Developments in the Analysis of Sewer System Data. East of Scotland Water – The Sewerage Infrastructure and Investment and Operational Planning (SIIOP)

Kieran Downey – SIIOP Project Manager; East of Scotland Water
Mark Bottomley - Principal Engineer; Montgomery Watson

Introduction:

In 1998 East of Scotland Water developed a new procedure for the development of a new approach for data collection and analysis of sewerage system data. This paper describes how the approach developed, and the benefits that were sought to be gained from the approach. The paper describes how the approach started, and its objectives. The entire procedure includes three volumes of specifications and a number of software items. This paper concentrates on the areas where East of Scotland Water have sought to use innovation to achieve their objectives.

Acknowledgements

Montgomery Watson and East of Scotland Water would like to acknowledge the substantial benefit that was gained in development of the SIIOP process as a result of the paperless reporting techniques that were carried out by Southern Water under Mr Barry Luck and Phil Broggio.

Asset Management Planning

Following the creation of East of Scotland Water (ESW) as a separate water corporation a corporate decision was made to adopt Asset Management Planning as a key corporate approach. However a combination of regional variations in data collection and maintenance and lack of investment in data gathering had left very limited information on the performance of the sewerage network. More importantly the investment needed to maintain or upgrade the assets could not therefore be established. East of Scotland Water commissioned Montgomery Watson to carry out a first pass assessment of the investment needs on the sewerage networks. This was carried out in the first months of 1998.

The first pass assessment of investment led to the creation of a process to implement the upgrading of the system. The first stage of the process was referred to as the **Sewerage Infrastructure Investment and Operational Planning (SIIOP) Process**

The title was chosen to reflect two fundamental business drivers – CAPEX and OPEX Both were to be covered in equal weight. The process was described by a number of specifications. These specifications were developed to take into account developments in sewerage planning that had altered the potential of a DAS type procedure to provide information. Developments such as those listed below required consideration when setting out a framework procedure for sewerage analysis.

- Requirement for data collected to be incorporated into a company wide business case that can be updated with relative ease;
- Better hydraulic models that allow more confidence in outcomes – and the need to consider the models as assets to ESW;
- Requirement to take into account UPM type approaches;
- First Time sewerage as a environmental benefit and revenue opportunity;
- Availability of desktop mapping;
- Availability of paperless reporting techniques;

Objectives of the SIIOP Process.

The objectives of the SIIOP process could be described as:

- Obtaining sufficient data to allow the capital programme to be developed in an effective manner;
- Ensuring that data collected was presented in a format that provided benefits for the operational programme;
- Providing improved estimates of capital spend to refine the first pass assessment of capital spend;
- Ensuring that data was collected to a suitable standard and that data collected was passed into the ESW system for reuse by others;
- Use of common prioritisation across the entire region to ensure that data and analysis work was carried out in areas where the CAPEX and OPEX expenditure warranted it.

The First Pass AMP Assessment

The first pass AMP assessment is a key part of the SIIOP strategy. This process provided the initial data, the first pass cost estimates and the prioritisation of the drainage area zones. This assessment used data from the corporate GIS, IMASS Customer Plus. and from previous reports. The assessment was based on expected levels of service for the following criteria.

- CSO performance – for water quality, aesthetics and design
- Structural condition of sewers
- Operational performance
- Bathing water quality
- Flooding of premises

Over 26,000 customer service records were geocoded and used to identify the hot spot areas for flooding and blockages. Asset information was obtained from existing GIS systems, and levels of asset data assessed. Data collection requirements were established and cost estimates produced for the collection of additional data. At the time of the assessment levels of service were not fixed, and assumptions had to be made on performance targets. These levels of service were applied to the system to identify the need for capital investment. (Investment Needs)

Data for the first pass assessment was very limited, and a number of performance/cost functions were used to determine the potential scale of the problem from the very limited catchment information. Costing of the asset management plan was based on historical rates for structural and operational problems and synthetic cost models for CSO's and bathing water storage. Flooding was given a simple linear cost per occurrence cost model. Developing costs of the CSO's presented difficulties due to the lack of data – in some catchments the number of CSO's was stated, but no backup information could be established to determine the location or asset information on the CSO's. A sensitivity analysis was carried out on the cost estimates – and areas of risk identified.

SAPS Planning Tool

The first pass assessment was carried out using spreadsheets, but all the resulting information asset information was held in a MapInfo application that was referred to as SAPS

The SAPS application contains a mixture of asset information, operational information, planning information and programme management data. It is designed to allow the prioritisation of the programme to be seen and tracked. Prioritisation of the next phase of the work, which was an extended drainage area study process, was carried out using the SAPS application.

