Drainage and Wastewater Management Plans

Technical Summary: Problem Characterisation

August 2021
Version 1

1. Introduction

The Problem Characterisation (PC) stage of Drainage and Wastewater Management Plans (DWMP) follows the Baseline Risk and Vulnerability Assessment (BRAVA).

Water UK guidance says that the Problem Characterisation (PC) stage of the DWMP is for: *"assessing a company's vulnerability to various strategic issues, risks and uncertainties, to allow the development of a proportional response in terms of the effort and cost devoted to adopting the selected decision-making tool. Its purpose is thus to help guide planners to the most appropriate decision-making tools given the planning problem that they face. This stage will guide companies towards the appropriate level of optioneering complexity for the next stage of the DWMP, which is the Option Development and Appraisal (ODA) stage".*

The PC stage, therefore, is a key step that enables the drivers and causes of the risks in our wastewater systems to be understood before moving on to the next stage of the DWMP - to develop and appraise the options for managing and reducing those risks. Our approach to the PC involves three main components:

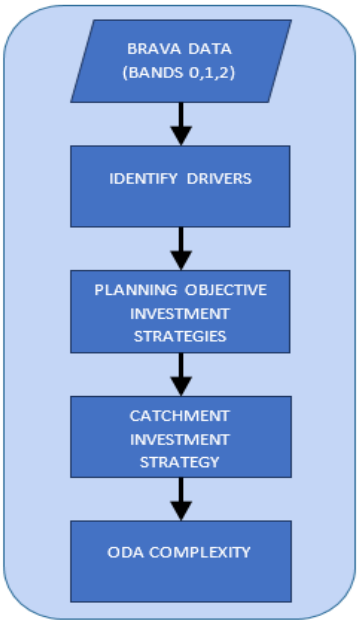
(a) Understanding the Drivers and Causes of the Risks

(b) Determining an Investment Strategy for our wastewater systems; and

(c) Applying the Problem Characterisation matrix.

This technical note describes our approach to these three components of the PC for all 381 of our wastewater systems across the 11 River Basin Catchments within our region. Figure 1 illustrates the process followed for the PC stage.

