

Assessing the Available Capacity in UK Sewerage Systems

Introduction

The vision of the 21st Century Drainage Programme is to enable the UK water industry, with support from the UK's governments and regulators, to make plans now that will ensure the sustainability of the water industry's drainage infrastructure in the future.

Each individual company has a good understanding of their own systems – but companies have used a variety of approaches and methodologies to monitor and assess their systems to date. This makes it difficult to understand the 'bigger picture' – so we need to have a more consistent understanding at a national level of the current and expected future risks to our drainage systems to decide what actions and interventions need to be taken.

The 21st Century Drainage Programme has developed a series of tools that companies throughout the UK are now using to do just this – one of which is the **Capacity Assessment Framework**, developed by HR Wallingford to provide a common methodology for assessing available drainage capacity and hence identifying risks.

The development of the framework was overseen by a project steering group co-chaired by the water industry and the Environment Agency; full details can be found at:

<https://www.water.org.uk/policy/improving-resilience/21st-century-drainage/long-term-planning>

The framework covering foul and combined sewers was published in April 2017, and water companies throughout the UK have been putting it into practice, supported by HR Wallingford, to produce the first ever present day 'National Picture' of available sewerage capacity in companies' foul and combined sewer networks.

Alongside other information, the Capacity Assessment Framework will help companies keep risks in their networks under review using their existing processes – and in the future using the new Drainage and Wastewater Management Planning processes.

A key point to note is that Capacity Assessment Framework uses '**leading metrics**'. That is, this 'present day' assessment is not an indication of where we necessarily have *current* problems, but gives a view of those areas that are at a higher degree of *risk* when the pressures of, for example, forecast growth and climate change have materialised.

It is intended to provide a basis for discussion with stakeholders about risks to our drainage infrastructure in relation to future pressures.

Background – why is it important to measure available capacity?

The water industry's drainage systems serve people and businesses by taking away both wastewater and rainfall runoff. Water company infrastructure comprises different types of sewers:

- Foul sewers carry wastewater from homes and businesses to wastewater treatment works.
- Combined sewers carry both rainwater and wastewater to wastewater treatment works.
- Surface water sewers carry rainwater that has drained off roads, roofs and other hard surfaces, releasing the water directly into rivers and streams, the sea, the ground (via soakaways) or to combined sewers.

However, it is important to note that these are not the only drainage systems – there are other systems that are not within the ownership or responsibility of water companies, for example highway drains and culverted watercourses.

Our drainage systems are not full all of the time. They are designed to have spare capacity to cater for an increase in population or surface water runoff when it rains. All drainage systems have a limit on how much water they can convey to wastewater treatment works and watercourses. When our drainage systems are full (usually during heavy rainfall), the water either spills in a controlled way via CSOs (Combined Sewer Overflows) or, in extreme circumstances, appears as flooding.

Over time, that spare capacity might reduce if action is not taken for a number of reasons:

- The nation’s population is growing and through development our urban areas are expanding, which results in increased flows from more homes being connected to our drainage systems. Large developments have new drainage systems or changes are made to the existing drainage system to accommodate the additional flows. Small developments are often connected directly into the local existing drainage system.
- Once built, urban areas continue to change and can be subject to what is commonly referred to as “urban creep” – this is where there is an increase in impermeable surfaces such as home extensions, conservatories and paving over front gardens for parking – which can add to the amount of water going into our drainage systems.
- The pipes that make up our drainage systems deteriorate over time, causing infiltration; this is where water from the ground can get into our drainage systems through cracks in the pipes or gaps at joints.
- Our climate is changing, so we also need to plan for more rainfall during the winter period and more intense storm events throughout the year.

The risk is, if action is not taken, that our drainage systems fill up more frequently, so the risk of flooding or CSO spills increases up until a point when the water company needs to take action. To ensure that these risks are not realised as reduced levels of service, company investments need to be proactive and well targeted and provide value for money.

Introduction to the Capacity Assessment Framework

The Capacity Assessment Framework is part of a suite of tools and approaches developed by the 21st Century Drainage Programme to provide a robust and consistent basis for long term decisions through a new overarching framework for planning for drainage and wastewater services – Drainage and Wastewater Management Plans.

The Capacity Assessment Framework itself is a consistent and high-level approach to assessing the available capacity in the UK's drainage systems to accommodate the flows we can expect in the future. In essence, it enables companies to understand:

- What is the current available capacity in our drainage systems?
- Will this be enough in the future?
- When will a lack of capacity risk become unacceptable if action is not taken?
- What do we need to do to manage this risk?
- When will we need to do it?

