WSX16 - Wastewater networks plus strategy and investment

Business plan
2025-2030

Wessex Water
YTL GROUP

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WSX16 - Wastewater networks plus strategy and investment

CONTENTS

This supporting document is part of Wessex Water's business plan for 2025-2030.

Please see 'WSX00 – Navigation document' for where this document sits within our business plan submission.

More information can be found at wessexwater.co.uk.

For annexes, see Supporting Document WSX17 – Annexes – Wastewater networks plus strategy and investment

Executive summary

A key priority area is to protect and enhance the environment and the natural capital in our region. Our outcomes are to provide an effective sewerage system and to enable excellent river and coastal water quality for our customers and wider society. These are two of our key environmental outcomes where significant investment between 2025-30 will deliver improvements for our customers and the environment as part of our longer-term strategy to 2050:

- Effective sewerage system – reducing storm overflow discharges to rivers and sewer flooding of properties.
- Excellent river and coastal water quality – reducing pollution incidents and nutrient levels in wastewater discharges.

These outcomes will be delivered through a combination of interventions and the use of data collection, through smart monitoring and investigations, to ensure investment is based on sound science and evidence.

We propose making £3.5bn of investment in 2025-30 to deliver a wide range of stretching outcomes for customers and the environment. Over half our AMP8 investment, £2.5bn, will improve the way we manage wastewater, most of which is ultimately to better protect the health of our rivers and seas. We have an important role to play in protecting and enhancing the water environment in our beautiful region. Key activities are:

- Storm overflows – we will spend record levels, over £400m, investigating and improving 128 storm overflows, prioritising wetland treatment and rainwater separation at source. This was detailed in our Drainage and Wastewater Management Plan (DWMP) published in May 2023 and further refined in this Business Plan
- Nutrient reduction – we will spend £900m on reducing nutrients (chiefly phosphorus) in treated wastewater discharges. Legislative requirements are changing promoting the use of traditional treatment solutions for the most part, but we will incorporate catchment permitting and nature-based solutions such as reedbeds and wetlands wherever possible.

A significant amount of this investment is to deliver statutory requirements, including £1.7bn needed to meet prescriptive statutory requirements, notably on nutrient removal and to reduce the number of storm overflow discharges, as set out in the Environment Act, Water Framework Directive, Levelling Up and Regeneration Bill and Storm Overflow Discharge Reduction Plan (SODRP). This is in addition to the expenditure to address wider policy and regulatory expectations around pollution reduction, for example. Customers have told us they want us to limit our expenditure by using more efficient approaches where possible.

We have based our environment programme on what we anticipate being the final Water Industry National Environment Programme (WINEP), which is being produced in collaboration with the Environment Agency and Natural England and associated regulatory guidance. The WINEP sets out the actions that we need to complete to fulfil our statutory and non-statutory requirements to improve the environment within our region. These measures may be investigations, monitoring, options appraisals or schemes to protect and enhance the environment. The WINEP aligns with the Water Industry Strategic Environmental Requirements[1] (WISER).

[1] https://www.gov.uk/government/publications/developing-the-environmental-resilience-and-flood-risk-actions-for-the-price-review-2024/water-industry-strategic-environmental-requirements-wiser

Additional investment is required to deliver a range of Performance Commitments and improvements associated with the Environmental Performance Assessment (EPA) and wider policy expectations. These have been developed in consultation with the Customer Challenge Group and through wider public consultation.

Customer research shows that environmental improvements are a priority for customers. Sewer flooding, both internal and external, and storm overflows are key issues which customers and stakeholders agree should be addressed. Similarly, increased media focus on coastal and river water quality has strongly influenced our customers' support for improvements to be delivered.

We have collaborated extensively with the Environment Agency and Natural England in the development of our proposed environment programme. Our overall aims have been to ensure that we adhere to the relevant legislative requirements contained in the Environment Act, Water Environment Regulations (Water Framework Directive) and Levelling-up and Regeneration Bill (at time of writing). In addition, we have always advocated that there is sound scientific evidence of the need for an environmental improvement, to consider alternative ways of achieving similar objectives more sustainably and with a greater cost-benefit, such as catchment solutions rather than asset-based solutions, and to challenge the timescales for delivery.

We have also considered where there are other drivers for investment in PR24, for example with other WINEP schemes (e.g. targeted phosphorus and ammonia removal) and growth schemes, to allow investment synergies. We give full consideration to whole life costs, as well as other non-monetary benefits to the environment and society. Through external benchmarking we have demonstrated that our cost estimates are efficient and competitive compared with the marketplace. This has enabled us to produce a best cost and efficient plan which is deliverable.

Affordability of this programme has been considered as part of the customer acceptability testing. We recognise that this is an unprecedented programme of work and we have specifically sought to reduce and defer investment wherever possible, particularly around storm overflows and nutrient reductions in line with recent advice, e.g. the recent information letters (Information Letter EA/16/2023 and EA/17/2023 PR24 WINEP and WRMP) have suggested that non-statutory WINEP drivers are delayed or deferred and the Defra letter of 07/09/2023 on the Amendments to the Levelling Up and Regeneration Bill, enabling further consideration of the nutrient reduction programme of work beyond the submission of this Business Plan.

Our proposals to protect and enhance the environment have been subject to scrutiny through our board assurance process and approved as indicated by the extract from the Board Assurance Statement (WSX44) below:

> We fully recognise and embrace the importance of Board level challenge of the PR24 Business Plan (the "**Plan**") and are clear that our Board is fully satisfied that the Plan represents the long-term vision and ambition of the Company within the current statutory and regulatory requirements.

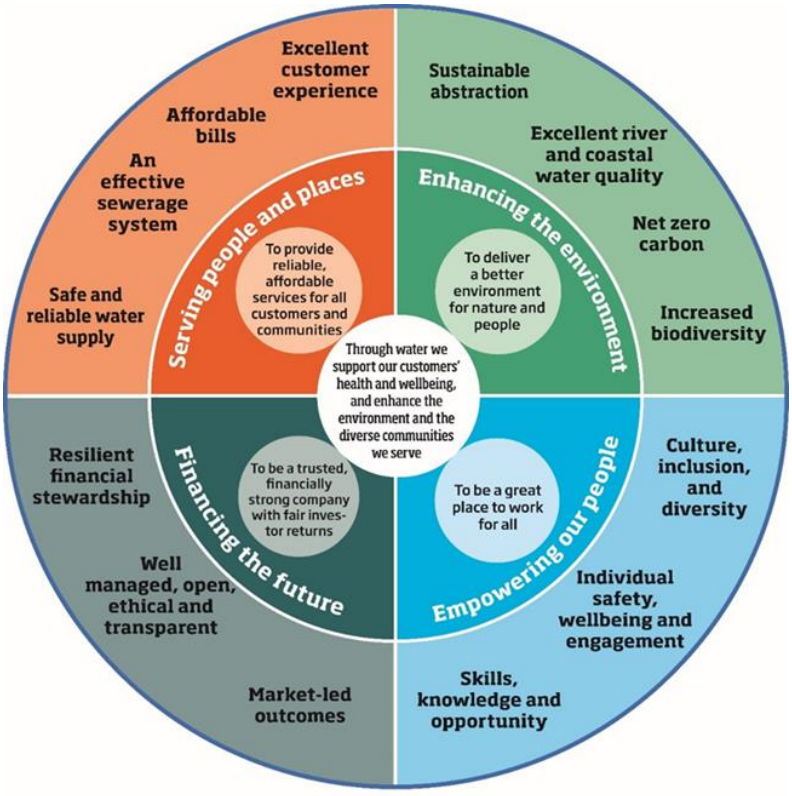
1. Introduction

1.1. Strategic Direction Statement

Our purpose is '*To support our customers' health and wellbeing and enhance the environment and the diverse communities we serve*'. As an essential services business, we have a responsibility to do what we can, in partnership with others, to address shared societal challenges of unprecedented scale and urgency – the climate and nature emergencies, the need for carbon neutrality, rising public expectations of the environment, higher living costs and long-term resilience.

In March 2022 we published our strategic direction statement entitled *Water – a new direction* which sets out exactly how we intend to stretch ourselves over the coming 25 years. It describes our long-term vision and ambition around the role we will play in delivering the outcomes that customers, communities, and stakeholders expect of us, through to 2050. '*Water – a new direction*[1] looks at delivering long term outcomes, as opposed to traditional short-term outputs, and presents the following wheel (Figure 1) to summarise our 25-year plan.

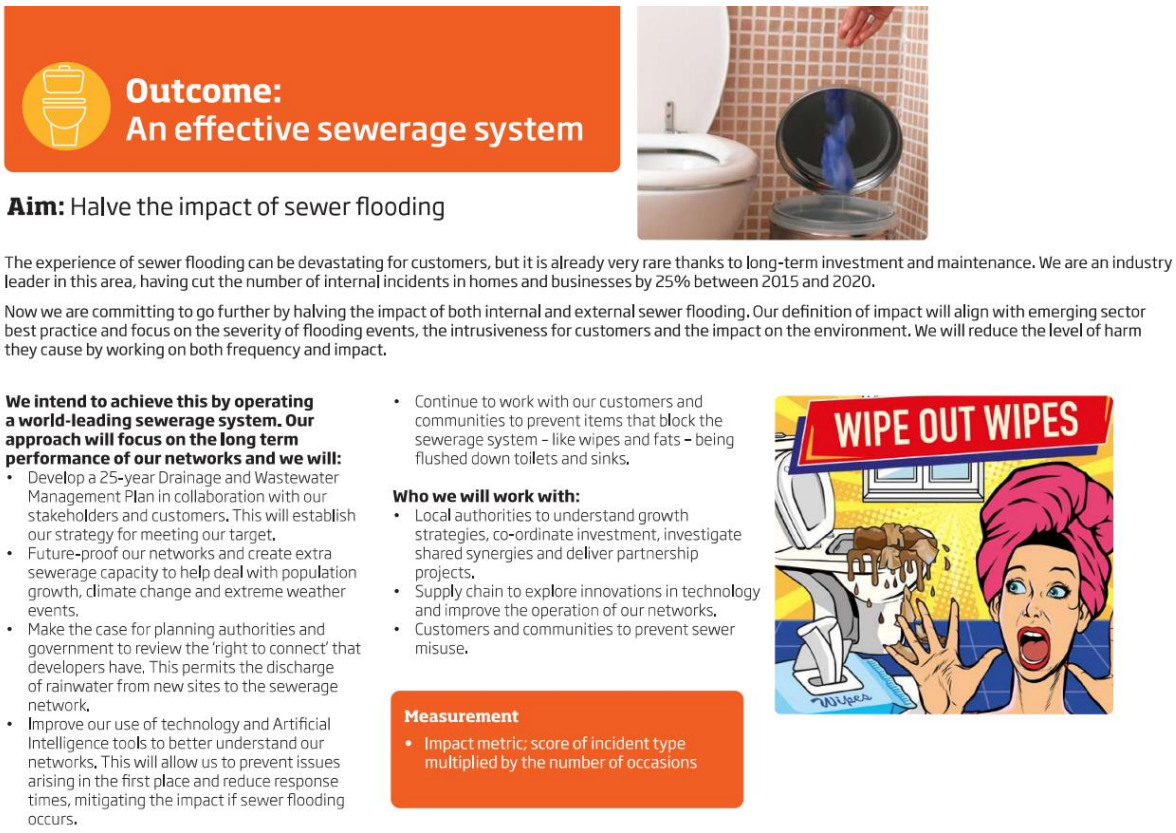
Figure 1 - Wheel summarising 25-year plan



At the heart of our SDS are eight outcomes, all co-created with stakeholders, all focused on long-term ambition. They cover customer, community and environmental outcomes and are shown in the top half of this wheel that summarises our 25-year plan. We have also identified some enablers, involving internal and wider supply chain partnerships, that we will need to secure to effectively deliver our eight outcomes, centred around strong financing and governance, and empowered people. These are shown in the bottom half of the wheel.

The extracts below (Figure 2 & Figure 3) describes how we intend on delivering two of the outcomes, for example, as part of the overall ambition *'To provide reliable, affordable services for all customers and communities'*.

Figure 2 - Extract from Water - a new direction - Outcome: An effective sewerage system



Outcome: An effective sewerage system

Aim: Halve the impact of sewer flooding

The experience of sewer flooding can be devastating for customers, but it is already very rare thanks to long-term investment and maintenance. We are an industry leader in this area, having cut the number of internal incidents in homes and businesses by 25% between 2015 and 2020.

Now we are committing to go further by halving the impact of both internal and external sewer flooding. Our definition of impact will align with emerging sector best practice and focus on the severity of flooding events, the intrusiveness for customers and the impact on the environment. We will reduce the level of harm they cause by working on both frequency and impact.

We intend to achieve this by operating a world-leading sewerage system. Our approach will focus on the long term performance of our networks and we will:

- Develop a 25-year Drainage and Wastewater Management Plan in collaboration with our stakeholders and customers. This will establish our strategy for meeting our target.
- Future-proof our networks and create extra sewerage capacity to help deal with population growth, climate change and extreme weather events.
- Make the case for planning authorities and government to review the 'right to connect' that developers have. This permits the discharge of rainwater from new sites to the sewerage network.
- Improve our use of technology and Artificial Intelligence tools to better understand our networks. This will allow us to prevent issues arising in the first place and reduce response times, mitigating the impact if sewer flooding occurs.
- Continue to work with our customers and communities to prevent items that block the sewerage system – like wipes and fats – being flushed down toilets and sinks.

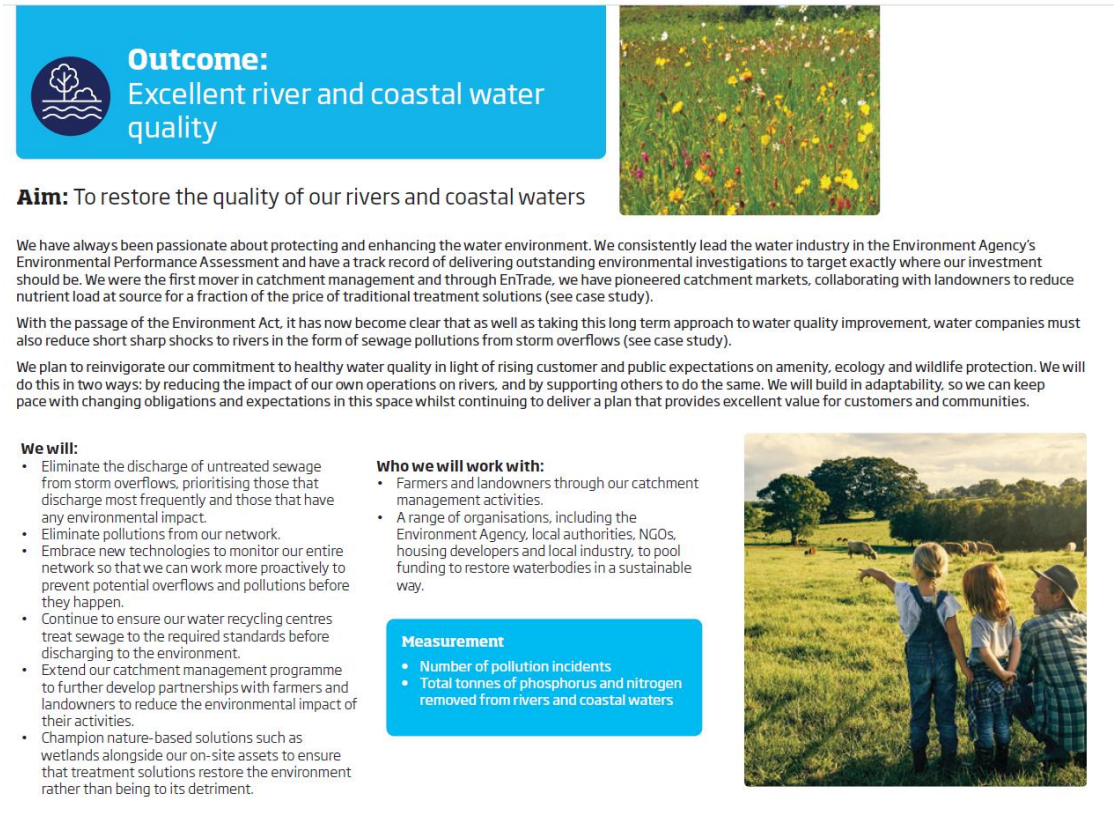
Who we will work with:

- Local authorities to understand growth strategies, co-ordinate investment, investigate shared synergies and deliver partnership projects.
- Supply chain to explore innovations in technology and improve the operation of our networks.
- Customers and communities to prevent sewer misuse.

Measurement

- Impact metric; score of incident type multiplied by the number of occasions

Figure 3 - Extract from Water - a new direction - Outcome: Excellent river and coastal water quality



Outcome: Excellent river and coastal water quality

Aim: To restore the quality of our rivers and coastal waters

We have always been passionate about protecting and enhancing the water environment. We consistently lead the water industry in the Environment Agency's Environmental Performance Assessment and have a track record of delivering outstanding environmental investigations to target exactly where our investment should be. We were the first mover in catchment management and through EnTrade, we have pioneered catchment markets, collaborating with landowners to reduce nutrient load at source for a fraction of the price of traditional treatment solutions (see case study).

With the passage of the Environment Act, it has now become clear that as well as taking this long term approach to water quality improvement, water companies must also reduce short sharp shocks to rivers in the form of sewage pollutions from storm overflows (see case study).

We plan to reinvigorate our commitment to healthy water quality in light of rising customer and public expectations on amenity, ecology and wildlife protection. We will do this in two ways: by reducing the impact of our own operations on rivers, and by supporting others to do the same. We will build in adaptability, so we can keep pace with changing obligations and expectations in this space whilst continuing to deliver a plan that provides excellent value for customers and communities.

We will:

- Eliminate the discharge of untreated sewage from storm overflows, prioritising those that discharge most frequently and those that have any environmental impact.
- Eliminate pollutions from our network.
- Embrace new technologies to monitor our entire network so that we can work more proactively to prevent potential overflows and pollutions before they happen.
- Continue to ensure our water recycling centres treat sewage to the required standards before discharging to the environment.
- Extend our catchment management programme to further develop partnerships with farmers and landowners to reduce the environmental impact of their activities.
- Champion nature-based solutions such as wetlands alongside our on-site assets to ensure that treatment solutions restore the environment rather than being to its detriment.

Who we will work with:

- Farmers and landowners through our catchment management activities.
- A range of organisations, including the Environment Agency, local authorities, NGOs, housing developers and local industry, to pool funding to restore waterbodies in a sustainable way.

Measurement

- Number of pollution incidents
- Total tonnes of phosphorus and nitrogen removed from rivers and coastal waters

Our SDS provides similar details on our ‘Net zero carbon’, ‘Excellent customer experience’ and ‘affordable bills’ outcomes.

1.2. Principles of Approach

Our approach to long term planning and identifying investment needs a combination of the following:

- priorities set out in *Water – a new direction* (our 25-year vision)[1]
- strategies set out in our *Drainage and Wastewater Management Plan*
- strategies to achieve challenging Performance Commitments
- managing identified risks and improving resilience
- horizon scanning of future obligations and trends such as modelling network resilience
- our Asset Management Framework, based on best practice, including our ongoing programme of strategic and minor capital maintenance
- review of people and systems.

As part of our internal governance process for the business plan, the outcomes from these methodologies have been tested through a series of internal risk and challenge meetings ahead of inclusion in our plan.

1. Risk management

The identification and management of risk is delivered through a tiered system of groups drawn from operational staff, management, Executive Directors, and the Board. The Board reviews and holds ultimate responsibility for the risk process, supported by the Audit and Risk Committee.

Asset and operational risks are reviewed, assessed, and recorded continuously by staff, as a result of regular reviews and in response to changes. Risks are scored using an externally accredited process which assesses probability and impact on a five-by-five matrix. Risk mitigation plans are recorded and implemented where appropriate and pre- and post-mitigation scores are recorded.

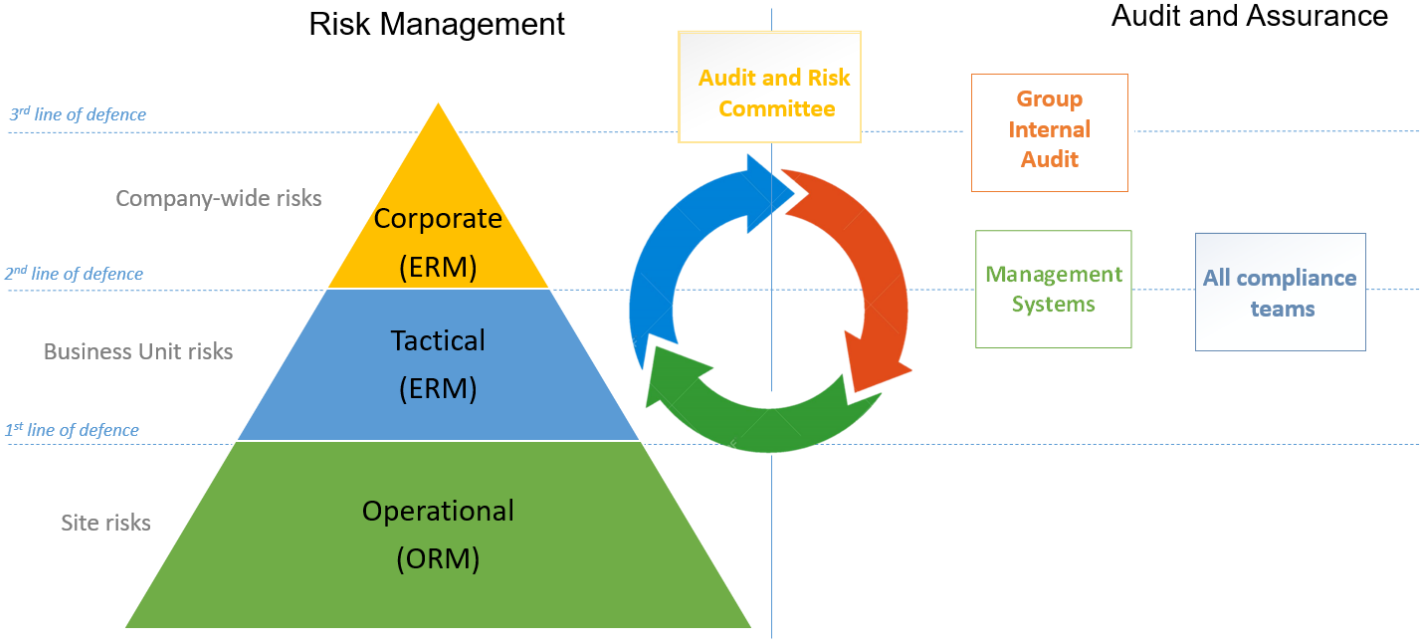
The risks identified provide a foundation for the risk hierarchy identifying more substantial tactical risks and a line of sight to the corporate risk register. The corporate risk register is maintained by senior managers from across the business who are experts in their respective fields. Oversight of this process is by our Risk Management Group (RMG) that review all business risks, including emerging and strategic risks. Where a risk is deemed out of tolerance, RMG will consider additional measures to reduce it to an acceptable level or escalate the risk as appropriate to the Executive Leadership Team (ELT) or the Board.

RMG meets through the year and submits an update on the strategic and principal risks to the ELT and the Board twice a year. Any significant new risks are reported to the monthly ELT meetings.

ELT scrutinises and challenges the risks and request additional work where necessary to better classify the risk or explore alternative mitigation methods.

In 2023 we are introducing a new corporate risk system which will integrate all of our company risk records and assurance activities, as represented in the Figure 4.

Figure 4 - New corporate risk system



This aims to:

- enable risks to be assessed consistently across the business with all relevant information in one place
- provide improved oversight of the company's overall risk profile and insight into detailed risk information
- produce a more succinct process for prioritising action plans for the mitigation and control of risks.
- allow us to make the better investment decisions by balancing risk, performance, and cost
- streamline and simplify the audit process across the business and enable "Integrated Assurance" – using information about risks in the business to target our audit and assurance efforts and track trends.

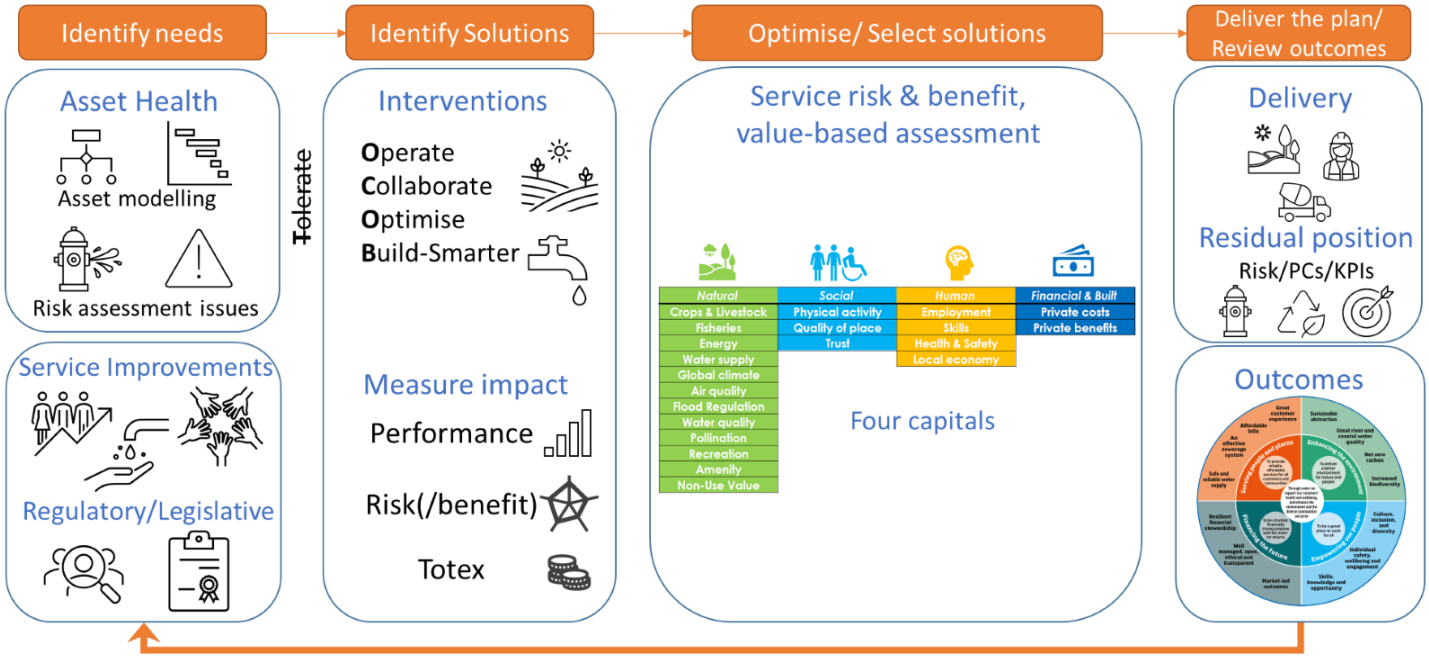
The audit module is already live and in use across the business. The risk module went live during September 2023. As part of this roll out, we have cleansed our existing risk data to maximise benefits of the system.

If a more substantial solution is required, involving a capital project, this will be dealt with through our investment management process. Suitable options are considered prior to an agreed solution being agreed. The capital scheme solution is then prioritised for funding based on the risk identified.

2. Investment management

Our new asset and investment management strategy is being implemented utilising the EDA (Enterprise Decision Analytics) decision support tool to enable optimal, data-driven decisions that balance complex factors for an optimal asset investment plan (Figure 5).

Figure 5 - Asset and investment management overview



This enables a consistent approach across the business for how we plan, manage and make-decisions on our investments, using service and value-based decision making. It uses a forward-looking approach to project the change in risk, to inform when the risk should be mitigated, and uses a hierarchy of interventions to identify appropriate solutions. The risk reduction and benefits added of each solution is quantified and assigned value using the Service Measure Framework (SMF). The SMF monetises risk and benefits using four capitals, Natural, Social, Human and Financial/Built. When an optimisation is run in EDA, solutions are evaluated to determine the best-value options and associated optimal timing for implementation, that also effectively contribute to the programme-level risk reduction and performance targets required, within given financial constraints.

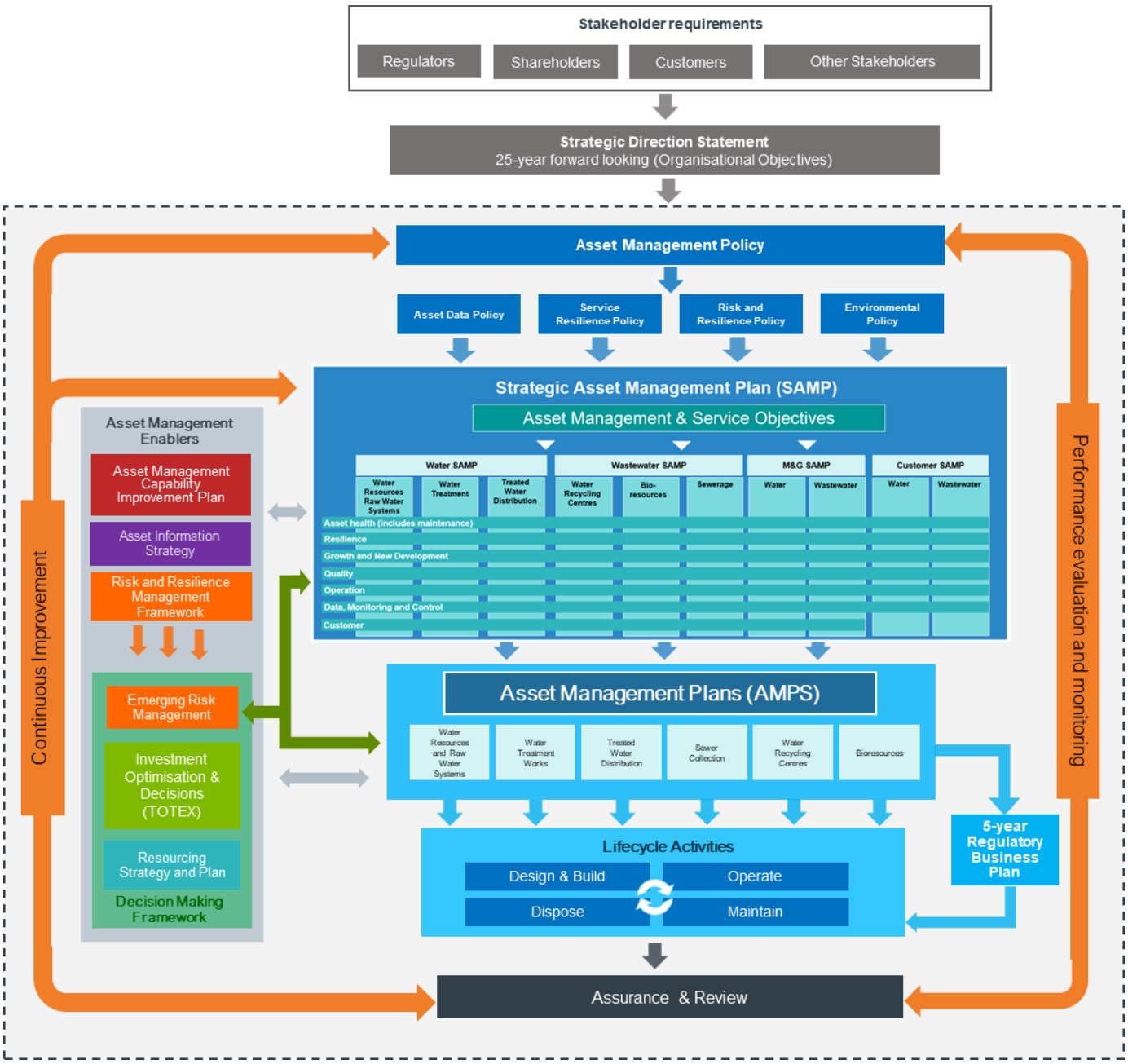
3. Asset management

Our asset management framework (Figure 6) is used to direct, coordinate, and control our asset management activities.

As a Water and Sewerage Company (WaSC), our assets are used to deliver service to our customers, so our asset management activities include all activities that allow us to:

- establish and deliver the objectives set out in our long-term strategic direction statement (including performance commitments)
- realise value from our assets for customers, communities, stakeholders, shareholders, and the environment.

Figure 6 - Asset Management Framework



Our asset management framework includes policies, strategies, plans, information management, decision-making processes and capital and operational delivery. It provides a number of important functions:

- it provides a clear line of sight so that everybody who works for or on behalf of Wessex Water understands how they contribute towards the delivery of our company objectives. The line of sight translates organisational objectives from our strategic direction statement into asset management policy, strategy, and objectives, which cascade down into more detailed asset management plans and delivery activities
- it ensures that our senior management decisions, strategies, and plans take into account the bottom-up, fact-based realities, i.e., asset capabilities, performance, opportunities and constraints through our risk management and resilience framework and our decision-making governance processes
- it provides our delivery staff with direct visibility of the purpose of the work they undertake – so they understand why it is needed, not just when and how to do it. This helps with identification and prioritisation of risks as well as encouraging innovation through identifying better ways of achieving objectives.

Our framework allows us to monitor our performance against all objectives through a hierarchy of KPIs and align our decision making and risk management processes to the achievement of objectives at all levels of our organisation.

Our asset management framework applies to the following types of assets:

- nature based assets e.g., reed bed, sustainable urban drainage
- physical assets used for the provision of services to our customers – Wastewater collection, treatment, bioresources and land
- equipment, inventory, and properties owned by Wessex Water
- data, information and operational technology and digital assets
- intangible assets – such as Wessex Water leases, brands, intellectual property rights, licences and software
- Wessex Water employees and third-party providers.

4. Resilience

‘Resilience is the ability to cope with, and recover from, disruption and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future’ (Resilience in the Round, Ofwat, 2017).

Resilience is at the heart of our business plan and is the fundamental driver behind how we deliver our strategic outcomes. We recognise the responsibility we have in providing essential public services to customers and in managing the natural environment, both now and for future generations. Maintaining and strengthening our resilience is critical to ensuring we can continue to deliver reliable and trustworthy services to our customers. This is particularly true given the landscape of an increasingly frequent experience of more extreme shocks and stresses. To be truly resilient and fit for the future, we recognise we must take a long-term view in our plans and procedures, with an aim to anticipate likely changes and actively respond or adapt as they occur.

In recent years, Covid-19, the war in Ukraine and global economic challenges have highlighted the increasing frailty of our supply chain, including people resources, power, chemicals, materials, technology, information security such that we are having to be more self-reliant and provide increased resilience just to maintain existing service performance (i.e. more generators, increased cyber security, early procurement, additional on-site resilience at key locations).

We face many challenges which will potentially affect our resilience, now and in the future, and we must predict and prepare for these eventualities. We recognise these are sector or wider issues, and we cannot address them all by ourselves, so we will also seek partnerships with others to address specific improvements.

Our Drainage and Wastewater Management Plan is key to ensuring we maintain a resilient drainage and wastewater treatment system, particularly due to future predicted environmental and license restrictions, gradual population increase and availability of sources.

1.3. Enhancement Assessment

Individual enhancement assessment case tables are provided in Supporting Document WSX17 for each of the material areas of proposed enhancement investment in the Wastewater networks plus price control.

2. DWMP summary

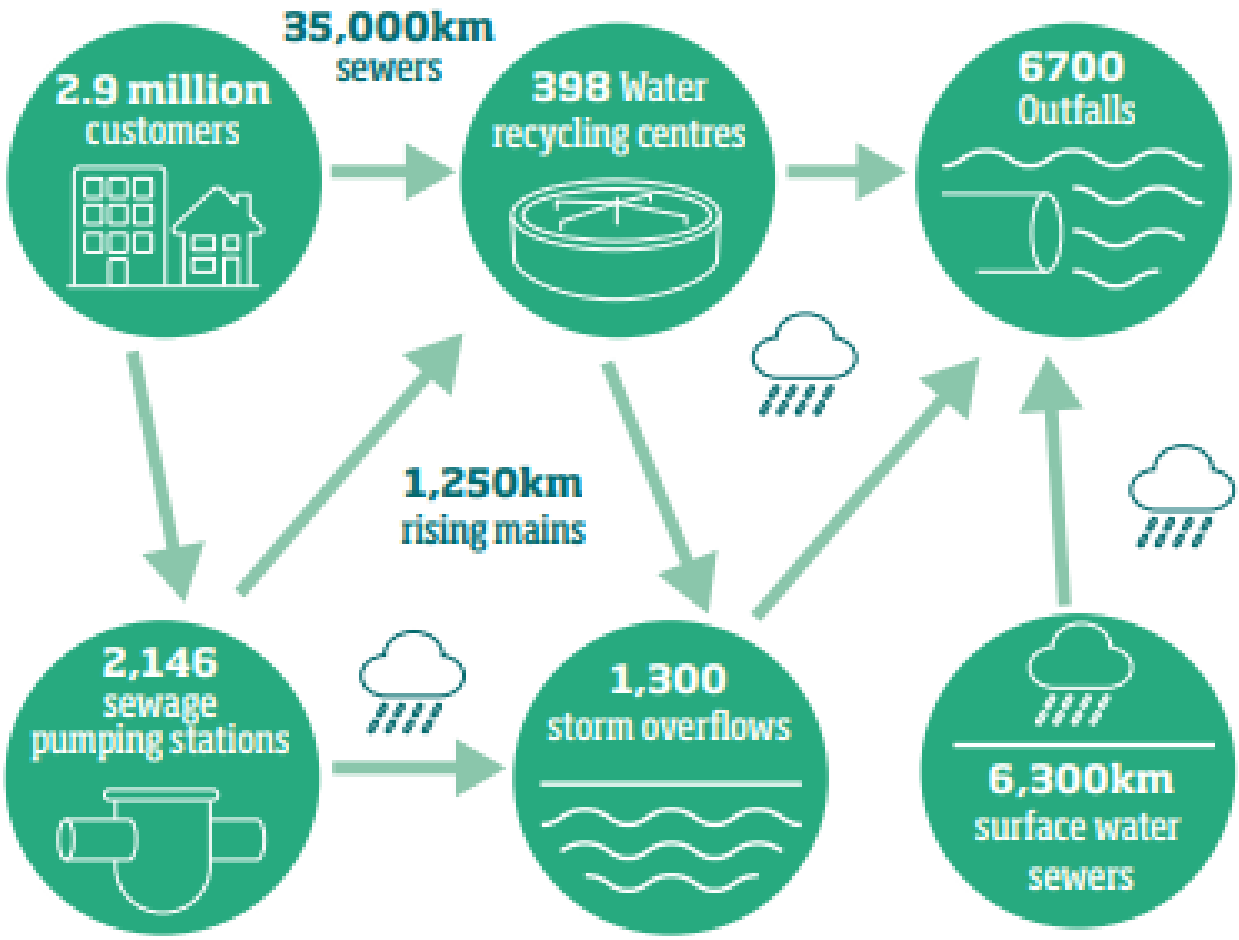
2.1. Overview

Our Drainage and Wastewater Management Plan (DWMP) is a strategic planning framework that gives visibility of our proposed long-term investment needs for the sewerage network and our water recycling centres (WRC). This gives a line of sight to investment requirements for the next 25 years and has informed this PR24 business plan for investment between 2025 and 2030. It is not intended to be the final version of our delivery plan and is subject to change.

Our first DWMP details the potential requirements for investment between 2025 to 2050 and takes into account future pressures on our infrastructure due to growth, urbanisation and climate change. It included the statutory requirements known at the time of writing, including storm overflow improvements and nutrient neutrality.

The development of our DWMP required a significant amount of work given the scale of Wessex Water assets relating to Drainage and Wastewater infrastructure as shown in Figure 7. The length of our public foul, combined and surface water sewers is larger than the circumference of the Earth at the latitude of the UK.

Figure 7 - Wastewater networks plus assets

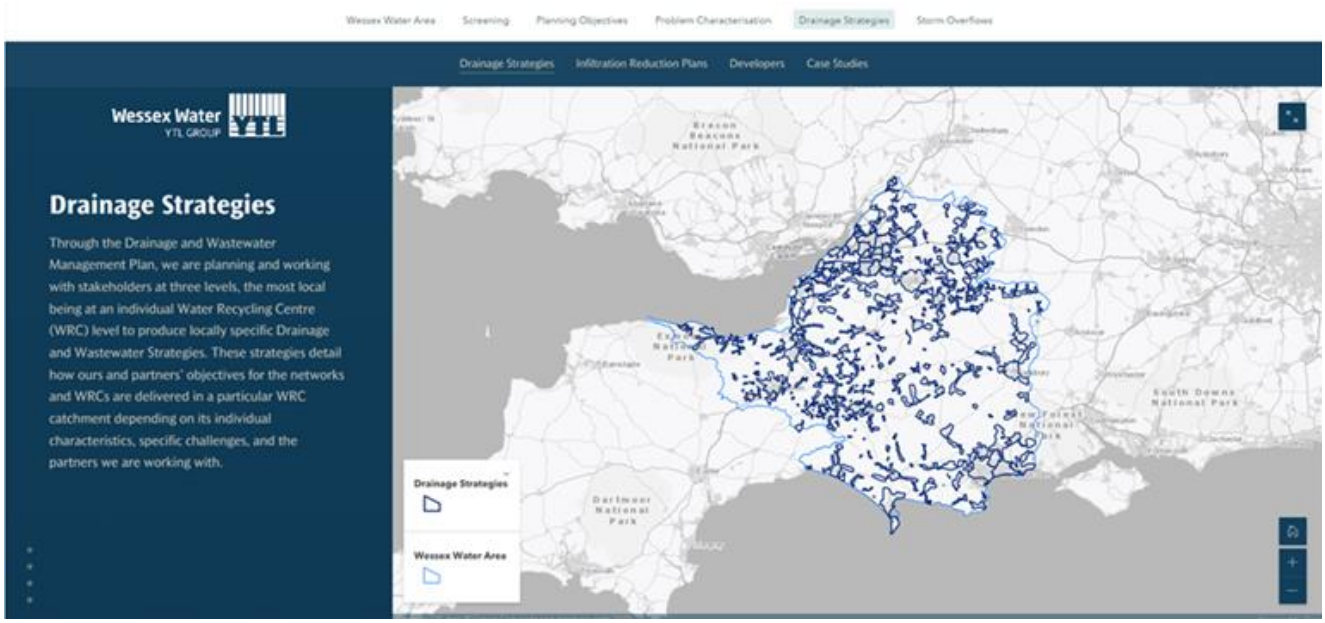


We published our first draft Drainage and wastewater management plan (DWMP) in June 2022 and our final DWMP in May 2023. The final DWMP was updated to take into account comments received from customers, regulators and

stakeholder during the 3-month consultation on the draft DWMP. The feedback was positive and constructive. Stakeholders recognised and supported the significant amount of work and potential opportunities for collaboration offered by this new evidence base.

The Wessex Water DWMP website provides links to access the DWMP Customer Summary Report, Non-Technical Summary Report and Full Report and hosts our geospatial portal[2] (Figure 8). The DWMP portal contains a wealth of information, relating to different phases of the DWMP framework and Drainage Strategy Framework. The DWMP portal also includes storm overflow performance and almost 200 drainage and wastewater strategy summary reports. Drainage and wastewater strategies summarise our plans for the short, medium and long-term for each of the major villages, towns and cities and provides an overview of investment that is being planned. The Full DWMP Report is also submitted alongside this plan – see WSX60. Please note there have been some changes as summarised in section 2.10.

Figure 8 - DWMP geospatial portal showing catchments with drainage strategies.



The following sections provide a summary of:

- partnership working through the DWMP (Section 2.2)
- the main stages of the framework (Section 2.3)
- water recycling centre improvements (Section 2.4)
- storm overflow improvements (Section 2.5)
- reduction in flooding and pollution incidents (Section 2.6)
- accommodating growth, creep and climate change (Section 2.7)
- other asset improvements (Section 2.8)
- adaptive planning to deal with uncertainties (Section 2.9)
- changes made between the DWMP and the PR24 plan (Section 2.10).

[2] https://arcg.is/1K8GaH

For PR24 Ofwat has also introduced the Long term delivery strategy (LTDS) reporting and data tables. These effectively are a higher level version of the DWMP report and data tables, covering the entire water company business and updated for PR24. See document WSX03 for more details.

2.2. Partnership working as part of the DWMP

Engagement with Flood Risk Management Authorities (RMAs), catchment partnerships and communities were an essential part of developing our DWMP due to the integrated nature of rainwater management across catchments.

Furthermore, as drainage responsibilities are complex (explained further in Section 8.2), work to increase the resilience of drainage and wastewater infrastructure often requires involvement of several risk management authorities and communities.

Collaboration was key to delivering integrated solutions and provided opportunities for identifying multiple outcomes and efficiencies in delivery. Our final DWMP (May 2023) proposed a step change in the level of investment towards partnership schemes.

The stakeholder and customer engagement section of our DWMP outlined a whole range of stakeholders across different geographic areas including national stakeholders, those interested in investment across the Wessex Area, strategic catchments, communities and customers.

Early on in our development of the Wessex Area DWMP, we undertook significant work with stakeholders to shape the strategic direction of our plan and to identify partnership priority areas. These recognised locations with the greatest opportunity to align investment plans. Proposed partnership solutions looked to progress opportunities to consider wider, long-term benefits to communities and the environment, using a systems and catchment-oriented approach to deliver integrated solutions that provided multiple benefits.

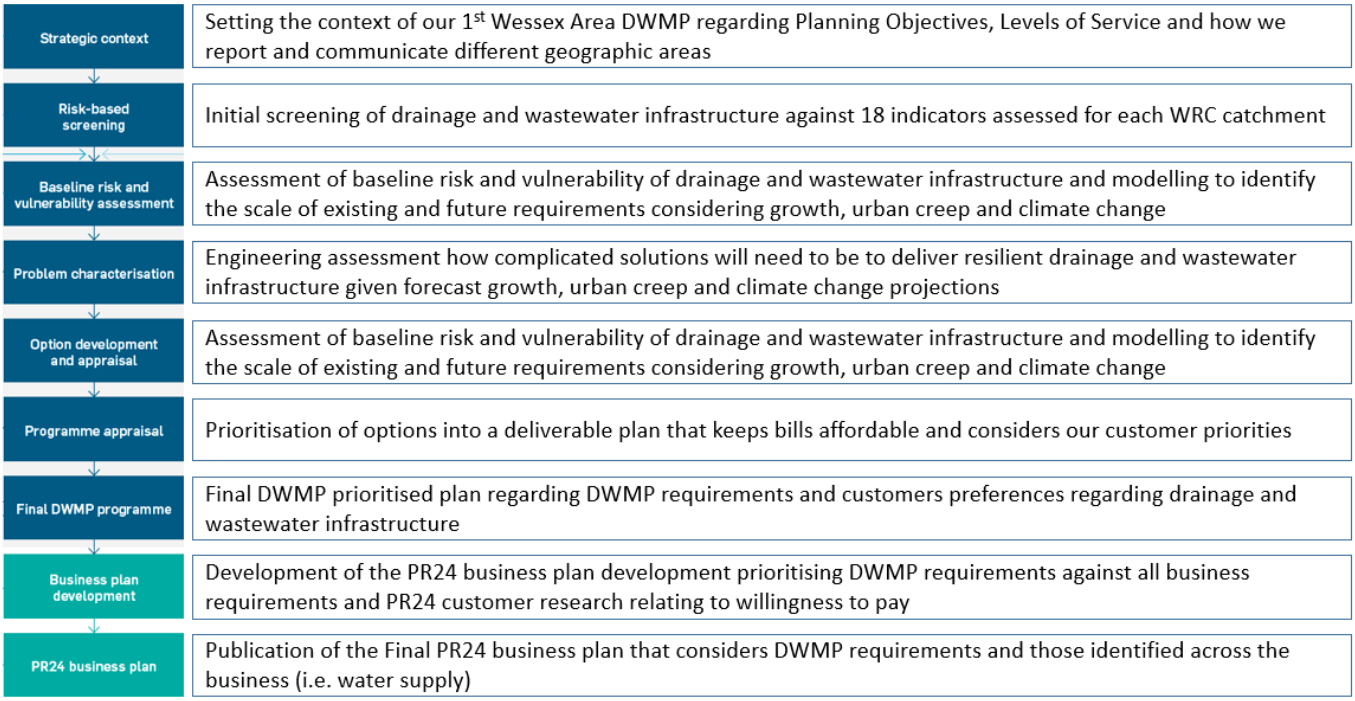
The improved line of sight for our investment in Wessex Water assets and infrastructure assisted our stakeholders in aligning priorities within their strategic plans, this also highlighted match-funding opportunities to help them secure other funding sources to deliver multiple benefits and outcomes.

The DWMP proposed a budget of £20m for partnership working for AMP8. This has reduced in our PR24 plan, as discussed in section 2.10. Further detail regarding partnership projects proposed for PR24 are provided in Section 8 of this document.

2.3. Developing our best DWMP

The DWMP framework contained a number of stages as summarised in Figure 9. Further details about the stages are provided below.

Figure 9 - Stages of the DWMP Framework



Strategic context

The Strategic context stage of our DWMP set out to define indicators, known as planning objectives, that represent the performance of the drainage and wastewater infrastructure. These were used to assign investment proposed within the DWMP.

To launch our DWMP we worked with stakeholders to define the strategic context and planning objectives.

Six planning objectives were agreed to be investigated by all water companies, known as common planning objectives which included:

- internal sewer flooding risk
- sewer collapse risk
- storm overflow performance
- pollution risk
- risk of flooding in a 1 in 50-year storm
- risk of water recycling centre quality compliance failure.

Our key stakeholders worked with us to help define bespoke planning objectives that are significant to the Wessex Area. These included the following indicators:

- risk of water recycling centre flow compliance failure
- river water quality improved
- partnership working opportunities
- blockage risk
- groundwater infiltration reduction
- sustainable drainage

Figure 10 demonstrates the alignment between the PR24 outcomes and DWMP planning objectives.

Figure 10 - Alignment between the PR24 outcomes and DWMP planning objectives

Unconstrained mapping of DWMP planning objectives to outcomes	An effective sewerage system	Greater customer experience	Good envirmomental water quality	Increased biodiversity	Water resource benefits	Net zero carbon	Affordable bills	Theme
	Outcomes							
WRC quality compliance	✓✓	✓	✓✓	✓	✓			Environmental
WRC flow compliance	✓✓	✓	✓✓	✓	✓			
Environment improved	✓✓	✓✓	✓✓	✓				
Storm Overflows	✓✓	✓✓	✓✓	✓	✓			
Internal flooding	✓✓	✓✓	✓	✓	✓			Effective sewerage
Flooding in a storm	✓✓	✓✓	✓	✓				
Blockages	✓✓	✓✓	✓			✓		
Pollutions	✓✓	✓✓	✓✓			✓		
Sustainable drainage	✓✓	✓✓	✓✓	✓✓	✓	✓✓		
Partnership working	✓✓	✓	✓✓	✓✓	✓	✓	✓	
Collapses	✓✓	✓✓	✓			✓		Asset health
Groundwater inundation	✓✓	✓	✓		✓			

Note: Bold planning objectives are common (national) planning objectives.
Two ticks show a lot of benefit, one tick shows some benefit, no tick shows no or negative benefit.

1. Risk-Based Catchment Screening

The Risk-Based Catchment Screening (RBCS) stage was the first stage of the DWMP framework. It determined which Water Recycling Centre (WRC) catchments (and its sewerage networks) required more detailed assessments through the Baseline Risk and Vulnerability Assessment (BRAVA) stage. The RBCS stage involved a high-level assessment of each WRC catchment against a range of indicators including flooding, pollution and WRC compliance. We also added one bespoke indicator – risk of groundwater inundation.

2. Baseline Risk and Vulnerability Assessment

The Baseline Risk and Vulnerability Assessment (BRAVA) was undertaken to assess the baseline risk for WRC catchment areas that had not already been filtered out by the Risk Based Catchment Screening (RBCS) stage. This assessment considered how current drainage and wastewater systems perform, how the risks will change in the long-term considering future demands including climate change, urban creep and population growth, and the identification of the principal drivers for those changes in risk.

The outputs of BRAVA provided a strategic view of the level of risk facing drainage and wastewater services now and for the long term (2050). These outputs were used to determine whether interventions are required to ensure a robust and resilient service can be provided. If interventions were required, these were developed through the Options Development Appraisal and Programme Appraisal stages and incorporated in our final DWMP.

3. Problem characterisation

The Problem Characterisation stage was used to determine the optioneering approach. This stage involved answering a series of questions for each Water Recycling Centre (WRC) catchment to understand “how big is the problem?” and “how difficult is it to solve?”. The answers to these questions determined the approach to options assessment as follows:

Standard (Green): current business planning approaches were used and standard optioneering methods considered to be sufficient to resolve issues in the water recycling centre catchment.

Extended (Yellow): options assessment using methods not previously used in wastewater planning. This included adaptive pathways, to resolve problems in water recycling centre catchment. These catchments typically had greater levels of population growth, multiple issues in the catchment and had interdependencies and interactions with other risk management authority's systems which required more consideration of options.

Complex (Red): considered methods not usually applied to wastewater and drainage planning such as adaptive pathways and complex modelling requirements. These catchments often had significant interactions with other risk management authority systems, significant population growth and traditional approaches were not sufficient in isolation to resolve the challenges in the catchments. These catchments also required greater sensitivity testing due to the complexity of resolving issues.

4. The Options Development and Appraisal

The Options development and Appraisal phase considered a long list of 40 generic options to help deliver increased resilience to our drainage and wastewater infrastructure. These were grouped into 6 main themes delivering improvements to:

- wastewater treatment
- combined, foul and surface water sewer systems
- surface water management
- customer management
- partnership working
- indirect measures.

Wherever possible, the screening process prioritised nature based and sustainable solutions including surface water separation to help deliver wider multiple benefits and maximise development of best value solutions that deliver multiple outcomes. To meet our ambitions of the DWMP and stringent regulatory requirements, hybrid solutions were considered which included a blend of traditional and nature-based solutions. These were then put forward to the programme appraisal phase.

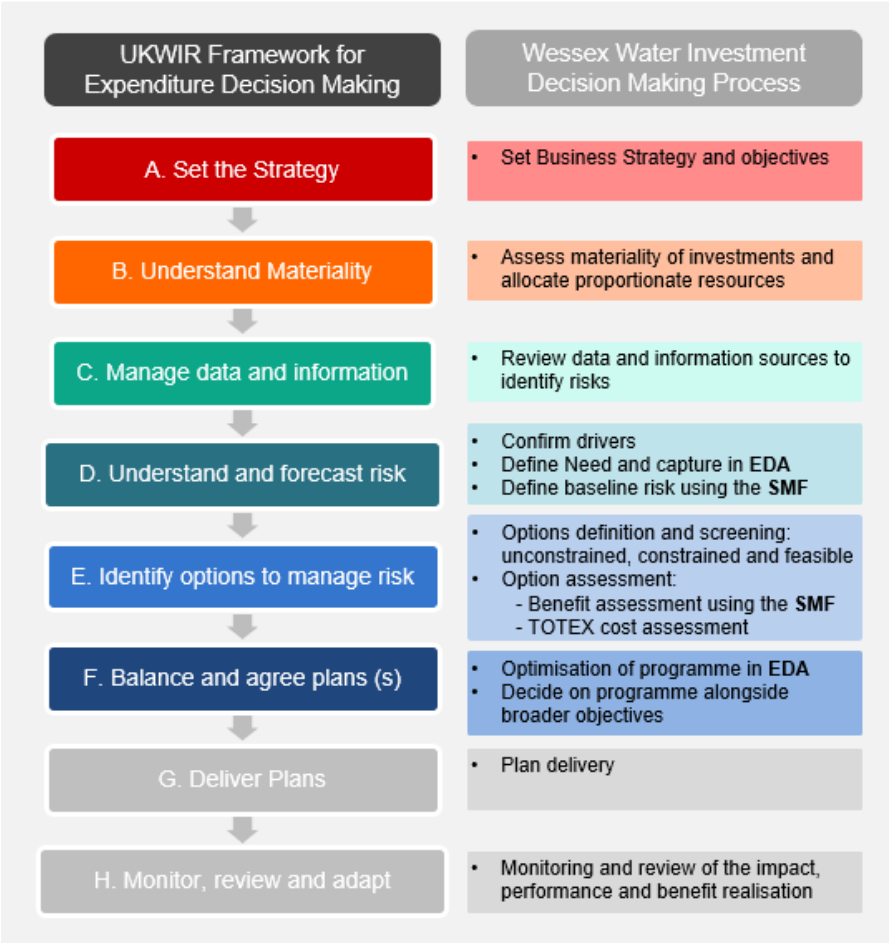
5. Programme appraisal

Wessex Water developed an integrated and consistent approach to investment planning and processes to inform the programme appraisal stage of our DWMP. This was aligned to the principles of the UKWIR Framework for Expenditure Decision Making (FEDM) shown in Figure 11.

This involved the development of:

- A decision-support approach which enabled objective comparisons of investment options across business areas drawing on common valuation criteria to support investment decision making. The defined approach utilises our corporate capitals-based Service Measure Framework (SMF) consistent with best practice across the industry
- A corporate decision-support and optimisation tool - Enterprise Decision Analytics (EDA) – to support Wessex Water in taking a data-driven approach to, and enable the optimisation of, asset investment planning and expenditure.

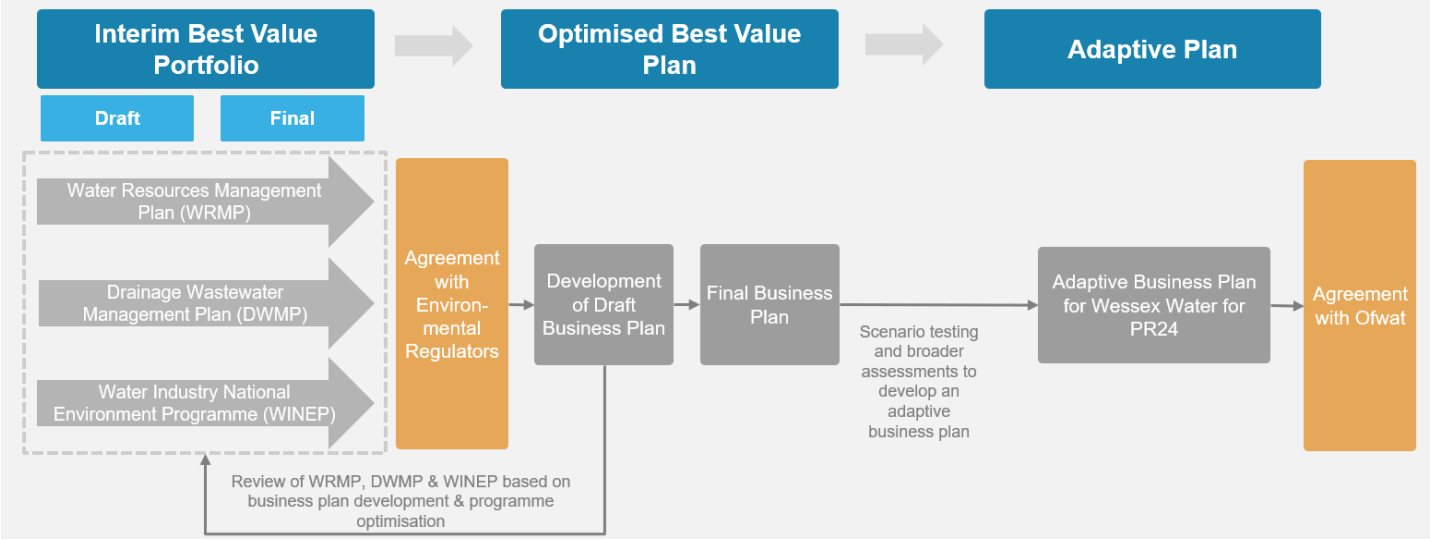
Figure 11 - Aligning investment decision making with the UKWIR framework



The DWMP framework recognised the translation of the DWMP into the business plan may require elements of the DWMP to be re-focused and re-prioritised to deliver outcomes within the broader business, customer and stakeholder constraints. The overarching alignment of the DWMP process within the context of the development of the Wessex Water business plan is outlined in the following diagram. An iterative process is proposed, whereby interim best value portfolios (e.g. WINEP) are developed and subsequently optimised within the wider business plan and updated to reflect broader organisation drivers and constraints.

Within the DWMP process, to ensure alignment between the DWMP framework and our internal investment decision-making process, the process outlined in the flow-chart (Figure 12) is followed at sub-programme level. It involves the use of the Wessex Water EDA and SMF to support the DWMP optioneering and programme optimisation across the broader business.

Figure 12 - Alignment of best value DWMP and our business plan



6. Drainage Strategies

Through the development of our first DWMP, we worked with stakeholders at three levels, the most local being at an individual Water Recycling Centre (WRC) level, to produce locally specific Drainage and Wastewater Strategies. These strategies provided a background to the catchment, the current performance, the future challenges and the proposed strategy to enhance the drainage and wastewater systems for the catchment as informed by the various stages of the DWMP described above. This resulted in almost 200 drainage and wastewater strategy summary reports that are now available through our website.

These local (level 3) strategies were aggregated into higher level summaries, such as catchment partnership areas (level 2) and the Wessex Area region (level 1).

2.4. Water recycling centre improvements

Water recycling centres (WRCs) are locations where we treat wastewater to make sure it is safe to release into local waterways. By treating wastewater, we can ensure harmful bacteria and organisms are removed which helps to protect habitats and wildlife and public health across the region.

Planning objectives that were defined as part of the DWMP relating to WRCs related to ‘WRC quality compliance’ and ‘WRC flow compliance’.

The DWMP WRC quality compliance planning objective defines the risk of the WRC quality compliance failure, as described in the Environment Agency’s methodology for their annual Environmental Performance Assessment of water companies.

Our aim is to have all WRCs 100% compliant. We set this planning objective to ensure we investigate catchments in advance of the WRC becoming non-compliant. For example, when significant development is planned, we can plan to expand the WRC proactively. This planning objective indicates risk, not failure. The WRC quality calculations for each WRC have been updated using the latest information of current and future demand requirement, these include:

- population equivalent projections based on potential development
- flow and load projections
- permit conditions where there is committed permit changes anticipated by 2025.

The DWMP WRC flow compliance planning objective defined the risk of WRC flow compliance failure. It is based on dry weather flow (DWF) compliance for WRCs that have a DWF permit.

DWF is the average daily flow to a WRC during a period without rain. The EA sets limits on the quality and quantity of treated effluent from WRCs to ensure discharges from WRCs do not cause an unacceptable impact on the environment. The flow that may be discharged in dry weather is one of these limits. Our target is to have all WRCs 100% compliant.

We set this planning objective to ensure we investigate catchments in advance of the WRC becoming non-compliant, for example when significant development is planned, we can plan to expand the WRC proactively. This planning objective indicates risk, not failure. The WRC flow calculations for each WRC have been updated using the latest information of current and future demand requirement (see Annex F of the DWMP). This includes:

- population equivalent projections based on potential development
- flow and load projections
- permit conditions where there is committed permit changes anticipated by 2025.

As part of the DWMP, Options were developed to ensure both quality and dry weather flow compliance at our WRCs. We typically used a 20-year design horizon when providing additional capacity, to account for reasonable growth projections without creating excessively oversized assets. This is also the approximate asset age of mechanical and electrical equipment.

For each WRC need, the baseline risk position was established. A process review and design was undertaken for any upgrades, to allow a high-level schedule of works to be developed that could be used for costing (capital and operational) and carbon (embodied and operational). This also assisted with benefit valuations.

Many of the options and proposals developed for the draft DWMP were superseded through the emergence of new legislation and/or changes to regulatory guidance and subsequently updated for the final DWMP.

The Wessex area DWMP core scenario for WRCs proposed £1.4bn enhancement in AMP8. An approximately similar value is being retained in our PR24 plan, however given changes since the final DWMP through the development of the WINEP there has been a wholesale changes to WRC proposals, including the proposing of less investment and accepting more risk for both ‘WRC quality compliance’ and ‘WRC flow compliance’ planning objectives. Further details can be found in Section 6 of this report.

2.5. Storm overflow improvements

Storm overflows are an integral part of our sewer system design and performance. Storm overflows are designed to prevent flooding during heavy rainfall, by acting as a relief valve allowing excess storm water to be released to the environment, such as rivers and the sea. Excess flow from the storm overflows that enter the environment are very dilute due to the large volumes of rainwater in the sewer and by the receiving sea or river, which will also be swollen by the heavy wet weather. Storm overflows prevent flooding of homes, roads and land.

Storm overflows are not new – most of them existed before Water Companies were privatised - with very few new overflows being constructed since 1991.

What is new is the information from event duration monitors (EDM) which record when the storm overflows discharge to the environment. Before 2015 we only had a few hundred overflows with EDM. Through WINEP enhancement, 700 more EDM were installed by 2020 and a further 305 EDM sites are currently in the process of being installed to achieve full monitoring by December 2023.

Wessex Water is giving full visibility to the EDM data which is downloadable from our website. This includes the annual performance of each monitored overflow (discharge count using the Environment Agency’s 12/24 hour rule) and also the stop-start times of every monitored discharge.

The government published a consultation in March 2022 on their ambitious storm overflow reduction plan. This has subsequently been included in the Environment Act and their Storm Overflow Discharge Reduction plan (SODRP) has been published[3]. The Environment Agency has converted the SODRP requirements into WINEP drivers for enhancement funding through the PR24 WINEP in AMP8 and beyond.

The SODRP sets out that water companies will have to achieve targets, such as:

- by 2035, water companies will have to improve all storm overflows discharging into or near every designated bathing water; and improve 75% of overflows discharging to high priority nature sites
- by 2050, this will apply to all remaining storm overflows covered by targets, regardless of location.

The SODRP frontloads action in particularly important and sensitive areas including designated bathing waters and high priority ecological sites such as Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SAC) and chalk streams. The Wessex Water region has a high proportion of these sensitive environments.

Water companies in England and Wales are therefore about to embark on the biggest single national investment programme in the history of wastewater infrastructure – a £56bn programme to reduce storm overflow discharges. Bills are likely to increase to fund storm overflow improvements.

The Wessex area DWMP included a core (preferred) plan to achieve the indicative SODRP targets. This will require approximately £3 billion investment by 2050. It also contained an adaptive pathway for elimination of all untreated discharges, which was significantly more expensive (£12 billion).

The DWMP contained 148 storm overflow improvements by 2030, to exceed the 38% interim indicative SODRP target. This has been reduced in our PR24 plan, as described further in section 2.10 of this report.

2.6. Reduction in flooding and pollution incidents

The effective sewerage theme recognises the need for investment relating to sewer flooding and pollution incidents.

Sewer flooding happens when sewage or foul water leaks from the sewerage system (through pipes, drains or manholes) or floods up through toilets, sinks or showers inside a building.

There are four main causes of sewer flooding:

- hydraulic overload, when the capacity of a sewer is insufficient for the volume of wastewater flowing through it; e.g. when surface water is connected to the foul sewer
- blockages, when the flow in a sewer is impeded by objects such as rags or wet wipes
- the collapse of the sewer itself
- and equipment failure, when the machinery driving the flow in the sewer, such as a pumping station, breaks down.

When rainfall runoff enters the sewerage system, the finite capacity of the sewer pipes, pumping stations or WRCs can be overwhelmed and sewer flooding can occur. This is known as hydraulic flooding. Hydraulic flooding only accounts for about 10% of flooding incidents. 90% of flooding incidents are caused by ‘other causes’, such as blockages (e.g. wet wipes, fats, oil, and grease), root growth increases into the sewers or flooding that is the responsibility of other risk management authorities.

[3] https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

While there are a number of sewer flooding causes, more often than not they are the result of a blocked drain. Blockages are usually caused by inappropriate items (wet wipes) being flushed down the toilet or put down the sink, such as FOG (fats, oil, and grease) and food leftovers. This is why we set ourselves a bespoke planning objective to reduce blockages. This is to do more to change customers behaviours, so they don't flush inappropriate material or put fat or food down sinks.

We have set ourselves a target to halve the impact of flooding by 2050.

We have also proposed to have zero pollutions by 2050.

One of Wessex Water's key commitments is to protect and improve the environment. When an escape of sewage occurs next to a river or stream, then the watercourse can become polluted. Pollution events can also occur from WRCs if they are not operating correctly. In severe cases, pollution incidents can cause fish kill. Fortunately, we have few pollution incidents, and when we do, most have minimal impact. We are aiming for zero pollutions by 2050. Our Pollution incident reduction plan (PIRP) explains what our plans are to minimise pollution incidents.

The DWMP identified planning objectives for risk of flooding in a storm, internal flooding, blockages, pollutions and sustainable urban drainage within the effective sewerage outcome theme.

The DWMP proposed a medium scenario of £40m in AMP8 to address hydraulic flooding requirements as part of the overall effective sewerage flooding core plan, which also included smart network (in-sewer monitors) blockage reduction and infiltration reduction with a total proposal of £60m in AMP8. The pollution reduction strategy included a further £30m, making the total flooding and pollution budget of £90m in AMP8.

2.7. Accommodating growth, creep and climate change

Based upon a range of information available, we maintain both short and long term demand projections for water resource and strategic drainage and wastewater planning. These are supported with a rolling capital programme for investment using a phased approach where necessary to maintain standards of service and compliance. Climate change continues to influence wider extremes of rainfall and weather patterns and future directives upon climate change may introduce variances in the strategic planning process to meet this challenge. Supporting growth and new development includes the following core activities:

- Providing network connections for new development
- Maintaining network capacity with resilience measures
- Providing water resources and wastewater recycling with process capacity
- Service quality in Developer Services markets

These ongoing activities have established processes to evaluate the impact of growth and new development upon the capacity and performance of sewerage assets. Regulation of the industry has led a path toward a greater focus upon investment planning at the 5-year Price Review. Longer term strategic planning is perhaps less visible to external stakeholders but has remained in the background as a fundamental part of capacity planning.

The growth plan within the Core DWMP identified a requirement for a total spend of £20m in AMP8.

2.8. Other asset improvements

2.8.1. Sewer collapses

We have 35,000,000 metres of public sewers. We do not know the structural condition that all of these are in, especially those transferred to us in 2011 under the section 105a private sewer transfer. Fortunately, sewers are long life assets that deteriorate slowly, so most will not need to be replaced for a very long time.

Sewer collapses can occur when sewers reach the end of their long life. This is an asset health common planning objective for the DWMP aimed at increasing investment in these long-term assets now rather than burdening the investment for future generations. We have a relatively low number of collapses compared with other WaSCs. However, we know we are not replacing assets at the rate of deterioration, so are building up a burden for future generations. We should be investing more now for a more sustainable future.

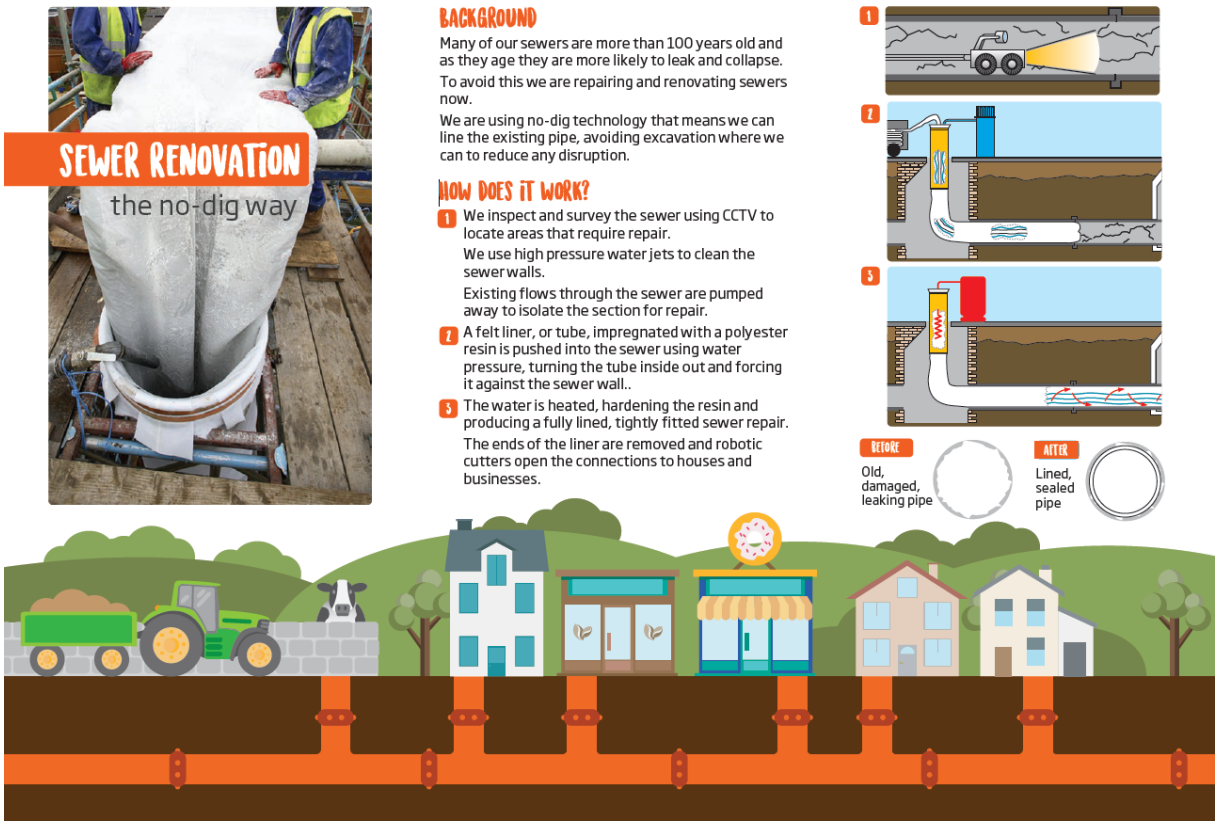
The medium investment scenario will see a slight improvement in the level of service from the base. The DWMP proposed to double the investment (£19m base and £20m enhancement) in AMP8 and then a further 30% increase every AMP. With this scenario there will be almost 130 avoided collapses by 2050 compared to status quo.

2.8.2. Sewer rehab

Many of our sewers are more than 100 years old and they are more likely to experience groundwater infiltration and collapse. To avoid this we are repairing and renovating sewers now. We use no-dig technology that structurally lines the existing pipe (effectively with a new pipe), so avoiding excavation where we can reduce any disruption. Sewer rehabilitation aims to improve asset health and prevent collapses. An explanation of the sewer rehabilitation process we use to repair sewer and reduce groundwater infiltration into the sewers is shown in Figure 13. We assess the need for sewer inspection and rehabilitation as per Wessex Water's risk-based policies to improve asset health condition and reduce the risk of future collapses.

We have also been developing and applying new innovative techniques through our sewer rehab work. This includes the application of calcium aluminate cement veneers to reduce the occurrence of biogenic corrosion resistance due to hydrogen sulphide (H_2S) attack (refer to WSX17 A6-1.2.1) or through installation of 'Latseals' to repair the connection from the house or road gully etc, to the original sewer, which can often be badly fractured or displaced (WSX17 A6-1.2.5).

Figure 13 - Description of sewer renovation process



2.8.3. Rising main replacements

The sewers take wastewater from our customers' homes and businesses and convey the flow by gravity to the WRC, where the wastewater is purified before being discharged back to the environment. Where the topography does not enable our sewers to flow by gravity, we also use sewage pumping stations (SPS) which lift flows over hills using pressurised pipes called rising mains.

If a rising main fails, this can have significant impact resulting in potential flooding and pollutions. This is why we have a programme of investment in replacing our rising mains. The DWMP identified that our deterioration modelling shows that our current level of investment is not sustainable (replacing 2.4km of rising mains a year). We are currently involved in a collaborative project to secure OFWAT funding to develop 'PipeBots' to identify metal loss in rising mains that can contribute to bursts, which can cause major pollution. Further details of this work can be found in WSX17 (A6-1.2.6).

Our rising mains are old and in need of replacing. We feel we are at a cliff edge and numbers will significantly increase if we don't proactively invest. We should be replacing 8 times the level of historical investment.

The DWMP proposed a budget of £35m for AMP8 to cover the costs of sewer collapses, sewer rehab. and rising main replacements, in addition to the historical base spend of £25m.

2.8.4. Groundwater inundation

During wet winters or prolonged times of rainfall, cracks or holes in sewers can allow infiltration of groundwater into our and private sewers, particularly when the groundwater table is high. Inundation from groundwater of foul sewers in the Wessex region is problematic because we have chalk geology in the southeast, mudstone geology in the north-west and fluvial inundation of the Somerset Levels and Moors during wet winters. Our video[4] explains how flooding in areas with chalk geology can impact our customers sewage services, meaning that they are unable to flush their downstairs toilet for several weeks during wet winters.

A budget of £10m was proposed in the DWMP to help increase the resilience of our drainage and wastewater assets by reducing groundwater infiltration and therefore inundation. Further details of how we are applying innovative techniques to vacuum test manholes to help identify infiltration and development of our own hibernated cure epoxy resin can be founded in WSX17 A6-1.2.9 and WSX17 A6-1.2.4 respectively.

2.8.5. Resilience

Our assessment into resilience identified 248 sites that are potentially at risk of flooding from an extreme rainfall event (1 in 1000 years Environment Agency flood extents from rivers and sea). We appraised 124 of these to estimate the mitigation costs. We extrapolated this sample to the 248 sites and estimated that this will cost £55m. The programme of these will be spread out over several AMPs, choosing the highest priority sites first. The shoreline management plans highlighted two schemes that should be constructed within the next decade. Further consideration is required of any implications of the ongoing Shoreline Management Plan that is undergoing a refresh at the time of writing.

The Final DWMP proposed £5m for spending on resilience measures in AMP8.

[4] https://www.youtube.com/watch?v=7b4uaY4H1Tk

2.9. Adaptive planning to deal with uncertainties within the DWMP

The best value plan proposed within Section 10 of our DWMP (summarised in the above sections) outlined our core plan. This contained our best estimate of investment requirements between 2025-2030 and provided a line of sight to delivery of the long-term plans. However, the DWMP also recognised many current uncertainties including requirements for continuous water quality monitoring and investigations and forecast predictions of climate change. Adaptive pathways were proposed to allow our DWMP and long-term delivery strategies to adjust more efficiently to reflect new information, options and experiences to address the current and future uncertainties that may be realised going forward.

Our preferred plan in the DWMP was different to our core plan regarding the level of ambition on storm overflows. The core plan achieves the governments storm overflow discharge reduction plan, using no/low regret solutions. The preferred plan completely eliminates untreated discharges in line with our current strategic direction statement by 2050. This required an additional £9 billion to achieve and some of the previous schemes will need to be revisited by undertaking more surface water separation or proving additional storage or capacity.

The triggers to review our adaptive pathway related to:

- our customer willingness to pay (affordability)
- whether the carbon footprint of solutions could be offset
- the government's review of their SODRP in 2027. Decision points regarding our adaptive planning proposals were informed by either the final determination of the business plans or the update to our Strategic direction statement.

As part of the DWMP we applied the following adaptive plans relating to:

- Climate change
- Asset health step change (groundwater)
- Banning of wet wipes
- Additional treatment requirements at WRCs
- A requirement to reduce hydraulic flooding risk
- Other adaptive plans and phase approaches
- Sea level rise adaptive plan
- New technology adaptive plan.

2.10. Changes made between the DWMP and the PR24 plan

Since the DWMP was published in May 2023, our regulators have changed their requirements, so our plans for PR24 have adapted.

The main changes are summarised in the table below, with references to where more detail can be found.

Table 1 - Changes from the DWMP to the PR24 business plan submission.

Description	Reason for change	Cost increase (Capex)	Reference to more detail in this document
Nutrient neutrality and other phosphorus-removal related expenditure has increased in AMP8	The new and anticipated Levelling-up and Regeneration Bill, and updated river water quality models	+c£200m	6.1.4

Growth at WRCs	Netted off above	-c£200m	6.1
the Storm Overflow programme has been reduced	Affordability, financabiliy and buildability	-c£150m	5.1
Continuous water quality monitoring has reduced	Revised guidance from Defra	-c£100m	7.1
Monitoring of emergency overflows has been reduced	EA requested phasing so 25% delivered by 2030	-c£18m	0
Hydraulic Flooding	Reduction in programme	-c£8m	5.3.1
Collapses and bursts	Not included enhancement proposal	+c£30m	WSX10
Reduction in flood risk partnership budget	To meet increased requirements of the WINEP and financeability	-c£11m	8.2

3. WINEP

3.1. WINEP background

A large part of our environmental programme is governed by the Water Industry National Environment Programme (WINEP). This identifies the specific environmental measures to be included in water companies' PR24 business plans for Asset Management Plan period eight (AMP8), for 2025-2030.

Defra's Strategic Policy Statement to Ofwat (SPS, published March 2022) set out the UK Government's priorities, including environmental priorities, for Ofwat's regulation of the water sector in England.

The Water Industry Strategic Environmental Requirements (WISER, published May 2022) was issued jointly by the Environment Agency and Natural England. It describes the environmental, resilience and flood risk obligations that water companies must consider when developing their business plans. The WISER particularly has a focus on considering enhancements that go beyond the statutory minimum where there is customer support and wherever possible identify opportunities for working in partnership in order to achieve wider benefits.

The WISER categorises environmental expectations of water companies as:

- Statutory obligations (S) – While it is important to understand the costs and benefits of measures needed, these statutory obligations must still be achieved.
- Statutory plus obligations (S+) – In cases where action is considered disproportionately expensive to meet statutory plus obligations, alternative objectives, or timescales to meet them may be set.
- Non-statutory requirements (NS) – Water companies should demonstrate that there is an environmental requirement and customer support and that such investments provide best value for customers over the long term.

Water management within the water sector is governed by 4 statutory planning frameworks. These are the:

- river basin management plans
- water resource management plans (WRMPs)
- drainage and wastewater management plans (DWMPs)
- flood risk management plans

The WISER requires water companies to take all these planning frameworks into consideration as well as the Water Industry National Environment Programme (WINEP). The WINEP is developed collaboratively between water companies and regulators, to identify specific environmental measures that water companies need to take to meet their environmental legislative requirements and related government priorities (as set out in SPS and WISER). These measures may be investigations, monitoring, options appraisals, or schemes to improve and protect the environment.

Table 2 – Strategic and specific guidance from regulatory bodies used in the development of our PR24 WINEP proposals

Defra Strategic Policy Statement (SPS)	Water Industry Strategic Environmental Requirements (WISER)	Water Industry National Environment Programme (WINEP)
Government (Defra) advice to Ofwat for PR24, with four strategic priorities for Ofwat:	WISER is a joint EA / NE strategic steer to water companies, based around objectives that water companies are expected to achieve:	WINEP sets out the actions that water companies need to complete to meet their environmental obligations.

• Protect and enhance the environment • Deliver a resilient water sector • Serve and protect customers • Use markets to deliver for customers	• A thriving natural environment • Resilience for the environment and customers • Expected performance and compliance	• Drivers for investment range from measures for protected areas, improvements to meet River Basin Management objectives and other local environmental priorities • There is an overall promotion of catchment and nature-based approaches, although some specific technical guidance does place restrictions

3.2. WINEP core obligations

Notwithstanding our fundamental duty to protect and enhance the natural environment, some of our responsibilities are further enforced by statutory obligations. The principal UK Regulations as identified in the WINEP are summarised in Table 3, with many transitioning/replacing EU Directives following Brexit.

Table 3 – Core obligations associated with protecting and enhancing the environment

Core Obligations
Bathing Waters (BW): Bathing waters and the seaside economy are valuable economically, socially, and environmentally to the UK. The aims of the Bathing Water Regulations 2013 are to protect and improve bathing water quality,
Drinking Water Protected Area (DrWPA): Similar to groundwater protection under the WFD, DrWPA objectives are to prevent deterioration in groundwater bodies, with the additional driver of reducing the level of purification treatment required in the production of drinking water. The latter are implemented through safeguard zones.
Eel Regulations (EE): The Eels (England and Wales) Regulations 2009 were introduced to meet the European Eel Regulations, with the aim of halting and reversing the decline in eel stocks. Priority actions are identified in Eel Management Plans prepared by the Environment Agency. Water companies are required to take those actions deemed necessary to deliver the Eel Management Plans, which include improvements to screening arrangements to protect eels from entrainment at our surface water abstractions and to structures that impede the migratory passage of Eels.
Environment Act (EnvAct): The Environment Act 2021 allowed the UK to enshrine better environmental protection into law once the UK left the EU. It provided the Government with powers to set new binding targets, including for air quality, water, biodiversity, and waste reduction.
Habitat Regulations (previously known as Habitats Directive) (HD): The Conservation of Habitats and Species Regulations 2017 protects certain species and habitats. The legislation requires the designation of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) and that these sites are properly protected and managed. SPAs and SACs contribute to the network of European sites, referred to collectively as Natura 2000.

Ramsar sites are wetlands of international importance, designated under the Ramsar Convention. Ramsar sites are treated in the same way as SPAs and SACs.
Invasive Species (INNS): Invasive non-native species (INNS) of flora and fauna are considered the second biggest threat after habitat loss and destruction to biodiversity worldwide. The GB Invasive Non-native Species Strategy is a strategic framework which coordinates the actions of government departments, their related bodies, and key stakeholders.
NERC Biodiversity Priority (NERC): The Natural Environment and Rural Communities Act 2006 (NERC Act) places a duty on every public authority, including water companies, to have regard to conserving biodiversity. This is with the aim of restoring or enhancing a species population or habitat and reflects government's ambition for the 'prevention of further human-induced extinctions of known threatened species'.
Shellfish Waters (SW): The Shellfish Water Protected Areas (England and Wales) Directions 2016 is designed to protect and improve shellfish waters. The legislation aims to protect areas designated for shellfish growth and production.
Sites of Special Scientific Interest (SSSI): The Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act 2000) requires statutory undertakers (including water companies) and public bodies to take reasonable steps, consistent with the proper exercise of their functions, to further conservation and enhancement of the flora, fauna or geological or physiological features of Sites of Special Scientific Interest (SSSIs).
Urban Waste Water Treatment Regulations (U): The Urban Waste Water Treatment (England and Wales) Regulations 1994 (UWWTD/R) concern the collection, treatment and discharge of urban wastewater (and from certain industrial sectors). The UWWTR sets minimum standards and deadlines for the provision of sewerage systems, and treatment of sewage according to the population served by sewage treatment works, and the sensitivity of receiving waters to their discharges.
Water Framework Directive (WFD) The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 establishes a framework for community action in the field of water policy. The WFD requires each water body to be classified in terms of its ecological status as high, good, moderate, poor or bad. This is determined by combining assessments results for biological (biomass/abundance of plants/algae) and physiochemical quality elements (nutrients, dissolved oxygen). The key objectives of the WFD are to: - prevent deterioration in the classification status of aquatic ecosystems, protect them and improve the ecological condition of waters - implementation of actions to improve water quality in terms of relevant WFD status objectives - promote sustainable use of water as a natural resource - conserve habitats and species that depend directly on water - progressively reduce or phase out releases of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment - progressively reduce the pollution of groundwater (GW) and prevent or limit the entry of pollutants - contribute to mitigating the effects of floods and droughts.

Abbreviations in brackets in the above table is the designation used in the WINEP for each core obligation.

Within the WINEP, each scheme has also been attributed a specific action, as described in Table 4, that is associated with the respective core obligation.

Table 4 – Actions associated with core obligations.

Actions	Action Code	Action Description
Action (to prevent deterioration)	ND	Measures to prevent deterioration of water quality or ecological parameters.
Action (to improve)	IMP	Measures to reach required status, such as reducing phosphorus at WRCs in order to meet WFD good ecological status. For some drivers, a 'g' suffix is applied (i.e. IMPg) to indicate a move to good status for that element.
Investigation	INV	Investigations and – as appropriate – options appraisals in PR24 to inform investment in PR29. The investigations will have a specific scope agreed with the EA.
Long term monitoring	MON	Long-term monitoring measures to inform investment in PR29 or PR34, such as Event Duration Monitoring (EDMs) of storm discharges, WRC flow monitoring, trend monitoring for chemicals and surveillance programmes for invasive species.

Each scheme identified within the WINEP has been assigned a primary core obligation and an associated action. For example, a scheme with a driver code of WFD_IMP is one requiring improvement to meet the WFD requirements. In some cases, a scheme may have secondary or tertiary drivers to address the same issue, such as HD_IMP and SSSI_IMP.

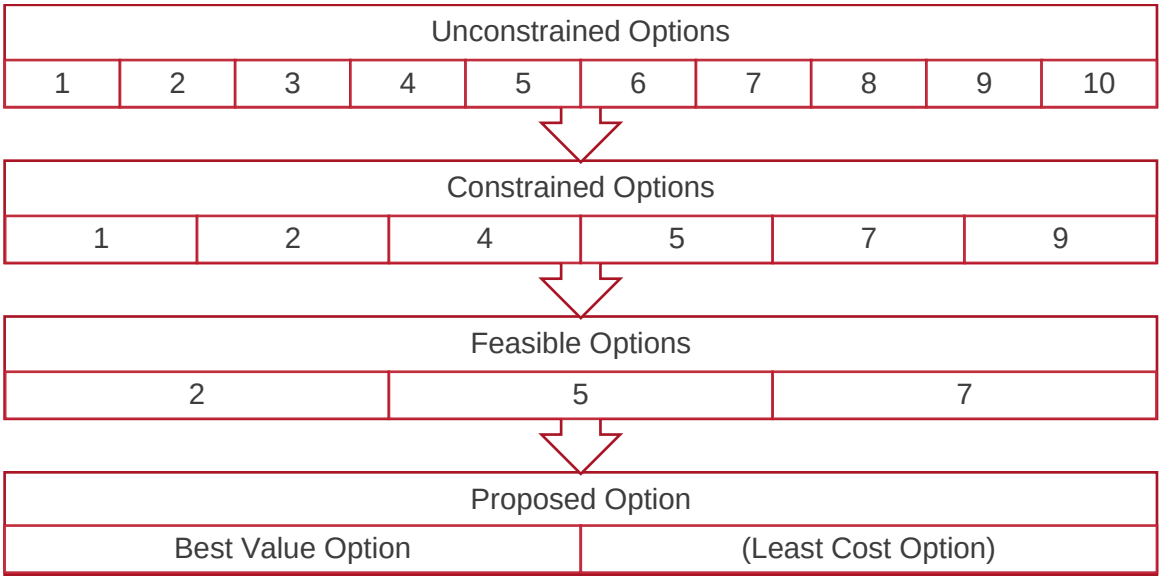
3.3. WINEP development

We have collaborated intensively with the Environment Agency and Natural England during development of the WINEP to ensure that it delivers the best possible outcomes for the environment and for our customers. Our overall aims have been to ensure that there is sound scientific evidence of the need for an environmental improvement, to always consider more beneficial alternative ways of achieving similar objectives and to challenge the timescales for delivery.

Alongside national direction, a series of workshops held with local EA and NE technical practitioners in April-June 2022 identified ~150 local environmental issues and risks to be investigated / addressed in PR24. These ranged from site-specific concerns (e.g. moving a WRC outfall) to regional-scale assessments (e.g. water resource requirements for designated nature conservation sites). Many of these were copied through into the WINEP for further development, although we did challenge and reject ~50 issues and risks considered not to be our responsibility and/or those that should be deferred to subsequent AMPs.

In developing the WINEP and as evidence that best value actions were being included in the WINEP, water companies were required to produce Options Assessment Reports (OARs) and Options Development Reports (ODRs) as appropriate. A best value plan is one that considers factors alongside economic cost and seeks to achieve an outcome that increases the overall benefit to customers, the wider environment and overall society. For those risks and issues with the possibility of different options, the emphasis was placed on water companies to develop and propose solutions, balancing various complementary and/or competing drivers in some cases. Similar to the WRMP and DWMP, there was a requirement to demonstrate a screening process before arriving at a Preferred / Best Value Option (and Least Cost Option, if different), as illustrated in Figure 14.

Figure 14 - WINEP Option Development – indicative option screening/selection process



In both the screening and development of options, the level of detail has been appropriate to the scale (and complexity) of individual areas of work, along with anticipation of potential challenge from the regulators. In some cases, there may only be a single valid option to address an environmental need. We have also constantly challenged where we believe legislation and regulatory guidance is leading us towards options not in the best interests of either the wider environment or our customers but have been constrained given these external limitations.

More details of options considered are included in the relevant sections that follow, and also in Supporting Document WSX17 A2 & A7.

The WINEP was developed under a set of legislative and regulatory obligations and drivers that are significantly different to those now in place. As a result, the WINEP will need very significant alteration and so our plan has been developed to keep up with the changing requirements.

3.4. Advanced/Alternative WINEP

3.4.1. Advanced/Alternative WINEP

Ofwat and the EA invited companies to propose advancing environmental improvements through the WINEP, by way of an Advanced WINEP (A-WINEP). Our A-WINEP proposals were submitted in January 2023, alongside much of our original PR24 WINEP proposals, for the EA to review potential inclusion in the WINEP itself.

In 2021 we announced a strategy that we had developed named Outcomes Based Environmental Regulation[5] (OBER). OBER was developed in recognition that water companies were being asked to make point-source interventions, where we believed that more collaborative working with other sectors could lead to the equivalent level of water quality improvements but with wider and greater environmental benefits, such as lower carbon footprint (embodied and operational) and improved biodiversity, all at a lower overall cost. The OBER concept expanded this by encouraging a market whereby different stakeholders could pool together – as well as accessing

[5] https://www.wessexwater.co.uk/news/ober-offers-greater-green-improvements-at-lower-costs

additional sources of finance – for the collective delivery of each of their outcomes and objectives at greater benefit and lower cost than if done individually.

Our A-WINEP recommended an OBER approach to allow the active promotion of catchment and nature-based solutions, which would have led to a saving of £250m on nutrient reductions, that we would reinvest in accelerating storm overflow improvements. We acknowledged that our A-WINEP would need shifts in policy and legislation to enable these A-WINEP approaches as the current wording in the Environment Act on phosphorus removal and the Levelling Up and Regeneration Bill (LURB) on technically achievable limits for both phosphorus and nitrogen mean we are not able to implement the full suite of catchment and nature-based solutions.

Our A-WINEP was rejected by the EA (in consultation with Ofwat), on the basis that it required legislative exemptions from government and due to a lack of quantification of environmental benefits.

Despite the rejection of our Advanced WINEP, we have continued to promote an 'Alternative' WINEP. We have extensively engaged with Defra, EA and Ofwat in the development of the WINEP. We have regularly emphasised the sheer scale of improvements being identified through the PR24 WINEP process – as well as the regulatory guidance forcing us towards what we believe to be cost ineffective and carbon intensive solutions in many areas – alongside our concerns regarding affordability, financeability and deliverability, including when considered alongside our whole PR24 Business Plan.

At a Chief Executive level quadripartite meeting with Defra, EA and Ofwat on 20 June 2023, we again emphasised our frustrations that regulatory guidance was restricting our ability to work with others to deliver better holistic solutions. A number of proposals were discussed:

- Phosphorus catchment permitting in the Hampshire Avon catchment, to achieve the equivalent of Levelling-up and Regeneration Bill load reduction targets.
- Phosphorus sub-catchment permitting in the Bristol Avon catchment, to achieve the equivalent of Water Framework Directive (WFD) targets, at sub-catchment (rather than waterbody) scale. This would build on the success of the already implemented catchment permitting approach in the catchment for WFD from AMP6. It was acknowledged that this sub-catchment approach would not meet WFD objectives at individual waterbody scale.
- Nature-based solutions be permitted for the treatment of groundwater-induced overflows, allowing the reduction of reporting spill frequency/volumes.

On advice from EA that a permitting approach was in the process of being developed for treatment of groundwater-induced overflows, and from Defra that there would be no amendments to the LURB on methods to achieve the targets, we wrote to the EA on 31st July 2023 with a revised phosphorus approach for the Bristol Avon. Our supporting report can be found in WSX17 A3-1.1.

