DRAINAGE & WASTEWATER MANAGEMENT PLAN

Dŵr Cymru Welsh Water

Technical Summary

DWMP Framework Approach

November 2023

IN PARTNERSHIP WITH

rps ATKINS Member of the SNC-Lavalin Group wsp

PREFACE

We have completed our first DWMP. This DWMP is being published as a final version after a 10-week consultation. We thank you for your comments on what we have produced and your opinions on how to prepare future DWMP's. We appreciate your comments on our approach to customer and environmental priorities, and how those priorities are to be used in the production of future plans.

This plan is different to other plans we have prepared; it not only tries to answer how we remain compliant with our operating licence, but it also tries to prepare the company for future challenges to society.

One of these challenges is the legacy of combined sewers, which are reliant on storm overflows to prevent localised customer flooding. We need to transition to separate foul and surface water sewers to reduce the need for storm overflows where possible, whilst maintaining our performance. The cost of achieving this during the 21st century is challenging. The environmental benefit of achieving this separation over time is to reduce nutrients, such as phosphates and nitrates, entering rivers, seas and groundwater. This is a major driver to achieve high standards set out in the water framework directive (European Parliament, 2000).

We need to set out the complexity of the drainage issues across our operating area. Our combined sewers often accept inflows of surface water from roads, car parks, building roofs and even land drainage, which we do not own or control. We need to work closely with other stakeholders, and need their ongoing support, to gather the evidence and deliver the right long-term solutions.

Our DWMP shows that the costs of making this transition will be significant. The DWMP provides an evidence base to begin discussion with Welsh Government, and our regulators, on the pace of change that they expect to see which will also be acceptable to you, our customers. It goes beyond the current focus on storm overflows, influencing long-term integrated drainage priorities for Wales and the border areas of England where we operate. We need access to funding to enable us to alter assets that are not owned by, or the responsibility of, the water company to bring about the real change that our customers and stakeholders wish to see. We are recommending that a National Drainage Programme is put in place alongside the National Environment Programme so that there are clear links for all parties, and actions for stakeholders to carry out and contribute towards our country's future in a Team Wales style.

The National Environment Programme includes investment in outcomes that are needed to meet today's challenges; however, this level of investment will impact customer bills. In our approach, we have considered how to include a methodology to proactively drive environmental improvements and we ask NRW/EA to work with us on this to agree an approach that fits alongside the current NEP methodology in readiness for DWMP29.

We recognise that stakeholders are looking to us to re-address storm overflows and minimise their use. Our preferred approach considers how to make widespread improvements at an affordable rate for our customers. We have estimated that to remove storm overflows and customer flooding would cost upwards of £13bn if it were possible and practical to be achieved everywhere. Welsh Government has carried out a similar estimate and suggest the cost is even higher, near to £48bn. This quantum, when considered as a bill increase, is not tenable and unlikely to be acceptable to our customers. Ultimately, the pace of the improvements we can make will be heavily dictated by the scale of water and sewerage bills that our customers can afford to pay now and in the future.

The pace of improvements required is also linked to real changes on the ground and the availability of contractors and the associated skilled workforce. This is a short-term issue as it will take time for the supply chain to adapt. There will also be an impact while construction work is taking place; we are mindful that customers have asked us to be considerate when developing our approach, so they do not feel that we are continually causing disruption. We need to ensure that we can explain why we have made these decisions.

As part of developing our first DWMP, we have followed the national DWMP Framework but have also developed our own innovative approaches to planning, which allow choices to be made in terms of what needs to be achieved in the short term, and then creating a pathway for each local area to maintain progress to that destination.

This builds on principles developed by all companies for water and sewerage planning to gain a holistic catchment approach to finding risks, developing options to resolve those risks, and providing an indicative timeline of when that risk may materialise and when the solution will need to be resolved.

The Plan and the regional summaries lay out the types of risks that we are facing, the strategic option types that are needed in each location to address those risks, and a high-level cost to get to improved performance in our wastewater systems.

This Plan has been written to explain the approach we have taken, the pace of change that is realistic and how we can integrate our approach with other stakeholders to deliver the best solutions for our customers and the environment we all share. We have identified several different investment scenarios to get us to our long-term destination in systematic, affordable steps.

We thank you for providing your opinion on which approach to take for our next cycle. We will introduce the preferred choices in our approach while developing the next Plan. The Plan, and the regional summaries which support it, lay out the types of risks we are facing, the types of strategic options that are needed in each location to address those risks, and a high-level cost to get to a future improvement. The Better River Quality Taskforce has also informed us of the milestone we need to achieve in terms of combined sewer overflow (CSO) improvements, and we will continue to work with the taskforce until we achieve the goal.

Alongside the Plan, we have undertaken a Strategic Environmental Assessment (SEA) and Habitats Regulations Assessment (HRA) of the options developed so far. These documents are also available to view.

How to use these documents

This suite of documents which make up our DWMP are as follows:

The Plan – A technical appraisal of risk, utilising different methodologies to inform and establish local and national best practice. This includes a strategic option assessment to aid understanding of the scale of the task to manage future pressures, supported by a staged option appraisal methodology. The document also includes programme appraisal methodology to ensure consistency with other long-term planning in the water industry and examples that highlight how we propose to undertake this detailed assessment in the second DWMP cycle.

The Technical Summary – A technical account of the first cycle plan presenting methodologies carried out.

The Non-Technical Summary – A Stakeholder facing summary of the key points and messages from the main plan.

The Area Summaries – A series of summaries, setting out the proposed regional (L2) and local (L3) strategy, risks, options, and preferred options.

Strategic Environmental Assessment and Post Adoption Statement– A formal review of the potential environmental impact of the proposals being promoted by the DWMP, to ensure that the most sustainable options are being promoted.

Habitats Regulations Assessment – A formal review of the potential impact of the DWMP proposals on protected habitats.

The suite of customer facing documents – A set of stage-based publications to continually engage with customers and stakeholders as the Plan develops.

- The DWMP Customer leaflet - a quick-read overview for customers
- The Strategic Context – produced at the end of the Strategic Context phase of each cycle.
- How and where and we want to work with you – produced at the end of the Risk Assessment stage of each cycle.
- The Options process – produced at the end of the Options Development phase of each cycle.
- The Programme – produced at the end of the Programme Appraisal stage of each cycle.
- The Statement of Response to the public consultation of the draft DWMP.

The documents produced have been written to engage with different audiences, assuming differing levels of understanding. The same material has been used to inform each document and the same message, strategy and principles have been reiterated.

Customers are directed to the suite of customer-facing booklets as these set out the principles and strategies of wastewater and drainage planning in a simpler and easier to understand format.

The Non-Technical Plan is aimed at stakeholders and councils and provides more detail, but still references the same strategies and principles.

The Plan and the Technical summary are aimed at our regulators and contain detailed information regarding methodology and practice. These documents are set out this way to inform the change between non statutory and statutory status.

A glossary of common terms used within these documents can be found in Appendix A.

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1 Overview

This document is the Technical Summary of the first Drainage and Wastewater Management Plan (DWMP) prepared by Dŵr Cymru Welsh Water (DCWW). This plan combines previous methods of sewerage planning with the latest government guidance and outlines our long-term options to respond to the socioeconomic and environmental challenges of population growth, urban creep, and climate change. The approaches and methodologies set out in this document are created specifically to address the new DWMP Framework published by Water UK in 2018.

1.1 How to use these documents

This Technical Summary follows the structure of the Main Plan and includes a summary of the Main Plan DWMP Framework methods and approaches along with an integrated approach from Water Resources Management Planning (WRMP). It introduces the approaches taken in developing the plan, and the initial outputs, from this first cycle.

We recommend that you read this document as an introduction to the technical methodologies.

1.2 Introduction to the DWMP

The DWMP is a framework for developing a shared vision for environmental water quality, drainage, and wastewater management. The DWMP is a long-term planning study, driven by the water company, which looks at the investment required in our wastewater system over the next 25-years, for the benefit of the environment and customers.

This is a customer driven plan that will set out how we intend to manage future challenges brought about by population growth, urban creep and climate change

It will set out how we intend to extend, improve and maintain drainage and wastewater systems across Wales and the areas of England that we serve.

It plans for the Long-term, setting out targets that are appropriate to the risks we face, but for a minimum period of 25 years that covers both England and Wales.

It is a best practice approach-built on processes already established such as Water Resources Management Plans and Sustainable Drainage Plans.

It demonstrates greater transparency, robustness and line of sight to investment decisions that affect our customers.

Developing this plan will help us work towards our Welsh Water 2050 vision to “earn the trust of our customers every day” and to achieve our mission of becoming “a truly world-class, resilient and sustainable service for the benefit of future generations”.

Figure 1 – What is a DWMP?

This first, non-statutory version of the DWMP is referred to as ‘Cycle 1’. Whilst our approach has built upon our previous sewerage planning methodology (the Sustainable Drainage Plan) and has been developed in line with the national DWMP Framework (WaterUK, 2018), some elements of the DWMP process (such as how to develop integrated plans with local authorities) are still being established. We are undertaking a series of trials to support this evolution of our plan, which will ensure that it offers greater value to stakeholders in future cycles.

The companies operating area is shown in Figure 2.

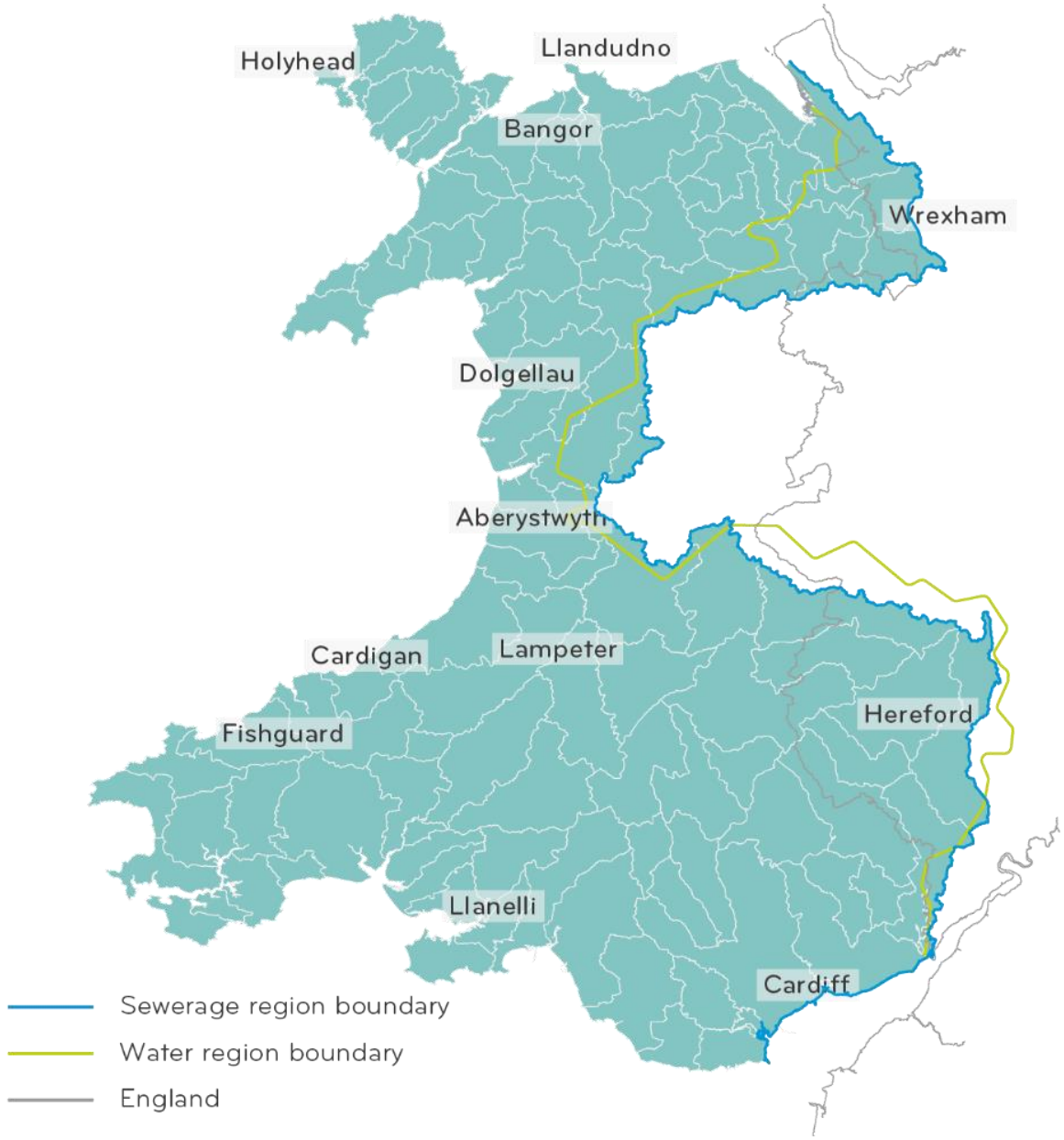

Figure 2 – Map Showing the Operating Area

1.3 Services covered by the Plan

Our sewerage network performs the critical public health function of protecting customers by transporting the sewage away from their homes and places of work to a point where it can be treated and returned to our rivers and the sea safely. In our towns and cities, the responsibility for most of this sewerage infrastructure falls to Welsh Water. Across our operating area, we are responsible for around 36,000km of sewer.

In many parts of that operating area, this sewerage infrastructure originates from the Victorian era, where sewage and rainwater (from roofs, yards and often roads) are carried in the same pipe, known as a combined sewer. Such an approach relies on overflows from these sewers into the environment, as a means of protecting customers from sewer flooding during heavy

rainfall. We have inherited over 2,000 of these overflows, which continue to serve the role they were designed for in reducing flood risk, but their impact on the environment is under increasing scrutiny.

In those combined sewers, surface water, which could safely be discharged to rivers and streams, is often pumped, and then treated before it can be returned to the environment – increasing the sizes of pipes needed to carry the flows and the capacity of our treatment works too. This approach, which was right for that time in history, is now perceived as being less acceptable in a 21st Century sewerage system but will require significant investment to address.

On newer, post war developments, the concept of separate foul and surface water sewers was introduced. In most cases, this infrastructure ensures that rainwater is soaked away into the ground or drained to a nearby stream but, occasionally the surface water is also connected into the nearest combined sewer.

The DWMP extends to our wastewater networks (foul, combined, and surface), Wastewater Treatment Works, and the effects on the waters we discharge to, such as rivers, streams, and other watercourses, estuaries, and coastal waters. It also considers the interconnections with private drainage systems, such as inflows from highway drainage, car parks and building drainage and how improvements to the performance of our sewers and treatment works may also be dependent on changes to those inflows.

As a result, we have developed a plan that considers our own wastewater systems (sewerage), as well as the impact in wet weather from those interconnections with other drainage systems (drainage):

- Sewerage (foul, combined and surface) – how we collect, transport, treat and return it to the environment.
- Drainage – how to manage drainage networks that impact the wastewater system across a geographical area.
- The Review of consents process – how we consider the future impacts from differing scenarios such as tightening quality parameters on permits and anticipated new legislation.
- Emergency flood planning – How we return to service as quickly as possible after a flooding event.

1.4 Planning for a secure sustainable service

Whilst the DWMP sets out the scale of our longer-term wastewater investment needs, it also identifies the roles we need government and regulators, stakeholders, communities, and customers to take, to meet our objectives for customers and the environment. Through later cycles of the DWMP, further guidance and growing familiarity with the process are expected to clarify those roles and interactions.

In developing our plan, we have reflected heavily on the WRMP process, which has been in place for over 20 years, to provide additional direction.

The following three stages have been replicated in the DWMP:

1. Pre-consultation and prepare the draft plan.
2. Publish the draft plan and carry out a formal consultation.
3. Assess consultation responses, revise the draft plan, and after direction from Government, publish a final Plan.

The following sections outline the roles of the key players in the development of the plan, the actions required to be carried out and who is required to deliver them to create a joint DWMP.

1.4.1 *The water company*

It is the water company's responsibility to deliver the plan. The company must complete the following actions:

- Coordinate with other organisations, government, and regulators to ensure the plan is developed.
- Prepare a draft plan.
- Undertake Environmental Assessment of the plan outcomes, incorporate the Strategic Environmental Assessment (SEA) in the process and the completion of a Habitats regulation assessment (HRA) where there are possible risks to designated areas and species.
- Communicate the plan to customers, stakeholders, regulators, and government.
- Carry out a formal consultation of the plan and the SEA and HRA and address any responses in a formal report named a Statement of Response (SoR).
- Revise the plan based on consultation responses.
- Publish a final plan when government has given their endorsement in line with Ministerial directions, including the preparation of a Post Adoption SEA statement and review the HRA in an iterative process against the Programme Appraisal.

1.4.2 *Government*

Welsh Water are a company that operates "wholly or mainly in Wales". As such, it is the responsibility of the Welsh Government to provide the initial direction to enable the plan to be developed. Such direction is usually provided in a suite of legislation that is yet to be written. They are likely to include Regulations, Directions and Guiding Principles. The first Guiding Principles for Drainage & Wastewater Management Plans (Defra, 2022) was published after much of the first cycle plan had been developed.

Before publication of the plan, the Welsh Government must also agree that the Water company has addressed issues of national security appropriately within its plan, and then direct the company to publish the final plan, once they are satisfied that it meets any Ministerial direction.

1.4.3 *Regulators*

In the context of the first cycle DWMP, the government have not specified how they will gain assurance that the plan meets the objectives set out within the newly enacted section 94A of the Water Industry Act 1991, and their "Guiding principles for drainage and wastewater management plans". In a WRMP context, the role of advisor to Government would be performed by NRW and the EA but, in the context of the DWMP, NRW and the EA are considered as stakeholders to the plan.

Ofwat, who are appointed by Government as the economic regulator to the water industry, will carry out their economic assessment of the proposals developed in this plan, as part of the 5-yearly price review process for the sector.

1.4.4 *Stakeholders*

Stakeholders, including local authorities, Natural Resources Wales, the Environment Agency, and environmental non-government organisations, will play a significant role in the successful delivery of the DWMP by providing information, attending collaborative meetings and supporting the development of joint programmes of work.

In this first cycle, the level of information gathered from stakeholders and the modelling needed to develop integrated drainage solutions has not been possible within the time available. Despite that, the plan, and especially the regional summaries, highlight the scale of the challenge we must deal with, and the approaches we need to develop to respond to those challenges. The DWMP provides a platform from which routine dialogue and increased data sharing can begin. It also offers an opportunity for stakeholders to align the key DWMP outputs with their own long-term strategies.

1.4.5 *Consumer Council for Water*

The Consumer Council for Water (CCW) provides an independent voice for customers in Wales and England. It carries out research and work alongside us to challenge our performance and efficiency. Through the DWMP we will be considering issues that could have material impacts on customers, from expectations over acceptable performance of our sewerage systems to impact of improvements on customer bills. As a result, CCW is more than a key stakeholder in the DWMP.

1.5 How we form and maintain a plan

This first cycle of the DWMP will provide a mechanism to convert our previous methods of wastewater planning (our Sustainable Drainage Plans) to the national approach set out in the DWMP Framework (WaterUK, 2018). To supplement those techniques, we have developed and applied a range of innovative approaches, not previously utilised in wastewater planning. As outlined above, these include approaches that have been developed by the UK water industry for water resource management planning.

The DWMP Water UK framework (WaterUK, 2018) forms the basic structure of the plan.

The plan consists of 5 stages listed below. These are presented in detail in Figure 3 and in the following Chapters.

- Stage 1: Setting and reviewing the strategic context and planning areas.
- Stage 2: Undertaking and updating risk assessments.
- Stage 3: Developing options and carrying out options and environmental appraisal.
- Stage 4: Producing a best value programme.
- Stage 5: Carrying out a formal consultation on the draft plan and publishing the final plan and annual review progress.

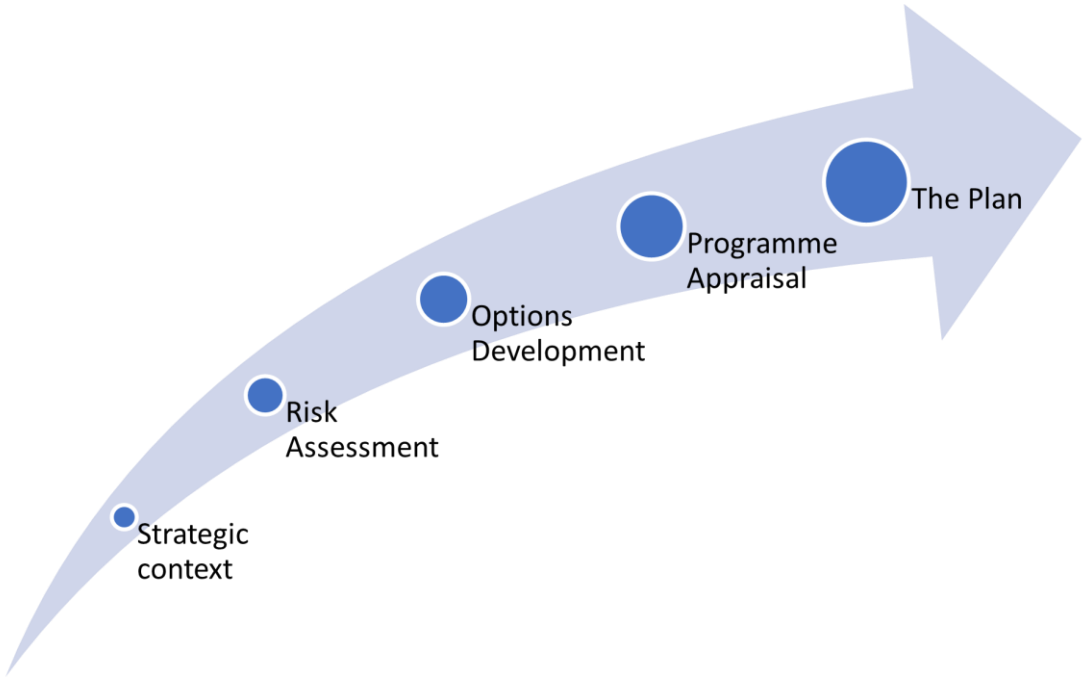

Figure 3 – Stages of the plan

1.6 How your comments have influenced the plan

We received fifteen responses to our public consultation, which was held from 27 July 2022 to 7 October 2022, seven responses from stakeholders along with three from regulators, three from customers and two from Welsh Government.

This has been combined with the willingness to support customer research where we discussed the draft plan with 500 customers and 100 businesses. We also delved deeply with 25-30 customers to draw out their thoughts and aspirations and considerations around affordability, pace of change and priorities.

From this, more than 230 unique comments and valuable insights were received. These have been analysed and we have provided responses and produced actions to address these.

From this process, we learnt that regulator responses need to be addressed prior to any publication or draft consultation. The regulator responses were mainly stating their assessment of application against their expectations.

The stakeholders provided feedback on our proposals, including areas of agreement and suggestions for improving our approach. They also had queries about certain aspects of the plan. We will use this feedback to inform the next round of planning, which is part of our cyclical management planning process.

As part of DWMP29, and in response to the feedback gathered during Cycle 1, we aim to:

- Increase customer awareness through annual updates and community forums.
- Use customer documents and social media to keep customers informed of wastewater and drainage progress.
- Inform and advise customers on how they can manage wastewater.

- Invest in managing wastewater and handling additional rainfall, prioritise sustainability over least cost, and explore joint working opportunities.
- Develop an environmental benefit approach and investigate solutions for managing customer flooding and preventing floods.
- Address concerns regarding sewer overflow spills and work with stakeholders to identify opportunities and involve communities.
- Create affordable incremental plans.
- Review the approach to historical sites to ensure access and build in a sympathetic fashion.

Welsh Government have also provided their strategic feedback on the content of our plan, and we will work with them as we move into the statutory phase of the DWMP which includes the development of the next government strategic direction for the DWMP.

We have highlighted some of the more difficult queries below. Further detail can be found in the Statement of Response.

We have been challenged by OFWAT with regards to the 6 DWF standard to be maintained between the Sewage and the Drainage Plan. We recognise that, generally, customers and stakeholders agreed to set the 6 DWF limit. However, OFWAT recommend that we only deliver this where it is cost beneficial. Therefore, we will revise this threshold as we enter the next planning forum. This means that we will contain less flow as a standard to be maintained and, in the short term, this will mean that greater emphasis will need to be placed on surface water separation and nature-based solutions using other drivers or mechanisms. In technical terms 6DWF is similar to Formula A which is a calculation used to prepare critical discharge permits.

We will continue to review this whilst developing the next plan as there is a fine balance between the outcome we are trying to achieve, versus the cost benefit of delivering a solution that could take longer to achieve the outcome of lower escapes. The reason we are proposing to set a standard is so that we can continue to assess the service we provide to customers to an agreed standard and continually re-affirm to customers that they are receiving that service.

Customers and stakeholders agreed with our approach to continue to work with them to explore how to create affordable incremental plans with agreed increments based on the DWMP24. We will continue to engage proactively and explore opportunities to provide more detailed examples using joint trials to provide real life examples to aid understanding and demonstrate incremental adaptive planning.

Please note Management of Carbon was not a topic raised during our consultation exercise but is a component of solution creation.

1.7 Policy

We have chosen to set our ambitions and believe the right solution should be driven by climate action as well as efficient use of funds. However, we recognise that there are barriers to the delivery of our Plan and the achievement of our goals, which depend on policy change at a Welsh and UK government level.

The DWMP has trialled new approaches to achieving our strategic aims and we hope that this will provide government with the evidence it needs to consider new legislation that enables us to achieve our ambitions. Since we acknowledge that this kind of policy change takes time, we have ensured that options that depend on policy change are only considered for delivery 10 years from the commencement of the Plan.

1.8 The structure of our plan

This document forms the main plan, developed as part of a suite of documents, which together formulate the first DWMP.

This suite of documents is comprised of:

- **The Main Plan** – A technical appraisal of risk, utilising different methodologies to inform and establish local and national best practice. This includes a Strategic option assessment to aid understanding of the scale of the task to manage future pressures, supported by a staged option appraisal methodology. The document also includes programme appraisal methodology to ensure consistency with other long-term planning in the water industry and examples that highlight how we propose to undertake this detailed assessment in the second DWMP cycle.
- **The Technical Summary (this document)** – A Technical account of the first cycle plan presenting methodologies carried out.
- **The Non-Technical Summary** – A stakeholder facing summary of the key points and messages.
- **The Customer Summary** – A customer facing summary of the key points and messages from the Plan.
- **The Area Summaries** – A series of summaries, setting out the proposed regional (L2) and local strategy (L3), risks, options, and preferred options.
- **Strategic Environmental Assessment and Post Adoption Statement**– A formal review of the potential environmental impact of the proposals being promoted by the DWMP, to ensure that the most sustainable options are being promoted.
- **Habitats Regulations Assessment** – A formal review of the potential impact of the DWMP proposals on protected habitats.
- **A suite of customer-facing documents –** A set of stage-based publications to continually engage with customers and stakeholders at the Plan develops:
    - The DWMP Customer leaflet - a quick-read overview for customers.
    - The Strategic Context – produced at the end of the Strategic Context phase of each cycle.
    - How and where and we want to work with you – produced at the end of the Risk Assessment stage of each cycle.
    - The Options Process – produced at the end of the Options Development phase of each cycle.
    - The Programme – produced at the end of the Programme Appraisal stage of each cycle.
    - The Statement of Response to the public consultation of the draft DWMP.

2 Strategic Context

The water industry has experience in developing long term management planning for water resources, an approach that has been maturing for over 20 years. Despite that, the industry has not had a similar method for wastewater planning. This is needed to ensure that adequate investment is targeted towards our drainage infrastructure, and to ensure it remains suitable to meet the long-term needs of customers and the environment.

2.1 The potential benefits

The anticipated outcomes and benefits of the DWMP process are summarised in Figure 4 below.

Figure 4 – Anticipated DWMP process outcomes

We have adopted the DWMP to achieve the following benefits:

- A collective view of the current and future challenges and actions needed to respond to them.
- Transparency and consistency in planning approach to the production of the DWMP.
- Greater confidence for customers, regulators, and stakeholders through the creation of a 'line of sight' from identification of risks to the investment decisions taken to address them.
- Responsive and flexible plans that can respond to rapid changes such as climate change and population growth.
- Supporting the development of plans for economic growth and resilient communities across Wales.
- A platform for effective engagement with customers and stakeholders.
- A culture of partnership working and co-creation of solutions that will benefit the economy, society, and environment over the long-term.

- Better investment decisions made by unlocking combined funding sources.

2.2 The need for collaboration

DWMPs will only fully realise their potential in delivering a robust and resilient drainage and wastewater service we aspire towards, by working in partnership with key stakeholders at both strategic and local levels.

Areas for collaboration can range from opportunities to help raise awareness with customers and stakeholders, to the introduction of sustainable drainage or natural flood management measures to slow the movement of surface water. By working in synergy with our key stakeholders, interest groups, communities, and our customers, the DWMPs will complement and integrate with other existing plans and strategies that manage drainage and environmental water quality, as shown in Figure 5 below.

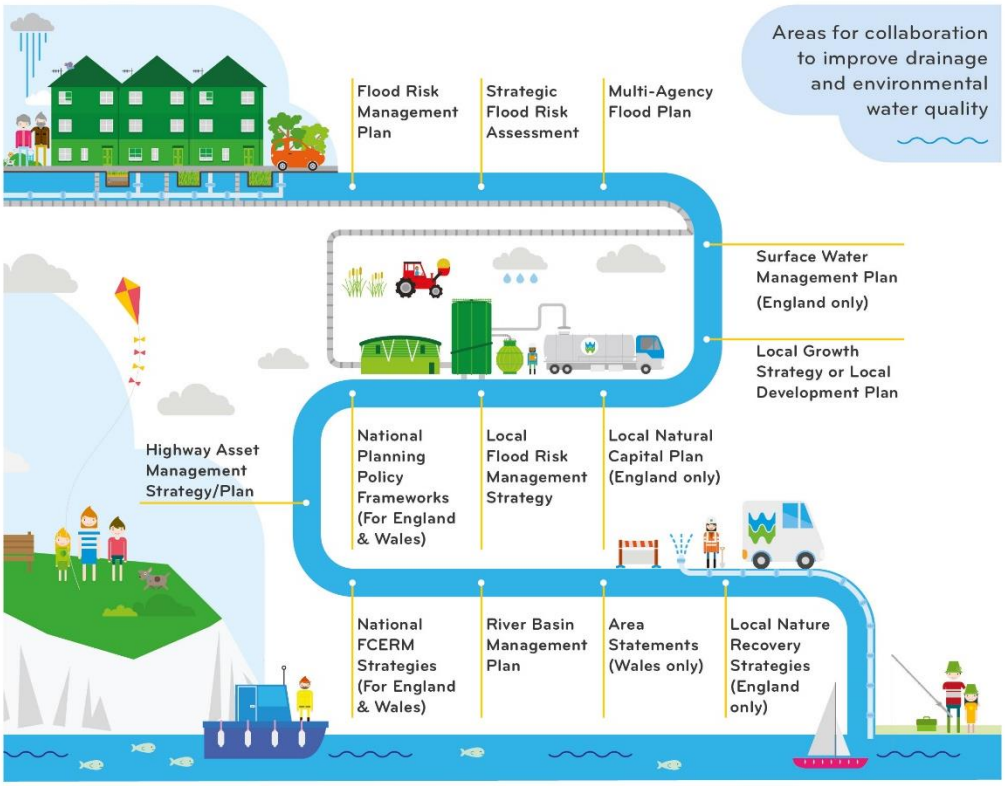

Figure 5 – DWMP integration with existing plans

2.3 Future requirements

This first cycle of the DWMP is not a legal requirement. Welsh Water, together with the other UK water and sewerage companies, has committed to prepare a plan in readiness for this planning approach becoming a statutory requirement. We are keen to develop our approach to the DWMP in this and the next cycle of the DWMP and would like to hear the views of customers and stakeholders as we develop our DWMP29, and beyond. This will help us to ensure that the plan provides a valuable output, which adequately supports the plans and strategies of other organisations.

Despite the non-statutory status of this plan, the Welsh Government is the devolved Government for Wales and has powers to manage the environment. The Welsh Minister will direct Welsh Water to publish the plan when the process is statutory. However, during this phase, the water company Board will carry out this final action in 2023. The Board has provided their direction to publish this plan as Final DWMP24.

2.4 Emerging trends and challenges

The nature of the environment in which we operate presents future uncertainties that are likely to have a significant impact on our service provision. We have considered these future trends, and the likely impact on our services, in our long-term business planning framework; Welsh Water 2050 (DCWW, 2018). The future trends are summarised in Figure 6 below. It is essential that the DWMP considers how long-term wastewater planning can help mitigate these challenges.

Changing climate patterns The increasing frequency and severity of extreme weather events such as drought and flooding.	**Emerging and persistent contaminants** Continuing to find solutions to legacy contaminants such as microplastics and pharmaceutical compounds. This includes issues with recycling of biosolids/sludge recycling, micropollutants, nitrate vulnerable zone designations and potential associated changes in regulations.
Decarbonisation and sustainable business practices The resource cost and trade-offs linked to implementing the necessary move towards net zero carbon to achieve 2050 target, as well as the need for energy efficiency in operations, circular economy practices, and sustainable supply chains.	**Increasing customer and stakeholder expectations.** Keeping up with accelerating customer expectations around service levels and technology, while ensuring we retain customer and stakeholder trust against a background of increasing environmental concerns such as carbon net zero, water quality impacted by phosphate levels and CSO discharges, recycling of bioresources, and the other concerns of stakeholders and pressure groups.
Price caps, affordability and potential trade-offs The constraints of balancing affordability concerns for customers, price caps imposed by regulators limiting necessary investment, and the need to invest in initiatives such as improving infrastructure and environmental protection.	**Legacy Infrastructure** Considering the set of risks posed by physical, biological and chemical degradation of infrastructure and/or lack of capacity in design of legacy infrastructure. Also considering the risks posed by ageing digital infrastructure.
Regulatory changes The UK Environment Act (2021), and several other regulatory changes which will become law in a post-Brexit Wales by 2025, are likely to bring tighter environmental standards, driving significantly increased monitoring and investment costs.	**Environmental responsibility.** Managing the impact of our activities on freshwater biodiversity and the important ecosystem services biodiversity brings. Considering the overall environmental responsibility of our operations.

Drainage and combined sewer overflows (CSOs) Managing issues of river water quality and pollution, linked to lack of treatment capacity or functionality in drainage systems, exasperated by climate change, whilst facing increasing public pressure and expectations to resolve such issues.	**Demographic and behaviour changes** The growth of homeworking and its implications and preparing for a growing and ageing population.

Figure 6 – Future trends influencing the DWMP

Through this analysis of future trends, risks and resilience, Welsh Water 2050 identified three key themes for investment planning:

- That the customer perception of risk has increased, following the recent pandemic, with greater expectation for authorities to do more to prepare for these risks.
- That protecting our service from climate change is a key priority.
- That we need to work collaboratively to ensure we make the best choices for the future of the services we deliver.

2.5 Legislative influences

As a water and sewerage company based "wholly or mainly in Wales" many of the requirements on us originate from Welsh Government legislation and regulation. In addition to those requirements, legislation, regulation, and guidance also sets out the aspiration of government, which we need to consider.

One example which this plan takes account of is the Environment (Wales) Act 2016. The Act aims to enable the environment in Wales to be managed in a more 'proactive, sustainable and joined up way' and embed Sustainable Management of Natural Resources (SMNR) principles as a core consideration in the decisions made by public authorities. Whilst not yet a mandatory requirement, the nine principles of Adaptability, Scale, Working Together, Engaging with the Public, Evidence, Understanding the Benefits Received from Natural Resources, Long-Term and Prevention are incorporated into our approach to the development of the DWMP.

This plan also considers the Well-being of Future Generations Act 2015. The legislation creates a legally binding common purpose which encourages sustainable economic growth and improves the environment in Wales. The act highlights the need for more effective collaboration between organisations, communities, and individuals when addressing recurring issues such as poverty, health inequalities, and climate change. The Act's seven well-being goals' and 'Five Ways of Working' are intended to support and deliver public services that meet the present needs without jeopardising future generations' capability to satisfy their own.

2.6 Welsh Water policy influences

The DWMP has allowed us to look at the consequences of climate change, growth, and urban creep to estimate how the risk of flooding and pollution will increase over time. To do this, we combined our Welsh Water 2050 strategic responses, national planning objectives (WaterUK, 2020) and feedback from customers and stakeholders into three high level planning themes:

- **Water Quantity** - Reduce the risk of (internal and external) flooding to communities.
- **Water Quality** – Improving water quality for the environment.

- **Resilience & Maintenance** - Adaptiveness to change while maintaining critical services and protecting the environment.

2.7 DWMP Framework

The DWMP framework has been developed through Water UK and builds on the principles outlined in the Drainage Strategy Framework (Ofwat, 2013). We have founded our approach to our first DWMP on the national DWMP framework, published by Water UK (2018), and have integrated elements of Water Resources Management Planning (WRMP) processes from the 2020 Guidance (EA/NRW/OWS, 2020), to address any gaps in the current guidance. The later stages of this document relate to the steps required in the DWMP framework, as show in Figure 7 below:

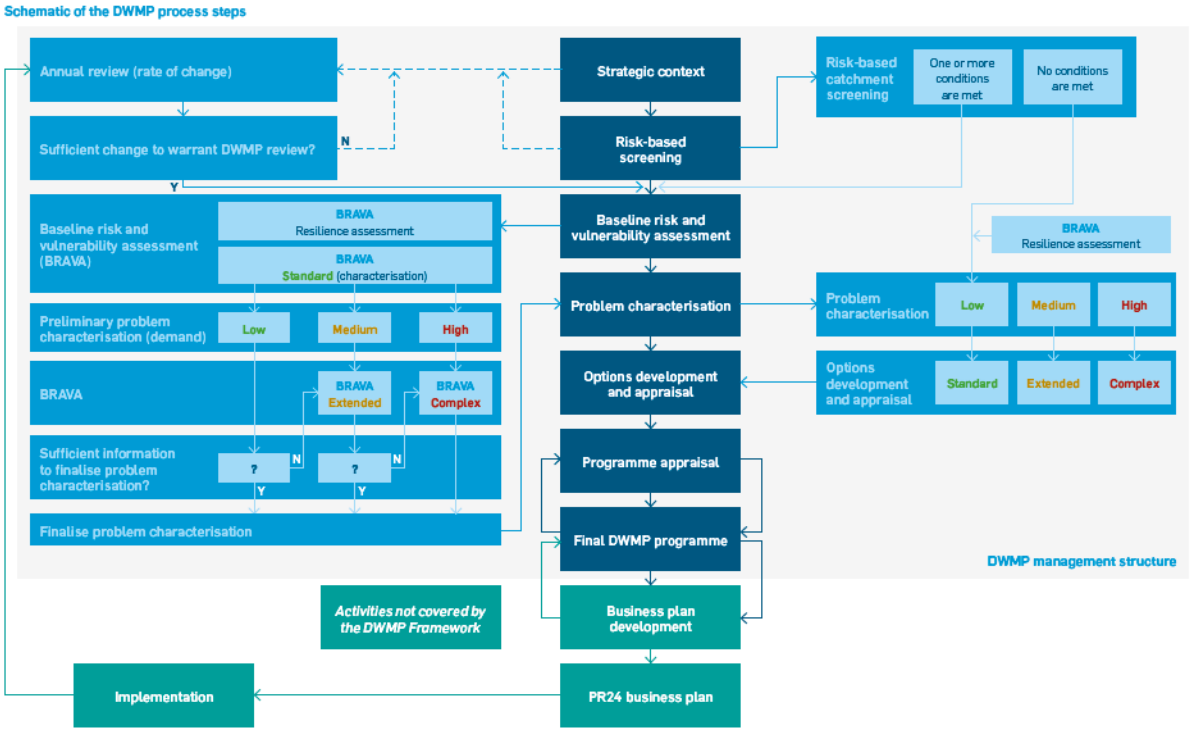

Figure 7 – Water UK DWMP Framework

The DWMP framework defines four new levels of planning which direct the granularity of the assessments being undertaken, and the levels at which the outputs of the DWMP will be consulted on and published:

Level 4 – The Wastewater Treatment Catchment – An area that drains to a treatment works. Our plan is set to discuss the Tactical Planning Unit as this encourages cocreation and River based planning for water quality.

Level 3 – The basic **Tactical Planning Unit** will be the wastewater treatment works and its catchment (or aggregations thereof for small catchments, or discrete sub-catchments for larger wastewater treatment works catchments). Companies can opt to disaggregate these level 3 tactical planning units further and designate those smaller areas as Level 4.

Level 2 – An aggregation of Level 3 units into larger **Strategic Planning Units**. The Level 2 strategic planning areas are used to describe strategic drivers for change, as well as facilitating a more strategic level of planning above the detailed catchment assessments.

Level 1 – Planning at Level 2 and Level 3 to be brought together at an overarching **Water Company Operational Level** to provide a strategic, long-term plan for drainage and wastewater resilience and associated investment over the plan period.

Figure 8 indicates this structured approach to plan areas for the DWMP.

Figure 8 – DWMP Planning Hierarchy

The Water UK DWMP Framework therefore required Welsh Water to define geographical areas which aligned with the definitions of those different plan levels.

