SRM5 Risk Based Prioritisation of Base Maintenance in NI Water

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The SRM V5 procedure focuses on adopting a risk based logic for decision making relating to all sewerage management financial and service decision making, i.e. balancing the risk of performance failure against the cost of intervention. It also generates prioritised lists for all key sewerage expenditure plans. The procedure follows an 11 step process to formulate a risk based Replacement and Rehabilitation (R&R) strategy and implementation plan in order to enable maintenance of the sewers and drains to a satisfactory structural condition over a +20 year period.

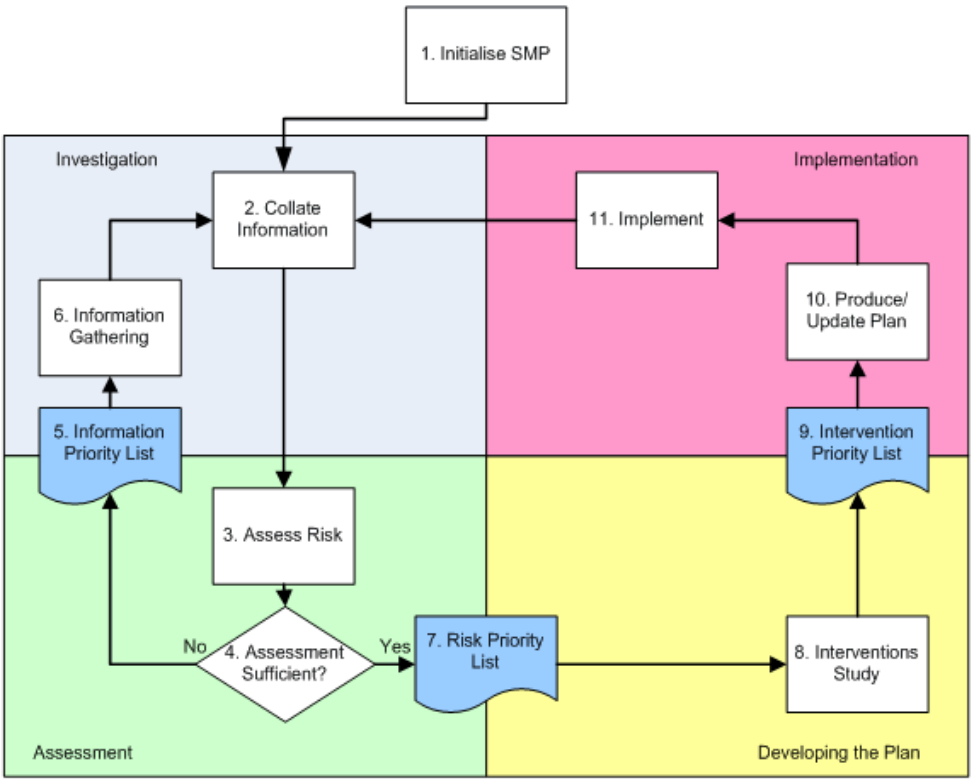

Figure 1 - SRM Procedure – Flow Diagram

Step 1 – Initialise SMP

Is an opportunity to define the terms of reference for the study such as Objectives, Process, Constraints, Performance Requirements, Planning horizons and Definition of Spatial Units.

Step 2 – Collate Information

Centralises the asset data, survey results, record and estimation of relevant information to enable a risk based assessment to be undertaken

Step 3 – Assess Risk

Is the risk based engine used to define and evaluate the “Risk of Service Failure” for each asset and for each failure mechanism based on the data collected in Step 2 and the spatial units defined in Step 1

Step 4 – Assessment Sufficient?
The risk based engine defined in Step 3 must return the uncertainty associated with the risk score calculated. If the uncertainty of score is high due to "Null" or low confidence or assumed data it could adversely affect the prioritisation process. Additional Data is thus required and the procedure follows Steps 5,6,2,3 until a new "Assessment Sufficient" analysis can be undertaken. Where the assessment returns a high certainty the procedure follows Steps 7,8,9,10,11.

Step 5 – Information Priority List (IPL)
The Information Priority List (IPL) is a risk and spatially based list of information needs that are required in order to further identify and understand the risk defined in Step 3. The IPL is needed to justify expenditure on information gathering and ranked to define prioritisation of data collection

Step 6 – Information Gathering
Involves the physical collection of data to inform the risk process in Step 3 and lower the calculated uncertainty in Step 4.

Step 7 – Risk Priority List (RPL)
The Risk Priority List (RPL) is a risk and spatially based list of information needs that are required in order to justify the requirement for and Interventions Study (Step 8). The RPL is ranked to define prioritisation of intervention studies.

Step 8 – Interventions Study
Through Step 7, regional approval has been given for incurring expenditure on the Interventions study within a defined SMP based spatial unit. Clearly the focus of this investigation will be the need to address the performance risk issues that gave rise to the prioritisation of the relevant spatial unit in the RPL In particular, the aim of Step 8 is to develop interventions that optimise the balance between improvements in performance risk and the cost of interventions to deliver those improvements.

Step 9 – Interventions Priority List(IntPL)
The Intervention Priority List (IntPL) is a prioritised list of all interventions identified in all available across the region following the common analysis in Step 8, Step 9 provides a ranked,risk based and economic based comprehensive schedule of interventions for inclusion in a utility business plan.