The EA responded on 31st August 2023, with a series of comments on our sub-catchment permitting proposals, with a necessity on us to achieve our phosphorus targets at waterbody scale to meet WFD objectives. This was in contrast to the agreement reached at the senior level meeting that a sub-catchment permitting trial could take place and so discussions are ongoing.

3.4.2. WINEP Profiling

In recognition of concerns regarding deliverability, financeability, and affordability of PR24 business plans, the EA wrote to companies on 5th July 2023 – with direction from the Secretary of State – with an opportunity for companies to undertake a WINEP and Water Resources Management Plan (WRMP) phasing exercise, and particularly to identify whether any elements in each company's WINEP or WRMP could be phased from PR24 into future price review periods.

Our response, submitted on 26th July 2023, is contained in WSX17 A3-1.2. We reiterated our concern about the significant risks around deliverability, particularly in the context of our wider PR24 business plan and associated UK-wide supply chain risks.

The work required under the original WINEP for nutrient improvements totalled c£1.3 billion, comparable to the totality of our entire, business-wide PR19 investment plan (c£1.5 billion). We face significant delivery challenges for our nutrient improvements at our Poole and Lytchett Minster WRCs due to the complexity of the schemes and site constraints, meaning the achievable delivery timescales for these sites extends beyond 2030. We have been in dialogue with Defra with regards to the challenges at these sites, providing further evidence of the contributing factors to these constraints and proposals to deliver further nutrient offsetting around Poole Harbour in the short term to mitigate the delayed output of these improvements. We face similar challenges at a number of our larger WRCs (including Wool and Wareham), requiring us to phase our investment plan into AMP9 in order to deliver these improvements as permitted in the WINEP process.

Our approach to assessing the deliverability of our PR24 plan is outlined in more detail in WSX29 (Transition and Delivery) and WSX44 (Our assurance strategy and assurance statements), with the ceiling of total investment deliverable as part of the PR24 business plan assessed at £3.5 billion. Owing to programme delivery constraints including land and planning requirements, supply chain and resourcing, the nutrient reduction investment programme for Wessex Water for PR24 is constrained to £900 million in AMP8.

Our Board has approved a proposal that would see us deliver our entire nutrient programme by 2033, spending £900m in PR24 with the remaining investment being spent in the first few years of PR29. This is aligned with the required delivery programmes of nutrient reduction improvements at Poole and Lytchett WRCs and other large sites, with c£250m of the total expenditure extending into AMP9 and an additional £150m being removed through catchment and nature-based approaches.

We include in WSX17 A3-1.2 a letter from Natural England received on 20th September 2023, in relation to our alternative WINEP proposals for nutrient reductions that impact on Habitats sites and SSSIs. They support our ambitions to develop and implement catchment and nature-based approaches that deliver both for water and for nature. Again, this is in contrast to the requirements set out in the WINEP but our plan reflects this approach given dialogue had been ongoing for several months.

We believe this plan does the right thing for customers and the environment – and, importantly, delivers very significant reductions in spill duration which will be to the benefit of government, regulators, and the industry. We are conscious that there’s significant work to do on nutrients but we do not believe that there are further opportunities to reduce other elements of our plan and still strike the right balance between meeting the outcomes that customers and the environment need alongside ensuring our plan is deliverable, affordable, and financeable.

The EA wrote to us on 18th September 2023 with an updated version of the WINEP, although this version was received too late to be reflected in this business plan submission. The latest WINEP reflects some but not all of the changes that we proposed; there remain a number of holding lines with other lines down as “clarify” requiring further engagement with the EA. For some of those lines classed as “proceed”, we accept the action but not necessarily the stated completion date, particularly for some large/complex schemes which we have deliverability concerns as highlighted above. It is clear, given the significant changes in legislation, support from Natural England for a more ambitious and innovative approach, and ongoing discussions regarding sub-catchment permitting for example, that the WINEP will need significant reworking. Our approach delivers our statutory obligations in a significantly more efficient way that enables deliverability.

4. PCs and PCDs

4.1. Performance Commitments

Our performance commitments (PC) are detailed in Supporting Document WSX47 – Outcomes – tables commentary. The detail is not replicated in this document.

The common PCs included in the Wastewater network plus areas of the business are listed in the following table. This includes references to the relevant sections in this document where supporting/complementary information is provided to that in WSX47.

We do not have any bespoke PCs in Wastewater network plus.

Table 5 – Performance commitments - Wastewater network plus

Ofwat PC ID	Title	See WSX16 section
8	Internal sewer flooding	5.3
9	External sewer flooding	5.3
10	Biodiversity	
15	Total pollution incidents	5.2
16	Serious pollution incidents	5.2
17	Discharge permit compliance	6
18	Bathing water quality	5.1 & 6 & 7.7.3
19	River water quality (phosphorus)	6
20	Storm overflows	5.1
23	Sewer collapses	5.5

4.2. Price Control Deliverables

Our price control deliverables (PCD) are detailed in Supporting Document WSX26 – Price Control Deliverables. The detail is not replicated in this document.

The PCDs included in the wastewater network plus areas of the business are listed in the following table:

Table 6 – Price control deliverables - Wastewater network plus

PCD ID	Title
PCDWW4	Increase flow to full treatment
PCDWW5	Storm overflows, Storm tanks, spill frequency
PCDWW9	Treatment for total nitrogen removal
PCDWW10	Treatment for phosphorus removal
PCDWW18	Investigations
PCDWW24	Sludge storage
PCDWW27	Growth at sewage treatment works (excluding sludge treatment)
PCDWW28	Reduce flooding risk for properties
PCDWW35	Pollutions

5. Effective Sewerage

Our vast sewerage network takes wastewater away from 2.3m people in the Wessex region. This sewerage network is known as foul when receiving flow from toilets, sinks and baths or non-household waste. As well as foul water, we also receive and convey surface water - which is rainfall runoff from roofs, roads and other impervious areas. Surface water is mostly conveyed and discharged to open watercourses, ponds or the sea. But in some older towns and cities the sewerage systems were designed as combined and these combined sewers receive both foul flows and surface water flows. It is these combined sewers that contain storm overflows, which prevent flooding occurring during heavy rainfall events.

We are responsible for:

- 35,000km of gravity sewers which transfers wastewater from our customers' homes and businesses and conveys the flow normally by gravity to the water recycling centre (WRC), where the wastewater is purified before being discharged back to the environment
- 2,150 sewage pumping stations (SPS) which lift flows over hills, into higher sewers or to WRCs through pressurised pipes called rising mains
- 1,290 storm overflows which act as relief valves, allowing excess storm water to be released to rivers, ground or sea, to protect properties from sewer flooding during heavy rainfall. The majority (over 1,000) of storm overflows are located within the sewerage networks, generally in urban towns and cities, and 262 storm overflows are at WRCs. Although storm overflows are integral and an important part of our drainage system, they are deemed to be discharging too frequently which has politically become unacceptable and so the Environment Act has required companies to make improvements in accordance with the government's storm overflow discharge reduction plan (SODRP)[6].

Our performance commitments (PC) are detailed in Document WSX47 – Outcomes – tables commentary. Performance commitments related to effective sewerage, and where in this chapter they are discussed, are:

- storm overflows - section 5.1
- total pollution incidents - section 5.2
- serious pollution incidents - section 5.2
- internal sewer flooding - section 5.3
- external sewer flooding - section 5.3
- sewer collapses and rising main bursts - section 5.5

We remain a strong performer across the key wastewater performance commitments, having:

- received financial rewards for internal sewer flooding annually since 2020, with performance within the top three companies each year
- performed above the industry average for total number of pollutions since 2020, receiving a green classification in the EPA for this in two of the three years
- been in the top three performers for sewer collapses each year since 2020.

[6] https://www.gov.uk/government/publications/storm-overflows-discharge-reduction-plan

5.1. Storm overflows

Storm overflows are relief mechanism on combined sewer system to prevent flooding of properties. Combined sewer systems carry both surface water (run-off from roof gutters, patios, driveways and some highways) and the foul water from homes and industry together in one pipe. The combined sewage is then transported to a water recycling centre to be treated. But during a storm event, heavy or prolonged rainfall can rapidly increase the flow in a combined sewer and cause it to become overwhelmed. Storm overflows are designed to release excess storm water into rivers or the sea when this happens to prevent sewer flooding. They were constructed as an integral part of the combined sewerage systems and have been in existence for decades, with some being older than a century.

However, with increasing public and political awareness, the water industry is under pressure to reduce the discharges from storm overflows. Please see section 2.5 for more background to our 1290 storm overflows in the Wessex Water region and the political pressure they are under.

The government has set the ambitious Storm overflow discharge reduction plan (SODRP) targets and the Environment Agency created associated WINEP drivers (EnvAct) for enhancement funding through the WINEP24 in AMP8 and beyond. The SODRP sets out that water companies will have to achieve targets, such as:

- by 2035, water companies will have to improve all storm overflows discharging into or near every designated bathing water; and improve 75% of overflows discharging to high priority nature sites
- by 2050, no storm overflow will be permitted to operate outside of unusually heavy rainfall or to cause any adverse ecological harm.

Our PR24 plan will invest a record high level in this area, over £400m, investigating and improving 128 storm overflows, prioritising wetland treatment and rainwater separation at source. This was detailed in our DWMP and further refined in this Business Plan. We have based our environment programme on what we anticipate to be the final WINEP, which is being produced in collaboration with the Environment Agency and Natural England and associated regulatory guidance.

Ofwat has set a new performance commitment for storm overflows. This metric is the average number of discharges that occur from storm overflows in a year, with a weighted adjustment for unmonitored overflow or missing data. The spill count data is derived from the event duration monitors (EDM) annual return data that records the number of storm overflow discharges to the environment per calendar. This EDM data states the discharge count from each monitored storm overflow using the EA 12/24 hour rule. The total number of discharge counts is divided by the total number of storm overflows, to give an average discharge per storm overflow. Where we have missing data (either EDM not installed or there is operational downtime) then a rate of 100 discharges per years is used on a pro-rata basis for these unaccounted discharges.

We started collecting robust EDM from 2016/17, although at that time had only critical overflows monitored. Previous years score are therefore high due to the missing data adjustment. As more sites have EDM, not through making hydraulic improvements, the metric has reduces.

We will have almost (98%) full EDM coverage by December 2023. We have not declared 100% monitoring by 2030, as some EDM equipment on our 1290 sites are vulnerable to operationally fail. Our current uptime is 98% from monitored sites, which we consider is upper quartile. Achieving 100% uptime is not realistic. This is discussed more in our OUT1-5 commentary.

Now we have full EDM coverage, the weather will dominate this PC metric. Wet years will see higher discharges than dry years.

Groundwater inundation is a challenge in the Wessex Water region, and we are proposing innovative nature based wetland solutions to treat such flows, so they do not count as discharges.

Our long term target is that by 2050 the PC will be less than 10, since all storm overflows will be improved to less than 10 discharges per year to comply with the SODRP.

Note: Our PR24 storm overflow plan is based on the August 2022 issue of the SODRP. An updated version of the SODRP was issued on 25 September 2023, which confirmed firstly that the frequency target applies to all overflows and secondly extends the high priority category to include Marine Protected areas. The first clarification does not affect our PR24 plan as we already included all our known storm overflows in our DWMP, LTDS and therefore our PR24 plan. The inclusion of Marine protected areas could require us to deliver more by 2035 to achieve the 75% improvement by 2035. We were unable to evaluate this change before this PR24 publication.

Deliverability of our programme is a major constraint and a £400m programme investing in 128 overflows is the upper limit of that constraint. This is reflected in our final plan.

5.1.1. Need for investment

There are almost 1,300 storm overflows in the Wessex Water region. Over half of these do not achieve the performance targets of the government's SODRP, so will need improvement by 2050. Also see section 2.5 for background to storm overflows and the Government's ambitious plan for water companies to improve their performance.

By 2050 the SODRP requires all storm overflows to discharge no more than 10 times a year and will have a fine screen. In sensitive environments they are also not allowed to cause ecological harm. If within 1km of a bathing water they are also not to discharge more than 2 or 3 times a bathing season, depending on the bathing water quality status. The majority of the improvements are to achieve a fixed frequency of discharge, regardless of the impact the overflow has on the receiving waterbody or environment.

We determine the discharge frequency from our storm overflow from our event duration monitoring (EDM) data. EDM equipment records the start and stop times of discharges. From this the total number of discharges (using the EA's 12/24 discharge count methodology) can be determined for reporting.

We publish our annual storm overflow EDM data on our website to give visibility of our storm overflow performance. In 2022 we reported the performance of our 1185 storm overflows that have EDM (92% of all our storm overflows). By December 2023 we will have full EDM coverage of all 1290 storm overflows, so future reports will be more complete.

The following table shows the number of storm overflows categorised into both discharge frequency and the environmental sensitivity of its discharge location. Each storm overflow is only included once against its highest priority environment category. It shows that hydraulic improvement is currently required at 700 storm overflows, as they discharge 10 times of more per year. The SODRP requires these to be improved over the next 25 years, with a profile mentioned earlier. The cells in the table highlighted red are the storm overflows that discharge to the highest priority environments and we are targeting at least 75% of those improvements by 2035, as required in the SODRP.

Over 500 storm overflows are discharging on average less than 10 times per year. Some of these may also need hydraulic improvement, if in high priority environments and found to be causing ecological harm (see section 5.1.2).

Table 7 – Storm overflow prioritisation, showing frequency of discharge and environmental priority

Environment amenity	Unit of frequency	Average EDM or Modelled discharge count (12/24)								Un-known
		00	<1	<2	<3	<5	<10	<20	<40	>40	
Designated Bathing Waters - Coastal	/BS	6	9	11	6	14	6	4	-	-	-
Designated Bathing Waters - Inland	/BS	-	-	-	-	-	-	-	-	-	-
Designated Shellfish waters	/Year	2	5	3	1	8	4	3	3	3	3
Recreational use	/Year	-	-	-	-	-	1	1	3	4	-
Reason for not achieving good ecologial status (RNAG)	/Year	6	4	2	1	3	12	4	19	12	1
Chalk stream	/Year	7	5	2	1	3	12	8	15	18	8
Sensitive Areas (protected area) prioritised by Natural England	/Year	7	6	5	4	6	12	16	15	25	-
Sensitive Areas (protected area) - SSSI, RAMSAR, SAC	/Year	3	5	2	2	1	6	19	16	7	5
Sensitive Areas (protected area) - Eutrophic	/Year	10	3	4	4	6	13	19	31	28	13
Not high priority. Frequency >=10 discharges per year	/Year	-	-	-	-	-	-	141	158	128	55
Not high priority. Spill<10 discharges	/Year	55	31	31	28	48	79	-	-	-	-
Sub-total		505						700			85

The discharge frequencies in the above table are the average EDM data where available and if EDM is not available then the predicted discharge frequency from our hydraulic computer model performance is used where available. The performance is our baseline (2023) performance.

The SODRP prioritises investment in high priority environments, as list in the above table. The SODRP has a target that 75% of those storm overflows in high priority environments that need to be improved, need improving by 2035. It also contains an indicative trajectory that 38% of them need improving by 2030, ie PR24.

There is uncertainty of the actual number of improvements needed to achieve the 38% and 75%. This is because not all overflows are monitored with EDM, so the number that need improving may increase, and also the 'no ecological harm' element is not known. If we just need to hit the 10 discharges per year target then 38% is between 111 and 123. Our PR24 plan achieves this interim SODRP target. However, if 'no harm' requires all the high priority environments to achieve 5 discharges per year (which we think is unlikely), then the 38% indicative target becomes between 137 and 149, which we will not achieve. The storm overflow investigations, which need completing by 2027, will determine the improvement requirements, so we can ensure we achieve the 75% improvements by 2035 target.

A government-led Storm Overflow Taskforce – comprising representatives of the water industry, regulators (Environment Agency and Ofwat), environmental groups, and CCW representing customers – commissioned Stantec to undertake a Storm Overflow Evidence Project[7] to explore policy options that could reduce the occurrence of storm overflow spills and any harm that is caused, to inform the SODRP. This project highlighted that Wessex Water were in the top three companies needing to invest for improvement, due to the high percentage of high priority environments.

Storm overflow performance will deteriorate due to future pressures of climate change increasing rainfall intensities, growth which will see new developments being built and other urbanisation (urban creep). Our complex computer models predict that with these future pressures the discharge frequency will not change much, but the volume of predicted discharges will increase, so may have a worse impact on the environment.

The SODRP has been written to improve current and future pressures to address the frequent spilling overflows. Our core plan delivers the SODRP required targets of discharge frequency performance of 75% by 2035.

[7] Storm overflows evidence project (publishing.service.gov.uk)

In developing options for the plan we assumed a mid-prediction climate change scenario of 20% increase in rainfall intensity. With climate change we will see increased rainfall intensities (see DWMP section 7.4.3 and 11.2 for more details). Our predictions of the storm overflow performance would see an increase of 7.6% by 2050, if adverse climate change scenario occurs and if not addressed, compared to the core scenario. Similarly the benign climate change scenario predicts a 7.0% reduction in performance.

Growth has a less dramatic affect than climate change with only +/-1% from the core scenario for the benign and adverse climate change scenarios.

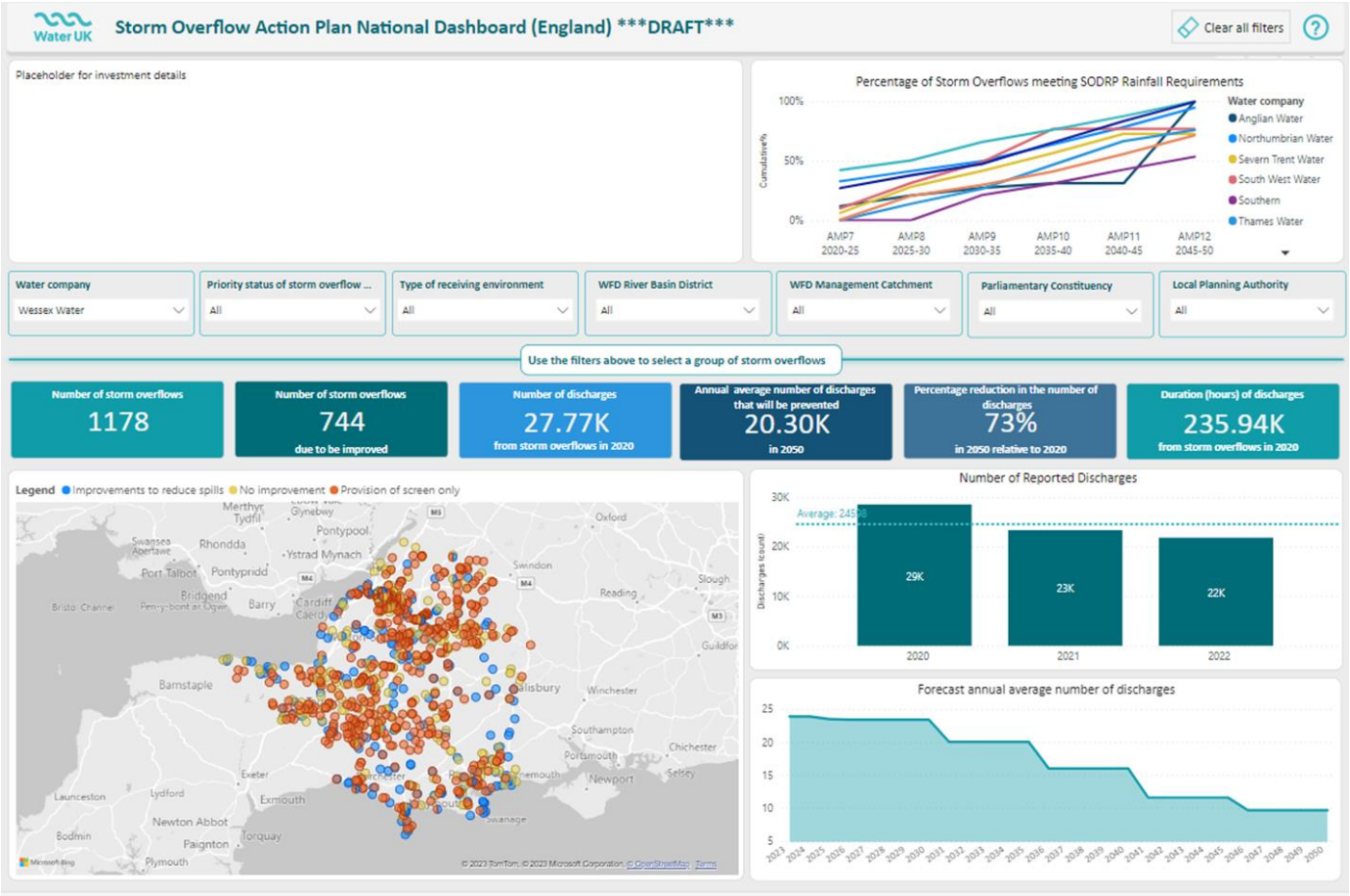
PR24 is the start of a significant investment programme to improve storm overflow performance. This is a step change in performance requirements and has not been funded in previous price controls. The table below shows the current prioritisation of the storm overflow improvements by 2050, broken down into each AMP cycle.

Table 8 – Number of storm overflow requirement by 2050 (AMP12)

Storm overflow improvements	AMP7	AMP8	AMP9	AMP10	AMP11	AMP12	Total
Bathing & shellfish waters improvements	3	25	13	0	0	0	41
High priority environmental improvements	8	98	140	25	0	0	271
Improvements for frequency (10 discharges/year)	6	5	21	104	142	140	418
Total SO improvements in AMP	17	128	174	129	142	140	730
Fine screens only	0	0	1	87	99	98	285
Unknowns and those currently discharging less than 10 per year							275
Total							1,290

The location of the improvements required by 2050 are shown in Figure 15. This is an early output of the SOEP project to allow visualisation of the national programme of storm overflow improvements.

Figure 15 - WaterUK SOEP national dashboard (draft) extract showing the Wessex Water improvements



The investment in storm overflows is a statutory obligation included in the WINEP for which the Environment Agency have confirmed the need. Our plan aligns with the government's storm overflow discharge reduction plan of 75% improvements by 2035.

Customer research shows that storm overflow discharge reduction improvements are a priority for customers, as described in section 5.1.7.

5.1.2. Investigations

This section discusses storm overflow investigations. Other water quality investigations are discussed in section 7.7.

The optioneering investigations used to inform both the DWMP and PR24 plan are discussed below. Then we discuss the PR24 storm overflow investigations that are required by 2027.

1. Investigations to inform the DWMP and this business plan

An enormous amount of work has been undertaken in developing options for storm overflows over the past few years. Over 100,000 detailed dynamic computer model simulations have been undertaken in determining the storm overflow options. For storm overflow performance predictions (existing and future) these use 10 years worth of rainfall data and are extremely slow to simulate. Our network modelling is discussed further in section 7.5.

The PR19 DWMP programme has proven invaluable in preparing us for this ambitious requirement from the governments SODRP, in that we now have a almost full stock of suitable hydraulic computer models to be able to use to develop the size of the solutions required.

By using our baseline models, we can predicted the 2025 performance. By adding future development, urban creep allowance and climate change s allowance, we can predict the future performance.

The current and future annual average discharges have been calculated using the Environment Agency criteria of '12/24 discharge counting'. Detailed hydraulic computer hydraulic modelling assessments used 10-year StormPac time series rainfall to determine the average annual discharges. These simulations are particularly time consuming, especially for large catchment like Bristol, when it can take 24 hours to run one set of rainfall.

For each modelled storm overflow, the predicted discharge volume for each of the hypothetic rainfall events over the 10 year period are ranked highest to lowest. The biggest predicted discharge volume is the amount of useable attenuation storage required to prevent discharge to the environment in 10 years. The 51st ranked spill volume would be the storage needed for 5 discharges in an average year. The 101st ranked spill volume would be the storage needed for 10 discharges in an average year.

Using cost curves, we can then estimate the cost required to achieve different frequency targets. It is these attenuation solutions that were generally used to inform the DWMP and LTDS 25 year requirements.

Separation schemes are more challenging to establish and cost. The amount of impervious area in the computer models can be reduced by 10%, 20%", 50% etc, and the residual discharge volumes should reduce, but often only slightly. The majority of our investigations has shown that an attenuation tank would also be required, even if 50% separation was achieved. The costs of these hybrid schemes are significantly more than the attenuation only option. Due to the complexity of this, we only developed separation options for most of the overflows that we thought would be in our PR24 plan.

Other options were also modelled where appropriate, such as increasing pipe sizes, increasing WRC capacity and transferring flows to other catchments. All selected options assume a reduced per capita consumption flow, to align with the WRMP.

The selection of options is discussed further in 5.1.3. Also see 5.1.4 for an example summary of a typical storm overflow options report. WSX17 A1-2 contains more of these reports for other PR24 storm overflow improvements.

2. PR24 investigations by 2027

The WINEP contains a requirement, under the EnvAct_INV4 driver, to undertake storm overflow investigations. These need to be completed by April 2027.

The WINEP guidance requires investigations to follow the Urban Pollution Management (UPM) Fundamental intermittent standard (FIS) and the 99 percentile methodologies: No local adverse ecological impact means achieving the UPM FIS for ammonia and dissolved oxygen and the UPM 99 percentile standards at point of mixing and critical location (e.g. lowest point of dissolved oxygen sag) downstream of the discharge point.

We have recently completed 30 Storm Overflow Assessment Framework reports, many of which used water quality modelling to estimate the impact of the overflow on the waterbody. Few identified any significant impact of the watercourses.

However, we have not completed any UPM studies recently, so we do not have the evidence of what harm is (or what impact the overflows have on the ammonia and dissolved oxygen sags). WxW completed a UPM style study in Bristol a decade ago, but the data collected was not conclusive, and was only a type 1 or 2 UPM study, not type 3 or 4 needed for PR24.

We are starting to collect more data, such as the Poole Harbour and near Bath (Warleigh Weir). Warleigh Weir is located on the River Avon and is visited by people who use the stretch of river for recreation, including swimming. Most swimmers are unaware of the hundreds of storm overflows and many WRCs that are upstream. In September 2020 intensive water quality monitoring took place, involving a partnership with The Rivers Trust with Bristol Avon Rivers Trust, Wessex Water, Sewage Free Swimmers and the Environment Agency, and a team of volunteers.

In Poole we are undertaking a real-time bacteria monitoring trial. The quality of bathing waters is measured by looking at the concentration of faecal indicator bacteria present in them. There is currently no technology that can continuously measure the concentration of these bacteria in rivers, which means we can't provide people with this information in real time. Instead, samples have to be collected by hand and taken to a laboratory where the bacteria are analysed under controlled conditions, which takes around three days.

However, there are many readily available sensors that can provide robust real-time measurements of other water quality indicators, including temperature, pH, conductivity, dissolved oxygen and river flow. We are working with UnifAI, a company specialising in the use of artificial intelligence (AI) technology, to trial an approach that uses algorithms to develop relationships between these readily measurable parameters and the concentration of bacteria in water.

The trial that is nearing completion, involved installing a series of sensors, collecting water samples and analysing bacteria in the laboratory. As more data is collected, the AI will develop these relationships, which will hopefully allow us to stop analysing samples in the laboratory and start providing the public with real-time water quality notifications.

The Continuous Water Quality monitoring programme (see section 7.1) will also inform the analysis of ecological impact.

Recently the Environment Agency has introduced an extra stage. This screening stage was intended to reduce the number of full UPM studies we will need to undertake, so that only 5 to 10% of the investigations will need full UPM studies.

We have doubts that it will reduce the number of full UPM studies required. These doubts are based on the comments made by Anglian Water in the 'sprint' meetings being held to develop the screening process. Anglian Water has flat catchments, which they have applied the screening process and said that potentially all of their overflows will require a full UPM study. This is of concern, as the Wessex region also contains a lot of flat areas (e.g. Somerset Levels and Moors). We have proposed to defer 222 storm overflow investigations into AMP9, to avoid the need to implement expensive UPM studies by 2027. There remains uncertainty in this programme.

Table 9 –Storm overflow investigations

Primary WINEP driver code	Description	Number of WINEP actions	Completion date
EnvAct_INV4	Storm overflow investigations – draft July 2023	370	April 2027
EnvAct_INV4	Storm overflow investigations – deferral proposal 2023	148	April 2027

5.1.3. Options

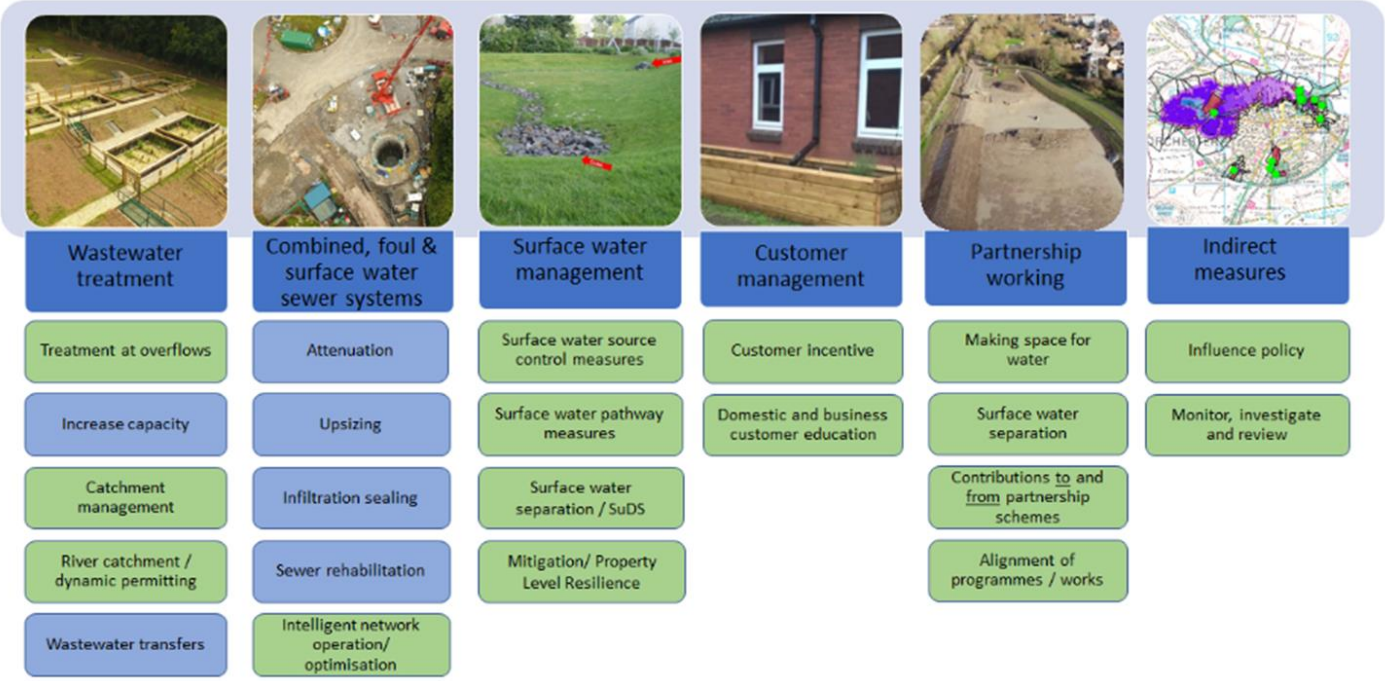
As mentioned in section 5.1.2, sewerage systems are complex and each storm overflow site need investigating individually to determine the best option for improvement, if required. An array of potential options available to reduce discharges at storm overflows, include:

- Separation at source
    - Retrofit sustainable drainage (SUDs) in the catchment to prevent surface water from entering the foul/combined sewer and manage surface water locally, adding benefits of water reuse (eg water butts)
    - Grey solutions to separate surface water out of foul/combined sewers
- Attenuation (normally underground storage tanks) to reduce the discharges from the overflow by storing combined sewage (rainwater and foul water) and then treating it after the rainfall has stopped: known as attenuation (or storage) solutions
- Increase capacity by increasing the continuation flow so that less flow needs to be discharged by the overflow of the
    - WRC – increases flow pass forward
    - Network – increase sewer size
    - Network - bigger pumping stations and larger rising mains
- Treat the storm overflow discharges (if diluted by groundwater), using nature based wetlands (or other appropriate treatment) to reduce harm – and say that it isn't a storm overflow discharge because it is treated effluent, so treat it as a small WRC discharge
    - Nature based wetlands
- Wastewater transfer
- Optimisation of network using smart systems
- Reducing per capita flows (used in all options)

Our DWMP explains (in over 40 pages in section 8 of the Full DWMP report[8]) how our unconstrained list of over 40 options were considered or dismissed during the optioneering stage, to reduce the number of constrained and then feasible options. The WINEP process also required a detailed guidance on how to develop options, which we followed. The following figure is taken from our DWMP and contains feasible options for wastewater network plus drivers.

[8] https://corporate.wessexwater.co.uk/media/cldo1kua/wessex-dwmp-the-full-report.pdf

Figure 16 - Wastewater options to improve performance



The table below shows the mix of solutions identified in the WINEP process which following the WINEP Options guidance to evaluating the best whole life cost benefits solution. The number of separation schemes is low because we could not substantiate the benefits of catchment scale separation in our service measure framework. All these options are subject to change when we appraise the schemes in more detail under the EnvAct_INV investigation driver. These investigations will re-evaluate options and wider benefits in more detail and chose the most appropriate solution on a case-by-case basis.

Table 10 – Number of different option selections on network and WRC

Storm overflow improvements	Number
Attenuation - Network	63
Attenuation - WRC	21
Separation/attenuation - Network	6
Separation/attenuation - WRC	2
Wetland - Network	11
Wetland - WRC	25
Total	128

Our complex computer models of the hydraulic sewerage network assume that all assets are maintained and operational (i.e. does not contain blockages). So all the solutions for storm overflow improvements related to heavy rainfall are to enhance the performance. Capital maintenance does not affect the underlying hydraulic capacity of the asset. Capital maintenance can reduce infiltration and we have increased our base spend by £10.9m to focus

reducing infiltration in the network upstream of storm overflows. However, infiltration sealing of our public sewers and the private assets connected to our public sewers will not solve the problem of groundwater inundation (see section 2.8.4), so we are proposing wetland solutions to address seasonal groundwater inundation.

By having these options for each of the optioneered storm overflow we selected the best value solution, taking Capex, Opex, carbon and the wider SMF benefits into account. This is described further in section 5.1.5.

Document WSX17 (section A1-2) contains summary reports of the detailed optioneering undertaken for many of the proposed storm overflow improvements (see example in section 5.1.4). Our modelling predicts the performance when reducing impermeable areas by 5%, 10%, 25% and 50% to assess the residual performance, and whether an attenuation would also still be needed - which is the case in most catchments, so attenuation tanks were generally selected.

This section continues to explain the most common options for improving storm overflow performance.

1. Separation of surface water out of combined and foul sewers

The fundamental principles for good rainwater management, (as stated in Defra's SODRP) are as follows:

- Rainwater should be treated first and foremost as a resource, captured locally and reused for the benefit of people and the environment
- Rainwater should be returned to the environment as close as possible to where it lands or channelled to a close watercourse without first mixing it with sewage.
- We expect water companies to achieve year on year reductions in the amount of surface water that is connected to their sewer network

Our preferred approach is therefore separating rainwater out of foul and combined sewers.

The costs of undertaking this is currently expected to be more than the benefits in many cases. We have selected 8 storm overflows that we will attempt separation rather than or as well as attenuation (hybrid solution). These were identified in the WINEP optioneering as the best value options.

Figure 17 - Separation scheme in Portland (runoff from cark park now discharges into a new surface water sewer)

We have selected some catchments where separation is considered to be feasible, with whole life costs that are lower than the grey solutions (or if the grey solution is unfeasible like in Clevedon). We will start these separation schemes before 2027. We need to agree with the Environment Agency when the extended target date of 2030 completion for these schemes.

Evershot is an example of a village that we will be targeting separation. There are two overflows that would benefit from this approach in this village (we have not double counted).

Significant proportion of roofs would need to be redrained (using soakaways, water butts, rainwater harvesting) and roads separated (using permeable paving, swales, tree pits etc). This option is not just a water company issue. It will require a society change, so customers are encouraged to stop putting surface water into the foul/combined sewers.

The green nature-based solutions may give lower carbon and additional benefits such as wellbeing to customers for living in a greened environment. For example house prices could be 5%-10% higher in tree lined streets. Our service measure framework (SMF) does not currently give a large, monetised value to these benefits, so currently the nature-based solutions are generally not the best value solutions.

Wessex Water have become a partner of Susdrain so that we show our ambition into evaluating the benefits and delivering more separation schemes going forward.

2. Attenuation of flows

Reducing the discharges from the overflow by storing combined (rainwater and foul water) sewage and then treating it after the rainfall has stopped is known as attenuation (or storage) solutions

This grey option is proposed at more than half of the AMP8 programme because it is often the lowest cost solution, is almost guaranteed to be successful and is buildable within a 5 year plan.

Although wanting to undertake separation schemes, our historic and frequent spilling overflow investigations shows that grey solutions are normally lower cost than sustainable solutions. Grey solutions are also more likely to be constructable within the short times scales proposed. Grey solutions (such as underground storage tanks) are tried and tested, so are almost guaranteed to achieve the target reduction in spill frequencies.

To determine the volume of storage required we used our hydraulic computer models of the sewerage system and simulated a 10 years of rainfall series to see how much discharge volume occurred. By ranking the discharge volumes, we can estimate the scale of storage required to achieve different spill frequencies. We then use cost curves to estimate the construction cost.

When projects progress through to design phase, we will re-evaluate options in more detail and choose the most appropriate solution on a case-by-case basis.

Figure 18 - Underground storage tank under construction

3. Treatment of groundwater inundation

The SODRP expects Water companies to prioritise nature-based solutions, carbon reduction and biodiversity net gain in their planning. Wetlands are the perfect opportunity to deliver this, as they are green solutions that have a low carbon footprint and will encourage biodiversity gain.

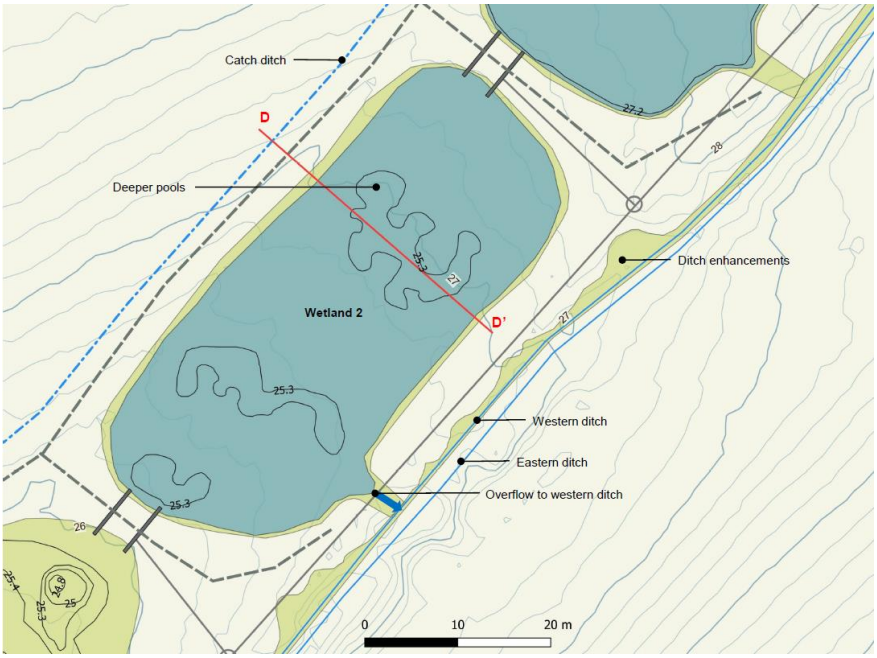
We are proposing to use these nature based solutions where overflow discharges are very dilute, due to groundwater inundation. These solutions, such as integrated wetlands, are feasible for treating dilute sewage and are our preferred solution. The alternative of making sure all the public and private assets are watertight, is carbon intensive, disruptive, expensive and is unlikely to be successful.

We have monitored groundwater-induced overflows at WRCs discharge and they are at a comparable or better quality than typical treated sewage. These continuous or near-continuous discharges occur due to high groundwater levels, potentially lasting for many months until the groundwater level drops. Given the low level of treatment required, a cost-effective option is to treat rather than store or remove the inflow. We are actively exploring whether we can treat storm overflows using wetlands, reedbeds or other nature-based solutions located adjacent to our WRCs

We have considered ‘green’ nature-based solutions particularly acting as a side stream for smaller WRCs or as a tertiary ‘polishing’ treatment stage, similar to the integrated constructed wetlands at Cromhall WRC.

We would not report these treated discharges as spills (in a similar way to continuous discharges from WRCs which are not reported to discharging 365 days a year).

Figure 19 - Bulbury Lane nature-based wetland solution



4. Increase capacity

Increasing the flow passed forward at WRCs, sewers network or pumping stations can be effective in reducing storm overflow discharges, but expensive. We have considered traditional ‘grey’ solutions as well as more novel ‘green’ nature-based solutions, with the latter particularly acting as a side stream for smaller WRCs or as a tertiary ‘polishing’ treatment stage.

For example the FPF at Avonmouth WRC would need to be increased to over 7000l/s to achieve the target. The alternative is 120,000m^3 (which is too big to be able to empty the tanks). This is not in our WINEP for improvement in AMP8, but an example of our optioneering.

Figure 20 - Increasing capacity of the continuation pipe

The above plan is based on robust, ‘grey’ solutions of attenuation/storage solutions. This is to ensure our plan is deliverable and successfully achieves the required outcomes in the short term. Ideally more nature based solutions and separation would be undertaken, but currently wetland technology is not proven and the benefits for separation do not outweigh the extra costs of implementation. An Ukwir study is looking at substantiating larger wider benefits for future separation schemes.

5.1.4. Example of options summary report

WWX17 Annex to this report contain summary reports for the detailed optioneering work we undertook for developing the best options for our customers.

An example report is below. This shows that we investigated numerous options to reduce the discharge frequency of the storm overflow. These options were appraised by using our complex hydraulic computer models of our sewerage networks (hydraulic modelling is discussed further in section 7.5).

Unique ref: 16379C

Catchment ID: 23013

Catchment name: AVONMOUTH STW CATCHMENT

Capex cost range: £1.8m to £3m for option B (traditional approach)

Delivery AMP: AMP8

Site overview

HENLEZE RD OS EASTFIELD IN is a gravity storm overflow that predominantly spills as a result of at joining point of two combined networks. It is located near the middle of the catchment in a predominantly residential part of the catchment. Upstream the hydraulically significant extent is limited by the head of the catchment, and downstream by overflow 16378c.

Spills at this site discharge to River Trym located approximately 503m away.

Need

This site has been investigated due to association with RNAG and EDM data suggests it spills on average 36.0 times per year. The hydraulic model predicts 43 spills per year and the objective of this investigation is to reduce the spill frequency to 5 per year. The solutions will be assessed against model performance, where this differs from EDM data then additional investigations may be required to ensure the suitability of the proposed options.

The need ID assigned to this investigation is 3262.

Previous investigations

This site has been investigated previously as part of the DWMP. Where appropriate these options have been checked to see if they can be refined to meet the objectives. The following project (s) have also looked at this site and should be checked before the options are progressed further: .

Methodology

This assessment has been undertaken on a 2050 design horizon model including planned growth and creep as assessed in the DWMP. Capital schemes that are partially built are included; however proposed schemes are not.

Hybrid option – solution A

The following solution has been developed using a step-by-step process involving generic options, unconstrained options, constrained options, and finally feasible options as identified here. It prioritises different option types on a range of factors in addition to performance. Financial costs and carbon costs have been calculated using high level cost curves and should be treated as indicative only.

- Solution ID: 120214
- The solution involves conveyance and attenuation (260m3) and reduced pcc
- Estimated financial cost: £2.0 million.
- Embodied carbon has been calculated as 12 tCO2e and operational carbon as 0 tCO2e per year.

Traditional option – solution B

The following solution has been developed using traditional approaches only. Financial costs and carbon costs have been calculated using high level cost curves and should be treated as indicative only.

- Solution ID: 120215
- The solution involves conveyance and attenuation (280m3)
- Estimated financial cost: £2.0 million. Costs excludes a fine screen.
- Embodied carbon has been calculated as 13 tCO2e and operational carbon as 0 tCO2e per year.

Sustainable option – solution C

The following option uses SuDS studio data to assess how much contributing area can be removed using SuDS. The option will either identify the area requiring removal to achieve the target spill frequency, or the residual spill volume to be addressed if all SuDS opportunities are implemented.

- Solution ID: 120216
- The solution involves suds
- The solution achieves 36 spills in the period of interest.
- Estimated financial cost: £60.5 million. n/a as solution does not deliver target performance.
- Embodied carbon has been calculated as 208 tCO2e and operational carbon as 0 tCO2e per year.

Sensitivity testing

Additional sensitivity testing has been undertaken as part of this assessment. The first part was a high-level assessment of different option types that disregarded buildability and budget but does indicate the potential for that option type to achieve the target spill frequency. The list below shows the residual spill volume associated with 11 such tests:

- 10% reduction in PCC - 119m3
- 5% contributing area removal through SuDS - 113m3
- 10% contributing area removal through SuDS - 106m3
- 25% contributing area removal through SuDS - 81m3
- 50% contributing area removal through SuDS - 39m3
- Increase pipe capacity - 120m3
- Remove infiltration - 120m3
- Improve maintenance - 121m3
- Increase FFT - 121m3
- Prevent new development - 121m3

Additional sensitivity testing was applied to options A, B and C above. These assessed the residual spill volume that would need to be addressed to achieve 1 per year and the amount of additional freeboard available beyond that needed to achieve 10 per year. The results of these tests suggest an additional 0m3

would need to be addressed to meet the higher level of protection, while there is currently 0.08m of available freeboard at the overflow which could be used without exceeding the lower level of protection.

Conclusion

It is recommended that a traditional approach be adopted to reduce the number of spills at this location. The solution identified here is high level and it is recommended that more detailed investigations regarding model performance and buildability are undertaken before the final design is developed.

5.1.5. Scale and costs of AMP8 storm overflow programme

The scale of the storm overflow improvements needed over the next 25 years is extremely challenging, in terms of deliverability, affordability and financeability, especially when combined with other business requirements.

New proposed changes to the government's Levelling-up and Regeneration Bill, may require WRCs to be improved to compensate for nutrient neutrality by 2030. This could result in a billion pound investment programme (which is similar scale to our AMP8 supply and waste enhancement programmes combined) – see section 6 for more details. Therefore, for affordability and financeability reasons, our proposed storm overflow programme in AMP8 has been reduced from our initial assumptions that were included in the DWMP and the draft WINEP.

The draft WINEP (July 2023) contained 148 storm overflow improvements, at a cost of circa £550m to deliver. This ambitious proposal exceeded the SODRP indicative target of 38% of improvements by 2030. Our customer research demonstrated that whilst storm overflow discharges are a concern, their reduction should not come at any cost and our £550m plan was too large.

Given this customer feedback and in response to the 5 July 2023 Environment Agency information letter 16/2023 asking us to consider phasing activities from PR24 into future price review periods, we proposed to scale back our AMP8 storm overflow proposal. This was therefore changed to improve 100 storm overflows, at a cost of circa £250m by 2030. We could still have achieved the 75% target by 2035 by including a larger AMP9 programme. This proposal was not welcomed by the Environment Agency or Defra, so in a meeting (24 August 2023) with Defra, we proposed a compromise that balances the wishes of customers, short-term and long-term obligations, alignment with interim targets, and affordability and deliverability constraints.

The PR24 storm overflow programme is now to improve 128 storm overflows, at a cost of circa £400m to deliver. This is the limit of deliverability for the storm overflow programme in AMP8. We have retained the same number of nature based solutions and selected the storm overflows at high priority environments, which included swapping 11 wetland sites with other wetland sites that are in higher priority sensitive environments. The table below lists the storm overflow drivers and how many improvements are needed in AMP8. The proposed 36 improvements with the EnvAct_IMP2 drivers are the wetland solutions.

We have not listed each scheme individually in this report, but they have been listed in WSX17 for completeness. The 128 schemes were included for improvement by 2030 in the Storm Overflow Action Plan, which is being developed nationally by WaterUK. Document WSX17 contains summary reports for some of the AMP8 storm overflow improvement schemes, with justification of the selected options.

Table 11 – AMP8 Storm overflow improvement programme by primary driver

Primary WINEP driver code	Description	Number of WINEP improvements with primary driver	Completion date
EnvAct_IMP2	Storm overflow improvements to reduce discharges to less than 10 discharges per year and no adverse ecological harm	36	2030
EnvAct_IMP3	Storm overflow improvements located at or close to a designated bathing water	16	2030
EnvAct_IMP4	Storm overflow improvements to reduce discharges to less than 10 times per year	76	2030
EnvAct_IMP5	Provide a fine screen only	0	2030

Approximately 60% of the 128 sites already have a fine screen in their permits (capital maintenance funding to maintain). We have included costs for providing screens at the remaining 40% in our storm overflow improvement costs.

The PR24 plan includes investment to improve storm overflow performance to less than 10 discharges per year to meet the SODRP target. It does not eliminate them. We have an adaptive plan that would eliminate all untreated discharges, which if supported by customers' may begin in AMP9 and will be included in our PR29 business plan. However, the government's SODRP impact assessment annex[9] shows that that complete elimination of storm overflows is not viable.

5.1.6. Robust and Efficient Costs

A representative sample of solutions covering a range types, sizes and complexities have been bottom-up costed to inform cost models for other schemes within out storm overflow programme.

ChandlersKBS were engaged to provide cost estimates for cost assurance benchmarking. They also reviewed our costing approach for many areas of the plan, including storm overflows. Their assurance report is contained in WSX45 – Annex A4.3.

For our storm overflow programme, they concluded that:

> *Due to the level of scope definition provided at Business Planning stage, we would identify the estimate class, as defined by the Association for the Advancement of Cost Engineering (AACE), as a Budgetary Estimate or Class 3 and, therefore, an expected accuracy range of between -20% and +30% to the outturn cost.*

[9] https://assets.publishing.service.gov.uk/media/651162052f404b0014c3d83c/Impact_Assessment_September_2023.pdf

Based on the AACE classification, the ChandlerKBS and Wessex Water accuracy ranges overlap which indicates a high probability of the outturn costs falling in this range. Therefore, the estimates can be deemed to be robustly efficient for Business Planning.

5.1.7. Customer views and protection

WSX04 describes the ongoing customer research we have undertaken, including customer research for our DWMP and for PR24.

Appendix B[10] of our DWMP contains details of our specific wastewater network plus customer research. This included obtaining presences of solution types, with the following outcome: Nature based solutions were positively received (compared to attenuation tanks). Customers also wanted us to deliver the programme of storm overflow improvements even though it is likely to increase customer bills.

This DWMP and PR24 customer research shows that environmental improvements, especially storm overflow improvements, are a priority for customers. Storm overflows are key issues which customers and stakeholders agree should be addressed. Similarly, increased media focus on coastal and river water quality has strongly influenced our customers' support for improvements to be delivered. Feedback was that we should be delivering the storm overflow programme at a faster pace than planned.

Table 12 – Storm overflow customer views (extract from WSX04)

Key insight	Examples of supporting evidence
Storm overflows are front of mind for an increasing number of customers who want action to be taken. In some cases, it is having a negative impact on perceptions of Wessex Water and the water sector.	• Once informed about CSOs, future customers view this as an urgent issue that requires action • Across the latest year overall, 'preventing sewage entering rivers and the environment' is an enduring priority and is the second place priority across all business activities. • For "reducing wastewater pollution incidents", customers are willing to pay for incremental improvements. • There has been a sizeable and sustained shift in the opinion of storm overflows…there is now a very clear balance of opinion towards finding storm overflows unacceptable. • Almost two fifths don't trust that their water company will prevent sewage from entering rivers. • 57% are satisfied with the company's cleaning of wastewater before releasing it back into the environment. • There were high levels of acceptance and support for the legally required investment in reducing storm overflows due to awareness of the need for action and concern for current water quality. Some feel this should be financed through company profits, rather than bill increases, however, enhanced investment is not affordable for many customers.
Customers want to see efforts from Wessex Water to improve on river and coastal water and there are generally high levels of support for investment when customers are informed.	• Customers' willingness to pay for river improvement increased with an increase in the improvement rate. • When customers are asked how to invest to reduce or resolve wastewater issues, the highest percentage of customers wanted to increase investment now to 2030 rather than increase slowly between now and 2040 or 2050 for example.

[10] https://corporate.wessexwater.co.uk/media/xhmc1cqx/wessex-dwmp-appendix-b-customer-research.pdf

	• There is evidence that significant proportions of customers are willing to pay increased bills to support investments that reduce the operation of storm overflows and improve river and coastal water quality. • Sewage in rivers and the sea has become increasingly top of mind in customers' agenda for what Wessex Water should improve on. • Respondents were presented with a choice between improving the quality of rivers or keeping bills low. Almost six in ten (59%) wanted their water company to prioritise improving the quality and cleanliness of rivers in England and Wales, even if this were to increase the price of their water bills.

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment and price control deliverable:

- PC20 Storm overflows
- PCDWW5 Storm overflows, Storm tanks, spill frequency

WINEP delivery is also a metric within the EA's annual Environmental Performance Assessment.

5.2. Pollutions

5.2.1. Need for Investment

The number of pollution incidents is recorded by water companies and the EA and reported via the Environmental Performance Assessment annually. The 2022 EPA indicated that nationally pollutions from water companies had risen from 1,883 in 2021 to 2,026. The EPA is tightening over the reminder of AMP7 and into AMP8, as indicated below:

- trend to minimise all pollution incidents (category 1 to 3) by 2025 – there should be at least a 40% reduction compared to numbers of incidents recorded in 2016
- serious pollution incidents must trend towards zero

Defra's Plan for Water published in April 2023 has a focus on improving water quality and reducing pollutions through the reduction in storm overflows, tackling nutrient levels and wider measures.

Since 2014, our number of total pollutions has varied annually from 72, in 2021-2, to 85 in 2015-16, with a current level of 77 in 2022-23. Our long term aspiration is to have zero pollution incidents. Our Pollution Incident Reduction Plan has been developed in AMP7 to undertake a varied range of activities to reduce these numbers. This Plan will be further enhanced during AMP8 as described within this section.

One of Wessex Water's four Strategic aims is to protect and improve the environment.

Many of the activities we carry out have the potential to cause pollution to the water and land environment if something goes wrong. When sewage or even clean water escapes from our systems, it can lead to environmental damage.

Pollution prevention has been a key area of work throughout AMP7 to drive down the frequency and impact of pollutions to achieve tightening Environmental Performance Assessment (EPA) targets and improve the environment. This is a multi-faceted approach covering the entirety of our sewerage network, treatment processes and working with household and commercial customers to raise awareness and change behaviours. We have adopted new technologies for data collection and are using Artificial Intelligence and machine learning to predict asset operation and use our networks more smartly. This approach is detailed in our Pollution Incident Reduction Plan and will be further developed through AMP8 to further reduce our impact on the environment.

This section of the Business Plan covers wider work to reduce the incidence of pollutions to date through our Pollution Incident Reduction Plan, plans for PR24 and focusses on the wider engagement work. This section should be read in conjunction with other parts of this document, namely:

Table 13 – Pollution reduction strategy

Activity	Description	Business Plan Reference
Serious and Total pollutions Performance Commitments	Delivering pollution reductions in line with the relevant Performance Commitments covering serious pollutions and total pollutions and to achieve the tightening targets required under the EPA	Section 5.2.8 of this document OUT 1-3 - 13 Serious Pollutions PC OUT 1-3 - 12 Total Pollutions PC
Asset heath: investment and improvement	Provides greater detail on the interventions planned to improve the sewer network, covering: • Investigations & surveys • Rehabilitation & repair • SPS investment • Data monitoring and analytics	Section 5.5 of this document Sections 7.2 – 7.4 of this document
Flooding	Focusses on flooding and the associated investment in mitigation measures to reduce these impacts for customers and the environment, covering: • Sewer capacity • Blockages • Partnership working typically with Lead Local Flood Authorities	Section 5.3 of this document
Water Recycling Centre investment and improvement	Provides greater detail on planning interventions to reduce the incidence of pollution at treatment sites, covering: • WRCs capacity • Maintenance requirements • Data and monitoring	Sections 5.4 & 6.1 of this document

These are all complimentary actions which will provide an overall reduction to our current level of pollution by 2030.

There are two common performance commitments related to the pollution incidents; total pollutions and serious pollutions. The Total pollutions performance commitment includes category 1, 2 and 3 pollution incidents from sewerage infrastructure, pumping stations, WRC and sludge/biosolids incidents. It reports pollution incidents as set out in Environmental Performance Assessment (EPA) relating to wastewater assets only and thus this measure will exclude non-sewer related pollutions, such as water treatment/supply assets, third party private assets etc. Serious pollutions is a sub-set, just including Cat 1 and 2 pollutions. Both are normalised by sewer length.

Historically we have about 4 serious pollutions per year. Our short term target is to reduce this significantly, but a target of zero by 2030 is probably not realistic due the scale of our assets and current lack of smart network monitoring information. We have set ourselves a target of 1 serious pollution per year by 2030.

5.2.2. Pollution Incident Reduction Plan

Our aspiration is to cause no pollution incidents – delivery of our Pollution Incident Reduction Plan (PIRP) our mechanism for achieving this.

The four main delivery themes for the PIRP are:

- people and process
- assets and maintenance
- customers and stakeholders
- data and analysis.

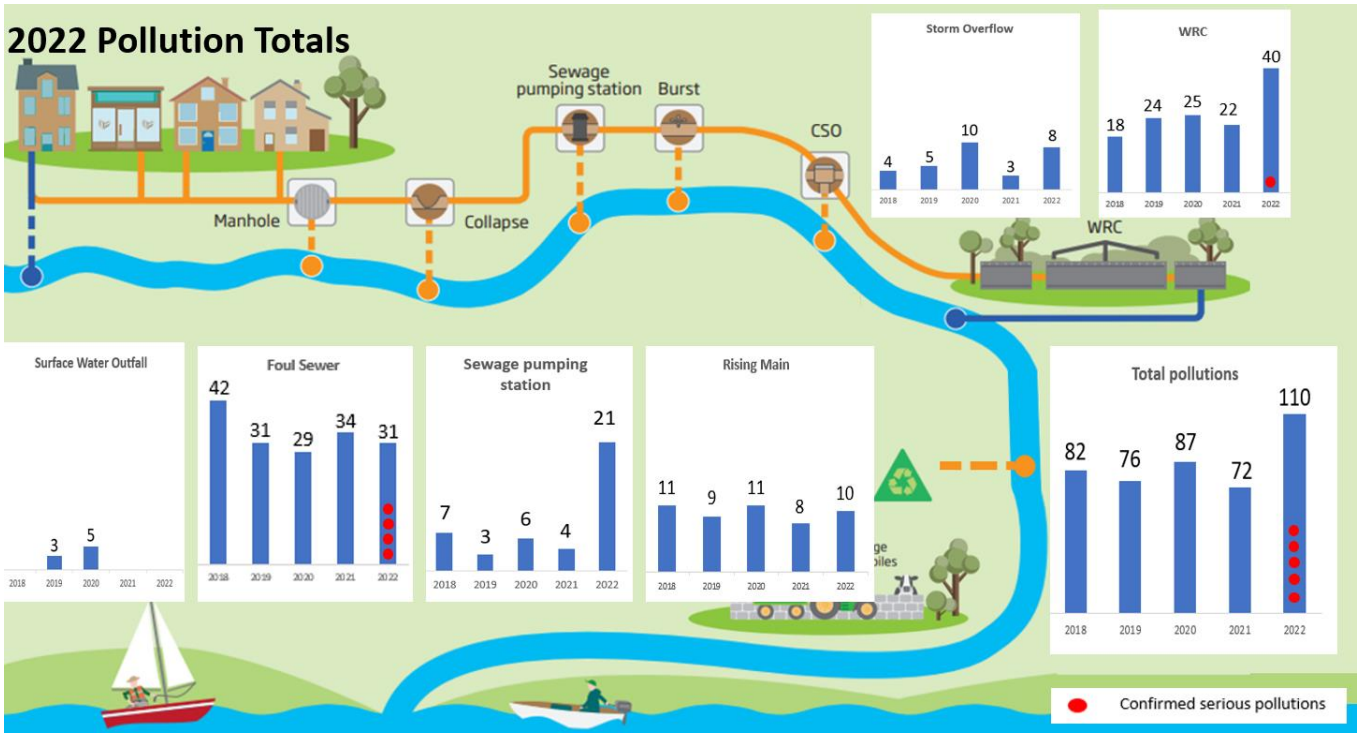
As part of our commitment to drive down pollutions from our assets, we have launched a unified Pollution Prevention Plan that covers both our Sewerage and Water Recycling activities.

In 2022 we saw an increase in our number of total pollutions, with the largest increases being from Water Recycling Centres (WRCs) and Sewage Pumping Stations. WRC incidents increased from an average over the previous four years of 22 incidents to 40 reported incidents and SPS incidents increased from an average of 5 incidents to 21 incidents in 2022.

The PIRP has previously been focused on sewerage assets particularly foul sewers due to most incidents emanating from these assets in the past. 2022 saw 31 incidents from foul sewers, this is a steady position with the average over the previous three years. Both surface water outfalls and rising main incidents have remained at consistent number of incidents for 2022.

Figure 21 below shows our total CAT 1–3 pollutions throughout the sewerage network and at WRCs between 2018 and 2022.

Figure 21 - 2022 Pollution Totals throughout the network



Analysis has shown that this increase is driven in part by the very dry drought conditions in 2022, which meant that although we had a similar number of escapes of sewage from our WRCs and SPSs, more of them were categorised

as CAT 3 (some environmental impact) rather than CAT 4 (no environmental impact) due to the exceptionally low flows in receiving water courses.

We have used our historic pollution data to inform our Pollution Prevention Plan, which is a subset of the PIRP, targeting the areas that should give us the greatest benefit. Our Pollution Prevention Plan highlights the key areas of work, aligned with our Make It Right ethical framework enabling continual improvement. The components of the Pollution Prevention Plan are outlined in Figure 22 below:

Figure 22 - Pollution Prevention Plan

The plan focuses on improvements to our Water Recycling inlet works that will remove blockage causing material from sites, along with improved flow control through the site. These two areas account for 44% of our WRC pollutions (CAT 1–4) in 2022.

We are also implementing Make It Right reviews to proactively identify potential pollution risks and control them before we have a problem. These reviews are similar to the Drinking Water Safety Plan reviews that we have successfully used in Water Supply to identify and control risks. This is also combined with our ongoing alarm rationalisation project that is aimed at reducing the significant number of low value alarms present in our telemetry system, which could mask real issues that need to be responded to. Further details of how we are applying innovative alarm intelligence to assist with decision making in the control room can be found in Annex WSX17 Section A6-1.1.1 and A6-1.2.7).

Following the success of our network monitoring programme, the intention is to roll it out to a further 250 high priority rising mains and 3,500 sewer locations over the next two years, with further expansion of the programme planned for AMP8. The increasing rollout of EDM has provided greater network on overflow operation which has consequently impacted our reporting numbers and operator visits to check overflow operation. To date we have noted a 27% increase in EDM related visits to assess overflow operation and the potential for pollution, to address this we are using data collected from our network to provide advance warning of spill operation, i.e. ‘pre-spill’ notifications.

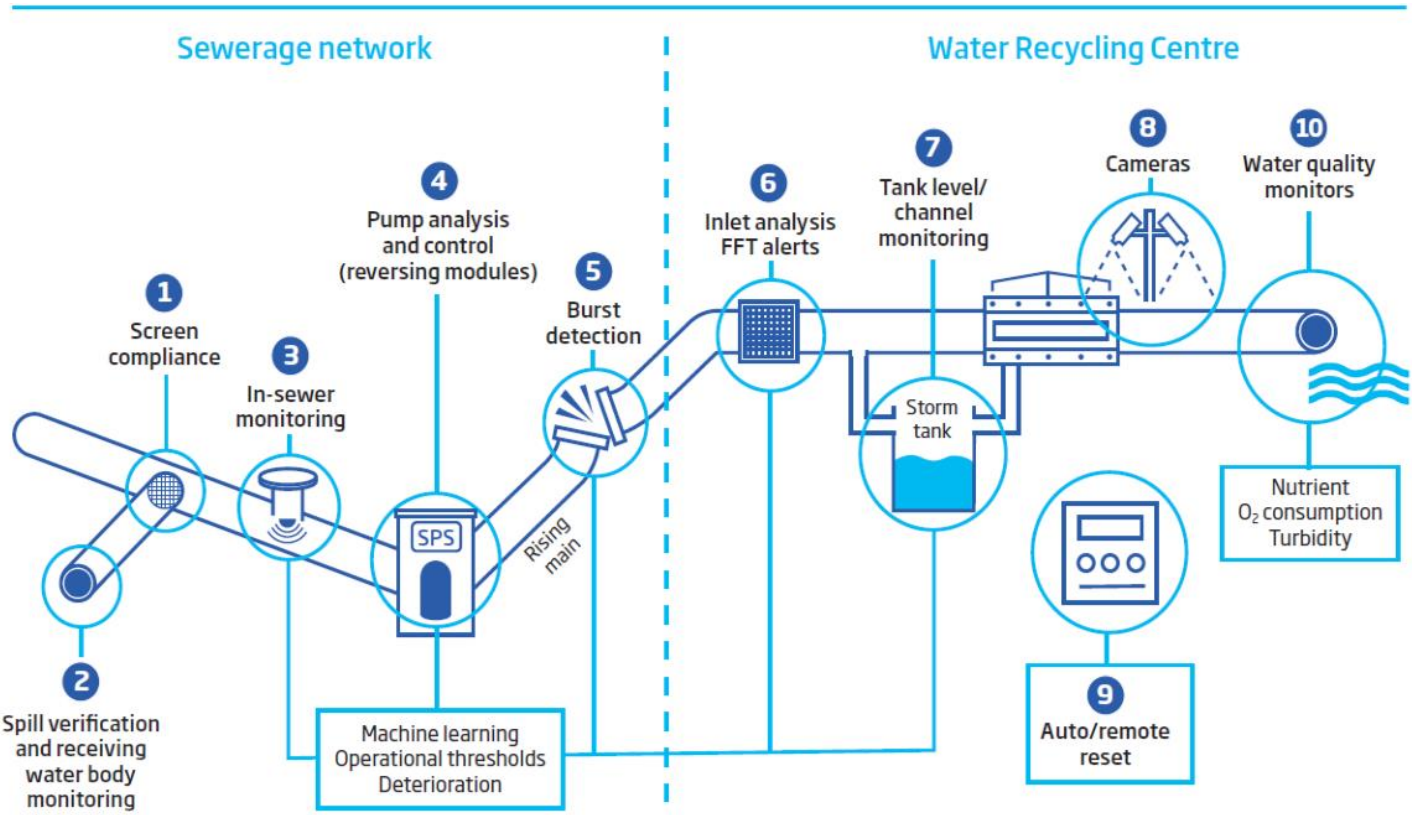
This approach will be taken even further through the development of three smart networks. Artificial Intelligence (AI) and enhanced analytics will be applied to the data from all of our assets in these areas, allowing us to tune our assets interaction, improving our operation, detecting issues earlier and direct maintenance interventions at the

optimal time. This will be complemented with a 24/7 waste monitoring and control team within the control room, allowing improved real time assessment of risk and interventions needed.

The Smart System approach is illustrated in Figure 23 below, highlighting the interaction between the sewerage network, WRC and receiving environment, with the key data or monitoring points numbered 1 - 10. The Westbury sewerage catchment will be our first Smart System trial in 2023-24 which will be progressed in two phases:

- The first phase will be combining all of the knowledge and innovations that we currently have in the Westbury catchment. This will show us the improvement we can gain by consistently applying the best available technologies to our existing data.
- In parallel, phase two will work with partner organisations to understand how they can help us close any data gaps we may have and advance our system further. We are currently working with Microsoft to develop a proof of concept to use their new (currently unreleased) data access and analytic engine 'Fabric' and Technolog on some of their new sensor technologies.

Figure 23 - Smart System Approach linking the sewerage network to the WRC and receiving environment



5.2.3. Commercial Engagement

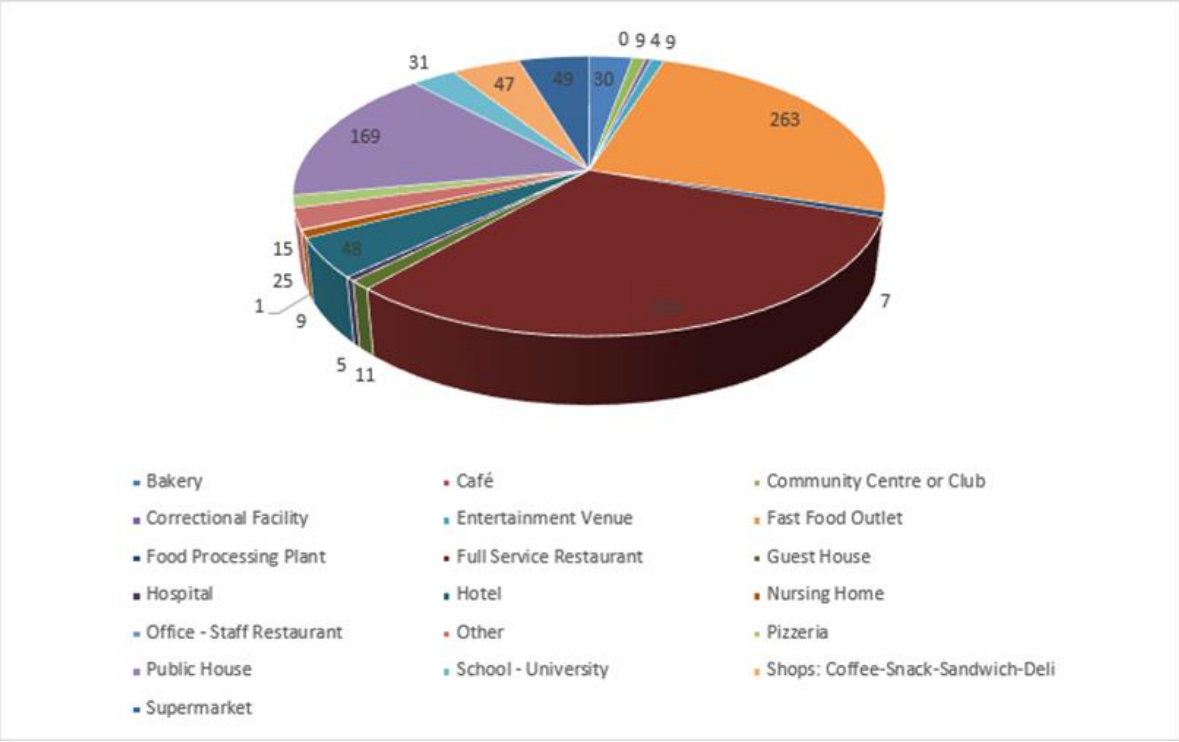
Since 2022 we have established a team within Wessex Water to focus on food establishments that have kitchen facilities on site, as a group these are referred to as food service establishments (FSE). We look to improve awareness and understanding of the impact fats, oils and greases (FOG) can have on their drains and on Wessex Water's sewerage network. The team have spent time visiting over 850 establishments to talk to the owners and operators about their potential impact of their operations on the network.

We have targeted areas in two ways:

- Whole towns where there are issues across the sewer catchment which ultimately build up at the Water Recycling Centre
- Specific locations identified through blockage clearance or inspections that show a build-up of FOG in the section of sewer. Information from blockages can pinpoint a list of possible food establishments to approach.

Figure 24 below highlights the types and numbers of commercial establishments currently included in our FOG programme. This will continue to grow throughout PR24 as we increase our coverage.

Figure 24 - Commercial Establishments included in the Commercial FOG engagement programme



Case Study: Commercial Engagement Officers (CEOs)

The commercial engagement team work with food service establishments (FSE) and other non-household customers to manage the disposal of fat, oils and grease. Their aim is to reduce blockages and asset failure which can result in detrimental environmental and customer impact. Working under the 4 “E”’s principles they:

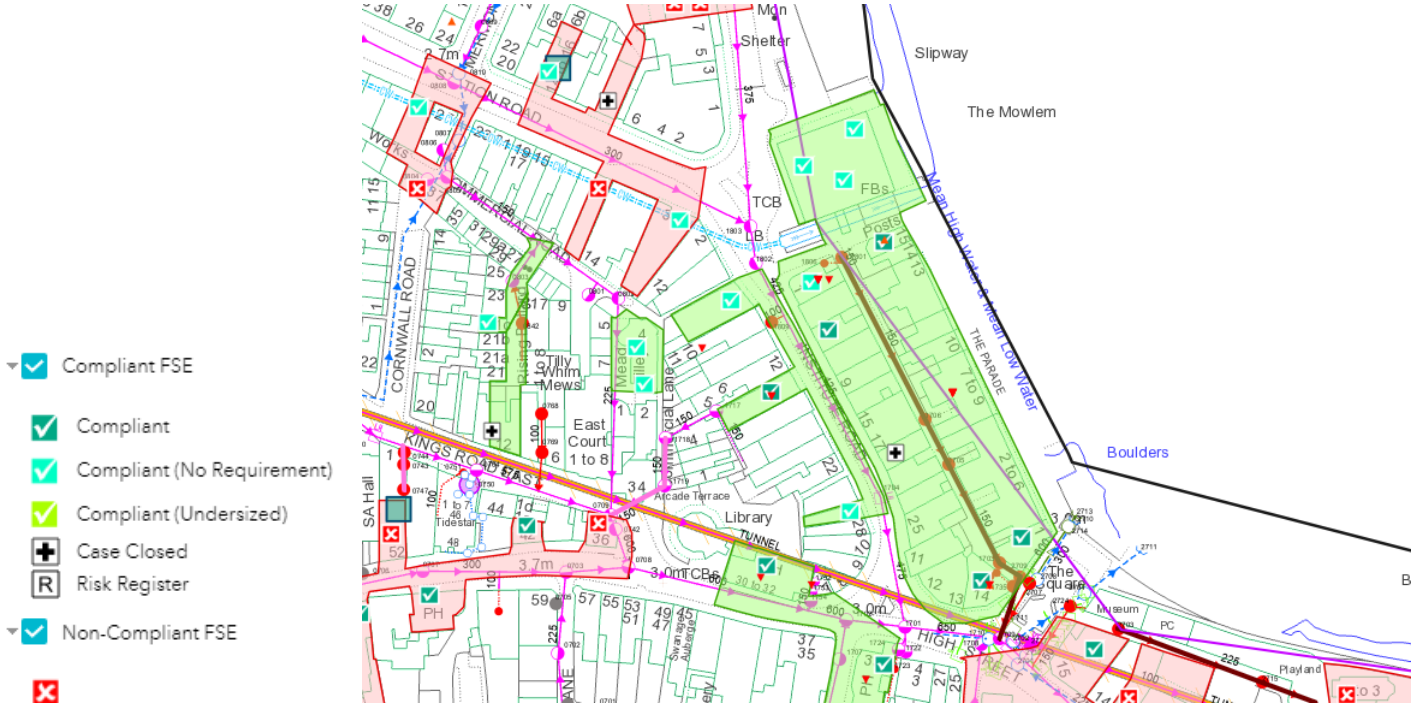
- Engage with food service establishments (FSE’s) and other non-household customers
- Educate regarding fats, oils & grease (FOG) damage and management
- Encourage best practice for correct disposal of FOG including installation of correctly sized grease trapping equipment
- Enforce where repeated breaches of Section 111 of sewer law, with aims to recover costs and prevent future misuse of the sewer.

Figure 25 - Manhole downstream of food service establishments (FSEs), with elevated FOG levels

This is usually done by visiting the FSE and inspecting their grease trap, while also enquiring how they dispose of the grease. The CEOs use an app called the Commercial FOG Targeting App to see which FSE are compliant, and which need monitoring and further intervention. FSE are organised into clusters, which enables monitoring of misuse caused incidents to be completed, and any incidents which occur attributed to one or a few FSEs. Clustering also allows the team to see if the engagement work being carried out is having a positive impact – i.e., from a reduction in blockage numbers within a cluster.

Example: The Parade, Swanage

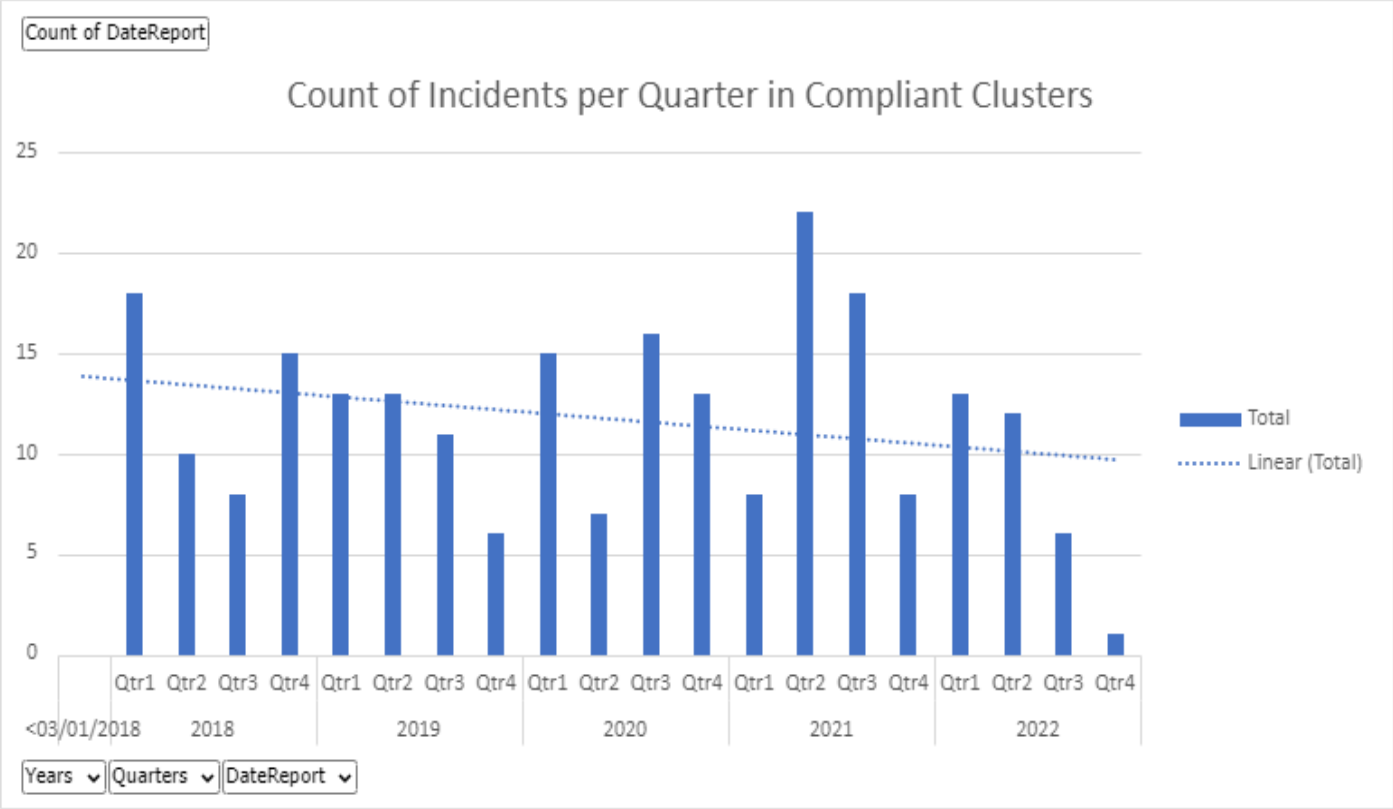
Figure 26 - Map highlighting compliant and non-compliant FSE on The Parade, Swanage



All FSEs within the Cluster on The Parade became compliant on 5/10/2021.

Prior to compliance, 11 incidents had occurred at the properties on The Parade in a 3-year period, 8 confirmed as cause by FOG, 3 attributed to an “unknown” cause. Since compliance was achieved here, there have been 3 recorded incidents. Two of these are attributed to residual FOG in the line from before compliance was achieved, the third was due to a rag blockage.

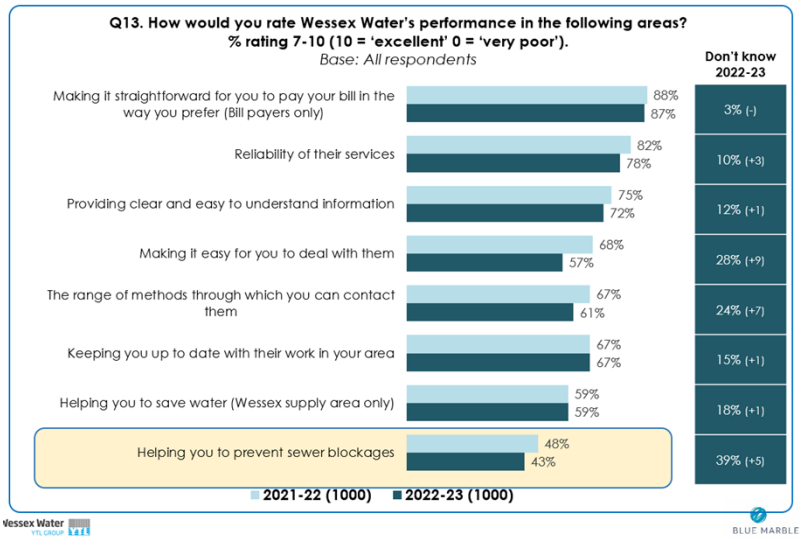
Figure 27 - Number of blockage incidents identified by Commercial Engagement Officers, 2018 - 2022



5.2.4. Household and community engagement

We deal with around 25,000 blockages a year that result from customer behaviours leading to items such as wet wipes, fat, oils and greases entering the sewer network, which is sometimes referred to as ‘sewer misuse’. Our strategy to reduce pollutions and sewer blockages therefore includes a comprehensive programme of customer engagement to encourage behavioural changes. Customer research tells us that many customers are not mindfully undertaking habits that they realise can cause blockages and there is sometimes confusion around wet wipe flushability, but there is also support for us to engage on the topic and help customers to prevent blockages.

Figure 28 - Customer tracker insight into how Wessex Water supports customers to prevent blockages



Our current baseline proactive engagement programme seeks to reach a wide proportion of our customer base as the behaviours that can result in sewer misuse are wide-ranging and may occur in households spanning across a variety of socio-economic and life stage segments. The programme includes:

- Social media promotions and seasonal campaigns – throughout the year our social media channels are used to inform and remind people about the effects of sewer misuse and most effective ways to avoid blockages. The sewer misuse posts are often top performing content – particularly on Facebook and on TikTok – where they received high levels of viewing, sharing and liking.

Figure 29 - Social media post examples

- Partner promotions supported by our social media ‘tool kit’. In 2023 we innovated this element by developing a social media toolkit which can be used by partners, such as local authorities, to share messaging on our behalf thereby extending the reach of our usual promotions. The toolkit went live in May 2023. In June 2023 there were 9 downloads of the ‘Stop the Block’ toolkit, and it was shared by both Bath and North East Somerset Council and Somerset Council. We will seek to engage more partners to support our messaging and campaigns with the toolkit over the coming months.

Figure 30 - Examples of social media toolkits

- Schools education – education officers met over 13,000 children and 400 adults in 2022, we have plans to extend this figure further and visit more schools and children’s groups. This opens up the opportunities to extend our customer’s knowledge of the water cycle and how we can all work together to protect our drains and sewers.

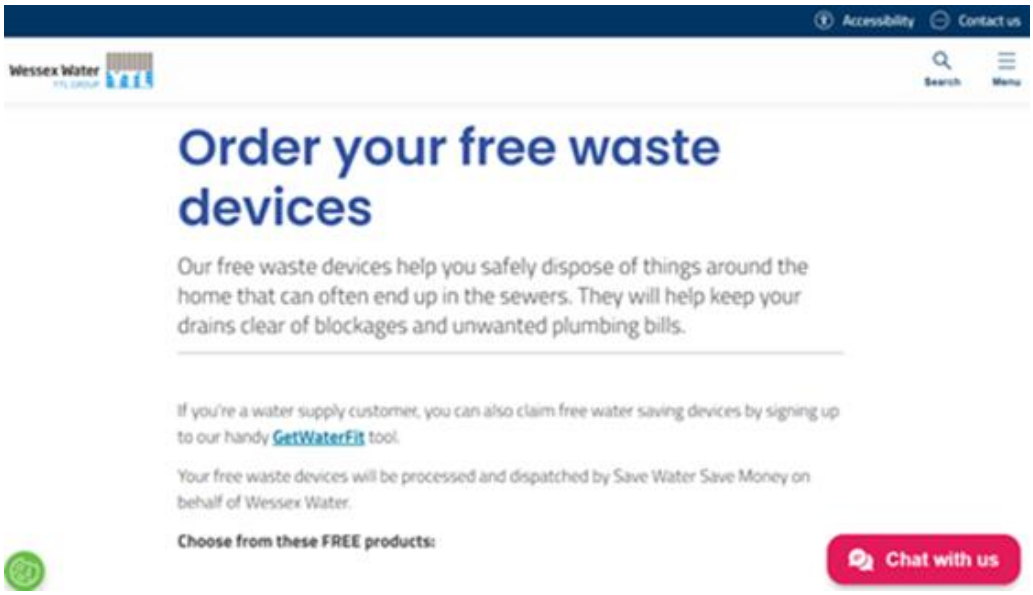
- Targeted engagement – engaging with students as they leave home and become more independent. We attend freshers' fair events in our region with bespoke publications and offer free blockage prevention packs to help with behaviour change. In addition to attendance at the freshers' events we run an online social media promotion in student areas which offers a link to order the free pack. In 2023 we met with over 500 students and 650 orders were made for the free pack.

Figure 31 - Bespoke leaflet for student engagement

- Events and open days – Around the Bend tours are where members of the public have guided access and tours of water recycling facilities. In 2023 we will be opening 21 water recycling centres across the region, for open days in September and October. In 2022 more than 1,000 customers attended the events at our water recycling centres where our operations colleagues provided a tour and explained each stage of the treatment process, we hope that by opening more sites across the region to increase this number in 2023 and in the future. We attend events throughout the year, such as the Taunton Flower Show and Corsham Eco fair, these events provide us with an opportunity to talk to our customers about the problem of sewer blockages and how we can work together to tackle these issues.

- Tailored community engagement – Community Connectors is a recent initiative, initially based in two of our region's towns, Chippenham and Bridport. Part of the programme is to involve customers in their local area through signage – such as QR codes on our assets – to share information with the community or visitors to the area. These signpost customers through a chatbot facility to advice and information including links to our free pack offer.

Figure 32 - Wessex Water web page for customers to order free pack (Order your free waste devices | Wessex Water)



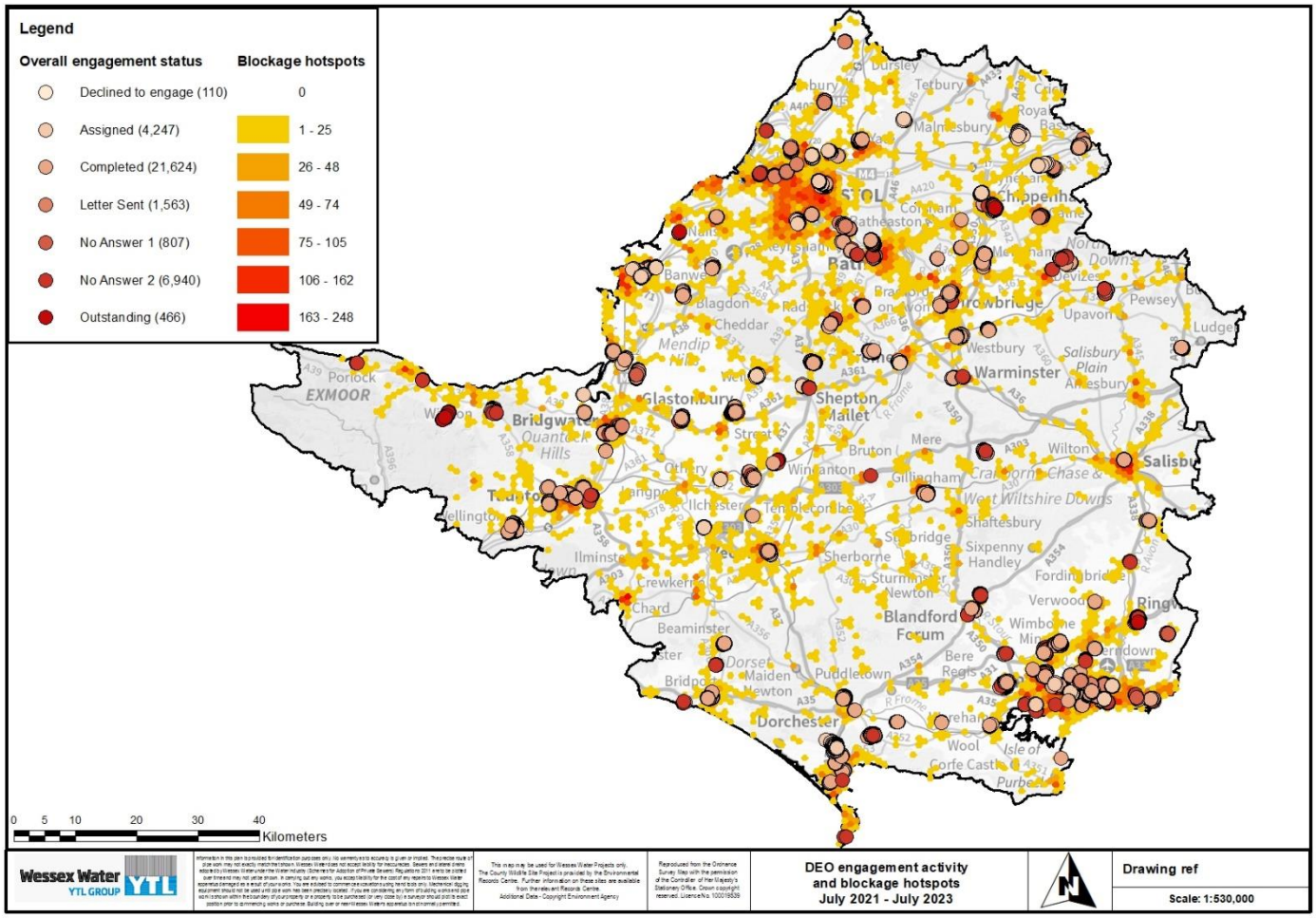
Our current reactive engagement programme makes use of continuous insight from operational blockage data to target engagement in communities experiencing 'blockage hotspots'. Activities include:

- Social media promotions of a free blockage prevention pack of products that encourages behavioural swaps to sewer friendly habits. The pack typically includes reusable face/make-up pads to reduce the number of disposable face wipes flushed away; a spray to moisten normal toilet paper for intimate care to reduce the likelihood of using disposable wet wipes for toileting; a 'gunk pot' to collect fats, oils and grease from cooking to cool before pouring into food waste bin; a plughole hair catcher to prevent hair and other bathing/showering debris from going down the plughole; and a sink strainer to prevent food scraps from washing down the kitchen plughole. We are one of the only companies to provide free blockage prevention products to customers. In 2022-23 our social media posts were viewed by over 190,000 people in blockage hotspot areas and over 13,000 households ordered packs.

- Our team of Domestic Engagement Officers (DEOs) attend households in blockage hotspot areas, knocking on doors and having face-to-face conversations on sewer friendly behaviours to help prevent blockages. They offer advice and hand out leaflets, so customers have a reminder of useful behavioural swaps and good disposal behaviours. The leaflet also includes details of how to order products in the blockage prevention pack. Prior to the DEOs attendance in an area, customers are sent a letter informing them that

the visit is due to take place. Since July 2021 we've had this direct doorstep engagement with over 21,000 households

Figure 33 - DEO engagement activity and blockage hotspots July '21 to July '23



- Due to launch in 2023-24 is our tiered household lettering programme. This data-led engagement approach will see the automation of letter mailings to blockage hotspot areas. Using GIS, the ten properties upstream from a blockage caused by misuse on the sewer network will receive a letter informing them of the recent blockage in their area and how their behaviours can help prevent future blockages. If a blockage reoccurs in the same location within a specified timescale, a subsequent letter is generated with an escalated message, further reoccurrence will result in a visit to the community by a DEO to carry out doorstep visits. Data and customer feedback will be used to fine-tune the process to evaluate the impact of the lettering and whether adjustments may be required, for example, to the number of properties upstream of each blockage that are lettered and the length of time considered when determining what constitutes a recurrent blockage.

Our future customer engagement programme will see a significant enhancement in activities and innovation in our approaches to enhance targeting and impact. Our proactive and reactive engagement programmes will be upscaled to reach more customers, more community hotspots, and more customer segments. New initiatives will include:

- Targeted engagement with the **care sector**: care homes and organisations that provide in-home care are recognised as a segment to engage with on wet wipe disposal practices linked to intimate client care. Through the vehicle of our Community Connectors programme we plan to co-create engagement materials

(e.g. leaflets, posters, training videos) on the ways to protect the sewer network through their behaviours in the homes of the people for whom they care. To maximise the benefits to customers and the environment of this engagement we'll also include information on our Priority Services Register and messaging on the safe disposal of pharmaceuticals. During the Chippenham Community Connectors programme the materials will be developed, tested and refined and if successful will become part of our standard portfolio of sewer misuse engagement activities.

- Targeted engagement with the **tourism sector**: people's behaviours on holiday are not always the same as when they are at home. Holiday accommodation premises including hotels, guest houses, B&Bs and independent lettings can sometimes suffer the inconvenience of sewer blockages. We will develop information and unbranded signage for display in accommodation to engage holiday-makers about how to keep sewers free from blockages. The materials will be developed and tested as part of the Bridport Community Connectors pilot and refined for wider roll out if successful.

- Enhancing our approach to the evaluation of our various blockage reduction customer initiatives is also a future focus area for us. We are particularly keen to evaluate the longevity of customer behavioural change encouraged by our free blockage prevention packs. In 2022-23 we are collaborating in CCW's industry Task and Finish Group to share findings and undertake engagement pilot projects. A growth in our capacity and capability for data analysis will also support future behavioural hypothesis testing and engagement evaluation.