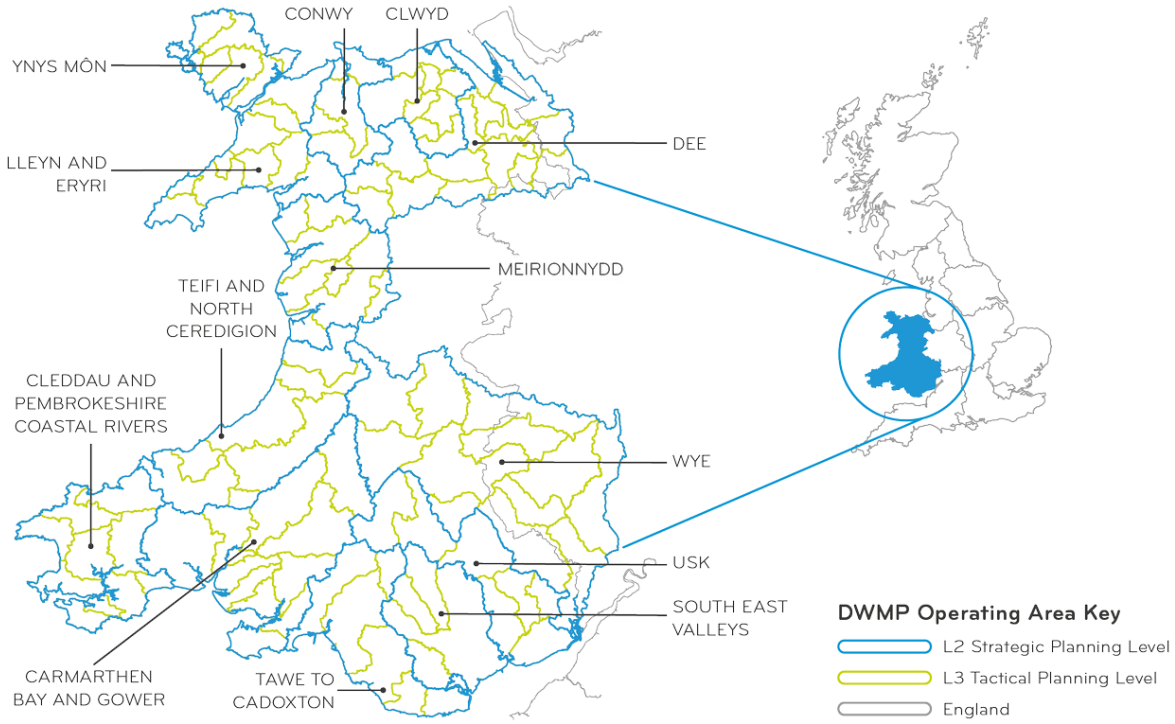

Figure 9 – DWMP Operational area map

Figure 9 shows a map of Welsh Water's supply area, divided by blue border lines into the 13 strategic planning units – also known as 'Level 2' or 'L2' areas, and divided again by green border lines into the 106 Tactical Planning Units – also known as 'Level 3' or 'L3' areas.

The whole of the Welsh Water supply area, including all L2 and L3 areas, is the Company Operational Level - also known as 'Level 1' or 'L1'.

2.8 Planning Objectives

2.8.1 *Introduction*

The DWMP incorporates planning objectives (POs) to measure risk throughout the company area, aligned to the Business Plan and Welsh Water 2050. POs are a combination of nationally derived common planning objectives for industry comparison, which are supplemented with a set of local objectives tailored to Welsh Water's stakeholders following consultation.

POs are then grouped under three themes - water quality, water quantity, and resilience and maintenance – to communicate them to stakeholders.

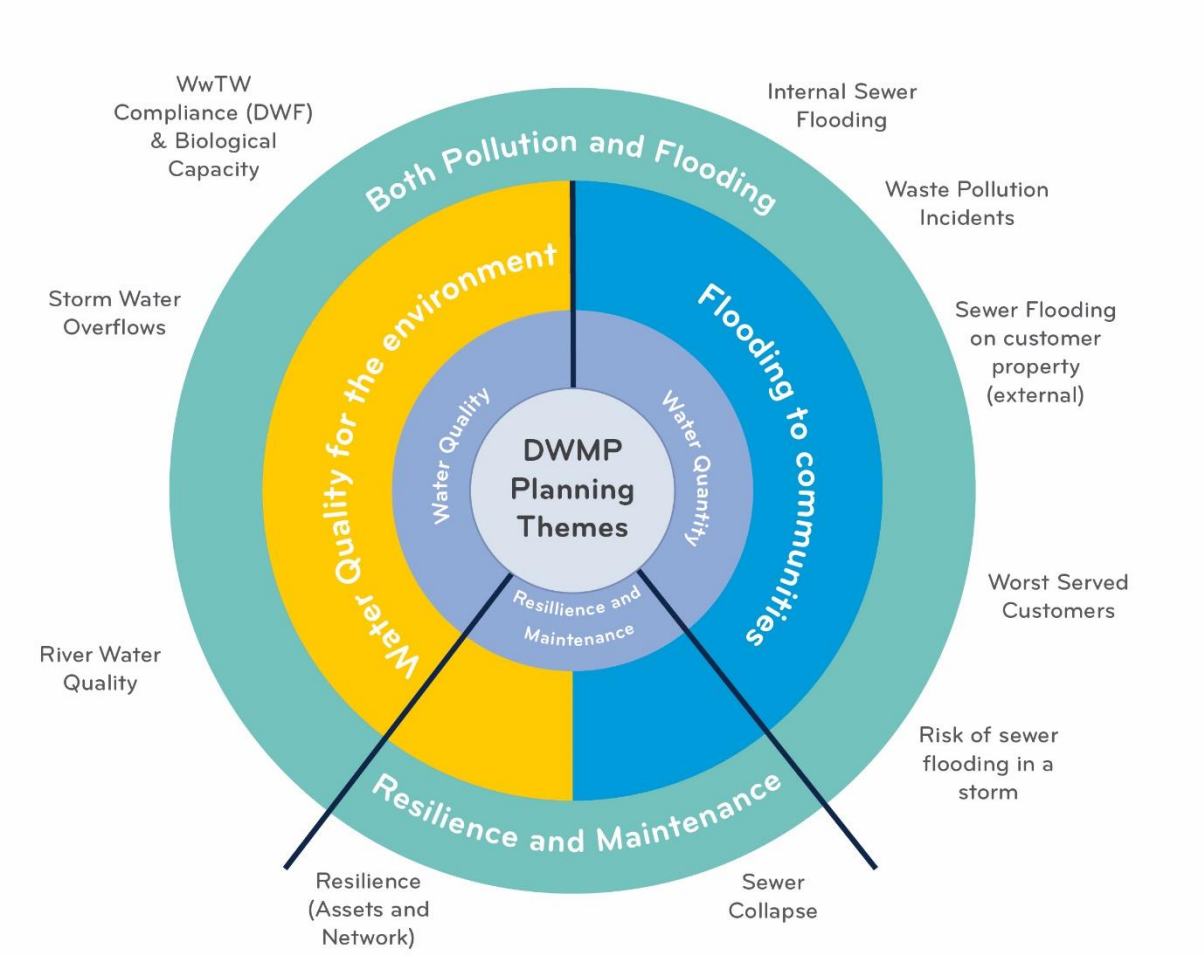

Figure 10 – Key planning themes and links with risk areas

2.8.2 *Priority Matrix*

The principle of Risk Management has been adopted. This enables a balance between different service priorities. The principle is based on incrementally assessing the risks to those considered a lower level of service and then taking them through the DWMP processes first. The matrix in Figure 11 combines the customer service priorities based on the protected status of a waterbody in another and ensures that both priorities are addressed at each plan iteration. This is to ensure that a balanced plan is created that is always concentrating on the highest priorities.

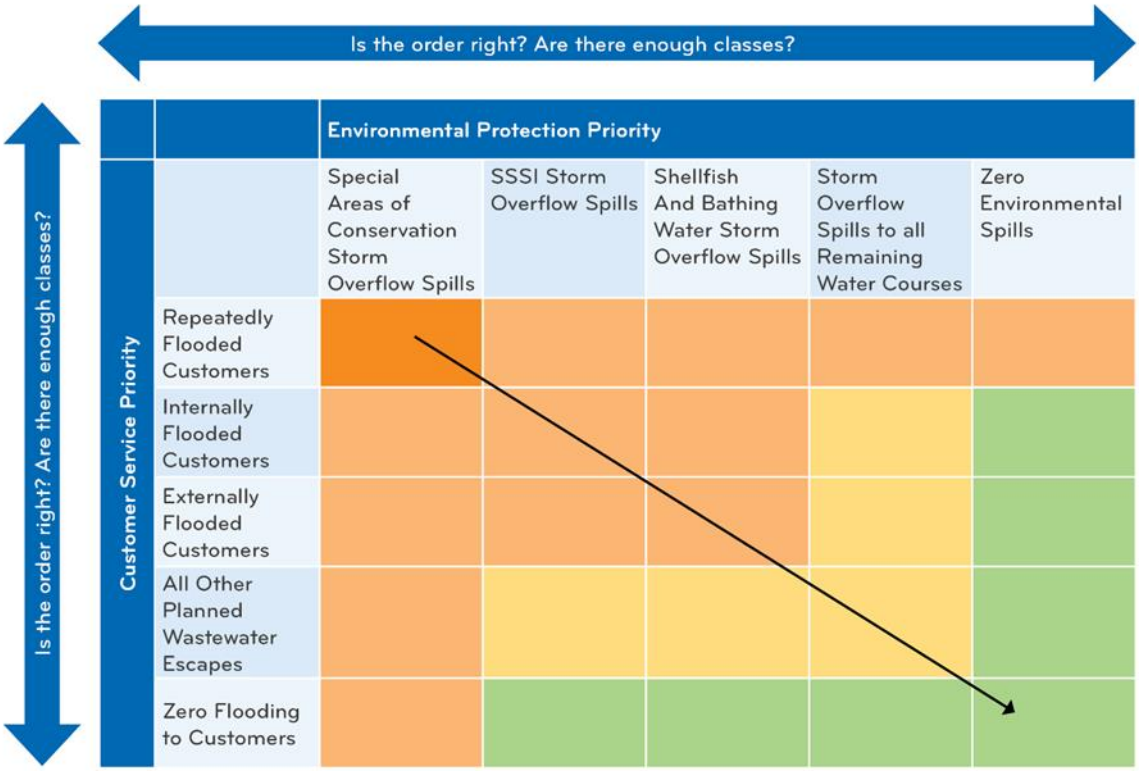

Figure 11 – Priority Matrix Principle

2.8.3 *Defining the planning objectives*

The final POs adopted for Cycle 1 are detailed in Table 1 below. This highlights where specific objectives sit within the three themes, and their national/local status. Each PO has a detailed definition, assessment methodology, and approach. This allows a robust grading of each PO's performance over the various time horizons considered in the DWMP risk analysis stage.

Table 1 – Planning objectives with description and units

Planning Objective		Description	Units
Water Quality			
National	WwTW Compliance DWF / Biological Capacity	STW Numeric performance limit compliance.	% Population served
National	Storm Overflow Performance	Assessment of spill performance based on annual rainfall.	Spill Count
Water Quantity			
National / Local	Internal Sewer Flooding (HO)	Properties affected by flood waters due to hydraulic overload conditions.	Property Count
National / Local	Internal Sewer Flooding (OC)	Properties affected by flood waters due to causes other than hydraulic overload.	
National / Local	External Flooding (HO)	Property curtilage affected by flood waters due to hydraulic overload conditions.	
National / Local	External Flooding (OC)	Properties curtilage affected by flood waters due to causes other than hydraulic overload.	

Planning Objective		Description	Units
National	Wastewater Resilience	Risk of flooding in a 1 in 50-year storm affecting population.	% Resident Population
Local	Worst Served Customers – Waste (HO)	Risk of repeat internal or serious external flooding due to hydraulic overload.	Property Count
Local	Worst Served Customers – Waste (OC)	Risk of repeat internal or serious external flooding due to causes other than hydraulic overload.	Property Count
Resilience and Maintenance			
National / Local	Waste Pollution Incidents (HO)	Pollution incidents as reported by EA/NRW (Category 1-3).	Incident Count
National / Local	Waste Pollution Incidents (OC)		
National	Sewer Collapses	Where structural deterioration has caused a collapse resulting in service failure.	Incident Count
Local	Asset Resilience (above ground)	Assets assessed against a pre-defined set of resilience criteria.	% Score
Local	Asset Resilience (below ground)	Assets assessed against a pre-defined set of resilience criteria.	% Score

Based on population or sewer length, the targets for this first DWMP cycle's planning objectives have been normalised across the company area. An example of the distribution of targets, and the risk trigger thresholds applied, can be seen in Figure 12.

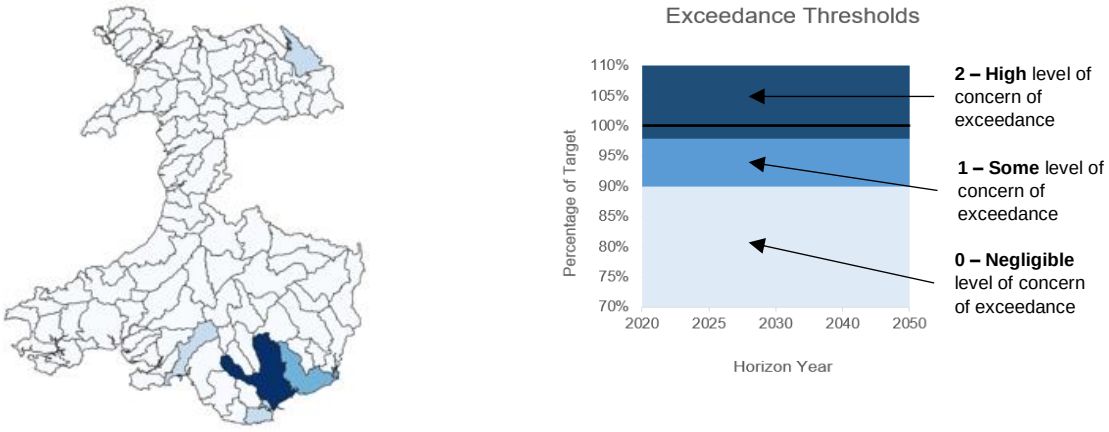

Figure 12 – Example PO target map (internal flooding) and target exceedance thresholds

2.9 Defining the Methodology to address Strategic Context

The risk assessments that will need to be carried out in later stages relate to the agreed outcome of the strategic context setting. When the context was developed, the methodology was required to characterise the outcome of the final plan. Initially it was thought that the plan would be a single plan including every common objective. It became clear that the risk and opportunity in each local area needed different levels of intervention. EG a foul only network didn't contain rainfall so needed to be compared with other similar catchments. A combined network was more complicated and needed greater detail. This led to the development of layers of assessments to be applied in a catchment.

These classes are inherent in the plan as reflected in the name of the plan itself, the Sewage Plan, Drainage Plan, Review of Consents Plan and Flood Plan. To examine the variances further, the idealised graph in Figure 13 can be used to focus the rainfall within the identified classes, represented by coloured bands.

We can determine the correct solution for a risk using rainfall classes. Using the Sewage plan as the example, what is the minimum pipe size to be used most of the time and will meeting the dry weather flow compliance of our permits? The assessment can be classed as the process to assess the sewage plan for today, with the addition of growth into the future the sewage plan then ensures that compliance is maintained for all catchments with additional housing and population and very light rain, dry days occur on average 240 days a year; this is visually presented as the blue area in the below chart. If we invest in these days for every catchment, we will then be able to state that the catchment is resilient for ~240 days every year at a calculated investment each 5 year interval. Then add on the drainage, review of consents and flood plans and the total combined will tell us the total investment required to reach and maintain a catchment to an agreed Strategic context.

What the assessment does in the sewage plan example is calculate the capacity or size of the pipework, pump or treatment works to manage the volume and quality of sewage. The calculation of capacity includes other forecast estimates such as infiltration, misconnections, and variable trade use. When all these are combined the sewage plan then requires scenarios to provide confidence in the result, an allowance for risk of incorrect assumptions. Each assumption needs to be agreed at the strategic context stage. This plan has only started to delve into the detail and for the first cycle the strategic context enabled us to learn that there is a need to clarify more questions. In this cycle we have presented the approach that we will be taking in cycle 2, the questions in our next strategic context will include the next level of detail so we can gain earlier agreement and direction.

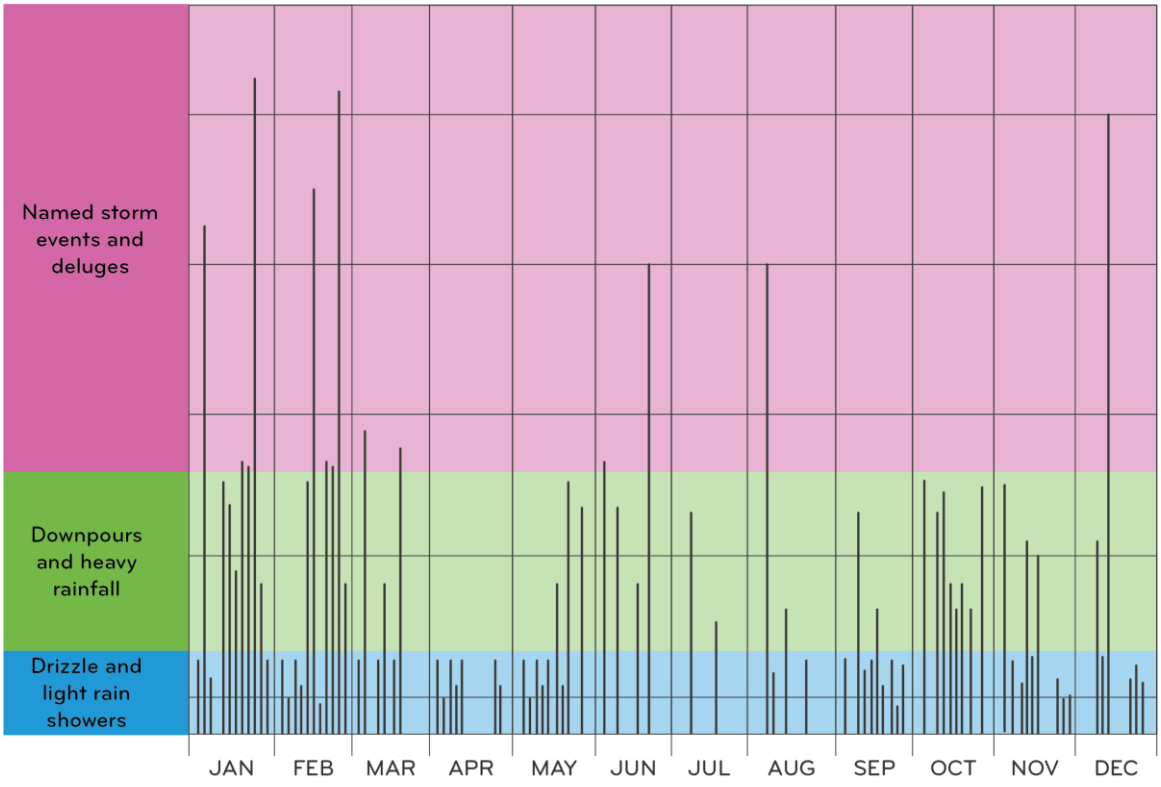

Figure 13 – Idealised graph of rainfall intensity and milestone zones of planning

2.9.1 *Understanding catchment capacity*

The Environment Act 2021 will amend the Water Industry Act 1991 to include a new requirement for water companies, which implies understanding sewer and drainage capacity is essential for success. At present, there is no standard method for assessing sewerage system capacity, and the industry is working towards developing this. Through adopting a pragmatic approach to this, we have developed a workable methodology, for use in this initial DWMP, to enable capacity to be considered across our operating area. This understanding of strategic network capacity, alongside performance against the specific planning objectives should support options development within the DWMP.

2.9.2 *Defining the minimum capacity of the network*

We have undertaken a company-wide assessment of network capacity using a simple geospatial approach to calculate the volume of flow within the network. Full Dry Weather Flow (DWF) is used to assess if the pipes, pumps, off-line storage, and wastewater treatment works are sized appropriately. Any capacity shortfalls are highlighted as 'at risk' and put forward for options development. Multiple growth, creep, and climate change forecasts are used to calculate the risk of not being able to contain and treat DWF throughout the plan period.

A second pass of the same assessment is also calculated to add allowance for drainage volumes using typical rainfall event intensity. Any other assets that are identified as not having sufficient capacity are then taken forward into Options Development.

2.9.3 *Defining the capacity of our treatment facilities*

Initially, we assume our treatment works will have the same capacity as the permit for the site. This initial definition assumes that capacity will not change over time. Meter installations are in progress to assess compliance with permitted flow pass-forward requirements by our treatment works in line with a methodology newly agreed by regulators.

In addition, we have developed an approach for calculating treatment capacity on a process-by-process level, based on site data. Biological processes are incorporated into the design of this tool so it can directly compare with network capacity assessment.

Using these approaches, sites where there has been a shortfall in permit or design capacity can be identified for further optioneering.

2.9.4 *Defining the capacity of the environment to receive wastewater and drainage flow*

Changes in environmental conditions (climate change and land use in particular), in combination with population growth, pose significant challenges to the DWMP. Under the new DWMP framework, investing in water industry assets must be informed by conditions in the receiving environment. To support this, SAGIS (Source Apportionment GIS) modelling can identify catchments and infrastructure which may be sensitive to changing environmental circumstances.

SAGIS provides a breakdown of in-river chemical concentrations from contributing sectors, so that regulators and water companies can use a common system to develop programmes of measures while maintaining the polluter pays principle.

It is anticipated that changes in policy, the environment, socio-economic factors, and asset performance may substantially alter the DWMP context in the future. To respond to this, SAGIS provides scenario analysis at various DWMP-relevant time scales, whereby ‘what if’ questions can be used to explore the implications of change and/or specific actions.

We used SAGIS as part of a method development framework to investigate how scenario planning might be used to inform the DWMP. The specific objectives were to:

- Develop a methodology for identifying catchments and wastewater infrastructure where the management may be sensitive to environmental changes likely to occur within the DWMP 25-year planning horizon
- Establish a reporting and data visualisation protocol (i.e., how to present the vast amount of data generated by modelling in a way that facilitates easy interpretation).
- Support our planning capability with tools and approaches.

2.9.5 *Understanding strategic network capacity- Dry Weather Flow (DWF) risk*

When assessing the impact of sewage treatment works discharges on the environment, DWF is a critical factor. The DWF represents the volume of foul flow generated by our domestic and trade customers (excluding surface drainage), as well as infiltration passed to the WwTW. When combined with the WwTW permits, it allows us to calculate the treatment load on the WwTW and, where needed, to compare that with the capacity of the environment and accept those discharges across our catchments.

We have adapted the WRMP's supply and demand concept to better understand capacity risk assessment. However, we must recognise that there are fundamental differences between water, wastewater, and drainage networks. In urban areas, runoff from rainfall changes the volumes in the wastewater system during storms. This requires layers of complexity and uncertainty that are not needed for water management planning.

A comparison of the wastewater network DWF capacity with the treatment works capacity at a strategic level suggests there are future DWF risks, including that our treatment capacity could be insufficient to treat all the loads we receive under dry weather conditions by 2050. The assessment process provides a strategic prioritisation tool to focus work where network capacity DWF and treatment capacity DWF (combining treatment and environmental capacity together) are shown to not have enough headroom between them for continued resilient service into the future. If there is a risk at Level 2, the tool highlights that there is a greater risk in that area than in another area. The assessment is then continued to Level 3 so that the contributing risk at a high level is found at a catchment scale, and programmes of work to resolve the risk can be created.

The tool also allows scenarios of risk to be assessed with the introduction of headroom. This is a simple approach where several different percentages are added to the network side until the level of resilience is determined. Again, those with lower headroom percentages are those that are at greatest risk in the future.

We have investigated the use of a DWF supply demand assessment to identify areas where capacity needs are forecast to be limited. However, these areas do not state that the whole area is not at risk; it shows strategically that, at a high level, there would be enough capacity if the zones network, treatment and environment were all connected together. The assessment information and conclusion are shown in Figure 14.

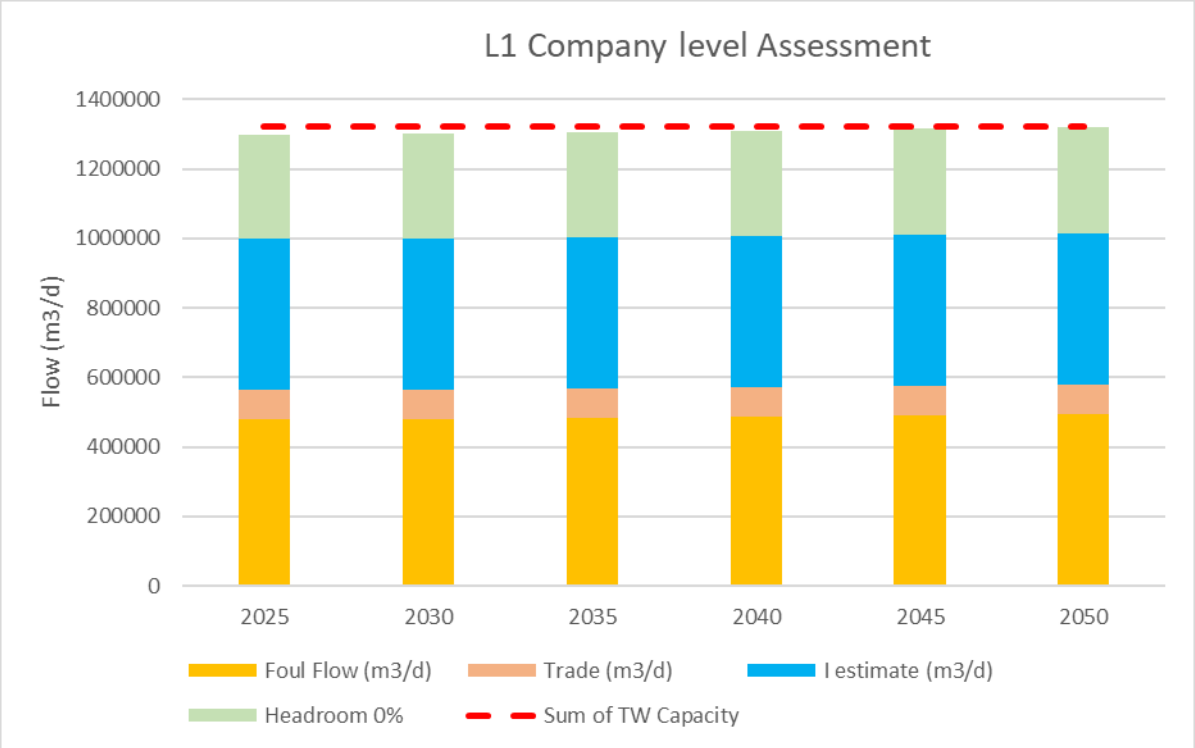

Figure 14 – Components of the L1 Company level capacity assessment

2.9.6 *Top-down capacity assessment methodology*

The analysis of our company's total treatment capacity in relation to the total DWF demand implies that we have some risk of insufficient capacity on a strategic level if all the processes are linked together. However, this ignores the spatial inequalities in DWF and treatment capacity; where the DWF arises and its networked connection is to a WwTW. The same analysis can be repeated at Levels 2 (SPU) and 3 (TPU) to determine areas in which shortages of supply and demand are likely to occur, and to inform our planning approach in these areas.

Mathematically DWF is defined as:

$$PG + Imax + E = DWF$$

Where:

Imax = the maximum Infiltration occurring within the network (an evidence-based winter value)

PG = Population (P) multiplied by Consumption (G) defining residential contribution

E = Trade Effluent

In assessing the needs of planning for greater headroom, we have assumed a flat percentage increase based on population forecasts aligning with our company demand forecast. There is significant uncertainty around future infiltration and commercial flow volumes, and these have not been varied in future scenarios, but need development within Cycle 2. In addition, as demand from customers and trade varies during the year, it shows that, even at a company level, a different approach to how the industry undertakes this planning should be considered in Cycle 2.

This is a new approach to assessing capacity at the strategic level. We are using this to get a more holistic view of our network and WwTW's capacity. There are some disadvantages to this approach as with previous wastewater planning, namely, multiple assessments are needed to understand capacity. Nonetheless, drilling down into the detail allows the components that make up the risk area to be better identified. During cycle 1, this top-down approach will be expanded toward cycle 2 as a possible long-term planning approach.

2.9.7 *Hydraulic capacity assessment tool – A bottom-up approach*

With this initial definition of treatment capacity, Cycle 1 can compare it with the high-level Cycle 1 network assessment and produce a simple network capacity versus treatment capacity risk assessment.

Wastewater capacity can be calculated based on WRMP's supply and demand mass balance principles. WRMP dry conditions are equivalent to DWMP dry weather flow capacity. During a year, there are, on average, 236 days without rainfall. The WRMP considers the critical period, or the most challenging demand conditions, for water supply at peak hot and dry days, but the DWMP evaluates such conditions in relation to peak rainfall that occurs after an extended period of wet weather i.e., storm duration and antecedent conditions.

This can be calculated using the same equation, but multiplied by a standard variable, defined by wastewater practitioners as 3x, 6x, or 12x DWF, and the maximum estimated infiltration rate (Imax) that occurs under these conditions (calculated from the treatment works flow meter or the CSO event duration monitor, typically a winter maximum). Multipliers correspond to storm volumes. The use of the Multiplier in front of the DWF is a pseudo reference the volume of rainfall entering the sewer system, i.e., DWF is no rainfall all the way to 12xDWF which could be classed as heavy daily rainfall and 16X DWMP could represent the future climate change volume. For instance, the 12x multiplier represents a worst-case winter storm. Peak rainfall volume would then be estimated as:

$$12(PG) + Imax + 12E = 12DWF$$

The component-based capacity assessment has been part of the commitment for some time. However, by bringing these together into a single view, capacity can be viewed as a single value for supply and a single value for demand.

Capacity demand is influenced by both customer need and rainfall runoff. This makes its definition more difficult. It is not possible to retain all the flows and treat the drainage flow to a combined sewerage network under all weather conditions. Consequently, the wastewater system is typically equipped with storage and/or relief points, Combined Storm Overflows (CSOs) that allow excess flows to pass to the environment without backing up and flooding customers' premises. Hence, any assessment of supply and demand is extremely complex, but we believe it is appropriate to continue to develop this methodology and use it as the foundation for a new approach to the assessment of wastewater.

During this cycle of the DWMP, the assessment of capacity was primarily based on permitted discharge volumes. However, in a few prioritised WwTW catchment areas, a process-by-process capacity calculation tool has been developed to improve this at a detailed process level. Based on this assessment, we will be able to anticipate when the hydraulic capacity of sites will be exceeded as population, trade load and drainage volumes change.

Cycle 2 of the DWMP evidence improvement programme will focus on:

- Further defining the components to calculate capacity.
- Further Improving the tools developed during cycle 1.

- Enhancing the reliability and confidence in the calculation by developing robust procedures.
- Building on CSO EDM monitoring already in place, installing a permanent and temporary monitoring system on our network and treatment sites.

The results will provide a more accurate assessment of the supply/demand balance, resulting in a better estimate of where the next investment should be made.

Table 2 below shows the Level 2 assessment of DWF risk using the approach alongside a resilience assessment at 20% headroom. Multiple variations of this table can be easily draw using the DWF, 3x, 6x and 12x DWF approach and then varying the headroom analysis alongside allowing a rapid risk assessment to be carried out for prioritisation of detailed work and at all levels of planning.

	Dry Weather	Dry Weather with 20% allowance for resilience
Dee		
Clwyd		
Conwy		
Llyn and Eryri		
Anglesey		
Meirionnydd		
Teifi		
Pembrokeshire		
Swansea Bay		
Tawe to Cadoxton		
SE Valleys		
Usk		
Wye		

Table 2 – Supply Demand Balance risk at level 2

2.9.8 *Storm response – Additional uncertainty in drainage resilience*

Our world is highly complex and comparing all types of storms to a single assessment obscures the reality of the situation. The different impacts of summer vs. winter storms on hydraulic performance, on capacity of the network, on flooding, and environmental risks are important. In this first cycle of the DWMP, we are exploring what these scenarios mean to customers.

We have characterised 'Risk' by using different types of rainfall and storms that impact different assets and catchments. Risk assessments have considered these differing rainfall patterns to ensure continuity of risk analysis now and into the future.

For our first cycle of the DWMP, we utilised a summer season, 60-minute storm with a one-year return period as our baseline. Statistically, this occurs only once every year. The baseline

allows us to explore how storms impact sewer flooding, and how this risk may change because of climate change, growth, and urban creep between now and 2050.

2.10 Outputs

2.10.1 *Catchment level results summary*

SAGIS Scenario modelling was undertaken, generating both high-level and site-specific results for now and 2050 covering phosphate, ammonia, BOD, and nitrate which summarise water quality conditions upstream and downstream of all our assets. The tool also lists discharges upstream and downstream of a selected "feature". This enables users to track other upstream or downstream inputs. This is useful because a target exceedance downstream of any individual treatment works might be substantially attributable to other upstream discharges.

The primary scenario results include:

- Baseline Scenario: Simulated conditions within the model calibration period (2010-2012).
- 2050 BRAVA: As in baseline, except treatment works discharge flows are updated for 2050 (based on BRAVA).
- 2050 BRAVA with variability: Conditions averaged across a range of scenarios (based on an ensemble of 27 individual scenarios), where the discharge treatment works discharge flows are those expected to occur in 2050.
- Permit scenario with variability: the same as the previous scenario, except treatment works have been modelled at the permit limit.

2.10.2 *Strategic summaries*

The information for individual treatment works has been aggregated for phosphate, ammonia, BOD, and nitrate and presented in bar chart form, for a range of modelled scenarios from baseline conditions to 'pessimistic' worst-case conditions.

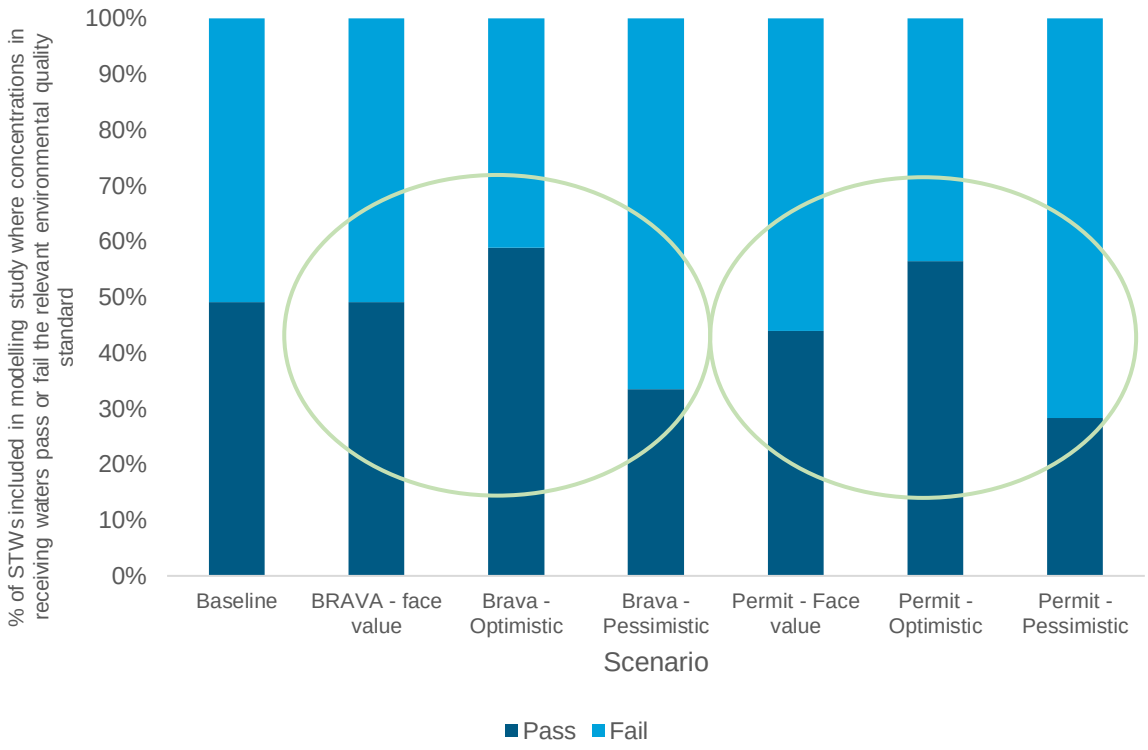

Figure 15 – Scenario results for phosphate for our treatment works included in SAGIS

Figure 15 shows, at a high level, how many treatment works are likely to exceed ('fail') or not exceed relevant environmental quality standards (EQS). This shows the percentage of treatment works that might be subject to some form of quality control upon discharge. Site-specific summaries can help planners and stakeholders understand the implications and challenges involved in planning to mitigate long-term impacts by providing a tangible illustration of what might happen in the future.

Comparing different permit variant scenario results ('face value', 'optimistic' and 'pessimistic') is most useful. This is because investment needs are usually based on the impact on receiving waters that may occur at the discharge permit limit. Underestimating the need for investment could lead to environmental damage, while overestimating it may withhold resources from other needs. Following this approach, we can assess and quantify these risks in advance and agree the base planning assumptions.

Conclusions and recommendations of the SAGIS study are:

- Phosphate exceeds the EQS in the greatest number of treatment works currently (baseline) and in future scenarios. Phosphate will likely drive the most significant investment and the majority will be managed through the industry environmental Programmes (WINEP and NEP).
- There are significant differences in the number of treatment works at which investment may be required for the baseline, optimistic and pessimistic scenarios. in the most extreme case, ‘optimistic’ and ‘pessimistic’ the differences are most noticeable for phosphate (142), followed by BOD (56), ammonia (41) and nitrate (25). In the case of baseline and pessimistic, the same trend is repeated for phosphate (105), followed by ammonia (50), BOD (46) and nitrate (19).
    - The values in brackets indicate the different relative number of treatment works potentially exceeding EQS between scenarios.
- This illustrates that the uncertainties around future conditions are relatively larger for phosphate than other determinants, and that plans based on current conditions are unlikely to provide adequate protection for the future.
- These results highlight the importance of understanding the contributions from other sectors, such as agriculture, as well as developing approaches that will allow all sectors to contribute to meeting water quality goals.
- In support of shorter-term planning processes, the assessments may be repeated following business-as-usual updates and other improvements to SAGIS.
- Data visualisation tools provide a tangible illustration of the implications of environmental changes that might occur within DWMP planning horizons. These tools support our efforts to engage stakeholders in defining future scenarios and those we should be planning for. Going forward, our planners, stakeholders, and customers could refine the alternative scenarios to shape a common vision.
- The modelling spreadsheet contains the priority treatment works for each scenario. Therefore, these can be used to develop an investment program spanning multiple AMP cycles, with consideration for how environmental conditions might change.

3 Engagement

3.1 Introduction

Engagement with stakeholders and customers is central to achieving our shared vision for the future improvement of environmental water quality and the management of drainage and wastewater.

Initial work with customers involved research groups to determine awareness, expectations, and support around the DWMP management options, and of wastewater services in general. Findings suggested that the DWMP objectives align with our customers' expectations of what Welsh Water should strive to achieve in the longer-term, to deliver the best outcome for the communities we serve and the environment we operate in.

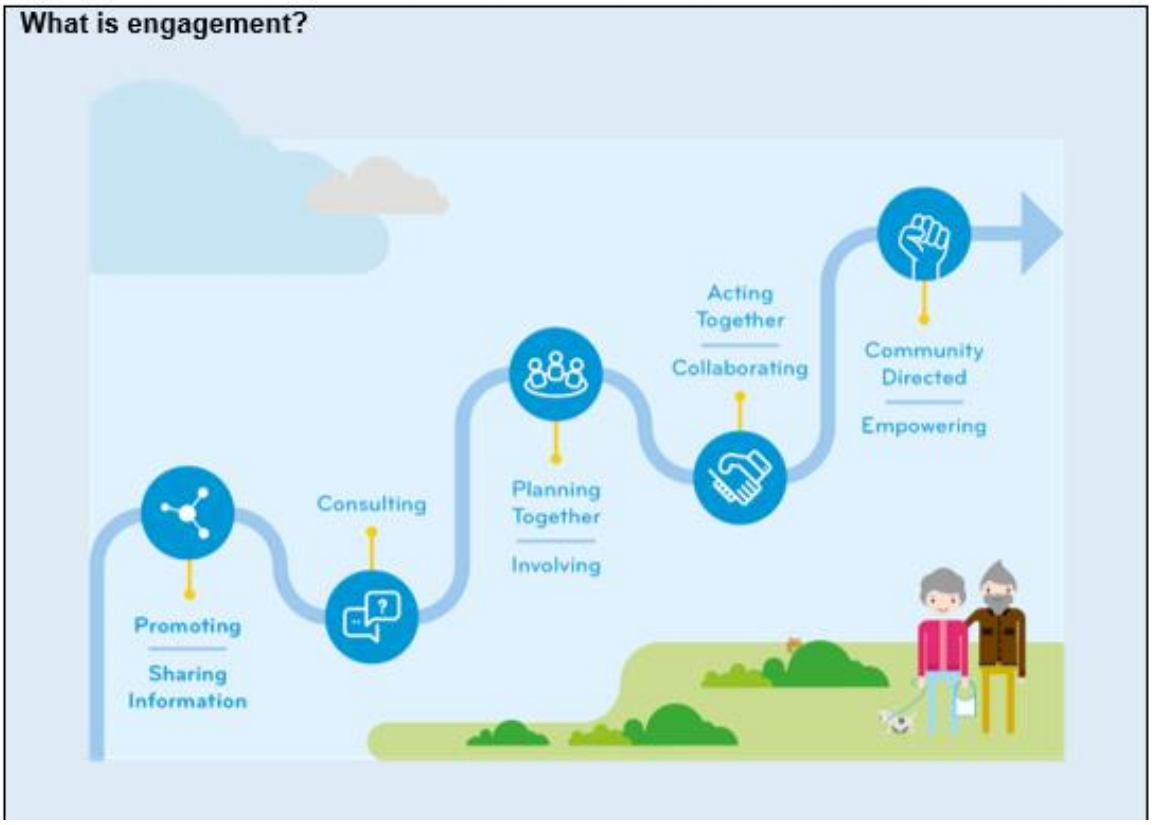

Figure 16 – What is engagement?

