Affinity Water

Cost Appendix

Enhancement investment cases

Part A

Contents

Enhancement Programme Overview

Introduction

This appendix details each sub-programme of our enhancement investment portfolio It summarises the relevant business cases and demonstrates how our proposed investments meet Ofwat's criteria to ensure value for money for customers.

Our enhancement programme totals £588m over AMP8 (including Accelerated and Transitional expenditure) and sets the basis for our long-term strategy as laid out in our LTDS. The programme has been developed and integrated with our Water Resources Management Plan (WRMP), Water Industry National Environment Programme (WINEP) and Drinking Water Inspectorate (DWI) programmes and our customers' views on discretionary improvements to service.

Over 70% of our investment is directly linked with the WINEP and WRMP statutory requirements. A further 15% addresses our raw water deterioration obligations from the DWI. Although there is limited discretion in the need to invest for these statutory requirements, we have challenged ourselves to ensure that all feasible options have been identified and considered; that our preferred solutions are efficient; that our customers' views support our preferred solution; and that we understand the cost benefits of our investments.

To protect the value to be delivered to our customers, we have used a combination of Performance Commitments and PCDs to monitor our performance and delivery. These are outlined in appendix **AFW19 – PCD Appendix**.

In developing our business cases, we have followed a rigorous and systematic approach of optioneering, economic analysis and investment justification that fully complies with Ofwat's, the EA's and the DWI's methodologies and benefit valuations.

Our enhancement programme has been built up from our detailed planning activities and is captured in individual business cases. In parallel, our long-term strategies, our customer research and stakeholder engagement have shaped and informed the programme. The enhancement programme has been aligned and optimised with our base investments throughout the process; both at the asset and site level and at the strategic levels. More information on our planning, optimisation and governance, processes and procedures are presented in **Chapter 7.6: Our Investment Planning Approach**. Yet further detail is laid out within appendix **AFW 8 – Our investment development process**.

Document structure

The following sections are grouped into our strategic theme areas, that align with our Long-Term Delivery Strategy. At the end of each section, we list the relevant business cases that make up the AMP8 investments for the theme. These business cases are then included in full at the back of this document.

Strategy	Capex AMP8 (m)	Opex AMP8 (m)	Totex AMP8 (m)	%
Net Zero	£ 3	£ 1	£ 4	1%
WINEP	£ 143	£ 23	£ 166	28%
WRMP	£ 244	£ 35	£ 280	48%
Resilience	£ 29	£ 0	£ 29	5%
SEMD	£ 9	£ 3	£ 11	2%
Water Quality	£ 90	£ 4	£ 94	16%
Lead	£ 4	£ -	£ 4	1%
	£ 522	£ 66	£ 588	100%

Figure 1 - PR24 enhancement expenditure breakdown, including accelerated and transitional funding

Net Zero

Ambition

In April 2019, as part of our WaterUK Public Interest Commitment we established a target to achieve net zero for operational emissions by 2030. In the same year, Parliament passed legislation requiring that Government achieve both operational and embedded territorial net zero emissions by 2050. Both of these commitments align to the UK's legal binding Net Zero target to reduce territorial emissions to Net Zero by 2050.

Ofwat has also set a clear expectation for water companies to achieve substantial greenhouse gas emission reductions. Companies should prioritise the elimination and reduction of GHG emissions before the use of offsets, utilising the GHG management hierarchy in doing so. Our customer research show that customers expect us to have a green operation, by switching to renewables and electric vehicles.

We are fully committed to achieving these targets and have started the journey in AMP7 with an expected 20% of our fleet convert to electric vehicles by 2025. Our long-term ambition is to play our part in reducing carbon emissions by ensuring that all of our operations are net zero five years ahead of the target, in 2045. We are also committed to achieving the intermediate target of net zero operational emissions by 2030.

In order to achieve our ambition and targets we need to use a wide-variety of techniques. Our initial focus is to reduce operational emissions, but in parallel we have started our journey to better understand, quantify and design for lower embedded carbon solutions. Many of these initiatives are included in our base investments and cover energy sourcing; energy reduction; efficiency; leadership and awareness etc.

Our enhancement investments go further and will enable further progress towards our net zero emissions targets to be achieved. Our catchment and nature-based schemes included in the WINEP invest to increase the sequestration of carbon. This is discussed in a following section and our WINEP business cases.

The key component in reaching our net zero 2030 goal and delivering benefits which contribute to our greenhouse gas performance commitment will be transitioning to a fully electric liveried fleet. Currently, all vehicles owned and leased by Affinity Water run on diesel or petrol. This transition has the potential to reduce out GHG emissions by approximately 1,920 tonnes of CO_2e per year.

The manufacture of diesel vehicles is being phased out, with a ban on new petrol and diesel vans in the UK planned for 2030. However, there is an opportunity to act sooner by implementing charging infrastructure now, and securing suitable electric vehicles to reduce emissions sooner. This will also enable our business to be resilient to any emerging risks associated with this phasing out.

Our objective is to build upon our transition to electric vehicles in AMP7, to accelerate our approach and make all eligible vehicles electric by the end of AMP8. This requires a completely new charging infrastructure to be installed at our home and depot locations particularly for our fleet of vans. Our proposed enhancement investment is to implement the charging infrastructure to enable the accelerated adoption of electric vehicles and hence achieve reductions in emissions earlier. All other investments, such as the vehicle costs are included in our base investments.

AMP8 Investment

Our AMP8 enhancement net zero investments are focussed on accelerating electric vehicle adoption and therefore making significant long-term reductions in our operational emissions. Our enhancement investments for AMP8 cover the following:

- Implementation of the charging infrastructure and associated software required to operate the fleet
- Support for any changes to the ways of working for our operational teams compared to current methods in order to minimise the negative impact on productivity and to identify additional operational emission reductions

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.91	0.97	0.84	0.43	0.33	**3.48**
Opex (£m)	0.08	0.13	0.18	0.19	0.24	**0.82**
Totex (£m)	0.99	1.10	1.02	0.62	0.57	**4.30**
Drivers						
100%	Greenhouse gas reduction (net zero)					
Benefits						
Operational greenhouse gas emissions (water)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**7.2**	NPV Benefits (£m) (2025-55)			**11.0**
NPV (£m) (2025-55)		**3.8**	Benefit / Cost Ratio			**1.5**
Six Capitals						
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**	
★ ★ ★	★ ★			★	★	
Performance						
Customers will be protected through the Performance Commitment target for operational greenhouse gas emissions						

Justification

There is an opportunity to invest in charging infrastructure at our sites and employee's homes to accelerate the adoption of electric vehicles, particularly our vans. This will provide significant reductions in our operation emissions sooner and on an on-going, long-term, basis.

Our economic analysis shows that the investment is strongly cost beneficial, with a benefit / cost ratio of 1.5. Furthermore, the analysis shows that the sooner the investment is made, the higher the benefits, which is logical. Our preferred solution has been selected to implement the charging infrastructure as quickly as possible following a period of learning in AMP 7.

The investment fully supports our long-term strategy and the achievement of the Government and water sector targets for net zero. The move to electric vehicles is supported by customers, who are keen that we start the process sooner rather than later.

Our approach is designed to work with Government initiatives on charging, private investments and technological improvements. The time is right to invest to gain the benefits, whilst managing the delivery risks. We will monitor the electric vehicle environment and technological advances and adapt our approach as the technology and legislation evolve over time.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	The investment aligns with the Government's, Ofwat's and the water sector's strategy and targets for net zero
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The AMP8 investment is shown to be cost beneficial and timely to maximise the benefits. The implementation timescales have also been balanced against the delivery risks. The time to accelerate implementation is right in terms of the need, political drivers, and maturity of technology
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	We will continue to invest in base to reduce operational emissions and to better understand how to reduce embedded carbon
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	This builds on and continues our transition to electric vehicles that we started in AMP7

Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	We have developed an adaptive long-term strategy for achieving our net zero targets, that is based on this investment and the need to accelerate the adoption of electric vehicles
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	Customer generally support the reduction in operational emissions and the transition to electric vehicles. They also support sooner rather than later implementation
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Generally not, although we might need to adapt our implementation approach to account for legislative and technological changes
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	We have considered a range of options and have selected the fastest implementation when taking into account deliverability. This will enable us to maximise the benefits, whilst managing any delivery risks associated with technological and legislative changes
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	Our economic analysis approach has shown that accelerated adoption of electric vehicles provides the highest long-term benefits Our analysis shows a strong, positive benefit / cost ration of 1.5 Our economic analysis approach has been assured by third-parties
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	Our economic analysis approach has assessed the carbon impacts, both operational and embedded to determine the benefits of the investment
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	Our economic assessment has considered the impact on the operational greenhouse gas emissions Performance Commitment arising from the investments
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection, including sensitivity analysis of the cost benefit assessment
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	This is not applicable for this business case
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its	We have engaged with customers and accounted for their views in our plans

contribution to addressing the need) to have informed views?	
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	Our costs for the charging units are based on industry available costs from suppliers. These are documented in supporting information to our business case Due to the immaturity of the market we consider the accuracy to be medium
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	We will continue to monitor technology and charging units costs to ensure efficiency as we implement during AMP8
Does the company provide third-party assurance for the robustness of the cost estimates?	Our costs have been developed with support from consultants Mitie who we have collaborated with to developed our EV strategy
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Customers are protected through the Performance Commitment for operation greenhouse gas emissions
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	Yes
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	This is not applicable for this business case

Supporting Business Cases

- Electric Vehicles: Electric Vehicles.docx

WINEP – Biodiversity

Ambition

There are a number of statutory and non-statutory drivers that stipulate a need to invest in restoring and improving the biodiversity of our land, operational sites and the river catchments that we abstract from. For example, the Environment Act 2021 sets objectives to:

- Halt the decline of species by 2030
- Increase species abundance
- Increase woodland cover
- Protect the health of our rivers

The Government has stated that some of the key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats; and provide a thriving natural environment with increased environmental value, clean rivers and a sustainable ecosystem. As such, we are investing through PR24 under the regulatory drivers under the Water Industry National Environment Programme (WINEP), following the statutory and non-statutory expectations and level of ambition set out in the Water Industry Strategic Environmental Requirements (WISER) to address these challenges within our supply area.

In addition, Defra's 25-Year Environment Plan and Plan for Water have ambitions to protect and restore wildlife, tackle invasive and non-native species (INNS) and provide opportunities to re-introduce species that we have lost from our countryside. There is also a focus on improving water environments for clean and plentiful water and working with nature to provide resilience against drought and flood events. Overall, there is a compelling need to invest in AMP8 and over the long-term in improving the biodiversity of our land, sites and rivers in our supply area.

These drivers align with our environmental long-term delivery strategy to progressively restore and improve the biodiversity and natural capital within our land and across the water courses of our region, and to ensure sustainable water resources. Implementing biodiversity restoration and improvements is now routinely included as part of our base and enhanced investment planning and delivery processes and will be implemented when we maintain our assets, build new assets, and as we restore rivers and natural habitats as part of the WINEP. Biodiversity is a core component of our day-to-day investment planning, our investment delivery programmes, and our WINEP approach.

This enhancement investment addresses the WINEP requirement to identify opportunities on company owned land where improvements could be made to habitats and species listed in Section 41 Natural Environment and Rural Communities Act (NERC41), for pollinators, and to improve biosecurity to manage INNS both on company owned sites and also working in partnership to address INNS in our catchments and communities.

As part of this process, management options have been created for 83 company sites which identify where improvements can be made to increase the quality or number of NERC41 habitats. Fifty sites were audited to identify options for increasing pollinator numbers and management options were created for these sites. The management plans will be cross-referenced with operational constraints to finalise the feasibility of the implementation actions. These measures were signed off by the EA and NE in December 2021 and April 2022, with the agreement that these management plans will be implemented in order of priority in AMP8. Alongside this under the NERC driver through WINEP, we are also including a scheme to enhance woodland and hedgerow habitat in our supply area. This will be achieved through the planting of trees and whips and a programme of third-party land biodiversity enhancement projects as part of our contribution to restoring natural functions of water and wetland ecosystems on third party land working with catchment partners.

In addition, a programme of investigations and schemes to maintain and/or prevent deterioration have been developed for Sites of Special Scientific Interest (SSSI) with the potential to be impacted by our water supply activities.

Additionally, we have committed under the WINEP to investigate and develop a funding mechanism by which support could be given to community projects and aiming to improve biodiversity and support future Local Nature Recovery Strategies (LNRS).

Walton Water Treatment Works has passive wedge wire screens that are designed to prevent entrainment of a large number of species and life stages of fish in the water abstracted at our River Thames intake. However, they do not meet the most recent Best Achievable Eel Protection (BAEP) requirements. As no eels were entrained in the AMP6 entrainment monitoring study, an exemption notice was issued by the EA with respect to the screening requirements of the Eels Regulations. The exemption has validity until 31 December 2030 (Year 1 of AMP9). For this reason, in AMP8 there is a need to undertake an options appraisal to determine the most cost- effective option to replace the existing screens with alternatives that meet the BAEP. The EA have requested that the option appraisal in AMP8 is carried out in conjunction with confirmatory monitoring to support the conclusions of the AMP6 study.

Affinity Water, Southeast Water and Thames Water have received a request from the Environment Agency to include in their respective PR24 WINEP submissions a funding contribution towards the EA led Lower Thames weir refurbishment and fish passage improvement works. The EA have provided estimated costs for a number of projects, but the preferred option and costs are yet to be finalised. The EA will fund 50% of project costs with the remaining 50% apportioned between water companies based on their licensed abstraction rates.

AMP8 Investment

Our AMP8 WINEP Biodiversity enhancement investments have been developed through consultation with a range of stakeholders. We have rigorously followed the WINEP methodology to develop options and then select the best value option. As we have developed our preferred solution, we have worked closely with the Environment Agency (EA), Natural England (NE) and other stakeholders, including catchment partnerships and Wildlife Trusts. We have also engaged with customers who have showed a high degree of support for the proposed environmental improvements. We have learnt from our previous biodiversity improvement projects to design, cost and value our programme of work.

This process has identified a list of risks and issues relating to biodiversity and habitat loss, invasive non-native species, the status of designated sites, protected species priorities, pollinators, climate change impacts and land management pressures that exist in the catchments in which we operate. As a result, our enhancement investments for AMP8 will address the following areas:

- Implementation of habitat management plans on NERC41 sites identified during AMP7 investigations.
- Implementation of pollinator strategy actions following the AMP7 pollinator investigation.
- Implementation of biosecurity recommendations following the AMP7 audit of all sites and their risk of spreading and receiving INNS.
- Implementation of a support scheme to work with local communities to improve biodiversity in their local area, following an investigation in AMP7.
- Implementation of partnership working to control INNS in the Mimram and Cam catchments.
- Investigation into the effects of abstraction on a number of SSSIs.
- Implementation of a scheme to tackle new reports of INNS in the Affinity Water supply area.
- Investigation into the possibility of water vole species reintroduction in our supply area.
- Continued monitoring of AMP7 projects to assess biodiversity benefits.
- Monitoring of water voles across and the supply area to assess what potential mink control measures need to be implemented.
- Investigate wider catchment opportunities to implement biodiversity improvements with partners and landowners.
- Co-funding of the EA's Lower Thames weir refurbishment and fish passage improvement works.
- Undertake an options appraisal into installation of replacement fish screens at Walton WTW.

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	1.64	1.64	1.64	1.65	1.65	**8.22**
Opex (£m)	0.45	0.45	0.45	0.45	0.46	**2.26**
Totex (£m)	2.09	2.09	2.09	2.10	2.11	**10.48**

Drivers	
69%	Biodiversity and conservation
23%	Invasive Non Native Species
5%	Eels/fish passes
3%	Eels/fish entrainment screens

Benefits
Biodiversity (units per 100 km^2)

Economic Analysis			
NPV Costs (£m) (2025-55)	**10.1**	NPV Benefits (£m) (2025-55)	**N/A[1]**
NPV (£m) (2025-55)	**N/A[1]**	Benefit / Cost Ratio	**N/A[1]**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

Performance
Customers will be protected through the Performance Commitment target for biodiversity units

[1] Benefits have not been quantified as per the Ofwat and WINEP methodologies.

Justification

This investment fully supports our statutory and regulatory requirements and non-statutory drivers. It is part of a longer-term goal to improve the environment and supports our stakeholders' long-term ambitions. The programme will build the foundations for additional future biodiversity improvements.

Our preferred, best value, option has been developed in full coordination with the EA and our other stakeholders. It is the preferred option because it creates a biodiversity programme that addresses the risks and issues across the company supply area that were raised by stakeholders and offers the most benefits. When reviewing the scale of benefits achieved through the delivery of the three options compared with their costs, the best value option achieved the most benefit on a qualitative basis.

The best value option is ambitious in that it considers all risks and issues raised and aims to deliver at a scale that is above and beyond the minimum requirement. The

cost of this option is lower than the alternative options because it offers a more flexible delivery by implementing improvements on 55 company sites following the AMP7 WINEP investigation in to NERC41 habitats, and 40 sites following AMP7 investigation into pollinator habitats. This means that sites can be delivered on a priority basis with those achieving the most biodiversity net gain being delivered first for greater benefits versus cost.

The best value option will be delivered following the principles of our Strategic Direction Statement and associated environmental strategy. The prioritisation and delivery of the programme will be developed with the relevant stakeholders and alongside our sustainability reduction, and catchment and nature-based solutions programmes to maximise wider environmental benefits.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	The investment addresses the statutory and regulatory requirements and the non-statutory drivers and expectations set out in the WISER. It is supported by our key stakeholders and aligns with their long-term ambitions
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The investment has been agreed for AMP8 with the EA, NE, and other stakeholders to meet the identified risks and issues.
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	There is separate investment within base and enhancement to routinely restore and enhance biodiversity as an when we invest on our assets. Our WFD and Drinking Water Protected Area scheme will also seek to improve biodiversity This enhancement investment addresses the other specific WINEP risks and issues identified with the EA and other stakeholders.
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This work supports our stakeholders' long-term strategies, our long-term environmental delivery strategy, and the Environmental Plan Options have been selected to ensure no regret investments and to enable adaptive delivery approach to be adopted
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	We have found that customers support the need to protect the environment for the future, and environmental projects are seen as having significant public and moral value. Our recent research has shown that cost of living concerns limit customers' willingness to invest in

	the environment. However, they support our WINEP plans and the desire to go beyond statutory requirements. We have designed our programme to align with our customers' views.
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Yes, the Thames Fish passage project will be driven and managed by the EA.
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide-range of options have been considered and discussed and verified with our stakeholders as per the WINEP methodology Options have been considered by the EA for the Thames fish Passage project
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	We have not undertaken an economic assessment as the WINEP and Ofwat methodologies recommend NOT quantifying biodiversity benefits. We have conducted a detailed qualitative option assessment using the WINEP methodology and in consultation with our stakeholders.
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	We have considered the carbon and natural capital impacts in our qualitative option assessment.
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	We have estimated the quantity of biodiversity units that will be delivered, but have not quantified the monetary benefits as recommended in the WINEP methodology.
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection. There are potential uncertainties with the EA Thames Fish Passage project.
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	We will work with catchment partners and strategic partners e.g. HMWT to identify co-funding and co-delivery opportunities and wider funding mechanisms from external sources.
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case.
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in the design of the programme.

Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The costs for each option have been calculated using a combination of our unit cost model which uses unit costs for biodiversity activities to build up projects, and costs from previous known work and schemes
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient The EA have developed cost estimates for the Thames Fish Passage project
Does the company provide third-party assurance for the robustness of the cost estimates?	We have used Atkins to carry out third-party assurance of this business case and an assurance report is available on request. The EA have developed cost estimates for the Thames Fish Passage project
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Customers are protected through the Performance Commitment for biodiversity
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	Yes
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	Third-party funding is only applicable for the EA Thames Fish Passage project. Also we currently have partnership agreements with Herts and Middlesex Wildlife Trust, White Cliffs Countryside Partnership and Essex Wildlife Trust which includes the development of management plans for a number of Affinity Water sites including Hilfield Reservoir. The financial and reputational benefits as well as the access to expertise and local knowledge through these partnerships should continue to be realised through their sustained support.

Supporting Business Cases

- WINEP Biodiversity: WINEP Biodiversity.docx
- Thames Fish Passage Improvements: WINEP Thames Fish Passage Improvements.docx
- Walton Fish Screens: WINEP Walton Fish Screens.docx

WINEP – Drinking Water Protected Areas

Ambition

The UK government environmental priorities, expectations and ambitions for PR24 are set out in the UK government's strategic policy statement. The EA and NE have set out these expectations in the Water Industry Strategic Environmental Requirements (WISER), which describes the legal obligations, government targets and statutory requirements that must be achieved in AMP8. To support this, we have developed a programme of catchment and nature-based solution (C&NBS) measures for our drinking water protected areas (DrWPA) with the objective of prevent deterioration in water quality to avoid an increase in the level of water purification treatment and aim for a long-term improvement in water quality. As such, we have set out our investment through PR24 under the WINEP and associated drivers to address key water quality challenges.

In addition, Defra's 25-Year Environment Plan and Plan for Water have ambitions to improve water environments for clean and plentiful water and working with nature to provide resilience against drought and flood events for which our DrWPA schemes will seek to deliver wider environmental benefits. Overall, there is a compelling need to invest in AMP8 and over the long-term in improving the natural capital of our surface and groundwater DrWPA catchments.

These drivers align with our environmental long-term delivery strategy to progressively restore and improve the biodiversity and natural capital within our land and across the water courses of our region, and to ensure sustainable water resources over the long-term.

We abstract circa 35% of our total potable water supply from four River Thames abstractions in West London, within the Lower Thames and Wey DrWPA's and associated surface water safeguard zones (SGZ) that are impacted by diffuse and point source pollution from agriculture and amenity land use.

The raw water quality abstracted is impacted by around 10,000km^2 of upstream catchment in the Thames River Basin District for pesticides and other pollutants, much of which is outside our supply area. We have already been delivering a combined programme of pesticide investigations and catchment mitigation schemes in partnership with Thames Water and South East Water through the Thames Catchment Management Steering Group (TCMSG) since AMP5 with each company leading on schemes in identified high risk catchment areas.

The TCMSG has investigated and mitigated other 'at risk' pesticides including metaldehyde throughout AMP6 and AMP7. Further 'at risk' pesticides including propyzamide and flufenacet pose a significant risk of breaching the pesticide DWS.

Additionally, our River Thames abstraction also experiences raw water deterioration issues caused by nitrate and microbiological contaminants, such as *Cryptosporidium*. The sources and pathways of these issues are similar to those for

pesticides and any measures implemented have the potential to mitigate this risk and deliver wider water quality benefits as well as measures that can deliver wider environmental benefits such as biodiversity enhancements and carbon sequestration.

We also have our group of groundwater sources with vulnerable geology, known as our karst groundwater sources in Hertfordshire. These have been designated as groundwater Safeguard Zones for pesticides and nitrate for which catchment management schemes have been developed under our DrWPA programme. We have been delivering catchment management schemes throughout AMP6 and AMP7, focused on metaldehyde, and have delivered investigations in AMP7 to determine appropriate measures to address nitrate and wider 'at risk' pesticides which will be addressed through schemes in AMP8.

AMP8 Investment

We have rigorously followed the WINEP methodology to develop options and then select the best value option using economic analysis. This process has identified a list of risks and issues relating to pesticides and pollutants that exist in the Lower Thames DrWPA and in the catchments for our karst groundwater sources and led to development of a comprehensive set of options.

As we have developed our preferred solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high-degree of support for the proposed environmental improvements. We have learnt from our previous river and catchment improvement projects to design, cost and value our programme of work.

The resulting set of catchment schemes form a wider programme that we be jointly delivered by Affinity Water, Thames Water and South East Water across the River Thames – Cookham to Teddington safeguard zone (SgZ) and Wey SgZ. Each water company leads on their catchment management activities and delivers schemes in defined high-risk catchments identified through the combined programme of pesticide monitoring carried out in AMP5, AMP6 and AMP7.

Of these defined high risk catchments, Affinity Water will lead on implementing catchment and nature based solutions in the River Colne, River Wey and River Loddon catchments. This will consist of a programme of pollution reduction schemes and spatially targeted catchment and nature-based solutions (C&NBS) in identified priority catchments with the aim of reducing pesticide and nutrient pollution in the catchments to prevent deterioration of raw water quality. This will provide resilience to our River Thames abstractions in the Lower Thames DrWPA.

Additionally, a similar a programme of pesticide reduction schemes and spatially targeted catchment and nature-based solutions (C&NBS) in identified priority catchments has been developed for pesticides and nitrate in the following SgZ's:

- North Mymms
- Essendon
- Tyttenhanger
- Roestock
- Bricket Wood
- Netherwild
- Eastbury
- Berry Grove

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.4723	0.71	0.83	0.83	0.60	**3.44**
Totex (£m)	0.47	0.71	0.83	0.83	0.60	**3.44**
3rd Party Funding	0.11	0.17	0.20	0.20	0.13	**0.81**

Drivers	
100%	Drinking Water Protected Areas

Benefits
Water Quality of Natural Water Bodies (km)
Sequested Carbon (tonnes CO_2e)
Air Quality Pollution Reduction (tonnes)

Economic Analysis			
NPV Costs (£m) (2025-55)	**3.9**	NPV Benefits (£m) (2025-55)	**8.1**
NPV (£m) (2025-55)	**4.2**	Benefit / Cost Ratio	**2.1**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

Performance
These projects will be monitored and tracked through a 'Project Executive' group with the EA which will provide the overall governance on delivering these measures in line with the WINEP. We will report annually against WINEP deliverables

Justification

The project is part of a longer-term goal to improve the environment of our local river catchments, specifically the DrWPA Lower River Thames, Wey and groundwater DrWPA SgZ catchments for our karst groundwater sources. It will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

The economic assessment of the different options for our catchment schemes has shown that the preferred option is the best value option that can be confidently delivered. Based upon our estimates, the preferred option offers NPV benefits of £1.0m with a benefit cost ratio of 1.5. Conservative estimates of the benefits have been made and the scheme has been assessed as cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	The investment addresses the statutory and non-statutory requirements agreed as part of our PR24 WINEP. It is supported by our key stakeholders and aligns with their long-term ambitions.
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The investment has been agreed for AMP8 with the EA and other stakeholders to meet the identified risks and issues
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	No
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This work supports our stakeholders' long-term strategies, our long-term environmental delivery strategy, and the 25yr Environmental Plan Options have been selected to ensure no regret investments and to enable adaptive delivery approach to be adopted
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	We have found that customers support the need to protect the environment for the future, and environmental projects are seen as having significant public and moral value. Our recent research has shown that cost of living concerns limit customers' willingness to invest in the environment. However, they support our WINEP plans and the desire to go beyond statutory requirements. We have designed our programme to align with our customers' views.
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	No

Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide-range of options have been considered and discussed and verified with our stakeholders as per the WINEP methodology.
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	We have undertaken a detailed economic assessment using the WINEP and Ofwat methodologies and benefit valuations. Our analysis has compared many options including a preferred and least cost option. Our economic analysis approach has been assured by third-parties.
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	We have considered the sequestered carbon impacts in our economic analysis and used these to determine the preferred option Other carbon and natural capital impacts have been qualitatively assessed though the option assessments.
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	We have consistently used the WINEP and Ofwat benefit valuations and benefit measure estimate methodologies in our economic analysis.
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection and our sensitivity analysis. Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis. We have used study results to support our benefit estimates.
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	We will work with catchment partners and neighbouring water companies through the TCMSG to identify co-funding and co-delivery opportunities and wider funding mechanisms from external sources.
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case.
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in the design of the programme.
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The costs for each option have been calculated using a combination of our unit cost model which uses unit costs for river restorations and natural capital activities to build up projects, and costs from previous known work and schemes.

Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient.
Does the company provide third-party assurance for the robustness of the cost estimates?	We have used Atkins to carry out third-party assurance of this business case and an assurance report is available on request.
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	There is no PCD due to investment below the materiality threshold. Deliverables will be tracked and assessed by EA through WINEP governance/project executive board, and we will report against interim milestones
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	Yes, further details included in the supporting business cases referenced below.

Supporting Business Cases

- WINEP: Lower Thames DrWPA Catchment Management: WINEP Lower Thames DrWPA Catchment Management.docx
- WINEP: Karstic Groundwater Improvements: WINEP Karstic Groundwater Sources Catchment Management.docx

WINEP - Water Framework Directive

Ambition

There are a large number of statutory and non-statutory drivers that stipulate a need to invest in restoring and improving water bodies and the associated catchments to meet objectives as set out in accordance with Water Environment (Water Framework Directive) (England and Wales) Regulations 2017.

UK government environmental priorities, expectations and ambitions for PR24 are set out in the WISER and describes the legal obligations, government targets and statutory requirements that must be achieved in AMP8. This includes actions to protect and improve the hydrological regime of water bodies as a supporting element for a water body to achieve good ecological statu As such, we are required to invest through PR24 under the Water Framework Directive (WFD) and the WINEP to address these challenges within our supply area.

In addition, Defra's 25-Year Environment Plan and Plan for Water have ambitions to improve water environments for clean and plentiful water and working with nature to provide resilience against drought and flood events. Overall, there is a compelling need to invest in AMP8 and over the long-term in improving the natural capital of our land, sites and rivers in our supply area and ensure a sustainable supply of drinking water for future generations whilst protecting the environment.

These drivers align with our environmental long-term delivery strategy to progressively restore and improve the biodiversity and natural capital within our land and across the chalk stream catchments of our region, and to ensure sustainable water resources over the long-term. Our WINEP strategy is central to achieving our ambitions of ending unsustainable abstraction from chalk groundwater sources and deliver a net gain in natural capital. The strategy will contribute to returning and maintaining water courses within our region to good ecological status, achieved through a range of investments.

Our WINEP programme is closely aligned to our Water Resource Management Plan (WRMP) which includes supply-demand measures to support delivery of the flow component of WFD Good Ecological Status, replacing unsustainable chalk aquifer abstraction with surface water sources from the west of our area.

AMP8 Investment

We have rigorously followed the WINEP methodology to develop options and then select the best value option using economic analysis. This process identified a list of risks, issues and opportunities to improve the rivers and catchments within our region. We have worked closely with a number of stakeholders to develop and assess a comprehensive set of options that consider sustainable abstraction reductions, river

restoration, habitat enhancement and catchment initiatives to deliver a gain in natural capital.

As we have developed our preferred solution, working closely with the EA, NE and other stakeholders. We have engaged with customers who have showed a high-degree of support for the proposed environmental improvements. We have learnt from our previous river restoration and catchment improvement projects to design, cost and value our programme of work.

The resulting set of schemes form a wider programme of river restoration, catchment and nature-based solutions (C&NBS) that also integrates our sustainability reductions in chalk stream catchments.. Our WINEP and WRMP programmes are fully integrated to provide long-term water supplies and environmental and social benefits from reducing our dependence on chalk stream abstractions.

The WINEP WFD investments for AMP8 include:

- A programme of sustainable abstraction reductions with ten sustainability reduction schemes; four average deployable output (ADO) relocation schemes; and nine no deterioration schemes;
- A programme of C&NBS incorporating river restoration and catchment management initiatives for the Colne; Upper Lea; Dour and Little Stour; Cam and Ivel catchments
- A flagship chalk stream catchment restoration scheme for the River Beane in Hertfordshire to deliver the ambition of Defra's Catchment Based Approach chalk stream restoration strategy and implementation plan.
- A programme of water resource investigations (including abstraction impact assessments) to plan for future enhancement requirements.

AMP8 Spend	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**	**Total**
Capex (£m)	18.74	25.00	31.23	25.00	25.00	**124.97**
Opex (£m)	1.65	3.14	4.20	4.16	3.93	**17.08**
Totex (£m)	20.39	28.14	35.43	29.16	28.93	**142.05**
3rd Party Funding	0.11	0.22	0.32	0.32	0.25	**1.22**
Drivers						
100%	Water Framework Directive					
Benefits						
Water Quality of Natural Water Bodies (km)						
Sequester**ed** Carbon (tonnes CO_2e)						

Air Quality Pollution Reduction (tonnes)					
Water Abstraction Reduction (Ml/d)					
No deterioration licence capping (Ml/d)					
ADO relocation volume (Ml/d)					
Loss of Supply Capacity (Ml/d)					
Economic Analysis					
NPV Costs (£m) (2025-55)	**141.1**[1]	NPV Benefits (£m)(2025-55)	**140.2**[1]		
NPV (£m) (2025-55)	**-0.9**[1]	Benefit / Cost Ratio	**1.0**[1]		
Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★
Performance					
We have designed a PCD to protect customers based upon the delivery of our planned abstraction reductions: this will be based on the total volume of deployable output in megalitres per day (Ml/d)					

[1] The water resources investigations have not been included in the economic analysis as per the WINEP guidance

Justification

Our WINEP WFD programme is fully integrated with our WRMP to jointly ensure long-term water supply, whilst sustainably reducing our chalk stream abstractions and providing a wide-range of environmental and social benefits. Each element of this, comprehensive set of investments has been optimised individually and as part of our overall enhancement programme.

The WFD investments meet our environmental statutory and non-statutory obligations drivers requirements, and it supports our statutory water resource drivers in the WRMP. It builds upon our previous catchment management investments and studies and continues to adapt our network and water resources for the long-term. Our programme goes further and will provide river water and air quality improvements; increased carbon sequestration; reduce groundwater abstractions; as well as provide social and recreational benefits.

We have undertaken economic assessments for the different options for each of our catchment schemes and sustainability reductions programme. In each case, we have selected the preferred, best value option. The C&NBS schemes are strongly cost beneficial showing the value of these investments. As such, we have increased our investment in this area to maximise the benefits for customers whilst ensuring that we can deliver within the AMP. A number of these schemes are already planned to

extend within AMP9 and beyond to help ensure deliverability and affordability for customers.

Our sustainable reduction programme is not shown to be cost beneficial when considered in isolation. However, these investments should be considered in the context of being able to integrate our WRMP and WINEP objectives and to support our long-term strategy. Overall, the whole WFD programme is shown to be marginally cost beneficial and its objectives are supported by our customers.

We have not considered the economics of the WR investigations programme as per the EA's methodology and because the benefits cannot yet be quantified. However, these investigations are important to ensure future enhancement expenditure is targeted in areas where there will be most environmental benefit. All of our economic analyses have used conservative estimates of the benefits.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	This investment addresses the statutory and regulatory requirements and the non-statutory drivers. It is supported by our key stakeholders and aligns with their long-term ambitions.
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The investment has been agreed for AMP8 with the EA and other stakeholders to meet the identified risks, issues and opportunities.
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	No
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This work supports the WRMP Environmental Destination Strategy and has a defined adaptive pathway set out in our Long Term Delivery Strategy (LTDS). Our WINEP and WRMP programmes are integrated to meet our long-term strategy and obligations. Options have been selected to ensure no regret investments and to enable adaptive delivery approach to be adopted.
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	We have found that customers support the need to protect the environment for the future, and environmental projects are seen as having significant public and moral value.

	Our recent research has shown that cost of living concerns limit customers' willingness to invest in the environment. However, they support our WINEP plans and the desire to go beyond statutory requirements. We have designed our programme to align with our customers' views.
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	No
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide-range of options have been considered and discussed and verified with our stakeholders as per the WINEP methodology.
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	We have undertaken a detailed set of economic assessments using the WINEP and Ofwat methodologies and benefit valuations. Our analysis has compared many options including a preferred and least cost option. Our economic analysis approach has been assured by third-parties.
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	We have considered the sequestered carbon impacts in our economic analysis and used these to determine the preferred option. Our operational and embedded carbon and natural capital impacts have been quantitively and qualitatively assessed though the option assessments.
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	We have consistently used the WINEP and Ofwat benefit valuations and benefit measure estimate methodologies in our economic analysis.
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection and our sensitivity analysis. Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis. We have used study results to support our benefit estimates.
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	We will work with catchment partners and strategic partners e.g. HMWT to identify co-funding and co-delivery opportunities and wider funding mechanisms from external sources. Further details are set out in the supporting business cases.
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case.

Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in the design of the programme.
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The costs for each option have been calculated using a combination of our unit cost model which uses unit costs for river restorations and catchment management activities to build up projects, and costs from previous known work and schemes. For the sustainability reduction schemes we have used a strategic level optioneering process incorporating a number of different modelling processes. Further details are included in the supporting business case referenced below.
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient
Does the company provide third-party assurance for the robustness of the cost estimates?	We have used Atkins to carry out third-party assurance of this business case and an assurance report is available on request
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	We have designed a PCD to protect customers based upon the delivery of our sustainability reductions which forms the largest component of investment under the Water Framework Directive.
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	Yes
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	We will develop formal partnerships and agreements with local catchment partnerships which will include co-design, co-delivery and co-funding objectives. We will develop our own, and participate in, catchment-trading of ecosystem services to generate wider funding of non-statutory measures such as the Landscape Enterprise Network. We will work with landowners and land managers through cluster groups to develop proposals to generate funding through mechanisms such as Landscape Recovery schemes

Supporting Business Cases

- WINEP: River Beane Catchment: WINEP Beane Flagship Scheme.docx
- WINEP: River Colne Catchment: WINEP Colne Catchment and River Restoration.docx
- WINEP: River Dour and Little Stour Catchment: WINEP Dour and Little Stour Catchment and River Restoration.docx
- WINEP: River Upper Lea Catchment: WINEP Upper Lea Catchment and River Restoration.docx
- WINEP: Rivers Ivel and Cam Catchments: WINEP Ivel and Cam Catchments and River Restoration.docx
- WINEP: Sustainability Reductions: WINEP Sustainability Reductions.docx
- WINEP: Water Resource Investigations: WINEP Water Resource Investigations.docx

WRMP

Ambition

At its core, our WRMP strategy ensures a resilient supply of water for customers over the long-term. The WRMP process in the current cycle has seen a step change in approach by taking a much more regional approach, facilitated by the regional water resources planning groups. Aside from the basic ambition of the WRMPs to balance supply and demand in the longer term, an implicit ambition in this round is to work outside the traditional water company boundaries and where possible move water around the country from places of surplus to areas in deficit.

As such, we are working with our neighbouring water companies on three major strategic regional resource projects, namely: the South-East Strategic Reservoir Option (SESRO); the Grand Union Canal (GUC), and the Thames to Affinity Transfer (T2AT). These are being considered to be Direct Procurement for Customers schemes, but require enabling and planning activities to be undertaken in AMP8.

In order to support these fundamental changes in our strategic resources and our ambition for WINEP sustainable abstraction reductions, we also need to start to implement our Connect 2050 programme to strengthen our network to transfer resources across our supply area. This programme of work will also simultaneously provide added resilience against future climate change. The Connect 2050 programme to strengthen our resilience is presented in the following Resilience section.

As well as these strategic resource options, we intend to double the level of meter installations in the short-term and move to smart meters in the medium-term. For the longer term, we have adopted the very ambitious target of achieving 110 l/h/d of water use in a dry year, which will require major customer and societal change, supported by Government legislation and policy.

We have undertaken extensive customer research to support the development of our WRMP. We have found that our proposals to share water between regions are positively regarded by customers. Customers have firmly established views on the priority of transfer options. These are less favoured than both demand options and supply options such as reservoirs, which customers feel bring added value to the community. Largely, transfers via river or canal are preferred to pipeline options because they are perceived by customers to have wider benefits and fewer negative impacts. However, customers do have various concerns about transfers, including cost, construction disruption, environmental impacts, energy use and lack of benefits to local communities. Overall, customers support the provision of additional water supplies, the transfer of water across the region and taking measures to reduce demand and leakage. We have used our research to optimise our programme against these views.

AMP8 Investment

Our AMP8 investments for WRMP form a fully integrated and much longer programme to evolve our water resources, strengthen our network; modernise our metering, and make significant cultural changes on how our customers manage their demand. Our enhancement investments for AMP8 cover the following areas:

- **SESRO:** Enablement of the major raw water storage reservoir in the upper River Thames catchment, with shared resource use by Thames Water, Affinity Water (via the T2AT) and Southern Water
- **GUC:** Enablement of the scheme to transfer recycled effluent from Severn Trent Water's Minworth STW to Affinity Water's Central Region via the Grand Union Canal (GUC), with intermediate treatment and associated distribution into the Affinity Water network. A new pipeline and existing canal will be utilised to convey a source of raw water from Minworth STW (this is a separate SRO project) to Affinity Water. In the southern section of the GUC, water will be abstracted from the canal at Leighton Buzzard and treated utilising a multiple barrier approach and final conditioning prior to distribution to our customers
- **T2AT:** Enablement of the transfer of raw water from Thames Water to Affinity Water's Central Region, with intermediate treatment and associated distribution into the Affinity Water network
- **Smart Metering:** Install 397k household and non-household smart meters that will allow us to reduce PCC, Business Demand and Leakage in AMP8. This will be followed by 546k and 543k smart meter installations in AMP9 and AMP10 respectively.
- **Connect 2050 (Part):** Network transfer improvements from Egham to Harefield; the Grove Park Link; to increase the DO at Egham, Chertsey & Walton; and the Midway North BPS upgrade
- **HS2 Non-SESRO:** Schemes at Perivale and Cockfosters to enable future transfer capabilities as a result of HS2
- **Tappington South -** Reinstatement of an existing, disused, groundwater source within an existing licence group

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	51.51	43.58	57.29	52.86	39.25	**244.49**
Opex (£m)	8.88	7.78	6.78	5.78	6.24	**35.46**
Totex (£m)	60.39	51.36	64.07	58.64	45.49	**279.95**
Drivers						
16%	Strategic Regional Resource (Additional Driver)					
55%	Various Metering Drivers					
27%	Supply demand balance improvements delivering benefits starting from 2031					

2%	Supply-side improvements delivering benefits in 2025-30

Benefits

Leakage (Ml/d)
PCC (Ml/d)
Business Demand (Ml/d)
Loss of Supply Capacity (Ml/d)
Capex and Opex Savings (£m)

Economic Analysis

NPV Costs (£m) (2025-55)	**301.9**	NPV Benefits (£m) (2025-55)	**330.0**[1]
NPV (£m) (2025-55)	**N/A**[1]	Benefit / Cost Ratio	**N/A**[1]

Six Capitals

Natural	Social	Financial	Manufact.	Human	Intellectual
★ ★	★ ★ ★	★	★ ★ ★		★

Performance

Customers are protected by the leakage, PCC and business demand Performance Commitments and PCDs for the other areas of investment. The PCDs cover the number of smart meters installed and the additional capacity provided by our Connect 2050 schemes

[1] Benefits have not been quantified for the strategic regional resource investments as the AMP8 investment is only a small part of the much longer-term investment. Our Smart metering and Connect 2050 investments have had economic assessments undertaken. These are reported in more detail in the respective business cases.

Justification

Overall, the WRMP investments integrate both the strategic regional water resource solutions with our own investment programmes to reduce our river abstractions; to enhance our catchments; and increase the resilience of our network against climate change impacts.

Our WRMP has been developed with key stakeholders and with extensive customer engagement. Our plans and requirements have been integrated into a regional resource strategy. As such, it has been subject to extensive review and challenge and optimised at various levels. It covers a wide range of different solutions that when integrated optimise the benefits to customers over the long-term. It integrates with our WINEP and supports our improvements in resilience. More fundamentally, it builds the foundations for a radical long-term strategy for water resources across the whole region.

The regional strategic resource projects are subject to their own economic assessments and will be challenged and reviewed through the on-going Gates. These are all considered for delivery by DPC.

We have undertaken economic assessments of the Smart Metering and Connect 2050 investments. Both of these show positive benefit / cost ratios of 1.6 and 1.2 respectively.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	The investment addresses the statutory and regulatory requirements and the non-statutory drivers. It is supported by our key stakeholders and customers, and aligns with their long-term ambitions
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The investment is required to enable the longer-term regional strategic investments to be delivered as planned. Each stage of the investment is managed through the Gate process
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	Following the OFWAT guidance, any jobs we were going to do regardless of Smart Metering will be in Base. I.e., replacements of damaged meters or installations of AMR meters outside our smart network will be in Base. In those cases, only the technology uplift will be in Enhancement.
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This investment is fully integrated into our WRMP and forms part of a much wider and long-term strategy for the provision of water resources across the wider region
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	There is extensive support from customers for the strategy and the schemes and solutions. We have consulted with customers and stakeholders to inform and shape our WRMP
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	The major strategic resource schemes are being developed in partnership with our neighbouring water companies. The investment process is dictated by the gated process overseen by RAPID
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide range of options have been considered and discussed and verified with our stakeholders as per the WRMP methodology
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	The major strategic resource schemes are subject to individual economic assessments as part of the regional and partnership solutions We have undertaken a detailed economic assessment using the Ofwat methodologies and benefit valuations for smart meters and Connect

	2050. Our analysis has compared many options including a preferred and least cost option Our economic analysis approach has been assured by third-parties
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	Other carbon and natural capital impacts have been qualitatively assessed though the option assessments
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	We have consistently used the Ofwat benefit valuations and benefit measure estimate methodologies in our economic analysis for smart meters and Connect 2050
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection and our sensitivity analysis Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	We have worked closely with the relevant third parties to agree funding requirements
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	Yes, DPC is being considered for the SESRO, GUC and T2AT projects
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have extensively engaged with customers and accounted for their views in the design of the programme
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The costs for the major schemes have been developed from the bottom-up and with unit cost curves in co-ordination with the relevant water companies For smart meters, our costs are built up from a wide range of Affinity Water and wider industry experience of previous meter install programmes Connect 2050 costs are based on our unit costs and previous cost information
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The majority of costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient. Please see the Costing & Investment Portfolio Optimisation appendix for more information
Does the company provide third-party assurance for the robustness of the cost estimates?	For Smart Metering, Stantec and PA consulting have initially provided 2 stages of assurance. Since then, we have made some changes and the business case has been reviewed by Baringa.

Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Customers are protected by the Gates for the major strategic resource schemes For our smart meter programme, Performance Commitments (Leakage, PCC and Business Demand) cover the majority of the investment, and we propose to add a PCD based upon the number of smart meters installed for added protection. For Connect 2050 we propose to use a PCD based on the supply capacity provided by the schemes We have designed a PCD to protect customers based upon the delivery of Tappington South and HS2 Non-SESRO, these are not covered under the RAPID gate process.
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	Yes
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	Our WRMP business cases include clear descriptions of how SRO scheme costs are allocated between WRSE companies and where funding is expected through DPC. Protections for customers will be through PCDs for all WRMP investments excluding SROs going through existing RAPID process, protecting customers through the controlled gated process.

Supporting Business Cases

- WRMP – SESRO: South East Strategic Reservoir Option.docx
- WRMP – GUC: Grand Union Canal.docx
- WRMP – T2AT: Thames to Affinity Transfer.docx
- WRMP – Smart Metering: Smart Metering.docx
- Connect 2050: Connect 2050
- WRMP – Tappington South: Tappington South LRMC.docx
- WRMP – H2S Non-SESRO: HS2 Non-SESRO Perivale.docx and HS2 Non-SESRO Cockfosters.docx

Resilience

Ambition

Our long-term strategy is to ensure that our network and treatment facilities are resilient to a range of external risks including the impacts of climate change, pandemics, third-party activities etc. A first step in this process is to ensure that our asset health is sufficient to continue to operate and deliver service to customers. As such, we have developed a base investment programme to continue to maintain and improve the health of our existing assets. As part of this we have started to fully adopt Ofwat's Operational Resilience Framework and incorporate the principles and methods into our asset and corporate planning processes. We have already improved our asset health reporting, data capture and analysis, and we intend to make further significant improvements in this area in the future to improve how we identify and prioritise our future investments for resilience.

We started base programmes of work to maintain the resilience of our assets, which continue to mitigate against the risks that we currently face. This works will continue through AMP8 and beyond as part of our long-term strategy.

Our enhancement investments for resilience will go further and focus on protecting against the emerging climate change and third-party impacts on our ability to supply water. This covers four key areas: increasing our ability to transfer water supplies across the region (Connect 2050); identifying and addressing the weakest areas of our network (Single Points of Failure); taking measures to increase the life of our network assets (Water Network Resilience to Climate Change - Network Calming); and protecting our key treatment works from flooding events (Flood Resilience). In each of these areas, we continue to invest in our base resilience programmes, but we have now been able to identify the emerging risks and where and how best we can enhance our assets for the future. Strengthening in these areas all support our long-term resilience delivery strategy and, in particular, our climate change pathway. The investments also align and integrate with our WRMP, WINEP and SEMD strategies.

Customers have told us that the provision of safe, secure, supply of water is a high priority for them. When considering resilience in this context, customers generally focus on reducing bursts and leakage. Bursts can have a significant impact on customer satisfaction as they can lead to disruption, traffic congestion and pollution. Reducing leakage is consistently mentioned in any engagement that we do, and always features in the upper quartile of priorities. As such, there is strong support for investing to address resilience issues, particularly by proactively reducing bursts and leakage through network calming initiatives such as pressure optimisation and real-time monitoring.

AMP8 Investment

Our enhancement investments for resilience in AMP8 focuses on addressing the impacts of climate change. Our investments are continuations of our long-term programmes of work to continuously strengthen the network and treatment assets. These are:

- **Water Network Resilience to Climate Change (Network Calming):** A programme of initiatives including implementing: smart valves for all DMA boundary valves; permanent trunk main transient monitoring; and pressure management optimisation
- **Single Points of Failure (SPOF):** Undertake a programme of work to identify, prioritise and resolve the most critical single points of failure
- **Flood Resilience:** A programme of works to review and evaluate flood protection measures and to implement physical protection on our above ground assets such as: repositioning electrical distribution cabinets; raising the headworks of boreholes; sealing of ducts into buildings & chambers; installing flood covers over ventilation louvres; drainage improvement works; installing flood protection doors; procuring flood vehicles; and training
- **Connect 2050 (part):** To provide additional cells at the Hadham Mills (20 Ml) and the Hills (10 Ml) service reservoirs. Our Connect 2050 resilience programme forms part of our wider Connect 2050 programme that also integrates with our WRMP and WINEP programmes

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	3.68	4.69	6.92	7.74	5.63	**28.66**
Opex (£m)	0.00	0.00	0.02	0.01	0.02	**0.05**
Totex (£m)	3.68	4.69	6.94	7.75	5.65	**28.71**
Drivers						
100%	Resilience					
Benefits						
Leakage (Ml/d) Water Supply Interruptions (property mins) Mains Repairs (number) Loss of Supply Capacity (Ml/d) Loss of Production Capacity (Ml/d) Climate Change Interruptions (mins)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**24.7**	NPV Benefits (£m) (2025-55)			**35.5**
NPV (£m) (2025-55)		**10.8**	Benefit / Cost Ratio			**1.4**

Six Capitals					
Natural	Social	Financial	Manufact.	Human	Intellectual
	★ ★ ★	★	★ ★		★

Performance
Customers are protected by the leakage, water supply interruptions and main repairs Performance Commitments and PCDs for the other areas of investment. The PCDs cover number of properties protected by single point of failure removal and the additional capacity provided by our Connect 2050 and Flood Resilience schemes.

Justification

Customers have indicated support for investing in resilience particularly in reducing bursts and leakage. However, our programme has to be affordable and deliverable and we, therefore, need to focus on the areas that provide the highest benefits to customers first. We need to be confident that our investments are no regrets and that we only invest at a rate that matches the increasing risk.

Estimating the risks and how best to mitigate these is complex. We have, therefore, undertaken economic assessments in each area to select the best value solutions and optimise the level of investment in AMP8. Our economic analysis builds upon our Risk and Value workshops that undertake in-depth assessments to better understand the resilience risks and how best, and when, to mitigate these.

We have separately assessed and optimised each of the four areas of investment: Connect 2050; SPOF; Water Network Resilience to Climate Change (Network Calming) and Flood Resilience. In each case, we have selected the best value option, which has generally also been the least cost option. In most areas, it is shown to better to invest less and focus on the highest risk areas first, and then invest more in later AMPs when our understanding has improved. We have found that all of our preferred options are cost beneficial, particularly the network calming programme which shows a very strong cost benefit. We have considered options to increase the investment levels, but, although these are also cost beneficial, the uncertainties and level of benefits are not shown to be as attractive for customers.

We appreciate that it is difficult to forecast climate change and other risks and so our approach and investment has been conservative. We believe that the best way to mitigate against these risks is with an on-going long-term programme of work that focuses on the more immediate and highest risk areas and learns and adapts over time.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	We are seeing more and more impacts of the changing climate on our ability to deliver service Our long-term delivery strategies and core pathways forecast a clear need to address the impacts of climate change
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	Our AMP8 investments are a continuation of our long-term strategies and programme of works We have considered many options and used our Risk and Value and economic assessments to optimise the timing and levels of investment against the risks that we face
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	We are investing across our asset base to improve our asset health and hence the net resilience of our network and treatment assets Our enhancement investments only relate to mitigating against future climate change impacts
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This work supports our long-term resilience strategy, and the core, climate change pathway in particular Options have been selected to ensure no regret investments and to enable adaptive delivery approach to be adopted
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	Customers support investing in resilience to ensure future water supply. Their focus is generally to reduce leakage and bursts to achieve this We have designed our programme to align with our customers' views
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Yes, all resilience investment is targeted to address externally driven risk from climate change, flooding or third party damage. Our Green Book approach ensures accurate NPV calculation with in period spend to save accounted for within base costs.
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	Yes. A wide-range of options have been considered and optimised to determine best level of investment within the AMP
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-	Yes. We have undertaken a detailed economic assessment using the Ofwat methodologies and benefit valuations

party technical assurance of the analysis provided?	Our analysis has compared many options including a preferred and least cost option using our risk and value processes Our economic analysis approach has been assured by third-parties
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	Operational and embedded carbon and natural capital impacts have been qualitatively assessed though the option assessments
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	We have consistently used the Ofwat benefit valuations and benefit measure estimate methodologies in our economic analysis
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection and our sensitivity analysis Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	This is not applicable for this business case
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	Connect 2050 (in its entirety, not just the resilience component) has been robustly assessed for DPC (in combination with our sustainability reductions programme to achieve the programme scalability threshold). It has been found not to be suitable (please see the DPC appendix)
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in the design of the programme
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The costs for the schemes have been developed from the bottom-up and with unit cost curves
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient. Please see the Costing & Investment Portfolio Optimisation appendix
Does the company provide third-party assurance for the robustness of the cost estimates?	Please see the Costing & Investment Portfolio Optimisation appendix

Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Customers are protected through the leakage, mains repairs and interruptions to supply Performance Commitments We have also designed a PCD to protect customers based upon the additional number of properties protected against climate change risks as well as flooding risks to sites.
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	Yes
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	This is not applicable for this business case

Supporting Business Cases

- Water Network Resilience to Climate Change: Water Network Resilience to Climate Change.docx
- Flood Resilience: Flood Resilience.docx
- Single Points of Failure: Resilience Single Points Of Failure.docx
- Connect 2050: Connect 2050.docx

SEMD

Ambition

The Water Industry Act of 1991 requires Water Undertakers to maintain essential services at all times. Section 208 of the Act gives the Secretary of State the authority to issue both general and specific directions to Water Undertakers in the interests of national security and resilience.

The DWI's Security and Emergency Measures (Water and Sewerage Undertakers) Direction (SEMD, 2022) is the principle general Direction issued under Section 208 of The Water Industry Act. Water Undertakers are legally obliged "to have regard" to any guidance, procedures, requirements, and policies relating to civil emergencies and national security that are notified to them by the Secretary of State.

The Direction requires UK Water Companies to make plans for the provision of potable water and national security. The recent SEMD requires a some significant changes to be made, with more stringent requirements for water supply during emergencies and cyber security measures.

We have found that our customers do not automatically identify resilience as an area of high concern especially when relating external factors, such as climate change, to the impact of delivering a secure supply of water. They generally think of bursts or leakage when they think about resilient supplies. They do, however, expect that we plan ahead and mitigate the risks that will impact on water supply.

Our policy and on-going ambition is to ensure that all of our sites, people, processes and suppliers remain resilient and compliant with the SEMD requirements. As such, we will continue to invest and comply with the SEMD requirements, and any future changes that are made, and by accounting for population growth and climate change. Our strategy is to ensure that customers always have access to alternative water during incidents and emergencies; mitigating vulnerabilities on our sites; and enhancing both our physical and cyber security measures as threats evolve and change.

AMP8 Investment

The need for investment is to ensure continued compliance and enhancement with the SEMD Direction. Each of the three key areas: emergency planning, physical security and cyber security have undertaken in-depth assessments against the respective SEMD requirements following the respective methodologies. Detailed risk assessments have been undertaken and followed up with our Risk and Value workshops. Options and solutions have then been identified and costed for economic assessment. Many of the requirements are statutory, albeit risk-based, which gives us some limited flexibility on how best to invest.

We have used our risk assessments and economic analysis to identify the best value options to meet our statutory obligations.

Our enhancement investments for AMP8 are summarised as:

- **Emergency Planning:** provision of four water tankers; a new storage area for bottled water; a new lorry to transport bottled water; three mobile power generators; satellite communications and the associated enabling works
- **Physical and Personnel Security:** Security upgrades at the newly designated CNI sites [redacted]
- **Cyber Security:** Improve the resilience and security of the systems that support the essential services. The improvement is necessary to mature the overall security controls and to meet stringent regulatory requirements for Critical National Infrastructure (CNI) company and an Operator of Essential Services

Additional details of the investment activities are presented in the respective business cases.

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	2.50	1.82	1.73	1.38	1.40	**8.83**
Opex (£m)	0.12	0.29	0.70	0.70	0.77	**2.58**
Totex (£m)	2.62	2.11	2.43	2.08	2.17	**11.41**
Drivers						
60%	Security - SEMD					
40%	Security - Cyber					
Benefits						
Health and Safety (incidents) Capex and Opex Savings (£m)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**9.7**	NPV Benefits (£m) (2025-55)			**14.1**
NPV (£m) (2025-55)		**4.4**	Benefit / Cost Ratio			**1.5**
Six Capitals						
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**	
	★ ★ ★	★ ★	★	★		
Performance						
Due to the low materiality of total costs and associated bill impact, we do not propose a PCD for customer protection, however all SEMD investments will be subject to significant regulatory scrutiny by the DWI who support our SEMD investments.						

Justification

Compliance with the SEMD is a statutory requirement and our enhancement investment has been targeted to meet this objective. Our economic analysis approach has shown that our investments are cost beneficial and customers have indicated that mitigating against extreme risks to water supply is expected from us.

We are currently required to supply a minimum of 10 litres per person per day to 20,000 people i.e. 200,000 litres of water based on a worst case scenario. However, from the start of AMP8, all companies must base their plans for alternative water on their local context and population, having regard to national reasonable worst-case scenarios. As a minimum, companies should plan to provide alternative water for 1.5% of their domestic population. This increases our reasonable worst case to 520,000 litres. We have demonstrated recently during the December '22 freeze/thaw that we were just able to supply the 200,000 litres of alternative water. As such, we need to invest to become compliant with the new requirement.

Security threats are dynamic by nature, as the threat vector changes and evolves over time, existing physical and electronic measures must be capable of meeting new or increased threat levels identified during actual incidents. or upon the guidance issued by the UK Government Security Services so that necessary levels of protection are maintained at all times. Two of our sites have been designated as CNI sites and require investment to comply with the SEMD requirements.

Whilst risks from unauthorised access to Critical National Infrastructure, water supply process, storage and distribution elements, have been suitably mitigated by our previous investments, our on-going site security risk assessments and repeated incidents has identified a number of vulnerabilities requiring further investment in physical and personnel security measures. These risks will be addressed as part of our base investments.

Critical infrastructure companies like Affinity Water face persistent and increasingly sophisticated destructive cyber campaigns that threaten services, and ultimately our customers' data and privacy. We are seeing an increase in attacks by a well-resourced threat actor with the potential to cause physical damage to industrial control systems, and in this case, to water treatment facilities, leading to disruption to water supply, longer recovery period and cost. In essence, our risks are increasing and we need to invest to protect against these risks.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	The investment addresses the statutory and regulatory requirements and the non-statutory drivers. It is supported by our key stakeholders and aligns with their long-term ambitions
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The investment is required in AMP8 to address the new SEMD obligations
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	We are investing in base to continue to strengthen our physical and personnel security, cyber security and emergency planning Our enhancement investments are required to meet the new obligations
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This work supports our ambition to continue to fully comply with the SEMD requirements and to ensure security of supply to customers against extreme events
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	We have found that customers expect us to plan and mitigate against extreme events to ensure secure water supplies, albeit their focus is generally related to resolving leakage and bursts
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	No
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide-range of options have been identified and considered through our Risk and Value assessments
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	We have undertaken a detailed economic assessment using the Ofwat methodology. We have used industry standard (ONS) benefit valuations for health and safety benefits Our analysis has compared many options including a preferred and least cost option Our economic analysis approach has been assured by third-parties
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when	We have qualitatively assessed the carbon impacts in our Risk and Value assessments and used these to inform our options

proposing a best value option over a least cost one?	
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	The main objective and impact is to ensure compliance. We have also estimated the impact of the investments on the risks
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection and our sensitivity analysis Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	This is not applicable for this business case
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in the design of the programme
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The cost numbers used to formulate the proposal have been taken from current cost of services, using data taken from procurement, existing contracts and research Therefore the confidence rating in the costs is mid to high
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient. Please see the Costing & Investment Portfolio Optimisation appendix
Does the company provide third-party assurance for the robustness of the cost estimates?	Please see the Costing & Investment Portfolio Optimisation appendix
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	SEMD is covered by DWI obligation, in addition it does not meet the materiality threshold. This encompassed all outputs and outcomes of the investments.
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how	This is not applicable for this business case

customers are protected against third-party funding risks?	

