WASTEWATER RESILIENCE– A COMPARATIVE METRIC

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Background

Infrastructure resilience is recognised by the UK Government and the National Infrastructure Commission as a prime driver for investment to ensure that future challenges can be met. Ofwat has been given a statutory resilience duty with a requirement to ensure that the water industry is planning for the long-term and investing appropriately to maintain the integrity of its assets and levels of service to its customers and the environment. Achieving this resilience outcome will require partnership working between the water industry and a broad range of stakeholders, to co-create and deliver integrated solutions. Our understanding of system resilience would be enhanced if we were able to measure it. To help with this, the first step is to define what it is. Ofwat has adopted the following definition of resilience (Ofwat, 2015):

"*Resilience is the ability to cope with, and recover from, disruption, and anticipate trends and variability in order to maintain services for people and protect the natural environment, now and in the future.*"

The primary driver is the need to maintain service to customers and to protect the environment. In respect of the wastewater system, the key impact on customers and the environment is when flows exceed available capacity; this can result in sewers flooding, treatment works becoming overloaded and not treating to the required permit standards, and combined sewer overflows (CSOs) spilling prematurely to watercourses. The hazards that can cause flows to exceed available capacity are multiple (e.g. lightning strikes causing power outages at pumping stations, illegal dumping in sewers causing blockages) but perhaps the most relevant, and easily understood by customers, is the impact of extreme wet weather events (UKWIR, 2017).

Sewer systems are generally designed to operate effectively under a range of conditions; the fact that systems are not running full all the time means that there is some spare capacity to act as storage under wet weather conditions which enables sewers to effectively convey wastewater to treatment works without impacting on customers. However, there is a limit to the amount of spare capacity that can be reasonably (considering both engineering and financial constraints) included into a sewer system. Coupled to an erosion in capacity over time from, for example, population growth, this does mean that sewers can become overloaded more frequently during extreme wet weather events, with flooding a consequence.

Extreme wet weather events do not mean that all sewers will flood. Catchment characteristics (e.g. topography) linked to previous interventions (e.g. to manage historical flooding issues) will likely dictate where, and to what extent, systems will be impacted. In order to understand and 'measure' the extent of resilience within a system, it is important to understand the vulnerabilities, and the probability that those vulnerabilities could lead to flooding and ultimately, as a consequence, the population that might be at risk from such flooding.

Objectives

In developing its approach to the 2019 price review, Ofwat set out a consultation on its proposed methodology, with two options for a metric designed to measure the resilience of drainage systems. The metric was a single hazard, single consequence measure and had been designed with a view to assessing existing and future resilience to an extreme wet weather event causing sewers to flood.

Under the auspices of Water UK, this project was established to review the options proposed by Ofwat. If appropriate, it was to revise and produce an alternative resilience metric that would have broad industry and stakeholder support as:

- An early stage metric that could be implemented in a consistent manner by the Water and Sewerage Companies in England and Wales at PR19 as a common performance commitment and with potential to be adopted by the rest of the UK.
- Avoiding unintended consequences.
- Consistent with the Drainage Strategy Framework established by Ofwat and the Environment Agency.

The outputs presented in the project report were developed with extensive engagement of a Project Steering Group comprising the Water and Sewerage Companies (WaSCs) of England and Wales, Scottish Water, Ofwat, the Environment Agency, Defra, CCWater and Water UK.

Review of options

The detail of Ofwat's proposed metric options can be found in Appendix 3 of their consultation document (Ofwat 2017). There were two options proposed (1a and 1b) and both followed a similar pattern; a characterisation step to provide a high-level indication of the vulnerability of the catchment, followed by a more detailed assessment based on either a more granular understanding of catchment characteristics (1a) or modelled outputs (1b). A catchment was defined as covering the WaSC foul and combined wastewater networks, and associated population numbers, that drain to a single wastewater treatment works.