Although it would be possible to report the actual available capacity for every pipe, this is meaningless without relating it to the service it is providing. To do this, a set of leading 'metrics' have been chosen that can be measured easily and relatively quickly, and give a good overview of system performance relating to drainage capacity.

As noted above, as these are leading metrics, they give an assessment not of where we necessarily have *current* problems but instead of those areas that are at a higher degree of *risk* when the pressures of, for example forecast growth and climate change have materialised. The assessments in this document are based on 'present day' assessment of risk; the Capacity Assessment Framework can also be used to assess risk in the future.

We generally have the best information about sewerage infrastructure in locations where problems have occurred in the past – as that's where we need to have best information in order to address those problems – and in these areas companies have typically built detailed hydraulic computer models to predict the drainage system performance in order to analyse and improve the system.

If we want to have the full picture for the UK we also need to have a way of assessing performance where we do not have existing models. Models may not have been developed, for example, where catchments have been determined to be low risk and investment in modelling would have been unnecessary. Therefore, the Framework has two methods for assessing performance - a simple 'Initial Method', for use where existing models are not available, and a more refined 'Enhanced Method' for use where models are already available.

The First National Pictures of present day available drainage capacity

Following the publication of the Capacity Assessment Framework, companies throughout the UK have been working with HR Wallingford to produce a First National Picture of present day drainage capacity risk.

In this first use of the Framework we have mapped the majority of the present day situation for the UK's foul and combined drainage networks – for both the pipes of the networks and for CSOs.

Below are a series of maps to show areas at varying degrees of risk, in terms of available capacity. The maps show 10 km hexagons across the UK with **levels of risk** on a scale from 1 to 5, using the Initial Method, the Enhanced method and both methods together.

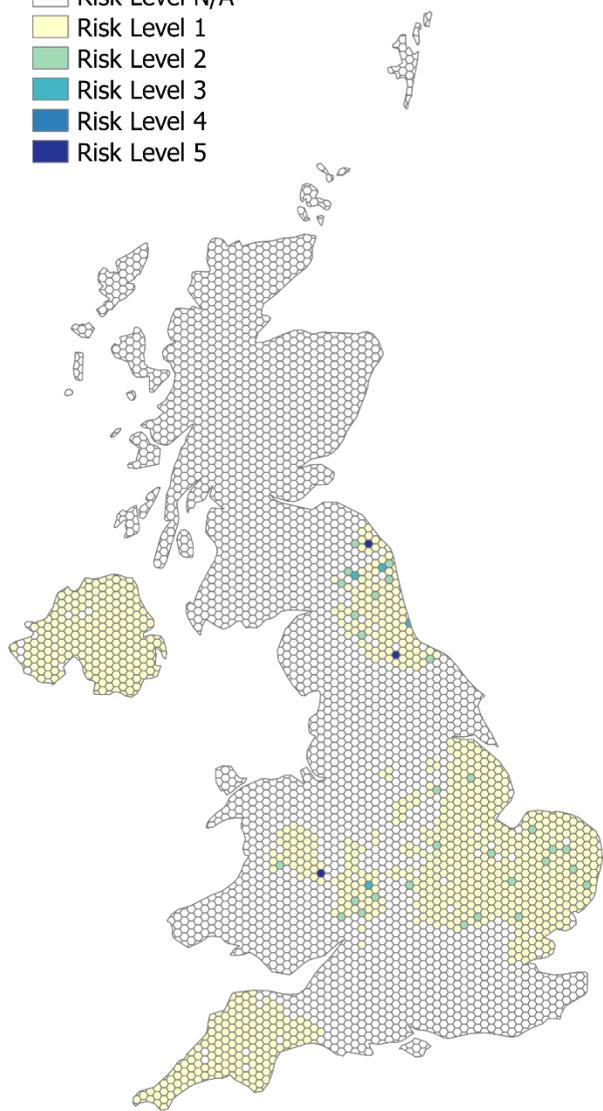
Water companies are still learning how to interpret the levels of risk, as the Framework is new. To provide a guide, the table below has a summary of typical interpretations, based on the limited company experience so far from the use of the new Framework. These descriptions are subject to revision and refinement as the Framework is used further, in particular through the implementation of a new long term planning framework, Drainage and Wastewater Management Plans, which is currently under development. They are also inevitably a simplification, as the level of risk across the whole of a 10km wide hexagon will not be the same.