Supporting Business Cases

- SEMD Emergency Planning: Emergency Planning.docx
- SEMD Physical and Personnel Security: Physical and Personnel Security.docx
- SEMD Cyber Security: Cyber Security.docx

Raw Water Deterioration

Ambition

Our customers and other stakeholders expect us to continue to actively manage any deterioration in raw water quality. Our long-term strategy supports this and aligns with the objectives of our WRMP and environmental programmes. As such, we will continue to invest to manage water quality at source through our WINEP, by strengthening our network, and also by upgrading the treatment facilities at our water treatment works where they are at risk. Our ambition is to continue to safeguard our industry leading water quality performance and to reduce the risk of interruptions to supply, resulting from water quality issues, over the long-term.

The Drinking Water Inspectorate (DWI) has issued Section 28(4) Notices which require the improvement of the treatment levels at the Egham and Iver WTWs to protect against *Cryptosporidium* outbreaks, at Broome, Kingsdown, and Stansted for nitrate reduction, and at Holywell for PFAS removal. These form statutory requirements that could result in enforcement proceedings under Section 18 of the Water Industry Act 1991 if not addressed in AMP8. We received letters of support from the DWI at the end of August covering all the remaining water quality schemes and have sent draft Notices to the DWI at the end of September for their approval.

Some of the groundwater aquifers that we abstract from have been found to have multiple Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) compounds present. This is usually the result of diffuse or point-source pollution events which took place in the past, although may also be related to on-going activities. In January 2021, the DWI published their revised guidance for the parameters PFAS and PFOA. This guidance reduced the value for wholesomeness (effectively the Permitted Concentration Value, PCV) for PFOS from 1 µg/l to 0.1 µg/l and for PFOA from 5 µg/l to 0.1 µg/l. In July 2022, the wholesomeness value was extended to 45 other PFAS (IL 03/22). As a result, we have reviewed our risk assessments across all sources and drinking water supplies and identified the following sites require risk mitigation measures: Wheathampstead, Blackford, Bowring & Baldock Road, and Holywell. Anglian Water have also carried out a similar review and have identified that Ardleigh WTW, an asset of shared ownership (50:50) between Anglian Water and Affinity Water, is also at risk and requires investment.

The concentration of nitrate is increasing in the raw water abstracted at our Kingsdown, Broome and Stansted WTWs. This has already resulted in sites having to be turned off during periods of high nitrate levels. Our modelling indicates that this issue will not begin to decrease for many years to come. The Stortford supply area, that is supplied by Stansted WTW, has a low resilience, due to its limited storage and the configuration of the network. Although, there is a provision in the WINEP for some catchment management schemes in this area for AMP8, the benefit from these schemes will only be realised in the long-term and will not reduce the amount of nitrate already present in the soil layers from historic agricultural use.

It is critical that investment is made in AMP8 at all of the affected sites to safeguard the supply-demand balance, protect and improve service levels to consumers, and to reduce the risk of unplanned outages, low pressure and interruptions to supply.

We have also considered going beyond the statutory requirements. Our qualitative customer research sessions indicated that customers generally preferred avoiding deteriorated service levels compared to making aesthetic water quality improvements. Household customers only modestly valued aesthetic improvements. Overall, our respondents felt that Affinity Water's services are good value for money and were generally satisfied with levels of services that they receive for water quality. There is no great desire for us to invest in improving aesthetic water quality.

AMP8 Investment

The DWI Notices require Affinity Water to address the deterioration in raw water quality, and make investments in AMP8 to maintain wholesome water. In addition, many of these schemes have been approved for accelerated funding. The programme consists of a range of different solutions that include:

- **Iver WTW:** A validated UV irradiation system for the inactivation of *Cryptosporidium* oocysts (delivery AMP7); optimisation of the clarification process; additional rapid gravity filters to treat full output; covers for the GAC filters; and the upgrade of the wastewater treatment plant to improve water recirculating to the head of the works
- **Egham WTW:** A validated UV irradiation system for the inactivation of *Cryptosporidium* oocysts (delivery AMP7); optimisation of the clarification process; upgrade of the RGF process; and the upgrade of the wastewater treatment plant to improve water recirculating to the head of the works
- **PFAS Schemes:** Works at Baldock Road and Bowring, Blackford, Holywell and Wheathampstead, and our share of Ardleigh with Anglian Water.
- **Nitrate Schemes:** Works to provide ion-exchange treatment at Kingsdown and Broome WTWs and installation of a new trunk main and additional boosters to provide extra resilience for the Stortford area.

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	28.82	32.05	19.83	8.95	0.00	**89.65**
Opex (£m)	0.20	0.29	0.81	1.37	1.50	**4.17**
Totex (£m)	29.02	32.34	20.64	10.32	1.50	**93.82**
Drivers						
100%	Addressing raw water quality deterioration (grey solutions)					

Benefits			
Loss of Production Capacity (Ml/d) Compliance Risk Index (score) Capex and Opex Savings (£m)			
Economic Analysis			
NPV Costs (£m) (2025-55)	**104.6**	NPV Benefits (£m) (2025-55)	**226.4**
NPV (£m) (2025-55)	**121.8**	Benefit / Cost Ratio	**2.2**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
	★ ★ ★	★	★ ★		

Performance
We have designed PCDs to protect customers based upon the additional production capacity at our sites: Iver & Egham; PFAS sites; and Nitrate sites

Justification

Our investment programme to manage raw water deterioration is required to address the statutory requirements and the DWI Notices. It is required to be completed within AMP8, and six of the schemes have accelerated funding to achieve the outputs as early as practically possible.

The DWI and customers support the investments, which align with our long-term strategic intent to continue to provide high-quality water supplies to customers. Our research shows that customers inherently trust us to manage water quality risks and make decisions about technology selection. They also have a strong expectation for us to meet our regulatory obligations at all times. They do not support investments in making aesthetic water quality improvements.

We have developed a wide-range of options, which have been through our Risk and Value workshops. The set of selected options have then been subjected to economic assessments to determine the cost benefits and to select the preferred options. All of our schemes have been shown to be cost beneficial and most are strongly cost beneficial. The nitrates schemes are less cost beneficial because the unit cost of treatment is higher than for *Cryptosporidium* and PFAS treatment facilities. In essence, these schemes provide security of supply, which is highly beneficial to customers. They are statutory requirements and failure to invest would result in fines and the need to undertake the work anyway but at higher cost.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	Strong evidence has been provided for the water quality risk change. The investment addresses the statutory and regulatory requirements. It is supported by our key stakeholders and aligns with their long-term ambitions
Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The investment has been agreed for AMP8 with the DWI and other stakeholders to meet the identified risks and issues
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	No
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	No
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	This work supports our stakeholders' long-term strategies, and our long-term strategy to continue to provide wholesome water to customers Our investments are required to be completed in AMP8 to meet our obligations
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	We have found that customers support the need to proactively manage water quality risks and issues and to comply with our statutory obligations. They trust us to select the best water quality treatment solutions We also tested customers' preferences for improving aesthetic water quality and found that customers were generally content with the current levels of service and had a preference for maintaining bills at current levels We have designed our programme to align with our customers' views
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	Investment is needed to address the DWI notices. However, the planning and design of the schemes has been under our control, albeit with consultation with the DWI
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide-range of options have been considered with detailed planning, Risk and Value workshops and with economic assessments. Our options and solutions have been discussed and verified with our stakeholders

Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	We have undertaken detailed economic assessments for each scheme using Ofwat methodologies and benefit valuations Our analysis has compared many options including a preferred and least cost option Our economic analysis approach has been assured by third-parties
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	We have considered the operational embedded carbon and natural capital impacts in our assessments to select our preferred options
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	We have consistently used the Ofwat benefit valuations and benefit measure estimate methodologies in our economic analysis
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection and our sensitivity analysis Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis We have used study results to support our benefit estimates
Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	This is not applicable for this business case
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in the design of the programme
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The costs for each option have been developed through detailed planning and by using a combination of our unit cost models and costs from previous known work and schemes
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs and are deemed to be accurate and efficient. Please see the Costing & Investment Portfolio Optimisation appendix for more information
Does the company provide third-party assurance for the robustness of the cost estimates?	The cost estimates have been validated using consultant cost models, checked internally and all cases subject to external review. Please see the

	Costing & Investment Portfolio Optimisation appendix for more information
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	Customers will be protected through a PCD for this project, which will be aligned with the requirements set out by the DWI in the Section 28(4) Notice. The PCD will be based on the production capacity that will be protected by our enhanced treatment facilities and network improvements
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	Yes
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	Third party funding not applicable

Supporting Business Cases

- Iver Surface Works: Iver Surface Works DWI.docx
- Egham Surface Works: Egham Surface Works DWI.docx
- PFAS Sites: Raw Water Deterioration PFAS Sites.docx
- PFAS - Ardleigh: Raw Water Deterioration PFAS Ardleigh.docx
- Nitrates Sites: Raw Water Deterioration Nitrates Sites.docx

Lead Replacement

Ambition

The presence of concentrations of lead in drinking water is a known health issue. World Health Organisation (WHO) and European Food Safety Authority (EFSA) agree that there is no safe lower limit of lead that should be in water supplies. Health effects are varied but most are acutely felt by small children (including unborn babies) as exposure to low-level lead concentrations are known to inhibit brain development. In adults it may impair kidney, heart and circulatory health. Adverse health effects from ingestion of drinking water which contains even very small amounts of lead, cannot be ruled out. This evidence has driven the first step in what will be a continuous decrease over time in the regulatory limit in the lead water quality standard, from 10 µg/l to 5 µg/l in the current recast of the EU Drinking Water Directive.

We have engaged with our customers to assess their level of support for lead replacement. Out of the five key investment areas tested with customers (reducing abstraction and environmental restoration, carbon net zero, improving resilience, lead replacement, and hard water) lead replacement ranked as the highest priority in a representative study. Just over half of respondents were aware that there are lead pipes in the Affinity area and most of those had either checked for them or had them removed. 48% of participants in the study opted for the highest possible level of investment when allocating spend to the different investment areas

The current permissible lead limit is 10µg/l. The DWI would like to see this reduced to 5 µg/l by 2050, essentially achieving "lead free" drinking water supply. This would require large-scale lead pipe replacements. Defra does not yet support this target. In fact, in February 2022, Defra set its strategic priorities for Ofwat for the next five-year period, which stated that investment should focus on trialling different approaches to reducing exposure to lead and removing lead pipes.

In the short-term, we will continue to deliver high-quality drinking water through our base activities and we will continue to invest to achieve the 10 µg/l target. However, our ambition for removing lead pipes aims to go well beyond this, supporting our ambition to exceed customers' expectations for drinking water. Our lead strategy ambition is to strive towards a 'lead free society' and to end orthophosphate dosing. We believe that the health benefits will ultimately be shown to be worth the investment.

In the short-term, we must firstly better understand how best to replace the lead pipes and the benefits of doing so. Key elements of the trials will be to reduce the unit costs of pipe replacement; how best to target the replacements; and how to work with the community. The results from the trials will inform the debate as to whether the targets should be changed or not and if so when.

In the longer term, we aim to remove all lead supply and communication pipes from customer properties in our eleven highest risk zones by 2050. We will combine this with continuing to replace supply and communications pipes at any property where lead is found at levels higher than 5µg/l and any property where the customer has replaced their own lead supply pipe.

AMP8 Investment

Our AMP8 lead strategy has been informed by activity from AMP6 and AMP7 and taken into account the differing regulatory views and approaches. It follows Defra's short-term approach. It also supports our long-term delivery strategy and DWI's longer-term target.

Our base investment will continue to target and replace properties with lead levels above 10µg/l. Our enhancement investments for AMP8 cover the following areas:

- To offer properties suffering a lead sample failure of 5ug/l or above a free communications and supply pipe renewal to the compliance point. We estimate that this will result in 1,000 properties being replaced over AMP8
- Undertake small scale innovation trials, aligned to the wider Ofwat approach, seeking to drive unit cost reductions and targeted approach on the more difficult properties

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.41	0.81	1.00	0.99	0.79	**4.00**
Opex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Totex (£m)	0.41	0.81	1.00	0.99	0.79	**4.00**
Drivers						
56%	Lead communication pipes replaced or relined					
22%	External lead supply pipes replaced or relined					
22%	Internal lead supply pipes replaced or relined					
Benefits						
Lead Health Improvements (properties)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**3.2**	NPV Benefits (£m) (2025-55)			**3.5**
NPV (£m) (2025-55)		**0.3**	Benefit / Cost Ratio			**1.1**
Six Capitals						
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**	
	★ ★ ★		★ ★		★	

Performance
We have designed a PCD to protect customers based upon the delivery of the number of properties where we replace lead supply and communication pipes within the AMP

Justification

We have a strong long-term ambition to remove lead pipes from our customers, which aligns to WHO and DWI perspectives, and is the right thing to do for society. However, Defra is clear that the time is not right to invest heavily in pipe replacements as the benefits are not clear and customers do not show great desire to tackle the problem at the moment.

Our own economic assessment shows that the health benefits are currently marginal for both supply pipe replacements, and supply and communication pipe replacements. However, we expect that future technical developments in pipe replacements, research into health impacts, and societal awareness is likely to change the cost benefits over time. Our trials should also help with how we can best target our investments to those at highest risk and hence realise higher benefits. It therefore makes sense to adopt the conservative approach, as proposed by Defra, and undertake trials for AMP8.

We are, and will continue to be, an active contributor to the Industry Lead Steering Group. As part of this, we will continue to lead the Innovation Working Group that looks for new and innovative approaches to delivering lead activity into the future. Our current approach with active trials renewing communications and supply pipes is already considered to be one of the leading delivery approaches. We intend to build upon this in AMP8.

Our long-term delivery strategy builds upon this, and aims to increase investment levels as and when the time is right to do so. Overall, this approach provides a coherent approach to the challenge of lead in the short, medium and long-term that aligns with our customers' and stakeholders' views. It utilises an adaptive pathway approach with low regrets, whilst being ambitious over the longer-term.

Meeting the Enhancement Criteria

Enhancement Criteria	
Need for Enhancement Investment	
Is there evidence that the proposed enhancement investment is required? (includes alignment agreed strategic planning framework or environmental programme where relevant)	The investment aligns with Defra's stated approach for AMP8, and supports DWI's and WHO's longer term objectives

Is the scale and timing of the investment fully justified, and for statutory deliverables is this validated by appropriate sources (for example in an agreed strategic planning framework)?	The AMP8 investment is appropriate to meet Defra's requirements and aligns with customers' preferences
Does the proposed enhancement investment or any part of it overlap with activities to be delivered through base, and where applicable does the company identify the scale of any implicit allowance?	We will continue to invest in base to meet the statutory requirements. Our enhancement investment is separate and positions for future changes in requirements and aligns with Defra's stated strategy
Does the need and/or proposed enhancement investment overlap or duplicate with activities already funded at previous price reviews?	This builds on and continues our development and understanding in how best to tackle lead pipe replacements
Is the need clearly identified in the context of a robust long-term delivery strategy within a defined adaptive pathway?	Defra has clearly stated the short-term requirements and DWI and WHO have set out longer term objectives
Where appropriate, is there evidence that customers support the need for investment (including both the scale and timing)?	Customer understanding and interest is relatively low, with generally a low-level of support for investment. Our AMP8 investment aligns with this
Is the investment driven by factors outside of management control? Is it clear that steps been taken to control costs and have potential cost savings (e.g. spend to save) been accounted for?	No
Best Option for Customers	
Has the company considered an appropriate range of options to meet the identified need?	A wide-range of options have been considered and economic analysis has been used to justify the preferred approach
Has a robust cost–benefit appraisal been undertaken to select the proposed option? There should be evidence that the proposed solution represents best value for customers, communities and the environment over the long term? Is third-party technical assurance of the analysis provided?	Our economic analysis approach has shown that lead pipe replacements are currently marginally cost beneficial. There are many uncertainties in the analysis. Our approach is to better understand the economics and reduce costs and to adjust future investment levels if and when they become more cost beneficial Our economic analysis approach has been assured by third-parties
In the best value analysis, has the company fully considered the carbon impact (operational and embedded), natural capital and other benefits that the options can deliver? Has it relied on robustly calculated and trackable benefits when proposing a best value option over a least cost one?	We have undertaken analysis of the impacts on embedded carbon and natural capital. The selection of our preferred option is not dependent upon the relative carbon and natural capital benefits
Is the impact (incremental improvement) of the proposed option on the identified need been quantified, including the impact on performance commitments where applicable?	Our economic assessment has considered the health benefits arising from the investments
Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where forecast option utilisation will be low?	Many options have been considered and the uncertainties in costs and benefits explored in our preferred option selection Our economic analysis approach has been conservative by design to account for the inherent uncertainties in the analysis

Where appropriate, has the company secured appropriate third-party funding (proportionate to the third-party benefits) to deliver the project?	This is not applicable for this business case
Has the company appropriately considered the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?	This is not applicable for this business case
Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?	We have engaged with customers and accounted for their views in our plans
Cost Efficiency	
Is it clear how the company has arrived at its option costs? Is there supporting evidence on the calculations and key assumptions used and why these are appropriate?	The majority of the cost forecasting for pipe renewal activities is based on either AMP6 or AMP7 actual delivery data. Costs are evidence based and so a high confidence grade would be considered for the data
Is there evidence that the cost estimates are efficient (for example using similar scheme outturn data, industry and/or external cost benchmarking)?	The costs derived for the options are based on the AMP6 and AMP7 costs. the disparate nature of the sites where activity is required limits our ability to drive efficiencies. Our trials in AMP8 will seek to find economies of scale from using street programmes and having a secondary purpose whilst undertaking the work
Does the company provide third-party assurance for the robustness of the cost estimates?	Please see the Costing & Investment Portfolio Optimisation appendix for more information
Customer Protection	
Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?	There is no protection for Lead as it does not meet materiality or aggregation requirements.
Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?	There is no protection for Lead as it does not meet materiality or aggregation requirements.
Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including how customers are protected against third-party funding risks?	This is not applicable for this business case

Supporting Business Cases

- Lead Programme: Lead Programme.docx

Full Business Cases

Affinity Water

Electric Vehicles

August 2023

Contents

Summary

Affinity Water, alongside other Water Utility Companies, have committed to achieving Carbon Net Zero by 2030 as part of our Public Interest Commitment with Water UK. For AMP 8 Ofwat are introducing a performance commitment for operational emissions of which fleet emissions play a significant part. Both of these commitments align to the UK's legal binding Net Zero target [1]to reduce territorial emissions to Net Zero by 2050.

A key component in reaching our Net Zero 2030 goal and delivering benefits which contribute to our greenhouse gas performance commitment will be transitioning to a fully electric liveried fleet. This transition has the potential to reduce out GHG emissions by approximately 1,920 tonnes of CO2e per year.

Our transition to an EV fleet aligns to Ofwat's position on Net Zero which expects companies to incorporate the following into business planning:

- to ensure their net zero plans are clearly linked to national government targets;
- action on net zero to encompass both operational and embedded emissions;
- to prioritise the elimination and reduction of GHG emissions before the use of offsets, utilising the GHG management hierarchy in doing so.

20% of the fleet is expected to convert to EV in AMP 7, allowing lessons to be learned in an emerging market, enabling an effective transition for the remainder of the eligible fleet in AMP 8 (some larger vehicles may not be suitable for transition during AMP 8). To support the new EV fleet, suitable charging infrastructure at home and depot locations will be required.

Assumptions have been made that purchasing our own charging infrastructure will provide best value in the long term, but that it will need to be supported by an expanding public infrastructure to minimise operational downtime.

We currently spend approximate £5m per annum (Opex Base) on vehicle leasing, a transition to EV will increase costs. The total level of investment required to make the transition is expected to be £4,302k in AMP8.

[1] https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.91	0.97	0.84	0.43	0.33	**3.48**
Opex (£m)	0.08	0.13	0.18	0.19	0.24	**0.82**
Totex (£m)	0.99	1.10	1.02	0.62	0.57	**4.30**

Drivers	
100%	Greenhouse gas reduction (net zero)

Benefits
Operational greenhouse gas emissions (water)

Economic Analysis			
NPV Costs (£m) (2025-55)	**7.2**	NPV Benefits (£m) (2025-55)	**11.0**
NPV (£m) (2025-55)	**3.8**	Benefit / Cost Ratio	**1.5**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

Project Description

The Electric Vehicles scope includes the leasing and delivery of our fleet of liveried vehicles by January 2030 plus the charging infrastructure and associated software required to operate the fleet. In addition to the activities directly related to managing the fleet, the project will support any changes to the ways of working for operational teams compared to current methods in order to minimise the negative impact on productivity.

Project Development

Baseline Assessment

Currently, all vehicles owned and leased by Affinity Water run on diesel. Drivers are mostly able to take their vehicles home at night and will refuel at a variety of facilities using their fleet-supplied fuel card. Electric vans require a completely new charging infrastructure to support their use. The viability of this has improved over recent years, now enabling companies to roll out for electric fleets.

Average daily mileage for our fleet has been analysed to assess distance covered versus EV vehicle range and approximately 67% of drivers/vehicles have been categorised as suitable for switching to EV with no impact on daily productivity. Changes to operational behaviour and planning are required for other drivers

Problem Statement and Stated Need / Driver

Government led targets and National policies mean petrol and diesel vehicles will no longer be manufactured from 2030[2] . Therefore, Affinity Water will need to begin the transition to a new fleet of vehicles.

Affinity Water, alongside other Water Utility Companies, have committed to achieving Carbon Net Zero by 2030 as part of our Public Interest Commitment with Water UK. For AMP 8 Ofwat are introducing a performance commitment for operational emissions of which fleet emissions play a significant part. Both commitments align to the UK's legal binding Net Zero target to reduce territorial emissions to Net Zero by 2050.

A key component in reaching our Net Zero 2030 goal and delivering benefits which contribute to our greenhouse gas performance commitment will be transitioning to a fully electric liveried fleet. This transition has the potential to reduce out GHG emissions by approximately 1,920 tonnes of CO2e per year. As a direct emission from our business fleet, these emissions are a priority to reduce.

This business case aligns with the expectations and requirements set out in the Water Industry Strategic Environmental Requirements (WISER), including the following non-statutory requirement:

- Contribute to the sector's ambition to achieve net zero carbon by 2030 as set out in Water UK's 'Net Zero 2030 Routemap' (NS)

[2] Outcome and response to ending the sale of new petrol, diesel and hybrid cars and vans (July 2021) https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans/outcome/ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans-government-response#executive-summary

Our transition to and EV fleet aligns to Ofwat's position on Net Zero [3]which expects companies to incorporate the following into business planning:

- to ensure their net zero plans are clearly linked to national government targets;
- action on net zero to encompass both operational and embedded emissions;
- to prioritise the elimination and reduction of GHG emissions before the use of offsets, utilising the GHG management hierarchy in doing so.

Implementing charging infrastructure alongside securing suitable EV vehicles will enable our business to be resilient to any emerging risks associated with this phasing out.

At this point in time, and with the options available on the commercial market, EV's are the most cost-effective alternative to diesel, petrol or LPG vehicles. A brand new charging infrastructure is needed to power the vehicles, requiring decisions to be made on the use of public, private and home chargers

Risks, Issues and Requirements

The industry has set itself a challenging timescale to complete its transition. As a result, a number of risks and issues exist at present:

Risk - Vehicle Range

Light commercial vehicles in the 2.5-3.5 ton range needed to support operational activities carried out by our teams have limited range compared to the traditional fuel options with no range issues.

Risk - Vehicle types

The range of vehicles available to choose from, and the range they can cover on a single charge does not currently support the needs of a significant proportion of our fleet, meaning behavioural changes and changes to operational practices are likely to be required.

Risk - Market availability

Lead time for EV is currently challenging and future availability is uncertain. With increasing demand for EVs globally there is a risk that our suppliers may be unable to provide vehicles at the rate we require to meet our targets.

Risk – operational changes

Publicly available charging infrastructure is vastly behind that of traditional fossil fuel filling stations currently (less than 40,000 points installed nationwide), making logistics

[3] Ofwat's regulatory framework and net zero (August 2022) https://www.ofwat.gov.uk/wp-content/uploads/2022/08/BEIS-commission-Net-Zero-response-August-2022.pdf

around covering high mileage a challenge currently. The cost of public charging remains much higher than charging on our own sites or at home where we control the tariffs also.

We expect to have a high reliance on home charging as a solution. This is not an option for all employees who park on public highways or do not own their property.

Allocation of Costs

We currently spend approximate £5m per annum (Opex Base) on vehicle leasing, a transition to EV will increase these costs.

Cost categories within the scope of delivering an EV fleet include the vehicles, charging points, associated software and the resources needed to deliver the project.

Electric Vehicles will be leased rather than purchased in the vast majority of cases. Costs for an electric equivalent compared to a diesel model are approximately £150 per month higher on average. These will be additional Opex costs and will be classified as Opex Enhancement.

Charging infrastructure, including the units, upgrades to site infrastructure and associated civils work will all be Capex Enhancement. Options to lease charging units rather than purchase have been explored in order and have been discounted.

Software needed to support staff reimbursement of home energy costs and the general charging and apportionment of costs to individual budget holders is expected to be Opex Enhancement.

Table 1 spend profile for AMP 8

	Year 1	Year 2	Year 3	Year 4	Year 5
Opex (Base)	£5m	£5m	£5m	£5m	£5m
Opex (Enhancement)	£77,660	£134,460	£177,660	£185,660	£243,360
Capex (Enhancement)	£912,050	£966,340	£836,044	£434,298	£334,513
Total Enhancement	**£989,710**	**£1,100,800**	**£1,013,704**	**£619,958**	**£577,873**

Research, Pilots, and Technology Development

Due to the emerging nature of the Electric Vehicle market and lack of experience within the Business, Mitie were engaged in August 2022 to support our 8 year transition to a fully electric fleet by 2030. They were tasked with understanding current working practises and fleet requirements to provide a detailed overview and recommendations for how best to deliver the required change, as well as providing insight and support to inform strategic decision and budget forecasts.

90% of AW's liveried vehicles are classed as Light Commercial Vehicles (under 3.5T) with Initial analysis indicating that 91% of drivers travel less than 100 miles per day and 67% of the total fleet would be easy to move to electric based on current behaviour.

80 vehicles (20% of the liveried fleet) are targeted to be electric before 1 April 2025, with pilot trials helping to inform delivery strategies and changes to operational activity ahead of AMP 8.

Technology associated with both the vehicles and charging infrastructure is expected to improve during AMP 8 such that batteries may be able to charge faster and vehicle range increase, thereby easing the transition for a number of drivers in the fleet. Whilst assumptions can be made around technological advancement nothing has been included within the financial forecast or delivery timescales based on current information available.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

Customer engagement on climate change and carbon has been undertaken as part of the customer focus groups and in-depth interviews for PR24. The themes of climate change and carbon have been considered in a variety of contexts and using different engagement techniques.

The key customer views are:

- Our customers struggle to connect how they can individually impact climate change and believe we can deliver the change they cannot.
- Support for environmentally led projects is tempered by concerns over costs and the need for 'proof' of investment.
- Concern over carbon emissions are increasing, although customers balance it with other environmental drivers. Transparency over cost and effectiveness over our solutions will help customers support our approach.
- Of five asset based investment areas, Environmental preservation & repair ranked highest in discussions on priorities, but Carbon net zero, lead and resilience are closely ranked, and not that far behind

Customer are not climate sceptics, but they often lack awareness of the link between their demand and environmental impact

There is a general feeling that climate change is a serious threat. Awareness of the potential for extreme water shortage is low, there is concern over where new supplies could come from and what that means for the next generation.

There is also evidence that few people understand the impact of their water use on the environment, with 45% of respondents from a 2022 national survey saying their use only had non or a small impact on the environment. Only 1 in 5 were able to correctly state how much impact personal water use has on the environment.

Customers expect leadership to come from Government, but we must play our part

Our customers do believe that climate change should be on the high on our agenda believing we can have more impact than they can.

Customers expect us to have a green operation, as a minimum action, by switching to renewables and electric vehicles. They expect us to plan for climate change now and will not be tolerant of interruptions caused by a lack of preparation.

Customers are largely positive to the Affinity Carbon Net Zero policy.

Three quarters felt positively towards it. The 5% who felt negatively thought we should be more focused on undoing damage already existing, such as sewage in rivers. More detail was wanted on the timeline of achieving net-zero, and how current emissions broke down.

Partnering

Collaboration and Partnering

Engagement with Stakeholders and Partners

Several areas have been explored internally to assess the ease of transition and help drive engagement. Surveys have been carried out within the business to assess attitude to adoption by current drivers, identify potential challenges at a local level and to review driver trends and the potential for home charger installation.

New company policy documents have been drafted to ensure the needs of the employee and the organisation have been accounted for and are clear. Roll out plans will be phased to ensure vehicle leasing penalties are not incurred unnecessarily on existing vehicles.

Mitie have been engaged as a Subject Matter Expert to provide advice ahead of the pilot trials. A number of industry-wide working groups are ongoing to improve knowledge levels within the organisation.

Co-design and Co-delivery

Mitie have provided early input into the strategic design for the EV roll out programme, utilising their experience with other organisations prior to Affinity Water committing to delivering an EV Fleet.

A delivery partner for installing and managing charging units and the associated software will be selected via a tender exercise. Agreements with fleet vehicle suppliers, our vehicle tracking supplier and field scheduling software supplier will all be utilised to assist with optimising the benefits of the investment.

The potential to lease charging units or utilise third parties to provide EV charging services on Affinity Water sites will be revisited during the delivery phase but are not currently economically viable.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

An EV Fleet is a key element within Affinity Water's strategy to becoming operational Net Zero by 2030. The fleet of liveried vehicles drives approximately 5.5 million miles per year, producing 1,920 tCO2e in the process. EV transition also represents an early and significant contributor to Affinity Water's long-term goal of becoming fully Net Zero by 2045 as outlined in outlined Strategic direction Statement.

Flowing the GHG protocol, direct operational fleet emissions are a priority to reduce before reducing the indirect emissions associated with our supply chain. For AMP 8 we have planned an ambitious EV roll out programme which will enable us to meet our 2030 target and keep us on track to hit our long-term goals. A move to EV fleet ahead of the ban in sales of new petrol and diesel vans will mean we are well placed to manage any potential disruption this may lead to. For example, we are less likely to be impacted by lack of vehicle availability and will have been able to manage the transition to EV in a planned manner.

-In addition to the carbon impact, the ability to publicise an electric fleet is expected to contribute to an enhanced public reputation.

Financial savings associated with using a cheaper fuel source will help drive better value for our customers, albeit the impact of higher lease costs for an electric vehicle in the short term is expected to offset this initially.

Adaptive Strategy

Early phases of the transition to EV are focused on vehicles and drivers able to switch to an EV with little impact on their role. They will include those able to charge the vehicle overnight at home, drivers currently driving low daily mileages or in smaller commercial vehicles. A proportion of the 80% of the fleet that will be delivered in AMP 8 are likely to require changes to operational practise and improvements in battery technology maybe required in order to switch.

Public charging infrastructure is expected to expand exponentially before the end of AMP 8, with the potential for less reliance on an internal charging infrastructure as public charging becomes more accessible may mean that a more reliable and cost-effective solution becomes available. Decisions on how best to procure and support vehicle charging will be made during the delivery of the project, which is expected to cover the full AMP.

Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

Doing nothing and continuing to lease diesel vehicles has been discounted at the outset. Government led targets and National policies mean petrol and diesel vehicles will no longer be manufactured from 2030[4] , so a requirement for charging infrastructure will be required in the future anyway.

Purchasing fleet vehicles has not been considered as part of this programme. Liveried fleet vehicles will continue to be leased in AMP 8.

Options around charging strategy have been investigated. Capital investment to install charging units at company sites could be significant, particularly if upgrades to incoming electrical supplies are required to accommodate the charging units. At the time of writing, the extent of the public charging network in the UK remains limited, not cost effective, and would not be sufficient to support the needs of a fleet needing to manage the operational assets that we do on a 24 hour basis. Therefore, there is a need to invest in a level of home and workplace chargers.

The lowest cost and risk option are home charging units. These would utilise a domestic supply to recharge the vehicle overnight on a daily basis with a small capital investment.

Installing charging units at company sites is being explored for operational and financial benefit. The ability to provide a fast charge to a vehicle whilst at a company site will support operational needs at a lower opex cost than using public charging infrastructure.

Public charging infrastructure is forecast to expand considerably during AMP 8, but costs and accessibility is still unknown and so will continue to be reviewed. At the time of writing, relying solely on public charging infrastructure would approximately double the opex cost of charging an EV fleet based on current electrical charges to Affinity Water compared to public charging rates, equivalent to £550k per year.

[4] Outcome and response to ending the sale of new petrol, diesel and hybrid cars and vans (July 2021) https://www.gov.uk/government/consultations/consulting-on-ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans/outcome/ending-the-sale-of-new-petrol-diesel-and-hybrid-cars-and-vans-government-response#executive-summary

Selected Options

Do Nothing, remain with a diesel fleet. Option 0

Not viable. Government targets state new vans sold from 2035 must be zero emissions, and only hybrids and electric options will be available from 2030. Whilst it would be possible to continue to lease new diesel vehicles in AMP 8, it would result in not achieving our Industry Net Zero commitments and would leave us exposed to changes in the vehicles market following the ban on sales of petrol and diesel vans.

Preferred, Best Value, Option 1

Transition 20% of the fleet and some basic charging infrastructure in AMP 7, with a high focus on home charging units and workplace chargers at a small number of office sites. The remaining 80% of the fleet to be delivered in AMP 8 along with the necessary charging infrastructure at other sites deemed critical to supporting operational activity. This option allows us to learn lessons ahead of large scale roll out, allows the emerging market to mature and potentially offer better value and reassess public charging options to minimise capital outlay.

Least Cost Option 2

Least cost option would be to delay the roll out as late as possible, limiting any detrimental OPEX impact, focus on home charging units and rely on public charging infrastructure to become more widespread and cost effective as the market grows. This option increases the risk of delivery and does not utilise the widespread potential of our own estate which could be used to offer more cost effective charging in the future. A compressed programme is likely to require additional resources and divert attention away from other delivery programmes in the AMP if the fleet transition becomes a major focus.

Option Assessment Approach

Economic Assessment

A separate Cost Benefit Analysis for Electric Vehicles is being developed alongside other deliverables in the Carbon Net Zero programme. The assessment will consider the costs and carbon benefits identified below in the 'Benefit Estimation' section.

This business case acts as a key enabler to ensuring that the net zero benefits case is realised and that the costs for the delivery of the carbon reduction associated with vehicle emissions can be compared against other workstreams for each tonne of CO2 saved.

It is expected that the costs associated with this business case and the phased approach being undertaken will demonstrate good value for money.

Cost Estimation

Costs have been collected via a number of sources to build an accurate cost profile for this workstream. Resource costs have been estimated using the PR24 (pioneer) unit cost database. Capital costs to install home charging units are based on industry averages.

The installation of charging units at Company sites are harder to forecast until detailed surveys have been carried out to assess existing infrastructure capacity. Costs have been estimated based on previous experience from suppliers, and an assumption that minor upgrade works will be required. A degree of flexibility exists on where units are installed to ensure best value is achieved. We have also considered costing advice from consultants Mitie who we have collaborated with to develop our EV transition strategy.

The impact on operational costs has been based on forecasted vehicle lease costs, current energy costs and mileage by our fleet drivers

Due to the immature nature of the EV market, confidence in the cost estimate can only be rated as medium.

Table 2 Budget Breakdown

Component			AMP 7		AMP 8		TOTAL
	Specification	Cost	Quantity	Total	Quantity	Total	
Vehicles			84		370		
Additional lease cost	£150/mth			£87,300	370	£1,422,000	£1,509,300
Fuel saving	6p/mile			-£22,440	370	-£785,400	-£807,840
Driver Training		£170	84	£14,280	370	£62,900	£77,180
Charging locations			4		32		
Depot charger installs	44kw	£25,000	4	£100,000	32	£800,000	£900,000
	22kw	£15,000	4	£60,000	6	£90,000	£150,000
	7kw	£5,000	8	£40,000	44	£220,000	£260,000
Additional Staff chargers (Hub etc)	7kw		0		50	£250,000	£250,000
O&M	<22Kw	£500	12	£6,000	100	£50,000	£56,000
	>22kw	£1,000	4	£4,000	32	£32,000	£36,000
Site infrastructure upgrades		£10,000	2	£20,000	34	£340,000	£360,000
Home charging units		£1,000	84	£84,000	140	£140,000	£224,000
Software							
Software license		£100	84	£8,400	370	£37,000	£45,400
Additional customisation costs				£20,000			£20,000
Project Resources				£240,000		£1,000,000	£1,240,000
Feasibility Study				£16,000			£16,000
20% Risk for Charger Costs				£64,800		£368,000	
overheads 8.58%						£275,246	
Capex (inc 20% risk for charger cost)				£644,800		£3,483,246	£4,128,046
Opex				£97,540		£818,500	£916,040
Total				**£742,340**		**£4,301,746**	**£5,044,086**

Benefit Estimation

Carbon reduction benefits will be tracked as a direct relationship between diesel vehicle mileage and EV mileage. EV's expect to be recharged on 'green' electricity tariff's and will therefore not count towards our carbon count. Diesel emissions are classified as Scope 1 emissions, from direct burning of fossil fuels.

Benefits will begin to be realised in AMP 7 when the first EV's are leased. In addition to the below figures, a focus will be places on drivers reducing their daily mileage via improved scheduling of work and better triage of work prior to dispatch.

Table 3 benefits profile

Year		Diesel Mileage	EV Mileage	Residual CO2
Amp 7	2023	5500000	5000	1920
	2024	5126000	374000	1789.4
Amp 8	2025	4576000	924000	1597.4
	2026	3740000	1760000	1305.6
	2027	2860000	2640000	998.4
	2028	1980000	3520000	691.2
	2029	880000	4620000	307.2
	2030	0	5500000	0

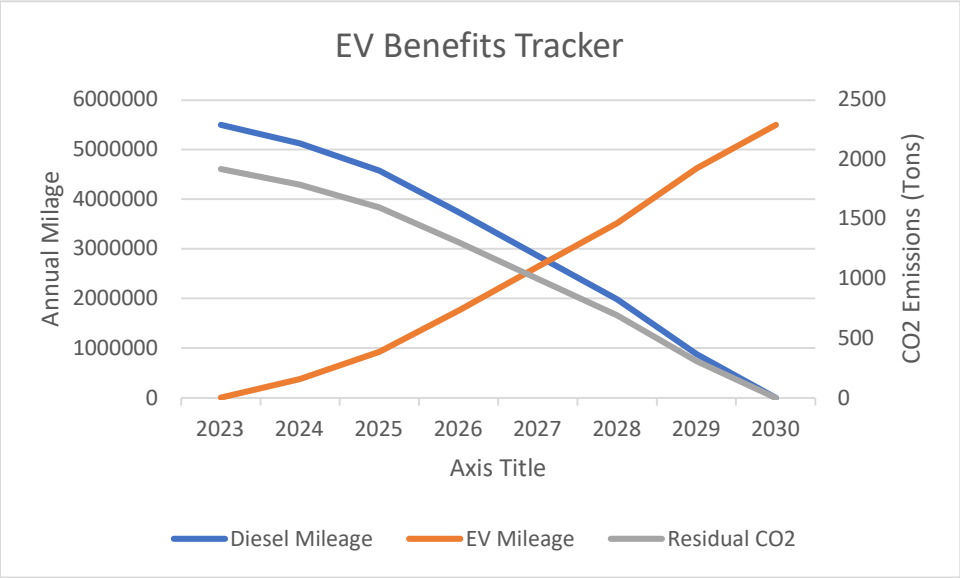


Figure 1: Graphical view of annual mileage and CO_2 emission reduction profile

The roll out of an EV fleet is expected to contribute towards Affinity Water's CMEX experience strategy via marketing campaigns and targeted branding to make customers aware of the ongoing investment in the area. No direct relationship between and EV fleet and improvement in the CMEX score has been calculated at this stage.

Dis-benefit Estimation

The installation of charging infrastructure will result in embedded GHG emissions. To estimate these disbenefits, the emissions per charger were researched (based on desktop a literature review). Based on our planned rollout of chargers a profile of emissions disbenefits was calculated.

Our estimation of disbenefits is limited to the purchase of the charging infrastructure and does not include any wider infrastructure requirements as the detail of this remains unknown until implementation.

A summary of the disbenefits profile is in Table 4 below and the calculations saved in spreadsheet *'EV Embedded emissions Calculations'*.

Table 4 Disbenefits profile for charging infrastructure

Charging Specification	Unit Cost	Quantity in 2025	Quantity in 2026	Quantity in 2027	Quantity in 2028	Quantity in 2029	tCO2e per charger	tCO2e in 2025	tCO2e in 2026	tCO2e in 2027	tCO2e in 2028	tCO2e in 2029
Depot charger (44kW)	£ 25,000	12	12	8	0	0	1.718	21	21	14	0	0
Depot charger (22kW)	£ 15,000	2	2	2	0	0	0.859	2	2	2	0	0
Depot charger (7kW)	£ 10,682	9	14	11	9	0	0.273	3	4	3	3	0
Additional staff chargers (7kW)	£ 6,800	15	15	15	3	3	0.273	4	4	4	1	1
Home charger	£ 1,167	26	26	34	17	17	0.273	7	7	9	5	5
							Totals	35.94	37.21	31.92	8.05	5.49
						Cumulative Profile		35.94	73.15	105.07	113.11	118.60

Efficiency

The preferred delivery option to focus on home charging in AMP 7 and defer the majority of workplace charger installs until AMP 8, allows for better site planning and data analysis to be carried out to improve the value achieved from the supplier.

A high volume of home charging units is expected to deliver an operational efficiency over the course of the project and beyond.

Potential charger unit volumes could deliver efficiencies but at the time of contract award there will be no guarantee provided to the supplier so it is not possible to confirm tangible values.

Focusing attention on delivering site based charging units in AMP 7 aimed at giving greater operational coverage during the initial roll out is not expected to provide adequate benefit to justify the strategy. The benefit to our fleet of installing fast chargers or low power chargers has not been tested at this stage.

Deferring all works to AMP 8 would potentially allow time to refine the scope and deliver efficiency through confirmed job volumes, however these savings could also be negated by additional delivery costs and risk associated with a compressed timescale.

Assumptions Made

A number of assumptions have been made due to the emerging nature of the EV market. These include:

- EV ranges in a single charge will improve as battery technology improves. This will reduce the frequency of recharging and the amount of downtime having to be planned.
- Public charging infrastructure will increase. In 2022, 38,000 chargers had been installed across the UK. This figure is expected to reach up to 720,000 by 2030. As part of this, it is assumed that public charging costs will reduce, making it more accessible and affordable to the fleet, reducing our need to install a higher number of chargers on our sites.
- Home charging is not possible for all employees if they do not own a property, or have a dedicated parking space for the vehicle. An assumption has been made that no more than 40% of drivers will be able to have a charger installed at home as part of the project scope.
- Changes to the way we operate will be supported by the business in order to accommodate the EV transition. Drivers will need to take breaks when vehicles need charging, activity may need to be more regionalised to minimise driving distances, and potential changes to employee contracts may be required.
- An assumption that adequate electricity will be made available on the national grid to support the switch to EV technology

Uncertainties and Sensitivity Analysis

Affinity Water currently has no EV's within its fleet. By the start of AMP 8 this is expected to have risen to 20% of the fleet and funding has been allocated to enable this. However, a number of uncertainties / challenges exist:

- Vehicle lead times are challenging and at risk of delay
- Driver behaviours will need to change to accommodate alternative fuelling
- Employee acceptance of home charging is untested (although surveys indicate there is some support)

Improvements in the vehicle technology in the period 2025 to 2030 are unknown. It is assumed that vehicle range throughout the year will improve, but the expected level of improvement is completely unknown. If vehicles ranges do not improve business operations may need to accommodate additional top up charging at public facilities (at an additional cost) or delay transition of some drivers to EVs. Initial impact assessment has identified that 8% of our fleet are currently not suitable for transition based on daily mileage. The impact of vehicles ranges not improving has not been modelled or undergone any specific sensitivity testing. We may adopt a different implementation pathway to manage this risk – slowing the pace of transition until technology improves. Sensitivity analysis has demonstrated that up to a 40% reduction in benefits would still deliver a costs beneficial project.

Public charging infrastructure is also assumed to be increasing but volumes, geographical locations and costs are still unknown, which affects our ability to plan for our own charger programme. If public charging facilities do not increase in number we may limit the number of vehicles we transition to those which can be charged sufficiently at home or depot locations. The impact of limited public infrastructure is difficult to quantify and as such we have not modelled this, however from sensitivity analysis we have assessed that up to a 40% reduction in benefits could be tolerated.

Option Assessment

Commentary on the Economic Assessment

Three options were reviewed to select the preferred delivery strategy for the project. Whilst each option aimed to deliver the same number of vehicles, site based chargers and home charging units at the end, each had a slightly different spend profile and resource requirement. The risk associated with each varied as well, affected the end forecast, as detailed below.

A copy of our cost benefit assessment can be found in spreadsheet '*230522 AW CBA Net Zero v3.3*'

Table 5 Project Spend AMP 7 and AMP 8

Component			AMP 7		AMP 8		TOTAL
	Specification	Cost	Quantity	Total	Quantity	Total	
Vehicles			84		370		
Additional lease cost	£150/mth			£87,300	370	£1,422,000	£1,509,300
Fuel saving	6p/mile			-£22,440	370	-£785,400	-£807,840
Driver Training		£170	84	£14,280	370	£62,900	£77,180
Charging locations			4		32		
Depot charger installs	44kw	£25,000	4	£100,000	32	£800,000	£900,000
	22kw	£15,000	4	£60,000	6	£90,000	£150,000
	7kw	£5,000	8	£40,000	44	£220,000	£260,000
Additional Staff chargers (Hub etc)	7kw		0		50	£250,000	£250,000
O&M	<22Kw	£500	12	£6,000	100	£50,000	£56,000
	>22kw	£1,000	4	£4,000	32	£32,000	£36,000
Site infrastructure upgrades		£10,000	2	£20,000	34	£340,000	£360,000
Home charging units		£1,000	84	£84,000	140	£140,000	£224,000
Software							
Software license		£100	84	£8,400	370	£37,000	£45,400
Additional customisation costs				£20,000			£20,000
Project Resources				£240,000		£1,000,000	£1,240,000
Feasibility Study				£16,000			£16,000
20% Risk for Charger Costs				£64,800		£368,000	
overheads 8.58%						£275,246	
Capex (inc 20% risk for charger cost)				£644,800		£3,483,246	£4,128,046
Opex				£97,540		£818,500	£916,040
Total				**£742,340**		**£4,301,746**	**£5,044,086**

Table 6 AMP 8 spend profile for options

Component	Specification	Cost		AMP 7 Home Chargers	AMP 7 High Spend	AMP 8 Deferred
Vehicles			454			
Additional lease cost		£150/mth		£1,422,000	£1,422,000	£1,674,000
Fuel saving		6p/mile		-£785,400	-£785,400	-£613,800
Driver Training		£100	454	£62,900	£62,900	£76,500
Charging locations			36			
Depot charger installs	44kw	£25,000	36	£800,000	£500,000	£850,000
	22kw	£15,000	10	£90,000	£0	£120,000
	7kw	£5,000	52	£220,000	£100,000	£240,000
Additional Staff chargers (Hub etc)	7kw		50	£250,000	£150,000	£250,000
O&M	<22Kw	£500	112	£50,000	£25,000	£53,000
	>22kw	£1,000	36	£32,000	£20,000	£34,000
Site infrastructure upgrades		£10,000	34	£340,000	£220,000	£340,000
Home charging units		£1,000	204	£120,000	£120,000	£200,000
Software						
Software license		£100	454	£37,000	£37,000	£45,000
Additional customisation costs		£20,000		£0	£0	£0
Project Resources				£1,000,000	£1,000,000	£1,200,000
Feasibility Study		£16,000		£0	£0	£0
Capex (inc 20% risk for charger cost)				£3,208,000	£2,332,000	£3,696,000
Opex				£818,500	£781,500	£1,268,700
Total				**£4,026,500**	**£3,113,500**	**£4,969,700**

Preferred, Best Value Option – Home Charger Installs AMP 7

Each option expects to satisfy the objective of all liveried vehicles transitioning to EV by 2030. Focusing on providing a home charging infrastructure in AMP 7 with minimal investment in site infrastructure expects to offer the following benefits:

- Allows the business to make a head start with running EV's in the fleet ahead of the AMP8 PC
- CO2 level reduction ahead of AMP 8
- Opportunity to learn lessons and reduce delivery risks in AMP 8
- Fuel cost savings in AMP8 increased in first years
- Project resource profile lower

This option has a benefit cost ratio of 1.48 with a total NPV of £3,404,899.

Least Cost Option – AMP 7 High Spend

A higher investment in site based chargers in AMP 7 would reduce the level on investment needed in AMP 8, however, due to the nature of the EV market in AMP 7, lack of visibility around vehicle technology and national infrastructure improvements it is proposed to delay the investment and focus on home chargers during the first phase of delivery.

As technology improves and the availability and cost of public charging becomes more viable there is potential that the location, number of and power capacity of the site based chargers could change and different investment decisions made.

This option has a benefit cost ratio of 1.40 with a total NPV of £2,721,864.

Alternative Option 1 – AMP 8 Deferred

Deferring all works to AMP 8 compresses delivery timescales into a 5 year period. It allows the business to spend time reviewing operational data and assessing changes in vehicle technology and national charging infrastructure before making investments but creates challenges as follows:

- Additional resources needed to deliver in 5 year period
- CO2 profile changes compared to starting in AMP 7. Additional risk of failing against GHG emission PC.
- Additional funding request in AMP 8 and higher total outturn cost expected.
- Fuel cost savings impacted if all vehicles still running on diesel at start of AMP

Sensitivity Analysis

Sensitivity analysis within the cost benefit assessment has shown that up to a 40% reduction in benefits would still offer a costs beneficial project.

Meeting Affinity Water's Outcomes

All options expect to fulfil the objective of a fully electric fleet by 2030 and offsetting all scope 1 diesel emissions and meeting the Public Interest Commitment made to Water UK.

Justification of the Preferred Option

The preferred option is believed to give the best chance of meeting the 2030 outcome of a fully electric liveried fleet, with the lowest risk and total outturn cost to the business. By focusing on home charging initially it is believed that a best value approach is being adopted to delivering EV vans with the minimum risk to operational activity.

Delivery Considerations

Related Projects

Plant, Vehicles and Fleet have little synergy with the EV transition, despite the name of the Business Case. All liveried fleet vehicles are included in this project

The Field Scheduler project will aim to improve planning performance for our delivery teams and reduce daily mileages by 20%. The requirements of our operational fleet will need to be supported by a scheduling tool, or a new tool introduced that allows the Business to operate effectively and efficiently.

Lessons Learnt

No similar projects exist that could be classed as suitable, however there are opportunities to learn from other organisations that have started the transition to an EV fleet that will be taken up. Initial investigations have suggested that;

Targeting the drivers that are more suited to running an EV (smaller vehicles, lower daily mileage) should be the initial focus. Home chargers and fast charger units are believed to offer the most operational benefit to our drivers when minimising potential down time.

Effort should be focused on the software provided to support the EV roll out, from a driver's perspective and fleet management perspective to ensure best use is made of the new charging infrastructure.

Manufacturers data should be viewed with a level of risk. Vehicle range varies considerably based on a number of factors supporting the plan to deliver the programme over a number of years so that operational impact can be controlled and technology can improve.

Delays are to be expected and costs will change, meaning adequate continency should be allowed for. A relatively high figure of 20% has been allocated against charger installation costs to start with.

A programme of activity to review how operational activity is planned and distributed will be run in parallel with the project. Previous ways of working may not suit an EV fleet, delivering additional benefits against time spent travelling and fuel consumption when doing so.

Delivery Risk Management

The early start strategy, delivering approximately 20% of the scope in AMP 7 is intended to provide greater understanding of any issues that may arise in AMP 8 and value through better decision making.

A plan to target low mileage drivers with vehicle types deemed 'easier' to operate as an EV is intended to allow more time to find solutions for the more complex vehicles and drivers.

Procurement agreements with additional vehicle manufacturers will be explored to offer as many delivery options as possible.

Home charging units will be installed at drivers homes where possible in order to reduce the reliance on site chargers and public charging infrastructure and to minimise operational impact.

Budgets associated with site charger installations include a 20% contingency to cover increased civil costs depending on the physical location needed. Alongside this is a separate value for infrastructure upgrades at sites to cover work on distribution panels or incoming supply capacity.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

EV and diesel powered vehicle numbers will be tracked during the programme, along with mileages. This should enable CO2 emissions to be calculated and reported to the Carbon Net Zero programme board. Data is readily accessible via fleet reports and vehicle tracker reporting.

Project spend will be tracked against forecast to ensure delivery profiles remain on track each year using standard Earned Value Management processes.

Supporting Information

Budget Breakdown is given in Table 2 to show the allocation of costs across the 7 year period.

A copy of the feasibility study carried out by Mitie ahead of the delivery activity is available if required. The study was commissioned to outline steps needed to deliver an EV fleet, an assessment of the ease of transition and wider strategic guidance for the Business to help understand the challenges ahead.

Affinity Water

WINEP: Biodiversity

August 2023

Contents

1 Summary

This report sets out the detailed PR24 WINEP options development process and outcomes for our proposed biodiversity programme.

The biodiversity WINEP programme includes delivering schemes and measures under the following WINEP Driver codes which have been developed as work packages with the programme:

- SSSI_INV and SSSI_ND
- NERC_INV and NERC_IMP
- INNS_INV; INNS_MON and INNS_ND

The 'best value' option described in this business case is defined as the following combination of work packages: **Option A of the SSSI management work package** which includes full investigations in to three SSSI sites, and the delivery of land management on 10 sites within or adjacent to SSSIs at 75% ambition; **Option B of the internal land management work package**, which includes an investigation into species reintroduction, the delivery of 55 site management plans for improving NERC41 habitats, the delivery of 40 site management plans for pollinator number increases, planting of 100,000 trees/hedgerows, improvements to Springwell reedbed and the implementation of a community support initiative focussed on biodiversity improvements in the supply area; **Option C of the INNS work package** which includes the management of mink, delivering INNS management in the catchment at a larger scale, a larger contribution to a National INNS trial, and a larger scale delivery of biosecurity infrastructure and training; **Option C of the third party land schemes work package** which is the delivery of five large scale partnership schemes on third party land, and **Option B of the strategic partnership work package** which is to fund partnership conservation organisations to achieve wider benefits through joint delivery on strategic sites.

We have followed the WINEP methodology to develop options and then select the best value option. As we have developed our preferred solution, we have worked closely with the Environment Agency, Natural England and other stakeholders. We have engaged with customers who have showed a high degree of support for the proposed environmental improvements.

The project is part of a longer-term goal to improve the local environment for customers and communities. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future biodiversity improvements. The best value option is the preferred option because it creates a biodiversity programme which addresses the risks and issues across the company supply area that were raised by stakeholders. When reviewing the scale of benefits achieved through the delivery of the three options compared with their costs, the best value option achieved the most benefit on a qualitative basis.

The best value option is ambitious in that it considers all risks and issues identified and raised by stakeholders and aims to deliver at a scale that is above and beyond the

minimum requirement. The costs of this option are lower than the alternative option because they offer a more flexible delivery approach by implementing improvements on 55 company sites based on the outcomes of the AMP7 WINEP investigation in to NERC41 habitats, and 40 sites based on the outcomes of the AMP7 investigation into pollinator habitats. This means that sites can be delivered on a priority basis with those achieving the most biodiversity net gain being delivered first for greater benefits versus cost.

The best value option will be delivered following the principles of our environmental strategy. The prioritisation and delivery of the programme will be developed with the relevant stakeholders and alongside our sustainability reduction, and catchment and nature-based solutions programmes to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

The biodiversity schemes within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a qualitative Natural Capital benefits assessment process. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation once defined.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence

To determine the best value option, an extensive options development process was undertaken with 31 unconstrained options, 10 constrained options reviewed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration

To determine the best value option, we have carried out a detailed risks and issues identification process with key stakeholders including the Environment Agency, Natural England and catchment partnerships. We have also developed our proposed solutions with input and feedback with key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	16 August 2023
Report Title	Biodiversity PR24 business case
Options Assessment Reports (WINEP)	08AF100002_OAR 08AF100003_OAR 08AF100004_OAR 08AF100005_OAR 08AF100006_OAR
Start Date	01/04/2025
Completion Dates	30/04/2027 (inv), 31/03/2030
WINEP Spreadsheet ID	
WINEP Action ID	08AF100002 08AF100003 08AF100004 08AF100005 08AF100006
WINEP Drivers	NERC_IMP (S+) NERC_INV (S) INNS_ND (S) INNS_INV (S) INNS_MON (S) SSSI_INV (S) SSSI_ND (S)
Scale of Action Delivery	Water Company Boundary

Tier 1Outcome	NERC_IMP (S+) Conserve and enhance biodiversity. NERC_INV (S) Conserve and enhance biodiversity. INNS_ND (S) Water company contribution to achieve improvement objectives or prevent deterioration. SSSI_INV (S) Maintain or restore SSSIs to favourable condition. SSSI_ND (S) Maintain or restore SSSIs to favourable condition.
Tier 2 Goal	NERC_IMP (S+) • Water company contribution to restoring, maintaining or enhancing pollinator numbers and NERC41 habitats and species across the supply area. • Affinity Water contribution to maintaining and enhancing reedbed habitat in the Colne catchment. • Affinity Water contribution to increasing the quantity, quality and connectivity of woodlands. • Water company contribution to the distribution and abundance of a priority species and habitat in Affinity Water supply area. • Affinity Water contribution to restoring natural functions of water and wetland ecosystems. • Affinity Water contribution to increasing the quantity, quality and connectivity of habitats in the supply area. NERC_INV (S) • Investigation into water company contribution to the distribution and abundance of a priority species in Affinity Water supply area. INNS_ND (S) • Reduce the spread of INNS species where appropriate and in line with RBMP along chalk streams in Affinity Water supply area. • Reduce the spread of INNS species where appropriate and in line with RBMP for Mimram and Cam. • Reduce the spread of INNS species where appropriate and in line with RBMP. • Reduce the risk and spread of INNS on water company assets. • Understand the scale of the invasive mink population in the catchment.

	SSSI_INV (S) • Affinity Water contribution to maintaining the favourable condition targets for flow attributes for Horsell Common SSSI. • Affinity Water contribution to maintaining the favourable condition targets for flow attributes for Cowslip Meadow SSSI. • Affinity Water contribution to maintaining the favourable condition targets for flow attributes for Dungeness SSSI. SSSI_ND (S) • Affinity Water contribution to meeting favourable condition targets for habitat and species for Wraysbury and Hythe End Gravel Pits SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Denge SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Alkham, Lydden and Swingfield Woods SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Folkestone and Etchinghill Escarpment SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Upper works SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Therfield Heath SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Mid Colne Valley SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Ruislip Woods SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Sherrardspark wood SSSI. • Affinity Water contribution to meeting favourable condition targets for habitat and species for Ash to Brookwood Heaths SSSI.
Tier 3 Output	NERC_IMP (S+) • Enhance habitat for pollinators and NERC41 habitats and species through delivery of AMP7 pollinator management plans, linking to National Pollinator Strategy, and NERC41 site enhancement plans. • Enhance reedbed habitat at Springwell by modelling local hydrology and investigating water management structures to create resilience against climate change. • Enhance woodland and hedgerow habitat in the supply area through the planting of trees and whips. • Support community groups to deliver biodiversity improvements to priority habitats in the supply area.