This prioritisation was made on the basis of the investment needs in the catchment. A function was applied to the characteristics of each catchment in the entire region and the resulting number was used to create a ranking for the data collection and performance assessment stage. Prioritisation is a key element in the SIIOP process, as the total data collection costs for the entire region were far in excess of the available budget.

The SAPS tool was designed to allow linking to the CSO database, which contains the results of the FWR 0466 surveys, and also to the costing database which hold scheme information.

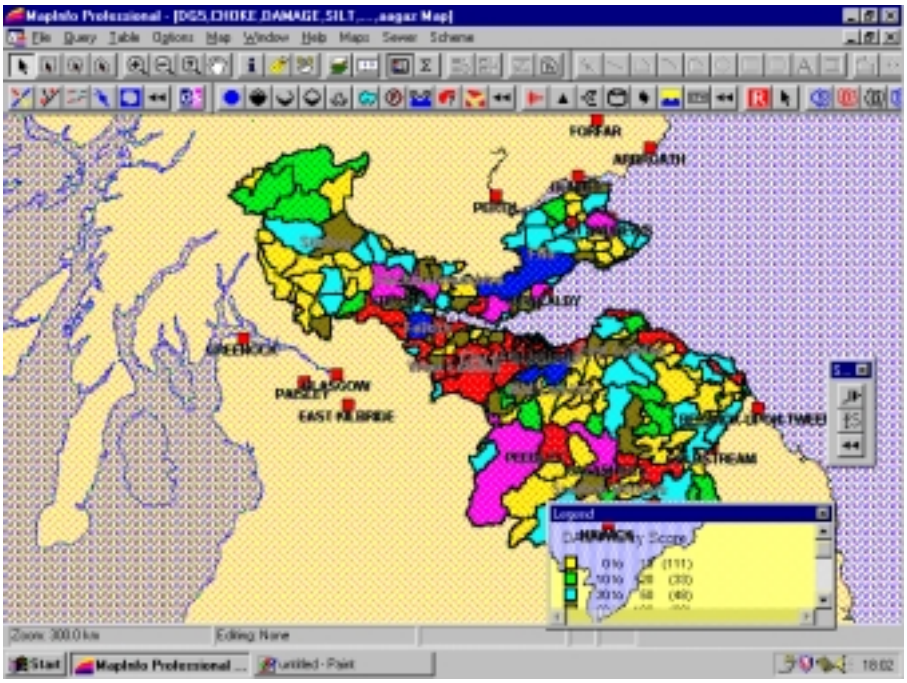

Figure 1: Use of Mapinfo for determination of prioritisation of DAS zones across the region

Specifications for Analysis of the Sewer Systems

In order to deliver the design inputs required for a capital investment programme the analysis of the sewer systems required specifications. This analysis programme is in essence an extended Drainage Area Study (DAS) process. However the key objectives of the process required detailed specifications that encompassed wider or different aspects of analysis and data collection than normally used in DAS processes. The key areas of differentiation are:

- Use specifications to take advantage of the changes in technology which allow the use of desktop mapping and easier data transfer to gain benefits for the business.
- Complete focus on the information required for the CAPEX and OPEX budgets.
- Expectation that the Needs Stage of the SIIOP Process will establish the cause of the problem, not only the problem.
- Expectation that the Needs Stage will link the problem to an asset or a number of assets.
- Inclusion of first time sewerage as a potential investment need – based on a business case for the connection of properties.
- Inclusion of a two stage audit for both needs assessment and solution assessment.
- Inclusion of “Interactions”. These are projects which may influence any solution to the problem, or affect the need. They may be client projects, or example PFI schemes, or third party schemes such as major road schemes.
- Allow the potential for all data from the studies to be appended across the entire region to give better analysis of the total system behavior. This was achieved by ensuring that all data is complied in databases of common format – and that free text and unspecified documentation is avoided as far as possible.
- Consideration of sustainable urban drainage principles in the development of solutions to identified problems.

A total of fourteen specifications were written which covered the SIIOP process from critical sewer assessment through to options development. The final outcome of the process is a scheme outline that has been through an audit process and a VM process prior to the writing of the options stage report. The aim is that this outline scheme can be passed to detailed design, or a D&C team without risk of a major change to the design input. Great effort was put into defining the checks and reviews required at need stage to avoid the possibility of reworking fundamental conclusions when the scheme is in the design stage. The specifications were written to ensure that operational users will receive benefit from the final outcomes of the study.

Reporting of Outcomes

Reporting from the SIIOP process was considered in detail. It was decided to adopt a "Paperless" approach to the reporting because this was the approach adopted by ESW for their IT strategy. The ultimate objective of a single database with the output from all the separate SIIOP studies was considered – and provision made for this to happen by use of standard GIS tables. The decision to use the paperless approach was made on a business case.