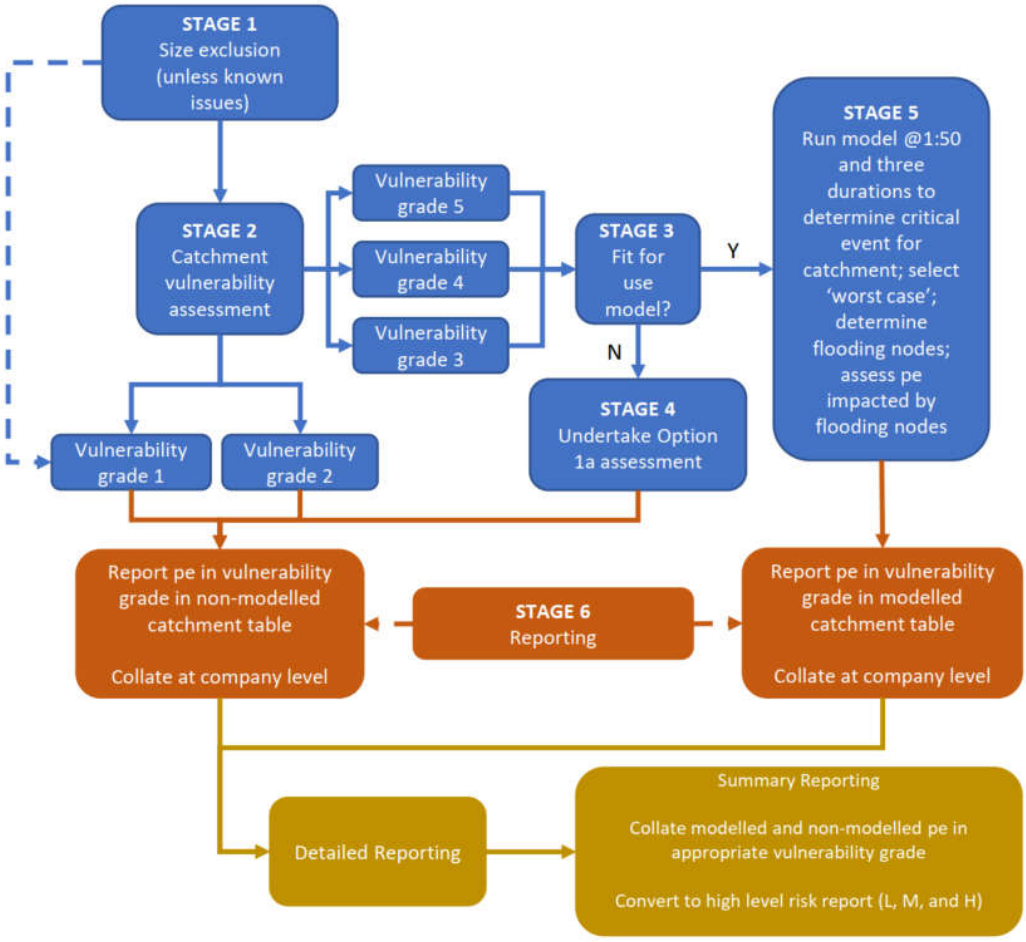
The initial characterisation step was common to both Options 1a and 1b. The step involved an assessment of each catchment against descriptive text and selecting the high-level vulnerability risk grade based on that text. Even if that vulnerability impacted only a small element of the catchment the whole catchment defaults to the highest grade.

The characteristics, the descriptive text, approach and resulting high-level vulnerability grade were developed through activities undertaken by the Water and Wastewater Resilience Action Group (WWRAG) and involved all England and Wales sewerage undertakers. As such, there was general agreement across the relevant Companies as to those factors from which catchment vulnerability can be inferred.

The review considered the main factors of the metric options and investigated their sensitivity and applicability. Results were presented to show their impact and used to inform the revised approach. The metrics proposed by Ofwat were then reviewed and a revised metric proposed.

Revised metric

A hybrid metric has been developed that makes use of both principles on which the Ofwat Options 1a and 1b were based (i.e. a mix of engineering judgement and modelled outputs). A high-level process diagram was prepared to show how it was envisaged the metric would work; this is shown in the following figure. The main project report provides more detailed guidance on the relevant stages. A worked example that covers all elements was included as part of the report.



Critique of developed metric

The process for deriving outputs for inclusion in the metric was based on Ofwat's initial proposals but refined to produce a hybrid metric which incorporates elements of both options. The objective has been to ensure that, in taking a proportionate and pragmatic approach in this initial stage of development, all catchments and hence customers, are considered within the context of the need to understand Companies' wastewater network resilience to extreme wet weather events.

The main project report sets out the criteria the metric was intended to address and considers the extent to which the developed metric meets the requirements. In general, the hybrid metric is considered to be consistent with Ofwat's criteria for a common performance measure. It is acknowledged that the use of engineering judgement for some elements of the assessment could lead to issues with comparability and reproducibility; however, as the measure is adopted and implemented there is scope for it to evolve in the future based on how it operates in practice.

Conclusions and recommendations

The project report concluded that the revised metric is a hybrid, with elements that incorporate engineering judgement and modelled outputs. The metric:

- Incorporates the principles behind Ofwat's options with a view to providing a wide coverage of Companies' catchments and populations.
- Takes a proportionate and pragmatic approach in the development of a baseline position.
- Provides a risk-based approach using engineering judgement to assess vulnerability.
- Utilises nodes predicted to flood as the modelled measure as it better reflects the vulnerabilities being assessed and is likely to be more relevant to customers.
- Is, on balance, consistent with Ofwat's criteria for a common performance measure and is aimed at driving and recognising positive behaviours from Companies.
- Provides a means for Companies to engage with their customers in respect of sewer flooding arising from extreme wet weather events.

The metric has been adopted in its current form by Ofwat as a common performance commitment for AMP7 and beyond (Ofwat 2019).

Several recommendations have been made in respect of review and future development of the metric. Key to this is the need for the metric to be integrated within Drainage and Wastewater Management Plans (DWMPs) that companies are currently developing to inform long-term investment strategies. One of the issues that does need consideration is how the measure may be developed further for such long-term assessments. As it stands the application of a 1:50 storm event does not take into consideration any climate change impacts directly. Looking to use the metric to assess vulnerability in the context of a long-term plan (e.g. DWMPs), may require consideration of a factor to reflect that the intensity of a 1:50 storm event now may not reflect that in 25- or 50-years' time.

Benefits

The developed metric is a single hazard, single consequence measure; however, it is designed to reflect Companies' performance against an impact that is of significant concern to customers. In addition to measuring outcomes, the metric is aimed at providing Companies with a means to prioritise investment, engage more extensively in partnership working (to derive better value to customers) and with customers, and, importantly, to focus the development of long-term planning strategies with a view to reducing the chances that customers will be flooded in future.

References

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