3.2 Engagement with Regulators

Engagement with regulators throughout the process has taken place through the Water UK and Welsh Government DWMP steering groups. These sessions have taken place quarterly or on an ad hoc basis. Looking ahead, we plan to introduce more formalised sessions to demonstrate the methodology being undertaken, with an opportunity for us to gather immediate feedback from our regulators.

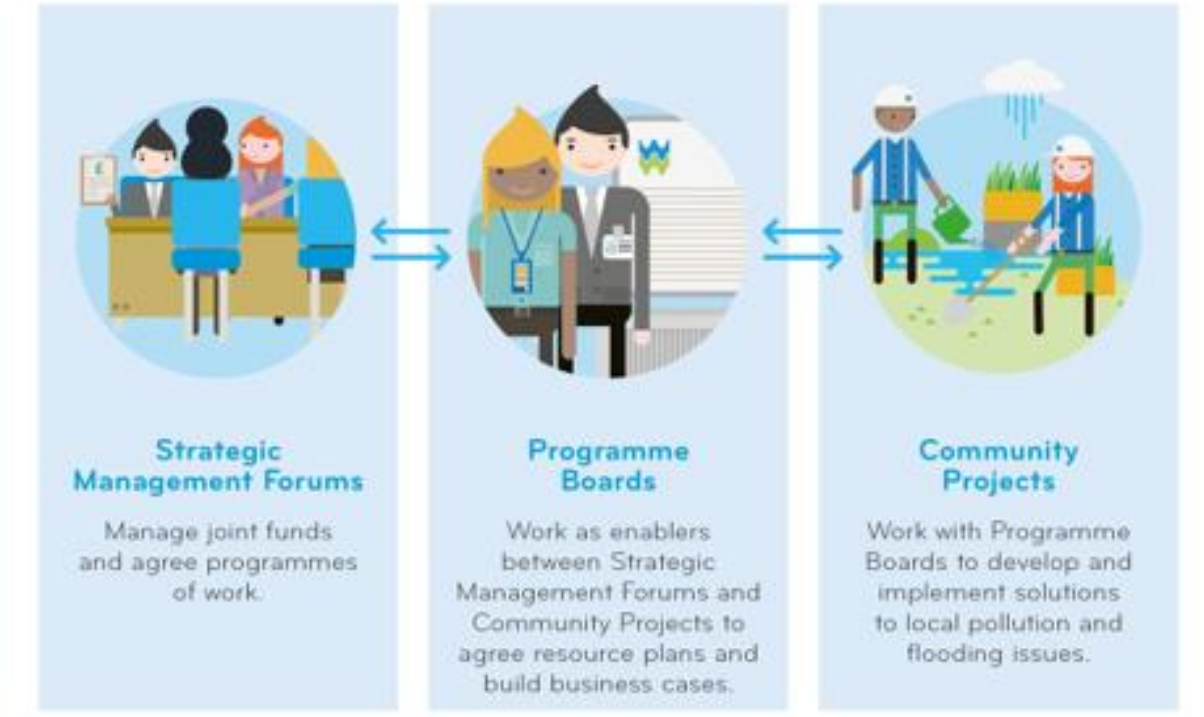

Figure 17 – Image showing joint working structure to support the engagement process.

3.3 Engaging with our customers in the development of our Plan

We are committed to bringing the voice of customers into the heart of our business and the DWMP. We want to understand the views of our customers on key parts of the plan, particularly in terms of how quickly we make improvements as this will impact on their bills.

We have ensured early research and ongoing engagement to provide opportunities for customers to help shape the development of the Plan, and the speed of proposed changes.

We have also met regularly with the Customer Challenge Group, an independent group of individuals from organisations that supply scrutiny of our plans from a customer point of view.

Throughout the development of the plan, we have worked closely with our customers through a series of research sessions. These sessions have informed us of customer awareness, expectations, and support for different options.

This has fed into the development of the Plan, ensuring that the outcomes are in the best interests of both existing customers and future generations who will benefit from it.

Our findings show a strong link between customer priorities and our objectives for the Plan; these include planning for the long term, acting in an environmentally friendly way and providing good value for money.

3.4 Methodology

The focus of engagement for the DWMP is to collaborate with stakeholders and develop plans to identify the benefits of the DWMP to stakeholders and customers. Key stakeholders are allocated to the Company (Level 1) and Strategic (Level 2) levels of the plan based on their geographic alignment and the level of plan detail they have an interest in.

We have developed the following engagement objectives:

- Engage all stakeholders proactively in a manner that meets different needs and expectations.
- Engage early, consistently, and meaningfully with key stakeholders to ensure that their views are understood and properly considered at every stage of the DWMP development process.
- Build a broad public awareness of the scale and complexity of the challenge involved in delivering the DWMP, by outlining the extent of the challenge through accessible material.
- Ensure that all DWMP communications are consistent in terms of style, tone and content to avoid mixed messaging.
- Identify risks early and proactively, implement effective actions to minimise or neutralise reputational or programme damage.

3.5 Outputs

Work on Welsh Water's DWMP was piloted in the Clwyd region of north Wales. Engagement at a regional level was also piloted in this region. As the Baseline Risk and Vulnerability Assessment (BRAVA) stage developed, the outputs of these catchment risk assessments were used as an introduction to the DWMP for stakeholders, and as an opportunity for stakeholders to provide their own risks or objectives which might align with the DWMP. Through a series of meetings, stakeholders were able to highlight specific areas on a map which they felt might be impacted by growth, flood risk or water quality, for consideration in the DWMP.

The approach to engagement undertaken in Clwyd was to be rolled out across all other parts of the Welsh Water operating area.

DWMP launches were held in Llyn and Eryri, Meirionnydd, Ynys Mon and Conwy and meetings held with several local authorities.

However, in March 2020, social distancing policies were enforced in response to the spread of the COVID-19 virus. The DWMP Engagement Plan was reviewed to comply with Government guidelines and prioritise the safety of staff, stakeholders, and the communities in which we operate. The activities and timings for engagement with key stakeholders were adapted so that the programme could continue to be delivered remotely, without any face-to-face contact. The consequence of these changes, and the associated impact on the work programme, has meant that much of our 1-2-1 regional stakeholder engagement, ahead of the consultation on Cycle 1, has not been possible. However, Table 3 sets out the communication activity achieved.

Between the Draft and Final plan development, we have returned to the original programme of meeting each council individually to map their opportunities as part of a more regular review which is now planned to be an annual activity.

Table 3 – Overview of engagement at each stage

Programme	Activities	Engagement purpose	Engagement outcomes
Strategic context	Customer Research	To gain an understanding of customers' awareness and understanding of drainage and wastewater; the level of service that customers expect, and customers' views on our 25-year plan for drainage and wastewater.	Awareness raising regarding the DWMP. An understanding of customer knowledge of drainage and wastewater and its future challenges. An understanding of customers' expectations for their drainage and wastewater service for the next 25 years.
	Emails to L1 and L2 stakeholders Meetings with L1 and L2 stakeholders Presentations to L1 and L2 stakeholders Website	Setting the direction and explaining the purpose of the DWMP and wastewater management, and the important role which stakeholders can play in its development. This will also be an opportunity to begin to understand and identify future trends such as population growth, economy, and climate change.	Awareness raising regarding the DWMP. Confirmation of specific stakeholder contacts within each organisation. Initial understanding of the most engaged stakeholders. Production of Strategic Context Customer Overview document.
Risk and issues (Baseline Risk and Vulnerability Assessment – BRAVA)	Joint working meetings and workshops with L1 and L2 stakeholders Presentations to L1 and L2 stakeholders Website	Discussing outputs from the Baseline Risk and Vulnerability Assessment and understanding if/where this aligns with stakeholder plans and policies.	Agreed areas of drainage and wastewater risk, now and in the future. Initial understanding of where and how Welsh Water and stakeholders may be able to work together to solve shared problems. Production of 'Where and How we want to work with you document.
Options	Meetings and workshops with L1 and L2 stakeholders Presentations to L1 and L2 stakeholders	Discussing and characterising the risks and problems previously identified in more detail and defining potential solutions to those problems. Environmental Assessment on the preferred options.	Mapping of different drainage and wastewater options. Managing expectations as to the realistic timescales of potential solutions. Understanding of opportunities which will require collaboration and/or co-funding.

Programme	Activities	Engagement purpose	Engagement outcomes
Action Plan: (Optimised Plan and Investment)	Presentations to L1 and L2 stakeholders	Review of previous risk and options work undertaken, and how this is to be reflected in the final draft DWMP. Review of DWMP investment solutions and priorities across different DWMP cycles.	Early understanding of overall feedback on the DWMP and progress made. Consensus on investment priorities and how this will be implemented through the DWMP.
Draft DWMP Strategic Environmental Assessment and Habitat Regulations Assessment and Consultation	A 10-week public consultation on the draft DWMP. Open to all stakeholders and the public.	An opportunity to provide formal comment on the plans, including assessment work undertaken and identification of options.	Collation and analysis of formal responses received to the DWMP consultation from all stakeholders. Understanding and reiteration of key issues and concerns from stakeholders regarding drainage and wastewater management.

Figure 18 and Figure 19 are two examples of outputs from the engagement activity.

The Strategic Context Document (DCWW, 2018) was used by the DWMP Planning Team as an introduction to the plans timelines and objectives.

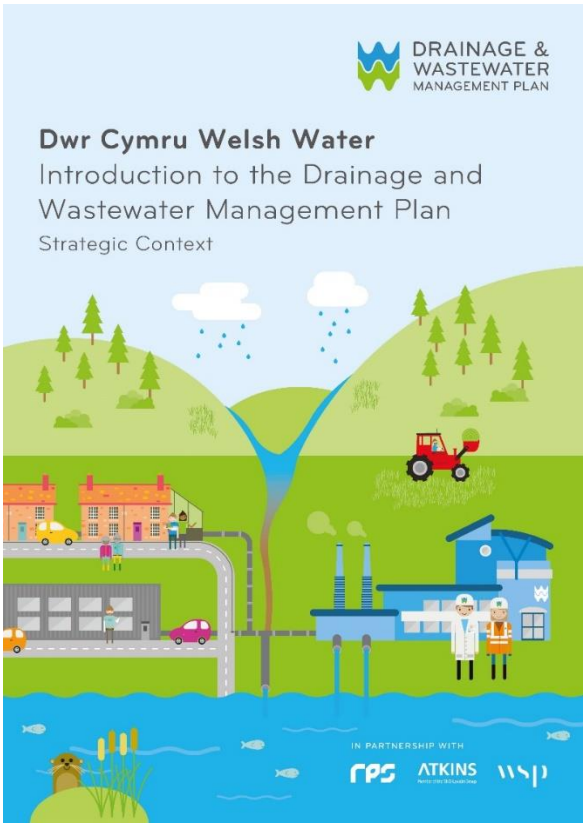

Figure 18 – DWMP Strategic context document

The ‘How and where we want to work with you’ document (Water, D. C., 2021) was produced following engagement with stakeholders at the BRAVA stage.

The document highlights the areas and risk themes identified from the baseline risk and vulnerability assessment. This enabled stakeholders to identify areas where they can work with us to start addressing future risks and reducing the effects of climate change.

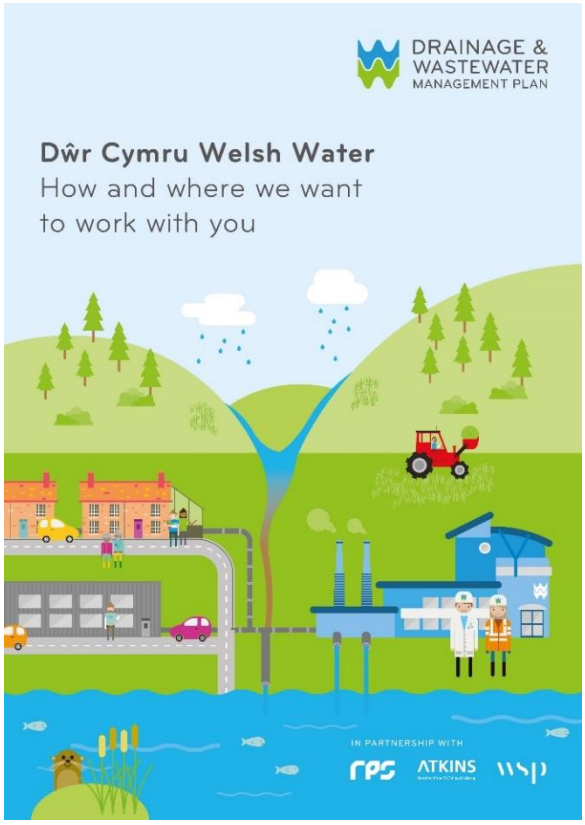

Figure 19 – ‘How and where we want to work with you’ document

One of the challenges in delivering the regional engagement activity in Wales was the lack of a Catchment Based Approach (CaBA). In England, this approach provides an existing platform for dialogue between organisations involved in the water environment.

A trial started in June 2021 with Isle of Anglesey County Council, aimed at developing a regional Project Board (now Programme Board), through which decisions on collaborative investigation and delivery could be made in the interests of water quantity (flooding), water quality (pollution) and asset resilience (coastal and other pressures). The group continues to operate and involves the local authority, with NRW joining when needed. Our aim in Cycle 2 is to create similar joint working arrangements through the set-up and repurposing of Strategic Management Forums and programme boards across Wales.

3.6 Next Steps

It is important that the DWMP complements and integrates with other existing plans and strategies that manage drainage and environmental quality. We understand that DWMPs will only fully realise their potential by working in partnership with key stakeholders, both at strategic and local levels.

We will continue to work with our key stakeholders, interest groups and customers to ensure we understand and consider their perspectives and views and provide them with what they need to know to enable them to deliver informed feedback.

During the first cycle of the DWMP, we engaged primarily with economic and environmental regulators, Lead Local Flood Authorities (LLFAs), Risk Management Authorities (RMAs), consumer councils and interest groups. Stakeholders provided invaluable guidance and advice, and these relationships will be continued throughout the consultation process. In the next cycle of the Plan, we will expand our engagement with Natural Resources Wales (NRW) and set up ongoing engagement with Environmental Non-Governmental Organisations. This will enable us to work together with relevant parties to identify and develop environmental solutions as part of the DWMP.

Our aim during the next cycle of the DWMP is to work more closely and directly with customers through both information and educational campaigns and via community projects. We are currently working with local authorities to identify areas we can work together to improve the drainage issues locally. Once these areas have been identified, we plan to set up Programme Boards to work with communities to develop and implement solutions to local pollution and flooding issues.

We will engage with all stakeholders at the end of every stage of the Plan to gain their input and agree next steps.

4 Risk – Catchment Vulnerability and Risk

4.1 Introduction

In the PR19 Framework and Methodology (Ofwat, 2017), Ofwat established a new requirement for annual reporting to provide a measure of the resilience of sewerage undertaker's drainage systems to extreme wet weather. An outline of how water and sewerage companies might assess how resilient their wastewater networks are was developed by Atkins "Developing and Trialling Wastewater Resilience Metrics Final Report" in 2017 (Atkins, 2017). This report provides a metric for measuring the resilience of the wastewater system to the specific threat of sewer flooding from a 1 in 50-year return period storm.

During the 2019 price review, WASCs produced resilience estimates based on a variety of different approaches based on Atkins' principles. The Atkins methodology was applied differently across the sector; as such, it was impossible to establish industry baseline figures for resilience. Water UK held a meeting on 'Consistency of Reporting for the Common Performance Measure (resilience metric)' in February 2019, and all companies agreed to align with the Atkins report, particularly where suitable models were unavailable. This led to the addition of Catchment Vulnerability Assessments to the process.

4.2 Methodology

We have developed a set of parameters to measure resilience, drawing on a wide range of data sources including GIS layers, incident datasets, and telemetry data. We have used the Aktins proposed metric of a 1 in 50-year storm return period for all wastewater hydraulic models that were previously verified as part of the development of our sustainable drainage plans (SDPs). By using pseudo 2D flood routing methods, the 1 in 50-year return period was also used to produce exceedance flood routing.

After overlaying these flood paths on background maps, we were able to estimate the percentage of the population at sewer flooding risk. For catchments where current hydraulic models were not available, the results were extrapolated across the whole region.

The final resilience metric from this analysis is expressed as number of (or percentage of) customers at risk to a 1 in 50-year flooding event. The metric also forms part of the Risk Based Catchment Screening (RBCS) as a Tier 2 metric for determining which Level 3 catchments should be assigned a Baseline Risk and Vulnerability Assessment (BRAVA).

The 16 vulnerability criteria (or metrics/ assessment parameters), labelled A to P, are provided in.

Table 4.

Table 4 – Vulnerability parameters

Assessment Metric / Parameter	Vulnerability Description
A	General catchment geographic topography funnelling all flows into one area
B	Catchments with a rapid response
C	Unknown asset data
D	Only drainage system in catchment / high proportion of combined sewers
E	Sewer flooding risk from historic reported incidents
F	Repeated blockage risk from historic reported incidents
G	Urban density (high population concentration)
H	Proximity to sea / river level
I	Large complex networks with many dependencies
J	Dependence on pumping
K	Proximity to water table
L	Growth potential (unplanned)
M	Consequence of flood risk management by others
N	Growth potential (planned)
O	Catchments with a slow response - flat sewers and septicity
P	Where no key issues identified

The Atkins guidance has been interpreted for use, as well as the process of assessing each metric. There is a detailed description of each vulnerability criterion, the vulnerability grade assigned to that criterion, and the detailed description provided by Atkins to assist the assessment. Next, the detailed methodology and criteria for scoring is considered.

4.3 Outputs

Outputs of the Catchment Vulnerability Assessment (CVA) are captured as a report spreadsheet, which has been formatted to align with OFWAT's reporting requirements, as of April 2019. This spreadsheet provides an overview of the results of the catchment assessments against each of the metrics, and the assessed vulnerability grade.

The grade is derived from the maximum vulnerability assigned by evaluating each of the 16 metrics for each catchment. The results have been integrated into the resilience metrics, and the risk-based catchment screening process of the DWMP.

5 Risk – Risk Based Catchment Screening

5.1 Introduction

Following the process of setting out the Strategic Context and understanding key drivers of the DWMP, the first stage of the risk assessment process, or 'Understanding the problem', is a high-level **Risk Based Catchment Screening** (RBCS).

The RBCS identifies which sewerage catchments are likely to be most vulnerable to future changes. It provides an initial screening of all catchments using existing quantitative and qualitative data to determine the assessment level required at the next stage.

5.2 Methodology

This series of metrics provide an indication of the environmental and customer impact of the sewerage and drainage in the area. These results are then aggregated against the 106 L3 TPUs. These performance indicators are detailed in Table 5 below.

Table 5 – RBCS performance indicator metrics

Number	Performance Indicator (RBCS metric)
1	Catchment Characterisation (*Tier 2*)
2	Intermittent discharges impact on bathing or shellfish waters
3	Continuous or intermittent discharges impact upon other discharge to sensitive waters (Part A)
4	Continuous or intermittent discharges impact upon other discharge to sensitive receiving waters (Part B) (*Tier 2*)
5	Storm Overflow Assessment Framework (SOAF)
6	Capacity Assessment Framework (CAF)
7	Internal Sewer Flooding
8	External Sewer Flooding
9	Pollution Incidents (categories 1, 2 and 3)
10	WwTW Quality compliance
11	WwTW Dry Weather Flow compliance
12	Storm overflows
13	Risks from interdependencies between RMA drainage systems
14	Planned residential new development
15	The Water Industry National Environment Programme (WINEP / NEP)
16	Sewer Collapses
17	Sewer Blockages
18	Bespoke Indicators* (*Tier 2*)

Tier 2 - Indicators have been classified into two tiers, providing a mechanism to differentiate between the priority of each indicator tier when considering whether further assessment is justified (with all other indicators being 'first tier').

*Bespoke indicators (Metric 18) will be included during Cycle 2.

Each metric was then assessed following the approach set out in the DWMP Framework.

5.3 Outputs

The completed RBCS spreadsheet is the primary assessment output. This provides a list of the catchments which should proceed to BRAVA, and detail on all triggered metrics for each catchment in a tabular format. This provides the starting point for BRAVA requirements at all TPUs.

Following three iterations of the process, all **106 L3 TPUs have been progressed to BRAVA,** having triggered sufficient screening metrics.

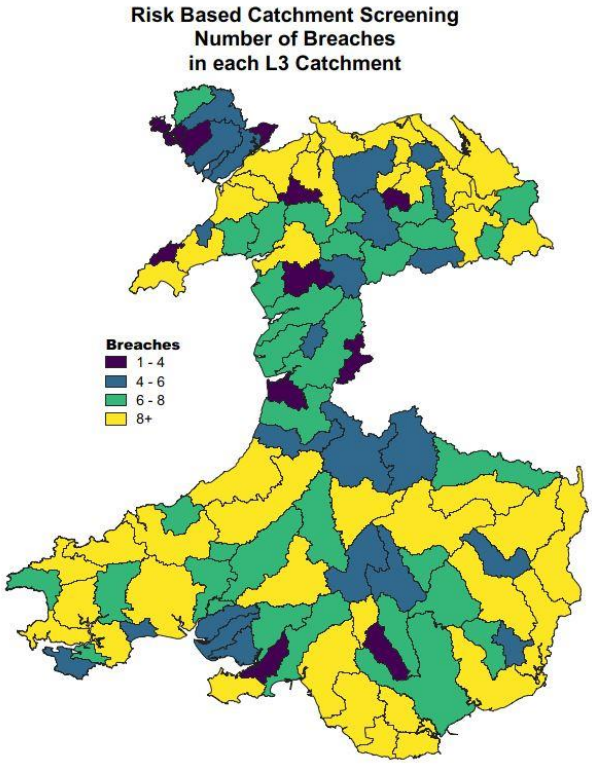

Figure 20 – RBCS L3 catchment breaches

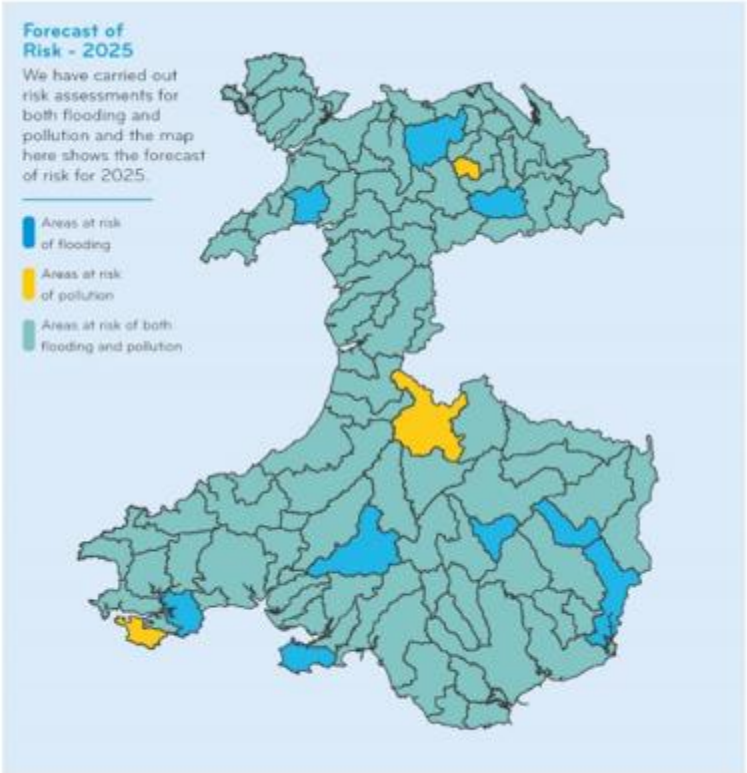

Figure 21 – Forecast Risk 2025

5.4 Future recommendations

As part of the development of the RBCS process, the following items have been identified which will influence this stage of the DWMP within future cycles:

- **Frequency of Iterations** – The results from the Cyle 1 annual assessments suggest no discernible difference in L3 catchment triggering. It is suggested that a 3-year frequency for this assessment will align with data and trends.
- **Catchment Triggering** – Triggering all 106 L3 catchments places a burden on the BRAVA process. For Cycle 2, it is suggested that there is a review of triggering thresholds to enable enhanced prioritisation. It is noted though that while the DWMP24 continued OFWAT indicated that the programme of work needed to be more encompassing.
- **Pollution extension** – Inclusion of Category 3 incidents to support better understanding of performance.
- **Improved RMA Data** – Enhancing the data relating to other RMA sites will provide a more robust understanding of RMA interactions and potential collaborative risks.

6 Risk – Baseline Risk and Vulnerability Assessment

6.1 Introduction

In the DWMP process, Baseline Risk and Vulnerability Assessment (BRAVA) follows the Risk-Based Catchment Screening (RBCS) procedure that first identified which catchments require investigation. Its objectives are to:

1. Review the performance of the current wastewater and drainage system.
2. Investigate the broader resilience concerns in the highlighted catchments.

The BRAVA process evaluates system performance against 'baseline' and future planning scenarios to 2050, with a view to understand the risk of service failure, and when it is most likely to happen (under chronic stresses or acute events).

There are a series of key steps within the methodology which define the level of input and assessment required at this stage, determining both the **complexity of the assessment,** and ultimately **informing the level of optioneering required**.

The cyclical nature of the DWMP allows us to monitor change. During each five-year DWMP planning cycle, we will update our risk assessments (BRAVA and problem characterisation) to determine if the current approach for catchments needs to change.

There are some risks that have not been considered in the first cycle of the DWMP for example odour problems at specific assets. This is intended to focus efforts on the most impactful risks, however we understand that some of these risks are significant issues for certain customers and will look to expand the scope of risks we look to address in future cycles.

6.2 Methodology

BRAVA is made up of two stages: An initial problem characterisation followed by the BRAVA assessment itself. The following paragraphs explain these stages.

6.2.1 *Preliminary problem characterisation*

The BRAVA employs a tiered approach to ensure the level of investigation in each catchment is appropriate to the availability of data and complexity of the challenges identified in the RBCS. **Preliminary Problem Characterisation** (PPC) is the first step of the process and uses a **Preliminary Strategic Needs Score** (PSNS), and a Population Growth Uncertainty Score (GUS), to determine a Preliminary Problem Characterisation Score via a decision matrix. This determines the complexity of the BRAVA assessment undertaken within the given catchment, as shown in Table 6 below.

Table 6 – Preliminary problem characterisation decision matrix, based on DWMP Framework Appendix C, Table C-1 and BRAVA level mapping

			Preliminary Strategic Needs Score			
			Negligible	Small	Medium	Large
			1-2	3-4	5-6	7-8
Growth Uncertainty Score	High	± >10,000 population	Standard	Extended	Complex	Complex
	Medium	± 5000-10,000 population	Standard	Standard	Extended	Extended
	Low	±<5000 population	Standard	Standard	Standard	Standard

The focus of this score is to understand the level of demand within the catchment, by combining growth with the performance challenges faced within the catchment and equating it to a level of BRAVA complexity (Standard, Extended, Complex).

6.2.2 *BRAVA Assessment*

Following on from the allocation of an initial level of BRAVA assessment from the PPC, we have decided to further sub-divide the Standard assessment into two levels: **Standard non-Modelled** and **Standard Modelled**. This formalises a level of investigation that is performed in catchments where there is less accessible data, or where tools to support modelling decisions are unavailable.

All catchments had Standard non-Modelled assessments undertaken to provide a consistent baseline across the entire region. Catchments with models available had additional processes undertaken, with a focus on catchments with historical internal flooding issues. The requirement for non-modelled assessments highlights a development need to improve model coverage.

Table 7 – BRAVA Levels

BRAVA Level	Description
Standard	**Non-modelled** No decision support tools (DSTs) are available, assessment is based on available data and engineering judgement.
	Modelled DSTs are available to produce modelled results to forecast future risk for some planning objectives. A central estimate of growth is applied.
Extended	Run standard BRAVA DST modelled scenarios but also apply ±30% uplift on growth projections to address uncertainties.
Complex	Run standard and extended BRAVA modelled scenarios but also multiple climate change uplifts, bespoke growth and creep scenarios defined in consultation with L2 SPG. Examples of the types of scenarios which may be proposed include: ± % climate change in line with local upper and lower estimates. Full build out rate for predicted growth.

The summary of L4 catchment allocation to a BRAVA assessment can be seen in Table 8 below. This data is also summarised in Level 3 and Level 2.

Table 8 – BRAVA Allocations

No BRAVA	Standard Non-Modelled	Standard Modelled	Extended	Complex
37	606	172	10	0

To support prioritisation as part of the BRAVA stage across our operating area, all catchments have undergone an additional assessment to generate a priority allocation score. This is based on a series of performance critical planning objectives, and an allocation against whether it is a main priority driver, a secondary priority driver or not a driver. The results of this assessment can be seen below.

Table 9 – BRAVA Priority Level 4 catchment allocation

	Hydraulic modelling programme for cycle 1 of DWMP						
	Priority 1	Priority 2	Priority 3	Priority 4	Priority 5	Priority 6	Priority 7
Number of catchments	25	106	51	7	17	592	37

With these considerations, a score of 0-2 is allocated for each catchment based on the likelihood of achieving the planning objective targets. This provides an overall score for each catchment against all planning objectives.

As part of the BRAVA stage, and the future time horizons under investigation, there are a series of strategic considerations which are included within the assessments:

- **Population Growth and Development** – Growth forecast and specific development sites from local plans are included within the various time horizon scenarios. This ensures the impact of future growth is included within assessment.
- **Climate Change** – The principal impact of changing rainfall patterns is considered within BRAVA assessments, with additional consideration when required for additional factors. These factors include sea level and tidal range.
- **Urban Creep** – Increased im-permeability, caused by a change in land allocation at property level (e.g., paving over a front garden or a property extension) is included based on industry standard methodologies.

6.2.3 *Outputs*

Table 10 below gives an example of the outputs from the BRAVA stage for two planning objectives and 5 L3 catchments.

Table 10 – Example BRAVA output across two planning objectives

L3 Catchment	WwTW Compliance					Waste Pollution Incidents HO				
	2020	2025	2030	2040	2050	2020	2025	2030	2040	2050
Aeron - confluence with Gwili to tidal limit	0	0	0	0	0	2	2	2	2	2
Afan - confluence with Pelenna to tidal limit	1	1	1	1	1	2	2	2	2	2
Afon Chwefru - source to conf R Irfon	2	2	2	2	2	2	2	2	2	2
Afon Llynfi - conf Dulas Bk to conf R Wye	0	0	0	0	0	2	2	2	2	2
Afon Lwyd - conf Dowlais Bk to Pont Sadwrn	0	0	0	0	0	1	2	2	2	2

The results were also used to generate **opportunity maps**, identifying regions where specific challenges had been identified and there was an opportunity for collaboration with local stakeholders.

6.2.4 *Strategic picture*

Whilst individual assessments have been undertaken at L4/L3 catchment level, the indication of whether we will meet its targets over the planning periods can be generated, providing that strategic insight into future risk. Table 11 below provides the results summary. The analysis shows that without solutions in AMP7 to AMP12 the PR19 targets will not be met. Please note

this assessment has been carried out prior to AMP7 being delivered and no correction has been made to solutions that are programmed to be delivered before 2025. What this means is that investment is required to ensure that we deliver the improvements that customers support. This also highlights that from a planning perspective the analysis of Risk will need to be updated during the process to take account of business planning updates which could compromise information provided at an earlier stage in the process. During cycle 1 the National Infrastructure commission (NIC) utilised the outputs from BRAVA, however the targets being created for PR24 may or may not change the below results, but would happen too late to be incorporated into any Risk publication at stage 2.

Table 11 – Results summary

	Do the BRAVA results show that the company will meet its PR19 targets? Yes /No		
	2025	2030	2050
Internal Flooding	No	No	No
Pollution	No	No	No
External Flooding	No	No	No
Sewer Collapse	No	No	No
WSC	No	No	No
Asset Resilience Wastewater (above ground)	Yes	No	No
Asset Resilience Wastewater (below ground)	No	No	No

7 Risk – Final Problem Characterisation

7.1 Introduction

Final Problem Characterisation (FPC) seeks to ensure that the approach to options development and appraisal processes are appropriate and proportionate. In a similar approach to the method used in PPC, FPC establishes a **Final Strategic Needs Score** (FSNS) and a **Complexity Factor Score** (CFS) which are combined via a decision matrix to determine the **Final Problem Characterisation Score** (FPCS) and ultimately the optioneering approach within the Options Development and Appraisal stage.

7.2 Methodology

The first stage is the calculation of a FSNS which describes the magnitude of the problem. The FSNS is established for each theme at near/medium term and long term. Using the guidance, this is based on the following questions:

- What is the level of concern that, without intervention, will impact planning objectives related to Demand?
- What is the level of concern that, without intervention, will impact planning objectives related to Supply?

The BRAVA scores for each catchment have been used as the best available proxy to answer these questions within Cycle 1 of the DWMP, given that the BRAVA score indicates the scale of problem within the catchment.

The Second stage in the FPC is an assessment of the complexity factors which influence how challenging the problems are to solve. This challenge is represented by the CFS. The assessment explores the risks and vulnerabilities within the DWMP. The goal is to identify whether these complicating factors, alongside the overall level of strategic risk, should lead us beyond standard planning approaches. The resulting CFS provides a general direction for developing suitable options.

The focus for the complexity factor assessment is risks associated with **supply** and **demand** in line with the first stage of the FPC process. The questions in the complexity factors assessment use a scale of significance to characterise their answers.

The questions which address demand risks can be summarised as:

- What is the level of concern about near/medium, or long-term, system performance, due to pressures from climate change, new development, and urban creep?
- To what extent is the uncertainty associated with the socioeconomic forecasts a cause for concern to the required level of investment?

The questions which address supply risks can be summarised as:

- What is the level of concern about near/medium, or long-term system performance, based on historical performance or unexperienced (but likely) future circumstances?
- What is the level of concern about near/medium, or long-term system performance, based on impacts of; asset deterioration, system misuse; data availability?
- What is the level of concern about potential changes to the regulatory requirement for newly emergent contaminants entering the wastewater system?
- Are there opportunities for cross catchment interventions which increase capacity or address supply needs?

In a similar approach to FSNS, the CFS is derived from the sum of the maximum scores from each of the above questions in each time horizon (near/medium and long term).

The FSNS and CFS are concatenated via a decision matrix to generate a Final Problem Characterisation Score (FPCS) which is used to in the optioneering stage. This can be seen in Table 12 below.

Table 12 – Problem characterisation decision matrix

		Strategic needs score ("How big is the problem?")			
		Negligible	Small	Medium	Large
		1-2	3-4	5-6	7-8
Complexity factors score ("How difficult is it to solve")	High (8+)	Low	Medium	High	High
	Medium (5-7)	Low	Low	Medium	Medium
	Low (<4)	Low	Low	Low	Medium

The allocated FPCS (low, medium, and high) indicates the categorisation of options development approaches suitable to the scale of challenge identified:

Low / Standard (green) – process defaults to companies existing investment planning practices to maintain existing levels of service.

Medium / Extended (amber) – the options development and appraisals process will build upon the standard processes to provide extended analytic approaches in supporting investment planning practices.

High / Complex (red) – the options development and appraisal process are undertaken considering a wide range of tools and approaches to explore.

7.3 Outputs

The results of the problem characterisation can be summarised at the different DWMP levels for both the catchment, but also for each of the planning themes. The full results have been summarised for the company in Table 13 below.

Table 13 – Company-wide problem characterisation results

Theme	Quality	Quantity	Resilience	Maintenance
High - Complex Optioneering Option	3	0	3	2
Medium – Extended Optioneering Option	41	5	16	25
Low - Standard Optioneering Option	467	478	8	623
No Issue	235	245	806	70
Monitoring	82	98	1	97
DST Development	7	9	1	18

Please note that an area characterised appears in each column once.

7.3.1 *How does the supply demand approach, worst risk approach and RBCS/BRAVA approach compare?*

As a comparative example, Conwy L2 area was highlighted in the supply demand capacity assessment, as a Level 2 area with a shortfall in either network or treatment capacity. The result of that assessment shows that it should be the first strategic (L2) area to focus on going forward.

The same Level 2 area was also highlighted in the Problem Characterisation (PC) method. However, in terms of PC, the DWMP process ranks risks into Standard, Enhanced and Complex, with a key element of the ranking being driven by population size and growth risk. Both the PC and Supply Demand methods identified the Conwy Level 2 area as a risk but, because the Level 2 catchment was not ranked as Enhanced and Complex, it was not taken forward to options development.

Nevertheless, we did find that, because the Supply Demand capacity assessment uses the same assessment to drill down to level 3, it provides added value at a tactical level, which further refines the geographical area to focus on.

The worst risk approach has helped us identify where to prioritise the efforts in Options Development and Appraisal (ODA). Through the worst risk approach, we have found that the focus for Conwy and other L2 areas has not been on the greatest risk but the greatest improvement to both customers and the environment. We have also concluded that the RBCS and BRAVA assess risk versus planning objectives but the Environment Act 2021 isn't asking the company to assess planning risk via objectives, but it is asking each company to assess its capacity risk to understand the level of risk in terms of pure capacity in the network assets, Treatment assets and the environment; Our recommendation would be to use the Supply Demand tool to assess this going forward, and to ensure that each level 2 and level 3 remains positive.

8 Options Development and Appraisal – Building our Plan

The options stage sets out the scope, cost and likely timing of interventions that could be chosen to achieve long-term company objectives. It assesses the value of different options, in terms of impact on flooding and pollution, but also their wider benefits to nature and to people.

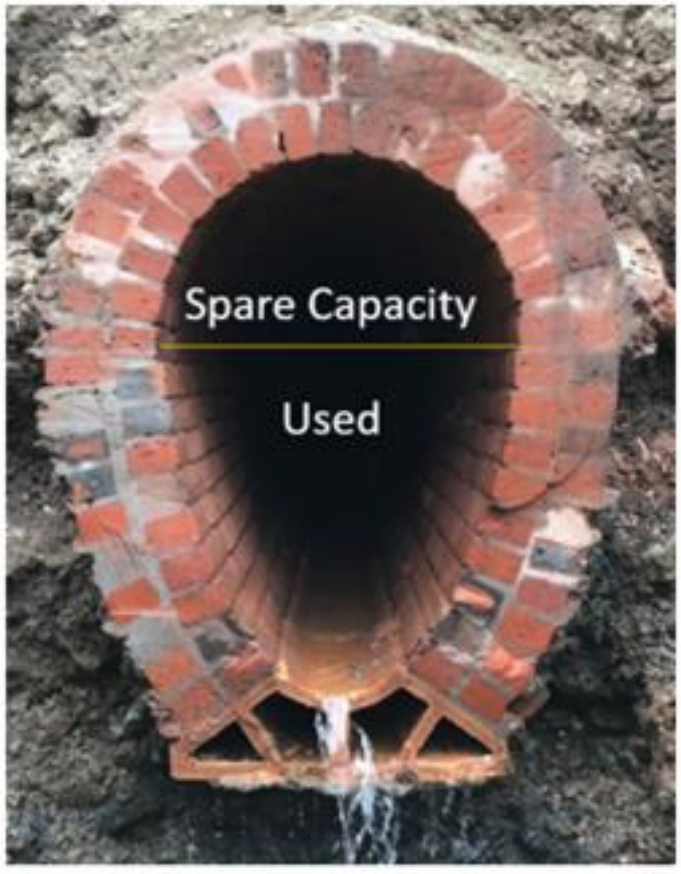

Figure 22 – Illustration of the capacity of a typical sewer

8.1 Methodology

8.1.1 *Wastewater Networks Assessment*

8.1.1.1 Options Development Appraisal – The DWMP Framework Strategy

Options development drives towards best value or preferred options that could feasibly address each identified risk. Across catchments where risks have been identified consistency in approach is driven by the options development pathway:

- **Generic Options** – Developed within the DWMP framework and expanded to a list of 85 generic sub-options considering future stakeholder requests. This is referred to as the **Options Long List**.
- **Unconstrained Options** – This involved peer review of the Options Long List for political and customer/stakeholder acceptability, filtering out options that had one of these 'red flag' criteria. Remaining options were then scored against service measures based on their ability to solve the problem.
- **Constrained Options** – Challenging the unconstrained list to provide a catchment level toolkit that has options that: fix the problem; are applicable at WwTW level; suitable for catchment characteristics; and does the right thing.

