The Use of InfoNet to Automate the PSSR Section of Drainage Area Plans

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1.0   INTRODUCTION

The Pre Structural Survey Requirements (PSSR) are used to identify the critical sewer network and the sewers that require CCTV surveying for structural purposes. The PSSR is carried out in parallel with the creation of the hydraulic model during the development of the Drainage Area Plan.

The results of the CCTV survey are then used to identify structurally poor sewers and also hydraulic problems for the hydraulic model.

In AMP3 the PSSR process was a long drawn out process that was undertaken either manually or was partially automated.

InfoNet can store various datasets including the sewer network and survey data. It is also compatible with InfoWorks which would be used to generate the hydraulic model.

Therefore it was determined that InfoNet would provide a suitably compatible platform for developing an automated procedure for the PSSR. The automation would be provided by using the Structured Query Language within InfoNet and is demonstrated in the Knowle Drainage Area Plan example within this paper.

2.0   BACKGROUND

During AMP3 Severn Trent Water started developing new procedures for their AMP4 Drainage Area Plan programme. In particular, the PSSR and the CCTV survey planning and preparation procedures required improvement.

These improvements were undertaken in order to automate the calculation of which sewers were critical within a Drainage Area.

Once the PSSR automation had been undertaken, it was necessary for all of the results to be available in a common format so that the sewers for CCTV survey could be identified easily. To this end, InfoNet was chosen as it provided a data store for all of the Critical sewers and all of the subsequent surveys. Figure 1 below illustrates the multi-faceted nature of the InfoNet software, enabling the storage and interrogation of many data aspects relating to a sewer network.
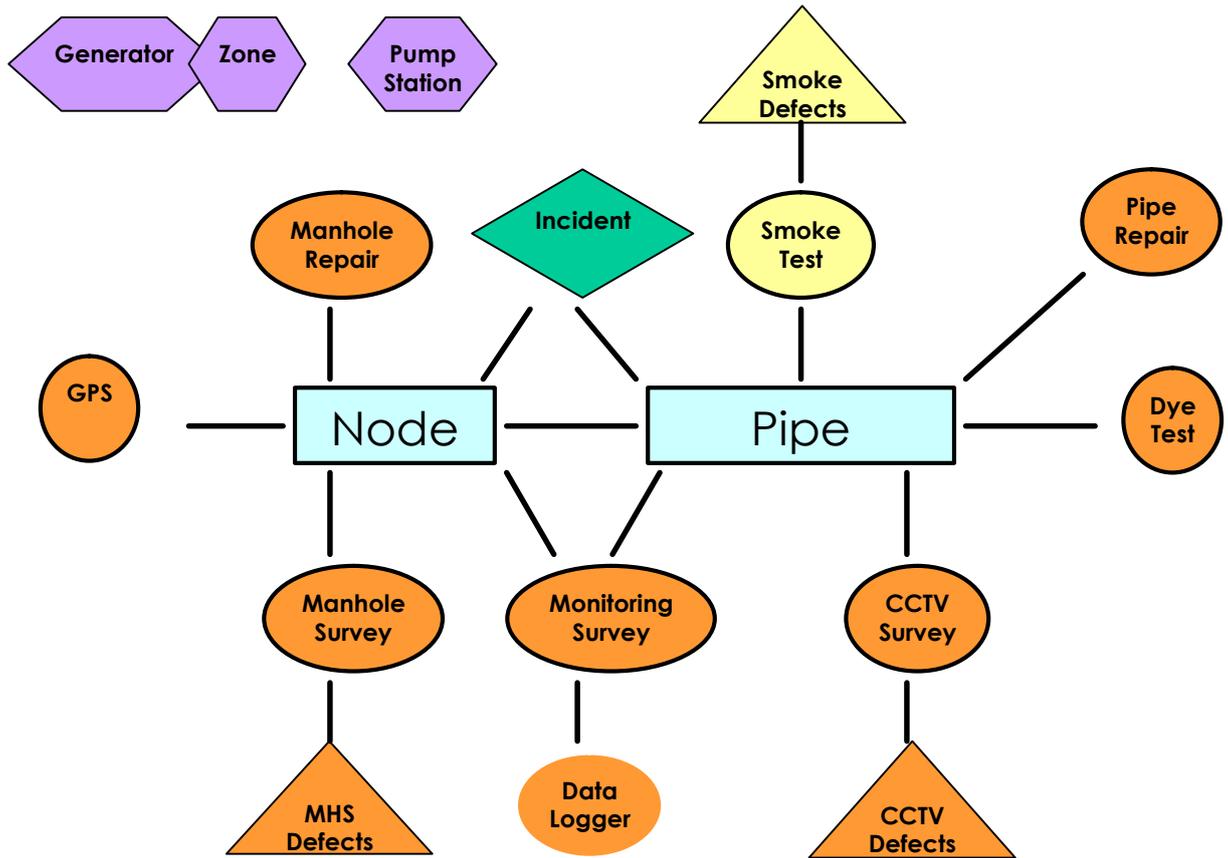
Figure 1 The links between the data that can be stored in InfoNet