	• Enhance chalk stream catchment to benefit chalk stream ecology, connectivity and catchment health. • Work with partners to enhance NERC41 habitats and connectivity to increase the abundance of priority species on Affinity Water sites and surrounding countryside. NERC_INV (S) • Investigation to identify options for reintroduction of a protected species in the Affinity Water supply area through monitoring, and use of BRC data, and working with partners. INNS_ND (S) • Work with HMWT and other partners to determine the mink population size in the supply area with the aim to control numbers. • Work with others to deliver ad hoc INNS management in the catchments in which Affinity Water operates. • Work with others to deliver catchment level INNS awareness and management of Himalayan Balsam in the Cam and Mimram catchments. • Reduce INNS and build biosecurity infrastructure at company sites with an INNS risk to reduce introduction and spread. Ensure biosecurity and INNS awareness training for all staff. • Contribute to national trial to test novel treatment of INNS. SSSI_INV (S) • Investigate whether company operation has an impact on the dwarf shrub heathland achieving favourable status. • Investigate whether company operation has an impact on the species-rich lowland meadow grassland meeting favourable status. • Investigate whether company operation has an impact on the dwarf shrub heathland achieving favourable status. SSSI_ND (S+) • Create matrix habitat, control scrub and control INNS at Wraysbury and Hythe End Gravel Pits SSSI for the assemblage of rare breeding birds and mosaic of open water, island, woodland and grassland habitats through creation and implementation of the site management plan. • Control invasive species and maintain wetland and lake habitat at Dungeness SSSI to help achieve favourable condition for saltmarsh, sand dunes, vegetated shingle, saline lagoons, standing waters, lowland ditch systems, and basin fens habitats on the Denge Site. • Contribute to achieving favourable status of Alkham, Lydden and Swingfield Woods SSSI by managing hazel woodland for lady

	orchids and dormouse, and sympathetic management of calcareous chalk grassland on the Lyeoak Site. • Contribute to achieving favourable status of Folkestone and Etchinghill Escarpment SSSI by managing the Upper Works site to achieve good quality unimproved chalk grassland. • Contribute to achieving favourable status of Folkestone and Etchinghill Escarpment SSSI by managing the Upper Works and Hills Reservoir sites to achieve good quality unimproved chalk grassland. • Contribute to achieving favourable status of Therfield Heath SSSI for East Anglian type of chalk grassland habitat through the management of Therfield site. • Contribute to achieving favourable status of Mid Colne Valley SSSI through the management of Northmoor Site. • Contribute to achieving favourable status of Ruislip Woods SSSI ancient semi-natural woodland habitats through the management of Poors Field and Ruislip Site. • Contribute to achieving favourable status of Sherrards Park Wood SSSI ancient woodland habitat through the management of Sherrardswood Reservoir site. • Contribute to achieving favourable status of Ash to Brookwood Heaths SSSI by managing the Pirbright site to enhance the heathland habitat in the SSSI site.

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	1.58	1.58	1.58	1.58	1.58	**7.91**
Opex (£m)	0.35	0.35	0.36	0.36	0.36	**1.77**
Totex (£m)	1.93	1.93	1.94	1.94	1.94	**9.68**

Drivers	
75%	Biodiversity and conservation
25%	Invasive Non Native Species

Benefits
Biodiversity (units per 100 km^2)

Economic Analysis			
NPV Costs (£m) (2025-55)	**1.6**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This business case describes the WINEP schemes and investigations developed to support our biodiversity programme which will address the following:

- Implementation of habitat management plans on NERC41 sites identified during AMP7 investigations.
- Implementation of pollinator strategy actions following the AMP7 pollinator investigation.
- Implementation of biosecurity recommendations following the AMP7 audit of all sites and their risk of spreading and receiving INNS.
- Implementation of a support scheme to work with local communities to improve biodiversity in their local area, following an investigation in AMP7.
- Implementation of partnership working to control INNS in the Mimram and Cam catchments.
- Investigation into the effects of abstraction on a number of SSSIs.
- Implementation of a scheme to tackle new reports of INNS in the Affinity Water supply area.
- Investigation into the possibility of species reintroduction in our supply area
- Continued monitoring of AMP7 projects to assess biodiversity benefits.
- Monitoring of water voles across and the supply area to assess what potential mink control measures need to be implemented.
- Investigate wider catchment opportunities to implement biodiversity improvements with partners and landowners.

3 Project Development

3.1 Environmental Risk and Issues

Through the PR24 WINEP Stage 2 risks and issues stakeholder engagement process, a risks and Issues register (Appendix 1 – Risk and Issues List) has been developed through consultation with a range of stakeholders including:

- Environment Agency
- Natural England
- Catchment partnerships
- Wildlife Trusts
- River groups

This process has identified a list of risks and issues relating to biodiversity and habitat loss, invasive non-native species, the status of designated sites, protected species priorities, pollinators, climate change impacts and land management pressures that exist in the catchments in which we operate.

3.2 Baseline Assessment

A requirement under the AMP7 WINEP was to identify opportunities on company owned land where improvements could be made to habitats and species listed in Section 41 Natural Environment and Rural Communities Act (NERC41), for pollinators, and to improve biosecurity to manage invasive non-native species on company owned sites (7AF20001, 7AF20006, 7AF20007).

As part of this process, management options have been created for 83 company sites which identify where improvements can be made to increase the quality or number of NERC41 habitats. Fifty sites were audited to identify options for increasing pollinator numbers and management options were created for these sites. The management plans will be cross-referenced with operational constraints to finalise the feasibility of the implementation actions. These WINEP measure specifications were signed off by the EA and NE in December 2021 and April 2022, with the agreement that these management plans will be implemented in order of priority in AMP8.

The AMP7 WINEP measure specification 7AF20008 required us to investigate a mechanism by which support could be given to community projects aiming to improve biodiversity. A scheme was developed and signed off by the EA in April 2022 with the expectation that the scheme would go live in AMP8, and associated funding would be sought through the PR24 WINEP process.

Through Water UK, there is an industry-wide commitment to increase tree cover across the UK. Affinity Water have committed to planting 100,000 trees to contribute to the commitment.

The 25-Year Environment plan has ambitions to protect and restore wildlife and provide opportunities to re-introduce species that we have lost from our countryside. There is also a focus on improving water environments for clean and plentiful water and working with nature to provide resilience against drought and flood events.

We currently have partnership agreements with Herts and Middlesex Wildlife Trust, White Cliffs Countryside Partnership and Essex Wildlife Trust who manage and survey some of our biodiversity key sites. The financial and reputational benefits as well as the access to expertise and local knowledge through these partnerships should continue to be realised through sustained support and we have therefore included this continued partnership approach in our AMP8 plans.

3.3 Drivers for the programme

3.3.1 Statutory Drivers

The statutory drivers are:

Water Industry Strategic Environmental Requirements (WISER)

- Water companies to contribute to maintaining SSSIs and European Sites.
- Contribute to Nature Recovery Network and Local Nature Recovery Strategy plans.
- Explore opportunities for partnership working within AONB units.
- Have regard for the needs of NERC41 habitats and species, river and lake habitat.
- The management of INNS on company land and where there in an impact on WFD good status.

Legislation

- Natural Environment and Rural Communities (NERC) Act 2006 (as amended)
- The Wildlife and Countryside Act 1981 (as amended)
- Environment Act 2021
- Water Industry Act 1991
- The Conservation of Habitats and Species Regulations 2010 (as amended)
- Health and Safety at Work Act (1974)
- Water Framework Directive

The specific WINEP drivers are:

- SSSI_ND – Action to contribute to maintenance of (prevent deterioration of) the condition of a SSSI.
- 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.
- INNS_ND – Delivery – Actions to prevent deterioration by reducing the risks of spread of INNS and reducing the impacts of INNS.

- INNS_IMP – Delivery – Improvement schemes to reduce the impacts of INNS, where INNS is a reason for not achieving conservation objectives or good status.
- INNS_MON – Surveillance – set up of surveillance programmes.
- 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.
- NERC_IMP – Changed to permits of licences, and / or other action that contributes towards biodiversity duties, requirements and priorities.

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment including:

- 25 Year Environment Plan
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Chalk streams restoration strategy and implementation plan
- Potential AMP8 Biodiversity Performance Commitment
- Water UK '11 million trees' tree planting commitment
- Government's strategic priorities for Ofwat – Policy paper February 2022
- AW0031 Affinity Water Strategic Direction Statement
- Hertfordshire and Middlesex Wildlife Trust (HMWT) State of Nature 2020 report and associated targets
- Hertfordshire County Council (HCC) Sustainable Hertfordshire Strategy
- The Kent Biodiversity Strategy
- National Pollinator Strategy
- Natural England's Nature Recovery Network objectives
- Convention on Biological Diversity (COP15)
- Local Nature Recovery Strategies across the supply area
- Water UK commitment for operational Net Zero by 2030
- England Trees Action Plan

3.3.3 Stated Need

Under the NERC Act (2006 as amended), The Wildlife and Countryside Act (1981 as amended) and the Conservation of Habitats and Species Regulations 2010 (as amended), this work is required to ensure Affinity Water is able to deliver against statutory commitments and obligations with regard to biodiversity, conservation and environmental management.

The Environment Act 2021 sets objectives, among others, to:

- Halt the decline of species by 2030.
- Increase species abundance.
- Increase woodland cover.
- Protect the health of our rivers.

One of the government's key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats; and provide a thriving natural environment with increased environmental value, clean rivers and a sustainable ecosystem.

To address these challenges within the supply area, Affinity Water are required to invest through PR24 under the following regulatory / statutory drivers for WISER and WINEP:

WISER

- Create, restore and enhance NERC s41 habitats.
- Manage INNS on company assets and where there is a risk to WFD.
- Contribute to Nature Recovery Networks and Local Nature Recovery Strategies
- Maintain SSSIs and AONB sites.

For cross-referencing of WISER in relation to the 'best value' option for this business case please see Section 7.4 Level of Confidence of Achieving the WINEP Outcomes.

WINEP

The EA expects that the 'best value' option defined in this business case takes account of the following wider environmental outcomes:

- **Natural environment outcomes:** Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.
- **Catchment resilience outcomes:** Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
- **Net zero outcomes:** Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of.
- **Access, amenity, and engagement outcomes:** Contributions to improving access to, amenity of, and engagement with the natural environment to support customer and community wellbeing.

We also have responsibilities for the health and safety of our staff and the public and need to ensure trees and footpaths on our landholdings are managed, particularly where there is public access.

3.4 Allocation of Costs

As all elements of this business case are driven by statutory WINEP drivers, all costs will be attributed to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

Through the AMP7 WINEP process, we were asked to investigate the potential for improvements to NERC 41 habitats and species on our land holdings, as well as the potential to improve sites for pollinators, and manage the risk of INNS across the estate. The outputs of those studies included reports with a list of 50 sites that have been identified for opportunities to improve pollinators, 83 sites for improvements or the creation of NERC41 habitats, and 57 sites recommended for the installation of biosecurity infrastructure to reduce the risk of introduction and spread of INNS.

The sites that have been identified through this investigation have management plans written which form the request for funding in AMP8.

A biosecurity infrastructure options appraisal was carried out which gives an indication of effective options for each site, depending on the sites risk of INNS spread of introduction. This options appraisal will be used to form the implementation of infrastructure in AMP8, working with the other site stakeholders to ensure that the option chosen is the most appropriate.

We have been working in partnership with a number of organisations in AMP7 and longer-term including Herts and Middlesex Wildlife Trust, White Cliffs Countryside Partnership, Essex Wildlife Trust, Groundwork and the RSBP. This partnership working enables efficient and cost-effective management of our sites, whilst being able to utilise the benefits of endorsement from these well-known organisations, and the expanse of local knowledge and expertise that is held within those organisations. Continuing to work in partnership and explore the option of new partnership working opportunities is imperative to the effective and efficient delivery of the WINEP, namely the management of designated sites, and those containing NERC41 species.

Under the Environment Act (2021), it will be legal requirement from 2023 to compensate for where biodiversity units are lost on a site due to a development, to ensure a net gain in biodiversity. In order to achieve a biodiversity net gain and where this cannot be achieved on the site, the gain could be achieved on another site through the delivery of a management plan under this business case. Improvements to biodiversity on a site will be measured against a baseline assessment using the latest DEFRA biodiversity net gain tool to report on gains and losses.

Ofwat are also developing a Performance Commitment associated with a gain in biodiversity units as a company. To meet this requirement, we will need to record and report on the gain achieved through the delivery of biodiversity incentives when compared to a baseline. The delivery of schemes under this business case will help to compensate for sites where a biodiversity loss will be caused from the delivery of a capital or operational scheme and cannot be replaced within the site boundary, as well as to achieve an overall gain in units per hectare across Company operations to achieve the Performance Commitment.

4 Partnering

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

4.1 Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value.

However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concern over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small, planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

> *"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer*

Meeting the statutory minimum is not considered to be enough, and most people continue to believe that Affinity Water should be going above and beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

> *"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer*

The four areas of priority: sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they believed it would have a positive impact on wildlife for the future. Some people believed that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.3 Biodiversity

It has been well received by customers that biodiversity improvement and improving river flows will be a priority for Affinity Water, as it shows that Affinity Water are doing more than just offering the required services. During our preferences research, customers repeatedly chose environmental options that not only achieved the statutory minimum in terms of reducing abstraction, but also has additional benefits from catchments under-going ecological and biodiversity improvements. Customers have also shown support for increasing biodiversity and improving the environment when building large infrastructure schemes.

Our household customers valued the following biodiversity projects most highly: specialist habitats created for wildlife at £3.87 annually; new wetland areas at £3.24 annually; and space provided for sustainable agriculture at £2.61 annually. The households' average valuation of any project addition was considerably higher in the environmental area (£3.05), than either the economic area (£1.19) or the social area (£1.16).

4.1.4 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.2 Collaboration and Partnering

4.2.1 Engagement with Stakeholders and Partners

The EA Fish, Biology and Geomorphology (FBG) teams, invasive species leads, and NE were engaged throughout the process of identifying the Risk and Issues list. This has been an on-going process throughout AMP6 and AMP7, but additional workshops have been coordinated during the Stage 2 Risks and Issues phase with these stakeholders to identify co-funding / co-creation / co-delivery opportunities for river restoration, biodiversity and wider C&NBS.

The Herts and Middlesex Wildlife Trust (HMWT) State of Nature report has been taken into consideration and HMWT catchment leads have contributed to the list. We have quarterly strategic partnership meetings with the HMWT which helps to link work on our sites with the wider landscape and other holistic initiatives.

Local nature plans have been considered and priorities have been pulled into the list where schemes that could have co-partners have been identified, such as the tackling of INNS on a catchment scale.

4.2.2 Co-design and Co-delivery

We are already working with a wide range of delivery partners with whom we have developed relationships with through AMP6 and AMP7. We are working with these partners on a number of company sites, as well as on third-party land, to co-design and co-deliver a number of the management plans associated with SSSI sites and other sites of biodiversity importance.

Our current partners include:

- Groundwork
- Herts and Middlesex Wildlife Trust
- White Cliffs Countryside Partnership
- Natural England (through CSF and our tenant farmers)
- RSPB
- Watford Borough Council
- Watford Green Gym
- Essex Wildlife Trust

We propose to continue this approach through AMP8 to maximise the joint benefits of partnership working, shared funding, and links to bigger initiatives.

We are trialling a scheme in AMP7 with a private landowner at a lake site, to explore how multiple funding streams can be used to achieve greater environmental benefit when approaching a project with the aim of multiple outcomes e.g., water quality, biodiversity, carbon capture, water resources and WFD. This approach will be used to implement the option in this business case to implement projects on third-party land that have multiple benefits and can help us to achieve a biodiversity performance

commitment, various statutory obligations, and the Company vision to be stewards of the local environment.

We have worked with the RSPB at Dungeness Bird Reserve to contribute to the management plan of the whole reserve, including our own land that forms part of it, to ensure we are maximising benefits.

We are engaging with our tenant farmers and neighbouring landowners to join up on landscape management initiatives where possible to achieve greater environmental benefit by connecting with the wider landscape.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment (LTDS)

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this business case.

5.2 Environment Strategy

Providing high quality drinking water in a region with such a diverse range of habitats poses challenges, particularly in the face of climate change and a growing population. We continue to seek to improve our understanding of our local

environment and interactions with it and use these insights to inform our decision making so that we protect and enhance our local environment for current and future generations.

This Biodiversity programme aligns with the vision to 'Leave the environment in a sustainable and measurably improved state' which is the first ambition statement set out in our Strategic Direction Statement, and to deliver on our purpose 'to provide high quality drinking water and to take cate of the environment for our communities now and in the future by delivering environmental benefits in on our own land, and on land in the catchments in which we operate.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive approach. Delivery and implementation is adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option sets out site specific SSSI requirements and is complimented by a selection of biodiversity schemes on other landholdings. It assumes that schemes will be delivered in order of priority and feasibility so that a flexible approach can be taken to achieve the overall aims. The scheme can adapt to:

- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g., Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific measures can be prioritised to support wider environmental targets and objectives, Net Zero and / or Biodiversity Net Gain priorities (e.g., offsetting)
- Types of measures implemented can adapt and evolve based on future changes to guidance e.g., the Defra Biodiversity Metric.
- Continual monitoring and NC evaluations of delivered biodiversity schemes (current and future) will enable continual refinement of this project to ensure the greatest outcomes are achieved.
- Biodiversity measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships and strategic partners.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options: the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 3 - Biodiversity Option Evaluation.

We have then assessed these further, with additional information; by developing hybrid solutions that take the best elements across a number of work packages, which grouped delivery actions (grouped options); and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment to select our best value option.

6.1 Unconstrained List

Further information on the biodiversity options and what each option covers is listed in Appendix 2 - WINEP Biodiversity scheme build 'summary of grouped options' tab.

The unconstrained list of options is listed below in Table 1. A suite of 31 options were considered at the initial unconstrained stage, made up of a combination of items from the Risk and Issues list. Of these 31 options, 14 were removed from further assessment, see table below for reasons for not taking forward. Seventeen were carried forward to be assessed using the Options Evaluation Assessment spreadsheet. Some options which did not meet all stakeholder and legislative requirements were also assessed using the Options Evaluation Assessment, to confirm that they did not achieve wider benefits that would have made them more cost beneficial than another option.

Seventeen options were assessed using the Options Evaluation Assessment spreadsheet which was able to give a high-level overview of the wider benefits achieved by each of the options. Those options which scored 30 or higher are listed in the below table, classified as 'C', and were carried forward to the constrained options list. The three options from the constrained list that scored highest on the course screening, "Proceed (P)" were then carried forward to the feasible option assessment.

Our unconstrained list of options are:

Table 1 - Unconstrained list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	(S only) Undertake basic statutory requirements on company owned SSSIs (SSSI ND) and basic INNS schemes (INNS INV INNS IMP and INNS ND).	R	Does not meet statutory requirements but assessed to confirm. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
2	(S only) Undertake basic statutory requirements on SSSIs, investigations into company impact on SSSIs in supply area (SSSI ND and SSSI INV) and basic INNS schemes (INNS INV, INNS IMP and INNS ND).	R	Does not meet Statutory requirements
3	(S only) Undertake enhanced statutory requirements on SSSIs, investigations into company impact on SSSIs in supply area (SSSI ND and SSSI INV) and basic INNS schemes (INNS INV, INNS IMP and INNS ND).	R	Does not meet Statutory requirements
4	(S only) Undertake enhanced statutory requirements on SSSIs, investigations into company impact on SSSIs in supply area (SSSI ND and SSSI INV) and enhanced INNS schemes (INNS INV, INNS IMP and INNS ND).	R	Does not meet Statutory requirements
5	(S only) Undertake enhanced statutory requirements on SSSIs, investigations into company impact on SSSIs in supply area (SSSI ND and SSSI INV) and enhanced + INNS schemes (INNS INV, INNS IMP and INNS ND).	R	Assessed for wider benefits as enhanced + options for SSSIs and INNS but doesn't address NERC schemes. Although does not meet all stakeholder requirements, assessment carried out to check for wider benefits. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation

6	(S only) Undertake basic SSSIs investigations and management (SSSI ND and SSSI INV), basic INNS schemes (INNS INV, INNS IMP and INNS ND), and basic NERC INV.	R	Does not address all Risk and Issues addressed by stakeholder so would not receive support
7	(S only) Undertake enhanced option on SSSIs (SSSI ND and SSSI INV), basic INNS schemes (INNS INV, INNS IMP and INNS ND), and basic NERC INV.	R	Does not address all Risk and Issues addressed by stakeholder so would not receive support
8	(S only) Undertake enhanced option on SSSIs (SSSI ND and SSSI INV), basic INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced NERC INV.	R	Does not address all Risk and Issues addressed by stakeholder so would not receive support
9	(S only) Undertake enhanced option on SSSIs (SSSI ND and SSSI INV), enhanced INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced NERC INV.	R	Assessed for wider benefits as S only, but enhanced options. Although does not meet all stakeholder requirements, assessment carried out to check for wider benefits. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
10	(S only) Undertake enhanced option on SSSI ND and SSSI INV, enhanced + INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced NERC INV.	R	Does not address all Risk and Issues addressed by stakeholder so would not receive support
11	(S only) Undertake enhanced option on SSSI ND and SSSI INV, enhanced + INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced + NERC INV.	R	Assessed for wider benefits as S only but enhanced and enhanced + options. Although does not meet all stakeholder requirements, assessment carried out to check for wider benefits. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
12	(S only) Undertake basic option on SSSI ND and SSSI INV, enhanced + INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced + NERC INV.	R	Does not address all Risk and Issues addressed by stakeholder so would not receive support

13	(S only) Undertake basic option on SSSI ND and SSSI INV, enhanced INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced NERC INV.	R	Does not address all Risk and Issues addressed by stakeholder so would not receive support
14	(S only) Undertake basic option on SSSI ND and SSSI INV, enhanced + INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced NERC INV.	R	Although does not meet all stakeholder requirements, assessment carried out to check for wider benefits with low cost Basic SSSI option. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
15	(S only) Undertake basic option on SSSI ND and SSSI INV, enhanced INNS schemes (INNS INV, INNS IMP and INNS ND), and enhanced + NERC INV.	R	Although does not meet all stakeholder requirements, assessment carried out to check for wider benefits with low cost SSSI option. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
16	(S and S+ grouped) SSSIs Option A, Internal Land Management Option A, INNS Option A, Third Party Land Schemes Option A, Strategic Partnerships Option A	R	Although does not meet all stakeholder requirements as option is without partnership schemes, assessment carried out to check for wider benefits. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
17	(S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS Option B, Third Party Land Schemes Option A, Strategic Partnerships Option A	C	Although does not meet all stakeholder requirements as option is without partnership schemes, assessment carried out to check for wider benefits. See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
18	(S and S+ grouped) SSSIs Option A, Internal Land Management Option C, INNS Option B, Third Party Land Schemes Option B, Strategic Partnerships Option A	R	Not feasible to deliver Land Management Option C with Partnerships Option A

19	(S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS Option C, Third Party Land Schemes Option A, Strategic Partnerships Option B	C	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
20	(S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS Option C, Third Party Land Schemes Option C, Strategic Partnerships Option B	P	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
21	(S and S+ grouped) SSSIs Option A, Internal Land Management Option A, INNS Option B, Third Party Land Schemes Option A, Strategic Partnerships Option B	C	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
22	(S and S+ grouped) SSSIs Option A, Internal Land Management Option C, INNS Option B, Third Party Land Schemes Option A, Strategic Partnerships Option A	R	Not feasible to deliver Land Management Option C with Partnerships Option A
23	(S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS Option B, Third Party Land Schemes Option B, Strategic Partnerships Option B	C	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
24	(S and S+ grouped) SSSIs Option A, Internal Land Management Option C, INNS Option C, Third Party Land Schemes Option A, Strategic Partnerships Option A	R	Not feasible to deliver Land Management Option C with Partnerships Option A
25	(S and S+ grouped) SSSIs Option A, Internal Land Management Option C, INNS Option C, Third Party Land Schemes Option B, Strategic Partnerships Option A	R	Not feasible to deliver Land Management Option C with Partnerships Option A
26	(S and S+ grouped) SSSIs Option B, Internal Land Management Option B, INNS option C, Third Party Land Schemes Option B, Strategic Partnerships Option B	P	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
27	(S and S+ grouped) SSSIs Option B, Internal Land Management Option B, INNS option A, Third Party Land Schemes Option A, Strategic Partnerships Option B	C	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation

28	(S and S+ grouped) SSSIs Option B, Internal Land Management Option C, INNS Option B, Third Party Land Schemes Option A, Strategic Partnerships Option A	R	Not feasible to deliver Land Management Option C with Partnerships Option A
29	(S and S+ grouped) SSSIs Option B, Internal Land Management Option B, INNS option C, Third Party Land Schemes Option C, Strategic Partnerships Option B	C	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
30	(S and S+ grouped) SSSIs Option B, Internal Land Management Option C, INNS Option C, Third Party Land Schemes Option B, Strategic Partnerships Option B	C	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation
31	(S and S+ grouped) SSSIs Option B, Internal Land Management Option C, INNS Option C, Third Party Land Schemes Option C, Strategic Partnerships Option B	P	See Options Evaluation spreadsheet in Appendix 3 - Biodiversity Option Evaluation

6.2 Constrained List

To form the constrained list, 10 options have been selected from the original 31 unconstrained based on their scoring using the Options Benefits Assessment criteria (Appendix 3 - Biodiversity Option Evaluation). Those that scored a 3, 4 or 5 on the Evaluation Assessment (or 30 or higher based on a positive point for a 'yes' and a negative point for a 'no') were carried forward to the constrained list, as they have the most overall benefit when assessing using the below criteria:

- Comply with the statutory obligations.
- Achieve the non-statutory requirements.
- Show customer support.
- Gain support from partners and stakeholders.
- Support the SDS and AWS long-term strategy, outcomes and targets.
- Support the other relevant strategies, e.g., WRMP, Water Basins, Catchment Strategies.
- Ensure no / low regrets if our strategy needs to adapt in the future.
- Support the natural capital outcomes.
- Support the net zero outcomes.
- Support the catchment resilience outcomes.
- Support the access, amenity and engagement outcomes.
- Deliver a net environmental gain.
- Address an environmental risk.
- Be resilient against climate change.

- Support the use of catchment and nature-based solutions.
- Work closely with partners to provide wider benefits.
- Develop new technology and innovation.
- Provide certainty in delivering the desired outcomes.
- Provide evidence to support the justification of the project.
- Be easily procured.
- Have a low overall cost.
- Provide overall cost benefits to society.
- Provide overall best value.
- Manage the delivery risks.
- Be delivered with the available skills and resources.
- Be able to be monitored and reported.

The 10 options were then assessed again using the WINEP course screening criteria to determine which of the three options was the most environmentally beneficial, met all statutory and non-statutory requirements, was technically feasible and was deliverable.

The results of the optioneering as defined using the WINEP coarse screening criteria is presented below in Table 2. The scores of each option were calculated through adding up of the number of 'Yes' scores the option achieved. The three with the most Yeses formed the feasible option list (numbers highlighted in green in the first column).

Table 2 - Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
(17) (S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS option B, Third Party Land Schemes Option A, Strategic Partnerships Option A	YY	Y	NN	N
(19) (S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS option C, Partnership Schemes Option A, Strategic Partnerships Option B	YY	YY	YY	YY
(20) (S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS option C, Third Party Land Schemes Option C, Strategic Partnerships Option B	YYY	YYY	YYY	YYY
(21) (S and S+ grouped) SSSIs Option A, Internal Land Management Option A, INNS option B, Third Party Land Schemes Option A, Strategic Partnerships Option B	Y	Y	YYY	YYY
(23) (S and S+ grouped) SSSIs Option A, Internal Land Management Option B, INNS option B, Third Party Land Schemes Option, Strategic Partnerships Option B	YYY	YY	YYY	YYY
(26) (S and S+ grouped) SSSIs Option B, Internal Land Management Option B, INNS option C, Third Party Land Schemes Option B, Strategic Partnerships Option B	YYY	YY	YY	YY
(27) (S and S+ grouped) SSSIs Option B, Internal Land Management Option B, INNS option A, Third Party Land Schemes Option A, Strategic Partnerships Option B	YY	YY	YY	YY
(29) (S and S+ grouped) SSSIs Option B, Internal Land Management Option B, INNS option C, Third Party Land	YYY	YY	YY	YY

Schemes Option C, Strategic Partnerships Option B				
(30) (S and S+ grouped) SSSIs Option B, Internal Land Management Option C, INNS option C, Third Party Land Schemes Option B, Strategic Partnerships Option B	YYY	YY	YY	YY
(31) (S and S+ grouped) SSSIs Option B, Internal Land Management Option C, INNS option C, Third Party Land Schemes Option C, Strategic Partnerships Option B	YYY	YYY	YY	YY

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

The final set of 3 feasible options are:

- SSSIs Option A, Internal Land Management Option B, INNS Option C, Third party Land Schemes Option C, Strategic Partnerships Option B
- SSSIs Option A, Internal Land Management Option B, INNS Option B, Third party Land schemes Option B, Strategic Partnerships Option B
- SSSIs Option B, Internal Land Management Option C, INNS Option C, Third party Land Schemes Option C, Strategic Partnerships Option B

6.3.1 Option 0: Do Nothing

Do nothing option. No delivery of any enhancement biodiversity schemes. Does not meet statutory requirements or achieve wider WINEP benefits. This is discounted as a feasible option.

6.3.2 Option 1: Preferred, Best Value, Option

SSSIs Option A, Internal Land Management Option B, INNS Option C, Third Party Land Schemes Option C, Strategic Partnerships Option B.

The preferred, best value options is made up of: **Option A of the SSSI management work package** which includes full investigations in to three SSSI sites, and the delivery of land management on 10 sites within or adjacent to SSSIs at 75% ambition; **Option B of the internal land management work package**, which includes an investigation into species reintroduction, the delivery of 55 site management plans for improving

NERC41 habitats, the delivery of 40 site management plans for pollinator number increases, planting of 100,000 trees/hedgerows, improvements to Springwell reedbed and the implementation of a community support initiative focussed on biodiversity improvements in the supply area; **Option C of the INNS work package** which includes the management of mink, delivering INNS management in the catchment at a larger scale, a larger contribution to a National INNS trial, and a larger scale delivery of biosecurity infrastructure and training; **Option C of the third party land schemes work package** which is the delivery of 5 large scale partnership schemes on third party land, and **Option B of the strategic partnership work package** which is to fund partnership conservation organisations to achieve wider benefits through joint delivery on strategic sites.

Total cost (FY2022/23 cost base):

AMP8 Enhancement Capex (£m)	**£7.915m**
AMP8 Enhancement Opex (£m)	**£1.767m**
AMP8 Totex (£m)	**£9.682m**

6.3.3 Option 2

SSSIs Option A, Internal Land Management Option B, INNS Option B, Third Party Land Schemes Option B, Strategic Partnerships Option B.

The least cost option is made up of: **Option A of the SSSI management work package** which includes full investigations in to three SSSI sites, and the delivery of land management on 10 sites within or adjacent to SSSIs at 75% ambition; **Option B of the internal land management work package**, which includes an investigation into species reintroduction, the delivery of 55 site management plans for improving NERC41 habitats, the delivery of 40 site management plans for pollinator number increases, planting of 100,000 trees/hedgerows, improvements to Springwell reedbed and the implementation of a community support initiative focussed on biodiversity improvements in the supply area; **Option B of the INNS work package** which includes delivering INNS management in the catchment at a smaller scale, a smaller contribution to a National INNS trial, and a smaller scale delivery of biosecurity infrastructure and training; **Option B of the third party land schemes work package** which is the delivery of 3 large scale partnership schemes on third party land and **Option B of the strategic partnership work package** which is to fund partnership conservation organisations to achieve wider benefits through joint delivery on strategic sites.

Total cost (FY2022/23 cost base):

AMP8 Enhancement Capex (£m)	**£7.245m**
AMP8 Enhancement Opex (£m)	**£1.617m**
AMP8 Totex (£m)	**£8.862m**

6.3.4 Option 3

SSSIs Option B, Internal Land Management Option C, INNS Option C, Third Party Land Schemes Option C, Strategic Partnerships Option B

The alternative option is made up of **Option B of the SSSI management work package** which includes full investigations in to three SSSI sites, and the delivery of land management on 10 sites within or adjacent to SSSIs at 100% ambition; **Option C of the internal land management work package**, which includes an investigation into species reintroduction, the delivery of 83 site management plans for improving NERC41 habitats, the delivery of 50 site management plans for pollinator number increases, planting of 120,000 trees/hedgerows, improvements to Springwell reedbed and the implementation of a 20% larger community support initiative focussed on biodiversity improvements in the supply area; **Option C of the INNS work package** which includes the management of mink, delivering INNS management in the catchment at a larger scale, a larger contribution to a National INNS trial, and a larger scale delivery of biosecurity infrastructure and training; **Option C of the third party land schemes work package** which is the delivery of 5 large scale partnership schemes on third party land and **Option B of the strategic partnership work package** which is to fund partnership conservation organisations to achieve wider benefits through joint delivery on strategic sites.

Total cost (FY2022/23 cost base):

AMP8 Enhancement Capex (£m)	**£9.196m**
AMP8 Enhancement Opex (£m)	**£2.053m**
AMP8 Totex (£m)	**£11.249m**

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high-**level of confidence in achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It demonstrates a significant increase in ambition compared to the programme in AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process, builds on the investigation measures that were explored during AMP7 NEP/WINEP programmes, proposes continuing with existing strategic partnerships to maximise benefits of external expertise, low delivery costs and joint organisational messaging, and includes the delivery of five large third party land partnership schemes that will provide multiple wider environmental benefits including greater access to nature, carbon capture, and resilience to climate change.

6.4.2 Option 2

This option has a **medium** level of confidence in achieving the WINEP wider environmental outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the investigation measures that were explored during AMP7 NEP / WINEP programmes, proposes continuing with existing strategic partnerships to maximise benefits of external expertise, low delivery costs and joint organisational messaging. This option takes a less holistic approach to tackling INNS in the catchment, contributing significantly to WFD, and is less ambitious with regard to the delivery of large third-party land partnership schemes that will provide multiple wider environmental benefits.

6.4.3 Option 3

This option has a **high-**level of confidence in achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It demonstrates a significant increase in ambition compared to AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process, builds on the investigation measures that were explored during AMP7 NEP / WINEP programmes, proposes continuing with existing strategic partnerships to maximise benefits of external expertise, low delivery costs and joint organisational messaging, and includes the delivery of five large third party land

partnership schemes that will provide multiple wider environmental benefits. This option also includes the enhanced + option for land management which includes the delivery of a further 28 management plants, and implementation of pollinator management on a further 10 sites. It also includes enhanced option for SSSI management to deliver a great number of improvements on the sites. This option is the most ambitious but is more challenging in terms of delivery than the other two options, as more resource will be required. This is reflected in the higher cost of this option as there will be a greater reliance on framework contractors to carry out the delivery.

Table 3 - Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the Biodiversity Programme

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	The PR24 programme must include actions to improve water body status to ensure that moderate status is achieved by 2030 as a minimum and improve further where technology allows	INNS options in the Biodiversity Programme will support meeting moderate status.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnerships
Environment Act	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	All Biodiversity Programme options focus on delivering multiple ecosystem services benefits
Environment Act	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	All Biodiversity Programme options focus on delivering multiple ecosystem services benefits including biodiversity
Environment Act	Anticipated that water companies will need to have regard to the priorities set out in the LNRS covering their operational area when agreeing PR24 priorities.	AWL engaging with HCC, KCC, HMWT and NE on priorities of LNRS.

Environment Act	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnerships Strategic Partnership with HMWT, WCCP and EWT established.
SSSI	We expect water companies to contribute to maintaining or achieving SSSI favourable condition both on their own land and in the catchments they operate in.	SSSI Options for investigations and delivery to maintain favourable status included in Biodiversity Programme.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	The Biodiversity Programme will focus on delivering multiple ecosystem services benefits including biodiversity, particularly in priority areas.
Natural environment	Help create climate resilient places and improve the resilience of communities to droughts, floods and coastal change by implementing cost-effective co funded solutions.	Biodiversity Programme measures within this scheme will support more resilient chalk stream catchments to flood and drought.
Ecosystem and natural function	The long-term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	Biodiversity Programme will support resilient chalk stream catchments and sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	Biodiversity Programme identify opportunities to restore, re-connect and enhance chalk stream habitats.
Water supply and environmental resilience	Water company plans should protect and improve the environment, considering both current and future challenges. This could mean tighter environmental protection for some sensitive habitats such as chalk streams, to meet env objectives.	Biodiversity Programme measures within this scheme will seek to protect priority habitats including chalk streams.
Climate Change	Water companies are expected to adopt nature-based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnerships
Climate Change	WCs should improve the natural resilience of the catchments in which they operate by restoring their natural function. Water companies should ensure that solutions build resilience of biodiversity in catchments, river systems and water bodies.	Biodiversity Programme measures within this scheme will seek to create more resilient chalk stream catchments in which AW operate with focus on delivering multiple benefits including biodiversity.

6.4.4 Can the Option Provide Net Benefits?

Option 1: Preferred, Best Value, Option

By working with partners, the best value option can provide the following net environmental benefits:

- The contribution to trials of new INNS treatments and the management of American mink in the Hertfordshire area, linking to the reintroduction of water vole to some key sites.
- The ability to support a larger number of partners in the management of INNS at a catchment scale which will have an increased likelihood of achieving overall Good Ecological Status (GES) in those catchments and subsequently on our landholdings too.
- Delivery of two additional large scale partnership projects which will have multiple benefits linked to flooding, water quality improvements, carbon capture, water retention and more resilient habitats.

Option 2

Option 2 can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process. The other feasible options can deliver the following additional environmental benefits.

Option 3

In addition to the net environmental benefits stated in the best value option, by implementing the enhanced + option across all 'work packages', there is an increased likelihood of meeting wider environmental outcomes for biodiversity, climate change regulation, SSSI habitat being enhanced, and being able to deliver 4 additional large scale partnership projects which will have multiple benefits linked to flooding, water quality improvements, carbon capture, water retention and more resilient habitats.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support meeting the WINEP wider environmental outcomes. Examples are shown below, but not limited to:

Natural Environment Outcomes

Habitat enhancement schemes on NERC41 habitats across the Affinity Water operational catchments which provide greater habitat and supporting ecology for priority species such as water voles.

Catchment Resilience Outcomes

River and lake improvements and habitat enhancement schemes on chalk streams and their catchments across the Affinity Water operational catchment to provide

benefits to water quality through reduction of silt build up, installation of hedgerows to reduce sediment run off from land and wetland creation to slow high flows.

Net Zero Outcomes

Biodiversity measures such as wetland creation and grassland management contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments.

Access, Amenity, and Engagement Outcomes

Habitat enhancement schemes on publicly accessible land to improve connectivity between priority habitats, people and communities, enhancing access and recreation opportunities.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding with regard potential schemes on third party land, working in partnership with other stakeholders, and through delivery of catchment wide INNS control by working with other catchment users.

Option 2

Option 2 has less proportional benefits to the environment versus the cost of delivery than Option 1. Option 2 looks to deliver two less third-party land partnership schemes than Option 1 which means less wide environmental benefit by connecting sites outside of Affinity Water ownership, and less opportunity to realise other benefits from these schemes such as flood alleviation, water quality improvements and carbon capture. This option also has fewer catchment wide benefits of INNS control at both catchment and national scale compared with Option 1.

Option 3

Option 3 adopts a similar approach to option 1 but aims to deliver a more ambitious programme of interventions and improvements on company owned sites, and a more ambitious programme of delivery on SSSI sites. This option is less appropriate to the size and complexity of the environmental risks and issues and is considered more challenging to deliver due to the scale of the programme. As this option aims to deliver all currently existing management plans, it is less adaptive than the best value option.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP business cases by PR24 Red Team
    b. Review of business cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 5 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 6.

Our economic and analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity testing, and combine projects for analysis as necessary.

The WINEP methodology does not monetise biodiversity benefits due to the inherent uncertainties in the metrics and valuations. It does, however, suggest that biodiversity units are used to quantify the benefits, if possible, where they are available. We have some unit baseline values which can be attributed to the delivery of elements of the programme, but do not have an overall programme level baseline to calculate biodiversity gains at this stage.

We have used our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

7.2 Cost Estimation

The costs for each option have been calculated using a combination of the Affinity Water unit cost model which uses unit costs for biodiversity activities to build up projects, and costs from previous known work and schemes.

7.3 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. Although in most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. Instead, we have discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics, and if these significantly materially impact the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have sometimes qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

7.4 Natural Capital Impacts

The Natural Capital assessment for the biodiversity programme has been carried out qualitatively, following the WINEP methodology guidance to not monetise biodiversity benefits. Once the individual schemes are more defined, baselines will be calculated so that full NCRAT tool assessments can be made before and after delivery to quantify schemes where possible.

7.5 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require.

8 Option Assessment

8.1 Commentary

The primary objective of the project is to improve biodiversity across the Affinity Water Estate and supply area, and this has formed the focus for our option assessment. Our analysis has been to assess the preferred, least cost and alternative options. We have not monetised our biodiversity benefits as per the WINEP methodology. However, we have estimated the improvements in biodiversity units where possible to do so. In other areas, we have had to make simple qualitative assessments of the biodiversity benefits. These estimates have been used to compare the options, whilst considering the option costs and other benefits and dis-benefits. We have also used the screening criteria for the option development to inform our final decision-making.

8.2 Benefit Screening

We have screened each feasible option to understand the potential benefits. These are captured in the following table (Table 5) and then used in our assessment.

Table 4 - Benefits screening

Benefit	Commentary
WINEP Benefits	
Biodiversity – SSSI Management	Considered but not measured
Biodiversity – NERC41 habitats site management	Considered and units quantified
Biodiversity – Pollinator numbers	Considered but not measured
Invasive species reduction	Considered but not measured
Increase in tree cover	Considered but not measured
WINEP Benefits	
Water purification by habitats	Considered but not measured
Water quality	Considered but not measured
Water supply	Considered but not measured
Climate regulation	Considered but not measured

Recreation	Considered but not measured
Recreation – angling	Considered but not measured
Food – shellfish	Not applicable
Air quality	Not applicable
Hazard regulation – flood	Considered but not measured
Volunteering	Considered but not measured
Education	Considered but not measured
Other Benefits	
Food production (ha)	Not applicable
Livestock (dairy and meat) (ha)	Not applicable
Timber production (ha)	Not applicable
Social health (ha)	Considered but not measured

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option 1**	**Yes**
	Option 2	**Yes**
	Option 3	**Yes**
	Option 4	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our option analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit assessment. By making conservative assumptions, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

Larger scale projects mean more benefits

- As we have only carried out a qualitative assessment, we have assumed that a larger scale project will have proportionately more benefits

Biodiversity Units

- Biodiversity units were calculated using metric 2.0 so may be different using the new version of the metric.

8.4 Non-Monetised Assessment

8.4.1 SSSI Management

The delivery of biodiversity interventions on SSSI sites will be able to be quantified once a BNG baseline assessment has been carried out, and then the site will be reassessed following the implementation of actions.

The preferred option 1 and option 2 has the same level of ambition for the SSSI Management work package, Option A. Option 3 includes Option B of this work package which is of higher value so as to deliver more improvement on the sites. Option B will likely provide a greater BNG value compared with Option A, although the costs for Option B are much higher, and may not give proportionate environmental gain for the additional money spent.

8.4.2 Internal Land Management

The internal land management work package includes the implementation of NERC41 and pollinator management plans, the delivery of biodiversity projects in the community, management of a reedbed habitat, investigation into the reintroduction of a species, and the creation of woodland and hedgerow habitat through tree planting.

The best value option 1 and option 2 have the same level of ambition for this work package, Option B, whereas the alternative option includes a more ambitious option, Option C of the work package.

The sites put forward for NERC41 habitat management plans to be implemented upon have had a BNG baseline assessment carried out, and have hypothetical post-implementation assessment values too, using the Defra BNG metric 2.0. The potential number of Biodiversity units that could be achieved through the delivery of Option B which aims to deliver 55 NERC41 site management plans is: 1674.

Option 3 has a higher level of ambition, Option C, which aims to deliver 83 NERC41 site management plans which have the potential to deliver 1699 biodiversity units.

A baseline assessment has not yet been carried out on the pollinator sites to quantitively assess the benefits of delivery of the management plans but this will be

done prior to the delivery of these plans, but it is assumed that a greater number of units will be delivered through Option C of the work package, as this aims to deliver on a larger number of sites (60, compared with Option B which aims to deliver 40).

The larger number of community biodiversity schemes that will be supported though Option C, which is 20% larger than Option B of the work package, is expected to have a greater NC benefit with regard volunteering opportunities, education through working with a greater number of groups, as well as greater BNG through the delivery of more schemes.

More NC value is therefore expected to be achieved through option 3, although the costs for this option are significantly more and may not be proportionate to the additional benefit.

8.4.3 INNS Management

This work package includes the management of INNS in the community, with partners at both a catchment and local scale, catchment wide eradication and the treatment of Himalayan balsam in the Mimram and Cam catchments, the management of INNS through treatment and the inclusion of biosecurity infrastructure on company land, and the contribution to national INNS treatment trial.

This work package is difficult to quantity due to the undefined nature of the schemes that will take place in the community at this stage, and the difficulty in knowing what can be carried out on third party land.

Option 2 includes option B of this work package, which is a less ambitious option than that covered by the preferred option and the alternative option.

Option C of this work package, included in the best value option 1 and option 3, has the ambition to deliver 2 additional catchment wide INNS control projects each year, an additional 10% local community INNS control schemes, 20% more treatment in the Mimram and Cam catchments, and a greater number of biosecurity infrastructure across publicly accessible sites compared with Option B covered by the least cost option. It also includes the additional task of carrying out mink monitoring and control.

While these projects cannot be assessed quantitively at this stage, Option C will have a greater value with regard education around INNS and how to manage them, volunteering effort and opportunity, increased input toward achieving good status under WFD on the Mimram and Cam chalk streams, recreational visits will be increased as species such as floating pennywort will be tackled which causes problems with angling and water sports, and greater balsam control can impact positively on water quality, bank erosion and riparian habitat.

8.4.4 Third-Party Land Partnership Schemes

This work package includes the delivery of larger partnership schemes on land not owned by Affinity Water.

As these projects are not yet defined, they are not able to be quantitively assessed, but the ambition is that these schemes will have multiple NC benefits including: education through working with local community and wider stakeholders and the addition of interpretation on environment and the link to water and water consumption; recreational use through opening areas currently private up to the public; volunteering opportunities through both project delivery and ongoing maintenance; carbon sequestration, benefits to water quality and climate change resilience through different land use creation (depending on the project and the implementation but, for example, a new wetland could have these benefits) as well as biodiversity benefits achieved through increasing the number and quality of priority habitats.

Option 2 include Option B of this work package, where 3 of these projects will be delivered.

The best value option 1 and option 3 include Option C of this work package, where 5 of these projects will be delivered, meaning a greater NC benefit from the best value option 1 and option 3.

8.4.5 Strategic partnership Working on Affinity Water Land

This work package includes working with strategic partners to deliver NERC41 habitat improvements on Affinity Water land and the wider landscape. All three options include Option B of this work package, as the benefits assessment carried out during the reduction of options from the unconstrained to the constrained list removed Option A on account of not achieving enough wider benefits and making the Land Management work package difficult to deliver without these partnerships.

NC benefits of working with these strategic partners include education, volunteering, access and recreation as well as biodiversity gains.

8.5 Wider Environmental Outcomes

8.5.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares as described in other sections.

8.5.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option 1**	^
	Option 2	^
	Option 3	^
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option 1**	^
	Option 2	^
	Option 3	^
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Preferred Option 1**	^
	Option 2	^
	Option 3	^
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option 1**	^
	Option 2	^
	Option 3	^

8.6 Risk Assessment

8.6.1 Option 1: Preferred, Best Value, Option

The best value option 1 significantly reduces the risk of non-delivery of the WINEP requirements by addressing the stakeholder gathered risk and issues list. This option also allows for an element of flexibility with regard delivery of site management improvements, as less sites are being put forward for delivery so that site constraints can be accommodated, and a flexible delivery approach can be taken. As the sites chosen for delivery will be done on a priority basis, a greater environmental gain will be achieved on the as the higher priority site implementation activities are delivered, and smaller gains will be achieved from the delivery of sites lower down the priority list.

The best value option also offers the opportunity to explore projects on third-party land that will be able to achieve greater wider environmental benefits. This option is less ambitious that of Option 3, but it more likely to succeed due to the smaller scale of the programme and, therefore, the ability to deliver with a combination of in-house and external resource.

8.6.2 Option 2

This option delivers fewer third-party land partnership schemes and supports fewer catchment wide INNS control schemes. This option will, therefore, have the potential to require more ongoing treatment of INNS as they are tackled at a smaller scale, addressing the risk of INNS spread in the catchment to a lesser extent than that of Option 1. There is a less ambitious third-party land partnership project option with Option 2 which is therefore less likely to deliver as many wider environmental benefits compared with Options 2 and 3.

8.6.3 Option 3

Option 3 has the greatest level of ambition with regard the delivery of environmental benefits, but also has a greater level of delivery risk as there is less flexibility in the delivery of the land management options. As the lower priority sites will be delivered last, the relative gain versus the cost will be smaller than those delivered under Option 1.

This option also has a greater investment in SSSI management, which addresses the risk of SSSI not achieving favourable status to a larger degree than Options 1 and 2. Although this Option addresses the WINEP requirements to the biggest degree, it also has a higher chance of failure due to the reduced flexibility in delivering the programme, and the increased reliance on external resource.

8.7 Justification of the Preferred, Best Value, Option

The best value option is the preferred option because it creates a biodiversity programme which addresses all of the risks and issues across the company supply area that were raised by stakeholders. When reviewing the scale of benefits achieved through the delivery of the three options compared with their costs, the best value option achieved the most benefit on a qualitative basis.

The option is ambitious in that it considers all risks and issues raised and aims to deliver at a scale that is above and beyond the minimum requirement. The costs of this option are lower than the alternative option because they offer a more flexible delivery by implementing improvements on 55 company sites following the AMP7 WINEP investigation in to NERC41 habitats, and 40 sites following AMP7 investigation into pollinator habitats. This means that sites can be delivered on a priority basis with those achieving the most biodiversity net gain being delivered first for greater benefits versus cost.

The low-cost option 2 does not offer as much environmental benefit as the programme is smaller, particularly with regard to INNS management at the catchment scale, and the delivery of large third-party land partnership projects which have multiple wider benefits including carbon capture, improved water environment, reduced flood risk, social value and increased biodiversity value.

The preferred option supports the Affinity Water environment policy and ambition to provide high quality drinking water whilst leaving the environment in a sustainable and measurably improved state. Through the delivery of projects both on Affinity Water land and in the catchments in which we operate with a biodiversity and conservation focus, the preferred Biodiversity option, working with the other WINEP programmes, will demonstrate the ambition to be stewards of the environment. The preferred option also includes environmental monitoring which will aid in demonstrating the benefits of the environmental schemes.

The preferred option will support the delivery of the Ofwat suggested biodiversity performance commitment (PC). The Biodiversity PC will likely require Affinity Water to have a net gain in biodiversity units using the latest approved Defra metric. This assessment will need to be carried out across all company owned land and project sites and will be assessed at the end of AMP8 versus a baseline established in AMP7. The current PC methodology suggests that an average units per ha will be used to assess this gain.

The preferred option is forecast to give the most cost beneficial likelihood of achieving a Biodiversity PC through the delivery of site management plans to increase quality of NERC41 habitats, and pollinator habitat, and the delivery of partnership projects on third-party land that will allow for the accounting of further BNG units as well as wider benefits such as carbon sequestration and providing public access to nature.

The project is part of our longer-term goal to improve the local environment for customers and communities. Our assessment of the different options has shown that the preferred option is the best value option. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

9 Delivery Considerations

9.1 Related Projects

The programme will be delivered alongside a number of capital projects where there will be a requirement to achieve biodiversity net gain under planning laws and the Environment Act 2021.

The programme will also maximise benefits where possible by being delivered in conjunction with some of the Catchment and Nature Based Solutions, and River Restoration projects in the wider environment portfolio. By partnering where possible on these schemes, efficiencies may be possible, particularly around third-party schemes, and utilising knowledge and resource from strategic and catchment partners.

The biodiversity programme will be delivered in collaboration with grounds maintenance and Estates and Facilities led projects to ensure that appropriate ongoing management on sites in being carried out to maximise biodiversity benefits.

The renewable energy programme of solar panel installation had competing requirements for larger land parcels to maximise the output of solar panels to offset carbon and we will work to ensure alignment between these two programmes and ensure opportunities are realised.

9.2 Lessons Learnt

In the past, it has been difficult to quantify the benefits of a biodiversity scheme. Being able to give a hypothetical value to the delivery of a project will also aid with internal discussion and business decisions around the best use for a site. To be able to assess the environmental benefits of delivery of the biodiversity programme, a biodiversity baseline will be gathered, using the Defra metric. This will then be used to compare post-project delivery to fully understand the benefits.

Lessons learnt from the river restoration schemes delivered in AMP7 will help to deliver the third-party land partnership schemes in AMP8 as there are many similarities. For example, the benefit of having very early stakeholder engagement with all parties, the use of illustrations and drawings of the concept design to help aid discussion, and the agreement up front of long-term management at the site once the project is delivered.

Efficiencies can be made when working more holistically across the company supply area with regard to delivering biodiversity across our Estate. The biodiversity team will work on engaging with the whole business to ensure efficient and effective delivery of site management.

Following some work with angling clubs on company sites through delivery of aquatic INNS surveys (AMP7 WINEP requirement), it has become clear that there are opportunities to work more closely with our tenants and leaseholders on sites open to the public to improve signage, access, and biosecurity and secure wider improvements and environmental outcomes.

9.3 Delivery Risk Management

There are a number of risks associated with delivery of the options. Table 5 summarises the delivery risks and the mitigation in place to add confidence to the ability to deliver the preferred option.

Table 5 - risks to delivery and mitigation

Risk	Mitigation
Difficulty in finding third party land projects	A good network of landowners has been established through the AMP7 delivery of river restoration and catchment management schemes means that there is confidence in the ability to deliver 5 schemes as per the preferred option. We can utilise catchment hosts and strategic partners to help with stakeholder engagement if needed
Potential for conflicting or alternative land use requirements for sites e.g., biodiversity, solar, new operational assets when looking to implement NERC41 and pollinator management plans	Cross company collaboration with site operators, project managers and the senior leadership team, and utilisation of our internal Land Group will ensure that the most appropriate option is taken forward with regard land use. The preferred option allows flexibility on sites for delivery so that we can maximise opportunities and benefits. A six capitals approach will be used where appropriate to assess the best value option for a site
Difficulty finding land appropriate to accommodate 100,000 trees	Trees can be planted as part of partnership projects, including partnering on other projects in the WINEP portfolio to ensure the trees are planted in the most appropriate locations
Delivery on SSSIs that are outside of Affinity Water ownership	There will be a requirement to work with NE and landowners to allow for implementation of management on SSSI sites that are outside of company ownership. We will utilise our

	network of stakeholders to maximise opportunity and minimise this risk
Catchment INNS management on Cam and Mimram relies upon access to third party private land	We will use our experience gained from previous projects where we have successfully worked with our framework contractors to contact third party landowners to tackle INNS on private land. We will work with the EA and catchment hosts on stakeholder engagement where necessary to engage with landowners
Insufficient resource and expertise to deliver the size of the preferred option	We will increase the in-house resource for delivery, working with our strategic partners and framework contractors to implement actions. We will develop our inhouse expertise and capability through training and development. Where possible we will work collaboratively with other projects both in and out of the WINEP portfolio
There is an option to not continue to support these partnerships in AMP8, but without the partnerships, the same delivery would have a significantly higher cost, and there would be a risk that the previous AMPs work on the sites would be undone through a lack of regular management.	Continue to fund, and expand the remit of, the project partnerships to achieve multiple benefits.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

9.4 Monitoring and Reporting of Benefits

Yearly progress reports will be submitted against each of the WINEP lines to report on the progress of delivery against each scheme. There will also be an end of AMP8 report provided to sum up the total benefits achieved.

Prior to on-the-ground delivery, a baseline assessment will be carried out using the latest Defra BNG metric to assess the number of biodiversity units before the project is delivered. Following delivery of the project, a post-implementation assessment will be carried out to assess the number of biodiversity units that have been created through delivery.

There will also be a Natural Capital assessment carried out on the projects before and after their completion so that the wider environmental benefits can be assessed for each of the schemes.

10 Supporting Information

Our supporting information is included in the Option Development Report and associated appendices.

10.1 Appendices

All appendices can be made available upon request.

Appendix 1 - PR24 WINEP Risk and Issues list

Appendix 2 - WINEP Biodiversity scheme build

Appendix 3 - Biodiversity Option Evaluation

Appendix 4 - NERC41 habitat final investigation report (AMP7 – 7AF200006)

Appendix 5 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 6 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Thames Fish Passage Improvements options appraisal

August 2023

Contents

1 Summary

Affinity Water, Southeast Water and Thames Water have received a request from the Environment Agency (EA) to include in their respective PR24 WINEP submissions a funding contribution towards the EA led Lower Thames weir refurbishment and fish passage improvement works. The legislative drivers for this work are:

- the Salmon and Freshwater Fish Act (1975)

- Eels Regulation (2009),

- Water Environment (WFD) (England and Wales) Regulations 2017

The three water companies' abstract water from the River Thames upstream of Teddington Lock. Under the WFD, this reach of the Thames is classified as a Heavily Modified Water Body due to both abstraction and navigation impacts. The EA have therefore requested a contribution from each water company towards fish passage improvements to the structures (weirs) that are considered to benefit abstraction through the operation and management of river levels.

The EA will deliver works through either their Thames Weir Refurbishment programme, as a Fisheries, Biodiversity and Geomorphology (FBG) lead Project or as part of the River Thames Scheme. The water company funding contribution to this project is subject to securing funding through the PR24 price review process and will be no more than 50% of the fish passage improvement costs for the identified structure. Where two water company river intakes are located upstream of the same structure, the water company funding contribution will be calculated based on the percentage split of their licensed abstraction relevant to the structure. Should any of the water companies not secure funding, the other company/companies will not be responsible for making up any funding deficit.

At the time of the PR24 WINEP Stage 3 Submission (30 November 2022), the EA have provided estimated costs for a number of projects, but the preferred option and costs are yet to be finalised. It is therefore noted that the water companies will need to review and revise their contribution following the provision of this information by the EA. At the time of producing this business case, no further updates around costs had been received from the EA.

The EA included seven structures along the waterbody that need interventions. Out of the seven structures, Affinity Water is required to contribute towards the costs of four: Chertsey TQ0537367034 (4% of the water company costs contribution), Penton Hook TQ0432469383 (100% of the water company costs contribution), Bell TQ0165472151 (25% of the water company costs contribution), Sunbury TQ1052168111 (100% of the water company costs contribution).

The EA have confirmed that in accordance with the Salmon and Freshwater Fish Act (1975) and Eels Regulation (2009), the owner or operator / responsible person, respectively, is responsible for maintenance of a structure. This requirement therefore

sits with the EA and no ongoing maintenance requirements or funding contribution from the water companies is required for this purpose.

We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

Base Information	
Report Date	16 August 2023
Report Title	River Thames Fish Passage Improvements – PR24 Business Case
Options Assessment Report (WINEP)	08AF100007_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030
WINEP Spreadsheet ID	
WINEP Action ID	08AF100007
Primary WINEP Drivers	WFD_IMP_WRHMWB (S+)
Scale of Action Delivery	Within the WFD waterbody
Location of Delivery	GB106039023232

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.10	0.10	0.10	0.10	0.09	**0.49**
Totex (£m)	0.10	0.10	0.10	0.10	0.09	**0.49**

Drivers	
100%	Eels/fish passes

Benefits
N/A

Economic Analysis			
NPV Costs (£m) (2025-55)	**0.5**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Business Case Description and drivers

Affinity Water, Southeast Water and Thames Water have received a request from the Environment Agency (EA) to include in their respective PR24 WINEP submissions a funding contribution towards the EA led Lower Thames weir refurbishment and fish passage improvement works.

2.1 Delivery

The EA will deliver works through either their Thames Weir Refurbishment programme, as a Fisheries, Biodiversity and Geomorphology (FBG) lead Project or as part of the River Thames Scheme.

The EA will fund 50% of the costs and the remainder 50% is assigned to the Water Company with surface water abstraction licences in the respective reach of the Thames. The water company funding contribution to this project is subject to securing funding through the PR24 price review process and will be no more than 50% of the fish passage improvement costs for the identified structure. Where two water company river intakes are located upstream of the same structure, the water company funding contribution will be calculated based on the percentage split of their licensed abstraction relevant to the structure. Should any of the water companies not secure funding, the other company/companies will not be responsible for making up any funding deficit.

At the time of the PR24 WINEP Stage 3 Submission (30 November 2022), the EA have provided estimated costs for a number of projects, but the preferred option and costs are yet to be finalised. It is therefore noted that the water companies will need to review and revise their contribution following the provision of this information by the EA. At the time of producing this business case, no further updates around costs had been received from the EA.

The EA have included seven structures along the waterbody that need interventions. Out of the seven structures, Affinity Water is required to contribute towards the costs of four (Figure 1 and Table 1).