Figure 1: Overview of the PC process

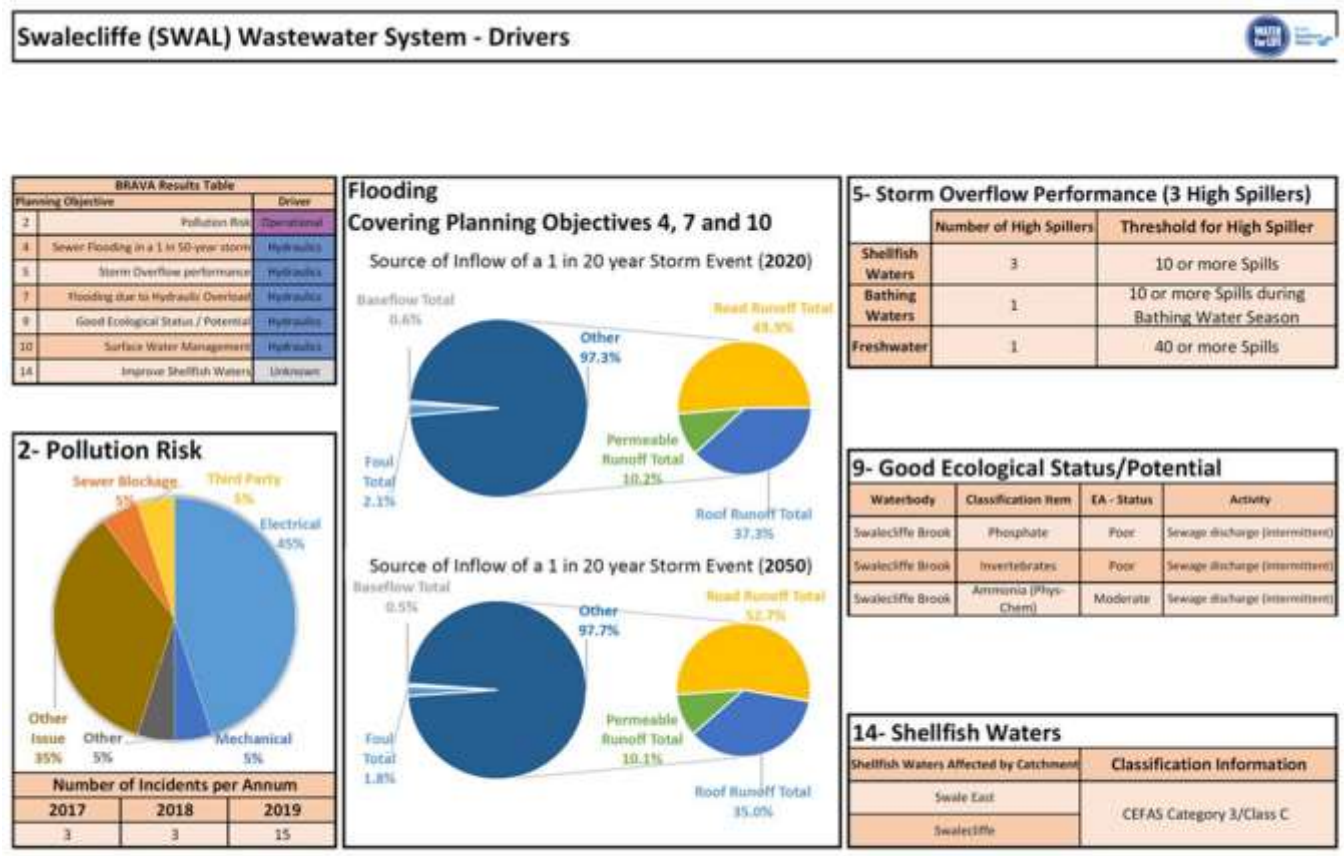


2. Understanding the Drivers and Causes of Risk

The first step of our approach was to review the multiple data sources that were used in the BRAVA risk assessments to identify the causes of the significant risks which are those in band 2 (very significant) and band 1 (moderately significant).

We produced a storyboard to set out these risks on a page, see an example for the Swalecliffe wastewater system in Figure 2. We have written a narrative to explain each of the significant risks in each wastewater system for publication as part of our DWMPs. All the narratives are published on our website under the relevant River Basin Catchment within the Problem Characterisation section.

Figure 2: Drivers and Causes of Risks for the Swalecliffe wastewater system



We used incident data, records and available evidence to identify the causes of the risks for each Planning Objective and categorised these into four key areas:

- Hydraulic – which means that risks are caused by too much flow in the wastewater system, either through excessive storm flows, combined sewer systems carrying both foul and surface waters or infiltration by ground waters, or a combination of these factors
- Operational – usually caused by electrical or mechanical failure

- Customer – customers using the wastewater system to dispose of inappropriate items such as nappies, wet wipes, fats, oils and grease causing blockages and sometimes sewer busts or rising main failure
- Quality – where the quality of our effluent is negatively impacting the receiving waters.

This process allowed us to identify the dominant drivers and primary causes of the risks. It has the added benefit of providing further clarity on the types of options that will be most effective in tackling these issues.

Understanding what is driving the risks helps ensure that we will be able to target the dominant contributor(s) for each Planning Objective. It also provides a mechanism we can use to help us target the significant risks, rather than all risks, ensuring we identify and deliver effective and efficient solutions.

3. Determining an Investment Strategy

Purpose of the Investment Strategies

We considered that it would be helpful to our customers and partner organisations if we set out clearly our long term management strategy for each wastewater catchment so we developed the concept of setting an Investment Strategy for each of our systems. This is so that customers and stakeholders can see whether we understand the risks that they are experiencing/facing and have a plan for addressing them and it will help them know what to expect.

The catchment investment strategies also inform colleagues in different teams across our business to enable them to work together to achieve a common goal. The strategies enable us to be clear where we need to maintain the performance of our system or, at the other end of the scale, where a system is not sustainable in its current form and therefore needs a fundamental change in the future.

The strategies are formed around a risk-based approach to managing the performance of our wastewater systems. Seven different catchment investment strategies were established. These are set out in figure 3.

Figure 3: Catchment Investment Strategies

The benefit of establishing a catchment investment strategy is that we can identify catchments where there are no immediate concerns about the performance of the system, so business as usual operations and maintenance can largely continue. Also, where the performance risks will not materialise until the medium to longer term, then investigation into the options to manage those risks can be deferred until nearer the time, or preparations can be made for future investment. Developing options to address all risks, especially those risks that are in the longer-term, is not efficient use of our resources and is not proportionate to the risks that we identified in the BRAVA stage.

Each of the 7 strategies establishes an associated programmes of work:

- Improve and Change strategies involve the greatest degree of effort during the Options Development and Appraisal (ODA) development, as the complex and urgent nature of the associated risks are likely to require a range of options to be considered.

- Enhance means that the risks are unacceptable at present but they are most likely to be resolved through enhanced maintenance and operational activities.