3.0   CRITICALITY

The Critical Sewers identified as part of the PSSR procedure are defined in the WRc Sewerage Rehabilitation Manual. In this manual it states that a Critical Sewer is defined as a sewer where the consequences of structural failure are likely to be severe.

A Critical Sewer can therefore be categorised by one of the following definitions:

- Sewers where engineering costs to repair the sewer in the event of failure are going to be high.
- Sewers in roads where the traffic delay costs in the event of failure are high.
- Sewers, which are considered strategically important.

A Critical Sewer can therefore be determined from its average depth, material type, diameter, ground condition and geographic location.

A critical sewer is given a different "Taking off Reference" depending on the reason for which it is deemed critical. These taking off references range from A1 – A6, B1 – B6 and C. This procedure forms the basis for critical sewer screening detailed in section four.

4.0   CRITICAL SEWER SCREENING PROCEDURE

The Sewer Rehabilitation Manual provides a Critical sewer screening procedure, which is used to determine the Critical Sewers, discussed in section three.

Table 1 below illustrates the WRC sewer rehabilitation manual table of classifications for the definition of critical sewers.

Taking Off Reference	Reason
A1	Any brick sewer 2m or more deep Any pipe sewer in good ground 6m or more deep Any pipe sewer in bad ground 5m or more deep Any combined or storm sewer with diameter greater than 1500mm Any foul sewer with diameter greater than 600mm All designated traffic sensitive streets
A2	Any sewer where failure would disrupt hospital traffic
A3	Any sewer under railways, canals, rivers, motorways
A4	Building other than prefabricated garages
A5	Main shopping streets
A6	Primary access to industry sites
B1	Any brick sewer up to 1.9m deep Any pipe sewer 3m or more deep Any combined or surface water sewer with diameter 600mm – 1500mm Any foul sewer with diameter 450mm – 600mm All remaining traffic sensitive streets
B2	Any sewer where access would be difficult for repair following collapse
B3	Any sewer in promenades or areas of high tourist attraction
B4	Any sewer within major industrial sites
B5	Any sewer within high risk installations
B6	Area where collapse would cause pollution to a Class 1 or 2 river
C	All remaining sewers

Table 1 WRC Sewer Rehabilitation Manual Table of classifications for the definitions of critical sewers.

Any sewer which is Critical Category A has greater consequences in the event of failure than a Critical Category B sewer. A Critical Category C sewer has fewer consequences in the event of failure than a category A or B sewer.

Prior to the AMP 4 revised DAP procedure, this procedure was undertaken differently by each consultant and the results returned to Severn Trent Water. To provide consistency it was agreed that InfoNet would be used to undertake the PSSR procedure.

5.0   STRUCTURED QUERY LANGUAGE

InfoNet provides a Structured Query Language which can be used to select, analyse and update columns within the software.