Table 1 Required Affinity Water contributions to structures

Structure	NGR	Affinity Water contribution (as % of water company contribution)
Chertsey	TQ0537367034	4 %
Penton Hook	TQ0432469383	100 %
Bell	TQ0165472151	25 %
Sunbury	TQ1052168111	100 %

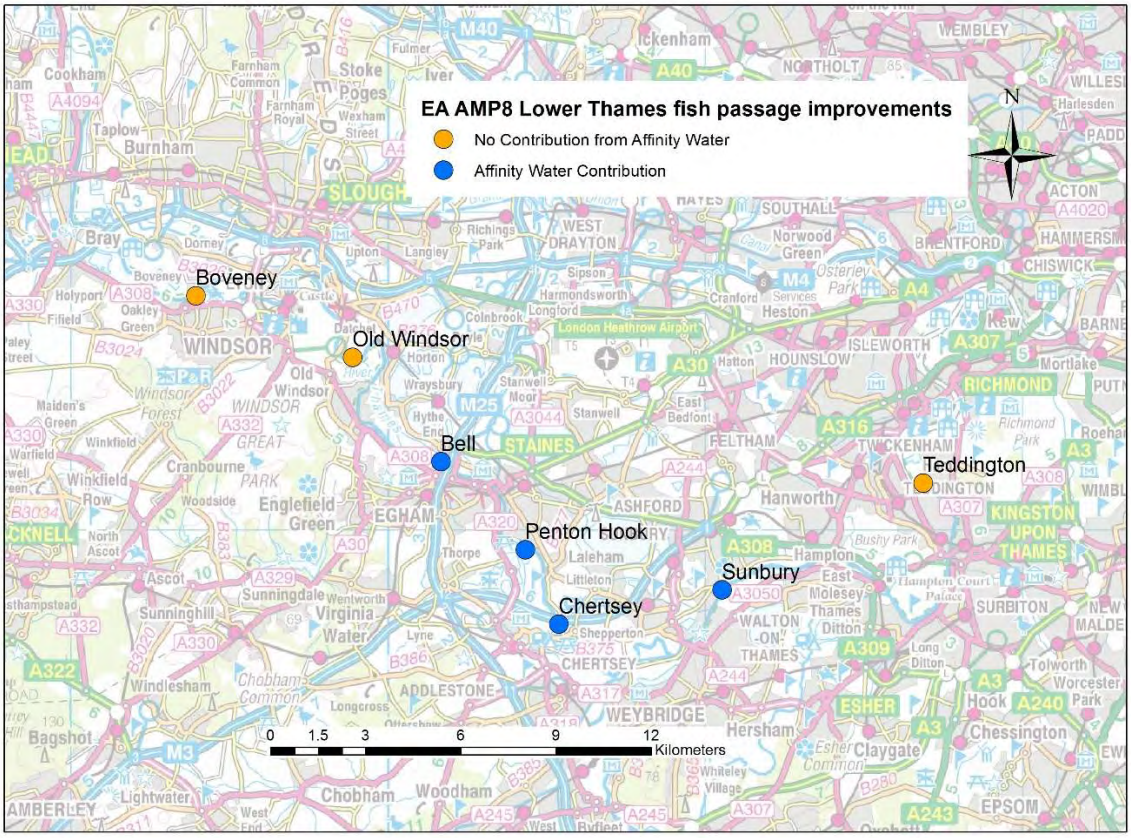


Figure 1 Location of the planned interventions

All the schemes planned by the EA for AMP8 in the area are detailed in Table 2 below. Affinity Water will be involved in the first four interventions.

Table 2 EA Weir refurbishments and fish passages for AMP8

No.	Weir	Upstream Intake(s)			EA Delivery Route
		Affinity Water	Thames Water	Southeast Water	
1	Bell	Sunnymeads	Hythe End		Thames Weir Refurb
2	Penton Hook	Egham			Thames Weir Refurb
3	Chertsey	Chertsey	Laleham		River Thames Scheme
4	Sunbury	Walton			River Thames Scheme
5	Old Windsor		Datchet		Thames Weir Refurb
6	Teddington		Surbiton		River Thames Scheme
7	Boveney			Bray	FBG Lead Project

3 Business Case Development

3.1 Baseline Environmental Assessment

The existing weirs on the River Thames upstream of Teddington Lock need remedial works to improve easement/passage for freshwater fish and eels. The EA are leading on this project and undertake routine surveys. At the time of writing, no additional information on the current baseline assessment of fish passage has been provided.

3.2 Drivers

Affinity Water, Thames Water and Southeast Water abstract water from the River Thames upstream of Teddington Lock. Under the Water Framework Directive (WFD), this reach of the Thames is classified as a Heavily Modified Water Body due to both abstraction and navigation impacts. The EA have therefore requested a contribution from each water company towards fish passage improvements at the structures (weirs) that are considered to benefit abstraction through the operation and management of river levels.

The legislative drivers for this work are:

- - the Salmon and Freshwater Fish Act (1975)
- - Eels Regulation (2009),
- - Water Environment (WFD) (England and Wales) Regulations 2017

The EA have confirmed that in accordance with the Salmon and Freshwater Fish Act (1975) and Eels Regulation (2009), the owner or operator / responsible person, respectively, is responsible for maintenance of a structure. This requirement therefore sits with the EA and no ongoing maintenance requirements or funding contribution from the water companies is required for this purpose.

The primary driver assigned to the schemes is:

- WFD_IMP_WRHMWB = action to improve ecological status (surface water)

Secondary driver:

- NERC_IMP = conserve and enhance biodiversity

Tertiary driver:

- EE_IMP = ensure structures meet requirements for fish and eels legislations

3.3 Stated need for each structure

Bell Weir:

Current fish passage facilities are currently limited to a Denil Salmon Pass built in 1991. The EA's fish pass prioritisation exercise for the River Thames has indicated this weir as impassable to coarse fish and eels. It has been classified as 'High' and 'Critical' priority for improvement for multispecies and eel passage respectively. Works to the weir are planned as part of the Thames Weir Refurbishment Package (TWRP), to provide multispecies passage, including for eels. The EA's technical specialists and the National Fish Pass Advisory Service are currently working with the designer (Jacobs) to develop a suitable design. This is likely to be an on-weir two-flight technical baffle-brush pass. An approximate capital cost estimate at this stage of £800k has been identified.

The EA will fund the scheme with 50% contribution to total costs. Out of the remainder 50% water company contribution, based on abstraction licence volumes, Affinity Water is expected to contribute 25% with Thames Water contributing for the remainder 75%.

Penton Hook Weir:

The current fish passage facilities at this site include a Larinier fish pass (in poor state of repair) and a nature-like bypass channel (fed by a 50m long culvert). The weir complex comprises two sets of gates and fixed overspills over a 1km length of river. Fish passage is rated as *insufficient* for all species. A number of fish pass improvements are being developed for this weir complex by Jacobs in consultation with EA fisheries specialists. This includes fish easement on the fixed spill weir, de-culverting of the bypass channel, upgrading the technical pass on the main weir and installing an eel pass on weir A. These works are to be included as elements of the Thames Weirs Refurbishment Package. There will be a range of costs across the options, but the cost estimate is approximately £150k. The proposal is that Affinity Water would contribute to at least one of these.

Of the proposed funding of one of the above elements, the EA will fund this with 50% contribution. Out of the remainder 50% water company contribution, Affinity Water is expected to contribute to 100% with no other water companies contributing.

Chertsey Weir:

Current fish pass arrangements at Chertsey include a traverse type fish pass for salmon constructed in 1990 (rated poorly effective for salmon) and an eel pass constructed in 2019. Passage is rated as *Insufficient* for salmonids, *Impassable* for coarse fish and *Satisfactory* for eel. An outline design has been developed by Atkins in consultation with EA fisheries specialists for a nature-like bypass channel across land to the right of

the weir. Detailed design will be developed in conjunction with the River Thames Scheme (RTS), as the downstream confluence of a proposed flood channel is located at this site. The fish pass will be delivered as part of the RTS works. The costs estimate at the outline design stage is approximately £700k.

The EA will fund the scheme with 50% Contribution. Out of the remainder 50% water company contribution, Affinity Water is expected to contribute 4% with Thames Water contributing the reminder 96%.

Sunbury Weir:

Fish passage facilities are currently limited to a Denil Salmon Pass built in 1991. The EA's fish pass prioritisation exercise for the River Thames has indicated this weir as 'Impassable to coarse fish and eel' and 'of High and Critical priority for improvement for Multispecies and Eel passage respectively'. Works to the weir are planned as part of the TWRP to provide multispecies passage, including for eel. The EA's technical specialists and the National Fish Pass Advisory Service are currently working with the designer (Jacobs) to develop a suitable design. This is likely to be an on-weir two-flight technical baffle-brush pass. The approximate capital cost estimate at this stage is £500k.

EA will fund the scheme with 50% Contribution. Out of the remainder 50% Water Company contribution, Affinity water is expected to contribute to 100% with no other water companies' contribution.

4 Partnering

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

4.1 Evidence of Customer Preferences and Support

This is an EA led project and therefore the EA have undertaken an options appraisal and selected the best options for each scheme. The EA have indicated to us the preferred scheme, and as we are only funding partners for the schemes, the EA have confirmed that we are not required to undertake an optioneering process. As part of our wider WINEP process we have undertaken customer engagement. The key findings of this are presented below.

4.1.1 Our Customer Engagement Activities

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

We have developed an 'insight framework' (Figure 2), around which we gather and triangulate customer evidence. This framework sets out the key objectives for engagement and links from our strategic direction, through to incentives and our investment strategies. Each new piece of evidence is evaluated and consolidated in alignment with our 'triangulation methodology'.

Figure 2 Triangulation Insight Framework

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

We know from our customer engagement activities for PR24, that our customers are conscious of the need to protect the environment for the future, and that environmental projects are seen as having significant public and moral value. However, the cost-of-living crisis and Ukraine war have impacted customer views and priorities. Some customers are concerned about costs, some find any increase to a bills unacceptable but others feel that the small, planned increases to bills are negligible in comparison to other price increases.

Focus group responses and other research suggests that customers think that fixing leaks is the most important thing that we can do to protect the environment, although there is continued support for environmental protection and improvements. Customers strongly approved of the existence of our plans for WINEP, however most customers wanted us to exceed what was seen as the statutory minimum. Customers' wanted clear proof as to why the investment is beneficial.

This view has been corroborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements, if there was proof that this money would be spent on WINEP projects and not shareholders' dividends. Some customers supported a higher discretionary annual bill increase of between £5 and £10. Non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why it was happening.

The four areas of priority SRs; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

4.1.3 River Restoration and Catchment and Nature-Based Solutions

In general, customers viewed the core activities as important but thought but that there should be room for Affinity Water to help the wider community too. Cleaning up and restoring rivers was popular as it showed that Affinity Water wanted to be a pillar to the community. There was some appetite to pay for this, as it links to customers wanting to do the right thing for the environment. Catchment and Nature-Based Solutions were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Some customers raised concerns however about the implementation costs of the nature-based solutions and the impacts of these on customers in vulnerable circumstances.

4.1.4 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, comprising abstraction reductions, river restoration, catchment and nature-based solutions and biodiversity improvements.

4.2 Collaboration and Partnering

4.2.1 Engagement with Stakeholders and Partners

The scheme is an example of a collaboratively funded project between the EA and water companies. The water companies have been asked to contribute to the scheme because the planned interventions are expected to benefit the ability to operate abstractions by improving the improvement operation and management of river levels. Initial discussions have been held between the water companies and a joint statement of collaboration has been drafted to support a proposal to work collectively with the EA on this project.

4.2.2 Co-design and Co-delivery

The design and delivery of the work is assigned based on the percentage split of licensed abstraction immediately upstream of each structure respectively. Should any of the water companies not secure funding, the other company/companies will not be responsible for making up any funding deficit. The EA have advised that they are not anticipating involvement of Affinity Water in the design or delivery of the projects, with the exception of administration linked to the financial contribution.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment

Our Strategic Direction Statement (SDS) sets out our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "working with our communities to create value for the local economy and society". These are aligned with efficient delivery of our statutory obligations under WINEP and are supported by our preferred option in this Business Case.

Our Long Term Delivery Strategy (LTDS) builds upon our ambitions as set out in our Strategic Direction Statement and includes a multi-AMP programme of measures informed by the dWRMP and WINEP investigations, ceasing abstraction and No Deterioration abstraction licence capping of chalk groundwater sources, alongside associated investments in our infrastructure, delivered in partnership with the Environment Agency through the Restoring Sustainable Abstraction programme.

This strategy is a "no regrets" investment and has been developed as a best value plan, taking an adaptive, evidence-based approach. It is required to achieve the supply and demand balance and implements the SRs agreed with the EA to support our long-term strategy.

The delivery and implementation of the SR's and the C&NBS is adaptive and can change to address risks, challenges and opportunities that arise throughout the 25-year planning horizon. The WINEP investigations, options appraisals and associated monitoring will provide the information to derive evidence-based decision making to inform the adaptive plan.

6 Solution Development

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

6.1 Third Party Assurance and Audit Trail

Our process for the wider WINEP is a three-tiered approach to assurance as follows:

1. Tier 1

    a) Review of WINEP Options Development Reports by PR24 Red Team
    b) Review of Options Development Reports by Head of Water Resources & Environment
    c) Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning

2. Tier 2

    a) Presented to EMT 16 November 2022
    b) Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery

3. Tier 3

    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 1 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 2.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the

proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

6.2 Cost Estimation

The EA has provided cost estimates for each scheme. The breakdown of costs for each individual scheme is presented in Table 3 below and uplifted to the 2022/23 cost base:

Table 3 Costs breakdown for each individual scheme (blue cell = no contribution)

No.	Weir	Upstream Intake(s)			Total cost (£m)
		Affinity Water (%/£m)	Thames Water (%/£m)	Southeast Water (%/£m)	
1	Bell	£0.111m			£0.800m
2	Penton Hook	£0.084m			£0.150m
3	Chertsey	£0.016m			£0.700m
4	Sunbury	£0.278m			£0.500m
5	Old Windsor				£0.800m
6	Teddington				£4.000m
7	Boveney				£0.080m
Affinity Water AMP8 total costs (£m)		£0.489m			

6.3 Uncertainties and Sensitivity Analysis

At the time of the PR24 WINEP Stage 3 Submission (30 November 2022), the EA have provided estimated costs for a number of projects, but the preferred option and costs are yet to be finalised. It is therefore noted that the water companies will need to review and revise their contribution following the provision of this information by the EA. At the time of producing this business case, no further updates around costs had been received from the EA.

6.4 Assumptions Made

We relied on the EA process of selecting the best option for the interventions and that they will undertake any planning permission, environmental permitting or impoundment licensing requirements as part of project delivery. The interventions are expected to improve passage for indigenous fish species along the Thames. We have taken a conservative view by assuming the minimum lengths of the river that may benefit from the interventions based on distance of improved fish passage. These are:

Bell = 7.1 km

Chertsey = 4.0 km

Penton Hook = 4.7 km

Sunbury = 7.0 km

6.5 Economic Assessment

Economic assessment for this business case has not been undertaken, as this is for a funding contribution towards an EA led scheme.

6.6 Wider Environmental Outcomes

6.6.1 Biodiversity

These schemes to which we are contributing are expected to improve the WFD status of the River Thames and contribute towards achieving Good Ecological Potential.

7 Delivery Considerations

7.1 Lessons Learnt

This project will be delivered by the EA with a funding contribution from the water companies. The EA are experienced in implementing these types of works and will utilise their experience in the delivery of these schemes.

7.2 Delivery Risk Management

There is a risk that the costs provided by the EA have underestimated the total scheme costs. In this event it is proposed that the EA will need to seek additional or alternative funding contribution(s) to make up the deficit.

Project delivery risks and mitigation will sit with the EA as lead partner.

Should any of the water companies not secure funding, the other company/companies will not be responsible for making up any funding deficit. A collaborative agreement between the three water companies has been drafted and is appended to this business case.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans

7.3 Monitoring and Reporting of Benefits

The requirement for monitoring and reporting of benefits will sit with the EA.

8 Supporting Information

Our supporting information is included in the Business Case and associated appendices.

8.1 Appendices

All appendices can be made available upon request.

Appendix 1 –– Atkins PR24 WINEP Assurance Report November 2022

Appendix 2 –– PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Walton fish screens upgrade options appraisal

August 2023

Contents

1 Summary

Affinity Water have passive wedge wire screens at Walton Water Treatment Works (WTW) which were installed in 2011. The screens at Walton WTW are currently functioning in terms of preventing harm to a large number of species and life stages of fish in the surrounding river. However, they do not meet the most recent Best Achievable Eel Protection (BAEP). Monitoring data collected between 2016 and 2017 through our AMP6 study undertaken by consultants Jacobs suggested that the rate of entrainment for all species is quite low, but there remains a chance that thousands of individuals could be entrained and removed each year. As no eels were entrained in the AMP6 entrainment monitoring study, an exemption notice was issued with respect to the screening requirements of the Eels Regulations. The exception has validity until 31st December 2030 (Year 1 of AMP9).

For that reason, in AMP8 there is a need to undertake an options appraisal to determine the most cost- effective option to replace the existing screens with alternatives that meet the BAEP. The EA have requested that the option appraisal in AMP8 is carried out in conjunction with some confirmatory monitoring to support the conclusions of the AMP6 study.

Our preferred option is therefore to undertake an options appraisal into installation of replacement fish screens at Walton WTW. There is customer support for this option and the wider WINEP programme.

Base Information	
Report Date	August 2023
Report Title	River Thames Fish Passage Improvements – PR24 business case
Options Assessment Report (WINEP)	08AF100001_OAR
Start Date	01/04/2025
Completion Dates	31/03/2027
WINEP Spreadsheet ID	
WINEP Action ID	08AF100001
Primary WINEP Driver	EE_INV
Scale of Action Delivery	Within the WFD waterbody
Location of Delivery	GB106039023232 - Walton Water Treatment Works

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.06	0.06	0.06	0.06	0.07	**0.31**
Opex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Totex (£m)	0.06	0.06	0.06	0.06	0.07	**0.31**

Drivers	
100%	Eels/fish entrainment screens
Benefits	
N/A	
Economic Analysis	

NPV Costs (£m) (2025-55)	**1.5**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals

Natural	Social	Financial	Manufact.	Human	Intellectual
★ ★ ★	★ ★			★	★

2 Business Case Description

Affinity Water have passive wedge wire screens at Walton Water Treatment Works (WTW) which were installed in 2011. The screens at Walton WTW are currently functioning in terms of preventing harm to a large number of species and life stages of fish in the surrounding river. However, they do not meet the most recent Best Achievable Eel Protection (BAEP). Monitoring data collected between in 2016 and 2017 suggested the rate of entrainment for all species is quite low, but that there remains a chance that thousands of individuals could be entrained and removed each year. As no eels were entrained in the AMP6 entrainment monitoring study, an exemption notice was issued with respect to the screening requirements of the Eels Regulations. The exception has validity until 31 December 2030 (Year 1 of AMP9).

For that reason, in AMP8 there is a need to undertake an options appraisal to determine the most cost- effective option to replace the existing screens with alternatives that meet the BAEP. The EA have requested that the option appraisal in AMP8 is carried out in conjunction with some confirmatory monitoring to support the conclusions of the AMP6 study. The preferred screening solution will then be included in PR29 for implementation in Year 1 of AMP9.

This has been included under our PR24 WINEP as an investigation (08AF100001) with a completion date of 30 April 2027.

3 Business Case development

3.1 Baseline Environmental Assessment

The existing fish screen at Walton WTW does not meet the most recent BAEP. The current exemption notice is valid until 31 December 2030. The EA have requested that Affinity Water undertake an options appraisal to determine the most cost- effective option to replace the existing screens with alternatives that meet the BAEP.

3.2 Drivers

The legislative drivers for this work are:

- the Salmon and Freshwater Fish Act (1975)

- Eels Regulation (2009),

- Water Environment (WFD) (England and Wales) Regulations 2017

The primary driver assigned to the schemes is:

- EE_INV = Ensure Structures meet requirements of fish and eel legislation

4 Partnering

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

4.1 Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

The insight and testing of our business plan with customers have been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

Figure 1 Triangulation Insight Framework

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and

environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concern over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small, planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considered it would have a positive impact on wildlife for the future. Some people considered that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.3 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, comprising abstraction reductions, river restoration, catchment and nature-based solutions and biodiversity improvements.

5 Solution Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Third Party Assurance and Audit Trail

Our process for the wider WINEP is a three-tiered approach to assurance as follows:

1. Tier 1

    a) Review of WINEP business cases by PR24 Red Team
    b) Review of business cases by Head of Water Resources & Environment
    c) Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning

2. Tier 2

    a) Presented to EMT 16 November 2022
    b) Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery

3. Tier 3

    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 1 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 2.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

This proposed options appraisal was accepted as 'proceed' as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023.

5.2 Cost Estimation

The estimated cost for undertaking the options appraisal is **£0.307m.** This has been estimated based on quotes for similar work undertaken for Affinity Water in 2017 with uplifted costs in the 2022/23 cost base.

As the options appraisal will inform the need for future investment, this will need to be delivered by 31 March 2027.

6 Delivery Considerations

6.1 Delivery Risk Management

This project will be delivered utilising experience of having delivered options appraisals as part of the WINEP programme and having installed fish screens at our River Thames intakes in AMP6. As the options appraisal will inform the need for further investment, either later in AMP8 or early in AMP9, it is required to be delivered by 31 March 2027, so funding is apportioned between the first two years of the AMP. The EA will be engaged throughout the process to ensure buy in to the options appraisal process and outcomes.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

6.2 Monitoring and Reporting of Benefits

The EA have requested that the option appraisal in AMP8 is carried out in conjunction with some confirmatory monitoring to support the conclusions of the AMP6 study.

7 Appendices

All appendices can be made available upon request.

Appendix 1 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 2 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Lower Thames DrWPA

Catchment and Nature-based Solutions

August 2023

Contents

1 Summary

This report sets out the detailed PR24 WINEP options development process and outcomes for our proposed Lower Thames Drinking Water Protected Area (DrWPA) no deterioration (DrWPA_ND) schemes for AMP8 (08AF100016). These schemes have been developed in partnership with Thames Water and South East Water and set out to address the following challenges:

- Prevent deterioration of 'at risk' pesticides (propyzamide and flufenacet) impacting the Lower Thames and Wey DrWPA's and our River Thames abstractions. Safeguard Zones are as follows:
  - Thames_SWSGZ4016_Cookham Teddington
  - Thames_SWSGZ4015_Wey
- Mitigate the risks and impacts of nitrate and microbiological pollution arising from agricultural and amenity land use activities.
- Undertake abstraction and catchment monitoring for additional pesticides 'of concern' with actions to address further challenges as they arise.
- Deliver measures that can achieve multiple benefits to contribute to addressing the WINEP wider environmental outcomes.

The 'best value' option described in this business case defines a programme of land management focused Catchment and Nature-Based Solutions (C&NBS) for the following catchments Affinity Water will be leading on delivery:

- Wey (Shalford to River Thames confluence at Weybridge)
- Wey (Tilford to Shalford) delivered in partnership with Thames Water
- River Loddon (prioritised sub-catchments) delivered in partnership with South East Water
- Colne (Confluence with Chess to River Thames)

This includes works a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater, improved soil health, greater water-holding capacity on land for flood and drought resilience, net zero benefits and biodiversity enhancements.

We have rigorously followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our preferred solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high degree of support for the proposed environmental improvements. We have learnt from our previous projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option that can be confidently delivered. Based

upon our conservative estimates, the preferred option offers NPV benefits of £0.993m with a benefit cost ratio of 1.45. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water.

Conservative estimates of the benefits have been made and the scheme has been assessed as cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements.

The best value option will be delivered under a catchment strategy for the Lower Thames and Wey catchments developed following the principles of our environmental strategy and existing Catchment Based Approach (CaBA) catchment plans. The prioritisation and delivery of the programme will be developed with the Environment Agency, Natural England, Thames Water and South-East Water to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

C&NBS within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS

Each project will utilise a range of C&NBS targeted spatially and/or temporally to prevent deterioration of water quality deliver the greatest wider environmental benefits.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence
To determine the best value option, an extensive options development process was undertaken with 12 unconstrained options, 6 constrained options reviewed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration
To determine the best value option, we have carried out a detailed water quality risks and issues identification process with key stakeholders including the Environment Agency, Loddon Farm Advice Project, Thames Water and South East Water. We have also developed our proposed solutions with input and feedback with these key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	14 August 2023
Report Title	Lower Thames DrWPA – PR24 Business Case
Options Assessment Report (WINEP)	08AF100016_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030
WINEP Spreadsheet ID	
WINEP Action ID	08AF100016
Primary Drivers	DrWPA_ND (S) - Primary 25YEP_IMP (NS) - Secondary
Scale of Action Delivery	Operational catchment
Location of Delivery	Thames (Cookham to Egham) -GB106039023231 Thames (Egham to Teddington) - GB106039023232 Wey (Shalford to River Thames confluence at Weybridge) including tributaries - GB106039017630 Measures also to be delivered – Colne (Confluence with Chess to River Thames) - GB106039023090 Wey (Tilford to Shalford) - GB106039017820 Slea (Kingsley to Sleaford) including tributaries - GB106039017750 North Wey (Alton to Tilford) - GB106039017830 Loddon (Swallowfield to River Thames confluence) - GB106039023160 Loddon (Sherfield on Loddon to Swallowfield) - GB106039017330 Twyford Brook - GB106039023190 Bow Brook (Bramley to Sherfield Green) - GB106039017140

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.22	0.42	0.50	0.50	0.28	**1.92**
Totex (£m)	0.22	0.42	0.50	0.50	0.28	**1.92**
3rd Party Funding	0.05	0.10	0.12	0.12	0.06	**0.45**

Drivers	
100%	Drinking Water Protected Areas

Benefits
Water Quality of Natural Water Bodies (km)
Sequested Carbon (tonnes CO_2e)
Air Quality Pollution Reduction (tonnes)

Economic Analysis			
NPV Costs (£m) (2025-55)	**2.2**	NPV Benefits (£m) (2025-55)	**3.2**
NPV (£m) (2025-55)	**1.0**	Benefit / Cost Ratio	**1.5**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

The Lower River Thames Drinking Water Protected Area (DrWPA) (Cookham to Teddington) and River Wey Safeguard Zone (SgZ) proposed catchment management scheme is a programme of pesticide reduction schemes and spatially targeted catchment and nature-based solutions (C&NBS) in identified priority catchments with the aim of reducing pesticide pollution in catchment to prevent deterioration of raw water quality and provide resilience to our River Thames abstractions:

- Iver water treatment works (WTW) (Sunnymeads)
- Egham WTW
- Chertsey WTW
- Walton WTW

The objective of the scheme is to build on the AMP7 DrWPA DrW1 scheme for metaldehyde and propyzamide and expand the approach to mitigate losses to water of key 'At risk' pesticides (flufenacet and propyzamide), based on experience from schemes and field trials carried out in AMP7. This catchment scheme will be delivered under the Water Framework Directive 'No Deterioration' (DrWPA_ND) driver and will support Affinity Water's compliance with the Drinking Water Directive standard for individual pesticides (0.1 µg/l) and total pesticides (0.5µg/l).

Affinity Water will lead on implementing C&NBS schemes in the River Colne, River Wey and River Loddon catchments. These schemes will be delivered in conjunction with a wider programme of catchment schemes being delivered by Thames Water and South East Water across the River Thames – Cookham to Teddington safeguard zone (SgZ) (SWSGZ4016) and Wey SgZ (SWGZ4015). Each water company leads on catchment management activities and delivers schemes in high-risk catchments identified through the combined programme of pesticide monitoring carried out in AMP5, AMP6 and AMP7. This proposal will focus only on the Loddon, Colne and Wey catchments that Affinity Water are the lead water company for scheme delivery.

C&NBS approach

Our catchment management approach is a land management focused programme of C&NBS spatially and temporally at the operational catchment scale (Loddon, Wey and Colne) to achieve the following outcomes:

- Prevent deterioration of 'at risk' pesticides (propyzamide and flufenacet) impacting the Lower Thames and Wey DrWPA's and our River Thames abstractions.
- Mitigate the risks and impacts of nitrate and microbiological pollution arising from agricultural and amenity land use activities.
- Undertake abstraction and catchment monitoring for additional pesticides 'of concern' with actions to address further challenges as they arise.
- Deliver measures that can achieve multiple benefits to contribute to addressing the WINEP wider environmental outcomes including, but not limited to:

- Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams.
- Connecting wildlife corridors and creation of habitats in partnership with local stakeholders.
- Wider biodiversity benefits (e.g., to priority habitats and species).
- Measures that contribute towards achieving the Water UK target of Net Zero by 2030 for operational emissions.

This project builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

3.1 Environmental Risk and Issues

Diffuse and point source pollution from agriculture and amenity land use in the River Thames catchment have led to the designation of the Lower River Thames as a DrWPA. Additionally, pesticide concentrations detected in the River Thames and at the public water supply abstractions for Affinity Water, Thames Water and South East Water has resulted in the designation River Thames – Cookham to Teddington SgZ (SWSGZ4016) and Wey SgZ (SWGZ4015) for 'at risk' pesticides propyzamide and flufenacet.

These 'at risk' pesticides also pose a risk to exceeding the DWS for pesticide at our four River Thames WTW's with raw water concentrations regularly exceeding the 0.1µg/l. Figure 1 shows that flufenacet detections >0.1µg/l have been increasing over the past 5 years with propyzamide showing regular high seasonal concentrations over the past 10 years. Reducing losses of these pesticides at their source through C&NBS with land managers will increase resilience of our abstractions and improve river water quality. These C&NBS also can reduce wider pollutants impacting on river and potable water quality including turbidity, nutrients (nitrate) and microbiological parameters (e.g. cryptosporidium which all pose risks to our abstractions. The best value option seeks to incorporate measures in high-risk catchments that can achieve multiple benefits for water quality and wider benefits including carbon insetting opportunities and enhancing biodiversity.

In addition, there are a number of environmental risks that are detailed in the Risk and Issues log (Appendix 2) has been developed for both the operational catchment and at the waterbody level which has been captured the available data on Catchment Data Explorer and through consultation with a range of stakeholders. This includes wider water quality issues including phosphate in the Lower Thames and future risks around the River Thames Flood Alleviation scheme.

3.2 Baseline Assessment

The Thames River Basin District (RBD) covers over 10,000km^2 upstream of our Iver (Sunnymeads), Egham, Chertsey and Walton WTWs. All four WTWs abstract directly from the River Thames to the west of London and are susceptible to upstream diffuse and point source pollution risks. Eighteen major river catchments flow into the Thames with 38 major tributaries which includes drainage and wastewater from 16 cities and key towns.

Each abstraction is routinely monitored for a range of water quality parameters, including pesticides. Pesticides are sampled at regular intervals throughout the year and frequency is adjusted to reflect seasonal risk. A further programme of catchment monitoring is carried out in partnership with Thames Water and South East Water to determine the high-risk areas of the Thames River Basin where catchment measures

should be focused. In 2010, we established a partnership for the River Thames DrWPA with Thames Water and South East Water referred to in this report as the Thames Catchment Management Steering Group (TCMSG), which has continued throughout AMP6 and into AMP7.

River Thames – Cookham to Teddington SgZ (SWSGZ4016) and Thames SgZ (SWGZ4015) have both been identified as being 'at risk' by the Environment Agency for pesticides flufenacet and propyzamide. Our River Thames abstractions regularly observe detections of both pesticides (Figure 1 and Figure 2) above the Drinking Water Standard (DWS) for individual pesticides (0.1µg/l) and pose a risk of breaching the total pesticides DWS (0.5µg/l). These exceedances of the DWS are observed over the autumn/winter period and can be attributed to arable farming applications to cereal crops and oilseed rape (OSR), primarily to control blackgrass weeds impacting crop yields.

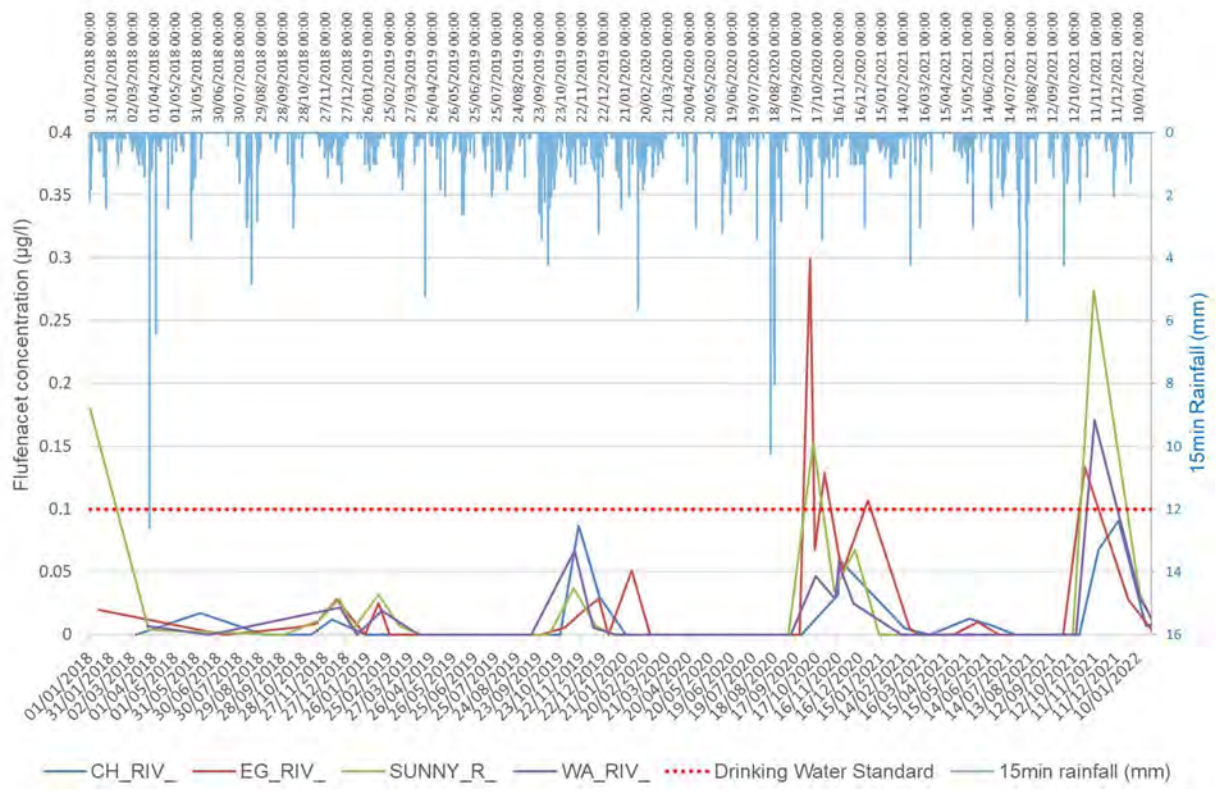


Figure 1: Flufenacet detections at Affinity Water River Thames abstractions 2018 – 2021

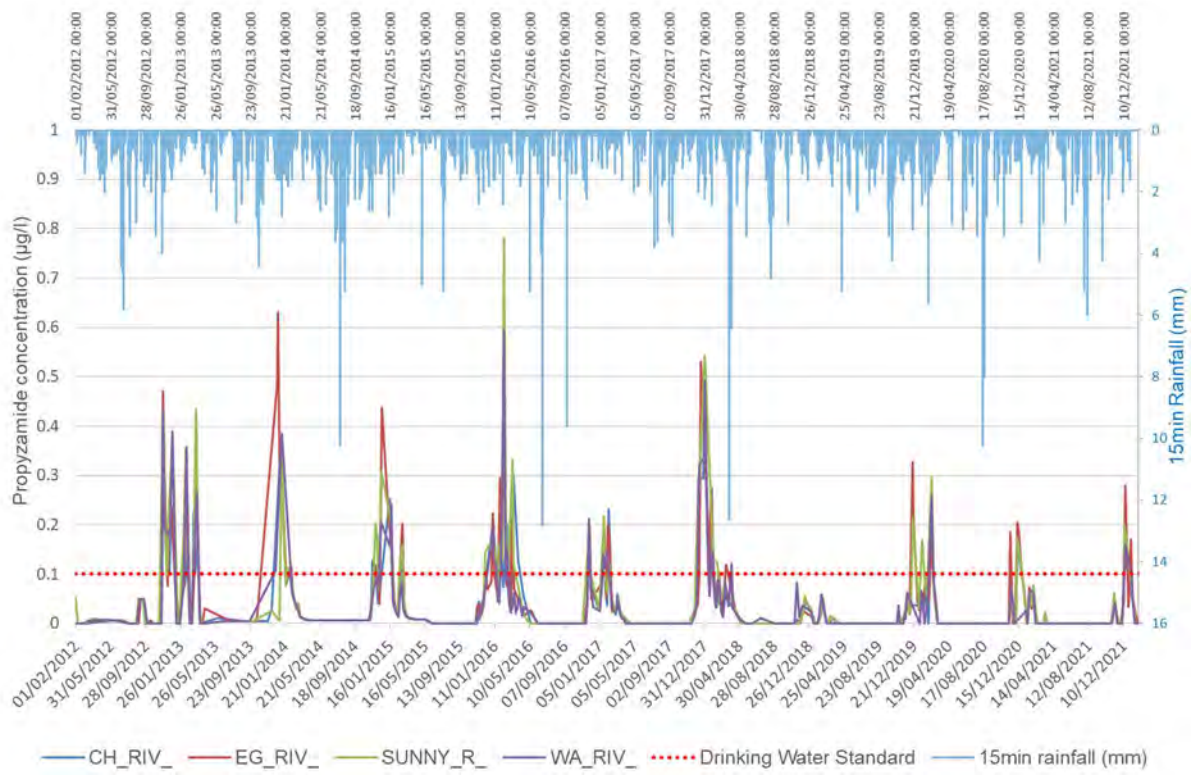


Figure 2: Propyzamide detections at Affinity Water River Thames abstractions 2012 – 2021

3.3 Drivers for the scheme

3.3.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 3 in section 7.4.3

2) The Drinking Water Directive

Drinking Water Directive standard for pesticides for individual pesticides (0.1µg/l), total pesticides (0.5µg/l) and nitrate is (50mg/l NO^3).

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP).

- Thames River Basin Management Plan

The specific WINEP Driver relevant to this scheme is:

- DrWPA_ND (S) = Catchment actions must prevent deterioration, or improve following a deterioration, of water quality or improve water quality.

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies
- AW0031 Affinity Water Strategic Direction Statement
- Blueprint for Water – Blueprint for PR24
- Relevant Safeguard Zones - River Thames – Cookham to Teddington SgZ (SWSGZ4016) and Thames SgZ (SWGZ4015)

3.3.3 Stated Need

Affinity Water abstract approximately 35% of our total potable water supply from four River Thames abstractions in West London, with the Lower Thames catchment. The raw water quality abstracted is impacted by ~10,000km^2 of upstream catchment in the Thames RBD for pesticides and other pollutants. We have been delivering a combined programme of pesticide investigations and catchment mitigation schemes in partnership with Thames Water and South East Water through the TCMSG since AMP5. The TCMSG has investigated and mitigated other 'at risk' pesticides including metaldehyde effectively under the DrWPA_ND (S) driver throughout AMP6 and AMP7. Propyzamide poses a significant risk of breaching the pesticide DWS and has been a component of the DrWPA_ND (S) scheme in AMP7. This has been effective to date in preventing further deterioration of water quality, but the risk has remained due to the scale of use, timing of applications and volatility in the OSR market due to the war in Ukraine. Flufenacet has emerged as an 'at risk' pesticide over the past 5 years with increased use to control blackgrass in cereal crops, for example Wheat. This proposed DrWPA_ND (S) scheme for AMP8 aims to prevent further deterioration of water quality for the 'at risk' pesticides, flufenacet and propyzamide with measures to reduce pesticide losses from oilseeds and cereal crops in the high-risk catchments Affinity Water leads on measures for the TCMSG.

Additionally, our River Thames abstraction also experience raw water deterioration issues caused by nitrate and microbiological contaminants (e.g. cryptosporidium). Non-WINEP investigations have been carried out for both nitrate and cryptosporidium, with reports available on request. The sources and pathways of these issues are similar to those for pesticides and measures implemented have the potential to mitigate the risk and deliver wider water quality benefits through effective targeting of measures.

Protecting and enhancing our nation's water environment is a priority for the government. One of the **Ofwat's key ambitions for water companies for PR24** is:

- Delivering greater environmental and social value, including by acting immediately on river water quality, moving faster towards net zero, as well as working differently into the future to adopt more catchment – and nature-based solutions.

This scheme supports this ambition around improving river water quality, and the use of C&NBS.

In addition, **WISER** – expectations that this scheme seeks to deliver include, but not limited to:

- Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
- Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
- Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
- Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this business case please see the 'Level of Confidence of Achieving the WINEP Outcomes' section in section 7.4.3.

Water Framework Directive (WFD)

- **WINEP** – The Environment Agency (EA) expects that the 'best value' option defined in this business case takes account of the following wider environmental outcomes:
    - Natural environment outcomes: Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.
    - Catchment resilience outcomes: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
    - Net zero outcomes: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of.
- **DWI long-term planning guidance expectation:**
    - Catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all 'source to tap' risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness, and acceptability of water supplies.

There are many drivers to improve the overall quality of the river with solutions that also support the wider community in terms of achieving net zero, and access and amenity benefits.

3.4 Allocation of Costs

This business case is 100% enhancement and all costs are allocated to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

We have extensive experience over multiple AMP/WINEP cycles in developing and delivering catchment management schemes in the Lower River Thames catchment. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

C&NBS for water quality:

Natural capital evaluation of the EnTrade cover crop scheme (2021):

To better understanding the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. 12 ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

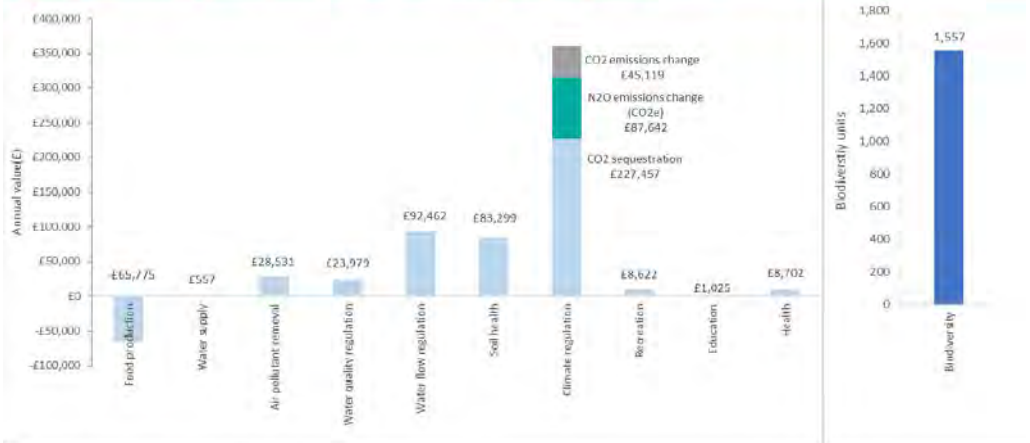
The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 3.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6:1 Natural Capital benefit ratio.

Total value	^	-	-	-	£403,450	£945,069	£541,619
Total value/ha	^	-	-	-	£500	£1,172	£671

Figure 2 - Natural capital valuation results – Annual change in ecosystem services*



* Biodiversity change is shown in terms of the the total change in habitat units

Figure 3. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen release from cover crops (NiCCs) field trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil.
    - effect of contrasting cover crop destruction methods e.g., glyphosate & minimum tillage vs mechanical destruction & minimum tillage.
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance.

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was tracked post cover crop destruction under different management regimes and subsequent cash crops to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit, and effective uptake of nitrogen for more sustainable arable farming.

Farming 4 Clean Water Scheme (2017-2022)

The 'Farming 4 Clean Water' scheme has been operating across the Upper Colne, Mimmshall Brook and Essendon catchments since 2017. This catchment scheme is delivered by our internal Agricultural Advisors, which has allowed us to evolve and develop the scheme in AMP7 to address pesticide risks as they arise and promoting best practice that benefits the water environment. Engagement with the local farming community has increased significantly over the life of the scheme and achieve the aim of preventing deterioration and delivering measurable water quality improvements.

An innovative catchment trading 'reverse auction' is run through the EnTrade online environmental trading platform which incentivises farmers to propose C&NBS to mitigate specific water quality risks such as companion cropping oilseed rape, switching to spring cropping and incorporating overwinter cover crops into rotations. This scheme has run for the past two seasons with positive uptake and feedback from farmers in the catchment. This scheme focuses on reducing the area of winter crops which require propyzamide to be applied and measures which help build soil organic matter and structure to prevent losses of pesticides and nitrate.

As well as the funding mechanisms, we also collaborate with the local Catchment Sensitive Farming Officer in high priority areas to encourage the uptake of countryside stewardship options to reduce diffuse pollution and capital items grants to improve infrastructure to protect water courses. Through intensive water quality monitoring, we have been able to identify point source risks and provide the provision for additional support when our abstractions are known to be at risk from pesticide use.

The loss of pesticides from fields which threaten our water sources more often occur during the autumn/winter months which rainfall generally increases. We have investigated and implemented new technologies such as smart, on-farm weather stations and weather forecasting to ensure all information is taken into account when farmers plan pesticide applications and best practice is promoted. Furthermore, we have been piloting different approaches to propyzamide applications such as the 'reduced dose' approach and our field trials have provided some encouraging results suggesting that careful resistance management and the use of other actives earlier on to control blackgrass in oilseed rape, can mean that doses of propyzamide can be reduced and so can the concentrations in soil water.

The Farming 4 Clean Water scheme is an example of a farmer led scheme driven by robust data from trials that provide nature-based solutions which are a benefit both crop production, soil health and the environment.

4 Partnering

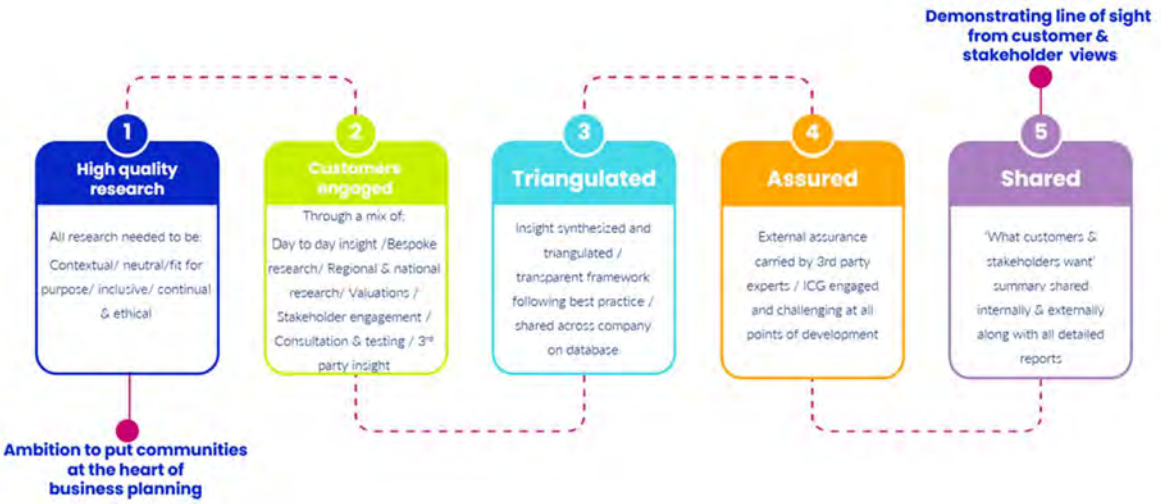
4.1 Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.



The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

5.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and

priorities. Their concern over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considered it would have a positive impact on wildlife for the future. Some people considered that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.2 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.1.3 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we

have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.2 Collaboration and Partnering

4.2.1 Engagement with Stakeholders and Partners

WINEP Stage 2 – Collaboratively identifying risks and issues

To support the development of the proposed solutions for the risks and issues included in this business case, we have undertaken a detailed review of risks and issues for each waterbody catchment. We have taken a collaborative approach to define the PR24 WINEP scope and develop the feasible options and ultimately determine the best value option. As part of this process, carried out between May and August 2022, we have completed the following activities:

- Early engagement with the EA and Natural England (workshops at area level) and follow up meetings meetings/correspondence with Driver leads).
- Reviewed, discussed and incorporated Natural England's Nature Recovery List for our region.
- Detailed review of Catchment Data Explorer, CaBA Catchment Plans, River Group meetings, stakeholder workshops and meetings alongside discussions with neighbouring water companies.
- Documented all risks and issues register collated through this process and used to develop the proposed solution described in this business case.

WINEP Stage 3 – Proposing solutions

As part of the development of our proposed solutions to contribute to addressing the risks and issues described in this business case, we have undertaken the following engagement and drawn on experience through our AMP7 WINEP programme delivery to explore options around developing, co-designing and co-delivering schemes which have formed the basis of the feasible options.

4.2.2 Working in partnership with neighbouring water companies – Thames Catchment Management Steering Group (TCMSG) joint statement for partners delivering the Lower Thames and Wey DrWPA_ND schemes

Thames Catchment Management Steering Group
Joint Statement - September 2022

In summary:

- The Thames Catchment Management Steering Group (TCMSG) comprises Thames Water, Affinity Water and South East Water and has been working in partnership since 2010 in response to diffuse pesticide pollution and wider pollution challenges.
- The task of leading catchment management initiatives across different parts of the Thames River Basin District (RBD) has been shared out between the three companies alongside a joint sampling programme and various catchment projects.
- The three companies have trialled various approaches to mitigate pesticide risk to drinking water and the wider environment. Results to date from delivering river basin-wide metaldehyde schemes show that improvements can be achieved at the sub-catchment scale. It has also highlighted that full engagement of large numbers of landowners over much larger areas is required to achieve no deterioration and the necessary water quality improvements at abstraction points.
- Alongside voluntary and incentivised catchment measures through the TCMSG's activities, regulatory mechanisms, such as product labelling and reviewing of risks to water prior to re-registration, and enforcement are going to be needed where the voluntary approach is not proving effective in the given timescales.

Three water companies abstract water from the River Thames: Thames Water, Affinity Water and South East Water. In September 2010 we established the TCMSG to work collaboratively to investigate and identify interventions to reduce the impact of diffuse pesticide pollution. The purpose of the partnership is to share data, evidence and information, coordinate work, avoid duplication, standardise target setting, share experiences and knowledge from engagement with farmers and agronomists, and support the EA with Water Environment (Water Framework Directive) Regulations delivery through the Water Industry National Environment Programme (WINEP).

The steering group meets bi-monthly to discuss progress with projects, exchange knowledge and ideas and determine how we can work together most efficiently. The group has worked to ensure that each company can lead on delivering catchment management in different areas of the Thames RBD. This ensures that overlap is minimised, and company resources can be effectively deployed.

Thames Water has responsibility for delivering catchment management across the Thames RBD as far as Maidenhead and in the Mole and Lee and upper Wey sub-catchments (Figure 4). South East Water manages delivery in the lower Thames catchment (Maidenhead to Egham) and associated minor tributaries. Affinity Water has responsibility for the Colne (Hertfordshire), Loddon and lower Wey sub-

catchments. Where overlap occurs, the companies work closely to share data and information on existing useful farmer contacts to ensure that water company/farmer liaison is managed as appropriately as possible.

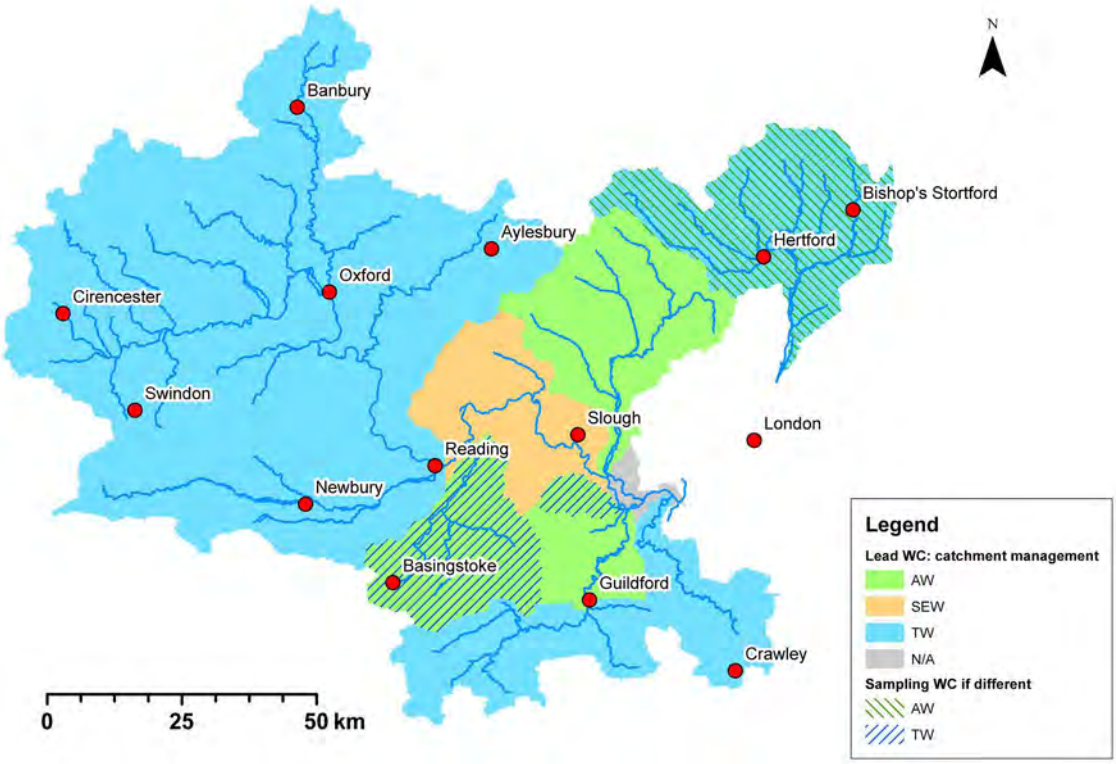


Figure 4: Map showing broad areas of responsibility for catchment management, as shared out between the three companies. Where a different water company is taking responsibility for sampling, this is shown with hatching. N.B. Not all areas will actually require active catchment management; some remain a watching brief or have been identified as low risk.

Alongside allocating responsibility for catchment management in different areas, we have developed a coordinated river sampling strategy across the Thames RBD and are sharing the data (as shown in the above map). This arrangement minimises the travelling undertaken by personnel from both companies involved (i.e. Thames Water and Affinity Water). In addition, the three companies are working collaboratively on various projects; examples include:

- Thames Water and Affinity Water sharing the costs and results of a remote sensing and catchment characterisation exercise in both the upper and lower Wey catchments;
- All three companies sharing the cost of a satellite remote sensing project covering the lower Thames, Chertsey Bourne, Addlestone Bourne and parts of the Colne catchment;
- South East Water carrying out investigations and delivering pilot catchment measures on behalf of all three water companies in the lower Thames region.
- Affinity Water and South East Water, along with Natural England, jointly funding an advisor to support projects in the Loddon catchment

The primary aim of our project work to date has been to trial a number of different mitigation methods for metaldehyde, carbetamide and propyzamide, establish the efficacy of each approach and provide farmers and other catchment stakeholders with a variety of catchment management tools. Projects applying different mechanisms such as Payment for Ecosystem Services (PES), product substitution, capital grants, field trials and innovation funding schemes have been piloted and expanded across the Thames catchment. By the end of AMP6 and into AMP7, schemes delivered by the TCMSG have covered over ~3,500km^2 (figure 5).

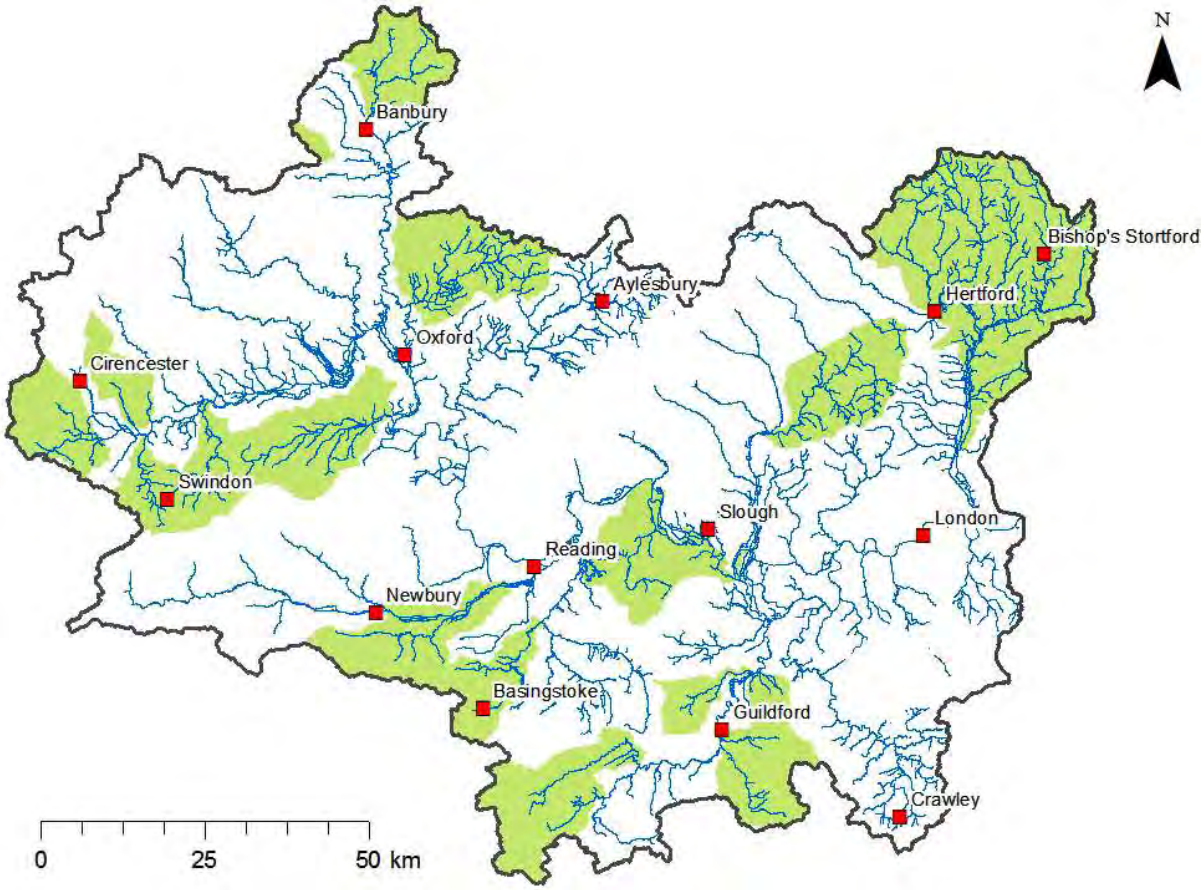


Figure 5: Map showing the extent of pesticide mitigation scheme areas covered by the TCMSG in 2022

Over the course of the past twelve years, we have gained extensive experience and understanding from these projects which can be applied to wider challenges in the water environment. There have been some successes, with water quality improvements reported for metaldehyde across the Thames RBD and at all TCMSG abstractions. There is no 'one size fits all' approach for catchment and nature based solution (C&NBS), but in most cases intensive engagement is required with a significant proportion of land managers across identified priority (high risk) catchment areas. It is apparent from results to date that changes in the way land is managed and the use of crop protection products and fertilisers are required at a much larger scale in order to achieve no deterioration and/or improvements in water quality both in the river and at abstraction points.

The TCMSG has successfully demonstrated over AMP6 and AMP7 that catchment measures can be upscaled to the river basin scale and that working in partnership can deliver positive outcomes against pollution challenges. During the remainder of AMP7 and beyond 2025, the TCMSG will need to work collaboratively with wider stakeholders to address emerging risk such as flufenacet, alongside ongoing challenges such as propyzamide. There is also a need to apply our experience to tackle wider challenges through the implementation of wider C&NBS that take a holistic approach and deliver wider ecosystem service benefits to achieve wider WFD outcomes.

4.2.3 Environment Agency (EA)

Several meetings were held between the TCMSG and the EA Thames area and Hertfordshire and North London area water quality driver leads as part of the WINEP stage 2: risks and issues process and stage 3: proposing solutions. As part of these meetings, we agreed the revised list of 'at risk' pesticides with supporting evidence. Discussed the proposed partnership approach between the three companies and options for measures to address the wider pollution risks referenced in this business case. After these meetings, the EA confirmed the addition of flufenacet to the 'at risk' substances list and that it will be included in the next revision of the SgZ action plans for which Affinity Water have an obligation to deliver actions through these proposed WINEP DrWPA_ND schemes.

4.2.4 Co-design and Co-delivery

See above TCMSG Joint Statement – September 2022 which sets out how Affinity Water, Thames Water and South East Water will work in partnership on co-design and co-delivery of the pesticides mitigation schemes for the Lower Thames and Wey Catchments. This includes, but is not limited to, a joint monitoring programme, co-funded local partnerships, co-funded research projects and field trials.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this business case.

5.2 Catchment Strategy

This business case is aligned with the Catchment Options development as set out in our draft Water Resources Management Plan and will inform the development of our Thames and Wey Catchment Strategy which is currently under development. This will

align with existing catchment plans for the Colne Catchment Action Network, Loddon Catchment Partnership and Wey Landscape Partnership.