With these caveats, for the **pipes** of the foul and combined network, this is what the levels of risk in the maps on page 5 might typically mean:

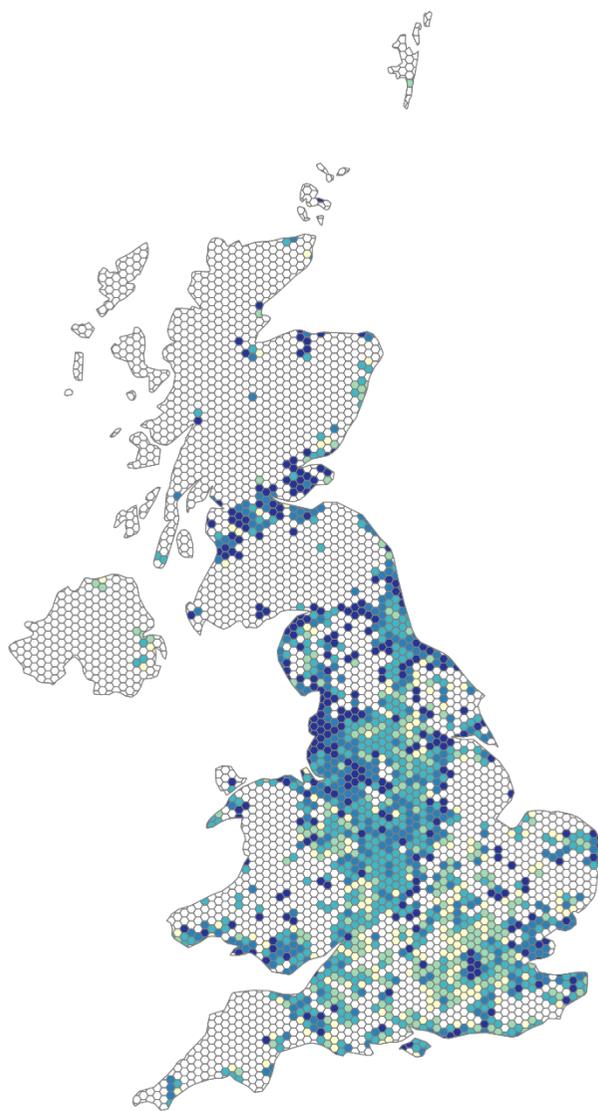
Risk Level N/A 	These areas either have no sewerage infrastructure or there are sewerage networks that have been assessed as low risk, or, for the separate maps for the initial and enhanced methods, have been assessed by using one but not both methods.
Risk Level 1 	These are sewerage networks where there is currently good performance and capacity risks are low. It is generally expected that there would be sufficient capacity to accommodate future pressures.
Risk Level 2 	These sewerage networks are generally performing well and whilst there may be localised capacity issues there is generally a good level of capacity to accommodate future pressures.
Risk Level 3 	These sewerage networks are likely to have some localised capacity constraints which may need to be addressed in the longer term. Whilst local interventions may be required to accommodate pressures these are not expected to be significant.
Risk Level 4 	These sewerage networks are likely to have more widespread capacity constraints which may need to be addressed in the medium term. There is likely to be a need to implement more significant interventions to accommodate future pressures.
Risk Level 5 	Sewerage networks in this category are also likely to require more significant levels of intervention to accommodate future pressures on the sewerage network. These sewerage networks are likely to require significant investment on the main trunk sewers which may require phased investment as part of a long term drainage strategy.