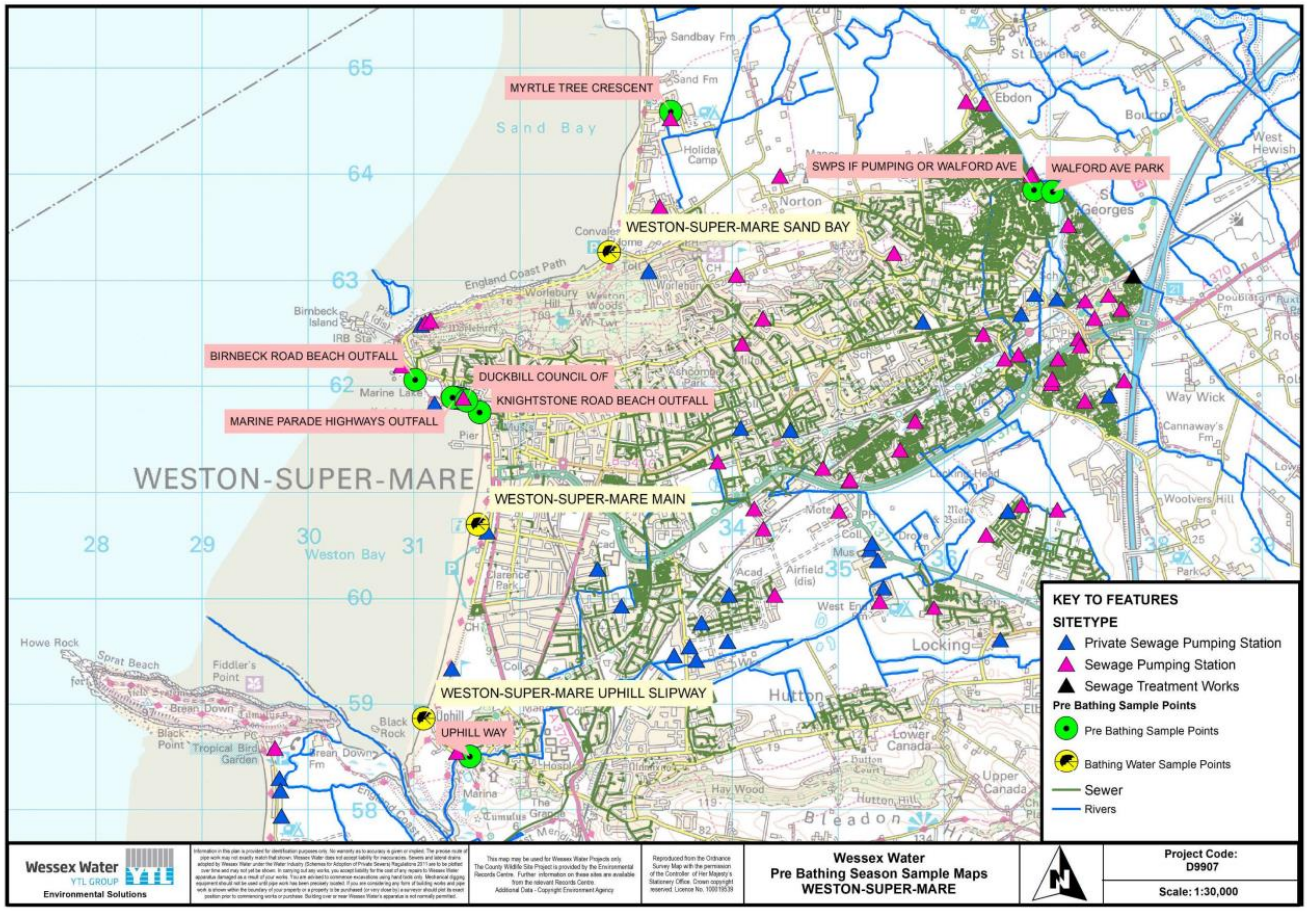
Stream Clean

We have been running our Stream Clean initiative for over a decade, engaging with homeowners to identify misconnected sewers to the surface water system. The project was originally co-delivered with Bristol City Council but is now entirely run by Wessex Water.

The team tends to focus on locations near designated Bathing Waters or sensitive sites where foul sewage can cause an environmental or human health impact. The team investigates surface water sewers during dry weather to trace where flows may originate and collecting water quality and litter samples to help identify the source and potential contaminants. The team have been instrumental in assisting with AMP7 Bathing Water investigations and pollution events. We are also looking for alternative ways to identify sources of misconnections and are proposing a pilot project to recruit a pollution reduction detection dog. Further details can be found in WSX17 (Section A6-1.2.2).

Figure 34 below illustrates the Stream Clean sampling points which were included in the AMP7 Bathing Water Ambition Investigations at Weston Super Mare and Sand Bay. Sample data from these locations was analysed over a five-year period from 2018 to 2022 to understand the level of influence misconnections may have on Bathing Water quality.

Figure 34 - Weston-Super-Mare Sand Bay, Main and Uphill Slipway Bathing Waters – Pre bathing season sample locations



The following locations had a high-risk rating in 2021 and required further investigation in 2022.

- Trinity Way, Minehead (not shown in Figure 34 above) was rated ‘high risk’ in 2018, 2019 and 2020, this was investigated but unresolved for a couple of years then a misconnection identified and resolved in 2020. No sample could be taken in 2021 as there was no flow, this location was prioritised for sampling in 2022 and found to be ‘no risk’.

- Uphill Way, Weston had a ‘high’ risk rating in 2018 and 2020 but ‘no risk’ in 2019 and 2021. This location was prioritised for sampling in 2022 and found to be ‘low risk’. This location will be prioritised for sampling in 2023. This sample location is frequented by ducks and the water is held back so fairly stagnant. Stream Clean haven’t identified any issues here other than a private blockage in 2021 which was going into a road gulley, this was resolved prior to the sampling.

In 2022 there was one sample location allocated high risk and all others were no risk, low risk or no sample taken (dry);

- Duckbill Council outfall, Weston super Mare, was added to the routine sample locations for pre-season sampling in 2022 and will be sampled annually going forwards. This location had elevated E.Coli and IE results, this was reported to North Somerset and Weston Council to investigate as Wessex Water have limited information on this discharge as it is Council owned. This will be prioritised for sampling in 2023.

Over and above the delivery of Bathing Water investigations, the Stream Clean team have created a programme of investigation for surface water outfalls; these can be identified by operating when it’s dry or show signs of misconnection, i.e., a smell of detergent, have large amount of very white foam or sanitary products on an ongoing

basis. The team routinely identifies a significant number of misconnections to be addressed, for example blocks of student accommodation near Bristol Floating Harbour. The managing agents were served with a misconnection notice. The work to remedy the misconnection was completed with confirmation of the number of assets misconnected within the accommodation block was 231 units each including toilets, basin, and shower plus 175 kitchen sinks.

We have continued to be very successful in identifying these cases of misconnection and tracing third party sources of pollutions into the Wessex Water sewers. This allows Stream Clean to maintain a short list of sites that have been identified and deal with these issues swiftly once they have been identified. The process also includes return visits to check the owner has rectified the problems and no other sources in the area have been identified before we can confirm the surface water line has returned to normal operations.

The future for our Stream Clean team comes in two forms:

- More and more of our own teams and the public are spotting where misconnections have happened, and the team will continue to keep delivering a swift and effective response.
- Some proactive checking of surface water sewers particularly near bathing water areas, even if there is no visible evidence of anything untoward entering the surface water sewer.

Water Guardians

The Water Guardians project recruits and trains local volunteers to monitor watercourses, identify possible pollution incidents and report them to us for further investigation.

Water Guardians are our additional eyes and ears on the ground, playing an integral role in protecting the health of their local rivers. As well as monitoring pollution to improve water quality, volunteers could also help by litter-picking, recording wildlife or organising local engagement events. Water Guardians help to assess and improve the condition of rivers, improve habitats for wildlife and create more natural solutions for flood alleviation.

Figure 35 - Our Water Guardians poster

The project is now in its third year and is in partnership with Somerset, Wiltshire, and Dorset Wildlife Trusts and is currently onboarding Bristol Avon River Trust (BART). Volunteers have training in ‘What is a Pollution?’ and how to

identify and report to the business. We also commit to give feedback on anything raised, including passing any reported pollution to the correct owner if it is not our asset or deemed our responsibility.

We currently have 173 volunteers across Dorset, Somerset and Wiltshire, holding 36 training events and to date 14 Wessex Water pollution incidents have been identified, investigated and resolved.

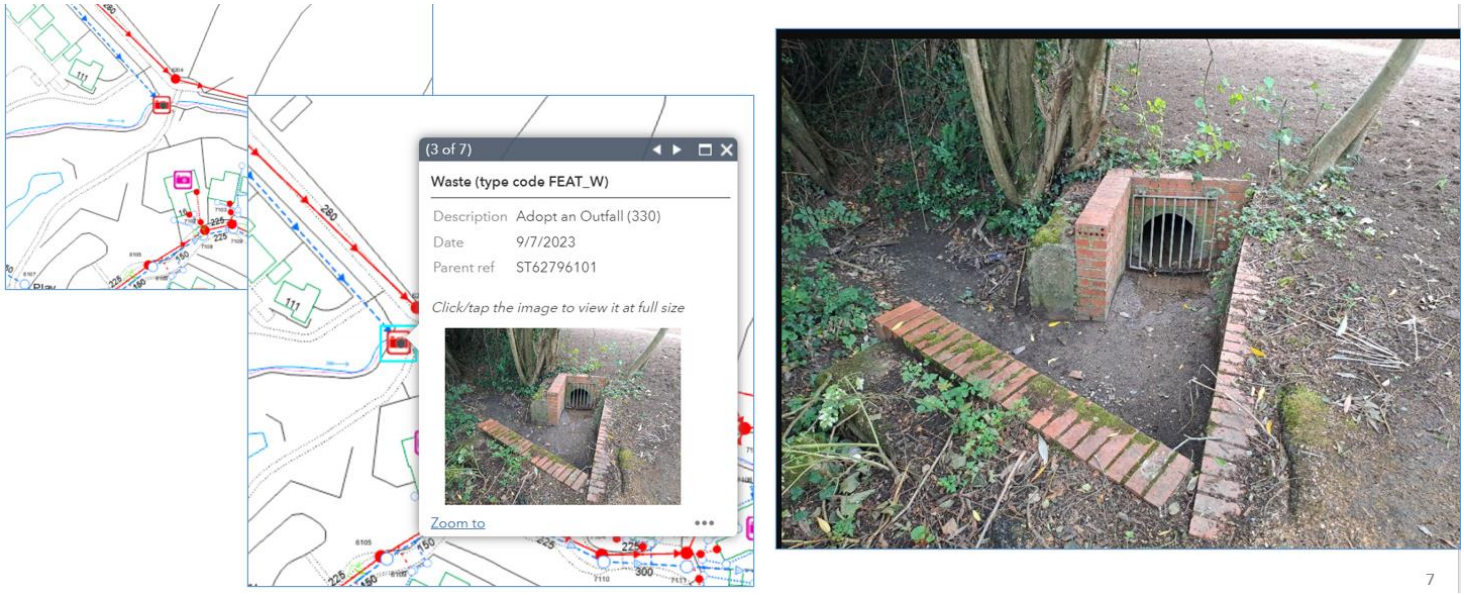
We plan to continue and grow this project in PR24 linking to wider citizen science approaches and working with other interest groups.

Adopt an Outfall

This initiative is currently being rolled out for Wessex Water employees only but will be expanded more widely in PR24 alongside our wider citizen science projects.

Wessex Water colleagues are invited to sign up for our new app to help improve the amount and quality of data we hold about our 10,647 outfalls across our region. To help collect as much data as possible, volunteers aim to look at their outfalls around once a week and record the data in an app, including anything unusual and take a photograph which will then be analysed, recorded and if necessary passed on for investigation. The photos are stored on our image bank associated with our sewerage maps, as illustrated in Figure 36 below.

Figure 36 - Adopt an Outfall data record



By August 2023, this initiative had delivered:

- 404 employees signed up and adopted at least one outfall
- 505 outfalls adopted, including surface water and private outfalls
- 692 surveys undertaken
- 152 issues identified and investigated by Sewerage Crews, of which 12 led to further action

5.2.5. National Campaigns

Water UK have two initiatives aimed at preventing blockages caused by misuse. The ‘fine to flush’ labelling system incentivises manufacturers to modify their products so they break down more quickly in sewers. In 2019 Water UK published a Water Industry Standard (WIS) defining the criteria for a wet wipe to be fully flushable. Products which pass the test get approved by Water UK and can display the fine to flush logo on their packaging.

Figure 37 - Image of 'fine to flush' logo.

Developments since 2019 have resulted in over 140 products now being certified under this scheme with some major retailers only stocking 'fine to flush' wet wipe products, and endorsement by the Marine Conservation Society. The caveat on this scheme is that it is based on customers using and flushing only one wet wipe at a time and does not include any other type of product which may be flushed (eg sanitary wear).Water UK are aware of these issues and are investigating different options on the future of this scheme.

The second initiative being actively promoted by Water UK is their 'Bin the Wipe' https://www.binthewipe.org/ campaign which is designed to change behaviour by influencing customers through education and information: *We're not telling everyone to stop using wipes. Water UK is just asking for one simple change of habit: When you use a wet wipe, put it in the bin, not down the loo*.

Figure 38 - Water UK Bin the Wipe print asset

This scheme is replicated by water companies across the country with different images and some wording change, Wessex Water uses 'Stop the Block'.

Wessex Water is an active participant in National forums. Extensive lobbying through the Sewer Network Abuse Prevention (SNAP) group and National Protection Forum (NPF) made up of representatives from all water companies, have resulted in involvement in behaviour change pilots being shared across the industry. Wessex are part of UK Water Industry Research Ltd (UKWIR) and Consumer Council for Water (CCW) behaviour change research into the use of, and disposal of, wet wipes across different demographics and customer sectors. We are keen to see future Government strategy and policy on single use plastic legislation. The current single use plastics ban does not include wet wipes, but this is due to change following a consultation exercise in 2021 when 96% of respondents were in favour of such a ban, however, there has been no confirmation of this yet.

The NPF are working with the Water Research Centre (WRc) to produce a new standard for grease traps that updates the existing standard that was written in the 1960s. This will focus on food establishments and users of commercial dishwashers to reflect the modern use of food oils and kitchen practises.

5.2.6. Cellular services resilience

Following the private pumping stations for adoption in 2016, on adoption Wessex Water installed monitoring technology. The monitoring solutions available at the time used cellular technology that was only available with

access to the 2G and 3G networks. These networks are being retired with the retirement of 3G already underway and 2G due in 2033. There is a need to update the technology to monitor Private Sewer Pumping Stations (PSPS) to supported communications technology. Our asset records show that we have around 430 devices that use 2G and 3G cellular networks monitoring PSPS. The technology installed from 2016 following the adoption of these stations is currently operating well and providing qualitative information on pumping station operation.

We are proposing a programme of change to meet the 2033 deadline for the end of 2G services. We are expecting the current devices to fall back to 2G operation as the 3G network gets shut down. This enables investment to span AMP8 and AMP9.

The cost to deliver this programme is £0.66m. Around 80% of this programme will be delivered in AMP8 and the remaining 20% in AMP9. Further details of this can be found in WSX17 A4-1.4.

5.2.7. Robust and Efficient Costs

The activities outlined in this section have been costed primarily based on experiences during AMP7 and through the development and ongoing delivery of our PIRP, including the following actions:

- Proactive investigation and rehabilitation (350km CCTV, 30km rehab)
- Enhanced customer engagement – domestic and commercial (1152 FSEs managed, 5% of FSEs)
- SPS performance analysis and optimisation
- Sewerage Incident Assessments (SIAs) & Make It Right (MIR)
- Network monitoring (Storm Harvester, EDM monitors, monitor trial)
- Water guardian programme

These are actively managed and budgeted programmes where the costings have informed continuation or extension of work required in AMP8. Costs have been developed using the following mechanisms:

- Bottom up costing of interventions based on work undertaken in AMP7
- Commercially tendered work
- Marketplace challenge around smart monitoring
- Modelling and extrapolation of the effectiveness of solutions to inform activity levels to achieve target levels in AMP8

All data tables and costings, including those associated with the two relevant pollutions performance commitments have been externally audited by Mott MacDonald. The following activities will be undertaken in AMP8 to reduce pollution incidents in line with our longer term target of zero pollution incidents by 2050:

Table 14 - Pollution reduction activities

Asset Type	Activity	AMP8 Totex (£m)	Related PC
Sewerage	Enhanced investigations	1.63	Total Pollutions
	Pollution focussed inspection and rehab	15.21	
	Pollution focussed maintenance	7.06	
	Customer engagement	2.88	
SPS	Performance management and optimisation	2.93	

WRC	Trade effluent permit compliance	6.25	
	Additional jetting of WRC inlet works and pipework	7.06	
	Tactical interventions	10.87	
Sewerage	Smart networks (12,000 monitors)	41.70	Serious Pollutions
	Proactive CCTV near watercourses	5.43	
TOTAL		**101.03**	

5.2.8. Customer Protection

The details described in the preceding sections covering the Pollution Incident Reduction Plan and engagement plans are the delivery mechanisms to achieve the relevant Performance Commitments, Environmental Performance Assessment and our longer term target of zero pollution incidents by 2050. More detail of the PCs is found WSX47, and summarised below.

Our research (WSX04 – 3.7 and 3.7) has shown that customers are increasingly aware of the environmental impact of sewage and expect their water company to cause minimal negative environmental damage, including not dumping waste into rivers and seas. Customers hear about this in the news, which strengthens expectations that this will be a standard water companies have to meet. They are increasingly aware of how they behaviours can also have an impact on the operation of the sewerage system through blockages caused by wet wipes for example.

Customers are more willing to invest to reduce or resolve wastewater issues, the highest percentage of customers wanted to increase investment now to 2030 rather than increase slowly between now and 2040 or 2050 for example. There is evidence that significant proportions of customers are willing to pay increased bills to support investments that reduce the operation of storm overflows and improve river and coastal water quality.

Total Pollutions

This includes category 1, 2 and 3 pollution incidents from sewerage infrastructure, pumping stations, WRC and sludge/biosolids incidents. It includes incidents caused by hydraulic overload (eg flooding and storm overflows operating outside permit conditions or due to overland rainfall induced pollution) and other causes (i.e., blockages, collapses and equipment failure).

Our long-term target is to have zero pollutions by 2050 – further detail is contained in WSX03 (Long Term Delivery Strategy).

Serious Pollutions

This is a subset of the total pollutions metric described above. Serious pollutions are those categorised by the EA as cat 1 or cat 2, and lead to fish kill or other high impact consequences.

Historically we have about 4 serious pollutions per year. Our short term target is to reduce this significantly, but a target of zero by 2030 is probably not realistic due to the scale of our assets and current lack of smart network monitoring information. We have set ourselves a target of 1 serious pollution per year by 2030.

5.3. Flooding

Flooding is one of the worst service failures a water company can have, leading to distressing damage, both physically and emotionally. The PC is the number of internal sewer flooding incidents (i.e. inside customers' homes or commercial buildings) normalised per sewer length.

Internal flooding is any sewer flooding (that the water company is responsible for) that escapes into an occupied building - from any cause (hydraulic, blockage, collapse, severe weather etc.). It excludes non-sewer related flooding such as from privately owned sewerage, fluvial, pluvial (except where linked to the incapacity of a sewer), land drainage, highway drainage and private drains.

Wessex Water has very low numbers of internal flooding compared to the industry, making us upper quartile in this metric.

External flooding is any escape of sewage within a property boundary regardless of reason (hydraulic or other cause) or severity of rainfall. The PC is the number of external sewer flooding incidents (ie within garden or property boundary) normalised per sewer length. Similar to internal flooding, it excludes non-sewer related flooding such as privately owned sewerage, fluvial, pluvial (except where linked to the incapacity of a sewer), land drainage, highway drainage and private drains.

Wessex Water are about average performance for external flooding compared to other WaSCs.

Most flooding incidents are caused by inappropriate materials being flushed down toilets (for example wet wipes) and put down sinks (fats and oils) which cause blockages. We will continue our targeted campaigns to promote customers only flushing 3-Ps (pee, poo and toilet paper) as well as other local campaigns, such as Bag it and Bin it leaflets and social media footage. We also are exploring innovative techniques to apply a superhydrophobic sewer coating to assist with the mobilisation of fats, oils and grease. Further details can be found in WSX17 (A6-1.2.8).

5.3.1. Hydraulic sewer flooding

This section discusses hydraulic sewer flooding, which is when flooding occurs because too much rainfall is entering the system which overwhelms the hydraulic capacity of the sewerage assets (pipes or pumping stations).

It is expected that our sewers are under pressures of increased rainfall intensities due to climate change, growth which will see new developments being built and urban creep of existing properties (eg increase in impervious areas causing more runoff).

With climate change we will see increased rainfall intensities. Our predictions of the PR19 hydraulic flooding risk metric 'Population in a storm' performance committment, suggests the number of properties at risk will increase by 42% by 2050, if climate change occurs as modelled and if not addressed. It will be very expensive to solve all hydraulic flood risks.

Growth has a less dramatic affect than climate change on the amount of flow, hence a much lower increase in flood risk. However, we have a duty to expand our networks, so we implement schemes to mitigate against significant development, so there is not an increase in the current flood risk post development.

Urban creep is probably going to worsen, as more customers turn front gardens into parking spaces to charge their electric cars. Planning permission for this is normally required, but is not currently policed. We should encourage the councils to enact this to prevent extra runoff entering our sewers.

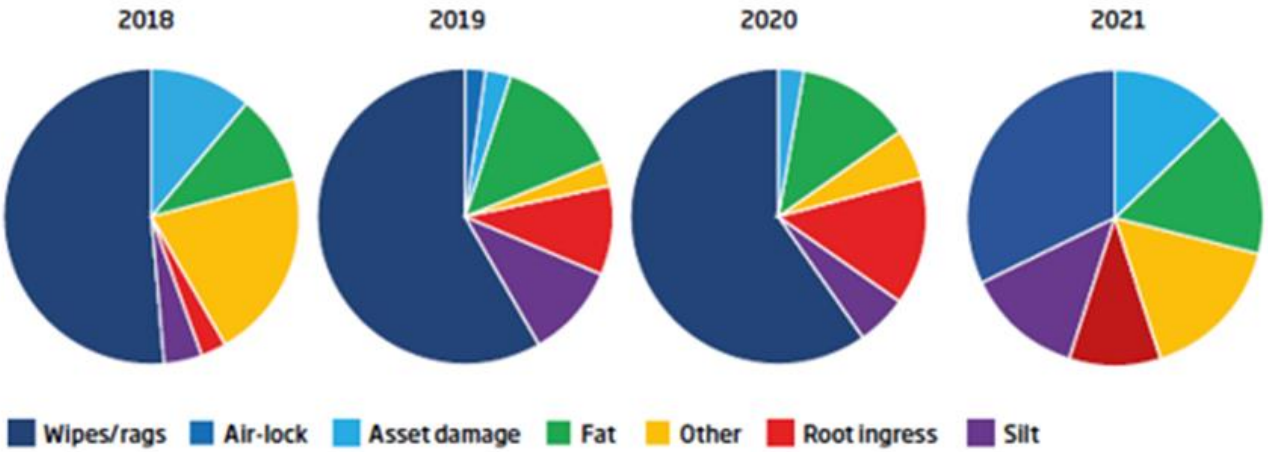
Our DWMP investigated sewer flood risk in detail. We developed options for over 1,000 locations predicted to be at risk of hydraulic sewer flooding. To solve those flood risks would cost around a billion pounds.

Our core plan has slightly more investment than we have historically had for hydraulic flooding. We have an adaptive pathway should we decide, or be required, to make a significant step change in flood risk reduction.

5.3.2. Flooding other causes

Most (c90%) flooding incidents are caused by other causes (not hydraulic). Most (c60%) of these are caused by inappropriate materials being flushed down toilets (for example wet wipes) or being put down sinks (fats and oils) which cause blockages. Statistics of the root cause of flooding from recent years are provided in the figure below.

Figure 39 - Root cause of sewer flooding



To address the main cause (wet wipes) we are trying to influence government to either ban wet-wipes or make it illegal to promote them as being flushable. If wet wipes didn't exist, then we think we would see a reduction of 3,000 incidents per year and would reduce our base expenditure by £10m per year. We have applied an adaptive pathway in our LTDS to reflect this outcome.

We need to continue our targeted campaigns to promote customers only flushing 3-Ps (pee, poo and toilet paper) as well as other local campaigns, such as Bag it and Bin it leaflets and social media footage, as our videos are promoting, but we need to do more of it.

We are also proposing to install in-sewer monitors to become informed of partial blockages in our network, so we can deal with them before they become full blockages and affect our customer or the environment. These in-sewer monitors combined with our EDM will start turning our network into a smart network. We have trialled such innovation using Storm Harvester, as detailed in section 7.7.3. Further details of how we are applying innovative alarm intelligence to assist with decision making can be found in WSX17 A6-1.1.1.

5.3.3. Partnership Working

For partnership working, please see section 8.

5.4. Growth

Our core duties as a water and sewerage undertaker include:

- allowing new development to connect to our wastewater network (see section 5.4.1)
- draining our area by providing, improving and extending a system of public sewers (see section 5.4.2)
- extending our non-infrastructure, such as WRCs, to ensure that the load from new development can be treated without impacting on the environment (see section 6.1)
- expanding our network to connect private properties for the first time if they are causing pollution and a scheme is viable (see section 5.4.4).

Our forecasts projections of development (growth) are made by a dedicated team in Wessex Water. This team informs both the WRMP and the DWMP for short, medium and long-term planning, so the plans are aligned.

5.4.1. Need for growth (development) investment

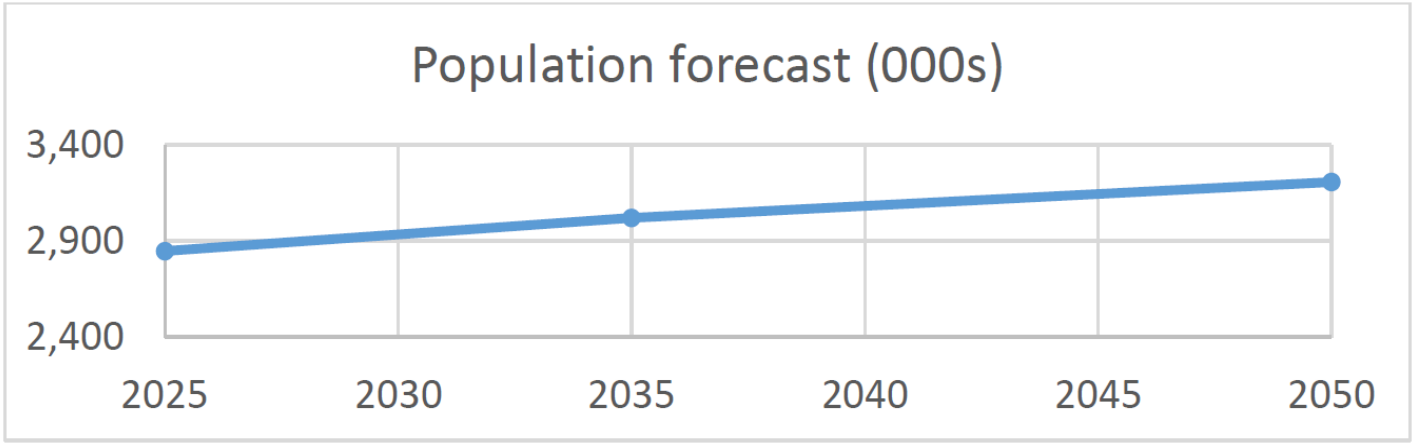
Water companies have a duty to expand our sewerage network and WRCs to accommodate development. The main requirement is sewerage network reinforcement to enable specific housing developments to meet the requirements of an increased population without a deterioration in performance.

Developers' right to connect makes sewerage companies vulnerable to assets becoming overloaded. The developer can connect a pipe of equal size to the existing public sewer. If unmanaged this creates a hydraulic issue and an increased risk of flooding on the downstream sewer. Ultimately, we need to identify and programme schemes required for network reinforcement, delivering capacity improvements to match the rate of development maintaining service standards and ensuring compliance with consents.

The Wessex Water region is mostly covered by 9 Unitary Authorities (recently Somerset become a unitary authority, and before that Bournemouth, Christchurch and Poole became a unitary authority). Each of these councils Local Planning Authority publishes adopted Local Plans. These include projections of development for 15 years ahead, estimating prescribed housing requirements and employment areas with allocations to deliver new homes and employment. We use this Local Plan data and also the ONS projections.

Demand projections for supply and wastewater are based upon the best available information. The following figure shows our expected population increase over the next 25 years.

Figure 40 - Population growth forecast



Planning policy ensures that larger allocations are directed at Towns and Cities with limited growth in rural countryside. Wessex Water engages with spatial planners through the plan making process, and we advise upon capacity requirements and constraints where necessary.

We can advise upon delay to Local Plan updates where there has been a pause in the process owing to the pandemic period and government intervention in the planning system. There are also transitional arrangements where newly appointed Unitary Authorities of Somerset, Bournemouth, Christchurch and Poole (BCP) and Dorset Council prepare for a Local Plan Review. The West of England Combined Authority has prepared a Joint Spatial Plan for the greater Bristol Housing Market Area, however this has now been withdrawn following a rejection at examination. Revised plans will be prepared and programmed for summer 2023 by Local Planning Authorities.

All planning authorities have adopted plans within the Wessex Water region, and most are undertaking Local Plan Reviews to carry forward a 15-year planning horizon to 2036. Beyond this point it becomes appropriate to apply proportionate growth to demand projections using long term averages from ONS projections.

Strategic housing allocations from these adopted Local Plans are provided in the document WSX17 section A5.

Our Planning Liaison team provides advice on both Local Plans and associated Statutory Development plan documents whilst responding to development management applications for major development. Mapping new sites onto GIS based software, allows catchment-based growth to be quantified by site location with annual build rates and phasing arrangements. This provides a current picture of development for business planning.

Demand in housebuilding is predicted to slow though 2023 reflecting the steady rise of interest rates and mortgage availability. In addition, the recent policy decision to withdraw housing targets from the planning system to protect the green belt, will also influence supply and housing delivery over the short term. The housing market will suffer from these events and the supply deficit will grow further with recovery likely to occur beyond 2025.

During the intervening period from adoption, these allocations have been subject to variation in the face of public opposition to the scale of development. Local Plan Reviews will be reporting over the next few years to confirm future development allocations.

Reformation of the charging rules introduced by Ofwat to improve competition and market operation continues with a number of changes for PR24. Site specific wastewater developer services will be removed from price controls. D-Mex will continue to ensure and improve service quality. Ofwat propose to review the need for any changes to charging rules where incumbents provide site specific services from 2025 onwards. We no longer receive income from developers at scheme level, but we receive the infrastructure charge for each new property. We balance the infrastructure charge with the schemes we deliver.

New Appointments and Variations (NAV) are becoming well established within the market and will increase as new sites come forward. We remain active as the wholesale supplier and the retail operations move to the new appointee as retail provider.

We have a rolling capital programme for investment using a phased approach where necessary to expand our system to accommodate growth and maintain standards of service and compliance.

Enactment of Schedule 3 will ensure future new developments are served by sustainable drainage.

Development is also affected by nutrient neutrality as described in section 6.2.1.

5.4.2. Growth investigations and options

New development can have a significant impact on our wastewater assets. Developers have a right to connect and we have a duty to expand our network to accommodate growth. The location of the development is critical in assessing the impact as development sites are normally located far away from WRC, so will connect into existing smaller sewers that may need reinforcing.

Therefore, we have a policy that all new development should provide separate systems of drainage. All surface water runoff should be sustainably drained and discharging attenuated flow to ground, watercourses or a public surface water sewer.

Our Planning Liaison team provides advice on both Local Plans and associated Statutory Development plan documents whilst responding to development management applications for major development. Mapping new sites onto GIS based software allows catchment-based growth to be quantified by site location with annual build rates and phasing arrangements. This provides a current picture of development for business planning.

These forecasts of development fed in to the DWMP computer modelling work. Development is predicted to make flooding 1% worse in the future. This is small compared to climate change.

Our engineering team are called to investigate the impact of any development that may cause some detriment to the existing system. This is undertaken for larger and medium sized developments upstream of storm overflows or known flooding locations, using our detailed hydraulic computer models.

Similar to storm overflow investigations (see section 5.1.2) this computer modelling determines the baseline performance and any deterioration post development. Then the computer network model can be used to test which options will maintain the existing status quo. Often oversizing the new sewers (section 98) which need to be laid to connect the development site to the existing sewerage system is sufficient to 'balance' flows.

The appraisals identified the need for off-site improvements to service the planned development and maintain the current level of flood risk. Works identified comprised new sewers, reinforcement or upsizing of sewers, provision of local attenuation tanks, new pumping stations and even a new treatment works. A summary of the outcome of these appraisals is provided in Table 15.

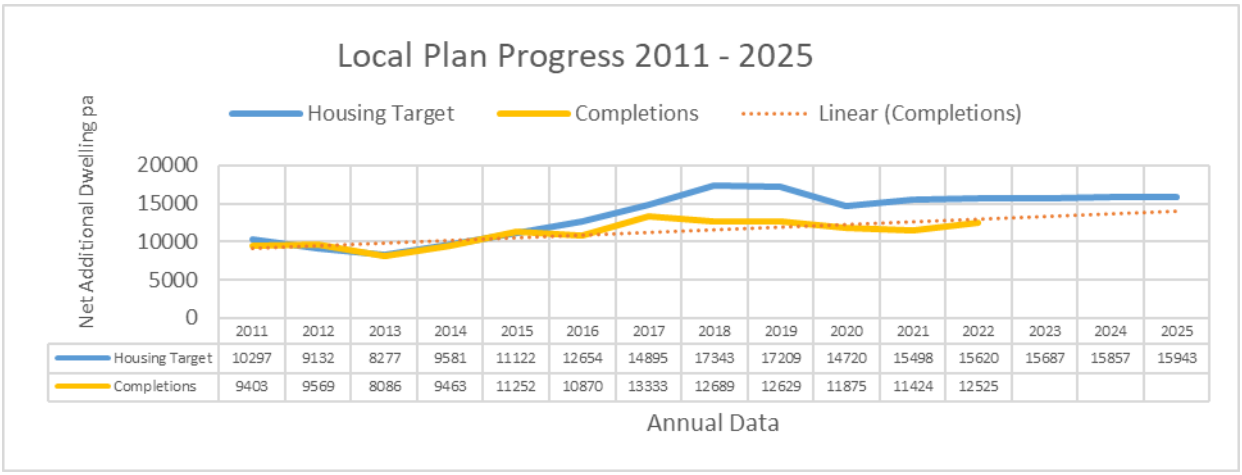
We determine the optimum design for the network reinforcement to service new development. We use drainage area sewerage models to assess the required reinforcement. We also enforce the use of sustainable drainage systems (SuDS) in applications where they are effective and reasonable cost.

Our strong links with planning authorities, developers and other key parties in the development sectors have helped us understand the short to medium term needs. The outputs from these relationships, in addition to in-depth assessments and modelling of key areas, have helped us to build a picture of investment needs going forward to 2030 and beyond.

5.4.3. Scale and cost of AMP8 growth programme

Figure 41 indicates the progress of housebuilding completions across the Wessex Water region against the housing targets provided from Local Plans between 2011 – 2025. A trend line generated beyond 2022 indicates increasing market capacity. However, the most recent trends reported by national housebuilders indicate a downturn in site reservations and completions affecting the market. These reflect the current economic circumstances of rising interest rates and inflation pressures on household income. Housing delivery will suffer from these conditions and the supply deficit will grow further with recovery likely to occur beyond 2025. We have therefore assumed a low build out rate.

Figure 41 - New development 2011 to 2025



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Housing Target	10297	9132	8277	9581	11122	12654	14895	17343	17209	14720	15498	15620	15687	15857	15943
Completions	9403	9569	8086	9463	11252	10870	13333	12689	12629	11875	11424	12525			

The following table summarises the defined schemes (most of which have already started or are gearing up to) and defined contingent schemes (have a probability of happening in AMP8), along with costs which are weighted by the likelihood probability. The costs are not bottom up at this stage but are based on similar sized recent development schemes.

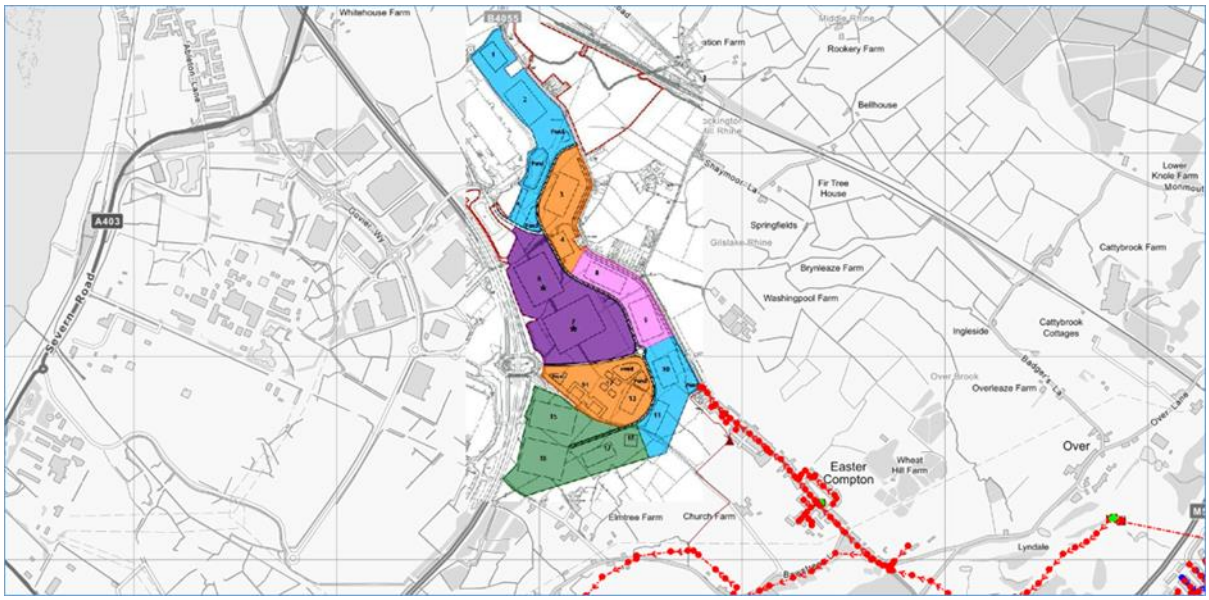
Table 15 –Network development schemes

Catchment	Likelihood	Scheme cost adjusted for likelihood (£m)
Avonmouth	Defined (100%)	4.4
Warminster	Defined (100%)	0.5
Salisbury	Defined (100%)	1.1
North Wimborne	Defined (100%)	1.1
Yeovil	Defined (100%)	2.2
Chickerell	Defined (100%)	1.1
Shepton Mallett	Defined (100%)	1.1
Palmersford	Contingent (75%)	1.6
Kingston Seymour	Contingent (75%)	1.6
Marnhull	Contingent (75%)	0.2
Chard	Contingent (75%)	1.6
Dorchester	Contingent (75%)	1.6
Lytchett Matravers	Contingent (75%)	1.6
Other Contingent schemes	Contingent	9.5
Total		29.3

The two large schemes are summarised in the boxes below, with others summarised in document WSX17 A6-1.3.

Avonmouth

This former Imperial Chemicals site located north of Bristol in the Severnside area is zoned for economic development, and benefits from extant planning consent granted in the post war period. This land is at high risk of flooding from climate change and coastal flood defences have been improved to protect low level land at Severnside.

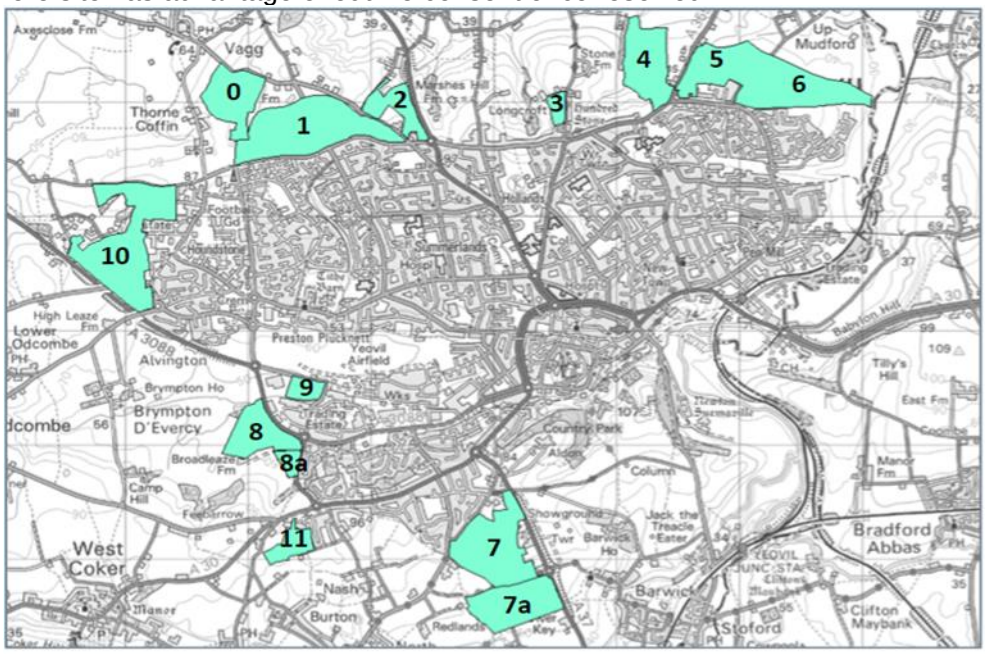


Existing public sewer networks service small domestic settlements scattered across the locality. Development as a site for light industry has commenced at the western approaches with connections to Redwick WRC at the north. Wessex has a long-term strategy to redirect flows to Bristol WRC at Avonmouth where capacity is available and provide relief from sewer flooding. Working in partnership with the site developer additional capacity will be provided to service future development.

This scheme has been reduced in scope now that the North Bristol Relief Sewer strategy commissioned in 2023 is operational. The length of the required rising main has been reduced accordingly.

Yeovil

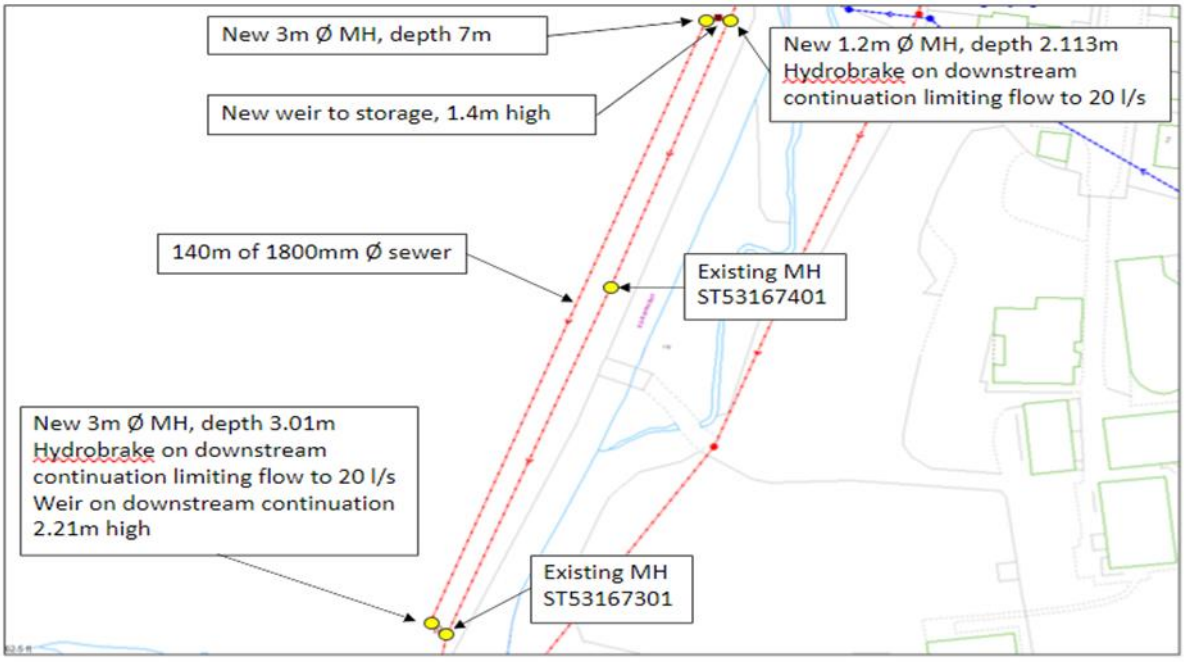
Yeovil is one of the strategic towns and cities within the southwest that has multiple allocations to satisfy demand for housebuilding. Most of these allocations are located on greenfield sites forming extensions to Yeovil town. Development pressures are building owing to the restrictive planning policy of nutrient neutrality and the Brimsmore site has advantage of outline consent once resolved.



The cumulative impact from these allocations has been appraised and a strategy has been developed to mitigate sewer flooding and improve capacity of critical sewers through the town. All public sewers flow to Pen Mill WRC located at the eastern boundary of the urban fringe.

Brimsmore at the north is one of the largest of the allocations at Thorne Road in excess of 1500 new homes with the first phase recently completed.

Options for a 400m3 storage tank are proposed with offline tank sewer and hydraulic controls to attenuate flows. This scheme can be located downstream within space available on local playing fields and will protect property from sewer flooding



5.4.4. First time sewerage

We have a duty to provide First Time Sewerage (FTS) for properties where they are causing environmental pollution if a public solution is shown to be viable by a study made in accordance with Section 101A of the Water Industry Act.

Our PR24 business plan (2025 – 2030) has only a couple of named s101a schemes at this stage, as recent applications have been unviable.

However, we continue to receive a small number of applications from parish councils and customers which may need delivery over the next price review period. We have included an allowance for undertaking viability studies and a newly arising allowance.

We have just received an application (August 2023) from an area that is likely to require a s101a scheme in AMP8. Approximately 20 houses in an urban area of North Somerset, which has an existing public sewer nearby, making a solution more viable than rural first time sewerage schemes. This is likely to be a £1.5m scheme, based on the number of properties and assuming £75k for each property.

Table 16 – First time sewerage costs

Catchment	Scheme cost adjusted for likelihood (£m)
Viability studies	0.5
Leigh Woods, North Somerset	1.5
Other newly arising schemes	3.3
Total	5.3

5.5. Asset health

Asset health is generally considered capital maintenance and is discussed in WSX10. However, it should be noted that sewer rehabilitation and rising main replacement are associated with performance commitments. As well as the collapse performance commitment (sewer and rising mains) we also discuss infiltration sealing to prevent groundwater entering our sewers in this section.

6. Effective Water Recycling

6.1. Capacity & growth

This section should in read in conjunction with and Supporting Document WSX09 – Annex A3 – CAC3 Growth at Water Recycling Centres (WRCs).

6.1.1. Need for Investment

In conjunction with enhancements proposed for the sewerage network, we plan to provide capacity at our Water Recycling Centres (WRCs) to accommodate growth in a timely manner, without planning restrictions and without reducing service levels for existing customers.

We have an aim to achieve 100% discharge permit compliance in every year of PR24, in line with regulator expectations. This compliance target is a level which no company has ever consistently achieved before; sufficient expenditure to increase WRC capacity in our region is integral to achieving and sustaining a high level of discharge permit compliance.

The investment in WRC growth will provide additional treatment capacity for a population equivalent (PE) of approx. 320,000 by 2030.

It will enable development to proceed within our region unhindered by WRC treatment capacity limitations. It will also ensure we maintain permit compliance at our “at-risk” WRCs on scheme completion and beyond 2030, contributing to our leading environmental performance and target for 100% discharge permit compliance.

The EA sets limits on the quality and quantity of treated effluent from WRCs to ensure discharges do not cause an unacceptable impact on the environment. The flow that may be discharged in dry weather is one of these limits. Dry weather flow (DWF) is the average daily flow to a WRC during a period without rain, and the permitted DWF limit is set as the planned annual 80% exceed daily volume discharged. For compliance purposes an exceedance is recorded for a calendar year only when the limit at the end of that year is exceeded by 90% or more of the recorded total daily volumes in that year (excluding spurious/missing flow readings).

To augment a site for a DWF permit increase, a hydraulic increase is associated with a pro-rata tightening of sanitary/nutrient permit limits under a ‘maintenance of load’ approach, alongside additional storm storage requirements (typically to meet 68l/hd, based on a residential population equivalent) as well as a potential increase to the flow passed forward (FPF) rate.

From 01/01/2026, the EA are changing their DWF compliance assessment. The DWF limits will have been complied with in an assessment calendar year unless the limit was exceeded in the compliance assessment year and two or more exceedances have occurred in the preceding 4 years, summarised as ‘3-in-5 year’ compliance. Along with discharge permit compliance, the EA are considering adding flow compliance (including DWF) as a further EPA metric from 2027 (based on the 2026 calendar year).

We have mitigated enhancement (and continue to) at WRCs linked with DWF compliance through maintenance activities in the sewerage network. This approach has, however, effectively led to a concertina effect where many sites are now at or imminently at risk of exceeding their DWF permit limits, and where infiltration reduction / sewer sealing is no longer sufficiently effective. This has resulted in a number of overlap schemes between AMP7 and AMP8 to ensure capacity schemes have been completed for sites at risk of failing DWF early in AMP8. Our investment plan includes the AMP8 expenditure for these schemes but the proportion of spend in AMP7 for these schemes is funded from the PR19 allowance (i.e. 2023-24 and 2024-25 expenditure for these schemes is not part of our submission for transitional investment).

6.1.2. Options Development

We have assessed current and forecast performance of our WRCs based on growth projections, as described in Section 5.4, allowing us to risk score every WRC for the range of common discharge permit parameters (namely BOD, Suspended Solids, and Ammonia) and also flow compliance with Dry Weather Flow (DWF) permits.

For the DWMP we developed options for each WRC identified to be at high risk now or in the next 20 years. A number of sites we have identified for capacity provision have also been identified as requiring enhancements under the WINEP, particularly regarding nutrient and sanitary requirements at our WRCs. However, there has been ongoing uncertainty regarding both the scope and scale of the WINEP for AMP8. Many of the developed options and proposed improvements to WRC discharges for DWMP have been superseded through the emergence of new legislation and/or changes to regulatory guidance. Costs will be purpose split as appropriate and in line with Ofwat's regulatory reporting guidelines. To minimise the cost impact to customers we have reduced our growth programme from that originally envisaged, to net off increases elsewhere in the plan.

The following table lists the WRCs with a possible growth driver identified for AMP8 (some of which have already started or are gearing up to).

Table 17 – WRCs identified for capacity upgrades in PR24

WRC	Driver	PE		
		2025	2050 Design Horizon	Increase
Avonmouth	DWF	844,646	1,159,417*	314,770
All Cannings (Bishops Cannings)	DWF	1,330	1,507	177
Buckland Newton	DWF	449	509	60
Cannington	DWF	4,547	5,151	604
Dowlish Wake	Capacity	287	325	38
Freshford	Capacity	1,577	1,787	209
Great Wishford	DWF	2,282	2,622	340
Hardington Mandeville	Capacity	516	585	69
Hurdcott	DWF	3,998	4,596	598
Ilton	Capacity	1,022	1,158	136
Leyhill	DWF	1,628	1,844	216
Longburton	DWF	534	596	62
Marnhull Common	DWF	7,157	8,097	940
Merriott	Capacity	3,994	4,524	530
Milborne Port	Capacity	5,118	5,686	568
Nether Stowey	DWF	2,230	2,526	296
Oakhill	Capacity	1,537	1,783	246
Pewsey	DWF	8,468	9,592	1,124
Pilton	Capacity	704	798	94
Stourton Caundle	Capacity	338	383	45
Thornford	Capacity	5,578	5,604	27
Wookey	DWF	1,247	1,413	166
Other WRCs (<250PE)	-	-	-	159
Total				321,446

* - the Design Horizon for Avonmouth WRC is 2040

Additionally, there are a number of sites for which design (and construction) will commence in AMP8 to enable completion in the first 2-3 years of AMP9. These include sites such as Amesbury, Bridgwater, Salisbury and Wimborne. On completion, these will provide capacity for a further 80,000 PE.

Technical Assurance/Benchmarking

We engaged Stantec UK Ltd. to undertake a technical review of our wastewater treatment programme, in particular a review of our internal guidance for the basis of design and technologies for future permits for our proposed PR24 interventions. Stantec provided feedback, affirming that our approach was consistent with the wider water industry. Further details can be found in WSX17 A2-1.

6.1.3. Robust and Efficient Costs

A representative sample of solutions covering a range of types, sizes and complexities have been bottom-up costed, incorporating supplier quotes, to inform cost models and any assumptions used on other schemes.

Operational costs have been reviewed at an appropriate scale which reflects the level of detail of the capital costing, including deriving breakdowns between maintenance, labour, power, sludge, chemical usage, and business rates for greater granularity and understanding between options. The costing approach for newer technologies, including green assets such as Integrated Constructed Wetlands has been carried out by external consultancies as well as internal estimating to provide a more robust range. Carbon valuations have again been provided by an external consultancy (Mott MacDonald) using industry standard data and assumptions.

ChandlersKBS were engaged to provide cost estimates for cost assurance benchmarking. They also reviewed our costing approach for many areas of the plan, including sewage treatment capacity and growth.

For our overall wastewater treatment programme (see WSX45 – Annex A4-3), they concluded that:

> *Due to the level of scope definition provided at Business Planning stage, we would identify the estimate class, as defined by the Association for the Advancement of Cost Engineering (AACE), as a Budgetary Estimate or Class 3 and, therefore, an expected accuracy range of between -20% and +30% to the outturn cost. Based on the AACE classification, the ChandlerKBS and Wessex Water accuracy ranges overlap which indicates a high probability of the outturn costs falling in this range. Therefore, the estimates can be deemed to be robustly efficient for Business Planning.*

They also provided a statement of robustness for the cost modelling process and methodology utilised by Wessex Water to estimate the WINEP and Growth programmes (see WSX45 – Annex A4-2):

> *The Waste Water Treatment cost models should be treated as having a moderate confidence in their cost output, particularly for the design stage. The cost models are based upon historical costs incurred by Wessex Water which may not reflect future costings. As the programme and solution designs progress, the cost models should be revised following the same methodology to maintain the high cost confidence and efficiency. The processes and methodologies used to derive the cost models for the Waste Water Treatment programmes were evidently robust and considered to be appropriate for producing efficient costs for the PR24 Business Plan.*

6.1.4. Customer Protection

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment(s) and/or price control deliverable(s):

- PC17 Discharge permit compliance
- PCDWW27 Growth at sewage treatment works (excluding sludge treatment)

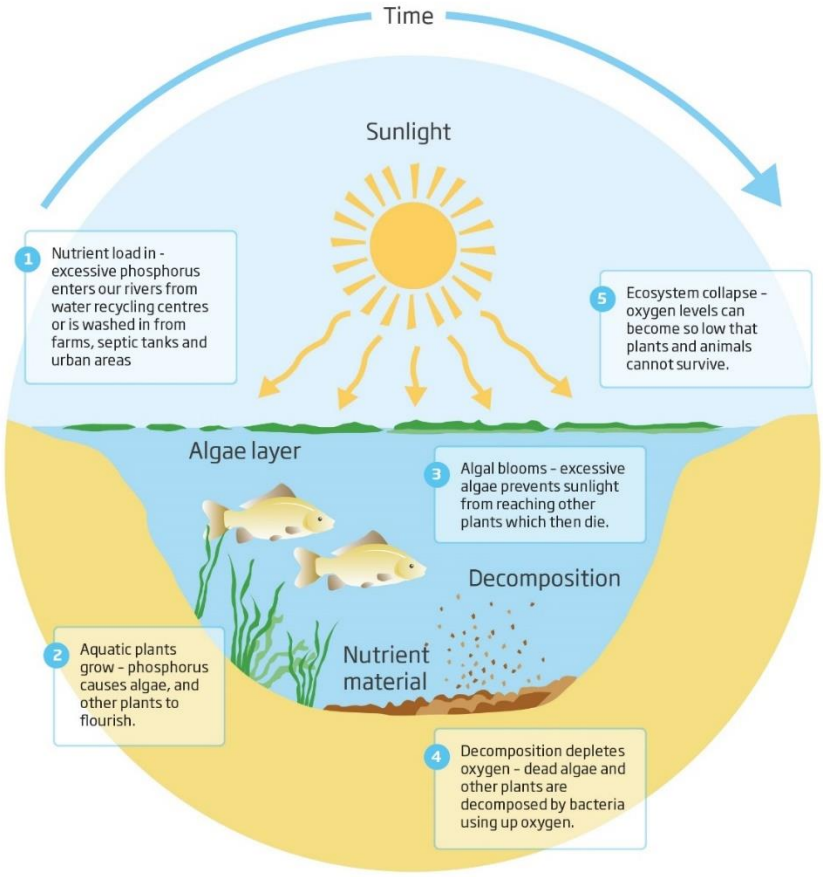
Other related PCs include: PC15 (Total pollution incidents); PC16 (Serious pollution incidents); and PC18 (Bathing water quality).

6.2. Nutrients (Phosphorus & Nitrogen)

6.2.1. Need for Investment

Increased concentrations of nutrients, including phosphorus and nitrogen, can lead to eutrophication, which causes excessive algae growth and damages the ecology of our rivers. Nutrients can enter our surface and groundwaters rivers from multiple sources, including Water Recycling Centres (WRCs) and storm overflows, and also animal urine and faeces in farm slurries, agricultural fertiliser, sewer misconnections, septic tanks, and private discharges.

Figure 42 - The eutrophication process



Targets for nutrient concentrations in river water bodies have been set under the WFD and under the revised Common Standards Monitoring Guidance for Rivers (rCSMG) to protect against eutrophication. The CSMG is the guidance produced by Joint Nature Conservation Committee to ensure protection of Sites of Special Scientific Interest (SSSIs) and Special Areas of Conservation (SACs).

Phosphorus is typically the major limiting nutrient in rivers and nitrogen is the major limiting nutrient in larger water bodies like lakes and estuaries. Historical targets have led to significant and geographically widespread investment in phosphorus removal at our WRCs, with a much lesser extent for nitrogen removal.

Customers support nutrient reduction but want to see it delivered as efficiently as possible using catchment and nature-based solutions where possible.

Regulatory Drivers

The principal UK Directives and Regulations affecting phosphorus and nitrogen removal are summarised below.

Water Framework Directive

Under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 'WFD Regulations'), environmental objectives have been set for all water bodies in England. These objectives include status objectives for each water body and a requirement to prevent deterioration of status. Once published in the river basin management plans (RBMP) these objectives are legally binding. The WFD requires each water body to be classified in terms of its ecological status as high, good, moderate, poor, or bad. This is determined by combining assessments results for biological (biomass/abundance of plants/algae) and physiochemical quality elements (nutrients, dissolved oxygen). The WFD establishes a framework for community action in the field of water policy. The key objectives of the WFD are to

- prevent deterioration in the classification status of aquatic ecosystems, protect them and improve the ecological condition of waters
- implementation of actions to improve water quality in terms of relevant WFD status objectives

The EA has historically adopted a uniform 'fair share' approach for determining target reductions for given sectors/contributors. This approach is grounded in the 'polluter pays' principle. For PR24, the EA – in collaboration with Defra and NE – have adopted a 'non-uniform' fair share approach. This considers sector percentages as per a uniform approach but makes an adjustment based on an assumption as to what each sector can reasonably achieve, which generally favours requesting the water industry to do more. As such, in many catchments we are being asked to go significantly beyond our proportional fair share to offset the inability of other sectors to achieve their reduction targets.

The PR24 WFD drivers for **phosphorus** improvements are:

- WFD_IMP – Implementation of actions to improve water quality in terms of relevant WFD status objectives. A subsequent suffix indicates what target the measure is aimed at achieving (i.e., g = Good status for the element).
- WFD_IMP_MOD – Actions to ensure no river, lake or estuary is in poor or bad ecological status due to the water industry.
- WFD_ND – Actions to meet requirements to prevent deterioration

Since the previous RBMP cycle 2, WFD nitrogen standards for good ecological status (GES) in lakes and reservoirs have been developed by the UK Technical Advisory Group (UKTAG) and accepted by Defra. The new standards, for total N, apply for the 2021 RBMPs and PR24. There are currently no river N standards for good ecological status so no PR24 driver, however N reduction at WRCs discharging to a river can be driven by the needs of a downstream lake/reservoir, a eutrophic saline water body, or by a riverine UWWTR Sensitive Area (Nitrate).

The PR24 WFD drivers for **nitrogen** improvements are:

- WFD_IMP – Implementation of actions to improve water quality in terms of relevant WFD status objectives. A subsequent suffix indicates what target the measure is aimed at achieving (i.e. g = Good status for the element).

Habitat Regulations

The Habitat Regulations, enacting the Habitats and Wild Bird Directives (HD), protect certain species and habitats in the UK. The legislation requires the designation of Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) and that these sites are properly protected and managed. SPAs and SACs contribute to the network of European sites, referred to collectively as Natura 2000. Ramsar sites are wetlands of international importance, designated under the Ramsar Convention. Ramsar sites are treated in the same way as SPAs and SACs. Targets for nutrient concentrations affecting designated sites are set under the rCSMG to protect rivers

against eutrophication. The CSMG is the guidance produced by Joint Nature Conservation Committee to ensure protection of Sites of Special Scientific Interest (SSSIs) and SACs.

The PR24 HD and SSSI drivers for **phosphorus** improvements are:

- HD_IMP – Actions to contribute to restoration of a European site or Ramsar site to move towards meeting the conservation objectives.
- SSSI_IMP – Action to contribute to restoration of a SSSI to favourable condition.

Alongside the new lake N standards under WFD, targets for nutrient concentrations affecting designated sites are set under the revised Common Standards Monitoring Guidance for Rivers (rCSMG) to protect against eutrophication. The CSMG is the guidance produced by Joint Nature Conservation Committee to ensure protection of Sites of Special Scientific Interest (SSSIs) and SACs.

The PR24 HD driver for **nitrogen** improvements is:

- HD_IMP – Actions to contribute to restoration of a European site or Ramsar site to move towards meeting the conservation objectives.

Site specific targets were originally set at the same level as LURB requirements but, given the recent amendment to the LURB, Natural England has written to us with support for nature-based solutions, catchment permitting, and catchment nutrient balancing where appropriate and in a way that meets our overall obligations. Our plan reflects this approach and the WINEP will need to be altered to also reflect it over the coming months.

Urban Wastewater Treatment Regulations

The Urban Wastewater Treatment Regulations (UWWTR) concerns the collection, treatment, and discharge of urban wastewater (and from certain industrial sectors). The UWWTR sets minimum standards and deadlines for the provision of sewerage systems, and treatment of sewage according to the population served by WRCs, and the sensitivity of receiving waters to their discharges. Under the UWWTR, WRCs that discharge directly – or indirectly qualify through their size of contribution – into designated sensitive areas are required to achieve certain phosphorus and nitrogen permits as shown in Table 18.

Table 18 – UWWTR Phosphorus and Nitrogen Permits

WRC Population Equivalent	Phosphorus Permit (Annual mean)	Nitrogen Permit (Annual mean)
< 10,000	n/a	n/a
≥ 10,000 and ≤ 100,000	2 mg/l	15mg/l
> 100,000	1 mg/l	10mg/l

The limits come into force within 7 years of date of designation or a WRC exceeding the population threshold (and contribution proportion).

The PR24 UWWTR drivers for **phosphorus** and **nitrogen** improvements are:

- U_IMP1 – Actions to improve discharges from agglomerations that, through population growth, have crossed the population thresholds in the UWWTR and therefore must achieve more stringent UWWTR requirements.
- U_IMP2 – Actions to reduce total phosphorus and/or total nitrogen in qualifying discharges associated with the next review of Sensitive Areas (Eutrophic).
- U_IMP3 – Actions to introduce more stringent treatment than UWWTR secondary treatment, to optimise reduction of nitrogen in qualifying discharges associated with the next review of freshwater Sensitive Areas (Nitrate).

The EA have recently undertaken a review of new Sensitive Areas (Eutrophic) and made a recommendation to Defra for sign off. The relevant qualifying discharges will need to meet the appropriate UWWTR phosphorus limits within 7 years of the date of designation. These improvements are not required to pass cost-benefit analysis.

- The Dorset Frome River (within the Poole Harbour catchment) is a newly designated SA(E), leading to UWWTR phosphorus permit limits of 2mg/l at Dorchester and Wool WRCs. This is a U_IMP2 driver.
- Dorchester WRC to require an N limit [15mg/l] on the basis that it has just exceeded the > 5% overall load contribution threshold for an indirect qualifying discharge to an existing SA(Eutrophic), Poole Harbour. This is a U_IMP1 driver.

Both Dorchester and Wool WRCs already have phosphorus removal to achieve tighter permit limits under other drivers and thus additional treatment for this purpose would not be required. The UWWTR driver, however, includes additional reporting and monitoring requirements. The limits come into force within 7 years of date of designation or a WRC exceeding the population threshold (and contribution proportion). Poole Harbour was designated a sensitive area in 2002, which led to the installation of a nitrogen removal process at Poole WRC in 2008 and Wareham WRC in 2021, after it reached the population threshold. Whilst some WRCs in the Poole Harbour catchment are approaching the 10,000 population threshold (Wool WRC as indirect discharge and Lytchett Minster WRC as direct discharge), neither are forecast to exceed within the next 5-10 years. In the case of Wool, even if it were to pass the threshold it is short of the > 5% overall load contribution threshold for an indirect qualifying discharge.

Environment Act

The Environment Act (EnvAct) operates as the UK's new framework of environmental protection. Developed following the UK's exit from the EU, it offers new powers to set new binding targets, including for air quality, water, biodiversity, and waste reduction. The EnvAct has targets of reducing nutrient pollution in water by reducing phosphorus loading from treated wastewater by 80% by 2038 and reducing nitrogen, phosphorous and sediment from agriculture to the water environment by 40% by 2038.

The PR24 EnvAct driver for **phosphorus** improvements is:

- EnvAct_IMP1 – Actions to Reduce phosphorus loading from treated wastewater by 80% by 2038 against a 2020 baseline. This is a national target, with the EA advising targets for each water company for their specific region.

This driver does not extend to include **nitrogen** improvements.

Levelling Up and Regeneration Bill

Where sensitive sites are in unfavourable status due to nutrient pollution, Local Planning Authorities (LPA) can only approve a plan or project if they are certain the development will have no negative effect on the site's integrity. Natural England have developed an approach called 'nutrient neutrality' to mitigate the impact of nutrient pollution so that development can go ahead. However, there is still a gap in the ability of LPAs and developers to find mitigation quickly and effectively.

The relevant sensitive areas within the Wessex Water region are:

- Chesil and the Fleet SAC/SPA/Ramsar site (P&N)
- Hampshire Avon SAC (P)
- Somerset Levels and Moors Ramsar site (P)
- Poole Harbour SPA/Ramsar site (P&N)

The Levelling Up and Regeneration Bill (LURB) is currently going through Parliament, with a number of amendments being tabled and discussed in recent weeks and months. The currently included wording places a new statutory duty on water companies to upgrade WRCs to achieve 'technically achievable limits' for phosphorus and/or nitrogen in these nutrient neutrality areas (by 2030). The technically achievable limit (TAL) has been determined by the EA as 0.25mg/l for phosphorus and 10mg/l for nitrogen. WRCs ≥2,000 population equivalent are

required to achieve TAL; <250pe are exempt; WRCs between 250-2,000pe are by default exempt but can be designated as requiring improvement by the Secretary of State. Improvements are required within 7 years of designation or passing the population threshold.

A recent amendment passed by the House of Lords enables the use of catchment permitting, nature-based solutions, and catchment nutrient balancing where approved by the Secretary of State. Our plan reflects this amendment and enables our nutrient programme to fit within our deliverability constraints.

The PR24 LURB driver for **phosphorus and nitrogen** improvement has been put under an HD code:

- HD_IMP_NN – Actions to reduce total phosphorus and/or total nitrogen levels to the Technically Achievable Limit (TAL) from discharges which drain to catchments where Nutrient Neutrality is advised.

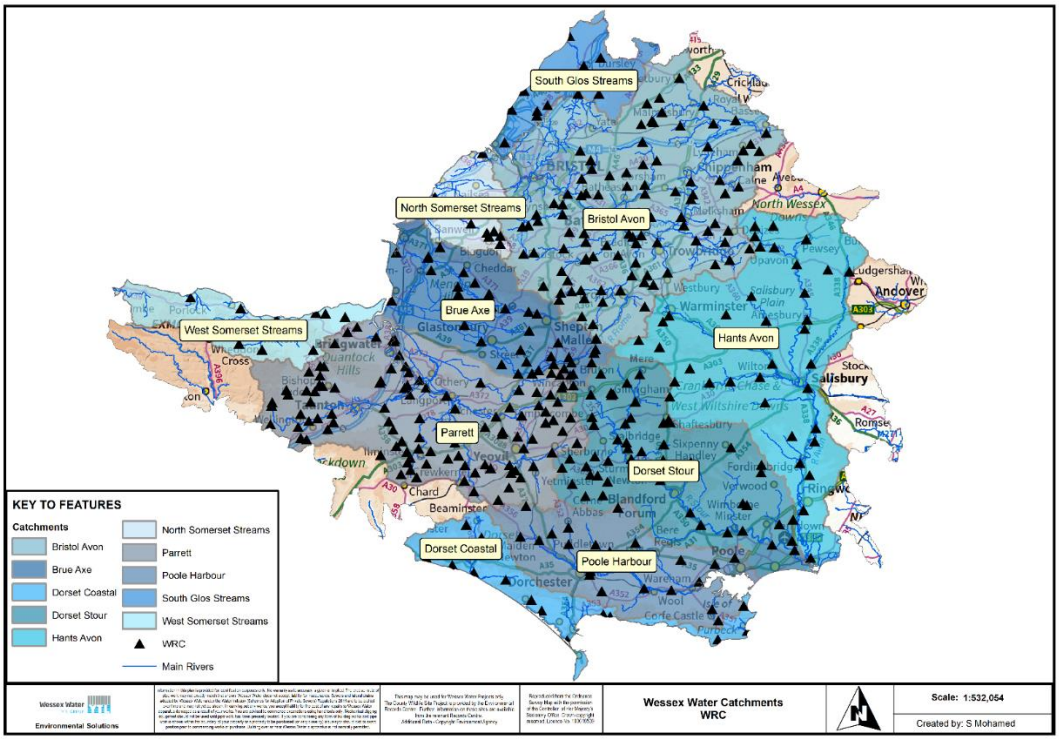
The current TAL for nitrogen is 10mg/l, which originally was based on complying with UWWTR uniform emission limit values. There is a growing need to consider more ambitious levels of N reduction. As such, the PR24 WINEP contains the WFD_INV_N-Tal driver, which involves technology/process trials to assess treatment options for nitrogen, as part of a national investigation. For details of our proposals refer to Section 7.8. The outcome of these trials could both inform a tightening of the TAL limit as well as provide direction on appropriate technologies that could achieve this. Whilst we aware of the future potential tightening of the N TAL limit, we are not speculating on the outcome of the PR24 investigation. It should be recognised that in some cases the best value / least cost option being put forward for PR24 may not achieve a tighter permit limit. Any subsequent tightening of the N permit could lead to abortive or inefficient spend, particularly if this is required in the following AMP.

6.2.2. Options Development

Sites/locations requiring improvement

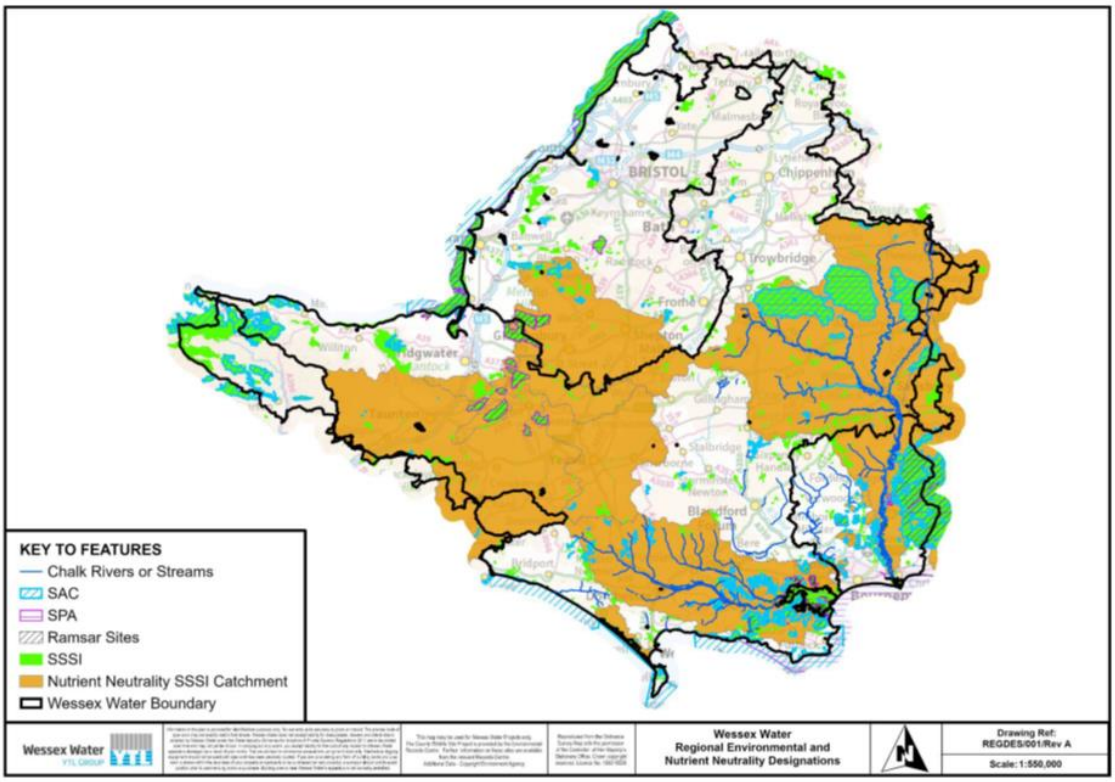
We have 398 water recycling centres (WRCs) serving a population of 2.8 million, across 10 catchments, as shown in Figure 43.

Figure 43 - Wessex Water River Catchment Areas



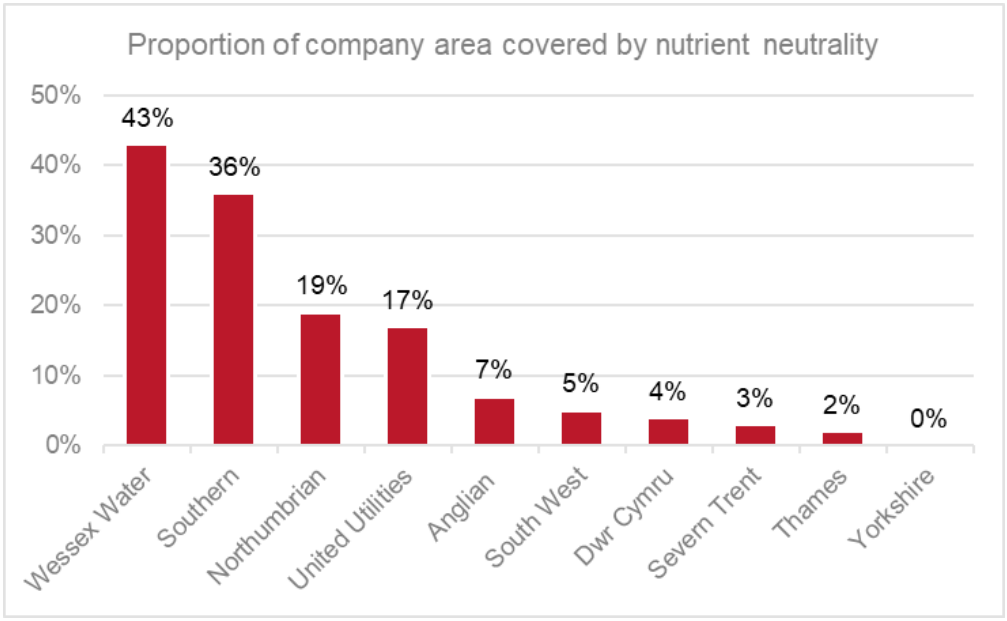
A significant proportion of the Wessex Water region has some form of environmental designation, as shown in Figure 44.

Figure 44 - Regional Environment & Nutrient Designations



Indeed, our assessment of nutrient neutrality catchments shows that over 40% of Wessex Water's area is affected by designated areas with the LURB, which is more than any other company (Figure 45, % values based on our assessment).

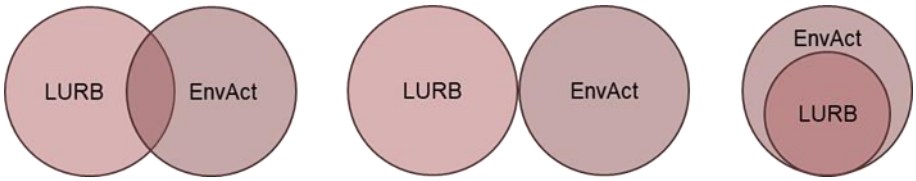
Figure 45 - Proportion of company area covered by nutrient neutrality



It should be recognised that even within the same catchment the sensitive area affected by LURB could be completely within the EnvAct areas, or completely distinct, for example:

- Christchurch WRC in Hampshire Avon has been identified for LURB but is not in an EnvAct (or WFD) catchment.
- Within West Dorset there are Puncknowle, Powerstock and West Milton WRCs in the EnvAct area but Abbotsbury and Langton Herring WRCs in the LURB area.
- A further 11 other WRCs within West Dorset are in neither EnvAct or LURB area generally as they have coastal discharges (ranging from Weymouth and Bridport treating >25,000p.e. each to Ringstead and Melplash treating <100p.e. each).

Figure 46 - Potential overlap between EnvAct and LURB requirements



The below table summarises PR24 (and PR29) catchment load reduction targets for the 10 catchments, from a 2025 baseline (i.e., on completion of AMP7 WINEP schemes).

Table 19 – Catchment phosphorus load reduction targets

Catchment	Reduction Targets				
	EnvAct (%)	EnvAct (tpa)	LURB (tpa)	NN within EnvAct area (tpa)	Total Reduction Target (tpa)
Bristol Avon - Urban - Rural	18% 64%	3.7 47.4	-	-	51.1
South Gloucestershire	69%	7.7	-	-	7.7
Hampshire Avon	33%	8.1	52.0	15.8	52.0
Dorset Stour	58%	45.1	-	-	45.1
Poole Harbour	48%	7.5	95.8	6.0	97.3
West Dorset	47%	0.4	-	-	0.4
Parrett - Parrett - Tone	45% 58%	16.7 12.7	29.2	29.2	29.4
West Somerset Streams	43%	0.1	-	-	0.1
Brue & Axe	61%	9.5	7.8	7.8	9.5
North Somerset Streams	0%	-	-	-	0
		158.9	184.9	58.7	**292.6**

LURB targets are based on all relevant WRCs ≥2,000p.e. being improved to 0.25mg/l.

The Environment Act 80% reduction is a national target. The EA provided us with a spreadsheet with required percentage removal rates for each operational catchment, along with an iteration of how this could be achieved through a list of WRCs, although we did query the reliability of some of the source data. The EnvAct has a regulatory date of December 2038. Given the quantum of phosphorus removal identified across our region and specifically those with 2030 regulatory dates for other drivers, for sites purely contributing to an EnvAct target we are generally proposing that these will not be delivered until AMP9. We consider this to be a balanced no/low regrets approach and recommend that model and targets are refined early in AMP8 based on the above to confirm/inform PR29.

For those WRCs not within the water quality models (such as Christchurch WRC), the flow used is the average from 2019-2021

It should be noted that these load reductions are based on permitted flows and concentrations (with an assumed default effluent concentration, if no permit, of 5mg/l). As such, they differ from any load reduction stated for the River Water Quality (Phosphorus) performance commitment, which is based on measured flows.

Due to the nature of our Water Recycling Centre (WRCs) we generally employ chemical treatment processes to achieve the amount of phosphorus removal required. We are aware that this is not the most sustainable solution and that the increasing demand for more stringent levels of phosphorus removal will exacerbate this further.

During AMP6 (2015-2020) and AMP7 (2020-25) we have continued to deliver alternative and more sustainable options for meeting the outcomes required by an expanding phosphorus removal programme. These have included:

- Catchment Permitting: Spreading the risk and avoiding excess asset redundancy by targeting stretch permits across several sites within the same catchment, reducing the overall capex and opex.
- Catchment Nutrient Balancing: Working with farmers to reduce phosphorus run-off from agricultural land to off-set that to be removed by asset solutions at WRCs.
- Constructed wetlands: Habitat creation to encourage the natural removal of phosphorus, as an alternative to investing at smaller WRCs when combined with flexible permitting.

Unconstrained Options

Table 20 lists the range of unconstrained options initially considered when a WRC has been identified as requiring improvements.

Table 20 – Unconstrained Options

Option	Description
Modify consents/permits	Review/revise permits with the Environment Agency.
River catchment / dynamic permitting	Work with the EA to spread loading across the catchment, or seasonal/flexible permitting.
Tolerate	Site already achieving new permit requirements.
Optimise/Operate	Increase the efficient use of the existing capacity with the existing assets.
Treat/pre-treat in network	Reduce load transferred to the WRC, e.g., network chemical dosing.
Rationalisation/centralisation	Close smaller treatment works and transfer flows to a larger one.
De-centralisation	Remove flows from a treatment works and create localised treatment works.

Catchment management initiatives	Source Control – Treating either diffuse or point-source non-domestic elements of wastewater before they enter the sewer system
	Catchment Nutrient Balancing – Treating and controlling the other contributors to the environment.
Discharge Relocation	Relocate effluent discharge to remove/reduce the need for other enhancement.
Increase treatment capacity	Green – Nature based solutions, such as integrated constructed wetlands.
	Grey – Invest in new assets to provide additional capacity.

Constrained Options

Table 21 on the following page lists the regulatory drivers for phosphorus reduction, along with whether the driver is statutory or statutory plus (required to be cost-beneficial), as well as any restrictions on the use of catchment-based approaches, such as catchment permitting (CP) or catchment nutrient balancing (CNB), as defined by regulator guidance.

Table 21 – Core obligations associated with nutrient (phosphorus and nitrogen) removal

PR24 driver/Legislation	Statutory?	Fairshare applies?	Point source or catchment solution	Criteria
Water Framework Directive (WFD)	IMP – S+ INV – S	Yes	Either	• Where WFD water quality standards are not being met and/or evidence of eutrophication and linked to water company activity.
WFD Poor and Bad Ecological Status WBs	IMP – S+ INV – S+	Yes	CNB encouraged	• Action taken by 2030 so that no river lake or estuary should be in poor or bad ecological status due to water company activities. • This relates to failure of biological elements only – phytoplankton, macroalgae, fish, invertebrates etc. • If AMP7 schemes meet PR24 requirements, no further action is needed. • *No Wessex Water WRCs meet this criterion for nitrogen.*
Water Framework Directive	ND – S	Yes	CNB not allowed due to the uncertainty around efficacy. CP could be considered on a case-by-case basis.	• Where there is actual deterioration of status of a water quality element within a water body; • Anywhere there is a risk of deterioration in WFD classification - certain or probable by 2035. • Elements that comprise ecological status are in the lowest status class. • *No Wessex Water WRCs meet this criterion for nitrogen.*
Habitats Directive	IMP – S ND – S INV – S	Yes	Either	• Anywhere favourable condition targets ('long-term targets') for water quality attributes are not being met and this can be linked to a water company activity.
UWWTR To meet Sensitive Area requirements	IMP – S	No	Point source only	• WRCs above 10,000 population equivalent (PE) that are direct discharges to designated SAE or indirect and contributing >5% nutrient load to SAE.
Environment Act targets To reduce P from by 80% load reduction at WRCs by 2038 against a 2020 baseline To be delivered on a catchment basis.	IMP – S	No (Beyond WFD fairshare)	CNB not allowed as it is about reducing load at the works	• As the deadline is 2038 these schemes could be spread over AMP8 and AMP9. • Only applies to rivers, not TrAC. • No PE cut off so works of any size. • Work prioritised (PR24) in catchments with P failures / eutrophication / P targets exceeded in European sites. All other catchments can be planned for PR29. To include in PR24 WINEP with a delivery date for PR29.
Levelling Up and Regeneration Bill	IMP – S	No	Point source only	• New statutory duty to upgrade WRCs ≥2,000pe to 'technically achievable limits' by 2030 in nutrient neutrality areas.

Table 22 summarises the applicability of the unconstrained options to the various regulatory drivers.

Table 22 – Applicability of unconstrained options to various nutrient regulatory drivers

Options	Driver			
	WFD	HD	UWWTR	LURB
Modify consents/permits	×			
River catchment / dynamic permitting	✓ Subject to load reduction requirements.		×	
Tolerate	✓ Only if WRC already has P or N removal processes.			
Optimise/Operate	✓ Only if WRC already has P or N removal processes.			
Treat/pre-treat in network	×			
Rationalisation/centralisation	✓ Through centralising the required treatment at a single, larger site.			
De-centralisation	✓ Assuming opportunity for new, smaller WRC to discharge to alternative waterbody/catchment, otherwise actual load entering the designated area would be unchanged, providing no environmental benefit.			
Catchment management initiatives (Source Control)	✓ Subject to load reduction requirements and/or if traders contribute the dominant load of nitrogen (inc. ammonia) to the WRC.			
Catchment management initiatives (CNB)	✓ Subject to load reduction requirements.		×	
Discharge Relocation	✓ Assuming new relocated discharge is to non-sensitive area/catchment, otherwise actual load entering the designated area would be unchanged, providing no environmental benefit.			
Enhance treatment capacity (Green)	✓ Subject to load reduction requirements		× Whilst wetlands can achieve the required 2mg/l P or 10/15mg/l N targets, they are not viable for WRCs > 10,000p.e. because of the area of land required (and associated costs).	× We do not have confidence that wetlands can achieve the required 0.25mg/l P targets.
Enhance treatment capacity (Grey)	✓			

Our PR24 nutrient proposals deviate from the current WINEP guidance in the areas highlighted below. We have and continue to engage with the EA and other regulators on this, as we believe our proposals deliver the equivalent load target reduction required at a more appropriate geographic scale and at lower overall cost and greater environmental benefits overall.

- *LURB – A recent amendment to the Bill was passed by the House of Lords allowing catchment permitting, nature based solutions, and catchment nutrient balancing where approved by the Secretary of State. The requirement would be to achieve the equivalent load for any WRCs > 2,000pe achieving TAL (or > TAL as advised by the Secretary of State), with water companies then free to achieve this load reduction through any point source discharge improvements, irrespective of the size of WRC, but subject to individual sites also achieving any other localised permit requirements, e.g. WFD. For example, P reductions at two WRCs of 1,000pe rather than reductions at one of 2,000pe will achieve the same load reduction.*
  - ***Our PR24 proposals include for catchment permitting for LURB.***
- *WFD – The WFD guidance requires improvements to achieve relevant WFD status objectives for individual waterbodies. Following the success of our phosphorus catchment permitting approach within the Bristol Avon for WFD (to meet AMP6 & AMP7 WFD objectives), this is being expanded with trials in the Parrett & Tone and Dorset Stour catchments as described in our PR19 business plan but included for within this PR24 plan, with stretch targets from January 2025. In all three catchments it was agreed by the EA that whilst this (plus CNB in localised areas within Parrett & Tone and Dorset Stour) would not meet WFD objectives at waterbody scale, it would be sufficient at catchment scale. Since PR19, there has been a refinement of WFD targets using updated river water quality models, alongside a change to using a 'non-uniform' fair share approach of the polluter pays principle and guidance that improvements for waterbody targets now just need to be cost-efficient rather than cost-beneficial.*
  - ***Our PR24 proposals include for catchment permitting at sub-catchment scale for WFD objectives in the Bristol Avon.***
- *HD – Where identified through CSMG modelling, Natural England initially requested WRCs to achieve the P TAL, limiting the opportunity for catchment and nature-based approaches. NE has recently written to us with an opportunity to explore how these approaches could be used for Habitats sites and SSSIs.*
  - ***Our PR24 proposals reflect a catchment and nature-based approach to meeting HD targets.***

As described earlier, sites and catchments may be covered under different drivers, which may restrict the ability for us to promote, for instance, catchment permitting or Nature-Based Solutions (NBS), specifically when stringent permit conditions are required at specific sites. In the following pages we describe our approach to assessment for the constrained options, along with screenshots of some of our criteria used for these assessments. In reviewing potential options, we have also taken into consideration related drivers, such as the Poole Harbour WRCs which are also getting tightened nitrogen permits under the LURB, or those WRCs with WFD_ND sanitary drivers or identified for capacity improvements.

River catchment / dynamic permitting

We have experience with catchment permitting for phosphorus, with a full Operating Techniques Agreement (OTA) for the Bristol Avon, following a successful 3-year trial 2018-2020. The EA have also agreed to our trial of phosphorus catchment permitting in the Parrett and Dorset Stour, with the trial OTA covering 2025-2027, as described in our PR19 Business Plan.

Where appropriate, we would propose a similar load-based catchment permitting approach for phosphorus for other catchments and replicate this approach for nitrogen.

Catchment permitting is not currently valid for UWWTR or LURB requirements, with both requiring improvements to specific point source discharges. However given the recent amendment to the LURB out plans

Tolerate / Operate / Optimise

In some cases, WRCs may already be regularly or occasionally achieving some or all of the future permit requirements. Targeted interventions to optimise existing asset performance could lead to more reliably achieving the new permit without substantial capital investment in the creation of new assets.

In many cases, however, this approach does increase the risk held by Wessex Water. Many sites do not have redundant process units and, with an ageing asset base, condition and performance would reasonably be expected to deteriorate more quickly as more reliance is placed on these units.

A number of WRCs also have other enhancement drivers such as nitrogen or sanitary parameters. As such, P drivers cannot be considered in isolation.

We have undertaken a coarse screening exercise to assess whether new PR24 P permits could reliably be achieved through tolerating or through certain aspects of the site being optimised or operating in a different manner (e.g., re-purposing assets).

Figure 47 - Coarse screening assessment template for Tolerate / Operate / Optimise

TOCOB	Ref	Criteria	Value	Validity agreed withSteering Group	Query agreed with SG	Data source
No build/Tolerate	1	Adequate TP performance		<=80% permit	*24 months P data required, w/95%ile <= 80% of permit*	Qlikview/Science Systems
	2	Adequate chemical dosing storage - condition and capacity			*Is there an existing ferric or PAC chemical dosing plant?*	Qlikview/Science Systems
	3			<4	*Is the condition of the chemical storage listed below condition grade of 4 on WAM*	WAM or Investment Engineer spreadsheet
	5			10 yrs at 2025	*Does the chemical storage unit have 10 years remaining of asset life?*	WAM or Investment Engineer spreadsheet
	6	Tertiary treatment stage		Tertiary treatment required?	*Is tertiary treatment required to meet the permit*	Qlikview/Science Systems
	7			10 yrs at 2025	*Does the tertiary treatment stage have 10 years remaining of asset life?*	WAM or Investment Engineer spreadsheet
	8			<4	*Is the condition of the tertiary treatment listed below condition grade of 4 WAM*	WAM
	15	Adequate sludge storage - Condition and capacity		>10 days	*Does the site have sufficient sludge storage capacity for future needs?*	Qlikview
	16			10 years at 2025	*Does the sludge storage unit have 10 years remaining of asset life?*	Qlikview
	17			<4	*Is the condition of the sludge storage listed below condition grade of 4 on WAM*	WAM or Investment Engineer spreadsheet

Rationalisation/centralisation

This option acknowledges that improvement and operational costs are generally disproportionately expensive at smaller WRCs and considers merging or relocating smaller WRCs to a larger common WRC to allow for economies of scale.

In screening to ascertain the feasibility of transferring flows to nearby WRCs, either directly to the WRC or indirectly by connecting somewhere in the sewerage catchment, consideration needs to be given to several factors, including:

- whether the destination WRC has capacity to accommodate the additional flows without requiring further improvement itself.
- whether removal/relocation of the WRC discharge could cause a deterioration to the local ecology of the local watercourse, as in some cases our continuous treated discharge comprises a significant proportion of the receiving river flows.

Figure 48 - Coarse screening assessment template for WRC transfers

Pump aways	1	Population Equivalent		<5000PE	*Maximum population equivalent for site flows to be transferred fr*	Popndata
	2	Distance		<10km	*Are the treatment works within 10km of each other?*	SAGIS
	3	Watercourse sensitivity		<30%	*If WRC contributes <30% of base flow to a watercourse, then assume it can't be transferred*	SAGIS
	4	Hydraulic headroom			*Are the flows being transferred + the receiving WRC DWF permit > the receiving site DWF * 150%?*	SWIMS
	5	DWF Headroom		>90%	*Does the receiving WRC have <90% DWF headroom? or that there is a planned upgrade scheme?*	SWIMS
	6	Land requirements			*Does the receiving treatment works have land available for future expansion/growth?*	GIS

Once pre-selected, a GIS tool allowed the auto-mapping of suitable routes taking into account topography, land-use types etc. Transfer connections could either be direct to the WRC or to an adequate point of connection in the network (and including any consideration for any subsequent reinforcement downstream thereafter). Figure 49 andFigure 50 show potential transfer routes for 4 WRCs for two different maximum distance considerations.

Figure 49 - Possible WRC flow transfers (scenario 10km)

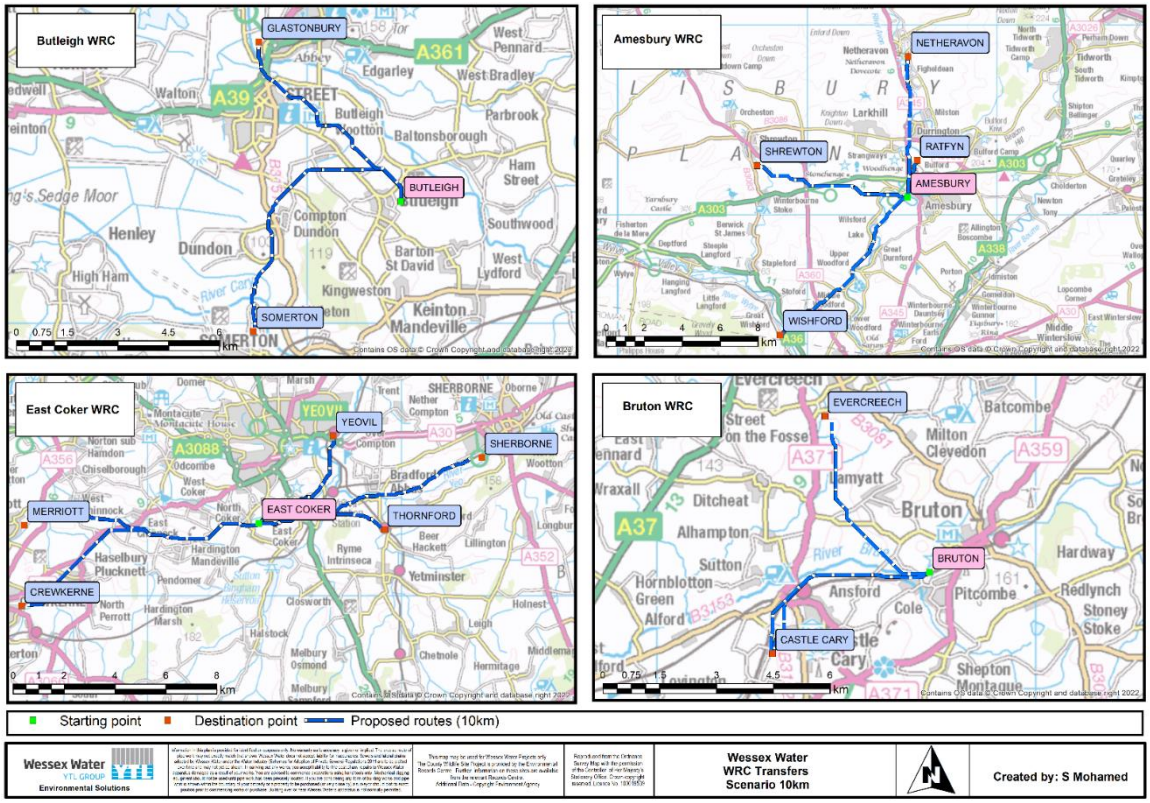
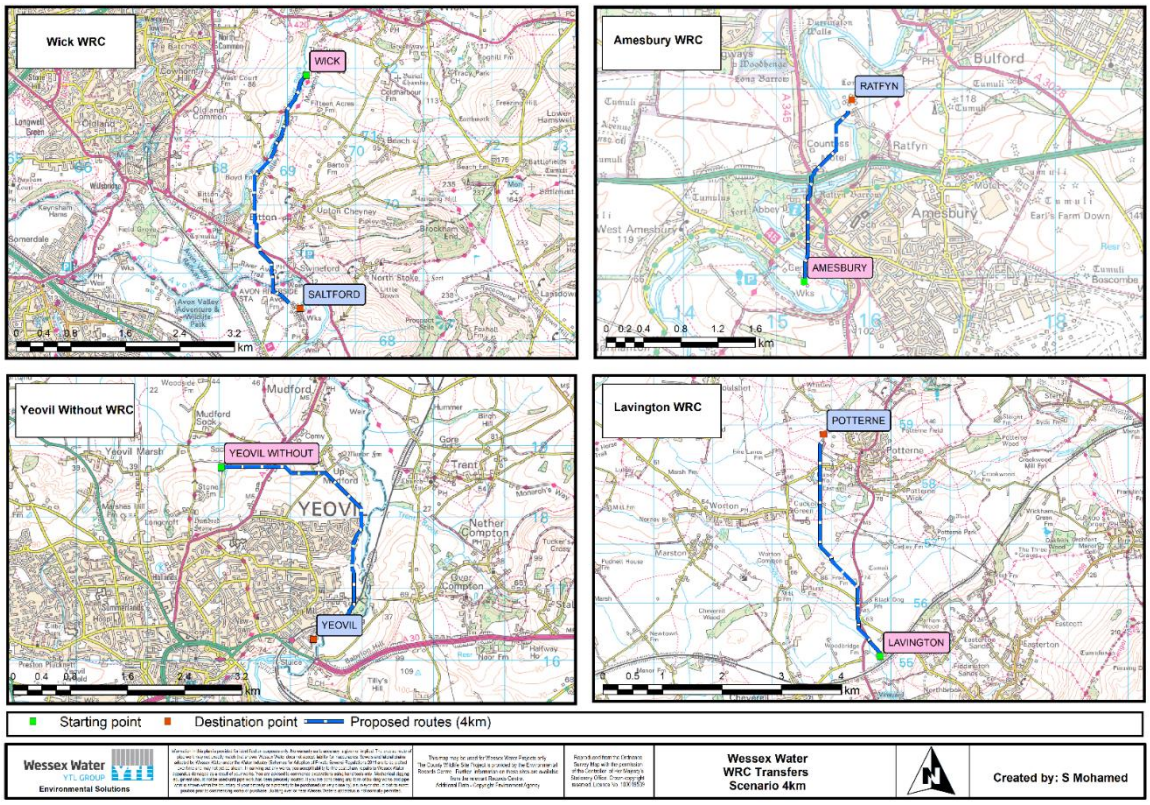


Figure 50 - Possible WRC flow transfers (scenario 4km)



Decentralisation

The opposite of centralisation, decentralisation recognises the potential benefit of dividing existing WRC catchments into smaller catchments. This is generally to avoid expensive sewerage network reinforcements to reduce flooding and/or to support new development, which could also involve significant disruption to communities. Whilst there are additional capital and operational costs associated with two WRCs rather than a single, combined one, these could be netted off against sewerage costs. It also gives the opportunity to strategically (re)locate WRCs, for example to be away from urban areas.