In addition diagram 2 below demonstrates one of the unique features in InfoNet:
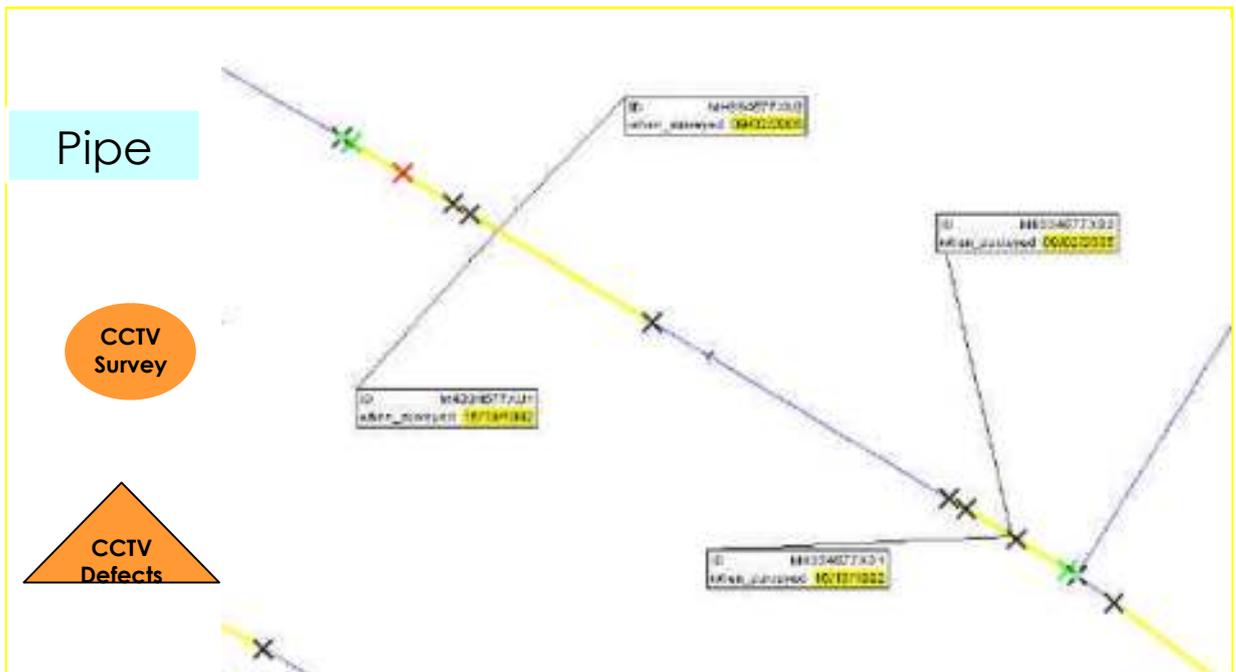
Diagram 2 The link between CCTV surveys and conduits in InfoNet

The unique feature is that any query on a pipe can also select the data from the manhole upstream or downstream of that pipe. This means that for example below the Upstream depth of the pipe can be set using the Upstream Node's cover level. This can be seen in example 1 below:

Example 1 – Depth Calculation:

'Set us_depth_from_cover = (us_node_cover_level-us_invert)'

In this example InfoNet is using the query to set the conduits 'Us_depth_from_cover" column from the nodes cover level minus the conduits upstream invert level.

The other useful unique feature is that the queries can utilise the GIS background layers to determine the Criticality of a sewer. For example the SQL's can automatically determine if a sewer is under a watercourse and label it Critical Sewer Category A3. Example 2 below illustrates

Example 2 – Watercourses Take Off

'Set criticality="A" where (taking_off_reference=""); set taking_off_reference="A3" where (taking_off_reference="")' where the Conduit is within a distance of 5m.

In example 2 above, InfoNet is setting the criticality and taking off reference of the sewer to A and A3 respectively. The query also only updates conduits where the taking off reference and criticality are blank and within 5m of the object on the GIS layer. In this case the watercourse layer.

Similarly there are 24 queries carried out by InfoNet to determine the Critical Sewers within the Drainage Area and these are demonstrated in the example below.