Pipes

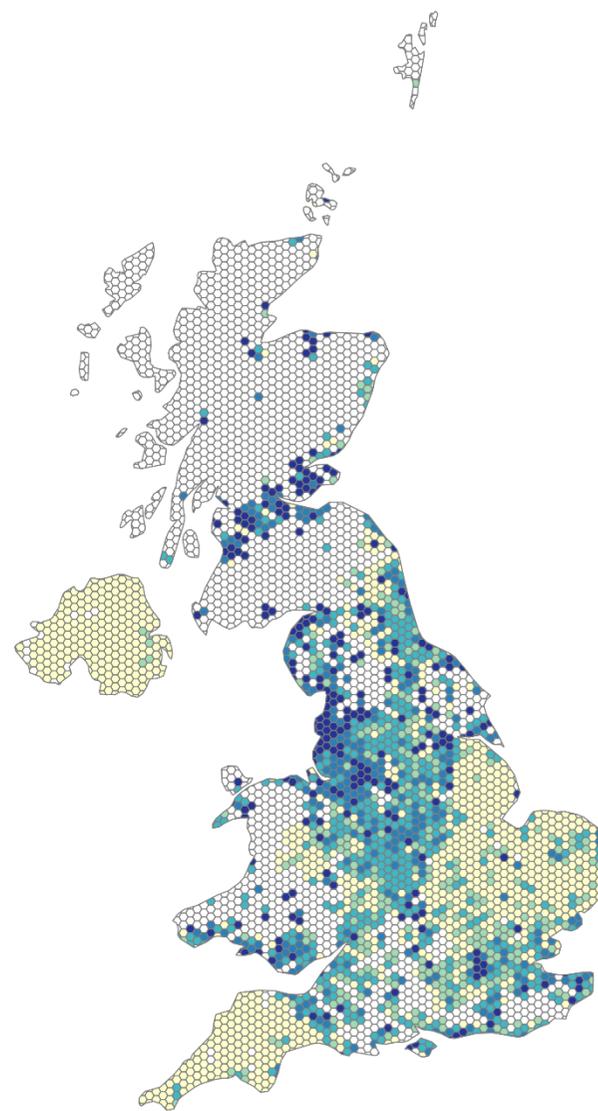
- Risk Level N/A
- Risk Level 1
- Risk Level 2
- Risk Level 3
- Risk Level 4
- Risk Level 5



Initial



Enhanced



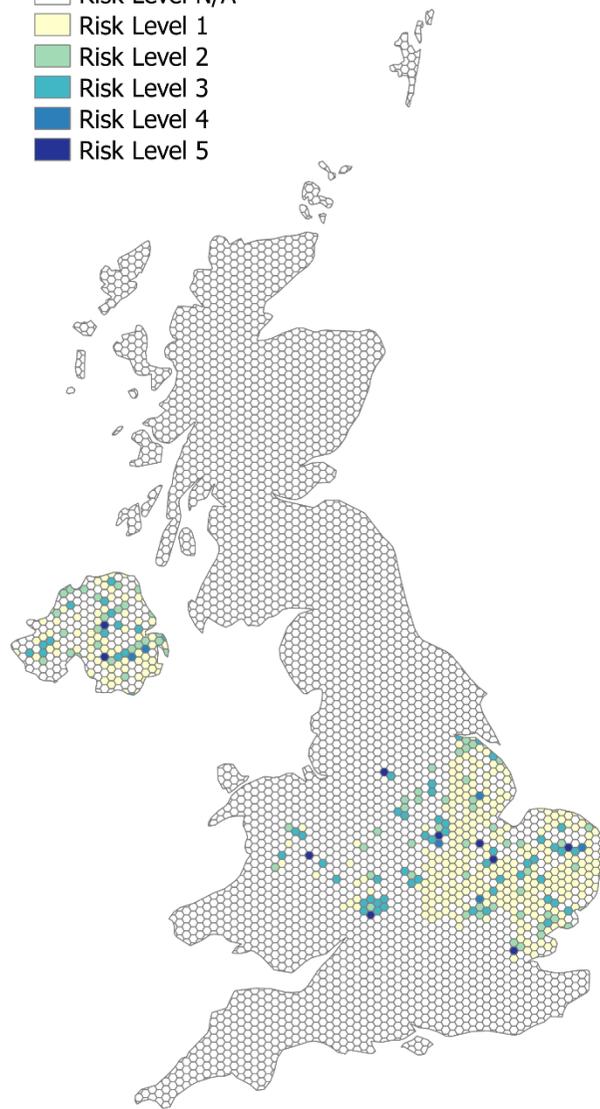
Initial and Enhanced

On a similar basis, using the limited company experience so far of the use of the new Capacity Assessment Framework, and subject to revision as the Framework is used further and through the of Drainage and Wastewater Management Plans, for **CSOs** this is what the risk categories shown in the maps on page 7 might typically mean:

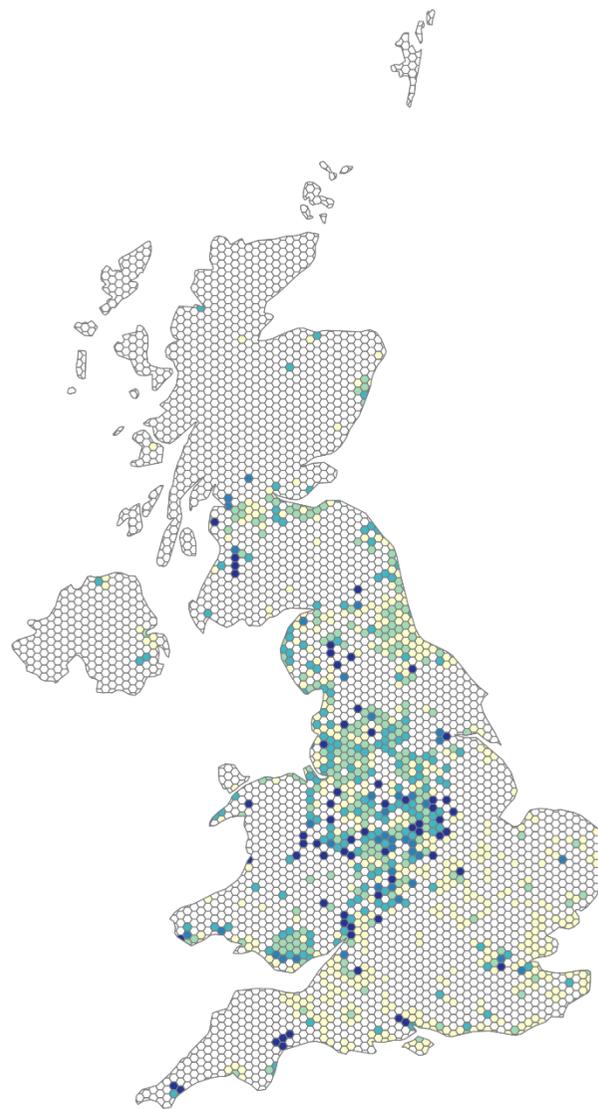
Risk Level N/A 	These areas either have no CSOs or where CSOs have been assessed as low risk, or, for the separate maps for the initial and enhanced methods, have been assessed by using one but not both methods.
Risk Level 1 	These sewerage networks are likely to have a few CSOs and these are generally performing well. These CSOs generally have sufficient capacity to accommodate future pressures.
Risk Level 2 	Whilst CSOs in this category are generally performing well there may be a few locations where limited headroom may require localised interventions to accommodate future pressures.
Risk Level 3 	Performance of CSOs in these sewerage networks are likely to be adversely affected by some localised capacity constraints which may need to be addressed in the longer term. Whilst local interventions may be required to accommodate pressures these are not expected to be significant.
Risk Level 4 	CSOs in these sewerage networks are likely to be struggling to maintain their required performance due to underlying capacity constraints which may need to be addressed in the medium term. There is likely to be the need to implement more significant interventions to accommodate future pressures on the sewerage network to ensure CSO performance does not deteriorate adversely.
Risk Level 5 	CSOs in these sewerage networks are also likely to be performing poorly against their operating parameters, which is likely to be associated within inherent capacity constraints within the sewerage network. These sewerage networks are likely to require significant investment on the main trunk sewers which may require phased investment as part of a long term drainage strategy.