Smaller WRCs – and especially those with surrounding land available – have a greater opportunity to benefit from nature-based solutions than larger WRCs, given the lower flows and load that require to be treated.

As summarised in Table 22, however, unless there is subsequent treatment for all/some of the flows there is a risk that any new or divided WRC(s) would be below the population thresholds for either UWWTR or LURB, and thus not require improvements under those drivers. We do not support this approach, as the actual load entering the designated area would be unchanged, unless the discharge from any new WRCs is outside of the sensitive area. Indeed, it is highly likely that the construction of any new WRC and associated sewerage connections is likely to cause an environmental disbenefit, particularly when taking into account any carbon footprint as well as the new waterbody being discharged into.

Catchment Management (Source Control)

We routinely work with trade effluent customers to help them reduce both the flow and load of their effluent being discharged into our system. Trade effluent is generally more highly concentrated than domestic sewage, and so by more targeted and localised treat-at-source options this can reduce the need and/or scale of improvements required at the WRC. In most cases, however, for anything other than very dominantly contributing traders, source control options will likely only reduce rather than remove the need for improvements at the WRC itself.

To reduce both water consumption bills and trade effluent discharges, we are seeing many traders exploring recycling their effluent on their site, such that their effluent discharges are of lower volumes but are of more highly concentrated loads. In these cases, we do consider source control as potentially proving more cost-effective, subject to land availability and the extent this would offset any improvements that may still be required at the WRC itself.

Figure 51 - Coarse screening assessment template for Source Control

Source control	1	If P load can be attributed to few discharges i.e. trader		>20%	*Is there a single trader/discharge point in the catchment with a high P load which could be treated at source?*	Trade effluent data
	2	Land availability		varies	*Is there land available within the traders site or next to the trader?*	GIS/maps

Our trader assessment has concluded that no traders are sufficiently dominant with P loads to change the solution at the WRCs identified for a new permit.

Table 23 – Output from coarse screening assessment for Source Control

Catchment name	Site name	Current P Removal at WRC?	Trader Risk category	Trader's activity
Bristol Avon	CHIPPENHAM	Y	Low	Commercial service
Brue Axe	SHEPTON MALLET	Y	High	Food and drink processing
			High	Food and drink processing
			Medium	Food and drink processing
Dorset Stour	GILLINGHAM	Y	Low	Commercial service
	PALMERSFORD	Y	Low	Commercial service
		Y	Medium	landfill leachate
	TARRANT CRAWFORD	Y	High	Food and drink processing
			Low	Commercial service
Hants Avon	DOWNTON	Y	Low	Commercial service
			Medium	Food and drink processing
	RATFYN	Y	Low	Vehicle wash
	RINGWOOD	Y	Medium	Commercial service
	SALISBURY	Y	Low	Commercial service
	WARMINSTER	Y	High	Food and drink processing
Poole Harbour	POOLE	N	Low	Commercial service
			Low	Food and drink processing
			Medium	Commercial service

Catchment Management (CNB)

We have many years of experience in offsetting work with the agricultural sector that demonstrate that reducing their contributions to the environment can be of lesser cost and better value than traditional 'grey' improvements at a WRC, providing benefits to both the farmer, us, and ultimately our customers and environment.

Specifically for phosphorus, in 2017 we appraised a 5-year CNB pilot in the Brinkworth Brook catchment (in the Bristol Avon), initially in lieu of upgrading Brinkworth WRC to achieve a phosphorus permit in AMP6. The appraisal considered the potential level of engagement from catchment farmers and the appropriate types and potential uptake of P reducing measures. In tandem with this work, Wessex Water's catchment scientists investigated the

potential P savings that could be expected from the measures once implemented. Farmscoper was used to calculate P reductions.

The main issues identified in this specific catchment included lack of knowledge of cross compliance issues and manure and slurry nutrient values, farm infrastructure issues, the intensity of farming practices and crop management. Infrastructure issues were also identified with excessive dirty water and slurry being created from poor surface water management. Management of arable land, including maize stubbles throughout the winter was also seen as a potential issue.

Measures to reduce P losses included the promotion of better nutrient management planning through soil and manure testing producing plans unique to each farm, infrastructure audits to establish investment requirements to help the long-term management of large quantities of nutrients and in-field measures such as buffer strips on arable ground as a barrier to pathways of nutrients from fields.

Following the success of our work in the Brinkworth Brook and as described in our PR19 Business Plan, our Catchment Permitting OTAs for the Parrett and Dorset Stour are supported by similar CNB OTAs. For these OTAs, the EA has agreed to an over delivery of 10% to account for uncertainty. We have also agreed extensive monitoring plans within the catchments, to better quantify and calibrate the phosphorus reduction from the various measures. Any CNB that we are proposing for PR24 will be based upon the same 10% buffer.

Figure 52 - Coarse screening assessment template for CNB

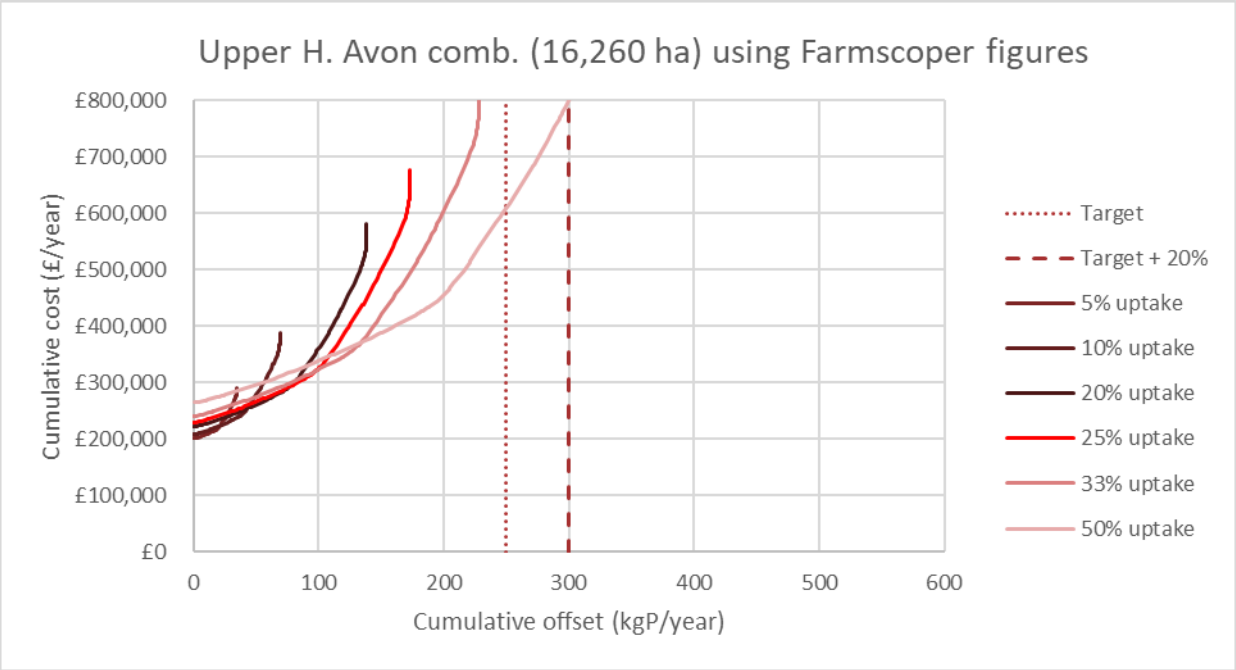
Catchment nutrient balancing	1	Catchment sensitivity			*Has a catchment or farm scale model identified areas of phosphorus detachment and mobilisation?*	Asset and Strategy
	2	Potential P mobilisation			*Is the estimated proportion of mobilised P reaching the watercourse significant e.g. >100 kg/ha*	Asset and Strategy
	3	River network connectivity			*Is the farm well connected to the river network?*	Asset and Strategy
	4	Target annual P reduction			*Is the target annual phosphorus reduction (kg/year ortho P) significant? >100 kg/ha*	Asset and Strategy

Phosphorus offsetting target quantities were used in conjunction with the PSYCHIC estimated agricultural phosphorus loadings to give an indication of the percentage of agricultural loading that would need to be reduced to offset the WRC, in catchment. Anything much greater than 10% would suggest that phosphorus offsetting is probably not viable. Other datasets were used to provide context and explanation to the assessment and to help sense check the potential opportunity for phosphorus offsetting.

Soil drainage is a key factor when considering catchment management of phosphorus. This is because less-permeable soils tend to result in a greater loss of phosphorus, due to the phosphorus bound to soil being lost through erosion of the soil washed into watercourses.

CNB costs are very variable depending on specifics of the catchment (i.e., soil type, land use, type of farmers, no./size of farm landholdings), and amount targeted to be removed. All the above has led us to develop a number of cost curves at catchment, sub-catchment and waterbody catchment scale, of which an example is Figure 53, which are all unique. These curves have generally been based on desktop studies and require onsite proofing to establish their validity.

Figure 53 - Example CNB cost curve, for different levels of farmer uptake within area



We have close working relationships with many of the farmers within our region and are respected for our engagement with them.

With farmers having their own nutrient reduction targets, other sectors also looking for land (e.g., council/developers for wetlands), as well as increases to food prices, there is an anticipation that offsetting costs are likely to escalate.

Whilst we accept the long-term uncertainty of CNB, through our performance commitment work, however, we have demonstrated that there is still the cost-effective potential for us to claim phosphorus credits over-and-above farmers' own targets, as well as supporting them in achieving their targets. Should, for whatever reason, CNB cease to be financially or environmentally attractive then the option remains for asset-based improvements. These asset upgrades could also be timed to coincide with capacity improvements or capital maintenance activities at the WRC.

Similarly, we have many years of experience in nitrogen offsetting work with the agricultural sector that demonstrate that reducing their contributions to the environment can be of lesser cost and better value than traditional 'grey' improvements at a WRC, providing benefits to both the farmer, us, and ultimately our customers and environment. We currently offset 40 tonnes of nitrogen per year around and upstream of Dorchester WRC in lieu of a nitrogen removal plant at the WRC, as agreed with the EA.

With farmers having their own nutrient reduction targets, other sectors also looking for land (e.g., council/developers for wetlands), as well as increases to food prices, there is an anticipation that offsetting costs are likely to escalate. Whilst we accept the long-term uncertainty of CNB, through our performance commitment work, however, we have demonstrated that there is still the cost-effective potential for us to claim nitrogen credits over-and-above farmers' own targets, as well as supporting them in achieving their targets. Should, for whatever reason, CNB cease to be financially or environmentally attractive then the option remains for asset-based improvements. These asset upgrades could also be timed to coincide with capacity improvements or capital maintenance activities at the WRC.

CNB is not valid for UWWTR, EnvAct or LURB requirements, with all three requiring improvements to specific point source discharges.

Discharge Relocation

Consideration has been given to relocating the discharges from the WRCs to an alternative location, to remove or reduce the need for enhancement at the WRC itself.

Whilst this option is a possibility to improve the condition of local waterbodies, in many cases it does not negate the need for some sort of phosphorus overall, particularly when the EnvAct requires a phosphorus load reduction across a whole catchment. With perhaps the exception of a few sites near the coast or discharging into particularly sensitive waterbodies there are no nearby non-sensitive waterbodies, areas or catchments for most other of our WRCs that make discharge relocation financially or environmentally viable.

Indeed, the drive for river quality improvements risks compromising river flow requirements. As mentioned earlier when describing site transfers, there is a risk that removal/relocation of a WRC's discharge could cause a deterioration to the local ecology of the local watercourse, as in some cases our continuous treated discharge comprises a significant proportion of the receiving river flows.

With respect to nitrogen, with perhaps the exception of Abbotsbury and Poole WRCs as described later, there are no nearby non-sensitive waterbodies, areas, or catchments for the other WRCs that make discharge relocation financially or environmentally viable.

Enhance treatment capacity: Phosphorus Removal

This option considers providing increased/enhanced treatment capacity at the WRC. We have considered traditional 'grey' solutions as well as more novel 'green' nature-based solutions, with the latter particularly acting as a tertiary 'polishing' treatment stage.

Table 24 shows the typical phosphorus load reduction for different sizes of WRCs if discharging at different permits. In the absence of a dedicated phosphorus removal process a typical final effluent concentration is assumed to be 5mg/l.

Table 24 – Phosphorus load removal across a range of WRC sizes for different permit levels

WRC Size	Phosphorus Load Removed			
	New Permit: 2mg/l	New Permit: 1mg/l	New Permit: 0.5mg/l	New Permit: 0.25mg/l
250 PE	53	70	79	83
1,000 PE	211	281	316	334
2,000 PE	422	632	632	667
5,000 PE	1,054	1,405	1,581	1,669

'Green' Solution

We have considered 'green' nature-based solutions particularly acting as a side stream for smaller WRCs or as a tertiary 'polishing' treatment stage, similar to the integrated constructed wetlands at Cromhall WRC, whose photo is Figure 54.

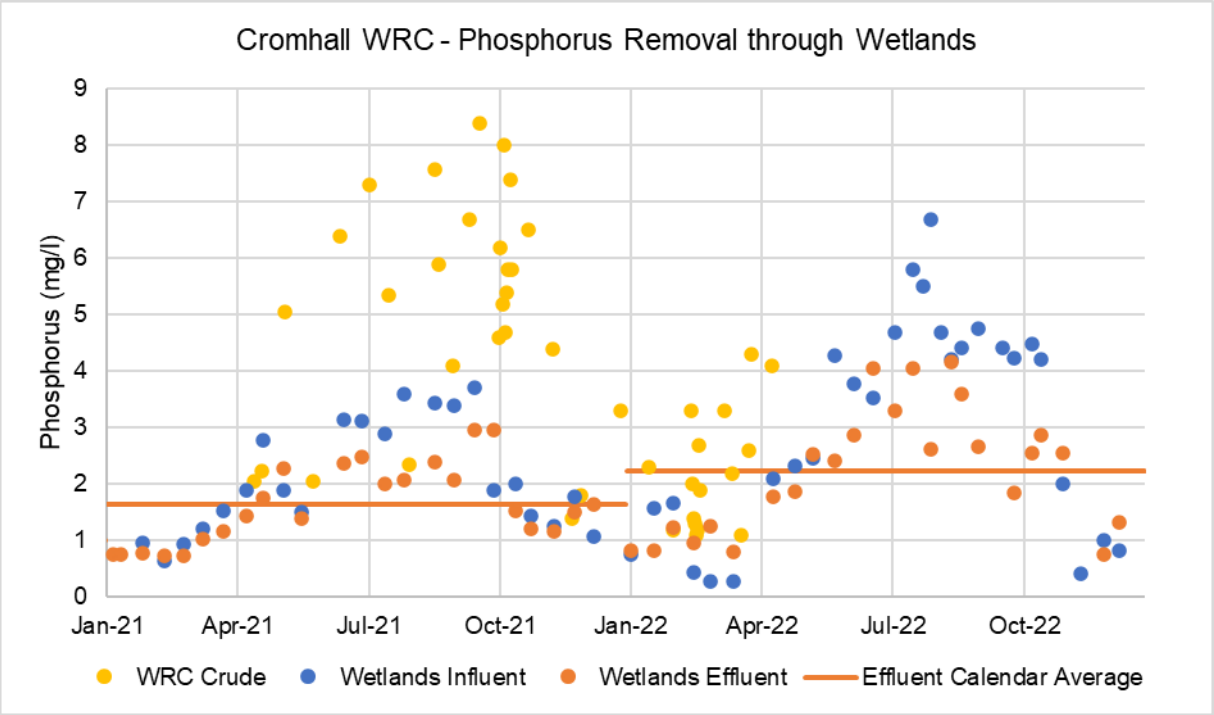
Figure 54 - Cromhall WRC – Integrated Constructed Wetlands

Two consultants undertook high level appraisals for 25 wetlands (15 sites each, with 5 overlaps for comparison/benchmarking) for phosphorus. The outputs from this have been used to derive sizing, costing and carbon curves, on which other wetlands can be interpolated. Only WRCs <2,000p.e. have been assessed.

Another consultant also undertook more detailed, but still reasonably high level, appraisals, for possible wetlands at Collingbourne Ducis and Maiden Bradley WRCs. These WRCs have been identified as requiring nitrogen removal, and thus required more nuances in design to ensure the most efficient removal rates of both phosphorus and nitrogen.

All consultants have confirmed our views that the lowest phosphorus level that wetlands can get to in the absence of upfront chemical dosing or other processes is 2mg/l. This is supported from sample data from Cromhall WRC, as shown in Figure 55, where a new integrated constructed wetlands became operational during 2020. The WRC is an oxidation ditch site with a degree of natural/biological removal: average incoming crude concentrations to the WRC are 4.0mg/l with an average removal rate of 35% to 2.6mg/l across the main WRC and the wetlands only making a further reduction of 35% to a 2-year average of 1.9mg/l.

Figure 55 - Cromhall WRC – Phosphorus removal through WRC and Wetlands



N.b. WRC crude results not routinely taken – those shown are overlayed from the same period 2016-2017.

It should be noted that the crude concentrations are lower than in most typical catchments. The Cromhall catchment has reasonably high levels of infiltration that dilutes the incoming load. The elevated concentrations in summer 2022 can generally be attributed to the extended dry period. The Cromhall WRC wetlands has an effective area of approximately 1Ha, which would be significantly undersized for phosphorus removal if influent levels were more typically to other WRC catchments.

Wetlands can achieve lower concentrations through the addition of upfront chemical dosing, but reliably achieving lower than 1mg/l would require excessive land area and cell redundancy to allow for maintenance.

Alternative ‘green’ solutions include reed beds. We have a number of small to medium size WRCs were there is a tertiary reed bed after the secondary settlement stage. None of these sites achieve <2mg/l in the absence of chemical dosing. Whilst we have examples of some sites regularly achieving less than 1mg/l with upfront chemical dosing, this is generally due to lower influent concentrations (i.e., more dilute), as in the case of Cromhall WRC.

We are not confident proposing either a wetlands or reed bed for permits lower than 1mg/l. We would only propose this solution type for a 0.5mg/l as a stretch target rather than a permit, and also after speciation analysis of the phosphorus.

‘Grey’ Solution

Chemical dosing for phosphorus removal works by bonding the phosphorus with the chemical ion, with the compound then removed as sludge. We generally use ferric sulphate for chemical dosing. The flocculation is most effective when the chemical is dosed upstream of a primary settlement process, as this is where most of the solids removal in a WRC occurs. However, phosphorus is an essential nutrient for the growth and maintenance of micro-organisms used in the biological treatment of wastewaters. It is known that below a certain concentration of phosphorus, the micro-organisms will become phosphate limited and become less effective in removing pollutants such as ammonia from wastewater. There is therefore a risk that if too much phosphorus is removed from the wastewater before nitrification stages, then the conversion of ammonia to nitrate will be significantly reduced.

To achieve more stringent phosphorus permits there is thus a need for not all of the phosphorus to be removed through a front-end chemical dose. A second chemical dosing point is added downstream of the nitrification stage; however, this then necessitates the introduction of a tertiary solids removal stage to capture the associated bound phosphorus.

A number of suppliers have been approached and a technology selection matrix has been developed to assist with which process we would be confident in proposing for PR24 to reliably achieve the TAL of 0.25mg/l. The below table provide a summary of some technologies and our level of confidence in their performance.

Table 25 – Technology assessment for different phosphorus removal technologies

Technology	Description
Pile Cloth Filters	Pile cloth filters (PCFs), such as the Mecana units licensed in the UK by Eliquo Hydrok or the Grenex Gdisk by FLI Water, are a tertiary solids removal technology which remove particulate phosphorus from wastewater. The technology relies on upstream chemical dosing to turn reactive soluble phosphorus into particulate phosphorus. The filters are a rotating pile cloth arranged in discs, which traps particulates as flows passes through. The cloths are backwashed using high pressure water and air spray bars to periodically remove particulates, and the dirty backwash water is returned to the inlet of the site. We are confident that this technology can achieve down to a 0.5mg/l P permit.
Disc Filters	Disc filters are a tertiary solids removal technology which remove particulate phosphorus from wastewater. The technology relies on upstream chemical dosing (coagulant plus polymer) to turn reactive soluble phosphorus into particulate phosphorus. The filters are a rotating mesh disc, which traps particulates as flows passes through. The mesh is backwashed using high pressure spray bars to periodically remove particulates, and the dirty backwash water is returned to the inlet of the site. We are confident that this technology can achieve down to a 0.5mg/l P permit and we are currently trialling the technology for a 0.25mg/l permit.
Multi Media Filters	Multi media filters (MMFs), such as the FilterClear units by Bluewater Bio, are a tertiary solids removal technology which remove particulate phosphorus from wastewater. The technology relies on upstream chemical dosing to turn reactive soluble phosphorus into particulate phosphorus. Flow is driven through four layers of different sized media, which trap particulates. The media is air scoured and backwashed regularly to remove particulates, and the dirty backwash water is returned to the inlet of the site. We are confident that this technology can achieve down to a 0.25mg/l P permit.
CoMag & Actiflow (Ballasted Media)	Both CoMag (by Evoqua Water Technologies) & Actiflow (by Veolia Water Technologies) are tertiary solids removal technologies which remove particulate phosphorus from wastewater. The two technologies use different ballast agents. These are added to the flow with a coagulant and flocculant (polymer), which facilitates the enhanced settlement of particulates within a clarification tank. The sludge is then removed and recycled, allowing the reuse of the ballast agent (micro sand for Actiflo and magnetite for CoMag) and the remaining sludge is returned to the inlet of the site. Actiflo is the only technology with reference sites for a 0.1mg/L TP and we are unclear on consistency of results. Southern Water have the only full-scale plants in the UK and are achieving 0.1 mg/l. We are confident that this technology can achieve down to a 0.25mg/l P permit.
Tertiary Continuously Backwashed Upflow (CoUF) Sand Filters	Tertiary Continuously Backwashed Upflow (CoUF) sand filters are a tertiary solids removal technology which remove particulate phosphorus from wastewater. The technology relies on upstream chemical dosing to turn reactive soluble phosphorus into particulate phosphorus. Flow is driven through sand, which traps particulate phosphorus. The sand is backwashed continuously to remove particulate phosphorus, the dirty backwash water is returned to the inlet of the site. We are confident that this technology can achieve down to a 0.5mg/l P permit (provided it is not an aerated sand filter).

Biological Nutrient Removal	Biological Nutrient Removal (BNR) occurs when an activated sludge plant is operated at a specific nutrient and oxygen level in different stages, creating an environment where different bacteria can remove ammonia, nitrogen & phosphorus. This technology can be introduced to an existing activated sludge plant but requires significant physical changes and additional stages added, or there are suppliers of package plants for new sites. The technology requires a significant carbon load, and as such relies on both methanol dosing and coagulant dosing to achieve low levels of phosphorus & nitrogen. The technology is an activated sludge plant using returned activated sludge & creating waste sludge. We are confident that this technology can achieve down to a 1 mg/l P permit. To reliably achieve less than 1mg/l an additional TSR (Actiflo/CoMag) and coagulant dosing are required downstream of the ASP.

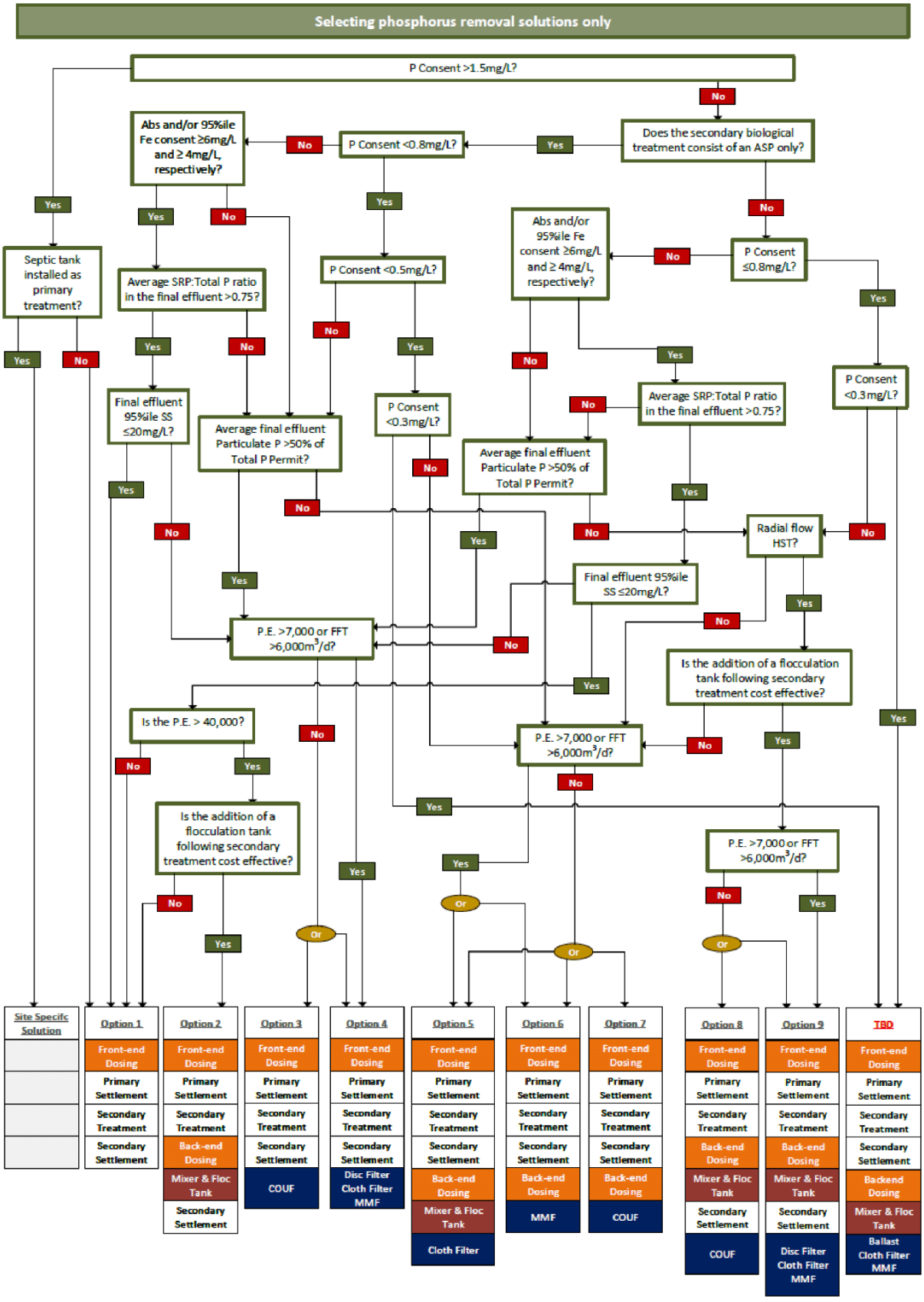
Chemically bound phosphorus is removed from the wastewater and transferred into sludge. For those with filtration processes, the dirty backwash water containing the phosphorus requires to be further filtered/settled, leading to the requirement for additional side stream treatment capacity.

Whilst our current tightest P permit is 0.35mg/l at Shepton Mallet WRC (with the scheme currently in design, for completion by December 2024), a number of other water companies had permits <0.5mg/l in their PR19 WINEP, although only a few of these were sites less than 2,000p.e.

Whilst we have confidence in the above technologies achieving stringent permit levels, for any small WRCs requiring these targets there will be a requirement for the sites to be optimally running at all times to ensure they meet the new P permits, which will require increased level of process redundancy, pro-active maintenance, and a step change in operational involvement from what these types of sites have historically had.

Figure 56 shows the decision tree contained within our phosphorus removal Design Standard. This is being used by designers for our AMP7 schemes to support them in the assessment and selection of the most appropriate process technology. The various branches/routes have been established through internal Wessex Water experience as well as feedback from other water companies. As with any decision tree, site-specifics may always warrant a deviation from a standard or typical approach.

Figure 56 - Decision tree with Wessex Water Design Standards to assist with selecting phosphorus removal technologies



As well as the main treatment process, a number of secondary and ancillary items are required for phosphorus removal, with photos of some shown in Figure 57.

Figure 57 - Typical M&E assets required for phosphorus removal at a WRC

A Tertiary Solids Removal stage is required for permits <1mg/l. Cloth Filters can be used for >0.5 to ≤0.8mg/l permits. Multi Media Filters (pictured) are our current technology of choice for ≤0.5mg/l permits.	
Chemical Dosing Kiosk Complete with emergency shower and delivery bund to capture any spillages during chemical delivery	
Sludge Tank	

Enhance treatment capacity: Nitrogen Removal

This option considers providing increased/enhanced treatment capacity at the WRC. We have considered traditional ‘grey’ solutions as well as more novel ‘green’ nature-based solutions, with the latter particularly acting as a tertiary ‘polishing’ treatment stage.

'Green' Solution

Mott MacDonald were commissioned to investigate the feasibility of utilising integrated constructed wetlands to achieve a nitrogen permit of 8.4mg/l at two of our groundwater discharge sites, for populations of 1,419 and 320.

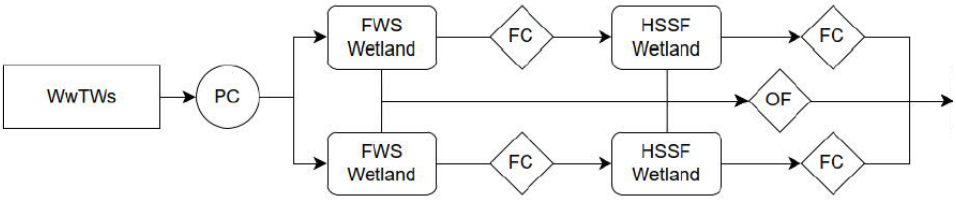
Whilst wetlands can achieve the target concentrations, for large WRCs the area required becomes disproportionately prohibitive. In many cases this option is not feasible either because of lack of land availability (e.g. constrained by adjacent buildings of specific land use areas) but mainly because in all cases we have found that at sites >2,000p.e. the alternative 'grey' solution is both least cost and best value, even when taking into consideration all monetised benefits.

Where technically/financially viable, the proposed configuration would consist of initial treatment through a free water surface (FWS) wetlands followed by treatment within a horizontal sub-surface flow (HSSF) wetlands (see Figure 58). There are two key principals behind the proposal of this configuration:

1. The FWS wetland can accommodate peak flows and higher hydraulic loading rates than the HSSF. It can therefore attenuate short term peak flow events (e.g., early morning) and slowly release the attenuated volume through the HSSF following the peak, this provides greater treatment of the flows with less peak flow being bypassed round the more hydraulic constrained HSSF wetland.

2. The effluent from the WRCs is likely to be low in carbon, the FWS wetland should have the capacity to introduce carbon into the flow stream through the natural cycling occurring within the wetland soils and plant matter decomposition. This should provide some additional carbon input to support effective denitrification in the downstream HSSF wetland.

Figure 58 - Conceptual Process Flow Diagram for proposed wetlands



'Grey' Solution

We have reviewed a number of different process technologies for nitrogen removal, as shown in Table 26.

Table 26 – Technology assessment for different nitrogen removal technologies

Technology	Description
Algal Bioreactor	Algae can absorb nutrients, minerals, and other compounds. They also require light to help growth; natural light is insufficient, and so lighting rods can be inserted into the algal broth to light it internally to improve its effectiveness. We have experience of algal bioreactors, through the algal pond trial at Beckington WRC and our link-up with Industrial Phycology and their trials at Avonmouth and Weston-Super-Mare WRCs.
Engineered Biocatalysts	Instead of relying on the growth and removal of mixed populations as sludge, engineered biocatalysts use a high density of single, highly efficient organisms that are controlled and protected in the versatile form of a biocatalyst composite.
Reactive Media	Traditional material used in constructed wetlands (i.e., sand and gravel) have low capacities to adsorb. An alternative is to use reactive medias. Reactive medias are natural materials or industrial by-products rich in calcium and/or iron that promote nutrient removal through various physico-chemical mechanisms. They have also been seen to remove metals and other emerging contaminants.

	Extensive trials undertaken by water companies as part of the Chemical Investigations Programme have shown a number of challenges associated with reactive media use, including pH management, leaching of metals, uncertainty of mechanisms of removal, media life, supply chain security.
Biological Nutrient Removal	Biological Nutrient Removal (BNR) occurs when an activated sludge plant is operated at a specific nutrient and oxygen level in different stages, creating an environment where different bacteria can remove ammonia, nitrogen & phosphorus. This technology can be introduced to an existing activated sludge plant but requires significant physical changes and additional stages added, or there are suppliers of package plants for new sites. The technology requires a significant carbon load, and as such relies on both methanol dosing and coagulant dosing to achieve low levels of phosphorus & nitrogen. The technology is an activated sludge plant using returned activated sludge & creating waste sludge. We are confident that this technology can achieve down to a 10 mg/l N permit.
Tertiary Nitrifying Continuously Backwashed Upflow (CoUF) Sand Filters	The technology relies on upstream methanol dosing to provide sufficient carbon load allowing bacteria to convert nitrate to nitrogen which is then vented to atmosphere. Flow is driven through sand, which provides a substrate for denitrifying organisms. The sand is backwashed continuously to remove particulates, the dirty backwash water is returned to the inlet of the site. Wessex Water currently has two nitrogen removal plants, at Poole and Wareham WRCs. Both sites successfully use the CoUF process to achieve 10 and 15mg/l respectively.

The above listed technologies have been assessed against a number of criteria, including:

- Process performance confidence
- Additional assets needed to support new treatment process (including carbon dosing requirements)
- Technical and serviceability support, including commercial consideration on the business' longevity/viability to support future maintenance or replacement activities
- Impact to the environment of constructing and operating the process

Table 27 – Process technologies assessed for nitrogen removal

Technology	Matrix outcome	Reason for outcome
Algal Bioreactor	Discounted	High risk in every category
Engineered Biocatalyst	Discounted	High risk in every category
Reactive Media	Discounted	High risk in every category
Biological Nutrient Removal	Site Specific	Likely wholesale rebuild of ASP required with high WLC. Still likely to require a carbon source.
Sand Filters and carbon dosing	Approved for PR24	Wessex Water currently has two nitrogen removal plants, at Poole and Wareham WRCs. Both sites successfully use the CoUF process to achieve 10 and 15mg/l respectively.

The current 'Technically Achievable Limit' (TAL) for nitrogen is 10mg/l, which originally was based on complying with UWWTR uniform emission limit values. There is a growing need to consider more ambitious levels of N reduction. As such, the PR24 WINEP contains the WFD_INV_N-Tal driver, which involves technology/process trials to assess treatment options for nitrogen, as part of a national investigation. The outcome of these trials could both inform a tightening of the TAL limit as well as provide direction on appropriate technologies that could achieve this.

Although whilst something may be classified as technically achievable it does not necessarily mean it is cost-beneficial, particularly when considering for small sites.

Whilst we have promoted some trial technologies and WRCs under WFD_INV_N-Tal, we have reservations about trialling novel processes on sites where a new permit will come into force and the risk of non-compliance (and any consequential costs) remaining with the water company. Although depending on the outputs from the trials and delivery profiling for the N improvement schemes when considered alongside the whole of our PR24 plan, there does remain an opportunity to implement some of these technologies at full-scale during the AMP.

For more details on the proposed technology trials, refer to Section 7.8.

Technical Assurance/Benchmarking

We engaged Stantec UK Ltd. to undertake a technical review of our wastewater treatment programme, in particular a review of our internal guidance for the basis of design and technologies for future permits for our proposed PR24 interventions. The assessment guidelines include generic guidelines and solution technology assessment guidance for varying permit/treatment requirements including phosphorus (itself including tertiary solids removal technologies to meet low limits), nitrogen, combined phosphorus and nitrogen. Stantec provided feedback, affirming that our approach was consistent with the wider water industry. Further details can be found in WSX17 A2-1.

Catchment Assessment Approach

We have taken a catchment-based approach in considering the best value / least cost options to achieve the required improvements. Cost and benefit models have been used to determine both best value and least cost options (if different) for a range of potential P load reductions at any given WRC. We have assessed in the order of 10 different solutions to give us a range of load reduction opportunities that can then be optimised alongside solutions at other WRCs in the sub-catchment or wider catchment as appropriate.

Some example assessments are shown below, with the full assessment including other benefit variables. N.b numbers are indicative and haven't gone through post-processing validation. CNB numbers can be over-and-above any P removed from the WRC.

Corfe Mullen WRC (8,736pe)
No current P permit, with PR24 EnvAct (catchment) driver.

Table 28 – Option assessment for Corfe Mullen WRC

Solution No.	Solution	P Permit (mg/l)	Load Reduction (kg/yr)	Capex (£m)	Opex (£k/y)	Embodied Carbon (TCO_2e)	Operational Carbon (TCO_2e/yr)
1	Wetlands	2	2,878	60.0	120	5,000	50
2	Grey	1	3,838	3.0	70	450	24
3	Grey	0.8 (stretch)	4,030	3.0	75	450	25
4	Grey	0.5	4,317	6.5	170	870	50
5	Grey	0.25	4,556	13.5	200	970	70
6	Grey	0.2 (stretch)	4,605	13.5	210	970	72
7	Transfer	0.25*	4,556	N/A (no viable destination WRC)			
8	CNB	Band 1					
9	CNB	Band 2					
10	CNB	Band 3					
11	CNB	Band 4					

* 0.25mg/l has been assumed for transfers, on the assumption that flows will be going to a larger WRC more likely to be receiving a stringent permit. This assumption is checked should the option appear favourable.

The regulatory restrictions from the EnvAct driver means that CNB is not viable. The size of WRC means that a wetland would be disproportionately large, and unviable due to a lack of available area and also financially. The step changes in costs between the grey solutions for the different permit levels correspond to the different technologies as described earlier, and also the knock-on implications when targeting stringent permits in handling backwash flows.

As the WRC has no current permit, going from the default 5mg/l to 1mg/l is the most cost-beneficial, with the unit cost getting progressively more expensive the more P that is removed. To satisfy the overall catchment load target this site will be considered alongside others in the catchment.

Hurdcott WRC (3,857pe)
Current P permit of 1mg/l, with PR24 LURB (site-specific) and EnvAct (catchment) drivers.

Table 29 – Option assessment for Hurdcott WRC

Solution No.	Solution	P Permit (mg/l)	Load Reduction (kg/yr)	Capex (£m)	Opex (£k/y)	Embodied Carbon (TCO_2e)	Operational Carbon (TCO_2e/yr)
1	Wetlands	2					
2	Grey	1					
3	Grey	0.8 (stretch)	242				
4	Grey	0.5	604				
5	Grey	0.25	906	13.5	200	970	70
6	Grey	0.2 (stretch)	967	13.5	210	970	72
7	Transfer	0.25*	906	N/A (no viable destination WRC)			
8	CNB	Band 1					
9	CNB	Band 2					
10	CNB	Band 3					
11	CNB	Band 4					

Given the regulatory restrictions from both the LURB and EnvAct drivers, options are limited to either a grey asset solution or a transfer to achieve at least 0.25mg/l. There are no viable destination WRCs, thus the sole option is a grey asset solution as a minimum for 0.25mg/l, with the opportunity for a stretch target.

Nynehead WRC (280pe)
No current P permit, with PR24 EnvAct (catchment) driver. Below the population threshold for LURB (site-specific driver).

Table 30 – Option assessment for Nynehead WRC

Solution No.	Solution	P Permit (mg/l)	Load Reduction (kg/yr)	Capex (£m)	Opex (£k/y)	Embodied Carbon (TCO_2e)	Operational Carbon (TCO_2e/yr)
1	Wetlands	2	54	1.7	20	160	5
2	Grey	1	72	1.2	50	210	10
3	Grey	0.8 (stretch)	75	1.2	55	210	11

4	Grey	0.5	81	2.5	90	420	40
5	Grey	0.25	85	6.6	130	470	60
6	Grey	0.2 (stretch)	86	6.6	135	470	62
7	Transfer	0.25*	85	2.0	25		
8	CNB	Band 1	22	0.02	10		
9	CNB	Band 2	43	0.02	27		
10	CNB	Band 3	65	0.02	50		
11	CNB	Band 4					

The regulatory restrictions from the EnvAct driver means that CNB is not viable, however values are included to show the cost-effective potential as an alternative to site-based improvements.

The transfer assessment takes into consideration either direct connections to the destination WRC or indirect by a modelled assessment of capacity in the sewer network. For Nynehead, a direct connection to Wellington WRC would appear to be the better route, as it does not require going underneath a railway line or upgrades to the network to accommodate the additional flows.

The 30-year whole life costs for Nynehead are shown in Table 31. As can be seen, an integrated constructed wetlands is the least cost solution. It is also the best value solution when accounting for monetised benefits. However, should the WRC be unexempted from the LURB and thus require a 0.25mg/l permit then the only viable options are the grey asset solution or transfer, of which the transfer is least cost (and also best value).

Table 31 – Whole life costs for Nynehead WRC

Solution No.	Solution	P Permit (mg/l)	Load Reduction (kg/yr)	WLC (£m)
1	Wetlands	2	54	2.1
2	Grey	1	72	2.1
3	Grey	0.8 (stretch)	75	2.2
4	Grey	0.5	81	4.2
5	Grey	0.25	85	9.0
6	Grey	0.2 (stretch)	86	9.1
7	Transfer	0.25*	85	2.5

Many of the regulatory restrictions are driving site-based solutions to achieve the TAL of 0.25mg/l, thus ruling out CNB or the opportunity for nature-based solutions, despite us keen to promote them.

We describe our proposed approach to nutrient removal in the subsequent sections on individual catchments.

Screening reports for all sites and option development summaries for a number of sites can be found in WSX17 sections A2-2 & A7.

6.2.3. Bristol Avon

The Bristol Avon rises from spring sources in the Cotswolds and flows eastwards through Malmesbury before turning south, passing through towns including Chippenham and Trowbridge. The river then flows westward through the cities of Bath and Bristol, before entering the Severn Estuary at Avonmouth. It is joined by tributaries including the Brinkworth, Rodbourne, Semington, By and Cam Brooks and the Rivers Marden, Frome, and Chew.

Our PR24 nutrient proposals deviate from the current WINEP guidance in the areas highlighted below. We have and continue to engage with the EA and other regulators on this, as we believe our proposals deliver the equivalent load target reduction required at a more appropriate geographic scale and at lower overall cost and greater environmental benefits overall.

- *WFD – The WFD guidance requires improvements to achieve relevant WFD status objectives for individual waterbodies. Following the success of our phosphorus catchment permitting approach within the Bristol Avon for WFD (to meet AMP6 & AMP7 WFD objectives), this is being expanded with trials in the Parrett & Tone and Dorset Stour catchments as described in our PR19 business plan but included for within this PR24 plan, with stretch targets from January 2025. In all three catchments it was agreed by the EA that whilst this (plus CNB in localised areas within Parrett & Tone and Dorset Stour) would not meet WFD objectives at waterbody scale, it would be sufficient at catchment scale. Since PR19, there has been a refinement of WFD targets using updated river water quality models, alongside a change to using a 'non-uniform' fair share approach of the polluter pays principle and guidance that improvements for waterbody targets now just need to be cost-efficient rather than cost-beneficial.*
  - ***Our PR24 proposals include for catchment permitting at sub-catchment scale for WFD objectives in the Bristol Avon.***

Following the success of catchment permitting for WFD in the Bristol Avon from AMP6 and with additional sites added in AMP7, we propose an alternative approach to delivery of our WINEP obligations, through a refinement of the existing catchment permitting approach to achieve both WFD (at sub-catchment scale) and EnvAct targets (at catchment scale).

For those sites attributed with a WFD_IMP_MOD driver – Actions to ensure no river, lake or estuary is in poor or bad ecological status for phosphorus due to the water industry activities – we only propose backstop permits, to ensure improvements are made to affect the locally affected waterbody. This affects Dilton Marsh, Marshfield and Urchfont. We accept our sub-catchment permitting approach will not necessarily achieve other individual waterbody objective targets, but it achieves the equivalent load reduction at sub-catchment scale. Further upgrades will also be required through PR29 to achieve EnvAct targets at catchment scale, mainly associated with the Bristol Avon Urban catchment, in the lower reaches of the Avon. Although it should also be noted that the WFD (and EnvAct) objectives will only be met if all sectors do their fair share reduction requirements, and not just Wessex Water.

Our alternative sub-catchment permitting approach submitted to Defra, EA and Ofwat on 20th June 2023 extends the existing catchment permitting delivered to date in the Bristol Avon catchment. The alternative focuses on delivering compliance with WFD fair share requirements at sub-catchment scale, rather than waterbody level. This differs from our current WINEP which meets water quality objectives at waterbody and catchment scale, as appropriate for the respective drivers. Refer to WSX17 A3-1.1 for more details of our submission.

Our proposals within the Bristol Avon have been informed by the success to date of the existing Bristol Avon catchment permit and wider benefits delivered from our Cromhall integrated constructed wetland. These benefits are summarised below.

Wessex Water has pioneered an innovative Catchment Permitting approach in the Bristol Avon, with support from the EA. The successes of this trial since 2015 have been reported in two separate WINEP investigations:

- 6Wx006352 Bristol Avon Catchment Permitting Trial assessment and reporting of the phosphate reduction achieved published in March 2021

- 7WW300290 Bristol Avon Catchment Permitting Environmental Assessment published in December 2022

Overall, the Catchment Permitting approach has:

- Exceeded the regulatory phosphorus load reduction target of 46tpa, typically achieving 50tpa reduction since 2019
- Improved the WFD phosphorus status of 10 waterbodies, where nine moved from Poor to Moderate and one moved from Moderate to Good
- Improved phosphorus concentrations within existing WFD classification in a further 11 waterbodies
- Reduced the embodied carbon costs by reducing the level of construction required compared to a traditional individual asset approach
- Reduced capital investment in assets by £24m

The success of the Bristol Avon catchment permitting trial has informed further Catchment Permitting trials in the Parrett and Dorset Stour catchments, based upon our AMP7 solutions currently in development. These trials are also supplemented through comparable Catchment Nutrient Balancing operating techniques agreements, providing a holistic and cost-effective solution to phosphorus removal in these catchments.

The water quality benefits from the Cromhall WRC integrated constructed wetland (ICW) are illustrated in Table 32 below for standard final effluent parameters.

Table 32 – Mean concentrations of suspended solids, ammonia and total phosphorus (wetland inlet and outlet)

Site	Total phosphorus (mgP/l)	Suspended solids (mg/l)	Ammonia (mgN/l)
Wetland Inlet	2.15	7.07	0.72
Wetland Outlet	1.56	5.72	0.27
Removal	0.59	1.35	0.45
% Removal	27.50	19.09	62.49

For total phosphorus the wetland appears most effective in summer when receiving lower flows (longer residence time), warmer temperatures, more daylight and significant macrophyte growth. During summer months, concentrations into the wetland of ~3 mg/l are common with discharges between ~2-2.5 mg/l (16-30% reduction in concentration). Removal percentages over the winter months are minimal where concentrations both in and out of the wetland are broadly similar but low (~1 mgP/l). Ammonia and suspended solids are also effectively removed by the wetland with average reduction rates of 62% and 19% respectively.

Emerging findings from PhD research (that we are supporting) show that influent concentrations of pharmaceutical and personal care product (PPCP) vary seasonally and daily, with up to 90 compounds identified at a quantifiable level from 140 investigated. The ICW appears to remove some compounds from the aqueous phase (>70% removal), however others show negligible removal or an increase in concentration through the wetland system. Early findings show that the ICW can effectively limit the export of AMR bacteria into the environment (95-99.9%), with removal rates above 95% achieved even during winter conditions, and that Cromhall ICW can effectively remove microplastics (>95%). The research so far shows reductions in both nitrogen and phosphorus. Nitrogen reduction is more sustained with rates of over 60%, whereas phosphorus removal is more variable.

Assessment using Biodiversity Metric 3.0 shows that Cromhall ICW has delivered a 111% and 42% increase in habitat and hedgerow biodiversity units, respectively. This is due to the limited biodiversity value of the preconstruction habitat (arable land) and the creation of the wetland and an area of surrounding neutral grassland

(priority habitat). As the neutral and wetland grassland quality improves with maturity and management the number of biodiversity units delivered will increase further. This is in direct contrast to what would be expected if a 'traditional' approach to phosphorus removal (such as chemical dosing) had been adopted, which would typically involve the loss of a small area of undeveloped land within the footprint of the WRC.

Comparisons show that since construction, the WFD water quality status of the furthest downstream sampling point on the Tortworth Brook has improved from indicative Bad to Poor. Orthophosphate 90th percentile concentrations have approximately halved, and ammonia levels have also reduced from an indicative standard of Moderate to High.

In the Bristol Avon this alternative approach delivers an equivalent level of phosphorus reduction as required by the WFD in PR24. However, this is achieved at a sub-catchment rather than waterbody level as required by current WINEP guidance. Our proposal in the Bristol Avon catchment delivers 51.3tpa phosphorus load reduction at a reduced capital and carbon cost, £30m and 1,000TCO_2e, respectively. In addition, this approach enables us to explore the use of nature-based solutions at a limited number of sites – that otherwise wouldn't have been possible given the stringent permit requirements – providing further environmental benefits including increased biodiversity, and greater reductions of nitrogen, emerging contaminants and bacteria than traditional phosphorus removal technologies.

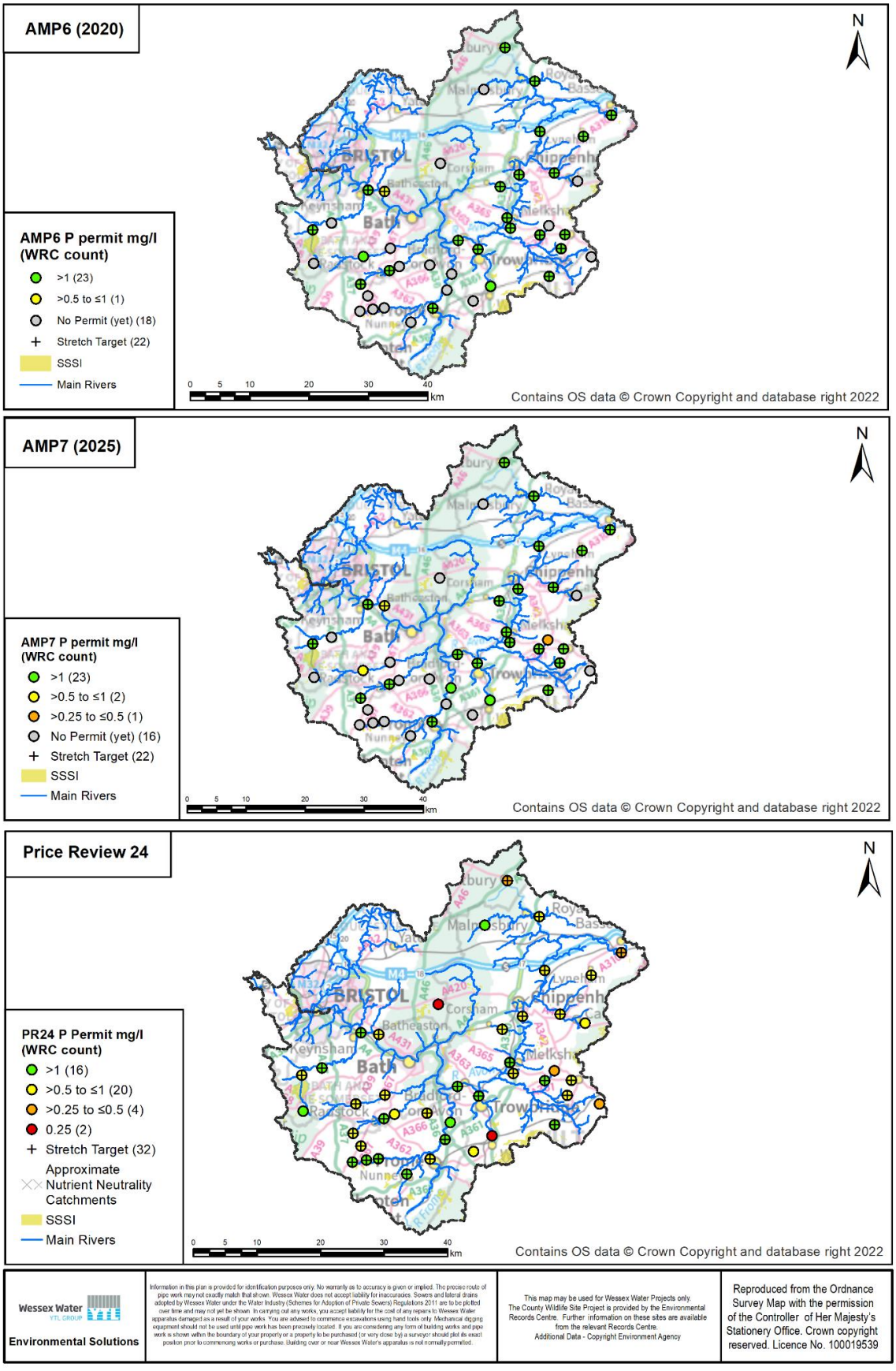
Table 33 lists WRCs within the Bristol Avon catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 59.

Table 33 – WRCs with phosphorus removal in Bristol Avon

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits			
			Historical		PR24	
			Permit (mg/l)	Stretch Target (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Bath (Saltford)	124,073		1	0.8	1	0.8
Beckington	1,175				2	1
Bowerhill	10,556		2	0.5	1	0.25
Bradford-On-Avon	12,209		2	1.4	2	1.4
Calne	22,030		2	0.5	1	0.25
Cam Valley	8,295				1	0.25
Chew Stoke	7,855		2	1	1	0.5
Chilcompton	2,086		1.5	0.8	1	0.8
Chippenham	44,455		2	0.6	1	0.25
Coleford	2,278				2	1
Compton Bassett	5,266				1	
Devizes	14,757		2	1.3	1	0.25
Dilton Marsh	1,850				1	
East Harptree	431				3	
Edford	1,841				2	1
Erlestoke	927		1.5	0.8	1.5	0.8
Frome	34,887		2	1.3	1	0.25

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits			
			Historical		PR24	
			Permit (mg/l)	Stretch Target (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Keynsham	23,781		2	1.3	2	1.3
Lyneham	5,812		2	1	1	0.25
Malmesbury	12,967		2	1	1	0.4
Marshfield	1,736				0.25	
Melksham	20,455		2	1.2	1.5	0.8
Norton St Philip	1,386				1	0.5
Nunney	1,427				2	1
Oakhill	1,471				2	1
Paulton	12,467		1		1	0.25
Potterne	13,366		2	1.1	1	0.25
Radstock	28,020	Y	2	0.7	2	0.7
Rode	1,202	Y	2		2	
Rowde	3,048	Y	0.5		0.5	
Royal Wootton Bassett	14,591		2	0.5	0.5	
Seend	1,060		2	1.1	2	1.1
Sherston	1,343				4	
Shoscombe	1,987				1	
Stanton Drew	1,230				2	1
Stratton-On-The-Fosse	1,141				1	0.3
Sutton Benger	9,157		3	2	1	0.5
Tetbury	7,924		2	0.5	0.5	
Thingley	21,489		2	1.2	1	0.5
Trowbridge	65,923	Y	2	0.5	2	0.5
Urchfont	1,278				0.4	
Westbury	25,497		2		1	0.25

Figure 59 - Locations of WRCs with phosphorus limits in Bristol Avon catchment



6.2.4. South Gloucestershire

The South Gloucestershire catchment contains the Little Avon River, which rises from spring sources on the Cotswold scarp slope. It flows north-westwards entering the Severn Estuary at Berkeley. The main settlements in the catchment include Wotton-under-Edge, Wickwar and Charfield.

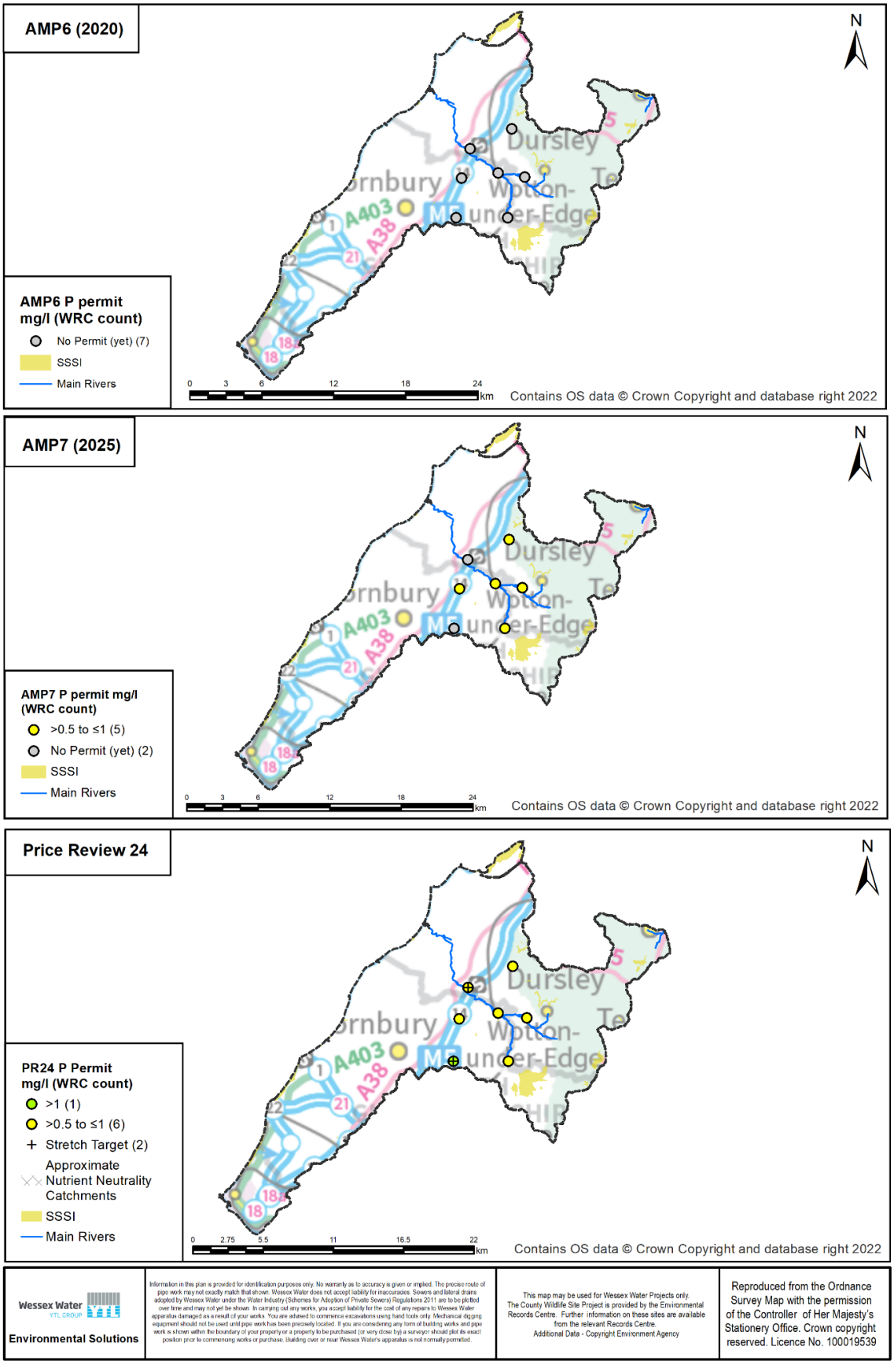
Table 34 lists WRCs within the South Gloucestershire catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 60 on the following page.

Table 34 – WRCs with phosphorus removal in South Gloucestershire

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits		
			Historical	PR24	
			Permit (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Charfield	5,002	Y	1	1	
Cromhall	2,132			4	2
Leyhill	1,326	Y	1	1	
Michaelwood	3,198			1	0.25
North Nibley	761	Y	1	1	
Wickwar	1,816	Y	1	1	
Wotton-Under-Edge	6,218	Y	1	1	

As previously described, we built an integrated constructed wetlands at Cromhall WRC during AMP6. Our PR19 plans were to achieve WFD Good Ecological Status, based on PR19 modelling and regulatory guidance (i.e., uniform fair share). The updates to the PR24 models and revision to regulatory guidance (i.e., non-uniform fair share), alongside the emergence of the EnvAct targets, mean that further phosphorus removal is required for PR24. Some of the sites improved for AMP7 will also need to be re-visited in AMP9 to help achieve the EnvAct targets.

Figure 60 - Locations of WRCs with phosphorus limits in South Gloucestershire catchment



6.2.5. Hampshire Avon

The Hampshire Avon is a large chalk-fed river with a catchment of approximately 1,700km^2. It flows from its headwaters in Pewsey in Wiltshire through Salisbury, then onto Ringwood before meeting the sea at Christchurch. The major tributaries joining the Avon north of Salisbury include the Wylye, the Nadder and the River Bourne. The River Ebble and number of other tributaries join the Avon south of Salisbury.

The catchment is predominantly rural and the main land uses are either agricultural or related to military activity (e.g. Salisbury Plain is the British Army's main training ground within the UK). Much of the river apart from the ephemeral headwaters is designated under the European Habitats Directive as a Special Area of Conservation (SAC) and the lower river is a Special Protection Area (SPA). Its tributaries have also been designated Sites of Special Scientific Interest (SSSI). The main towns are Warminster, Salisbury, Ringwood and Christchurch.

WRCs within Poole Harbour have been identified as requiring phosphorus and/or nitrogen removal.

Our PR24 nutrient proposals deviate from the current WINEP guidance in the areas highlighted below. We have and continue to engage with the EA and other regulators on this, as we believe our proposals deliver the equivalent load target reduction required at a more appropriate geographic scale and at lower overall cost and greater environmental benefits overall.

- *LURB – We are aware of ongoing discussions about the allowing of catchment permitting with the LURB, whereby the requirement would be to achieve the equivalent load for any WRCs > 2,000pe achieving TAL (or > TAL as advised by the Secretary of State), with water companies then free to achieve this load reduction through any point source discharge improvements, irrespective of the size of WRC, but subject to individual sites also achieving any other localised permit requirements, e.g. WFD. For example, P reductions at two WRCs of 1,000pe rather than reductions at one of 2,000pe will achieve the same load reduction.*
  - ***Our PR24 proposals include for catchment permitting for LURB in the Hampshire Avon.***
- *HD – Where identified through CSMG modelling, Natural England initially requested WRCs to achieve the P TAL, limiting the opportunity for catchment and nature-based approaches. NE has recently written to us with an opportunity to explore how these approaches could be used for Habitats sites and SSSIs.*
  - ***Our PR24 proposals reflect a catchment and nature-based approach to meeting HD targets.***

Table 35 lists WRCs within the Hampshire Avon catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 61.

Table 35 – WRCs with phosphorus removal in Hampshire Avon

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits		
			Historical	PR24	
			Permit (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
All Cannings (Bishops Cannings)	1,286		1		0.5
Amesbury	12,408		1	0.5	0.25
Barford St Martin	411		2	2	
Christchurch	61,168			0.25	
Downton	5,646		1	0.5	0.25
East Knoyle	721		1	1	0.5

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits		
			Historical	PR24	
			Permit (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Fordingbridge	10,557		1	0.5	0.25
Fovant	1,442		1	1	0.5
Great Wishford	2,222		1	1	0.25
Hurdcott	3,870		1	1	0.25
Marden	871		2	1	0.5
Netheravon	2,099		1	1	0.25
Pewsey	8,338		1	0.5	0.25
Ratfyn	13,003		1	0.5	0.25
Ringwood	18,640		1	0.5	0.25
Salisbury	69,420		1	0.5	0.25
Shrewton	2,040		1	1	0.25
Stanton St Bernard	167			1	
Tisbury	4,854		1	1	0.25
Upavon	1,228		1	1	0.5
Warminster	25,480	Y	0.5	0.5	0.25

There are 37 WRCs within the Hampshire Avon catchment, of which 32 discharge to water bodies under the remit of the Environment Act. Christchurch WRC, discharging into Christchurch Harbour is the sole WRC within the LURB area but not within the Environment Act. The other WRCs are either groundwater discharge sites or coastal discharges.

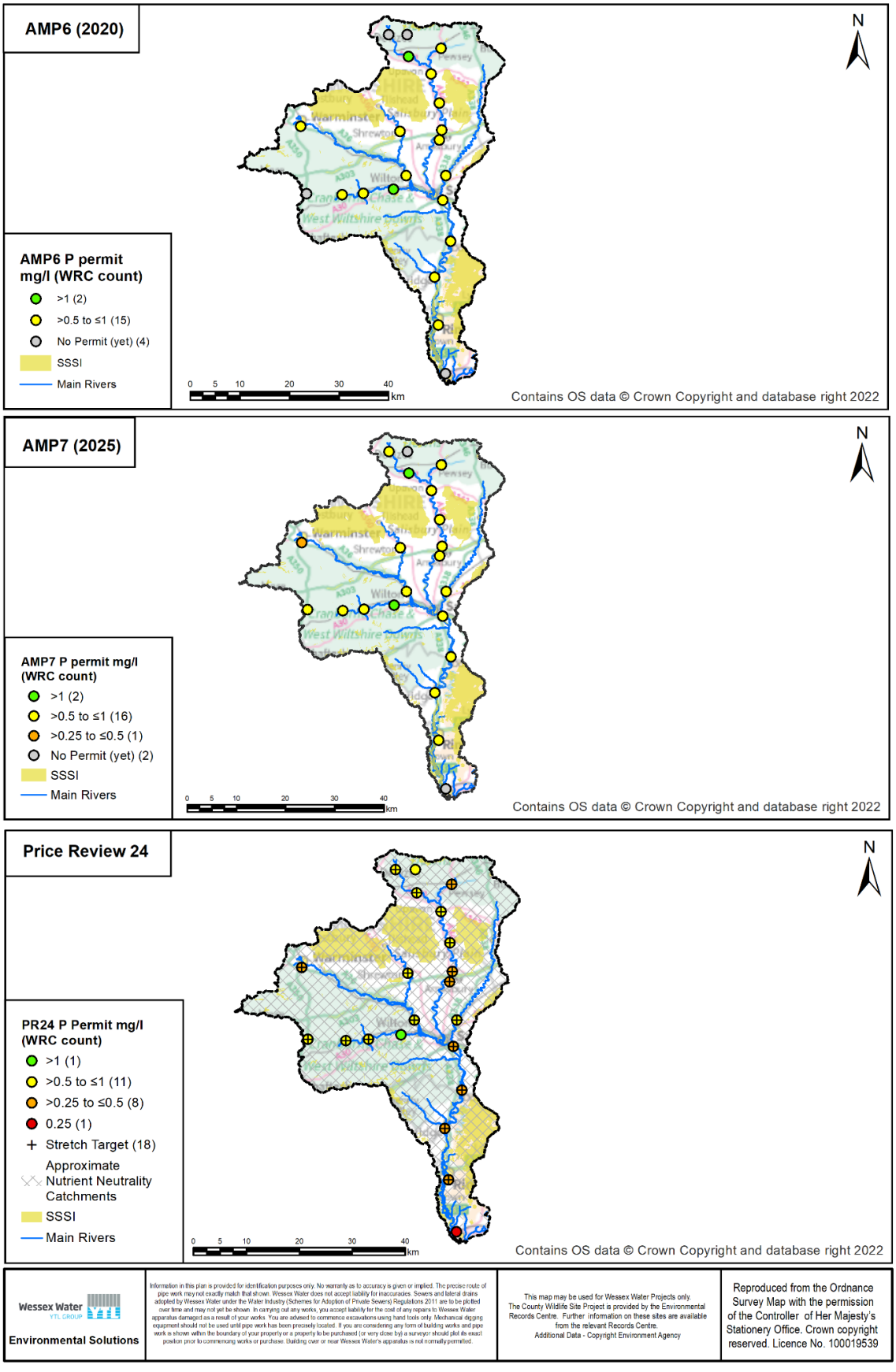
In the development of the PR19 WINEP, five WRCs had been identified as requiring improvements to mitigate the impact of sewage effluent discharges on nitrate concentrations in groundwater. Effluent discharging to ground will make its way ultimately to nearby watercourses, although the rate will depend on a number of factors, such as groundwater levels and location of the winterbourne head.

We felt there was significant uncertainty at each of these sites as to both the extent of, and mechanisms involved in, potential nitrate groundwater contamination. We also felt that the capital and ongoing costs were disproportionate to the size of the works. It was agreed with the EA to undertake investigation work during AMP7, reviewing available evidence, undertaking targeted monitoring and, where appropriate, trialling new technologies to assess the impacts of these discharges and allowing evidence-based decision making to inform works required for PR24. Alongside this investigation work, it was proposed to undertake catchment management in the surrounding area to offset the impact whilst the investigation is completed. The AMP7 investigation concluded that of the original five WRCs, only two had an impact to groundwater, with improvements proposed through PR24 as shown in Table 36.

Table 36 – WRCs with nitrogen removal in Hampshire Avon

Site	PE	Recently upgraded (AMP7)	Nitrogen Limits	
			Historical	PR24
			Permit (mg/l)	Enhanced Permit (mg/l)
Collingbourne Ducis	1,403			9.5
Maiden Bradley	326			15.5

Figure 61 - Locations of WRCs with phosphorus limits in Hampshire Avon catchment



6.2.6. Dorset Stour

The River Stour flows from its source at Stourhead south to the coast at Christchurch Harbour. It passes through Gillingham, before being joined by the River Cale and the River Lydden from the west and onto Sturminster Newton and Blandford Forum. The River Allen drains the north east of the catchment and joins the Stour before it flows to Bournemouth and then on to Christchurch Harbour. The geology in the north and the west of the catchment is predominantly clay and limestone. As the river flows to Blandford Forum it crosses into an area of chalk geology until just before the river reaches Bournemouth, where the geology moves into areas of clay and sandstone.

The Dorset Stour contains some of our larger works, including Holdenhurst and Palmersford WRCs. Many of the tributaries to the Stour are over chalk substrates, however, because much of the Stour's course itself is across clay soil there is a considerable seasonal variation in water levels. Low water level in summer makes the river a diverse and important habitat, supporting many rare plants. In winter, the river often floods, and is therefore bordered by wide and fertile flood plains.

Our PR19 Business Plan included for catchment permitting (CP) with the Dorset Stour catchment with backstop permits in AMP7 and stretch targets through PR24, and also catchment nutrient balancing (CNB), with both combined achieving our WFD objectives and all other known legislation/guidance as defined at the time. Operating Techniques Agreements (OTAs) for both CP and CNB have been agreed and signed between Wessex Water and the EA. We have already begun ramping up CNB in AMP7. Our PR19 plan envisaged that the CP stretch targets, however, would come into effect from December 2027, although the developed OTA requires a three year trial from January 2025 – December 2027.

Subsequent legislation and change in regulatory guidance for PR24 means we are adapting what was proposed at PR19, to include for further tightening of some of these stretch targets. Given that CNB is not valid to contribute to EnvAct requirement – which requires improvements to specific point source discharges – it will be phased out from the end of AMP8, to align with delivery of WRC-based improvements through PR29 for EnvAct regulatory dates (not included in the below table). Some of the WFD stretch targets may also require further tightening through PR29 to help achieve EnvAct catchment load targets.

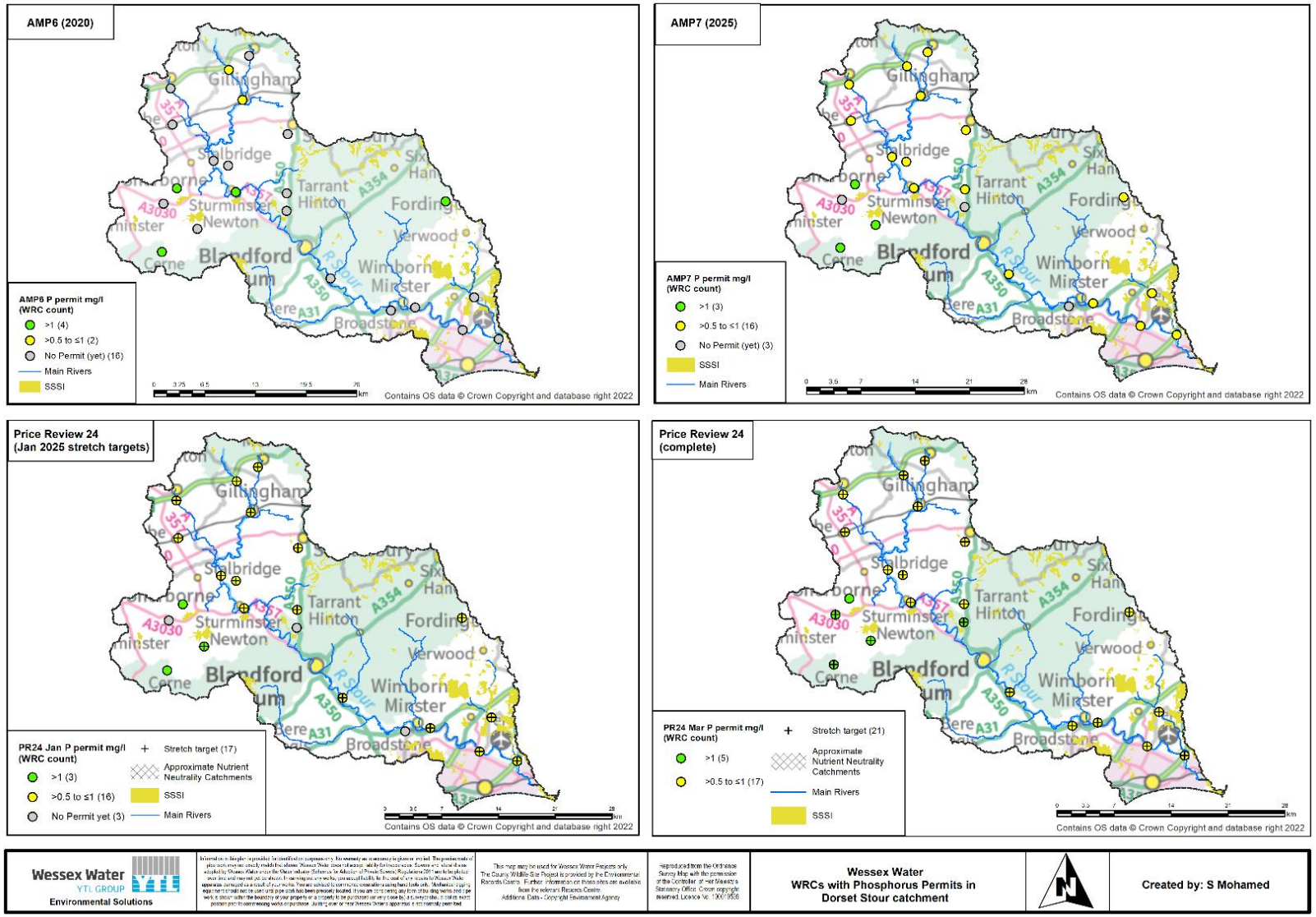
Table 37 lists WRCs within the Dorset Stour catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 62.

Table 37 – WRCs with phosphorus removal in Dorset Stour

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits			
			Historical	PR24		
			Permit (mg/l)	Initial Stretch Target (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Bishops Caundle	420				1.5	0.8
Bourton	1,774		1	0.8	1	0.8
Buckland Newton	435		4		4	1
Corfe Mullen	8,775				1	0.8
Cranborne	787	Y	1	0.8	1	0.8
Gillingham	15,418		1	0.8	1	0.8
Hazelbury Bryan	970	Y	1.5	0.8	1.5	0.8
Holdenhurst	174,681	Y	1	0.65	1	0.25
Iwerne Minster	1,358	Y	1	0.8	1	0.8

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits			
			Historical	PR24		
			Permit (mg/l)	Initial Stretch Target (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Kinson	48,793	Y	1	0.65	1	0.5
Marnhull	641	Y	1	0.8	1	0.8
Marnhull Common	7,091	Y	1	0.8	1	0.8
Mere	3,660	Y	1	0.8	1	0.8
Palmersford	45,704	Y	1	0.65	1	0.5
Shaftesbury	16,941	Y	1	0.8	1	0.8
Shroton	428				1.5	0.8
Stourton Caundle	328		1.5		1.5	
Sturminster Newton	9,458	Y	1	0.8	1	0.8
Tarrant Crawford	24,853	Y	1	0.8	1	0.8
Templecombe	1,722	Y	1	0.8	1	0.8
Wimborne	26,399	Y	1	0.8	1	0.8
Wincanton	8,751	Y	1	0.8	1	0.8

Figure 62 - Locations of WRCs with phosphorus limits in Dorset Stour catchment



6.2.7. Poole Harbour

The Poole Harbour catchment is approximately 832km^2 in area and contains two major rivers – the River Frome and the River Piddle. The Frome flows from its source at Evershot through Maiden Newton to Dorchester, on to Wareham and to Poole Harbour. The River Piddle rises at Alton Pancras and flows southeast to Wareham and meets Poole Harbour just north of the mouth of the River Frome. Both of the major rivers have several tributaries and there are also several small streams that flow directly into Poole Harbour.

The catchment geology is predominantly chalk at the top of the catchment, with clays and sandstone towards the bottom of the catchment, around Poole Harbour. The largest urban area within the catchment is Poole, although some of the town is found within the River Stour catchment. Other urban areas include Dorchester and Wareham.

Poole Harbour is one of the largest and shallowest natural harbours in the world and is of exceptional ecological value. Central to this are the intertidal mudflats, sandflats and marshes and the diversity of the shoreline ranging from reed and marsh to sand and shingle. The harbour is a transitional water body and also a 'protected area', the latter due to its Special Protection Area and Ramsar designations. The intertidal habitats and coastal waters of Poole Harbour are of international nature conservation importance.

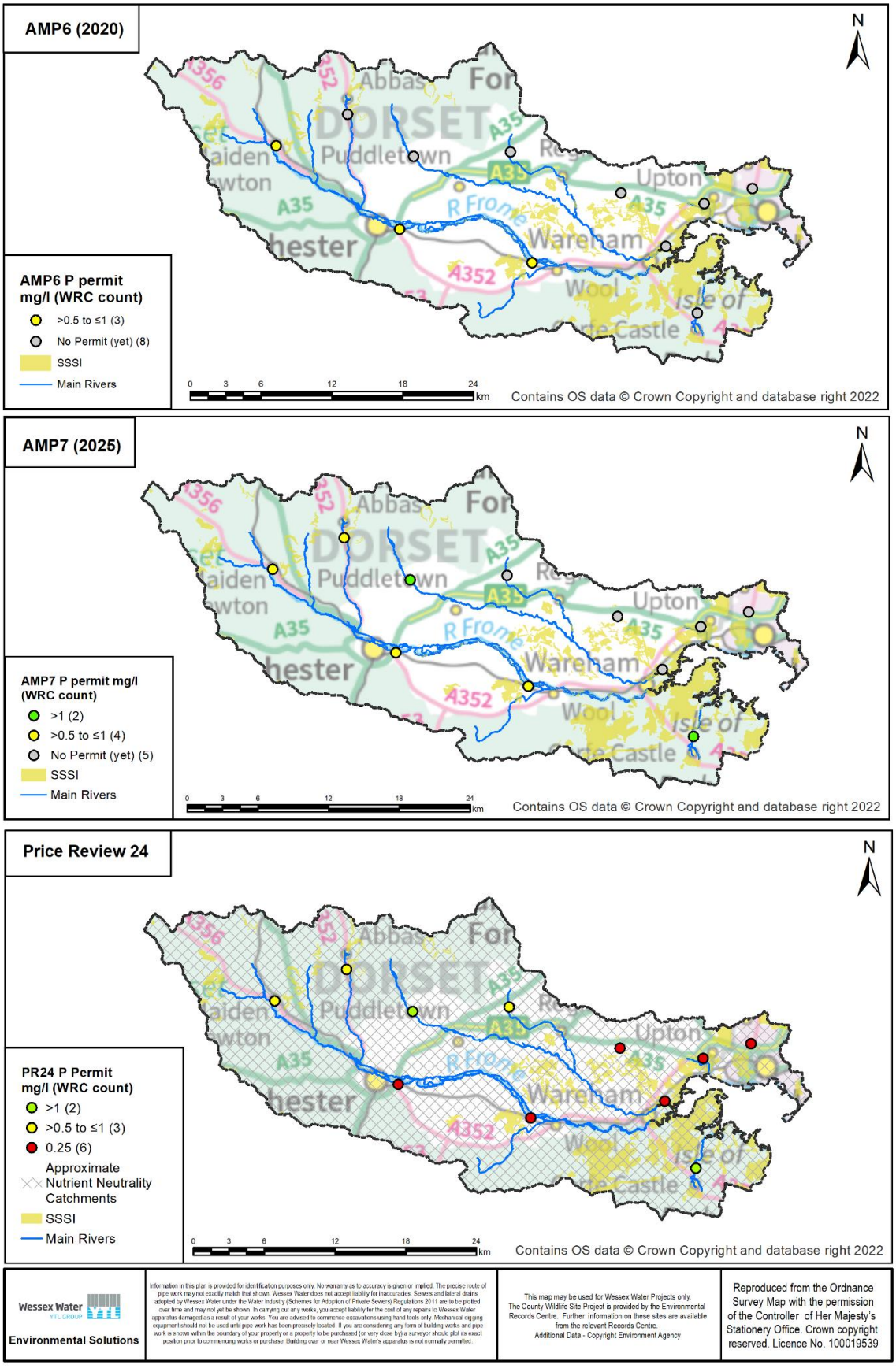
WRCs within Poole Harbour have been identified as requiring phosphorus and/or nitrogen removal.

Table 38 lists WRCs within the Poole Harbour catchment with existing (on completion of AMP7) or proposed phosphorus and nitrogen removal through PR24. Locations are shown on Figure 63 on the following page.

Table 38 – WRCs with phosphorus and nitrogen removal in Poole Harbour

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits		Nitrogen Limits	
			Historical	PR24	Historical	PR24
			Permit (mg/l)	Enhanced Permit (mg/l)	Permit (mg/l)	Enhanced Permit (mg/l)
Blackheath	6,445			0.25		10
Cerne Abbas	1,002	Y (P)	1	1		
Corfe Castle	1,640	Y (P)	1.3	1.3		
Dorchester	35,749	Y (P)	0.7	0.25		10
Lytchett Minster	8,714			0.25		10
Maiden Newton	1,726		1	1		
Milborne St Andrew	1,766			1		
Piddlehinton	1,122	Y (P)	4	4		
Poole	173,870			0.25	10	5
Wareham	12,978	Y (N)		0.25	15	10
Wool	8,126		1	0.25		10

Figure 63 - Locations of WRCs with phosphorus limits in Poole Harbour catchment



6.2.8. West Dorset

The West Dorset catchment contains all the watercourses that meet the sea along the south coast of Dorset. The nature of the catchment means that the watercourses are generally short in length and the total catchment area is 393km^2. The main watercourses include the River Brit, the River Bride, and the River Wey. The catchment also contains the Fleet Lagoon, which is a saline lagoon to the west of Weymouth.

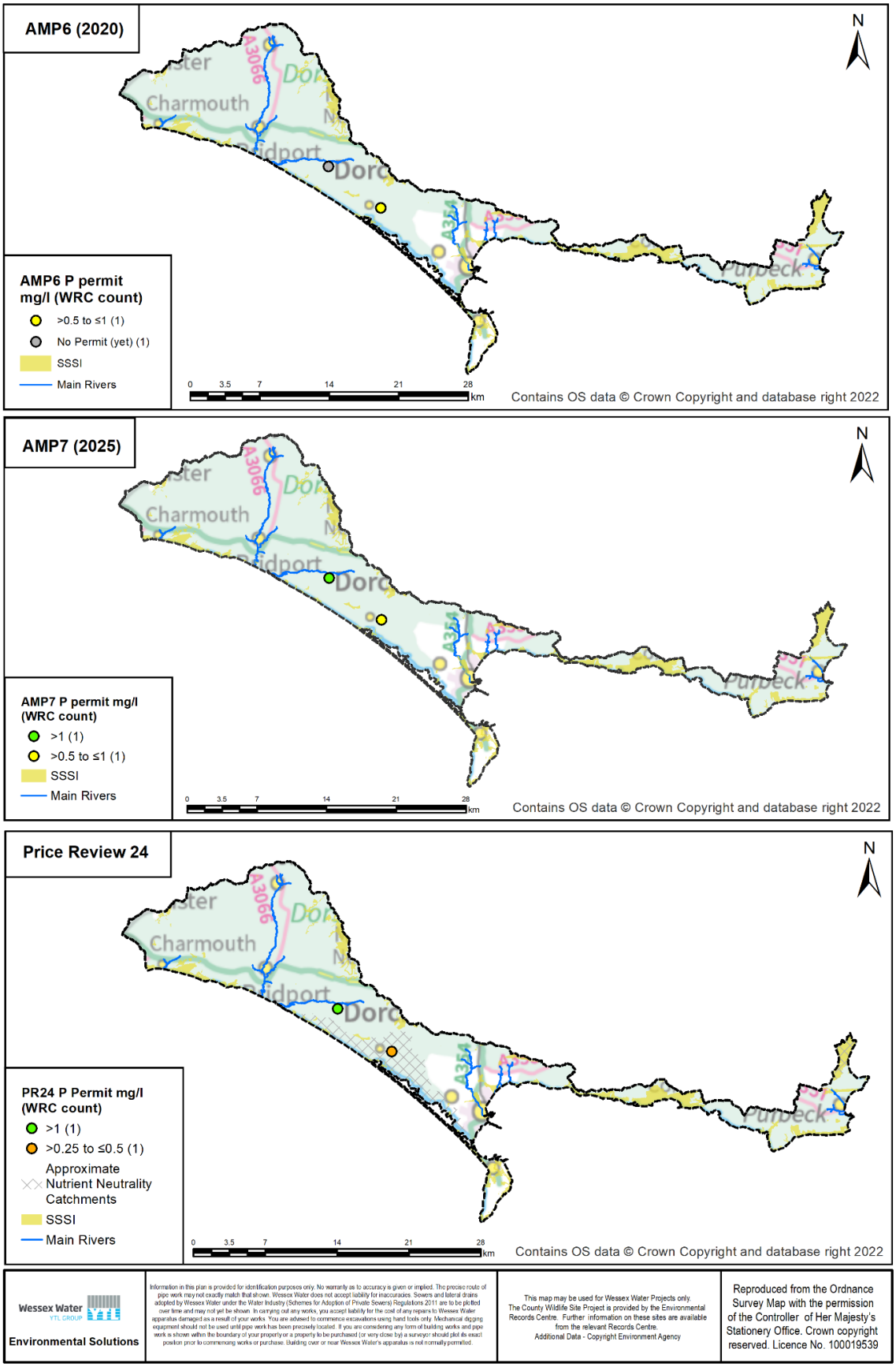
The geology of the catchment is clays with some sandstone and limestone areas. Part of the catchment, around Weymouth and the Fleet, is a Nitrate Vulnerable Zone (NVZ). The urban areas to note are Bridport, Weymouth, Portland, and Swanage.

Table 39 lists WRCs within the West Dorset catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 64 on the following page.

Table 39 – WRCs with phosphorus removal in West Dorset

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits	
			Historical	PR24
			Permit (mg/l)	Enhanced Permit (mg/l)
Abbotsbury	1,162		0.81	0.5
Puncknowle	1,327	Y	2.5	2.5

Figure 64 - Locations of WRCs with phosphorus limits in West Dorset catchment



6.2.9. Parrett

The River Parrett catchment is a large river system predominantly in Somerset, with the source in Dorset. The river flows northwest towards the Bristol Channel and meets the sea at Burnham-on-Sea. The catchment is an area approximately 1,600km2 and the River Parrett is 60km long. It is tidal for 43km, to just upstream of Burrowbridge at Oath.

The major tributaries include the River Isle which flows from the west and joins the Parrett just south of Langport. The River Yeo flows through Sherborne and Yeovil from the east and joins the Parrett south of Langport, just downstream from the Isle confluence. The River Tone flows from the most westerly point of the catchment, through Bradford-on-Tone and Taunton to join the Parrett at Burrowbridge.

The geology is predominantly clay with some small areas of chalk in the headwaters and bands of limestone. The catchment is mainly rural with steep upper sections and very flat lower sections, which form part of the Somerset Levels. The Somerset levels are prone to flooding, especially between Burrowbridge and Bridgwater. This low-lying land has had ditches and rhines dug across it to aid drainage, which has resulted in a complex system of waterways. The land use is predominantly agricultural, with the largest urban areas being Taunton, Yeovil, and Bridgwater.

Our PR19 Business Plan included for catchment permitting (CP) with the Parrett (& Tone) catchment with backstop permits in AMP7 and stretch targets through PR24, and also catchment nutrient balancing (CNB), with both combined achieving our WFD objectives and all other known legislation/guidance as defined at the time. Operating Techniques Agreements (OTAs) for both CP and CNB have been agreed and signed between Wessex Water and the EA. We have already begun ramping up CNB in AMP7. Our PR19 plan envisaged, however, that the CP stretch targets would come into effect from December 2027, although the developed OTA requires a three year trial from January 2025 – December 2027.

Subsequent legislation and change in regulatory guidance for PR24 means we are adapting what was proposed at PR19. Given that CNB is not valid to contribute to EnvAct or LURB requirements – with both requiring improvements to specific point source discharges – it will be phased out in the latter stages of AMP8 to align with delivery of WRC-based improvements for LURB regulatory dates. Furthermore, some of the initial WFD stretch targets will be superseded later in the AMP by more stringent permits, although some sites will see their stretch targets retained.

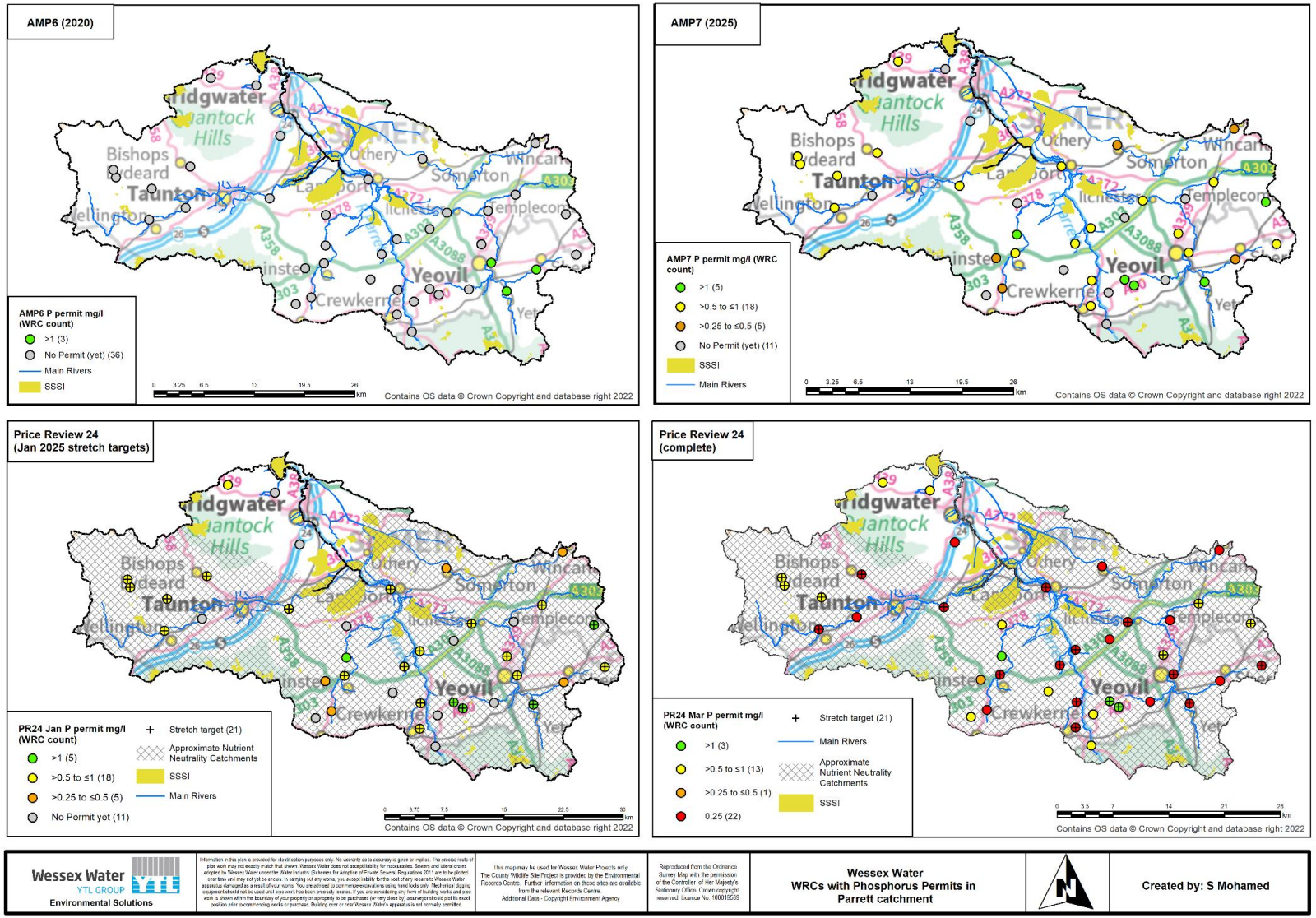
Table 40 lists WRCs within the Parrett catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 65.