6.0   EXAMPLE : KNOWLE DRAINAGE AREA PLAN

Knowle Drainage Area Plan (DAP) is a catchment within a batch of 10 urban DAP's being undertaken by Pick Everard on behalf of Severn Trent Water. This DAP provides a good example of the use of the automated procedure as the DAP is a self contained smaller DAP which contains many reasons why a sewer could possibly be Critical.
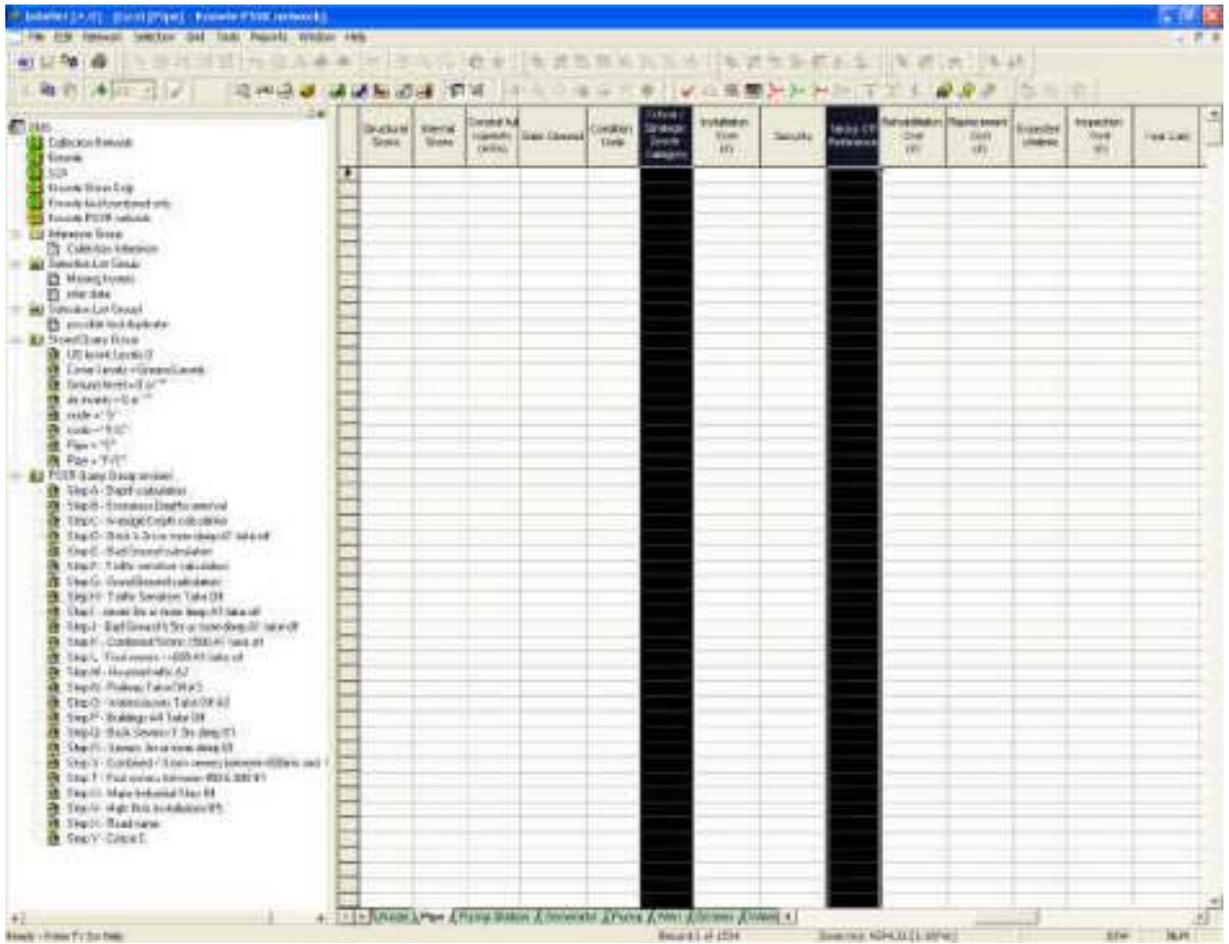
The example is split into stages outlined below.