C&NBS will be prioritised in areas of the catchment identified as priorities within our catchment risk characterisation activities to provide greater resilience to our River Thames abstractions to support our future sustainability reduction programme and in particular, our long-term Environmental Destination programme.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. This is part of a combined monitoring programme for the Thames River Basin delivered in partnership with Thames Water and South East Water since AMP5. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS.

The scheme can adapt to:

- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g. Wastewater company schemes, Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities (e.g. offsetting).
- Types of measures implemented can adapt and evolve based on future scientific evidence.
- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships, Rivers Trusts.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options: the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 1 – River Thames DrWPA Option Evaluation v1.0

We have then assessed these further, with additional information; by developing hybrid solutions that take the best bits from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

6.1 Unconstrained List

Unconstrained options that are chosen to either 'Proceed' or 'Clarify' are then included in our Options Evaluation spreadsheet. Options that are 'Rejected' do not proceed beyond the unconstrained list below.

It should be noted that options that include 'TCMSG' (Thames Catchment Management Steering Group) in the option description have been developed to align with the wider DrWPA_ND scheme delivery of Thames Water and South East Water for the priority catchments each company either leads or provides support. Alternative options that include 'non-TCMSG' in the option description work outside of the TCMSG partnership Terms of Reference.

It should also be noted that options in the unconstrained list have been developed at different scales (e.g., whole DrWPA) and targeting different measures (e.g., at risk pesticides only or multiple pollutants/environmental benefits.

Our unconstrained list of options are:

Table 1 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on treatment options	R	Does not meet S and NS requirements

2	Non-TCMSG - Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues and newsletters – generic non-targeted	R	Does not meet S and NS requirements
3	TCMSG - Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects targeted in Loddon, Wey and Lower Colne	C	See assessment in Options Evaluation spreadsheet
4	Non-TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in the Loddon catchment	R	Does not meet S and NS requirements
5	Non-TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in the Lower Wey catchment	R	Does not meet S and NS requirements
6	Non-TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in the whole Wey catchment	R	Does not meet S and NS requirements
7	Non-TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in the Lower Colne catchment	R	Does not meet S and NS requirements
8	TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in Loddon, Wey and Lower Colne	P	See assessment in Options Evaluation spreadsheet
9	TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in Loddon, Wey and Lower Colne	P	See assessment in Options Evaluation spreadsheet
10	Non-TCMSG enhanced with spatial prioritisation and targeting and delivery of	C	See assessment in Options

	C&NBS with delivery of C&NBS for pesticides at whole Lower Thames and River Wey DrWPA catchments		Evaluation spreadsheet
11	TCMSG C&NBS - CM enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole Loddon, Wey and Colne catchments	P	See assessment in Options Evaluation spreadsheet
12	Non-TCMSG - CM enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole Lower Thames and River Wey DrWPA catchments	C	See assessment in Options Evaluation spreadsheet

6.2 Constrained List

Six options have been selected from the original 12. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 1) and is presented below to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 2. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
TCMSG - Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects targeted in Loddon, Wey and Lower Colne	**NNN**	**NN**	**YYY**	**YYY**
TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides	**YY**	**YY**	**YY**	**YY**

in Loddon, Wey and Lower Colne				
TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in Loddon, Wey and Lower Colne	YYY	YYY	YY	YY
Non-TCMSG enhanced with spatial prioritisation and targeting and delivery of C&NBS with delivery of C&NBS for pesticides at whole Lower Thames and River Wey DrWPA catchments	YY	YY	Y	N
TCMSG C&NBS - CM enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole Loddon, Wey and Colne catchments	YYY	YYY	Y	Y
Non-TCMSG - CM enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole Lower Thames and River Wey DrWPA catchments	YYY	YYY	N	N

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

Our final set of three feasible options are:

1. TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in Loddon, Wey and Lower Colne
2. TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in Loddon, Wey and Lower Colne

3. TCMSG C&NBS - CM enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole Loddon, Wey and Colne catchments

6.3.1 Option 0: Do Nothing

Do nothing option. Focus solely on treatment options.

6.3.2 Option1: Preferred, Best Value Option

TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in Loddon, Wey and Lower Colne catchments (costed option C)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£1.918m**

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues engagement process. The proposed option includes:

- Schemes and measures in catchments where Affinity Water will lead on delivery to prevent deterioration of 'at risk' pesticides and monitor the risk of emerging pesticide risks.
- Reduce sediment and nutrient losses, along with associated pollutants including nitrate and microbiological contaminants, in priority areas identified through monitoring and modelling carried out in AMP6 and AMP7
- Identify opportunities to protect and restore natural assets in the operational catchments to improve overall catchment resilience.
- Deliver multiple benefits for water quality, resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Incentivised pesticide reduction schemes with farmers.
- Funding towards infrastructure improvements including pesticide handling areas.
- Funding towards substitution of high risks crops, with lower risk alternatives.
- Cover crops.
- Herbal leys.
- Resurfacing of farm gateways.
- Arable reversion.
- Chalk grassland restoration.
- Tree/woodland planting.

- Regenerative agriculture measures such as reduced/no tillage.

6.3.3 Option 2: Least Cost

TCMSG - CM enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides in Loddon, Wey and Lower Colne (costed option B)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£1.180038m**

The least cost option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to prevent deterioration of the 'at risk' pesticides and monitor emerging pesticide risks.

6.3.4 Option 3: Alternative Option

TCMSG C&NBS - CM enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole Loddon, Wey and Colne catchments (costed option D)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£3.295772m**

Alternative option is similar in scope to the best value option but proposes a significant increase in the scale of developing a programme of land management C&NBS without spatial targeting with measures being funded and implemented across the whole catchment. This option will prioritise the risks and issues identified in the Stage 2 WINEP risks and issues engagement process, but also to contribute to achieving wider environmental outcomes to meet the 25 Year Environment Plan.

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option contributes to meeting Water Industry Strategic Environmental Requirements (WISER) as detailed in Table 3 below. It demonstrates an increase in ambition compared to AMP7 to deliver multiple benefits from measures implemented, as well as, building on extensive knowledge and experience of the target catchments

gained during the schemes delivered in AMP6 and AMP7. It also supports the partnership approach for the wider Lower Thames and Wey catchments through the TCMSG. It addresses the risks and issues identified in Stage 2 of the WINEP development process, primarily, the 'at risk' pesticides for the DrWPA's. This option recognises the wider pollution issues impacting on our River Thames abstractions that fall outside of WINEP and through developing and delivering C&NBS for multiple benefits will further support the WINEP wider environmental outcomes, alongside opportunities for carbon in-setting and biodiversity net gain for Affinity Water.

6.4.2 Option 2: Least Cost Option

The least cost feasible option has a **medium** level of confidence in the achieving the WINEP wider environmental outcomes. This option contributes to meeting the Water Industry Strategic Environmental Requirements (WISER). This option builds on the extensive knowledge and experience of the target catchments gained during the schemes delivered in AMP6 and AMP7. It also supports the partnership approach for the wider Lower Thames and Wey catchments through the TCMSG. It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, primarily, the 'at risk' pesticides for the DrWPA's. This option takes a less holistic approach to delivering C&NBS and is less likely to address the wider pollution issues impacting our River Thames abstractions and will miss opportunities to support achieving Net Zero through carbon in-setting.

6.4.3 Option 3: Alternative Feasible Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option contributes to meeting Water Industry Strategic Environmental Requirements (WISER). It demonstrates a significant increase in ambition compared to AMP7 to deliver multiple benefits from measures implemented, as well as an increase in the geographic scale for which the measures will be targeted. This option does not fully account for the extensive knowledge and experience of the target catchments gained during the schemes delivered in AMP6 and AMP7 and where to prioritise measures for the greatest benefits. It does support the partnership approach for the wider Lower Thames and Wey catchments through the TCMSG. It addresses the risks and issues identified in Stage 2 of the WINEP development process, primarily, the 'at risk' pesticides for the DrWPA's. This option recognises the wider pollution issues impacting on our River Thames abstractions that fall outside of WINEP and through developing and delivering C&NBS for multiple benefits will further support the WINEP wider environmental outcomes, alongside increased opportunities for carbon in-setting and biodiversity net gain for Affinity Water, compared to the best value option. However, the less targeted approach to delivering C&NBS and greater level of intervention required may not deliver the best value for investments in nature-based solutions. This option could also lead to deliverability issues due to the scale of intervention required.

Table 3: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the Colne Operational Catchment

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures proposed in the best value option will support this wider resilience by incorporating measures to address wider DrWPA pollution challenges for more resilient water supply from the River Thames abstractions supporting wider SR's
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures proposed in the best value option will support this wider resilience by incorporating measures to address wider DrWPA pollution challenges, creating greater resilience for our abstractions and potential reduction in treatment
Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for pesticides in the Lower Thames catchment delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	C&NBS primary focus on working with farmers to reduce 'at risk' pesticide losses to water. Best value option will include measures to reduce nitrate, turbidity and microbiological contaminants

Environment Bill	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits where appropriate
Environment Bill	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits where appropriate
Environment Bill	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnership Working section 5.2 Strategic Partnership with South East Water and Thames Water through the TCMSG.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.
Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.
Eels	Water companies must comply with the requirement of the Eels regs 2009 to support the recovery of the European eel stock.	Fish screens for the River Thames abstractions is being dealt with under a separate WINEP line/BC
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	C&NBS measures within this scheme will support sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance habitats where appropriate
Climate Change	Water companies are expected to adopt nature based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2

Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature based solutions	AMP7 C&NBS measures co-funded through the TCMSG, EnTrade and LENS. Experience and lessons-learned adopted for PR24.

6.4.4 Can the Option Provide Net Benefits?

The least cost option 2 can meet the statutory requirements and address the risks and issues related to the 'at risk' pesticides for the DrWPA/SgZ. The other feasible options can deliver the following additional environmental benefits.

Option 1: Preferred, Best Value, Option

By aligning C&NBS measures upstream of river restoration and habitat enhancement schemes, the best value option can provide the following net environmental benefits:

- Mitigate wider pollution risks impacting our River Thames abstractions and the wider environment including nitrate, turbidity/sediment and microbiological contaminants.
- Provide opportunities for carbon in-setting to support reaching our Net Zero target for operational carbon by 2030.
- Provide potential Biodiversity Net Gain opportunities on 3rd party land through working with land managers.
- Greater opportunities for bringing in co-funding opportunities from wider stakeholders/government through aligning multiple benefits from best value option with other priorities e.g., Environmental Land Management schemes to support wider WFD drivers.

Option 2: Least Cost Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process. The other feasible options can deliver the following additional environmental benefits.

Option 3: Alternative Feasible Option

In addition to the net environmental benefits stated in the best value option, by implementing wider C&NBS measures at the 'whole catchment' scale there is an increased likelihood of meeting wider environmental outcomes for biodiversity, carbon in-setting, surface water quality and increased likelihood of achieving overall Good Ecological Status (GES) across all waterbodies in the Lower Thames catchment.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support meeting the WINEP wider environmental outcomes. Examples are shown below, but not limited to:

Natural Environment Outcomes

C&NBS measures following regenerative agriculture principles can support creation of temporary, long-term or additional habitats to support biodiversity and provide Biodiversity Net Gain opportunities.

Catchment Resilience Outcomes

C&NBS measures following regenerative agriculture principles can hold more water on the land to enable improved infiltration, reduced surface run-off leading to staggered flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. This option will utilise the extensive knowledge and experience of the catchments, stakeholders and farmers gained from delivering pesticide reduction schemes in AMP6 and AMP7. There is also a greater co-design and co-funding opportunity for schemes, research, field trials and realising multiple benefits through this option, as it will work in partnership with Thames Water and South East Water through the TCMSG. Both companies are also experiencing the same wider pollution issues at their respective River Thames abstractions.

Additionally, there is potential for major infrastructure schemes to commence during this period including the River Thames Flood Alleviation Scheme and expansion of Heathrow Airport. As the best value option is seeking to address wider pollution challenges and explore opportunities wider benefits including carbon and biodiversity, this option could adapt to risks, issues and opportunities that may arise.

The best value option will use a Natural Capital assessment framework to ensure the greatest environmental benefit is derived for every pound invested.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but without targeting of C&NBS to mitigate additional pollutant issues (e.g., nitrate) beyond pesticides, and deliver wider environmental benefits. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements for the DrWPA_ND scheme but will not prevent further deterioration of wider pollution risks to the Lower Thames and Wey DrWPA's.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but with less spatial targeting of C&NBS measures and focuses on increased uptake and funding of C&NBS at the whole catchment-scale. This option will seek to invest in a significantly larger number of measures and will require a greater level of investment. This option is less appropriate to the size and complexity of the environmental risks and issues and could create duplication with wider environmental programmes such as ELMS and is less adaptive than the best value option.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP business cases by PR24 Red Team
    b. Review of business cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 3 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 4.

Our economic analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We have used our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

7.2 Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. A bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1.

7.3 Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.452m** in partnership funding contributions towards the non-statutory tertiary driver aspects of the Lower Thames DrWPA WINEP scheme across AMP8. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Develop and deliver our Soil Innovation Fund which requires a % contribution from the farmer/landowner towards funded measures.
- Continue our partnership (TCMSG) with Thames Water and South East Water which could include:
    - Co-funding of measures
    - Collaborative research and field-trials (joint funded)
    - Joint bids for external funding
    - Developing a potential catchment-trading market for ecosystem services in the Lower Thames
- Establish an AMP8 5-year formal partnership agreement with the CaBA Wey Landscape Partnership, Colne Catchment Action Network and Loddon Catchment Partnership. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Identification, scoping and co-funding/co-delivery of river improvement works.
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Work with key stakeholders such as local catchment partnerships to explore options with working with farm cluster groups in the Upper Lea to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

7.4 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of

benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics, and if these materially impact the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the rivers that we are restoring are unique in nature and therefore of higher environmental value to society.

7.5 Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The business case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g. hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

7.6 Efficiency

We have used our experience of delivering similar projects over the past ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require.

7.7 Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

8.1 Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost, and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the maintenance and improvement of the water quality, but the overall water quality improvements will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

8.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable
Air quality	Monetised as per WINEP and impacted by the natural capital investments

Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the Lower Thames DrWPA and Wey DrWPA will be maintained to some extent as Moderate status as a result of our activities. This is part of the much wider programme of activities delivered through the TCMSG partnership and Natural England's Catchment Sensitive Farming across the DrWPA.

- We have calculated the total length of the Thames impacted as 61 km for the Thames from Cookham to Egham and Egham to Teddington, and 76 km for the River Wey from Shalford to the Thames.
- We have assumed that the whole length is currently in Moderate condition as per Catchment Data Explorer.
- We have assumed that our natural capital activities will maintain the status of the river and make a small proportional start to improving the water quality and that further, future activities will be required to achieve full Good Ecological Status for the associated river system.
- For each option, we have assumed a different annual rate of deterioration that can be addressed by our investments. For the preferred option we have assumed a 1% deterioration rate per year, which equates to the relevant length of river moving to Poor status in 100 years without any intervention. If the deterioration rate is lower, then we expect to see some water quality improvements. Because this is a conservative estimate, we expect that our interventions should be able to manage higher deterioration rates.
- We have also assumed that there are on-going additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

Air Quality Pollution Reduction and CO_2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 5-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g., cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.
- We have assumed that the preferred option will impact a total of 5,250 hectares (ha), comprising of: 2,639 ha of enclosed farmland; 24 ha of freshwaters, open waters, wetlands and floodplains; 2,065 ha of semi-natural grasslands; and 521 ha of woodlands.
- We have reduced these values to 2,600 ha for the least cost option and increased the value by 13,500 ha for the alternative option.

8.4 Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is highly cost beneficial for the natural capital activities in our C&NBS proposed project. These activities will provide significant environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a positive NPV of **£0.993m**, and a good benefit / cost ratio of **1.45**. The benefit / cost ratio is higher than both the least cost and the alternative options, demonstrating best value.

We have assumed a 1% deterioration rate in water quality in the analysis, i.e., the river will deteriorate to Poor status within 100 years without investment. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. For example, our cover cropping scheme realised a river water quality benefit of over 40%; CO2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 0.95% would result in cost benefits. This provides a high-level of confidence that the scheme will be cost beneficial.

Some of the natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

8.5 Least Cost Option

The least cost option is cost beneficial with an NPV of **£0.284m** and a benefit / cost ratio of **1.21**.

8.6 Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, with a forecast NPV of **£2.399m**. The benefit / cost ratio is slightly higher than the preferred option, **1.63**. However, it should be noted that there are uncertainties in the benefit estimation in the options. It is prudent to work on the preferred option initially and monitor progress; to better understand how best to invest in the future;

and then to secure on-going environmental improvements, where we have a higher level of confidence of benefit realisation. We consider that the delivery risks, particularly with the ability to secure partnership funding, means that the preferred option provides the most confidence of delivering the benefits at this time, and that the additional work in the alternative option are best considered in AMP9.

8.7 Alternative Option 2

There was no second alternative option in this analysis.

8.8 Non-Monetised Information

We have rigorously applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Arable production
- Livestock production (dairy and meat)
- Flood and drought resilience

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least cost option; all in proportion to the number of hectares set aside for the production. There will clearly be some benefits from arable and livestock production, but these are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these

benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

C&NBS within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

8.9 Wider Environmental Outcomes

8.9.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.9.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option**	-
	Least Cost Option	-
	Alternative Option 1	-
	Alternative Option 2	o

8.10 Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option that can be confidently delivered. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Conservative estimates of the benefits have been made and the scheme is cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis is conservative and has been benchmarked against the Natural Capital evaluation carried out by Atkins of our EnTrade cover crop scheme in the Lee catchment delivered in 2020/21. We will review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**1.45** compared to **1.21**). The alternative option of doing more does offer better value as the costs provide a little more additional benefit, with a benefit / cost ratio of **1.63**, but it also has higher delivery risks, which makes it less attractive.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. Our sensitivity analysis shows that the scheme will be cost beneficial if the river quality is maintained against any water quality deterioration rate greater than 0.95% per annum. When this is considered with our conservative assumptions, the project is worthwhile and will be strongly beneficial to customers and society.

The best value option aligns with the WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments in the Lower Thames and will be delivered alongside our AMP8 and AMP9 Sustainability Reductions programme to create greater resilience and security of supply from our River Thames abstractions which will be required to replace water from our sources subject to reductions in abstraction.

9 Delivery Considerations

9.1 Related Projects

This project is similar to our other C&NBS schemes. Collectively they form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in our River Thames abstractions and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25 years. Preventing deterioration of raw water quality will also support our future Environmental Destination programme and SDS ambition to end unsustainable abstraction in chalk groundwater, by ensuring water availability for future schemes such as Connect 2050.

There is potential for major infrastructure schemes to commence during this period including the River Thames Flood Alleviation Scheme and expansion of Heathrow Airport. As the best value option is seeking to address wider pollution challenges and explore opportunities wider benefits including carbon and biodiversity, this option could adapt to risks, issues and opportunities that may arise.

9.2 Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP6 and AMP7 schemes and associated monitoring programme with Thames Water and South East Water has developed a good understanding of the sources and pathways for pollution in the catchments we are leading on. This will help us target C&NBS spatially and temporally to deliver the greatest benefit.
- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to an operational catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits beyond the primary DrWPA_ND driver for pesticides.

9.3 Delivery Risk Management

We have already delivered similar catchment management schemes, and therefore have a strong understanding of the delivery risks and how best to manage these. The most significant risk to the project is to secure partnership funding. This is beyond our control, being dependent on wider water company funding contributions, other stakeholders (e.g., catchment partnerships, and government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

In addition, the following risks and mitigations have been identified for this project:

- Farmers and land managers unwilling to engage with us on land management C&NBS.
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable agricultural advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes.
- Uncertainties around climate change and associated flood, drought and other impacts.
    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8.
- Increasing demand at a national level for specialist local agricultural advisors to deliver farm engagement activities leading to delays in overall programme delivery.
    - We have an established network of local advisors already delivering projects on our behalf which we will build on for AMP8.
- Increasing cost of resources to deliver projects.
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs.
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS.
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

9.4 Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits we will undertake the following activities:

- Combined programme of pesticide sampling across the Thames River Basin in partnership with Thames Water and South East Water.
- Development of KPI's and associated success measures focused on prevention of deterioration and improvements.
- Detailed in-catchment monitoring in priority sub-catchments to determine pollutant source and pathways including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring
- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the Option Development Report and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 6 shows the workstream followed for each scheme estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott McDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each scheme we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on investigations carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each scheme will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, km of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

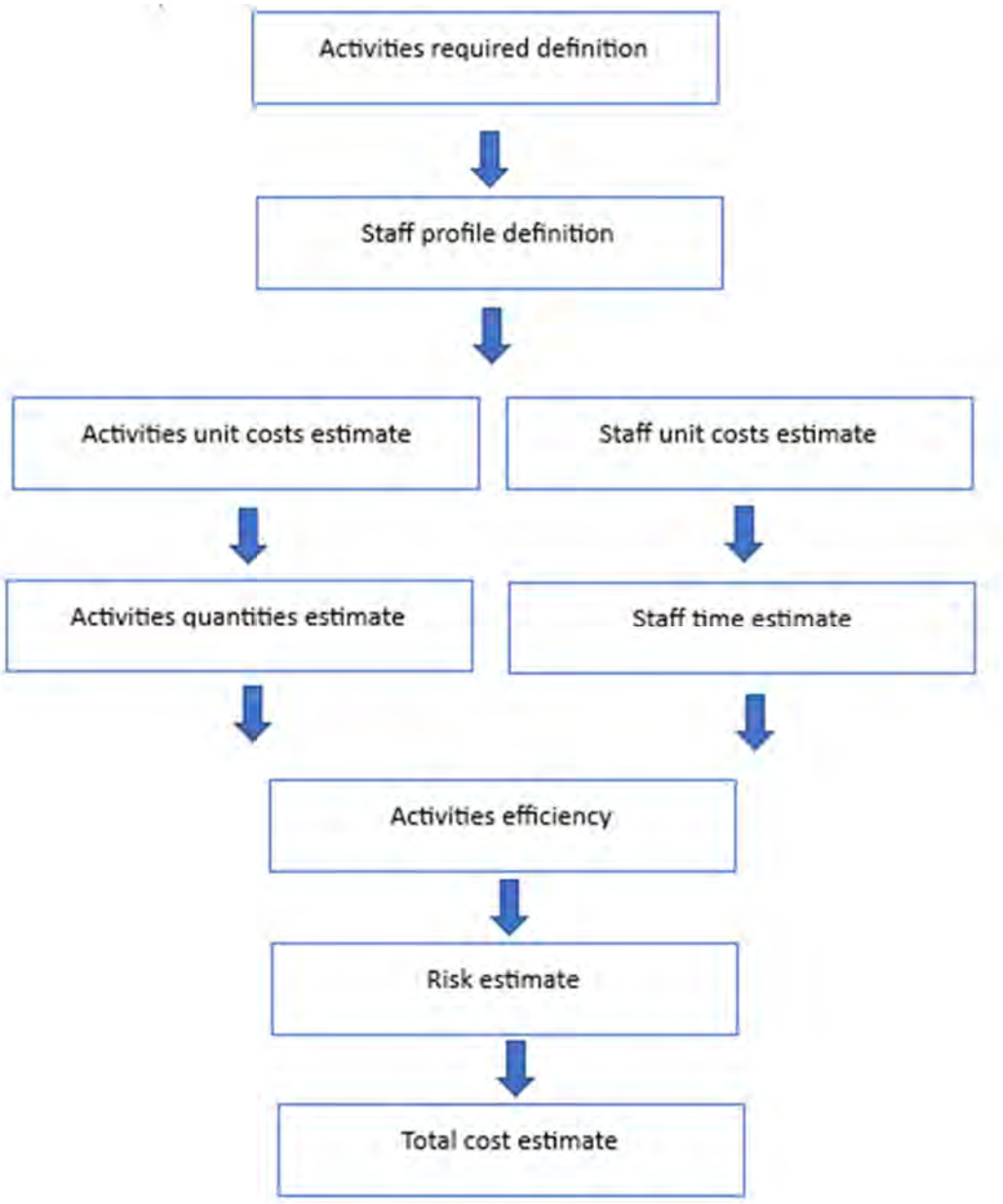


Figure 6 Cost Estimate workstream diagram

Activities quantities estimate: for each activity we determined the most likely quantities based on the agreed objective of the scheme. The quantities have been calculated using maps tools here appropriate (e.g. km of watercourse) as well as experience gained from previous AMPs schemes. Where possible, significant attention has been paid to make efficiency across schemes. For instance, quantities of field monitoring rounds required for a small scheme have been reduced if a nearby scheme included larger monitoring rounds.

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar investigations undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director time have been

allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Activities efficiency: where possible, significant attention has been paid to make efficiency across investigations. For instance, field monitoring rounds estimated for a small investigation have been incorporated into a nearby larger investigation monitoring activity, so that time and resources spent are minimised.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – River Thames DrWPA Options Evaluation v1.0

Appendix 2 – Affinity Water WINEP Stage 2 Risks and Issues Register v1.0

Appendix 4 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 5 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Karstic Groundwater Sources

Catchment and Nature-based Solutions

August 2023

Contents

1 Summary

This business case sets out the detailed PR24 WINEP options development process and outcomes for our proposed no deterioration (DrWPA_ND) schemes for our North Mymms and Clay Lane group of sources to be delivered in AMP8. This includes the following groundwater abstractions:

- North Mymms group of groundwater sources including:
  - North Mymms
  - Essendon
  - Roestock
  - Tyttenhanger
- Clay Lane group of groundwater sources including:
  - Bricket Wood
  - Netherwild
  - Eastbury
  - Berry Grove

The scheme aims to address the following challenges:

- Prevent deterioration of 'at risk' pesticides (propyzamide and flufenacet) impacting the sources listed above, associated groundwater bodies and waterbodies.
- Mitigate the risks and impacts of nitrate and microbiological pollution arising from agricultural and amenity land use activities.
- Undertake abstraction and catchment monitoring for additional pesticides 'of concern' with actions to address further challenges as they arise.
- Deliver measures that can achieve multiple benefits to contribute to addressing the WINEP wider environmental outcomes.

The 'best value' option described in this Business case defines a programme of land management focused Catchment and Nature-Based Solutions (C&NBS) for the following groundwater catchments and associated waterbodies:

Groundwater catchments
- GB40601G602900 - Upper Lee Chalk groundwater body
- GB40601G601200 - Mid-Chilterns Chalk groundwater body

Waterbodies
- GB106039029850 - Colne (upper east arm including Mimmshall Brook)
- GB106039029820 - Upper Colne and Ellen Brook
- GB106039023100 - Tykeswater
- GB106039029840 - Colne (from Confluence with Ver to Gade)
- GB106038033392 - Lee (from Luton Hoo Lakes to Hertford)

This includes works a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater, improved soil health, greater water-holding capacity on

land for flood and drought resilience, net zero benefits and biodiversity enhancements.

We have followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our preferred solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high degree of support for the proposed environmental improvements. We have learnt from our previous projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option that can be confidently delivered.

The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water. Conservative estimates of the benefits have been made and the scheme has been assessed as cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. Based upon our conservative estimates, the preferred option offers NPV benefits of £3.162m with a strong benefit cost ratio of 2.81.

The best value option will be delivered under a catchment strategy for these catchments following the principles of our environmental strategy and existing Catchment Based Approach (CaBA) catchment plans (where relevant). The prioritisation and delivery of the programme will be developed with the Environment Agency, Natural England, Thames Water and South-East Water to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

C&NBS within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS

Each project will utilise a range of C&NBS targeted spatially and/or temporally to prevent deterioration of water quality deliver the greatest wider environmental benefits.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in WINEP Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence

To determine the best value option, an extensive options development process was undertaken with 13 unconstrained options, 7 constrained options assessed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration

To determine the best value option, we have carried out a detailed water quality risks and issues identification process with key stakeholders including the Environment Agency and Thames Water. We have also developed our proposed solutions with input and feedback with these key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	14 August 2023
Report Title	Karstic Groundwater Sources C&NBS – PR24 business case
Options Assessment Report (WINEP)	08AF100015_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030
WINEP Spreadsheet ID	
WINEP Action ID	08AF100015
Primary Drivers	WFDGW_ND (S) - Primary 25YEP_IMP (NS) - Secondary
Scale of Action Delivery	Groundwater body
Location of Delivery	GB40601G602900 - Upper Lee Chalk groundwater body GB40601G601200 - Mid-Chilterns Chalk groundwater body GB106039029850 - Colne (upper east arm including Mimmshall Brook) GB106039029820 - Upper Colne and Ellen Brook GB106039023100 - Tykeswater GB106039029840 - Colne (from Confluence with Ver to Gade) GB106038033392 - Lee (from Luton Hoo Lakes to Hertford)

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.24	0.29	0.33	0.33	0.33	**1.52**
Totex (£m)	0.24	0.29	0.33	0.33	0.33	**1.52**
3rd Party Funding	0.06	0.07	0.07	0.07	0.08	**0.35**

Drivers	
100%	Drinking Water Protected Areas

Benefits			
Water Quality of Natural Water Bodies (km)			
Sequested Carbon (tonnes CO_2e)			
Air Quality Pollution Reduction (tonnes)			
Economic Analysis			
NPV Costs (£m) (2025-55)	**1.7**	NPV Benefits (£m) (2025-55)	**4.9**
NPV (£m) (2025-55)	**3.2**	Benefit / Cost Ratio	**2.8**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

The Affinity Water karstic groundwater sources proposed catchment management scheme is a programme of pesticide reduction schemes and spatially targeted catchment and nature-based solutions (C&NBS) in identified priority sub-catchments with the aim of reducing pesticide and nitrate pollution in catchment to prevent deterioration of raw water quality and provide resilience to our following sources:

North Mymms Group of Sources:

- North Mymms (Safeguard zone - GWSGZ0249)
- Essendon (Safeguard zone - GWSGZ0160)
- Tyttenhanger (Safeguard zone - GWSGZ0233)
- Roestock (candidate SGZ – TBC)

Clay Lane Group of Sources

- Bricket Wood (candidate SGZ – TBC)
- Netherwild (Safeguard zone - GWSGZ0276)
- Eastbury (Safeguard zone - GWSGZ0275)
- Berry Grove (candidate SGZ – TBC)

The objective of the scheme is to build on previous WFDGW_ND schemes for metaldehyde and propyzamide and expand the approach to mitigate losses to water of wider 'At risk' pesticides and nitrate based on experience from schemes, extensive surface/groundwater tracer testing, and field trials carried out in AMP6 and AMP7. This catchment scheme will be delivered under the Water Framework Directive 'No Deterioration' (WFDGW_ND) driver and will support Affinity Water's compliance with the Drinking Water Directive standard for individual pesticides (0.1 µg/l), total pesticides (0.5µg/l) and nitrate (50mg/l NO_3).

This scheme is expanding in scope and scale based on the outcome of the WFDGW_INV completed 31 March 2022 for nitrate which recommended the implementation of a C&NBS scheme in AMP8 and has been signed off and supported by the EA Hertfordshire and North London Area driver leads. It also aims to prevent deterioration of pesticide risks from propyzamide and flufenacet that have been identified through Affinity Water's extensive catchment monitoring programme in these catchments and in the raw water at the public water supply abstractions.

C&NBS approach

Our catchment management approach is a land management focused programme of C&NBS prioritised both spatially and temporally to achieve the following outcomes:

- Prevent deterioration of 'at risk' pesticides (propyzamide and flufenacet) impacting the sources listed above, associated groundwater bodies and waterbodies.
- Mitigate the risks and impacts of nitrate and microbiological pollution arising from agricultural and amenity land use activities.

- Undertake abstraction and catchment monitoring for additional pesticides 'of concern' with actions to address further challenges as they arise.
- Deliver measures that can achieve multiple benefits to contribute to addressing the WINEP wider environmental outcomes including, but not limited to:
    - Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams.
    - Connecting wildlife corridors and creation of habitats in partnership with local stakeholders.
    - Wider biodiversity benefits (e.g., to priority habitats and species)
    - Measures that contribute towards achieving Net Zero by 2030 for operational emissions.

This project builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality, and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

Environmental Risk and Issues

Diffuse and point source pollution from agriculture and amenity land use in the Upper Colne and Upper Lee (Essendon) catchments have led to the designation of most of the catchment as groundwater safeguard zones for pesticide and nitrate. These 'at risk' pesticides and nitrates are also reasons for not achieving good ecological status (RNAG) in the associated waterbodies.

Reducing losses of these pesticides and nutrients at their source through use of C&NBS with land managers will increase resilience of our abstractions and improve river water quality. These C&NBS also can reduce wider pollutants impacting on river and potable water quality including turbidity and microbiological parameters (e.g. cryptosporidium) which pose risks to our abstractions and create further deterioration in water quality in the associated surface water and groundwater bodies. The best value option aims to incorporate measures in high-risk areas identified in these catchments, through our sampling programme and tracer testing of karst solution features, that can achieve multiple benefits for water quality and wider benefits including carbon insetting opportunities and enhancing biodiversity.

Baseline Assessment

North Mymms water treatment works (WTW) in Hertfordshire has a groundwater source licensed to pump up to 9.055Ml/d and treats raw water from our sources at Essendon, Roestock and Tyttenhanger. All four sources are treated as a group which can supply water to approximately 250,000 people.

Clay Lane WTW in Hertfordshire supplies approximately 400,000 customers and treats raw water from a combination of eight groundwater sources. Bricket Wood PS, Berry Grove PS, Netherwild PS and Eastbury PS have been identified as being vulnerable to a range of pesticides.

The North Mymms (except for Essendon) and Clay Lane group of abstractions are situated in the Upper Colne catchment (GB40601G601200 - Mid-Chilterns Chalk groundwater body). Essendon is situated in the Upper Lee (GB40601G602900 - Upper Lee Chalk groundwater body) catchment. Due to the presence of a karstic drainage network in these catchment, rapid deterioration of water quality can occur at these abstraction points following rainfall events, particularly during the autumn/winter where there is greater connectivity between surface and groundwater due to these karst features. Consequently, our regular monitoring of surface water and groundwater has observed significant peaks in concentration of nitrate and pesticides linked to land use activities in these catchments (Figures 1-4).

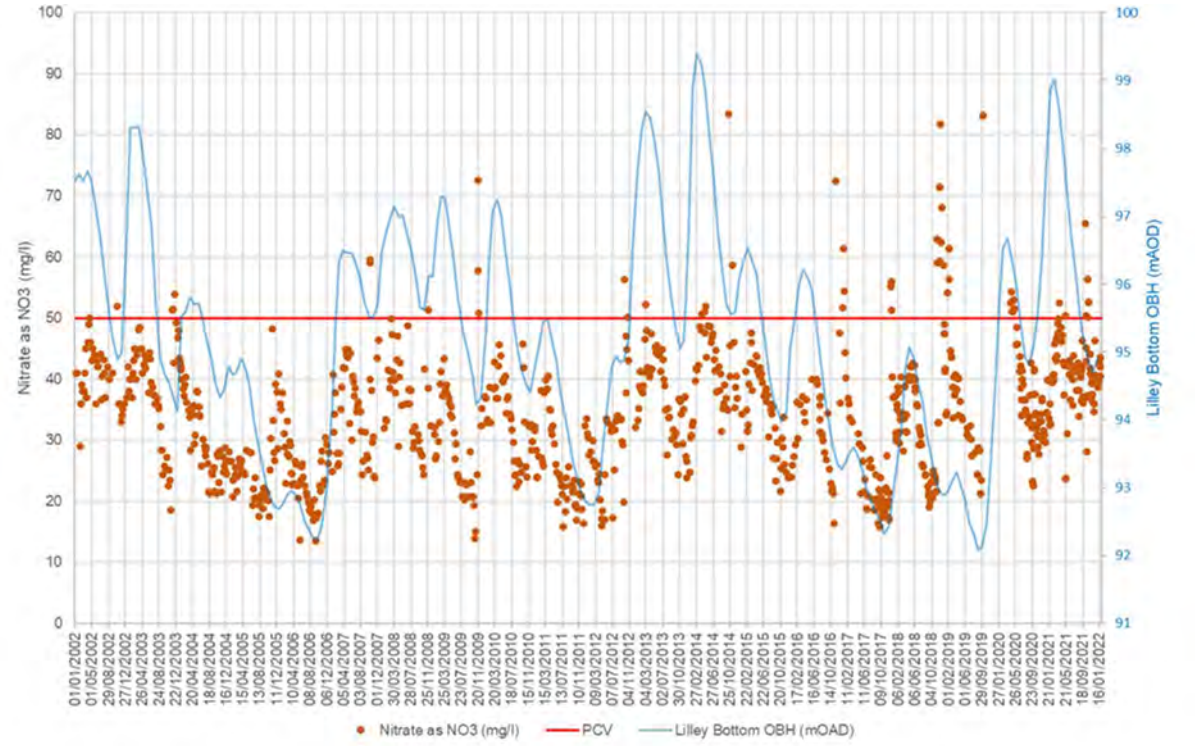


Figure 1: nitrate concentrations at North Mymms WTW with plotted groundwater levels from Lilley Bottom OBH 2002 – 2022

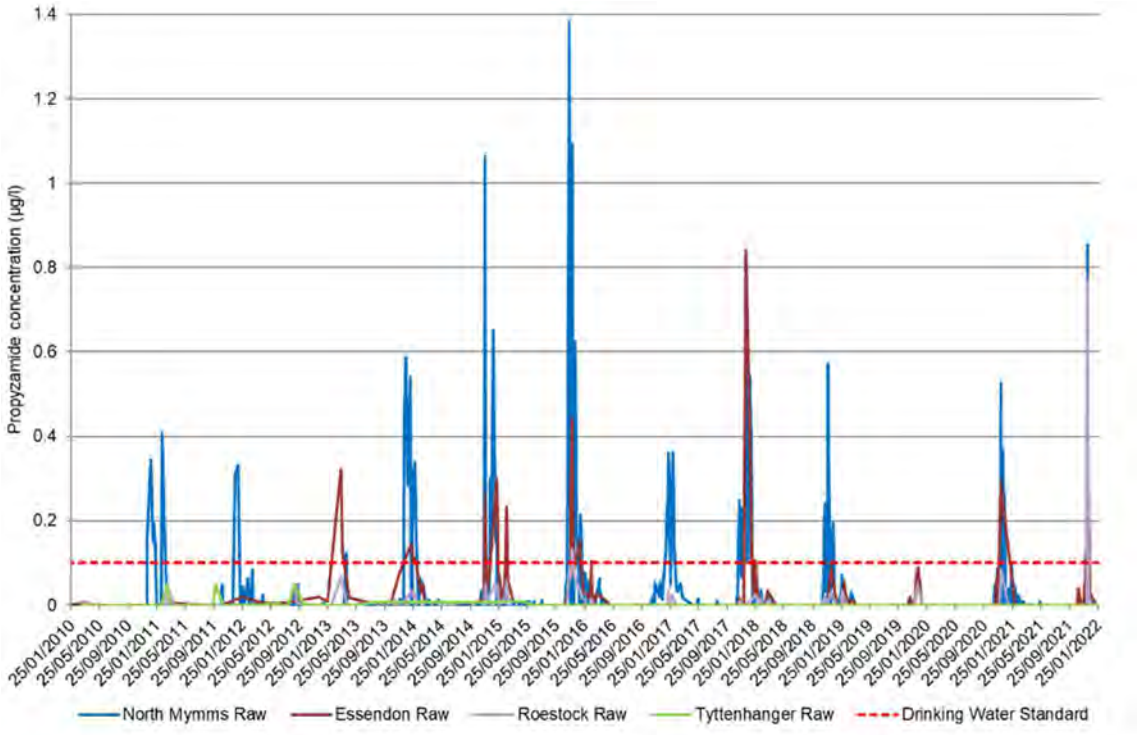


Figure 2: North Mymms & sources raw water propyzamide results 2010-2021 (µg/l)

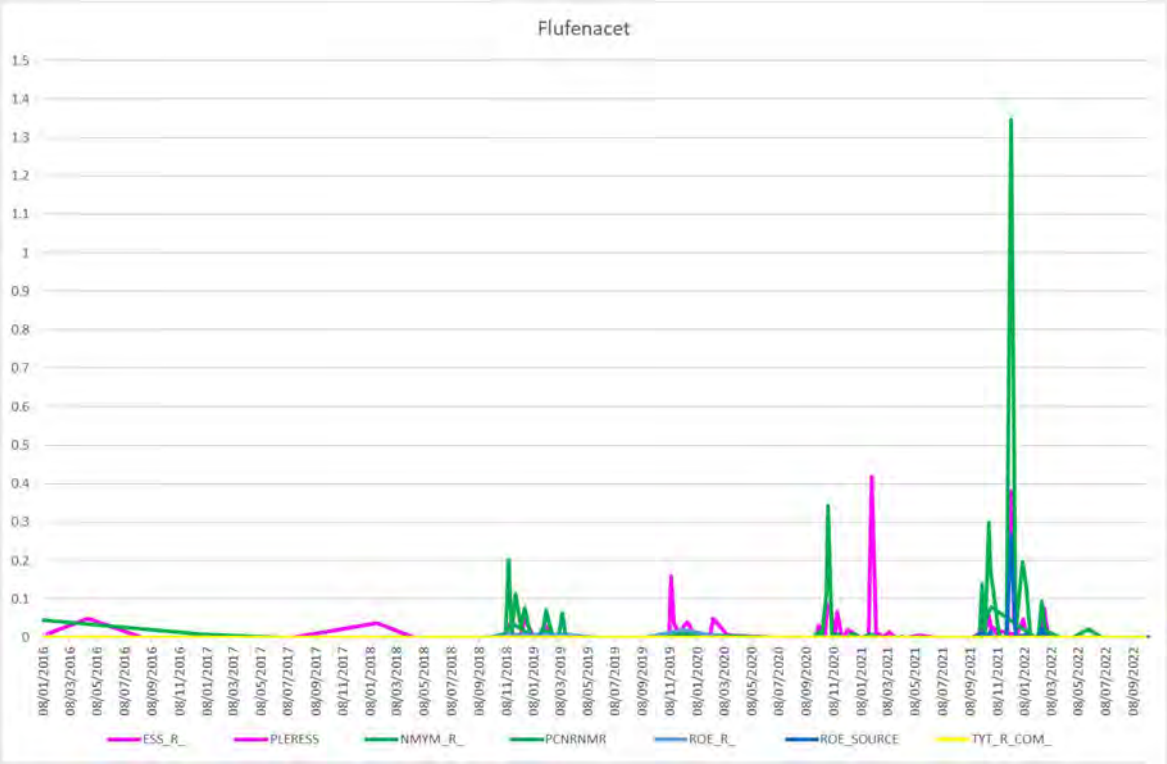


Figure 3: Flufenacet concentrations (µg/l) detected at the North Mymms sources

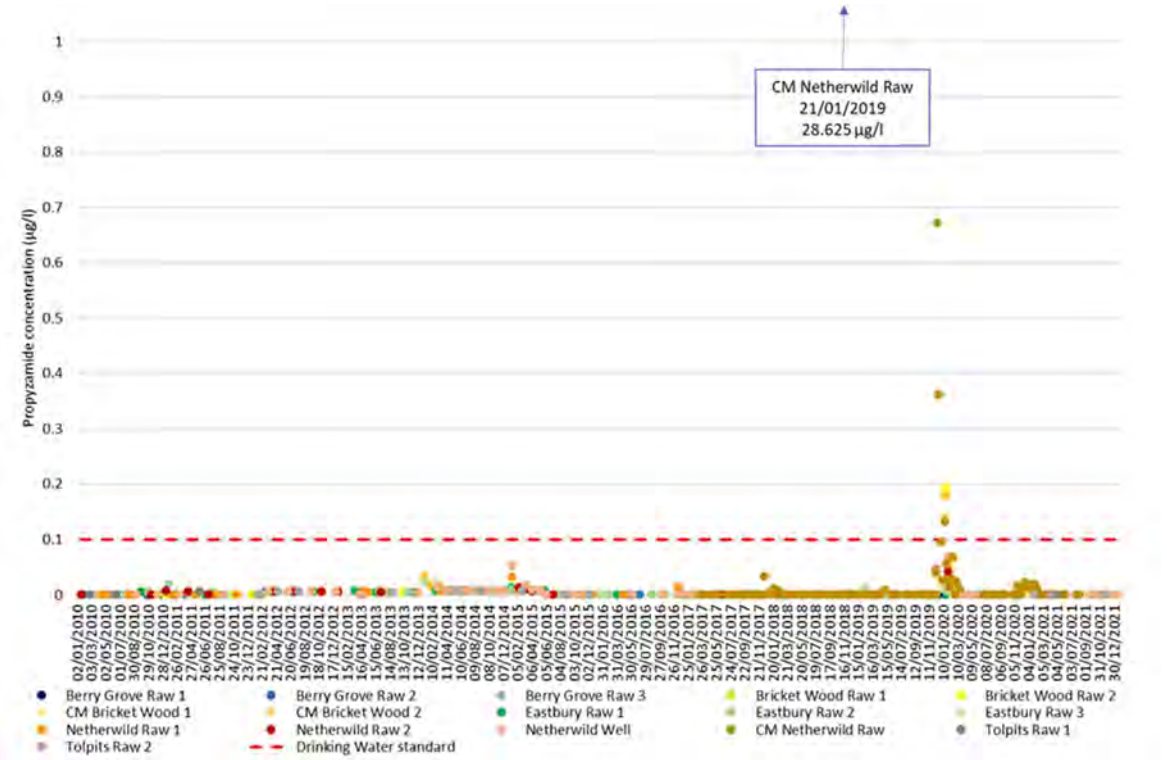


Figure 4: Propyzamide concentrations (µg/l) detected at the Clay Lane sources 2010 – 2021

Drivers for the scheme

3.1.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 4 in section 7.4.3

2) The Drinking Water Directive

Drinking Water Directive standard for pesticides for individual pesticides (0.1µg/l), total pesticides (0.5µg/l) and nitrate (50mg/l NO_3).

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP).

- Thames River Basin Management Plan

The specific WINEP Driver relevant to this scheme is:

- WFDGW_ND (S) = Catchment actions must prevent deterioration, or improve following a deterioration, of water quality or improve water quality.

3.1.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies
- AW0031 Affinity Water Strategic Direction Statement
- Blueprint for Water – Blueprint for PR24
- Relevant Safeguard Zones –
    - North Mymms – GWSGZ0249
    - Tyttenhanger – GWSGZ0233
    - Netherwild – GWSGZ0276
    - Eastbury – GWSGZ0275
    - Essendon - GWSGZ0160

3.1.3 Stated Need

Affinity Water supplies potable water to approximately 650,000 customers from our karstic sources in the Mid Chilterns Chalk and Upper Lee Chalk groundwater bodies. The groundwater abstracted experiences rapid deterioration in raw water quality

following rainfall in the autumn/winter months due to surface - groundwater connectivity caused by a number of karst features (stream sinks, swallow holes and dolines) in these catchments. These features have been identified through a mapping and risk assessment project with the British Geological Survey carried out in 2017 and subsequent tracer testing carried out through a PhD study through the University of Leeds, carried out between 2020 and 2022. This study has been funded by Affinity Water to determine the contribution of water (and associated contaminants) from each karst feature to a series of receptors (including our abstractions). Alongside this, we have been delivering a programme of pesticide investigations and catchment mitigation schemes since AMP5, including metaldehyde and have extensive experience of determining sources and pathways for pesticide pollution and developing interventions to address the risk. We have successfully mitigated the risk from metaldehyde through our NEP/WINEP WFDGW_ND schemes throughout AMP6 and AMP7 prior to its ban in March 2022. Propyzamide (Figures 2 and 4) poses a significant risk of breaching the pesticide DWS and has been a component of the WFDGW_ND(S) scheme in AMP7. This has been effective to date in preventing further deterioration of water quality, but the risk has remained due to the scale of use, timing of applications and volatility in the Oilseeds market due to the war in Ukraine. Flufenacet (Figure 3) has emerged as an 'at risk' pesticide over the past 5 years with increased use to control blackgrass in cereal crops, for example Wheat. Additionally, nitrate (Figure 1) frequently exceeds the drinking water standard at North Mymms due primarily to seasonal losses from agricultural fertiliser applications. A WFDGW_INV investigation was completed and signed off by the EA Hertfordshire and North London (HNL) Area Team in March 2022 (Appendix 1 – AWL WINEP WQ Investigation Completion Report HNL 2020 – 2022) and identified that C&NBS could prevent further deterioration of raw water quality and provide greater resilience to our treatment and blending capabilities at North Mymms WTW.

This proposed WFDGW_ND (S) scheme aims to implement spatially and temporally targeted C&NBS to prevent further deterioration of water quality for the 'at risk' pesticides and nitrate with measures to reduce losses of pesticides and nitrate from agricultural and amenity land use in the high-risk sub-catchments identified through our WINEP investigations and catchment monitoring programme.

Additionally, protecting and enhancing our nation's water environment is a priority for the government. One of the **Ofwat's key ambitions for water companies for PR24** is:

- Delivering greater environmental and social value, including by acting immediately on river water quality, moving faster towards net zero, as well as working differently into the future to adopt more catchment – and nature-based solutions.

This scheme supports this ambition around improving river water quality, and the use of C&NBS.

In addition, **WISER** – expectations that this scheme seeks to deliver include, but not limited to:

- Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
- Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
- Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
- Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this Business case please see the 'Level of Confidence of Achieving the WINEP Outcomes' section 7.4.3.

Water Framework Directive (WFD)

- **WINEP** – The Environment Agency (EA) expects that the 'best value' option defined in this Business case takes account of the following wider environmental outcomes:
    - Natural environment outcomes: Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.
    - Catchment resilience outcomes: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
    - Net zero outcomes: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of.
- **DWI long-term planning guidance expectation:**
    - Catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all 'source to tap' risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness and acceptability of water supplies.

There are many drivers to improve the overall quality of the river with solutions that also support the wider community in terms of achieving net zero, and access and amenity benefits.

Allocation of Costs

This Business case is 100% enhancement and all costs are allocated to enhancement expenditure.

Research, Pilots, and Technology Development

We have extensive experience over multiple AMP/WINEP cycles in developing and delivering catchment management schemes in the North Mymms and Clay Lane catchments. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

AWL WINEP WQ Investigations Final Completion Report HNL 2020 – 2022

See Appendix 1: Section 4 (North Mymms WFDGW_INV for nitrate) and Section 5 (Roestock WFDGW_INV for pesticides)

Karst Tracer Testing PhD Study

In 2020, CASE studentship PhD funded by Affinity Water in collaboration with the University of Leeds, the British Geological Survey and the Environment Agency commenced to investigate chalk aquifer function in the Mimmshall Brook and Upper Colne catchments and understand the impact of stream sinks on groundwater quality. The PhD student from the University of Leeds has been working with Affinity Water using North Mymms WTW and sources as case studies. An extensive programme of both dye testing (sodium fluorescein) in the Essendon Brook and bacteriophage tracer testing in the Mimmshall Brook has been undertaken between 2020 and 2022.

Groundwater tracer testing is a method used to investigate preferential flow paths through the chalk aquifer to both prove a connection between stream sinks and water sources and/or springs and with more intensive, quantitative monitoring, the evaluation of tracer breakthrough curves can provide valuable insights into the flow characteristics of an aquifer.

In November 2021, two groundwater tracer tests were simultaneously conducted from stream sinks in the catchment of the Mimmshall Brook. In each test, North Mymms WTW and its sources at Essendon, Roestock and Tyttenhanger were monitored as well as springs in the Lea Valley. These tracer tests are determining which karst stream sinks have the greatest contribution to each abstraction point, and thus enabling us to target C&NBS where we will achieve the greatest benefit to groundwater quality. Further tracer testing is planned in 2022/23 with the final report due in 2024. The outputs of this PhD study will inform our targeting of measures for both nitrate and pesticides and support our wider investigation carried out between 2020 and 2022.

C&NBS for Water Quality

Natural Capital Evaluation of the EnTrade Cover Crop Scheme (2021)

To better understand the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was

to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. 12 ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 5.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6:1 Natural Capital benefit ratio.

Total value	^	-	-	-	£403,450	£945,069	£541,619
Total value/ha	^	-	-	-	£500	£1,172	£671

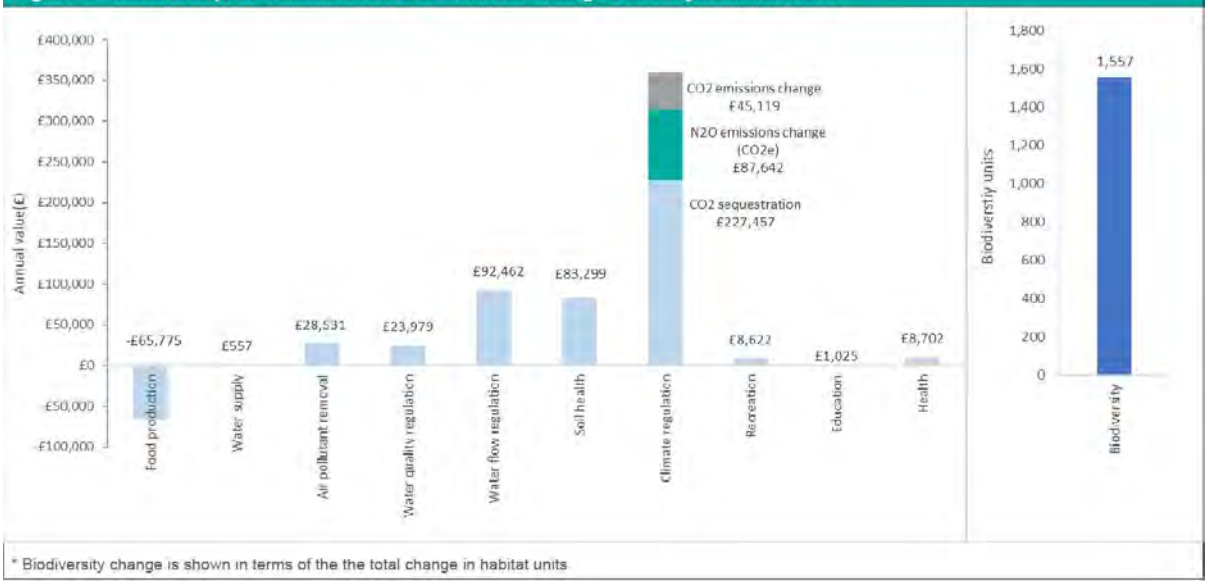


Figure 5. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen Release from Cover Crops (NiCCs) Field Trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil.
    - effect of contrasting cover crop destruction methods e.g., glyphosate & minimum tillage vs mechanical destruction & minimum tillage.
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance.

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was then tracked post cover crop destruction under different management regimes and subsequent cash crops to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit and effective uptake of nitrogen for more sustainable arable farming.

4 Partnering

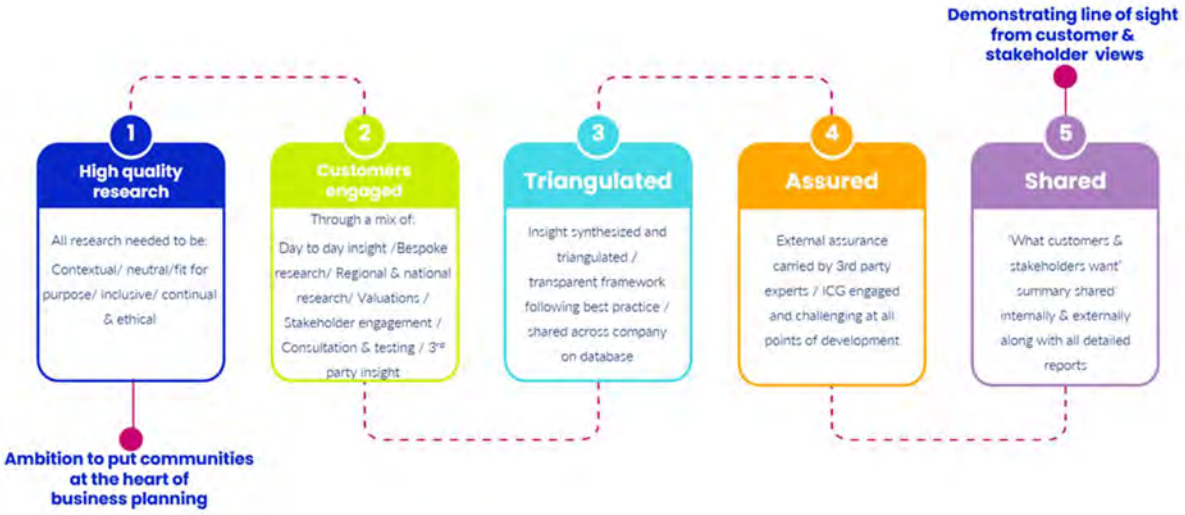
Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers have been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.



The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concern over costs is, however, mixed; with some finding any increase

to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considered it would have a positive impact on wildlife for the future. Some people considered that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.3 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.1.4 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we

have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

Collaboration and Partnering

4.1.5 Engagement with Stakeholders and Partners

WINEP Stage 2 – Collaboratively identifying risks and issues

To support the development of the proposed solutions for the risks and issues included in this Business case, we have undertaken a detailed review of risks and issues for each waterbody catchment. We have taken a collaborative approach to define the PR24 WINEP scope and develop the feasible options and ultimately determine the best value option. As part of this process, carried out between May and August 2022, we have completed the following activities:

- Early engagement with the EA and Natural England (workshops at area level) and follow up meetings meetings/correspondence with driver leads).
- Reviewed, discussed and incorporated Natural England's Nature Recovery List for our region.
- Detailed review of Catchment Data Explorer, CaBA Catchment Plans, River Group meetings, stakeholder workshops and meetings alongside discussions with neighbouring water companies.
- Documented all risks and issues register collated through this process and used to develop the proposed solution described in this business case.

WINEP Stage 3 – Proposing solutions

As part of the development of our proposed solutions to contribute to addressing the risks and issues described in this business case, we have undertaken the following engagement and drawn on experience through our AMP7 WINEP programme delivery to explore options around developing, co-designing and co-delivering schemes which have formed the basis of the feasible options.

4.1.6 Working in partnership with neighbouring water companies – Thames Catchment Management Steering Group (TCMSG) joint statement for partners delivering the Lower Thames and Wey DrWPA_ND schemes

Affinity Water | Thames Water | south east water

Thames Catchment Management Steering Group
Joint Statement - September 2022

In summary:

- The Thames Catchment Management Steering Group (TCMSG) comprises Thames Water, Affinity Water and South East Water and has been working in partnership since 2010 in response to diffuse pesticide pollution and wider pollution challenges.
- The task of leading catchment management initiatives across different parts of the Thames River Basin District (RBD) has been shared out between the three companies alongside a joint sampling programme and various catchment projects.
- The three companies have trialled various approaches to mitigate pesticide risk to drinking water and the wider environment. Results to date from delivering river basin-wide metaldehyde schemes show that improvements can be achieved at the sub-catchment scale. It has also highlighted that full engagement of large numbers of landowners over much larger areas is required to achieve no deterioration and the necessary water quality improvements at abstraction points.
- Alongside voluntary and incentivised catchment measures through the TCMSG's activities, regulatory mechanisms, such as product labelling and reviewing of risks to water prior to re-registration, and enforcement are going to be needed where the voluntary approach is not proving effective in the given timescales.

Three water companies abstract water from the River Thames: Thames Water, Affinity Water and South East Water. In September 2010 we established the TCMSG to work collaboratively to investigate and identify interventions to reduce the impact of diffuse pesticide pollution. The purpose of the partnership is to share data, evidence and information, coordinate work, avoid duplication, standardise target setting, share experiences and knowledge from engagement with farmers and agronomists, and support the EA with Water Environment (Water Framework Directive) Regulations delivery through the Water Industry National Environment Programme (WINEP).

The steering group meets bi-monthly to discuss progress with projects, exchange knowledge and ideas and determine how we can work together most efficiently. The group has worked to ensure that each company can lead on delivering catchment management in different areas of the Thames RBD. This ensures that overlap is minimised, and company resources can be effectively deployed.

Thames Water has responsibility for delivering catchment management across the Thames RBD as far as Maidenhead and in the Mole and Lee and upper Wey sub-catchments (Figure 6). South East Water manages delivery in the lower Thames catchment (Maidenhead to Egham) and associated minor tributaries. Affinity Water has responsibility for the Colne (Hertfordshire), Loddon and lower Wey sub-

catchments. Where overlap occurs, the companies work closely to share data and information on existing useful farmer contacts to ensure that water company/farmer liaison is managed as appropriately as possible.