Table 40 – WRCs with phosphorus removal in Parrett

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits			
			Historical	PR24		
			Permit (mg/l)	Initial Stretch Target (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Bishops Lydeard	2,541	Y	1	0.8	0.25	-
Bradford-On-Tone	1,435				0.25	
Broadway	1,473	Y	0.5		0.5	
Cannington	4,469				1	
Castle Cary	4,599	Y	0.5		0.25	
Chard	16,677	Y	0.5		0.25	

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits			
			Historical	PR24		
			Permit (mg/l)	Initial Stretch Target (mg/l)	Enhanced Permit (mg/l)	Enhanced Stretch Target (mg/l)
Charlton Horethorne	557	Y	1.5	1	1	-
Combe St Nicholas	1,059				1	
Crewkerne East	7,869	Y	1	0.8	0.25	-
East Chinnock	464	Y	1.5	1	1.5	1
East Coker	3,959				0.25	
Fivehead	1,125				1	
Hardington Mandeville	504	Y	1.5	1	1.5	1
Haselbury Plucknett	952				1	
Hornsey Bridge	1,522				0.25	
Ilchester	2,766	Y	1	0.8	0.25	-
Ilminster	8,612	Y	1	0.8	0.25	-
Ilton	1,008	Y	5		5	
Langport	10,002	Y	1	0.8	0.25	-
Longbridge	1,358				1	
Martock	9,743	Y	1	0.8	0.25	-
Merriott	3,938	Y	1	0.8	0.25	-
Milborne Port	5,446	Y	1	0.8	0.25	-
Milverton	1,720	Y	1	0.8	1	0.8
Nether Stowey	2,206	Y	1		1	
North Petherton	4,252				0.25	
Sherborne	13,725	Y	0.5		0.25	
Somerton	9,200	Y	0.5		0.25	
South Perrott	853				1	
South Petherton	6,390	Y	1	0.8	0.25	-
Sparkford	1,938	Y	1	0.8	1	0.8
Taunton	97,815	Y	1	0.8	0.25	-
Thornford	5,578		1.5	1	0.25	-
Tintinhull Ash	1,505				0.25	
Wellington	19,447	Y	1	0.8	0.25	-
Wiveliscombe - Hillsmoor	1,812	Y	1	0.8	1	0.8
Wiveliscombe - Styles	1,501	Y	1	0.8	1	0.8
Yeovil	63,485	Y	0.59	0.55	0.25	-
Yeovil Without	1,828	Y	1	0.8	0.25	-

Figure 65 - Locations of WRCs with phosphorus limits in Parrett catchment



6.2.10. West Somerset

The West Somerset catchment is predominantly rural with many streams and small rivers flowing north to the Bristol Channel, draining an area of approximately 367km^2. The nature of the catchment means that the streams and rivers are short in length and quickly reach the coast. Many are fast flowing streams that respond rapidly to rainfall. The geology is mainly clays and sandstone. The impermeable nature of the catchment contributes to the rapid response of the streams to rainfall. The largest urban area in the catchment is Minehead.

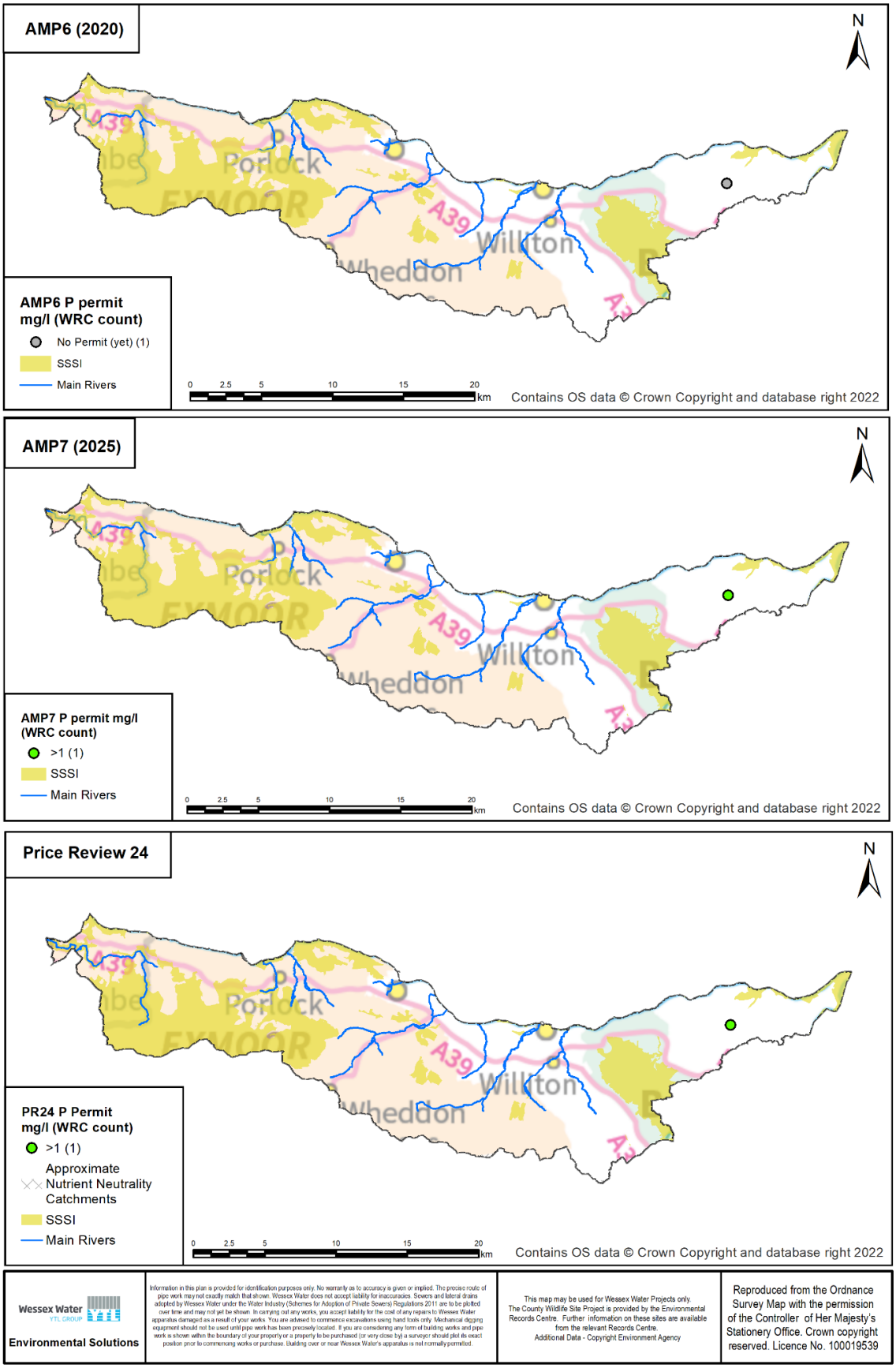
We are not proposing any additional phosphorus removal in the West Somerset catchment as part of PR24.

Table 41 lists the single WRC within the West Somerset catchment with existing (on completion of AMP7) phosphorus removal. Its location is shown on Figure 66 on the following page.

Table 41 - WRCs with phosphorus removal in West Somerset

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits	
			Historical	PR24
			Permit (mg/l)	Enhanced Permit (mg/l)
Stogursey	1,094	Y	2.1	2.1

Figure 66 - Locations of WRCs with phosphorus limits in West Somerset catchment



6.2.11. Brue and Axe

The Brue and Axe catchment contains the Rivers Brue, Axe, and their tributaries. The River Brue rises near North Brewham and flows west for 50km through Bruton and Glastonbury, then across the Somerset Levels to Burnham-on-Sea. To the southwest of Wells, the Brue is joined by the River Sheppey, which flows from Shepton Mallet. The catchment also contains the South Drain which flows from Street into the Huntspill River and reaches the sea south of Burnham. The River Axe begins at Wookey Hole where it flows out through the limestone and on towards Wookey, where the channel splits in two. The channels flow through an area containing many rhines and ditches before they re-join and continue on to Cheddar, Loxton and finally reach the sea at Weston-Super-Mare, where it flows into the SSSIs at Bridgwater Bay and the Severn Estuary.

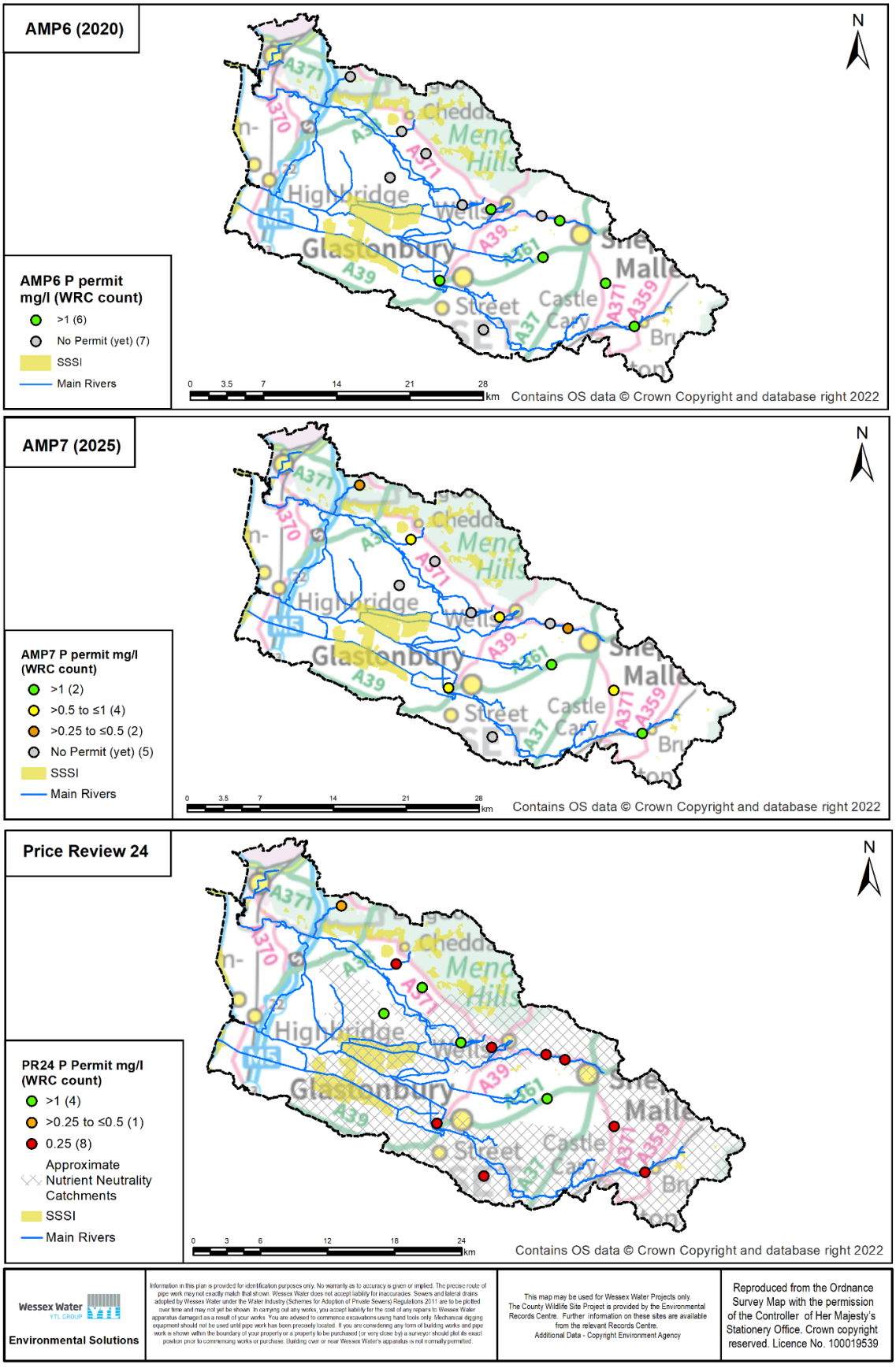
The catchment is complex containing many channels, drains and ditches. Some are natural, some man-made, and some modified, whilst many channels are interconnected in a complex drainage system. The water levels and flows are managed by the Internal Drainage Board to deliver a number of outcomes including reducing flood risk, provide drainage and provide animal watering. The geology is predominantly clay soils with some limestone areas to the northeast of the catchment. The major towns in the catchment are Wells, Glastonbury and Shepton Mallet.

Table 42 lists WRCs within the Brue and Axe catchment with existing (on completion of AMP7) or proposed phosphorus removal through PR24. Locations are shown on Figure 67 on the following page.

Table 42 – WRCs with phosphorus removal in Brue and Axe

Site	PE	Recently upgraded (AMP7)	Phosphorus Limits	
			Historical	PR24
			Permit (mg/l)	Enhanced Permit (mg/l)
Bruton	3,690		2	0.25
Butleigh	2,913			0.25
Cheddar	10,584	Y	0.7	0.25
Croscombe	620			0.25
Draycott	1,336			2
Evercreech	3,009	Y	1	0.25
Glastonbury	28,201	Y	0.8	0.25
Pilton	698		2	2
Shepton Mallet	42,324	Y	0.35	0.25
Wedmore	1,865			1.5
Wells	18,326	Y	1	0.25
Winscombe	4,469	Y	0.5	0.5
Wookey	1,207			1.5

Figure 67 - Location of WRCs with phosphorus limits in Brue and Axe catchment



6.2.12. North Somerset

The North Somerset catchment includes the Congresbury Yeo and the River Kenn. The Congresbury Yeo rises at its source in Compton Martin before it enters Blagdon Lake (a SSSI), then flows on to Congresbury and across the Somerset Levels. The river is joined along its course by both natural and manmade tributaries. The river joins the sea at Wick St Lawrence, just south of Clevedon, and flows into the Severn Estuary SSSI which is also a SPA and Ramsar site. The River Kenn flows from the source, west of Dundry to the sea at Clevedon. The river flows through the SSSI at Tickenham, Nailsea and Kenn Moor and into the Severn Estuary SSSI. The geology is predominantly clay soils with some limestone areas. The major towns in the catchment are Weston-Super-Mare, Nailsea, Portishead and Clevedon.

We are not proposing any additional phosphorus removal in the North Somerset catchment as part of PR24.

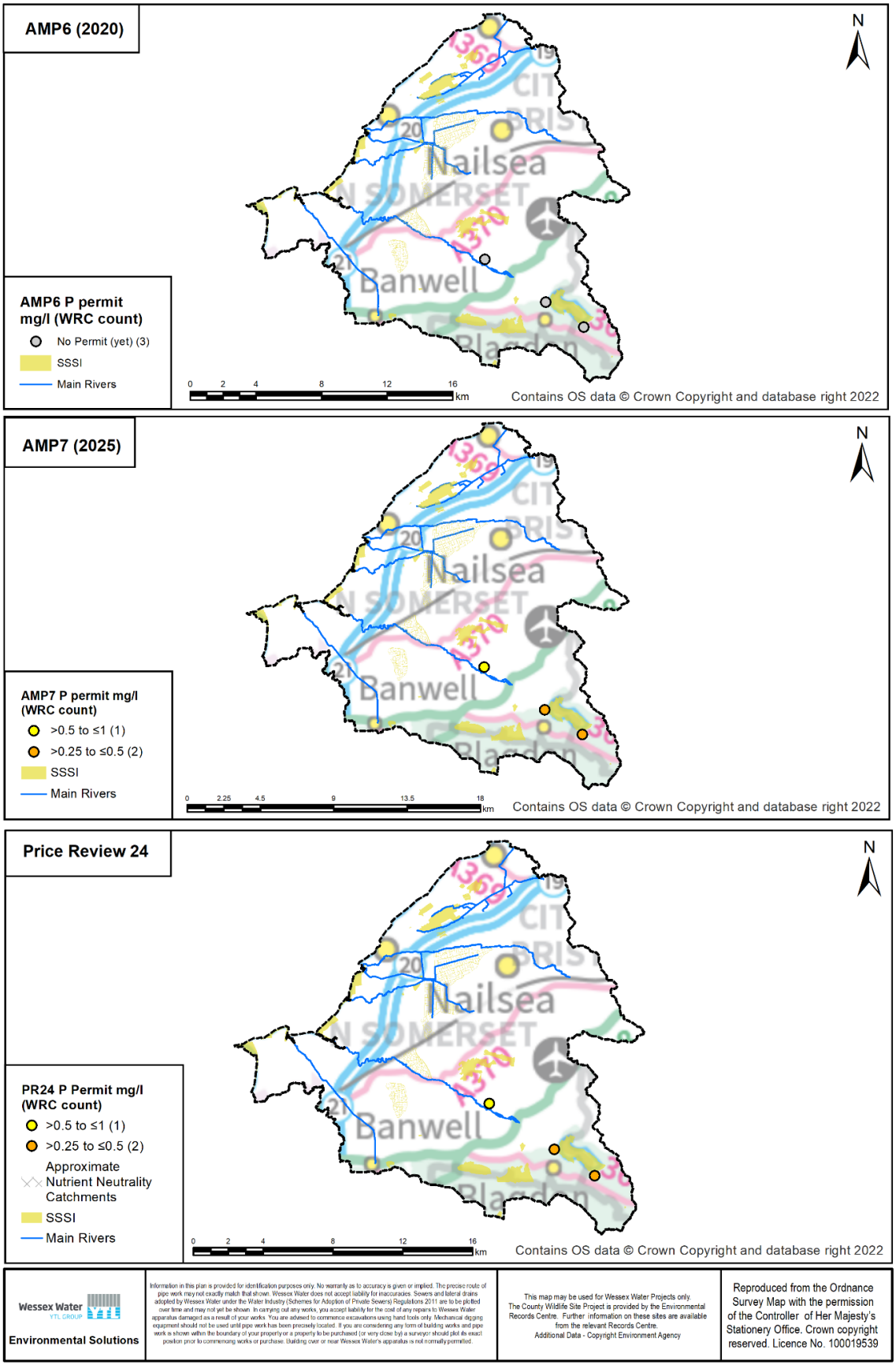
Table 43 lists WRCs within the North Somerset catchment with existing (on completion of AMP7). Locations are shown on Figure 68 on the following page.

Table 43 - WRCs with phosphorus removal in North Somerset

Site	PE	Recently upgraded (AMP7?)	Phosphorus Limits	
			Historical	PR24
			Permit (mg/l)	Enhanced Permit (mg/l)
Blagdon	1,053	Y	0.5	0.5
Ubley	1,065	Y	0.5 (See below)	-
Wrington	2,593	Y	1	1

Ubley WRC is being converted in AMP7 to a pumping station and closed as a WRC, with flows transferred for treatment at Blagdon WRC to the equivalent phosphorus standard.

Figure 68 - of WRCs with phosphorus limits in North Somerset catchment



6.2.13. Robust and efficient costs

We have worked with suppliers and contractors to develop a range of standardised designs for phosphorus removal elements that are common across several different sites, such as chemical delivery areas, chemical dosing rigs, flocculation tanks and tertiary filters. Where appropriate, we have promoted the off-site manufacturing of package plants, as this significantly reduces overall costs from subsequent efficiencies in site construction work, as shown in Figure 69 below.

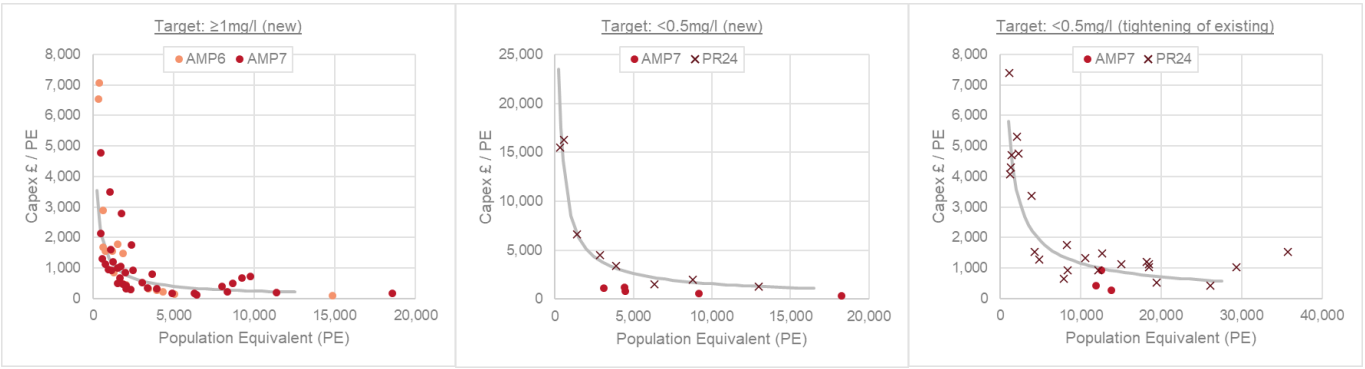
Figure 69 - Left: Dosing kiosk being lifting into position onto concrete plinth, Right: Dosing kiosk in location with nearby emergency shower

This standardised approach to phosphorus removal schemes streamlines delivery, realising programme and cost savings. This approach also ensures that we focus on site specific requirements to deliver the most cost beneficial solution at each site.

Both capex and opex costs have been derived through a mixture of bottom-up estimates cost models and cost curves. A representative sample of solutions covering a range of technology types, sizes and complexities have been bottom-up costed by our in-house estimating team and third-party estimators, to inform the cost models and cost curves. Operational costs have been reviewed at an appropriate scale which reflects the level of detail of the capital costing, including deriving breakdowns between maintenance, labour, power, sludge, chemical usage, and business rates, and calibrating through actual site-based opex costs.

For other PR24 phosphorus removal schemes, cost curves have been developed based off historic out-turn costs (AMP6 and AMP7 to date) and the specific PR24 cost estimates. These cover a range of options, such as one-point (front-end) chemical dosing and two-point (front-end and back-end) chemical dosing with tertiary treatment; refer to Figure 70. Our standardised approach facilitates this cost curve approach.

Figure 70 - Cost curves for phosphorus removal



The costing approach for newer technologies, including green assets such as Integrated Constructed Wetlands has been carried out by external consultancies as well as internal estimating to provide a more robust range.

Carbon valuations have again been provided by an external consultancy (Mott MacDonald) using industry standard data and assumptions.

ChandlersKBS were engaged to provide cost estimates for cost assurance benchmarking. They also reviewed our costing approach for many areas of the plan, including our phosphorus removal and wider WINEP programmes.

For our overall wastewater treatment programme (see WSX45 – Annex A4-3), they concluded that:

> *Due to the level of scope definition provided at Business Planning stage, we would identify the estimate class, as defined by the Association for the Advancement of Cost Engineering (AACE), as a Budgetary Estimate or Class 3 and, therefore, an expected accuracy range of between -20% and +30% to the outturn cost.*
>
> *Based on the AACE classification, the ChandlerKBS and Wessex Water accuracy ranges overlap which indicates a high probability of the outturn costs falling in this range. Therefore, the estimates can be deemed to be robustly efficient for Business Planning.*

They also provided a statement of robustness for the cost modelling process and methodology utilised by Wessex Water to estimate the WINEP and Growth programmes (see WSX45 – Annex A4-2):

> *The Waste Water Treatment cost models should be treated as having a moderate confidence in their cost output, particularly for the design stage. The cost models are based upon historical costs incurred by Wessex Water which may not reflect future costings. As the programme and solution designs progress, the cost models should be revised following the same methodology to maintain the high cost confidence and efficiency.*
>
> *The processes and methodologies used to derive the cost models for the Waste Water Treatment programmes were evidently robust and considered to be appropriate for producing efficient costs for the PR24 Business Plan.*

6.2.14. Customer Protection

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment(s) and/or price control deliverable(s):

- PC17 Discharge permit compliance
- PC19 River water quality (phosphorus)
- PCDWW9 Treatment for total nitrogen removal
- PCDWW10 Treatment for phosphorus removal

WINEP delivery is also a metric within the EA’s annual Environmental Performance Assessment.

6.3. Sanitary Drivers

6.3.1. Need for Investment

Context

Sanitary parameters include Ammonia, Biological Oxygen Demand (BOD) and Suspended Solids.

Ammonia Impact

Ammonia can be toxic to aquatic wildlife. A high build up in the watercourse can reduce the ability of aquatic wildlife to excrete ammonia produced within their own bodies. This in turn can cause stress, gill and organ damage affecting ability to breath and can lead to death.

BOD and Suspended Solids Impact

BOD is a method of measuring organic pollutants. It is the amount of oxygen required by biological organisms to break down the organic material over a specified time period which is normally 5 days. Organic pollution therefore reduces oxygen levels in the watercourse whilst the bacteria break down the organic matter. If excessive this can lead to insufficient oxygen levels available to support the normal plants and wildlife present.

Gross contamination can lead to anaerobic conditions leading to sewage fungus. Bacteria then present will be anaerobic and can produce unpleasant odours and gases such as methane, hydrogen sulphide and ammonia. At this stage the ecosystem is unlikely to have sufficient flora and fauna to regenerate oxygen through photosynthesis.

The organic proportion of suspended solids are likely to contribute to the BOD value. They also, however, contain an inorganic portion, this can lead to silt build up in watercourses reducing water levels and flow. Inorganic suspended solids may also contain toxic substances such as metals although these generally have a separate permit limit.

Regulatory Drivers

Under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (the 'WFD Regulations'), environmental objectives have been set for all water bodies in England. These objectives include status objectives for each water body and a requirement to prevent deterioration of status. Once published in the river basin management plans (RBMP) these objectives are legally binding.

The WFD_ND driver is used to identify actions to prevent deterioration of water quality elements within receiving water bodies, due to Water Recycling Centre (WRC) effluent discharges. Actions can be identified under the 'prevent deterioration' driver when:

- There is an actual deterioration of status of a water quality element within a water body at the 2021 baseline, when compared to the 2015 baseline. This is where deterioration has been identified and attributed to the permit, or to growth at a water company discharge location. The water body must be restored back to the 2015 baseline, or
- There is growth prediction that is certain or probable by 2035 and the associated discharge load increase (within permit headroom) is certain to cause a failure or unacceptable further deterioration in either the 2015 or 2021 baseline status, or
- Elements that comprise ecological status are in the lowest status class; actions should be identified to prevent any further deterioration of that element.

A related driver is U_IMP7, which requires that septic tanks that discharge to surface water are replaced or upgraded to secondary treated sewage effluent discharges (equivalent to 40:60 BOD:suspended solids standard) to satisfy the requirements of Government Policy on small sewage discharges to surface waters and the Urban Wastewater Treatment Regulations (UWWTR). When the General Binding Rules and Rule 6 came into effect the ambition was for compliance to be achieved by 2020, although this did not align with the PR19 WINEP process, hence inclusion in the PR24 WINEP.

6.3.2. Options Development

Sites requiring improvement

The following sites have been identified under the WFD_ND driver as requiring a tightening of permit standards due to actual deterioration or predicted deterioration due to forecast growth but are compliant with current permit conditions.

Table 44 – Sanitary reduction drivers at WRCs identified in PR24

WINEP ID	Driver Code	WRC	Parameter	Current Permit (95%ile mg/l)	PR24 Permit (95%ile mg/l)	Justification
08WW100250	WFD_ND	Blackheath WRC	AmmN	7	4.2	Growth
08WW100251	WFD_ND	Bowerhill WRC	BOD AmmN	14 5	8.5 2	Growth
08WW100200	WFD_ND	Cannington WRC	BOD AmmN	40 10	21 9	Growth
08WW100252	WFD_ND	Devizes WRC	AmmN	5	2.3	Growth
08WW100253	WFD_ND	Haselbury Plucknett WRC	AmmN	10	3.4	Growth
08WW100254	WFD_ND	Leyhill WRC	AmmN	10	3.8	WFD Class Deterioration
08WW100255	WFD_ND	North Petherton WRC	AmmN	8	5	Growth
08WW100256	WFD_ND	Potterne WRC	AmmN	8	3	Growth
08WW100206	WFD_ND	Ringwood WRC	BOD AmmN	20 10	17 8	Growth
08WW100257	WFD_ND	Royal Wootton Bassett WRC	AmmN	10	2.1	Growth
08WW100258	WFD_ND	South Perrott WRC	AmmN	10	6.6	Growth
08WW100259	WFD_ND	South Petherton WRC	BOD AmmN	15 5	5 2.4	Growth
08WW100260	WFD_ND	Sparkford WRC	AmmN	10	4	Growth

We have worked closely with the EA in the establishment and refinement of this list, particularly where the justification for a sanitary driver is forecast growth, to model an appropriate level of deterioration. We have also considered alignment where possible to other enhancement drivers, such as phosphorus removal.

The following septic tanks have been identified under the U_IMP7 driver as having primary (septic tank) only treatment and discharging to a surface water.

Table 45 – Septic tank improvements identified in PR24

WINEP ID	Driver Code	WRC	Catchment	Waterbody
08WW100210	U_IMP7	Ashwicke (Oakford Lane) WRC	Bristol Avon	St Catherines Bk - source to conf R Avon (Brist)
08WW100212	U_IMP7	Dunwear WRC	Parrett	PARRETT
08WW100213	U_IMP7	Lottisham (Fir Cottages) WRC	Brue Axe	Brue - Tootle Bridge to Clyse Hole

Unconstrained Options

Table 46 lists the range of unconstrained options initially considered when a WRC has been identified as requiring improvements.

Table 46 – Unconstrained Options

Option	Description
Modify consents/permits	Review/revise permits with the Environment Agency.
River catchment / dynamic permitting	Work with the EA to spread loading across the catchment, or seasonal/flexible permitting.
Tolerate	Site already achieving new permit requirements.
Optimise/Operate	Increase the efficient use of the existing capacity with the existing assets.
Treat/pre-treat in network	Reduce load transferred to the WRC, e.g., network chemical dosing.
Rationalisation/centralisation	Close smaller treatment works and transfer flows to a larger one.
De-centralisation	Remove flows from a treatment works and create localised treatment works.
Catchment management initiatives	Source Control – Treating either diffuse or point-source non-domestic elements of wastewater before they enter the sewer system
	Catchment Nutrient Balancing – Treating and controlling the other contributors to the environment.
Discharge Relocation	Relocate effluent discharge to remove/reduce the need for other enhancement.
Increase treatment capacity	Green – Nature based solutions, such as integrated constructed wetlands.
	Grey – Invest in new assets to provide additional capacity.

Constrained Options

Through a coarse screening exercise, a number of the unconstrained options were screened out due to either regulatory restrictions or technical unviability. BOD and AmmN degrade more rapidly than nutrients, and thus have more direct effect on the local ecology than further downstream. As such, adopting catchment permitting or catchment nutrient balancing offsetting is not feasible. The following constrained options have been assessed:

Tolerate / Operate / Optimise

In some cases, WRCs may already be regularly or occasionally achieving some or all of the future permit requirements. Targeted interventions to optimise existing asset performance could lead to more reliably achieving the new permit without substantial capital investment in the creation of new assets.

In many cases, however, this approach does increase the risk held by Wessex Water. Many sites do not have redundant process units and, with an ageing asset base, condition and performance would reasonably be expected to deteriorate more quickly as more reliance is placed on these units.

Rationalisation/centralisation (Transfer)

This option acknowledges that improvement and operational costs are generally disproportionately expensive at smaller WRCs and considers merging or relocating smaller WRCs to a larger common WRC to allow for economies of scale.

A screening assessment was undertaken to ascertain the feasibility of transferring flows to nearby WRCs, either directly to the WRC or indirectly by connecting somewhere in the sewerage catchment. This assessment took into consideration several factors, including:

- whether the destination WRC had capacity to accommodate the additional flows without requiring further improvement itself.
- whether removal/relocation of the WRC discharge could cause a deterioration to the local ecology of the local watercourse, as in some cases our continuous treated discharge comprises a significant proportion of the receiving river flows.

Catchment Management – Source Control

We routinely work with trade effluent customers to help them reduce both the flow and load of their effluent being discharged into our system. Trade effluent is generally more highly concentrated than domestic sewage, and so by more targeted and localised treat-at-source options this can reduce the need and/or scale of improvements required at the WRC. In most cases, however, for anything other than very dominantly contributing traders, treat-at-source options will likely only reduce rather than remove the need for improvements at the WRC itself, requiring increasing capacity needing to be considered in parallel.

To reduce both water consumption bills and trade effluent discharges, we are also seeing many traders exploring recycling their effluent on their site, such that their effluent discharges are of lower volumes but are of more highly concentrated loads. Furthermore, we have experience of trade effluent customers closing, reducing, or relocating away from WRCs, and as far as possible we consider modular type solutions if increased capacity at WRCs is required solely for trade effluent reasons.

Our assessment has concluded that no traders are sufficiently dominant to change the solution at the WRCs identified for the new permits.

Discharge Relocation

Consideration has been given to relocate all or part of the discharges from the WRCs to an alternative location, to remove or reduce the need for enhancement at the WRC itself.

Given the sensitivities of other local waterbodies and that most sites already discharge into the largest (and most dilute) waterbodies in the area, this option has not been progressed further.

A viable option (on paper) for the septic tanks is Discharge Relocation, with the potential for changing from the current discharge to surface water to an appropriate designed soakaway, although in all cases ground conditions mean that there is insufficient percolation for this to be technically viable. Some sites were historically soakaways but were converted to surface water discharges for this very reason.

Enhance treatment capacity

This option considers providing increased/enhanced treatment capacity at the WRC. We have considered traditional ‘grey’ solutions as well as more novel ‘green’ nature-based solutions, with the latter particularly acting as a tertiary ‘polishing’ treatment stage.

Ammonia, BOD, and suspended solids are generally treated in our WRCs through settlement and biological treatment and solids removal processes. Biological treatment is by providing an environment for naturally forming bacteria to cultivate and an oxygen source, normally air by air gaps, mechanical agitation, or introduction of compressed air. Tertiary solids removal processes can be nature-based solutions such as reed beds/grass plots/lagoons or mechanical filtration.

Technical Assurance/Benchmarking

We engaged Stantec UK Ltd. to undertake a technical review of our wastewater treatment programme, in particular a review of our internal guidance for the basis of design and technologies for future permits for our proposed PR24 interventions. The assessment guidelines include generic guidelines and solution technology assessment guidance for varying permit/treatment requirements including ammonia. Stantec provided feedback, affirming that our approach was consistent with the wider water industry. Further details can be found in WSX17 A2-1.

6.3.3. Robust and efficient costs

A representative sample of solutions covering a range types, sizes and complexities have been bottom-up costed, incorporating supplier quotes, to inform cost models and any assumptions used on other schemes.

Operational costs have been reviewed at an appropriate scale which reflects the level of detail of the capital costing, including deriving breakdowns between maintenance, labour, power, sludge, chemical usage, and business rates for greater granularity and understanding between options.

The costing approach for newer technologies, including green assets such as Integrated Constructed Wetlands has been carried out by external consultancies as well as internal estimating to provide a more robust range.

Carbon valuations have again been provided by an external consultancy (Mott MacDonald) using industry standard data and assumptions.

ChandlersKBS were engaged to provide cost estimates for cost assurance benchmarking. They also reviewed our costing approach for many areas of the plan, including our WINEP programme.

For our overall wastewater treatment programme (see WSX45 – Annex A4-3), they concluded that:

> *Due to the level of scope definition provided at Business Planning stage, we would identify the estimate class, as defined by the Association for the Advancement of Cost Engineering (AACE), as a Budgetary Estimate or Class 3 and, therefore, an expected accuracy range of between -20% and +30% to the outturn cost.*
>
> *Based on the AACE classification, the ChandlerKBS and Wessex Water accuracy ranges overlap which indicates a high probability of the outturn costs falling in this range. Therefore, the estimates can be deemed to be robustly efficient for Business Planning.*

They also provided a statement of robustness for the cost modelling process and methodology utilised by Wessex Water to estimate the WINEP and Growth programmes (see WSX45 – Annex A4-2):

> *The Waste Water Treatment cost models should be treated as having a moderate confidence in their cost output, particularly for the design stage. The cost models are based upon historical costs incurred by Wessex Water which may not reflect future costings. As the programme and solution designs progress, the cost models should be revised following the same methodology to maintain the high cost confidence and efficiency.*
>
> *The processes and methodologies used to derive the cost models for the Waste Water Treatment programmes were evidently robust and considered to be appropriate for producing efficient costs for the PR24 Business Plan.*

6.3.4. Customer Protection

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment(s) and/or price control deliverable(s):

- PC17 Discharge permit compliance
- PCDWW10 Treatment for phosphorus removal (as described in WSX26)

WINEP delivery is also a metric within the EA's annual Environmental Performance Assessment.

6.4. Chemicals

6.4.1. Need for Investment

The EA and Defra are developing a strategy for managing chemicals in surface waters, which is likely to suggest a balance between source control for widespread, accumulating chemicals and end of pipe treatment for chemicals with more localised impacts. The strategy has yet to be approved at ministerial level.

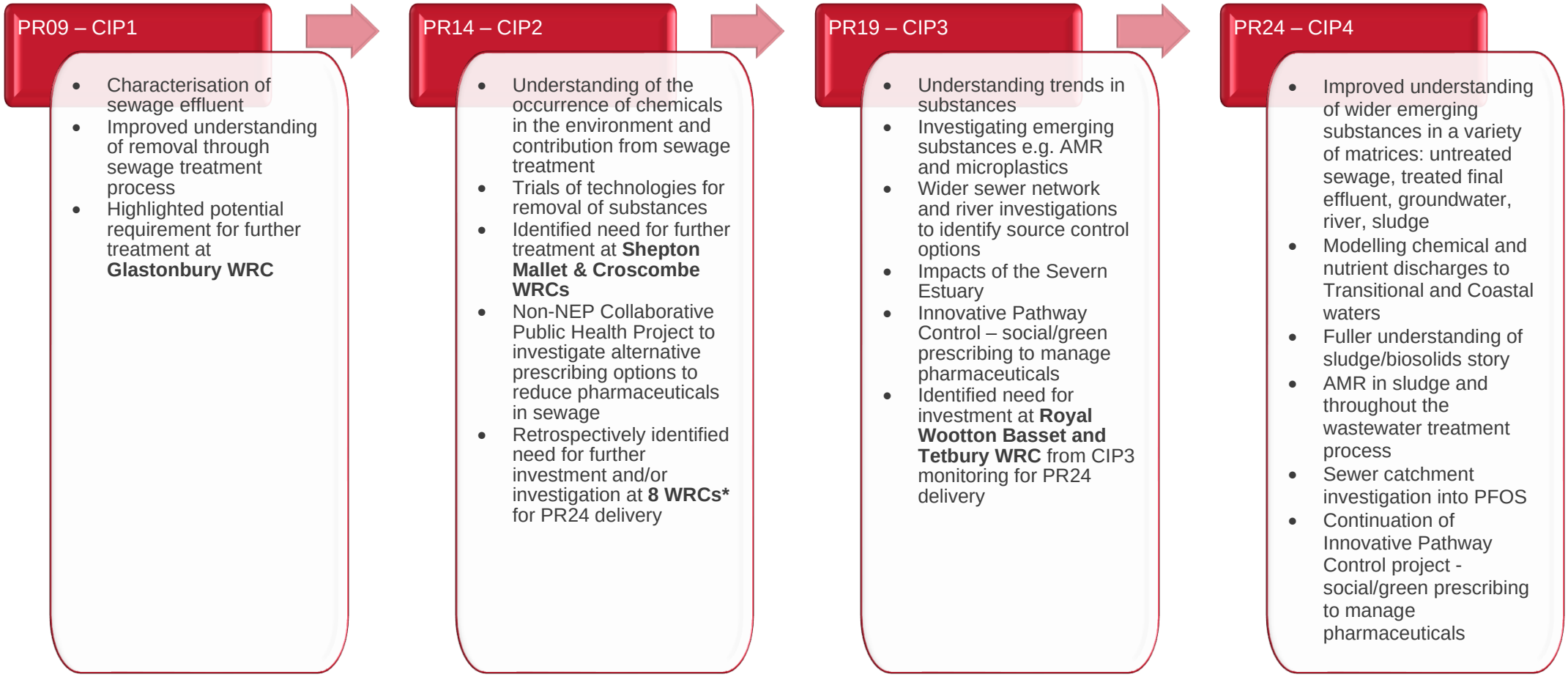
Water industry-wide investigations have been established to inform this strategy, and are supported through the WINEP (and NEP, as known previously). The Chemical Investigation Programme (CIP) originated in PR09, delivered through CIP1 as a follow-on water industry investigation to the previous Endocrine Disrupter Compounds work (PR04). A collaborative approach across the water industry – including the collection and sharing of data – has enabled efficiency and benefits to be achieved over the last three AMP cycles.

Data collected through these investigations has been used in the following ways:

- nationally to inform approaches to managing chemicals in the environment and the associated costs,
- to inform European datasets, standards and substances of concern, and
- to identify where further work is required, either to better understand available treatment options or to require the installation of additional treatment at specific sites.

Figure 71 demonstrates the flow of data and techniques over the current and previous three price review periods and where, in bold, investment in treatment has been identified.

Figure 71 - Approach to Chemicals in PR09, PR14, PR19 and PR24



*CIP2 sampling was conducted through four tranches to allow the monitoring of 30 WRCs to be evenly spread over AMP6. The need for investment and investigation at sites from Tranche 1 and Tranche 2 were identified for PR14 investigations (Shepton Mallet and Croscombe WRCs) and delivered in AMP7. Sites from Tranches 3 and 4 were not identified until part-way through AMP7, therefore any investment decisions have been incorporated into PR24 investment cycle. The 8 sites from Tranche 3 and 4 for PR24 delivery are: Castle Cary, Crewkerne, Devizes, Merriott, Shepton Mallet, Somerton, Sparkford, Thingley.

6.4.2. Options Development

Due to elevated levels identified through CIP phase 2 (2015-2020) and CIP phase 3 (2020-2022) monitoring, 10 WRCs were identified for proposed permits for chemicals from the Environment Agency; these are detailed in Table 47. The Tier 1 outcome for all issued permits is to contribute to achieve improvement objectives for water quality or prevent deterioration (Environment Agency, 2022).

Table 47 – Chemical Removal at WRCs identified in PR24

Driver Code	WRC	Chemical of Interest	Proposed Permit (µg/L)
WFD_IMP_CHEM	Crewkerne East WRC	Cypermethrin	0.0004423 (95%ile) 0.0019306 (upper tier)
WFD_IMP_CHEM	Merriott WRC	Cypermethrin	0.0016107 (95%ile) 0.006462 (upper tier)
WFD_IMP_CHEM	Shepton Mallet WRC	Zinc (dissolved)	84 (95%ile)
WFD_IMP_CHEM	Somerton WRC	Cypermethrin	0.00039957 (95%ile) 0.00114236 (upper tier)
WFD_ND_CHEM3	Tetbury WRC	Cypermethrin	0.0012578 (95%ile) 0.0063424 (upper tier)
WFD_ND_CHEM3	Crewkerne East WRC	Cypermethrin	0.000627 (95%ile) 0.002738 (upper tier)
WFD_NDLS_Chem1	Crewkerne East WRC	Cypermethrin	0.00093 (95%ile) 0.0040588 (upper tier)
WFD_NDLS_Chem1	Merriott WRC	Cypermethrin	0.0021044 (95%ile) 0.0084424 (upper tier)
WFD_NDLS_Chem1	Somerton WRC	Cypermethrin	0.0017356 (95%ile) 0.004962 (upper tier)
WFD_NDLS_Chem2	Castle Cary WRC	Copper (dissolved)	13.5 (bioavailable mean)
WFD_NDLS_Chem2	Devizes WRC	Cypermethrin	0.00021627 (95%ile) 0.0006964 (upper tier)
WFD_NDLS_Chem2	Royal Wootton Bassett WRC	Cypermethrin	0.00026 (95%ile) 0.0009 (upper tier)
WFD_NDLS_Chem2	Sparkford WRC	Cypermethrin	0.0024158 (95%ile) 0.0100642 (upper tier)
WFD_NDLS_Chem2	Thingley WRC	PFOS	0.389
WFD_NDLS_Chem2	Tetbury WRC	Cypermethrin	0.001369 (95%ile) 0.0044516 (upper tier)
WFD_NDLS_Chem2	Devizes WRC	Nickel (dissolved)	5.05 (bioavailable mean)
WFD_NDLS_Chem2	Devizes WRC	Zinc (dissolved)	44.0 (bioavailable mean)

*Thingley WRC has been given a WFD_ND_CHEM4 driver, however our approach is a catchment investigation under CIP4 which is WFD_INV_CHEM with regulatory date of 30/04/2027.

Regulatory drivers

The permit limits in the previous table have been assigned specific drivers based on the PR24 driver Guidance for chemicals (Environment Agency, 2022). The conditions for all available drivers for these permits are described in Table 48.

Table 48 – WINEP driver descriptions for chemical permits

Primary WINEP driver code	Description	Number of WINEP schemes	Completion date
WFD_NDLS_CHEM1	Measures related to load standstill requirements for chemicals (where EQS exceedance is predicted but measures fail economic assessments associated with EQS).	3	31/03/2027
WFD_NDLS_CHEM2	Measures related to load standstill requirements for chemicals (below EQS). These are set where a wastewater treatment works is discharging significant concentrations of a chemical, but the EQS is not threatened immediately downstream. Targets are set to ensure current effluent quality does not deteriorate and to contribute to broader aims to cease and phase out emissions, discharges and losses of priority hazardous substances and prevent pollution swapping. This driver would be used where there is no risk growth between 2015 and 2021 would cause an actual failure of the EQS.	8	31/03/2027
WFD_ND_CHEM3	Actions to meet requirements to prevent deterioration in chemical status because of growth.	2	31/03/2030
WFD_ND_CHEM4	Actions to meet requirements to prevent deterioration to maintain existing standstill limits for chemicals if there is growth in the sewage works' catchment.	0	N/A
WFD_IMP_CHEM	To meet either good ecological status or good chemicals status. Needed where an EQS is exceeded downstream of a wastewater treatment works discharge. Measures that fail economic tests will receive standstill limits under WFD_NDLS_CHEM1.	4	31/03/2030
	Total	**17**	

Permitting approaches

The following section will look at the different permitting approach guidelines, including various flexible options and requirement for the three drivers: No Deterioration, No Deterioration Load Standstill, Implementation/Rivers Need.

Approach 1: Catchment permitting

Operators able to trade permitted discharge loads between sites within the catchment to achieve water quality targets whilst reducing cost, carbon emissions and regulatory risk. This can be applied to any permit driver type, or a combination.

Approach 2: 99%ile look up table

The 99%ile confidence approach assesses compliance on a 12-month rolling average. This allows for one additional exceedance before overall fail compared to 95%ile (Table 49). This is applicable to NDLS, and IMP/rivers needs drivers only.

Table 49 – Chemical permits 99%ile look up table

Number of samples	(BOD, Ammonia, SS) Number of exceedances allowed under a 95% confidence approach	(Chemicals) Number of exceedances allowed under a 99% confidence approach
4	1	2
12	2	3
24	3	4

Approach 3: Best Endeavours

Applicable to sites where evidence shows there is a reasonable prospect of achieving a stringent improvement permit limit. Installation of effective treatment solution and operation using best endeavours approach to remove as much of the substance as is reasonably practicable.

Approach 4: Maximising benefits

Many sites for which new substance limits are being proposed are already subject to improvement obligations (mainly WFD phosphorus) in the WINEP. Technologies to be deployed for phosphorus removal in AMP7 have the potential to deliver significant chemical removal. Approach 4 recognises that this may not result in achieving the desired outcome for chemicals. Each company installs the best treatment solution to deliver AMP requirements and operate works using best endeavours approach to remove as much of the substance as is reasonably practicable. This approach can be used for chemicals with improvement limits in the current WINEP or where the company considers it wishes to utilise this option to demonstrate performance for a potential future improvement obligation (PR24).

PFOS approach 1:

The application of standstill limits on identified WRCs permit using an Operating Techniques Agreement (OTA);

- OTA is linked to the operating techniques condition of the permit.
- Non-compliance with the OTA constitutes a descriptive condition failure

PFOS approach 2:
PFOS source control investigation at identified sites with the following objectives;

- To identify significant sources of PFOS in the sewerage catchment
- To gather evidence to prevent further significant deterioration
- To inform next steps for permitting approach
- To inform next steps to eliminate/reduce PFOS at source
- To optimise treatment processes
- Develop long term plans to address PFOS if no obvious

Treatment selection process and options

According to the PR24 driver guidance prepared by the EA, the following substances should be considered for end of pipe treatment: dissolved nickel, dissolved lead, dissolved copper, dissolved zinc, total cadmium, total iron, total chromium, total mercury, nonyl-phenol, octyl-phenol, and cypermethrin. This has been considered during our option development, as described for the appropriate chemicals in the following sections.

The next two sections describe the chemicals of interest, their sources, mechanisms of removal, and potential treatment solutions. These sections summarise the high-level findings from the following UKWIR reports from the Chemical Investigations Programme, full copies of the reports are available on the UKWIR website and can be found using the following UKWIR report references:

- 18/EQ/01/14: The National Chemical Investigations Programme 2015-2020: Volume 3 Wastewater treatment technology trials. *Referred to as CIP2 technology trials.*
- 22/EQ/01/31: The National Chemical Investigations Programme 2020-2022: Volume 10 Substances removed by installed technologies. *Referred to as CIP3 CHEM11 investigation.*
- 22/EA/01/29: The National Chemical Investigations Programme 2020-2022: Volume 8 Mechanisms of chemical removal. *Referred to as CIP3 CHEM12 investigation.*

Cypermethrin

Cypermethrin is an insecticide chemical which rapidly degrades in soil and sediment. Other chemical properties include very low water solubility, adding to its affinity to sorb to sediment. These properties make it more likely that removal will be linked to suspended solids removal in wastewater treatment.

The CIP3 CHEM11 investigation monitored 15 different treatment technologies which have been installed in operational WRCs. They have been monitored for similar emerging contaminants as in CIP2 technology trials, although there were no accompanying sanitary determinands analysed alongside the emerging contaminants.

The CIP3 CHEM12 investigation aimed to understand the mechanisms of removal for selected emerging contaminants. Research was based on a small-scale laboratory mimic of an activated sludge plant with spiked synthetic sewage. Findings showed removal of cypermethrin was stable in liquid phase. Overarching findings suggest high removal with sorption to solids as the removal mechanism (confirming previous insight about cypermethrin). Cypermethrin accumulates in sludge stream as a result.

The main mechanism of removal for cypermethrin is partition to sludge/removal via solids (UKWIR 2022b). Processes such as coagulation followed by a filtration treatment step should work e.g., ferric sulphate dosing followed by mixed media filter (e.g. FilterClear). Similarly, enhanced bio-flocculation such as an ASP followed by FilterClear should also produce similar results.

Final approach

The findings from the CIP2 technology trials and CIP3 technology investigations have been taken into consideration, as well as learnings from the CIP3 CHEM12 mechanisms of removal investigation on how cypermethrin behaves in wastewater when considering final options. This is also in addition to the practicality of implementation, current AMP7 installations and permit driver. Our preferred final options are detailed in Table 50.

Table 50 – Wessex Water's approach for Cypermethrin permits.

WRC	Permit drivers	AMP7 action/ installation by Dec 2024	Investment AMP8?	Approach	AMP8 installation by Mar 2030
Crewkerne	WFD_NDLS WFD_ND WFD_IMP	Front end ferric dosing	N	Approach 2 (NDLS, ND) Approach 4 (IMP)	Flexible permitting
Devizes	WFD_NDLS	MMF planned late AMP7/early AMP8 due to capacity need	N	Approach 2 (NDLS)	Flexible permitting and continued monitoring (see also Dissolved Metals section for other metals permits requirements at Devizes)
Merriott	WFD_NDLS WFD_IMP	Front end ferric dosing	N	Approach 2 (NDLS) Approach 4 (IMP)	Flexible permitting and continued monitoring
Royal Wootton Bassett	WFD_NDLS	CIP3 CHEM6 sewer catchment investigation for Cypermethrin	Y	Approach 2 (NDLS)	Mixed Media Filter (to supplement/replace TASF) for AMP8 and continued monitoring
Somerton	WFD_NDLS WFD_IMP	Front end ferric dosing and MMF	N	Approach 2 (NDLS) Approach 4 (IMP)	Flexible permitting and continued monitoring
Sparkford	WFD_NDLS	Front end ferric dosing	Y	Approach 2 (NDLS)	Mixed Media Filter for AMP8 and continued monitoring
Tetbury	WFD_NDLS WFD_ND	CIP3 CHEM11 technology trials – Mecana.	Y	Approach 2 (NDLS, ND)	Mixed Media Filter (to supplement/replace Mecana) in AMP8 and continued monitoring

Dissolved Metals

The Environmental Quality Standard (EQS) for copper, nickel and zinc is measured as bioavailable, meaning only a fraction of the soluble metal concentration is included in the standard. Dissolved organic carbon (DOC), pH, and the concentration of calcium ions (Ca^{2+}) affect how readily copper, nickel or zinc is absorbed by living organisms.

a) Copper (dissolved)

Copper occurs naturally in the environment. High concentrations of copper within organisms can inhibit normal cell function and metabolism. Copper and copper-containing compounds are widely used as biocides and fungicides due to this property.

Human activities such as mining and other industrial processes can input high concentrations of copper and other heavy metals into the surrounding soil, sediment, water environments and can bioaccumulate in nearby organic

materials or organisms. Copper can also be present within the environment in varying background concentrations, this is influenced by the local geology.

b) Nickel (dissolved)

Nickel is a naturally occurring metal. It is present in the environment on its own and as various alloys with other metals and compounds. It is resistant to air, water and alkali corrosion which makes it a good industrial material. The majority of nickel that is mined is used for industrial processes and applications, such as jewellery, stainless steel household items and electrical equipment. Nickel compounds are also used in electroplating.

Nickel is found in the environment from natural and anthropogenic sources. The greatest source of nickel in the atmosphere is through the combustion of fossil fuels. Direct leaching from rocks and sediments can produce high local concentrations of nickel from local geology containing nickel.

c) Zinc (dissolved)

Zinc occurs naturally in the environment in varying natural background concentrations. Ambient concentrations represent the level of zinc from natural concentrations from geological processes and inputs from historic anthropogenic activities such as mining. When assessing zinc, consideration of a background concentration is an explicit part of the EQS. This is due to the relative abundance of zinc in the environment compared to other metals (WFD UKTAG, 2014).

Anthropogenic sources of zinc can come from industry and trade effluent, such as electroplating and other metal manufacturing processes; brewery processes and leaching from tyre particles can cause increased concentrations of zinc into the environment.

Dissolved zinc, copper and nickel are soluble so filtration will not work on its own. CIP trials suggest adsorption of metals onto bio-flocs which is why ASPs (or variants of ASP e.g., BNR or Nereda) seem to work well. ASP combined with a filtration process works better because more of the bio-adsorbed metal gets removed as the suspended solids are removed. Studies from the US EPA supports the bio-flocculation theory with the microbial flocs stated as adsorbing heavy metals, removal efficiencies reported are 74-95% for zinc, 50-79% for copper and 30% for nickel.

Final approach

The findings from the CIP2 technology trials and CIP3 technology investigations have been taken into consideration, as well as learnings from the CIP3 CHEM12 mechanisms of removal investigation on how metals behave in wastewater when considering final options (UKWIR 2018, 2022a, 2022b). This is also in addition to the practicality of implementation, current AMP7 installations and permit driver.

Both Devizes and Shepton Mallet WRCs have existing ferric sulphate dosing for phosphorus removal. It is known that trace amounts of other metals -such as nickel and zinc – are in the coagulant. Castle Cary is gaining a new phosphorus permit (0.5mg/L), and Shepton Mallet a tightened phosphorus (2 to 0.35mg/L), both by 22/12/2024. As Devizes and Castle Cary’s permits are NDLS, the limits should be achievable particularly with added investment in AMP7 to improve overall treatment.

Shepton Mallet upstream river, final effluent and downstream were sampled during CIP2 monitoring, between 2015 to 2016. A standstill permit of 48µg/L was proposed to come into effect in December 2022 to prevent deterioration in water quality in the river based on high concentrations upstream. An improvement permit of 42 µg/L was also proposed for the site to come into effect December 2023 to improve the quality of treated effluent to meet the EQS in the receiving watercourse downstream of the WRC.

An AMP7 sewer and river catchment investigation was carried out between 2021 and 2022 and revealed high inputs into the network from traders that were previously not representatively discharging during the CIP2 monitoring. Consequently, the EA have agreed that the AMP7 standstill limit should be changed to 111µg/L (by 22/12/2022), and through re-modelling the improvement limit should be 84µg/L.

Through the investigations we identified that a single trader was the dominant source of zinc into the WRC catchment. We have already begun actively working with them to identify which of their chemical products contain zinc, and whether these can be replaced with non-zinc alternatives.

We have not been able to identify dominant sources of the metals in the Castle Cary or Devizes catchments to avoid the need for improvements at the WRCs themselves.

Table 51 – Wessex Water's approach to dissolved metals permits.

WRC	Permit driver	AMP7 action/ installation by Dec 2024	Investment AMP8?	Approach	AMP8 installation by Mar 2030
Castle Cary (sol copper)	WFD_NDLS	MMF	N	Approach 2 (NDLS)	Flexible permitting, working with traders, continued monitoring
Devizes (sol nickel)	WFD_NDLS	MMF planned late AMP7/early AMP8 due to capacity	N	Approach 2 (NDLS)	Flexible permitting, working with traders, continued monitoring
Devizes (sol zinc)	WFD_NDLS	MMF planned late AMP7/early AMP8 due to capacity	N	Approach 2 (NDLS)	Flexible permitting, working with traders, continued monitoring
Shepton Mallet (sol zinc)	WFD_IMP	MBBR & MMF	N	Approach 4 maximising benefits	Work with traders, maximising benefits of AMP7 installations

6.4.3. Robust and Efficient Costs

As described in section 6.4.2, we have looked at the different permitting approach guidelines, including various flexible options and requirement for the three drivers: No Deterioration, No Deterioration Load Standstill, and Implementation/Rivers Need. Where flexible permitting approaches are unavailable, we have assessed the available chemical removal technologies which have been informed by prior CIP trials (CIP2 Feasibility and Pilot technology trials report (UKWIR: 18/EQ/01/14), and results from CIP3 investigations around the fate and removal of chemicals under certain treatment processes: UKWIR 22/EQ/01/31 and 22/EQ/01/29).

ChandlersKBS were engaged to provide cost estimates for cost assurance benchmarking. They also reviewed our costing approach for many areas of the plan, including our WINEP programme.

For our overall wastewater treatment programme (see WSX45 – Annex A4-3), they concluded that:

> *Due to the level of scope definition provided at Business Planning stage, we would identify the estimate class, as defined by the Association for the Advancement of Cost Engineering (AACE), as a Budgetary Estimate or Class 3 and, therefore, an expected accuracy range of between -20% and +30% to the outturn cost.*

Based on the AACE classification, the ChandlerKBS and Wessex Water accuracy ranges overlap which indicates a high probability of the outturn costs falling in this range. Therefore, the estimates can be deemed to be robustly efficient for Business Planning.

They also provided a statement of robustness for the cost modelling process and methodology utilised by Wessex Water to estimate the WINEP and Growth programmes (see WSX45 – Annex A4-2):

The Waste Water Treatment cost models should be treated as having a moderate confidence in their cost output, particularly for the design stage. The cost models are based upon historical costs incurred by Wessex Water which may not reflect future costings. As the programme and solution designs progress, the cost models should be revised following the same methodology to maintain the high cost confidence and efficiency.

The processes and methodologies used to derive the cost models for the Waste Water Treatment programmes were evidently robust and considered to be appropriate for producing efficient costs for the PR24 Business Plan.

6.4.4. Customer Protection

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment(s) and/or price control deliverable(s):

- PC17 Discharge permit compliance

WINEP delivery is also a metric within the EA's annual Environmental Performance Assessment

6.5. Flow

Our Water Recycling Centres (WRCs) receive sewage and trade effluent from catchments where at least a proportion of the sewerage network is combined foul and surface water. This means that the sewerage network carries run-off as well as sewage and trade effluent discharged by householders and traders. As a consequence, the volume of sewage arriving at a WRC can increase significantly after a period of rain.

Minimum flow rates are set for the amount of flow that needs to be passed forward to treatment before overflows are permitted to the storm tanks. For all flows being treated through the WRC, effluent quality limits need to be met. This rate is known as the Forward Passed Flow (FPF), previously known as Flow to Full Treatment (FFT) and is normally specified in permits for discharges to storm tanks.

Increased permit FPF will ensure that storm tanks do not fill prematurely and are emptied effectively to prevent more frequent, higher strength and longer duration spills from storm tanks to receiving waters and allow receiving waters to respond to rainfall events to provide additional dilution.

6.5.1. Need for Investment

Ensuring that the FPF flow capacity is proportionate to the permitted dry weather flow (DWF) will reduce the frequency, volume, concentration, and duration of storm sewage overflow discharges into receiving waters and so contribute to the delivery of WFD objectives of Good Ecological Status (GES) in receiving water bodies.

It will also contribute to meeting the Urban Wastewater Treatment Regulations (UWWTR) 1994 requirements in relation to duties to provide and maintain wastewater collecting systems and operate treatment plants. Furthermore,

it will contribute to meeting a number of the 25 Year Environment Plan objectives, the Environment Act's ambition for reducing sewage discharges from storm overflows, and to the delivery of outcomes from the Storm Overflow Taskforce, as described in Section 5.1.1.

Table 52 – Flow capacity improvement driver codes in the WINEP

Driver Code	Driver Details
U_IMP5	Upgrades to WRCs to ensure flows receive the appropriate full treatment. i.e., the permit FFT is set to ensure that flows do not spill to storm on dry days.
U_IMP6	Provision of additional storm storage to meet EA guidelines of either 68L/head population or 2hours at max flow to storm

6.5.2. PR24 WINEP Development

In the development of the PR24 WINEP, the EA stated that the PR24 U_IMP5 and U_IMP6 drivers will only apply to WRC overflows that were identified with these drivers in PR19 but were deferred for inclusion in PR24.

PR19 WINEP and Business Plan

In the development of the PR19 WINEP, the EA requested water companies review WRCs that were at risk of spilling to storm on a dry day. We concluded that 13 of our WRCs were believed to spill to storm on a dry day, with these subsequently being included in the AMP7 WINEP with a FFT permit increase driver. Additional WRCs may spill on a dry day, although they were not confirmed, as these WRCs need the installation of Event Duration Monitors on discharges into storm tanks to confirm this, therefore there is a likely requirement for further FFT increase schemes in AMP8.

The development for the U_IMP5 FFT requirements was over a very short period of time. EA issued PR19 Guidance for these drivers in November 2017, with water companies having to complete an EA WINEP Tracker by January 2018, which effectively set the design FFT for the business plan. Our business plan submission in September 2018 was based on the WINEP3 as issued March 2018, albeit the WINEP did not include these design FFT figures.

Subsequent Development during AMP7

For the U_IMP5 FFT driver the EA PR19 guidance required that there should be no spills to storm on a "dry day", and that FFT should be calculated using 3PG+Imax+3E. We used our standard approach to calculate the required FFT using 3PG+Iwinter+3E, where Iwinter is based on 7 days of dry winter weather. It only became apparent later during further discussions/guidance with the EA that there is a significant difference between EA's Imax calculation and Wessex Water's Iwinter calculation, as used for our business plan.

WRCs do not measure total flows entering a works (only the total flow being treated). If the existing permit FFT control setting is set too low, it is difficult to determine the peak flow received on a dry day, as flows will go to storm and not be measured. Using the Imax approach required by the EA, this uses the highest daily flow on a "dry day" which will occur infrequently. The definition of a "dry day" being a day with less than 0.25mm of rainfall, with the first "dry day" being excluded in the Imax calculation.

For WRCs with DWF permit headroom, linking the FFT to the DWF permit increases the required FFT flow above what was identified in the business plan, as during our Jan 2018 tracker development with local EA they stated that they did not want growth to be included within the quality driver.

Of our 13 WRCs included in the PR19 WINEP, one site no longer requires an FFT increase (due to operational improvements to improve flow balancing) and two retain the design FFT as per our Business Plan proposal,

however, based on the revised Imax calculations, 10 WRCs have seen their design FFT increase, as shown in Table 53.

Table 53 – Sites in the PR19 WINEP with a U_IMP5 FFT Increase driver

Site	FFT / FPF (l/s)			% Increase above Business Plan	Comments
	Existing	Business Plan	Revised*		
Avonmouth	3,472	4,700	5,300**	+ 13%	At permitted DWF
Bath (Saltford)	580	734	802	+ 9%	At permitted DWF
Bourton	6.8	11.3	13	+ 15%	Reduced permitted DWF
Castle Cary	25.5	31.1	34	+ 9%	At permitted DWF
Cheddar	83.5	90	94	+ 4%	At permitted DWF
Compton Bassett	17.5	45.8	49	+ 7%	At permitted DWF
Ditcheat	4.8	6.5	6.5	0%	At permitted DWF
Halstock	2.3	3	4.8	+ 70%	At permitted DWF
Lacock	4.6	8	10	+ 25%	At permitted DWF
Marnhull Common	40	60	-	-	
Rode	6.1	8	8	0%	At permitted DWF
Shillingstone	19.5	22.5	27.5	+ 22%	Reduced permitted DWF
Shoscombe	10	13	16	+ 23%	Reduced permitted DWF

* Calculated excluding Wessex Water identified outliers, as allowed by the EA.
** To date we have absorbed the increased costs due to the revised flow calculations for the WRCs, although the Avonmouth scheme is an order of magnitude larger in terms of flow and cost, hence our proposal to include in the PR24 WINEP.

PR24 WINEP

Notwithstanding differences in the calculation of FPF as described earlier, in our discussions with the EA in the development of the PR19 WINEP we flagged that additional WRCs may spill on a dry day (although they were not confirmed) as these WRCs needed the installation of Event Duration Monitors on discharges into storm tanks to confirm this. Given the short duration to review and our uncertainty, none of these sites were included in the PR19 WINEP. Whilst we flagged some as being at risk, none were explicitly deferred for inclusion in PR24.

Following the EA's direction that the PR24 U_IMP5 and U_IMP6 drivers will only apply to WRC overflows that were identified with these drivers in PR19 but were deferred for inclusion in PR24, we have not undertaken a review of any further potential candidate U_IMP5 or U_IMP6 schemes.

There remains a risk that, on completion of the U_MON3 and U_MON4 programmes, additional sites may be identified that spill on a dry day, necessitating an increase to their FPF. In the absence of a valid U_IMP5 WINEP, we would still consider this to require enhancement funding, potentially through one of the Environment Act drivers related to storm overflows.

6.5.3. Avonmouth WRC

Since submission of the PR19 business plan, the design FPF value at Avonmouth WRC has increased with a subsequent substantial increase in cost and time. The WRC is also forecast to exceed its DWF permit towards the end of AMP8/beginning of AMP9, necessitating a new DWF permit and a further increase to the FPF permit.

In recognition, we requested an extension to the U_IMP5 completion date from 31/03/2025 to 31/03/2028, so as to provide additional FPF capacity to bring forward the AMP8/9 DWF increase scheme. This extension was agreed with the EA, subject to us exploring whether any mitigation measures could be implemented in the intervening period, such as temporary treatment or storm storage.

The below paragraphs – along with some of the context provided earlier – were provided to the EA as part of this alteration request. We are not seeking funding through the WINEP process for any DWF-related elements, and so do not cover this further. We are, however, seeking the re-inclusion of Avonmouth WRC in the PR24 WINEP in recognition of the substantial increase in design FPF from that originally considered for the PR19 WINEP.

Increase in FPF from PR19 WINEP

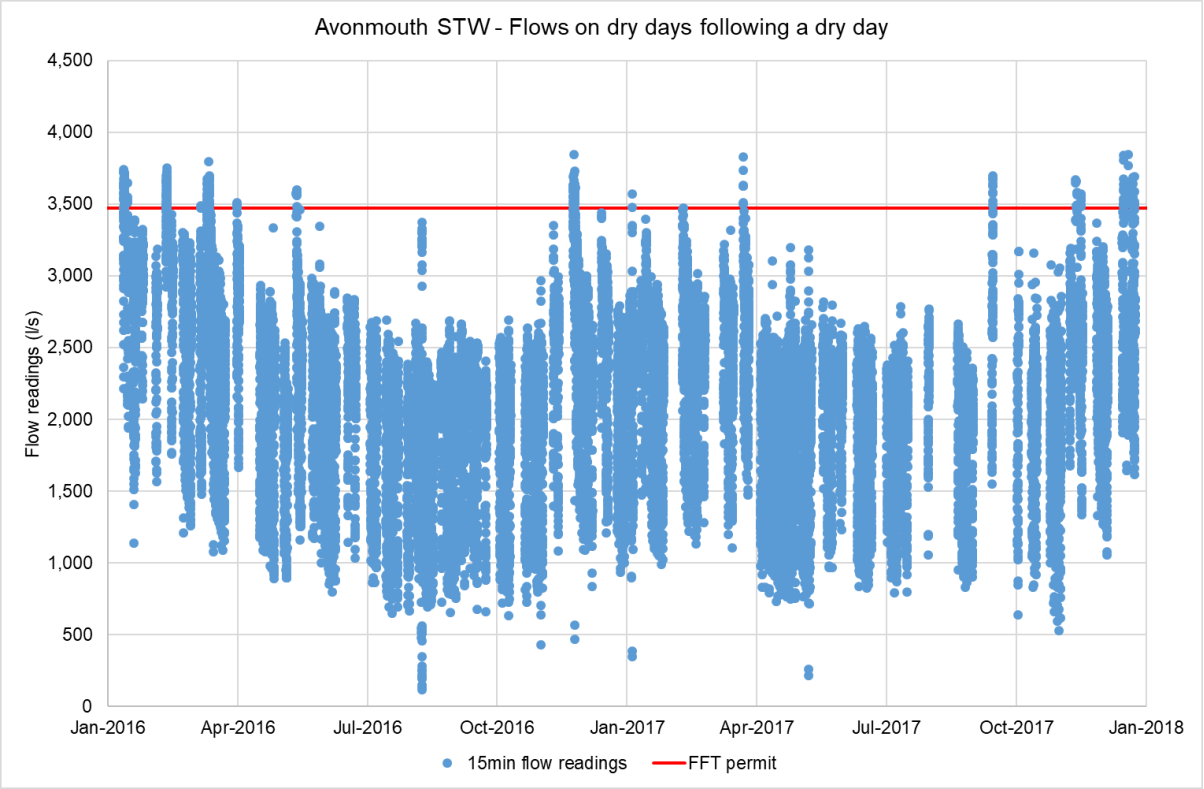
Spilling to storm on dry days

Avonmouth WRC is Wessex Water's largest WRC, serving a population equivalent of c.800,000 (plus tankered imports). It treats sewage from most of the Bristol city area and also receives a high trade load, particularly from nearby industries in the Severn Estuary. The site is co-located with a Bioresources Centre which also receives sludge imports from other WRCs. Additional loads are also received from the onsite Organic Waste facility and the Food Waste facility.

The Avonmouth catchment is more complicated than most, due to its size, topography, network sewer storage, the time it takes for flows to move from the outer part of the catchment to the WRC and the time for storm tank contents to be returned to treatment. This could result in storm flows still being received at the WRC during "dry days".

Avonmouth WRC has an FPF:DWF ratio of 1.7. The permitted FPF has historically been based on winter DWF diurnal peaks. As can be seen in the chart below, the WRC routinely treats flows in excess of permit FPF on dry days, hence inclusion of the U_IMP5 driver in the WINEP (this chart was included in our PR19 Business Plan submission).

Figure 72 - Flows through Avonmouth WRC on dry days (and following a dry day)



Flow Scope Increase

Table 54 summarises the variation in FPFs at Avonmouth using the different methods of calculation as described earlier.

Table 54 – Changes in design FPF at Avonmouth WRC

Site	FPF (l/s)	% Change from permit
Current permitted FPF	3,472	-
Business Plan - Wessex Water standard approach (3PG+Iwinter+3E)	4,700	+35%
Latest Design - Revised Calculation (3PG+Imax+3E) - excluding outliers (identified by WW) - including outliers	 5,300 5,900	 +53% +70%

Options

PR19 Optioneering

There are two treatment streams at Avonmouth WRC, the largest treating approximately 91% of the inflow comprises 11 Sequencing Batch Reactor (SBR) basins. The last investment in capacity occurred in 2003, with the addition of three SBR basins. The other stream consists of a conventional Activated Sludge Plant (ASP).

The existing treatment streams are at the limit of their hydraulic capacity, and thus for the site to pass the required FPF to meet the WINEP requirements, an additional process stream is required. This has been sized as follows:

Table 55 – PR19 design flow parameters for increased FPF at Avonmouth WRC

	Current	By 2025
DWF	179,867 m^3/d = 2,082 l/s	2,082 l/s
FPF	3,472 l/s	4,700 l/s
FPF: DWF Multiplier	1.67	2.26
Flow splits to process streams		
Existing SBRs (11no. tanks as twin stream)	90% = DWF: 1,874 l/s FPF: 3,125 l/s	66% = DWF: 1,384 l/s FPF: 3,125 l/s
Existing ASP (twin lane)	10% = DWF: 208 l/s FPF: 347 l/s	7% = DWF: 154 l/s FPF: 347 l/s
New Process Stream	-	26% = DWF: 544 l/s FPF: 1,228 l/s

Two options were considered to provide the required hydraulic capacity enhancement. In brief, these two options included the following:

- Option 1 – 4 additional SBRs
  - Four new PSTs
  - Four new SBR basins and associated ancillaries, as per design of existing
- Option 2 – Additional ASP stream
  - Four new PSTs
  - New aeration lanes
  - Eight new final settlement tanks FSTs

Both of these options would be located on our land to the south of existing site operational boundary.

Table 56 – PR19 treatment options for Avonmouth WRC

Option	Option 1 4no. SBRs	Option 2 ASP
Provides hydraulic capacity to meet new FPF	✓	✓
Provides treatment capacity to 2025	✓	✓
Permits future expansion on site for future growth	✓	✗
Scheme Capex (£m)	46.02	80.84

Opex (£k/yr)	778	2,297
Lowest whole-life cost	✓	✗

As can be seen above, Option 1 (4no. SBRs) has the lowest whole life cost. This option also provides synergies with future treatment capacity and was originally included in our PR19 proposal submitted as part of our Business Plan in October 2018.

Subsequent to the challenges from Ofwat to our plans in their Initial Assessment of Plan in January 2019, we appointed an independent consultant, Stantec, to review and challenge the proposed option and its technical scope. Stantec confirmed the option selection and its main scope but also have advised that 3 only, rather than the 4 planned, new primary settlement tanks are required. We therefore reduced the planned investment accordingly by £2m.

Our final business plan submission in September 2019 included £44.020m capex and an in-AMP7 opex of £0.127m (at 2017/18 prices) related to Avonmouth WRC.

AMP7 Options Study

A number of potential technology options were (re)considered, including activated sludge plants, SBRs (various suppliers), the Nereda® (by Royal HaskoningDHV) and the Actiflo® (by Veolia) processes. Taking into account permit requirements (the WRC is only required to do carbonaceous treatment as it has no ammonia permit) and high-level costings led to the narrowing down of the treatment technology to an SBR-type process.

A number of different designers/suppliers for SBRs were approached (including Evoqua, Xylem, Trant and Sweco) and detailed reviews were undertaken of their technologies. Rather than go for a completely proprietary process, it was concluded to develop an in-house hybrid design, taking where possible (and subject to patent protection) the best elements from the suppliers, and our experience of operating a large SBR plant at the site for over 30 years.

Table 57 identifies the options taken forward and their main process elements, having chosen to maintain the existing peak flow to the existing primary tanks and SBR plant.

Table 57 – Main process elements for 5,300l/s

Option	Load Horizon	Flow Split to new stream	PSTs	SBRs	Sludge Treatment
Option 1A PSTs and SBR	2045	32%	3 nr 38.6m	6 basins each 60m x 30m x 6.5m TWL	None
Option 2A Crude SBR	2045	32%	None	8 basins each 60m x 34m x 7m TWL	SAS thickening and storage
Option 3A Phased Crude SBR	Phased up to 2045	20% to 4670 l/s Then rising to 32%	None initially but phased up to 3 nr 38.6m	6 basins each 62m x 34m x 7m TWL	SAS thickening and storage

Common to all options was the need for a significant upgrade to the electrical power supply for the site, including a new 11kV switchboard and transformer(s), along with standby generators to provide backup to the mains supply.

Following an initial review of the capital and operating costs of each option, Option 2A was discounted, and sub-options of 1A and 3A were developed with more flow treated in the existing plant by optimising and maximising the capacity of the existing asset reducing the size of the new plant.

Hydraulic modelling has shown that the existing plant has a maximum hydraulic capacity of 4,088L/s if all six primary tanks are in service. This flow has therefore been used to develop the sub-options and results in the flow split to the new plant reducing to 26% from 32%. Two designs were developed for each sub-option – one retains the same number of new SBR basins and the other reduces the number by one, as described in Table 58 and Table 59.

Table 58 – Main process elements for 5,300l/s

Option	Load Horizon	Flow Split to new stream	PSTs	SBRs	Sludge Treatment
Option 1B	2045	26%	3 nr 35.2m	6 basins each 27m x 55m x 6.3m TWL	None
Option 3B	Phased up to 2045	20% to 5,110 L/s Then rising to 26%	None initially but phased up to 3 nr 35.2m	6 basins each 61.5m x 34m x 6.5m TWL	SAS thickening and storage

Table 59 – Options comparison for 5,300l/s

Option	Positives	Negatives	Capex
1A	Robust solution Process capacity to 2045 More primary sludge More gas income Less solids for disposal Smaller aeration blowers Largest reduction in load to existing process	Additional pumping station Excavation for primary tanks High CAPEX	£61-71M
1B	*In addition to Option 1A:* Smaller tanks Smaller pumps and pipeline sizes	*In addition to Option 1A:* Less reduction in load on existing SBR Relies on 6 PSTs Pushes existing plant to its hydraulic limit	£59-69M
3A	Lower CAPEX Less pumping cost	More SAS Less gas income More solids for disposal Larger blowers Crude SBR process risks Variable flow split process risk **Future upgrade required**	£57-66M
3B	*In addition to Option 3A:* Smaller tanks Smaller pumps and pipelines	*In addition to Option 3A:* Relies on 6 PSTs Pushes existing plant to its hydraulic limit **Future upgrade required**	£57-66M

As can be seen, having already refined the type of options the capex values are comparable. For all options the opex was similarly in the order of £2.4m/yr.

The selected option taken forward to outline design was based on new primary tanks and secondary SBR treatment:

- Screened sewage pumping station
- 3 Nr PSTs
- Pumped auto desludge and primary sludge transfer pumps
- Settled sewage pumping station
- 6 Nr SBR basins
- SAS transfer pumps

PR19 v PR24 Business Plan

Our PR19 business plan for Avonmouth included a total capex of 46m (when adjusted for inflation, to a 2021/21 price base) for a total FPF of 4,700l/s. To provide confidence to Ofwat of our solutions and costings, an external design consultant verified our options and two cost consultants provided benchmark estimates. Given the scale of Avonmouth compared to both our and other companies' FPF schemes, we invited Ofwat to consider Avonmouth as a standalone scheme. Ofwat accepted our proposal in the Final Determination, although only insofar as excluding it from their econometric modelling – the general FPF programme efficiency value (21%) along with a generic 'WINEP in-the-round' efficiency cut (9.58%) were imposed, resulting in an effective c.27% cut applied to Avonmouth, to c.£35m capex.

We have absorbed the increased costs due to the revised flow calculations for the previously listed WRCs, however the Avonmouth scheme is an order of magnitude larger in terms of flow and cost.

Table 60 – Costs increase for Avonmouth WRC scheme due to FPF change

Scenario	Design FPF (l/s)	Capex (£m)
Business Plan (using Iwinter)	4,700	46
Latest Design (using Imax)	5,300	59 - 69

All costs have been adjusted to 2020/21 price base.

These costs relate to achieving the U_IMP5 FFT driver based on Avonmouth's current DWF permit.

As noted earlier, the WRC is also forecast to exceed its DWF permit towards the end of AMP8/beginning of AMP 9, necessitating in a new DWF permit and a further increase to the FPF permit, to 5,700l/s.

As part of our date extension request to the EA, we proposed a merging of the AMP7 FPF Increase and AMP8 DWF increase schemes, which would:

- Enable a more efficient delivery.
- Enable earlier deliver of the DWF increase scheme than would have been the case if it were an end of AMP8/early AMP9 scheme.
- Smooth the end-of-AMP / beginning-of-AMP dip in resources and expenditure.
- Enable the case to be made to Ofwat for additional funding to supplement the shortfall in the PR19 determination (related to the U_IMP5 driver).

6.5.4. Robust and Efficient Costs

The Avonmouth scheme is at the end of its detailed design stage, which is being undertaken by an external designer.

The scheme's cost estimate is the most recent forecast, being developed to align with completion of detailed design and internal scheme governance and approval processes. It has been produced by our in-house estimating team, using supplier and tender prices for many areas.

Given the scale of the scheme, both the scope and scale have undergone a number of prior reviews to ensure we are delivering both a cost-efficient and cost-effective solution.

6.5.5. Customer Protection

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment(s) and/or price control deliverable(s):

- PC17 Discharge permit compliance
- PCDWW14 Increase flow to full treatment

WINEP delivery is also a metric within the EA's annual Environmental Performance Assessment.

6.6. WRC Discharge Relocations to Improve River Flows

6.6.1. Need for Investment

Two WRCs have been identified as having a localised impact on downstream river flows.

Table 61 – Discharge relocations identified in PR24 to improve downstream river flows

WINEP ID	Driver Code	WRC	Action Description
08WW100214	HD_IMP	Ratfyn WRC	Discharge relocation from WRC, to upstream in river, to improve river flow upstream of abstraction.
08WW100215	HD_IMP SSSI_IMP NERC_IMP	Shrewton WRC	Discharge relocation from WRC to improve river water quality in winterbourne stretch.

Ratfyn WRC

The Hampshire Avon is designated as a Special Area of Conservation (SAC). This high level of environment designation comes with stringent flow and quality standards, as defined by the Common Standards Monitoring Guidance. Regarding flow, abstraction cannot reduce flow by more than 10% of the natural flow at times of low flow.

The public water supply (PWS) abstraction at Durrington – located upstream of the discharge of Ratfyn WRC – is currently causing flows to drop below the permitted 10% limit and therefore negatively affecting the ecological status between Durrington Water Treatment Centre (WTC) and the continuous discharge from Ratfyn WRC.

Shrewton WRC

The Environment Agency recently undertook an ecological impact assessment of the River Till, downstream of the discharge from Shrewton WRC. The assessment found that the WRC is having a localised impact on the invertebrate communities of the River Till in its sensitive and valuable ephemeral reaches. The organic loadings from the discharge have caused a significant shift in the invertebrate community away from one that is able to support the notable winterbourne specialist species in the reach immediately below the works.

This is either due to infiltration resulting in discharge of high levels of untreated effluent, or due to treated effluent being discharged into a dry river for much of the year therefore receiving no dilution and turning what should be an ephemeral reach into a perennial ponded reach made up of 100% effluent for long periods of time.

The Environment Agency have advised that a solution should be sought for Shrewton WRC that

i) reduces or eliminates the frequency and magnitude of infiltration related discharges of untreated effluent from the works, and
ii) reduces or eliminates the discharge of secondary treated effluent to what should be an ephemeral (periodically dry) watercourse.

This would allow the reach immediately downstream of Shrewton WRC to return to a fully ephemeral watercourse and should eventually allow expansion of the important winterbourne communities seen upstream and downstream.

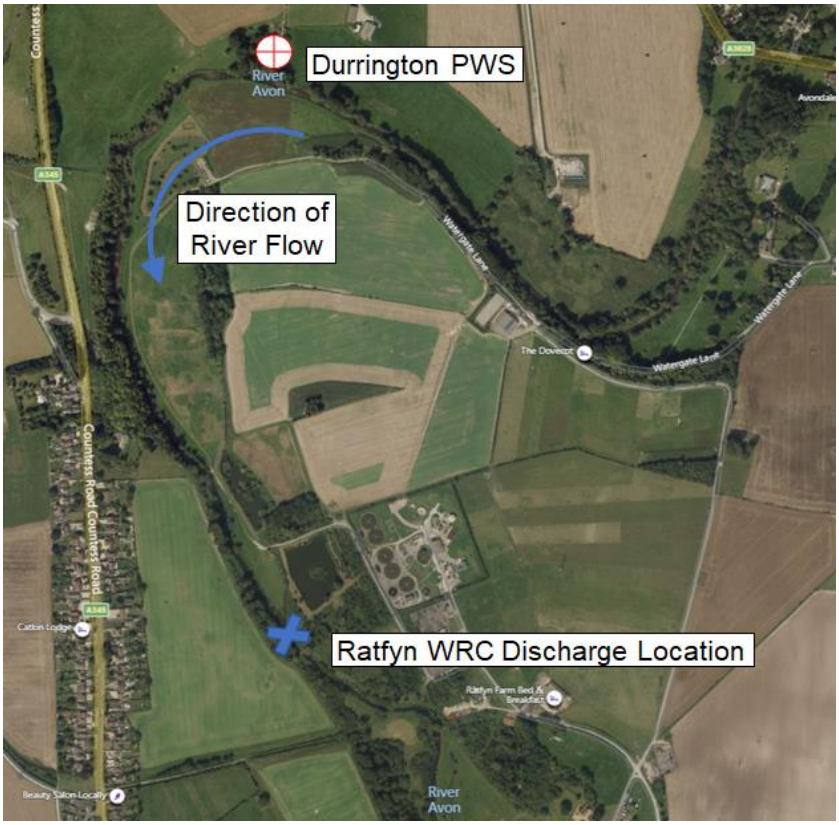
6.6.2. Options Development

More details on the options development for both Ratfyn and Shrewton can be found in WSX17 A2-5, although a summary of each is provided below.

Ratfyn WRC

The comparative location between Durrington PWS and Ratfyn WRC is shown in Figure 73. The distance along the river between the sites is 1.2km. Consideration has been given to various points of discharge upstream of the Durrington WTC abstraction location.

Figure 73 - Location of Ratfyn WRC in relationship to Durrington PWS



We recently installed a new sewerage rising main to the site and, as such, are acutely aware of various ecological/environmental as well as third party issues that may arise when undertaking this project, including:

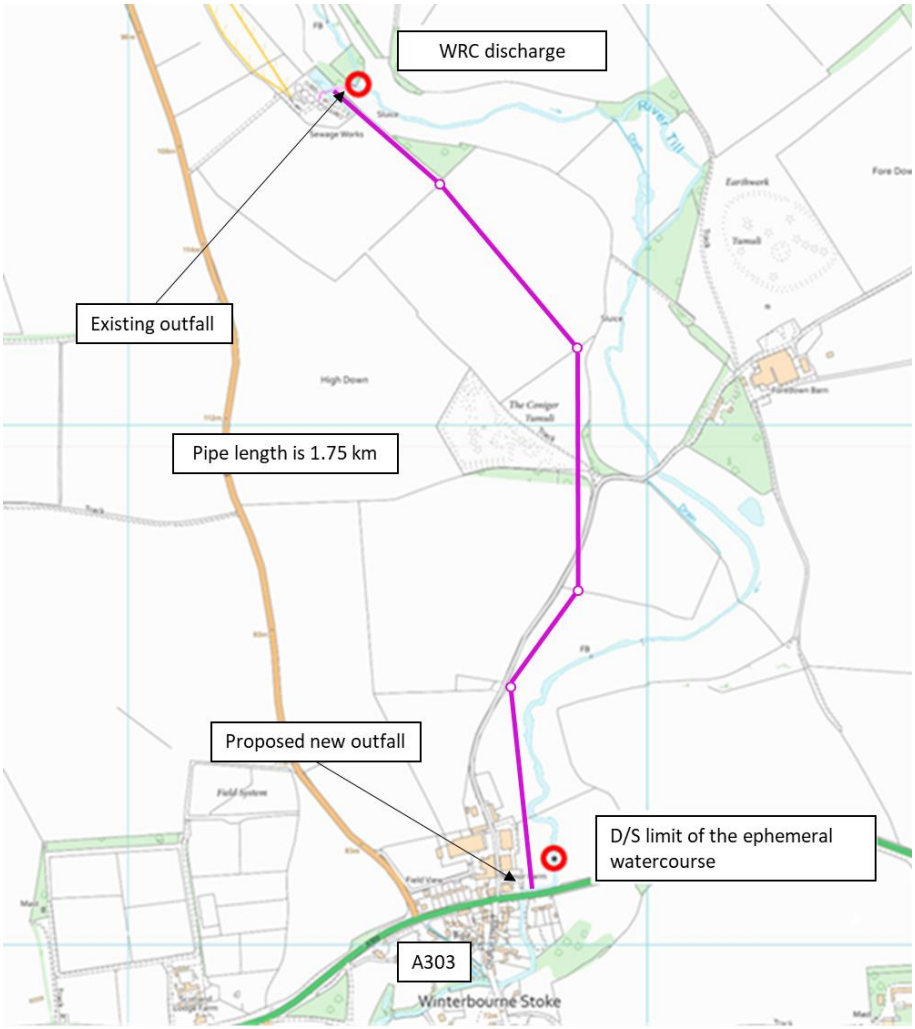
- Soil born virus in the fields to the north of the WRC
- Badger setts near the riverbank
- Established trees along portion of riverbank
- Nearby salmon fishing club, and also fishing in the main Avon

Shrewton WRC

Despite extensive sewer sealing in the catchment, Shrewton WRC suffers from high levels of groundwater infiltration, which we describe in a case study in our DWMP (Figure 80 of 'The full plan'). Two new reedbeds were built in 2022 to provide groundwater treatment – post screening and settlement – before re-combining with the fully treated final effluent. We are in liaison with the EA about the appropriate permitting of this treatment.

The downstream limit of the ephemeral watercourse is in Winterbourne Stoke, although historical observations have shown that on dry years the perennial head could be as far downstream at Berwick St James (at least a doubling of the distance).

Figure 74 - Proposed outfall pipeline route from Shrewton WRC, if discharge relocated to Winterbourne Stoke



Discharge relocations to Winterbourne Stoke and Berwick St James were proposed to the EA, but following their concerns on the suitability of either locations, we propose early in PR24 to develop further options, which could include, for example, a seasonal linear soakaway alongside the river, with an agreed solution to be implemented by

the end of AMP8. The EA have stipulated that the costs for this additional optioneering are outside of PR24 funding request.

6.6.3. Robust and efficient costs

Costs for a range of pipeline routes have been developed for both Ratfyn and Shrewton. These have been built up using in-house network costing tools that combine unit rates and site-specific adjustments. They are the same level of detail as would be developed for optioneering/feasibility schemes, and thus deemed appropriate robustness and efficiency for the business plan.

6.6.4. Customer Protection

Due to the bespoke nature of these particular schemes, and also noting optioneering is ongoing with regards to Shrewton, they do not have a directly associated performance commitment or price control deliverable.

Customers will, however, be protected if the investment is cancelled as WINEP delivery is a metric within the EA's annual Environmental Performance Assessment

Other related PCs include:

- PC15 Total pollution incidents
- PC16 Serious pollution incidents

6.7. Asset Health

Asset health is generally considered capital maintenance and is discussed in WSX10.

7. Improving data and understanding

Data and evidence are fundamental to supporting informed investment decisions and monitoring the performance of interventions. This section outlines requirements relating to the monitoring, collection and analysis of data. We have identified a number of innovative projects to maximise efficiency in our operational response and opportunities for designing best value solutions to increase the resilience of our drainage and wastewater infrastructure. Details of innovation approaches to how we are collecting analysing and using this data can be found in Section A6 of the annexes in WSX17.

7.1. Continuous Water Quality Monitoring

7.1.1. Background

The Environment Act 2021 sets out ambitious targets for the protection of our rivers, estuaries, and coastal areas. When brought into force, new duties in section 141DB of the Water Industry Act 1991 introduce a requirement on water companies to monitor water quality upstream and downstream WRC and storm overflows discharging to watercourses for a range of parameters. The statutory duty only applies to watercourses through which water flows (rivers and estuaries) and excludes other bodies of water such as seas and lakes. The duty will not apply to transitional waters (estuaries) in PR24 as the complexity of these environments makes them very challenging to monitor therefore investigations in PR24 will be carried out to inform how these waterbodies can be monitored effectively with monitors to be installed in AMP9. The key objectives of this programme of work are to;

- quantify the local water quality impacts of assets on a watercourse,
- increase stakeholder and public understanding of the impact on water quality of discharges from assets,
- inform improvement programmes to meet the Storm Overflow Discharge Reduction Plan targets and
- inform regulatory action.

The Act requires the installation of continuous water quality monitoring equipment upstream and downstream of all storm overflows and WRCs. With over 20,000 storm overflows and over 7,000 WRC in England & Wales, this Act creates a significant challenge to the water industry in terms of installation, monitoring and maintenance. Water companies have not previously been required to install such equipment and are therefore commencing this programme from a ‘standing-start’, raising technical challenges but also placing significant demand for equipment on a relatively small market.

There are 1,483 assets in the Wessex Water region that will require continuous water quality monitoring under this legislation by 2035. The prioritisation of the installations is stipulated in the technical guidance document, published in August 2023[11]. The following sections summarise the requirements of the guidance (Section 7.1.2 and show how this has been applied by Wessex Water to determine a programme of installation and investigation in PR24 and PR29 (Section 7.1.3).

[11] Defra (2023) Continuous Water Quality Monitoring Programme Technical guidance for sewerage undertakers. August 2023, Version: 1.0

7.1.2. Monitoring requirements

Monitoring intervals

Monitors are required to sample at least every 15 minutes if either of the following conditions are met:

- during storm overflow operation; or
- where anything occurs that affects, or has the potential to affect, the water quality of a final effluent discharge.

At other times, sampling must take place at least every hour. Where the conditions are met, testing must stay every 15 minutes for 24 hours following the end of the event which triggered the switch.

Monitoring parameters

Monitors are required to accurately and reliably monitor and log data on a series of key water quality parameters:

- dissolved oxygen;
- temperature and pH values;
- turbidity;
- levels of ammonia; and
- anything else specified in regulations made by the Secretary of State.

Monitor installation

The technical guidance recommends pumped kiosks as the primary method of installation however in river-installations are an option (Figure 75), sondes can be deployed directly in the river where pumped kiosks are not possible (remote locations, difficult access or limited power supplies). Site surveys will be required of individual sites to establish the most appropriate system to be installed, for the purposes of costing pumped kiosks are assumed for all locations in the absence of detailed site surveys.

Figure 75 - Example of pumped kiosk installation (left) and in-river installation (right)

Phasing and exceptions

The guidance recommends that roll-out should begin as soon as is practicable and no later than 2025. Monitoring of statutory assets must be completed by 2035. A minimum of 25% of eligible sites must be monitored by the end of PR24, this should focus on high priority sites, which are;

- Sites of Special Scientific Interest (SSSIs);
- Special Areas of Conservation (SAC);
- Urban Wastewater Treatment Regulations sensitive areas;
- Chalk streams;
- Any assets within 5km upstream of designated inland or estuarine bathing waters; and,
- Waters currently failing WFD ecological standards due to storm overflows or final effluent.

The number of monitors to be installed is determined by a screening and clustering process stipulated in the guidance and outlined here;

- WRC with descriptive permits do not need to be monitored;
- Clustering of assets: 1km distance between discharge outlets considered to be a cluster however the downstream monitor must be <500m downstream of the point of cross-sectional mixing for the first asset in the cluster;
- Storm overflows with an average of <10 discharges per year over 5-year period (shown through EDM data) do not need to be monitored. Where five years of EDM data are not available, performance can be modelled using CIWEM's model verification guidance[12];
- Require to install monitors at 25% of eligible sites by 2030.

In addition to the exceptions outlined above, the guidance also allows for the exclusion of outfalls discharging to any watercourse with a year-round, permanent depth of 4cm or shallower. In the preparation of this business plan it has not been possible to undertake the necessary site surveys to determine the depth of water in receiving watercourses and it currently not known how many sites in the Wessex Water region would be excluded on this basis.