Reporting data was held in the following formats

Data	Format	Reason
Boundary / Area tables	Fixed format Mapinfo tables created by Mapbasic routines	Common format to allow all area data to be incorporated into the SAPS application. (Ie all major developments across ESW region)
Asset Data (Pipes & MHs)	Mapinfo tables	To allow performance to be shown on each pipe if needed in SAPS application – for export to GIS
Other Asset and Need data	Access Tables – fixed format	Common format to allow all asset data to be appended together

All data records were required with NGR's to allow representation geographically.

Specific Reporting Requirements

Reporting on Flooding required the SIIOP consultant to carry out investigations on site to confirm the cause of the flooding. This could include modelling of overland flow in some cases to prove the likelihood of flooding in a particular location. This additional stage was incorporated because in many cases anecdotal evidence shows that flooding problems are not correctly linked to cause – and the resulting schemes to alleviate flooding are uneconomic and environmentally unsustainable.

This process of determination of cause is strengthened by the need for the model to be audited by an independent auditor at two stages:

- First to confirm that the model is a satisfactory model in terms of both short term flow data and historic needs. Needs (eg. Flooding) must be correctly identified by the model both in terms of location and frequency.
- Second to confirm solutions are correctly modelled. Solutions are developed at the options stage and go through a VM workshop. The models are then audited to confirm the model represents the solutions that are proposed.

These requirements are designed to avoid the frequent problem of unacceptable discrepancy between the reality of a customer complaint and the system analysis from a model, either at needs or options stage. It is essential that the SIIOP process delivers solutions that can be built. Needs (for example flooding problems) that cannot be

represented in a hydraulic model do not therefore go forward for options until the cause is properly established. The objective of the specification is to ensure that effect and cause are linked.

CSO's problems are reported on as assets that cause problems in the watercourse, rather than problems in themselves. This is done to reflect the use of UPM where the problem is correctly identified as a watercourse deficiency. The CSO may be a cause of the problem, but it may only a contributory cause. Effective solutions must include all potential causes, and this may include WwTW's , other CSO's or even surface water outfalls. Under the SIIOP process therefore the need will be a watercouse, and this need will be linked to a number of contributory causes. Solutions may address all or some of the causes, but must be shown to solve the problem.

Reporting for Operations Staff

In order to bring the reporting methodology in line with the operational requirements the outputs of the reports were designed from the outset to be read by operational staff using a paperless report. The front page of the report is shown left.

The traditional DAS reporting structure of structural needs, hydraulic needs, water quality needs and operational needs was modified. These basic categories were still used, but the SIIOP consultants who will implement the studies are required to identify key assets in the system. These key assets are reported on separately, and all needs and analysis relating to them are reported in one place. This allows an operational user to call an asset in the paperless report, and all relevant operational information will be found in that section. The image right shows how the document looks to an operational user. The left hand side navigation control allows the user to select the asset of interest. All relevant information is displayed on that asset – including flooding, water quality, operational and structural needs.

Increased Efficiency

The SIIOP process has added more processes to the traditional DAS report. It has done this to achieve the objectives stated earlier. In order to counteract the cost and time implications of these processes a number of tools have been developed to allow the users to carry out these processes efficiently. Examples of these tools are:

- Costing database: An Access database giving direct scheme costs, with NPV's for typical sewerage solutions. The costing database is written in access and allows the user to build up scheme costs from a number of separate cost models. Cost models are specifically related to sewer schemes, and use parameters which are appropriate for sewer design. NPV and construction cost mark up functions are available in the database
- Paperless compiler. A compiler for completion of a paperless report from standard .DOC, .MDB and .JPEG files. The paperless compiler works for needs, options and model build/verification reports.
- Mapinfo Routines: Mapbasic routines to add extra menus to the standard toolbars. These menus allow the creation of the ESW specific tables which form part of the paperless reporting process.

Conclusions

The total SIIOP process has required the development of a number of tools and specifications. These tools and specifications have been used to take the DAS process further into line with the business requirements of the water companies. The specifications have sought to build on the best /most appropriate technologies, and allow new requirements to be brought into practice. The wider view of ESW assets included strict data management procedures and model build/verification processes to avoid future costs of resurvey or rebuilding models. The sum of these developments can be seen as incremental steps to developing an integrated strategy for management of information related to sewer systems.

Discussion

Question **John Blanksby** **Sheffield Hallam University**

Operational data is being updated daily, how do you deal with this?

Answer

Consultants are given a frozen in time image at the beginning of the study. It is feasible to bring in “live” data but this is not being proposed at the moment. It would be possible to bring in the data at any stage. As studies last only 9 months we do not anticipate big changes.