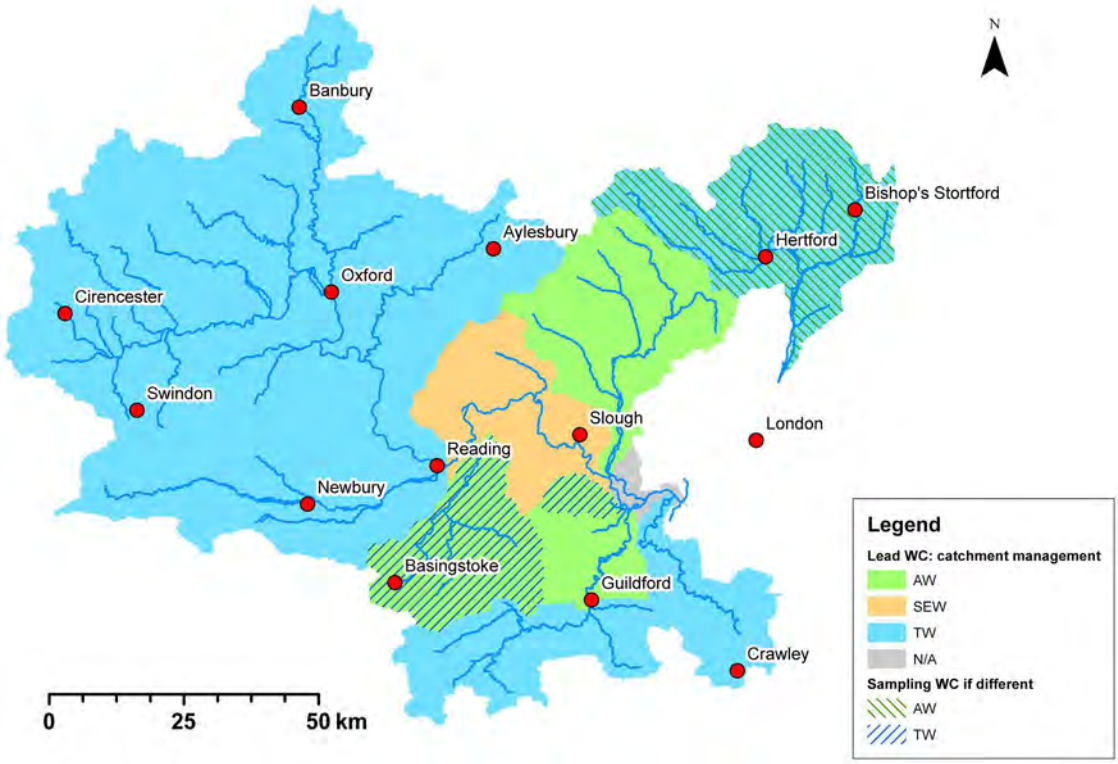


Figure 6: Map showing broad areas of responsibility for catchment management, as shared out between the three companies. Where a different water company is taking responsibility for sampling, this is shown with hatching. N.B. Not all areas will actually require active catchment management; some remain a watching brief or have been identified as low risk.

Alongside allocating responsibility for catchment management in different areas, we have developed a coordinated river sampling strategy across the Thames RBD and are sharing the data (as shown in the above map). This arrangement minimises the travelling undertaken by personnel from both companies involved (i.e. Thames Water and Affinity Water). In addition, the three companies are working collaboratively on various projects; examples include:

- Thames Water and Affinity Water sharing the costs and results of a remote sensing and catchment characterisation exercise in both the upper and lower Wey catchments;
- All three companies sharing the cost of a satellite remote sensing project covering the lower Thames, Chertsey Bourne, Addlestone Bourne and parts of the Colne catchment;
- South East Water carrying out investigations and delivering pilot catchment measures on behalf of all three water companies in the lower Thames region.
- Affinity Water and South East Water, along with Natural England, jointly funding an advisor to support projects in the Loddon catchment

The primary aim of our project work to date has been to trial a number of different mitigation methods for metaldehyde, carbetamide and propyzamide, establish the efficacy of each approach and provide farmers and other catchment stakeholders with a variety of catchment management tools. Projects applying different mechanisms such as Payment for Ecosystem Services (PES), product substitution, capital grants, field trials and innovation funding schemes have been piloted and expanded across the Thames catchment. By the end of AMP6 and into AMP7, schemes delivered by the TCMSG have covered over ~3,500km^2 (figure 7).

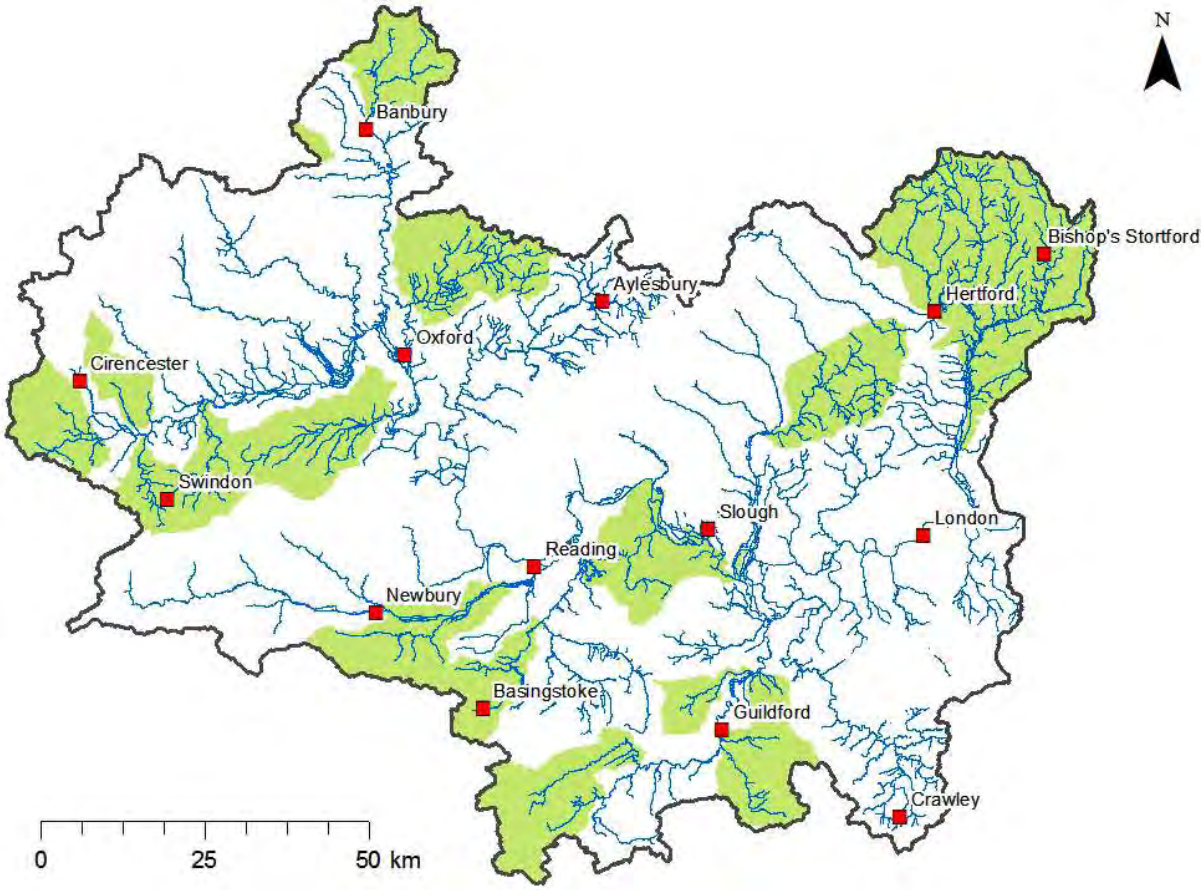


Figure 7: Map showing the extent of pesticide mitigation scheme areas covered by the TCMSG in 2022

Over the course of the past twelve years, we have gained extensive experience and understanding from these projects which can be applied to wider challenges in the water environment. There have been some successes, with water quality improvements reported for metaldehyde across the Thames RBD and at all TCMSG abstractions. There is no 'one size fits all' approach for catchment and nature-based solution (C&NBS), but in most cases intensive engagement is required with a significant proportion of land managers across identified priority (high risk) catchment areas. It is apparent from results to date that changes in the way land is managed and the use of crop protection products and fertilisers are required at a much larger scale in order to achieve no deterioration and/or improvements in water quality both in the river and at abstraction points.

The TCMSG has successfully demonstrated over AMP6 and AMP7 that catchment measures can be upscaled to the river basin scale and that working in partnership can deliver positive outcomes against pollution challenges. During the remainder of AMP7 and beyond 2025, the TCMSG will need to work collaboratively with wider stakeholders to address emerging risk such as flufenacet, alongside ongoing challenges such as propyzamide. There is also a need to apply our experience to tackle wider challenges through the implementation of wider C&NBS that take a holistic approach and deliver wider ecosystem service benefits to achieve wider WFD outcomes.

Environment Agency (EA)

Several meetings have been held between the TCMSG and the EA Thames area and Hertfordshire and North London area water quality driver leads as part of the WINEP stage 2: risks and issues process and stage 3: proposing solutions. As part of these meetings, we have presented the evidence to include flufenacet to the revised list of 'at risk' pesticides and are currently (November 2022) producing and submitting a 'Drinking Water Protected Area/Water Framework Directive Risk Assessment' with supporting evidence for inclusion of flufenacet in the next revision of the SgZ action plans for which Affinity Water have an obligation to deliver actions through this proposed WINEP DrWPA_ND scheme.

4.1.7 Co-design and Co-delivery

Water companies

See above TCMSG Joint Statement – September 2022 which sets out how Affinity Water, Thames Water and South East Water will work in partnership on co-design and co-delivery of the pesticides mitigation schemes for the Thames River Basin District. This includes, but is not limited to, a joint monitoring programme, co-funded local partnerships, co-funded research projects and field trials.

Catchment partnerships / River groups

In addition, we are working with the Colne Catchment Action Network to explore collaborative farm advice and C&NBS schemes across the Colne operational catchment.

Stakeholder consultation with River groups and catchment partnership hosts through our WINEP engagement process has reinforced the need for a joined approach at the catchment-scale. Feedback has included:

> *"Opportunities here to bring in expertise of landowner engagement officers and farming officers across Chilterns AONB to ensure this is truly catchment-wide; and makes the most of existing farm clusters."*
>
> *"Development of farmer clusters in the catchments to help with carbon storage / GW recharge / GW quality*
>
> *e.g. https://www.chilternsaonb.org/farmercluster.html*
>
> *potentially links here to work of farmer clusters - engaging farmers in trials of methods to enhance 'clean' groundwater recharge; linking benefits of carbon sequestration to improved soil structure and hence enhanced water retention and infiltration properties. Possibly working with new remote sensing capabilities to track changes at landscape scale?"*
>
> **Allen Beechey, ColneCAN Catchment Partnership host (Chilterns Chalk Stream Project)**

Wider stakeholders / partners

Landscape Enterprise Networks (LENS) East Anglia:

Affinity Water alongside Anglian Water and a number of companies within the agricultural supply chain including Nestlé Purina and Cargill are co-funding C&NBS measures in the Upper Lee operational catchment (including this scheme area) with a focus on regenerative agriculture measures to deliver a range of ecosystem services including soil health, biodiversity, carbon and water quality. We are working with 3Keel and the investment partners to further develop the scheme for future years which will support our 20% aspirational partnership funding contribution.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this Business case.

Catchment Strategy

This business case is aligned with the Catchment Options development as set out in our draft Water Resources Management Plan and will inform the development of both

our Colne and Upper Lee Catchment Strategies which are currently under development.

Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS and river improvement works projects, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS.

The scheme can adapt to:

- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g. Wastewater company schemes, Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale, and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities (e.g. offsetting).
- Types of measures implemented can adapt and evolve based on future scientific evidence.
- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships, Rivers Trusts.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options, the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 2 – Options Evaluation Karstic sources v1.0

We have then assessed these further, with additional information; by developing hybrid solutions that take the best bits from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

Unconstrained List

Unconstrained options that are chosen to either 'Proceed' or 'Clarify' are then included in our Options Evaluation spreadsheet. Options that are 'Rejected' do not proceed beyond the unconstrained list below.

It should be noted that options in the unconstrained list have been developed at different scales (e.g. whole catchment, sub-catchment and per group of sources) and targeting different measures (e.g. at-risk pesticides only or multiple pollutants/environmental benefits.

Our unconstrained list of options are:

Table 1 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on treatment options	R	Does not meet S and NS requirements
2	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues and newsletters – generic non-targeted	C	See assessment in Options Evaluation spreadsheet

3	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues and newsletters – targeted specifically to farms in drainage area for karst features	R	Not practical to deliver and does not meet S and NS requirements
4	Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides only	C	See assessment in Options Evaluation spreadsheet
5	Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for nitrate only	C	See assessment in Options Evaluation spreadsheet
6	Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides and nitrate	P	See assessment in Options Evaluation spreadsheet
7	Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in catchments for North Mymms and sources	C	See assessment in Options Evaluation spreadsheet
8	Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in catchments for Clay Lane group	R	Does not meet S and NS requirements
9	Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon)	P	See assessment in Options Evaluation spreadsheet
10	Restoration of the Water End swallow network with emphasis on managed wetlands for pollution mitigation with no wider C&NBS measures	R	Does not meet S and NS requirements
11	Catchment Management enhanced + with delivery of C&NBS for multiple benefits	P	See assessment in Options

	(pesticides, nitrate, microbiological, biodiversity and carbon) at whole catchment scale		Evaluation spreadsheet
12	Catchment Management enhanced + with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) inc. restoration of Water End Swallow hole network SSSI	C	See assessment in Options Evaluation spreadsheet
13	Catchment Management enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) at whole catchment scale inc. restoration of Water End Swallow hole network SSSI	R	Rejected due to deliverability issues and considered disproportionate investment

Constrained List

Seven options have been selected from the original thirteen. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 2) is presented below to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 2. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues and newsletters – generic non-targeted	**NN**	**NN**	**YYY**	**YYY**
Catchment Management enhanced with spatial prioritisation and targeting	**N**	**N**	**YY**	**YY**

and delivery of C&NBS for 'at risk' pesticides only				
Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for nitrate only	N	N	YY	YY
Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides and nitrate	YYY	Y	YY	YY
Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) in catchments for North Mymms and sources	N	YY	YY	YY
Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon)	YYY	YYY	YY	YY
Catchment Management enhanced + with delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) inc. restoration of Water End Swallow hole network SSSI	YYY	YYY	Y	N

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

Selected Feasible Options

Our final set of 3 feasible options are:

1. Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides and nitrate.
2. Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon).

3. Catchment Management enhanced + with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) inc. restoration of Water End Swallow hole network SSSI.

6.1.1 Option 0: Do Nothing

Do nothing option. Focus solely on treatment options.

6.1.2 Option1: Preferred, Best Value Option

Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) (costed option C).

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£1.523m**

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues process. The proposed option includes:

- Schemes and measures in catchments to prevent deterioration of 'at risk' pesticides and monitor the risk of emerging pesticide risks.
- Reduce sediment and nutrient losses, along with associated pollutants including nitrate and microbiological contaminants, in priority areas identified through monitoring and modelling carried out in AMP6 and AMP7.
- Identify opportunities to protect and restore natural assets to improve overall catchment resilience.
- Deliver multiple benefits for water quality, resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Incentivised pesticide reduction schemes with farmers
- Funding towards infrastructure improvements including pesticide handling areas
- Funding towards substitution of high risks crops, with lower risk alternatives
- Funding to take arable land out of production upstream of high-risk karst solution features.
- Cover crops
- Herbal leys
- Resurfacing of farm gateways
- Arable reversion
- Chalk grassland restoration

- Tree/woodland planting
- Regenerative agriculture measures such as reduced/no tillage.

6.1.3 Option 2: Least Cost

Catchment Management enhanced with spatial prioritisation and targeting and delivery of C&NBS for 'at risk' pesticides and nitrate (costed option B)

Total cost (FY2022/23 cost base) - not including partnership co-funding) =

AMP8 totex costs (£m)	**£1.100m**

The least cost option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to prevent deterioration of the 'at risk' pesticides, nitrate and monitor emerging pesticide risks. This option will not support addressing the wider environmental outcomes and multiple benefits described in the best value option under the 25YEP_IMP driver.

6.1.4 Option 3: Alternative Option

Catchment Management enhanced + with spatial prioritisation and targeting and delivery of C&NBS for multiple benefits (pesticides, nitrate, microbiological, biodiversity and carbon) including restoration of Water End Swallow Holes SSSI (costed option D).

Total cost (FY2022/23 cost base) - not including partnership co-funding) =

AMP8 totex costs (£m)	**£2.273m**

The Alternative option is similar in scope to the best value option but proposes an additional large-scale restoration project of the Water End Swallow Holes SSSI close to the North Mymms water treatment works. This option will prioritise the risks and issues identified in the Stage 2 WINEP risks and issues engagement process, but also the additional SSSI restoration project to contribute to provide additional catchment resilience for water quality at North Mymms and Essendon as well as contributing to achieving wider environmental outcomes to meet the 25 Year Environment Plan through the additional habitat restoration/enhancement scheme.

Level of Confidence of Achieving the WINEP Outcomes

6.1.5 Option 1: Preferred Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option contributes to meeting Water Industry Strategic Environmental Requirements (WISER). It demonstrates an increase in ambition compared to AMP7 to deliver multiple benefits from measures implemented, as well as, building on extensive knowledge and experience of the target catchments gained during the schemes delivered in AMP6 and AMP7. It also supports the partnership approach for the wider Thames River Basin through the TCMSG. It addresses the risks and issues identified in Stage 2 of the WINEP development process, primarily, the 'at risk' pesticides and nitrates for the karstic groundwater catchments. This option recognises the wider pollution issues risks to our karstic abstractions that fall outside of WINEP and through developing and delivering C&NBS for multiple benefits will further support the WINEP wider environmental outcomes, alongside opportunities for carbon in-setting and biodiversity net gain for Affinity Water.

6.1.6 Option 2: Least Cost Option

The least cost feasible option has a **medium** level of confidence in the achieving the WINEP wider environmental outcomes. This option contributes to meeting the Water Industry Strategic Environmental Requirements (WISER). This option builds on the extensive knowledge and experience of the target catchments gained during the schemes delivered in AMP6 and AMP7. It also supports the partnership approach for the wider Thames River Basin through the TCMSG. It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, primarily, the 'at risk' pesticides and nitrate in the karstic groundwater catchments. This option takes a less holistic approach to delivering C&NBS and is less likely to address the wider pollution issues impacting our karstic abstractions and will miss opportunities to support achieving Net Zero through carbon in-setting.

6.1.7 Option 3: Alternative Feasible Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option contributes to meeting Water Industry Strategic Environmental Requirements (WISER). It demonstrates an increase in ambition compared to AMP7 to deliver multiple benefits from measures implemented, as well as, building on extensive knowledge and experience of the target catchments gained during the schemes delivered in AMP6 and AMP7. It also supports the partnership approach for the wider Thames River Basin through the TCMSG. It addresses the risks and issues identified in Stage 2 of the WINEP development process, primarily, the 'at risk' pesticides and nitrates for the karstic groundwater catchments. This option recognises the wider

pollution issues risks to our karstic abstractions that fall outside of WINEP and through developing and delivering C&NBS for multiple benefits will further support the WINEP wider environmental outcomes, alongside opportunities for carbon in-setting and biodiversity net gain for Affinity Water. Additionally, the restoration of the Water End Swallow network would contribute further towards achieving the WINEP wider environmental outcomes. However, there is uncertainty as to the extent such a restoration project would deliver benefits against the statutory outcomes for pesticides and nitrates and would require a detailed feasibility study and benefits evaluation.

Table 3: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures proposed in the best value option will support this wider resilience by incorporating measures to address wider pollution challenges for more resilient water supply from the North Mymms and Clay Lane groups of sources supporting wider SR's
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures proposed in the best value option will support this wider resilience by incorporating measures to address wider pollution challenges, creating greater resilience for our abstractions and potential reduction in treatment

Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for pesticides in the North Mymms and Clay Lane groups of sources delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	C&NBS primary focus on working with farmers to reduce 'at risk' pesticide losses to water. Best value option will include measures to reduce nitrate, turbidity and microbiological contaminants
Environment Bill	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits where appropriate
Environment Bill	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits where appropriate
Environment Bill	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnership Working section 5.2 Strategic Partnership with South East Water and Thames Water through the TCMSG.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.
Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	C&NBS measures within this scheme will support sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance habitats where appropriate

Climate Change	Water companies are expected to adopt nature based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2
Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature based solutions	AMP7 C&NBS measures co-funded through the TCMSG, EnTrade and LENS. Experience and lessons-learned adopted for PR24.

6.1.8 Can the Option Provide Net Benefits?

The least cost option 2 can meet the statutory requirements and address the risks and issues related to the 'at risk' pesticides and nitrate karstic groundwater safeguard zones. The other feasible options can deliver the following additional environmental benefits:

Option 1: Preferred, Best Value, Option

The best value option can provide the following net environmental benefits:

- Mitigate wider pollution risks impacting our North Mymms and Clay Lane groups of sources and the wider environment including turbidity/sediment and microbiological contaminants.
- Provide opportunities for carbon in-setting to support reaching our Net Zero target for operational carbon by 2030.
- Provide potential Biodiversity Net Gain opportunities on 3rd party land through working with land managers / farmers.
- Greater opportunities for bringing in co-funding opportunities from wider stakeholders/government through aligning multiple benefits from best value option with other priorities e.g., Environmental Land Management schemes to support wider WFD drivers.

Option 2: Least Cost Option

This option can meet the statutory requirements to prevent deterioration of water quality for the at-risk pesticides and nitrate. The other feasible options can deliver the following additional environmental benefits.

Option 3: Alternative Feasible Option

In addition to the net environmental benefits stated in the best value option, by undertaking restoration of the Water End Swallow Holes SSSI, additional water quality, biodiversity, climate change regulation and community benefits could be realised.

6.1.9 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support meeting the WINEP wider environmental outcomes. Examples are shown below, but not limited to:

Natural Environment Outcomes

C&NBS measures following regenerative agriculture principles can support creation of temporary, long-term, or additional habitats to support biodiversity and provide Biodiversity Net Gain opportunities.

Catchment Resilience Outcomes

C&NBS measures following regenerative agriculture principles can hold more water on the land to enable improved infiltration, reduced surface run-off leading to staggered flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. This option will utilise the extensive knowledge and experience of the catchments, stakeholders and farmers gained from delivering pesticide reduction schemes in AMP6 and AMP7. There is also a greater co-design and co-funding opportunity for schemes, research, field trials and realising multiple benefits through this option, as it will work in partnership with Thames Water and South East Water through the TCMSG.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but without targeting of C&NBS to mitigate additional pollutant risks (e.g., microbiological and turbidity) beyond pesticides and nitrate. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements for the DrWPA_ND scheme but will not deliver the wider water quality benefits or contribute to achieving the WINEP wider environmental outcomes.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but with the addition of an ambitious restoration project of the Water End Swallow Holes SSSI. This has the potential to deliver significant environmental benefits to support the WINEP environmental outcomes. There are also potential benefits towards the statutory outcomes of the WFDGW_ND driver. However, this is not fully understood and would require a detailed feasibility study with Natural Capital assessment to determine the benefits of the additional investment.

Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business cases by PR24 Red Team
    b. Review of Business cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 3 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 4.

Our economic analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We have used our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. A bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1.

Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.353m** in partnership funding contributions towards the non-statutory tertiary driver aspects of the Karstic Groundwater C&NBS WINEP scheme across AMP8. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Participate as a buyer in the Landscape Enterprise Network East Anglia and work closely with our buyers of ecosystem services to target and co-fund measures in our priority areas in the Upper Lea. We have successfully achieved this in AMP7 as a pilot in the Upper Lea catchment.
- Establish an AMP8 5-year formal partnership agreement with the Colne Catchment Action Network host, Groundworks South. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Working in partnership with neighbouring water companies and water and sewerage companies that overlap our supply area to identify co-funding opportunities that mutually benefit each company.
- Work with key stakeholders to explore options with working with farm cluster groups in the Upper Lea to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In

some areas, we have had to estimate the metrics, and if these materially impact the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology.

Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The business case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g., hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

Efficiency

We have used our experience of delivering similar projects over the past ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require.

Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement water quality, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable

Air quality	Monetised as per WINEP and impacted by the natural capital investments
Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.1.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the Colne (Upper east arm including Mimmshall Brook), Tykeswater and Upper Colne will improve to some extent from Poor to Moderate status as a result of our activities, as part of the much

wider activities delivered through the TCMSG partnership and Natural England's Catchment Sensitive Farming.

- We have calculated the total length of the Colne (upper east arm including Mimmshall Brook), Tykeswater and Upper Colne impacted as 46km.
- We have assumed that the whole length is currently in Bad condition as per Catchment Data Explorer (Colne (upper east arm including Mimmshall Brook).
- We have assumed that both our natural capital activities will make a proportional start to improving the water quality and that further, future activities will be required to achieve full Poor status for the associated river system. Because the natural capital activities will change in the options, we have assumed that the least cost option will only deliver a 5 % improvement towards Poor status: the preferred option 10 % and the alternative option 12.5%.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

Air Quality Pollution Reduction and CO_2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 5-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we have to assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g., cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.
- We have assumed that the preferred option will impact a total of 6,000 hectares (ha), comprising of: 3,016 ha of enclosed farmland; 28 ha of freshwaters, open waters, wetlands and floodplains; 2,360 ha of semi-natural grasslands; and 595 ha of woodlands.
- We have reduced these values to 4,850 ha for the least cost option and increased the value by 7,000 ha for the alternative option.

Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is highly cost beneficial for our C&NBS proposed project. Jointly these activities will provide significant environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a positive NPV of **£3.161m**, and a good benefit / cost ratio of **2.81**. The benefit / cost ratio is higher than both the least cost and the alternative options, demonstrating best value.

We have assumed a 10 % increase in water quality in the analysis. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. Our cover cropping scheme realised a river water quality benefit of over 40%; CO_2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 5 % would result in cost benefits. This provides a high-level of confidence that the scheme will be cost beneficial.

The natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

Least Cost Option

The least cost option is cost beneficial with an NPV of **£1.7m** and a benefit / cost ratio of **2.36**.

Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, with a forecast NPV of **£3.383m**. However, the benefit / cost ratio is not as high as the preferred option, **2.29,** showing that the return on investment is lower than the preferred option. It should be noted that there are uncertainties in the benefit estimation in the options. It is prudent to work on the preferred option initially and monitor progress; to better understand how best to invest in the future; and then to secure on-going environmental improvements, where we have a higher level of

confidence of benefit realisation. We consider that the delivery risks, particularly with the ability to secure partnership funding, means that the preferred option provides the most confidence of delivering the benefits at this time, and that the additional work in the alternative option are best considered in AMP9.

Alternative Option 2

There was no second alternative option in this analysis.

Non-Monetised Information

We have applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Arable production
- Livestock production (dairy and meat)
- Flood and drought resilience

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least cost option; all in proportion to the number of hectares set aside for the production. There will clearly be some benefits from arable and livestock production, but these are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

C&NBS within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Wider Environmental Outcomes

8.1.2 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.1.3 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o

Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option**	^
	Least Cost Option	-
	Alternative Option 1	^
	Alternative Option 2	o

Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Conservative estimates of the benefits have been made and the scheme is clearly cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis is conservative and has been benchmarked against the Natural Capital evaluation carried out by Atkins of our EnTrade cover crop scheme in the Lee catchment delivered in 2020/21. We will

review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**2.81** compared to **2.36**). The alternative option of doing more does not offer better value as the costs do not provide much more additional benefit, with a benefit / cost ratio of **2.29,** whilst having higher delivery risks.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. When this is considered with our conservative assumptions, the project is considered worthwhile and will be strongly beneficial to customers and society.

The best value option aligns with the WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments and will be delivered alongside our AMP8 Sustainability Reductions programme to create greater resilience and security of supply from our River Thames abstractions which will be required to replace water from our sources subject to reductions in abstraction.

9 Delivery Considerations

Related Projects

This project is similar to our other C&NBS schemes. Collectively they form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in our North Mymms and Clay Lane groups of sources, and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25 years. Preventing deterioration of raw water quality will also support our future Environmental Destination programme and SDS ambition to end unsustainable abstraction in chalk groundwater, by ensuring water availability for future schemes such as Connect 2050.

Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP6 and AMP7 schemes and associated monitoring programme with Thames Water and South-East Water has developed a good understanding of the sources and pathways for pollution in the catchments we are leading on. This will help us target C&NBS spatially and temporally to deliver the greatest benefit.
- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to an operational catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits beyond the primary DrWPA_ND driver for pesticides.
- Our tracer testing PhD study of karst solution features in these catchments has enabled us to understand the sub-catchments that provide the greatest contribution of water, and associated pollutants, to our abstractions. This will enable us to target C&NBS upstream of the highest risk karst features to achieve the greatest water quality benefit.

Delivery Risk Management

We have already delivered similar catchment management schemes, and therefore have a strong understanding of the delivery risks and how best to manage these. The most significant risk to the project is to secure partnership funding. This is beyond our control, being dependent on wider water company funding contributions, other stakeholders e.g., catchment partnerships, and government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

In addition, the following risks and mitigations have been identified for this project:

- Farmers and land managers unwilling to engage with us on land management C&NBS.
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable agricultural advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes.
- Uncertainties around climate change and associated flood, drought and other impacts.
    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8.
- Increasing demand at a national level for specialist local agricultural advisors to deliver farm engagement activities leading to delays in overall programme delivery.
    - We have an established network of local advisors already delivering projects on our behalf which we will build on for AMP8.
- Increasing cost of resources to deliver projects.
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs.
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS.
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits we will undertake the following activities:

- Combined programme of pesticide sampling across the Thames River Basin in partnership with Thames Water and South East Water.
- Development of KPI's and associated success measures focused on prevention of deterioration and improvements.
- Detailed in-catchment monitoring in priority sub-catchments to determine pollutant source and pathways including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring
- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the business case and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 8 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott McDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each investigation we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on investigations carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each scheme will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, km of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

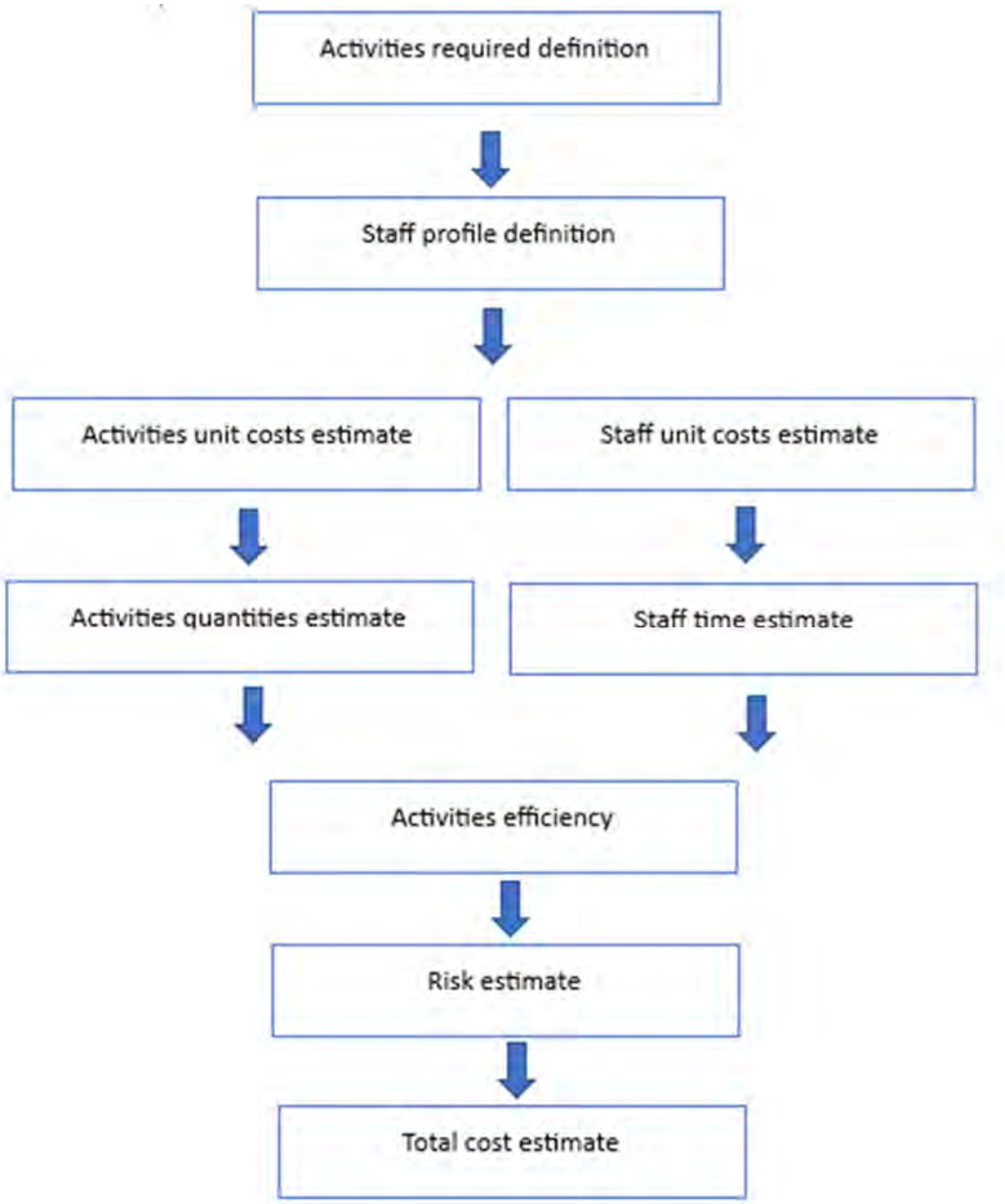


Figure 8 Cost Estimate workstream diagram

Activities quantities estimate: for each activity we determined the most likely quantities based on the agreed objective of the investigation. The quantities have been calculated using maps tools here appropriate (e.g. km of watercourse) as well as experience gained from previous AMPs schemes. Where possible, significant attention has been paid to make efficiency across schemes.

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar schemes undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director time have been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient

allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – AWL WINEP WQ Investigations Completion Report HNL 2020 - 2022

Appendix 2 – Options Evaluation Karstic sources v1.0

Appendix 3 –– Atkins PR24 WINEP Assurance Report November 2022

Appendix 4 –– PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: River Beane CaBA Flagship Chalk Stream Catchment Restoration Scheme

Catchment and Nature-based Solutions (inc. River Restoration)

August 2023

Contents

1 Summary

As part of the launch of the 2021 Catchment Based Approach (CaBA) Chalk Stream Restoration Strategy, water companies with chalk streams within their supply areas, were asked to nominate chalk stream catchments to form a national network of flagship restoration projects. The ambition of the CaBA strategy is for each nominated catchment to be restored over a 10-year period (2025-2035), with the aim to realise and implement all aspects of the CaBA strategy and to act as exemplars to assist in the restoration of other chalk catchments.

This business case sets out the detailed PR24 WINEP options development process and outcomes for our proposed Beane Flagship project for AMP8. Additionally, it includes high level costs for AMP9 as part of a longer-term planning horizon and phasing of the best value option. It sets out to address the following challenges:

- Deliver the ambition of the CaBA chalk stream catchment restoration strategy in the River Beane catchment and our associated 2022 Scoping Document submitted to Defra
- Manage the drinking water quality pressures for our groundwater sources
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and the reasons for deterioration (RFD) in the following waterbodies:
    - GB40601G602900 - Upper Lee Chalk
    - GB106038040110 - Beane (Source to Stevenage Brook)
    - GB106038033310 - Beane (from confluence with Stevenage Brook to Lee)
    - GB106038033410 - Stevenage Brook

The 'best value' option described in this Business case defines a catchment-scale programme of Catchment and Nature-Based Solutions (C&NBS) for the River Beane catchment. This includes river improvement works through our Revitalising Chalk Rivers partnership on the waterbodies listed above and a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater; improved soil health; greater water-holding capacity on land for flood and drought resilience; net zero benefits and biodiversity enhancements.

We have followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our best value solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high degree of support for the proposed environmental improvements. We have learnt from our previous river restoration and natural capital improvement projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. Based upon our conservative estimates, the preferred option offers NPV benefits of £6.494m with a benefit cost ratio of 1.33. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water.

Conservative estimates of the benefits have been made and the scheme has been assessed as clearly cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements.

The best value option will be delivered under a catchment strategy for the Beane operational catchment developed following the principles of the CaBA Chalk Stream Restoration Strategy and Implementation Plan and building on the existing catchment plan developed through the Beane Catchment Partnership. To support the development of the Implementation Plan, we submitted a Flagship Chalk Stream Catchment Restoration Project Scoping Document to Defra in October 2022 setting out the risks and issues in the Beane catchment, as well as reporting the outputs from our stakeholder scoping workshop for the Beane catchment held in August 2022. This scoping workshop and stakeholder input, alongside ongoing dialogue with stakeholders since August 2022, has helped define the aims and objectives for this flagship project, which form the basis of this business case. The prioritisation and delivery of the programme will be developed with the Environment Agency and Beane partnership stakeholders to maximise wider environmental benefits and outcomes. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS

Each project will utilise a range of C&NBS targeted spatially and/or temporally to deliver the greatest environmental benefits.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence

To determine the best value option, an extensive options development process was undertaken with 21 unconstrained options, 12 constrained options reviewed through our options evaluation process and three feasible options subject to a detailed benefits assessment.

Collaboration

To determine the best value option, we have carried out a detailed risks and issues identification process with key stakeholders including the Environment Agency, Natural England and catchment partnerships. We have also developed our proposed solutions with input and feedback with key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	11 August 2023
Report Title	River Beane Flagship Scheme C&NBS – Business case
Options Assessment Report	08AF100012_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030 (AMP8) and 31/03/2035 (AMP9)
WINEP Spreadsheet ID	
WINEP Action ID	08AF100012
WINEP Drivers	WFD_IMP_Flow (S+) (Primary) WFDGW_ND (S) (Primary) NERC_IMP (S+) (Secondary) 25-YEP (NS) (Tertiary)
Scale of Action Delivery	Waterbody
Location of Delivery	GB40601G602900 - Upper Lee Chalk GB106038040110 - Beane (Source to Stevenage Brook) GB106038033310 - Beane (from confluence with Stevenage Brook to Lee) GB106038033410 - Stevenage Brook

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.33	0.53	0.78	0.67	0.32	**2.65**
Totex (£m)	0.33	0.53	0.78	0.67	0.32	**2.65**
3rd Party Funding	0.04	0.07	0.11	0.11	0.03	**0.36**
Drivers						

100%	Water Framework Directive				
Benefits					
Water Quality of Natural Water Bodies (km)					
Sequested Carbon (tonnes CO_2e)					
Air Quality Pollution Reduction (tonnes)					
Economic Analysis					
NPV Costs (£m) (2025-55)	**4.9**	NPV Benefits (£m) (2025-55)	**6.5**		
NPV (£m) (2025-55)	**2.6**	Benefit / Cost Ratio	**1.3**		
Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This business case describes the WINEP scheme and Flagship Chalk Stream Catchment Restoration project developed to address the challenges impacting the River Beane chalk stream catchment (see Figure 1).

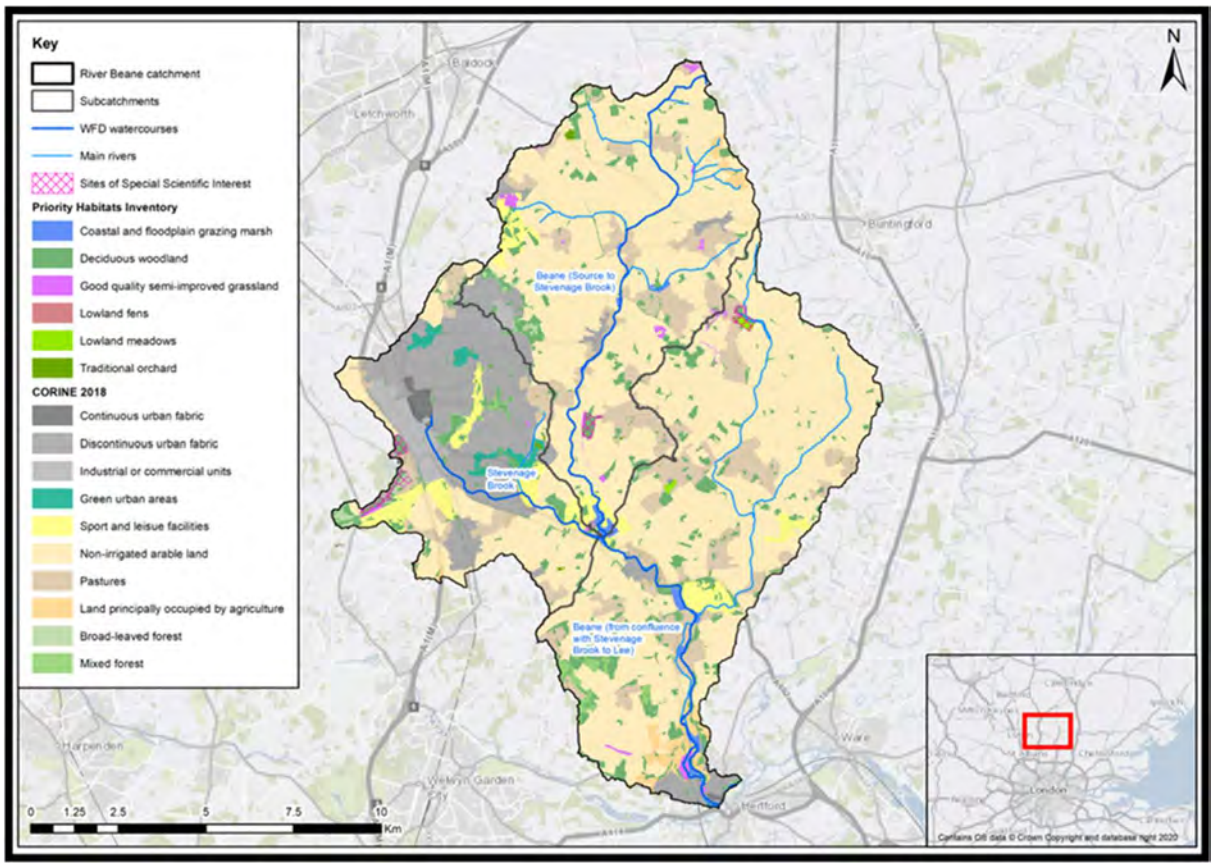


Figure 1 – River Beane catchment map with land-use types

As part of the development and launch of the 2021 CaBA Chalk Stream Restoration Strategy, water companies with chalk streams within their supply areas, were asked to nominate chalk stream catchments to form a national network of flagship restoration projects. The ambition of the CaBA strategy is for each nominated catchment to be restored over a 10-year period, with the aim to realise and implement all aspects of the CaBA strategy and to act as exemplars to assist in the restoration of other chalk catchments. A set of criteria for nominating catchments was established and required the selection of chalk streams that were medium in length (c. 15km long), have active stakeholder engagement to drive projects forward and have the buy in from local landowners willing to participate.

In a letter to the then Parliamentary Under Secretary of State at the Department of Environment, Food and Rural Affairs, Rebecca Pow, in August 2021, Affinity Water proposed two catchments to be considered for the Flagship Restoration Project: The River Chess and the River Beane. The River Chess Flagship project is to be delivered in collaboration with Thames Water and a separate proposal is being prepared under the Smarter Water Catchments initiative. A separate Business case has been

developed for the Colne operational catchment which includes the River Chess. This document focuses on the River Beane.

The 'best value' option described in this business case defines a catchment-scale programme of Catchment and Nature-Based Solutions (C&NBS) for River Beane catchment including:

Revitalising Chalk Rivers (RCR)

Chalk streams are rare ecosystems that are important to protect. 85% of all chalk streams are in England, mainly in the south and east of the country. Many of these chalk streams in this operational catchment are considered to be impacted by our abstraction for public water supply. Consequently, reduced flows potentially caused by abstraction, are also leading to the natural river processes not taking place impacting the habitat and ecology of the river. Alongside abstraction impacts which are being addressed through our sustainability reductions programme, it is important to ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding. These rivers are ultimately failing to meet Good Ecological Status (GES) under the Water Framework Directive and therefore action needs to be taken to address this, unless assessed to be disproportionately costly.

Our programme of chalk stream river improvement works, and habitat enhancement schemes commenced in AMP6, and this document proposes an expansion of river improvement works within the rivers listed above and associated riparian zone. This builds on the existing programme developed in partnership with the EA referred to in this document as Revitalising Chalk Rivers (RCR).

Undertaking river channel modifications (e.g. installation of deflectors, channel re-profiling to create a low flow profiled channel) can help increase in-channel velocities which are known to be a key element in the ecological requirements of a river. These channel enhancements and modification works will be delivered alongside our wider C&NBS schemes to maximise the benefits and support achievement of the WINEP wider environmental outcomes, CaBA Chalk Stream Restoration Strategy, 25 Year Environment Plan and Environmental Destination requirements. In order to achieve GES these rivers need to be a properly functioning ecosystem.

Some of the benefits of such river improvement works include:

- Ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding.
- Restoring the rivers back to a more natural state by removing barriers to fish, re-meandering, reconnecting them to groundwater and re-establishing chalk stream characteristics.
- Healthy chalk stream systems can also lead to improved water quality and support greater ecological diversity.

- To meet our environmental objectives and targets as a company to ensure we are improving the local environments while maintaining high quality drinking water supply.
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 1 - End unsustainable abstraction from chalk groundwater sources
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital.

River improvement works that form the best value option in this document will be delivered during AMP8 through a process of prioritisation with the EA detailed later in the document, engagement with the wider Beane Catchment Partnership and utilising a range of different funding streams (e.g. ELMS, BNG, Section 106, LENS and wider government funding) to facilitate, fund and deliver multi-stakeholder partnership projects. A full geomorphological survey of the river will also be undertaken to determine the requirements for a full restoration which will be used to determine the further river restoration and improvement works requirements to develop and refine AMP9 RCR programme and wider stakeholder project development and delivery.

Resilient Chalk Catchments (RCC)

Delivered in combination with the RCR programme, Resilient Chalk Catchments (RCC) is our land management focused programme of C&NBS. This programme will work in partnership with landowners, farmers, businesses, environmental NGO's, regulators, Beane Catchment Partnership, and the River Beane Restoration Association (RBRA) to target C&NBS spatially and temporally at the catchment scale (Beane) to achieve the following outcomes:

- Enhanced infiltration / aquifer recharge
- Prevent deterioration of groundwater quality (nitrates)
- Habitat enhancement for priority species
- Chalk stream protection and resilience from land management pressures (sediment, pesticides, nutrients etc.)
- Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams
- Connecting wildlife corridors and creation of habitats in partnership with local stakeholders
- Wider biodiversity benefits e.g. to priority habitats and species

- Support achieving a number of our 'strategic focus' areas in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions).
    - Strategic Focus 3 - Deliver a net gain in natural capital.

This programme builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes which were focused on water quality no deterioration schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality, and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

3.1 Environmental Risk and Issues

There are a number of environmental risks that are detailed in our Appendix 1 - Risk and Issues log that was developed as part of our WINEP Stage 2 risks and issues identification process.

Additionally, Table 1 sets out the current WFD status of the River Beane and our 'Flagship Chalk Stream Catchment Restoration Project Scoping Document' (Appendix 2) submitted to Defra in October 2022 sets out the environmental risks, issues and requirements that this scheme will seek to address.

As detailed in the EA Catchment Data Explorer for the Beane catchment, there are a number of significant water management issues which are attributed to a number of business sectors including the water industry determined as the RNAG status. These include:

- Changes to the natural flow and level of water
- Invasive non-native species (INNS)
- Physical modifications
- Pollution from rural areas
- Pollution from towns, cities and transport
- Pollution from wastewater

Several of these issues, including pollution from rural and urban areas, also affect the groundwater quality of water abstracted for public water supply, in addition to the waterbodies within the catchment.

3.2 Baseline Assessment

The River Beane is a chalk stream that flows in the county of Hertfordshire, England and is around 33km in length from source northeast of Stevenage to its confluence with the Lea at Hertford. It has been identified as failing to meet Good Ecological Status (GES) as defined by the Water Framework Directive (WFD) and considered at risk of deterioration from the Affinity Water public water supply abstraction at Whitehall.

The catchment covers a predominantly rural area, with arable farmland and a number of small villages but also includes the urban areas of Stevenage and Hertford (Figure 1). Our extensive work in the catchment throughout AMP6 and AMP7 has identified a wide range of pressures including agricultural, urban and road runoff, an extensive presence of invasive non-native species, historic channel modifications and land drainage issues.

A significant groundwater abstraction reduction has already been implemented in the catchment at Whitehall, with average abstraction reduced in 2017 from 18Ml/d to 2Ml/d. The in-combination effect of these pressures is resulting in poor water quality (e.g. increased turbidity and sediment loading), poor habitat and flow diversity, reduced connectivity, and consequently poor chalk stream health.

In addition to the reduction in abstraction, extensive river restoration projects have been delivered by Affinity Water throughout AMP6 and AMP7. However, the River Beane's Overall Waterbody Classification under the Water Framework Directive (WFD) is still classed as 'Poor' as shown in table 1:

Table 1. Water Framework Directive classifications for the three sub-catchments: Beane (from confluence with Stevenage Brook to Lee), Beane (Source to Stevenage Brook) and Stevenage Brook

Beane (from Confluence with Stevenage Brook to Lee)	2013	2014	2015	2016	2019
Ecological	Poor	Poor	Poor	Poor	Poor
Biological quality elements	Poor	Poor	Poor	Poor	Poor
Physico-chemical quality elements	Good	Good	Moderate	Moderate	Moderate
Hydromorphological Supporting elements	Supports good	Supports good	Supports good	Supports good	Supports good
Specific pollutants	Moderate	Moderate	High	High	High
Chemical	Good	Good	Good	Good	Fail
Priority hazardous substances	Good	Good	Good	Good	Fail
Priority substances	Good	Good	Good	Good	Good
Beane (Source to Stevenage Brook)	**2013**	**2014**	**2015**	**2016**	**2019**
Ecological	Moderate	Bad	Poor	Poor	Poor
Biological quality elements	Moderate	Bad	Poor	Poor	Poor
Physico-chemical quality elements		Moderate	Moderate	Moderate	Moderate
Hydromorphological Supporting elements	Supports good	Supports good	Supports good	Supports good	Supports good
Specific pollutants	High	High			
Chemical	Good	Good	Good	Good	Fail
Priority hazardous substances	Good	Good	DNRA	DNRA	Fail
Priority substances	Good	Good	DNRA	DNRA	Good
Stevenage Brook	**2013**	**2014**	**2015**	**2016**	**2019**
Ecological	Poor	Poor	Poor	Poor	Poor
Biological quality elements	Poor	Poor	Poor	Poor	Poor
Physico-chemical quality elements			Moderate	Moderate	Moderate
Hydromorphological Supporting elements	Supports good	Supports good	Supports good	Supports good	Supports good
Specific pollutants	Moderate	Moderate	High	High	High
Chemical	Fail	Fail	Good	Good	Fail
Priority hazardous substances	Fail	Fail	Good	Good	Fail
Priority substances	Good	Good	Good	Good	Good

There is an existing 'Catchment Management Plan' for the River Beane that has been developed by the River Lea (Beane) Catchment Partnership. As part of the development of this plan, the aims, that will also be mirrored through this Flagship Project are to address:

Flow

A. That there is water flowing along the whole length of the river at all times (excluding historic winter flowing sections)

B. That there is adequate flow along the length of the river to support a 'good status' chalk stream ecology (as defined by Water Framework Directive)

Water Quality, Habitats & Wildlife

C. That whatever the flow level, the river and its associated habitats, including banks and floodplains, are managed to support chalk stream species

D. That water quality, temperature and riverbed quality are such that they support chalk stream ecology

People

E. To increase the attractiveness, visibility and public access, to enable people to appreciate the river (commensurate with managing and protecting sensitive habitats and species)

F. To increase the public's appreciation of the unique chalk stream environment and their participation in its conservation

Status & Monitoring

G. To achieve the highest possible level of legal protection for the river

H. To monitor the status of the river and its species to gauge if its condition is improving

An important component of the River Beane CaBA Flagship Chalk Stream Catchment Restoration Project will be to work with the Catchment Partnership to review the current status of the Catchment Plan, review the themes, objectives and aims and develop this Catchment Strategy building on the work already undertaken through this partnership. A separate 'Flagship Chalk Stream Catchment Restoration Project Scoping Document' has been submitted to Defra in October 2022 (Appendix 2). This proposal was developed following a scoping workshop held in August 2022 (further detail in the Customer Engagement Section).

There are a number of environmental risks that are detailed in the Risk and Issues log (Appendix 1). has been developed for both the operational catchment and at the waterbody level which has been captured the available data on Catchment Data Explorer and through consultation with a range of stakeholders including:

- EA
- Natural England (NE)
- Catchment partnerships

    - Beane Catchment Partnership
    - Herts and Middlesex Wildlife Trust (CaBA partnership hosts)
    - River Beane Restoration Association (RBRA)
- Hertfordshire County Council and Hertfordshire Countryside Management Service (Herts CMS)
- Local landowners and farmers

The process has identified a list of risks and issues in each waterbody, and collectively in the catchment as a whole, which this project and associated projects/Business cases) will seek to address. These include:

- Abstraction
- Low flows
- River morphology
- Diffuse and point source pollution
- Water quality
- Land management pressures
- Climate change
- Loss of habitat and wildlife
- INNS

During AMP7 a WINEP investigation was carried out under driver WFDGW_INV into increasing concentrations of nitrate in the Whitehall groundwater abstraction source. The investigation was completed in March 2022, with recommendation to implement a WFDGW_ND scheme for nitrate. See Appendix 3 for the AWL WINEP WQ Investigation Completion Report HNL 2020 - 2022. This no deterioration scheme will be incorporated as part of this Flagship Project to ensure an integrated approach to implementing C&NBS that deliver multiple benefits, including for nitrate mitigation in both groundwater and the chalk stream.

3.3 Drivers for the scheme

3.3.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 4 in section 7.4.3

2) The Drinking Water Directive

The standard for nitrate is (50mg/l NO_3) and for pesticides is (0.1µg/l).

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP)

- Thames River Basin Management Plan

The specific WINEP Drivers relevant to this scheme are:

- WFD_IMP_Flow (S+) = Actions to improve ecological status (surface water)
- WFDGW_ND (S) = Groundwater prevent deterioration action relating to water resource or water quality
- NERC_IMP (S+) = Actions that contribute towards biodiversity duties, requirements and priorities.

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan.
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals.
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Catchment Based Approach (CaBA) chalk stream strategy and implementation plan.
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies.
- AW0031 Affinity Water Strategic Direction Statement.
- Blueprint for Water – Blueprint for PR24.
- Lea CaBA Partnership catchment plan.
- Hertfordshire and Middlesex Wildlife Trust (HMWT) State of Nature 2020 report and associated targets.
- Hertfordshire County Council (HCC) Sustainable Hertfordshire Strategy.

3.3.3 Stated Need

Prior to the CaBA Chalk Stream Strategy being published in October 2021, Affinity Water received a letter for Defra Minister, Rebecca Pow in June 2021, (See Appendix 4) setting the expectation of water companies to be "a key partner at the heart of the chalk stream restoration strategy". As part of this expectation companies Minister Pow stated, "I am now writing to ask you to work with the Chalk Streams Restoration Group and commit to supporting one or two flagship projects in your operational area". Affinity Water formally responded in August 2021 (Appendix 5) nominating the River Beane catchment as lead organisation in developing a catchment restoration plan and the River Chess, as a supporting partner to Thames Water who are developing the corresponding catchment restoration plan.

We stated in our response (Appendix 5):

> In order to achieve Good Ecological Status, we consider these pressures would be best addressed at a landscape scale, through an integrated and holistic approach. To develop the flagship project, we will look to establish a core working group building on the existing contacts. We will lead the group and work with the Environment Agency, local interest groups, catchment partnership, Wildlife Trust, farmer representatives, local authorities, lead local flood authority and the large estates within the catchment to establish this. We will also engage with Thames Water as the wastewater undertaker for the catchment and in relation to their abstractions downstream in the Lea catchment.

Protecting and enhancing our nation's water environment is a priority for the government. One of the government's key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats such as chalk streams, as articulated in the letter from Minister Pow (Appendix 4). As such, Affinity Water are required to invest through PR24 under the following regulatory / statutory drivers which align with this Business case:

- **WISER** – requirements including, but not limited to:
    - Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
    - Must include actions to improve water body status to ensure 'moderate' status as a minimum is achieved by 2030.
    - Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
    - Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
    - Create, restore and enhance habitats.
    - Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this Business case please see the 'Level of Confidence of Achieving the WINEP Outcomes' section 7.4.3.

Water Framework Directive (WFD)

Restoring Good Ecological Status (GES) to chalk streams.

WINEP

The Environment Agency (EA) expects that the 'best value' option defined in this business case takes account of the following wider environmental outcomes:

- **Natural environment outcomes:** Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.

- **Catchment resilience outcomes:** Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
- **Net zero outcomes:** Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of.
- **Access, amenity, and engagement outcomes:** Contributions to improving access to, amenity of, and engagement with the natural environment to support customer and community wellbeing.

DWI Long-term Planning Guidance Expectation

Catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all source-to-tap risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness and acceptability of water supplies.

There are many drivers to improve the overall quality of the river with solutions that also support the wider community in terms of achieving net zero, and access and amenity benefits.

3.4 Allocation of Costs

This business case is 100% enhancement, and all costs are allocated to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

We have extensive experience over multiple AMP / WINEP cycles in developing and delivering river restoration and catchment management measures. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

Revitalising Chalk Rivers (RCR) Programme – Natural Capital Evaluation of Completed Schemes in the River Beane Catchment (2022)

In 2022, we commissioned Atkins to carry out a Natural Capital Assessment for five of Affinity Water's River Improvement Works (RIW) projects in the River Beane catchment in Hertfordshire. This evaluation sought to quantify and (where possible

and appropriate) value the ecosystem services benefits of our RIW projects completed in AMP6 and AMP7. The purpose of the evaluation is to support our WINEP options development and assessment submissions using evidence from projects that have already been implemented on the ground. The evaluation has helped us understand the wider ecosystem services value of their investments in RIW to support business planning.

The evaluation was undertaken using data sources and assessment methods recommended by the EA's WINEP guidance and supplemented by other recognised tools such as FARMSCOPER. GIS desk-top mapping, site survey information, and site-specific data provided by Affinity Water were combined to quantify changes in ecosystem services by comparing pre- and post-project land cover and in-channel management. The 5 projects evaluated were all of differing size and scale including a small weir removal, in-channel improvements and construction of a large bypass channel.

The results, shown as an overview in Figure 2, have enabled us to benchmark the range of potential RIW projects to be delivered within this scheme. This has helped us ensure our benefits assessment for the programme of measures for each of the feasible options are conservative and comparable with this assessment of a range of completed projects.

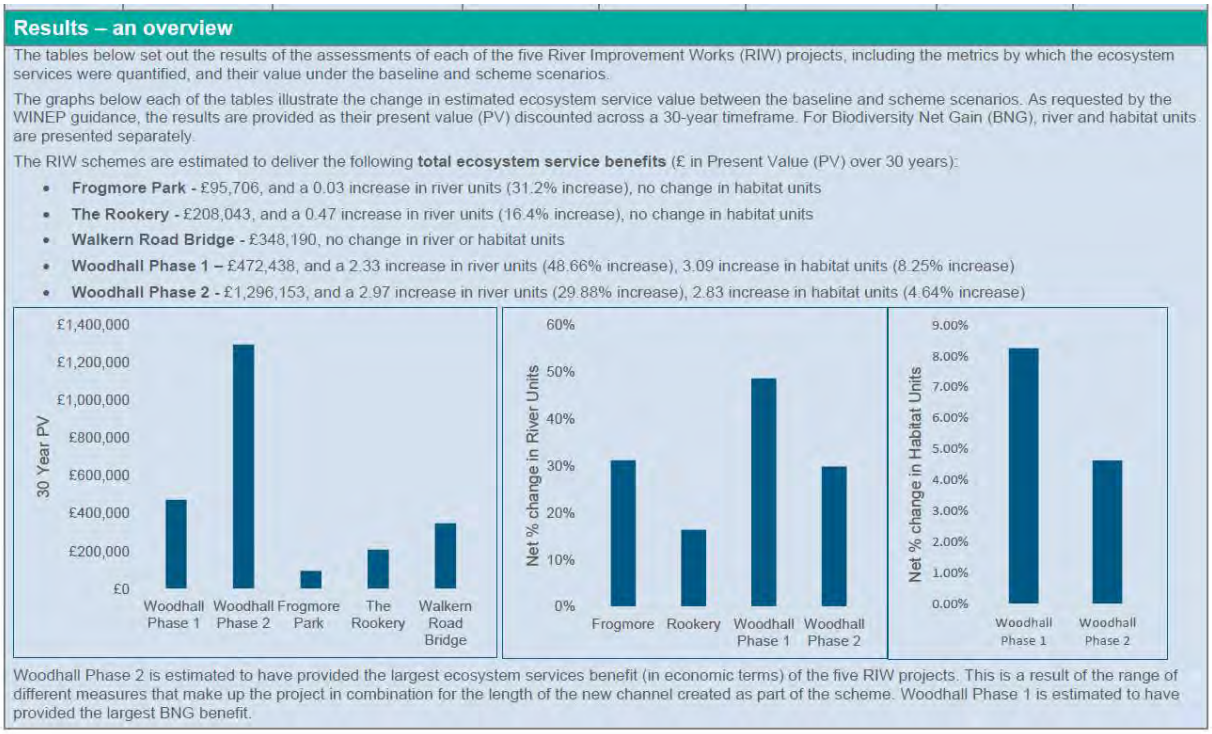


Figure 2. Excerpt from Natural Capital evaluation report on completed RIW projects on the River Beane highlighting the ecosystems services benefits in Present Value over 30 years

Resilient Chalk Catchments (RCC) C&NBS for Water Resources – Catchment Assets for Water Project

To support the development of C&NBS options for the Beane Catchment, we have commissioned a partnership project with South-East Rivers Trust (SERT), Catchment Assets for Water (CAfW). The primary aim of CAfW approach is to support the valuation of the contribution of natural assets to water resources and resilient catchments at both site and catchment scales. This includes the targeting of nature-based solutions for water, and the tracking and reporting of change in the contribution of various assets to water-related ecosystem services.