Screenshot One below illustrates the location of the Knowle DAP in relation to the Other DAPS currently being undertaken in the Birmingham area.
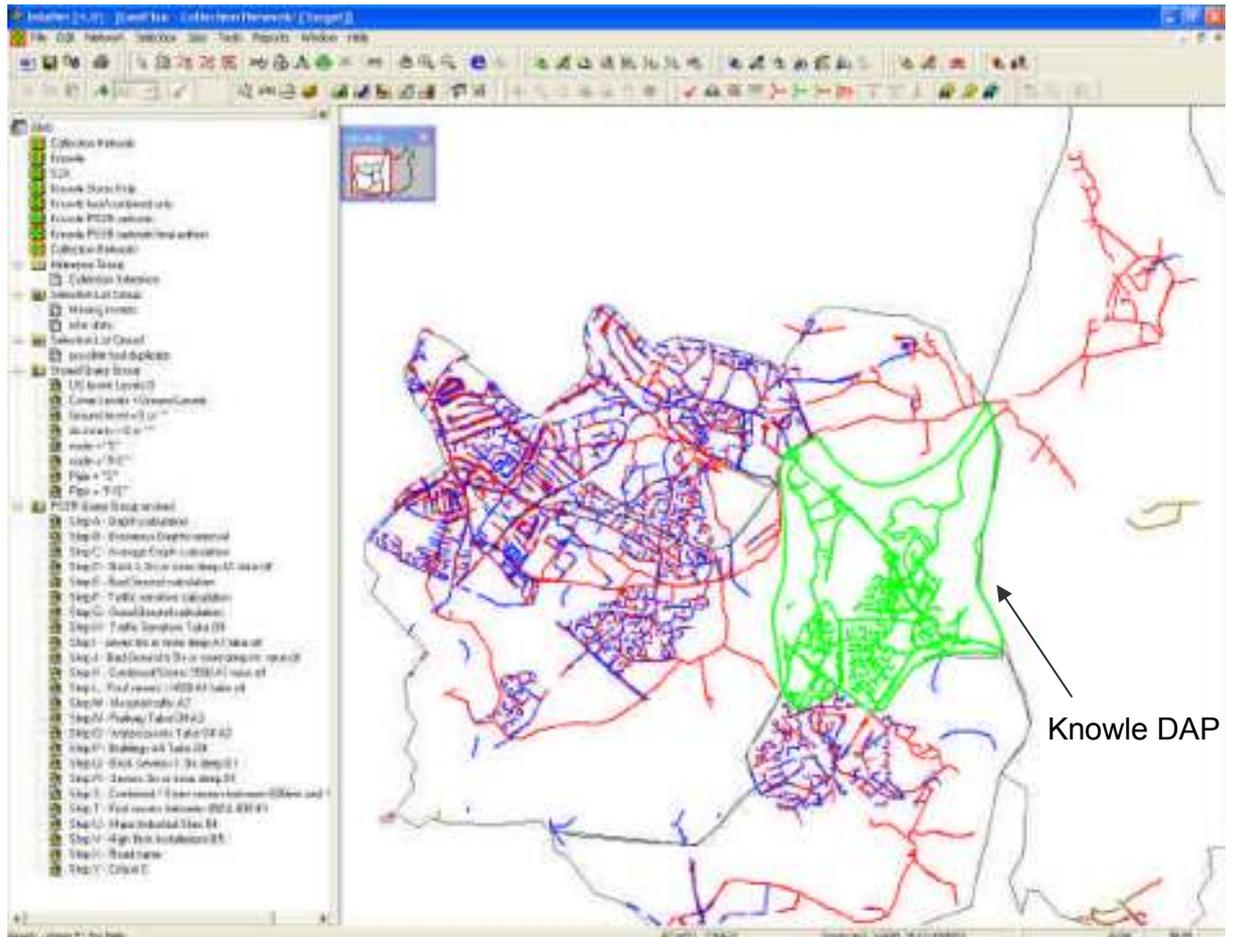
Screenshot 1 – Knowle DAP

Screenshot one has the Knowle DAP highlighted in green by selecting by zone all of the pipes within the Drainage Area.

Screenshot 2 – Pipe details

To enable the PSSR to be undertaken correctly using the automated queries the Critical Sewer Category and the Taking off Reference category columns have to be blanked. These are the two columns highlighted in black on the screenshot above.

These are blanked, as the SQL's only update the pipes which do not have a Critical Sewer Category. This prevents any SQL overwriting a previous SQL and therefore allows the Critical Sewers to be allocated in order, A1 – A4, B1 – B5 and C.