- **Feasible Options** – Additional criteria are applied to the constrained list ensuring acceptability for the specific catchment in terms of feasibility and a wider understanding of the operational aspects of an option – 'does the option impact on wider compliance risk in the system?' and finally an environmental assessment and an understanding of best value options through collaboration, driving environmental net gain. This is referred to as the **Options Short List**.
- **Preferred Options** – At localised risk areas these are the options developed for each risk cluster and TOTEX calculated, with additional wider benefits assessment through B£ST. Selected options are based on Average Incremental Cost (AIC) or Average Increment and Social cost (AISC), with additional HRA and SEA review.

8.1.1.2 Developing the Plan – An options development approach for all catchments

Based on assessments through BRAVA and Problem Characterisation, risk areas that required option development is categorised within one of the following:

- **Standard** – follow company's 'existing investment planning practices to maintain or enhance existing levels of service.' It was anticipated that a 'standard' approach would be applicable to most tactical planning units.
- **Extended and Enhanced** – 'build upon standard processes to provide extended analytical approaches.'
- **Complex** – 'Uncertainties in the forecasts. The likely complexity of the interventions required to meet all planning objective exceedances is high involving multiple options and/or stakeholders and the potential lead in times are long.' An adaptive pathway approach may be applicable in complex risk areas. **Note, no Complex Optioneering was identified.**

Our approach to options development has four elements which test the suitability of the approach:

- **Area assessment - Long-list of options to address all risks but mainly focusing on flooding and pollution risk** - Through consultation with stakeholders, we have developed a long list of generic options that could address flooding and pollution risks. However, the characteristics of each treatment works catchment, including the specific issues within that catchment, will influence the most suitable options.
- **Resilience for growth** – We carried out a regionwide assessment of current and future asset capacity to ensure that our networks are not a blocker to economic development in Wales now, and in the future.
- **Set the catchment strategy** – These tests have set our long-term direction for each catchment, assessing what type of options are likely to have the greatest benefit in each catchment, with a focus on sustainable drainage
- **Localised option tests** – Where we have a known, significant risk, we have spent more time testing and refining options, aligned to long term catchment strategy, providing a higher level of confidence in the likely scale of investment needed in priority areas.
- **Strategic assessment -** Capacity risk for assets such as pipes, rising mains and pumps.
- **Strategic Green opportunity assessment –** Developed opportunities to work with 3rd party stakeholders such as Local authorities.

BRAVA drives catchment performance based on current PR19 planning objectives, but evolving pressures such as increased focus on overflow performance and the new Environment Act can shift targets. To support these shifts, '**reference option'** costs were

developed to inform all stakeholders the likely cost to hit future levels of service, with a focus on the key network performance metrics of flooding and overflow discharges. This assessment included:

- **Storm overflow assessment** - Calculating required storage volume to reduce spill frequency from storm overflows for a range of scenarios (up to removing all spills) using hydraulic modelling which was then costed to support comparative assessment.
- **Sewer flooding assessment** - Calculation of required storage volume for storage of network sewer escapes for a range of scenarios and time horizons using hydraulic model outputs, which was then costed to support comparative assessment.
- **Non modelled assessment** – extrapolating the results from the modelled catchments storm overflow and sewer flooding assessments to provide a holistic view of cost

8.1.1.3 Setting the catchment strategy – Defining the pathway

We have assessed what type of options are likely to have the greatest benefit in each catchment. Infiltration removal may be effective in some catchments, whereas Sustainable Drainage Systems (SuDS) might be more effective in others. These tests focused on the whole catchment, not localised risks, and enabled us to see which options should form part of the strategy for an individual catchment – termed its 'pathway'.

To achieve this, the feasible options were grouped into option 'bins', based on the model test required. Six 'bins' were created to cover all the options on the unconstrained options list. The six high level bins were contributing area/inflow removal, Increased conveyance, smart networks, bespoke tests – not covered by other bins and no modelling (not feasible to model using current decision support tools). These were then further reduced to a list which could be rapidly tested using hydraulic models, which represented: percentage reduction in impermeable area connected to the sewerage network (10, 25 & 50% removal), percentage removal of base flow infiltration (50%), per capita consumption reduction (100 l/h/d target) and percentage reduction in trade flow (25%).

These scenarios were tested using current and 2030/2050 growth creep and climate change scenarios, demonstrating the improvement in performance within the catchments assessed. The 'Feasible Options Impact Assessment Tool' was used to review the effectiveness of options against a range of service measures, providing an overview of the impact of the proposed option bins on the catchment's performance against objectives for flooding and pollution.

Where hydraulic models were not available, a 'surrogate' approach was required. This non-modelled approach was run on all catchments using MCERT data, consent/permit data, infiltration assessments and theoretical impermeable area connection within catchments, applying a total volumetric reduction based on these two sources of information in line with the option bins tested in hydraulic models.

Within specific high priority risk areas (containing either worst-served customers or overflows spilling to SACs), it was agreed that option development at the tactical level would be steered by the pathway, but not constrained by it. Engineering judgement could be used to deviate from the overarching strategy; catchment knowledge could be used to identify a more feasible or beneficial approach in a specific zone. However, the catchment pathway guides the order of option testing. This more tactical options development approach was undertaken for all Priority 1 catchments. Options included sustainable and traditional solutions as well as a blend of the two to meet performance objectives.

8.1.2 *Methodology – Wastewater Treatment Works Assessment*

Three types of assessment have been undertaken at WwTW to support capacity assessment:

- Supply/Demand Balance - to readily assess whether our wastewater treatment works have adequate capacity now and, in the future, when reviewing consented/estimated flows under both dry weather and wet weather conditions.
- WwTW Capacity Assessment Tool – Focussing on Priority 1 catchments and reviewing the capacity of each part of the treatment stream with incoming flow at the site.
- WwTW Environmental Resilience – Exploring the use of SAGIS to decide the type of future to be planned for from a catchment perspective, incorporating wider impacts on water quality within river catchments.

An example of a nature-based solution that could address a Treatment Works risk is shown in Figure 23. It shows the new wetland jointly developed and now owned by Herefordshire Council, and aims to reduce phosphorus, before returning the effluent to the local river. It is the 1st wetland of its kind that will be generating 'Nutrient Credits' for local housing sector. The aim of this particular wetland is to deliver betterment to the river Wye to return the Wye back to "favourable status".

Figure 23 – An example of a Nature based solution delivered on the river Wye

8.1.3 *Methodology – Rising Main, Pumps and Pipes*

The strategic assessment tool Infoasset Manager has been used to indicate the need for a detailed investigation locally. This assessment has been carried out on Network pipes to understand capacity without storage for Dry weather flow and for multiples of rainfall such as 3 and 6x DWF (Which is similar to Formula A). A similar strategic assessment has been carried out to assess the capacity of Rising mains, Pump requirements and the consequence of failure of an asset.

8.1.4 *Customer Management*

The company has a baseline programme of customer engagement that provides company level and sometimes more local level information and water efficiency programmes. The DWMP has recognised that more targeted or enhanced messages could be required in the future and work has been undertaken to assess the cost of additional, more regular information packages.

Water efficiency measures were reviewed and it was decided that at this point the current base activities are sufficient. Water efficiency communications and solutions are available to all customers. No enhanced solutions have been put forward during this stage of development of the DWMP. We will collaborate with Water Resources West to manage water efficiency.

8.2 Outputs

8.2.1 *Options Development*

The objective of the DWMP is to enable a consistent approach to the development of catchment strategy at all levels within a company. A critical part of this is the Options development journey, a process undertaken to enable targeted feasible options to be defined at a catchment level in a consistent manner, enabling feasibility as well as acceptability to be included within the process.

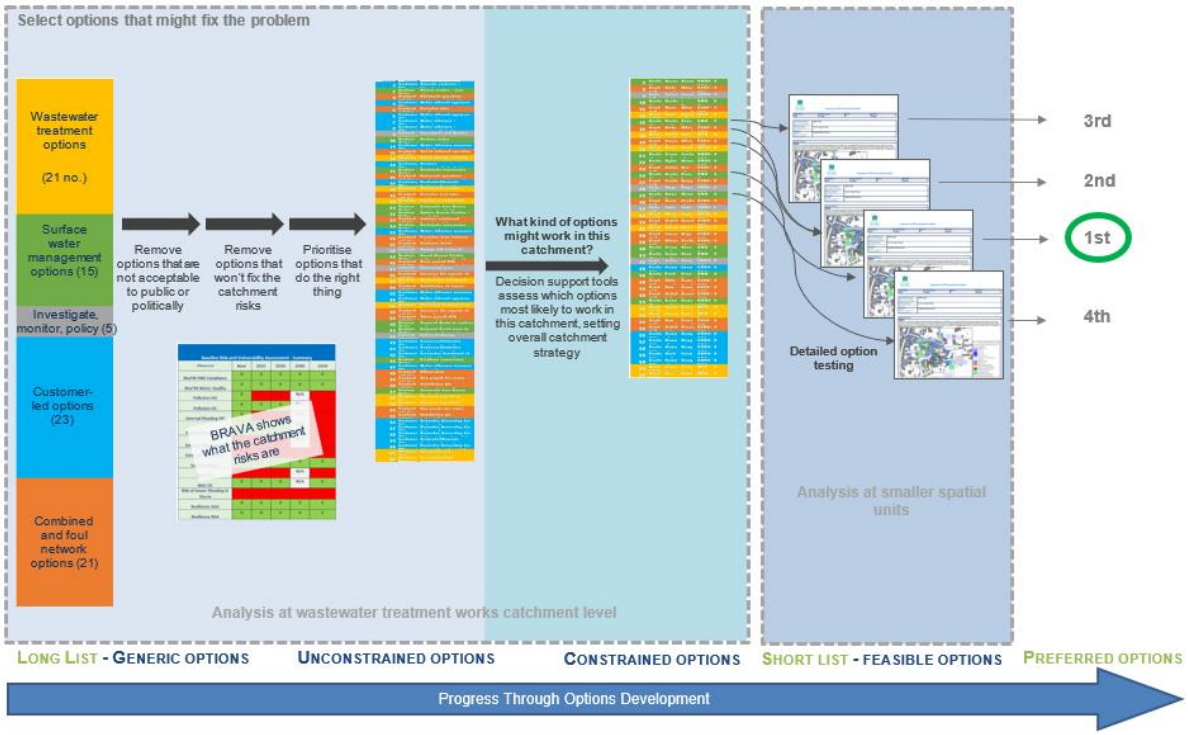

Figure 24 – Option Development Pathway

The process of working through the options development pathway (illustrated in Figure 24) is managed within the DWMP Options Screening Decision Support Tool. This spreadsheet tool helps planners to identify the options that are likely to be viable for each of the WwTW catchments in Welsh Water's operating area by working through the options development pathway to deliver a set of feasible options before a preferred set of best value options are presented for each catchment as part of the DWMP plan.

The following outline each stage of the Options Development Pathway, reviewing the definitions within the Water UK guidance and how we have delivered the refinement of the process and the options included to meet the needs of our customers and catchments. It should be noted, that to achieve certain planning objective requirements there may only be a certain number of options which are known to be feasible up front. In these cases, we have enabled these options to jump straight to the feasible 'toolkit' for those specific planning objectives.

Generic Options - As part of the development of the DWMP framework, Water UK produced a generic options list containing 43 options, which was created as a starting point for all water companies. Expanding on this, A list was developed of 200 'stakeholder friendly' requests which were likely to be made in future cycles. This generated **85 generic sub-options,** based on the original 43 provided by Water UK, forming the baseline Generic Options toolkit.

Unconstrained Options - All 85 sub options identified at the generic options stage were internally peer reviewed by our Stakeholders and each was allocated a score between 0 and 4 for 'Political Acceptability' and 'Customer and Stakeholder Acceptability', with scores of 0 demonstrating the highest level of acceptability and 4 demonstrating the lowest (i.e., 'unacceptable'). This filtering process supported the definition of the unconstrained options list.

These two screening criteria were identified as 'red flag' criteria, failure of which would prevent the sub-option being considered further down the options development pathway, resulting in exclusion from the unconstrained options list and its suitability for inclusion within a catchment strategy.

The remaining 80 unconstrained options were scored against each service measure, based on how well the option would resolve the problem. For instance, option SW05-001 (Connect roofs to surface water systems), could resolve "quantity" service measures relating to hydraulic overload, but would not resolve "maintenance" service measures which relate to other-cause issues.

Constrained Options - The unconstrained options list faced **four challenges** to determine what options can make the screened constrained options list and form the basis of the catchment level feasible option toolkit, they were:

- Does the option fix the problem?
- Is the option applicable at L4?
- Are interventions suitable based on catchment characteristics?
- Does the option do the right thing?

Feasible Options - From the constrained options stage the feasible options are defined based on an additional range of criteria which ensures acceptability in the context of the catchment as well as the ability of the option to against the planning objective requirements, including an assessment of feasibility and risk.

These options provide the catchment level toolkit used to meet planning objective requirements. Within our Processes this has been called the **Options Short List**.

Preferred Options - The selection of preferred options has been carried out at the Wastewater Treatment Works (WwTW) catchment level. The interventions that have been developed for each risk cluster within the catchment have all been collated and the Net Present Value (NPV) for the following aspects been calculated for the intervention to calculate the TOTEX of the intervention for the life cycle of the schemes.

1. CAPEX;
2. OPEX;
3. Repeat CAPEX;
4. Variable OPEX;
5. Carbon; and
6. Benefit.

In addition to the costs of intervention the NPV of the benefits calculated through B£ST have been calculated for the life cycle of the intervention; this provides a 'negative' cost.

The preferred interventions for each risk cluster have been selected based on the Annual Incremental Cost (AIC) over the lifecycle of the scheme. The preferred schemes to resolve the catchment drivers assessed, in this cycle the Worst Served Customer flooding and CSOs which spill to Special Areas of Conservation, have then been reviewed with catchment knowledge to understand if the scheme should progress forward through to Programme Appraisal. The HRA and SEA have been undertaken on each preferred option to assess if the option is likely to be blocked and scored on a Red-Amber-Green (RAG) status

8.2.2 *Developing the Plan*

Three levels of option development are outlined in the DWMP Framework. Based on assessments through BRAVA and Problem Characterisation, catchments, and the option development required is either categorised as:

Standard – follow company's 'existing investment planning practices to maintain or enhance existing levels of service.' It was anticipated that a 'standard' approach would be applicable to most catchments.

Extended or Enhanced – 'build upon standard processes to provide extended analytical approaches.'

Complex – 'Uncertainties in the forecasts … The likely complexity of the interventions required to meet all planning objective exceedances is high involving multiple options and/or stakeholders and the potential lead in times are long.' An adaptive pathway approach may be applicable in complex catchments. Note, no catchments were identified in Cycle 1 as requiring Complex optioneering, however the Long-Term Drainage Strategy for OFWAT has resulted in the assessment of 44catchments against an adaptive planning approach.

Our approach has been segregated into three separate processes aligned to the framework. For all Standard risks we have chosen to allow the current business process to address risks as part of the normal approaches to planning. It is anticipated that any NEP requirements would be addressed as part of a standard approach. We have also separated out the approach for Growth & Creep and Climate change in our network from an approach for Climate change for Surface water Management.

In this plan we will develop the ODA process of the Framework and we will test the approach using our priority catchments and then create a Climate change opportunity assessment ready to develop additional joint projects going forward.

The business-as-usual approach is aligned to the Price review process of PR19 and the improvements to business planning being made during the development of our PR24.

8.2.2.1 Our approach to options development

Network assessment - Long-list of options to address flooding and pollution risk - Even if our assets are big enough to cope with foul flows, flooding and pollution can still occur due to rainfall, infiltration, blockages, or collapses. Through consultation with stakeholders, we have developed a long list of options that could address flooding and pollution risks. However, every option will not work in every catchment. We have considered the characteristics of each treatment works catchment and the types of issues to whittle down the long list of options for each catchment.

Resilience for growth – We undertook a regionwide assessment of the capacity of every one of our pipes, pumps and treatment works for foul flows now and in future (Foul flows include flows from residential properties, commercial premises, and consented traders). To ensure that our networks are not a blocker to economic development in Wales, we need capacity for growth that has already occurred and for growth that is likely to occur in future.

Set the catchment strategy – We have assessed what type of options are likely to have the greatest benefit in each catchment. Infiltration removal may be effective in some catchments, whereas Sustainable Drainage Systems (SuDS) might be more effective in others. These tests have set our long-term direction for each catchment.

Localised option tests – Where we have a known, significant risk, we have spent more time testing and refining options. This gives us a higher level of confidence in the likely scale of investment needed in priority areas. Where practical, these localised options align with our long-term catchment strategies.

8.2.2.2 Cycle 1 Strategy – A top-down approach

The BRAVA stage of the DWMP assesses a catchment's performance against our current planning objectives. For each planning objective, each catchment is scored 0 if there are 'no known concerns', 1 if there are 'some concerns over exceedance', or 2 if there are 'significant concerns over exceedance'. A score of 2 indicates that we may fail to meet our planning objectives and that an option may need to be developed.

These scores are, however, based on current planning objectives, as set in our PR19 business plan. We recognise that external pressures, or improvements in data availability and confidence, can lead to shifting targets. For example, we have seen increasing focus on the performance of our overflows and introduction of a new Environment Act, all of which could lead to changes in our future targets.

Recognising this, we have developed **'reference option'** costs, which aim to inform Government, the company, its stakeholders and customers of the likely cost to hit different future performance targets. These will allow us to discuss what our future targets should be. Can we afford a no-spill future? Is it feasible to stop all flooding in future? When?

8.2.2.3 Scale of investment needed in our networks (reference options)

The reference option is a high-level strategic top-down approach that provides a cost to achieve different levels of service for flooding and overflow discharges across Wales. The cost is representative of the broad type of work we may need to undertake to maintain and/or improve the network.

This will provide a company-wide indicative figure quantifying the cost to achieve a no network discharge for 2050 scenario which can aid our discussions about affordability both internally and with external stakeholders.

The approach taken provides costs for incremental service improvements at L1 through to L4 and therefore comparative analysis of the cost across regions can be made.

The reference option is not meant to be directly compared with detailed options developed for individual risks, instead it is considered to set the context within which detailed options are considered.

The assessment incorporates three parts:

1. **Storm overflow assessment** - Calculating required storage volume for storage of discharge volume from storm overflows for a range of scenarios.
2. **Sewer flooding assessment** - Calculation of required storage volume for storage of network sewer escapes for a range of scenarios.
3. **Non modelled assessment** – extrapolating the results from the modelled catchments to provide a holistic view of cost

8.2.2.4 Storm Overflow Assessment

The following scenarios have been assessed in this cycle of the DWMP, for each epoch, providing indicative environmental requirements at sensitive sites for discussion with regulators and stakeholders:

- **Maintain** - No increase in discharge volume in future.
- **40 spills** - Reduce spill frequency to a maximum of 40 spills per annum in a typical year.
- **20 spills** - Reduce spill frequency to a maximum of 20 spills per annum in a typical year.
- **10 spills** - Reduce spill frequency to a maximum of 10 spills per annum in a typical year.
- **No spills** - Reduce spill frequency to 0 in a typical year across all assets, this does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.
- **No Spills to SACs** - Reduce spill frequency to 0 spills in a typical year at SACs and 40 spills at all other assets. This does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.
- **No Spills to SSSIs** - Reduce spill frequency to 0 spills in a typical year at SSSIs and 40 spills at all other assets. This does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.
- **No Spills to BW/BR** - Reduce spill frequency to 0 spills in a typical year at BW/BRs and 40 spills at all other assets. This does not mean no spills entirely as the assets will still operate to protect the upstream network from flooding in large storm events that are not expected in a typical year.

These scenarios provide an understanding of the scale of investment needed to achieve the environmental destination and are indicative of SOAF investigation thresholds and common aspirational spill performance. They are all providing evidence to support the journey that would be required to get to a zero spills catchment, however the journey and the end environmental position will differ catchment by catchment over the duration of the strategic plan. These scenarios provide an understanding of the investment needed to achieve the environmental destination which will need to be discussed with local stakeholders and customers at both catchment and strategic level.

8.2.2.5 Sewer flooding assessment

To assess the scale and associated cost of resolving all flooding across our operating areas an approach consistent with the methodology for the modelled overflow process stated above was taken for the modelled flooding assessment. The assessment was carried out using the hydraulic model representation of the catchment by running design storm events for 1-in-30 and 1-in-50-year storm intensities and identifying the flood volume at each manhole. This exercise was carried out for 2020, 2025 and 2050 design horizons. The method of assessment varied depending on the availability of models and existing model simulations.

For each flooding risk cluster identified in the catchment the cumulative storage equivalent volume was calculated for both 1-in-30 and 1-in-50-year storms for the ‘current’ scenario, then increases in flooding assessed for the 2025, and 2050 epochs. If there was no prediction of flooding from the hydraulic model at a known flooding risk cluster, then a scheme was costed at a standard model enhancement option cost prepared for the DWMP.

At a catchment level and when combined with the other modelled catchment datasets and the non–modelled approach, the output produced the flooding equivalent storage cost model. This model provides a tool for the business to use internally and with external stakeholders to convey the costs associated with mitigating flooding now and in the future across different levels of the DWMP.

8.2.2.6 Non-modelled catchments

Where a catchment is not modelled or prioritised, CSO spill frequency and flood volume results are extrapolated and applied based on the modelled catchments to generate a cost. Event Duration Monitoring (EDM) data has been used as an alternative source for spill frequency data for non-modelled catchments. Generated costs are summarised into each regional boundary (L1, L2, L3 and L4).

8.2.2.7 Prioritising option development

Final Problem characterisation prioritised only a small number of level 4 catchment via the extended and complex route. The BRAVA scoring (0 to 2) has enabled us to prioritise our catchments even further for investigations. Based on overall performance, catchments have been ranked from 1 – high priority to 7 – low priority. (See BRAVA reports for details). The first 39 catchments ranked as high priority (1) have proceeded to more detailed option testing. With the additional 5 catchments proceeding that completed the extended and complex location from final problem characterisation.

Within each priority 1 catchment, decisions still need to be made about where to invest to hit our targets. If a catchment has 'significant concerns over exceedance' (2) for hydraulic flooding, for example, which flooding should we fix first? Or should we be working towards a catchment with no flooding? Two approaches have been trialled to provide choices to our business, customers, and stakeholders (Network Options A & B).

8.2.2.8 Network Option A

This is an incremental, tactical approach designed to address risk based on the level of criticality assigned to it. A criticality classification was assigned to risk as shown the matrix shown in Table 14.

In this first cycle of the DWMP options have been developed to address priority '1' risks, and subsequent priority risks will be developed in later cycles of the DWMP.

Table 14 – Risk prioritisation

Priority	Flooding	Pollution
I (Highest)	Worst Served Customers (WSC's)	Special Areas of Conservation (SAC's) impacted
II	Reported internal flooding listed on Welsh Water's hydraulic flooding register (the Definitive Flooding List)	Sites of Special Scientific Interest impacted
III	Reported severe external flooding listed on the Definitive Flooding List	Bathing Waters impacted
IV	Reported external flooding listed on the Definitive Flooding List	Other high amenity watercourses impacted
V (Lowest)	Reported highway flooding listed on the Definitive Flooding List	Other watercourses impacted

8.2.2.9 Network Option B

This methodology is like a Water Resources Management Plan (WRMP), whereby the level of service in a prioritised drainage catchment area is assessed and options derived which ensure the entire catchment area is brought up to the same level of performance. In Cycle 1 of the DWMP the approach has been trialled in three catchments: Llannant, Gresford and Cilfynydd.

The level of service trialled has been to ensure no flooding or spills from a Combined Storm Overflow (CSO) up to and including a worst case 1 in 30-year rainfall event. Flooding from both surface water systems and from combined/foul systems has been considered. The methodology has been applied to the short-term planning horizon 2030 and the long-term planning horizon 2050 including an allowance for growth, creep and climate change based on the average emissions scenario.

We recognise that the 'option B' approach will provide huge investment costs. We are viewing this as a long-term aspiration, beyond the timeframes of the DWMP, and are considering how we might phase the required investment.

8.2.3 *Standard Options Methodology – Setting the Catchment Pathway*

Standard – process defaults to companies' existing investment planning practices to maintain or enhance existing levels of service.

This section details how we have developed options to fix issues in our wastewater networks. We have used strategic tools to assess capacity for growth across all our network. High-level assessments have allowed us to set a pathway – a vision for the types of options that should be implemented in each catchment.

8.2.3.1 Network Resilience (Creating capacity for growth)

Cycle 1 of the DWMP has focused on gathering data to better understand resilience across our network. We have developed new tools to understand how long we have available to respond in the event of an asset failure, and how much capacity we have for growth, urban creep, and climate change. The following sections explain this work.

Note that Ofwat includes financial and corporate resilience in its definition of resilience, but these are outside the scope of the DWMP at present.

Whilst it is recommended that most options follow the process outlined above a distinction is made for options to improve resilience:

'The resilience assessment will have identified key areas that will be required to be addressed. Given the hazards/consequences included in the assessment it is likely that many of the options will be non-specific (but, for example, sized to the specific catchment needs); as such, it is not considered necessary for the resilience options to undergo the same level of development and appraisal. Costs should be developed based on companies' existing costing practices. It is recommended that the options are collated at L2, to demonstrate that 'local' resilience issues have been addressed, and in the L1 DWMP documentation to demonstrate a company's overall resilience position.'

Whilst the whole DWMP assesses resilience of our network, we have focussed on specific aspects of resilience in this section– 'Environmental Resilience'.

8.2.3.2 Pipe Capacity

For every pipe, we have assessed headroom in peak and average dry weather flow conditions, and under three and six-times dry weather flow scenarios. The latter two scenarios are approximations for peak dry weather and small storms occurring in the network.

An InfoAsset database was created comprising all pipes in our network. Our GIS sewer records were imported into the database and key missing data, such as pipe invert levels, were inferred. Using scripts in GIS and SQL codes within InfoAsset, we assigned cumulative dry weather flows to every pipe. We then calculated how much pipes would need to be upsized by to ensure that they have adequate capacity.

The results are summarised in Table 15, which shows the total length of pipe to be upsized in each river basin under dry weather, three times dry weather and six times dry weather flow scenarios. The results can be used to drive more detailed investigations into areas with a lack of capacity. They furthermore indicate at a strategic level the investment required to bring our networks up to certain basic levels of service (i.e., such that they can cope with approximately 'Formula A' flows).

The InfoAsset database additionally provides a basis for assessments of asset health and consequence of failure, an example being the pumping station resilience assessment described in the following section.

Table 15 - Summary of pipe capacity assessment project results

River basin region	Total length of pipes to upsize in dry weather flow (m)	Total length of pipes to upsize in 3x dry weather flow (m)	Total length of pipes to upsize in 6x dry weather flow (m)
Wye	554	2,718	12,006
Usk	40	1,902	4,568
Teifi and North Ceredigion	5	712	2,306
Cleddau and Pembrokeshire Coastal Rivers	636	2,438	5,165
Carmarthen Bay and the Gower	444	2,157	13,087
Llyn and Eryri	37	686	7,899
Clwyd	852	2,145	3,599
Conwy	42	684	2,614
Meirionnydd	0	408	915
South-East Valleys	2,183	14,333	78,722
Tawe to Cadoxton	1,437	3,996	18,975
Dee	2,490	17,528	48,887
Ynys Mon	442	1,660	3,178
TOTAL	8,721	49,707	198,743

8.2.3.3 Pumping Station and Rising Main Capacity

The InfoAsset database created for the pipe capacity project has further been used to understand resilience of all 2463 pumping stations across our network.

The dry weather flows assigned to each pipe have been adjusted based on DWMP-estimated future populations in 2050. Each pumping station that we own has then been added to the InfoAsset database, allowing us to understand dry weather flows arriving now and estimated flows for 2050. Using industry guidance on the design of pumping stations, we can use the dry weather flow data to assess how much flow our pumps should be able to pass forward now and in 2050, and how big the associated rising mains should be.

As for the pipe capacity project, this is a step change from previous plans, which have focused on known high-risk locations, and not our entire asset base. Our goal is to compare these required capacities with performance data for our pumping stations during Cycle 2; this will help us to drive pumping station capacity assessments and to adjust that capacity with investment in line with the environmental and customer destinations planned, going forward.

8.2.4 *Setting the Catchment Strategy*

This section sets out the different assessments between the catchments that are modelled and those that are non-modelled.

8.2.4.1 Modelled Network Assessments

Hydraulic model tests were undertaken to assess which of the generic sub-options were likely to benefit a given treatment works catchment. These tests focused on the whole catchment, not localised risks, and enabled us to see which options should form part of the strategy for an individual catchment – termed its 'pathway'.

To achieve this, the feasible options were grouped into option 'bins', based on the model test required. Six bins were created to cover all the options on the unconstrained options list:

- Additional storage;
- Contributing area/inflow removal;
- Increased conveyance;
- Smart networks;
- Bespoke tests – not covered by other bins; and
- No modelling (not feasible to model using current decision support tools).

These bins were further reduced to a list which could be rapidly tested using hydraulic models. The tests were as follows:

- **10% impermeable area removal** - Reducing modelled contributing area by 10% is considered a reasonable catchment wide representation equivalent to feasible commercial/public building roof removal. The option is considered suitable for application in the short term as it is likely there will only be one stakeholder (e.g., local authority).
- **25% impermeable area removal** - Reducing modelled contributing area by 25% is considered a reasonable catchment-wide strategy equivalent to feasible highway removal. The option is considered suitable for application in the short term (2030 scenario) as it is possible there will only be one stakeholder (e.g., county council or Highways Agency). The allocation of 25% is in recognition that only a few opportunities will be realistic to achieve in the short term.
- **50% impermeable area removal** - Reducing modelled contributing area by 50% is considered a challenging catchment-wide representation equivalent to wider highway removal and private residential runoff separation. The option is considered suitable for application in the long term (2050 scenario) as it is likely there will be multiple stakeholders to liaise with.
- **50% base flow removal** - Reducing modelled baseflow by 50% is considered the maximum reduction which could be achieved by relining the public sewer network. The 50% allowance is to allow for contribution from lateral connections that will likely occur but not be feasible to reline.

- **Per capita consumption (PCC) reduction** - The reduction is applicable to long-term planning only due to the time taken to implement widescale water efficiency measures. A target value of 100l/head/day by 2050 is set in our most recent business plan.
- **25% trade flow reduction** - The reduction is applicable to long term planning only. A realistic target of 25% reduction by 2050 achieved by application of water efficient measures.

An option model was created for each of the above listed bin tests and 30-year return period design storms were run using the 2030 and 2050 "growth, creep and climate change" scenario. These tests demonstrated the impact these options would have on observed flooding in the catchment. In addition, a spreadsheet-based approach (Rainscape and storage n+1 spill estimator) to identify the potential impact of these options on CSO performance was developed.

A bespoke tool has been developed to identify the effectiveness of options against a range of service measures, The Feasible Options Impact Assessment Tool. The tool provides an overview of the impact of the proposed option bins on the catchment's performance against objectives for flooding and pollution.

The following scoring matrix in Table 16 was assigned for each catchment:

Table 16 - Scoring assigned to option bins

Each option is rated from 1 to 5 against each metric and is given a 2050 and 2025 score	
5 - option eliminates problem	
4 - option achieves or exceeds target	
3 - option partially achieves target	
2 - option makes a difference	
1 - option has no effect or negative effect	
Weighting of objectives are as follows	
2050 flooding of a worst-served customer (WSC) or pollution of a Special Area of Conservation (SAC)	10
2025 WSC/SAC	9
2050 internal flooding or pollution of a Site of Special Scientific Interest (SSSI)	8
2025 internal flooding/SSSI	7
2050 external flooding or pollution of bathing waters	6
2025 external/bathing	5
2050 pollution/ pollution of a high amenity waterbody	4
2025 pollution/ high amenity	3
2050 other flooding	2
2025 other flooding	1

The scores against each of the listed metrics are added together and normalised to provide a score between 1 and 5. Scores of below 1 can be assigned to an option and this is indicative of a catchment not experiencing any issue against several the service measures, for example no overflows that spill to SACs.

Table 17 is an example of the output from the feasible options impact assessment. The options are ranked based on these scores to set out the overarching strategy for the catchment, which shapes the development of tactical options.

Table 17 - Example of a 'bin' tests score outcome

Scenario description	Description	Assessed?	Catchment Example area Score	Rationale
bin1	10% impermeable area removal	Yes	0.77	Take bin forward for further testing
bin2	25% impermeable area removal	Yes	0.85	Take bin forward for further testing
bin3	50% impermeable area removal	Yes	1.17	Take bin forward for further testing
bin4	PCC reduction - 100 l/head/day	Yes	0.55	No significant impact
bin5	25% trade flow reduction	Yes	0.55	No significant impact
bin6	50% base flow removal	Yes	0.73	No significant impact
bin7	Universal upsize	No	Not Assessed	Not assessed

The option bin effectiveness scores have helped to define a pathway for each catchment over the next 30 years. During detailed option testing options which rank highly were tested first, and subsequent options were built upon those until the objective was achieved.

These catchment level strategies are also used to define the company strategy. Option bin tests have been carried out across 141 high priority catchments across the whole region and the option scores and rankings have been collated to define what the overall strategy for the region could look like. This is summarised in Figure 25.

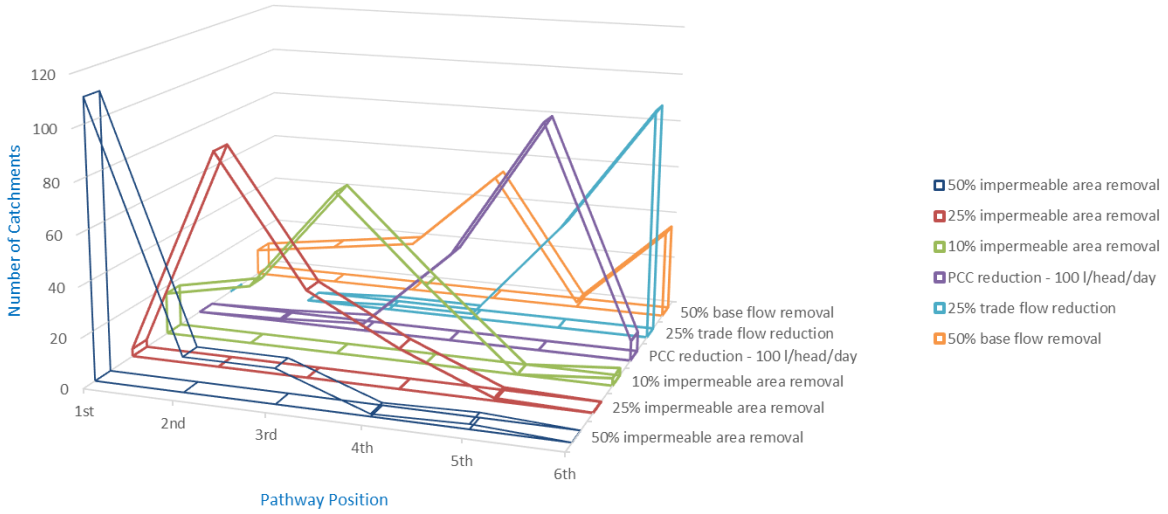

Figure 25 - Preferred pathway counts for specific options

8.2.4.2 Non-Modelled Network Assessments

A limitation to the above was the requirement for a suitable model to exist and be analysed within the timeframe available. To ascertain the benefits tested by the bin tests in all catchments a non-modelled approach was developed. The non-modelled approach was

undertaken on all catchments, irrespective of whether the catchment had been included in the modelled analysis.

This analysis has included data from 835 WwTW catchments of which 391 have MCERT flow to full treatment data available. The infiltration reduction estimate has been based on the 391 catchments which have available MCERT data. The volume of infiltration calculated for each catchment with MCERT data was inferred to catchments without MCERT data, normalised by catchment population.

The MCERT data was analysed to determine the components of flow based on a series of available datasets including:

- Theoretical Load (Population Equivalent) - Ofwat Definition / June Return;
- Theoretical Load (Population Equivalent) - Urban Waste Peak Month;
- Consent Details;
- Annual measured billed Trade Effluent volume (m3/year) & Metered Commercial volume;
- DWF Permit headroom; and
- Catchment infiltration assessment.

The analysis presented in this study combined data recorded by the MCERT monitors at the WwTW inlets and theoretical demands on the network. It is therefore expected that there will be variations between this assessment and the full modelled assessments undertaken as part of the DWMP.

The data presented has been calculated for 2050 utilising rainfall inclusive of climate change. For the non-modelled analysis, a straight-line regression of the 2050 results to 2025 has been assessed.

The analysis considered the reduction in runoff built up from theoretical impermeable area values for each catchment taken from the ‘all catchments area take-off’ completed as part of the operating area wide programme of work. As the non-modelled approach applies a percentage reduction to the total area the volumetric reduction will always reflect the level of impermeable area removed.

The reduction in PCC was calculated based on the impact on the MCERT data rather than the impact on the flood volume, which was the analysis undertaken in the modelled catchments. The reduction in DWF because of PCC reduction should therefore be viewed as an increase in capacity which will likely result in a decrease in escape volume, however this was not assessed as part of the desktop exercise. The modelled approach assessed the impact on escapes and is therefore not directly comparable.

Table 18 - Theoretical Volumetric Reductions for BIN Options shows the theoretical volumetric reduction, by applying each set of options. All results have been shown as per day volume, assuming one storm per day (a standard 1 in 1 year 60-minute design event volume).

Table 18 - Theoretical Volumetric Reductions for BIN Options

Epoch	Highway area disconn-ection (m3/day)	50% base flow removal (m3/day)	Commercial & paved area removal (m3/day)	Residential Area Removal (m3/day	PCC reduction target 100 l/head/day (m3/day)	Trade flow reduction target 25% (m3/day)
2030	109221	32482				
2035	218443	64963	87377			
2040	327664	974471	131066	655328	79660	21156
2045	436885	129927	174754	873771	106213	28208
2050	546107	162412	218443	1092213	132766	35260

Based on the above a cumulative graph has been developed (Figure 26) which shows the best case overall volumetric reduction which could be achieved across the operating region by implementation of each option test. The AMP lead in time for each set of options has been shown on the graph. The below should therefore be considered a visual guide to the most effective option types at any given epoch up to 2050. These workstreams will need to be targeted to establish whether the amount of Surface Water removal is even possible at these rates. If not then more traditional options will need to drive the change to meet out comes.

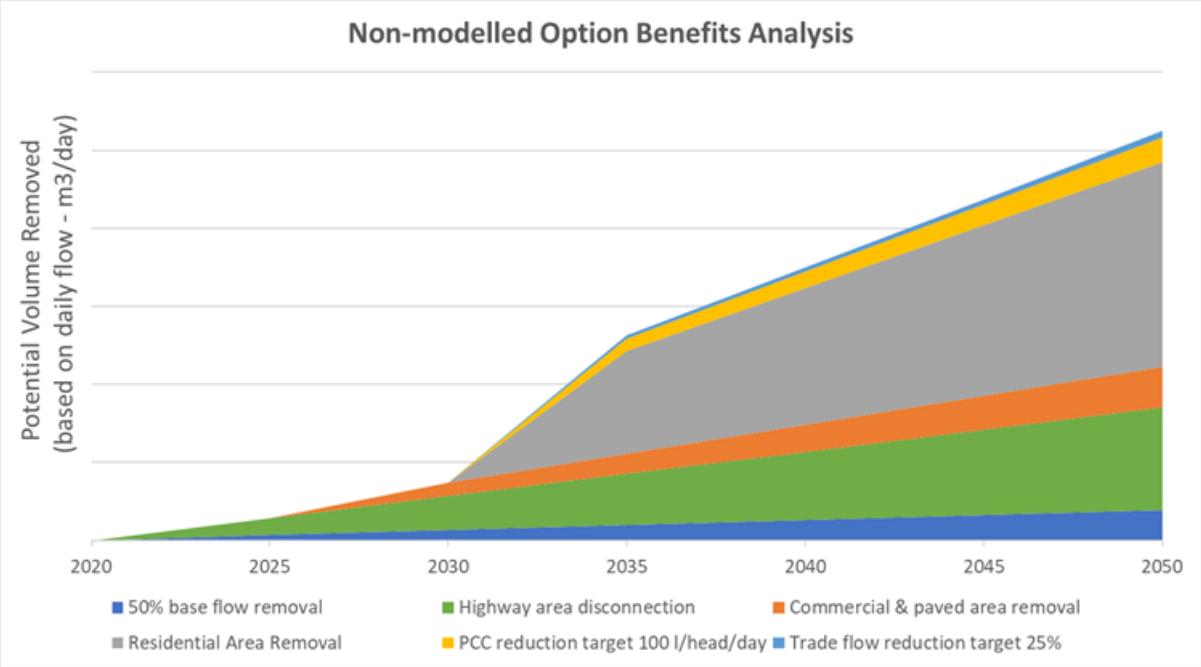

Figure 26 - Non-modelled Options Benefits Analysis

8.2.5 *Strategic Planning Journey Plan*

Following on from that informative research, we began the company level options development assessment approach. We took the long list of solutions from the framework and considered a few more alongside.