- Maintain and Sustain strategies are less time-consuming and reflect a business as usual approach. This means the performance of our wastewater system is currently acceptable and is predicted to remain so in the near future. Our Operations staff should keep doing what they are doing to operate and maintain the system. The Sustain approach recognises future climate or growth pressures and suggests that our operational staff should seize opportunities to incrementally improve the system as and when assets need replacing in order to keep pace with climate change and growth in the catchment.

- Prepare and Defer strategies are where future investment is needed. Prepare suggests a medium term investment need so we may need to consider the need for a study, investigation, data collection or model development so that we are in a good position to plan the investment in the medium term. This is because large, complex projects may take several years of work prior to implementation. Defer applies to where the investment is in

the longer term and there is no need to have any early investigations to commence the journey towards that future investment.

- Where we need to improve the performance of a system, but we do not yet have the data, models or tools to understand the problem or plan major capital investment then a study or investigation can be proposed.

All of our wastewater systems have been assessed in this way across each of the 14 planning objectives and had an appropriate investment strategy assigned.

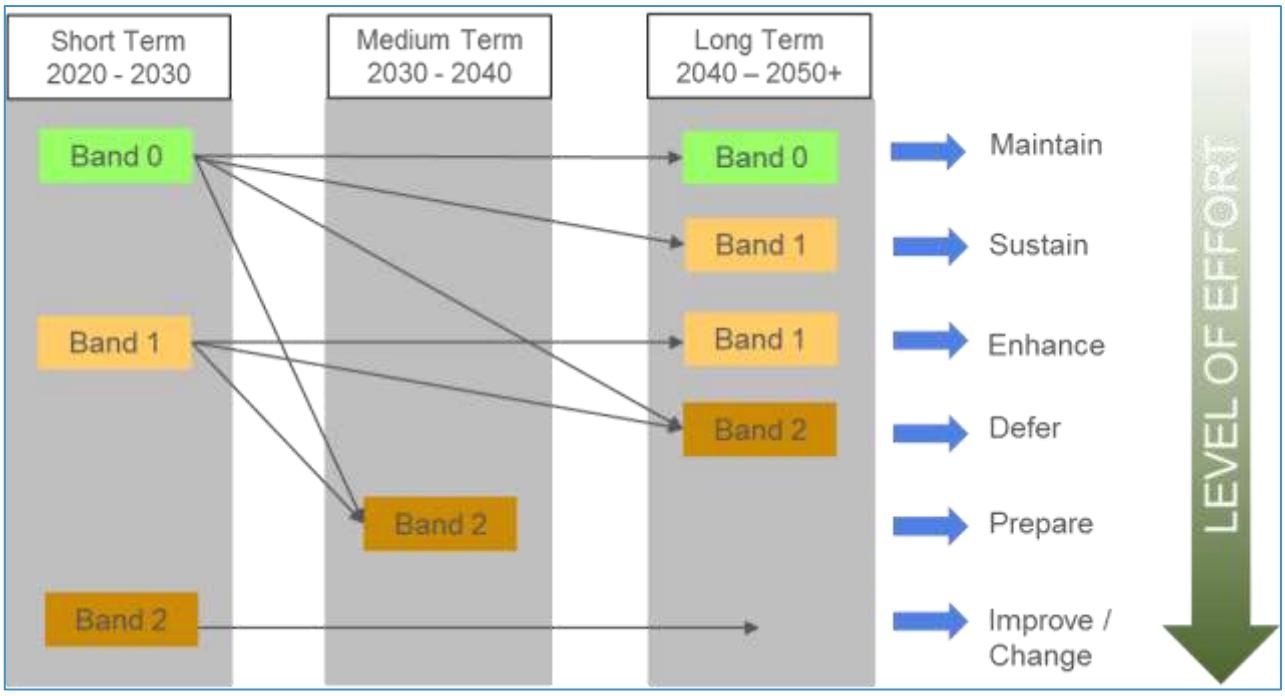
Applying the Catchment Investment Strategies

An appropriate investment strategy for each wastewater system was determined using the BRAVA results. We reviewed the BRAVA 2020 baseline results alongside the future risk forecasts to identify how the risks might change through time taking into account future risks such as climate change, growth, urban creep and asset deterioration. This showed:

- risks that are not significant now and are unlikely to become more significant in the medium to longer term
- risks that are not significant now but which are likely to become more significant through time
- risks that are of concern now and will either stay the same without intervention of some sort, or which will become more significant as time passes
- risks that are highly significant now and need addressing in the short term.

We developed an automated process to use the risk scores and the timing and drivers of those risks to assign the appropriate investment strategy for that wastewater system. The principle is based on the scale and timing of the risks, as illustrated in figure 4.