Screenshot 3 overleaf has the bad ground and watercourse GIS layers loaded on in the background.
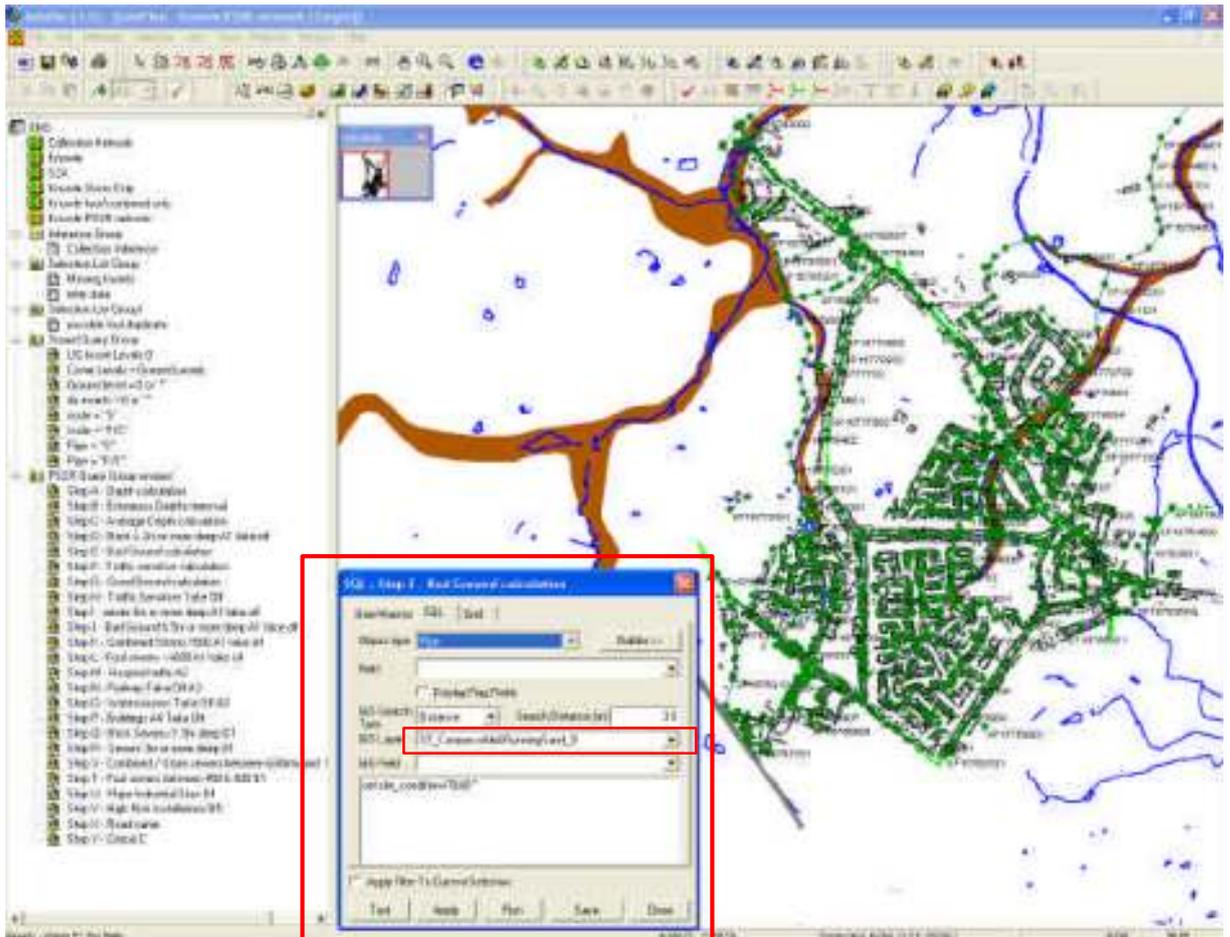
Screenshot 3 – Associating the SQL's with the GIS layers

The red box highlighted in the screenshot above is the SQL for Step E which determines the areas of Bad Ground. In this case the GIS layer the SQL will use is being allocated and if a pipe is within 3m of the bad ground (shown in brown) then the SQL will set the site condition of the pipe to 'BAD'.