We continued with the assessments in a handful of trial sites at first and confirmed that the answers grouped into actions to be undertaken at a strategic level. The Company DWMP strategy driven from the process is within the graph in Figure 27. The approach lists a hierarchy of actions.

- Starting with repairing and renewing pipes to manage infiltration i.e., the water from groundwater that gets into sewers through cracks in the pipes etc.;
- Prioritising communicating with customers to reduce blockages caused by fats oils and grease and non-flushable items like wet wipes, and supporting the message for water efficiency by educating customers on how to reduce run-off caused by paving over gardens and driveways;
- Then to support sewage planning - building bigger to manage future developments and population changes.
- This is where the difference between sewage planning, and drainage planning become pronounced. We need to change national policy to remove surface water from the sewer and find a more sustainable green and natural approach to integrated drainage management;
- Then and only then make plans to build bigger sewers that continue to have a dual purpose because we know that either of the two following points will be true in the future:
- Surface water is removed from the sewer and the bigger capacity network built to contain it will no longer be required at a point in the future and becomes redundant; or
- In the future at some point, we will need to build a bigger sewer again and again to keep up with climate change because we didn't start to remove surface water from the sewer in time to manage the impact from climate change.
- Prevent harm to the environment by preventing poor quality water from entering our rivers and beaches;
- Help suppliers divert rainwater away from sewers by helping them change surfaces that are not good at absorbing water and re-directing rainwater away from roads and driveways back into the environment;
- Communicate with homes and businesses to help reduce water use;
- Where possible, protect our assets during periods of extreme flooding, and ensuring our service can get back to normal as soon as possible;
- If we still cannot meet our goals with other options, consider storage of wastewater as a last option. There may be innovations in future which mean this may not be needed.

Consider how these programmes will change with different assumptions in the future. High or low climate change, high or low number of new developments, what if the future is warmer more often or wetter more often and conversely colder more often or drier more often. The Strategic journey plan is highlighting the programmes that are most likely.

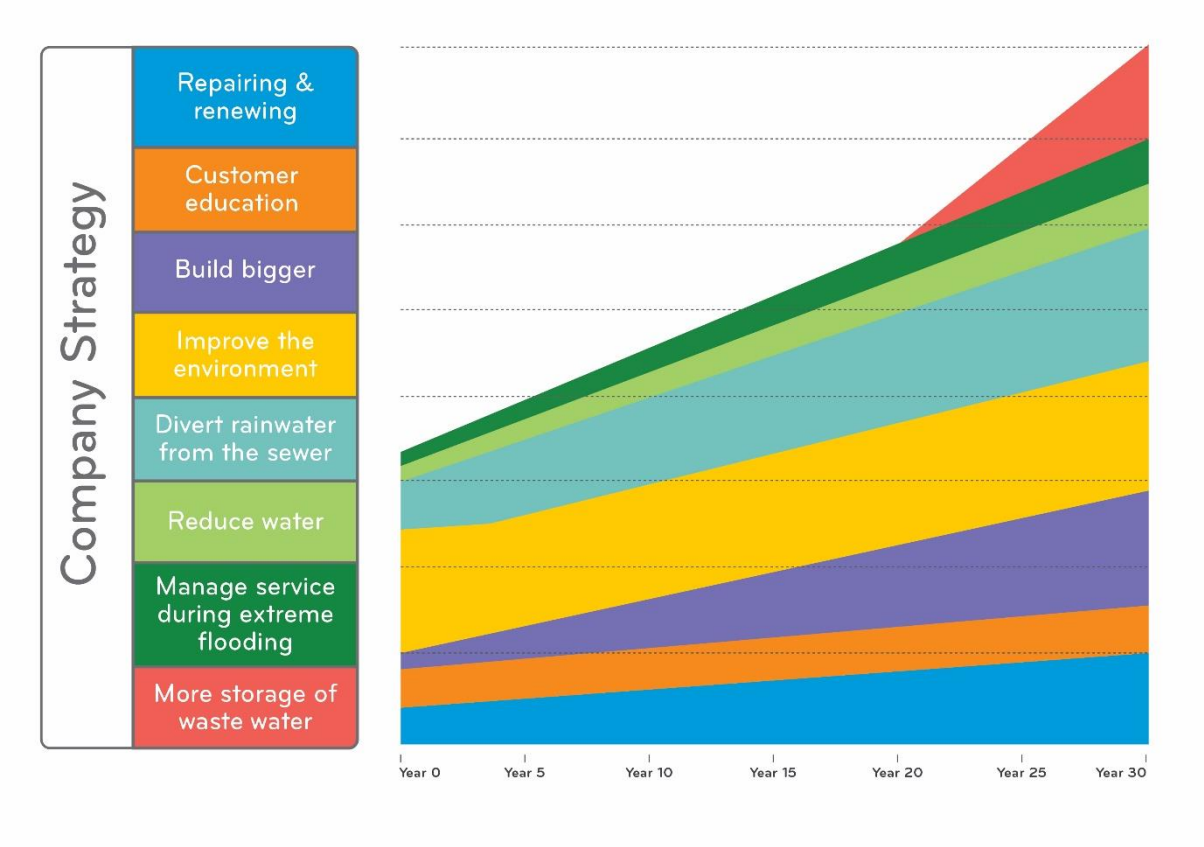

Figure 27 - Strategic Planning Journey Plan

The Journey plan can also be demonstrated at a catchment journey level as shown in Figure 28 with the same colours showing the type of programme required overtime.

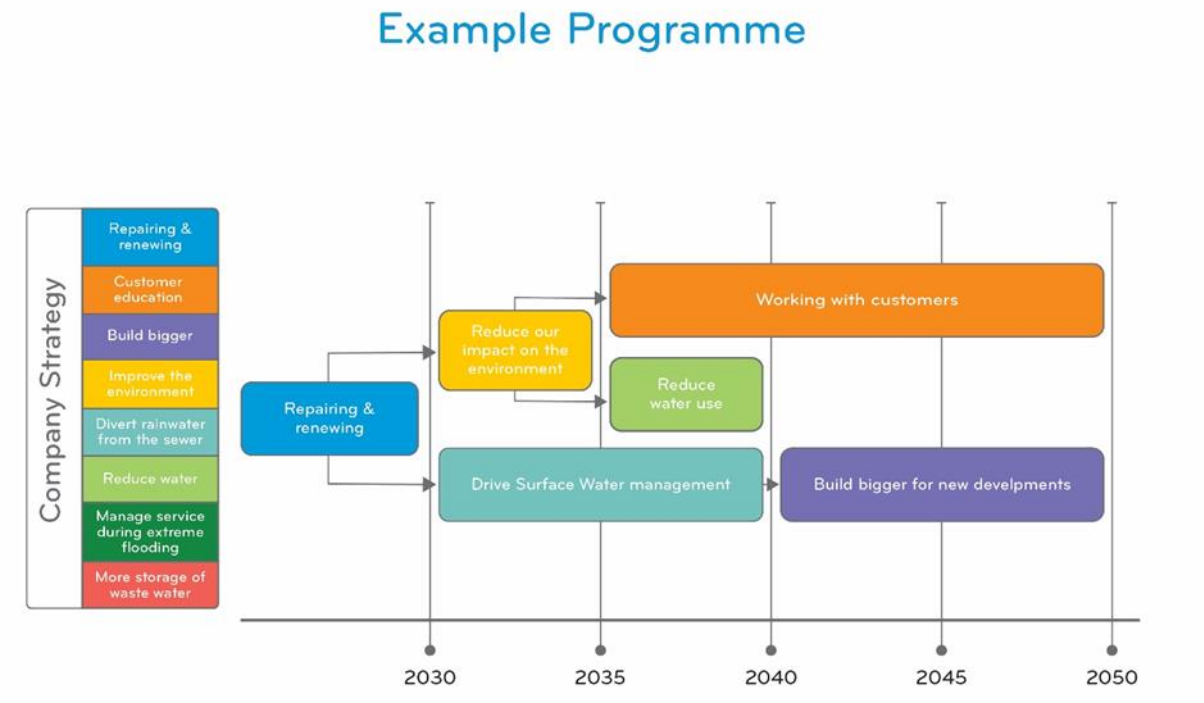

Figure 28 Example catchment level programme coloured to match the journey plan

When each catchment plan is added together the resultant list produces the company programme, which is ready to be passed to the business plan process for negotiations that are constrained by customer bills and funds that can be obtained by other financial arrangements.

Blockages and the relationship with the items being flushed down the loo

In general, a sewer is there to take away the 3 p's. Pee, Poo and Paper. Over time as our sewerage system developed, kitchens were added, and sewers were then considered as a bin from kitchen waste too. The pipework struggles to keep these non-flushable items moving in the pipes and they gather together and clog like a plug and stop the 3 p's flowing. Eventually a person has to physically remove the plug. This is what is happening today. A short list of non-flushable items are fat, oil, grease, wet wipes*, nappies.

*Wet wipes even those marked as flushable still cause and contribute to blockages.

8.3 Strategic Assessments

8.3.1.1 Sewer Overflows Discharge Reduction Plan

Welsh Water, DEFRA and Welsh Government are currently assessing the scale of the costs required to mitigate impact from sewer overflows, it is therefore important to note that our estimate is just one estimate being produced. Defra ran a project (The Storm Overflow Evidence Project) to inform their understanding, and Welsh Government are doing the same too and we are following a similar approach. The figures quoted below includes investment for both storm overflows and customer flooding service improvements.

We then set about building a policy information table, one that could support investment decisions by the business, but also to help Government to prioritise where to make improvements first.

Table 19 below shows 3 of the 4 estimates we created. It shows the company level estimated investment needed over a century to reach the joint destination of customer flooding and storm overflow escapes. The cost is based on the assumption that there is a volume of water that is forecast into the future that cannot be contained by the current size of the sewer system. It assumes that either a traditional or green intervention could be required but, in every case, a traditional solution is possible and therefore the cost has been estimated on a traditional approach alone. The estimate includes all customer and highway flooding and any escape to the environment. The costs were created using a very simple approach. The volume of escapes was obtained from our modelled areas and similarly assumptions associated for our non-modelled areas. This provided a total volume predicted to escape. This was then multiplied by a cost to store that volume in tanks and pipes taken from our database of average costs per volume stored. These have also been estimated for each level 2 area which can be found in the level 2 summaries.

Table 19 - Cost of environmental and customer Destination

	Environmental zero spill and Customer Destination	Remove environmental Harm from storm overflow and Customer Destination	Environmental 10 spill and Customer Destination	Environmental 40 spill and Customer Destination
Cost of Customer Service improvements	£5.508 Billion	£5.508 Billion	£5.508 Billion	£5.508 Billion
Cost of Drainage Service improvements	£8.477 Billion	£5.160 Billion	£3.206 Billion	£1.175 Billion
Total	£13.985 Billion	£10.668 Billion	£8.714Billion	£6.683 Billion

8.4 Methodology - Wastewater Treatment Works Assessment

As part of assessing resilience of our wastewater treatment works to future change, we have undertaken trials for the following three types of assessments as part of the DWMP:

- A high-level analysis of treatment works capacity for every WwTW– 'Supply/Demand balance'.
- A more in-depth analysis of the capacity of individual treatment streams within a WwTW– 'Wastewater Treatment works capacity assessment tool'.
- We have examined the resilience of the receiving water environment – 'Environmental Resilience'.

The NEP will drive the Wastewater Treatment Works programme in AMP8 and AMP9. The DWMP will inform the investigations for the next iteration of NEP.

8.5 Options appraisal, costing and benefits

Options selected within catchments need to be based on greatest benefit. Option costs for the DWMP are based on the our Unit Cost Database (UCD), generating industry standard cost models for solutions identified. The enhanced Solution Target Pricing Tool (STPT) used for DWMP uses UCD supported by additional indirect costs associated with options scope.

OPEX expenditure has also been determined, supported by historical information to drive a TOTEX cost for the scope detail. There are carbon models to support this, which review embodied carbon within the scope.

Assessing scheme benefit requires the quantification of Least Cost, in addition to Average Incremental Cost (AIC), when delivering optimisation to identify the scheme to progress. The cumulative net present value, including CAPEX, OPEX, Carbon, is divided by the benefit to arrive at the AIC. Based on the principles of WRMP a consistent volumetric benefit metric of the 'volume of escape', which allowed quantification for both a flooding and overflow performance assessment, using a 1 in 30-year, 60-minute storm event to drive further consistency, with value driven by scheme implementation.

The principles of driving a best value plan within the WRMP have been reviewed and the DWMP aligned where possible and the following have been undertaken in Cycle 1:

- We have considered environmental and social costs (B£ST) to determine which of the localised options tested offers best value (AISC).
- We have considered any technical constraints, as part of option testing.
- We have prepared a stakeholder consultation on options for later this year, through which customer views will be considered as part of 'do the right thing' assessment for the long list of options.
- We have considered multi-criteria optimisation and sensitivity testing and will work to develop our approach further in later plan cycles.

In addition, a review of Natural Capital accounting tools considering all ecosystem services within the options process was carried out. This resulted in the CIRIA B£ST tool being defined as the assessment tool of choice.

The Coarse assessment section of B£ST has been aligned to the DWMP options process to provide a timely and comparable multi-benefit estimate. Six key questions were used to monetise the benefits focusing on tree planting, social benefit to residents, flood benefits, land-based biodiversity enhancement and length of watercourse improvement. These assumptions also developed a specific SuDS type benefits table used within the wider options assessment. As well as natural capital, carbon equivalent costs were developed for options within the STPT.

The average cost of a solutions prepared is £2.8million ranging from £33,000 to £25million. An exceptionally high solution considered to be a programme is also included at £83million, this solution will be broken down into phases in DWMP29.

8.5.1 *Opportunities for working together*

Within Cycle 1, we have undertaken mini projects to identify our best opportunities to work with others, the outcomes of which will form part of our DWMP consultation. These initiatives are focussed on opportunities to work with stakeholders, customers and in the community:

- SuDS Retrofit in Schools & public places – Strategic opportunities to deliver SuDS at local authority owned sites where there is often significant impermeable area and potentially shorter timescales and especially where local development growth is restricted due to capacity.
- Education on Water Efficiency and Consumption – Options to progress and enhance existing campaigns. Indicative programme options developed and costed that will enhance the company baseline programme.
- Education on Blockage formation through Fats, Oils & Grease - Options to progress and enhance existing campaigns. Indicative programme options developed and costed that will enhance the company baseline programme.
- Misconnections – Establishing surface water misconnection and removing runoff will be a part of long-term network management. Opportunities to work with the local councils in the first instance to identify large misconnections will be developed through appropriate governance arrangements in Wales.
- Sea Level Rise – Climate change will influence sea level. We have reviewed likelihood of outfalls becoming impacted in the future, and what the impact of hydraulically locked outfalls will have on the upstream network. We will continue to work with stakeholders in relation to sea defences and interaction with our assets and the Shoreline Management Plan.

8.5.2 *Capacity improvements and adding operational resilience*

We undertake a range of projects to improve maintenance outcomes, and the DWMP has sought to complement these rather than duplicate ongoing work. Our PR19 Investment Case for Wastewater Network Maintenance (DCWW, PR19 Investment Case: Wastewater Network Maintenance, 2018) lists around 19 innovations to be trialled in AMP7 to reduce blockage/OC risk.

Our network resilience project generated an InfoAsset database including almost every pipe in our wastewater network. For every pipe, if invert levels, pipe sizes or ground levels were missing, we inferred the missing values. We also estimated dry weather flows and peak weather flows for every pipe in the database. The data generated through this project has subsequently fed into a deterioration modelling project, led by our Asset Planning team, and delivered by ICS Consulting, to calculate likely blockage and collapse risk for every pipe.

The outcome from the InfoAsset analysis has provided additional risk information and also allowed programme level costs to be derived in terms of investigation at an asset level and simple size times average cost to be derived. This analysis will be used going forward to direct investigations outside of the NEP programmes to further clarify investment for AMP9 onwards.

8.5.3 *Customer Management*

The conclusion of this area of work highlighted that the company provides water efficiency advice via the Water supply messaging. This support is adequate to also support Wastewater.

In addition, localised events have been considered and the cost of delivery has been brought forward if there is another project working in the area. When more than messaging can be delivered the cost benefit of localised events becomes cost effective.

8.6 Future Recommendations

An important evolution in benefits assessment in Cycle 2 relates to improving the definition of Multi-Capital Benefits. This will extend the work carried out within the B£ST tool to enhance the assessment of options against Social Capital, Human/Intellectual Capital, Financial Capital, Manufactured Capital, and Natural Capital.

9 Programme Appraisal

9.1 Introduction

The programme appraisal stage considers the formulation of a portfolio of interventions, optimised to deliver 'best value', considering drainage and wastewater planning objectives. It has been developed at a company level to support strategic decision making, and is designed to optimise the delivery of interventions across multiple investment periods spanning AMP8 to AMP12.

In this cycle of the DWMP, the programme appraisal has been carried out on the Preferred Options for each risk cluster that was identified as highest priority via the problem characteristics and the priority matrix, this is to focus our assessment on the highest priorities for this plan. All schemes from the options appraisal stage were combined at a company level by collating individual preferred options for our highest risks and where tactical interventions have been developed through the DWMP. The interventions developed in this cycle of the DWMP are designed to address existing Worst Served Customer flooding and reduce CSO spills within a Special Area of Conservation to 0 spills. The solutions set out to resolve the existing issue, and provide future protection to 2050, in line with the approach set out in Figure 29.

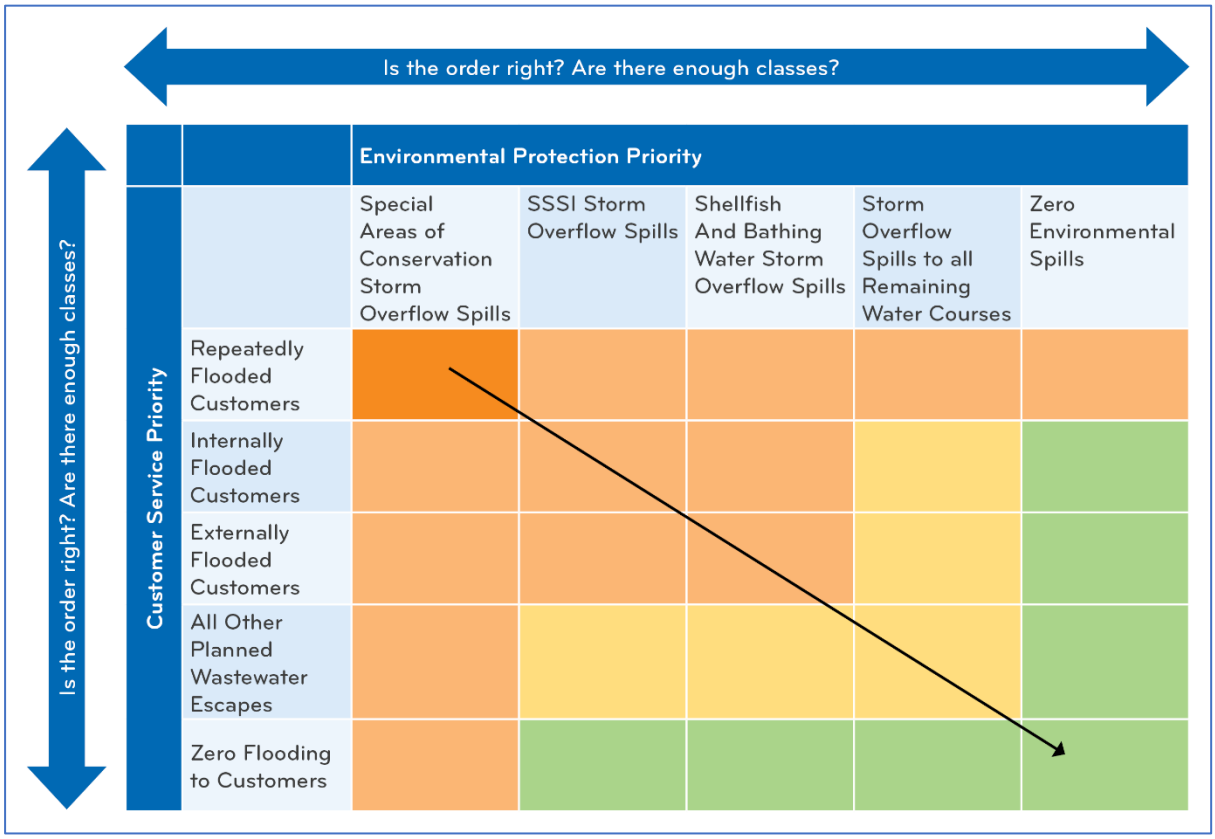

Figure 29 – Priority matrix principle

Three delivery approaches have been developed and are calculated in the programme appraisal tool. These approaches provide the flexibility and variability to support the investment planning and scenario testing to optimise the delivery of outcomes.

The Programme Appraisal delivery methods are as follows:

- Delivery Approach 1 – Fixed Budget (Constrained delivery plan approach)
- Delivery Approach 2 – Variable Budget (per AMP)

- Delivery Approach 3 - AMP8 Full delivery, AMP9+ Flat Variables

Each of the delivery approaches takes the output from the NPV Optimisation process at individual catchment level and collates them at Company level (L1). Once collated, all preferred options are prioritised into investment planning periods based on AISC value as this was the preferred approach from our Stakeholders. The least cost ranked approach was also presented but requests favoured the AISC approach, the AISC approach is the demonstration of Best value using financial benefit assessment guidance. The schemes are then turned into a programme of investment priority via the fixed CAPEX cost to align with company decisions in business planning for the available DWMP delivery budget within each investment planning period. This ensures alignment with the business approach to delivery planning.

The approach is carried out twice, once prior to the environmental assessment SEA and HRA, and then again post SEA and HRA to take account of any negative environmental impacts which are removed for reassessment rather than taken forward for down the line assessment.

9.2 Methodology

During cycle 1, the ambition was to achieve a strategic view of the scale of the problem that needed to be solved. It became clear that to "Solve" an area overall would require a considerable volume of water to be either stored in the network and treated or removed from the network and redirected elsewhere.

For the first cycle, we needed an approach that was easy to use, already in existence requiring very little alteration but would also allow us to discuss the difference between a least cost scheme and a scheme with added benefit. In conclusion, the jointly created AIC and AISC comparison approach from the WRMP EA tables was the logical choice.

Once the zonal best value option was chosen, these were collated together to create a programme at Level 3. These were then ordered by their AISC, and within their time horizon, to create an environmental benefit plan for 25 years.

9.3 Outputs

Throughout the Cycle 1 plan, decisions have had to be made in respect of what is strategic decision making and what is tactical decision making and, as a result, what level of information is required for each section of the plan.

Our bottom-up approach is a tactical programme and a maturing process. The outputs from this programme appraisal will be included within the business plan. This will help us to trial the process and develop a greater understanding of how a DWMP fits with price reviews. It will also allow us to combine processes together to bring added efficiencies.

The area covered complied with the DWMP Framework - extended and complex locations. There were 44 catchments where the detailed work took place.

9.3.1 *Delivery Approach 1 – Fixed Budget (Cost Constrained and post SEA/HRA assessment)*

This approach uses a fixed budget available for delivery in AMP, and the budget is consistent across each AMP. In the outputs below, the value of the fixed budget was originally set at £60m per AMP. The budget has been applied as a parameter for scenario testing. This approach allows the assessment of how many schemes could be delivered in one planning period and highlights the number of planning periods required to deliver all schemes. If a scheme CAPEX is greater than the remaining budget in an AMP period, the scheme will be programmed for delivery in a later period, and the next available scheme in the ranking that can be delivered within the remaining budget will be programmed in the delivery period.

Where a scheme CAPEX is greater than the total in period budget, the scheme will be programmed into the future planning period, beyond those within the DWMP cycle of AMP8-AMP12. This sometimes results in schemes with a greater AIC or AISC value being placed in priorities lower than those with a smaller AIC or AISC value, but it is designed in such a way to maximise efficiency from the available budget.

Table 20 details the intervention programme for Priority 1 to 6 schemes, and a definition of the investment priority profile is defined in Table 24. In these examples, Investment Priority 1 schemes are expected to be delivered in the first investment period (i.e., AMP8), Priority 2 schemes in AMP9, and so on. The table shows the impact from Pr24 investment decisions which has reduced the initial £60m constraint to £50m, the remaining AMPs are still fixed at £60m.

Table 20 – Intervention Programme Fixed Budget Assessment

Delivery Approach 1 - Fixed Budget			
Priority	**Total Number schemes**	**Total Cost**	**Proportion of total schemes**
Inv. Priority 1	21	£49,324,071	3%
Inv. Priority 2	29	£60,047,180	7%
Inv. Priority 3	22	£59,997,165	11%
Inv. Priority 4	9	£60,049,969	15%
Inv. Priority 5	15	£59,982,453	19%
Inv. Priority 6	123	£1,264,982,215	100%

Table 20 demonstrates that, at a spend profile of £50m in the first AMP and £60m per AMP in 4 AMP periods, 19% of schemes would have been delivered in 25 years. This would leave 123 projects for delivery in subsequent AMPs, requiring further investment of £1.26 bn.

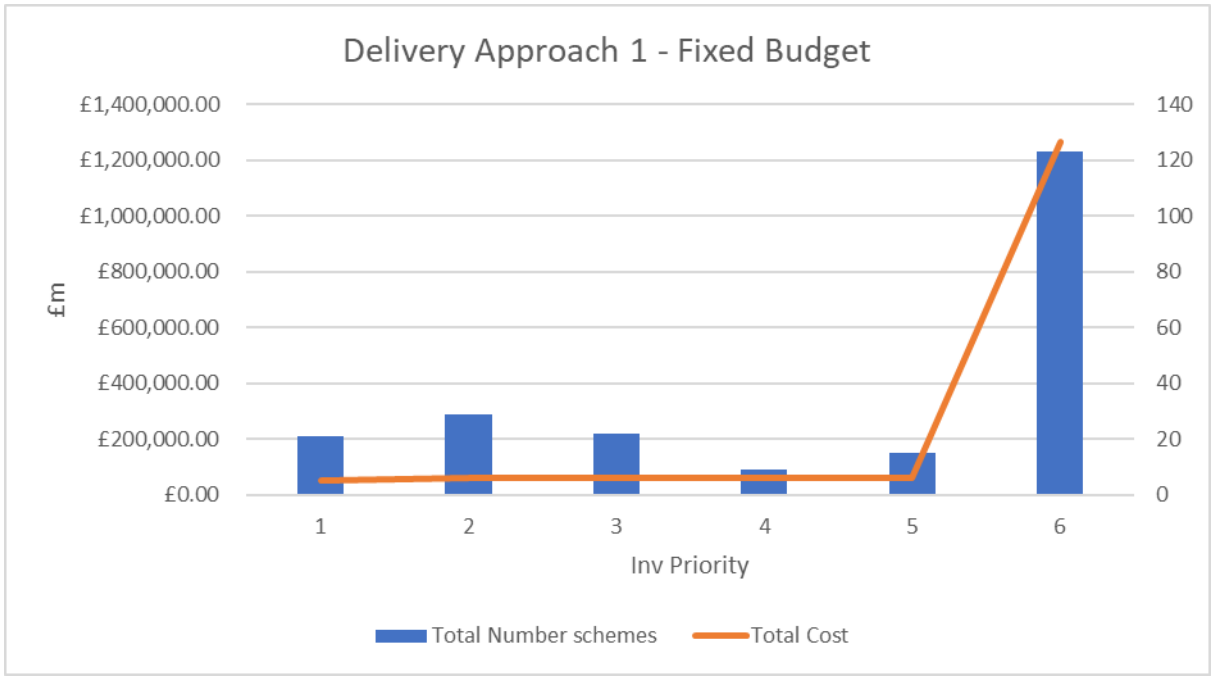

Figure 30 – Fixed Budget Investment Priority Profile

9.3.2 *Delivery Approach 2 – Variable Budget (per AMP)*

This approach considers a variable budget over each AMP period. The methodology can apply any budget constraint to an AMP period and allows the spend profile of schemes within each AMP to be adjusted accordingly. In the scenario below, the value of the fixed budget has been set at £50m in AMP8 post PR24 review and then at £120m for AMP9 and doubling for subsequent AMP periods until all solutions are profiled.

Table 21 details the intervention programme for Priority 1 to 6 schemes and the investment priority profile is defined in Figure 31.

Table 21 – Intervention Programme Variable Budget Assessment

Delivery Approach 2 - Variable Budget			
Priority	**Total Number schemes**	**Total Cost**	**Proportion of total schemes**
Inv. Priority 1	21	£49,324,071	3%
Inv. Priority 2	51	£120,482,532	11%
Inv. Priority 3	42	£240,477,573	26%
Inv. Priority 4	39	£480,474,880	57%
Inv. Priority 5	60	£657,833,830	99%
Inv. Priority 6	6	£5,790,165	100%

The table above demonstrates how, at the proposed variable budget distribution, all 219 schemes will have been completed over 6 AMP periods.

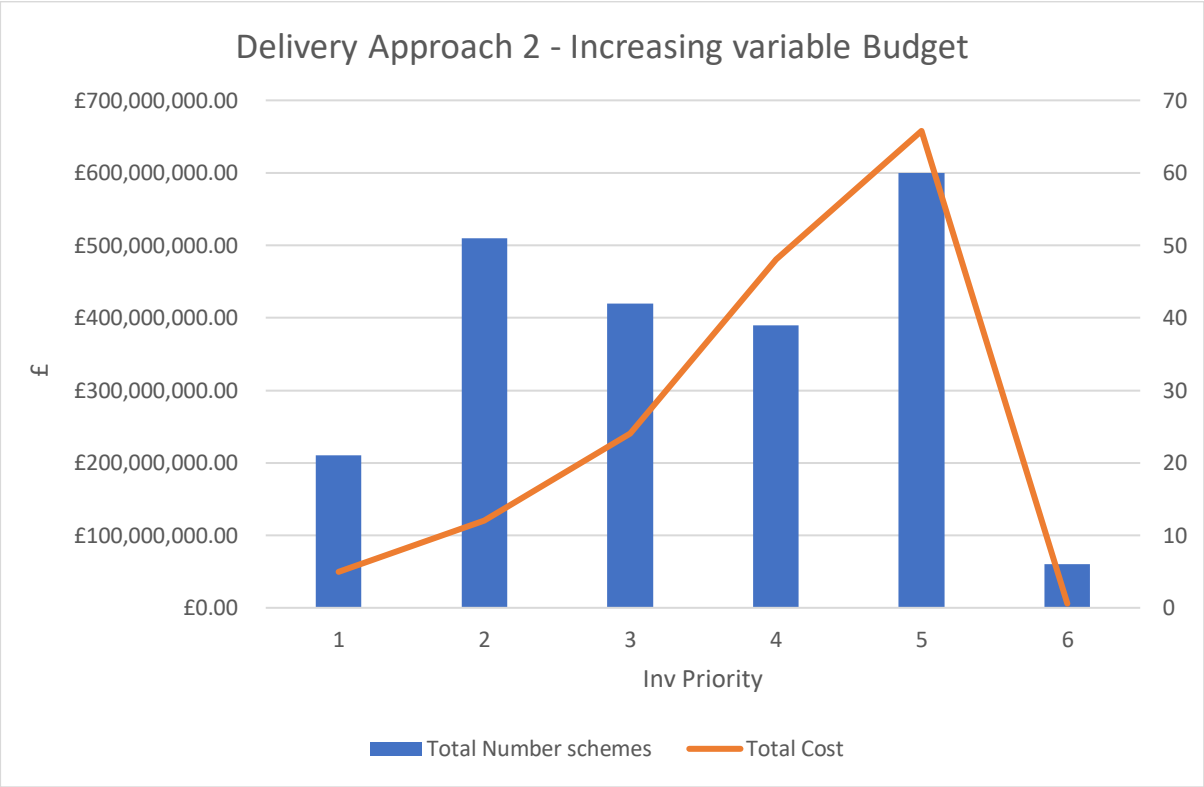

Figure 31 – Variable Budget Investment Priority Profile

9.3.3 *Delivery Approach 3 – Investment Priority 1 Full Delivery, Investment Priority 2 + Flat Variables*

This approach provides an indication of the total cost required to deliver the preferred options for each scheme to resolve all worst-served customers and stop SAC spills within the first planning period (AMP8). The delivery of enhancement schemes, to provide the additional protection up to 2050 (no flooding or spills at these locations) is then split across the remaining AMPs of the DWMP. This is distributed across the AMPs via the total CAPEX averaged across each AMP.

Table 22 below details the intervention programme for Priority 1 to 6 schemes and the investment priority profile is defined in Figure 32.

Table 22 – Intervention Programme Investment Priority 1 Full delivery, Investment Priority 2 + Flat Variables Assessment

Delivery Approach 3 – Inv. Priority 1 Full delivery, Inv. Priority 2+ Flat Variables			
Priority	**Total Number schemes**	**Total Cost**	**Proportion of total schemes**
Inv. Priority 1	175	£1,485,831,008	80%
Inv. Priority 2	27	£25,923,840	92%
Inv. Priority 3	10	£23,634,300	97%
Inv. Priority 4	4	£17,682,266	99%
Inv. Priority 5	3	£1,611,639	100%
Inv. Priority 6	0	£0	100%

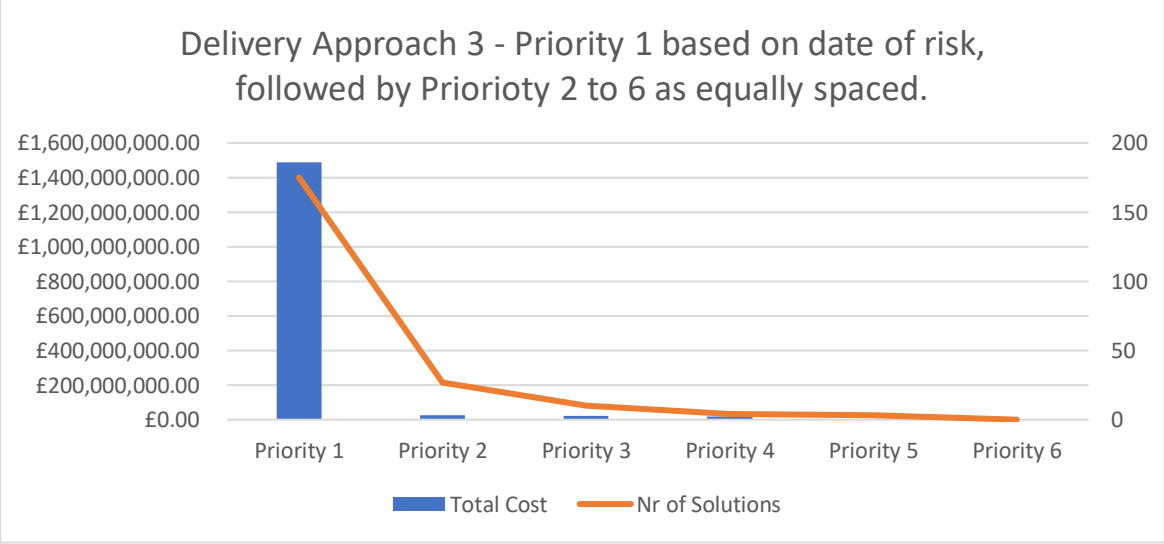

Figure 32 – Variable Budget Investment Priority Profile

The above investment scenarios demonstrate that solving all the worst served customer flooding issues and addressing pollution to protected waterbodies to meet the final destination would not be practical or affordable in a single AMP period, as set out in Delivery Approach 3. It does, however, show that both the fixed and variable budget approaches could be viable.

The assessment also highlights that the choice made when the solution is developed can seriously impact the ability of the optimiser to programme a solution to meet the risk. Table 23 below shows that from the list of solutions there are 24 solutions that need to be delivered

by 2030 costing £72 Million, however the optimiser and the way we have created our solutions also indicates that it is more cost beneficial to early prioritise a further 154 solutions as the 5-year cost benefit is less cost effective than an early delivered 25-year solution. But the overall investment available to the company unfortunately cannot fund both the schemes to protect against current risks and to protect against future risk that are more cost effective and beneficial if delivered early.

Total Overview		
	Total Number schemes	Total Cost
2025-2030	21	£49,324,071
2030-2050	44	£68,852,047
2025-2050	154	£1,436,206,936
Total	219	£1,554,383,055

Table 23 – distribution of solutions by date

The outputs of these approaches were assessed, as part of our PR24 investment planning work, and determined whether the indicative budget, outlined in Table 23 could be funded in AMP8. Only the 2025-2030 schemes were progressed. We'll examine again what the preferred spend profile for future AMPs will be to allow the relevant schemes to be selected for AMP9 delivery in readiness for DWMP29.

9.3.4 *Regional Investment Strategies*

For each of the 13 L2 River Basin Catchments, a summary overview report has been generated. As well as providing the pathway for that region through the DWMP process. They present a review of the best value plan for the region, which included the testing of types and combination of schemes, through to the 2050 Time Horizon and strategically to the End Destination.

These regional strategies have identified the likely costs required to mitigate future predicted pollution through CSO performance and predicted catchment flooding, two critical network planning objectives. These likely costs across the region are presented as a series of scenarios towards achieving performance improvements based on current catchment conditions as well as the Future Scenarios where the additional impact of growth, creep and climate change influence the investment needs. These summaries include detailed model driven options development, as well as non-modelled approaches to determine strategic costs.

9.3.5 *Programme*

The consultation provided customer feedback that preferred a smaller increase in the early years along with incremental change in the future as long as there were no sudden step changes that could be considered similar to the recent energy utility company rises seen during 2022-23. This meant that delivery approach 2 was preferred by customers as long as the incremental rise to bills was affordable.

The draft Plan identified that there were areas where work was required, and the locations where work was required was either of highest customer risk, i.e. internal flooding in the past and expected to continue into the future, or where the escape would impact a SAC and that any future risk escape was expected to continue or get worse. These were chosen because we were aiming to achieve detailed prefeasibility design of solutions ready for delivery i.e. solutions that were must do.

With the first 44 catchments being distributed across 9 of the 13 Level 2 areas and providing a mixture of traditional construction, green sustainable, and those that were a combination of

both, to get the best outcome. These solutions were suites of solutions and not individual interventions as when working at the delivery level there would be multiple small interventions required to “solve” an area for flooding or pollution.

An example would be that at a site in North Wales, a housing estate which is below sea level often backs up. The area now it has been built cannot drain totally to sea at the location due to the influence of the tide so a 100% sustainable solution would not be possible. So at that location there would be a need for a pump size increase to include the additional flows for climate change in the future and smaller sustainable intervention that allows some rain to drain to a local watercourse when there was opportunity to do so at low tide. The combination of all the interventions provide one scheme, and this case a mixed scheme.

We knew at the draft plan stage that the National Environmental Programme (NEP) would be significantly higher than previous AMP cycles and therefore would cause an affordability issue to other future focussed schemes. The DWMP produced 219 suites of schemes that solved risks between 2025 and 2050. The first 24 schemes that resolved risks between 2025 and 2030 were past into the business plan process where 21 schemes were incorporated. The remaining 198 schemes will be reassessed in the next cycle. The price review process excluded 3 CSO programmes as the NEP CSO programme would define the CSO locations for implementation in AMP 8 and therefore our 3 CSO programmes have been deferred until AMP9.

We have also concluded from this process that once the most cost beneficial solutions are delivered the remaining higher cost solutions are still needed but become harder to drive when programming against other lower cost solutions but provide different outcomes. The need to continue to drive to meet the destination will then ensure that the last few remaining least cost beneficial but highly environmental or customer beneficial solutions will still be delivered. This is important to reflect on as this evidence is saying that the more best value schemes are also cheaper on average but as we deliver more and more schemes and start to resolve the last few remaining locations the cost of these locations will be more expensive on average but we have to factor this consequence into our plans to continue to make programmes affordable to drive to the destination.

We have produced a delivery programme addressing the worst served customers and CSO’s spilling to the environment. This ensures all locations achieve zero escapes to customer homes, businesses, and the environment. This delivery programme has informed solution development and will once delivered improve the minimum level of service to customers and improve the health of our rivers. Our plan indicates how affordability affects the pace of change which then impacts the programme to be delivered.

We will discuss the impact on the programme due to the negative conclusion of the SEA and the HRA. However, for prudence, we have deferred these solutions to the next cycle. Solutions are still required but more time is needed to ensure that they achieve the best outcome for the environment and customers.

Our DWMP has provided the strategy and action plans for every Level 2 and 3 in our operating area. Most of the actions are carried out as part of business as usual, such as repairs and collapses. These programmes of work are discussed in section 12 where we combine DWMP, the NEP with the price review. The DWMP process provides a focus to prioritise the most deserved areas and highest risks first. Which means that in terms of our DWMP we have produced schemes at about 5% of our operating area which are ready with a spade in the ground 25 year delivery programme.