Data and reporting

The guidance requires that water quality data must be made publicly available in near real time (within one hour), and in a common format across England as this will help meet Defra's programme objective of increasing public understanding. Furthermore, the guidance outlines the requirement to develop a visualisation platform to host the data which assesses water quality in both near real time and over long-term trends, preferably in the form of an interactive map. EDM data must also be overlaid in the visualisation platform.

This sits alongside the duty arising from section 81 of the Environment Act, which requires water companies to publish data on the frequency and duration of discharges from storm overflows.

There will be a requirement to provide an annual report including monitoring duration and water quality impact for each asset, the format of this report will be provided by the Environment Agency. It is likely that a nationally consistent platform will be developed by Water UK of behalf of the water industry however this is to be determined.

Non-statutory monitoring

The scope of Section 82 of the Environment Act excludes waterbodies through which water does not flow, such as coastal waters and lakes. Government consultation in the development of the guidance found that there is not yet a

[12] The Chartered Institution of Water and Environmental Management (CIWEM) (2017) Code of Practice for the Hydraulic Modelling of Urban Drainage Systems. Version 01

sufficiently robust understanding of how best to continuously monitor these waterbodies and effectively link to asset performance.

Investigative drivers have been put in place via the WINEP and will enable investment in pilot investigations on how best to monitor coasts, lakes and other standing bodies of water, canals and groundwater. There will be industry-wide investigations and catchment pilot studies, these will need to be complete by 2027 to inform PR29 planning for monitor installation.

Estuarine Waters

The intent of the Environment Act is that estuarine waters are included in the monitoring programme. Some estuarine waters present significant challenges when it comes to continuous monitoring, including tides changing the direction of flow, and high tidal ranges. Defra recognise that further research is required to establish how these waters can be effectively monitored. To allow time for investigations to be carried out these sites will be phased in from AMP9, investigations will be carried out in AMP8, these investigations may be water industry wide collaborative investigations, this is yet to be established.

7.1.3. Monitoring programme and investigations

Wessex Water has applied the above guidance to determine a programme for monitoring installation and investigations in AMP8 and AMP9. This is described below but in summary, 470 monitors will be required in AMP8 and delivered under a EnvAct_MON4 driven WINEP action. A further 1,406 monitors will be required in AMP9. Data from the monitors installed in AMP8 will be made available to the public through a EnvAct_MON5-driven WINEP action (Table 62).

Table 62 – Continuous Water Quality Monitoring AMP8 WINEP Monitoring Actions

Primary WINEP driver code	WINEP ID	Action name	Number of WINEP actions	Completion date
EnvAct_MON4	08WW100015a	Inland watercourses: Installation of continuous water quality monitoring	1	31/03/2030
EnvAct_MON5	08WW100195a	Develop and implement the ability to publish continuous water quality monitoring data in near-real time in a standardised format	1	31/03/2030
TOTAL			**2**	

No monitoring will be undertaken in AMP8 under EnvAct_MON2, EnvAct_MON3. Instead and in accordance with Government guidance, three investigations will be undertaken in AMP8 to inform monitoring approaches for estuarine, coastal and complex inland (groundwater, lakes, canals) in AMP9.

AMP8 and AMP9 installation programme

Government guidance for the development of this programme was published very late in the development of the business planning process (August 2023). This necessitated a desk-based approach to screening of outfalls; it has not been possible to ground-truth the desk based assessment with a programme of site surveys. The resultant programme of installation will be dynamic in nature, reflecting the uncertainties arising from the application of a desk-based screening exercise. For example, it is likely that it will not be possible to site sensors at the optimum

monitoring locations specified in the guidance for reasons including, but not limited to, local river morphology, landowners precluding access and insufficient year-round water depth). Equally, it may be found that more than two monitors are required per cluster to enable optimum monitoring of water quality impacts. The numbers presented below should therefore be considered indicative of the scale of implementation in AMP8 and AMP9 and subject to change.

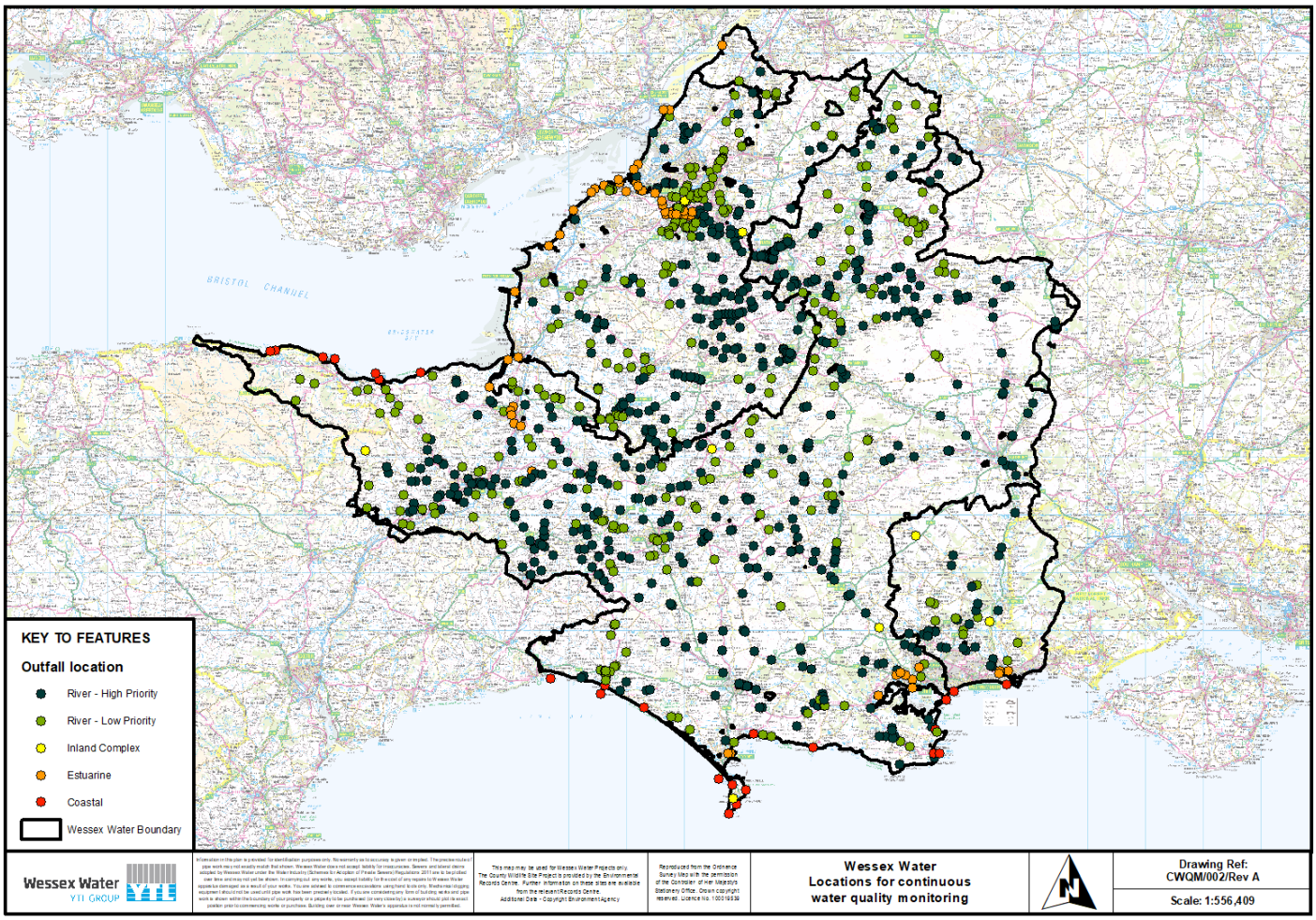
Table 63 shows there are a total of 1,483 assets that will require monitoring by 2035 and that after the screening process has been applied, there are 938 clusters to be monitored. There is a requirement to install 25% of eligible outfalls by 2030, therefore 235 clusters are required to be monitored by 2030. Assuming one upstream and one downstream monitor per cluster, 470 monitors will be required in AMP8. All 235 clusters in AMP8 will be high priority river locations. There are more assets (1483) than outfalls (1125), this is because there are common outfalls and culverts where multiple assets discharge to one location. 703 clusters (1406 monitors) will require monitoring in AMP9, a combination of river, estuarine, coastal and groundwater water bodies.

The location of monitors across the Wessex Water region are shown in Figure 76.

Table 63 – Prioritisation of monitoring installations

Receiving Water	**Number of** assets	**Number of outfalls**	**Number of** clusters
River – High priority (AMP8)	919	694	565
River – Low priority (AMP9)	393	330	284
Tracs – High priority (AMP9)	105	3	41
Tracs – Low priority (AMP9)	17	8	13
Inland complex - High priority (AMP9)	0	0	0
Inland complex - Low priority (AMP9)	0	0	0
Groundwater – High priority (AMP9)	4	49	3
Groundwater – Low priority (AMP9)	9	15	8
Coastal – High priority (AMP9)	29	20	19
Coastal – Low priority (AMP9)	7	6	5
Total	1483	1125	938

Figure 76 - Distribution of monitors



In accordance with government guidance, where assets are in a cluster and the downstream monitor detects elevated levels of pollutants, investigations must be carried out to identify the specific asset in the cluster that is responsible for the elevated readings. These investigations will be in two phases. The first phase will be a desk study using available data to identify impacts (to be carried out within 90 days). if phase one is inconclusive a phase two longer term assessment will be required to assess the source and significance of any impact (within 12 months).

Continuous Water Quality Monitoring Investigations

Three WINEP-funded investigations will be undertaken in AMP8 to inform the installation of monitors in AMP9 in estuarine, inland complex and coastal environments. In the development of PR24 guidance the Government has recognised that continuous water quality monitoring in these environments poses different challenges to that in a inland watercourse. For example, tidal ebb and flow mean that sensors can be 'upstream' and 'downstream' depending on the stage of the tidal cycle, whilst stratification in still bodies of water (such as lakes) may require monitoring at optimum or multiple depths. Furthermore, the parameters that are monitored in inland waterbodies may not be applicable in other environments; ammonium cannot be continuously monitored in saline conditions using existing technology.

The AMP8 investigations will allow these uncertainties to be addressed and the best approaches to monitoring in these locations to be developed in AMP8. Details of how these investigations will be delivered are yet to be determined however, given that this requirement is place on all water and sewerage companies in England, there is

potential for collaborative (Water UK or UK Water Industry Research (UKWIR)) approaches to be adopted to deliver these most efficiently.

Table 64 – Continuous Water Quality Monitoring AMP8 WINEP Investigation Actions

Primary WINEP driver code	WINEP ID	Action name	Number of WINEP actions	Completion date
EnvAct_INV1	08WW100189a	Investigation/pilots to monitor estuarine waters	1	30/04/2027
EnvAct_INV2	08WW100190a	Investigation/pilots to monitor inland complex environments	1	30/04/2027
EnvAct_INV3	08WW100191b	Investigation/pilots to monitor coastal environments	1	30/04/2027
TOTAL			**3**	

7.1.4. Robust and Efficient Costs

Costs for the continuous water quality monitoring programme of work have been developed internally, using indicative unit costs that the Environment Agency incur to run their National Instrumentation Centre, and comparative costs from external suppliers that have been used to validate unit costs. The overall costing is based on a combination of experience of undertaking similar (smaller scale) monitoring programmes and the roll-out of the Event Duration Monitor (EDM) programme. Assumptions have been made to scale these up or where costs are not available.

Defra, the EA, Wessex Water and other water companies were involved in the Technical Monitoring Sub-Group of the Storm Overflows Taskforce and representative unit costs were shared by the Environment Agency to inform the development of the PR24 and WINEP guidance. The steering group recognised that there would be significant differences between the approaches to continuous water quality monitoring by the Environment Agency National Instrumentation Centre and the approaches that the water companies would need to adopt, and that these would lead to significant additional costs. Examples of these differences include:

- **Land access.** The EA rely on the good will of landowners to allow the deployment of units on a temporary basis. Water companies will require land purchase and/or lease agreements with landowners to install monitors on a permanent basis. We do not have powers of compulsory purchase in this circumstance, allowances have therefore been made based on costs incurred for land purchase/access elsewhere.
- **Permitting.** Permanent and/or semi permanent monitoring kiosks will require planning permission and the necessary permitting associated with developments such as ecological surveys, flood risk assessment, appropriate assessment under the Habitats Regulations and mitigating visual intrusion in protected landscapes. Allowances have been made using experience from our capital delivery programme.
- **Capability to monitor at 15 minute intervals**. The EA use solar panels to monitor hourly however at 15 minute intervals alternative power supplies will be require (methanol fuel cells or mains electricity). We have made assumptions over different methods of powering monitors.
- **The need for a national data platform**, to provide information to the public in near real time, overlain with EDM data on storm overflow performance. This will need to be developed and maintained and queries from the public addressed.
- **Need to investigate elevated pollution levels**. Allowances have been made for operational staff to investigate and report on the source of elevated pollutant concentrations (as required by the guidance).

There are potential options yet to be explored such as using a service provider to deliver the installations, maintain and calibrate monitors and provide the required data platforms.

7.1.5. Customer Protection

As described in WSX26, we have not proposed a price control deliverable for continuous river water quality monitoring. Whilst this area is in excess of the materiality threshold, given the late confirmation of the guidance in this area (August 2023), we have not had time to develop a full proposal for consideration.

Other related PCs include:

- PC15 Total pollution incidents
- PC16 Serious pollution incidents

WINEP delivery is also a metric within the EA's annual Environmental Performance Assessment

7.2. Monitoring emergency overflows

7.2.1. Monitoring Emergency only overflows with EDM

Our permits database currently includes 195 Emergency only overflows. This is slightly lower than our APR23 return of 199 (Table 7c line 9).

We have followed the phasing EA letter of 5 July 2023 and further Q&A instruction to defer 75% of the U_MON6 installations to AMP9. We have applied 25% of the 195 EO only sites for our AMP8 profile for U_MON6 delivery.

There are 49 EO only EDM on our PR 24 plan.

7.2.2. Monitoring Emergency overflows and Storm overflows with flow monitors

Our permitting database identifies that there are 408 storm overflows at sewage pumping stations or WRCs that also have EOs. 25 of these are at WRCs. We have assumed these 25 are at the inlet works of the WRCs.

We have included 25% of the 408 EO/SO at pumping stations and WRC sites for our AMP8 profile for U_MON6 delivery of pass forward flow monitoring of SPS in AMP8. This follows the EA phasing letter of 5 July 2023 and further Q&A instruction from the EA to defer 75% of the U_MON6 installations to AMP9.

There are 102 new pass forward flow monitors included in our PR24 plan.

7.3. Smart networks

The Network Monitoring Team (NMT) has been set up to utilise data captured by sensors installed across our sewer network. Enhanced analysis and machine learning tools, such as Storm Harvester, allow the team to interrogate and proactively resolve issues before they result in pollution and flooding incidents. Analysis principally focuses on blockages, bursts, pump operation and event duration monitoring (EDM). The team is currently averaging over 22 'good catches' per month that may have caused negative impacts to customers and/or the environment, if not for the interventions actioned by operational field teams.

The NMT work with multiple teams to achieve these outcomes, therefore engagement and process planning has been key to the development and success of the team.

Key to realising ‘good catches’ is being able to trigger appropriate actions. Often the data can indicate a problem before anything is noticeable in the field. This can be especially problematic when rising mains have burst as impacts may not be visible/obvious at the surface. We have therefore developed templated action plans to follow up the flagged data with further investigations to locate and resolve the issue.

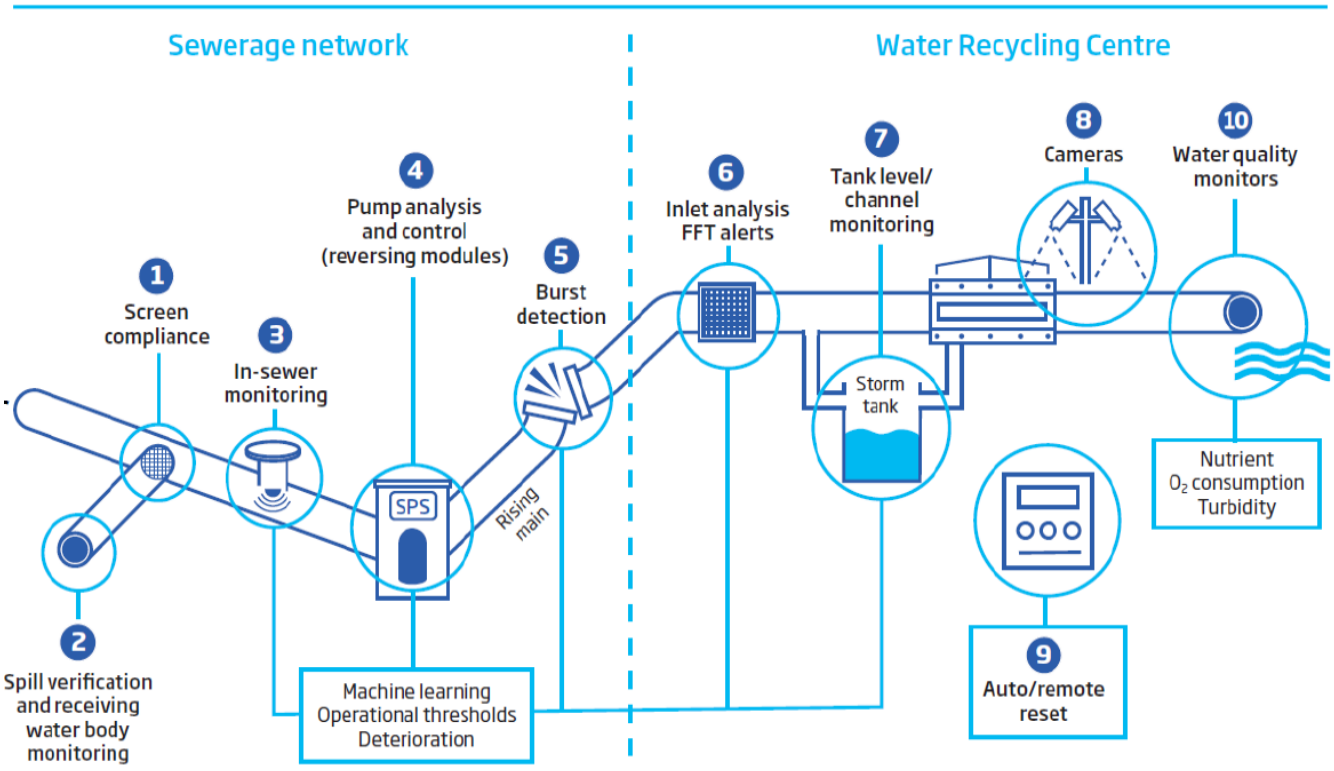
Alongside this, as we are so reliant on data, we need to ensure that sensors/monitors are maintained and are providing reliable information. Working closely with operational field teams and the Asset Reliability Team has been critical in ensuring we continue to have good quality data to analyse and feed into our tools.

Work is ongoing rolling out further monitors and developing the suite of analytical tools at our disposal. As more monitors are installed across the sewer network, the team will get a better overview of how the network is operating. This will result in better insights into problems and therefore improve the quality of actions given to the field teams.

We are currently at the trial stage of a Marketplace Challenge looking into new cost-effective monitor technology available to us. This will ultimately feed into Wessex Water’s Sewer Network Monitoring Strategy, ensuring we invest in the right solutions for the future. Figure 77 highlights the smart monitoring approach which we are trialling to integrate sewerage network and WRC asset data to understand capacity and performance, in time this will also link to river water quality monitoring to determine the environmental impact of asset operation. Integrated data is a significant tool in our approach to reducing pollution.

Further details of how we have Applied ‘intelligent’ analytics to enhance asset monitoring and anomaly detection can be found in WSX17 (Section A6-1.1.4). We are also implementing changes within our control room to benefit from innovative use of cloud technologies to provide real-time data and analytics to the incoming alarm stream (WSX17 Section A6-1.1.1) and developing a Digital Twin to assist with forecasting issues (WSX17 A6-1.2.3) and generating automated reports within our telemetry (ScopeX) system to identify configuration issues (WSX17 A6-1.2.7). We are also looking to develop a waste ‘Smart System’ to utilise and improve the data and control that we have over our Waste assets to most effectively deal with challenges including storm overflows, carbon environmental performance etc (WSX17 A6-1.2.10).

Figure 77 - Smart Monitoring Approach



We will launch a phased install of 3,500 monitors before the end of AMP7 using the outcomes of the Marketplace challenge. These will target hotspot locations using a manhole risk model, and takes in to account factors such as proximity to sewer ancillaries, watercourse, historic performance etc to determine the areas where we want the monitoring to be installed.

7.4. Burst Detection

Over the past 12 months we have continued to deploy sensors that allow us to detect bursts on our rising mains. The methods used have been chosen to give accurate alerts of a burst on the rising main, while also providing us with data to allow for better operation and control of our assets. This forms part of our £9m programme for burst detection monitoring of our sewerage rising main assets over the AMP7 investment period. The sites selected were classified using a consequence-based methodology; where rising mains have the highest consequence of causing a significant pollution these have been prioritised.

The first step in detecting bursts on rising mains is retrieving data from the assets. The second step is analysing the data to alert us to a potential (or real) burst. As the number of sensors has increased, the requirement for this has continued to grow. We have deployed complex algorithms to reduce false alerts where possible, whilst also extending our performance monitoring. This combined with the recently formed Network Monitoring Team (NMT) has allowed for timely notification of issues and much more effective use of site-based crews. Overall, this has resulted in less impact to the environment following a burst.

We have focused on developing an accurate solution that ensures we are detecting any anomalies. Through our development we have determined that pressure sensors alone, provide the majority of the benefits. As this a more cost-effective solution it will allow a wider rollout across our estate as part of a two phase approach - installing the pressure monitoring first to give early visibility of issues; to be followed with the flow monitoring at these sites as this will give us better insights than pressure alone. Our higher risk sites will still have both pressure and flow but sites with less risk site may just have pressure monitoring.

To better understand our assets, we will be launching a marketplace challenge for rising main burst detection and pumping station analytics, which will inform our PR24 strategy.

7.5. Network hydraulic modelling

7.5.1. Completing our modelling stock

The first cycle delivery of our DWMP over the past 5 years has included the rebuilding our hydraulic computer models of our sewerage networks.

These are dynamic models that run time series or design rainfall with rainfall intensities changing every minute in the storm to create simulated runoff from contributing areas from the catchment. That runoff is routed into the model of the below ground network (manholes/sewers/pumping stations) and the model predicts the resulting time varying flows and surcharge in the network. The sewerage models are thus able to predict resulting spills to the environment from overflows and flooding in the system. The flow regime through receiving WRCs is also simulated at an appropriate level of detail.

We have good models of our foul and combined sewers networks and the hydraulic performance of these has been verified at strategic locations, utilising both custom flow surveys and telemetry data. We have modelled but not verified the surface water networks, as these are very discrete. We do, working with other flooding risk management authorities, develop surface water management plans at high risk locations, as discussed in section 8.2.

We estimate that over 300,000 dynamic simulations has been undertaken for the DWMP and PR24, to assess the hydraulic flooding risks and the performance of our storm overflows.

Figure 78 - Example of model predictions plan view and long section

7.5.2. Future pressures of climate change, urban creep and development

Climate change and population growth is happening and published research indicates that there is now a 66% chance we will pass the 1.5°C global warming threshold between now and 2027. We are therefore already at the low climate change scenario of 1.5°C to 2°C referred to in Ofwat's Long term delivery strategy

The UK is faced with unprecedented environmental challenges and our day-to-day work is greatly influenced by the weather. The climate crisis will lead to drier summers, wetter winters and more frequent extreme weather events. This will have a direct bearing on the services we provide and that is why we are building long-term resilience into our DWMP. The scale and urgency of these challenges allied to rising customer and environmental expectations cannot be underestimated.

The DWMP framework states that at the 2050-year horizon we should apply a 20% uplift of rainfall intensity for climate change allowance, with sensitivity tests at 14% and 26% when assessing flooding. A new tool[13] that the EA has published (The peak rainfall climate change allowance by management catchment) also includes a 20% uplift in rainfall for the central emissions prediction and 35% to 40% increase for the high emissions prediction, as detailed in the table below.

Table 65 - Peak rainfall increase allowances for climate change

Catchment	2050's Central for 30 year return period	2050's upper end for 30 year return period	2070's upper end for 30 year return period
Avon Bristol	20%	35%	40%
Avon Hampshire	20%	35%	40%
Dorset	20%	35%	40%
Somerset	20%	35%	40%

We have applied 20% uplift to the FEH13 rainfall for the 2050 horizon to align with the DWMP framework and the table above. Sensitivity testing (+/- 6% of 20% climate change uplift) was applied to the complex catchments, like Bristol in the DWMP.

[13] https://www.gov.uk/government/publications/peak-rainfall-climate-change-allowances-by-management-catchment

Climate change will also potentially raise sea levels, but not significantly by 2050. The Met Office 'UKCP18 Marine report', has been used for the complex catchment of Bristol which could be affected by the Bristol channel which has the second highest tidal range in Europe. Future cycles of planning will include more assessment of sea level rise risks, in other catchments including Weymouth and Poole.

Climate change is also predicted to increase the probability of wet winters. This is problematic for Wessex Water because we have several catchments that are impacted by seasonal severe groundwater infiltration. It appears the impact of this may already be evident, since between 2010 to 2020, three years had severe seasonal inundations/elevated groundwater periods, whereas in previous decades these only impacted in one year.

We have used our hydraulic computer models to predict how much larger the solutions would need to be for the high climate change scenario and for development, for storm overflow and flooding described below.

Sensitivity of growth projections are much lower with only 1% variation. This is fairly insignificant in comparison with the increases in sewer flows resulting from increased rainfall intensities included in our climate change uplift. Furthermore, population growth will also be mitigated by our plans to reduce per capita consumption flow rates (as set out in our Water resource management plan).

7.5.3. Storm overflow performance predictions

To determine the predicted average annual spill frequencies for storm overflow performance (existing and future), simulations using 10 years' Storm Pac time series rainfall are required. Even though our modelling IT hardware has been significantly enhanced, these require a great deal of time simulate.

For storm overflows, the current and future annual average discharge frequencies have been calculated using the Environment Agency criteria of '12/24 discharge counting' methodology. Our design standards define the rainfall to be used (e.g. wet antecedent conditions, numerous return periods and numerous durations).

For each modelled storm overflow, the predicted discharge volume for each of the hypothetic rainfall events over the 10 year period are ranked from highest to lowest. The biggest predicted discharge volume gives an indication of the amount of useable attenuation storage required to prevent discharge to the environment in 10 years. The 51st ranked spill volume would be the indicative storage needed for 5 discharges in an average year. The 101st ranked spill volume would be the indicative storage needed for 10 discharges in an average year.

The storage volumes derived are only indicative as this approach doesn't fully allow for the impact of subsequent rainfall occurring when attenuation tanks are already partly full. Therefore, a much more detailed approach is used during optioneering as described in section 7.5.5.

For storm overflows, the models predict a 36% increase in discharge volumes for the mid climate change scenario compared to the baseline and a 46% increase for the high scenario.

7.5.4. Flooding performance predictions

For flooding, we have predicted the frequency that flooding could occur at every modelled manhole, now, in 5 years, 10 year and in 25 years' time, allowing for development, urban creep and climate change.

By using our baseline models, we can predict the 2025 performance. By adding future development, urban creep allowance and climate change allowance, we can predict the future performance. Our modelling predicts that the risk of flooding in a storm for the high climate change scenario would result in 30% more properties being at risk of flooding.

The predicted flooding for each manhole and predicted surcharge frequency results for each pipe are imported into a geospatial database. A summary of the database of hydraulic model results is available on our corporate GIS system.

7.5.5. Optioneering

A huge amount of detail is needed to evaluate options for storm overflow and hydraulic flooding. We are also developing a tool to compare model performance to actual performance as detailed in WSX17 (Section A6-1.1.3) to assist with classifying our EDM spills to inform our options assessment.

Our recent DWMP and PR24 optioneering has generated over 100 Terabytes of data of results for flooding predictions of design storms and stochastic rainfall storm overflow predictions.

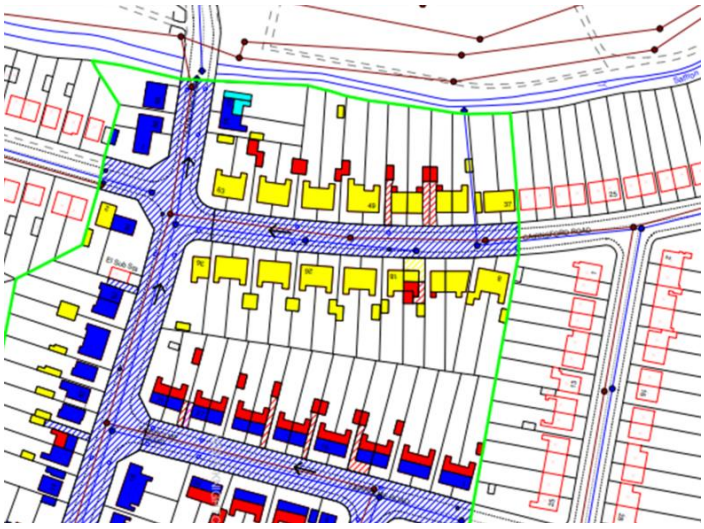
For example, to assess separation solutions, different models have to be set up with varying reductions in modelled impervious area, simulated and then the results collated. This information is then used to target separation in areas where it has the most impact for a given objective.

See section 5.1.4 for an example summary optioneering report, that shows the different types of optioneering we undertook as a minimum when developing options.

7.5.6. Model maintenance

We continue to maintain our sewerage hydraulic model stock. We have developed a model maintenance procedure that effectively audits our models against the current sewer records. Where discrepancies are found either our models or our sewer records are corrected, once we have confirmed which data is correct, using new surveys if necessary. All survey data is captured on a geodatabase to facilitate model updates. In particular, there has been renewed focus on targeted connectivity/ impermeability surveys to understand the source of storm flow responses. An example of the output from these surveys is shown below.

Figure 79 - Impermeable area connectivity results



The above modelling approach described above is our standard hydraulic modelling. Occasionally we extend this to include more detail, such as intergrade models (i.e. includes overland flow modelling).

We are also trialling using forecast rainfall to predict where flooding may occur in 6 hours' time.

7.5.7. Integrated models

We are working with our partners to build integrated models in catchments where our partners have identified particulat needs/drivers. These integrated models include 3rd party assets such as watercourses, highway drainage

and overland flow routing. These are often 2-D models and are more complex than our standard 1D approach. Figure 80 shows an example of an integrated model.

Figure 80 - Examples of 2D integrated hydraulic computer models

7.6. Monitoring for Flow Compliance at WRCs

7.6.1. Need for Investment

Context

Our WRCs receive sewage and trade effluent from catchments where at least a proportion of the sewerage network is combined foul and surface water. This means that the sewerage network carries run-off as well as sewage and trade effluent discharged by householders and traders. As a consequence, the volume of sewage arriving at a WRC can increase significantly after a period of rain.

Minimum flow rates are set for the amount of flow that needs to be passed forward to treatment before overflows are permitted to the storm tanks. For all flows being treated through the WRC, effluent quality limits need to be met. This rate is known as the Forward Passed Flow (FPF), previously known as Flow to Full Treatment (FFT) and is normally specified in permits for discharges to storm tanks.

Flow monitoring is undertaken in compliance with the EA's Monitoring Certification Scheme (MCerts) framework of standards. The flow installations are routinely inspected by independent MCerts inspectors to confirm that the required flows are being measured and that the measurement is within specific levels of accuracy.

Historically, the majority of our overflows and storm tanks at WRCs did not have monitors on their overflows, and so we are not able to determine frequency of spilling to the environment and also how this relates to FPF (i.e., whether flows spill to or from the storm tanks during dry weather). Many sites also only had flow measurement installations for Dry Weather Flow measurement as required by the EA (at the time) and may not comply with the EA's requirement of an accuracy of ±8% at the permit FPF flow setting and an ability to link instantaneous flows to overflow operation.

In order to declare compliance against FPF, there is a need for appropriate monitoring of both flows and overflows.

Regulatory Drivers

The U_MON3 and U_MON4 drivers in the WINEP require storm sewage discharges from WRCs to have MCERTS certified overflow operation and FPF for full treatment monitoring that allows performance with their permit conditions to be better regulated.

Table 66 – Flow monitoring driver codes in the WINEP

Driver Code	Driver Details
U_MON3	Provision of event duration monitors (EDMs) to identify when flows go to storm.
U_MON4	Provision of suitable MCerts flow measurement installations.

These drivers were also present in PR19 WINEP, however knowledge gained since has led to the development of more detailed procedures and the identification of additional regulatory requirements, for example U_MON3 overflow operation monitoring must be MCERTS certified. In the PR19 WINEP there was also a U_INV2 driver, as a sub-driver of U_MON4, for sites to be investigated to confirm (or otherwise) their flow measurement accuracy and suitability for permit FPF measurement, with acknowledgement that any installations found to be unsuitable would be identified for replacement in the PR24 WINEP. In recognition of this, a number of driver sub-groups have been identified for the PR24 WINEP, as identified in Table 67.

Table 67 – Flow monitoring driver sub-groups in the WINEP

PR24 U_MON3/U_MON4 sub-groups	Description
U_MON3a MCERTS certification of an AMP7 U_MON3 driver output overflow operation monitor	Existing U_MON3 overflow operation monitor will be MCERTS certified; may need some improvement work requiring MCERTS inspector assessment to obtain certification
U_MON3b MCERTS certified overflow operation monitor	Installation and MCERTS certification of a U_MON3 overflow operation monitor which was not included in AMP7. There may in some unusual cases also be a need for a new discharge operation monitor (EDM) to be installed as well.
U_MON4a Move AMP7 U_MON4 driver output to 2-minute flow monitoring	Existing front-end flow passed forward flow monitors which were AMP7 U_MON4 outputs will move from 15 to 2-minute flow monitoring. This may require work at the monitor and/or elsewhere to allow the additional monitoring data to be received and processed.
U_MON4b Move AMP7 U_INV2 driver output to 2-minute flow monitoring	Existing front-end flow passed forward flow monitors that were AMP7 U_INV2 outputs capable of being MCERTS certified in AMP7 (so no U_MON4 in PR24) will move from 15 to 2-minute flow monitoring. This may require work at the monitor and/or elsewhere to allow the additional monitoring data to be received and processed.
U_MON4c PR24 U_MON4 from U_INV2 investigation	Installation and MCERTS certification of a front-end flow monitor, monitoring at 2-minute intervals, where the AMP7 U_INV2 investigation concluded that there was no suitable existing flow monitor for measuring flow passed forward flow. The work required will involve civils which could range from installing a new flume and monitor to an entire rebuild of a WwTW inlet works.
U_MON4d MCERTS certified Flow passed forward flow monitor	Installation and MCERTS certification of a U_MON4 flow passed forward flow monitor, monitoring at 2-minute intervals, which was not included in AMP7.

U_MON4e MCERTS certified Flow passed forward flow monitor	Installation and MCERTS certification of a U_MON4 flow passed forward flow monitor, monitoring at 2-minute intervals, which was not included in AMP7. The work required will include civils which could range from getting MCERTS certification of an existing flow monitor to an entire rebuild of a WwTW inlet works.

7.6.2. Options Development

The PR19 WINEP included 227 sites with U_MON3 drivers, 63 sites with U_MON4 drivers, and 163 with U_INV2 drivers. Of the latter 163, 72 have existing flow monitoring instruments that will be certified in AMP7 for FPF compliance. A further 22 WRCs have been identified with a permitted FPF but were omitted from the PR19 WINEP.

Table 68 summarises the number of WRCs against each of the driver codes for the PR24 WINEP, with further detail in the following sections.

Table 68 – Flow monitoring driver sub-groups in the WINEP

Driver	No. of Sites
U_MON3a	227
U_MON3b	48
U_MON4a	63
U_MON4b	71
U_MON4c	91
U_MON4d	0
U_MON4e	22

U_MON3a – MCERTS certification of an AMP7 U_MON3 driver output overflow operation monitor

Early in AMP7 and in the absence of technical guidance from the EA, we began installing level probes to comply with EDM requirements, as in many cases these were more cost efficient than level sensors (e.g., ultrasonics). When we became aware that the EDMs would require MCERTS certification we changed to install appropriate level sensors.

Any level probe EDMs already installed before this change will need to be revisited and replaced with a level sensor. Whilst in some cases no other modifications are required, for some sites there may be a requirement for some alterations. 13 sites will need to be revisited to have probes replaced with MCERTS-approved level sensors at an estimated total capex cost of £40k. Furthermore, 22 sites will need to be revisited to have non-compliant level sensors replaced with MCERTS-approved level sensors at an estimated total capex cost of £42k.

Table 69 – U_MON3a sites that require additional work

	No. of Sites
Probe Replacement	13
Level Sensor Replacement	22

U_MON3b – MCERTS certified overflow operation monitor

The below table lists the 21 WRCs with an FPF permit but omitted from the PR19 WINEP for a U_MON3 driver. In all cases, any current EDMs or flow meters are not to MCERTS standard and would require replacing.

Table 70 – U_MON3b sites

WINEP Action ID	Site	Existing EDM?	Existing Flow Meter?
08WW100853	Alderton WRC	-	-
08WW100854	Alford WRC	Y	-
08WW100855	Ashill Main WRC	-	-
08WW100856	Chaffcombe WRC	-	-
08WW100857	Charlton Musgrove (Barrow Lane) WRC	-	-
08WW100858	Combe Florey WRC	-	Outlet
08WW100859	Godmanstone WRC	-	-
08WW100860	Halse WRC	-	-
08WW100861	Hinton St Mary WRC	Y	-
08WW100862	Kingstag WRC	Y	-
08WW100863	Langton Herring WRC	Y	-
08WW100864	Loxton WRC	-	Outlet
08WW100865	Lydlynch WRC	Y	Inlet
08WW100866	Monkton Deverill WRC	Y	-
08WW100867	Parbrook WRC	Y	-
08WW100868	Poyntington WRC	Y	-
08WW100869	Ringstead WRC	-	Feed to UV plant
08WW100870	Sandford Orcas WRC	-	Outlet
08WW100871	Tockenham WRC	Y	Inlet
08WW100872	West Bagborough WRC	-	Outlet
08WW100873	West Milton WRC	Y	-

There are also a further 27 sewage pumping stations included in the WINEP with a U_MON3b driver. These already have U_MON1 monitors installed for detecting spills to the environment from their overflows, but they also have permitted storage volumes and Pass Forward Flow (PFF) limits, and thus need additional monitoring to ensure PFF compliance.

U_MON4a – Move AMP7 U_MON4 driver output to 2-minute flow monitoring

63 sites were upgraded in AMP7 with new flowmeters installed and certified to MCERTS standard.

The cost for the 5-yearly recertification is £200 per additional instrument, recognising that these sites are already been visited by the inspectors. Whilst most sites will have a single EDM and single flowmeter, we do have some with multiple flowmeters given the different process streams and connectivity of any internal recirculation / return flows.

Whilst currently reporting at 15-minute intervals, they have been set up to allow reporting at 2-minute intervals. The EA are still developing the output template for reporting FPF operation; however, we believe our systems are being set up to be able to adequately meet expected requirements without undue additional cost. It is also assumed there are no permitting change costs.

U_MON4b – Move AMP7 U_INV2 driver output to 2-minute flow monitoring

During the AMP7 U_INV2 flow investigations we identified 72 sites where existing inlet flow meters met the requirements of the U_MON4 driver with appropriate certification and no modifications. These have been certified in AMP7 for FPF compliance.

Similar as U_MON4b above, the cost for the 5-yearly recertification is £200 per additional instrument, recognising that these sites are already been visited by the inspectors. Whilst most sites will have a single EDM and single flowmeter, we do have some with multiple flowmeters given the different process streams and connectivity of any internal recirculation / return flows.

Whilst currently reporting at 15-minute intervals, they have been set up to allow reporting at 2-minute intervals. The EA are still developing the output template for reporting FPF operation; however, we believe our systems are being set up to be able to adequately meet expected requirements without undue additional cost. It is also assumed there are no permitting change costs.

U_MON4c – PR24 U_MON4 from U_INV2 investigation

The AMP7 U_INV2 investigations identified 91 sites where new installations would be required.

Aust WRC was included in the PR19 WINEP for both a U_MON3 and U_INV2 driver. The output from the U_INV2 flow investigation led to us submitting a permit variation application to the EA for the removal of the storm overflow, and the deletion of the U_MON3 driver. On completion of the application, the site will not have an FPF permit and thus not require a U_MON4 (or U_MON3) driver.

A brief summary of the work required for monitoring FPF compliance is listed below. In some cases, this could be by the addition of a flow meter onto an existing pipeline, whereas in other cases rebuilds of whole inlet works may be required. For more details of the proposed improvement works at each site, refer to the AMP7 U_INV2 investigation reports, although noting that further development on the option(s) has taken place at some sites since these reports were written, including the need for other PR24 upgrades for other drivers, e.g. somewhere between the inlet works and downstream primary settlement tank(s) with sufficient turbulence to ensure adequate chemical dosing and mixing for phosphorus removal.

Table 71 – U_MON4c sites

AMP7 WINEP Action ID	PR24 WINEP Action ID	Site	Work Required
7WW200011	08WW100630	Almondsbury WRC	Install high-level alarm and float switch on overflow at filter distribution chamber.
7WW200013	08WW100631	Alveston WRC	New bypass with Magflow, demolition of existing flume, new washwater flowmeter.
7WW200044	08WW100633	Avonmouth WRC	Installation of new magflow arrangement on the food waste compost pad drainage pipework.

AMP7 WINEP Action ID	PR24 WINEP Action ID	Site	Work Required
7WW200079	08WW100637	Bishops Caundle WRC	Breakout inlet channel and install new standard stainless-steel flume to comply with BS ISO 4359. Divert storm returns upstream.
7WW200087	08WW100639	Blackheath WRC	New MCERTS FPF Magflow installation and diversion of works return and recirculation mains
7WW200091	08WW100640	Blagdon WRC	Remove Hand Valve.
7WW200103	08WW100642	Bowerhill WRC	New flowmeter on washwater supply, metalwork modifications and PLC work.
7WW200105	08WW100643	Box WRC	Diversion of road drainage.
7WW200123	08WW100646	Bridport WRC	Install 2 new flowmeters
7WW200132	08WW100648	Broadmayne WRC	New Inlet Channel with flume & level sensor, new weir, and level sensor in Inlet PS.
7WW200143	08WW100651	Buckland Newton WRC	Manhole weir plate to be raised
7WW200147	08WW100652	Burton WRC	New Magflow with pipeline diversions and temporary pumping.
7WW200152	08WW100653	Butleigh WRC	Install new overflow outlet chamber pipework to include MCERTS magflow and actuated penstock. Pipework to discharge into PST DC. Permanently close post-PST overflow valve. Install alarm on emergency overflow at Filter DC.
7WW200164	08WW100656	Cannington WRC	New Flowmeter on washwater main, trace heating, replace FPF penstock, move pipework, new magflow chamber, new isolation valves.
7WW200169	08WW100657	Castle Cary WRC	Replace channel with prefabricated channel & flume.
7WW200179	08WW100658	Chard WRC	New Flowmeter on washwater and ultrasonic alarm on intermediate PS
7WW200198	08WW100662	Cheddar WRC	New Flowmeter on washwater, civil modifications to inlet structure.
7WW200211	08WW100666	Chilthorne Domer WRC	Remove existing inlet flume, install new stainless-steel channel with FPF flume. Install ultrasonic and actuated penstock for flow control.
7WW200217	08WW100667	Chippenham WRC	Certify existing double flume channel and divert SAS and site drainage returns.
7WW200220	08WW100668	Christchurch WRC	Install a high-level alarm on the emergency overflow pipe at the works return PS wet well.
7WW200227	08WW100669	Coleford WRC	Divert screening liquors downstream of existing MCERTS flume and ultrasonic.
7WW200264	08WW100680	Crewkerne East WRC	Divert dewatering liquor pipework to discharge downstream of the MCERT.
7WW200269	08WW100682	Croscombe WRC	Certify existing FPF flume with ultrasonic in the inlet channel downstream of balance tank, re-screed inlet channel and build a new dedicated works return PS. Use FE measurement for DWF. Divert all works liquors to discharge into the new works return PS and return new rising main downstream of new MCERTS flume.
7WW200279	08WW100684	Devizes WRC	Liquors from dewatering unit to be diverted upstream of the MCERTS flume and ultrasonic.
7WW200294	08WW100688	Donyatt WRC	Install MCERTS magflow on new inlet pipework to PST feed chamber. Install actuated penstock in inlet channel,

AMP7 WINEP Action ID	PR24 WINEP Action ID	Site	Work Required
			downstream of storm overflow weir. Divert works return rising main into PST feed chamber.
7WW200304	08WW100690	Dowlish Wake WRC	Install new FPF MCERTS magflow. Separate return liquors from inlet flow, constructing a new works return PS
7WW200308	08WW100691	Downton WRC	Magflow on washwater supply to inlet works.
7WW200312	08WW100692	Doynton WRC	New raised inlet structure with MCERTS flume and ultrasonic
7WW200323	08WW100694	East Chinnock WRC	Construct either storm or works return PS (assuming FPF flowmeter is installed as part of AMP7 P scheme).
7WW200333	08WW100696	East Harptree WRC	New Flume & ultrasonic on Inlet, retain outlet for DWF. New signals via cellular comms PLC system
7WW200339	08WW100697	Edford WRC	Magflow meter to be installed in the location of existing bypass pipework with modifications to pipework and PST distribution channel. Works returns diversion downstream of MCERTS magflow and associated pipework.
7WW200350	08WW100699	Evercreech WRC	Install new 100 mm dia. pipework, magflow and chamber. New actuated penstock for flow control.
7WW200353	08WW100700	Evershot WRC	Install new 100 mm dia. pipework, magflow and chamber. New actuated penstock for flow control.
7WW200355	08WW100701	Farmborough WRC	Install a MCERTS Magflow meter into the PST feed pipe, with a jet-point/ automatic flush downstream of the magflow. Magflow mounted on a slab at ground level. Divert works returns downstream of magflow.
7WW200374	08WW100706	Frome WRC	Magflow on washwater supply to inlet works.
7WW200402	08WW100710	Great Badminton WRC	Install 4 new flowmeters
7WW200417	08WW100713	Halstock WRC	New Inlet PS & Magflow Chamber
7WW200427	08WW100716	Hatch Beauchamp WRC	New works return pumping station and rising main to primary settlement tank distribution chamber. New front-end flume certified to FPF
7WW200458	08WW100720	Holdenhurst WRC	Substantive works return diversions and flow measurement.
7WW200497	08WW100732	Keynsham WRC	New Flowmeter on washwater.
7WW200508	08WW100734	Kinson WRC	New Liquors Return Pumping Station.
7WW200524	08WW100737	Leigh On Mendip WRC	Replace Flume and move returns to correct locations or install Magflow
7WW200532	08WW100738	Long Dean WRC	Replace existing inlet flume for compliant flume arrangement, modulating penstock, storm weir shortening, & dewatered sludge liquors diversion.
7WW200537	08WW100739	Longbridge WRC	MCERT of re-located electromagnetic flow meter on inlet & installation of new access platform.
7WW200553	08WW100743	Maiden Bradley WRC	FPF Rectangular Flume, FPF Penstock, Concrete Flume Chamber & Works Liquors Pumping Station. Outlet MCERT to be retained and recertified for dry weather flows.
7WW200567	08WW100746	Marnhull Common Lane WRC	
7WW200578	08WW100749	Martock New WRC	New Flowmeter on washwater.
7WW200584	08WW100750	Meare WRC	Divert storm return rising main to discharge downstream of overflow weir. Install new Sludge Liquor Pumping Station in existing chamber. Relocate the ultrasonic further upstream of the existing FPF flume and certify to MCERTS

AMP7 WINEP Action ID	PR24 WINEP Action ID	Site	Work Required
7WW200587	08WW100751	Melksham WRC	Divert works return to downstream of flume.
7WW200590	08WW100752	Mells WRC	Install FPF crump weir with ultrasonic in the inlet channel downstream of balance tank and divert works returns downstream of new MCERTS crump weir.
7WW200595	08WW100753	Mere WRC	Magflow installation at the inlet and MCERTS certification,
7WW200599	08WW100754	Merriott WRC	Lower inlet screen and bypasses. Replace existing flume arrangement for certification.
7WW200613	08WW100757	Milverton WRC	Break out existing flumes and install SS steel channel with new MCERTS flume and storm overflow. Separate return liquors from storm return and inlet flow, constructing new works return PS.
7WW200634	08WW100760	North Cadbury WRC	New arrangement and rectangular flume installation. New, storm feed PS and storm return rising main modifications.
7WW200640	08WW100761	North Nibley WRC	New works return pumping station and rising main to primary settlement tank distribution chamber. New front end magflow certified to FPF
7WW200653	08WW100764	Nunney WRC	New flowmeter on screenings rising main and measured flow to be added to the MCERTS measurement at the flume.
7WW200656	08WW100765	Oakhill WRC	Replace existing flume arrangement for MCERTS certification and install modulating penstock.
7WW200673	08WW100767	Paulton WRC	Storm returns discharge relocation upstream of the MCERTS flowmeter.
7WW200682	08WW100769	Pilton WRC	Break out existing flume and remove channel material. Install new SS channel, including MCERTS flume
7WW200699	08WW100772	Portbury Wharf WRC	Magflow on washwater supply to inlet works
7WW200703	08WW100773	Potterne WRC	New MCERTS flowmeter on screen washwater supply. FPF compliance recommendation to install new MCERTS flume and storm separation chamber.
7WW200710	08WW100774	Pucklechurch WRC	Replacement of existing flume with new MCERTS flume.
7WW200721	08WW100777	Radstock WRC	Magflow on washwater supply to inlet works.
7WW200732	08WW100778	Ratfyn WRC	Diversion of used screen washwater upstream of the MCERTS installation.
7WW200749	08WW100782	Rowde WRC	New flowmeter on screenings pumping main and measured flow to be added to the MCERTS measurement at the flume.
7WW201028	08WW100783	Royal Wootton Bassett WRC	New inlet pumping station to divert incoming gravity sewer from Marlborough Road.
7WW200754	08WW100784	Salisbury WRC	Certification of existing flume, new returns PS to divert sludge liquor returns downstream of MCERTS.
7WW200760	08WW100785	Sandhill Park WRC	Modification and certification of replacement flume, new humus desludge pumping station and rising main with MCERTS magflow.
7WW200764	08WW100786	Seend WRC	Install new SS inlet channel and replace the existing inlet flume with an MCERTS flume. Separate storm water returns from the humus descum and divert storm rising main to return upstream of the MCERTS flume. Discharge humus descum to works returns PS.
7WW200769	08WW100787	Shaftesbury WRC	Washwater Electromagnetic Flow Meter.

AMP7 WINEP Action ID	PR24 WINEP Action ID	Site	Work Required
7WW200787	08WW100789	Sherborne WRC	Certify existing magflows on crude pumping mains, install magflow on the washwater pumping main to the inlet and construct new sludge decant liquor PS.
7WW200793	08WW100791	Shillingstone WRC	Install a high-level alarm on the emergency overflow at the interstage pumping station.
7WW200798	08WW100792	Shoscombe WRC	FPF Electromagnetic Flow Meter, FPF Control Eccentric Plug Valve & Works Liquors Electromagnetic Flowmeter.
7WW200814	08WW100796	South Perrott WRC	Remove existing inlet flume, install new stainless channel with FPF flume, ultrasonic and actuated penstock for flow control. Divert works return rising main into chamber upstream of PST distribution chamber. Install new ultrasonic monitor with EO high-level alarm at the PST effluent channel.
7WW200824	08WW100798	South Wraxall WRC	Replace existing flume arrangement for MCERTS certification and install modulating penstock.
7WW200827	08WW100799	Sparkford WRC	New MCERTS flowmeter on filter feed pumping main and washwater rising main; replacement of existing 2 no. filter feed pumps with variable speed pumps to regulate FPF. Humus sludge return flow estimated by drop test and FPF increased accordingly.
7WW200867	08WW100807	Sutton Benger WRC	Replace existing flume, divert sludge decant liquors and install ultrasonic on secondary PS overflow.
7WW200876	08WW100809	Sydling St Nicholas WRC	Replace existing flume ultrasonic with an MCERTS device and certify arrangement to FPF.
7WW200906	08WW100815	Tintinhull Ash WRC	Construct new storm return pumping station, lay associated return pipework. Replace existing FPF magflow by approved MCERTS device. Monitoring of emergency overflow
7WW200918	08WW100818	Trowbridge WRC	New PST3 Return Pumping Station and monitoring of humus desludge overflow, recertification of flowmeter on tanker imports.
7WW200926	08WW100820	Urchfont WRC	New extending inlet channel and new flume.
7WW200954	08WW100827	Wellow WRC	Ultrasonic monitor with EO high-level alarm to be installed in the filter effluent chamber
7WW200961	08WW100828	Wells WRC	Installation of Magflow on washwater pipework
7WW200976	08WW100832	Westwood WRC	New inlet works, constructed offline next to existing
7WW200987	08WW100835	Wick WRC	New Electromagnetic Flowmeter (Magflow) installation at Inlet Works.
7WW201006	08WW100838	Wincanton WRC	Divert dewatering liquor pipework to discharge to site drainage. Divert fine screen liquors to discharge to proposed mixing chamber.
7WW201013	08WW100840	Winsley WRC	Repositioning of penstock to the channel entrance and replacement of flume.
7WW201018	08WW100841	Wiveliscombe (Hillsmoor) WRC	Measure and subtract washwater supply to compactor from current MCERTS.
7WW201030	08WW100848	Worth Matravers WRC	Install FPF MCERTS Magflow on aeration tanks feed pipe and divert sludge dewatering liquors downstream of the MCERTS Magflow.
7WW201049	08WW100850	Yeovil Pen Mill WRC	Magflow on FE washwater supply to inlet screens. Relocation of tanker connection point upstream of the MCERTS flume

AMP7 WINEP Action ID	PR24 WINEP Action ID	Site	Work Required
7WW201056	08WW100851	Yeovil Without WRC	MCERTS magflow on inlet screen washwater.

U_MON4d – MCERTS certified Flow passed forward flow monitor
As noted earlier, for any sites omitted from the PR19 WINEP any existing instruments are not to MCERTS standard, thus there are 0 sites identified against this driver.

U_MON4e – MCERTS certified Flow passed forward flow monitor
As noted earlier, a number of sites with an FPF permit were omitted from the PR19 WINEP. In all cases, any current EDMs or flow meters are not to MCERTS standard and would require replacing.

In addition to the previously listed 21 sites in Table 70, a further site (Butcombe WRC) had a U_MON3 driver in the PR19 WINEP but no corresponding U_INV2 or U_MON4 driver.

7.6.3. Robust and Efficient Costs

For those sites assessed through the PR19 U_INV2 driver, high level engineering estimates were developed alongside the investigation reports and form the basis of our cost build up.

Cost build ups for the new small sites have been made for every site dependent on its perceived complexity and existing assets, with capex estimates ranging from c.£25-50k per site.

The MCERTS standard requires annual self-certification and an independent recertification every 5 years. Any instrument installed in AMP7 will already have had cost allowances included for operating and maintaining, however additional opex is required for the 5-yearly recertification at £927 per site, which is also required when a site is first certified. Should any sites require additional flow meters, such as for works returns, then the cost for certification/recertification of additional meters is £200, recognising that these sites are already been visited by the inspectors. Whilst most sites will have a single EDM and single flowmeter, there are some with multiple flowmeters given the different process streams and connectivity of any internal recirculation / return flows.

Whilst currently reporting at 15-minute intervals, any installed meters or monitors have been set up to allow reporting at 2-minute intervals. The EA are still developing the output template for reporting FPF operation; however, we believe our systems are being set up to be able to adequately meet expected requirements without undue additional cost. It is also assumed there are no permitting change costs.

We expect the permitting cost to the EA for a combined U_MON3 and U_MON4 install to be at the current rate for a minor variation of £2,295 per site.

Permitting and certification costs have been proportioned across the U_MON3 and U_MON4 drivers, to avoid double counting.

7.6.4. Customer Protection

As described in WSX26, we have not proposed a price control deliverable for flow monitoring, as it is less than the materiality threshold. Installation of flow and spill monitors is, however, a requirement under the WINEP, and clauses are also being added into discharge permits regarding reporting.

We recognise the importance of appropriate flow monitoring, and are already advancing delivery of the U_MON4c installations with the aim to deliver the majority by 2025, over a year ahead of the Dec 2026 regulatory date.

7.7. Water Quality Investigations

Over the past 25 years we have worked with the Environment Agency and others to investigate where there are concerns that the operation of our wastewater assets – water recycling centres (WRCs) and storm overflows – may have an impact on the water environment. This section describes how we investigate these discharges and the work that the company is committed to over the period 2025 – 2030 reduce our environmental impact.

Our investigations typically follow the process summarised in Figure 81. They are instigated when our regulators identify a risk that our discharges may affect achievement of environmental targets or are prompted by a regulatory change or new designation. Discharges identified through this process are included in the WINEP for investigation in the next AMP.

Figure 81 - Summary of WINEP investigation lifecycle

The investigation phase commences with a scope of work being agreed and a monitoring plan put in place to collect the information required to determine the effect of discharge(s). We monitor a range of environmental variables such as river flow, water quality, including microbial indicators and aquatic ecology (plants, fish and insects). This information is analysed and used to develop models that can simulate the effects of different discharge regimes under a range of environmental conditions.

The outcome of these investigations is reported to our regulators and other stakeholders and a course of action agreed for implementation in subsequent investment periods. Historically some investigations have led to changes to permit conditions or other mitigation measures being made, whilst others have found that the environmental effects of our discharges are not significant and no changes to our assets have been required. In some cases, our investigations have highlighted other sources which are causing the water quality decline requiring attention from the Environment Agency and other sectors.

We recognise that ensuring our discharges have a minimal or no impact on the environment is an ongoing process, particularly to ensure compliance with the Water Framework Directive and the Common Standards Monitoring Guidance. Between 2025 and 2030 we will deliver 39 water quality WINEP investigation WINEP actions under eight primary drivers (Table 72).

Table 72 - Summary AMP8 of water quality WINEP investigation drivers

Primary WINEP driver code	Description	Number of WINEP investigation actions	Completion date
HD_INV	Investigation and/or options appraisal to determine impacts of Water Company activities, or permit/licence conditions/standards on a European	13	30/04/2027

	Site or Ramsar site or to determine the costs and technical feasibility of meeting targets		
SSSI_INV	Investigation and/or options appraisal to determine impacts of water company activities, or permit or licence conditions/standards on a SSSI or to determine the costs and technical feasibility of meeting targets	1	30/04/2027
WFDGW_INV	Groundwater good status investigation relating to water resource or water quality	4	30/04/2027
WFD_INV	Investigations of actions to improve water quality in terms of relevant WFD status objectives	2	30/04/2027
WFD_INV_CHEM	Investigations [chemical investigations]	19	30/04/2027 31/03/2030
WFD_INV_MP	Investigations into micro-plastics	2	30/04/2027
SW_INV	Shellfish waters improvement or prevent deterioration investigation	3	30/04/2027
BW_INV5	Investigations at non-designated waters where there is evidence of customer support	1	30/04/2027
NERC_INV	Investigations and/or options appraisal for changes to permits or licences, and/or other action that contributes towards biodiversity duties, requirements and priorities.	1	30/04/2027
25_YEPINV	Investigations into a locally significant environmental issue not eligible under any other driver, but with clear evidence of customer support	1	30/04/2027
	Total	**47**	

7.7.1. Nutrient Investigations

We have completed a number of nutrient (phosphorus and nitrogen) investigations in preceding AMP periods to better understand the contribution which our discharges may have with respect to the relevant legislation such as Habitats Regulations, SSSI obligations under the Countryside and Rights of Way Act or the Water Framework Directive. During AMP7 we undertook investigations to understand the impact of our wastewater discharges (and abstractions) with against the revised Common Standards Monitoring Guidance, under the Habitats Regulations, in the following locations:

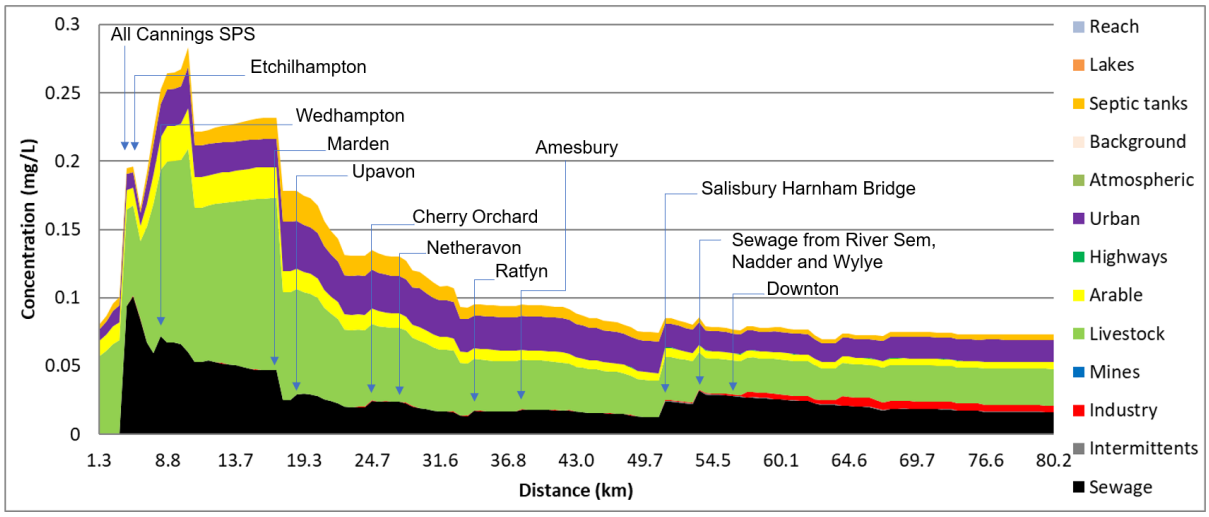
- Hampshire Avon
- Dorset Frome
- Poole Harbour, covering phosphorus and nitrogen
- River Crane, Moors River System

These investigations typically focused on favourable condition targets for phosphorus, DO, ammonia and un-ionised ammonia and has identified significant investment that will be undertaken at WRCs during AMP8 across these

catchments. In addition, in the Dorset Frome we assessed the opportunity to undertake seasonal phosphorus removal, increasing the level of ferric dosing in the summer months to achieve a lower discharge concentration, rather than the standard annual average permit. The Poole Harbour investigations improved our understanding of the nitrogen contributions from our discharges, including both WRCs and storm overflows.

Figure 82 below provides an example of the modelling results from the AMP7 Hampshire Avon CSMG investigation, illustrating the different sector contributions of orthophosphate in the lower reaches of the catchment.

Figure 82 - Orthophosphate concentration apportionment along Etchilhampton Water to Lower Hampshire Avon river



In AMP8 we have a programme of nutrient investigations that will inform investment in AMP9 and beyond; these are summarised in Table 73 and described further below.

Table 73 - Summary of AMP8 WINEP nutrient investigation actions

Primary WINEP driver code	WINEP ID	Action name	Number of WINEP actions	Completion date
25YEP_INV	08WW100012a	Benefits of wetlands investigation	1	30/04/2027
HD_INV	08WW100016a	Poole Harbour surface water sewers nutrient investigation	1	30/04/2027
NERC_INV	08WW100018a	Sustainable nutrient management to land investigation*	1	30/04/2027
HD_INV	08WW100019a	Nutrient legacy and cycling in the Somerset Levels and Moors Partnership Project	1	30/04/2027
HD_INV	08WW100019b	Somerset Levels and Moors Seasonal Nutrient Investigation	1	30/04/2027
WFDGW_INV	08WW100034a	WRC nitrogen to groundwater investigations - Dundry WRC	1	30/04/2027
WFDGW_INV	08WW100034b	WRC nitrogen to groundwater investigations - Lulsgate Downside WRC	1	30/04/2027

WFDGW_INV	08WW100034c	WRC nitrogen to groundwater investigations - Everleigh WRC	1	30/04/2027
WFDGW_INV	08WW100034d	WRC nitrogen to groundwater investigations - Milborne St Andrew WRC	1	30/04/2027
HD_INV	08WW100059a*	Impacts of Sewage Sludge Disposal on Designated Sites in WW area	1	30/04/2027
HD_INV	08WW102220a	Partnership investigation into sea grass and saltmarsh restoration	1	30/04/2027
HD_INV	08WW100120a	Partnership investigation into opportunities for minimising floating plant dominance in the Somerset Levels and Moors Ramsar driven by nutrient enrichment and climate change.	1	01/03/2030
WFD_INV	08WW100021a	Somerton WRC dissolved oxygen investigation	1	30/04/2027
HD_INV	08WW102204	Fleet Lagoon - Nutrient Reduction Investigation & Options Appraisal	1	30/04/2027
WFD_INV	08WW102205	Halstock WRC - Nutrient Reduction Investigation	1	30/04/2027
HD_INV	08WW103155a	Investigation into the impact of groundwater discharges from water recycling centres on phosphorus concentrations in meeting objectives for surface waters	1	30/04/2027
SSSI_INV	08WW103156a	Understand the sources of nutrient inputs from surface water sewers to the Moors River (Crane) SSSI	1	30/04/2027
Total			17	

* This WINEP action is included in the Bioresources Price Control but is described here due to the nutrient links.

Christchurch Harbour, Poole Harbour and the Fleet Lagoon are designated as SSSIs and have been assessed by Natural England (NE) to be in declining unfavourable condition. As such Wessex Water will be undertaking a modelling investigation to understand the impacts of nutrients from our assets in the upstream catchments on these coastal and estuarine environments. This will be managed under the Chemical Investigations Programme (CIP), and is discussed further in Section 7.7.2 (WINEP Actions 08WW100016b-d, f).

In AMP7 we investigated the feasibility and delivery of integrated constructed wetlands to deliver multiple benefits in ecosystem services, such as water quality and biodiversity to reduce phosphorus entering into the Somerset Levels and Moors SSSIs. In addition, a number of nature-based solutions were installed at storm overflows and at our WRCs. In AMP8 a WINEP investigation (08WW100012a) will assess the benefits of different types of wetlands Wessex Water constructed or constructed in partnership during AMP7, these were wetlands for: continuous sewage discharge (WRC), intermittent sewage discharge (storm overflows), supply and offsetting (catchment nutrient balancing). Cromhall WRC and Hanging Langford SO are included in this investigation as they are established; monitoring through this investigation will inform on the performance of integrated constructed wetlands over time. This investigation will assess the performance in terms of water quality including nutrients as well as the wider multiple benefits wetlands can offer including carbon accounting during construction, biodiversity net gain and ecosystem services. This investigation will also look to assess how the performance of wetlands changes over time as they mature and become established and allow comparison to other (grey) water treatment solutions. This work will also recommend a robust monitoring programme for future wetlands.

A number of Wessex Water's own landholdings are within safeguard zones, designated to protect water quality. However, the larger sites are often tenanted to low intensity farmers. In AMP8 we will investigate these sites to ensure that the requirements under Farming Rules for Water are being adhered to by the tenants and any improvements are carried out. This project (WINEP Action 08WW100018) will comprise farm and field surveys of the land within our ownership but managed by our tenants.

At present we dispose of much of our sewage sludge on agricultural land through commercial contracts with farmers and landowners. This 'landbank' is set to increase with increasing volumes of sewage sludge. There is a requirement to investigate the impact of this spreading on environmentally designated areas. In AMP8 we will be investigating the existing and proposed landbank to assess the impact (WINEP Action 08WW100059). The investigation will include the collation of historic data on where sludge arising from Wessex Water has been spread, soil indices and collection of new soil nutrient data to fill in the gaps. It will result in recommendations on where further sludge spreading is in keeping with the restoration of the habitats sites (and how much) and where it is not. There will be a need to investigate alternative solutions to disposal if the area where further spreading is deemed inappropriate is increased.

During AMP7 Wessex Water implemented wide reaching water quality investigations in Poole Harbour rivers and on the River Crane. We investigated the contribution of our wastewater assets to non- compliance with the Common Standards Monitoring Guidance for Rivers (CSMG), the guidance produced by Joint Nature Conservation Committee to ensure protection of SSSIs and SAC. These investigations identified the need for investment at our WRCs during AMP8. However, catchment modelling from the AMP7 investigations suggests that there are sources of nutrients entering Poole Harbour rivers and the River Crane from urban drainage that need to be investigated. During AMP8 we will aim to understand nitrogen and phosphorus loads carried by urban drainage in Poole Harbour (WINEP Action 08WW100016a) and the Moors River (Crane) SSSI (08WW103156a). We will identify wastewater misconnections to ensure that sewage enters the wastewater network rather than rivers via surface water drainage. We will also work with the local authorities to identify solutions to reduce the nitrogen and phosphorus load entering rivers from urban drainage.

Poole Harbour comprises extensive areas of intertidal marshes and mudflats and has important areas of seagrass, cited in the conservation designations. There are many reasons why these habitats have been declining such as sea level rise, increased wave action and habitat destruction due to boating activities. There is evidence to suggest that there is a source-pathway-receptor link of excess nutrients coming from the catchment, which have led to a deterioration in water quality in the harbour and affecting these important habitats. As a result, the harbour's mudflats have become covered in green algae, which has smothered sea grass and saltmarsh, impacting on wetland birds and other ecosystems and wildlife (Figure 83). Poole Harbour is currently at moderate ecological status for nutrients which means that the conditions are not supporting a wide range of flora and fauna throughout the Harbour area.

Wessex Water has been working to reduce nutrient loading at the source and with catchment farmers. Whilst this is an important measure, it is also important to address the impacts and develop measures to mitigate the damage downstream that will increase the quality and resilience of habitats such as seagrass and saltmarsh and restore their ecosystem services. In AMP8 we will work in partnership with other organisations who are already looking into the issues and restoration of sea grass and saltmarsh within Poole Harbour to:

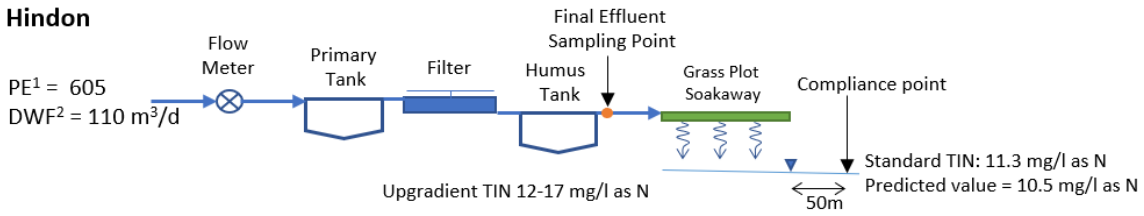
- understand the key issues and drivers for restoration of sea grass and saltmarsh in Poole Harbour;
- map/model the potential areas of sea grass and saltmarsh within the existing areas of open water in the harbour; and
- contribute towards the research of restoration of these habitats through the partnership.

This investigation (08WW102220a) aims to understand how to maintain and enhance existing areas of seagrass within the Wessex Water operational area and how best to increase the areas.

Figure 83 - Left: Environmental monitoring in Poole Harbour (Acoustic Doppler Current Profiling) as part of the AMP7 Poole Harbour environmental investigations. Right: Algal mats in Holes Bay, Poole Harbour (photo from Dorset Wildlife Trust)

The AMP7 WINEP included investigations assessing the potential impact of final effluent discharge to groundwater and its contribution to nitrogen concentration standards in groundwater. Five WRCs located on outcropping chalk in the Hampshire Avon and Stour River catchments were investigated; Hindon, Tilshead, Maiden Bradley and Collingbourne Ducis. Hindon was subject to the most detailed investigation with the construction and subsequent monitoring of eight boreholes and, in agreement with the EA, the findings from Hindon were used to inform the modelling of impact at the other WRCs. At Hindon, groundwater quality monitoring and mass balance calculations demonstrated that 83% of the effluent total inorganic nitrogen (TIN) does not reach the water table, due to denitrification occurring beneath the soakaway in the soil and unsaturated chalk zone (Figure 84). The investigation determined that investment in nitrogen removal was only required at two of the five sites, Collingbourne Ducis and Maiden Bradley, and these have been included with our AMP8 plan. In AMP8 we will build on this work to deliver similar investigations at four sites identified by the Environment Agency; Dundry, Lulsgate Downside, Everleigh and Milbourne St Andrew WRCs (WINEP Actions 08WW100034a-d).

Figure 84 - Total Inorganic Nitrogen mass balance calculation, Hindon WRC; output from AMP7 investigation



The AMP7 investigations have provided an understanding of how groundwater discharging WRC can impact nitrogen concentrations in groundwater. However, the Environment Agency have identified the need to understand whether such WRC impact the phosphorus concentrations of groundwater and the SSSI and SAC rivers linked to these aquifers. This investigation (08WW103155a) will explore this issue and the contribution these WRCs have on SSSI rivers. Such investigations are fundamental to planning improvements to WRCs in AMP9 that may be impacting groundwater, SSSI and SAC rivers.

During AMP6 in the Parrett rivers, sources of nutrients were investigated to address uncertainty and provide sufficient information on the scope and scale of likely action required to meet WFD status objectives, at a catchment

level. As previously highlighted, during AMP7 we have been undertaking a Catchment Nutrient Balancing (CNB) approach to further reduce and offset our phosphorus concentrations into the river and ditch system across the Somerset Levels and Moors, particularly in the Tone and Parrett catchment. This will continue throughout AMP8.

However, the SSSI ditch systems fed by the Parrett are classified by NE as unfavourable declining status. Research funded by Wessex Water during AMP7 indicates that targeting nutrient contributions to SSSI ditch systems during summer maybe necessary to reverse the decline in status. As such, Wessex Water will investigate the seasonal loading of nutrients of SSSI offtake locations (08WW100019b). We will work closely with the local Internal Drainage Board (IDB) to understand how water is manged throughout the SSSI ditch systems, enabling Wessex Water to understand its seasonal contribution to the SSSI in relation to other sources and to understand if we are achieving our fair share of nutrient load reduction. Should further nutrient load reductions be required beyond our current AMP8 phosphorus investment, we will assess mitigation measures necessary to restore the SSSI.

In 2022, Wessex Water investment at WRCs discharging to the Parrett rivers has resulted in a circa 55% reduction in phosphorus load in comparison to 2010. By the end of AMP8 a further phosphorus reduction will be realised. Nonetheless, there is a legacy of phosphorus built up of years within the SSSI for contributions from WRC and farming. As such, we will fund research, via an investigation, to assess the availability of legacy of nutrients and implications for future WRC and farming, water level, ditch and land management within the SSSI (08WW100019a).

Figure 85 - Left: The landscape and rhyne system of West Sedgemoor SSSI. Right: Oath inlet from the River Parrett to West Sedgemoor SSSI

The Somerset Levels and Moors (SSSI) are designated as a Ramsar for wetland interest and SPA for its important bird populations. Water quality within the ditch network is impacting on these designations, with elevated levels of phosphorus from sources including our wastewater discharges leading to eutrophication in surface waters. This can change the plant communities from submerged aquatic vegetation to algae or duckweed dominance, leading to anoxic conditions. There is some emerging evidence that it maybe possible to undertake macrophyte biomass harvesting to remediate and undertake nutrient recycling. Through an AMP8 investigation (08WW100120a) we will work in partnership with others to investigate the practicality and success rate of harvesting duckweed within SSSI ditch systems. The investigation aims to deliver the following;

- funding contribution towards collaborative investigation of mitigation options to minimise floating plant dominance in the Somerset Levels and Moors - such as floating plant harvesting, increasing flow and surface ripple through existing features, creating ‘new’ open water habitats);
- to undertake a critical literature review of the above mitigation options; and
- to undertake a feasibility study of floating plant harvest in the SLMs system (which could also be linked to nutrient neutrality markets).

The final WINEP action listed in Table 73 concerns a localised depletion of dissolved oxygen in a section of the River Cary downstream of Somerton WRC that has been observed, although the extent of the effect is currently not known. Under the Water Framework Directive, dissolved oxygen saturation must be maintained above 60% for 90% of the time to achieve good ecological status. This is currently not the case in this location. Further investigation is necessary to understand the extent of the impact and the degree to which Somerton WRC contributes to this depletion, and an investigation has been included in our AMP8 WINEP under a WFD_INV driver. The findings of this investigation will ensure that, should Somerton WRC be found to be a factor in this localised depletion of dissolved oxygen, any improvement to treatment to reduce this impact is based on sound science and represents good value.

7.7.2. Chemicals

The industry recognises that there is insufficient data on chemicals in the environment to inform widespread investment to achieve WFD chemicals compliance by 2027, therefore a further national programme of investigations is planned in PR24. This also recognises the need to better understand emerging substances in response to public pressure, e.g. microplastics and antimicrobial resistance, and the role sewerage and wastewater assets play in their transport and removal. The scope and extent of investigations for chemicals and other emerging substances has been developed through the Chemical Investigations Programme (CIP) project steering group (PSG). The PSG is led by the Environment Agency, with input from Natural England, UKWIR and water company representatives.

To enable efficiencies and standardisation of these complimentary investigations across the industry, the programme will be centrally managed. All UK Water and Sewerage Companies will contribute to the programme management costs under the Ancillary costs' driver. This will be co-ordinated via UKWIR.

A summary of the AMP8 CIP4 investigations are included in Table 74 including the title, description, site detail (where possible), WINEP driver, unique WINEP Action ID and completion date. There are eight CIP categories listed in the AMP8 WINEP under the WFD_INV_CHEM driver. These 24 WINEP actions[14] cover an array of issues and approaches, though some do not denote a specific identifiable theme:

- 4a Investigation to develop and trial a framework that meets statutory requirements
- 4b Sludge investigation
- 4c Groundwater investigation
- 4d AMR investigation
- 4e Emerging substances investigation
- 4f Innovative Pathway Control project
- 4g Local investigation
- Ancillary costs

[14] The 24 WINEP actions include 19 WFD_INV_CHEM investigations plus five HD/SSSI_INV TraC investigations

Table 74 - AMP8 WINEP chemical investigations to be delivered through CIP4

Driver	WINEP ID	Action name	Site and Description	Completion Date
WFD_INV_CHEM	08WW100023a	4a PFOS	Thingley WRC sewer catchment investigation to identify sources and hotspots of PFOS inputs to sewer and understand discharges to receiving watercourse. The EA will trial regulating PFOS through an Operating Techniques Agreement.	30/04/2027
WFD_INV_CHEM	08WW100022a	4a Integrated Constructed Wetlands (ICW)*	An UKWIR club investigation to understand how effective ICWs are as a treatment method for removing emerging substances. Wessex Water's Cromhall wetland will be one of the sites for the national study.	30/04/2027
WFD_INV_CHEM WFD_INV_MP	08WW100055a	4a Sludge to groundwater field trials*	An UKWIR club investigation to understand the impact of emerging contaminants contained within biosolids spread to land on groundwater quality. Sites will be chosen on a national scale.	30/04/2027
WFD_INV_CHEM	08WW100024a	4a Trac Severn Estuary chemical Modelling (EA)**	Investigation to model chemical discharges to the Severn Estuary, including PAHs, Metals, and PFOS. The purpose is to understand chemical EQS compliance across the TraC waterbody.	30/04/2027
HD_INV	08WW100016e	4a Trac Severn Estuary chemical Monitoring (NE)***	Monitoring of WRCs discharging directly into the Severn Estuary to identify chemical contributions of PAHs and Cypermethrin to the water body.	30/04/2027
HD_INV	08WW100016b	4a Trac Poole Harbour chemical Monitoring (NE)***	Monitoring of WRCs discharging directly into Poole Harbour to identify chemical contributions of PAHs, insecticides and a biocide chemical to the water body.	30/04/2027
HD_INV	08WW100016f	4a Trac Poole Harbour Nutrient Modelling (NE)***	Investigation modelling Poole Harbour TraC waters to identify any sources or assets contributing to nutrient non-compliance in the SPA and SAC.	30/04/2027

Driver	WINEP ID	Action name	Site and Description	Completion Date
HD_INV, SSSI_INV	08WW100016c	4a Trac Christchurch Harbour Nutrient Modelling (NE)***	Investigation modelling Christchurch Harbour TraC waters to identify any sources or assets contributing to nutrient non-compliance in the SPA and SAC.	30/04/2027
HD_INV	08WW100016d	4a Trac Fleet Lagoon Nutrient Modelling (NE)***	Investigation modelling Fleet Lagoon TraC waters to identify any sources or assets contributing to nutrient non-compliance in the SPA and SAC.	30/04/2027
WFD_INV_CHEM	08WW100025a	4b Sludge*	To understand the fate and removal of emerging substances in sludge treatment. This study will focus on one site at Wessex Water, location to be confirmed, which will feed into the national study.	30/04/2027
WFD_INV_CHEM	08WW100026a	4c Groundwater chemicals	To understand the impact of final effluent discharge to ground on groundwater quality. This investigation will focus on Hindon WRC, the results will feed into the national study.	30/04/2027
WFD_INV_CHEM	08WW100027a	4d AMR*	An investigation to understand the presence and fate of antimicrobial resistance (AMR) within wastewater treatment process. this investigation will focus on Saltford WRC, the results will feed into the national study.	30/04/2027
WFD_INV_CHEM	08WW100030a	4e Emerging substances Endocrine Disruptor*	Monitoring endocrine disruptor chemicals entering the environment from effluents. Site is to be confirmed, results will inform the wider national study.	30/04/2027
WFD_INV_CHEM	08WW100031a-e	4e Emerging substances Trend	Continuation of long-term trend morning of 21 chemicals at five WRCs, these are: Saltford, Bowerhill, Weston-super-Mare, Avonmouth, and Swanage.	31/03/2030

Driver	WINEP ID	Action name	Site and Description	Completion Date
WFD_INV_CHEM	08WW100032a-b (Surface water) 8WW100033 (Groundwater)	4e Surface water emerging substances 4e Groundwater emerging substances	Monitoring at two WRCs and receiving watercourse (sites to be confirmed), and one groundwater site (confirmed as Hindon WRC) for the following sub-investigations. The results will feed into the national study and improve understanding of emerging issues within water and wastewater: **PFAS** – detailed monitoring of PFAS (per- and polyfluoroalkyl substances) **PEWS:** Prioritisation and Early Warning System – additional monitoring of chemicals identified by the EA using the PEWS tool **Non-target screening*** – to understand more obscure emerging contaminants to inform future monitoring and surveillance. **CIP3 chemicals** – three substances in CIP3 identified as requiring further monitoring	30/04/2027
WFD_INV_CHEM	08WW100028a	4f Innovative Pathway Control	Monitoring innovative source control measures at Paulton and Radstock WRC catchments to understand if social prescribing can reduce pharmaceutical loads entering the sewer network and therefore the environment.	30/04/2027
WFD_INV_CHEM	08WW100053a	4g Ecotoxicity in Hampshire Avon	Ecotoxicological study at Ratfyn WRC and the wider Hampshire Avon river catchment, to understand if there is anything contained in the final effluent discharge from the WRC which may be affecting the local river ecology.	30/04/2027
WFD_INV_CHEM	08WW100029a	Ancillary costs*	Project management and co-ordination of CIP4 investigations	30/04/2027

* Industry-wide collaborations
**Collaborative modelling project co-funded with Severn Trent Water and Dŵr Cymru (Welsh Water), to be procured through UKWIR
*** Parallel TraC modelling and monitoring investigations led by Natural England but included under CIP due to overlaps in management and delivery

Microplastics Investigations

It is widely recognised through previous UKWIR research (e.g. UKWIR Sink to River – River to Tap report, reference 19/EQ/01/18) that microplastics are effectively removed during drinking water and wastewater treatment processes. However, the microplastic loss from wastewater and sludge/biosolids assets during treatment is less widely understood.

Therefore, there is a better need to understand the mass balance and fate of microplastics during wastewater treatment in a holistic way, as well as in response to public and environmental pressure to increase monitoring and surveillance.

In response, Wessex Water and the other nine WaSCs have proposed two investigations which focus on the issues highlighted above, to understand microplastic fate during wastewater and sludge treatment, and to review thermal conversion sludge treatment in the context of microplastics. These investigations will be steered through the microplastics working group, as part of the wider CIP PSG.

The two microplastic investigations are included in the AMP8 WINEP under the WFD_INV_MP driver, summarised in Table 75.

Table 75 - Summary of microplastics investigations included in Wessex Water's WINEP submission

Primary WINEP driver code	WINEP ID	Action name	Number of WINEP actions	Completion date
WFD_INV_MP	08WW100054b	Contribution to industry research on MP generation within WRCs through attrition of plastic based equipment	1	30/04/2027
WFD_INV_MP	08WW100054c	Contribution to thermal conversation sludge treatment technologies – review & trials	1	30/04/2027
		Total	2	

7.7.3. Bathing and Shellfish Waters

Our rivers, beaches and coastlines are valuable economically, socially, and environmentally. The two main regulations that govern environmental improvements at our coastlines are the Bathing Water Directive and the Shellfish Waters Directive (now part of the Water Framework Directive). Previous investment has been focussed on coastal bathing waters however, but in recent years customers have become more connected with their local environment and watercourses, prompting increasing interest in the designation of inland bathing waters. This section focusses on coastal and inland bathing waters.

Improving bathing and recreational waters is strongly aligned with our plans to improve storm overflows as detailed in Section 5.1 of this report and our Drainage and Wastewater Management Plan and Storm Overflow Improvement Plan.

Bathing Water Directive

The Bathing Water Directive provides the framework for the management of bathing waters in England. New tighter standards were introduced in 2015, with bathing waters being classified as: Excellent, Good, Sufficient and Poor.

It is well known that bathing water quality is affected by numerous factors, not just the quality of the discharges from our sewage treatment works and sewerage system. Our responsibility is to ensure that our assets perform in line with their permits and to work with partners to minimise issues that could impact on quality.

There are 49 designated bathing waters in our region, including the recently designated beach at Manor Steps in Bournemouth. However, one bathing water is closed indefinitely and one is a private swimming lake, therefore our activities relate to 47 bathing waters. The majority of our bathing waters are classified as excellent or good, based on sample data for the past two years, as shown in Figure 86.

Figure 86 - Location and status of Bathing Waters in our region

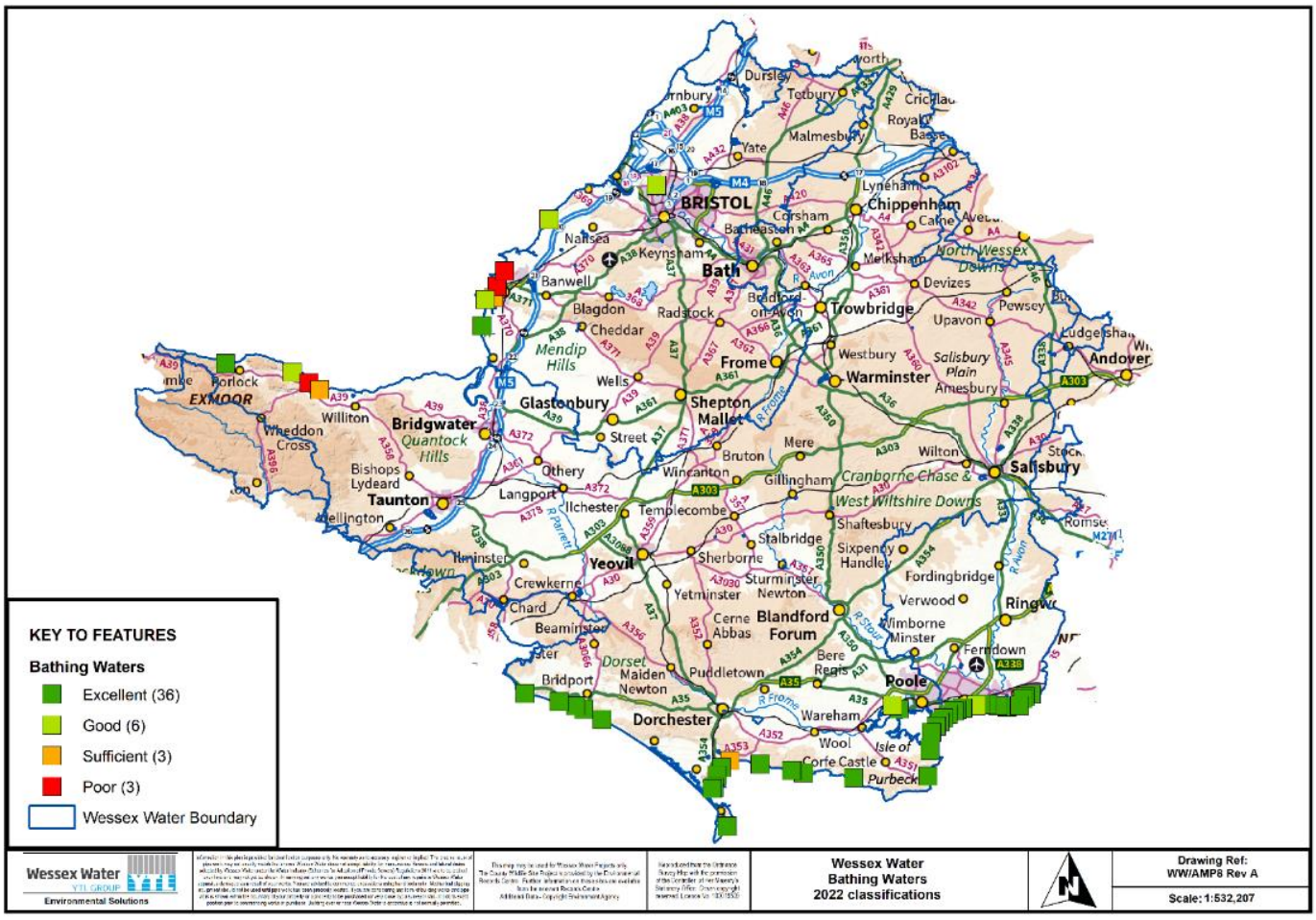


Figure 86 highlights the currently designated bathing waters, of which all but one (Henleaze Lake) are coastal. During 2022-23 a further location, Poole Harbour Whitley Lake, was put forward for designated but declined by Defra. We are also aware of a number of potential inland bathing waters where there is interest in applying for designation, including:

- Farleigh & District Swimming Club, at Farleigh Hungerford on the Somerset Frome;
- Warleigh Weir, near Bath on the Bristol Avon; and

- Conham River Park, near Bristol on the Bristol Avon

To date, these are yet to be designated, applications submitted and approved or rejected. The first inland river bathing water was designated in December 2021 on the River Wharfe in Ilkley, Yorkshire, followed by the Wolvercote Stream in Oxford in April 2022 and there has been increasing pressure from local campaign groups and lobbyists for a greater number of rivers to be designated. In April 2023, four new bathing waters were designated by Defra, including three inland locations on Rutland Water and the River Deben at Waldringfield, Suffolk. However, there was a greater number of applications submitted to Defra, the majority of which were unsuccessful.

Coastal Bathing Waters

In AMP7 we completed nine 'bathing water ambition' investigations Bournemouth Boscombe Pier, Minehead Terminus, Dunster North West, Blue Anchor West, Berrow Unity Farm, Weston-Super-Mare Uphill slipway, Weston-Super-Mare Sand Bay, Clevedon Beach and Weston-Super-Mare Main.

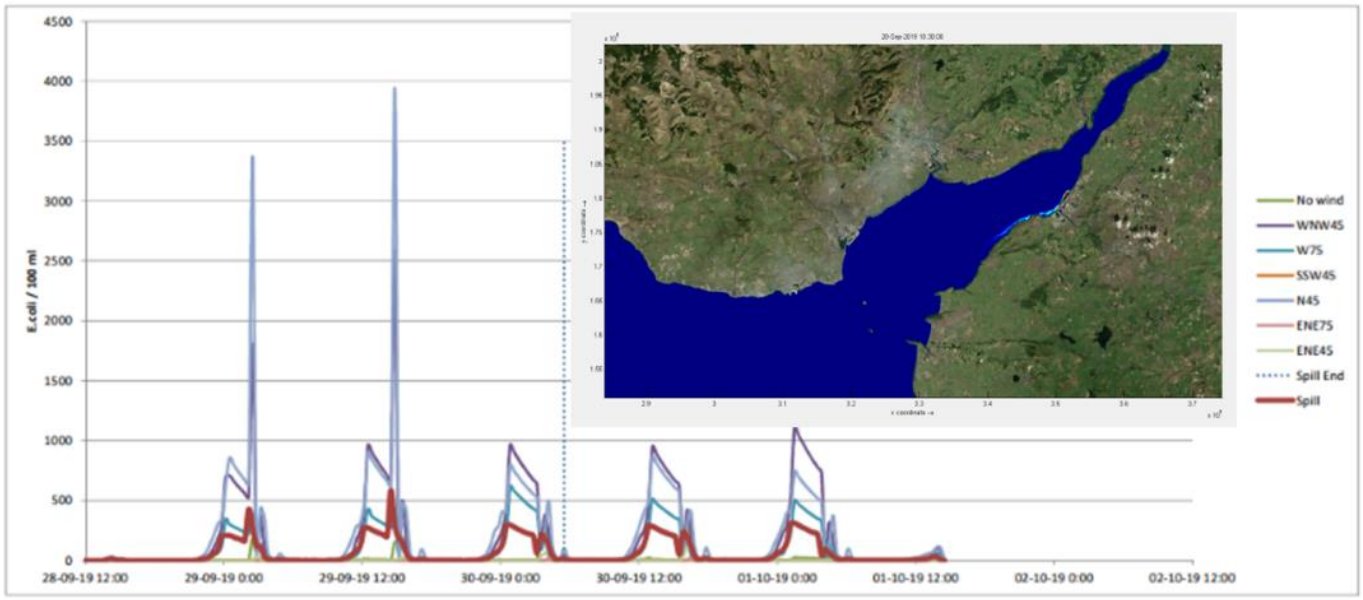
At the time these investigations were conceived, the nine bathing waters under investigation were identified by the Environment Agency as not consistently achieving a robust Good or Excellent classification. The Environment Agency included these investigations in the AMP7 WINEP so that Wessex Water could investigate the role of its assets in not achieving robust Good or Excellent classification and the steps that may be required to improve water quality. The investigations included three parallel workstreams:

- **Continuous discharge assessment** – investigating the performance of Wessex Water's continuous discharges on the nine bathing waters being investigated.
- **Storm overflow assessment** – investigating the potential effect of storm overflows on bathing water classification and identifying what improvements may be required (and their cost) to improve bathing water quality.
- **Stream Clean assessment** – summarising the annual and routine work that Wessex Water completes to check surface water discharges for evidence of misconnections that may lead to impacts on bathing water quality.

The investigations found that:

- Final effluent from Wessex Water WRCs is not contributing to non-attainment of robust Good and Excellent status at the nine bathing waters. No further action is required.
- It is inconclusive whether discharges from surface water outfalls result in non-attainment of robust Good and Excellent status at the nine bathing waters investigated here. The annual pre-bathing season checks by Wessex Water's Stream Clean team will continue to address misconnections as they arise and minimise the risk to bathing water quality.
- Storm overflows may be a contributing factor to non-attainment of robust Good and Excellent status at the nine bathing waters however, this investigation did not explore causal relationships between storm overflow performance and bathing water quality. Consequently, improving storm overflow performance to meet discharge frequency targets (as per Government guidance) may not deliver robust Good or Excellent classification.