Figure 4: Assignment of an Investment Strategy for each wastewater system



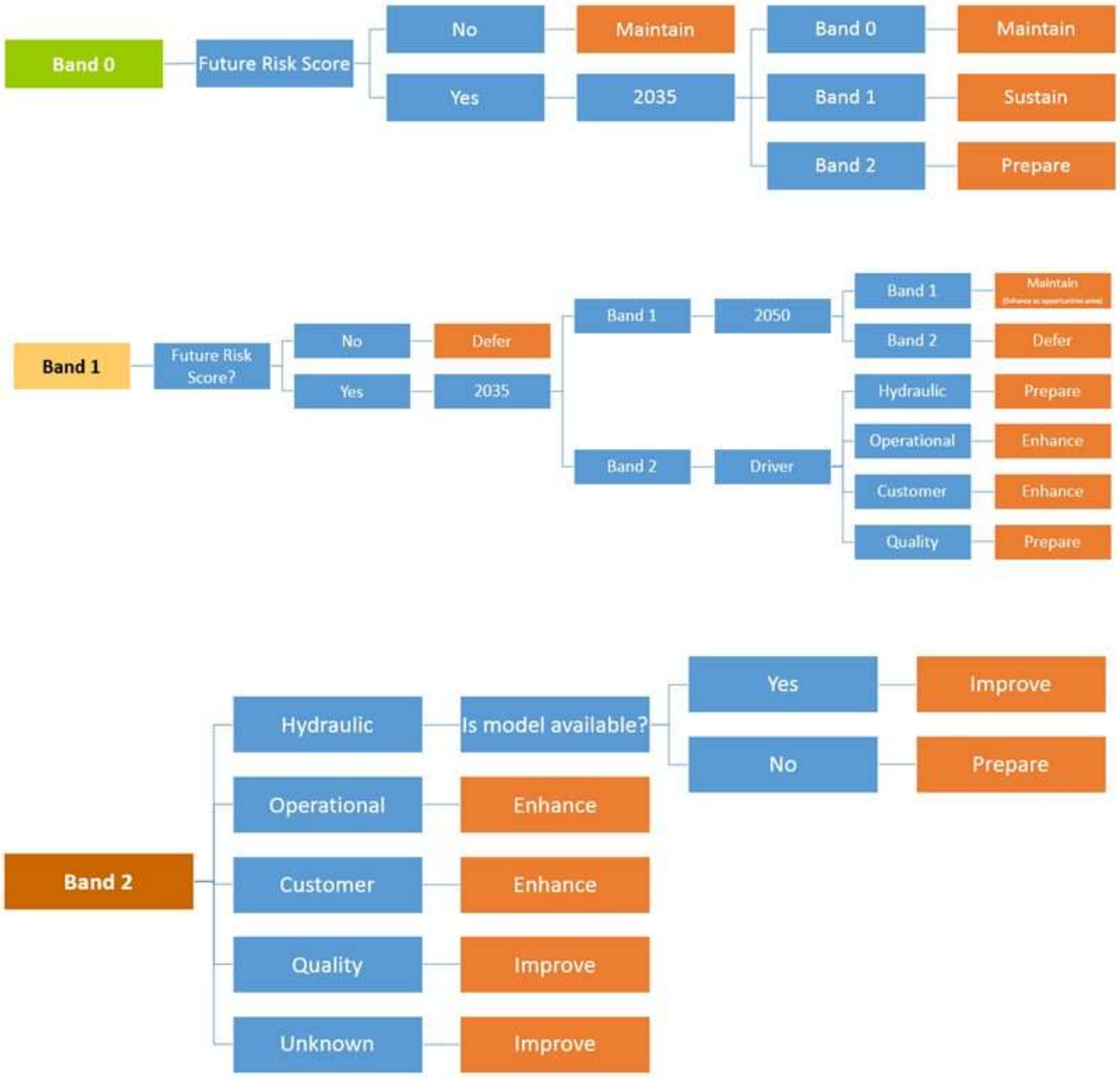
The first step was to apply these principles for each of the risks for the 14 planning objectives. For the first round of DWMP, not all of the planning objectives have both the 2020 and 2050 risk assessment. This limits the opportunity to identify systems with an acceptable performance now but where the risks may increase to unacceptable in the future. The development of the BRAVA methodologies to incorporate future assessments will enable us to refine the selection of an appropriate investment strategy.

A decision tree has been developed for each risk band to identify the most appropriate investment strategy based on:

(a) the BRAVA results
(b) Predicted change in risk over time
(c) The drivers (causes of risk).