The remaining 95% of our operating area is made up of our business-as-usual approach (51%) and NEP (44%). We have also influenced choices made at a strategic level regarding spills to the environment with a strategic view of costs to achieve differing targets and we have also

informed the business to the ultimate cost to addressing customer flooding. Both these strategic costs have influenced the business when they have considered the rate of bill increase within PR24.

We will take the conclusion from this plan forward into DWMP29. We will continue to resolve flooding both to customers and the environment at each location we prioritise while alongside developing a 'review of consent model' that incorporates the status of waterbodies and their transition from Poor to Excellent over time.

Table 24 below is an extract from the optimisation tool showing the calculated AIC and AISC for each solution. The list within the optimisation tool produces a company, Level 2 and Level 3 and Level 4 programme each over 25 years. What we have learnt by carrying out this exercise is that while we redevelop the areas already included and objectives incorporated from cycle 1, we can add more areas and more planning objectives as part of continuously improving our understanding of localised planning and delivery programmes that are affordable and also produce the company affordable business plan.

Name		Location Details				Scheme Description			Delivery Details
Scheme Ref	Scheme Name	L2 Ref	L3 Ref	L4 Ref	L4 Name	AIC	AISC	Combination	Investment Priority
3137-AB-RZ01-DFL.000089-2025-2030-M1	Abergele South Flooding - Green Engineering 2030	Clwyd	Glanfyddion Cut	3137	KINMEL BAY	£505.44	-£1,136.07	Yes	AMP8
3137-AB-RZ02-DFL.001448-2025-2030-M1	Towyn East Flooding - Green Engineering 2030	Clwyd	Glanfyddion Cut	3137	KINMEL BAY	£84.11	£4.98	Yes	AMP8
3137-AB-RZ06-DFL.002655-2025-2030-T1	Rhyl Coast Road Flooding - Storage and sewer upsize	Clwyd	Glanfyddion Cut	3137	KINMEL BAY	£827.70	£796.69	Yes	AMP8
3333-A-RZ07-DFL.002633-2025-2030-S1	Rhos on Sea Flooding - Paved area removal	Conwy	Nant y Groes	3333	GANOL STW	£2,318.80	£710.87	Yes	AMP8
50628-A-RZ002-DFL.000000_3a-2025-2030-M	Street flooding_Mixed_2030	Carmarthen Bay and the Gower	Lliw - headwaters to confluence with Llan	50628	GOWERTON	£752.77	£468.34	No	AMP8
50628-A-RZ002-DFL.001211_Dyffryn_3a-2025-2030-M	001211_Dyffryn_Mixed_2030	Carmarthen Bay and the Gower	Lliw - headwaters to confluence with Llan	50628	GOWERTON	£2,069.50	£1,266.88	No	AMP8
50628-A-RZ005-DFL.002911_3a-2025-2030-M	002911_Mixed_2030	Carmarthen Bay and the Gower	Lliw - headwaters to confluence with Llan	50628	GOWERTON	£2,566.06	£772.33	No	AMP8

53154-ABC-RZ006-DFL.Street_3a-2025-2030-M	Street_Mixed_2030	Tawe to Cadoxton	Afan - confluence with Pelenna to tidal limit	53154	AFAN	£833.04	£461.31	No	AMP8
675-A-RZ01-DFL.000756-2025-2030-M1	Chirk (Crogen) - Relief sewer, offline tank, IA roads removal (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£616.60	£276.64	Yes	AMP8
675-A-RZ03-DFL.001426-2025-2030-T1	Johnstown - Bypass relief and upsize (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£1,502.68	£1,309.87	Yes	AMP8
675-A-RZ04-DFL.003153-2025-2030-M3	Wrexham - Wetlands, pipe relay and upsize, pipe jetting (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£657.88	-£208.71	Yes	AMP8
675-A-RZ07-DFL.002809-2025-2030-M1	Southsea- Wetlands, property level protection (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£649.04	£301.83	Yes	AMP8
675-A-RZ07-DFL.004147-2025-2030-S1	Coedpoeth 2 - IA paved removal, property level protection (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£1,005.75	£355.53	Yes	AMP8
675-A-RZ09-DFL.003130-2025-2030-T1	Wrexham - Storage tank and pipe relining (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£1,006.58	£985.95	Yes	AMP8
675-A-RZ09-DFL.003172-2025-2030-T1	Wrexham - Relief sewer to offline storage tank (1/2)	Dee	Clywedog - Dee to Gwenfro	675	FIVE FORDS (WREXHAM)	£676.53	£631.62	No	AMP8
72152-A-RZ01-DFL.004110-2025-2030-M1	Penysarn Flooding - Wetland overflow (1/2)	Ynys Mon	Alaw	72152	Amlwch WwTW	£1,860.28	£1,338.06	Yes	AMP8
72152-A-RZ01-DFL.004110-2025-2030-T1	Penysarn Flooding - Traditional Storage	Ynys Mon	Alaw	72152	Amlwch WwTW	£1,351.99	£1,247.77	No	AMP8

846-A-RZ03-DFL.001262-2025-2030-M1	Gronant Flooding - Green Engineering	Dee	Un-named Dee Estuary South	846	LLANASA (NR PRESTATYN)	£1,362.51	£96.04	Yes	AMP8
846-A-RZ04-DFL.002542-2025-2030-T1	Steet Flooding - Pipe Upsizing	Dee	Un-named Dee Estuary South	846	LLANASA (NR PRESTATYN)	£170.80	£160.63	Yes	AMP8
846-A-RZ04-DFL.002554-2025-2030-T1	Street New Storm Network	Dee	Un-named Dee Estuary South	846	LLANASA (NR PRESTATYN)	£538.81	£511.68	Yes	AMP8
873-A-RZ01-DFL.000517-2025-2030-S1	1. BETHESDA BACH - Impermeable Area Removal	Llyn and Eryri	Gwyrfai	873	LLANFAGLAN	£374.65	£152.90	Yes	AMP8

Table 24 extact of the Least Cost AMP8 Programme of Work for example Risk Zones

9.3.6 *How the Consultation has influenced the plan.*

The plan has been revised based on comments from the analysed consultation responses and conclusions made from the customer research. We have, where it was possible, altered our methodology and applied those alterations within the final Plan. Where we need to reflect on requests, develop our approach based on direction from consultation responses or have not been able to address the comment in time to publish this final Plan, we have written our commitment to carry out more work as part of future cycles within chapter 9 of our Statement of Response to the consultation.

The key highlights from the statement of response are summarised below.

Table 25 – Response to consultation feedback

	Your comments	Our actions
1	We want you to continue working with stakeholders and engage at every stage of the Plan.	We have updated our Engagement Strategy to include more detail on how we will work with stakeholders and engage now, and in the future, as the Plan continues to develop.
2	We want to see updates to the DWMP documents as a way of keeping everyone up to date. We also want to see clear signposting on guidance for customers. There needs to be direct communications for those who request it, including a commitment to working at a local level and involving communities.	Our updated Engagement Strategy sets out how we are: • Producing a range of different documents on key areas of the Plan to keep you informed. • Investigating the best options for signposting customers to guidance and initiatives. • Committed to having more direct conversations with stakeholders and working at a more local level to engage with communities.
3	The Plan needs to reflect our comments around legislation, planning processes and guidance.	We have provided more detail to explain how our Plan considers future policy and planning changes.
4	The Plan needs to reflect the DWMP framework.	We have included the framework guiding principles in the final DWMP.
5	We want to see how you have reflected our feedback on risk and risk assessments.	More detail on monitoring change, growth and emissions scenarios, maintenance and resilience has been added to our risk assessments.

	Your comments	Our actions
6	The Plan needs to have more detail on the option development process, including information on specific aspects such as the priority matrix, solution examples, and the link with river quality.	We have added more detail on how we have developed options including: • Targeted prevention as a risk solution. • Examples of nature-based solutions and community catchment programmes. • More information on the link between options and river quality impacts.
7	There needs to be more detail explaining how your methodology aligns with the OFWAT long-term delivery strategy.	We have added a chapter to the Plan titled 'Adaptive Planning' setting out how our methodology aligns with the long-term delivery strategy.
8	We want to see some more detail on the programme around affordability, deliverability, costs, and links with other work, such as pricing reviews.	We have added more detail to the Plan programme on how affordability, deliverability and financing dictate the pace of change. We have added a comparison table of the least cost programme with the best value plan, together with information on how our methodology integrates price reviews, management planning, the NEP and CSO road map.
9	The SEA and HRA needs to reflect our feedback including the addition of a post adoption statement and a review of negatively assessed options.	We have updated the SEA and HRA to reflect comments from the consultation. A post adoption statement has also been prepared. Negatively assessed options have been reviewed with the inclusion provided in the methodology.
10	Will the L2 and L3 summary documents be updated?	We have continued to develop the L2 and L3 area summary documents and added more detail.
11	How is the environmental improvement budget distributed? What about the budget for improving storm overflows?	We have added a chapter to the Plan titled 'The Review of Consent – the National Environment Programme' which provides more information in these areas.
12	We would like more detail on the delivery strategy and small zone approach.	We have added a chapter to the Plan titled 'Our plan' explaining our delivery strategy and the small zone approach which has been altered to reflect feedback.

10 Environmental Assessment of the Plan

Following the identification of priority schemes across the our region, their environmental impact must be reviewed to ensure that they have no detrimental impact on the environment. Initially the principles of environmental assessment were incorporated into the options developed assessment and to conclude the legal requirements and facilitate this, a Strategic Environmental Assessment, and a Habitats Regulations Assessment, were planned and undertaken for the preferred options sites to document the conclusions. The process for these two assessments is detailed below.

Where the environmental impacts were deemed to exceed the identified thresholds within the two assessments, these schemes were removed from the plan, and included for more detailed review in Cycle 2 to understand in more detail how the environmental impacts can be mitigated.

We have also considered the additional carbon required to deliver the solutions but there is still consideration regarding how to offset this impact on plans and programmes at this strategic level.

10.1 Strategic Environmental Assessment (SEA)

A strategic environmental assessment (SEA) is a formal, systematic process that identifies and analyses the potentially significant and cumulative effects a plan, or program, may have on the environment. The SEA regulations apply to statutory planning obligations of large-scale activities according to various screening criteria.

As the DWMP process is not yet a legal requirement, a DWMP is not within the scope of the SEA regulations and completion of an SEA is regarded as a demonstration of best practice. In future cycles, the DWMP will become part of the normal planning duties, thus making the SEA a requirement.

The purpose of the SEA of the DWMP will be to:

- Identify the potentially significant environmental effects of the draft plans in terms of the drainage and wastewater management proposals being considered.
- Help identify appropriate measures to prevent, avoid, reduce or manage adverse effects and to enhance beneficial effects associated with the implementation of the plan wherever possible.
- Give the statutory SEA bodies, stakeholders and the wider public the ability to see and comment upon the effects that the plan may have on them and encourage them to make responses and suggest improvements to the plans.
- Inform the selection of drainage and wastewater management proposals to be taken forward into the final version of the plan.

10.1.1 *SEA Process*

The SEA has five key stages:

- Stage A: Scoping.
- Stage B: Develop and Refine Alternatives and Assess Effects.
- Stage C: Prepare Environmental Report.
- Stage D: Consult on the Draft Plan and Environmental Report and Prepare the Post Adoption (SEA) Statement.
- Stage E: Monitor Environmental Effects.

The first stage of the SEA was a review to identify the major economic, social, and environmental concerns that will be considered in the DWMP. The key issues identified have informed the framework that will be used to analyse the consequences of the proposed DWMP.

The assessment of the DWMP involved a quantitative risk assessment, and qualitative appraisal, of the likely impacts. These impacts will be mitigated through implementing different options. The SEA looked to identify prevention and mitigation measures including specific proposals to minimize, eliminate, reduce, or offset significant adverse effects on environmental considerations, identified through stages within the DWMP process.

To be compliant with the SEA, a plan or program must consider the cumulative effects of its provisions. This includes the overall impact of the proposed DWMP in conjunction with other plans and programmes, as well as the individual impacts of specific measures within it. The proposed approach is considered in accordance with Schedule 2 (6) of the SEA regulations.

10.1.2 *SEA Assessment*

The impact of the measures proposed in the DWMP were evaluated based on its type, when it occurs, the geographic scope, sensitivity of human or environmental receptors that may be affected, and the duration of any impact. For each of the SEA goals, a set of criteria was established to determine what constitutes a significant, minor or no impact.

The proposed assessment objectives are assessed against the core sustainable and traditional options considered within the DWMP and assessed against their positive or negative impacts during construction and operation. This generic assessment is detailed in Table 26. This assessment was undertaken for each of the options generated across the DWMP.

Table 26 – Generic assessment of options

Option	Stage	1. Biodiversity	2. Soils, Geodiversity and Land Use	3. Water Quality	4. Flood Risk	5. Air Quality	6. Greenhouse Gas Emissions	7. Climate Change Resilience	8. Economic and Social Well-being	9. Human Health	10. Water Resources	11. Waste and Materials	12. Historic Environment	13. Landscape
Sustainable	Construction (negative)	-/?	-/?	0	-/?	-/?	-/?	-/?	0	-/?	0	-/?	-/?	-/?
	Construction (positive)	+/?	+/?	0	0	0	0	0	+/?	0	0	+/?	0	0
	Operation (negative)	0	0	0	0	0	0	0	0	0	0	0	-/?	-/?
	Operation (positive)	+/?	0	+/?	+/?	0	0	+/?	+/?	+/?	+/?	0	0	+/?
Traditional	Construction (negative)	-/?	-/?	0	-/?	-/?	-/?	-/?	0	-/?	0	-/?	-/?	-/?
	Construction (positive)	0	+/?	0	0	0	0	0	+/?	0	0	+/?	0	0
	Operation (negative)	0	0	0	0	0	-/?	0	0	0	0	0	-/?	-/?

Option	Stage	1. Biodiversity	2. Soils, Geodiversity and Land Use	3. Water Quality	4. Flood Risk	5. Air Quality	6. Greenhouse Gas Emissions	7. Climate Change Resilience	8. Economic and Social Well-being	9. Human Health	10. Water Resources	11. Waste and Materials	12. Historic Environment	13. Landscape
	Operation (positive)	+/?	0	+/?	+/?	0	0	+/?	+/?	+/?	+/?	0	0	0

The specific detail for all options reviewed across the entire region can be found in the full DWMP SEA Environmental Report. The assessment of the full L2 River Basin Catchments, the full summary of options screened in, likely effects identified and specific comments from the assessment, is illustrated in Table 27. This does identify schemes where there are potentially significant negative effects against SEA objectives.

Table 27 – Summary of options screened for assessment and findings

L2 River basin catchment	WwTW Catchment area	Number of options screened in	Likely significant effects identified	Comments
Carmarthen Bay and the Gower	Gowerton Llanelli Coastal	2 1	☒ ☒	A range of minor and moderate positive and negative effects for construction and operation have been identified and assessed, reflecting the small scale of the proposed schemes
Clwyd	Kinmel Bay	2	☑	Two proposed schemes with likely significant negative effects against one SEA objective during construction.
Conway	Ganol STW	6	☑	One proposed scheme with likely significant negative effects against one SEA objective during construction.
Dee	Five Fords (Wrexham) Llanasa (Nr Prestatyn)	2 5	☑ ☑	Two proposed schemes with likely significant negative effects against one SEA objective during construction. In operation, likely significant positive effects against one SEA objective. Two proposed schemes with likely significant negative effects against one SEA objectives during construction.
Llyn and Eryri	Bangor Treborth Porthmadog	9 4	☑ ☒	One proposed scheme with likely significant negative effects against two SEA objectives and one likely significant positive effect during construction. In operation, likely significant positive effects against four SEA objectives
Meirionnydd	Tywyn	3	☑	One proposed scheme with likely significant negative effects against one SEA objective during operation.
Southeast Valleys	Cardiff Bay Cilfynydd Newport Nash	2 1 27	☒ ☒ ☑	15 proposed schemes with likely significant negative effects against up to five SEA objectives and one likely

				significant positive effect during construction. In operation, likely significant positive effects against up to five SEA objectives.
Tawe to Cadoxton	Pen-Y-Bont Swansea Bay	2 2	☒ ☑	One proposed scheme with likely significant negative effects against three SEA objectives and one likely significant positive effect during construction. In operation, likely significant positive effects against five SEA objectives.
Total		68*		

Construction activity is unlikely to lead to cumulative significant effects on receptors (unless this activity is of significant scale, concentrated in specific localities and occurring concurrently). It is anticipated that the effects of the options can be managed through the application of the mitigation hierarchy, and a range of construction mitigation practices.

However, for schemes that represent significant engineering works and capital investment, there will be individual and cumulatively significant positive and negative effects in terms of SEA Objectives 6 'Greenhouse Gas Emissions', 8 'Economic and Social Wellbeing' and 11 'Waste and resources' which need to be considered where appropriate.

10.1.3 *SEA next steps*

Now the final DWMP has been adopted and a post adoption statement produced, the selected schemes for managing drainage and wastewater contained in it will need to be implemented through specific projects. As part of this process, each project may be subject to further assessment to understand and manage its potential environmental and social impacts.

These assessments, which may additionally include HRA and EIA, will take account of the issues discussed in this report but will also be informed by the greater detail available as the work progresses about construction techniques, building materials, and agreed locations and routes.

We have now carried out the production of the post adoption statement and it is published alongside this plan.

10.2 Habitats Regulations Assessments (HRA)

Habitats Regulations Assessment (HRA) – examines the potential effects of a plan or project on nature conservation sites that are designated to be of European importance. The HRA is mandated by the Conservation of Habitats and Species Regulations 2017 (the 'Habitats Regulations'), which transposes into UK law the European Directive 92/43/EEC (The Habitats Directive).

The HRA process begins when the development of the DWMP has reached sufficient progress to include specific details about potential projects, such as location and scale. There are no formal guidance or precedent cases to directly inform the application of a HRA to the DWMP. Therefore, there is a degree of flexibility for the HRA process. This allows the process to be run in a manner that provides maximum benefit for plan development and decision-making.

10.2.1 *HRA Process*

Stage 1 – Screening or 'Test of significance'

This stage looks for the potential consequences of a project or plan on a designated site, either alone, or in combination with other projects or plans, and assesses whether these outcomes are likely to be significant.

Stage 2 – Appropriate Assessment (including the 'Integrity test')

This stage is a more thorough analysis of the plan or project, in which the consequences on relevant locations have been identified as significant or uncertain and is required to assess the likely significant effects of the proposal on the integrity of the site and its conservation objectives.

The HRA test must show beyond all reasonable scientific doubt if an adverse effect on the site's integrity can be ruled out; this is called the 'Integrity Test'.

Mitigation measures, which have been included in the plan, or have been developed during the HRA process in response to the potential adverse effects, must be assessed to determine likely effectiveness.

Stage 3 – Assessment of Alternative Solutions

Where adverse effects remain after the inclusion of mitigation measures, Stage 3 examines alternative ways of achieving the objectives of the plan that avoid these impacts. A plan that has adverse effects on the integrity of a designated site cannot be permitted if alternative solutions are available, except for reasons of overriding public interest.

Stage 4 – Assessment Where No Alternative Solutions Exist and Where Adverse Impacts Remain

This stage assesses compensatory measures where it is deemed that there are no alternatives that have no or lesser adverse effects on designated sites, and the project or plan should proceed for imperative reasons of overriding public interest (IROPI).

The HRA process will therefore be used iteratively to inform the optioneering stage by providing a mechanism for proposal assessment that ensures proposals are not ultimately prohibited under the Habitat regulations.

10.2.2 *HRA Scope and approach*

A key issue for the HRA is the level at which assessment can be reasonably and meaningfully undertaken. For a DWMP L3 level, which is relatively wide-ranging; an HRA undertaken would necessarily be quite high-level also and would likely defer much of the assessment to a lower planning tier due to the absence of detail on the location of interventions. With risk clusters considered at greater resolution within individual WwTW catchments to resolve issues, the scope of the HRA is based on a review of the scale and characteristics of the specific options proposed. Following high level screening against proximity to European sites, options which could not be excluded from having an impact had an additional '**appropriate assessment**' undertaken to identify in closer detail other features that may be relevant to site integrity including typical species, supporting habitats and functional habitats.

In most instances, the environmental changes associated with the options will almost certainly be manageable or avoidable at the scheme level. However, this relies on mitigation assumptions and, as such, some options and WwTW Catchments are 'screened in' for appropriate assessment.

The following L4 areas and European sites are therefore considered in an 'appropriate assessment'.

Table 28 – WwTW Catchments where appropriate assessments were undertaken and site triggers

WwTW Catchment	Sites
Bangor Treborth	Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC Traeth Lafan/ Lavan Sands, Conway Bay SPA
Five Fords	Johnstown Newt Sites SAC River Dee and Bala Lake/ Afon Dyfrdwy a Llyn Tegid SAC
Ganol STW	Liverpool Bay / Bae Lerpwl SPA Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC
Llanasa	The Dee Estuary Ramsar The Dee Estuary SPA
Llanfaglan	Afon Gwyrfai a Llyn Cwellyn SAC Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC
Newport Nash	River Usk/ Afon Wysg SAC River Wye/ Afon Gwy SAC
Porthmadog	Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC
Tywyn	Pen Llyn a`r Sarnau/ Lleyn Peninsula and the Sarnau SAC

Specific details of the 'appropriate assessments' for the WwTW Catchments, including potential effect pathways and mitigation and effect assessment, can be found in the full DWMP HRA document. The key points are summarised below:

- Whilst options are identified the proposals are not intended to be definitive plans for schemes that cannot be deviated from; in practice, none of the options are of a scale or type where adverse effects (through construction or operation) are likely to be an unavoidable consequence of their delivery.
- For all options, the environmental changes associated with construction will be manageable or avoidable at the scheme level using standard project-level avoidance and mitigation measures that are known to be available, achievable, and effective.
- Regarding operation, the options within the current iteration of the DWMP are fundamentally addressing relatively small-scale local flow-management issues to reduce spills or flooding at a particular location and ensure that these volumes can be passed to the relevant WwTW for treatment (in accordance with the WwTW's permits). As such, their operational effect on receiving waters is likely to be positive (or at least neutral) compared to the status quo.

The effects of options operating 'in combination' have been explored through the screening and appropriate assessment phases. These assessments have concluded that adverse effects 'alone' are not likely to occur for any European sites or features as any such effects can be avoided or mitigated at the project level; this also applies to 'in combination' effects between options due to the following:

- The environmental changes and zones of influence of options in different L4 areas will be negligible and will not overlap spatially or temporally; nor will this result in complex synergistic or temporally dispersed effects.
- Mitigation can be relied on to reduce the effects from any individual option to the extent that there will effectively be 'no effects' due to construction or operation.

As such, the options will not have adverse effects 'in combination' that are likely to be unavoidable at the project level.

Regional and local plans have been reviewed at a high level to determine whether there are any likely significant 'in combination' effects with proposed options. This review has not indicated any potential or likely 'in combination' effects that could occur because of cumulative development pressure. Furthermore, the timescales involved in the implementation of the DWMP options, and the absence of detail on allocation proposals, makes any 'in combination' assessment difficult and of limited value. However, the DWMP options account for anticipated local and regional growth and are inherently unlikely to operate 'in combination'.

10.3 SEA and HRA Consultation

It is important to recognise that the DWMP consultation includes the separate formal consultations of the draft SEA and HRA.

The consultation culminated with three responders, Natural England, Welsh Government and Afonydd Cymru. In general all were supportive of our approach. However, there was concern regarding our decision to not put forward solutions that showed an overall negative effect on the environment. We have re-considered that some of the solutions can still go forward with an allowance for a down the line assessment when more information is available but there still remains a small number that really need to be re-evaluated for additional mitigation measures and will go back to options development and go around the cycle again. We will learn from the additional application of the process and bring the process earlier into the planning stages so that there is more time to review the impacts on the environment.

Respondent feedback on mitigation in the SEA and HRA has also been taken into account. The SEA identifies potential preventative and mitigation measures, including those related to cultural heritage. Further opportunities for enhancing heritage assets will be considered during the DWMP development. If a scheme progresses, the planning process will address any adverse impacts on cultural heritage or landscape.

Respondents expressed appreciation for the SEA and HRA in the DWMP. Their support influenced the selection of preferred solutions. It was also recognized that the implementation of the DWMP needs to be considered based on these assessments. To address this, ongoing collaboration with the Welsh Government will continue, focusing on further developing the methodology.

The final SEA and HRA and SEA post adoption document are produced and published alongside the plan.

10.4 Impacts to Net Carbon

In the production of delivery solutions, the carbon impact was also quantified. The additional carbon from the programme has been noted and a further assessment is being considered to build in an offsetting process. Trials and cost of an offsetting process will need to be built into the overall solution if best practice on this topic can be derived.

There are also other ways to reduce our Net Carbon. One of these is at our WwTW where through the process gases are emitted such as Nitrous Oxide and Methane. We are going to work on reducing the emission of these gases as part of our carbon reduction plans. There are always going to be solutions that increase our carbon footprint. However, by using other carbon reduction schemes to offset the increase we intend to keep our carbon footprint stable while providing the additional service to more customers for instance, and then make a positive reduction to ensure we continue to drive our carbon impact down.

11 Adaptive Planning

Adaptive planning is a process to show how our short term investment plans support a wide range of possible future investment plans, which take account of possible different future challenges or emerging policy changes. It helps us to show that we understand what may trigger us to change strategy and when greater certainty might enable us to make a decision to shift to a different investment pathway. An example of an emerging policy change is occurring during the first development of the DWMP. That is the change to storm overflow legislation. The policy currently can range from what is currently in place in a consent to a new consented requirement. In a management plan this is shown as a step change. What adaptive planning is in essence is the assessment that states in the end what action would you take in every scenario tested as those actions are always needed.

11.1 Methodology

The scenarios that were modelled for cycle one of the DWMP are set out in Table 29. Due to time constraints, model runs were undertaken for the three 2050 scenarios in Table 29 and for a 2020 baseline, but for no interim epochs. These scenarios were undertaken for the 44 catchments (61 models) listed in the Appendix Section 13.2.

Table 29 – Scenarios that will be modelled for cycle one DWMP

Year	Scenario name	Demand**	Creep*	Climate Change	
				Rainfall Intensity – Flooding	Time Series – Overflow Spills
2020	Base	-	-	-	-
2050	Low	Based on historic build-out rates	Using UKWIR methodology reduced by 30% (x0.7)	5% uplift	No perturbation – use 2020 typical year
2050	Most Likely	'Central estimate' for growth: based on ONS forecasts, historic growth and LDP.	UKWIR methodology	Existing DWMP method – UKCP09 between low and medium scenario, from UKWIR 2017 paper central estimate. 35% uplift for north, 15% for south.	Using RED-UP version 3, RCP8.5 projections to 2030
2050	High	Based on local authority projections	Using UKWIR methodology increased by 30% (x1.3)	UKCP09 high scenario, from UKWIR 2017 paper. 65% uplift for north, 35% for south.	Using RED-UP version 3, RCP8.5 projections for 2050

***Creep is not mentioned in Ofwat's LTDS guidance but has been included in the DWMP assessment.**
****Modelling does not include reductions in daily water use by households or businesses. However, impacts of reducing water use were explored as part of DWMP option development.**

The following sections explain why these model scenarios were chosen.

11.1.1 *Growth*

Growth is made up of a combination of population and property forecasts multiplied by the return to sewer component of per capita consumption. It is the combination of increasing properties, the number of people distributed amongst them, and the amount of water forecast to be consumed that provides the growth forecast and variations of these forecasts that provide the growth scenarios.

The long-term delivery strategy uses a defined set of combinations to address the uncertainty in the components of the growth forecast.

The Low scenario is made up of the forecast derived from the historic build out rates (the properties expected to be built)

The Most Likely scenario includes the forecast based on local development plan (the properties planned to be built and allocated by the council) combined with the office of national statistics forecasts.

The High scenario include the forecast based on (the properties allocated by government to drive development at a regional scale)

In each scenario the population and return to sewer rate has been used linked to the WRMP.

11.1.2 *Creep*

There is limited information on current rates of urban creep, rates of urban creep in rural areas, or rates of urban creep in Wales. Current industry practice and the DWMP Framework recommends UKWIR's 2010 report (UKWIR, Impact of Urban Creep on Sewerage Systems, 2010) and this report has therefore been used to generate the DWMP 'Most Likely' scenario.

There is even less information on likely creep for the Low and High scenarios. The DWMP Framework recommends sensitivity testing at ±30% of the UKWIR-estimated urban creep and these were therefore used, -30% for Low scenario and +30% for High scenario. No caps on the amount of urban creep have been considered in the High scenario - i.e., creep may exceed the available permeable area within a catchment.

11.1.3 *Design Rainfall*

There is limited guidance on applying RCP2.6 or RCP8.5 forecasts from UKCP18 to design rainfall, as required by Ofwat in its LTDS report. UKWIR have published guidance on uplifting design rainfall for the medium and high emissions scenarios in UKCP09 (UKWIR, Rainfall Intensity for Sewer Design - Technical Guide, 2015). Further evidence is published in The Institute of Civil Engineers 'UKCP18 Briefing Report' (ICE, 2022) and suggests that RCP8.5 in UKCP18 is broadly equivalent to the UKCP09 high emissions scenario, in terms of temperature. Using this evidence, the UKCP09 'between low and medium' scenario was used for the 'Most Likely' scenario in Table 30 below.

Table 30 – Extract from the ICE UKCP18 Briefing Report - Equivalence with UKCP09

UKCP18 RCP	Increase in GMS temperature (deg C) by 2081 - 2100	UKCP09 most similar SRES scenario (in terms of temperature)
RCP2.6	1.6 (0.9 – 2.3)	None
RCP4.5	2.4 (1.7 – 3.2)	Low emissions (SRES B1)
RCP6.0	2.8 (2.0 – 3.7)	Between low and medium (SRES B2)
RCP8.5	4.3 (3.2 – 5.4)	High emissions (SRES A1F1)

No low emissions scenario rainfall uplift values could be found for UKCP09 or UKCP18. The CIWEM Urban Drainage Group Rainfall Modelling Guide (CIWEM, 2016) suggests a lower end estimate for all England of 5% for 2050 based on UKCP09 and this has therefore been adopted for the Low scenario.

An alternative option was to derive new uplift parameters for UKCP18, but this was not considered feasible within the time available for model runs. Guidance is provided in Future Drainage: Guidance for applying rainfall uplifts (Murray Dale, 2021), however, a comparative approach has been provided by JBA below. This suggests that the UKWIR 2017 uplift values for high and central scenarios are generally greater than or similar to likely UKCP18 uplift factors, with the exception of the central estimate for south UK, which is around 5% lower than the likely UKCP18 values in Figure 33 below.

Table 1 – Approximate comparison of uplifts to the UKWIR 2017 values for 2050, 30-year return period.

UKWIR 2017 values			FUTURE-DRAINAGE Range	
			From	To
North West UK	Central estimate	35%	15%	30%
	High estimate	*65%*	*35%*	*45%*
North East UK	Central estimate	20%	10%	30%
	High estimate	*50%*	*25%*	*45%*
South UK	Central estimate	15%	20%	25%
	High estimate	*35%*	*25%*	*35%*

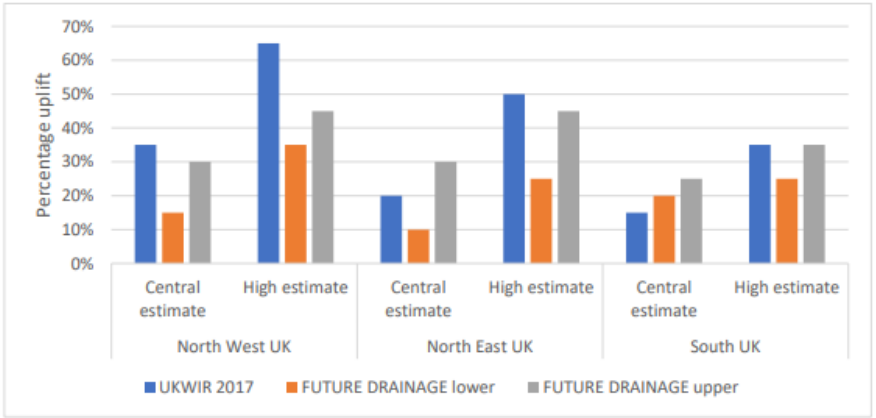

Figure 3 - Approximate comparison of uplifts to the UKWIR 2017 values for 2050, 30-year return period.

Figure 33 – Approximate comparison of uplifts to the UKWIR 2017 values for 2050, 30-year return period

The UKWIR DWMP Framework is more simplistic than the approach proposed here with a standard percentage uplift for all of UK.

From the model runs, predicted flood volumes from sewers (design rainfall) and predicted number of overflow spills (time series rainfall) were generated. These were then converted to number of properties at risk of internal flooding and number of pollution events. See section 4 (Risk Assessment) for further detail regarding this process.

11.2 Outputs

Our modelling indicates that currently there are 75,512 properties which could be at risk of internal sewer flooding in the 2020-time horizon across 44 catchments. We have used our models to assess how this could be impacted by the scenarios proposed by the Ofwat Adaptive Pathway possible scenarios.

As would be expected the number of properties predicted to be at risk of internal sewer flooding increases between 2020 and 2050 varies significantly depending on the pathway followed. Based on these findings, and as illustrated in Figure 34, there is an estimated 41% increase in properties at risk of internal sewer flooding for the Low pathway, 68% for Most Likely pathway and 109% for the High pathway when compared to the 2020 time horizon model.

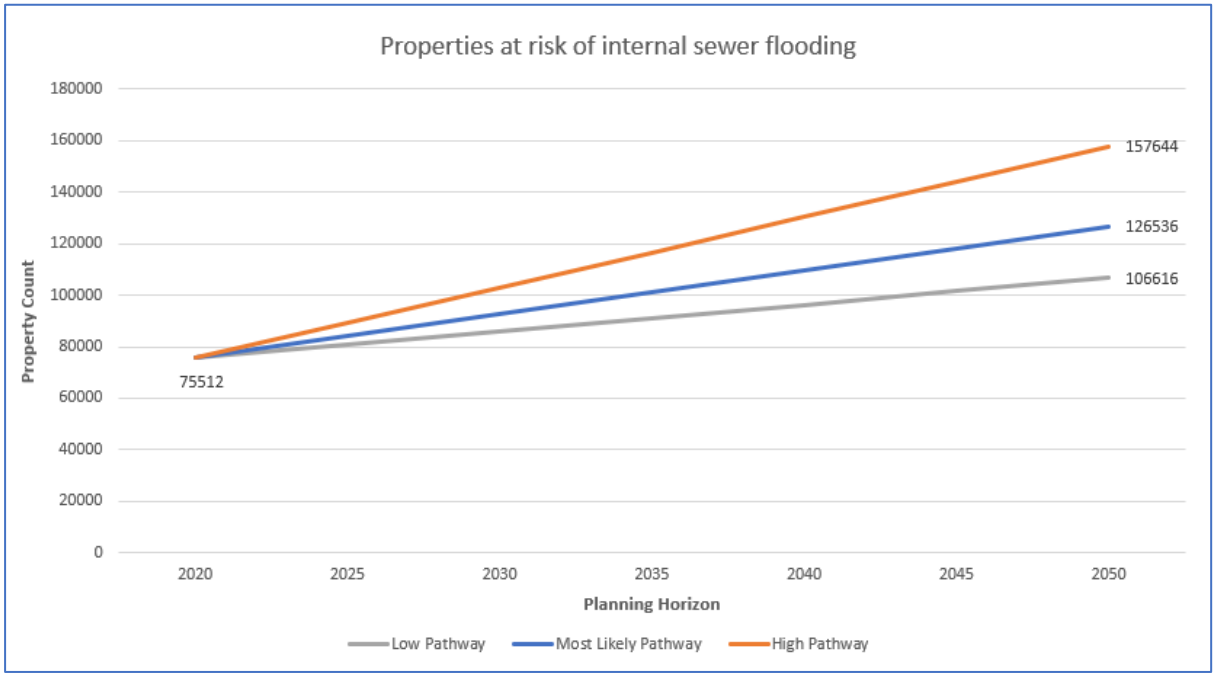

Figure 34 – Variation in properties at risk of internal sewer flooding between adaptive pathways

11.2.1 *Costs*

To assess the potential impact of the proposed 2050 scenarios on the size and therefore cost of potential solutions we have looked at both the Reference Option, as described in the Options Chapter, and options developed following The Journey Plan. The reference option is a simplified cost estimate which may realistically resolve the flooding or pollution at a given location. It is not necessarily the most appropriate solution, however it provides a comparable cost across a range of catchments. The potential variation in costs using the Reference Option for the possible scenarios assessed is shown in Figure 35 and Table 31.

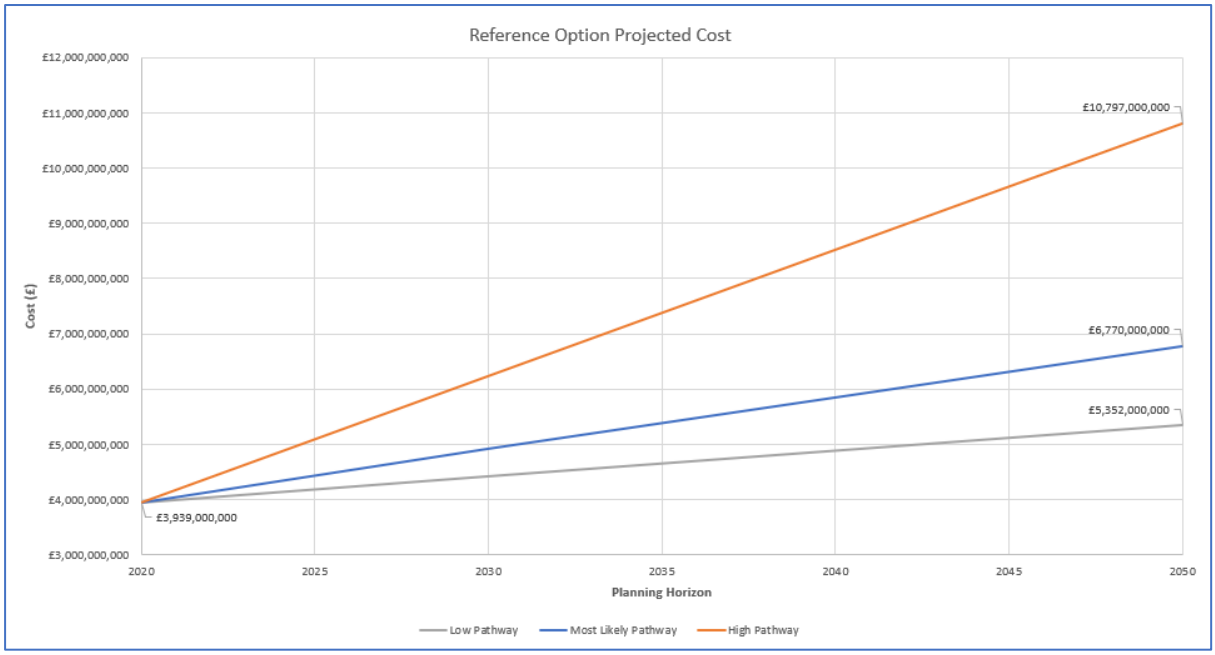

Figure 35 – Reference option cost variation for each of the three potential scenarios that includes both Storm overflows and customer flooding with a target of 40 spills

	2020	2030	2050
High	£3,939,000,000	£6,224,000,000	£10,797,000,000
Most Likely	£3,939,000,000	£4,907,000,000	£6,770,000,000
Low	£3,939,000,000	£4,410,000,000	£5,352,000,000

Table 31 - Reference option cost variation for each of the three potential scenarios

In line with the Journey Plan detailed in this report, we have developed options for the 2030 Most Likely and then assessed any additional requirements against each of the Ofwat planning scenarios. The Journey Plan was designed to deliver the best hydraulically beneficial schemes for each catchment. The Journey Plan promotes the removal of rainfall runoff from connected impermeable area which could help mitigate against the impacts of climate change and future uncertainties. The tests undertaken on the 44 catchments are shown in Figure 36 and Table 32.