Figure 87 - Coastal water quality modelling, AMP7 bathing water ambition investigation

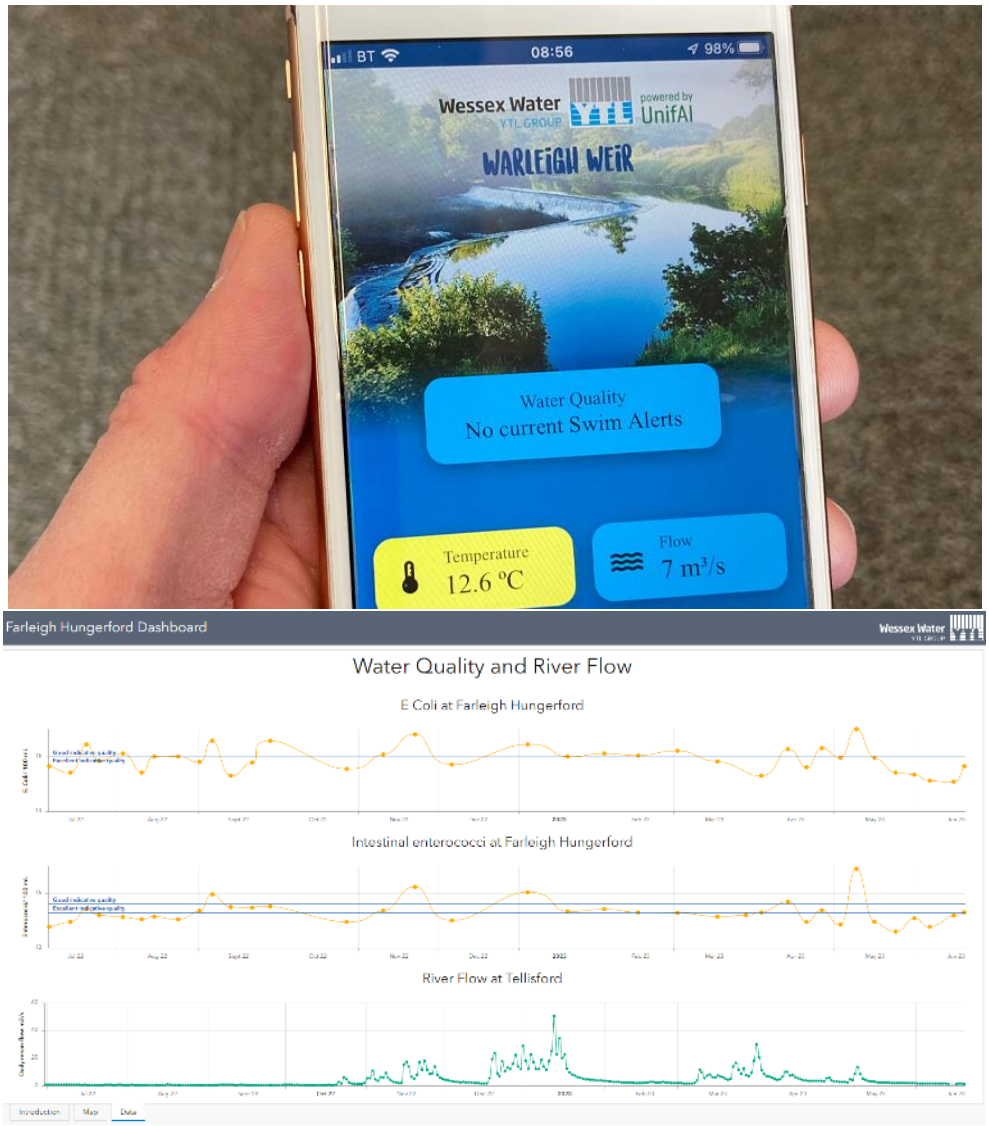


Inland Bathing Waters

Water quality is influenced by a number of factors including the natural environment, rural and urban activities and the drainage infrastructure in the upstream catchment. The level of influence which these factors have will vary at every location and it is essential to understand these before they can be addressed. For example, urban runoff from roads can contribute hydrocarbons, microplastics and metals; whereas rural runoff can contribute nutrients, pesticides and bacteria and sewerage systems, whether private or public, can also contribute nutrients, bacteria and a range of contaminants influenced by the area and population served. Understanding the relative influence and contributions from these sources means that we can reduce the impact by providing the most appropriate (and sustainable) solutions.

As part of our inland bathing water investigation at Warleigh Weir we have used real time water quality monitoring and machine learning to develop the UK's first water quality risk app, providing recreational users with information on water quality risk at point of use. This app also provides other useful information for wild swimmers such as water temperature and river flow, as illustrated in Figure 88.

Figure 88 - Water quality web app developed to display water quality to recreational users in near real time (top), water quality sampling information for Farleigh Hungerford from the Wessex Water website (bottom)



In addition to the app, we also have up to date flow and water quality information available on our website for Warleigh Weir and Farleigh Hungerford (Farleigh & District Swimming Club). This provides the data from water quality samples taken and analysed at the laboratory for *E. Coli* and Intestinal Enterococci (the indicators used in the Bathing Water Regulations). It typically takes 3-4 days for these samples to be analysed as the bacteria needs to be cultured (grown), and so the data presented is recent rather than real time.

- Warleigh Weir: Warleigh Data
- Farleigh Hungerford: Farleigh Data

Our project at Warleigh Weir has been seen as a 'living lab' to trial a range of different Real Time collection techniques including:

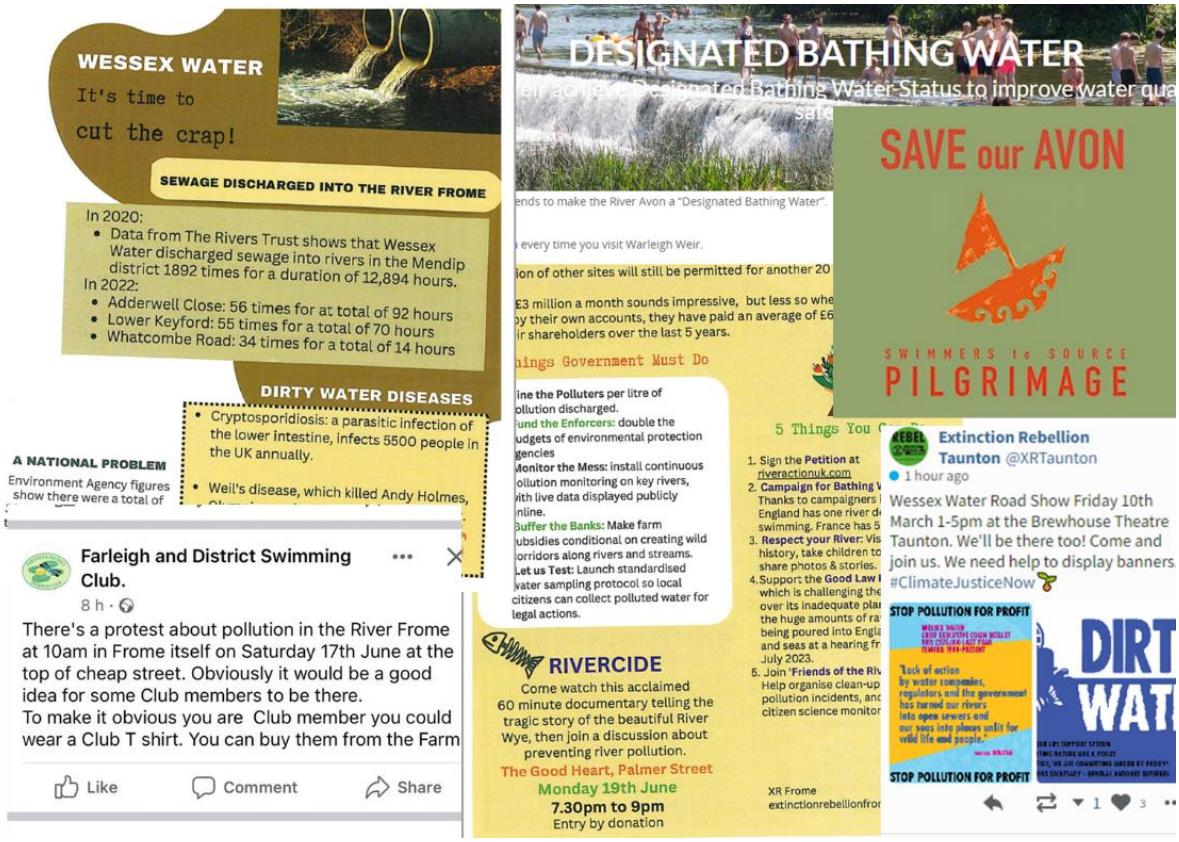
- Real-time water quality sensors, including Proteus Probe, Fluidion, multi-parameter sondes, WATR sensors and much more basic Pro-Automation (swimming pool) sensors. These have been performance tested to understand accuracy, reliability, durability and application at other locations.

- Environmental DNA (eDNA) techniques to understand the mammalian sources of bacteria, whether it's human or animal, including wild animals (e.g. birds, deer, rabbits, rats); farmed animals (e.g. cattle, sheep, pigs) or domestic animals. This helps to understand the sources of bacteria impacting bathing water quality and the possible interventions

AMP8 Inland recreational water investigation

Following the success of the trial at Warleigh Weir, an AMP8 investigation into Inland Bathing Waters (IBW) will be carried out. This investigation aims to improve our understanding of the characteristics of water quality at locations where rivers are used recreationally by members of the public. There are currently no designated inland river bathing waters in the Wessex Water operational catchment however, local interest groups and customers have expressed their concerns about water quality in rivers across our regions, indicating support for investment in this area (Figure 89). Our willingness to pay research undertaken in preparation of this business plan also supports this investigation, as customers expressed willingness to pay for incremental improvements in river and coastal water quality, the need for which will be informed by monitoring undertaken through this investigation.

Figure 89 - Examples of customer and local interest groups in river water quality



Using a combination of our own knowledge, customer contacts and discussions with stakeholders such as local councils, Rivers Trusts and groups involved in in-river recreation activities, we have identified around 40 locations in the Wessex Water region that are used for swimming/ immersive water based recreation to varying degrees. Through this WINEP Action our intention is to build on the successful work delivered at Warleigh Weir and provide year-round water quality risk information to recreational users via a webapp or similar platform at 20 of these locations by the end of AMP8. Continuous water quality monitoring instruments will be installed and water quality samples taken, along with samples from the catchment upstream and treated final effluent from upstream WRCs

likely to be impacting the location. This data will allow the development of statistical models through machine learning which will allow the risk to river users from bacteria to be estimated in real time. These estimates can be made available to river users, allowing them to make informed decisions when using the river, while also giving indications of the Wessex Water assets which are significantly contributing to bacterial concentrations in the river at these locations during periods of higher risk.

The locations to be investigated by this project will be selected through engagement with stakeholders to ensure that locations are supported by users, landowners, and local authorities. Where there is desire to apply for inland bathing water designation then the data collected as part of this investigation will be made available to river groups to support these applications. Some locations have been identified as candidate monitoring locations based on interest from the stakeholder groups detailed above, such as the Bristol Avon at Bathampton Meadows and the River Frome at Farleigh Hungerford. A River Recreation Liaison role has been created and appointed to support his investigation through engagement with stakeholder and customers to facilitate this approach.

Shellfish Waters Directive

Bivalve shellfish such as mussels, clams and oysters feed by filtering the water that surrounds them, a consequence of this type of feeding is that the shellfish retains a variety of organisms from their environment, and therefore the quality of the water that the shellfish are harvested from determines whether it can be passed as fit for human consumption.

The EC Shellfish Waters Directive was implemented in 2006 and was designed to protect and improve shellfish waters, and therefore protect the quality of shellfish entering the food chain for human consumption. It set physical, chemical and microbiological water quality requirements that designated shellfish waters must either comply with ('mandatory' standards) or endeavour to meet ('guideline' standards). The Directive also provides for the establishment of pollution reduction programmes for the designated waters.

The directive was repealed in 2013 by the EC Water Framework Directive, which provides the same level of protection to shellfish waters (which the WFD classifies as protected areas).

Shellfish intended for human consumption must comply with EC Food Hygiene Regulations, implemented by the Food Standards Agency in England. The regulations set out the classification of production areas according to the extent of contamination shown by monitoring of *E. Coli* in shellfish flesh. Treatment processes are stipulated according to the classification status of the area.

In AMP8 we will be undertaking three investigations to understand the influence of our assets on newly designated Shellfish Waters in Porlock, Lyme Bay and Weymouth. These will primarily be desk based investigations to assess overflow operation, WRC discharges and modelling bacteria loading to these areas. Since these are newly designated, in April 2022, there is limited water quality data collected by the Environment Agency or CEFAS to understand classification and so we will undertake a limited bacteriological monitoring programme at these three locations.

These investigations were identified in the Risk and Issues (Stage 2) WINEP development process by the EA, with the following comment:

"The objective for all designated shellfish protected areas is to endeavour to observe the microbial standard of 300 or fewer E. coli per 100ml of shellfish flesh and intravalvular fluid. Any existing data should be reviewed and probable non-compliance investigated."

The outcomes of these investigations will inform any asset improvement requirements in PR29.

Poole Harbour Real Time Water Quality Platform

In addition to this investigation, we are currently trialling Storm Harvester machine learning based software platform to provide alerts for seven storm overflows that discharge to Poole Harbour. The Storm Harvester module used is the Sewer Overflow Predictor, which is focussed on predicting and warning of sewer overflows before they occur. There are three elements to this:

- Interpretation of incoming hyperlocal rainfall forecast data and its impact in real-time on stormwater and wastewater assets.
- Big data analytics on sewer network data from pumping stations, CSOs and sewer level monitors.
- Development of a proprietary approach which tests the accuracy of hundreds of different machine learning models and selects the most accurate model for each asset enabling the platform to quickly and accurately 'learn' the behaviour of a wastewater network and then make predictions on how the network will perform in real-time.

This advance warning allows shellfisheries to raise shellfish out of the water to prevent accumulation of viral and bacterial contaminants.

During 2023 we have been working with the Poole Harbour shellfisheries sector and Seafish on a 12-month project, funded through Defra's Fisheries and Seafood Scheme, to investigate the link between community levels of norovirus and that found in shellfish flesh. This involves weekly sampling and analysis of norovirus and *E.coli* from:

- The influent and effluent from four WRCs;
- Two locations in the harbour; and
- 60 kg of oysters from two locations

These samples are being analysed by Bangor University and the data will be linked with the CEFAS 2D tidal model to understand circulation within the Harbour through the seasons and under different weather conditions. These data will also be used to input into an AI platform which we are developing to provide water quality risk prediction and notification to local user groups during 2024. The AI element will comprise a 12-month trial during AMP7 with data ingestion, learning and development of a platform and/or API for external use, user testing and then roll out. This project aligns with our vision for real time water quality monitoring and investigations in AMP8.

Table 76 - Summary of AMP8 WINEP Bathing Water and Shellfish Water investigation actions

Primary WINEP driver code	WINEP ID	Action name	Number of WINEP actions	Completion date
SW_INV	08WW100020a	Weymouth Shellfish Water Investigation	1	30/04/2027
SW_INV	08WW100020b	Lyme Bay Shellfish Water Investigation	1	30/04/2027
SW_INV	08WW100020c	Porlock Bay Shellfish Water Investigation	1	30/04/2027
BW_INV5	08WW100014a	Inland Bathing Water investigations	1	30/04/2027
		Total	**4**	

7.7.4. Options Development

We strongly believe that investment should be based on a robust evidence base, highlighting where our wastewater assets are impacting the aquatic environment and so requiring improvement. Our water quality investigations enable Wessex Water, our regulators and stakeholders to have a better understanding of the water environment to understand the key sources causing decline and options for improvement. The data collected via these investigations are also used to improve the SAGIS water quality model for the Wessex Area allowing better decision making beyond just water industry action.

The completion dates for the water quality investigations have been determined by our environmental regulators and confirmed within the WINEP. These investigations will typically report in early AMP8 to enable the findings to inform further investment requirements in PR29.

A number of investigations have been included to monitor the effectiveness of different solutions, such as wetlands, and explore catchment or nature based solutions to address nutrient and other contaminants. The findings of these investigations will inform the wider application of these solutions in the future, strongly aligning to the aspirations laid out in WISER, Strategic Policy Statement and the Environment Act.

The Chemical Investigations Programme is nationally driven, strongly influenced by Defra and the EA, to improve our understanding of the risks posed by a wider range of existing and emerging contaminants. These investigations enable the collection of robust data at a national scale to inform longer term treatment solutions. Throughout AMP7 there has been a significant increase in stakeholder interest around emerging contaminants and the current chemical status of our waterbodies.

Our proposals for the inland bathing water investigation are based on the costs and effectiveness of the AMP7 Warleigh Weir investigation and feedback from stakeholders who have been engaged with this project. Working with wider river recreational groups we have a better understanding of the information they would like to see to improve confidence in river water quality enabling further enjoyment of the water environment. This feedback has influenced the development of the inland bathing water investigation to ensure that it delivers for our customers and interest groups across our region.

During AMP8 Wessex Water will be undertaking investigations in three newly designated shellfish areas: Lyme Bay; Porlock and Weymouth Bay. These investigations will aim to understand if the performance of our assets could be impacting on shellfish water compliance. We will assess all Wessex Water discharges to these areas and determine if additional sampling is necessary. If needed, we will undertake a 12-month monitoring programme to supplement historic data. These data will enable us to assess the risk our assets pose to failures to achieve the microbial standard.

7.7.5. Robust and Efficient Costs

Our water quality investigation costings have been developed through external benchmarking and previously competitively tendered work where we have demonstrated that our cost estimates are efficient and competitive compared with the marketplace. They have also been informed by costs incurred during the delivery of our AMP6 and AMP7 investigations in the following ways:

- Using actual costs from similar projects within AMP7, for example CSMG nutrient investigations, Warleigh Weir bathing water investigation, previous Bathing Water and Shellfish Investigations, including externally contracted services for sampling and modelling

- Investigations have used a bottom up costing approach
- Partnership projects delivered as part of the AMP7 Bathing water Investigation
- External consultants where work has been competitively tendered during AMP7, for example laboratory costs under the CIP programme, the intensive water quality sampling in Poole Harbour and coastal modelling associated with the AMP7 Bathing Water Ambition investigations

7.7.6. Customer Protection

Customers will be protected if the investment is cancelled, delayed or reduced in scope through the following performance commitment(s) and/or price control deliverable(s):

- PCDWW18 Investigations

WINEP delivery is also a metric within the EA's annual Environmental Performance Assessment.

7.8. Nitrogen TAL Investigations

Increased concentrations of nutrients, including phosphorus and nitrogen, can lead to eutrophication, which causes excessive algae growth and damages the ecology of our rivers. The current 'Technically Achievable Limit' (TAL) for nitrogen is 10mg/l, which originally was based on complying with UWWTR uniform emission limit values. There is a growing need to consider more ambitious levels of N reduction.

As such, the PR24 WINEP contains the WFD_INV_N-Tal driver, which involves technology/process trials to assess treatment options for nitrogen, as part of a national investigation. The outcome of these trials could both inform a tightening of the TAL limit as well as provide direction on appropriate technologies that could achieve this. Although whilst something may be classified as technically achievable it does not necessarily mean it is cost-beneficial, particularly when consideration small sites.

The EA had an aspiration that every company would propose a minimum of three trials. In liaison with the EA, we are promoting the three sites and technologies identified in Table 77 for inclusion within this national trial.

Table 77 – Nitrogen TAL Investigations

WINEP Action ID	Action Component	Site	Proposed Technology
08WW100216	a	N/A - Project Management	-
08WW100216	b	Wareham WRC Optimisation	Optimisation of existing sand filters
08WW100216	c	Studland WRC	iPhyc
08WW100216	d	Milborne Port WRC	Microvi

Wessex Water currently has two Water Recycling Centres (WRCs) with nitrogen permits – Poole (10mg/l) and Wareham (15mg/l). The nitrogen permit at Wareham WRC came into effect Dec 2021, and was met through tertiary sand filters with methanol dosing. As the assets are new this is an ideal site to try and optimise. The WRC serves a reported population equivalent of 12,978, albeit with a significant seasonal variation/uplift in the summer. It

discharges into Poole Harbour, which has Special Protection Area and Ramsar designations. Wareham has also been identified as requiring a tightened nitrogen limit to 10mg/l and new phosphorus permit of 0.25mg/l. Early delivery of this trial could help inform the scope of the scheme to meet these limits.

Whilst also located in the Poole Harbour Catchment, Studland WRC (PE 657) discharges by long pipeline into a sheltered bay bordering Purbeck Heaths National Nature Reserve, one of the most impacted areas from eutrophication with lots of ‘green’ mudflat and piles of washed up algae wrack on the edge of the NNR. The WRC is on the radar for future nutrient removal, possibly in AMP9 or AMP10. The site is completely surrounded by SSSI, but has limited alternative discharge locations due to close by bathing beaches to seaward, so would need to expand into the SSSI for any other treatment process.

The iPhyc process (by Industrial Phycology) is an algal bioreactor. Algae can absorb nutrients, minerals and other compounds. They also require light to help growth; natural light is insufficient, and so lighting rods can be inserted into the algal broth to light it internally to improve its effectiveness.

Milborne Port WRC (PE 5,446) discharges upstream of Sherborne Lake in the Somerset Levels and Moors. The SLM isn’t designated for nitrogen, but Sherborne Lake has been flagged through PR24 as having elevated nitrogen levels, but hasn’t had a supporting PR19 investigation. It is on the radar for N removal in PR29. Milborne Port has also been identified as requiring a tightened phosphorus permit to 0.25mg/l as described in section 6.2.9 through PR24. Early delivery of this trial could help inform the scope of the scheme to meet these limits, albeit the trial is primarily focusing on nitrogen rather than phosphorus removal.

The Microvi MNE process (by Microvi Biotech) uses Engineered Biocatalysts. Instead of relying on the growth and removal of mixed populations as sludge, engineered biocatalysts use a high density of single, highly efficient organisms that are controlled and protected in the versatile form of a biocatalyst composite.

One of the limitations on nitrogen reduction technologies, particularly at small sites, is the requirement for a source of carbon dosing, and part of the trial will be to see what is possible with a natural carbon source from BOD/COD in the effluent, although noting levels are very site-specific.

Figure 90 - Proposed nitrogen removal technologies: Microvi (L) and iPhyc (R)

The costs for the trial include the rental of the pilot units for the duration of the 12-month trial. Also included are the costs for weekly sampling of crude influent, upstream of process and downstream of process. There may also be requirements for small-scale ancillary works, such as pre-treatment, power upgrades (including any pumping to/from the unit) and increased levels of telemetry.

It is envisaged that the trials will be similar to that of the CIP phosphorus technology trials in AMP6, with data management and report writing coordinated through UKWIR. Much detail will be clarified post business submission, as we produce an Action Specification Form in conjunction with the EA and other companies.

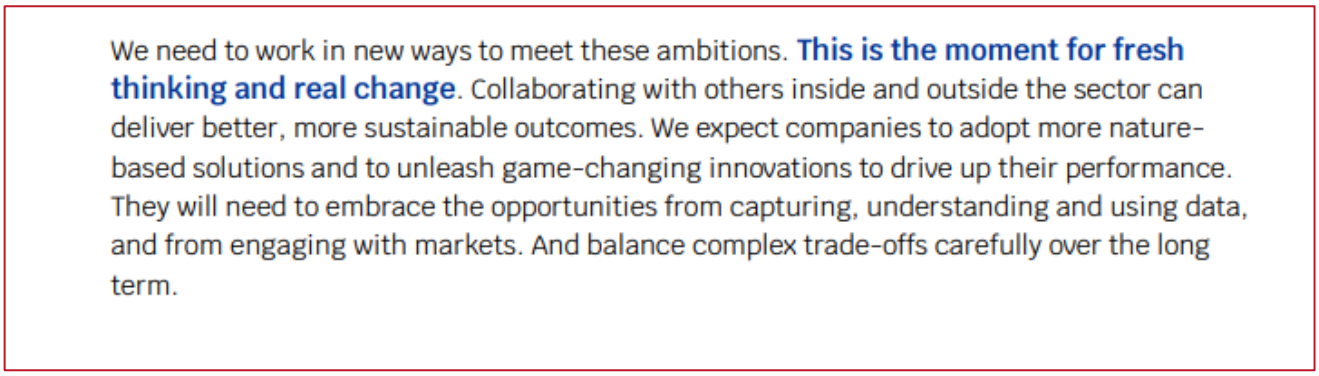
8. Partnership working

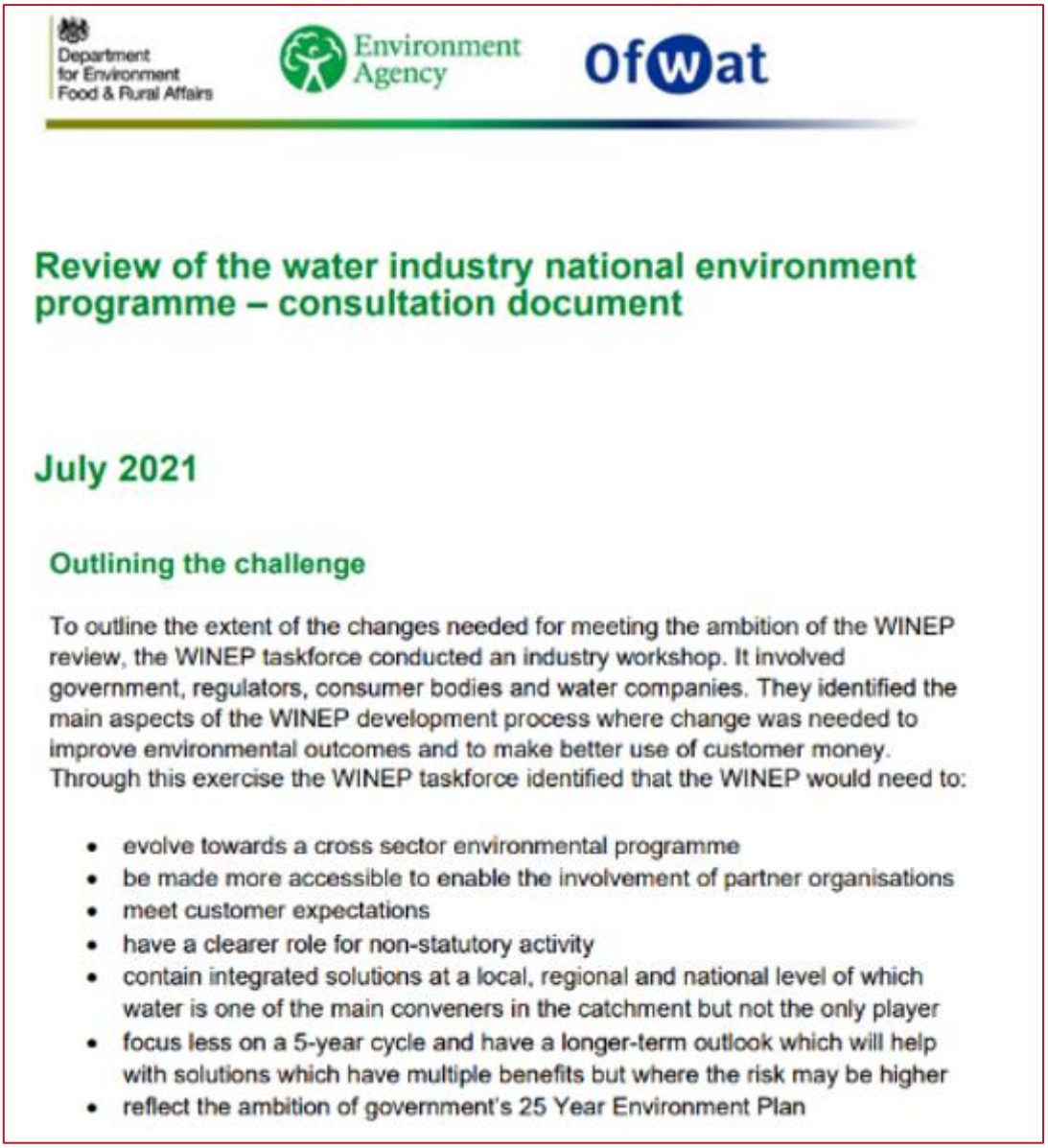
Wessex Water has a long history in partnership working with a range of stakeholders to deliver water quality improvements and increased flood resilience to drainage and wastewater infrastructure. This has been achieved through collaboration at a global scale through our work with external stakeholders across the world through involvement in the World Sewer Operators (WSO) (WSX17 A6-1.2.11); at a UK scale through involvement in national groups and industry networks and stakeholders within the Wessex Area.

Proposed partnership solutions within the Wessex Area will look at opportunities to consider wider, long-term benefits to communities and the environment, using a systems and catchment-oriented approach to deliver integrated solutions that provide multiple benefit. Alternatively, investment in Wessex Water assets and infrastructure can also be used by stakeholders as match funding for other funding sources to demonstrate requirements for investment in other areas of the catchment to achieve shared outcomes.

Catchment Partnership projects were developed through a series of workshops during 2022-23, highlighting the emphasis regulatory guidance and direction placed on co-designing and co-delivering projects by working in partnership. This is illustrated in Figure 91 below, highlighting the key strategic documents produced by Ofwat: 'PR24 and beyond: Creating tomorrow, together' in May 2021 and Defra's consultation on the WINEP, in July 2021, both of which advocated the importance of partnership working and the convening opportunity for water companies.

Figure 91 - Extracts from Ofwat and Defra consultations on PR24 In May and July 2021


We need to work in new ways to meet these ambitions. **This is the moment for fresh thinking and real change**. Collaborating with others inside and outside the sector can deliver better, more sustainable outcomes. We expect companies to adopt more nature-based solutions and to unleash game-changing innovations to drive up their performance. They will need to embrace the opportunities from capturing, understanding and using data, and from engaging with markets. And balance complex trade-offs carefully over the long term.



Department for Environment Food & Rural Affairs

Environment Agency

Ofwat

Review of the water industry national environment programme – consultation document

July 2021

Outlining the challenge

To outline the extent of the changes needed for meeting the ambition of the WINEP review, the WINEP taskforce conducted an industry workshop. It involved government, regulators, consumer bodies and water companies. They identified the main aspects of the WINEP development process where change was needed to improve environmental outcomes and to make better use of customer money. Through this exercise the WINEP taskforce identified that the WINEP would need to:

- evolve towards a cross sector environmental programme
- be made more accessible to enable the involvement of partner organisations
- meet customer expectations
- have a clearer role for non-statutory activity
- contain integrated solutions at a local, regional and national level of which water is one of the main conveners in the catchment but not the only player
- focus less on a 5-year cycle and have a longer-term outlook which will help with solutions which have multiple benefits but where the risk may be higher
- reflect the ambition of government's 25 Year Environment Plan

Given the integrated nature of drainage and wastewater infrastructure with other components of catchment management and flood risk management, our final DWMP (May 2023) proposed a step change in the level of investment towards partnership schemes. This supports the ambitions of OFWAT and the Environment Agency detailed in their 'Joint approach for how water companies should consider flood and coastal resilience in the context of their statutory roles and duties' in June 2022. The importance of collaboration with stakeholders was also emphasised in Principle 4 of the 'Guiding principles for drainage and wastewater management plans (DWMPs) of the UK and Welsh Governments' and the environmental and economic regulators' (including Natural Resources Wales (NRW), Environment Agency and Ofwat) updated in August 2022. This is illustrated in Figure 92.

The Stakeholder and customer engagement section of our DWMP outlined a whole range of stakeholders at different levels and geographic areas from strategic managers and political leaders to communities and customers who we already engage and interact with and work with regarding drainage and wastewater infrastructure.

This section details Wessex Water's proposals to work with Catchment Partnerships and Lead Local Flood Authorities to deliver projects achieving greater environmental outcomes and flood resilience.

Figure 92 - Extracts from Ofwat and Environment Agency joint approach for how water companies should consider flood and coastal resilience in the context of their statutory roles and duties and the Guiding principles for drainage and wastewater management plans

To support the effective management of flood and coastal erosion risk, we expect water companies to collaborate and work in partnership with others within and beyond the sector, reflecting the needs of the areas in which they operate. We want companies to routinely consider the wider, long-term benefits to communities and the environment when putting forward solutions, using a systems and catchment oriented approach. They should use adaptive approaches to maintain a focus on the long term and identify, develop, fund, and deliver schemes to improve resilience of the water supply and wastewater and drainage services provided to customers, including to the risks posed by floods and climate change.

Principle 4: Collaboration

Collaboration with other organisations and stakeholders is key to the development of comprehensive DWMPs. So, companies should do all they can to foster collaborative working.

The importance of collaboration

While the responsibility for development and publication of DWMPs sits with companies, they cannot develop plans which deliver their full potential without the input of other stakeholders within and around the companies' areas of operation.

Plans need to be developed and created closely with other stakeholders, including those who have responsibility for other elements of drainage. Local authorities and the environmental regulators can be responsible for aspects of surface water drainage and management of flood risks, and other drainage assets which feed into a companies' networks.

The new FCERM strategy for England was adopted by UK government on 25 September 2020 and provides the framework for all RMAs to improve the nation's resilience to the risk of flooding and coastal change.

It sets out the long-term delivery objectives the nation should take over the next 10 to 30 years as well as shorter term, practical measures risk management authorities should take now, working with partners and communities.

A national flood and coastal erosion risk management strategy for England action plan was published on GOV.UK in May 2021 on how the Environment Agency and national stakeholders will take forward measures in the strategy.

The strategy emphasised the importance of working together on DWMPs and early engagement with beneficiaries to help unlock jointly funded opportunities.

A key action is: 'The Environment Agency will work with Water UK and Ofwat to assess the degree to which all relevant RMAs are actively contributing to the production of Drainage and Wastewater Management Plans by May 2022'.

Other stakeholders, like environmental non-governmental organisations (NGOs) could also have an interest, for example, in a habitat close to a company asset, and can share their knowledge about the requirements of the habitat and how any potential risks to it could be prevented or addressed.

8.1. Catchment Partnership Projects

Wessex Water has a long history in partnership working. In 2009, we were one of the EA Catchment Partnership pilot projects funded through the Defra family, pioneering the Frome and Piddle Catchment Initiative which later become the Poole Harbour Catchment Partnership when the national Catchment Based Approach (CaBA) was launched in 2012. Since 2015, we have co-hosted two Catchment Partnerships in our region:

1) Bristol Avon Catchment Partnership, with the West of England Rural Network
2) Dorset Catchments Partnership, with Dorset Wildlife Trust

We support and co-fund two further Catchment Partnerships in the Hampshire Avon and Somerset, actively representing the company on the steering group.

Wessex Water has benefitted from the shared learning, data and evidence made available through these partnerships and their members. In many cases, Wessex Water and the wider partners have a shared vision to improve river health and biodiversity across our region, and so working in partnership is an efficient and economical way of achieving this. Within this section, we have highlighted five projects which have been developed in partnership to efficiently deliver environmental outcomes. These have been co-designed and developed with partners, including our two neighbouring water companies, Bristol Water and Bournemouth Water. These projects strongly align with the statutory guidance provided by our regulators, focussing on partnership delivery, innovation, climate change, resilience and the delivery of the 25 Year Environment Plan:

- Ofwat, PR24 and beyond: creating tomorrow, together
- The Government's strategic priorities for Ofwat, July 2021
- Water Industry Strategic Environment Requirements (WISER), July 2021

In addition to these five partnership projects, Wessex Water is committing to continue to co-host and support the four Catchment Partnerships across our region and explore wider opportunities for co-delivery. In WSX25 – Improving Biodiversity, we describe our Biodiversity Action Plan Partners Programme which has been delivering biodiversity benefits in partnership since 1998. Also, in document WSX12 - Water resources strategy and investment we provide details on our working with the agricultural sector to protect raw water quality, both for groundwater and surface water sources.

Earlier, in Section 6.2, we provided detail on further farmer engagement as we continue to deliver our Catchment Nutrient Balancing commitments to reduce phosphorus concentrations in the Parrett & Tone and Dorset Stour catchments. Section 2 (of this document) covers our Drainage and Wastewater Management Plan covering our partnership working, primarily with Local Authorities, to improve flood resilience. Furthermore, Section 7.4 describes our investigations to protect and improve Bathing and Shellfish Waters, a key part of this entails working with local partners and communities to enable behaviour change, education and awareness of how everyday activities can impact recreational waters.

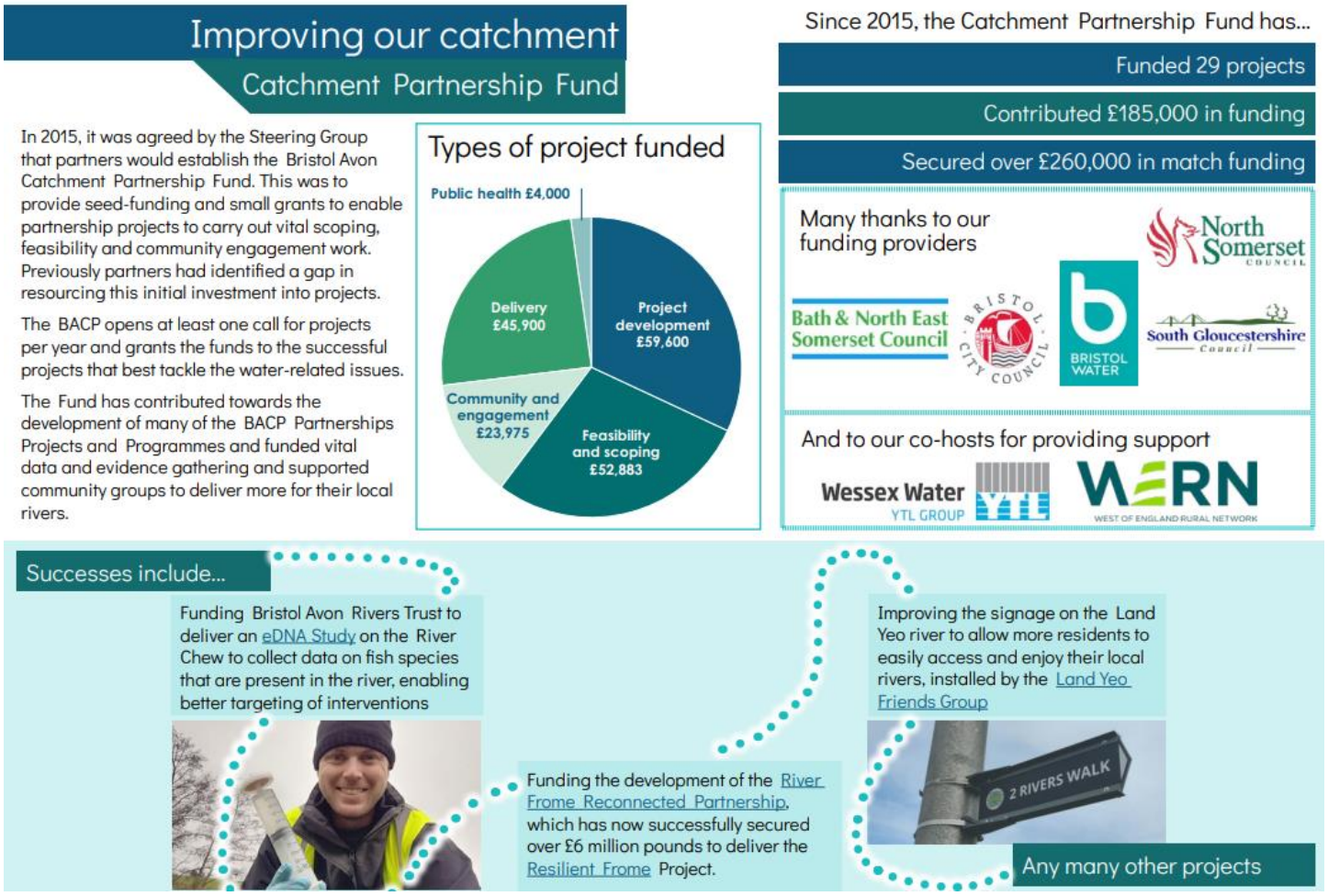
8.1.1. Bristol Avon

Bristol Avon Catchment Partnership

Wessex Water has co-hosted the Bristol Avon Catchment Partnership since 2016, providing Co-ordinator support for the wider partners. In 2015 we developed the Catchment Partnership fund to seed-fund the development of more strategic projects and business cases for development, such as the River Frome Reconnected Project (link) which secured £6m funding from Defra's Flood & Coastal Resilience Innovation Fund. This Catchment Partnership Fund featured in the Government's recent Plan for Water: link. Further details about what is proposed in the Next Bristol Avon Catchment Partnership Fund can be found in WXS17 A6-1.1.2.

Figure 93 below highlights the level of funding and benefits achieved from the Catchment Partnership Fund since it's development in 2015.

Figure 93 - Bristol Avon Catchment Fund Infographic



We will continue to co-host and financially support the Bristol Avon Catchment Partnership into PR24. It is as a result of this partnership involvement that the Chew Valley and Cam and Wellow Partnership projects described below have been developed.

In addition to the Wessex Water asset improvement schemes identified in section 6.2.3 above to deliver nutrient reductions and wider investigations to lessen the impact of our operations across the Bristol Avon catchment, we have been working with a number of partners to develop more holistic projects.

These partnership projects have a primary driver to deliver nutrient reductions but will contribute more widely to environmental improvement through additional natural capital and social improvements. These projects have been co-designed with the Catchment Partnerships and other stakeholders.

Table 78 - Catchment partnership projects

WRC/location/catchment	WINEP Action ID	Primary driver	Secondary driver
Chew Valley Lake (East Harptree WRC)	08WW102203	HD_IMP	WFD_IMPg
Cam & Wellow sub catchment,	08WW100036 09WW100036	25 YEP_IMP	N/A
River Chew sub catchment,	08MU100852 (Wessex Water) 09MU100852 (Wessex Water 08BW100003 (Bristol Water)	HD_IMP	25 YEP_IMP

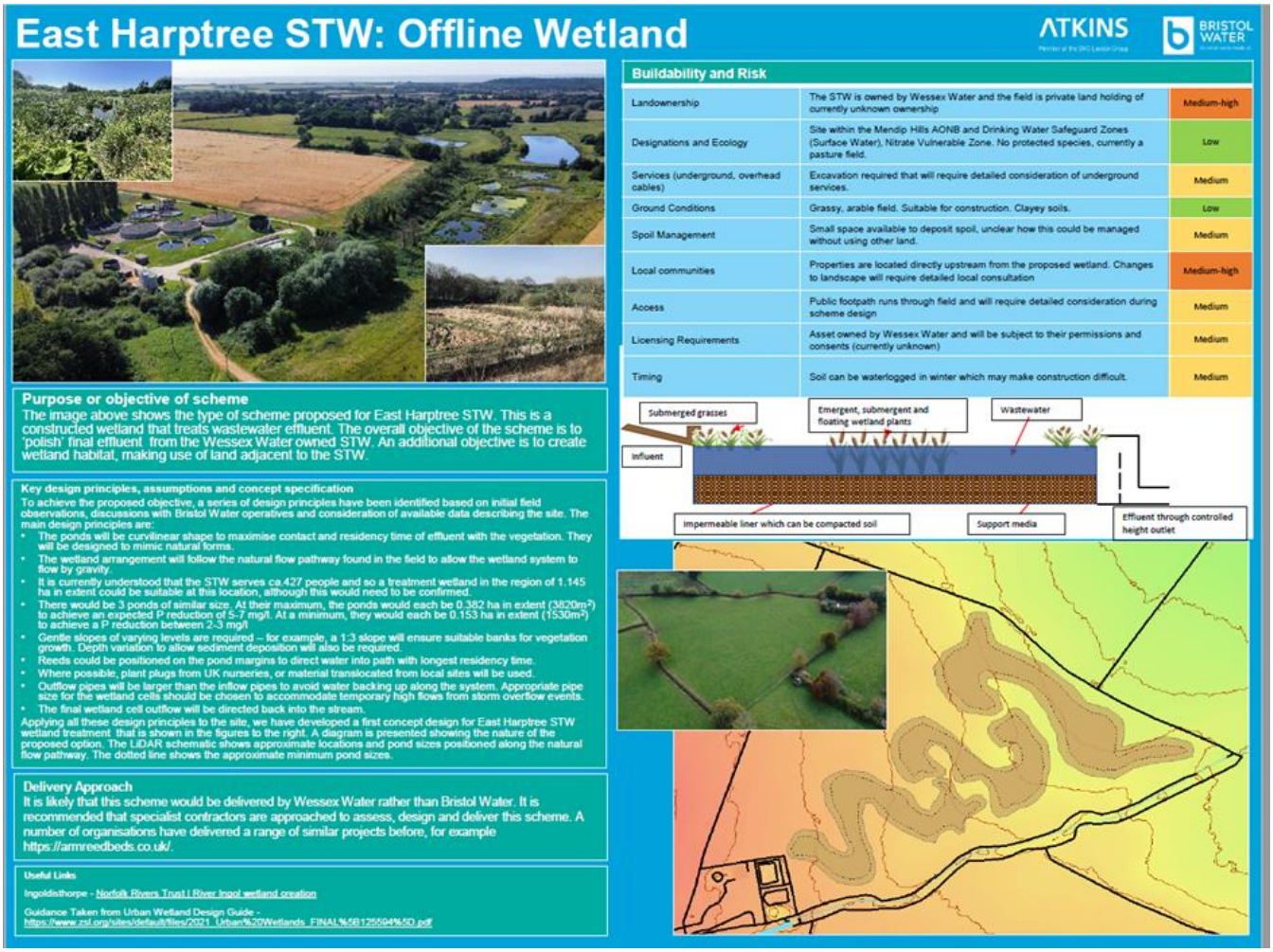
Chew Valley Lake (East Harptree WRC)

East Harptree WRC (431pe) discharges into a small stream and in turn the River Chew, upstream of Chew Valley Lake.

We have been working with Bristol Water (who own Chew Valley Reservoir) and are proposing an integrated constructed wetland located at East Harptree WRC. We understand Bristol Water are no longer including river water quality monitoring of the receiving watercourse in their PR24 WINEP following Information Letter EA/16/2023 but will defer to AMP9 or deliver under the following (Chew Valley) Partnership Project. This will be a partnership project with the landowner, the Duchy of Cornwall, and wider Partnership to deliver water quality and natural capital benefits.

The purpose of the integrated constructed wetland is to provide phosphorus and nitrogen reductions to improve the WFD status of the receiving waterbody. Chew Valley Lake is currently classified as at Poor Ecological Status. The Cycle 3 (updated in August 2022) classification indicates moderate status for total nitrogen and poor status for phosphorus. Sewage treatment (continuous) discharges are cited as Reasons for Not Achieving Good Status (RNAGS) with respect to phosphorus and ecology (macrophytes and phytobenthos).

Figure 94 - Integrated constructed wetlands proposal for East Harptree WRC



Chew Valley Catchment Partnership Project

Chew Valley Lake is a Special Area of Protection for Birds (SPA), site code UK9010041, designated under the Habitats Directive and a Site of Special Scientific Interest (SSSI). Natural England updated their advice and condition assessment of the SPA in January 2019, it is this supplementary advice which has been used to inform the driver for this improvement scheme.

Chew Valley Lake SPA is located south of Bristol and is the largest artificial freshwater lake in South West England. It is a large, shallow reservoir with peripheral areas of reedbeds, carr woodland and neutral grassland, some of which is species-rich. The site has been designated as it supports Shoveler *Anas clypeata* during the non-breeding season. This bird species is reliant upon undisturbed open waters with sufficient submerged and emergent vegetation to support prey species found on or just below the surface.

The NE's Supplementary Advice notes the importance of water quality within the Lake in supporting the population of Shoveler, ensuring the correct vegetation for feeding, as well as supporting wider bird species which are listed within the corresponding SSSI citation for this site. The Advice recommends:

For many SPA features which are dependent on wetland habitats supported by surface water, maintaining the quality and quantity of water supply will be critical, especially at certain times of year during key stages of their life

cycle. Poor water quality and inadequate quantities of water can adversely affect the availability and suitability of breeding, rearing, feeding and roosting habitats.

Typically, meeting the surface water and groundwater environmental standards set out by the Water Framework Directive (WFD 2000/60/EC) will also be sufficient to support the SPA Conservation Objectives but in some cases more stringent standards may be needed to support the SPA feature. Further site-specific investigations may be required to establish appropriate standards for the SPA. Chew Valley Lake is known to be highly eutrophic and exhibits blue-green / green algal blooms due to high nutrient levels. This has the potential to impact upon food provision but is thought to be of less importance to Shoveler than water quantity.

The Lake is also designated as a SSSI for a greater variety of nationally significant bird populations: Gadwall (at populations that occasionally qualify as internationally important); Great crested grebe; Little grebe; Teal; and Coot. Other species with populations of nationally importance but not currently part of the SSSI designation include: Pochard; Tufted duck; Cormorant. The lake is also known as a very significant winter roost for gulls including nationally important populations for Black-headed gull, Common gull and Lesser black-backed gull; again these would qualify as SSSI features but do not currently form part of the designation.

Gadwall are particularly sensitive to water quality where some of the units of the Chew Valley SSSI are at Condition 'High Threat' and if the water quality declines further the current condition could deteriorate. Table 79 below highlights the WFD waterbodies to be included in this Partnership project and their current status. It should be noted that one waterbody (GB109053021851 Chew – source to Chew Valley Lake) is upstream of the Lake, currently at Poor ecological status and therefore directly impacts the water quality within the Lake. This waterbody will be the focus for improvement with respect to the Habitats Directive (HD_IMP) driver. The remaining three waterbodies identified, downstream of the Lake, will be the focus for the secondary driver relating to delivery of the 25 Year Environment Plan targets (25YEP_IMP) which require us to:

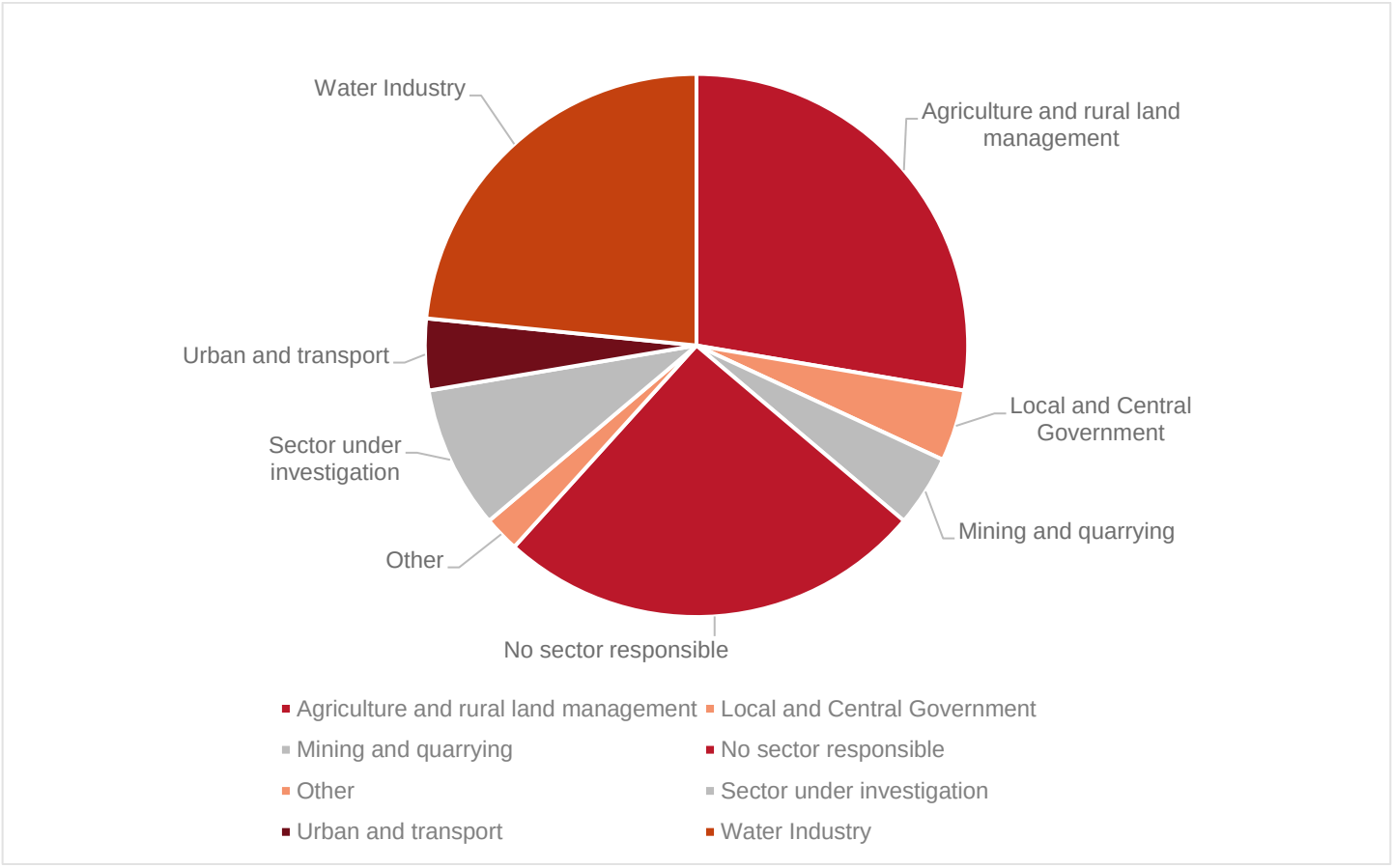
- Halt the decline in species populations by 2030, and then increase populations by at least 10% to exceed current levels by 2042
- Restore precious water bodies to their natural state by cracking down on harmful pollution from sewers and abandoned mines and improving water usage in households
- Deliver our net zero ambitions and boost nature recovery by increasing tree and woodland cover to 16.5% of total land area in England by 2050
- Halve the waste per person that is sent to residual treatment by 2042
- Cut exposure to the most harmful air pollutant to human health – PM2.5
- Restore 70% of designated features in our Marine Protected Areas to a favourable condition by 2042, with the rest in a recovering condition.

Table 79 - WFD Waterbodies included within the Chew Valley Partnership Project area

Waterbody ID	Waterbody Name	WFD Classification (2019)
GB109053021851	Chew – source to Chew Valley Lake	Poor
GB109053021852	Chew Valley Lake to conf of Winford Brook	Moderate
GB109053021950	Chew – conf Winford Brook to conf R Avon	Moderate
GB109053021900	Winford Brook- source to conf R Chew	Poor

As highlighted in Table 79 above, three of the waterbodies included within this project are downstream of Chew Valley Lake SSSI and SPA and so investigations and implementation schemes will be focussed on delivering improvements under the 25 YEP. Similarly, these waterbodies are all classified as Moderate or Poor Status under the WFD. The Reasons, identified by the EA, for Not Achieving Good Status (RNAGS) are illustrated in Figure 95 below.

Figure 95 - Chew sub-catchment: Reasons for Not achieving Good Status by Sector



The Chew Valley Partnership Project has evolved from smaller-scale projects delivered in specific locations within the catchment. One example is the work undertaken by Bristol Water and Bristol Avon Rivers Trust (BART) to connect a section of river downstream of Chew Valley Lake. The collaboration between Bristol Water and BART also included their engagement with local communities, delivering training on river fly monitoring and developing a network of volunteers[15]. Similarly, both Wessex Water and Bristol Water have worked with the University of Bristol to support PhD research understanding nutrient contributions within the sub-catchment. However, Wessex Water has not undertaken any specific environmental investigations within the sub-catchment to understand the impacts of our assets on water quality either within the Lake, or downstream.

[15] See: https://bristolavonriverstrust.org/chew-catchment-project/

It is recognised that these activities, although very valuable, have to date not been integrated thus potentially missing opportunities to maximise outcomes. This Project will bring existing and additional partners, data and funding together to deliver improvements at sub-catchment scale, building on the experience and strengths of the individual partners, to deliver multiple benefit outcomes. This Partnership project will, over the ten-year duration include further monitoring and evaluation to demonstrate the improvements delivered to water quality and wider environmental outcomes to satisfy the improvement elements of these drivers.

The Project will be co-designed, co-delivered and co-funded by the Partners over a ten-year period to deliver improvements to the Chew Valley Lake SPA and SSSI and downstream river environment. Actions will be delivered by partners to satisfy these improvements, monitored using robust techniques and reported using standard metrics. Actions will be delivered within the wider catchment to contribute towards the improvement in the conservation status of the SPA and SSSI and wider watercourse. According to the EA's 25YEP WINEP guidance, a wide range of actions may be included as illustrated in Table 80 below.

Table 80 - Extract from the EA 25 YEP Guidance on appropriate actions

25YEP action examples	Clean Air	Clean and plentiful water	Thriving plants and wildlife	Reducing risk of harm from environmental hazards such as flooding and drought	Using resources from nature more sustainable and efficiently	Enhanced beauty, heritage, and engagement with the natural environment	Mitigating and adapting to climate change	Minimizing waste	Managing exposure to chemicals	Enhancing biosecurity
Plan and protect assets in line with 2°C and 4°C scenarios. Safeguard services, proactively identify risks and implement actions using an adaptive planning approach.				√			√			
Improve chalk streams and the biodiversity they support (SSSI, HD or NERC drivers are also applicable to chalk streams).		√	√			√				
Contribute to the delivery of biodiversity strategies – - England Peat Action Plan - England Trees Action Plan - National Pollinator Strategy		√	√			√	√			
Explore alternatives to end of pipe treatment solutions for chemical substances and emerging substances.		√							√	

25YEP action examples	Clean Air	Clean and plentiful water	Thriving plants and wildlife	Reducing risk of harm from environmental hazards such as flooding and drought	Using resources from nature more sustainable and efficiently	Enhanced beauty, heritage, and engagement with the natural environment	Mitigating and adapting to climate change	Minimizing waste	Managing exposure to chemicals	Enhancing biosecurity
Prevent damage to, and enhance the resilience of, ecosystems on water company land or in the catchments within which you operate. This includes maintaining supply and growth and development and supports Nature Recovery Networks.	√	√	√	√	√	√	√			
Actions to restore form and functions of the natural environment to improve resilience of ecosystems to warmer water temperatures, more frequent floods and drought, and rising sea level (where this goes beyond statutory obligations)										
Allowing space for rivers to adapt to the impacts of climate change		√	√	√		√	√			
Meet the supply demand balance metric set in WRMP for 2030.		√								
Reduce water demand and per capita consumption		√			√		√			
Set challenging targets for leakage informed by customers' views and potential for innovation		√			√		√			
Assess resilience to predicted droughts and other non-drought water supply hazards. Deliver solutions to support meeting resilience of 1 in 500 year drought by 2039.		√		√	√		√			
Understand risks and implement solutions to improve flood resilience				√			√			

25YEP action examples	Clean Air	Clean and plentiful water	Thriving plants and wildlife	Reducing risk of harm from environmental hazards such as flooding and drought	Using resources from nature more sustainable and efficiently	Enhanced beauty, heritage, and engagement with the natural environment	Mitigating and adapting to climate change	Minimizing waste	Managing exposure to chemicals	Enhancing biosecurity
(including working with RFCCs). Support the delivery of flood resilience through jointly-funded schemes with other RMAs and other parties.										
Reduce the number of properties at risk of all sources of flooding by contributing to jointly funded schemes with other Risk Management Authorities.				√			√			

A sound science and robust evidence approach will be used to inform the location of interventions to achieve the outcomes required under both the Habitats Regulations and 25 YEP. Whilst the focus of Wessex Water's funding will primarily address nutrient issues with respect to water quality, the interventions will aim to achieve multiple benefits for the wider environment and community.

Table 81 indicates the wider aims of the Partnership over 10-year project period within the Chew sub-catchment.

Table 81 - Indication of the aims and outcomes of the Partnership Project by 2035

Project	Aims	Outcomes
Chew Valley Partnership	• To understand the key drivers of pollution in the Chew Valley catchment • To improve water quality by working with land managers and other stakeholders to restore the catchment to Good Ecological Status • To deliver resilience and adaptation measures in response to climate change that enable communities and nature to thrive • To restore and enhance ecological connectivity of terrestrial and aquatic ecological networks to increase biodiversity and provide social and economic benefits • To improve access and people's connection with nature, supporting and enabling positive local action, also supporting the collection and use of citizen science data	• 10,642ha agricultural land improved management • 24.67km river improved • 55km habitat improved/created (linear features) • 325ha habitat improved/created • 1,200 people engaged/volunteers • 15ha SuDS features created

	• To enhance and improve management of the landscape including its historic features and sites	

The indicative 10-year project cost for delivery is £14.8m, including contributions from Wessex Water and Bristol Water. Details of the water company financial contributions are show in Table 82 below.

Table 82 - Water company contributions to the 10-year Chew Valley Partnership Project

Water Company	WINEP Action ID	PR24 Contribution	Indicative PR29 Contribution (tbc)	Total Contribution
Wessex Water	08MU100852 09MU100852	£2m	£2m	£4m
Bristol Water	08BW100003	£2.21m	£2m	£4.21m
Total water company contribution (over 10 years)				£8.21m

The two water companies will contribute up to 55% of the project costs across two AMP periods, with the remaining 45% (£6.59m) match funding obtained through the wider Partnership. The exact nature of this match funding is to be determined but likely to include:

- EA- Water Environment Improvement Fund (WEIF) estimate- £100,000
- NE- Catchment Sensitive Farming (CSF) or Environment Land Management Scheme (EMLS) Capital Grants (£625,000), plus a further £625,000 of Farmer/landowner/ capital – estimated total investment of £1.25m
- Keynsham Memorial Park Project: £1.5 million- Heritage Lottery Fund (HLF) and £461,000 – West of England Combined Authority (WECA)
- Trees for Climate funding: £250,000 for hedgerow creation/maintenance
- ELMs Trees for Climate: funding areas set aside for nature, estimated £500,000+
- West of England Green Recovery Fund/Investment Fund, estimated £1m+
- Bristol Avon Catchment Market/Biodiversity Net Gain from the developer offset market, estimated £500,000
- Bath & North East Somerset council Community Infrastructure Levy funding, estimated £100,000
- Defra- Slurry Investment Grant (£500,000) and Farmer landowners capital investment into farm to match fund Slurry interventions (£500,000) – total capital investment of £1m
- Private investment through Freshwater Biodiversity Model currently being piloted/developed in Chew catchment and Bristol Avon Catchment Market – level to be confirmed
- UK Research Institute funding via relevant Natural Environment Research Council calls – to be confirmed

Total estimated match funding at this stage is £6,661,000, although it should be note that some of these applications may not be successful and other appropriate funding streams and grants may be developed during the lifespan of the Partnership Project.

In addition to these match funding sources which will be explored, the project partners will also contribute direct funding as illustrated in Table 83.

Table 83 - Project Partner direct funding contributions

Project Partner	Contribution Level	Description	Timescale
B&NES Council	£4,659	Project management transitional funding	To Oct 2023
B&NES Council	£242,000	Chew Valley Lake Recreational Trail	Sept 24 April 25
Bristol Avon Rivers Trust	tbc	In-kind staff contributions	Sept 24 to April 24
University of Bristol	£40,000	In-kind contribution from previous PhD	Tbc

The water company funding will deliver a subset of these over-arching 10-year project outcomes during PR24, rather than the totality identified in Table 81 (indication of project aims and outcomes).

The outputs and outcomes specifically relating to Wessex Water's contributions are identified in Table 84 below.

Table 84 - Wessex Water Outputs and Outcomes delivered by 2030

Partnership Project	Outputs to be delivered by 2030	Outcomes to be delivered by 2030
Chew Valley Partnership	• Develop a Landscape Recovery Plan for the Chew catchment • Develop a greater understanding of the key drivers of pollution and most effective solutions to improve water quality in the catchment • Public engagement campaign to inform communities about sustainable urban drainage measures people can take at home & in businesses • Free site-specific ecological advice provided to individuals and communities through Avon Wildlife Trust's Team Wilder Ecological Advisory service (TWEAS) • Scope and develop a Catchment Monitoring Programme • Deliver the agreed targets and interventions identified in the Landscape Recovery Plan • Recommendations to inform delivery interventions in AMP9 • Deliver the Chew Valley volunteer and engagement programme through Chew Valley Reconnected Partnership to provide opportunities for local people to connect with and improve their local environment • Communities implement, and benefit from, more sustainable urban drainage solutions	• Improved understanding of pollutant issues in rivers • Engaged farming community taking action • Sustainable land management to help improve water quality and the recovery of nature • Improved access to nature-rich green and blue spaces • Increased opportunities for community engagement/volunteering/participation • Communities taking action to improve their local environment • Improved environmental resilience to climate change

	to improve water quality and enable communities to take steps to improve climate resilience • Develop CVR green and active travel social prescribing network, engaging local health networks, establishing a local nature-health offer and referral pathways and linking the natural environment with the health system • Wildlife Champions are identified to support sustained local action. A peer learning network is created, supported by a training programme and resources to create community nature-based projects, link to wider volunteering and citizen science programmes	

The outputs and outcomes identified in Table 84 above relate to outputs and outcomes which will be delivered using funding provided by Wessex Water's PR24 Business Plan. These are a subset of the wider 10-year Partnership outputs and outcomes illustrated above. The 10-year Partnership outputs and outcomes will be subject to the availability of match funding and the success of the Partnership in accessing these. Therefore, the financial contributions from Wessex Water and associated outputs/outcomes should be seen as a subset of the wider project ambition.

This is a two-AMP Partnership Project, whereby Wessex Water will seek additional funding in PR29 to deliver further outputs and outcomes by 2035. The specific actions to be delivered post 2030 are yet to be determined and will be informed by the success of measures implemented in AMP8 and refined by the monitoring data and evidence collected in parallel to inform the effectiveness of the interventions funded.

It should be noted that this Partnership project is over and above the additional WINEP obligations which Wessex Water will deliver in PR24, described elsewhere in this document. Further WINEP obligations in this sub-catchment are described in section 6.2.3 of this document.

Cam and Wellow Catchment Partnership Project

This Partnership Project will deliver 25 Year Environment Plan (25YEP) outcomes over a 10-year, two AMP period, to 2035. This project will have a 25YEP_IMP driver, described in EA guidance as: *Locally significant environmental measures not eligible under any other driver, but with clear evidence of customer support.*

The 25YEP goals are to achieve:

- Clean air
- Clean and plentiful water
- Thriving plants and wildlife
- A reduced risk of harm from environmental hazards such as flooding and drought
- Using resources from nature more sustainably and efficiently
- Enhanced beauty, heritage and engagement with the natural environment

In addition, pressures on the environment will be managed by:

- Mitigating and adapting to climate change
- Minimising waste

- Managing exposure to chemicals
- Enhancing biosecurity

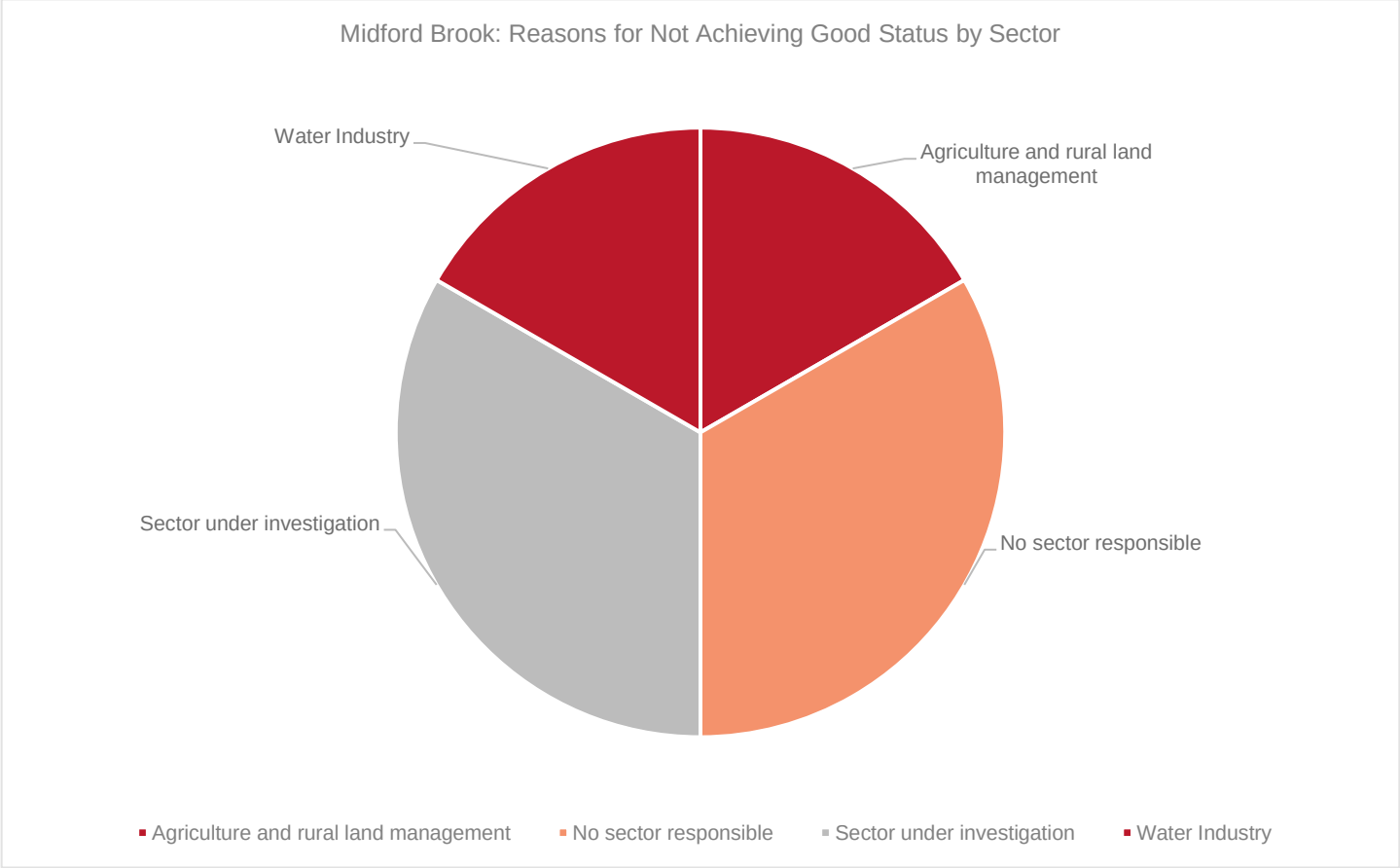
The WFD waterbodies to be included in this partnership project are detailed below with their current WFD classification, Table 85. All waterbodies are classified as either Poor or Moderate. The Reasons for Not Achieving Good Status (RNAGS) primarily identify agricultural and wastewater as the key contributing sectors.

Table 85 - Cam & Wellow sub catchment waterbodies & WFD classification

Waterbody ID	Waterbody Name	WFD Classification (2019)
GB109053022290	Cam brook – Source to confluence with the Wellow brook	POOR
GB109053022271	Wellow brook – snails brook to Bristol Avon	POOR
GB109053022250	Wellow Bk - source to conf Snails Bk Water Body	MODERATE
GB109053022230	Kilmersdon Str - source to conf Snails Bk Water Body	POOR
GB109053022251	Somer Water Body	MODERATE
GB109053022240	Snails Bk - source to conf Kilmersdon Str Water Body	MODERATE

The Reasons for Not Achieving Good Status (RNAGS), shown in Figure 96, demonstrate that an individual sector approach has not been successful in delivering real change to waterbody classification. A collaborative approach focussing on delivering outcomes is the only way to improve river health across these catchments to achieve 25 YEP goals.

Figure 96 - Cam & Wellow sub catchment - Reasons for Not Achieving Good Status by Sector



Wessex Water and wider partners have collaborated on a number of investigations and projects in recent years to better understand the source apportionment of nutrients and identify the impacts of wastewater asset and other sectors on the environmental status. These investigations are summarised in Table 86 below.

Table 86 - Relevant investigations and projects informing the delivery of the Cam & Wellow Partnership Project

Investigation/Project Name	Findings to date	Completion Date
Warleigh Weir Investigations (PR19 WINEP ID 7WW300302)	• 95th percentile concentrations of E.coli and Enterococci on the main River Avon are generally lower than on the tributaries. This is more pronounced in Enterococci. • The 95th percentile concentration for E. coli at Midford Brook at Monkton Combe school is also higher (6805 cfu/100mL), suggesting that 95th percentile concentrations at Warleigh Weir maybe impacted by the Midford and Cam brooks. This observation is also true for Enterococci. • Elevated concentrations of bacteria are seen downstream of the WRCs at Bowerhill (site 29), Chilcompton (site 24), Radstock (Site 19), Paulton (site 17), Frome (site 8) and Trowbridge (site 28). • Site 16 (upstream Paulton WRC) has consistently high bacterial concentrations, with no Wessex Water continuous discharges upstream.	30/09/2023

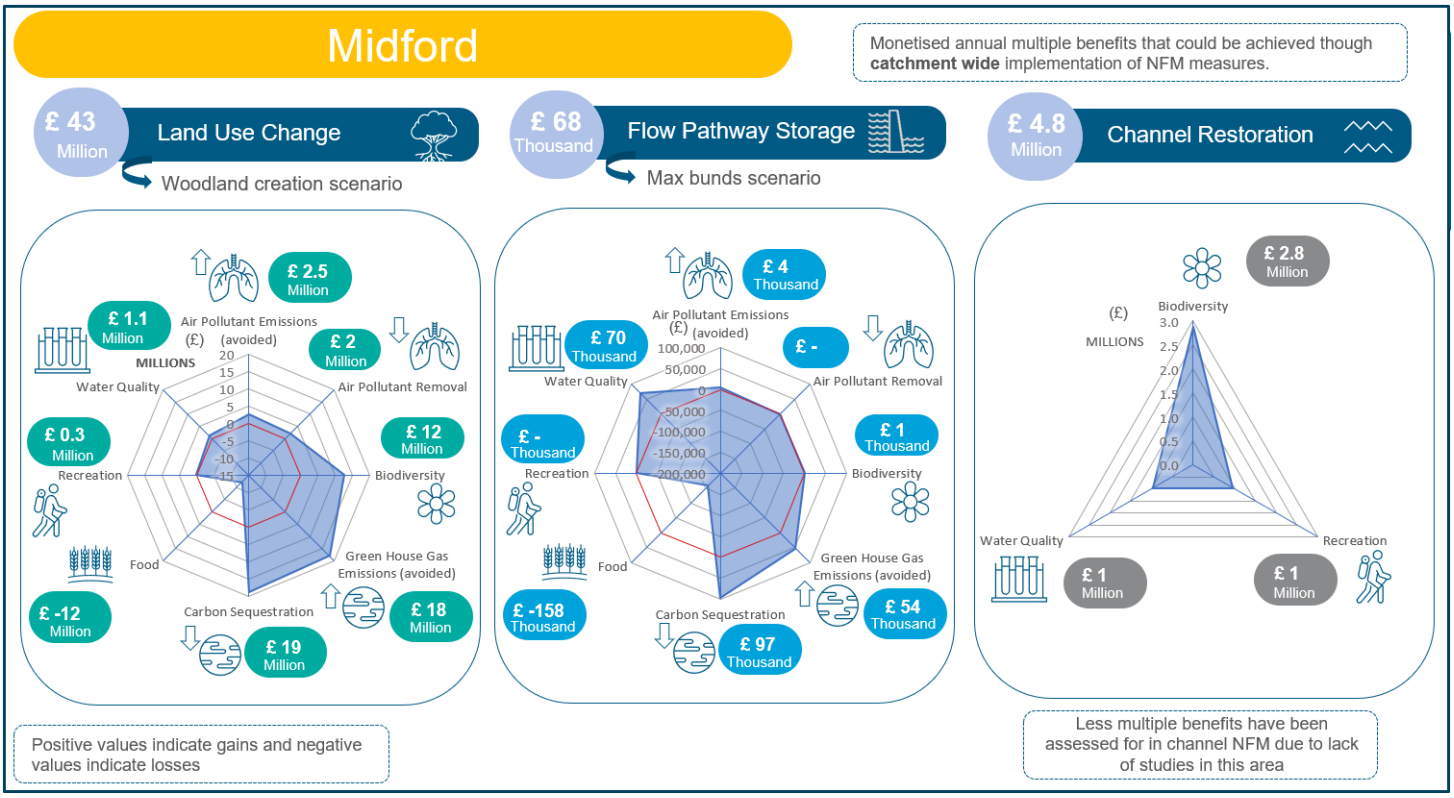
Investigation/Project Name	Findings to date	Completion Date
	• Initial correlation of daily rainfall at Claverton Down and E. coli and Enterococci at Warleigh Weir indicate that a 96-hour moving average of 5 mm is likely to result in bacterial concentrations that would result in 95th percentile standards to be exceeded. Such relationships will be explored further as more data become available. More information is available here	
Innovative Pathway Control (PR19 WINEP ID CHM00374)	• Wastewater Based Epidemiology (WBE) provides data on societal health through pharmaceutical excretion rates and biomarkers. • Models have been developed identifying the relationship between prescription rates and sewage influent concentrations • Establishing a new Green Social Prescribing infrastructure in an area takes time. GSP Providers and partners reported that having a dedicated project support role to identify the key influencers and build relationships has been successful as they are now working together as a network to offer GSP and manage green spaces better. • The project has been successful in building a network of GSP providers in the Somer Valley that is sustainable. • The St Chad's pilot evaluation shows indications of improved wellbeing and nature connection but this is a small sample and the data has limitations due to the variety of activities More information is available here	30/09/2023
Cam & Wellow Source Apportionment Study, undertaken by Atkins[1]	• The SAGIS model for the Cam and Wellow catchment has been run with the most up to date data provided by Wessex Water and EA. The apportionment outputs indicate sewage to be the primary source of phosphate within the catchment, followed by inputs from livestock farming, arable farming and urban run-off. • NFM Studio and SuDS Studio can be used with FARMSCOPER to generate a series of Nature Based Solutions (NBS) measures aimed to reduce phosphorus loadings to the catchment. The measures include changing land use and Nature-Based solutions, to enable the water quality in the Cam and Wellow catchments to achieve GES • Stakeholder engagement found that NBS requires a multi-faceted approach, involving awareness-raising campaigns, policy reforms, innovative funding mechanisms, stakeholder engagement, capacity-building efforts, and robust monitoring and evaluation frameworks.	Ongoing to 2024
Somer Valley Rediscovered, led by Bath & North East Somerset Council[2]	More information is available here	Ongoing (2020-2025)
Cam & Wellow projects and deliverables, led by Bristol Avon Rivers Trust[3]	BART have delivered a number of projects throughout the sub catchment which have increased understanding of the condition of species and habitats as well as trialling innovative techniques and restoration projects. Examples of these are listed below which will inform interventions to be delivered as part of the wider Cam & Willow Partnership Project: • Cam & Wellow Initiative: here	Ongoing (2018 – 2025)

Investigation/Project Name	Findings to date	Completion Date
	• Wellow Brook Project delivering river restoration and community engagement: here • Fish surveys and trialling eDNA: here • Wellow boulder weir removal: here • Restoring the Cam & Wellow Brooks: here • Midford Brook habitat enhancement work: here	

[1] *Funded by Wessex Water*
[2] *Partnership project with financial contribution from Wessex Water*
[3] *Assorted partnership projects with financial contributions from Wessex Water and other partners*

The data obtained from these investigations, combined with walkover surveys and other data sources provides a more robust understanding of the sub catchment, locations of potential interventions and the focus for those. As an example, the source apportionment work undertaken by Atkins has illustrated the potential (modelled) benefits from deploying a nature-based solutions approach throughout the sub catchment, which is illustrated in Figure 97 below.

Figure 97 - Infographic showing the monetised multiple benefits that could be achieved using NBS across the catchment.



The data and evidence presented in the table above, alongside the modelling already undertaken, will help the Partners to identify the most appropriate interventions to enable delivery of the 25YEP outcomes, in addition to wider societal benefits. These data will direct the funding available from Wessex Water and the wider partnership.

These data will provide the foundation for the delivery of appropriate interventions across the sub catchment over the two AMP periods. This Partnership project will, over the ten-year duration, include further monitoring and

evaluation to demonstrate the improvements delivered to water quality and wider environmental outcomes to satisfy the improvement elements of these drivers.

The table below summarises the key aims and outcomes associated with these projects over the ten-year delivery period. All costs have been prepared by the Catchment Partnerships as bottom up assessments based on their historical budgets and delivery cost for similar activities.

Table 87 - Holistic aims, outcomes and costs over the 10-year duration.

Project	Aims	Outcomes
Cam & Wellow Partnership	• To understand the key drivers of pollution in the Cam and Wellow catchment • To improve water quality by working with land managers and other stakeholders to restore the catchment to Good Ecological Status • To deliver resilience and adaptation measures in response to climate change that enable communities and nature to thrive. • To restore and enhance ecological connectivity of terrestrial and aquatic ecological networks to increase biodiversity and provide social and economic benefits • To improve access and people's connection with nature, supporting and enabling positive local action, also supporting the collection and use of citizen science data • To introduce One Health interventions and test their effectiveness • To enhance and improve management of the landscape including its historic features and sites	• 100ha agricultural land managed more sustainably • 70 farmers engaged • 25ha wildlife rich habitat created • 105ha grassland restored • 5,000 trees for water planted • 10km river improvements • 6 barriers removed • 15ha community green space created • 50 community engagement events • 10 schools engaged

The Cam and Wellow Partnership Project is within the Wessex Water waste and supply area, so there will be no contributions from our neighbouring water companies.

The indicative 10-year project cost for delivery is £13m, including contributions from Wessex Water. Details of the water company financial contributions are show in Table 88 below.

Table 88 - Wessex Water contributions to the 10-year Cam & Wellow Partnership Project

Water Company	WINEP Action ID	PR24 Contribution	Indicative PR29 Contribution (tbc)	Total Contribution
Wessex Water	08WW100036 09WW100036	£2.5m	£2.5m	£5m
Total water company contribution (over 10 years)				£5m

The Wessex Water will contribute up to 38% of the project costs across two AMP periods, with the remaining 62% (£8m) match funding obtained through the wider Partnership. The exact nature of this match funding is to be determined but likely to include:

- Direct contributions from farmers in terms of time and co-funding solutions, estimated at £30,000
- Environment Land Management Scheme Capital Grants- £1.2 million, which will be match funded by farmers capital investment of a further £1.2 million [total estimated for improvement delivery £2.4m]
- Big Chalk Heritage Lottery Fund, which is to be developed by Bath & North East Somerset Council (£200,000 estimated)
- West of England Green Recovery Fund, estimated £1m
- Bristol Avon Catchment Market and/or Biodiversity Net Gain contributions to enable development (£250,000 estimated)
- West of England Combined Authority Investment Fund, £828,000
- Bath & North East Somerset Community Infrastructure Levy funding, £150,000
- Engineering & Physical Sciences Research Council infrastructure fund to build analytical infrastructure in the region for OneHealth actions via University of Bath, estimated £1.8m

Total estimated match funding is £6,658,000, although it should be noted that these applications may not be successful and other appropriate funding streams and grants may become available during the life time of the Partnership project. To date, £1.6m of match funding has been secured to deliver elements of the actions identified below, or the preparatory work between 2022 and 2025. This includes £923,246 from the WECA Investment Fund.

In addition to these match funding sources which will be explored the project partners will also contribute direct funding as illustrated in Table 89.

Table 89 - Project Partner direct funding contributions

Project Partner	Contribution Level	Description	Timescale
B&NES Council	£167,680	In-kind staff costs and Community Infrastructure Levy	2025-30
Bristol Avon Rivers Trust	TBC	In-kind staff contributions	2025-30
Natural England	£45,000	CSF Adviser additional time within the catchment to align advice and funding options	2025-30
University of Bath	£1,230,000	Academic staff support and lab equipment	2025-30

The water company funding will deliver a subset of these over-arching 10-year project outcomes during PR24, rather than the totality identified in Table 87 (indication of project aims and outcomes).

These are commitments included in the PR24 WINEP to 2030, but these projects have delivery targeted over a 10-year period to 2035. The outputs and outcomes specifically relating to Wessex Water's contributions are identified in Table 90.

Table 90 - Wessex Water Outputs and Outcomes delivered by 2030

Partnership Project	Outputs to be delivered by 2030	Indicative Outcomes to be delivered by 2030
Cam & Wellow Partnership	• Develop and deliver a Landscape Recovery Plan for the catchment • Establishment of a Somer Valley Farmer Cluster Group • Delivery of volunteer programme continuing the programme established through Somer Valley Rediscovered (SVR) Partnership in 2022-2025 • Support communities to create nature-based projects where they live, expanding on the SVR Greenspaces project and other initiative undertaken through current SVR Partnership. • Public engagement campaign to inform communities about sustainable urban drainage measures people can take at home & in businesses • Design and deliver a bespoke One Health Platform (OHP) with all partners for environmental and public health assessment that encompassing contributions from all catchment users, including citizens/community, agriculture and industry • Scope, develop and implement a comprehensive Catchment Monitoring Programme • Commence Cam and Wellow Catchment monitoring and Assess Environmental and Public health status in the Cam and Wellow Catchment • Work with healthcare practitioners and other policy and third sector stakeholders to design intervention strategies for at-source reduction of chemical burden in the catchment taking account of current B&NES Public Health and SVR green and active travel social prescribing	• 100ha farmland managed more sustainably • A further 15 ha of community green space improved • Deliver 50 community engagement events and training workshops • 25 ha of new, wildlife-rich habitat (incl grassland and woodland) created by 2030Restore 105ha of grassland habitat through extending B-Lines into the Cam and Wellow catchment • 5000 ‘trees for water’ planted • 10km of in-stream river habitat (KM improved) • 6 River barriers removed by 2030 • Understanding of which barriers to remove or make passable – strategy for catchments • Fish spawning habitat unlocked

The outputs and outcomes identified in Table 90 above relate to outputs and outcomes which will be delivered using funding provided by Wessex Water’s PR24 Business Plan. These are a subset of the wider 10-year Partnership outputs and outcomes illustrated in Table 87. The 10-year Partnership outputs and outcomes will be subject to the availability of match funding and the success of the Partnership in accessing these. Therefore, the financial contributions from Wessex Water and associated outputs/outcomes should be seen as a subset of the wider project ambition.

It should be noted that this Partnership project is over and above the additional WINEP obligations which Wessex Water will deliver in PR24, described elsewhere in this document. Further WINEP obligations in this sub-catchment described in section 6.2.3 of this document.

8.1.2. Dorset

Wessex Water co-hosts the Dorset Catchment Partnerships in the Stour and Poole Harbour operational catchments with Dorset Wildlife Trust. Wessex Water was one of the pioneers of Catchment Partnerships, piloting this in the Frome and Piddle, Dorset, which informed the development of the Catchment Based Approach in 2012. Since then the Dorset Catchment Partnerships have gone from strength to strength.

The Partnership has recently updated its strategy describing the partners, projects and delivery of the vision that: "Dorset's river catchments are sustainably healthy, resilient and safe for people and wildlife".

The Partnership has been successful in convening projects and securing funding to enable their delivery. There are two management catchment scale projects: Dorset Wild Rivers and Dorset Peat Partnership, funded via the Nature for Climate Peatland Grant Scheme. In addition, there are projects in the Stour and Poole Harbour catchments which have helped to inform the development of the wider partnership projects detailed in this section. These projects are:

Table 91 – Existing catchment partnership projects in Dorset

Catchment	Project Name	Aims
Poole Harbour	Poole Harbour Nutrient Management Scheme (link)	To support and encourage farmers within Poole Harbour catchment to use more nutrient efficient farming practices and reduce the use of nitrates and other nutrients, in response to the Poole Harbour Consent Order Technical Investigation and Recommendations produced by the Environment Agency and Natural England.
	Enclosed Beaver Trial (link)	Dorset Wildlife Trust are running the Enclosed Beaver Trial for 5 years to investigate how beavers impact hydrology and biodiversity following reintroduction
Dorset Stour	Stour Headwaters (link)	To address water quality, flooding and habitat issues in the Upper Stour by working with farmers to adapt land management practices, adapt farm infrastructure to reduce diffuse pollution, and through community engagement and monitoring.

We will continue to co-host and financially support the Dorset Catchment Partnership into PR24. It is as a result of this partnership involvement that the Stour Chalk Streams and Clay Vales and Frome Headwaters Flagship Partnership projects described below have been developed.

Wessex Water has also supported the Litter Free Coast and Sea Project (now Litter Free Dorset) to engage with stakeholders to improve bathing water quality and coastal experiences. This project has been instrumental in delivering elements of our current AMP7 Bathing Water Performance Commitment.

We will continue to support the Litter Free Dorset project throughout AMP8 to continue to deliver engagement and behaviour change projects which work together to improve bathing water quality, a few key projects are illustrated in Table 92.

Table 92 - Examples of Litter Free Dorset engagement campaigns to improve bathing water quality

Location	Details	
West Bay	Working with the local town council to reduce the levels of takeaway little which contributed to water quality issues due to vermin but also caused littering with high levels of plastic waste. Part of the project worked with a local artist to produce a plastic litter sculpture to raise awareness.	
Hive/Burton Bradstock	The project set up a volunteer group of local dog walkers to undertake beach cleans, pick up discarded dog waste and liaise with local and visiting dog walkers.	
Castle Cove & Sandsfoot Castle	Working with another local artist the Project highlighted the issues of surface water impacts on bathing water quality via an 'Only Rain Down the Drain' campaign.	

Other relevant campaigns include:

- Don't feed the locals – raising awareness about littering and seagulls
- What not to flush – particularly for visitors
- Misconnections
- Avoiding fatbergs – with local businesses, holiday rental companies and local residents
- Dog fouling
- Love your harbour – aimed at the boating community and waste disposal best practice

In addition to the Wessex Water asset improvement schemes identified in earlier sections above to deliver nutrient reductions and wider investigations to lessen the impact of our operations across Dorset, we have been working with a number of partners to develop more holistic projects.

These partnership projects have a primary driver to deliver 25 Year Environment Plan (YEP) improvements. These projects have been co-designed with the Catchment Partnerships and other stakeholders.

Table 93 – Catchment partnership projects in Dorset

WRC/location/catchment	WINEP Action ID	Primary driver	Secondary driver
Stour Chalk Streams & Clay Vales	08MU100853 (Wessex Water) 09MU100853 (Wessex Water) 08SW102805 (South West Water - Bournemouth Water)	25 YEP_IMP	N/A
Upper Frome Headwaters Flagship Project	08WW100037	25 YEP_IMP	HD_IMP

Stour Catchment Partnership project: Chalk Streams and Clay Vales

This Partnership Project will deliver 25 Year Environment Plan (25YEP) outcomes over a 10-year, two AMP period, to 2035. This project will have a 25YEP_IMP driver, described in EA guidance as: *Locally significant environmental measures not eligible under any other driver, but with clear evidence of customer support.*

The 25 YEP goals are to achieve:

- Clean air
- Clean and plentiful water
- Thriving plants and wildlife
- A reduced risk of harm from environmental hazards such as flooding and drought
- Using resources from nature more sustainably and efficiently
- Enhanced beauty, heritage and engagement with the natural environment

In addition, pressures on the environment will be managed by:

- Mitigating and adapting to climate change
- Minimising waste
- Managing exposure to chemicals
- Enhancing biosecurity

The principle environmental pressures in the Stour Chalk Streams and Clay Vales project area include sediment and nutrient inputs from the water industry and agriculture influencing water quality, winter high surface flows in the clay catchments causing flooding and summer low fluvial flows in the chalk catchments reducing climate resilience and potential for future water resources issues.

The project will be led by Dorset Wildlife Trust, in partnership with Wessex Rivers Trust, FWAG SW, Wessex Water, Bournemouth Water and supported by other organisations within the Dorset Catchment Partnerships as relevant. The programme will contribute to wider environmental outcomes of natural environment, net zero, catchment resilience, and access, amenity and engagement by co-ordinating strategic delivery in three core themes: water, soils, wildlife and habitats.

All aspects of this project build on previous work in the areas highlighted. Dorset Wildlife Trust, Wessex Rivers Trust and FWAG SW have extensive track records of working together in various partnership combinations on projects in catchment and are experienced at blending their specialist skills to realise maximum environmental benefit.

The proposed programme aligns with Dorset Catchment Partnerships' Strategic Programmes for reducing nutrient and sediment inputs in the upper Stour catchment, for improving base flows in Dorset's chalk winterbournes and for preventing deterioration in catchments already at 'good ecological status'. The EA has affirmed that the proposed work aligns with their strategies for the Stour, chalk streams in Dorset and the Heart of Wessex programme.

Establishing a long-term, co-ordinated approach to delivery across the highlighted catchment will provide landowners and other stakeholders with confidence of a consistent source of advice and support, increasing the likelihood and quality of engagement.

None of the waterbodies within this catchment achieve WFD Good Status, under the 2019 classification, these were identified as Bad, Poor or Moderate, Table 94. The water industry, both abstractions and discharges, are noted as contributing to 13% of the RNAGS, with agriculture contributing 28%, however, as with the other three catchments identified a significant contribution to the RNAGS is not linked to any specific sector, Figure 98. This highlights that a collaborative project is the only way to deliver real improvement to these waterbodies, rather than a individual sector approach.

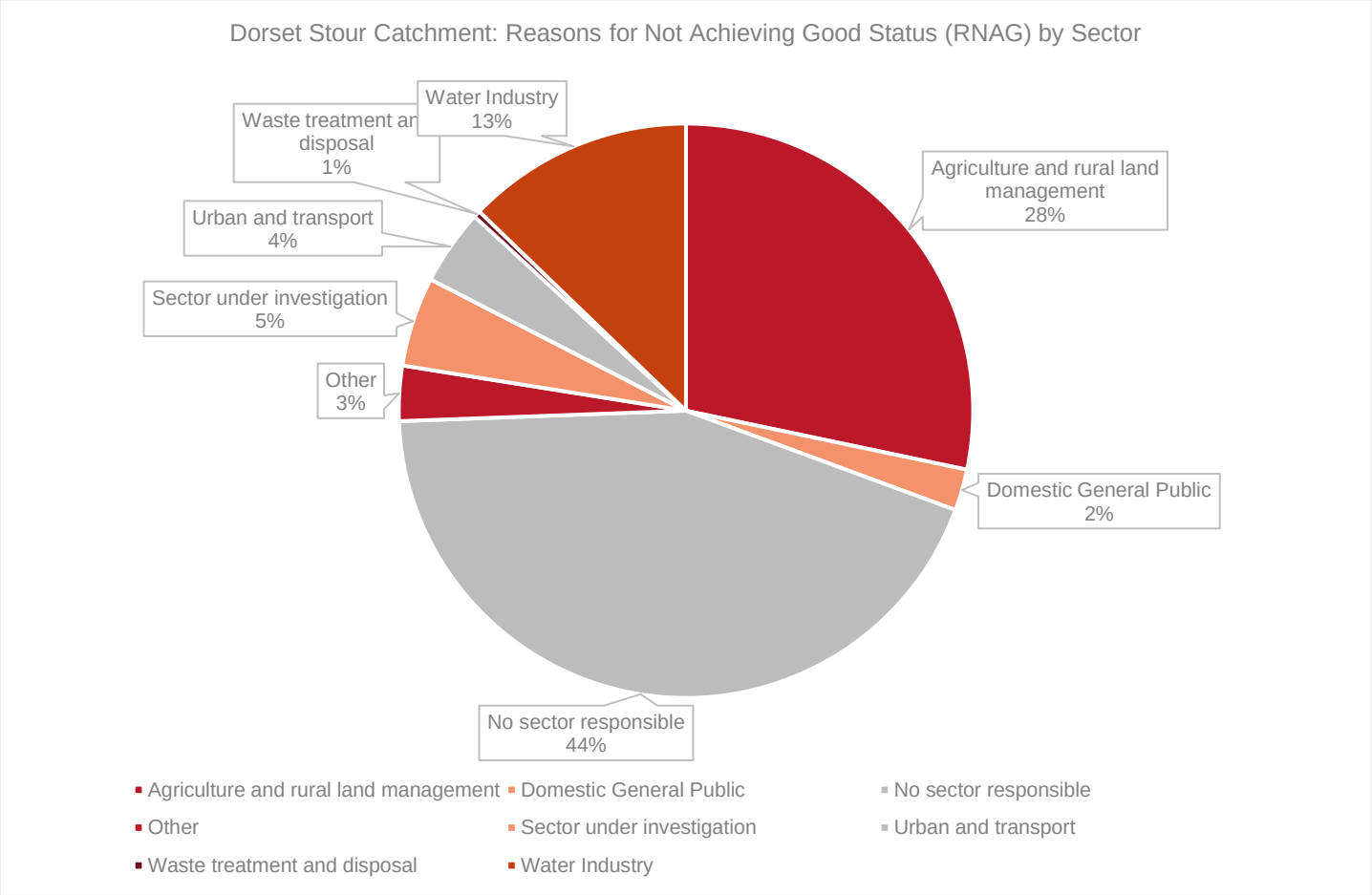
Table 94 - Dorset Stour Waterbodies and WFD classification status

Waterbody ID	Waterbody name	WFD Classification (2019)
GB108043015820	Bow Brook North	Poor
GB108043015821	Bow Brook South	Moderate
GB108043015822	Henstridge Stream	Moderate
GB108043015850	Cale	Moderate
GB108043015890	Lydden (Upper)	Moderate
GB108043015900	Wonston Brook	Poor
GB108043015910	Caundle Brook (Upper)	Moderate
GB108043015930	Cam (Dorset)	Poor
GB108043015940	Lydden (Middle)	Poor
GB108043015950	Caundle Trib (Caundle Marsh)	Moderate
GB108043015960	Caundle Brook (Lower)	Moderate
GB108043015970	Lydden (Lower)	Poor
GB108043016030	Divelish	Poor

Waterbody ID	Waterbody name	WFD Classification (2019)
GB108043016040	Manston Brook	Moderate
GB108043016060	Stour Trib (Bibbern Brook)	Moderate
GB108043016080	Fontmell Brook	Bad
GB108043016100	Key Brook	Moderate
GB108043016110	Stirchell Brook	Moderate
GB108043016170	Stour (Upper)	Moderate
GB108043022440	Lodden	Bad
GB108043022450	Shreen Water (including Ashfield Water)	Poor
GB108043022490	Stour (Headwaters)	Poor

Figure 98 highlights the Reasons for Not Achieving Good Status (RNAGS) as identified by the EA as part of the WFD classification. This illustrates that there are a range of sectors contributing to the current condition, with only 13% identified as due to water industry (Wessex Water and South West Water), with the greatest proportion, at 48%, with no sector identified as being responsible. This supports the partnership approach to achieve more holistic river health improvement within the catchment.