The methodology was developed by SERT through the Interreg ProWater project for which Affinity Water were an industry partner. The modelling and output mapping here focuses on identifying the current contribution of habitats in the catchment to the ecosystem service of water supply and quality but does not provide a volumetric or monetary quantification. However, a volumetric quantification of the impact of some measures is attempted in the land use change scenario modelling. The latter approach allows the comparison between scenarios by changing habitat type or condition indicating a reduction or increase in an asset's value/score, and the comparison of different areas within the catchment based on the current value/score. It can be viewed at field and catchment scales. This allows the user to assess potential interventions on a site, as well as understand their context in the wider landscape.

An important benefit of catchment scale maps and this methodology is to identify the potential role of each parcel of land in the wider context of the catchment. This has an important role to play in supporting collaboration on a landscape scale, helping to guide and inform scheme design beyond holding boundaries and bringing scientific evidence to play in discussions.

To support this, the model has been developed as a collaboration between a range of local stakeholders including EA, NE, Catchment Partnership hosts, Wildlife Trust, HCC and other local catchment experts. The model outputs have produced a series of 'opportunity maps' (see Figures 3 and 4), which identify target areas to 'protect' and 'restore' (hatched areas on the maps) where the greatest water resource benefits can be derived. Table 2 below shows the priority 'restore' areas shown in Figure 3 with the different habitats and their respective area (ha). These priority areas, alongside the C&NBS options and modelled benefits using the InVEST model developed by Stanford University, have been used to inform the costs and development of the best value option.

This approach has a number of benefits:

- Methodology and approach have been aligned with the catchment options for our water resource management plan
- Can be updated and refined to support an adaptive planning approach and/or investigate and develop options for specific issue or need

- Spatial prioritisation and targeting of C&NBS using scientific evidence and local stakeholder input can support targeted investment to achieve the best value outcomes
- Taking a Natural Capital (NC) approach can help identify wider benefits and support the investment case for implementation of C&NBS
- All outputs of the modelling and mapping have been provided to all partners to support co-creation and co-funding of projects as well as join up wider initiatives (e.g., Herts Sustainability Strategy, Local Nature Recovery networks, Biodiversity New Gain, Local Development Plans and Environmental Land Management schemes)
- Output NC maps can be used as tools for engagement with landowners, land managers and farmers
- Revisited throughout AMP8 with the priority areas refined and condition assessments revisited once C&NBS measures have been implemented.

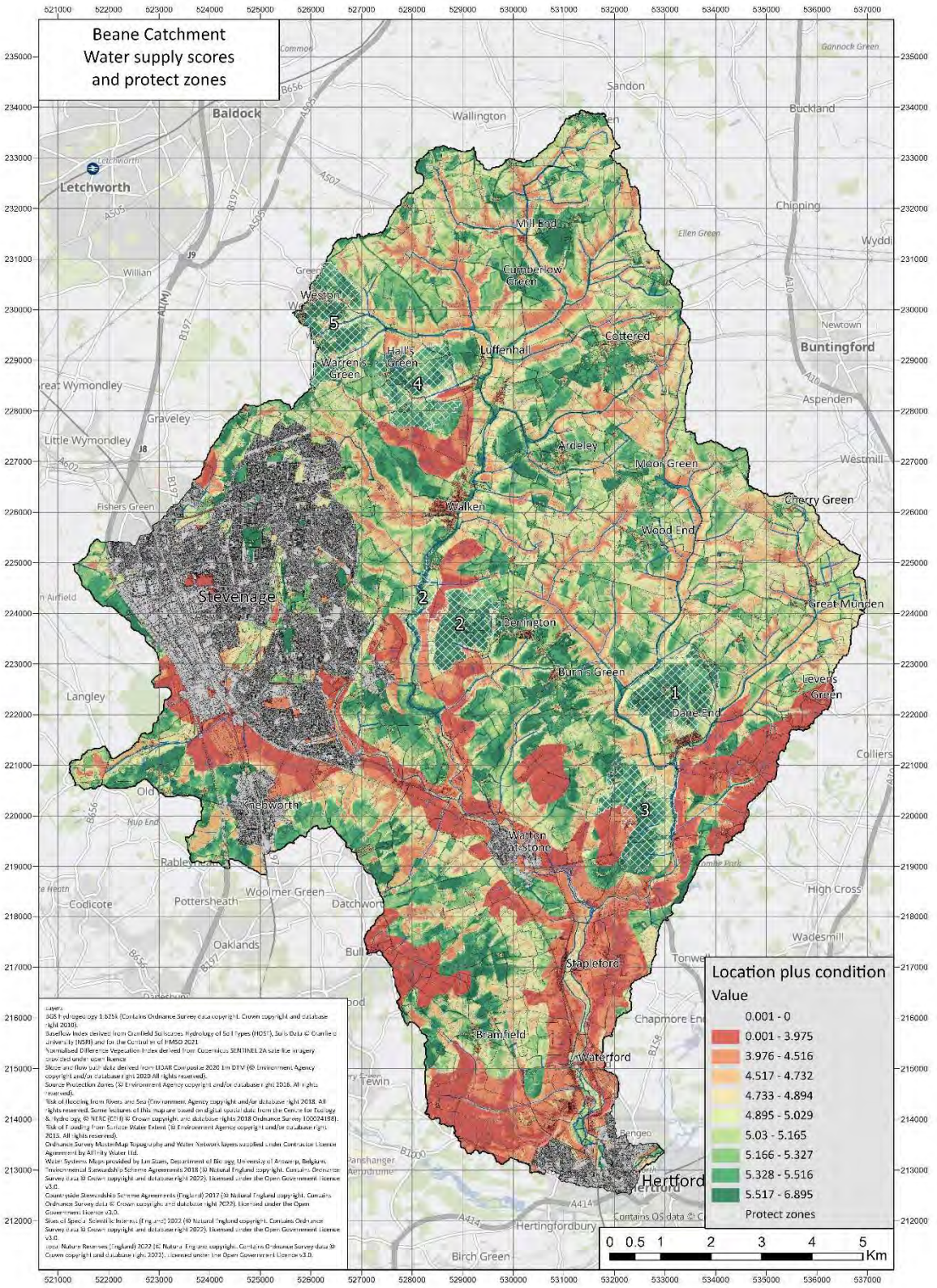


Figure 3. CAfW 'protect' NC map with priority areas highlighted for the Beane catchment

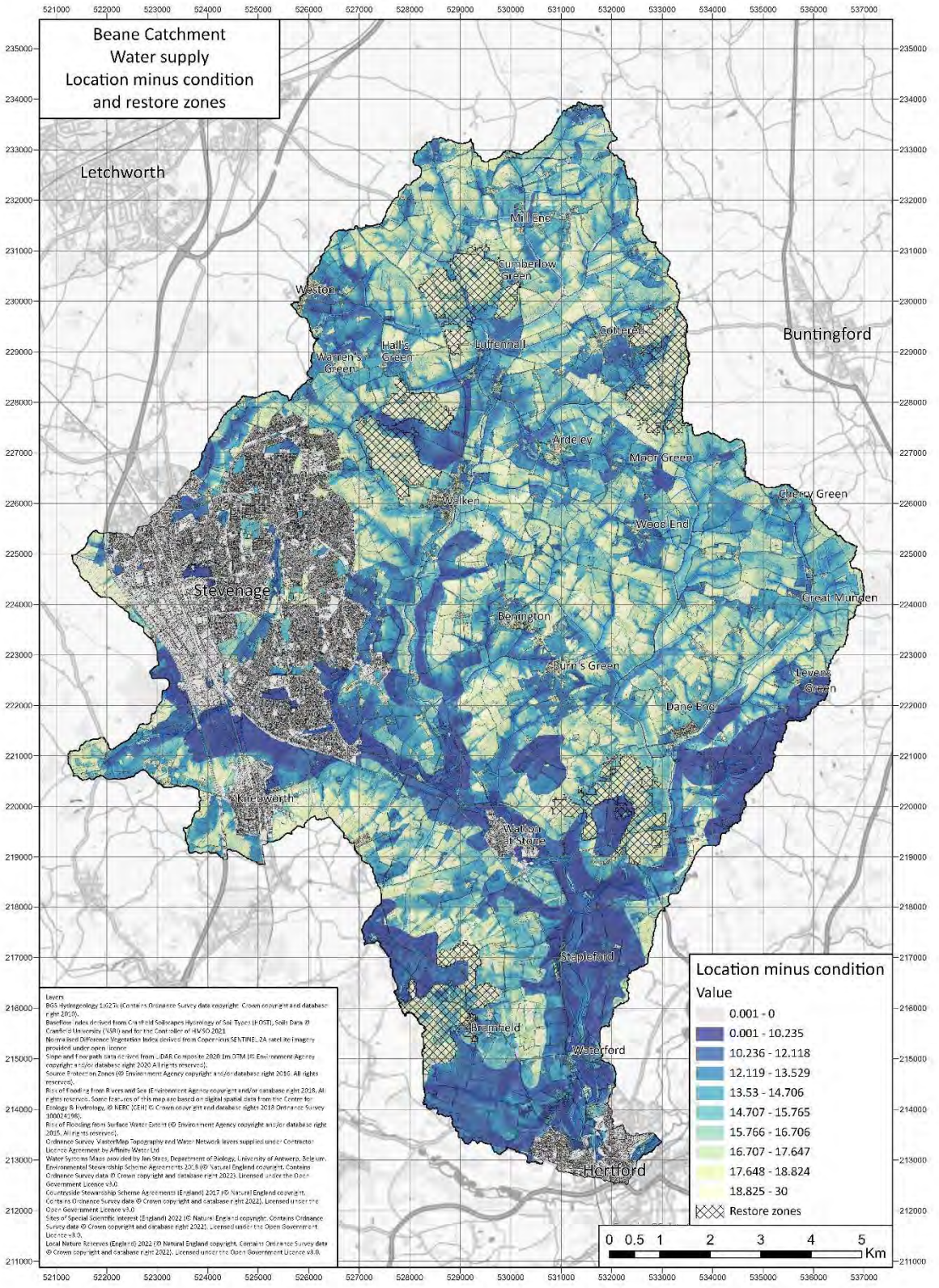


Figure 4. CAfW 'restore' NC map with priority areas highlighted for the Beane catchment

Table 2: Habitat types and associated area (ha) for CAfW 'restore' priority areas 1-5 with potential C&NBS measures identified in Figure 4

Landcover in high impact areas (Herts Biodiversity Baseline Map)	Area (ha)	Key location factors informing potential NbS	Nature-based Solutions to consider prioritising
Arable and horticulture	1311.76	Stream length: 6.34km	Extended riparian buffer strips, consider where in-channel works are possible
		Riparian area: 22 ha	Convert to grassland or scattererd scrub, wetlands where possible
		Infiltration area: 183 ha	Ensure best practice soil management, consider reversion to grassland
Broadleaved woodland	180.00	Stream length: 1.82 km	Leaky woody dams and in-channel restoration
		Riparian area: 5 ha	Consider floodplain reconnection where possible
		Infiltration area: 27 ha	Consider reversion to grassland where appropriate, discuss management and re-planting
Built-up areas	134.36		
Mixed woodland - plantation	102.98	Stream length: 0.56km	Leaky woody dams and in-channel restoration
		Riparian area: 2 ha	Consider floodplain reconnection where possible
		Infiltration area: 30 ha	Consider reversion to grassland where appropriate, discuss management and re-planting
Improved grassland	56.41	Stream length: 0.31km	Consider leaky woody dams and floodplain reconnection, ensure extended buffer strip
		Riparian area: 1 ha	Consider floodplain reconnection, scrapes and wetland restoration
		Infiltration area: 5ha	Consider low-nutrient management, reversion to species rich grassland
Coniferous woodland	39.44	Stream length: 0.08km	Leaky woody dams, in-channel restoration
		Riparian area: 0.5 ha	Consider reversion to grassland or wet woodland
		Infiltration area: 9 ha	Consider reversion to broadleaf or grass-/heathland
Water	4.46		
Poor semi-improved grassland	3.82	Stream length: 0.29km	Floodplain reconnection, leaky dams, wetland restoration
		Riparian area: 0.3 ha	Wetland restoration
		Infiltration area: 0.4 ha	Ensure appropriate management
Scrub - dense/continuous	2.98		
Neutral grassland - semi-improved & unimproved and Acid grassland	3.08	Stream length: 0.09 km	Leaky woody dams, in-channel restoration
		Riparian area: 0.3 ha	Wetland restoration, scrapes where appropriate
		Infiltration area: 0.2 ha	Ensure appropriate management
Bare ground	0.65		Investigate use
Fen, marshy grassland, or tall herb and fern	0.21	Riparian areas: 0.13 ha	Restore – consider relevant in-channel works
		Stream length: 0.03km	In-channel restoration, leaky woody dams
Scrub - scattered	0.04		
Cultivated/disturbed land - Amenity grassland	0.03	Infiltation areas: 0.03 ha	Consider alternative management
Calcareous grassland	0.003		Investigate use and ensure appropriate management

RCC C&NBS for Water Quality

Natural Capital Evaluation of the EnTrade Cover Crop Scheme (2021)

To better understanding the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. Twelve

ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 5.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6:1 Natural Capital benefit ratio.

Total value	^	-	-	-	£403,450	£945,069	£541,619
Total value/ha	^	-	-	-	£500	£1,172	£671

Figure 2 - Natural capital valuation results – Annual change in ecosystem services*

* Biodiversity change is shown in terms of the the total change in habitat units

Figure 5. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen Release from Cover Crops (NiCCs) Field Trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil
    - effect of contrasting cover crop destruction methods e.g. glyphosate & minimum tillage vs mechanical destruction & minimum tillage
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was then tracked post-cover crop destruction under different management regimes and subsequent cash crops. This was used to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit and effective uptake of nitrogen for more sustainable arable farming.

4 Partnering

4.1 Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers have been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value.

However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concern over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small, planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considerd it would have a positive impact on wildlife for the future. Some people considerd that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.3 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.1.4 Biodiversity

It has been well received by customers that biodiversity and improving river flows will be a priority for Affinity Water, as it shows that Affinity Water are doing more than just offering the required services. During our preferences research, customers repeatedly chose environmental options that not only achieved the statutory minimum in terms of reducing abstraction, but also has additional benefits from catchments under-going ecological and biodiversity improvements. Customers

have also shown support for increasing biodiversity and improving the environment when building large infrastructure schemes.

Our household customers valued the following biodiversity projects most highly: specialist habitats created for wildlife at £3.87 annually; new wetland areas at £3.24 annually; and space provided for sustainable agriculture at £2.61 annually. The households' average valuation of any project addition was considerably higher in the environmental area (£3.05), than either the economic area (£1.19) or the social area (£1.16).

4.1.5 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.2 Collaboration and Partnering

4.2.1 Engagement with Stakeholders and Partners

We have carried out a wider process of stakeholder consultation with River groups and catchment partnership hosts across the Lee operational catchment. Feedback has included:

> *'Asks' for plans – just to engage as much as possible to ensure the wider public understands the issues and their role in the issues and how to make improvements. As you would expect, funding is always going to be a restricting factor for the partnership and financial support would be gratefully received and would allow much greater planning and impact rather than the annual wait to be informed whether we have any funds. We would like to see the design and delivery of projects by yourselves continue as this has been a key way to get improvements completed.*
>
> [redacted] **Luton Lea Catchment Partnership host (Groundworks)**

As part of the focused development of the Flagship Chalk Stream Catchment Restoration Project Scoping Report (Appendix 2) submitted to Defra in October

2022, an initial Scoping Workshop for the Flagship Project was held at Affinity Water's head office in August 2022. This workshop included local stakeholders, customers, and landowners as well as representatives from the Environment Agency (EA), Hertfordshire and Middlesex Wildlife Trust (HMWT), Natural England (NE), Hertfordshire County Council (HCC), and the River Beane Restoration Association (RBRA). As part of the workshop, attendees were placed into groups and asked to highlight their most desired outcomes for the Flagship project within the Beane catchment and select their top three. The results for each group are shown in Figure 6 and have been used to develop the best value option:

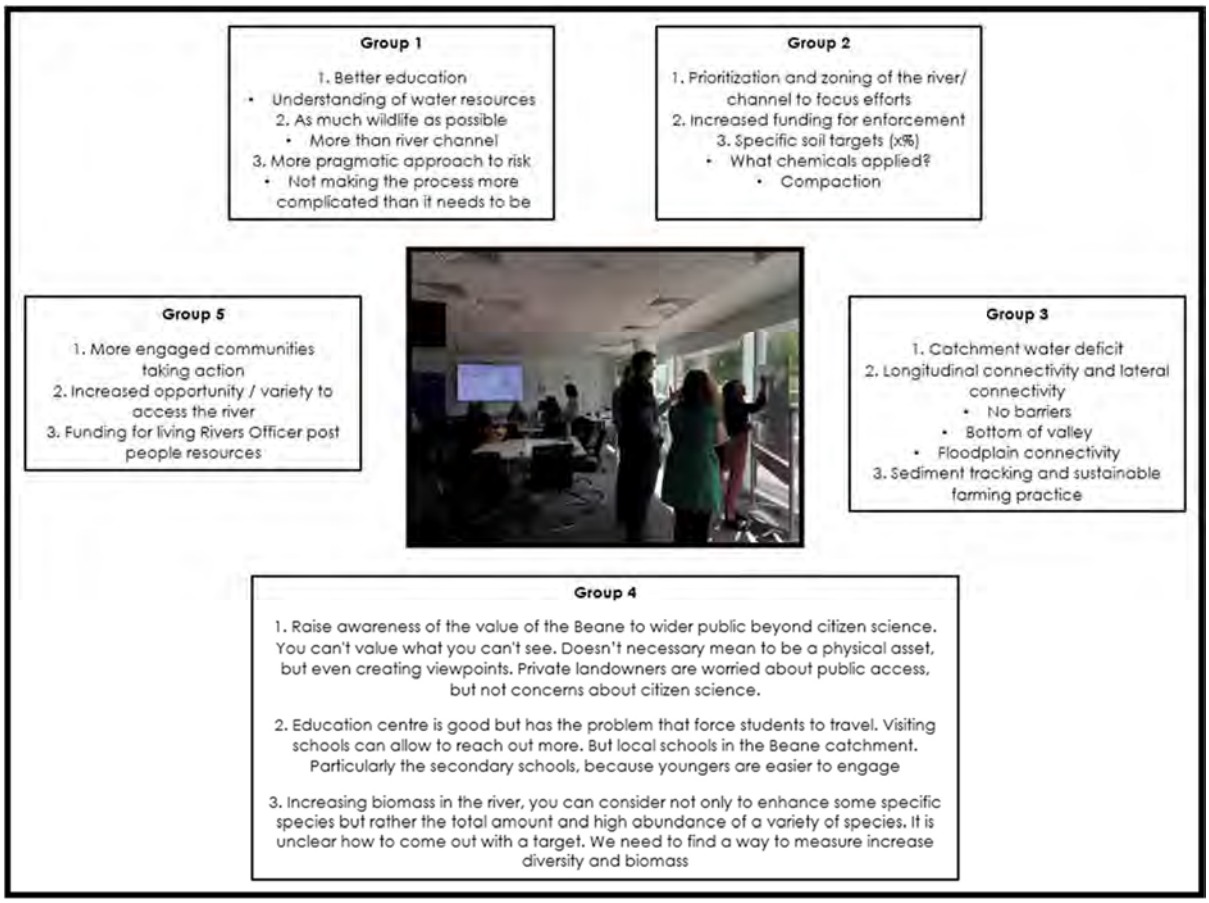


Figure 6: Results of each group from the first CaBA Flagship Chalk Stream Restoration project meeting

WINEP Stage 2 – Collaboratively identifying risks and issues

To further support the development of the proposed solutions for the risks and issues included in this Business case, we have undertaken a detailed review of risks and issues for the River Beane. We have taken a collaborative approach to define the PR24 WINEP scope and develop the feasible options and ultimately determine the best value option. As part of this process, carried out between May and August 2022, we have completed the following activities:

- Early engagement with the EA and Natural England (workshops at area level) and follow up meetings meetings/correspondence with Driver leads).

- Reviewed, discussed and incorporated Natural England's Nature Recovery List for our region.
- Detailed review of Catchment Data Explorer, CaBA Catchment Plans, River Group meetings, stakeholder workshops and meetings alongside discussions with neighbouring water companies.
- Engagement and discussions with the Chalk Stream Steering Group and Defra Flagship Projects Programme Board.
- Documented all risks and issues register (Appendix 1) and the Flagship Chalk Stream Catchment Restoration Project Scoping Report (Appendix 2) collated through this process and used to develop the proposed solution described in this Business case.

WINEP Stage 3 – Proposing solutions

As part of the development of our proposed solutions to contribute to addressing the risks and issues described in this Business case, we have undertaken the following engagement and drawn on experience through our AMP7 WINEP programme delivery to explore options around developing, co-designing, and co-delivering schemes which have formed the basis of the feasible options.

We continue to work with a wide range of stakeholders to develop joint solutions. We described the many pilots and research projects that we are currently working on in the areas in a previous section. Through the Revitalising Chalk Rivers partnership with the EA, we are engaging with Catchment Partnership hosts, RBRA, Hertfordshire County Council's Countryside Management Service, and other partners. This has been an ongoing process throughout AMP6 and AMP7, but additional workshops have been coordinated during the WINEP options development phase with these stakeholders to identify co-funding / co-creation/co-delivery opportunities for river restoration and wider C&NBS.

In addition, we also have a strategic partnership with Herts and Middlesex Wildlife Trust (HMWT) for which quarterly meetings identify opportunities and ensure that delivery of our schemes support delivery of the wider Catchment Plan for the Beane catchment.

4.2.2 Co-design and Co-delivery

Affinity Water and Environment Agency Revitalising Chalk Rivers Prioritisation Methodology

As the competent authority for the Water Framework Directive the Environment Agency will act in an advisory role for proposed river improvement works actions delivered through the best value option. The Environment Agency role will be to advise Affinity Water on whether a proposed project is expected to contribute to improving the ecological status of the waterbody or improve resilience.

The prioritisation is designed to help the Environment Agency to advise Affinity Water on whether projects are suitable to meet the ecological objectives of the river restoration programme. It is expected that other factors will also be considered by Affinity Water when deciding which projects to progress, for example funding, requirements of local groups and feasibility.

A river walkover will be undertaken with both Environment Agency and Affinity Water present. This walkover will be an opportunity to identify reach by reach unconstrained river restoration actions. These actions will then be scored for their environmental benefit and feasibility (as defined below). These scores will then be used to prioritise the river restoration actions (projects) identified from the walkover.

Environmental Benefit

- Use technical expertise to rank actions based on their predicted benefit to ecology.
- Ecology = biological elements as assessed under the Water Framework Directive (fish, invertebrates, plants).
- Feasibility of actions should not be considered (this will be assessed separately as defined below).
- One way of judging benefit is to assess the current impact of modifications on ecology and the degree to which these will be rectified by the proposed action.
- The assessment will be on a scale of 1-10 (decimals are allowed where necessary to differentiate between actions).
- Whilst directly comparable benefit scores between catchments would be nice to have, it is not vital.
- The objective is a prioritised list for each catchment to form a work programme for Affinity Water.

Feasibility

- Score of 1 = project very unlikely to be feasible, leave these off the work programme.
- Score of 2 = project may be feasible. Some significant difficulties anticipated but the project is worth pursuing.
- Score of 3 = project likely to be feasible.

Wider Stakeholders/partners

In addition to the prioritisation methodology above, we are also engaging with wider partners through the following:

- EA and Natural England through Stage 2 Risks and Issues workshops held in June 2022
- Catchment partnership hosts and other key stakeholders through risks and issues review (stage 2)
- AMP6/7 Revitalising Chalk Rivers programme delivered in partnership with the EA and catchment partnership hosts (HMWT)

- Discussions with the Beane Catchment Partnership on potential co-design, co-funded and co-delivered projects that could be implemented in AMP8.
- Stakeholder consultation with River groups and catchment partnership hosts during Stage 3 (Proposing solutions). Feedback has included:

Key 'asks' from the Lea (Beane) Catchment Partnership:

- *As part of the development of the CaBA flagship project Catchment Strategy it is important to not forget the existing Catchment Plan and this should be reviewed and revisited as part of this work*
- *We have recently undertaken a water vole reintroduction to the River Beane and it will be important to protect existing habitat and create new habitat to enable the water vole population to thrive*
- *We request that the regular RCR meetings are re-established with the EA, Affinity Water and HMWT going forward to avoid duplication and ensure everyone is aware of what EA partner are doing in the catchment.*

Tim Hill and Sarah Perry (HMWT), Lea (Beane) Catchment Partnership host

4.2.3 Environment Agency HNL Water Environment Vision 2100 – Beane Catchment

The Environment Agency Hertfordshire and North London team for which the River Beane catchment is located within are developing a Water Environment Vision 2100. As part of this they are currently developing a supporting Beane Catchment Vision document through the Lee2100 core team. The 'vision' states:

All rivers, groundwater, aquatic ecosystems and wetlands are restored and protected.

- All WFD rivers and groundwater bodies support Water Framework Directive good ecological status / potential.
- Aquatic ecosystems (including wetlands) are resilient to extreme weather conditions, including high and low flows, and the impacts of climate change
- in-channel, marginal and riparian habitats are restored and defragmented.
- Communities and stakeholders are engaged in restoring the water environment and become more self-aware of their individual impacts as a result.

Through the development of the Catchment Strategy for the Beane under this Flagship project alignment will be made between the Water Environment Vision 2100, alongside the current Catchment Plan developed through the Lea Catchment Partnership.

4.2.4 HMWT Hertfordshire State of Nature Report and Targets

In 2020, HMWT published the Hertfordshire State of Nature Report which brings together the story of Hertfordshire's wildlife over the past 50 years. The report assesses over 7,500 different species and how their numbers have changed between 1970 and 2020. The results are based on over 2.8 million species records held by the Hertfordshire Environmental Records Centre.

The report looks at both habitats – such as woodlands, grasslands and wetlands – and species to give a clear picture as to how the country's wildlife has changed over the last 50 years. This highlights what has been lost over the last 50 years and just how many species are now threatened with extinction in Hertfordshire. It concludes that to halt and reverse the decline, it is important to act now and focus on reinstating conservation management of existing habitats as well as creating and connecting habitats across the county. It also highlights that partnership working will be the key to achieving this. Through this Flagship project we will work in partnership with HMWT to support the target of 30% of land in that can support spatial connectivity of species.

4.2.5 HMWT Water Vole Reintroduction

In July 2022, Herts and Middlesex Wildlife Trust released 138 water voles at Woodhall Estate in the Beane catchment with support from the RBRA. Loss of quality wetland habitat and predation by invasive non-native species has caused water vole populations to decline significantly over the last 50 years with the last recorded population in the River Beane catchment in 2000. The Woodhall Estate was chosen as a release site due to their commitment to conservation and overall river habitat suitability. Continued engagement with HMWT is important to track the success of the reintroduction and to ensure future projects in the Beane compliments and monitors any additional benefits to water voles.

4.2.6 Thames Water Catchment Management Programme

Thames Water are running a catchment fund in parts of the Lee operational catchment in AMP7, including the River Beane catchment. The fund is aimed at assisting farmers to reduce diffuse pollution which can affect their water abstractions from the River Lee in north London. Farmers can apply for up to £10,000 for options such as cover crops, under sowing maize and buffer strips next to water courses. We will work in partnership with Thames Water to co-design, fund and deliver improvement grants for the Beane catchment.

4.2.7 River Beane Farm Cluster Group (funded by Affinity Water)

We fund a Farm Cluster Group in the Beane catchment which is facilitated by the Farming and Wildlife Advisory Group (FWAG East) which includes over 20 farmers and landowners in the catchment. It is hoped that the flagship restoration project can utilise funding through the developing Environmental Land Management scheme (ELMS) to deliver some of the improvements needed. Funding for improvements to soil health on farmed land and landscape recovery will be explored. Once further details are released on ELMs it will be incorporated into the long-term plan for the River Beane catchment.

4.2.8 Landscape Enterprise Network (LENS) East Anglia

Affinity Water alongside Anglian Water and a number of companies within the agricultural supply chain including Nestlé Purina and Cargill are co-funding C&NBS measures in the Upper Lee operational catchment, including the Beane catchment, with a focus on regenerative agriculture measures to deliver a range of ecosystem services including: soil health, biodiversity, carbon and water quality. We are working with 3Keel and the investment partners to further develop the scheme for future years.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment (LTDS)

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this Business case.

5.2 Catchment Strategy

This Business case is aligned with the Catchment Options development as set out in our draft Water Resources Management Plan and will inform the development of

our Beane Catchment Strategy which will be developed through the CaBA strategy implementation plan in 2023. C&NBS will be prioritised in areas of the catchment identified as priorities within our CAfW modelling and catchment monitoring programme. This will align with existing catchment plans for the catchment partnership and SWC plan for the River Chess Flagship project.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation of this project are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS and river improvement works projects, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS. The scheme can adapt to:

- Outcomes of the Catchment Plan development and findings of the full fluvial and ecological survey.
- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g., Wastewater company schemes, Local Nature Recovery Strategy, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities e.g., offsetting.
- Types of measures implemented can adapt and evolve based on future scientific evidence.
- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships and river groups.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options, the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 6 – Option Evaluation Beane Flagship Project v1.0.

We have then assessed these further, with additional information; by developing hybrid solutions that take the best actions from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

6.1 Unconstrained List

Our options include a combination of land management focused C&NBS referred to as Resilient Chalk Catchments (RCC) and a river restoration / river improvement works options referred to as Revitalising Chalk Rivers (RCR). For the RCR options we have defined the options into a series of 'small' and 'large' projects. A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of both RCC and RCR C&NBS options are described for the best value option, with further examples of AMP6 and AMP7 river improvement works can be observed in Appendix 7 AWL River Restoration Project Examples AMP6-AMP7

Unconstrained options documented in Table 3 that are chosen to either 'Proceed' or 'Clarify' are then included in our constrained list with additional screening using Options Evaluation spreadsheet. Options that are 'Rejected' due to not meeting Statutory and Non-Statutory requirements do not proceed beyond the unconstrained list below.

Our unconstrained list of options are:

Table 3 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on agreed sustainability reductions	R	Does not meet S and NS requirements
2	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects.	R	Does not meet S and NS requirements
3	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project)	R	Does not meet NS requirements
4	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects)	R	Does not meet NS requirements
5	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects)	C	See Options Evaluation spreadsheet
6	Beane flagship project C&NBS option A (Awareness, advice and partnership support)	R	Does not meet S and NS requirements
7	Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	R	Does not meet S and NS requirements
8	Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	R	Does not meet S and NS requirements
9	Beane flagship project C&NBS option D (Whole catchment and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	C	See Options Evaluation spreadsheet

10	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option A (Awareness, advice and partnership support)	R	Does not meet NS requirements
11	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	P	See Options Evaluation spreadsheet
12	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)	P	See Options Evaluation spreadsheet
13	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option D (Whole catchment and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	C	See Options Evaluation spreadsheet
14	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option A (Awareness, advice and partnership support)	R	Does not meet NS requirements
15	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	P	See Options Evaluation spreadsheet
16	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support). This option also includes a nitrate reduction scheme for	P	See Options Evaluation spreadsheet

	Whitehall pumping station following the WINEP investigation completed in AMP7.		
17	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option D (Whole catchment and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	P	See Options Evaluation spreadsheet
18	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option A (Awareness, advice and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	P	See Options Evaluation spreadsheet
19	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	P	See Options Evaluation spreadsheet
20	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	P	See Options Evaluation spreadsheet
21	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option D (Whole catchment and partnership support). This option also includes a nitrate reduction scheme for Whitehall pumping station following the WINEP investigation completed in AMP7.	C	See Options Evaluation spreadsheet

6.2 Constrained List

Twelve options have been selected from the original 21. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 6) is presented below to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 4. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes	Technically feasible	Deliverability
Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects)	NN	Y	Y	N
Beane flagship project C&NBS option D (Whole catchment and partnership support)	NN	Y	N	N
Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding)	N	YY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)	Y	YY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option D (Whole catchment and partnership support)	Y	YY	Y	N
Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures	N	YY	YY	YY

upstream of River restoration (RCR) schemes and no partnership funding)				
Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)	YYY	YYY	YY	YY
Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option D (Whole catchment and partnership support)	YYY	YYY	Y	N
Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option A (Awareness, advice and partnership support)	N	YY	Y	Y
Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding)	N	YYY	Y	Y
Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)	YYY	YYY	Y	Y
Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Beane flagship project C&NBS option D (Whole catchment and partnership support)	YYY	YYY	NN	NN

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

Our final set of three feasible options are:

1. Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)
2. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)
3. Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects) and Beane flagship project C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support)

6.3.1 Option 0: Do Nothing

Do nothing option. Do not proceed with the flagship chalk stream catchment restoration project on the River Beane.

6.3.2 Option 1: Preferred, Best Value, Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (two small projects and two large projects) and Resilient Chalk Catchments RCC C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and partnership support fund to external stakeholders)

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues engagement process. The proposed option includes:

RCR – The best value option has been developed building on our extensive experience of delivering river improvement works in chalk stream catchments in AMP6 and AMP7. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. The experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs.

A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. Examples of a small project could include:

- Tree works to allow more light into the river channel
- encouraging the development of new habitat through growth of macrophytes (plants)

- Fencing along the riverbank to prevent livestock or horses from damaging the riverbanks and channel, thus reducing sediment input and allowing vegetation to establish along the river margins and in the channel.
- Planting of native aquatic macrophytes where these are absent and unlikely to colonise naturally.

A large project would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of a large project could include:

- Removal of a weir or structure and regrading of river channel up and downstream,
- Creating chalk stream habitat.
- Bypassing of a weir or structure to allow fish passage and help establish typical chalk stream features.
- Restoring the river channel to its original location in the flood plain/valley bottom.

RCC – the best value option includes, but is not limited to, the following actions:

- Protect and restore natural assets in the operational catchments identified through the Catchment Assets for Water project detailed above to improve water resource and chalk stream resilience in this operational catchment.
- Undertake detailed catchment monitoring including river water quality sampling, sediment sampling and fingerprinting, eDNA analysis (as required)
- Understand the sources and pathways for urban diffuse and point source pollution including:
    - Wastewater misconnections
    - Urban/road run-off
- Manage, reduce, and where possible eradicate INNS from the catchment.
- Work in partnership with the River Beane Farm Cluster and wider land managers to mitigate the impacts of agricultural and amenity diffuse and point source pollution risks and issues in the catchment.
- Work in partnership with the RBRA and Natural History Museum Riverfly monitoring partnership to identify issues impacting on aquatic ecology and implement C&NBS to mitigate the impacts.
- Implement appropriate C&NBS measures upstream of river improvement works under the RCR to ensure greater resilience of those schemes and maximise environmental benefits through a holistic catchment management approach.
- Deliver multiple benefits for water quality, resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Urban and rural Sustainable Urban Drainage (SUDS)
- Cover crops
- Herbal leys
- Resurfacing of farm gateways
- Arable reversion
- Chalk grassland restoration
- Tree/woodland planting
- Regenerative agriculture measures such as reduced/no tillage

Total cost (FY2022/23 cost base) - not including partnership co-funding phased across AMP8 and AMP9 as per the WINEP =

AMP8 totex costs (£m)	**£2.648m**
AMP9 costs (£m)	**£2.655m**

6.3.3 Option 2: Least Cost Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (two small projects and two large projects) and RCC C&NBS option B (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes and no partnership funding to wider stakeholders)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£2.166m**

The least cost option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to enhance water resources for groundwater (CAfW) and not targeted upstream of RCR projects to deliver multiple benefits and wider environmental outcomes.

6.3.4 Option 3: Alternative Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and C&NBS option D (Whole catchment and partnership support)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£4.217m**

Alternative option is similar in scope to the best value option for river improvement works (RCR) but proposes a significant increase in the scale of developing a programme of land management C&NBS without spatial targeting with measures

being funded and implemented across the whole operational catchment. This option will prioritise the risks and issues identified in the Stage 2 WINEP risks and issues engagement process, but also contribute to achieving wider environmental outcomes to meet the 25-Year Environment Plan.

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes and supports the aims and ambition of the CaBA Chalk Stream Catchment Restoration Strategy. This option also meets the Water Industry Strategic Environmental Requirements (WISER) as detailed in Table 6 below. It demonstrates a significant increase in ambition compared to AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process and accounts for the requirements of the Beane catchment stakeholders documented in the Scoping Workshop held in August 2022. It also builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes, including lessons-learned such as joining up river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits.

6.4.2 Option 2: Least Cost Option

The least cost feasible option has a **medium level** of confidence in the achieving the WINEP wider environmental outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes. However, this option will not fully realise the aims and ambition of the CaBA Chalk Stream Catchment Restoration Strategy and does not account for all the requirements documented from stakeholders in the Scoping Workshop held in August 2022. This option also takes a less holistic approach to delivering C&NBS and is less likely to address many of the reasons for not achieving good ecological status for the associated chalk streams caused by land management activities within the Beane catchment.

6.4.3 Option 3: Alternative Feasible Option

Option 3 has a **high**-level of confidence in the achieving the WINEP outcomes and supports the aims and ambition of the CaBA Chalk Stream Catchment Restoration Strategy. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process and accounts for the requirements of the Beane catchment stakeholders documented in the Scoping Workshop held in August 2022. It builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits. This option shows a significant increase in ambition and financial investment in C&NBS. However, the less targeted approach to delivering C&NBS and greater level of intervention required may not deliver the best value for investments in nature-based solutions for our customers. This option could also lead to deliverability issues due to the scale of intervention required.

Table 6: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the Beane Operational Catchment

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. RCR/RCC C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	The PR24 programme must include actions to improve water body status to ensure that moderate status is achieved by 2030 as a minimum and improve further where technology allows	RCR schemes developed in partnership with EA and associated C&NBS measures will support meeting moderate status.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Water body status	Water companies should apply the fair share approach when developing measures to address nutrients	Funding of C&NBS to mitigate nitrate leaching to groundwater will also take account of wider ecosystem services benefits.

Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures using CAfW spatial mapping will target opportunities for more resilient water resources and mitigate deterioration of water bodies.
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures will be deployed to reduce pollution losses from land management activities (nutrients and pesticides) into the River Beane and improve water quality for downstream Thames Water surface abstractions
Drinking Water Protected Areas	Groundwater bodies must also meet good groundwater chemical status and upward pollutant trends should be reversed.	C&NBS measures will be deployed in groundwater SgZ's to mitigate nitrate pollution of groundwater and associated impact in chalk stream quality
Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for nitrate in groundwater delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	RCC C&NBS primary focus on arable farming building on AMP6 and AMP7 catchment management schemes.
Environment Act 2021	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits
Environment Act 2021	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits including biodiversity
Environment Act 2021	Anticipated that water companies will need to have regard to the priorities set out in the LNRS covering their operational area when agreeing PR24 priorities.	AWL engaging with HCC, HMWT and NE on priorities of LNRS.
Environment Act 2021	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnership Working section 5.2 Strategic Partnership with HMWT established.
SSSI	We expect water companies to contribute to maintaining or achieving SSSI favourable condition both on their own land and in the catchments they operate in.	RCR and RCC C&NBS will prioritise opportunities for measures delivered on SSSI's within Beane catchment as appropriate.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	RCR and RCC C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.

NERC Act 2006	Sustainable abstraction, reducing demand for water and reducing pollution, particularly from storm overflows are key actions water companies should take to protect and enhance chalk streams. In line with CaBA Chalk Stream Restoration Strategy 2021, water companies should lead on behaviour change around water resources, encouraging customers to use and pollute less. Water companies should drive innovation solutions and lead the way on water supply issues, demand management, sewerage and sewage treatment.	RCR schemes will protect and enhance chalk streams, particularly supporting sustainability reductions. RCC C&NBS measures will seek to reduce pollution for enhanced chalk stream resilience. Flagship CaBA Chalk Stream Restoration projects in the Beane (Lee) and Chess (Colne).
Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.
Healthy and resilient fish stocks	Water companies should identify measures to improve abstractions and outfalls to prevent the entrainment of fish and to address barriers to passage of fish factoring in the wider benefits of fish pass solutions such as improved geomorphology. Removal of barriers should always be considered as first option.	RCR schemes designed and developed to improve fish passage (e.g. weir removal) and improve geomorphology.
Eels	Water companies must comply with the requirement of the Eels regs 2009 to support the recovery of the European eel stock.	RCR schemes designed and developed to support eel migration (e.g. weir removal) and improve geomorphology to support recovery.
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Natural environment	Help create climate resilient places and improve the resilience of communities to droughts, floods and coastal change by implementing cost-effective co funded solutions	RCR and RCC C&NBS measures within this scheme will support more resilient chalk stream catchments to flood and drought.
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	RCR and RCC C&NBS measures within this scheme will support resilient chalk stream catchments and sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	RCR and RCC C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance chalk stream habitats.
Flood resilience	Water companies should contribute to partnership schemes to reduce flood risk to communities and themselves	This scheme will align with EA Lee2100 vision.

drainage resilience	Water companies and other risk management authorities should work together to manage water in a more integrated way to improve flood resilience, enhance the natural environment and deliver value for customers	RCC C&NBS measures within this scheme will identify opportunities to use NFM measures to slow flow and hold more water in headwaters of chalk stream catchments.
Water supply and environmental resilience	Water company plans should protect and improve the environment, considering both current and future challenges. This could mean tighter environmental protection for some sensitive habitats such as chalk streams, to meet env objectives.	RCR and RCC C&NBS measures within this scheme will seek to protect chalk streams in the Lee Operational Catchment.
Water supply and environmental resilience	WCs should consider whether their abstractions are truly sustainable looking across a catchment as a whole and consider investment in integrated catchment schemes to improve drought resilience and WQ.	RCR and RCC C&NBS measures in this scheme integrated alongside SR programme.
Climate Change	Water companies are expected to adopt nature-based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2
Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature-based solutions	Experience of this through AMP6 and AMP7 river restoration programmes. AMP7 C&NBS measures co-funded through EnTrade and LENS. Experience and lessons-learned adopted for PR24.
Climate Change	Water companies should invest in the restoration of natural form and function of the catchments and wider landscapes in which they operate to contribute to resilience to the impacts of climate change	RCR and RCC C&NBS measures within this scheme will seek to protect, restore and enhance the Beane chalk stream catchment
Climate Change	WCs should improve the natural resilience of the catchments in which they operate by restoring their natural function. Water companies should ensure that solutions build resilience of biodiversity in catchments, river systems and water bodies.	RCR and RCC C&NBS measures within this scheme will seek to create more resilient Beane chalk stream catchment with focus on delivering multiple benefits including biodiversity.

6.4.4 Can the Option Provide Net Benefits?

Option 1: Preferred, Best Value, Option

The best value option can meet the ambition of the CaBA chalk stream restoration strategy, through which can provide the following net environmental benefits:

- enhanced resilience for the effectiveness of delivered river restoration schemes by both Affinity Water and the catchment partners (e.g. reduction in sediment and pollutant loading) and increased likelihood of achieving overall Good Ecological Status (GES).
- Provide greater connectivity of habitats in priority areas for RCR/RCC measures to support the water vole reintroduction at the Woodhall Estate.

- Create, restore and protect habitats that support achievement of non-statutory requirements such as the HMWT State of Nature targets for creating 30% more habitat by 2030.
- Provide greater flood and drought resilience through more sustainable land management and urban run-off and drainage practices.
- Improved water quality to support chalk stream ecology.

Option 2: Least Cost Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process and deliver net benefits. This option takes a less holistic approach to implementing land management focused C&NBS alongside river improvements works and thus not realising additional net benefits described in the other options.

Option 3: Alternative Feasible Option

In addition to the net environmental benefits stated in the best value option, by implementing wider C&NBS measures at the 'whole catchment' scale there is an increased likelihood of a net benefit contribution to achieving wider environmental outcomes for biodiversity, climate change regulation, surface and groundwater quality and increased likelihood of achieving overall Good Ecological Status (GES) across all waterbodies in the Beane.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support the achievement of meeting the WINEP wider environmental outcomes. Some examples are shown below, but not limited to:

Natural Environment Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Beane catchment which provide greater habitat and supporting ecology for priority species such as water voles.

Catchment Resilience Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Beane catchment with support C&NBS measures to provide greater chalk stream resilience to land management pressures such as reduction in upstream sediment losses.

C&NBS measures targeted using CAfW outputs to hold more water on the land to enable improved infiltration and aquifer recharge, slower flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

Access, Amenity, and Engagement Outcomes

River restoration and habitat enhancement schemes to improve the chalk streams in the Beane catchment can provide greater connectivity between the precious chalk streams and their local communities, enhancing access and recreation opportunities. For this flagship project, we will work in partnership with a range of partners both in terms of the development and delivery of the schemes within this project. We will also work closely with the other Flagship Chalk Stream projects and the CaBA Chalk Stream Steering Group to share knowledge, experience, funding and research opportunities to further maximise the benefits and meet the wider environmental outcomes and ambitions of the CaBA strategy.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the ambition and aims of the CaBA Chalk Stream Restoration Strategy and Implementation Plan.

This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. The phased approach over AMP8 and AMP9 will enable further studies such as a reach-by-reach geomorphological survey of the Beane to determine future investment needs, where that investment can be obtained and working with the wider partnership to deliver the required outcomes. It will utilise the modelling outputs from the CAfW project and water quality risk review to identify priority areas for C&NBS measures to achieve the greatest benefit for water resources and water quality, as well as aligning with wider priorities and non-statutory drivers. An intensive programme of monitoring will run alongside the project delivered both by Affinity Water, catchment partnership and the RBRA to continually monitor and refine the delivery plan.

There is also a greater co-design and co-funding approach to this option will be delivered through a Catchment Strategy and Plan developed by all partners. This option will seek align, co-fund and co-deliver wider partner projects, support and co-fund future Environmental Land Management Schemes (ELMS), catchment partnership plans and Local Nature Recovery Strategy (LNRS) and Lee2100 vision (natural flood management) projects.

The proposed river restoration and habitat enhancement programme (RCR) will be adaptive and developed in partnership with the EA and the Beane Flagship partnership and use a Natural Capital assessment framework to ensure the greatest environmental benefit is derived for every pound invested.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but without targeting of C&NBS measures upstream of RCR projects. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements but increases the likelihood that river improvement works project do not deliver longer term environmental benefits they will not be delivered holistically with land management C&NBS designed to increase the resilience of river improvement works and deliver multiple environmental benefits to support meeting GES and the wider environmental outcomes.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but with less spatial targeting of C&NBS measures. This option will seek to invest in a significantly larger number of measures and will require a greater level of investment. This option is less appropriate to the size and complexity of the environmental risks and issues and could create duplication with wider environmental programmes such as ELMS and is less adaptive than the best value option.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business cases by PR24 Red Team
    b. Review of Business cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology

in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 8 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 9.

Our economic analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We have used our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

7.2 Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. For both the RCR and RCC options, a bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes that we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1.

7.3 Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.756m** in partnership funding contributions towards the non-statutory tertiary driver aspects Beane flagship WINEP scheme across AMP8, with further partnership funding contribution estimated for AMP9. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Participate as a buyer in the Landscape Enterprise Network East Anglia and work closely with our buyers of ecosystem services to target and co-fund measures in our priority areas in the Beane catchment. We have successfully achieved this in AMP7 as a pilot in the Upper Lea catchment.
- Establish an AMP8 5-year formal partnership agreement with the CaBA Lea Catchment Partnership hosts, Herts. and Middlesex Wildlife Trust. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Identification, scoping and co-funding/co-delivery of river improvement works.
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Working in partnership with neighbouring water companies and water and sewerage companies that overlap our supply area to identify co-funding opportunities that mutually benefit each company.
- Work with key stakeholders to explore options with working with farm cluster groups in the Upper Lea to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

7.4 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the rivers that we are restoring are unique in nature and therefore of higher environmental value to society.

7.5 Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The business case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g., hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

7.6 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. This experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs. Additionally, our experience of delivering a range of large and small projects has enabled a good understanding of the true costs of delivering such projects. In AMP6 and AMP7, the mean average cost of delivering a river restoration project unit (equivalent to one small project) was £124,245 not including monitoring

costs and actual costs at time of implementation (cost range 2016-2022). Our unit cost model cost for this proposed scheme has been estimated at £160,871 per unit in 2022/23 price base (not including monitoring costs). This increase also includes associated overheads and is reflective of the increased ambition and scale of the river restoration programme, and associated resource requirements. This will result in an increased reliance on our supply chain for aspects of delivery including stakeholder engagement, design and construction elements, where internal resource would have been used previously.

7.7 Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

8.1 Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement water quality, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

8.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the river restoration investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable

Air quality	Monetised as per WINEP and impacted by the natural capital investments
Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Best Value Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the River Beane will improve to some extent from Poor to Moderate status as a result of our restoration activities.

- We have calculated the total length of the Beane (Source to Stevenage Brook), Beane (from confluence with Stevenage Brook to Lee) and Stevenage Brook to be 40 km taken from Catchment Data Explorer.
- We have assumed that the whole length is currently in Poor condition as per Catchment Data Explorer.
- We have assumed that the water quality benefits will be realised after 7 years. this is based on the AMP7 Frogmore Park scheme NC evaluation carried out by Atkins (see section 4.5).
- We have assumed that both our river restoration and natural capital activities will make a proportional start to improving the water quality and that further, future activities will be required to achieve full Moderate status for the whole river system. Because the natural capital activities will change in the options, we have assumed that the least cost option will only deliver a 5% improvement towards Moderate status; the best value option 10% and the alternative option 12.5%. Our previous river restoration projects suggest that these are conservative estimates. We have selected these conservative values due to the dependency on flow to support these improvements. We also recognise similar activities from other partners including river groups, the EA and catchment partnerships to support the improvement to Moderate Status in addition to our proposed activities.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

Air Quality Pollution Reduction and CO_2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 10-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g., cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

- We have assumed that the preferred option will impact a total of 3,850 hectares, comprising of: 1,936 ha of enclosed farmland; 18 ha of freshwaters, open waters, wetlands and floodplains; 1,514 ha of semi-natural grasslands; and 382 ha of woodlands.
- We have reduced these values to 2,500 ha for the least cost option and increased the value by 11,250 ha for the alternative option, assuming the same profile of land use.

8.4 Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is highly cost beneficial for both the river restoration and natural capital activities. Jointly these activities will provide significant environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a positive NPV of **£1.597m**, and a good benefit / cost ratio of **1.33**. The benefit / cost ratio is higher than both the least cost and the alternative options, demonstrating best value.

We have assumed a 10 % increase in water quality in the analysis. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. For example, our recent river restoration on the River Beane has delivered biodiversity net gains across the different areas in river units between 16% and 49%, with a weighted average of 28% based on river length. There is also a corresponding average improvement of the habitat units of 6%. Similarly, our cover cropping scheme realised a river water quality benefit of over 40%; CO_2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 3 % would result in cost benefits. This provides a high-level of confidence that the scheme will be cost beneficial.

The natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

8.5 Least Cost Option

The least cost option is marginally cost beneficial with an NPV of **£0.933m** and a benefit / cost ratio of **0.78**. This is logical because the preferred option has the additional natural capital activities to fully build upon the river restoration work to optimise the overall environmental benefits.

8.6 Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, with a forecast NPV of **£3.130m**. The benefit / cost ratio is slightly higher than the preferred option, **1.47**. It should be noted that there are uncertainties in the benefit estimation in the options and also greater risks around the deliverability of this option. It is prudent to work on the preferred option initially and monitor progress; to better understand how best to invest in the future; and then to secure on-going environmental improvements, where we have a higher level of confidence of benefit realisation.

8.7 Alternative Option 2

There was no second alternative option in this analysis.

8.8 Non-Monetised Information

We have rigorously applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Flooding reduction from woodlands
- Arable production
- Livestock production (dairy and meat)
- Timber removal
- Recreation

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least cost option; all in proportion to the number of hectares set aside for the production. There will clearly be some benefits from arable and livestock production, but these are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

In addition, we recognise that there will be further benefits currently not fully understood and monetised as part of the delivery of this Flagship restoration project including:

- Educational benefits through engagement with, and participation from local schools
- Increased opportunities to visit the river promoting wellbeing for local residents and schools
- Additional volunteering opportunities through collaborative projects, INNS management and monitoring activities such as a River Warden scheme

8.9 Wider Environmental Outcomes

8.9.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.9.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing	**Preferred Option**	^
	Least Cost Option	^

environmental capacity, and securing sustainable alternative water resources	**Alternative Option 1**	^
	Alternative Option 2	o
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o

8.10 Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments and increasing their resilience to climate change, flood, drought, and development pressures. It also supports our Strategic Direction Statement ambition of being stewards of the local environment. It builds on our reduction in abstraction at Whitehall pumping station in 2014 and our extensive river improvement works and habitat creation delivered during AMP6 and AMP7. It also supports delivery of the ambition of the CaBA chalk stream restoration strategy and our commitment to deliver a flagship chalk stream catchment restoration project within our supply area.

The economic assessment of the different options has shown that the preferred option is the best value option. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Estimates of the benefits have been made and the scheme is clearly cost beneficial in terms of both river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis has been benchmarked against the Natural Capital evaluation carried out by Atkins of the river improvement works completed on the River Beane detailed in section 4.5. Additionally, from our Natural Capital Evaluation of the EnTrade Cover Crop Scheme in 2021, also detailed in section 4.5 has demonstrated that greater environmental net gain benefits can be derived from our C&NBS measures targeted effectively. We will review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**1.33** compared to **0.78**). The alternative option of doing more does offer slightly better value as the costs do provide an additional benefit, with a benefit / cost ratio of **1.47**. It also presents a scalability and deliverability challenge that may reduce overall effectiveness.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. Our sensitivity analysis shows that the river restoration will be cost beneficial if there is more than a 3 % increase in river water quality and ignoring the natural capital benefits. When this is considered with our conservative assumptions, this assessment has determined the project is worthwhile and will be beneficial to customers, the environment and society.

The best value option aligns with the CaBA Strategy and draft Implementation Plan, WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments.

9 Delivery Considerations

9.1 Related Projects

This project is similar to our other river restoration and catchment improvement schemes. However, this project represents a significant increase in ambition through implementation of the CaBA chalk stream restoration strategy. The experience gained from this flagship project will inform future C&NBS schemes in AMP8, AMP9 and beyond. Collectively, our AMP8 C&NBS programme, including this flagship project will form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in several of our groundwater sources in the operational catchment and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25 years.

The effectiveness of river improvement works is also dependent upon the effectiveness of sustainability reductions and/or impacts of land management activities and climate change in terms of providing additional flow. The prioritisation of C&NBS schemes delivered by this project will be aligned with our current and future sustainability reductions programme and targeted in the headwater areas of the catchments (subject to landowner agreement and participation) to hold more water in upper reaches in order to maximise the benefits of C&NBS and any reduction or cessation of abstraction. River improvement works, where appropriate, will be targeted further down the catchments where greater ecological benefits can be derived.

Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 river restoration and catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to the catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our extensive experience of delivering small and large river improvement works has enabled us to better understand the risks, issues and opportunities that can arise and how to develop the programme more efficiently as well as an increased understanding of the true cost of delivering these types of schemes.
- Our experience of engaging with landowners and local environmental groups and knowledge in the Beane catchment where future schemes are

proposed for AMP8 and AMP9 will allow us to deliver an ambition programme drawing on partnership support and contributions.

- The Natural Capital evaluation of our river improvement works completed to date in the River Beane catchment has been helpful in understanding the potential benefits of these type of schemes and informing this benefits assessment.
- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits.

9.2 Delivery Risk Management

We have delivered similar river improvement works and catchment management schemes during AMP6 and AMP7, and therefore have a strong understanding of the delivery risks and how best to manage these. However, the most significant risk to the project is delivering the ambitious target for river restoration projects and associated units due to permitting and landowner permission constraints. To mitigate this, we have proposed phasing of the best value option across AMP8 and AMP9 in recognition of the long lead in time for delivery of some projects and the number of projects that do not progress beyond detailed design as a consequence of permitting constraints such as Flood Risk Activity Permits (FRAP), requirements for also securing impoundment licensing and landowners not wishing to proceed.