CSOs

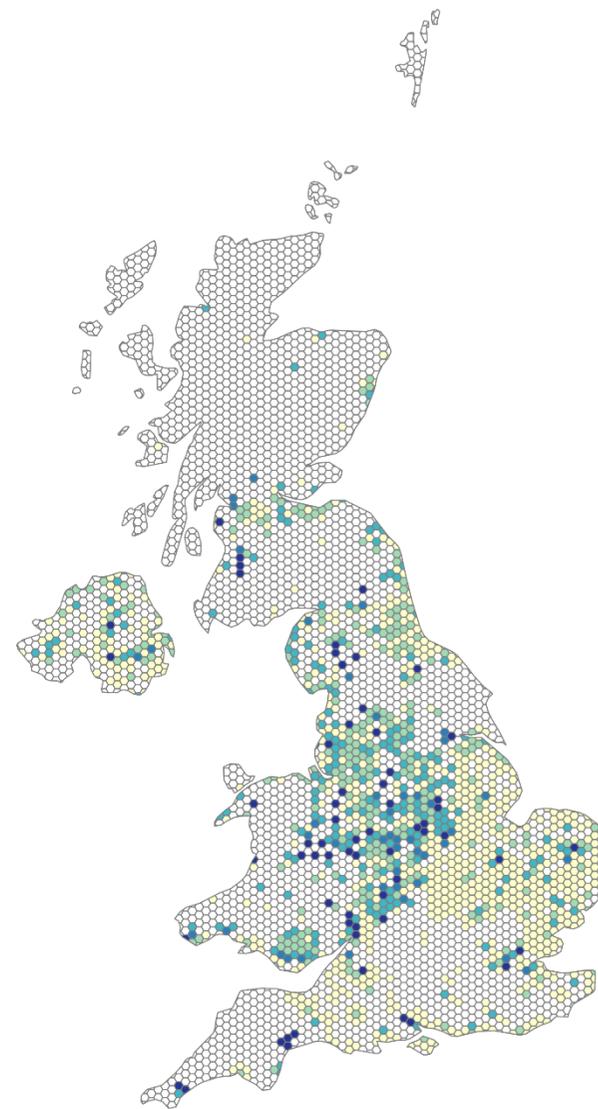
- Risk Level N/A
- Risk Level 1
- Risk Level 2
- Risk Level 3
- Risk Level 4
- Risk Level 5



Initial



Enhanced



Initial and Enhanced

What are companies doing about these risks?

Companies already carry out strategic sewerage planning but this Capacity Assessment Framework introduces, for the first time, a consistent approach to enable us to view a National Picture.

Each company keeps risks in its networks under review using their current processes – and will in the future use the new Drainage and Wastewater Management Planning processes – to identify any actions that are needed, now or in the future. What action is needed, and when, will depend on the specific circumstances of each part of the network.

When companies have compared the results of the National Pictures above with their ‘on the ground’ local knowledge, they have found a good match – areas that the modelling through the Capacity Assessment Framework have shown to be higher risk are typically areas of known or potential capacity constraints where action is being taken. This gives confidence that the results from the Framework provide a good basis for planning for the future.

To aid understanding, a **general** indication of the practical actions that companies might **typically** take for different categories of risk is provided in the table below. However, any particular situation might either need no action at this point, or different actions. Individual companies will be able to provide information about the circumstances – and any need for action – in specific areas.

Risk Level	Illustrative Actions and Practical measures
Risk Level N/A 	If there is no sewerage network in the area, then no action is required. If there is a network but it is not currently modelled due to low risk of capacity problems, then monitor CSOs and performance of system for change and keep under an appropriate level of risk and performance review.
Risk Level 1 	Likely that level of risk will be mitigated by standard operational maintenance and monitoring. Monitor CSOs and performance of system and keep under an appropriate level of risk and performance review.
Risk Level 2 	Operational led assessment for localised mitigation and undertake planned maintenance and monitoring. Monitor CSOs and performance of system and keep under an appropriate level of risk and performance review.
Risk Level 3 	Dependent on level of risk, review prioritisation and carry out localised network investigation if required. Undertake planned maintenance and monitor performance. Monitor CSOs and performance of system and keep under an appropriate level of risk and performance review.
Risk Level 4 	Undertake detailed local investigation to determine root cause and develop interventions. Prioritise and implement investment through standard planning processes. Monitor CSOs and performance of system and keep under an appropriate level of risk and performance review
Risk Level 5 	Dependant on level of risk it is likely that measures to manage demands on the sewerage network will include localised capital schemes, such as increases in capacity, or more strategic schemes covering a wider area. These will be proposed for investment and implemented as a priority. Monitor CSOs and performance of system and keep under an appropriate level of risk and performance review.

Next steps

Producing the first ever present day UK-wide picture of available sewerage capacity, on a consistent basis across all companies, is a significant step forward, albeit with some gaps in the present day data.

Companies will use this information to support their existing catchment planning to develop effective long term plans for the future – and in particular companies in England and Wales will draw on this information as they prepare their Business Plans for the next price review, PR19.

Looking forward, there is scope to extend this work by:

- Extending the coverage of the Enhanced method.
- Producing a forward look (for example 25 years into the future) to identify the effect of future pressures.
- Extending the coverage to cover surface water sewers under water company ownership; an initial trial commenced in January 2018 as a separate project.
- Extending the coverage to cover surface water drainage - that is including all surface water drainage assets irrespective of ownership, which would require a collaborative effort involving all asset owning organisations.