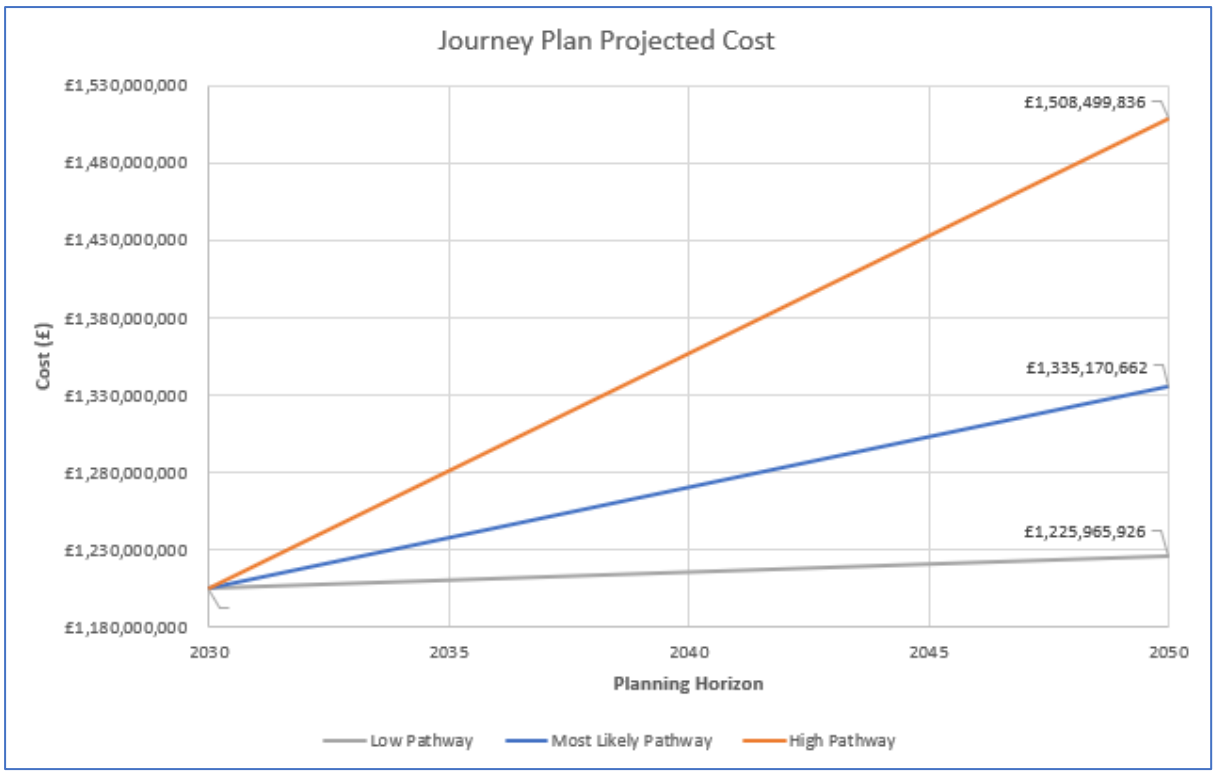

Figure 36 - Journey Plan projected cost for each of the three potential scenarios covering both storm overflow to 40 spills and customer flooding

	2030	2050
High	£1,204,903,838	£1,508,499,836
Most Likely	£1,204,903,838	£1,335,170,662
Low	£1,204,903,838	£1,225,965,926

Table 32 – Journey Plan cost variation for each of the three potential scenarios

The results indicate that when Options are developed in line with the Journey Plan, the impact of future uncertainties are mitigated to a much greater extent when compared to the reference option, which has been derived using traditional hard engineering solutions. The most significant benefit of the Journey Plan option is the removal of runoff from impermeable area draining to the foul or combined sewer network. The removal of the connected area mitigates against the impact of increased runoff because of climate change.

11.2.2 *Tipping Points and Decision Points*

The key to adaptive planning is knowing which future scenario is most likely to occur and therefore when to switch to the appropriate planned pathway. In the 2023 DWMP we have assessed what the likely impact of three scenarios could be, however when we need to switch between each of the scenario pathways is a much more complicated question. We have reviewed possible Tipping Point and Decision Points below:

Population Change: A Tipping Point:

We have undertaken analysis of historical build out rates and taken into account data available in Local Development Plans in determining whether population change in a region will itself be positive or negative and what the change in population will mean for the performance of our assets. However this assessment is based on models and is not necessarily what will happen. We will therefore continue to review our population predictions and when developments start to have an adverse impact on the performance of our assets, which could be used as a means of informing us that population is changing in such a way that we need to adjust our management plan.

Climate Change: A Tipping Point:

We will monitor the performance of our assets to determine when we think changing weather patterns are triggering a change in the performance. Through modelling we will work to determine triggers which could be used as a means of informing us that the climate is changing in such a way that we need to adjust our management plans.

Legislation: A set of Decision Points:

We are currently committed to delivering investment in our sewer network, over and above our normal levels of maintenance (termed Base Expenditure) primarily through existing guidance:

- The Water Industry National Environment Programme (WINEP/NEP); and
- The Storm Overflow Assessment Framework (SAOF).

We are also developing our plan to ensure zero environmental harm from our assets on the water bodies within our operating region. The impact of these existing and future pieces of legislation will impact when we make investment in our sewerage network.

By reviewing our DWMP every five years we will review each of these potential tipping points and decision points on a regular basis and amend the revised plan accordingly.

As we reassess our plans each five years we will use the core plan and the DWMP most likely plan as backdrops to new decision year and trigger year indicators.

11.2.3 *Development of the Adaptive Plan*

We will continue to review the impact of the change on our sewer system. We will continue to ensure that the DWMP drives the LTDS to ensure the requirements of OFWAT are met, whilst ensuring our plan remains resilient to external demands and changes to policy and legislation in the future.

The business has continued to develop the long term delivery strategy merging in the methodology with the Price review for 2024 and the following graph (figure 40) has been produced based on the information provided from the DWMP and work streams looking at resilience and business as usual approaches.

The Core Pathway and Alternative pathways developed to support the Price Review are show below in Figure 37.

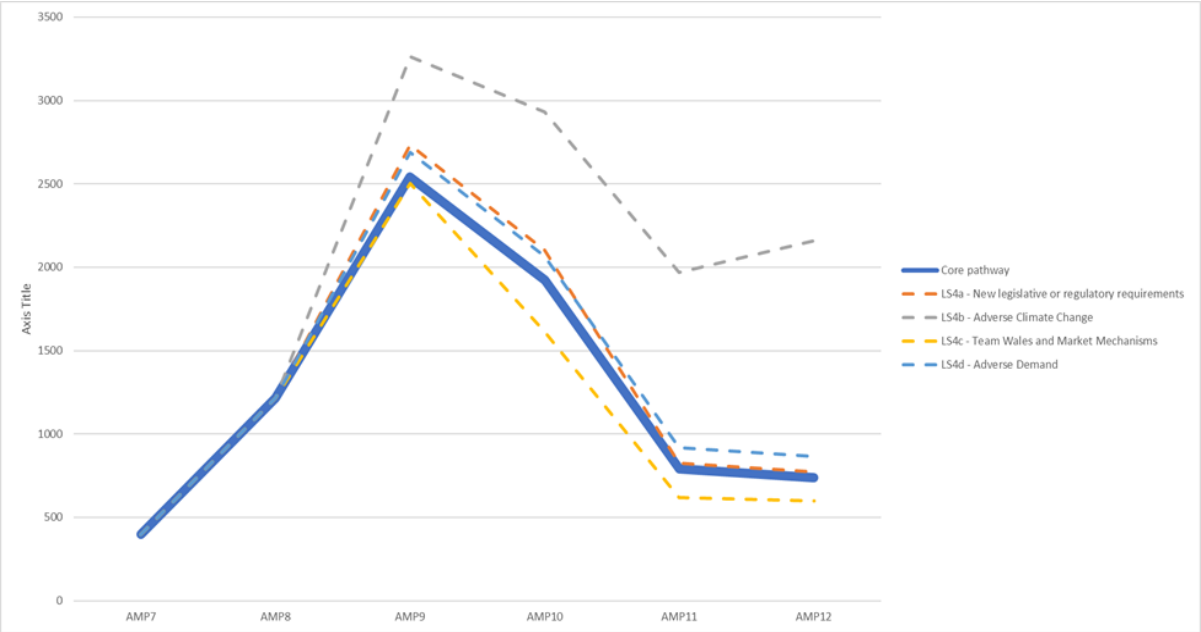

Figure 37 - Core Pathway and Alternative Pathways

The core pathway and its alternatives are based on the assumption that investment in Storm overflows will continue throughout the 25 years, but the current NEP will end within 15 years. The company's application of this methodology has led to an investment that peaks and then drops back.

This profile highlights that the current NEP which would normally have been delivered by 2027 has been spread over a longer time period to make the investment more manageable to customers. The company NEP is limited to drivers from NRW/EA and those drivers are to meet a deadline linked to the water framework directive cycles which is current to deliver improvements by 2027.

What the DWMP is introducing is that beyond the prescriptive NEP there will always be investment required to continuously improve our predicted impact on the environment. Whether that is to achieve greater phosphorus or nitrate removal or go further than regulators expectations of upper quartile performance. We have already discussed with customers their expectations of final destinations for sewer flooding and storm overflow activation. Therefore, we know that we need to sustain investment into the next 50 years to reach these destinations. With this knowledge it is no longer about what we need to achieve but it is about when we can

reach all of the destinations given the limited amount of funds, we can obtain from customer bills and financial investments.

Drawing again from customer research, customers are willing to increase their bills as long as we drive the improvements therefore the more likely investment which is shown in the DWMP rather than the LTDS shows the same early years increases but retains the higher investment in AMP 11 and 12 as the DWMP highlights that the following 25 years will also show an increasing profile for Wastewater assets and performance improvements.

The graph in Figure 38 shows how the LTDS core plan and the DWMP most likely plan differ towards the final decade indicating a requirement to retain investment at approximately £2billion up until 2050. It is also expected that investment will rise again after 2050 with the continued drive to increase areas for wild swimmers and improved water quality in our rivers and coastal waters.

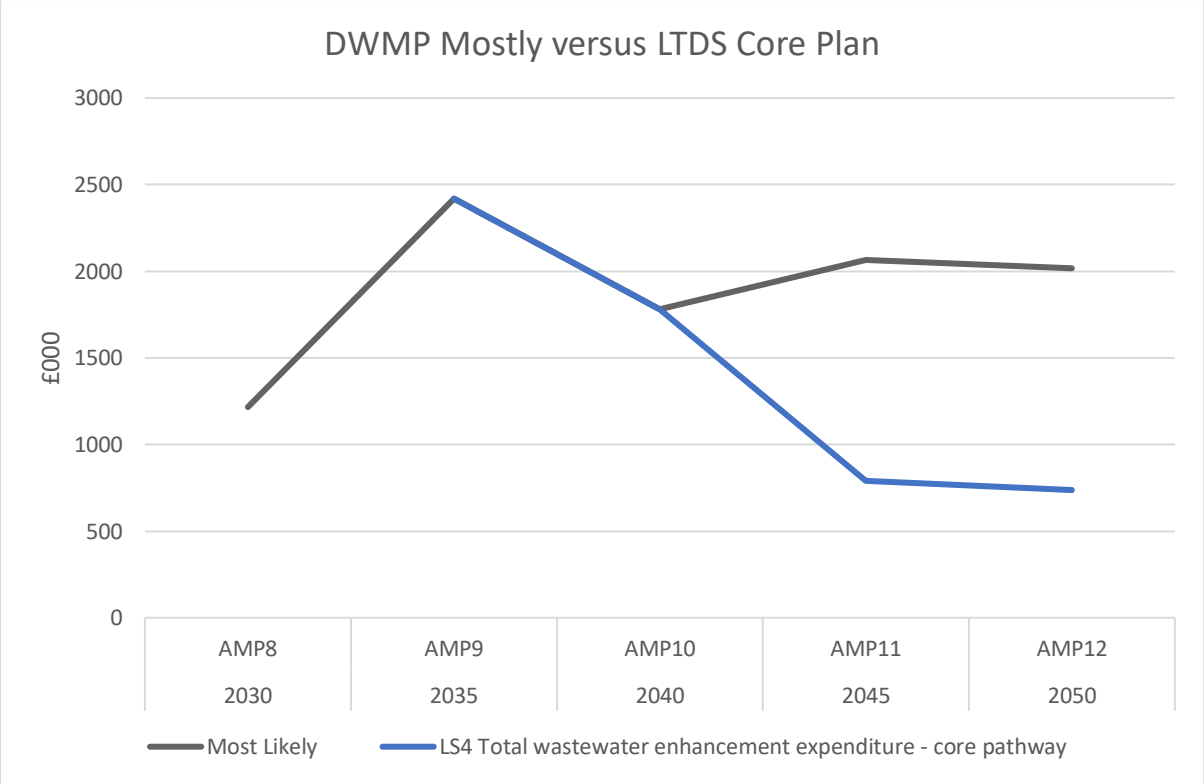

Figure 38 DWMP Most Likely scenario versus LTDS core Plan

12 Turning the plan into a funded Delivery plan

What we have created by applying the management plan principles to our price review process, which includes both business planning and asset planning approaches, is the contextual understanding of why we need to carry out work to drive change. The approach also shows where those changes are required to meet the future aspirations of our customers combined with the limitations of affordability.

We have sectioned the plan into 2 halves; activities to maintain our service, and activities to deliver our obligations under the National Environment Programme (NEP). We can assume that there will always be both drivers over the next 25 years even if the detail beneath these drivers change. We have forecast that the latest estimate will continue unchanged over the 25 years so that we will continue to require 56% to maintain our service for today and for the future, and 44% to continually deliver improvements to the environment by reducing our impact on it from intermittent discharges, our assets such as those that cause barriers to fish migration, and improving water quality with the management of nutrients at our sites via offsetting approaches.

We can lay out that for every £1billion needed 56% will support the delivery of our service while 44% will continue to reduce out impact on the environment due to our operation.

It is anticipated that our business can currently deliver at a pace of change that is affordable to customers and deliverable based on the supply chain available to us at a rate of £1billion every 5 years. If we assume that the percentages assumed are continually applied our plans can then travel at differing paces set by the funding available to us, however, the programmes discussed in this chapter will change their pace to meet the new pace.

If more funds were available, and we continue to invest using the same proportions then improvements would still be 56% relating to maintain our service and 44% to support reducing our impact on the environment. What would change is the overall pace to achieve the interim milestones to the customer and environmental destinations.

12.1 Differences between Planning approaches

This chapter has been included here to show the differences between planning approaches, and tries to draw out why there are differences and that each plan is aimed at different outcomes, but also reflect on why there needs to be more than one plan.

12.1.1 *Management planning*

Management planning is a process of assessing where a company is going and through the development of milestones and incremental steps to achieving the desired destination. The approach looks into the future and considers different ways such as funding, pace, aspiration and threats that could impact the ability to reach that destination. In this plan we have considered the planning objective approach currently incorporated into investment planning and business planning, and the companies Welsh Water 2050 aspirations, and put both of these against more recent aspirations of reducing escapes from the sewer network to encourage safe wild swimming and other water uses, along with customer expectation regarding the minimum level of service for sewer flooding to homes, businesses and property. We found that the cost to achieve the new aspirations could not be delivered with short term planning or even within 25 years.

This new understanding aided conversations within the company, at the Better River Quality Taskforce and at our Glas Cymru Board. Our consultation on this plan has then supported our approach regarding the direction of travel and also indicated the highest preference in terms of pace. These influential elements of consultation enable management planning to now go forward developing staged improvements. Always returning back to the destination to

continually inform Government, Regulators, stakeholders and customers of the progress made and the consequences from actions taken or not taken. This strategic approach sets the landscape and interim milestones and the first actions to take to ensure consistent and even improvement across the whole operating area.

A Management plan need only to be as detailed enough to confirm that given differing futures the aspirations inform the direction of the company so that the first milestones to the destination inform the business plan. Each solution created in a management plan is made up of assumptions that are written down that have a level of accuracy which is to be confirmed or reassessed through the planning process. The historical expenditure from the past are used to describe the impact on pace of change which then informs the Company whether to increase the short term investment required to bring forward the milestones or slow down the investment to meet affordability challenges and delay achieving the milestones.

12.1.2 *Business Planning*

A Business plan is a document that sets out in detail how a company is going to achieve its goals both financially and operationally. The plan explains what the company does and explains the product and service it provides. The aim of a business plan is to ensure that there is enough information for the Company to be satisfied that the operation of the business is affordable and achievable on a day-to-day basis.

A key element to a business plan is the financial projections that supports the deliveries of the goals stated. It breaks down the plan into annual budgets required to carry out the business. A business plan can cover short- or long-term goals however the information required is generally to support the finance ability of the plan and the certainty of changes required that demonstrated the need to finance it.

A business plan is detailed and requires certainty to support a financial projection. Its plan delivers the decision for customers to pay and the approach to obtain funding via borrowing to supplement investment required to deliver capital improvements.

12.1.3 *Asset Management planning*

Asset Management planning is a process that defines the actions to undertake to manage the infrastructure of a company by considering the assets life cycle. The plan considers when an asset will need to be replaced and what its new aim will be. Each asset is assessed in term of its usefulness and its overall operating efficiency, how it interacts with other assets and where on the life cycle curve the asset sits and how strategically important is the asset if it were to break down and what the consequence of that failure were to be if it did fail and it could not be fixed, or replaced in a reasonable time to maintain service.

The asset plans considered the purchase of new assets then maintenance and once they have carried out their task, their disposal. The plan then concludes the cost of making appropriate changes to a fixed annual budget and estimates the risk of failure on the business if the budget were not enough to maintain the service. This in turn then informs the business of the amount of funding required going forward based on the costs of asset management and the company's risk appetite.

An asset plan is detailed enough to ensure that the cost of an asset replacement programme is affordable and is manageable given the financial constraints identified through business planning. The assumptions set out in the Management plan are again reviewed and confirmed or reassessed increasing the level of certainty through the planning process.

12.1.4 *Delivery Planning*

A Delivery plan focuses on the here and now and takes the solutions expected to be needed immediately or with the next 2 years and then further refines each solution into a more detailed

project that is capable of being constructed. Site work confirms the assumptions made through the planning process and where the assumptions are proved incorrect the delivery project corrects the assumptions and alters the end solution to take account of what was found but the solution has to address the original need as well as what was found in reality after the site investigation work.

12.1.5 *Integrating Planning Approaches across Organisations*

In the area of wastewater and drainage management, planning hadn't really emerged into a process that could be applied transparently and uniformly across the UK. The DWMP Framework sought to address this.

What has been learnt by its application during this first cycle is that there are a number of Government policies, strategies and plans that need to be considered during the management planning section that would not be included in an asset plan, as their ownership and responsibility for their maintenance are not included in an asset plan or would be considered for funding in a business plan.

What has been concluded in our plan is the separation of wastewater aspirations and drainage aspirations so that there is a clear funding route and ownership for the assets that perform during average conditions. This indicates that the need for those assets is continuously required and will always be needed giving asset plans a certainty with regards to the policy to be achieved which is containment and the funding route to maintain that asset.

The emergency flood plans of the company, on the assets we own, are a mixture of asset plans driven by the cost of consequential failure, and the asset's ability to return to service as soon as practicable after a flooding event.

The company's decisions along with the decisions made by the Flood and Coastal Erosion Committee to defend, retreat, or hold the line of a community flood defence form the basis of investment. Often the community flood defence is formed of assets owned by the company and others who form the riparian ownership of a river or sea edge.

These are new approaches for the wastewater industry as this direction has not been shared previously in a systemic fashion. The more uncertain area of drainage relates to the climate and expected and anticipated changes to the types of storms expected, their duration and intensity. These uncertainties alone indicate that to manage these in an asset plan would require the delivery of large capital schemes and then there would be times and even years when these assets would not be utilised.

The information provided with regards to drainage assets owned by the company and those owned and operated by others then informs the business plan how to influence policies and strategies by others so that overall the asset and business plans for all involved, and developed with each other's goals and funding limitations considered, meet the needs of society driven and supported by Government.

12.2 Maintaining our service

We have calculated that during the first 5 years of the plan 56% of every £1billion of our funds will deliver programmes that support the principles laid out in our journey plan. We would like to suggest that this level of investment will continue over the next 25 years.

These are to continue to increase our operating area along with proposed new developments/growth, and keep pace with service improvements as indicated by the improving performance commitments, which underpin the quality, quantity, resilience and maintenance sections of the plan.

12.2.1 *Maintaining our current performance with todays and tomorrow's customers*

We expect that the majority of funds will be required to deliver continuous proactive and reactive maintenance. We have a large asset portfolio with every asset being pushed to ensure we gain as much life from it as possible without impacting on critical service delivery. These assets include:

- Pipes
- Pumps
- Overflows
- Sea outfalls
- Treatment processes
- Sludge disposal
- Telemetry
- Mechanical and electrical systems

All of these need a minimal level of funding to keep them in working order. There are also programmes to ensure pumps, pipes and channels are cleaned so that their efficiency isn't compromised. But it is not just about the asset and its life cycle but also about the staff required to run those assets and the parts held in storage to ensure the delivery of an essential part doesn't impact customers service, and also includes the buildings in which we work.

12.2.2 *Carbon*

One of the ways we can reduce our carbon impact is at our WwTW where through the process, gases are emitted such as Nitrous Oxide and Methane. We are going to work on reducing the emissions of these gases as part of our carbon reduction planning.

12.2.3 *Decisions support Tools, monitoring and investigations.*

The DWMP has informed the company of the need for investment in permanent and temporary monitoring along with continued development of models informed by the monitoring programme.

We have learnt from the introduction of the Event Duration Monitoring (EDM) programme, which was a requirement as part of Government strategy, that the data and decision tool improvement programme needs to be developed and implemented over time with the pace of implementation informed by affordability.

During our first DWMP the BRAVA stage identified that more decision tools were required before we could conclude the overall risk of an area without reference to anecdotal evidence. We took a pragmatic decision to continue to develop every location to a strategic point for the first cycle which is shown in the journey plan for each area, as without the development of a model or the investigation into risks at sites BRAVA would always conclude that there was more to understand before going any further.

The delivery plan specifically relating to the DWMP continuous development become a must do requirement so that plans in the less informed areas could be improved. The programme of work required to support this improvement over the first 5 years of this plan is to increase our hydraulic model coverage from 80% population coverage to 95% population coverage with a stretching target to achieve 98% population coverage (based on our annual performance report FT2 performance commitment).

It is important to know that in terms of the number of distinct models required to cover the remaining 20% of the population would increase the number of models from 199 to 828.

In addition to hydraulic model coverage, other asset level models are required such as those that indicate the correct size of pumps to deliver the future volumes of flow, and the size and dimensions of processes within a treatment works to meet and maintain the future flow requirement once CSO's are contained, or variations of containment from reducing environmental harm all the way to meeting levels required for bathing waters to the end destination, and also driving the new requirements required to meet the WFD status of good and then to excellent.

These new models that could be combined to create a new Review of Consent process that works within the management plan to inform the environmental destination of sewerage and drainage to aid regulation of the future impacts to environmental policies.

There are other programmes of work that we have classed as DWMP continuous improvements, and these are related to working with stakeholders and customers.

12.2.4 *Investigations and reviews of data programmes*

There is also a requirement within any planning system to understand what is changing over time and the consequence of that change causing an impact to customers. Another aspect of planning is assessing then reassessing the assumptions that had been made during the planning process. As time passes with proposed solutions ready for delivery in the future, a programme of investigations to improve assumptions can also be driven that continually improves the certainty of the solutions being put forward.

What this means is that there is a need to undertake investigations for many reasons most linked to the solution that is going to be delivered. Therefore, a proportion of maintain service is set aside to answer questions raised from an operational perspective and to improve assumptions made during the planning process. Now with the advent of management planning, the need to answer questions in a consistent and systematic approach brings the added cost of widespread formal investigation programmes.

Again, these investigations are driven by affordability. Programmes therefore need to be set to cover as many assets and catchments as possible. At a rate and detail that enables continuous improvements. Carried out in a timeframe suitable to inform:

- the management plan to reflect and evidence strategies to deliver,
- then to inform the asset plan risk and consequence assessments and then the business plan to inform the short-term funding requirements, and
- the delivery plan when the assumptions become clearer and known factors, as the project concludes,
- which are then fed back into the planning process and information improves.

Investigations culminating in confirmation that the current permit is fit for now and the future or that new permits will be required and when will they be needed.

The list of items below that provide answers to the following topics need to be investigated.

Quantity - Pg+I+E

- Infiltration
- Trade Permit agreements
- Population Growth
- Urban creep
- Climate change

Quality - Formula A

- Flow into the WWTW's
- Chemical impacts
- Nutrient impacts
- Trade Permit Agreements
- Discharge permits

Environmental – dilution

- Flow in the river during dry and normal and wet conditions
- Ability of the river to mix the permitted discharge.
- Ability of the river to dilute the permitted discharge.

12.2.5 *The customer area of options development*

The information required in a proactive way to effect a behavioural change in the population. This includes UK level Welsh, Regional and Local levels. The delivery vehicles of messaging is different for each level covered, such as TV, radio, social media, newspapers and roadshows at supermarkets and other popular locations such as the Royal Welsh Show.

The topic relevant to these informative sessions are;

- Reduction of water demand during the whole year and not only during a drought to support a reduction in the volume returned to the sewer,
- The impact of continual disposal of wet wipes, fats oils and grease via a sewer system that still continues to escape into our rivers and seas.
- Understanding the consequences of building over sewers on land owned by customers and businesses.
- Understanding ownerships of culverted watercourses and how to maintain them.
- Information to understand plumbing and misconnections and the consequences to the environment of those connections.

The cost of developing material for these sessions is low and can be classed as similar for each topic.

The cost of the delivery mechanism at the level to inform the audience is another suite of costs.

Costs are derived using a simple permutation approach.

The cost of the topic material	X	The delivery mechanism (TV, social media)	X	Population Reach

Figure 39 - Cost, Delivery and Approach

The programme of sessions to provide information is currently part of business-as-usual activities such as company level campaigns relating to stop the block. There is also benefit when combining messaging from other areas of the business such as water demand programmes and leakage programmes.

In addition, and again using the business-as-usual model, we can also focus our messaging at trouble spots to resolve localised blockages.

The programme of work in this area has been assessed and where the cost of delivery and the method of delivery is calculatable, the method to calculate benefit is not yet available to support a cost versus benefit assessment. As it is the right thing to do, and our customers support the continued delivery of information, we will continue in the most efficient delivery way while we develop a research programme to obtain the benefit data to drive additional informative programmes.

12.2.6 *Surface water removal campaigns*

We have also started to develop programmes targeting surface water removal at specific land ownerships or type of settlement. We have started with schools publicly owned so that we can influence the educational departments programme of school improvements. These locations can be retrospectively fitted with SUDS or other surface water systems that can aid the councils sustainability goals and carbon reducing targets.

It would be unlikely that we could support the funding to make the alterations as from the programme identified the opportunities are spread across our operating area and as yet do not form a high enough priority to support investment on their own. In terms of understanding the volumes of rainwater achievable to redirect back to the environment we would support a programme of investigations across Wales to understand where the opportunities could be and quantify the contribution to a local driver.

In a similar way there are also places where we can help councils and government building managers to retrospectively improve their sustainability and carbon footprint by providing information as to approaches to apply. Again, we can support others by carrying out investigations to quantify the benefit from a volumetric standpoint. Once we have enough areas mapped from both these programmes, we then can also use the data to inform surface water opportunities either as co-funded or joint programmes with other stakeholders. This wider investigation programme to map locations identified as possibilities is just as important as delivering confirmed solutions.

These possible locations and the transition from a dot on a map to a fully funded project for the community can take between 5 and 10 years to reach a delivered benefit. Even though when linked with education programmes to stakeholders and customers, benefits can be delivered by others when they are empowered to make the right decisions.

We have costed how much it could cost to make improvements retrospectively to all of the locations identified at this stage, however, the cost of delivery would be high if all delivered over 25 years.

Understandably, the pace of delivery is linked strongly to affordability, deliverability and finance ability. So the pace will start slowly and gain pace as funds become available. What will be created is a pipeline of opportunities already for co-funding and joint delivery to meet joint government driven outcomes.

Another investigation programme will also be developed ready for the next plan which is to increase our targets to include industrial and business parks.

When these programmes are combined at a catchment scale and turned into staged improvements to meet our drainage plan we can then demonstrate the need for investment in our delivery programme and confirm the benefit to gain support through the final determination business plan process.

12.2.7 *Localised Solution development to meet future aspirations*

We have worked on developing a mechanism that identifies solutions that can be compared so that we can explain the costs versus benefits of delivering a traditional construction scheme versus delivering a more sustainable nature-based scheme at a hydraulically connected area, sometimes where there are approximately 50-100 houses.

However we must recognise that the permutations of possibilities are of too great a magnitude to carry out this intensively at every catchment of our operating area within the time period of 1 cycle. We have roughly estimated that there could be as many as 4000 areas in which we need to assess the risk with this level of detail. And similarly, the intensity required to establish the exact possibility to deliver is also costly and time consuming.

Over the years the decision to deliver a solution to a problem at a location has taken many years to establish the route cause and determine the exact course of action before sourcing funding and putting the spade into the ground. The investigation phase into the need for a delivery scheme has always meant that the most urgent current needs go through this detailed assessment. This stage of detailed planning is still required. With the advent of management planning the level of detail is reduced but the number of areas to carry out investigations increases until there is adequate information to understand the total current risk along with the predicted risk of the future.

What this means for management planning is that we need to develop the next level of refinement regarding the hierarchy of planning. This is required to draw population at risk of flooding estimates so that we can reassure customers and governed etc that the risk is low but the distribution of risk is widespread.

Drawing on evidence from the risk of sewer flooding in a severe storm performance commitment there are approximately 25% of the population at risk with current estimates, however we know from the BRAVA assessment that sewer flooding risk occurs in every Level 2 strategic planning area, and nearly every Level 3 tactical planning unit.

What we also learnt from the development of solutions to meet a 2030 and a 2050-time horizon in the future was that the cost to achieve both end destinations at once with a two-stepped time frame everywhere was just too fast to meet the affordability pace which is currently being assessed as part of business planning. This indicates that we need to create greater detail around the milestones to be achieved when working at local areas and how these influence business targets and performance commitments in the short term compared with the long term. The local target provides benefit to the overall company target so when a localised solutions is developed the impact or benefit to the company target must also be calculated.

A change to our approach is needed that will turn strategic direction solutions into delivery programmes while also widening the approach to include all areas in our operating area.

The greatest benefit to this change of approach is to confirm that an area has already achieved a minimum standard. Setting the minimum standard during the first cycle gained agreement from customers and our stakeholders. The standard we proposed at the draft was the equivalent to 6DWF or the more technical term to Formula A throughout the network and treatment works system. Our financial regulator did not support this approach so we will look at it again in the next cycle.

12.3 National Environment Programme (NEP)

There is in the region of 44% of the first 5 years investment contributing to the overall environmental improvement programme. We can assume that there will always be an NEP as there has been an NEP historically for at least 20 years.

The drivers to make change have altered overtime but in general a percentage of investment has always been set aside to deliver improvements. The current areas where an improvement is required is listed in the following sections. The new requirement to improve storm overflows is current set at over a third of the environmental improvement budget. The remaining 2 thirds support the other drivers listed.

12.3.1 *River Water Quality – Continuous and Intermittent*

Work here covers improvements to river water at locations where nutrient and pollutant levels within the river can be improved. This includes nutrients such as phosphorus and compounds that have an acute impact on water quality such as ammonia. These improvements are above levels indicated on our current permits and will lead to a new permit in the future.

12.3.1.1 Storm Overflows

During wet weather, more water enters our sewers than we can fully treat. To prevent this water from directly impacting customers through flooding of homes and businesses, sewerage systems have release points which discharge excess flows into nearby watercourses. Understandably, this raises concerns for customers about the impact of the operation of these discharge points on the receiving watercourses. To manage this impact and to work towards eliminating the ecological impact harm caused by this interaction, we have installed monitors on all our storm overflows, which measure when wastewater is being discharged and for how long.

This data allows us to identify overflows which are discharging frequently, and currently we are investigating all overflows which discharge over 40 times per year. These investigations allow us to identify and implement schemes to reduce/eliminate the impact of these overflows on the receiving watercourse. We will expand our investigations to include all storm overflows in between 2025 and 2030, AMP8.

12.3.1.2 Storm Discharges

The recent ambition set out by the Wales Better River Quality Taskforce recognises that the scale and complexity of delivering sustainable solutions for eliminating the impact of storm discharges with require investment over several AMP investment periods.

The current approach for storm discharges is a prioritisation based on ‘harm’ to fish and the ecology of our rivers and includes waterbody sensitivity as directed by the Better River Quality Taskforce. For investment in AMP8 (2025-2030), the outcome of our impact investigation programme will be used to prioritise investment based on ecological harm and sensitivity of the receiving water body.

The method for assessing the impact of a storm overflow on the ecology of a water body and the water quality needed to support its environmental objectives are based on a nationally agreed Storm Overflow Assessment Framework (SOAF) process and in line with the objectives of the Better River Quality Task Force, the strategic steer from Welsh Government and our regulators’ requirements.

We have developed our PR24 investment plan for storm discharges from a sample set of over 250 completed SOAF investigations to date. Once the impact of all storm overflows has been assessed in AMP8, the AMP9 and 10 investment programmes will be modified to ensure no storm overflows have an ecological impact after 2040.

We have also identified a number of unpermitted storm overflows. These have had the same overflow monitoring installed and they are being assessed at the same time as other sites. They will be included in the improvement programme with a similar priority for investment.

As we operate “wholly or mainly in Wales” water quality targets for the areas of England we serve are determined by Welsh Government, the EA has established drivers in their WINEP.

12.3.1.3 Barriers to Fish

Migratory fish such as salmon and sea trout have obstructions in the rivers that they need to navigate past to spawn. There are currently 366 listed barriers that have been identified as being owned by us across our operating area that may be a barrier to fish migration. We need to confirm they are barriers, rank how that barrier is affecting fish migration and produce our resulting programme for removal or improvement of the barrier.

12.3.1.4 Flow

NEP drivers under to increase full flow to treatment (FFT) at WWTWs and increase storm storage at treatment works were part of an adaptive plan set out originally in AMP7. We have carried out a rationalisation of all FFT, storm storage and monitoring requirements to refine the programme for AMP8 and it represents a substantial component of the NEP programme.

There is also investment in flow pass forward monitoring at the last storm overflows before WWTWs which will allow us to report against new monitoring requirements in AMP8.

12.3.1.5 Emergency overflow monitoring

In addition to storm overflows we also have emergency overflows at many of our pumping stations. These ensure that homes and businesses are not flooded in the event of a mechanical or other failure (such a power failure in the area) but do not normally operate in wet weather.

In AMP8 we will be extending our spill monitoring network to over 750 of these sites so that our operation can be monitored and reported to regulators. NRW’s requirements differ from the EA requiring overflow monitoring only and not flow monitoring at the pumping station too.

12.3.1.6 SAC Rivers

Since NRW published revised SAC data in January 2021 we have led on the development of Source Apportionment GIS (SAGIS) models for the 7 designated freshwater SAC rivers wholly in Wales and worked jointly with the EA on the modelling for the Wye and Dee which cross the Welsh border. SAGIS modelling is a standard approach adopted by Regulators and the industry across the UK for assessing the sources of nutrients such as phosphorus in rivers and it allows companies and regulators to agree the improvements required at WWTWs.

In January 2023 NRW completed an external audit of the models and planning tools developed which concluded they are suitable for investment planning and setting measures for us.

A collaborative NRW and our working group senior leaders was established and we committed to adding an additional £60m, enabled by our not-for-profit model, to our AMP7 investment programme at the Welsh First Minister’s summit in July 2022. This investment allowed us to bring forward investment on 12 large WWTW to be completed early in AMP8 and enable planning approvals and housing development to restart in those areas. AMP8 programme then targets a further 26 WWTW. The combination of the AMP7 and 8 programme will see over 90% of our fair share phosphorus reduction contribution delivered by the end of AMP8. The remaining WWTWs will be improved in AMP9.

In addition, we have supported NRW’s recent policy position to apply backstop phosphorus limits to prevent deterioration all other WWTWs above 20 m3/d within the SAC ‘catchment’.

12.3.1.7 Appropriate treatment

We undertook a regulatory review of the driver criteria, to understand the legislative, policy grounding and potential overlap with other drivers. We have proposed AMP8 investment that targets only high confidence sites (where we have data and where we have certainty of the legislative need) and high priority sites (based on river needs, designation and environmental benefit that can be delivered). This approach results in 5 sites being proposed for AMP8. All 5 sites are to improve septic tanks in our ownership discharging to surface waters.

Where additional sites qualified but are of lower priority (low priority due to low population served and lack of river need, for example high status of the water course they discharge to), we proposed those sites are profiled for investment in future AMPs. That will allow for multi-AMP planning based on river and environmental needs.

12.3.1.8 WFD Water Quality

For rivers not designated as SAC catchments other water quality improvements have been included in the NEP to comply with Water Framework Regulations (WFD). To support this a complex assessment of water quality data (recorded on the Reasons for Not Achieving Good or RNAG database), causes of water bodies not meeting the required WFD standard and consideration of locations that met cost benefit criteria was undertaken with regulators.

The AMP8 programme will look to improve all WWTWs present on the RNAG database with a positive cost benefit. This programme will see approximately 200km of river improved. NRW also set the ambition for a full assessment of river needs on all non SAC water bodies which we have included in the AMP8 investment plan.

There are 30 WWTW listed within the NEP with 60 obligations (revised permit limits).

Where improvements we considered to be disproportionately costly, it was agreed that we would accept a programme level obligation to develop a framework and guidance for such cases. In collaboration with NRW, we will undertake a wider benefits and natural capital assessment during AMP8, with an aim to build an AMP9 approach in PR29.

12.3.1.9 Nitrogen TAL

The technically achievable limit, or TAL, for total nitrogen is considered to be 10mg/l at present. This limit is to be reviewed by a review of what can be achieved by existing treatment processes designed to limit the total nitrogen emitted by WWTWs as part of a national study. We will contribute to this study by studying how its existing WWTWs with total nitrogen limits can be optimised.

12.3.1.10 UWWTD & Sensitive areas

WG have recently added Milford Haven to the list of Welsh water bodies designated at sensitive under the Urban Wastewater Treatment Regulations. This has led to the inclusion of phosphorus limits at Merlins Bridge WwTW (serving Haverford West).

12.3.1.11 Chemicals

AMP7 saw a large investigation programme managed through the national Chemical Investigation Programme 3 (CIP3), the majority of which was profiled to conclude 31 March 2022 to support PR24. Under the issued NRW guidance, there are no obligations for ‘implementation’ of any outputs of CIP3 in AMP8. NRW have agreed an approach to advance our understanding with further investigations. There is no specific environmental destination for Wales at present, and full agreement that the resources in research and trial offered through the industry Task and Finish groups (TAF) is expected.

12.3.2 *Bathing and Shellfish*

We work with our environmental regulators to ensure that designated shellfish and bathing waters are protected. We are also working with our regulators to increase the number of locations that wild swimming and other water users can use.

12.3.2.1 Bathing Waters

In 2022 more than 95% of Welsh bathing waters were classed as either Excellent or Good with over 99% of bathing waters passing minimum bathing water standards. Bathing waters are essential to the Welsh economy and tourist sectors as well as important for the health and wellbeing of our customers. In recent years there has been an increase in designations of coastal bathing waters in the South East and South West areas and more are expected throughout Wales in the future including riverine bathing water sites.

There is approximately 1700 miles of coastline in Wales, and in 2022 there were 106 designated coastal bathing waters and 1 inland location at Llyn Padarn. Bathing water quality is monitored by NRW during the bathing season (May to September inclusive) and classification is based on concentrations of Intestinal Enterococci and Escherichia Coli measured over four years. The classifications are linked to the likelihood of bathers becoming ill as a result of swimming in that class of water.

Improvements to sewerage systems and WWTWs alone will not guarantee good bathing water quality. The generic risks to each bathing water are recorded on NRW's Bathing Water Quality website (NRW, 2023) namely:

- Pollution from sewage – bacteria from sewage can enter our waters because of system failures or overflows or directly from sewage works
- Water draining from farms and farmland – manure from livestock or poorly stored slurry can wash into rivers and streams resulting in faecal material entering the sea
- Animals and birds on or near beaches – dog, bird and other animal faeces can affect bathing water as they often contain high levels of bacteria (much higher than treated human waste)
- Water draining from populated areas – water draining from urban areas following heavy rain can contain pollution from a variety of sources, including animal and bird faeces
- Domestic sewage – misconnected drains and poorly located and maintained septic tanks can pollute surface water systems

NRW also identify risks specific to individual bathing waters in its profile[1], for example Rhyl East bathing water[2].

We have included investment for bathing waters in AMP8, but our investment is limited to 3 areas:

- Bathing waters where we are the reason for deterioration from the 2017 baseline – only the Barry bathing waters fall into this category. This will be a multi AMP investment across the catchment area targeted at reducing surface water in the Barry area. There are other

[1] NRW, Find a bathing water: https://environment.data.gov.uk/wales/bathing-waters/profiles/
[2] NRW, 2023 Bathing Water Profile for Rhyl East: https://environment.data.gov.uk/wales/bathing-waters/profiles/profile.html?site=ukl1302-40650

bathing waters at risk, but we are a minor contributor in those cases (a good example is Rhyl which is mainly impacted by diffuse inputs).
- A study to investigate how bathing waters can be improved from sufficient and good to good and excellent.
- Work to allow 5 inland bathing waters be classified at our recreation sites.

We will also investigate the reasons for any newly designated bathing water failing to meet the minimum standard.

Welsh Government have set an ambition to begin a process to designate new inland bathing waters. We are a key partner in the working group and currently supporting a trial to help designate more inland sites. We will work to understand what these requirements are likely to be. We are also undertaking trial work at five visitor centres to help develop the process, and we will support these new designations through the development of detailed bathing water quality models which will provide information on the risk of failure to meet standards.

12.3.2.2 Shellfish

We have delivered substantial investment in AMP6 to protect shellfish water quality, particularly in the Loughor Estuary with post scheme analysis confirming that this has been successful. In AMP7 we are investing to protect shellfish on the Menai straight and AMP8 will include more investment in the Loughor and Menai along with investment in Swansea.