The decision trees are shown in figure 5. These decision trees have been developed for each planning objective and embedded into the ODA process to automatically identify the investment strategy based on the decision tree.

Figure 5: Planning Objective 1 Decision Trees



Once an investment strategy for each of the Planning Objectives within each wastewater system had been assigned, we chose the highest priority for action and investment as the catchment-wide investment strategy. For example, where there is a need to 'improve' the performance of the wastewater system due to any of the planning objectives being a significant risk, then that strategy was applied to the whole system.

4. Applying the Problem Characterisation Matrix

The problem characterisation matrix is described in the Water UK Guidance, Annex C. We have applied the principals of the Water UK framework in assessing the strategic need (how big the problem is) and the complexity factor (how difficult it is to solve).

The problem characterisation matrix has two main elements:

(i) Assess the strategic needs

How big is the problem? This is a high-level assessment of the scale of the need for interventions to address near, medium and long-term performance concerns, and which provides a strategic needs score (see Table C-2 below extracted from the Water UK Guidance, Sept 2018).

Table C-2 - Assessment of the strategic needs score ("How big is the problem?")

Strategic needs factors	Not significant (Score = 0)	Moderately significant (Score = 1)	Very significant (Score = 2)	Don't know
Demand (flow/load) risks	2 questions: > Minimum score = 0 (no significant concerns for all planning objectives) > Maximum score = 4 (very significant concerns for all planning objectives)			
Supply (capacity) risks	2 questions: > Minimum score = 0 > Maximum score = 4			
Total	**4 questions:** > **Minimum score = 0** > **Maximum score = 8**			

(ii) Determine the Complexity

How difficult is the problem to solve? This is an assessment of the issues that affect the catchment and how they interact with each other which then provides a complexity score (see table C-3 below).

Table C-3 - Assessment of complexity factors for DWMP purposes

Complexity factors	Not significant (Score = 0)	Moderately significant (Score = 1)	Very significant (Score = 2)	Don't know
Demand (flow/ load) risks	3 questions: > Minimum score = 0 > Maximum score = 6			
Supply (capacity) risks	5 questions: > Minimum score = 0 (no significant concerns for all planning objectives) > Maximum score = 10 (very significant concerns for all planning objectives)			
Total	**8 questions:** > **Minimum score = 0** > **Maximum score = 16**			

To assess the strategic need we utilised the BRAVA results (band 0, 1 and 2) and the catchment investment strategy to identify the severity of the problem.

Complexity was assessed by evaluating the BRAVA risks and the drivers of the risks across all 14 of our Planning Objectives to identify the interventions that need to be taken forward to manage the risks and the performance of our wastewater systems.

Together, these two scores were used to populate a matrix which indicates how much time and effort should be applied to the 'optioneering' (the range and type of options that are looked into to solve the issue) as required in the subsequent ODA stage, (see table C-4 below).

There are three levels of concern, and an explanation of the meaning of the standard, extended and complex methods of optioneering and decision-making are summarised below in Table 1.

Table 1: Required complexity of optioneering and decision-making approaches

Level of concern	Optioneering and decision-making approach	
Low	Standard	Generally, 'current' approaches should be adequate to determine and justify interventions and resultant investment proposals to ensure planning objectives are met (noting earlier guidance on the usage of additional future scenarios, as defined within the CAF).
Medium	Extended	'Extended' approaches to optioneering may add considerably to a company's understanding. 'Extended' refers to methods not previously widely used in drainage and wastewater planning, but which have been utilised previously on specific catchment investigations that are deemed to be at the 'leading edge' of current planning approaches, or tested to at least the 'proof of concept' stage for actual UK drainage and wastewater systems and have outputs that can be readily understood by planners.
High	Complex	Consider whether it would be useful to go beyond the 'extended' approaches to decision making (referred to a 'complex'), as this could add considerably to the company's understanding. Here, 'complex' approaches refer to more advanced, conceptually complex methods not yet applied to the UK drainage and wastewater planning context, although these may be under current investigation in academia/currently developed by companies.

The number of catchments in the three categories (red, amber and green) are shown in table 2.

Table 2: Number of catchments in each PC Matrix band

Level of Concern	Catchment Investment Strategy	No of catchments	Population served	% total population
High	Improve	13	1,253,360	26.5%
Medium	Improve	34	2,027,250	42.9%
Low	Improve	197	1,370661	29.0%
	Prepare	52	39,100	0.8%
	Enhance	3	11,193	0.2%
	Sustain	3	1,797	0.0%
	Maintain	79	27,385	0.6%
Totals		381	4,730,746	100%