This will allow further queries to identify if a sewer is Critical Category A1 as it is within bad ground and at least 5m deep.
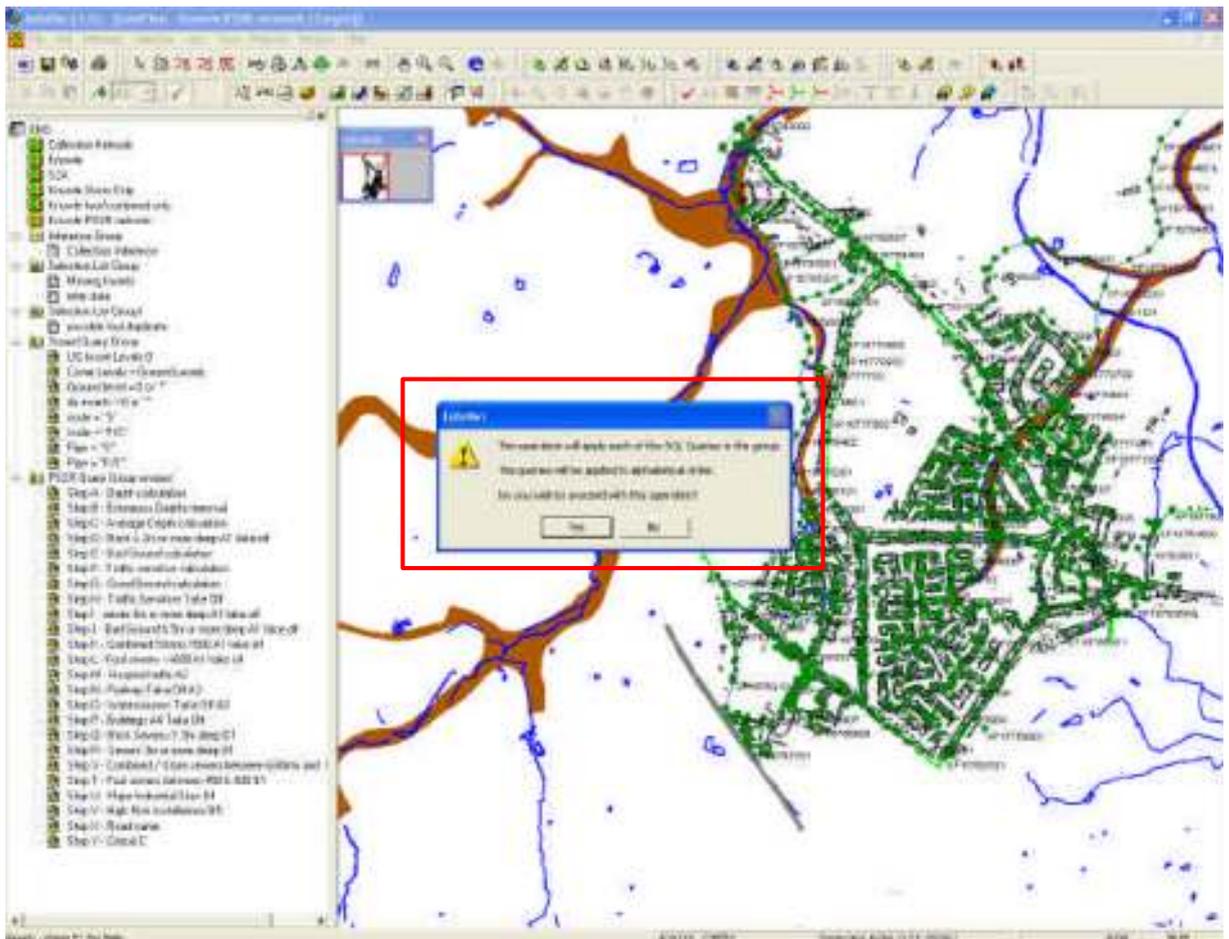
Screenshot 4 – Automating the SQL's

In the screenshot above the dialog box generated when running the SQL's automatically is shown. This dialog box is achieved by setting the SQL's as steps A – Z and then dragging the title folder over. This then brings the dialog box up and by clicking yes it will run the SQL's automatically in order from A – Z.