Step 10 – Produce/Update Plan
Involves documenting Step 9 to inform a Business Case and seek approval for implementation.

Step 11 – Implement
The implementation of approved interventions is the final step of the SRM Procedure and involves utilising the sewerage utility's approved budgets to carry out the appropriate tasks (e.g. detailed design and construction of capital works) within the scheduled timescale. The approved expenditure can be incurred with confidence, given that it represents value for money because of the integrated, risk based analyses that have been carried out.

The Risk Assessment Methodology

The Step 3 Risk Assessment is by far the most complex element of the technical approach. The methodology revolves around calculating the ***Risk of Service Failure*** for each asset.

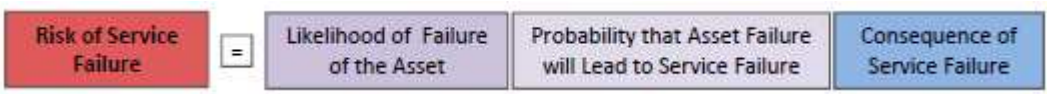

Figure 2 – Risk Formula

The ***Risk of Service Failure*** is a function of the following:

Service Failure Effects (SFE) – The term "Failure" fundamentally requires definition. Commonly for all sewerage assets there 5 service failure effects:

- Surface Water Pollution - to inland watercourses or coastline
- Flooding – of Properties, Roads and open spaces
- Disruption – of Traffic and to People in their day to day routine
- Odour/Noise – From the Assets or in Maintaining Assets at the required level of service
- Ground Water Pollution – discharge from manholes and through exfiltration

Sometimes an additional SFE "Restricted Facilities Use" is used. It was important to establish early in the project the SFEs that were relevant to NI Water assets to ensure ALL failure effects are analysed.

SFEs are denoted by the yellow boxes in the Risk Matrix below.

Failure Mode Type (FMT) – Are the physical mechanism that occur to initiate an Service Failure Effect. Commonly for all sewerage assets there are 5 failure model types that lead to a SFE:

- Hydraulic Overload – Rain overloads the sewers
- Blockage – A temporary object/s restricts normal flow
- Siltation – A gradual build up of debris (hard or soft) restricts flow
- Power/M&E Failure – Incorrect operation of powered assets such as Pumping Stations
- Asset Condition – Physical condition of asset restricts flow

It is very important not to confuse SFEs and FMTs so the analysis is clear. FMTs lead to SFEs they do not necessarily cause failure on their own. For example, a "Blockage" may not cause any SFE because of an upstream bifurcation. There are many example of this. The FMTs for all assets were agreed with NI Water prior to analysis.

FMTs are denoted by the green boxes in the Risk Matrix below.

Likelihood of Service Failure – How likely is the asset to cause a SFE. This is often calculated from a database of historic Failure and from condition information but can also be drawn from physical attribute data such as the flatness of sewers or reverse gradients.

Likelihood for each SFE and FMT requires definition and procedure based on the data collected in step 2.

Likelihood is denoted by the purple boxes in the Risk Matrix below.

Probability that Asset Mode Failure will lead to Service Failure – Asset Mode Failure does not necessarily mean service failure. For example, a collapsed sewer may not cause flooding. It might surcharge and discharge through a combined sewer overflow (CSO and discharge to a watercourse. Similarly, a badly cracked and displaced sewer might not be causing a groundwater problem if the vulnerability of the surrounding soil is low (nonporous).

Probability for each SFE and FMT requires definition and procedure based of the data collected in step 2.

Probability is denoted by the lilac boxes in the Risk Matrix below.

Consequence of Service Failure – is the final parameter in the risk calculation and evaluates how serious the consequence is when failure occurs. For Example if flooding occurs what is the severity such as Property/Road/Opens space and what is the extent 1 property or multiple properties. Similarly is Disruption is going to occur is it across an unpopulated field or under a railway line

Consequence for each SFE and FMT requires definition and procedure based of the data collected in step 2.

Probability is denoted by the blue boxes in the Risk Matrix below.

Figure 3 – SRM Risk Methodology Matrix – Wastewater Assets

The Risk of Service Failure is then calculated for each SFE and weighted to define the "***Total Risk of Service Failure"***

NULL Anlysis

Step 4 the uncertainty analysis is most easily implement is undertaken at the same time as the risk analysis. For each of the defined calculations involving ***Likelihood, Probability or Consequence*** returns a NULL value due to lack of information this should be stored against the SFE and if needed critical in the overall analysis and ranking the asset should be pulled in the stream attributed to further data collection. So, for example if the methodology for sewer assessment is fundamentally driven by internal condition assessment then the risk calculation should be deferred until internal condition assessment is established.

Total of NULL values for a given SFE is denoted by the brown boxes in the Risk Matrix below.

Spatial Analysis and Ranking

The above analysis is undertaken on an individual asset basis from the data collected in step 2. However, the granularity of Risk Assessment and ranking is defined by Spatial Analysis. Boundaries require definition across the NI region that enables the relative scores of assets within to be ranked and contrasted. These rankings inform the priority of Step 5 - Information Priority List (IPL) and Step 7 Risk Priority List (RPL).

The boundaries should be linked directly to Area Manager and Field Manager boundaries so that roles and responsibilities for undertaking data collect and R&R can be clearly demarked.

Summary

The presentation will focus on lessons learnt and experience of undertaking the most complex part of this analysis the Risk Assessment Methodology.