12.3.3 *Marine water quality and protected areas*

Investment in AMP8 will be focused on investigations into a number of transitional and coastal (TRAC) water bodies with a focus on Marine Protected Areas (MPA) such as Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Marine Conservation Zones (MCZ). We will develop hydrodynamic coastal models that are able to reflect the transitional environment focusing on WFD DIN failures. TRAC waterbodies will be prioritised in AMP8 based on likelihood that our assets are the cause of the problem and suitability of base hydrodynamic model. We will develop our models in these areas, include existing data available from NRW and upgrade with revised SAGIS models for the rivers that discharge to the transitional areas. It is likely that further water quality monitoring will be required by NRW to allow these models to be developed further so as to support a robust basis for investment in AMP9.

12.3.4 *Biodiversity*

Investment in this area covers work to record and enhance the current biodiversity on our land, improve the conservation status of terrestrial SSSIs on our land or that we are putting at risk or measures to reduce the spread of invasive non-native species (INNS).

The combined impact of our measures should help to ensure that we can play its part in meeting the nature emergency and supporting measures to help deliver the Welsh Governments objective of delivering ‘30 by 30’ in line with the COP15 conclusions.

12.3.4.1 Biodiversity

Biodiversity drivers include investigations to consider necessary changes to licenses and the identification of opportunities to maintain or enhance biodiversity either on our or others’ land.

The NEP includes investment to meet these drivers by investigating the biodiversity benefit provided by using constructed wetlands, baseline studies for improving connectivity corridors on between our sites and other habitats, and other biodiversity enhancement opportunities on our designated and undesignated sites.

Improvements cover the requirement to fund the changes to licenses and actions to maintain and enhance biodiversity including measures to improve peatland and heath land areas. The NEP includes investment to improve non-designated areas as well as those with Section 7 priority species to bring them into favourable conditions through enhancement and restoration through meadows and connectivity corridors and woodlands. Measures also include creation of a native plant nursery and seed banks to support biodiversity restoration and enhancement projects and creating of native plant wetlands.

12.3.4.2 Invasive Non Native Species

Invasive Non Native Species (INNS) drivers include investigation drivers to identify potential INNS pathways and mitigation measures, to monitor and report on INNS, to prevent deterioration, and actions to reduce the impacts of INNS through direct management or partnership working. The NEP includes investment to assess the interactions between INNS and changing conditions due to climate change and subsequent impacts on water quality, build on our AMP7 investigations using evidence to deliver improvements identified and continuing support Wales Resilient Ecological Network (WaREN) Project to prevent deterioration.

12.3.4.3 SSSI

SSSI drivers include investigations to consider necessary changes to licenses and the identification of opportunities to maintain or enhance biodiversity either on our or others' land, improvement drivers to cover the requirement to fund the changes to licenses and actions to maintain and enhance biodiversity, measures to monitor the condition of SSSI's and investigation, and improvement measures to prevent deterioration in the status of SSSI's on our land. The NEP includes investment to investigate and improve designated sites for enhancement opportunities (including woodlands).

Our largest individual project will be to replace a sewer that runs from Caldicott to Newport (Nash) WWTW which crosses much of the Gwent Levels SSSI and where a number of key species, such as the Shrill Carder bee, have been found to be in unfavourable conservation status and our current approach to managing the risk of failures on the sewer is insufficient to support restoring good conservation status of these and other species.

12.3.5 *Net zero*

We have a Net Zero Strategy with the aim of reaching net zero by 2040 and our plan accounts for "process emissions" where methane and nitrous oxide compounds can be given off at WWTWs as well dealing with the more conventional carbon sources such as vehicle fuel, electricity needs, embedded carbon in construction materials and carbon associated with our supply chain. Our AMP8 plan will build on the investment already delivered and help us on our journey to 2040.

12.3.6 *Biosolids*

In terms of investment this aspect is not included in the DWMP currently, but it has been written as an introduction here to explain what is excluded from the DWMP.

The sewage sludge (biosolids) drivers are aimed at delivering improvements in the resilience of the sludge management chain. This can be achieved by improved sludge management practices, increased agronomy support for farmers and the creation of suitably robust contingency measures. Developing and utilising new and additional sludge treatment and management technologies, and better contingency plans to manage impacts of climate change and periods of supply chain disruption, will better serve the continuous production of treated sludge (biosolids) that are beneficially supplied to farmers for spreading onto their agricultural land, helping to maintain the productivity of their soils and reduce costs and carbon associated with imported artificial fertilisers.

Investments through these drivers will also support requirements to assess the impact of our biosolids on soil and water quality, as well as helping the broader net zero carbon commitments to be realised. The obligations include implementation of trial technologies to increase dried product, investigations into chemicals and microplastics, innovation in nutrient removal and resilience in landbank and storage.

12.3.7 *Microplastics*

AMP8 will include investigations into microplastics as part of a National working group which will have to develop approaches and methodologies for this project. We are fully committed to this area where the obligation will have to be defined further once confirmed at a national level.

12.3.8 *Profile and Outcomes*

Our NEP list of obligations is currently ambitious and will be highly dependent on the availability of key resources within the industry, supply chain and NRW for its delivery. The PR24 plan has seen a continuation to the approach developed in PR19, an adaptive plan with considerable areas of advanced evidence being collated to support the next price review (PR29). Technical resource areas in water quality modelling, chemicals and ecology will be key to the investigation programmes to meet the 2027 timeframes set out.

12.3.9 *The link to the review of the Consents Plan*

It became clear during the draft consultation that our regulators would prefer to see the NEP and scenarios for the future within the DWMP process. We have included the NEP in its entirety showing all the drivers for investment to improve the environment from this cycle of improvements. With the addition of these additional objectives which were not set out in the strategic context phase of DWMP24 or covered as part of the DWMP Framework in any detail the opportunity to combine the NEP cycle with the DWMP cycle was missed.

To reflect on the new possibilities, we have combined scenario planning of drainage, namely The Drainage Plan alongside the NEP. We have included a combined scenario to innovate and consider how to bring together both workstreams in a coordinated way, while still allowing the water company to prepare plans for the remaining areas not in the focus of the NEP. This will form the main principle behind our DWMP, including the NEP for DWMP29.

This section includes any future permit or policy driven change that is not needed as part of today's consent or legislation. The benefit of bringing in this additional section of the plan (the Review of Consents plans) clearly separates the work of the company to enhance its operation for growth creep and climate change rainfall (the Sewage and Drainage plans). We can compare this to work supporting the national drivers, such as new legislation and new government direction which, brings a step change to normal operation.

In this plan drivers relating to storm overflows now sit within the review of consents plan as the outcome and direction from regulators and government is driving a change to the company's current permits. Once the permit is agreed and certain the storm overflow improvement programme can become part of the sewage and drainage plan to maintain its operation efficiently while planning for growth, creep and more rainfall.

The drive to remove environmental harm from the operation of storm overflows is now included within the NEP but our customers' ambition to improve storm overflows further is highlighted here. It is scenarios like this that indicate a future plausible opportunity that would not normally be considered within a business plan.

A similar consideration that could impact the company in the next 25 years would be the introduction of the revised Urban Wastewater Treatment Directive which is still being reviewed at the European Parliament. If Welsh Government decides to include it within its legislation

there will be a cost implication to the company and this needs to be considered and information provided to government via a DWMP prior to their decision on its introduction, improving the facts to draw conclusion.

Climate change will also be included in this section going forward as there is still uncertainty around the scenario that ties into the reality of today's climate and how climate change will be represented in future permits.

12.4 DWMP delivery schemes

The schemes in this area focus in on the highest priority risk and the highest environmental consequence taking account of future risks at that location from growth, creep and climate change. In this plan this makes up 5% of the investment needs.

We have produced 219 suites of solutions across 44 WWTW catchment areas culminating in programmes that are contained within the journey plan. For example, building bigger to resolve short stretches of pipes that are too small to convey DWF, increasing the size of a pump to pass forward a larger volume during storm conditions and also providing new drainage systems to allow rainfall to drain to soakaways. The solutions are made up of options taken from the full 82 long list developed through the DWMP approach.

In this current plan we have prioritised Worst Served customers and in the same area where there are escapes to SAC designated rivers produced a 25-year programme of £1.5 billion. With the full programme distributed over the 25 years of Cycle 1.

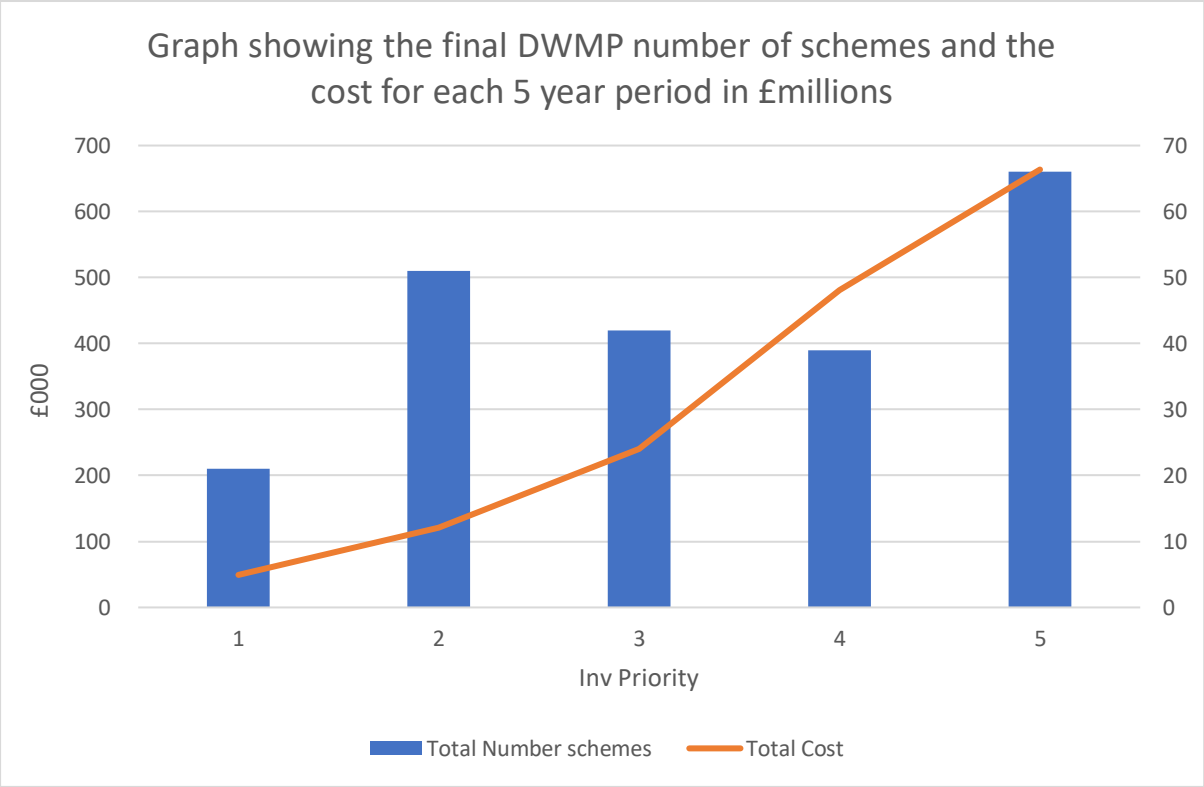

Figure 40 - Final DWMP Number of Schemes

12.5 The Strategy to inform the Programme

In terms of what needs to be done, we can conclude that what the industry does is still the right thing to do.

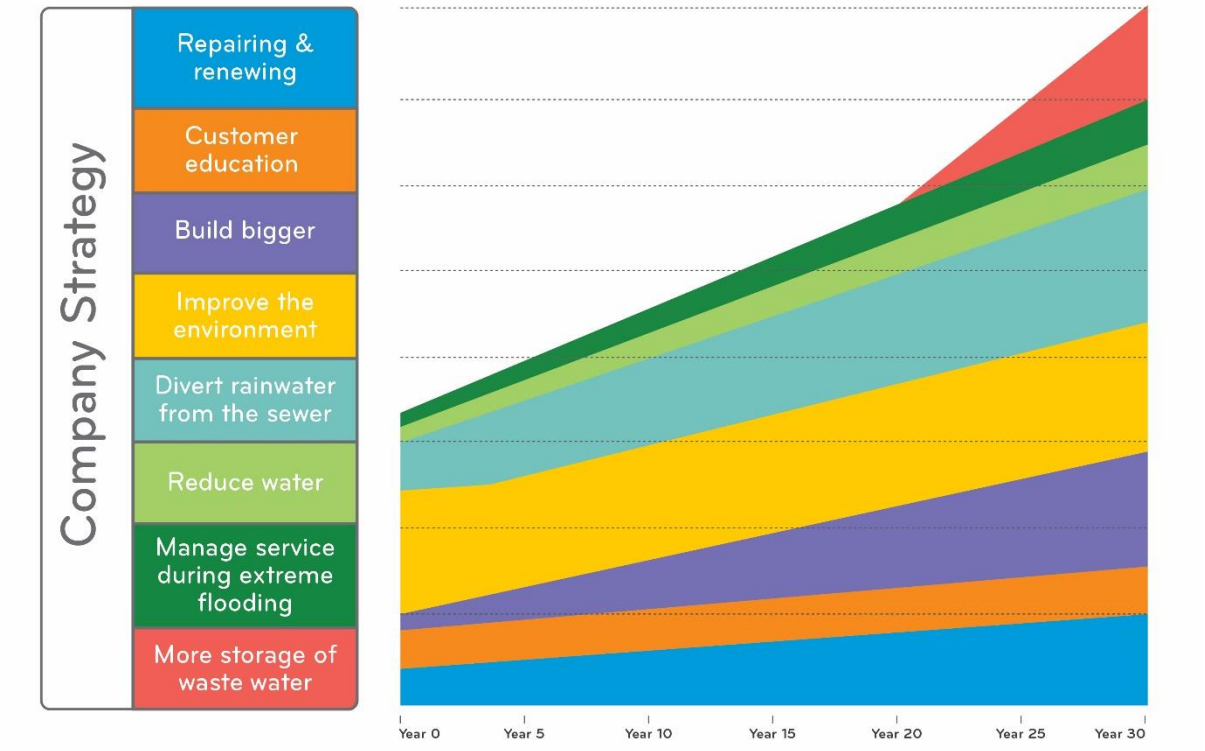

Figure 41 - Journey Plan

The Company DWMP strategy driven from the Cycle 1 process is displayed within Figure 41. The approach lists a hierarchy of actions.

- Starting with repairing and renewing pipes to manage infiltration i.e., the water from groundwater that gets into sewers through cracks in the pipes etc.;
- Prioritising communicating with customers to reduce blockages caused by fats oils and grease and non-flushable items like wet wipes, and supporting the message for water efficiency by educating customers on how to reduce run-off caused by paving over gardens and driveways;
- Then to support sewage planning - building bigger to manage future developments and population changes.
- This is where the difference between sewage planning, and drainage planning become pronounced. We need to change national policy to remove surface water from the sewer and find a more sustainable green and natural approach to integrated drainage management;
- Then and only then make plans to build bigger sewers that continue to have a dual purpose because we know that either of the two following points will be true in the future:
- Surface water is removed from the sewer and the bigger capacity network built to contain it will no longer be required at a point in the future and becomes redundant; or
- In the future at some point, we will need to build a bigger sewer again and again to keep up with climate change because we didn't start to remove surface water from the sewer in time to manage the impact from climate change.

- Prevent harm to the environment by preventing poor quality water from entering our rivers and beaches;
- Help suppliers divert rainwater away from sewers by helping them change surfaces that are not good at absorbing water and re-directing rainwater away from roads and driveways back into the environment;
- Communicate with homes and businesses to help reduce water use;
- Where possible, protect our assets during periods of extreme flooding, and ensuring our service can get back to normal as soon as possible;
- If we still cannot meet our goals with other options, consider storage of wastewater as a last option. There may be innovations in future which mean this may not be needed.

13 Planning Cycle Approach

13.1 Implementation

This first non-statutory cycle of the DWMP has developed the tools and approach for meeting the stages of the national DWMP framework.

The DWMP assessment of risk has allowed us to highlight the areas at greatest risk, but also those areas where there is remaining uncertainty. The certain and complex risks have been taken forward to optioneering, and then into programme appraisal. At programme appraisal, solutions have been selected to achieve the best suite of options to meet the recommended customer destination and environmental destination for the localised area. These localised solutions have been aggregated to develop a programme of investment at DWMP Level 2 and Level 1, which has been phased over short to long-term timescales to deliver the most effective strategic wastewater investment programme.

It must be noted that, during this first non-statutory cycle, this strategic investment programme does not identify the specific solutions required to meet each performance commitment. This task will be developed as part of our PR24 and subsequent price reviews. However, the DWMP does identify the type of solutions required to meet the overall destination over time. We have trialled the approach which is shown as the DWMP suite of solutions, we need more time to construct these solutions into more affordable staged programmes.

Our plan gives us tools and outputs that can help inform national policy on the pace and affordability of change. It also demonstrates the scale of the challenge of managing surface water inflows to our combined sewers and misconnections into our foul sewers and what we have to do in addressing customer and environmental risk.

The disjointed ownership of drainage in our urban communities will mean that implementation of our plan in future cycles will require considerable integration with other stakeholders. We view this ability to inform and influence policy decisions, that will inform future DWMP cycles, as an essential long-term component of this first iteration.

13.2 Annual Review and Monitoring Progress

Twelve months after the plan is published, the first annual review of the plan will be required, and annually on the same date each year until the next DWMP plan is published. The annual review steps, which are outlined in the national framework (WaterUK, 2018), ensure that any new information is reviewed and assessed in a timely manner. Any new information that alters the direction of the DWMP sufficiently to alter the policies or direction from Government will trigger the production of a new plan.

13.3 Conclusions

To ensure that our strategic long-term wastewater plan can help inform this policy debate, we have considered the likely outcome of various policy impacts and their potential consequences for customer bills. However, as a society, we cannot single out storm overflows alone for improvement. We need to ensure that our long-term plans set out to deliver the broader aspects of wastewater resilience at our treatment works and sewers, to manage water quantity and quality in the face of the impacts of climate change, growth, and urban creep.

In developing our plan, we have explored the impact from an affordability, deliverability, finance ability, skill shortage and resource perspective. This has led us to promote a set of realistic investment scenarios for consideration in our PR24 business plan preparations in addition to the wider, more strategic level outputs of our plan.

Observations driven from the first cycle of plan development are summarised below:

- Intensive modelling will be required to fully understand catchment performance from a quality and quantity scale, particularly the interactions with other drainage systems. This reliance on modelling, to increase confidence in the bottom-up assessments, will have an impact on the pace of improvements and the accuracy of our plan in future cycles.
- If many solutions are required in a 5, or 10-year period, a traditional approach is more likely to be chosen than a more sustainable approach. This is mainly because the lead time before getting to site is longer for SuDS and other sustainable solutions.
- Collaborative schemes that take multiple organisations to get together to resolve drainage or pollution take a longer lead time, sometimes greater than 5 years in discussions and planning.
- Joint funding of collaborative solutions is not clearly defined in government processes, presenting significant challenges in aligning funding, accounting for benefits, and ensuring delivery programmes can be met.
- Ofwat do not have a clear finance ability policy on co-funding schemes that others will deliver.

13.4 What Our Plan has Established

In developing our Plan, in accordance with directions from Welsh Government, we have engaged with our customers and other stakeholders, so that their views were considered. This included Regulators, Local Authorities, our Independent Environment Advisory Panel (IEAP) and Independent Challenge Group (ICG), and the Consumer Council for Water - all to seek their views on what they see as the important priorities and choices to consider within the Plan.

Our Plan has two key long-term outcomes, developed from our extensive consultation with stakeholders:

- No customers should experience flooding from sewage inside their homes due to a lack of sewer network capacity.
- Our rivers and coastal waters should only ever receive treated flows from the sewerage system to protect their biodiversity and ecology.

In achieving these we have sought to:

- Identify solutions that are the most sustainable and best value for customers, having regard to the carbon costs of schemes, and wider environmental issues identified through Strategic Environmental and Habitats Regulations Assessments
- Contribute to the achievement of ‘Good’ ecological status as required by the UK Water Framework Regulations
- Protect habitats and species of international importance as defined by the UK Habitats and Birds Regulations
- Meet our statutory duties for urban flooding and promote water efficiency, biodiversity and nett carbon reduction planning.
- Deliver against our national obligation to support continued maintenance of community flood defences.

We recognise that our DWMP has to be designed to be deliverable, and financeable, and to strike the right balance of ambition and affordability. Given that this first cycle is purely indicative of the scale of investment required and not a fully implementable plan, it will be

necessary for these criteria to be applied to the outputs of the second cycle, based on complete catchment modelling and integrating storm overflow investment assessed on the basis of ecological harm. Although we have a large geography and a substantial number of discrete wastewater catchments, we have a relatively small customer base, who ultimately pay for the service and improvements through their water bills.

13.4.1 *Indicative investment required by Cycle 1*

Based purely on the methodology we have had to adopt for this first DWMP cycle, and recognising the extent of extrapolation and assumption that has been necessary from the detailed work in the 44 priority catchments, our plan indicates that investment in the region of £13bn will be required to enable the drainage system to handle the projected flows within the central climate change scenario adopted by Welsh Government without causing customer flooding and storm overflows only operating in very exceptional circumstances. This drops to £11.6bn with overflows operating around 10 times a year. Included in those sums is £5.5bn which is associated with eliminating the risk of sewer flooding on homes and businesses. At the current level of investment in AMP 7 this would not be achieved until after 2100. To achieve these outcomes sooner, by 2075 for example, we need to increase our environmental performance enhancement investment over the next 25 years from circa £1bn per AMP to circa £2bn per AMP and maintain this level of investment thereafter.

Given the impact on bills of such investment and the societal impact of the engineering associated with such proposals, between now and finalising our second cycle DWMP we will need to continue with important consultation with customers, government bodies and other stakeholders. This engagement will then determine what outcomes and engineering standards should be used as they will be critical to setting the direction, pace and costs of delivery going forward, as well as the pace of progress to ensure that our future plans are deliverable, affordable, and financeable. We will continue to seek to use nature-based solutions and 'green infrastructure' to manage flows within our network and to also reduce the impact on the environment if the network cannot contain all the flow. Such outcomes and standards will ultimately be a matter for Welsh Government and will need the support of multiple stakeholders in their delivery, particularly Local Authorities.

With such a transformation required to both reduce flooding but also the operation of storm overflows in one of the wettest parts of the UK, this has to be developed across multiple 5-year investment cycles. Indeed, with so many of the sewers in Wales being combined foul and surface water, work will be required in every community, urban and rural, large and small. We will prioritise this based on tackling the places where our operations are having the greatest impact on the environment, following Welsh Government Policy.

13.4.2 ***Informing Future Investment***

Given the extent of the required future investment indicated by this first cycle we will seek to initiate discussions with Government, Regulators and stakeholders so that by the completion of cycle 2 in 2028, we will have developed the programme of work that is affordable, deliverable and financeable to form a long-term integrated sewerage and drainage investment programme covering the whole of our operational area. In our PR24 submission, the Long-Term Delivery Strategy (LTDS) sets out an estimate of the scale of future investment, particularly around storm overflows and network improvements to contain flows, that may be able to be contained within such a programme to meet those criteria.

The completion of the SOAF assessments, improved model coverage in our DWMP, and feedback from the range of 'grey' and 'blue-green' solutions we are delivering in early AMP8, together with the adoption of innovative approaches and interaction with other stakeholders, in particular local authorities, to reduce flow entering the drainage system will allow us to refine further the cost estimates in the current LTDS for the future investment cycles.

As part of our engagement with customers during the consultation period, we explored the potential impact on affordability and customer bills. Customers were provided a range of scenarios and provided feedback on these. Generally, customers advocated an incremental rise in bills to avoid any sudden increases, supporting our long-term programme. We have since reflected this feedback in the profile of the indicative investment in our Plan alongside the outputs of our work on the Company's LTDS. Welsh Government's report by Stantec (Stantec, 2023) has also provided useful validation of our cost estimates.

13.5 Recommendations

We must recognise that during the first cycle a range of pilots and other learning activities have been undertaken to identify the most appropriate tools and approaches to deliver a DWMP. This work has identified that, to achieve a mature, resilient, repeatable plan we will need to invest in data that we have not collected before. We also need to consider investing in systems to analyse that data and expert staff resources to apply the processes.

Building on our learning from Cycle 1, the following general recommendations are proposed going forward:

- We need to increase the data collected to support our modelling and data improvement aspirations.
- We need to develop integrated systems not just within Welsh Water but jointly with our colleagues from Councils, OFWAT, Natural Resources Wales and the Environment Agency and Environmental NGO's so that we collect and work from the same data, improving the usefulness of that data and increasing our joint understanding so that we all work together to improve the environment from both Quality (pollution impact) and Quantity (flooding and drought impact) perspective.
- We need to integrate the National Environment programme(NEP and WINEP) into a single approach to management planning.
- We need to develop the equivalent (NEP) as a National Drainage Programme in Wales as a unifying approach to manage multiple land owners of drainage.
- We need to increase our understanding of asset capacity and increase the coverage of our hydraulic models to forecast that capacity, including integrated models that consider the implications of our surface water separation plans on other catchment drainage systems.
- We need to improve and automate our DWMP analysis tools to integrate these results together to provide more time to review data and less time checking and verifying.
- We need to acknowledge that we must continue to capture lessons learned by those responsible for DWMP production, as the first iteration is completed, so that they can be embedded in time for second cycle DWMPs.
- We need to continue to work with the contacts and groups created during the development of the framework, and associated workshops, as a practitioner support network throughout the DWMP process, enabling a shift in focus to a shared vision, to obtain the greatest benefit from net gains.
- We need to ensure that the DWMP Framework and process continues to evolve and embeds current good/best practice.
- We need to develop the framework to facilitate collaborative working with other organisations who can play a role in the implementation journey for the DWMP, such as local authorities and our environmental Regulators.

Our customers have confirmed that they would like us to continue to develop our plans as per our preferred approach. Which is to develop all areas and provide a continuous improvement programme for each. What this means is that even though our initial investment plan in PR24 for year 2025 to 2030 has been made up of the standard approach which has been carried out within the industry for many years and is supported by OFWAT, we will now implement catchment-based planning via the methodologies we have created. We will also review other companies progress and while working with them we will incorporate industry best practice techniques to continually improve the planning process.

We note that an area that has been carried out to a hugely varying degree across the industry is option development and optimisation, and this is the area where we will work with the industry to understand their level of ambition and progress. It is likely that we will still continue to work with OFWAT to prepare Price review style business plans but we hope all recognise that our preferred approach can deliver a greater benefit to society as it will need to include **integrated planning** (IWRP) to inform government of the future requirements and anticipated investment required for sewage, drainage, review of consents, flood and coastal erosion plans and emergency flood plans in a Team Wales approach.

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15 Appendices

15.1 Appendix A – Glossary of Terms

Terminology	Description
Annual Performance Report (APR)	Water companies in England and Wales must provide an annual performance report to the economic regulator, Ofwat. The report allows Ofwat to compare across the sector on common metrics but also to measure individual company performance against the targets set at each Price Review. Information from the APR process is made available on the Ofwat website.
Area Statement	The seven Welsh Area Statements are a collaborative response to the Natural Resources Policy, published by the Welsh Government in 2017, which sets out the key challenges and opportunities for the sustainable management of Wales's natural resources into the future.
Asset Management Period (AMP)	An AMP, sometimes referred to as the 'Price limit period' (see 'PR') is a 5-year period beginning on 1 April in years ending in 0 or 5; the current period is AMP 7 (2020-2025). Water companies prepare business plans before each AMP. In response to those plans the water industry regulator (Ofwat) sets price limits on customer bills, which define how much the industry can spend.
Baseline Risk and Vulnerability Assessment (BRAVA)	A step in the DWMP process that follows Risk Based Catchment Screening (RBCS) in the DWMP. It's used to collate information about known drainage issues, analyse current and future risks, and their causes.
Biodiversity Action Plan (BAP)	The UK Biodiversity Action Plan (UK BAP) was published in 1994 as the UK Government's response to the Convention on Biological Diversity (CBD), which the UK signed up to in 1992 in Rio de Janeiro. The CBD called for the development and enforcement of national strategies and associated action plans to identify, conserve, and protect existing biological diversity, and to enhance it wherever possible.
Climate Change Committee (CCC)	An independent, statutory body established under the Climate Change Act 2008. Its purpose is to advise the UK and devolved

	governments on emissions targets and to report to Parliament on progress made in reducing greenhouse gas emissions and preparing for and adapting to the impacts of climate change.
Combined Storm Overflow (CSO)	An overflow to the environment from the sewer system, which is aimed at reducing the risk of sewer flooding from combined sewers during periods of rainfall.
Company Operational Level [DWMP - Level 1]	A company level view of the DWMP reflecting the entire Welsh Water operating area. Information at this level is a consolidation of smaller Level 2 (SPU) & 3 (TPU) assessments.
Customer Challenge Group (CCG)	The CCG is an independent customer focused stakeholder group that provides scrutiny and challenge to us, ensuring that the needs of current and future customers and communities are at the heart of how we operate.
Consumer Council for Water (CCW)	CCW is the independent voice for water consumers in England and Wales, helping consumers resolve complaints against their water company or retailer, while providing free advice and support. Their work is informed by extensive research, used to champion the interests of consumers and influence water companies, governments, and regulators.
Demand	The loading on our wastewater treatment systems, which in all systems is worsened by new development, and in combined and surface water networks is also impacted by urban creep and changes in climate.
Drainage	The entire water company network served by a WwTW, and interaction points with *non-water company drainage systems*. Drainage also includes water company surface water assets not draining to a WwTW.
Dry Weather Flow (DWF)	The average daily flow to a WwTW during a period without rain.
Environment Agency (EA)	An executive non-departmental public body in England, sponsored by the Department for Environment, Food & Rural Affairs (DEFRA). Its role is to protect and improve the environment, for example, adapting to climate change; reducing its impacts,

	including flooding, drought, sea level rise and coastal erosion, and improving the quality of water, land, and air by tackling pollution.
Flood and Coastal Erosion Risk Management (FCERM) (Government, U., 2021)	DEFRA strategy for a future resilient to flood and coastal erosion risk. The department provides funding for flood risk management through grants to the EA, local authorities, and internal drainage boards. These RMAs and others have their own responsibilities and powers that they can use to carry out these responsibilities.
Flood Risk Management Plan (FRMP)	FRMPs are statutory plans under the Flood Risk Regulations 2009, which explain the risk of flooding from rivers, the sea, surface water, groundwater, and reservoirs, and set out how NRW/EA, LLFAs and other RMAs work together, including with communities, to agree priorities and manage those risks. These plans are only produced in Flood Risk Areas where flood risk is considered significant.
Habitats Regulations Assessment (HRA)	An assessment, required under the EU Habitats and Species Directive (as incorporated into The Conservation of Habitats and Species Regulations 2017), of the potential effects of a proposed plan, programme, or project on the designated National Sites Network.
Internal drainage boards (IDB)	Independent public bodies responsible for water level management in low lying areas (an internal drainage district – administered in Wales by NRW). They work in partnership with other authorities to reduce flood risk to people and property and manage water levels for agricultural and environmental needs within their district. They can make byelaws to ensure that a drainage system works efficiently, regulate the environmental effects of a system, or ensure that flood risk management work is effective.
Local Development Plan (LDP)	The LDP sets out each local planning authority's proposals for future development and use of land in their area. The plan is a primary consideration in the determination of planning applications for the development or use of land.
Lead Local Flood Authorities (LLFA)	LLFAs are county councils and unitary authorities. They lead in managing local

	flood risks (risks of flooding from surface water, ground water and ordinary (smaller) watercourses). This includes ensuring co-operation between the Risk Management Authorities in their area (see LFRMS/P).
Level of Service (Los)	Water and sewerage companies within England and Wales report on their levels of service (LoS) for, providing transparency about company performance over a wide range of metrics. Level of service is defined as the quality of a given service. It is the combination of physical asset performance, customer expectation and satisfaction. The performance level of the service is a tactical LoS whereas customer perspective is a strategic LoS.
Local Flood Risk Management Strategy (LFRMS)	Under the Flood & Water Management Act 2010 LLFA's have a duty to develop and maintain a strategy for local flood risk management. The strategy only deals with local flood risk which is defined in the act as being a flood risk from: surface water runoff, groundwater, or ordinary watercourses (main river flooding remains the responsibility of Natural Resource Wales and the Environment Agency). In areas where there is also a FRMP in place strategies will complement or be integrated with the FRMP.
Local Planning Authority (LPA)	The local UK government body that is empowered by law to exercise urban planning functions for a particular area.
National Environment Programme (NEP)	The NRW water quality NEP outlines the improvements we need to make to comply with new or amended environmental legislation and identifies investigations and potential investment requirements to meet those requirements. The NEP is the counterpart in Wales to the EA WINEP.
National Infrastructure Commission (NIC)	The Commission carries out in-depth studies into the UK's major infrastructure needs and makes recommendations to the government, covering all sectors of economic infrastructure.
Natural Resources Wales (NRW)	A Welsh Government sponsored body, which became operational from 1 April 2013, taking over the management of the natural

	resources of Wales as a merger of the Countryside Council for Wales, Environment Agency Wales, and the Forestry Commission Wales, whose role is broadly comparable with that of the EA in England.
Non-water company drainage systems	Drainage systems that are not in the ownership of Welsh Water. These are often the responsibility of local authorities or land and property owners and could include highway drainage, private foul and surface water drainage, land drains and watercourses.
Ofwat	The Water Services Regulatory Authority is the water industry's economic regulator in England and Wales.
Per Capita Consumption (PCC)	The metric used to quantify the amount of water consumed per person, in terms of domestic consumption for a household. Units can typically be in litres / day.
Population Equivalent (PE)	A means of expressing the strength of organic material in wastewater. The amount of biodegradable matter whose oxygen consumption during biodegradation equals the average oxygen demand of the wastewater produced by one person. A comparison of the polluting potential of an industry with the population equivalent which would produce the same polluting load.
Price Review (PR)	Ofwat determines the price limits that water companies can increase or decrease the prices charged to customers over an AMP period. Each water company submits a business plan for the forthcoming 5-year period, which is assessed by Ofwat. Preparation is underway for the PR24 submission which will set out our investment proposals from April 2025 to March 2030.
Risk	A measure that combines an assessment of the probability of an event occurring with the magnitude of its impact if it occurs.
Risk Based Catchment Screening (RBCS)	The RBCS stage of the DWMP risk screening process uses existing, readily available data to identify where there is a potential risk or vulnerability in the sewer catchment to future changes. This enables effort to be focused on these catchments

	during the subsequent step of the DWMP (BRAVA).
River Basin District (RBD)	EA and NRW defined river basin districts or catchments for management planning (RBMP).
River Basin Management Plan (RBMP)	EA and NRW led River Basin Management Plans (RBMPs) describe the challenges that threaten the water environment and how these challenges can be managed and funded.
Risk Management Authorities (RMA)	An Authority defined within the Flood & Water Management Act 2010 with responsibilities for the management of specific risks. Other RMA include EA, NRW, LLFA, district council, highway authority or IDB.
Sewerage	See 'Wastewater'
Strategic Environmental Assessment (SEA)	A process of assessing the environmental opportunities and restrictions of a project and identifying and managing its implications.
Strategic Planning Unit (SPU) – [DWMP - Level 2]	An aggregation of Level 3 TPU into 13 larger Level 2 strategic planning areas, which are based on RBMP areas (revised to take account of sewers crossing those borders). We will be consulting with stakeholders and customers at this level about regional issues and our proposed responses to them.
Supply	The available capacity in our wastewater treatment systems to managing incoming flows, to treat them and return them to the environment whilst meeting performance requirements.
Supply-demand balance (SDB)	The calculation of total demand capacity against total supply capacity in our wastewater treatment works, which assesses whether there is either a positive or negative capacity overall.
Sustainable Drainage Plan (SDP)	An approach to Drainage Area Planning (DAP) developed by Welsh Water, which precedes the DWMP
Sustainable Management of Natural Resources (SMNR)	A principle introduced in the Environment (Wales) Act 2016 to promote the use of natural resources in a way and at a rate that

	maintains and enhances the resilience of ecosystems and the benefits they provide.
Tactical Planning Units (TPU) – [DWMP - Level 3]	A typical TPU will be the medium sized wastewater treatment works and its catchment. For smaller communities this may be an aggregation of catchments, and for larger communities may reflect a discrete sub-catchment area.
Wastewater (sewage)	Wastewater and other excrement that has been produced in the home, in a business, or as part of an industrial process and which is normally discharged into a foul or combined drainage system.
Wastewater Treatment Works (WwTWs)	A site for the processing and treatment of wastewater, to separate out solid matter for reuse and to remove contaminants from the effluent before it's returned to the environment.
Water and Sewerage Companies (WaSCs)	There are 10 WaSCs in England and Wales, regulated by Ofwat, NRW and the EA. Welsh Water is one of the 10 WaSCs and operates across much of Wales and parts of neighbouring England. Welsh Water is the only WaSC in England and Wales to operate to a not-for-profit model.
Water Framework Directive (WFD)	The Water Framework Directive is a piece of EU legislation that establishes a framework for the protection and improvement of inland and coastal water bodies. It is designed to return all surface waters, groundwater and transitional waters into good chemical, physical and biological condition by 2027.
Water Industry National Environment Programme (WINEP)	The programme of work water that WaSCs who operate in England are required to do to meet their obligations from environmental legislation and UK government policy. A 5-yearly programme (currently 2020-2025) of environmental investment in asset improvements, investigations, monitoring and catchment interventions. It sets out how the water industry will contribute to improving the natural environment and is mirrored by the NEP in Wales.
Water Resource Management Plan (WRMP)	Water Resource Management Plans (WRMPs) are statutory documents that all water companies must produce at least

	every five years. They set out how the water company intends to achieve a secure supply of water for their customers while protecting and enhancing the environment. The plan must forecast the expected water supply and demand (for public water supply) over, at least, 25 years and determine a preferred programme to meet the water resource deficit by identifying and appraising a range of options.
Water UK	Water UK are the representative body for the water industry in the United Kingdom. It engages with companies and regulators to ensure customers receive high quality tap water at a reasonable price and that our environment is protected and improved. It promotes the conditions by which the water sector can provide world-class services and enhance the UK's quality of life and commissioned the Framework for the DWMP.

15.2 List of Level 4 catchments taken through ODA

Catchment ID	Catchment/Model Name	Total Population Equivalent
466	BETWS-Y-COED	734
467	CAPEL CURIG	226
486	HENLLAN (NR DENBIGH)	755
495	LLANARMON DYFFRYN CEIRIOG	102
511	CAERNARFON	11,437
547	LLANBEDR (GWYNEDD)	2,297
661	GREENFIELD	15,553
675	FIVE FORDS (WREXHAM)	123,046
699	CAERWYS	1,070
701	CEFN-MAWR	6,336
705	ABERSOCH	2,959
719	BETHESDA	5,035
776	FLINT	17,497
795	DOLGELLAU	4,295
801	DYFFRYN ARDUDWY	2,184
846	LLANASA (NR PRESTATYN)	30,575
858	CHESTER	116,582
932	QUEENSFERRY	55,888
945	RHUDDLAN	10,132
956	RUTHIN	5,875
972	PORTHMADOG	4,030
973	ST ASAPH	3,732
995	BUCKLEY TY GWYN	15,538
3137	KINMEL BAY	58,582
3219	BEAUMARIS & LLANFAES (ANGLESEY)	1,766
3242	BANGOR TREBORTH	29,477
3333	GANOL	70,489
70011	PENMAENMAWR	4,573
30808	COSLECH	51,704
30843	CILFYNYDD	76,835
30861	CYNON	65,632
30900	HAY-ON-WYE SWK	1,859
30903	HEREFORD EIGN	106,545
30948	LLANFOIST WWTW	17,077
30996	NEWPORT NASH (Cae Brinton)	293,005
30996	NEWPORT NASH (Caerleon)	
30996	NEWPORT NASH (Caldicot)	
30996	NEWPORT NASH (Chepstow)	
30996	NEWPORT NASH (Magor Pill)	
30996	NEWPORT NASH (Malpas)	
30996	NEWPORT NASH (Newport East)	
30996	NEWPORT NASH (Newport West)	
31050	PONTHIR WWTW	98,731
33726	COG MOORS (Barry East)	214,936
33726	COG MOORS (Cardiff West)	
33726	COG MOORS Barry West	

33726	COG MOORS Penarth	
33726	COG MOORS Sully and Dinas	
33785	CARDIFF BAY (Cardiff Central)	897,336
33785	CARDIFF BAY (Cardiff East)	
33785	CARDIFF BAY (Lower Rhymney)	
33785	CARDIFF BAY (Upper Rhymney)	
33785	CARDIFF BAY (Rhondda)	
33785	CARDIFF BAY (Y & P)	
33785	CARDIFF BAY (WV)	
50621	GARNSWLLT	30,303
50628	GOWERTON	56,772
50679	LLANNANT	16,111
50743	PEN-Y-BONT (MERTHYR MAWR)	159,828
53100	SWANSEA BAY	185,873
53154	AFAN	139,433
	TOTAL:	3,012,745