Screenshot 5 – The results of sewers under railways or watercourses

Screenshot 5 above shows the results of query Step O – Watercourses Take Off A3. The red columns are the Critical Sewer Category and Taking off Reference columns and these have been filled in only where a sewer is under a watercourse.
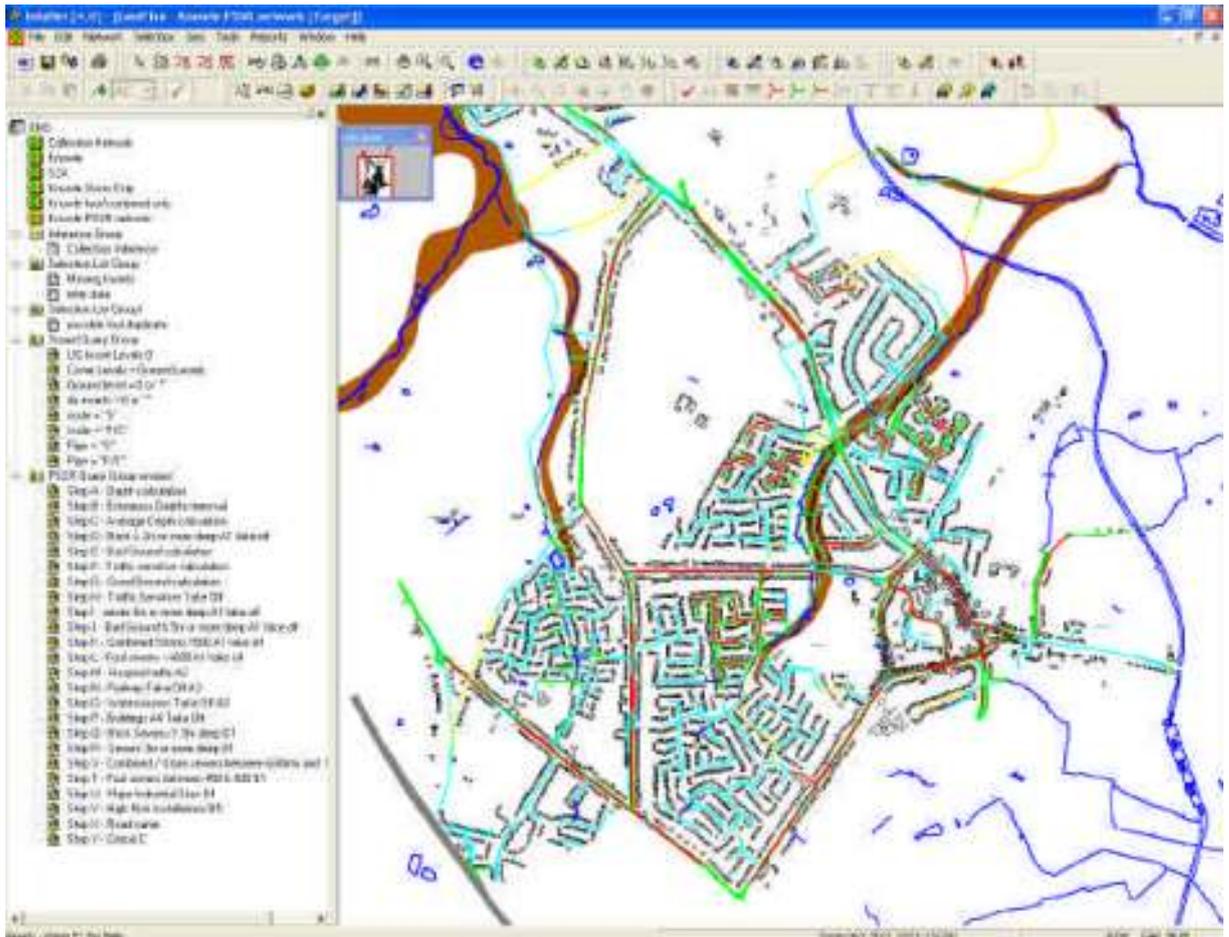
Screenshot 6 – Thematic of final results

Screenshot 6 above shows the Critical sewers thematically coloured according to their critical sewer category. The thematic colours are as follows:

- Green – Critical Category A
- Red – Critical Category B
- Cyan – Critical Category C

In the Knowle DAP the majority of the Critical sewers are Critical Category A as they are located on traffic sensitive streets. There is a small number of Critical Category B sewer scattered throughout the Drainage Area and the Critical Category C sewers are located on the smaller housing estates within the catchment.

Following the visual check of the network and the Critical Sewer Category's the PSSR is complete and the data can be exported to MapInfo and Excel.

7.0   RESULTS

The output of the Critical sewer identification procedure is an InfoNet snapshot file, Excel sewer schedule and MapInfo plan of the sewer locations. These are sent to Severn Trent Water and used to determine the sewers to be CCTV surveyed.

Once the CCTV survey has been completed the results are provided to Severn Trent Water and an InfoNet snapshot file is provided. Using InfoNet this can be used to update the existing system data.

In automating the PSSR area of the procedure the following results have been identified:

- The taking off references are easily identifiable and transparent results can be produced.
- The automated procedure assumes that all traffic sensitive streets are critical category A.
- Consistent results in an identical format from the consultants to Severn Trent Water.
- Time savings as the process is relatively quick to set up, run and check in comparison to the previous system.

8.0   CONCLUSIONS

In conclusion by utilising the power of the SQL's available within InfoNet a robust automated procedure has been developed which will provide significant savings in both time and effort.

9.0   OTHER APPLICATIONS

The power of the queries within InfoNet can be used for a variety of functions including the following:

- o Determination of junction manholes
- o Determination of manholes within private land
- o Determining manhole surveys
- o Identifying areas missing large amounts of data

There are many other uses of InfoNet within the sphere of sewer analysis.

10.0   ACKNOWLEDGEMENTS

This paper has been published with the permission of Severn Trent Water and Pick Everard. The views expressed in this paper represent the views of the author and not necessarily the views of these organisations.

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