpretation of UPM has been the drive towards simplified, or less sophisticated, forms of the procedure. There are several ways in which simplification can be achieved. One is in the form of standards with which compliance is sought to be demonstrated; for example 99 percentiles in rivers, as opposed to UPM Fundamental Intermittent Standards; spill frequencies in bathing and shellfish waters, rather than a quality based approach. Another is the tools employed. The simplified integrated urban pollution model, SIMPOL, was provided with UPM1 and various alternatives which address some, if not all, of the aspects considered by SIMPOL have been developed by several users. It has been suggested that such tools offer around 80% of the benefits of more detailed models, at perhaps 20% of the effort.

And what of the UPM Procedure itself? How has that evolved over the last decade? As already noted, UPM1 was published at the start of the period, in 1994. The most notable development came with the publication of the second edition of the UPM Manual in 1998. Updating of the document relatively soon after initial publication might be taken to indicate that there were significant deficiencies in the original. However, this was not the case. The major tenets of the procedure are listed below and were carried directly over from one version to the next:

- Holistic Approach - consideration of the wastewater system, comprising the sewer system, the treatment plant and the receiving water as a single entity.
- Environmental Standards – underpin the approach in so much that compliance with standards specified by the regulator must be demonstrated.
- Appropriate Modelling – to meet the technical needs of the particular study, bearing in mind the complexity of the problem and the scale of costs to address it.

As such, the fundamentals were deemed to be right and not in need of improvement. What had changed was the fund of available experience in applying what was relatively novel technology and the market place in terms of the tools that were available for use by practitioners. The new edition sought to bring the benefits of these changes to new users. The opportunity was also taken to improve several presentational aspects of the Manual, not least by making it available in the form of a CD-ROM as opposed to a hard bound book. A particular benefit of this medium was anticipated to be the ease of future updating – something that, for a variety of reasons, has not occurred.

Returning to the basic tenets of UPM, perhaps the aspect which has been least successfully implemented is the first – that of taking a truly holistic approach to all of the problems in an urban wastewater system. Yes, the industry has learnt to look at all of the CSOs in a network in an integrated manner, but it has been much less successful at marrying together the environmental effects of the CSOs with those of the treatment works. The reasons for this are difficult to pin down. Certainly it is in part due to the fact that, in the majority of utilities, the sewer system and the treatment works are managed and operated separately. But is this the chicken or the egg as, in practice, these components are also regulated and funded separately. It may be that, in this case, the operators are, to some extent at least, the victim of circumstances.

Looking more widely than the technical detail and application experience of the UPM Procedure, what about the other predictions of the earlier paper? It is no surprise that the predictions about tightening of environmental standards and financial constraints have proved to be true; for example, the introduction of environmental requirements for Shellfish Waters – a trend which will undoubtedly continue over the next decade as well. Likewise, the anticipated improvements in computing hardware have been delivered in full and will continue in the future. Software improvements have also occurred, but perhaps not exactly in the ways anticipated. The evolution from HydroWorks to InfoWorks as the industry standard tool, with the associated improvements in data management and presentation are in-line with expectations. However, the expected development in sewer quality modelling, leading on from MOSQITO and MOUSETRAP of the early 1990's, has not occurred. This area has effectively stagnated for the last decade. Nor has the thrust towards integrated detailed urban catchment flow and quality modelling, as pioneered by DHI's Integrated Catchment Simulator (ICS), flourished. The reason for these failures is perhaps tied up with the failure to make the anticipated progress in another area, that of data collection. These types of model require good quality, site specific quantity and quality data to enable them to be effectively calibrated and verified. In 1994, it was anticipated that instrumentation technology would have developed to the point where, by now, such data could be collected on-line to facilitate the convenient and cost-effective use of such models. These developments have not been forthcoming to the anticipated degree. Hence, the models remain difficult and costly to apply.

The data collection and management issue, perhaps, has a bearing on why another prediction has not come to fruition. Real Time Control of urban drainage systems also requires on-line data. However, in the case of RTC, data collection issues cannot be the only reason because the data required, except in the most sophisticated of cases, is not quality data. A great deal could be achieved with the more simple to collect rainfall, level and flow data. Hence, there must be other reasons why RTC technology has not advanced in the manner foreseen. One answer to this is probably the innate conservatism of the water industry. History repeatedly shows us that new technology, no matter how good it is, is rarely taken up with the alacrity that its developers would like. UPM itself is fair example of this. The concepts, if not the detail, of UPM have been promoted within the industry since the mid to late 1980's and yet they are still regarded as novel by a fair proportion of practitioners. RTC by comparison is very recent, although reasonably advanced schemes have been implemented in North America and Continental Europe for 20 years or more. Another reason (or a variation of the same reason) could be the risk-averse nature of the industry and its regulators as it is presently funded and structured. Rightly or wrongly, actively controlled drainage systems are perceived as higher risk than conventional passive systems and with the present industry structure, this is considered to be an unacceptable risk – better to build something simple and big that you know is going to work!

Looking Ahead to the Next 10 Years

In AMP4 and beyond, there are still, notionally, around a further 2000 UIDS to be improved to address the wastewater legacy problem. This includes a number of the largest CSO problems. Moreover, it is likely that, over time, schemes completed in AMPs 2 and 3 may become unsatisfactory due to factors such as population changes, increased climate variability and changes to environmental performance criteria associated with the implementation of new EC Directives, such as the Water Framework Directive. It has become clear from the outcome of the planning and consultation process for AMP4 that there is an increasing public concern over higher future water charges. This is particularly the case where the increases would be the result of new environmental legislation as the general public has been given little understanding of the needs and benefits. It is possible that the forthcoming AMP4 programme (2005-2010) may be the last major capital investment programme. It seems likely that relatively smaller funds will be available for future capital investment. Consequently, future technological solutions will need to be more cost-effective by achieving an improved level of performance from existing assets by, for example:

- the use of source control and SUDS to reduce wet weather flows wherever practical;
- greater use of integrated sewer and treatment works solutions, including better use of storm tanks for treatment of wet weather flows; and
- source control – ‘Think-before-you-flush’ for aesthetic pollution control and water minimization measures for sanitary sewage, and
- Real Time Control – notwithstanding the experience of the past decade, this is a technology whose time will come.

These technologies will need to come to the fore rather than the continued reliance on the widespread use of in-sewer storage and screens at CSOs that have been the mainstay of capital expenditure in AMPs 2 and 3.

Conclusions

The concept of Urban Pollution Management has been available to the UK water industry for some ten years. The major principles upon which UPM is founded have not changed in that time, suggesting that it is soundly based. Updates of the UPM Manual have resulted in the provision of improved technical guidance. In England and Wales, and elsewhere, the use of UPM is underpinning the planning effort and decision making that is required to enable the full environmental benefits of the major water industry investment programmes to be achieved.

It is likely that new environmental criteria may need to be established by the requirements of the Water Framework Directive. Undoubtedly new planning and evaluation tools will be required, as the proposed Water Framework Directive will represent an overhaul of the existing aquatic environmental management regime. The Directive’s main provisions, particularly the concept of river basin planning, and public consultation, fits well with the way in which the UK currently manages the water environment. The UPM Procedure will form the urban wastewater management element for future river basin management planning. Other countries often look to the UK as leading the way in river basin management. However, it is possible that the UK is lagging behind others in terms of the development of innovative solutions to urban wastewater problems.