Figure 98 - Dorset Stour catchment - Reasons for Not Achieving Good Status (RNAG) by Sector



Wessex Water and partners have undertaken many investigations to understand the factors influencing water quality, quantity and ecology in the catchment. There have also been a number of collaborative projects at catchment, sub-catchment and waterbody scale to deliver improvements. A number of these are detailed in the table below, demonstrating the evidence base to support this partnership approach and interventions recommended as part of this project.

Table 95 - Relevant investigations and projects informing the delivery of the Stour Partnership Project

Investigation/Project Name	Findings to date	Completion Date
Abstraction Incentive Mechanism (Mere) (PR14)	• During summer 2013 a joint trial between Wessex Water and residents monitored flows in the rivers in Mere. Flow gauging structures were installed on the Shreen and on Ashfield Water, whilst samples were collected to monitor the ecological health of the rivers. • Mere Rivers Group encouraged residents to help by reducing their water use and we minimised transfer out of the catchment as far as possible. • As a result of the AIM trial, summer flows in the watercourses were improved, however residents wanted further improvements	2019

Investigation/Project Name	Findings to date	Completion Date
	• Stream support was agreed with the EA, following installation this commenced in 2021 on the Ashfield Water. • More information: here	
Middle Stour Hydrology Investigation (PR19 WINEP ID 6WW100024)	• Following the completion of our Integrated Water Supply Grid in 2018, this investigation assessed the impacts to watercourses following abstraction changes. • The River Tarrant, the Pimperne Brook and the North Winterbourne are all winterbournes which naturally dry in summer months. This investigation collected new water quality, ecology and flow data to understand the extend of any impact resulting from increased abstraction in the Middle Stour. • River Tarrant: full licence use of the source would increase the extra drying to 17 days • The findings showed that the abstraction at Black Lane does not affect the behaviour of Pimperne Brook. • Modelling showed that full use of our abstraction licences at Shapwick, Sturminster Marshall and Corfe Mullen would have minor impacts on the river, slightly increasing the drying period by 15 days (a 6% reduction in the flowing period) but that this would not have a detrimental impact on the watercourse. • More information: here	2018
Managing Uncertainty: Water Quality in the River Stour (PR14)	• The aim was to assess the effect our water recycling centres (WRCs) have on the water quality of rivers, compared to other sources, such as farming, urban runoff and septic tanks • The investigation has shown that Wessex Water's impact on river phosphate water quality is greatest downstream of Wincanton, Shaftesbury and Hazelbury Bryan WRCs, resulting in P removal at these assets in AMP7. • Targeting only Wessex Water's WRCs will not go far enough for the River Stour to achieve good ecological status. The phosphorus input from other sources, such as farming, needs to be addressed in order to reduce the concentration in the rivers, leading to increased catchment management and partnership working in AMP7. • More information: here	2018
Moors and Uddens Rivers Water Quality Investigation (PR19 WINEP ID 7WW300205)	• During AMP6, Wessex Water investigated discharges from 21 storm overflows and water recycling centres (WRCs) to the Moors River system to understand if their operation is hindering the achievement of environmental targets. • The evidence was, however, inconclusive and the Environment Agency and Natural England required us to investigate these sites further in AMP7 • The investigation is ongoing including water quality monitoring of 3 overflows, invertebrate sampling and sewer flow surveys. • More information: here	2022
Stour Headwaters – Dorset Catchment Partnership project	• The Stour Headwaters Project aims to address water quality, flooding and habitat issues in the Upper Stour by working with farmers to adapt	Ongoing

Investigation/Project Name	Findings to date	Completion Date
	land management practices, adapt farm infrastructure to reduce diffuse pollution, and through community engagement and monitoring. • The project has funded a number of different interventions to improve river habitats, reduce impacts from agricultural soils and nutrients and supporting rural businesses. • Key partners are FWAG SW, Dorset Wildlife Trust, Dorset Council, EA and Wessex Water. • More information: here	

Working with South West Water, our neighbouring water company, we believe this partnership project represents Wessex Water and Bournemouth Water's preferred best value approach to deliver statutory and statutory plus WINEP drivers in the Dorset Stour catchment, primarily focussed on Drinking Water Protected Areas and supporting WFD and Environmental Destination drivers.

The table below summarises the key aims, outcomes and costs associated with these projects. All costs have been prepared by the Catchment Partnership as bottom up assessments based on their historical budgets and delivery cost for similar activities.

Table 96 - Details of Catchment Partnership Project aims, outcomes and costings over a 10-year period

Project	Aims	Indicative Outcomes
Stour Chalk Streams & Clay Vales	• Reduce agricultural impacts on water quality and quantity • Restore or improve natural hydrological function • Increase biodiversity, bio-abundance and habitat connectivity within the river corridor and wider catchment • Increase climate resilience for community and wildlife benefit •	• 3 in-channel barriers eased / removed • 4,622Ha of land (20% of phase 1 waterbody area) brought into active catchment management • 10% biodiversity net gain delivered (using Defra BM3.0) on delivery sites • 500Ha of habitat created (or restored) • 20Ha of wetland created (or restored) • 20km of waterbody improved • 60km^2 of waterbody improved • 19.7tonnes Carbon sequestered (CO_{2e}/ha/year) (580t over project lifetime based on hedge planting, woodland planting and conversion of intensive grassland) • 3000 hours of nature-based volunteering • 1000 people engaged • 50% catchment (waterbody) areas engaged • 10,000 m^3 flood storage on habitat created • 420t CO_{2e}/ha/year air pollution reduction based on the amount and type of habitat created • 37,000 trees planted • 10km of INNS managed

This is a £4.5m project to be delivered over a 10-year period with contributions from Wessex Water and Bournemouth Water (South West Water) across two AMPs, contributing 81% of the total project costs.

Table 97 - Wessex Water contributions to the 10-year Stour Partnership Project

Water Company	WINEP Action ID	PR24 Contribution	Indicative PR29 Contribution (tbc)	Total Contribution
Wessex Water	08MU100853 09MU100853	£1m	£1m	£2m
Bournemouth Water (South West Water)	08SW102805	£1m	£1m	£2m
Total water company contribution (over 10 years)				£4m

Both water companies' funds will contribute to all areas of the project, although delivery may be further targeted to support each company's drivers as the project plan progresses. At the present stage of development the project assumes 50:50 responsibility for water-company-funded WINEP activities between Wessex Water and Bournemouth Water.

Match funding will be used across all areas of the project; the amount of match funding secured by the project will influence the achievable outcomes; all plans outlined here assume the full £400k will be secured and therefore indicate the maximum delivery potential.

Table 98 - Project Actions, Outputs and Outcomes delivered by 2030

Partnership Project	Actions to be delivered by 2030	Outcomes to be delivered by 2030
Stour Chalk Streams and Clay Vales	In the headwater, clay catchments the project will involve working with land managers and owners to deliver: • **Action** to identify, plan and deliver improvements to land management practice which improve soil health and reduce sediment and nutrient losses. • **Action** to identify, plan and deliver improvements to river ecology and natural hydrological function at a sub-catchment scale. In the chalk catchments of the Shreen and Ashfield Water and the middle Stour tributaries, the project will deliver: • **Investigation** into opportunities for improving natural hydrological function across all catchments, including for catchment-scale 'stage zero' restoration. The information collected in this investigation will be used to inform decisions for PR29 and subsequent work in AMP 9. 'Quick win' delivery opportunities will be identified and delivered within AMP 8. • **Action** to develop and deliver existing plans for restoring and improving natural hydrological function in the catchments prioritised by the above investigation.	To be confirmed, these will be monitored and reported using the following metrics: • Area of land brought into active catchment management • Km waterbody improved • Land area covered by engaged farmers • Indicative Biodiversity Net Gain provided by implemented actions • Area of flood storage created • Number of people engaged • Volunteer hours recorded

Poole Harbour Catchment: Frome Headwaters Flagship (Chalk Stream) Project

Wessex Water will deliver the Frome Headwaters Flagship (Chalk Stream) Project which relates to the following WINEP Actions, in partnership with relevant stakeholders including Dorset Wildlife Trust and the Catchment Partnership.

Table 99 - Frome Headwaters Flagship (Chalk Stream) Project

WRC/location	WINEP Action ID	Primary Driver
Dorset Frome Headwaters (4 waterbodies)	08WW100037	25YEP_IMP

This project will deliver a wide range of environmental benefits including water quality improvements for nutrients. This project is described in this section of the Business Plan, detailing partnership projects in the Dorset Management catchment but is relevant to other sections relating to aquatic biodiversity and flows (WSX12 Water Resources Strategy and Investment).

In 2021 the Chalk Stream Restoration Group (CSRG), a consortium of interested parties, published the Chalk Stream Restoration Strategy (CaBA, 2021). This document highlighted the longstanding barriers that have stymied past efforts to improve chalk stream health and proposed new recommendations for overcoming these, chief among which was the call for distinct statutory protection to recognise the global importance of chalk streams and open pathways for investment. A subsidiary recommendation was the formation of a national network of ‘flagship’ catchment restoration projects, in the form of long-term (10-year), catchment-wide strategies to demonstrate what is possible in chalk stream restoration.

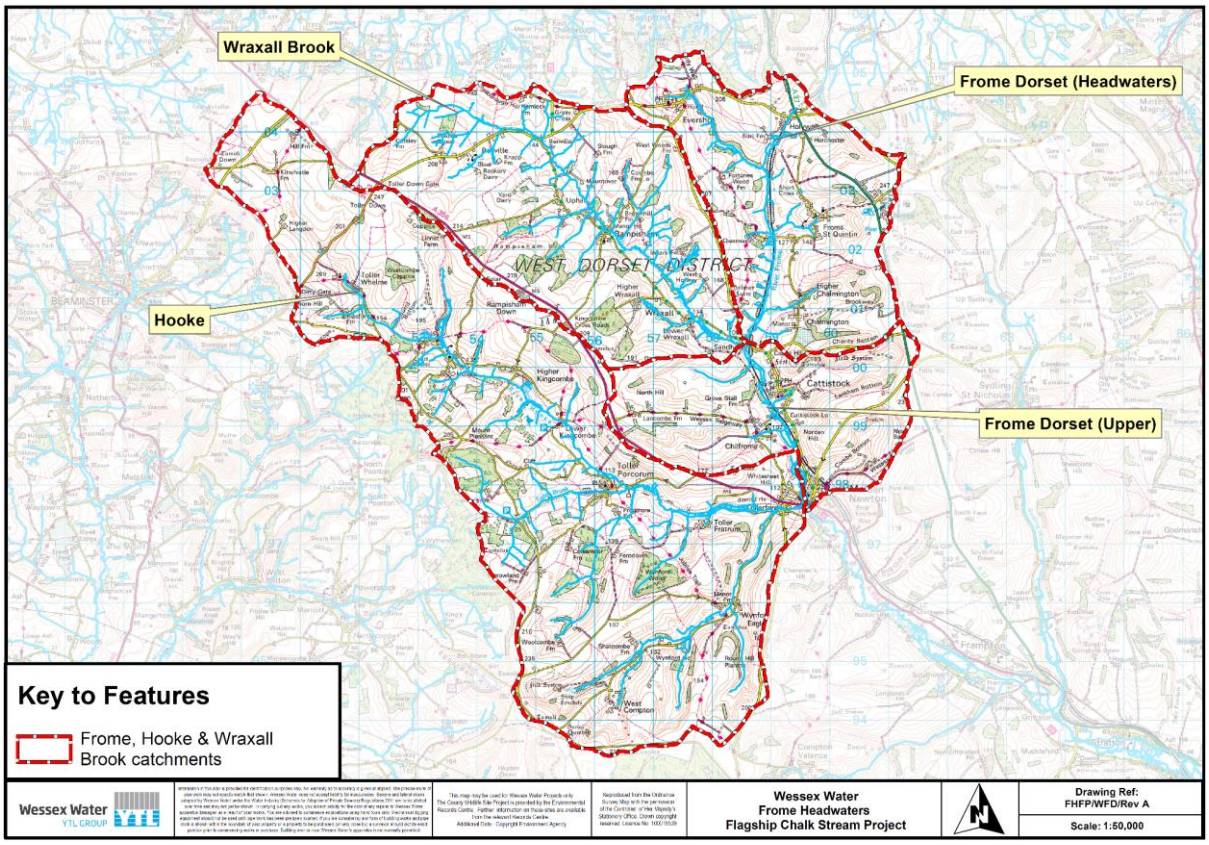
The CSRG set out expectations that flagship projects should (1) address issues of water quantity and quality and physical habitat restoration; (2) focus on rivers and catchments not currently benefitting from protected area status; (3) heavily involve local stakeholders, rivers trusts and catchment partnerships; and (4) rely on water companies for initial core funding. To this end, Defra asked each water company with a chalk stream flowing through its operating region to ‘adopt’ an exemplar catchment. Wessex Water nominated the Frome Headwaters, comprising the Dorset Frome downstream to Maiden Newton, Wraxall Brook and River Hooke. This is a catchment of manageable but ambitious size, three of those four constituent WFD-assessed waterbodies fail to achieve good ecological status. The catchment is also home to various water company supply and wastewater assets and has been the focus of existing, smaller-scale catchment restoration efforts that have involved local stakeholders.

The CSRG strategy recommended that each water company kick-start flagship project development by providing initial funding through the Water Industry National Environment Programme (WINEP), in turn helping to attract future investment via other funding streams as the project evolves. The role of Wessex Water in the Frome Headwaters project is therefore to expedite project progress through upfront funding and preparation of this scoping report, laying the groundwork for next year’s restoration strategy. This will be a more applied document jointly developed by the various project partners.

The CSRG recently published the Implementation Plan, endorsed by Water Minister Rebecca Pow, detailing the recommendations made with commitments and timelines for all sectors. The Implementation Plan includes the commitment made by Wessex Water to contribute towards the delivery of a collaborative ten-year restoration plan in the Upper Frome Headwaters.

This Flagship Project will deliver improvement action in four waterbodies, collectively called the ‘Frome Headwaters’ and comprising: Hooke, Wraxall Brook, Frome Headwaters and Upper Frome. These waterbodies are illustrated in Figure 99.

Figure 99 - Map illustrating the four waterbodies comprising the Frome Headwaters Flagship Project



A scoping study undertaken by Wessex Water, in collaboration with Dorset Wildlife Trust (DWT), during 2022 has identified a number of pressures impacting the project area, which can only be addressed through a collaborative approach. These pressures include:

- Instream barriers
- Channel diversion/embankment/straightening
- Riverbank poaching
- Overshading
- Invasive species
- Sediment runoff
- Nutrient enrichment – from agriculture, aquaculture, sewage and ponds or lakes
- Links to river morphology
- Water quantity (flow)

A number of potential activities have been identified through stakeholder engagement and review of previous walkover and fluvial surveys and recommendations, these are listed in Table 100.

Table 100 - Examples of potential restoration measures

Restoration measure	Rationale	Potential target sites/reaches	Reference site example(s)
Remove instream structures (weirs, fords), realign channel around structures and/or other mitigation (e.g. increase culvert capacity)	Improve fish passage, restore natural geomorphological processes	Weir at Toller Fratrum (Hooke) EA gauging weir at Hooke (Hooke) Ford at Sandhills (Wraxall Brook) Weir at Rampisham (Wraxall Brook) Barriers on headwaters/ tributaries	Higher Frome waterbody
Move river from perched/modified channel to natural course	Restore natural geomorphological processes	Toller Porcorum water meadow (Hooke) Toller Fratrum water meadow (Hooke) Upstream of Frome confluence (Wraxall Brook) Maiden Newton water meadow (Frome)	Downstream of Toller Porcorum (Hooke) Downstream of Chilfrome (Frome)
Re-meander channel	Restore natural geomorphological processes	Toller Porcorum water meadow (Hooke) Toller Fratrum water meadow (Hooke) Upstream of Frome confluence (Wraxall Brook) Maiden Newton water meadow (Frome) Chantmarle to Chalmington (Frome)	Downstream of Toller Porcorum (Hooke) Downstream of Chilfrome (Frome)
Install riparian fencing	Reduce poaching of riverbanks, restore marginal habitats	Toller Porcorum to Toller Fratrum (Hooke) Headwaters/ tributaries with riparian grazing	Woolcombe SSSI Aunt Mary's Bottom SSSI
Introduce woody debris to channel, re-profile riverbanks, restore floodplain connection	Improve instream and riparian habitat diversity, slow flows in headwaters	Hooke to Higher Kingcombe (Hooke) Toller Porcorum water meadow (Hooke) Toller Fratrum water meadow (Hooke) Upstream of Rampisham (Wraxall Brook) Upstream of Lower Wraxall (Wraxall Brook) Upstream of Cattistock (Frome) Downstream of Chilfrome (Frome) Canalised headwaters/ tributaries	Kingcombe Nature Reserve Woolcombe SSSI Aunt Mary's Bottom SSSI

Block/remove manmade drainage channels at spring sources	Increase water retention to encourage development of fen and wet woodland	Modified headwaters/ tributaries	Woolcombe SSSI Aunt Mary's Bottom SSSI

In addition a number of measures have been identified to improve water quality within the project area, this includes improvements to Wessex Water and third party assets. These measures are detailed in the Table 101below.

Table 101 - List of potential water quality improvement measures

Water quality pressure	Objective(s)	Possible action(s)
Water Recycling Centres (WRCs)	Improve the quality of treated effluent released into rivers	Install phosphorus-removal measures at WRCs, including treatment wetlands where appropriate
Storm overflows	Reduce the frequency and/or impact of storm overflow discharges	Increase stormwater storage capacity Separate surface and foul water across the source catchment through SuDs or similar Install nutrient-removal measures including treatment wetlands where appropriate
Septic tanks	Understand impacts of septic tank discharges on river water quality	Identify septic tank runoff and water quality impact hotspots
Aquaculture	Understand impacts of fish farm effluent on river water quality	Water quality and ecological monitoring upstream and downstream of discharge(s)
Sediment and nutrient runoff	Reduce soil erosion and runoff of sediment and nutrients from farmland Quantify relative significance of sediment sources	Work with farmers to increase the uptake of responsible farming practices (ploughing approach, harvest timing, planting of winter cover crops, secure slurry storage) Improve sediment interception across the landscape (drainage grips, bunds) Undertake sediment fingerprinting analyses

In addition to the potential interventions identified above, the partners have been developing an ongoing monitoring plan to be delivered throughout the ten-year duration of the Flagship Project. The monitoring plan includes water quality, water quantity, aquatic and terrestrial ecology and fish surveys. These data will inform the outcomes delivered and progress towards an appropriate assessment of Chalk Stream health and restoration within these waterbodies.

8.1.3. Hampshire Avon

Wessex Water has actively supported the Hampshire Avon Catchment Partnership for a number of years and a range of predecessor partnerships. Traditionally our involvement has been with Wiltshire Wildlife Trust and angling

clubs to better understand the impact of our abstractions on the Chalk Stream habitat and fisheries and deliver collaborative river restoration interventions. Since the formation of CaBA in 2012, the catchment interests have become more wide ranging and holistic. We financially contribute towards the Catchment Partnership and fund a number of supportive projects through our Biodiversity Action Plan Partners Programme and catchment management activities, described elsewhere in this document.

Table 102 - Catchment Partnership project in the Hampshire Avon Catchment

WRC/location/catchment	WINEP Action ID	Primary driver	Secondary driver
Resilient Avon Project	08MU100851 (Wessex Water) 09MU100851 (Wessex Water) 08SW102806 (South West Water - Bournemouth Water)	HD_IMP	

Hampshire Avon Catchment Partnership: Resilient Avon Project

In addition to the Wessex Water asset improvement schemes and investigations identified above (sections 6.2.5 and 7.7) to deliver nutrient reductions and wider investigations to understand the impact of our operations across the Hampshire Avon catchment, we have been working with a number of partners to develop more holistic projects.

This partnership project has a primary driver to deliver Habitats Regulations improvements, delivering a wide range of interventions for water quality, flow and biodiversity. This project has been co-designed with the Catchment Partnerships and other stakeholders.

Natural England's 2018 Condition Assessment of the Hampshire Avon SAC highlights the features of interest and current pressures experienced. The qualifying features relate to aquatic plants, fish species and a mollusc which are associated with Chalk Streams:

- 3260. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho Batrachion* vegetation; Rivers with floating vegetation often dominated by water-crowfoot
- S1016. *Vertigo moulinsiana*; Desmoulin`s whorl snail
- S1095. *Petromyzon marinus*; Sea lamprey
- S1096. *Lampetra planeri*; Brook lamprey
- S1106. *Salmo salar*; Atlantic salmon
- S1163. *Cottus gobio*; Bullhead

In 2014, Natural England produced a detailed Site Improvement Plan for the River Avon and Valley, highlighting the current pressures, responsible bodies and potential interventions. Many of these interventions have been incorporated and delivered by preceding Business Plans and investment in waste and supply assets, in addition to further investigations to better understand Wessex Water's operational impacts compared to other sectors. A summary of these investigations and wider projects are detailed in Table 103, which have been used to inform the focus and actions of this partnership project.

Table 103 - Relevant Wessex Water investigations and projects

Investigations	Findings to Date	Completion Date
Teffont Stream Investigation (PR09 WINEP)	The AMP5 investigation studied the current ecology of the stream and to consider the effect of groundwater	2012

Investigations	Findings to Date	Completion Date
	abstraction both at its actual rates of abstraction and at theoretical full licence. The effects of abstraction on stream ecology at historic levels are not detectable. The effects at the theoretical full licence abstraction rate are predicted to be insignificant on the ecology. The Fonthill Brook, abstraction licence was reduced to 5.5Ml/d during summer flow periods More information: link	
Hydrology of the Western Arm (Upper Avon) (PR09 WINEP)	The AMP5 investigation set out to find the impact of abstraction on river flow both at normal rates of abstraction and at a theoretical full licence condition. Abstraction may reduce flows by 12-18% at times when flows are naturally lowest; it will have a much smaller effect at average levels The ecology in the river is affected by nutrient enrichment – the presence of nitrate and phosphorus – and also by depth and gradient. The outcome of this work is an agreed River Avon Restoration Plan To help protect flows in the river we reduced our abstraction licences at Barton and Bishops Cannings by more than 3Ml/d. More information: link	2015
Western Arm River Restoration (PR14 WINEP)	This project aimed to implement river restoration within a section of the Western Arm of the Upper Hampshire Avon to improve channel morphology and help the river meet its WFD and SSSI objectives. Restoration project delivered: Regrading 350m of river bank (Wilsford) Reconnecting river to floodplain (Wilsford) Creation of offline pond (Wilsford) 43 in-stream installations, eg, flow deflectors, brushwood berms, woody material (Chirton to Wilsford) More information: link	2020
Ecology of the Hampshire Avon (PR14/PR19 WINEP)	The monitoring programme continues in AMP7 allowing a five year post water supply grid implementation period (March 2018-March 2023) of data collection that can be compared with the baseline dataset This investigation continues into AMP7 More information: link	Ongoing
Phosphorus Removal Trials (Warminster WRC) (PR14 WINEP)	Our trial involved increasing iron dosing beyond normal operational requirements to see how much phosphorus removal is possible whilst using an existing technology The results from the 11-month trial show that the ASP in conjunction with iron dosing could reach total phosphorus concentrations as low as 0.1 mg/l, with an average over the trial period of 0.35 mg/l.	2020

Investigations	Findings to Date	Completion Date
	The trickling filters achieved an average total phosphorus concentration of 0.33 mg/l. During the 11-month trial, we found that sludge quantities increased by 34% The Total P permitted was tightened to 0.5mg/l in December 2021 More information: link	
Managing Uncertainty: Water Quality in the Hampshire Avon (PR14 WINEP)	The aim was to assess the effect our water recycling centres (WRCs) have on the water quality of rivers, compared to other sources, such as farming, urban runoff and septic tanks. Our impact on water quality is greatest downstream of East Knoyle WRC – permit tightened to 1mg/l in AMP7 The Hampshire Avon still has further to go to achieve CSMG targets as reduction in phosphate load is needed from other sectors including farming The Hampshire Avon SAC and SSSI is at risk from elevated levels of phosphorus. Some of the phosphorus is coming from groundwater from the Upper Greensand aquifer More information: link	2020
Emerging Contaminants (Tilshead WRC) (PR19 WINEP)	This investigation aims to build a baseline dataset to better understand the behaviour and persistence of trace chemicals in groundwaters that receive treated effluent from WRCs More information: link	Ongoing
CIP3 Sludge Investigation (Ratfyn WRC) (PR19 WINEP)	This investigation is concerned with understanding the quality of the final sludge product at Ratfyn sludge treatment centre. More information: link	Ongoing
Wider Wylye, Wiltshire Wildlife Trust	Partnership Project to understand the interactions between the river and it's catchment and deliver effective restoration and interventions. More information: link	Ongoing

The **Resilient Avon Programme (RAP)** will contribute to wider environmental outcomes through delivering improvements to water quality, water quantity, biodiversity, and climate change resilience. The RAP encompasses the whole of the Avon Hampshire Operational Catchment. Adopting a catchment scale approach will enable the partnership to respond to emerging challenges and opportunities which deliver the biggest gains for the environment and local communities in the right places. Supported by ~£50k of active and planned investigations in 2023-2025, a flexible programme of investigation, design, and delivery will be carried out during AMP8 and 9. Monitoring and evaluation will inform a programme refresh period towards the end of AMP8 to ensure the best possible outcomes are identified and delivered in AMP9.

The Wessex Rivers Trust-led programme will be delivered in partnership with Wiltshire Wildlife Trust, Wessex Water, Bournemouth Water, and supported by wider members of the Hampshire Avon Catchment Partnership. This

partnership approach will extend to the local communities and land managers across the catchment, such as the growing Farmer Cluster movement which encompasses over a third of the Avon catchment.

Despite the Hampshire Avon being recognised as a fine example of a Chalk Stream, with many sections designated at SSSI or SAC, none of the WFD waterbodies achieve good status, all are either Moderate or Poor, based on the EA's 2019 classification (Figure 100 and Table 104). Water industry actions, both abstractions and discharges, are recognised as contributing to 8% of the Reasons for Not Achieving Good Status (RNAGS), but the greatest contribution has not been attributed to a specific sector. This indicates a complex mix of factors impacting the health of the Chalk Stream, requiring a holistic partnership approach to address this.

Figure 100 - Hampshire Avon Catchment: Reasons for Not Achieving Good Status (RNAG) by Sector

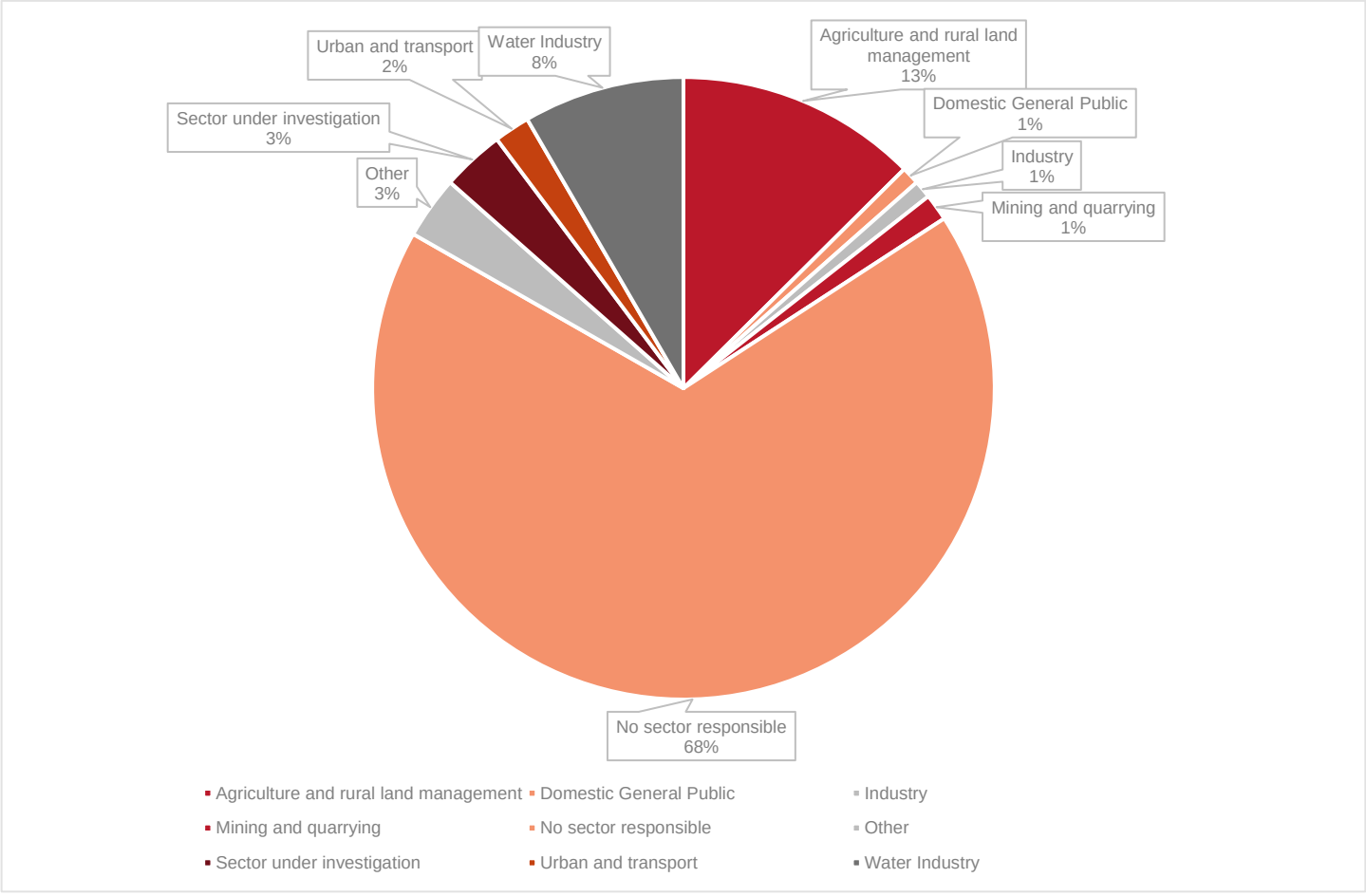


Table 104 - Hampshire Avon catchment waterbodies and current WFD classification

Waterbody ID	Waterbody Name	WFD Classification (2022)
GB108043015800	Ashford Water (Allen River)	Good
GB108043011012	Bisterne Stream	Moderate
GB108043022390	Bourne (Hampshire Avon)	Good

Waterbody ID	Waterbody Name	WFD Classification (2022)
GB108043022560	Chitterne Brook	Moderate
GB108043011011	Clockhouse Stream	Moderate
GB108043015770	Ditchend Brook	Good
GB108043015740	Dockens Water	Moderate
GB108043015830	Ebble	Good
GB108043015870	Ebble (Upper)	Good
GB108043015860	Ebble Trib (Chalke Valley Stream)	Moderate
GB108043022430	Etchilhampton Water	Moderate
GB108043022500	Fonthill Stream	Moderate
GB108043016190	Fovant Brook	Moderate
GB108043022420	Hampshire Avon (East) and Deane Water	Poor
GB108043022410	Hampshire Avon (East) and Woodborough Stream	Poor
GB108043015842	Hampshire Avon (Lower)	Moderate
GB108043015841	Hampshire Avon (Middle)	Moderate
GB108043022352	Hampshire Avon (Upper) d/s Nine Mile River confl	Moderate
GB108043022351	Hampshire Avon (Upper) u/s Nine Mile River confl	Poor
GB108043022370	Hampshire Avon (West)	Moderate
GB108043015750	Huckles Brook	Moderate
GB108043015720	Linford Brook	Moderate
GB108043011020	Mude	Good
GB108043016160	Nadder (Headwaters)	Poor
GB108043015880	Nadder (Lower)	Good
GB108043022470	Nadder (Middle)	Moderate
GB108043016200	Nadder (Upper)	Moderate

Waterbody ID	Waterbody Name	WFD Classification (2022)
GB108043016180	Nadder Trib (Swallowcliffe)	Poor
GB108043022360	Nine Mile River	Moderate
GB108043011010	Ripley Brook	Poor
GB108043016210	Sem	Moderate
GB108043015730	Sleep Brook	Good
GB108043015810	Sweatfords Water	Good
GB108043022471	Teffont	Moderate
GB108043022570	Till (Hampshire Avon)	Good
GB108043022520	Wylye (Headwaters)	Poor
GB108043022510	Wylye (Lower)	Good
GB108043022550	Wylye (Middle)	Moderate
GB108043022530	Wylye Trib (Heytesbury Stream)	Good
GB108043022540	Wylye Trib (The Were or Swan)	Moderate

Working with South West Water, our neighbouring water company, we believe this partnership project represents Wessex Water and Bournemouth Water's preferred best value approach to deliver statutory and statutory plus WINEP drivers in the Hampshire Avon catchment, primarily focussed on Habitat Regulations implementation, Drinking Water Protected Areas, and supporting WFD and Environmental Destination drivers.

The table below summarises the key aims, outcomes and costs associated with these projects. All costs have been prepared by the Catchment Partnership as bottom-up assessments based on their historical budgets and delivery cost for similar activities.

Table 105 - Details of Catchment Partnership Project aims, outcomes and costings over a 10-year period

Project	Aims	Indicative Outcomes
Resilient Avon Programme	• To deliver Chalk Stream restoration, primarily focussing on flow resilience • Delivery of multiple benefits, including: nature recovery, catchment resilience (low flows & floods), • Improved water quality	• 166 Ha of habitat created (or restored) • 27 Ha of wetland created (or restored) • 50 Area of flood storage (Ha) - based on floodplain reconnected and wetland habitat created/restored • 10 In-channel barriers eased / removed • 38 Km of waterbody improved

	• Sustainable river flows • Increased uptake in agri-environment schemes and biodiversity net gain • Greater understanding of key issues impacting the catchment • Volunteer engagement.	• 305 Km^2 of waterbody improved • 280 Landowner/farmers engaged • 1200 Number of hours of nature-based volunteering • 559 Carbon sequestered CO_{2e} Tonnes/ha/yr – based on area of habitat created • 2800 Ha of land brought into active catchment management – land with improved management for water, soil, biodiversity etc • 1400 uptake of appropriate ELM/ FFCP measures: Ha under targeted agreements

This is a £12m project to be delivered over a 10-year period with contributions from Wessex Water and Bournemouth Water (South West Water) across two AMPs. To date, the Partnership has committed to securing £200,000 in match funding during AMP8, with £10,000 of in-kind support in addition.

Table 106 - Wessex Water contributions to the 10-year Resilient Avon Project

Water Company	WINEP Action ID	PR24 Contribution	Indicative PR29 Contribution (tbc)	Total Contribution
Wessex Water	08MU100853 09MU100853	£5m	£5m	£10m
Bournemouth Water (South West Water)	08SW102805	£1m	£1m	£2m
Total water company contribution (over 10 years)				£12m

At present, Wessex Water's financial contribution will largely contribute towards flow resilience based outcomes, and Bournemouth Waters will contribute to water quality based outcomes.

All delivery is subject to achieving the match funding value. Partners have an excellent track record of securing funding for similar projects, but if the match target is not achieved, programme target outputs and outcomes of the project may be subjection to revision accordingly.

Table 107 - Project Actions, Outputs and Outcomes delivered by 2030

Partnership Project	Actions to be delivered by 2030	Outcomes to be delivered by 2030
Resilient Avon Programme	Improvement/prevent deterioration actions (2025-27) • Deliver farm demo sessions with agri stakeholders to aide engagement and identify opportunities to deliver nature-based solutions in line with the outcomes of the Programme at priority locations across the Programme area.	To be confirmed, these will be monitored and reported using the following metrics: • Area of land brought into active catchment management • Km waterbody improved

	• Promote and inform stakeholders of Programme progress via quarterly HACP partnership and wider stakeholder events and comms. Improvement/prevent deterioration actions (2027-30) • Deliver river and floodplain restoration projects, including in-channel barrier easement/removal at priority locations in Programme area identified by investigation phase. • Design and deliver nature based solutions trial projects with farmers, including advice, education, and P2P 'farm demos' with agri stakeholders at priority locations in Programme area identified by investigation phase. • Informed by learning from trial projects, support/lead on implementation of further nature based solutions at priority locations in Programme area.	• Land area covered by engaged farmers • Indicative Biodiversity Net Gain provided by implemented actions • Area of flood storage created • Number of people engaged • Volunteer hours recorded

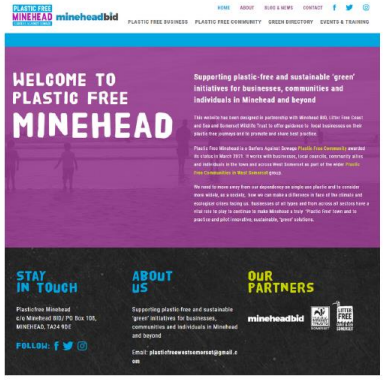
8.1.4. Somerset

Wessex Water has actively supported the Somerset Catchment Partnership for a number of years and a range of predecessor partnerships. Traditionally our involvement has been with Somerset Wildlife Trust and Farming and Wildlife Advisory Group SW to better understand how our assets and diffuse pollution impact the nutrient levels within the watercourses and rhyne system. Since the formation of CaBA in 2012, the catchment interests have become more wide ranging and holistic. We financially contribute towards the Catchment Partnership and fund a number of supportive projects through our Biodiversity Action Plan Partners Programme and catchment management activities, described elsewhere in this document.

Wessex Water has also supported the Litter Free Coast and Sea Project (hosted by the Severn Estuary Partnership) to engage with stakeholders to improve bathing water quality and coastal experiences. This project has been instrumental in delivering elements of our current AMP7 Bathing Water Performance Commitment.

We will continue to support the Litter Free Coast and Sea throughout AMP8 to continue to deliver engagement and behaviour change projects which work together to improve bathing water quality, a few key projects are illustrated in Table 108.

Table 108 - Examples of Litter Free Dorset engagement campaigns to improve bathing water quality

Project	Details	
School League	Launched in 2021 to work with coastal primary schools to provide education and activities to relate children to their beach and water quality issues. In 2023, 19 schools had signed up with many activities underway	
Plastic Free Communities	Working with Plastic Free Porlock and Minehead, the team developed a website with access to information and resources for these communities to use, reducing single use plastics and litter.	

Other relevant campaigns include:

- Don't feed the locals – raising awareness about littering and seagulls
- Bin your butt – cigarette awareness campaign and work with local councils to provide bins
- Business Award Scheme – working with local businesses to reduce their impact on the coast
- Avoiding fatbergs – with local businesses, holiday rental companies and local residents
- Dog fouling

8.1.5. Best Option for Customers

These projects are either ongoing or have been developed with the Catchment Partnerships over the last 18 months (since winter 2021/spring 2022).

The partnership projects are based on solid foundations with good working relationships between partners due to preceding collaborative working. The partnership projects have defined timelines and deliverables during AMP8 with indicative plans for AMP9, although these will be refined based on learning and delivery over the next 5 years.

The Upper Frome Flagship Project is in alignment with the National Chalk Stream Strategy and associated timelines.

These projects deliver holistic environmental recovery and engagement. Robust and Efficient Costs

The costs for the Catchment Partnerships and Litter Free Coast and Sea Partnerships remain unchanged from AMP7.

The five Partnership Projects: Chew Valley Catchment, Cam and Wellow, Stour Catchment Partnership, Hampshire Avon Catchment Partnership and Upper Frome Flagship Project have been developed by the partners themselves, using their resources and costs for delivery. These costs have been based on their previous project work delivered in recent years. The key partners, such as Wildlife Trusts and Rivers Trusts have been recipients of a wide range of public and private funding in the past, the costs and activities listed in the projects mirror those which have been undertaken previously and identified in successful funding bids for EA WEIF funding or Heritage Lottery Funding, for example.

Costs identified for the academic research elements of these projects have been provided by our academic partners and approved by the respective universities (Bristol and Bath) having been signed off by Faculty Offices. Similarly, these costs are consistent with those incorporated in recent successful UK Research Institute funding bids.

All third party costs provided relate to bottom up assessments of the proposed delivery programme and have been checked by Wessex Water prior to submission.

8.1.6. Customer Protection

The projects include co-funding from partners and wider funding stream ensuring that they are delivered more efficiently than by a water company alone. The involvement of different partners enables access to wider funding streams.

Action Specification Forms (ASF) will be developed for each Partnership Project describing the actions and benefits attributable to the water company within the context of the wider project to be delivered. This will detail specific actions which will be delivered by the partners and water companies using funding identified in both AMP8 and AMP9, in the context of the wider investigation outcomes. ASFs will be used to confirm partner accountabilities and agreed by all partners but approved by EA and NE (as part of the WINEP process) by December 2024.

WINEP delivery is a metric within the EA’s annual Environmental Performance Assessment.

8.2. Flood Risk Management Partnerships

Under the Flood and Water Management Act (2010) roles and responsibilities were assigned to different Flood Risk Management Authorities and riparian owners (Figure 101). The Environment Agency was given a responsibility for flood and coastal erosion risk management activities on main rivers and the coast. Councils were assigned a role of Lead Local Flood Authority (LLFA). As part of this role, they lead in managing local flood risks, i.e. risks of flooding from surface water, ground water and ordinary (smaller) watercourses. As flooding is often caused by a range of factors that are the responsibility of different organisations, collaboration is essential to increasing flood resilience of drainage and wastewater infrastructure. An increased awareness of better rainwater management in helping to deliver increased resilience of wastewater infrastructure, has resulted in flood risk management authorities, town and parish councils, community groups and individuals in wanting to know how they can help play their part in integrated surface water management through a suite of short-, medium- and long-term plans.

The DWMP Drainage Strategies and Surface Water Management Plans (SWMP) provide the foundations in identifying areas to target where greatest outcomes will be obtained through either traditional solutions or better surface water and rainwater management. These measures will identify where surface water and sewer flooding and frequency of storm overflow operation can be reduced. This provides the basis for more detailed design and

delivery of a suite of measures. A key element to DWMP and SWMP strategies recognises the importance of better rainwater management in targeted areas by both riparian owners and risk management authorities.

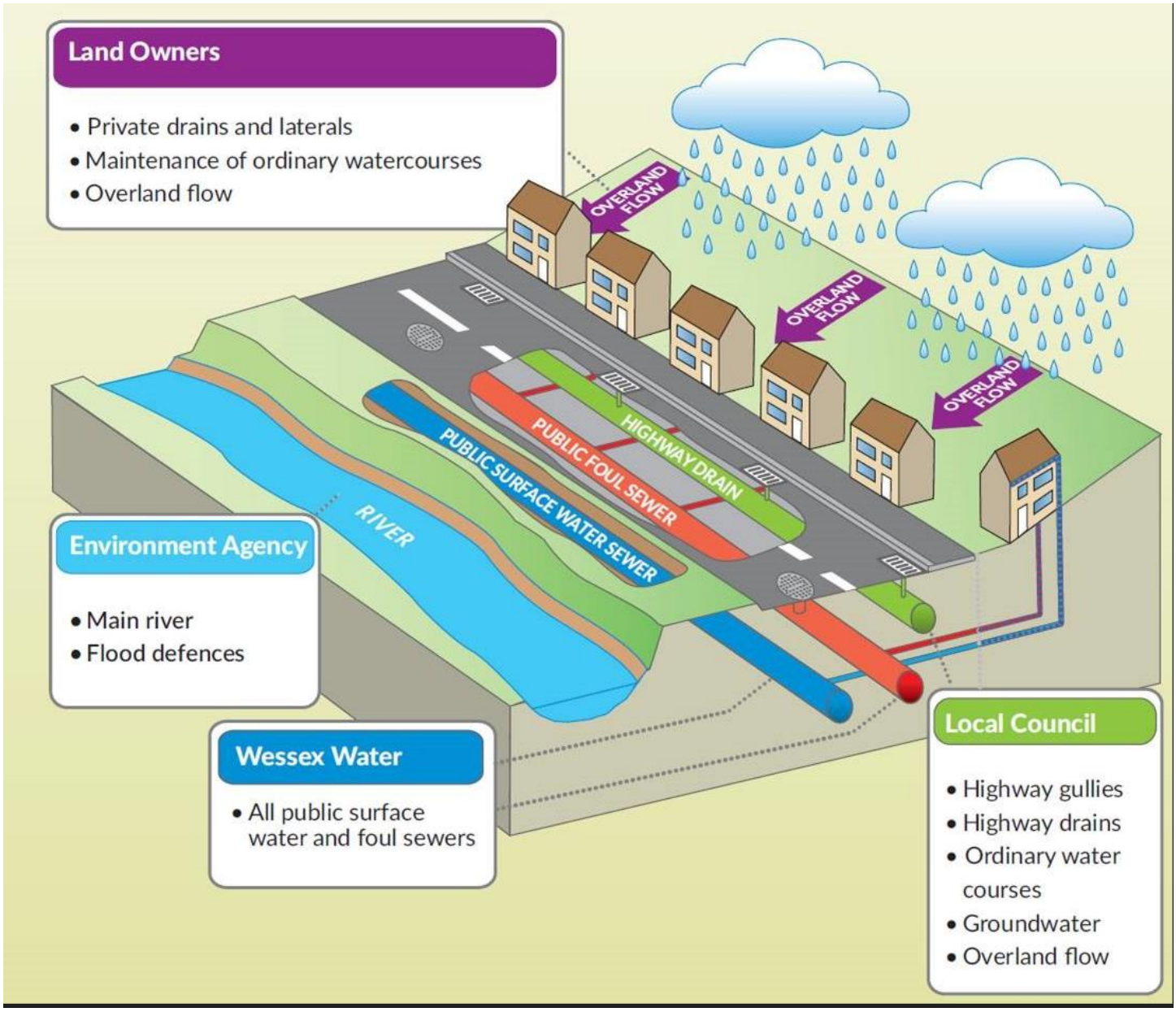
Communities that have either experienced flooding or have an informed awareness of the challenges of drainage and wastewater infrastructure are keen to be empowered to understand how they can help. We can provide support in contributing to increasing their resilience to some of the challenges presented by climate change, growth and urban creep. The DWMP strategies and SWMP recommendations can help direct measures where greatest outcomes can be achieved.

It is recognised that the greatest benefits of surface water separation from the sewerage network can be achieved and delivered through:

- integrating improvements to drainage and wastewater infrastructure as part of projects developed to address flood risk from other sources of flooding,
- regeneration schemes,
- delivery of sustainable drainage solutions within public open spaces;
- treatment of highways drainage through SuDS; or
- empowerment of local communities, landowners and residents in taking action.

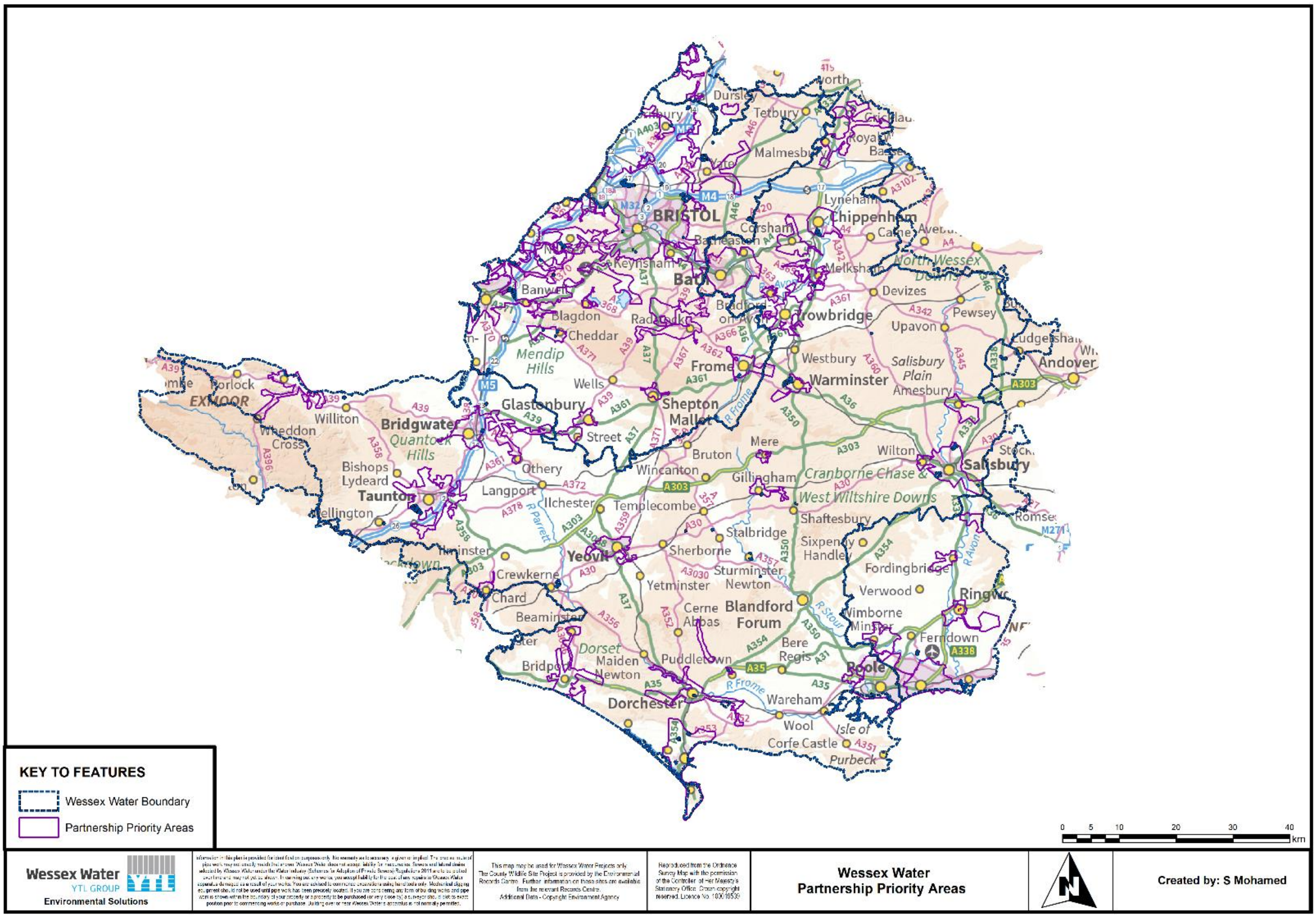
This also opens significant opportunities for partnership funding through alignment of programmes of work. It is also important to be able to increase the awareness of the impact that management and maintenance of riparian drainage infrastructure can contribute to integrated rainwater and surface water management. There is also the potential to deliver water efficiency drivers through attenuation of water in water butts and raingardens. These individual property measures can provide a great engagement opportunity with individual residents. However, it is recognised that the scale of multiple benefits of solutions that can be achieved at an individual property level do not deliver the potential scale of multiple benefits that can be achieved through retrofitting opportunities through rainwater management within public areas.

Figure 101 - Roles and responsibilities of flood risk management



As part of the DWMP our flood risk management authorities and catchment partners were given the opportunity to identify partnership priority areas to align with their strategies and priority areas. These are and are shown in Figure 102.

Figure 102 - Partnership priority areas identified by DWMP stakeholders



The opportunities that have been identified for flood risk management partnership projects can be summarised into four main categories as follows:

- projects that align to flood risk management projects allocated funding from Flood Defence Grant in Aid;
- improved surface water management to deliver a reduced frequency of storm overflows operation;
- partnership flood alleviation projects identified through flood investigations, Surface Water Management Plans and DWMP drainage strategies;
- flood risk resilience improvements informed by the DWMP resilience assessment.
- opportunities identified by town and parish councils that can demonstrate benefits to drainage and wastewater infrastructure.

Projects that align to flood risk management projects allocated funding from Flood Defence Grant in Aid
The Environment Agency's Medium-Term Plan details a range of Flood and Coastal Erosion Risk Management projects in the Wessex Water area that have Flood Defence Grant in Aid (FDGiA) funding allocated to them. In a number of locations, there are potential opportunities to deliver increased flood resilience to drainage and wastewater infrastructure either in conjunction or in parallel to proposed works that are being developed with significant allocations of FDGiA funding, as described in the tables on the following pages.

Improved surface water management to deliver a reduced frequency of storm overflow operation and increased resilience to drainage and wastewater infrastructure.
Further to the finalisation of the Storm Overflow Action Plan, an assessment of flood risk partnership opportunities will be undertaken of the storm overflows that require investment in AMP8 and AMP9 to identify locations where surface water separation opportunities can be delivered that also provide surface water flood risk benefit. The surface water management solutions are unlikely to be able to guarantee to reduce the operation of the storm overflows to required thresholds. However this work will inform where hybrid solutions delivering wider multiple benefits to enable stakeholders to be able to contribute to part of the solution and potentially secure additional partnership funding.

Partnership flood alleviation projects for DWMP priority areas or identified through flood investigations, Surface Water Management Plans or DWMP drainage strategies.
The root cause of flooding can often be associated with different sources of flooding that are the responsibility of a range of risk management authorities or riparian owners. In order to reduce the risk of flooding from multiple sources, a range of actions are often required by different stakeholders. This work can either be progressed as independent partnership projects or may require further investigations to identify the root cause(s) of flooding and development of best value, collaborative solutions. As part of the DWMP approximately 30 additional locations were identified where a number of partnership priority areas were raised to investigate known flooding locations, consider surface water management opportunities in areas of high surface water flood risk or to align with other flood alleviation and regeneration projects.

Details of these projects are still under development and locations for these strategies are still being agreed with LLFAs, flood risk management authorities, infrastructure and utility providers and government departments. These projects can and include input from catchment partners where opportunities for natural flood management may support the delivery of integrated measures to reduce flood risk. Most projects align with the partnership priority areas identified by stakeholders through the development of the DWMP as shown in Figure 102. We have also undertaken a strategic prioritisation assessment of all schools within the Wessex Water area to develop further opportunities for SuDS in schools projects where flooding incidents or storm overflows are present in the sewage network downstream of schools. We will look to extend this assessment to explore opportunities with other government departments and social care providers.

Flood risk resilience improvements informed by the DWMP resilience assessment
Further work will be done to identify potential alignment of high priority sites for resilience improvement with flood risk management projects being progressed with partners.

8.2.1. Flood Risk Management Partnerships in the Bristol Avon catchments

The fluvial catchment of the Bristol Avon covers the council Lead Local Flood Authority areas of Wiltshire, Somerset, Bath and North East Somerset, South Gloucestershire, Gloucestershire, Bristol City Council and North Somerset.

Flood risk management projects that have Flood Defence Grant in Aid funding allocated within the Bristol Avon Catchment where there is a medium to high confidence in developing opportunities to deliver increased flood resilience to drainage and wastewater infrastructure are detailed in Table 109.

Table 109 - Flood risk partnership opportunities that align to flood risk management projects allocated Flood Defence Grant in Aid funding in the Bristol Avon catchment

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
Bristol Avon Strategy - Phase 1	Bristol City Council and the Environment Agency have identified that there is a significant risk to Bristol city centre from tidal and fluvial river flooding. The risk of flooding increases significantly with sea level rise. Up to approximately 2,800 residential properties may be at risk in 2110. This project proposes a strategic solution to manage the risk of climate change. Localised solutions to manage the risk in the short term may also be required.	- Develop design and deliver short term measures to increase resilience to storm overflows and surface water outfalls that will be impacted by increased river levels in locations of phase 1 of the flood scheme. - Continue to further develop a medium to long-term DWMP drainage and wastewater strategy for Bristol to inform identification of further enhancements to the sewerage network.
Bristol Resilient Frome	Bristol City Council led a successful collaborative bid with South Gloucester Council, Wessex Water and the Environment Agency to the Defra Flood and Coastal Resilience Innovation fund for a series of measures to adopt a catchment-based approach to increasing flood resilience using a variety of measures including NFM, SuDS, improved monitoring, innovative financing and policy change.	- Development and delivery of Sustainable Urban Drainage Solutions (SuDS) to help increase the resilience of drainage and wastewater infrastructure through work to improve understanding of the wider multiple benefits, opportunities, process and challenges of retrofitting SuDS on highways, industrial estates and schools.
Portishead Sewerage and Surface Water Strategy	North Somerset Council have identified Portishead as one of their priority locations given an increased frequency of flood incidents from a combination of surface water, river, Rhyne and sewers.	- Given the complexities of the drainage and wastewater infrastructure in Portishead, this work will produce a new Integrated Catchment Model (ICM) to provide greater understanding of combined flood risk within the area and to inform development of integrated flood alleviation measures to deliver increased resilience to the drainage and wastewater infrastructure.
Somerset Frome Sewage and Surface Water Strategy	Somerset Council and Wessex Water have identified a need to further investigate surface water management in Frome that are particularly vulnerable to surface water flooding.	- Develop a surface water and sewerage strategy for sub catchments impacted by flooding to identify actions to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term through surface water management. - Progress options to look at surface water management and floodplain reconnection to align with measures to reduce the frequency of storm overflow operation in this area.

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
Yate Station Road regeneration	South Gloucestershire Council is currently proposing regeneration of the Station Road area using funding they have secured from the West of England Combined Authority through the government's 'City Region Sustainable Transport Settlement fund to investment in public transport and better walking and cycling infrastructure' fund. This work also aligns with the masterplan for regeneration of the area.	- Develop designs to deliver surface water separation and to improve management of surface water as part of proposed regeneration of the area. - Work with Network Rail to progress opportunities for surface water separation from the foul network and deliver improved surface water management.
Chippenham Sewerage and Surface Water Strategy	The Environment Agency are leading development of a fluvial flood alleviation scheme in Chippenham. Wiltshire Council have identified Chippenham as a priority area to construct an integrated catchment model to understand surface water flood alleviation measures could be incorporated within the Chippenham masterplan work to provide increased resilience to the drainage and wastewater infrastructure.	- Develop a surface water and sewerage strategy to identify actions and opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term through surface water management. - Investigate the impact of changes in water level resulting from the fluvial flood alleviation scheme on surface water and storm overflow outfalls.

A number of additional opportunities have been identified by flood risk management authorities and catchment partners within the Bristol Avon Catchment area where partnership opportunities may arise during the PR24 funding period. These projects are still under development, they are likely to include opportunities to collaborate and align funding in areas where storm overflow investment has been targeted or where communities have experienced flooding from multiple sources. Communities that have been identified where further partnership opportunities may materialise within the different LLFA areas are as follows:

- BaNES – Bath
- Bristol - Ashton Vale and St Phillips Marsh
- North Somerset – Clevedon, Weston-super-Mare, North Somerset Levels and Moors
- South Gloucestershire - Frampton Cotterell, Charfield
- Wiltshire – Trowbridge, Bradford on Avon, Calne, Malmesbury, Corsham

Proposals will be scoped with relevant flood risk management authorities, contributions and actions agreed to deliver outcomes that result in increased resilience of the sewer network and improved water quality.

8.2.2. Flood Risk Management Partnerships in Dorset catchments

The areas covered by the Dorset Catchment partnerships covers the council Lead Local Flood Authority areas of Dorset and Bournemouth, Christchurch and Poole (BCP).

Flood risk management projects that have Flood Defence Grant in Aid funding allocated within the Dorset catchments where there is a medium to high confidence in developing opportunities to deliver increased flood resilience to drainage and wastewater infrastructure are detailed in Table 110.

Table 110 - Flood risk partnership opportunities that align to flood risk management projects allocated Flood Defence Grant in Aid funding in Dorset catchments

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
Hamworthy and Upton FDS	Bournemouth, Christchurch and Poole Council (BCP) and the Environment Agency have identified Hamworthy and Upton areas as high priority tidal flood risk areas within the Poole and Wareham Strategy. Recent detailed modelling has quantified the risk and proposed two sites where earth banks need to be constructed to provide a 1200 SOP up to 2060 for tidal protection.	- Develop a surface water and sewerage strategy to align with work on the proposed tidal flood alleviation scheme to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term. - Progress delivery of short-term measures.
Swanage Town Coastal Scheme	Dorset Council is leading a project to assess coastal flood alleviation options within the community of Swanage. The main access to the Wessex Water WRC is expected to have experienced an increase in frequency and scale of flooding from coastal storms.	- Contribution towards this partnership project to ensure routine and emergency access to the Swanage WRC is not compromised by the projected increased frequency and severity of coastal storms associated with climate change or design of the scheme.
Weymouth Harbour & Esplanade FCERM Scheme Phases 1 & 2	Dorset Council is leading a project to progress development of coastal and tidal flood alleviation options for the town of Weymouth including Weymouth harbour, Weymouth Town Centre and Park District properties. The area of Weymouth also has surface water flood risk, with highways gullies connecting directly to the combined sewer network. There are also a number of surface water outfalls and highway drains where flooding occurs during high tides that coincide with storm conditions.	- Develop a surface water and sewerage strategy to align with work on the proposed tidal flood alleviation scheme to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term. - Progress delivery of short-term measures, promoting surface water management measures to deliver increased resilience of surface water infrastructure and explore additional opportunities to separate highways drainage from the combined system. - Review and develop long term measures through further development of options considered in the Weymouth DWMP strategy.
Sherborne Sewerage and Surface Water Strategy	There are a number of areas in Sherborne that have experienced surface water and sewerage flooding from intense rainstorms attributed to highways infrastructure, culverted watercourses and the capacity of the sewerage network.	- Develop a surface water and sewerage strategy to identify actions to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term. - Progress delivery of short-term measures.

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
North Allington	There are a number of areas in the North Allington area of Bridport that have experienced surface water and sewerage flooding from intense rainstorms attributed to highways infrastructure, and capacity of the surface water sewerage network.	- Develop a surface water and sewerage strategy to identify actions to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term. - Progress delivery of short-term measures.
Piddle Groundwater and Surface Water Strategy	Communities within the Piddle valley in Dorset have received funding from the Environment Agency as part of the frequently flooded communities' allowance. The community suffers from groundwater flooding.	This project will look at ways to - divert groundwater that is often pumped into the sewer network into that watercourse - consider alternative measures within the catchment to attenuate groundwater to reduce the magnitude of groundwater flows getting into the sewer network.

A number of additional opportunities have been identified by flood risk management authorities and catchment partners within the Dorset Catchments where partnership opportunities may arise during the PR24 funding period. These projects are still under development, they are likely to include opportunities to collaborate and align funding in areas where storm overflow investment has been targeted. Communities that have been identified in addition to projects identified in Table 110 where further partnership opportunities may materialise within the different LLFA areas are as follows:

- BCP – Kinson, hatch pond, Bourne valley, Whitley lake, Poole and Baiter park
- Dorset - Portland, Gillingham, Wimborne, various communities that experience high groundwater levels

Proposals will be scoped with relevant flood risk management authorities, contributions and actions agreed to deliver outcomes that result in increased resilience of the sewer network and improved water quality.

8.2.3. Flood Risk Management Partnerships in Hampshire Avon catchments

The areas covered by the Hampshire Avon catchment covers the council Lead Local Flood Authority areas of Wiltshire, Hampshire and Bournemouth, Christchurch and Poole (BCP).

Flood risk management projects that have Flood Defence Grant in Aid funding allocated within the Hampshire Avon catchment where there is a medium to high confidence in developing opportunities to deliver increased flood resilience to drainage and wastewater infrastructure are detailed in Table 111.

Table 111 - Flood risk partnership opportunities that align to flood risk management projects allocated Flood Defence Grant in Aid funding in the Hampshire Avon catchment

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
Warminster	The Environment Agency, Wiltshire Council and Wessex Water have identified Warminster as an area with potential to deliver integrated flood alleviation measures.	- Develop a surface water and sewerage strategy to identify actions and opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term through surface water management.

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
Wilton	The Environment Agency, Wiltshire Council and Wessex Water have identified Wilton as an area with potential to deliver integrated flood alleviation measures.	- Develop a surface water and sewerage strategy to identify actions and opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term through surface water management.
Christchurch Bay and Harbour Flood and Coastal Erosion Risk Management (FCERM) Strategy	Bournemouth, Christchurch and Poole Council (BCP) and New Forest District Council (NFDC) are working together with the Environment Agency to produce a strategy for Christchurch Bay and Harbour. It will guide how the frontage from Hengistbury Head to Hurst Spit, encompassing Christchurch Harbour, may be sustainably managed for the next 100 years. It will identify where, when and broadly what type of works are needed to manage the risks of coastal flooding and erosion and what they may cost. It will also consider the effects of predicted climate change on coastal communities, including sea level rise and increased levels of storminess.	- Develop a surface water and sewerage strategy to align with work on the proposed tidal flood alleviation scheme to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term.

A number of additional opportunities have been identified by flood risk management authorities and catchment partners within the Hampshire Catchments where partnership opportunities may arise during the PR24 funding period. These projects are still under development, they are likely to include opportunities to collaborate and align funding in areas where storm overflow investment has been targeted or where communities have experienced flooding from multiple sources. Communities that have been identified in addition to projects identified in Table 111 where further partnership opportunities may materialise within the different LLFA areas are as follows:

- Wiltshire – various communities that experience high groundwater levels, Wilton, Downton
- Hampshire – Fordingbridge, Ringwood
- BCP – Christchurch

Proposals will be scoped with relevant flood risk management authorities, contributions and actions agreed to deliver outcomes that result in increased resilience of the sewer network and improved water quality.

8.2.4. Flood Risk Management Partnerships in Somerset catchments

The areas covered by the Somerset catchments covers the council Lead Local Flood Authority area of Somerset.

Flood risk management projects that have Flood Defence Grant in Aid funding allocated within the Somerset where there is a medium to high confidence in developing opportunities to deliver increased flood resilience to drainage and wastewater infrastructure are detailed in Table 112.

Table 112 - Flood risk partnership opportunities that align to flood risk management projects allocated Flood Defence Grant in Aid funding in Somerset

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
Chard Flood Alleviation Scheme	Multiple extreme surface water flooding incidents occurred in 2021 that were of a magnitude greater than the design capacity of drainage and wastewater infrastructure. This resulted in flooded properties and businesses. Immediate actions to investigate and undertake enhanced maintenance by Somerset Council and Wessex Water, combined with the development of a very empowered flood group of volunteers have led to a reduction in flood risk from low return period storms. Somerset Council and Wessex Water completed development of a joint integrated catchment model for Chard which has identified a range of measures to reduce the flood risk to the community in the short, medium and long term.	- Progress design and delivery of measures identified within the surface water management plan to deliver increased resilience of drainage and wastewater infrastructure in partnership with Somerset Council and other stakeholders.
Minehead Integrated Flood Alleviation Scheme	Somerset Council, Wessex Water, the Environment Agency, The Somerset Drainage Board and partners from the Somerset Rivers Authority have completed construction of an integrated catchment model for Minehead and identified a series of hybrid measures to reduce the flood risk of surface water, sewer, river and drainage infrastructure (viable for FDGiA funding) and to inform future strategic housing allocation sites and regeneration plans.	- Undertake collaborative engagement with flood risk management authorities to engage in a dialogue relating to enabling a shared understanding of current and future flood risks from all sources of flooding in Minehead. Secure views and community input regarding options to increase the resilience of the catchment to the challenges of climate change.
Bridgwater	Rising sea levels and deterioration of existing defences along the River Parrett will decrease flood protection to Bridgwater and surrounding areas. The project will reduce flood risk to10,000 properties in Bridgwater and surrounding areas through a new tidal surge barrier on the River Parrett and deliver improved downstream defences. This will also provide flood alleviation the Wessex Water Chilton Trinity WRC.	- Review the proposed impact of the elevated water levels when the barrier is operated on the ability of storm overflow and surface water outfalls to discharge - Develop a surface water and sewerage strategy to identify actions to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term. - Progress design / delivery of short-term measures.
Taunton (TSFAIS option TTC5)	Somerset Council and the Environment Agency have developed the Taunton Strategic Flood Alleviation Scheme to reduce the risk of fluvial flooding and help accommodate new development, which will be delivered in phased sections over the next 100 years. The flood alleviation scheme proposed to provide fluvial flood alleviation to ~ 289 residential properties,	- Develop a surface water and sewerage strategy to identify actions to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term through surface water management. - Investigate the impact of changes in water level resulting from the fluvial flood alleviation

Individual Scheme title	Brief Description of Problem and aims of partnership work	Actions to progress during AMP 8
	200 commercial and public buildings and infrastructure.	scheme on surface water and storm overflow outfalls.
Ilminster Surface water strategy	Somerset Council have led the development of a joint integrated catchment model following multiple flooding incidents resulting in Section 19 reports.	- This funding will look to progress schemes to deliver improved surface water management and progress surface water separation measures to increase the resilience of the drainage and wastewater network in the area. This will complement the Ilminster fluvial flood alleviation study.
Somerset Frome Sewage and Surface Water Strategy	Somerset Council and Wessex Water have identified a need to further investigate surface water management in Frome that are particularly vulnerable to surface water flooding.	- Develop a surface water and sewerage strategy for sub catchments impacted by flooding to identify actions to identify opportunities for collaboration to deliver increased resilience to drainage and wastewater infrastructure in the short, medium and long term through surface water management. - Progress options to look at surface water management and floodplain reconnection to align with measures to reduce the frequency of storm overflow operation in this area.

A number of additional opportunities have been identified by flood risk management authorities and catchment partners within the Somerset Catchments where future collaborative opportunities may arise during the PR24 funding period. These projects are still under development, they are likely to include opportunities to collaborate and align funding in areas where storm overflow investment has been targeted or where communities have experienced flooding from multiple sources. Communities that have been identified in addition to projects identified in Table 112 where further partnership opportunities may materialise within Somerset are as follows: Yeovil, Sheppy communities, Burnham on Sea, Watchet.

Proposals will be scoped with relevant flood risk management authorities, contributions and actions agreed to deliver outcomes that result in increased resilience of the sewer network and improved water quality.

8.2.5. Flood Risk Management Case Studies

Wessex Water has an established track record of working with flood risk management authorities since the introduction of the Flood and Water Management Act (2010). This section begins by providing examples of projects that have been delivered during AMP 7 through collaboration with Flood Risk Management Authorities. It then moves on to provide a further detail of a number of projects that are being developed and due for delivery in AMP8 (identified in Section 8.2.1 to 8.2.4).

North Somerset – Summer Lane

Wessex Water has contributed funding towards a £1.3million Flood Alleviation Scheme led by North Somerset.

The project has extended the capacity of a surface water attenuation pond which led to significant flooding in 2012 in the area between Summer Lane and Moor Lane.

During the floods, North Somerset, Wessex Water and Environment Agency installed barriers and pipeline which prevented several residential properties, including a care home, from flooding. The new scheme will reduce the flood risk to 85 properties identified and prevent significant disruption to key infrastructure, including Wessex Water's assets in the area.

Somerset - Field Way – Highbridge

Wessex Water completed construction of a surface water flood alleviation scheme in Highbridge, which received partnership funding from Somerset County Council, and Local Enterprise Partnership funds from Heart of the South West administered by the Somerset Rivers Authority. The Internal Drainage Board also supported the works to the rhyne system. The scheme attenuates surface water flows to reduce the risk of regular restricted toilet use and need for tankering to prevent sewage flooding and restricted toilet use experienced by the local community.

Case Study: Southmead regeneration parntership Sustainable Drainage Systems (SuDS)

Wessex Water contributed funding towards a Bristol City Council led partnership project with Homes England for the installation of SuDS features in the ward of Southmead. SuDS were installed to reduce existing flood risk through reduced flow to the surface water sewer systems. This helped to facilitate a proposed regeneration area and better protect existing residential dwellings. The location is situated within a High-Risk Surface Water area and its contributing catchment. The works were undertaken in a phased approach; Phase 1 consisted of the SuDS Pods within in the regeneration area, Arnside works and the Parking Spaces on Greystoke Avenue. Phase 2 consisted of SuDS features within the wider area, focussing on the High-Risk Surface Water Area in the vicinity of Trowbridge Road.

Benefits of the scheme for Bristol City Council, Wessex Water and the Environment Agency included:

- Reduced surface water flood risk posed to the regeneration area and existing community, providing approximately 240m³ of additional storage capacity.
- Improved urban realm,
- Provision of amenity benefits and green infrastructure,
- Improved water quality, particularly of the receiving watercourse, the River Trym,

Working together in partnership to develop resilience to climate change

(By Rob Henderson Wessex Water)

RESCCUE
RESILIENT CITIES FACING CLIMATE CHANGE

Wessex Water is a partner organisation in the EU-funded RESCCUE project providing a model for city resilience to climate change, particularly focusing on the effects of sea level rise, more extreme rainfall conditions and the cascading impact of flooding on other city functions such as transport, power supply and waste management. Bristol is one of three European cities being used to develop and prove methodologies for a Resilience Action Plan.

A fundamental cornerstone of the RESCCUE approach is understanding how city services and people from different organisations interact. A wealth of technical and organisational expertise exists within corporate systems, cultures and workforces, however this tends to be geared towards their own business. Shared knowledge and understanding with other organisations is essential to develop resilience within a city.

A high level of dialogue between the service providers and key individuals is required for successful sharing of RESCCUE methodologies, software tools and information. This breaking down of "silos" and better communication and data sharing is proving to be invaluable in understanding and anticipating some of the critical interactions and problems that would be faced in emergencies. are essential to understand the potential impacts of flooding risks, both now and in the future, and to understand the problems (and solutions) of common interest.

The project is considering practical adaptation measures to mitigate the effects of climate change. One potential example in the Ashton Vale area of Bristol, involving stream channel improvements and a land-drainage pumping station would be of direct benefit to the Environment Agency, Wessex Water and Bristol City Council in that it would counteract the increasing flooding risk caused by rising sea levels as well as providing opportunities for stormwater separation and hence reduced combined sewer overflow discharges. Furthermore, there may be an opportunity to integrate these improvements with redevelopment planned for part of the area.

RESCCUE has further strengthened partnership working within Bristol to consider resilient measures on the ground and inform the city's long-term flood protection and resilience strategy. Further details can be found here: www.resccue.eu/

CASE STUDY: CHARD INTEGRATED CATCHMENT STRATEGY

Project Partners: Somerset Council, Somerset Rivers Authority, Environment Agency, and the community of Chard

Following two intense flood incidents in Chard and surrounding communities in 2021, a significant amount of work has been undertaken by various Flood Risk Management Authorities, stakeholders and the community of Chard to reduce surface water flood risk, including enhanced maintenance, flood investigations and identification of measures to reduce the risk of surface water and sewerage flooding.

Future work proposed to help reduce the flood risk from surface water flooding

- Wessex Water and Somerset Council, with funding support from Somerset Rivers Authority, have secured funding for a water butt pilot in autumn 2023, to provide a free water butt to residents in selected areas of Chard that have greatest potential to reduce surface water and sewer flood risk by attenuating water where it falls.
- Somerset Council's Flood Risk Management team has been successful in its bid for funding from the Environment Agency's 'Frequently Flooded Allowance' scheme. This will allow more detailed design and investigations to be progressed. This will support future funding bids for further surface water flood alleviation measures within the Chard. This will also provide an evidence base to inform opportunities for surface water management through regeneration and strategic housing allocation sites.
- Wessex Water is continuing to develop detailed designs to increase the capacity of a section of sewer network in the Glynswood / Furnham Road area to reduce the frequency of sewer flooding.

CASE STUDY: BRISTOL AVON FLOOD STRATEGY (BAFS)

Project Partners: Bristol City Council and the Environment Agency

Bristol City Council are working with the Environment Agency to deliver a long-term plan to better protect homes and businesses from flooding and enhance the river for all. Their ambition is for flood defences that work for Bristol all year, not just when the river floods. By designing defences that improve public spaces, the project will provide: (i) new green spaces; (ii) better access to the river; (iii) enhanced heritage features; (iv) improved transport connections.

Wessex Water have been working alongside the Bristol City Council's project team to investigate surface water and storm overflow outfalls that are situated within the Bristol Avon flood strategy area, in order to understand the impact of increased river levels due to climate change and modified water levels as part of the flood alleviation scheme.

A total of 29 outfalls that are the responsibility of Wessex Water have been identified for further review of partnership opportunities in each of the three sub-areas:-

5. Bristol (Crews Hole to Ashton Vale) Outfalls
6. Keynsham and Kingswood (Local Defences) Outfalls
7. Sea Mills, Shirehampton and Pill (Local Defences) Outfalls

It is expected that a range of options could be considered including:

- Replacement of flap valves
- Consider addition of in-line check valves in upstream chambers
- Sealing manhole covers
- Detailed review of impact on CSO
- Consider rationalising outfalls
- Installation of infrastructure to enable temporary pumps to be brought in during times of extreme river levels
- Consider opportunities for maximising SuDS in redevelopment and regeneration areas to deliver benefits for Wessex Water infrastructure
- No improvement required (in some areas)
- Consider development of partnership integrated catchment studies for specific sub-catchments
- Continued internal and external liaison regarding BAFS

Bristol City Council and the Environment Agency are currently building an Outline Business Case for the first phase of the strategy. Once they have secured Flood Defence Grant in Aid funding in 2024, ground investigations, a topographical survey, public engagement and technical assessments will be carried out. First phase works are expected to begin from around 2025. The Wessex Water work on the outfalls and storm overflows will contribute as partnership funding. This which will help secure approval for the scheme to progress.

Further work about the Bristol Avon Flood Strategy scheme can be found on the Bristol City Council's website here: Flood risk strategy and responsibility (bristol.gov.uk)

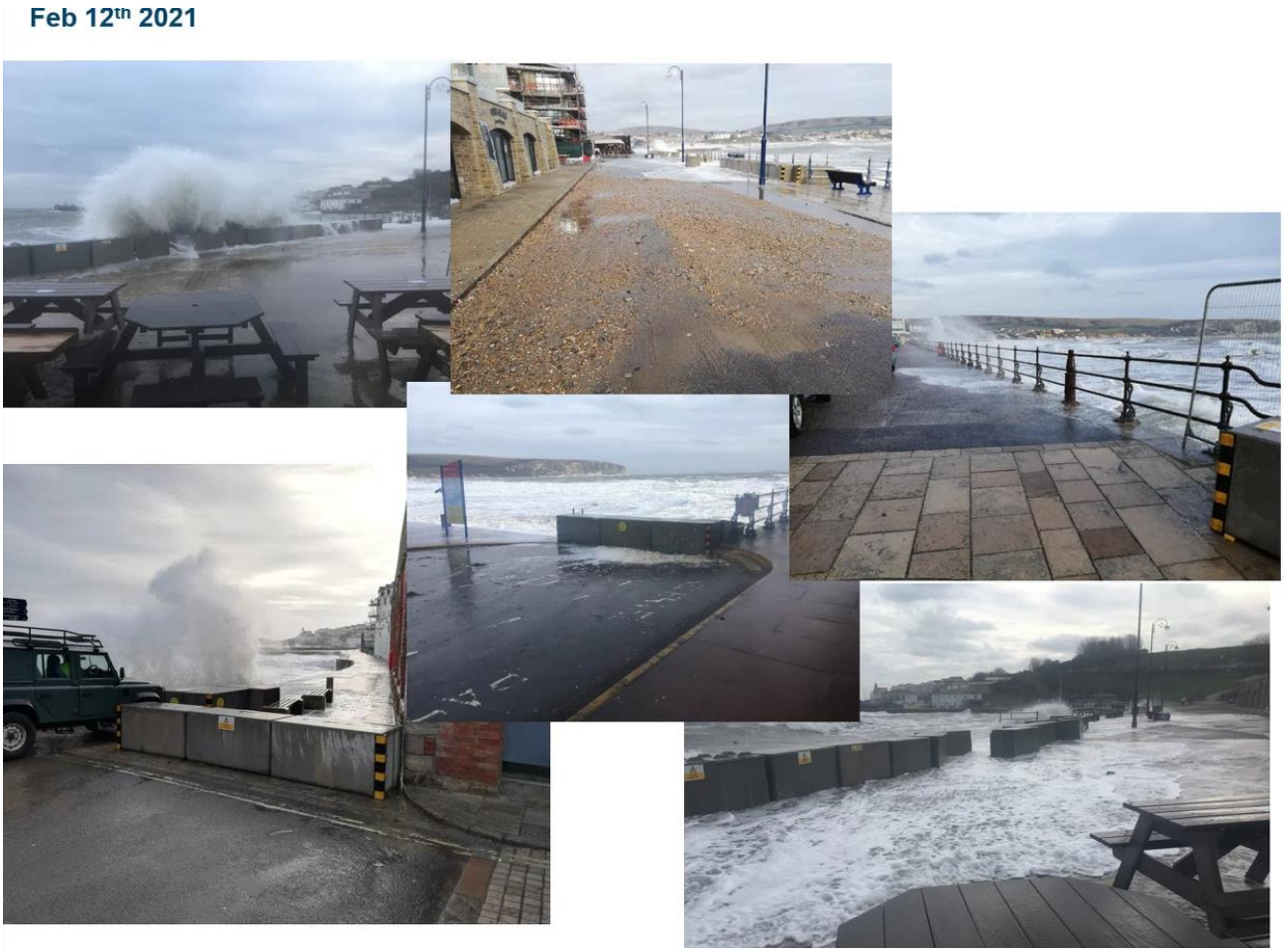
CASE STUDY: SWANAGE TIDAL FLOOD ALLEVIATION SCHEME

Project partners: Dorset Council, Swanage Town Council, Dorset Coast Forum, and the Environment Agency

The Swanage Town Coastal Protection Scheme aims to provide a permanent flood defence scheme to Shore Road and the Mowlem Slipway area, The Square, The Parade and Lower High Street. This central location currently relies on emergency temporary de-mountable flood defences which are deployed in the winter by the Environment Agency to protect from high tides and storms. Dorset Council are leading the progression of a single scheme to protect and mitigate tidal flood risk and in addition, help provide public realm improvements.

An outline business case is being developed by the project team and will be submitted to the Environment Agency to bid for government funding for the scheme. A number of proposals have been assessed against key feasibility criteria including; technical, financial, accessibility, maintenance, active/ passive design, heritage and potential for public realm improvements.

Wessex Water are involved in being part of this scheme given that the main access road to the Swanage WRC has the potential to be restricted during coastal flooding which could impact routine and emergency access to the WRC. We are working in partnership with the project team to ensure access to the WRC is not compromised. An outline proposal is currently being developed to support the business case and bid for funding. If successful, public consultation will be held to move this work from outline design to a detailed design.



Further details available here: Swanage Town Coastal Protection Scheme

CASE STUDY: PARTNERSHIP SUDS IN SCHOOLS

Project partners: Department for Education and various Lead Local Flood Authorities in the Wessex area

In 2023, we installed our first SuDS in Schools project at St Gregory's Catholic School in Bath. This was a large-scale SuDS project including installation of raingardens to remove surface water from the sewer network to accommodate new development and to help reduce the operation of storm overflows in the downstream sewer network. The alternative solution to the SuDS in schools project would have required upsizing the sewer network on a trunk road into the city which would have incurred significant cost and traffic disruption and would not deliver any wider benefits. This SuDS in schools project provides an example of where it is possible to remove large amounts of surface water from the sewer network by installing SuDS and also deliver multiple benefits including educational, wellbeing, water quality and biodiversity benefits with the involvement of students.

Our Wessex Water education team facilitated a 'SuDS special' day for one year group to take part in a range of different SuDS related workshops in science and geography. They also had the opportunity to get involved in the planting of the raingarden. The school was very pleased with their new SuDS garden and used it to host their end of year award celebration evening.

We are keen to work with the DfE as part of their Sustainable Drainage Systems (SuDS) in school(s) project. The DfE will contribute up to 50% of the total project cost for the SuDS in school project. The DfE contribution is based on their assessment of surface water flood risk to the school site based on EA flood risk maps. The level of contributions will vary, depending on whether the school is primary or secondary as well as the type of SuDS. We have undertaken a multicriteria decision making assessment of all schools in the Wessex Area that are understood to connect to the sewerage network where there are storm overflows or hydraulic flooding issues in the downstream network.

The SuDS programme delivers a number of benefits, including:

- reduction of water entering the sewer system,
- reduction of risk of the school flooding from surface water
- provision of ongoing educational benefits on sustainability and climate change,
- an increase in biodiversity on school sites through blue or green infrastructure
- extended customer engagement

Through surface water partnership working in PR24 we are looking to progress design and delivery of additional schools within the Wessex Area where we can demonstrate tangible benefits to the drainage and wastewater network. We will also look to progress opportunities for surface water separation on other government and publicly funded buildings.

CASE STUDY: RESILIENT FROME – (DEFRA FLOOD AND COASTAL INNOVATION PROGRAMMES)

Project partners: South Gloucestershire Council, Bristol City Council and the Environment Agency

The Resilient Frome programme recently received over £6 million from the Department for Environment, Food and Rural Affairs (Defra) to develop six projects that are adopting a catchment based approach to deliver sustainable solutions to land and water management, improve flood resilience, respond to climate change and bring a range of benefits to communities covering the whole River Frome catchment. Innovative and nature-based flood solutions will mean homes, businesses, the environment and jobs along the River Frome will be more resilient to flooding in the future.

The River Frome starts in Dodington Park, South Gloucestershire and flows 20 miles through rural countryside and urbanised environments to Bristol where it joins the river Avon and the floating harbour. Some of the proposed improvements to the river catchment will be localised in the city, but because partners are working across the whole catchment, the project will bring multiple benefits to multiple locations. Six distinct project areas will be worked on over the next five years (2022 – 2027), as part of the Resilient Frome project. They will help to better protect areas in Bristol at risk of flooding and will also support the council to regenerate brownfield city centre land to safely build housing and new community spaces in the future.

The projects include:

- **Sustainable land management practices, such as the creation of new 'storage' ponds and woody dams in rural upstream areas of South Gloucestershire, to improve water quality and ecology as well as help to reduce flood risk**. Nature-based solutions used to reduce the impact of flooding will not only help communities be more resilient to future climate change but will also benefit wildlife and water quality and improve the urban environment.
- **Retro fitting Sustainable Drainage Systems (SUDs) to enable better management of rainwater to prevent surface water and sewer flooding and overflow discharges.** SUDs provide storm water storage to reduce surface water flooding and improve water quality, as well as transforming local public spaces by introducing green infrastructure and improving biodiversity in more urban areas. Wessex Water are leading on the retro fitting Sustainable Drainage Systems workstream. This involves exploring and understanding the process of progressing SuDS solutions in certain land use types including: schools, industrial estates and highways.
- **Installing flow monitors that will allow us to understand how much water is coming down the river and into the floating harbour.** Flow monitors at three key locations will go in during 2023 at Wade Street where the river disappears under Cabot Circus, Broadweir near the Galleries and Netham Lock, to help us better understand risk of flooding in the city centre when water is not able to be discharged from the floating harbour at the point of high tide.
- **Exploring the challenge of meeting important national planning policy requirements, to ensure new development is safe and adaptable to climate change risks.** We are investigating innovative ways to regenerate brownfield land to deliver much needed housing and new community spaces in areas at risk of flooding. This work ensures new development is safe in respect of flood risk and resilient to climate change.
- **Restoration of the river as part of the** Frome Gateway regeneration project**.** The restoration will be a key component of the emerging development framework, building on community engagement and what local people would like to see. We will continue to work closely with community and businesses to ensure the river restoration project aligns with the Frome Gateway regeneration project, to put the river at the heart of a transformed area with new homes, jobs, and public spaces.
- **Bringing funding from businesses and land managers together to find environmental solutions that deliver multiple positive outcomes within the catchment area.**

The Resilient Frome project is funded by Defra as part of the £200 million Flood and Coastal Innovation Programmes, which is managed by the Environment Agency. The programmes will drive innovation in flood and coastal resilience and adaptation to a changing climate.

CASE STUDY: WEYMOUTH FLOOD DEFENCE PROJECT

Project partners: Dorset Council, Dorset Coast Forum, and the Environment Agency

Project overview
As a low-lying coastal town, Weymouth is at risk of coastal erosion and flooding from the sea and flooding from the river and surface water. If a severe weather event takes place in Weymouth, thousands of homes and businesses could be flooded. We know sea levels are rising and extreme weather events will happen more often and may be more severe. In 100 years, the average sea level will be more than one metre higher than it is today.

As part of the Weymouth flood and coastal defence project, Dorset Council is leading development of an Outline Business Case (OBC). An OBC is a document required by the UK Government Treasury when government funds are requested. The OBC will investigate costs and benefits of a range of options, then recommend the preferred options to improve Weymouth's resilience to flood and erosion risks. This OBC project will build on earlier work carried out by Dorset Council and the Environment Agency exploring possible options for managing flood and coastal erosion risk in Weymouth. The earlier work recommended a phased approach to improve resilience in three stages: (i) up to 2042; (ii) up to 2062; (iii) beyond 2062.

The OBC being produced will apply for funding for the first phase of work to take the project up to 2042. It will prioritise sections of harbour walls that are currently lower, or close to the end of their design life, and sections identified along the esplanade which are at the most risk of erosion. Managing impacts associated with any proposed improvements is a key consideration. These include minimising disruption as far as practicable to businesses, harbour operations, residents, and the community of Weymouth, and managing impacts on fisheries and the environment. As part of the project, we will also be delivering exciting new regeneration opportunities for Weymouth. The preferred option for the scheme is expected to be finalised in 2024.

Reducing flood risk in Weymouth
We'll be looking at options to address the different sources of flooding in Weymouth. These include:
Surface water flooding (this is caused by rain falling directly onto Weymouth but not being able to drain naturally)
Flooding from the sea during high tides
Flooding from waves crashing over the sea front
Flooding from the River Wey

The benefits to Wessex Water are likely to mainly relate to opportunities to maximise surface water separation through regeneration which will be informed by development of an integrated catchment study in parallel to the coastal work. Other options could include:

- Replacement of flap valves
- Consider addition of in-line check valves in upstream chambers
- Sealing manhole covers
- Installation of infrastructure to enable temporary pumps to be brought in during times of extreme river / tidal levels
- No improvement required (in some areas)
- Continued internal and external liaison regarding the Weymouth Flood Alleviation scheme.

Further development of the DWMP strategy for Weymouth to be completed in parallel with this work.
Further details available here: Weymouth flood defence project

8.2.6. Best Option for Customers

The flood risk management partnership projects proposed for development and / or delivery as part of our PR24 business plan outlined in Sections 8.2.1 to 8.2.4 have been identified as high priority locations for flood risk management authorities. Collaboration in these areas presents opportunities to deliver increased resilience for Wessex Water assets and infrastructure. The Flood Defence Grant in Aid (FDGiA) funding allocated to Flood Risk Management Authorities in the Wessex area through funding has increased significantly in recognition of the challenges posed by climate change on fluvial, coastal, surface water and groundwater flood risks.

Through working together with other stakeholders to manage water in a more integrated way, prioritising sustainable drainage systems and nature-based solutions, we propose to help improve the resilience of services to communities to all sources of flood and coastal risk. This will also provide opportunities to enhance the natural environment and deliver value for customers. This is likely to deliver schemes that deliver greater outcomes including public value, delivering more for customers, society and the environment through helping to manage flood and coastal erosion risk.

Development of collaborative projects to deliver improved rainwater and surface water management will identify opportunities for future applications by Wessex Water for FDGiA funding. Furthermore, opportunities identified through work with wider regeneration projects provides opportunities to maximise potential of schemes and promote sustainable drainage solutions that make space for water. Involvement of stakeholders through integrated water management also facilitates access to additional funding streams.

8.2.7. Robust and efficient costs

The proposed investment for flood risk management partnership projects in AMP8 is a step change from AMP7. A number of projects identified for collaboration have Flood Defence Grant in Aid funding allocated to them. As these projects move through to detailed design and delivery between 2025-2030, opportunities to deliver increased resilience to drainage and wastewater infrastructure and associated costs will also be refined. The proposed costs have been based on the costs of previous project work delivered by Wessex Water. Where partnership working represents an efficient delivery of services to customers, the potential savings, efficiencies in delivery of work through partnerships and work with other risk management authorities will contribute to a range of projects that increase resilience to flooding and coastal change.

8.2.8. Customer Protection

The projects include co-funding from partners and wider funding stream ensuring that they are delivered more efficiently than by a water company alone. The involvement of different partners enables access to wider funding streams and presents opportunities to deliver more for less.

The project development stage for a selection of projects will continue until the beginning of AMP 8 to continue to develop and agree governance arrangements, refine the scope and detail of projects, ensure appropriate resources are available to facilitate project development and delivery between 2025-2030. Given the step change in scale of ambition of proposed partnership work, a formal governance structure will be established with new DWMP partnership programme meetings. These will be scheduled with key stakeholders to facilitate clarity on aims, objective and critical milestones. Programmes will be shared with wider stakeholders to assist with identification of future opportunities for collaboration.

Our approach to the engagement will continue to be flexible across the Wessex Area to recognise different structures and scale of resources and wider factors influencing delivery of projects. We will continue to work closely with our catchment partnerships to support engaging additional stakeholders and workshops where appropriate to assist with development and alignment of integrated strategies.

9. Summary

Our enhancement expenditure in AMP8 for the Wastewater network+ price control is summarised in the table below.

Table 113 - Summary of enhancement expenditure in WWN+ price control. Costs are at 2022/23 price base and include pre Real Price Effect and Frontier shift adjustment.

	Sewerage	Sewage Treatment
WINEP Enhancement		
Capex	£551m	£1,190m
Opex	£29m	£31m
Totex	**£580m**	**£1,221m**
Other Enhancement (e.g. capacity provision & flooding)		
Capex	£146m	£151m
Opex	£41m	£11m
Totex	**£187m**	**£163m**

The WINEP enhancement lines include:

- Storm overflows - £405m *(against sewerage)*
- Nutrients reduction - £944m *(against sewage treatment)*
- Continuous water quality monitoring - £107m *(against sewerage)*