A further significant risk to the project is securing partnership funding and the co-delivery element of the project. These are beyond our control, being dependent both effective collaborative working and generation of partnership funding e.g., through catchment partnership, financial contributions through catchment-trading mechanisms including agricultural supply chain and other government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

The following risks and mitigations have been identified for this project:

- Delays in delivering river improvement works due to delays and/or limitations from permitting/flood risk modelling outcomes.
    - Our RCR partnership with the EA and regular engagement can help manage risks and issues around permitting/flood modelling.
    - We will commence permitting applications at the earliest possible stage and engage with the EA in a timely manner with an understanding of timescales.
- Lack of engagement, participation and funding from Highways, local authorities including Stevenage Borough Council and East Hertfordshire

Borough Council to support mitigating the impacts of urban point source and diffuse pollution on the River Beane.
    - We will work closely with the CaBA chalk stream steering group on developing and implementing best practice techniques at engaging and involving local government.
    - We will engage with them at the earliest possible stage and ensure involvement of these organisation in the development of the Catchment Strategy and Implementation plan.
- Lack of permission from landowners to carry out river improvement works.
    - We will use an adaptive management approach to identify wider opportunities for projects in alternative reaches.
    - We will utilise our Agricultural Advisory specialists and other partners in the catchment to engage with landowners.
    - Opportunities through schemes such as ELMS to work constructively with landowners and generate additional funding streams.
- Uncertainties around climate change and associated flood, drought and other impacts.
    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8 and AMP9.
- Increasing demand at a national level for specialist contractors to deliver river improvement works leading to delays in overall programme delivery.
    - We have an established framework with a number of the specialist contractors already delivering projects on our behalf which will build on for AMP8 and AMP9.
- Increasing cost of resources to deliver projects.
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs.
- Farmers and land managers unwilling to engage with us on land management C&NBS.
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable Agricultural Advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes.
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS.
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

9.3 Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits we will undertake the following activities alongside our abstraction impact assessment monitoring detailed in our Water Resources Business case:

- Baseline monitoring and long-term benefits monitoring for river improvement works in catchment, alongside our sustainability reduction programme including the following:
    - Flow gauging
    - Macrophyte and macroinvertebrate surveys
    - Groundwater level monitoring
    - Rain gauge monitoring
- Chalk stream monitoring linked to our land management C&NBS including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring
- Align our monitoring activities with citizen science monitoring in the catchment through the RBRA (Riverfly monitoring and groundwater level monitoring).
    - Build on the Beane Demo Catchment under the CaSTCo. National citizen science project delivered in AMP7 through the Ofwat Water Breakthrough Challenge fund.
- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the Option Development Report and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 9 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by consultants Mott MacDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each investigation we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on investigations carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each scheme will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, kilometres of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

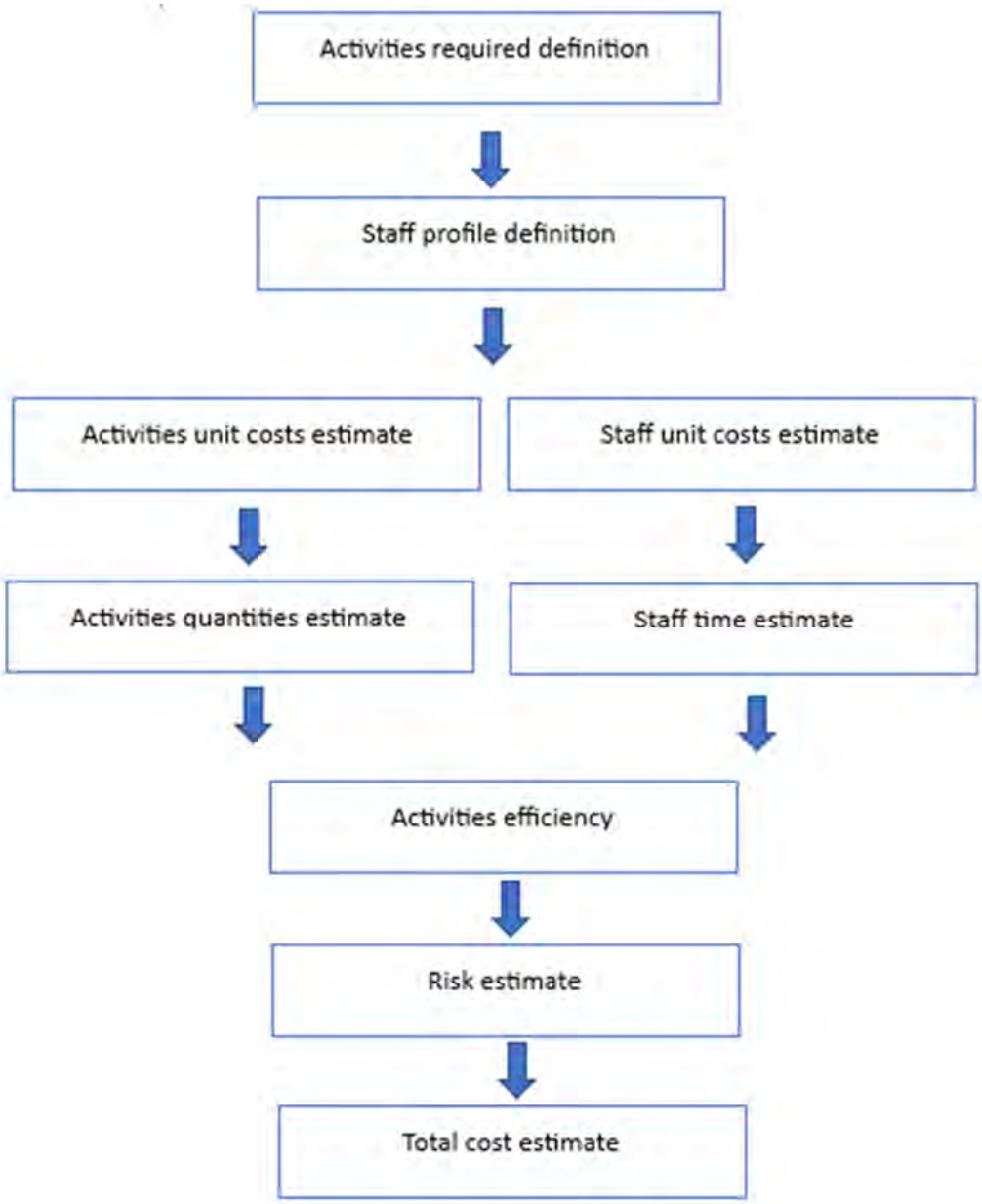


Figure 6: Cost Estimate workstream diagram

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar investigations undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director time have been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Activities efficiency: where possible, significant attention has been paid to make efficiency across investigations. For instance, field monitoring rounds estimated for a

small investigation have been incorporated into a nearby larger investigation monitoring activity, so that time and resources spent are minimised.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – Affinity Water WINEP Stage 2 Risks and Issues Register v1.0

Appendix 2 – Flagship Chalk Stream Catchment Restoration Project Scoping Document

Appendix 3 – AWL WINEP WQ Investigations Completion Report HNL 2020 – 2022

Appendix 4 – Letter from Minister Pow – Pauline Walsh

Appendix 5 – 210803 Rebecca Pow MP (Response letter)

Appendix 6 – Options Evaluation Beane Flagship Project v1.0

Appendix 7 - AWL River Restoration Project Examples AMP6-AMP7

Appendix 8 –– Atkins PR24 WINEP Assurance Report November 2022

Appendix 9 –– PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: River Colne Catchment

Catchment and Nature-based Solutions (inc. River Restoration)

August 2023

Contents

1 Summary

This business case sets out the detailed PR24 WINEP options development process and outcomes for our proposed Colne operational catchment programme of catchment and nature-based solutions (C&NBS) for AMP8. Additionally, it includes additional scoping, costs, and benefits assessment to continue the programme into AMP9 as part of a longer-term planning horizon and phasing of the best value option. It sets out to address the following challenges:

- Manage the drinking water quality pressures for our groundwater sources in the Colne catchment.
- Contribute towards mitigation of the impacts of climate change at the operational catchment-scale to create more resilient catchments for water resources.
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and the reasons for deterioration (RFD) in the following waterbodies:
    - GB40601G601200 - Mid-Chilterns Chalk
    - GB106039029890 - Bulbourne
    - GB106039029870 - Chess
    - GB106039023090 - Colne (Confluence with Chess to River Thames)
    - GB106039029840 - Colne (from Confluence with Ver to Gade)
    - GB106039023010 - Colne Brook
    - GB106039029900 - Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC)
    - GB106039029860 - Gade (from confluence with Bulbourne to Chess)
    - GB106039029830 - Misbourne
    - GB106039029820 - Upper Colne and Ellen Brook
    - GB106039029920 – Ver
    - GB106039023900 - Hughenden Stream (part of the Chilterns South catchment, but included as part of the Colne scheme)

The ‘best value’ option described in this Business case defines a landscape-scale programme of Catchment and Nature-Based Solutions (C&NBS) for the Colne operational catchment. This includes river improvement works through our Revitalising Chalk Rivers partnership on the waterbodies listed above and a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater; improved soil health; greater water-holding capacity on land for flood and drought resilience; net zero benefits and biodiversity enhancements.

We have followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our preferred solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high degree of support for the proposed environmental improvements. We have learnt from our previous river restoration and natural capital improvement projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme

has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. Based upon our conservative estimates, the preferred option offers NPV benefits of **£10.715m** with a benefit cost ratio of **2.36.** The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water.

Conservative estimates of the benefits have been made and the scheme has been assessed as clearly cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements.

The best value option will be delivered under a catchment strategy for the Colne operational catchment developed following the principles of our environmental strategy and existing Catchment Based Approach (CaBA) catchment plans. The prioritisation and delivery of the programme will be developed with the Environment Agency and alongside our sustainability reduction programme to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS

Each project will utilise a range of C&NBS targeted spatially and/or temporally to deliver the greatest environmental benefits.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER),

addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence

To determine the best value option, an extensive options development process was undertaken with 21 unconstrained options, 11 constrained options reviewed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration

To determine the best value option, we have carried out a detailed risks and issues identification process with key stakeholders including the Environment Agency, Natural England and catchment partnerships. We have also developed our proposed solutions with input and feedback with key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	09 August 2023
Report Title	Colne Catchment C&NBS – PR24 Business case
Options Assessment Report (WINEP)	08AF100011_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030 (AMP8) and 31/03/2035 (AMP9)
WINEP Spreadsheet ID	
WINEP Action ID	08AF100011
WINEP Drivers	WFDGW_ND (S) (Primary) WFD_IMP_Flow (S+) (Primary) NERC_IMP (S+) (Secondary) EDWRMP_IMP (S+) (Secondary) 25YEP_IMP (NS) (Tertiary)
Scale of Action Delivery	Operational catchment
Location of Delivery	GB40601G601200 - Mid-Chilterns Chalk GB106039029890 - Bulbourne GB106039029870 - Chess GB106039023090 - Colne (Confluence with Chess to River Thames) GB106039029840 - Colne (from Confluence with Ver to Gade) GB106039029900 - Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC) GB106039029860 - Gade (from confluence with Bulbourne to Chess) GB106039029830 - Misbourne GB106039029820 - Upper Colne and Ellen Brook GB106039029920 – Ver GB106039023900 - Hughenden Stream

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.45	0.81	0.96	0.97	0.97	**4.16**
Totex (£m)	0.45	0.81	0.96	0.97	0.97	**4.16**
3rd Party Funding	0.02	0.04	0.06	0.06	0.05	**0.23**

Drivers	
100%	Water Framework Directive

Benefits
Water Quality of Natural Water Bodies (km)
Sequested Carbon (tonnes CO_2e)
Air Quality Pollution Reduction (tonnes)

Economic Analysis			
NPV Costs (£m) (2025-55)	**7.9**	NPV Benefits (£m)(2025-55)	**18.6**
NPV (£m) (2025-55)	**10.7**	Benefit / Cost Ratio	**2.3**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This Business case describes the WINEP scheme developed to address the challenges within the Colne operational catchment (see Figure 1).

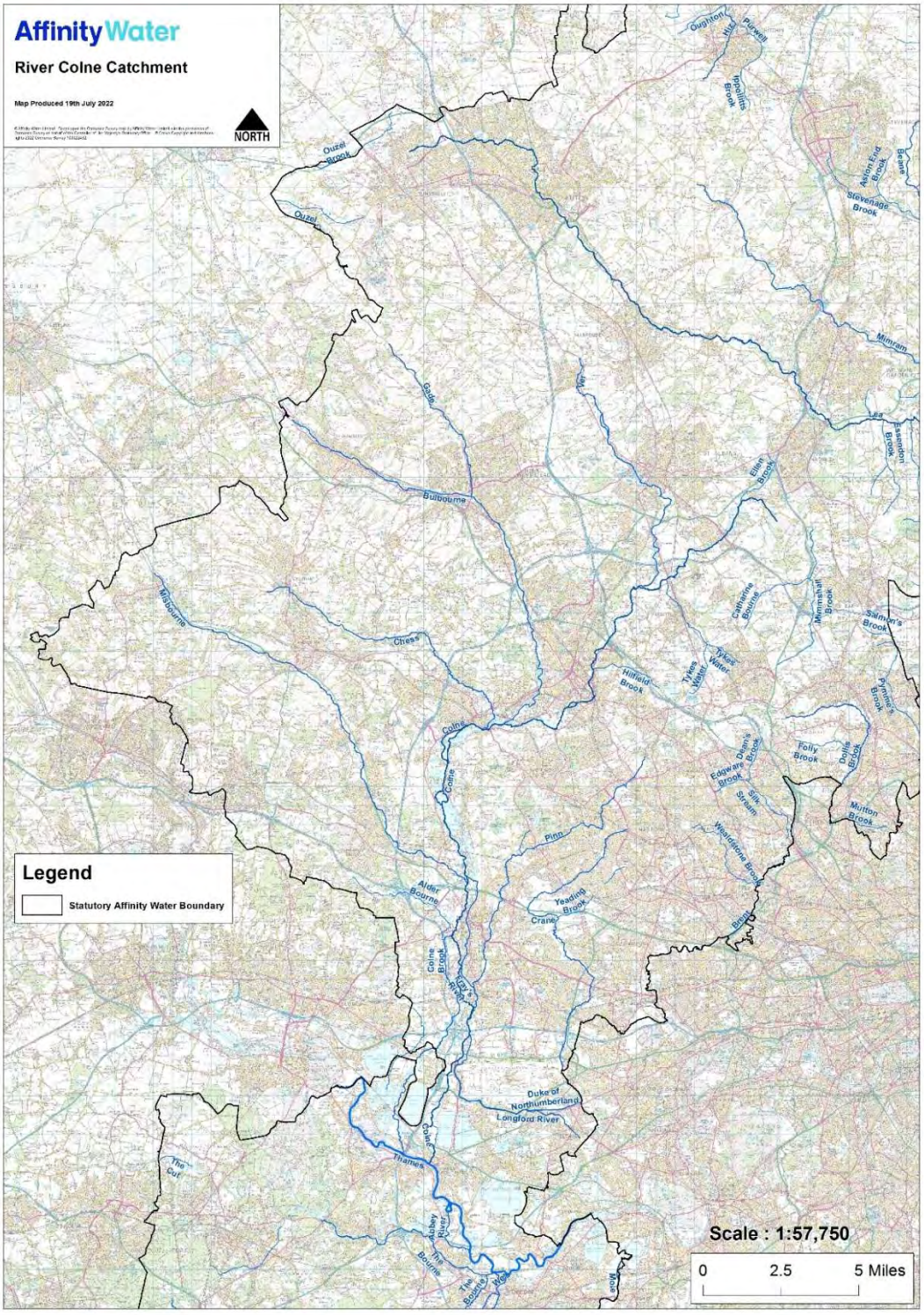


Figure 1. Catchment areas of the Colne operational catchment

The challenges are to:

- Manage the drinking water quality challenges for our groundwater sources.
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and reasons for deterioration (RFD) in the following waterbodies:
    - GB40601G601200 - Mid-Chilterns Chalk
    - GB106039029890 - Bulbourne
    - GB106039029870 - Chess
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    - GB106039029820 - Upper Colne and Ellen Brook
    - GB106039029920 – Ver
    - GB106039023900 - Hughenden Stream (part of the Chilterns South catchment, but included as part of the Colne scheme)

The 'best value' option described in this Business case defines a landscape-scale programme of Catchment and Nature-Based Solutions (C&NBS) for the Colne operational catchment including:

Revitalising Chalk Rivers (RCR)

Chalk streams are rare ecosystems that are important to protect. 85% of all chalk streams are in England, mainly in the south and east of the country. Many of these chalk streams in this operational catchment are considered to be impacted by our abstraction for public water supply. Consequently, reduced flows potentially caused by abstraction, are also leading to the natural river processes not taking place impacting the habitat and ecology of the river. Alongside abstraction impacts which are being addressed through our sustainability reductions programme, it is important to ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding. These rivers are ultimately failing to meet Good Ecological Status (GES) under the Water Framework Directive and therefore action needs to be taken to address this, unless assessed to be disproportionately costly.

Our programme of chalk stream river improvement works, and habitat enhancement schemes commenced in AMP6, and this document proposes as expansion of river improvement works within the rivers listed above and associated riparian zone. This builds on the existing programme developed in partnership with the EA referred to in this document as Revitalising Chalk Rivers (RCR).

Undertaking river channel modifications (e.g. installation of deflectors, channel re-profiling to create a low flow profiled channel) can help increase in-channel

velocities which are known to be a key element in the ecological requirements of a river. These channel enhancements and modification works will be delivered alongside our sustainability reductions programme, further abstraction impact assessments, and wider C&NBS schemes to maximise the benefits and support achievement of the WINEP wider environmental outcomes, 25 Year Environment Plan and Environmental Destination requirements. In order to achieve GES these rivers need to be a properly functioning ecosystem.

Some of the benefits of such river improvement works include:

- Ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding.
- Restoring the rivers back to a more natural state by removing barriers to fish, re-meandering, reconnecting them to groundwater and re-establishing chalk stream characteristics.
- Healthy chalk stream systems can also lead to improved water quality and support greater ecological diversity.
- To meet our environmental objectives and targets as a company to ensure we are improving the local environments while maintaining high quality drinking water supply.
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 1 - End unsustainable abstraction from chalk groundwater sources
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital.

River improvement works that form the best value option in this document will be prioritised and profiled over AMP8 and AMP9. This is done through a process of prioritisation with the EA detailed later in the document and to align with our sustainability reductions (SR) programme.

Resilient Chalk Catchments (RCC)

Delivered in combination with the RCR programme, Resilient Chalk Catchments (RCC) is land management focused programme of C&NBS. This programme will work in partnership with landowners, farmers, businesses, environmental NGO's, regulators, catchment partnerships and river groups to target C&NBS spatially and temporally at the operational catchment scale (Colne) to achieve the following outcomes:

- Enhanced infiltration / aquifer recharge
- No deterioration of groundwater quality (nitrates)
- Habitat enhancement for priority species
- Chalk stream protection and resilience from land management pressures (sediment, pesticides, nutrients etc.)
- Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams

- Connecting wildlife corridors and creation of habitats in partnership with local stakeholders
- Wider biodiversity benefits e.g. to priority habitats and species
- Support achieving of a number of our 'strategic focus' areas in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital.

This programme builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes which were focused on water quality no deterioration schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality, and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

3.1 Environmental Risk and Issues

As detailed in the EA Catchment Data Explorer for the Colne operational catchment, there are a number of significant water management issues which are attributed to a number of business sectors including the water industry determined as the RNAG status. These include:

- Changes to the natural flow and level of water
- Invasive non-native species (INNS)
- Physical modifications
- Pollution from rural areas
- Pollution from towns, cities and transport
- Pollution from wastewater

Several of these issues, including pollution from rural and urban areas, also affect the groundwater quality of water abstracted for public water supply, in addition to the waterbodies within the catchment.

3.2 Baseline Assessment

There are a number of environmental risks that are detailed in the Risk and Issues log (Appendix 1) has been developed for both the operational catchment and at the waterbody level which has been captured the available data on Catchment Data Explorer and through consultation with a range of stakeholders including:

- EA
- Natural England (NE)
- Catchment partnerships
    - Colne Catchment Action Network (ColneCAN)
    - River Chess Smarter Water Catchments Partnership (Chess SWC)
    - Chilterns Chalk Stream Project (CCSP)
- Wildlife Trusts
- Colne Valley Regional Park
- River groups

The process has identified a list of risks and issues in each waterbody, and collectively in the catchment as a whole, which this project and associated projects will seek to address. These include:

- Abstraction
- Low flows
- River morphology
- Diffuse and point source pollution
- Water quality
- Land management pressures

- Climate change
- Loss of habitat and wildlife
- INNS

In addition, an assessment of groundwater quality issues through our Drinking Water Safety Plans (DWSP) has been undertaken to determine the issues that this project will seek to prevent, namely deterioration and seek improvements in water quality through catchment-based C&NBS. Figures 2, 3 and 4 show risk maps covering the Colne operational catchment alongside our public water supply sources where C&NBS measures will be targeted under the best value option. Please note that C&NBS water quality measures for the Upper Colne East Arm (including Mimmshall Brook) and Upper Colne and Ellenbrook (highlighted red in the heat maps in Figures 1,2 and 3) are costed and detailed in our Karstic Groundwater Sources Business case as they are being delivered as water quality focused Drinking Water Protected Areas schemes.

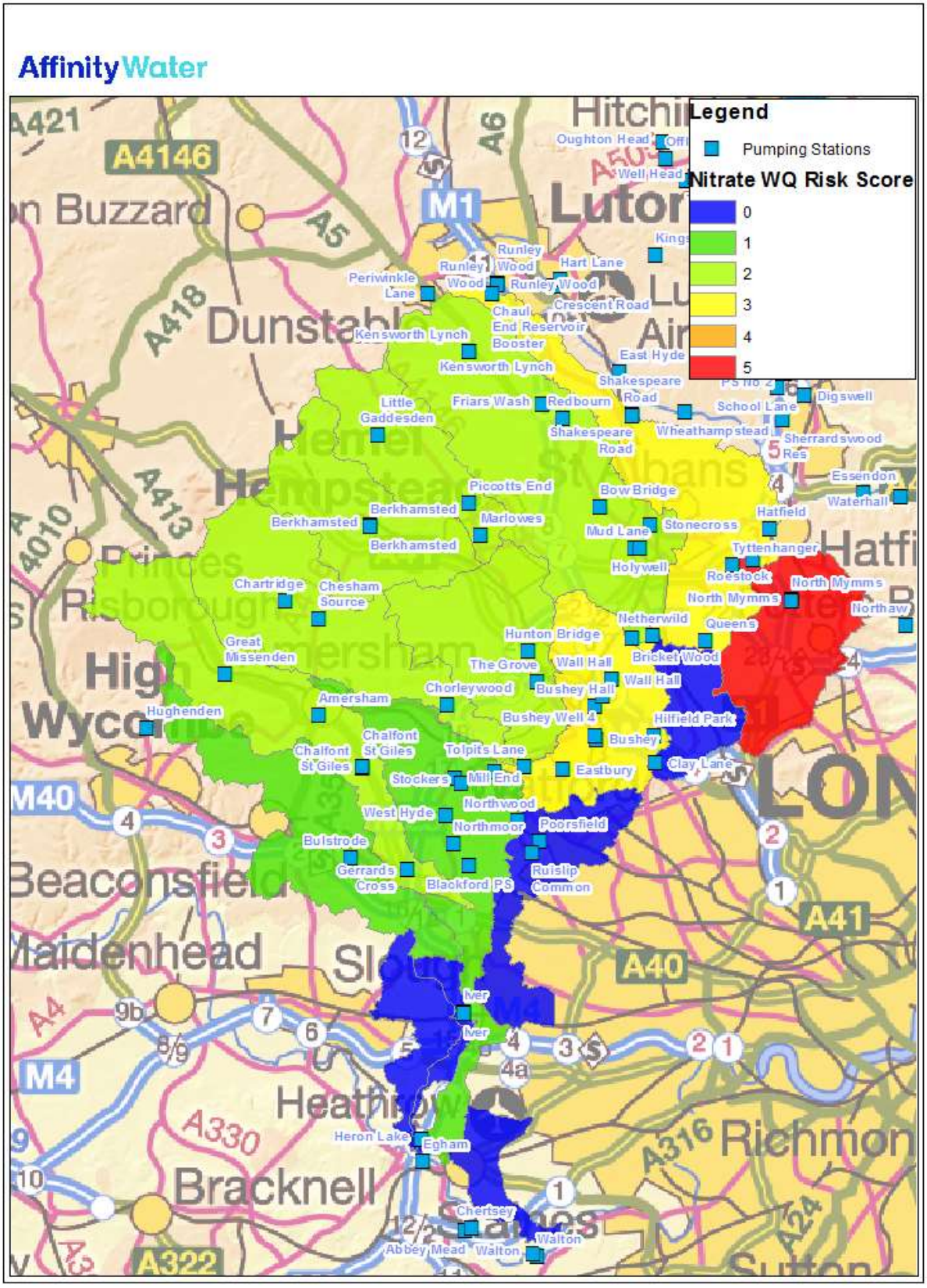

Fig 2. Nitrate water quality risk score heat map

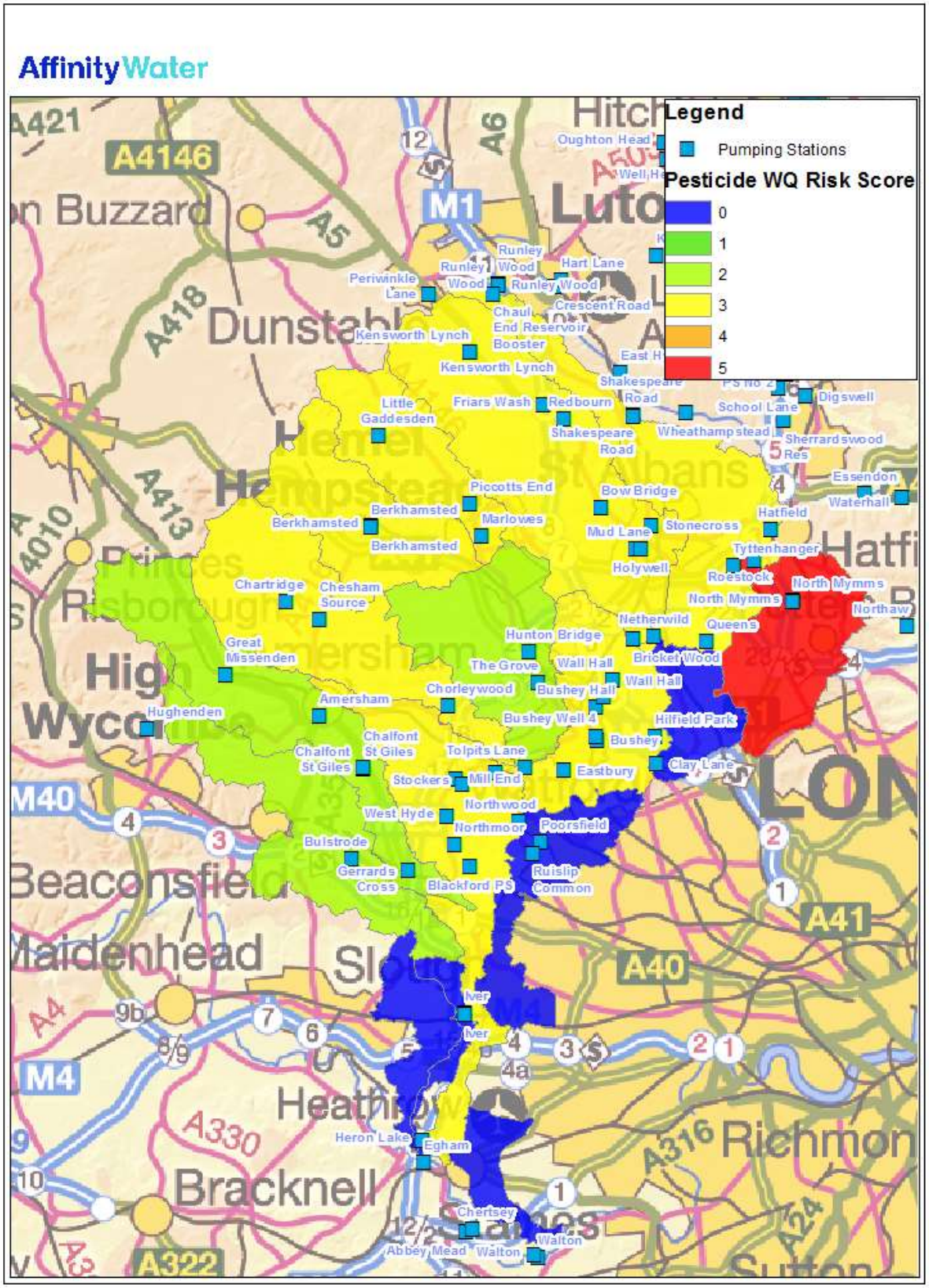

Fig 3. Pesticide water quality risk score heat map

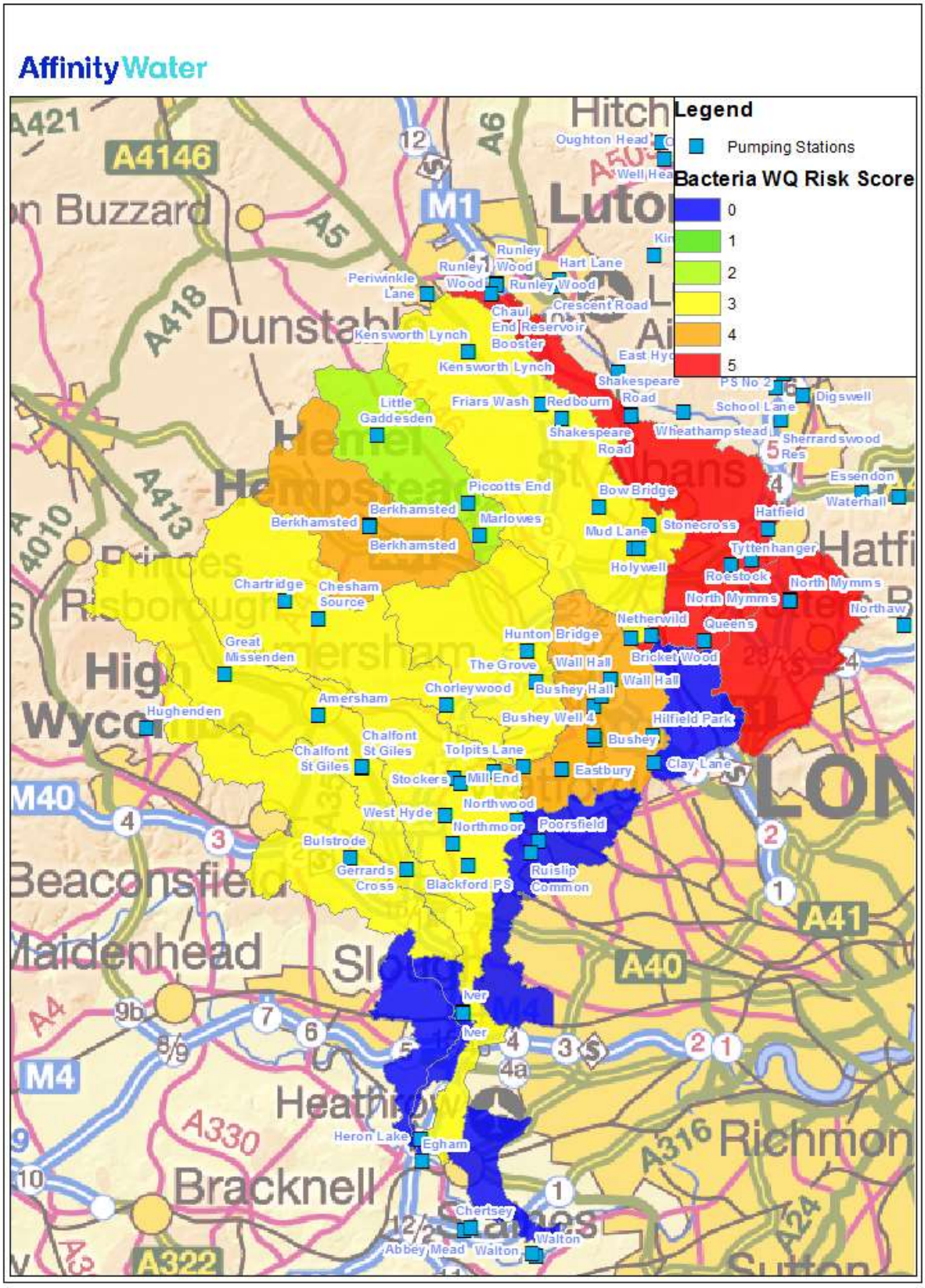

Fig 4. Microbiological water quality risk score heat map

3.3 Drivers for the scheme

3.3.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 4 in section 7.4.3

2) The Drinking Water Directive

The standard for nitrate is (50mg/l NO^3) and for pesticides is (0.1µg/l).

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP)

- Thames River Basin Management Plan

The specific WINEP Drivers relevant to this scheme are:

- WFDGW_ND (S) = Groundwater prevent deterioration action relating to water resource or water quality
- EDWRMP_IMP (S+) = Actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements.
- WFD_IMP_Flow (S+) = Actions to improve ecological status (surface water)
- NERC_IMP (S+) = Actions that contribute towards biodiversity duties, requirements and priorities.

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies
- AW0031 Affinity Water Strategic Direction Statement
- Catchment Based Approach (CaBA) chalk stream strategy and implementation plan.
- Blueprint for Water – Blueprint for PR24.
- Relevant Safeguard Zones (Berkhamsted, Eastbury, Netherwild).
- Colne Catchment Action Network (ColneCAN) catchment plan
- Hertfordshire and Middlesex Wildlife Trust (HMWT) State of Nature 2020 report and associated targets
- Hertfordshire County Council (HCC) Sustainable Hertfordshire Strategy

- Colne Valley Regional Park Green Infrastructure Strategy
- Forthcoming Local Nature Recovery Strategies

3.3.3 Stated Need

The Colne operational catchment is an area of water stress, where the average daily water use is amongst the highest in the country. Groundwater supplies water for local people, and 90% of water abstracted is used for this purpose. Rivers in the catchment suffer from low flows and a number of abstractions are considered to be impacting groundwater including the rivers Ver, Misbourne, and Gade. Local action involving partners working together to identify the sources of pollution, raise awareness and support people and business is being carried out to prevent incidents throughout the catchment for which this project will support and align with.

Protecting and enhancing our nation's water environment is a priority for the government. One of the government's key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats such as chalk streams. To address these challenges within the Colne, Affinity Water are required to invest through PR24 under the following regulatory / statutory drivers:

- **WISER** – requirements including, but not limited to:
    - Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
    - Must include actions to improve water body status to ensure 'moderate' status as a minimum is achieved by 2030.
    - Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
    - Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
    - Create, restore and enhance habitats.
    - Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this Business case please see the 'Level of Confidence of Achieving the WINEP Outcomes' section 7.4.3

Water Framework Directive (WFD)

Restoring Good Ecological Status (GES) / Good Ecological Potential (GEP) to chalk streams.

WINEP

The Environment Agency (EA) expects that the 'best value' option defined in this Business case takes account of the following wider environmental outcomes:

- **Natural environment outcomes:** Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.
- **Catchment resilience outcomes:** Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
- **Net zero outcomes:** Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of
- **Access, amenity, and engagement outcomes:** Contributions to improving access to, amenity of, and engagement with the natural environment to support customer and community wellbeing.

DWI Long-term Planning Guidance Expectation

Catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all source-to-tap risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness and acceptability of water supplies.

There are many drivers to improve the overall quality of the river with solutions that also support the wider community in terms of achieving net zero, and access and amenity benefits.

3.4 Allocation of Costs

This business case is 100% enhancement opex, and all costs are allocated to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

We have extensive experience over multiple AMP / WINEP cycles in developing and delivering river restoration and catchment management measures. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

Revitalising Chalk Rivers (RCR) Programme – Natural Capital Evaluation of Completed Schemes in the River Beane Catchment (2022)

In 2022, we commissioned Atkins to carry out a Natural Capital Assessment for five of Affinity Water's River Improvement Works (RIW) projects in the River Beane catchment in Hertfordshire. This evaluation sought to quantify and (where possible and appropriate) value the ecosystem services benefits of our RIW projects completed in AMP6 and AMP7. The purpose of the evaluation is to support our WINEP options development and assessment submissions using evidence from projects that have already been implemented on the ground. The evaluation has helped us understand the wider ecosystem services value of their investments in RIW to support business planning.

The evaluation was undertaken using data sources and assessment methods recommended by the EA's WINEP guidance and supplemented by other recognised tools such as FARMSCOPER. GIS desk-top mapping, site survey information, and site-specific data provided by Affinity Water were combined to quantify changes in ecosystem services by comparing pre- and post-project land cover and in-channel management. The 5 projects evaluated were all of differing size and scale including a small weir removal, in-channel improvements and construction of a large bypass channel.

The results, shown as an overview in figure 5 from the report, have enabled us to benchmark the range of potential RIW projects to be delivered within this scheme in AMP8 and AMP9. This has helped us ensure our benefits assessment for the programme of measures for each of the feasible options are conservative and comparable with this assessment of a range of completed projects.

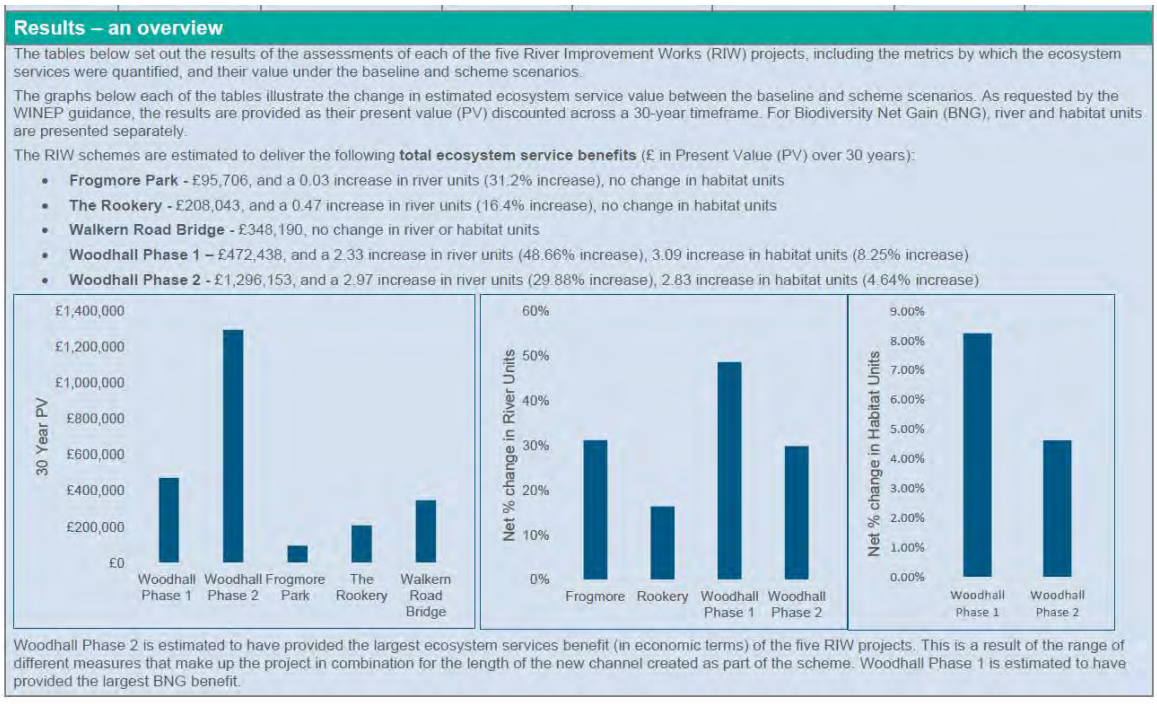

Figure 5. Excerpt from Natural Capital evaluation report on completed RIW projects on the River Beane highlighting the ecosystems services benefits in Present Value over 30 years

Resilient Chalk Catchments (RCC) C&NBS for Water Resources – Catchment Assets for Water Project

To support the development of C&NBS options for the Colne Operational Catchment, we have commissioned a partnership project with South East Rivers Trust (SERT), Catchment Assets for Water (CAfW). The primary aim of CAfW approach is to support the valuation of the contribution of natural assets to water resources and resilient catchments at both site and catchment scales. This includes the targeting of nature-based solutions for water, and the tracking and reporting of change in the contribution of various assets to water-related ecosystem services.

The methodology was developed by SERT through the Interreg ProWater project for which Affinity Water were an industry partner. The modelling and output mapping here focuses on identifying the current contribution of habitats in the catchment to the ecosystem service of water supply and quality but does not provide a volumetric or monetary quantification. However, a volumetric quantification of the impact of some measures is attempted in the land use change scenario modelling. The latter approach allows the comparison between scenarios by changing habitat type or condition indicating a reduction or increase in an asset's value/score, and the comparison of different areas within the catchment based on the current value/score. It can be viewed at field and catchment scales. This allows the user to assess potential interventions on a site, as well as understand their context in the wider landscape.

An important benefit of catchment scale maps and this methodology is to identify the potential role of each parcel of land in the wider context of the catchment. This has an important role to play in supporting collaboration on a landscape scale, helping to guide and inform scheme design beyond holding boundaries and bringing scientific evidence to play in discussions.

To support this, the model has been developed as a collaboration between a range of local stakeholders including EA, NE, Catchment Partnership hosts, Herts & Middlesex Wildlife Trust, HCC and other local catchment experts. The model outputs have produced a series of 'opportunity maps' (see Figures 6 and 7), which identify target areas to 'protect' and 'restore' (hatched areas on the maps) where the greatest water resource benefits can be derived. Table 1 below shows the priority 'restore' areas shown in Figure 6 with the different habitats and their respective area (ha). These priority areas, alongside the C&NBS options and modelled benefits using the InVEST model developed by Stanford University, have been used to inform the costs and development of the best value option.

This approach has a number of benefits:

- Methodology and approach have been aligned with the catchment options for our water resource management plan.
- Can be updated and refined to support an adaptive planning approach and/or investigate and develop options for specific issue or need.

- Spatial prioritisation and targeting of C&NBS using scientific evidence and local stakeholder input can support targeted investment to achieve the best value outcomes.
- Taking a Natural Capital (NC) approach can help identify wider benefits and support the investment case for implementation of C&NBS.
- All outputs of the modelling and mapping have been provided to all partners to support co-creation and co-funding of projects as well as join up wider initiatives (e.g., Herts Sustainability Strategy, Local Nature Recovery networks, Biodiversity New Gain, Local Development Plans and Environmental Land Management schemes).
- Output NC maps can be used as tools for engagement with landowners, land managers and farmers.
- Revisited throughout AMP8 with the priority areas refined and condition assessments revisited once C&NBS measures have been implemented.

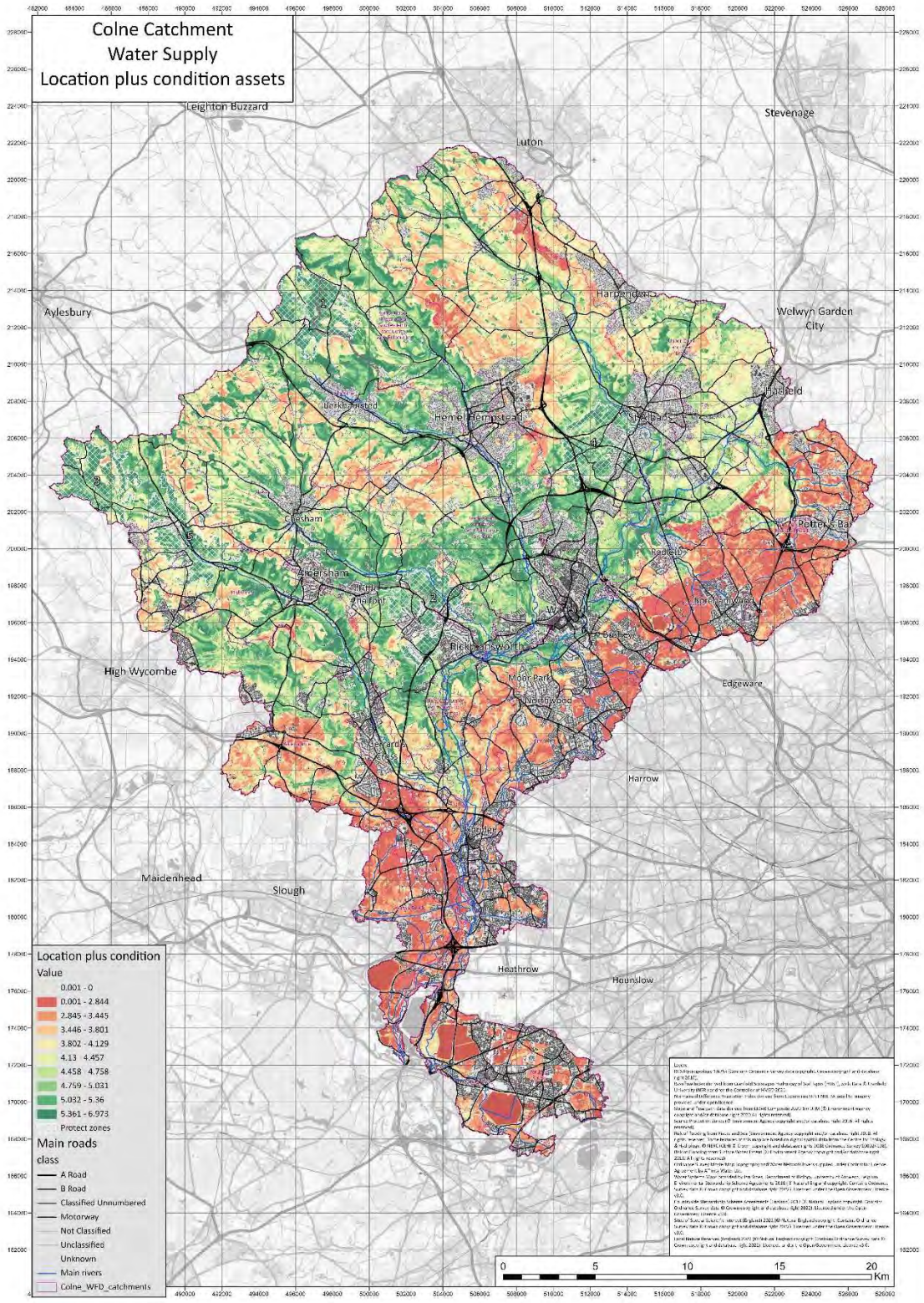

Figure 6. CAfW 'protect' NC map with priority areas highlighted for the Colne operational catchment.

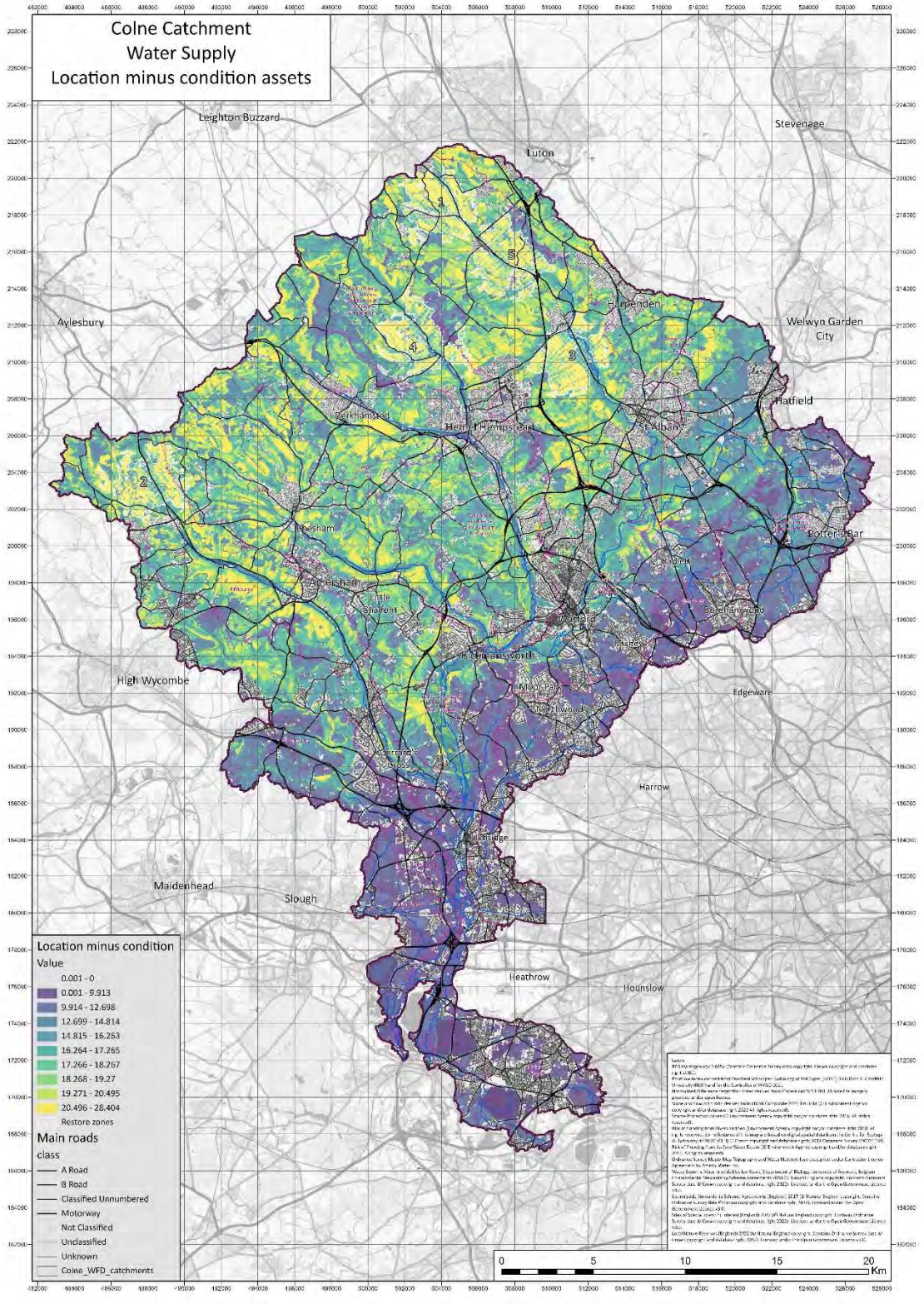

Fig 7. CAfW 'restore' NC map with priority areas highlighted for the Colne operational catchment.

Table 1: Habitat types and associated area (ha) for CAfW 'restore' priority areas 1-5 with potential C&NBS measures identified in Figure 7

Habitats across all 5 'Restore' clusters	Area (ha)	Estimated possible NbS opportunities for different types*	Area (ha) covered by NbS
Arable and horticulture	6,410		
of which in high impact areas	2177	20% conversion to grassland	368
		40% soil health improvement (cover crops, herbal leys, min. till, ...)	736
of which on dry hilltops and slopes (infiltration priorities)	642	50% soil health improvement	321
		30% conversion to grassland	192.6
of which in both high impact and infiltration areas	337	50% conversion to grassland	168.5
Broadleaved mixed and yew woodland	1,084		
of which in high impact areas	412	10% conversion to wet woodlands (on heavier soils, within local depressions)	29.6
of which on dry hilltops and slopes (infiltration priorities)	233	5% conversion to grassland (on light soils)	5.8
of which in both high impact and infiltration areas	116	20% conversion to grassland (on light soils)	23.2
Built-up areas and gardens	484	Investigate use of SuDS where appropriate	
Coniferous woodland	20		
of which in high impact areas	17	5% conversion to grassland	0.55
		20% conversion to broadleaved woodland	2.2
of which on dry hilltops and slopes (infiltration priorities)	8	100% conversion to broadleaved woodland	8
of which in both high impact and infiltration areas	6	100% conversion to broadleaved woodland	6
Improved grassland	2,159		
of which in high impact areas	64	10% conversion to semi-natural grassland (on light soils and slopes)	5.9
		40% soil health improvement (rotation, species rich leys, ...)	23.6
		5% restoration to wet grasslands incl. features such as scrapes	2.95
		10% conversion to broadleaved woodland (on heavy soils)	5.9
of which on dry hilltops and slopes (infiltration priorities)	177	30% conversion to semi-natural grassland	53.1
of which in both high impact and infiltration areas	5	100% conversion to semi-natural grassland	5
Inland rock	14	NA	
Stream network (DRN) (km)	39.5		
(note - overlap with below)		10% introduce LWDs and similar retention measures on smallest streams	4 km
		50% widen buffer by 2m	4
Riparian corridor (15m from centre of channel)	201		
of which in arable	58	50% convert to buffer strip	29
of which in grassland	102	50% restore wet grassland / floodplain mosaic	51
of which in broadleaved woodland	27	30% restore wet woodland	8.1

** The estimated areas of uptake are based on assumed landowner willingness and engagement with the measures suggested. This is based on experience and previous discussion for similar measures and schemes carried out by SERT, Affinity Water and other partners, but is only a first estimate.*

RCC C&NBS for Water Quality

Natural Capital Evaluation of the EnTrade Cover Crop Scheme (2021)

To better understand the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. 12

ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 8.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6:1 Natural Capital benefit ratio.

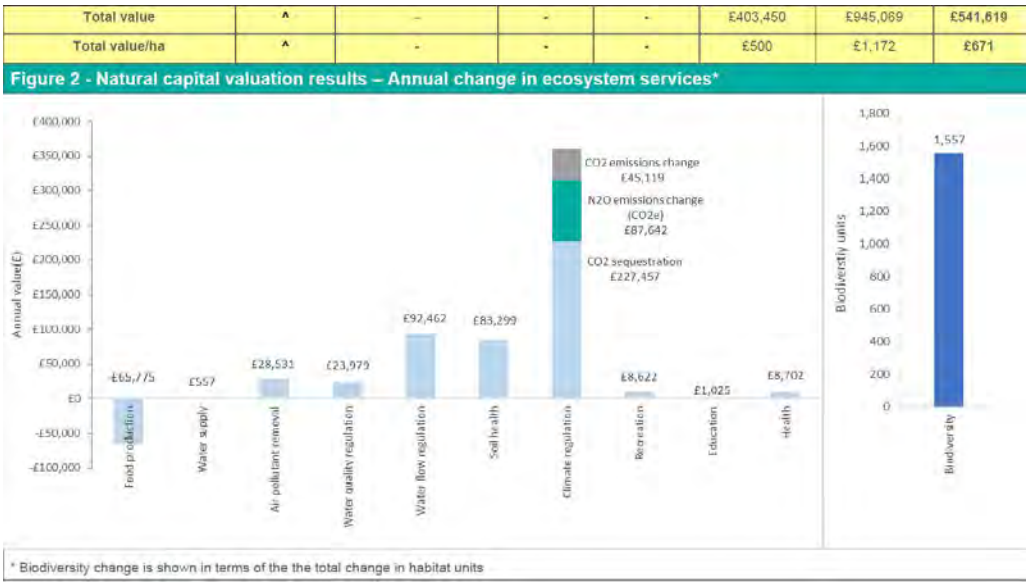

Figure 8. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen Release from Cover Crops (NiCCs) Field Trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil
    - effect of contrasting cover crop destruction methods e.g. glyphosate & minimum tillage vs mechanical destruction & minimum tillage
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was then tracked post-cover crop destruction under different management regimes and subsequent cash crops. This was used to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit and effective uptake of nitrogen for more sustainable arable farming.

4 Partnering

4.1 Detail of Customer Engagement work

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.2 Evidence of Customer Preferences and Support

4.2.1 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concern over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

> *"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer*

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considerd it would have a positive impact on wildlife for the future. Some people considerd that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.2.2 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay

more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.2.3 Biodiversity

It has been well received by customers that biodiversity and improving river flows will be a priority for Affinity Water, as it shows that Affinity Water are doing more than just offering the required services. During our preferences research, customers repeatedly chose environmental options that not only achieved the statutory minimum in terms of reducing abstraction, but also has additional benefits from catchments under-going ecological and biodiversity improvements. Customers have also shown support for increasing biodiversity and improving the environment when building large infrastructure schemes.

Our household customers valued the following biodiversity projects most highly: specialist habitats created for wildlife at £3.87 annually; new wetland areas at £3.24 annually; and space provided for sustainable agriculture at £2.61 annually. The households' average valuation of any project addition was considerably higher in the environmental area (£3.05), than either the economic area (£1.19) or the social area (£1.16).

4.2.4 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.3 Collaboration and Partnering

4.3.1 Engagement with Stakeholders and Partners

WINEP Stage 2 – Collaboratively identifying risks and issues

To support the development of the proposed solutions for the risks and issues included in this Business case, we have undertaken a detailed review of risks and issues for each waterbody catchment. We have taken a collaborative approach to

define the PR24 WINEP scope and develop the feasible options and ultimately determine the best value option. As part of this process, carried out between May and August 2022, we completed the following activities:

- Early engagement with the EA and Natural England (workshops at area level) and follow up meetings meetings/correspondence with Driver leads)
- Reviewed, discussed and incorporated Natural England's Nature Recovery List for our region
- Detailed review of Catchment Data Explorer, CaBA Catchment Plans, River Group meetings, stakeholder workshops and meetings alongside discussions with neighbouring water companies
- Documented all risks and issues register collated through this process and used to develop the proposed solution described in this Business case

WINEP Stage 3 – Proposing solutions

As part of the development of our proposed solutions to contribute to addressing the risks and issues described in this Business case, we have undertaken the following engagement and drawn on experience through our AMP7 WINEP programme delivery to explore options around developing, co-designing and co-delivering schemes which have formed the basis of the feasible options.

We continue to work with a wide range of stakeholders to develop joint solutions. We described the many pilots and research projects that we are currently working on in the areas in a previous section. Through the Revitalising Chalk Rivers partnership with the EA, we are engaging with Catchment Partnership hosts, local river groups, Hertfordshire County Council's Countryside Management Service, Chilterns Chalk Stream project (CCSP) and other partners. This has been an ongoing process throughout AMP6 and AMP7, but additional workshops have been coordinated during the Stage 2 Risks and Issues phase with these stakeholders to identify co-funding / co-creation/co-delivery opportunities for river restoration and wider C&NBS.

In addition, we also have a strategic partnership with Herts and Middlesex Wildlife Trust (HMWT) for which quarterly meetings identify opportunities and ensure that delivery of our schemes support delivery of the wider Catchment Plan for the Colne catchment.

4.3.2 Co-design and Co-delivery

Affinity Water and Environment Agency Revitalising Chalk Rivers Prioritisation Methodology

As the competent authority for the Water Framework Directive the Environment Agency will act in an advisory role for proposed river improvement works actions delivered through the best value option. The Environment Agency role will be to

advise Affinity Water on whether a proposed project is expected to contribute to improving the ecological status of the waterbody or improve resilience.

The prioritisation is designed to help the Environment Agency to advise Affinity Water on whether projects are suitable to meet the ecological objectives of the river restoration programme. It is expected that other factors will also be considered by Affinity Water when deciding which projects to progress, for example funding, requirements of local groups and feasibility.

A river walkover will be undertaken with both Environment Agency and Affinity Water present. This walkover will be an opportunity to identify reach by reach unconstrained river restoration actions. These actions will then be scored for their environmental benefit and feasibility (as defined below). These scores will then be used to prioritise the river restoration actions (projects) identified from the walkover.

Environmental Benefit

- Use technical expertise to rank actions based on their predicted benefit to ecology.
- Ecology = biological elements as assessed under the Water Framework Directive (fish, invertebrates, plants).
- Feasibility of actions should not be considered (this will be assessed separately as defined below).
- One way of judging benefit is to assess the current impact of modifications on ecology and the degree to which these will be rectified by the proposed action.
- The assessment will be on a scale of 1-10 (decimals are allowed where necessary to differentiate between actions).
- Whilst directly comparable benefit scores between catchments would be nice to have, it is not vital.
- The objective is a prioritised list for each catchment to form a work programme for Affinity Water.
- Projects must be designed to benefit the agreed depleted reaches.

Feasibility

- Score of 1 = project very unlikely to be feasible, leave these off the work programme.
- Score of 2 = project may be feasible. Some significant difficulties anticipated but the project is worth pursuing.
- Score of 3 = project likely to be feasible.

Wider Stakeholders/partners

In addition to the prioritisation methodology above, we are also engaging with wider partners through the following:

- EA and Natural England through Stage 2 Risks and Issues workshops held in June 2022
- Catchment partnership hosts and other key stakeholders through risks and issues review (stage 2)
- AMP6/7 Revitalising Chalk Rivers programme delivered in partnership with the EA and catchment partnership hosts (ColneCAN)
- Discussions with Groundworks around co-funding opportunities in the Lower Colne with the Colne Valley Regional Park 'lakes & rivers habitat corridor' theme from the proposed application for National Highways Funding
- Discussions with the ColneCAN and CCSP on potential co-design, co-funded and co-delivered projects that could be implemented in AMP8.
- Smarter Water Catchment Partnership in the River Chess (Chess SWC) to align our C&NBS programme with the SWC catchment strategy and delivery plan
- Stakeholder consultation with River groups and catchment partnership hosts during Stage 3 (Proposing solutions). Feedback has included:

> *"At the moment multiple organisations (including the CCSP) are planning and delivering restoration projects with little overview of how all the pieces fit together. Catchment partnerships would like to see a return to a more collaborative approach with a working group for each catchment set up to provide oversight and ensure more joined up approach.*
>
> *In future, we would like to see Affinity work more collaboratively with local catchment delivery partners like the CCSP and Groundwork South, who can deliver small to medium scale river restoration projects cost effectively and engage local communities. This will increase Affinity's capacity to delivery its WINEP targets in a more cost-effective manner whilst securing greater engagement and support from local communities.*
>
> *Could a catchment-scale approach help you to target eg. which weirs are the best to remove for sediment transport / fish migration between restored reaches? This would also help with presenting rationale for individual projects to landowners and local communities."*
>
> **Allen Beechey, ColneCAN Catchment Partnership host (Chilterns Chalk Stream Project)**

Landscape Enterprise Networks (LENS) East Anglia:

Affinity Water alongside Anglian Water and a number of companies within the agricultural supply chain including Nestlé Purina and Cargill are co-funding C&NBS measures in the with a focus on regenerative agriculture measures to deliver a range of ecosystem services including soil health, biodiversity, carbon and water quality. We are working with 3Keel and the investment partners to further develop the scheme for future years which will support our 20% aspirational partnership funding contribution. This could potentially be expanded into the Colne operational catchment.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this Business case.

5.2 Catchment Strategy

This Business case is aligned with the Catchment Options development as set out in our draft Water Resources Management Plan and will inform the development of

our Colne Catchment Strategy which is currently under development. This will align with existing catchment plans for the catchment partnerships and Smarter Water Catchment plan for the River Chess.

C&NBS will be prioritised in areas of the catchment identified as priorities within our CAfW modelling and align with our sustainability reduction programme, particularly our cessation of abstraction at Redbourn pumping station. This prioritisation will also align with the proposed abstraction reductions at Piccotts End, Great Missenden, Amersham, Kensworth Lynch and Chalfont St Giles pumping stations and the potential ADO relocation (upstream reductions replaced with increased GW abstraction from lower down the Colne), subject to being able to increase downstream sources and where no deterioration licence capping is taking place. Priority will also be given to river improvement works in the waterbodies where reductions or cessations of abstraction have already taken place, such as the River Chess.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation of this scheme are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS and river improvement works projects, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS. The scheme can adapt to:

- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g., Wastewater company schemes, Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities (e.g., offsetting).
- Types of measures implemented can adapt and evolve based on future scientific evidence.

- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships, Rivers Trusts.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options: the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 2 – Colne catchment Option Evaluation v1.0.

We have then assessed these further, with additional information; by developing hybrid solutions that take the best actions from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

6.1 Unconstrained List

Our options include a combination of land management focused C&NBS referred to as Resilient Chalk Catchments (RCC) and a river restoration / river improvement works options referred to as Revitalising Chalk Rivers (RCR). For the RCR options we have defined the options into a series of 'small' and 'large' projects. A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of both RCC and RCR C&NBS options are described for the best value option, with further examples of AMP6 and AMP7 river improvement works can be observed in Appendix 3.

Unconstrained options documented in Table 2 that are chosen to either 'Proceed' or 'Clarify' are then included in our constrained list with additional screening using Options Evaluation spreadsheet. Options that are 'Rejected' due to not meeting Statutory and Non-Statutory requirements do not proceed beyond the unconstrained list below.

Our unconstrained list of options are:

Table 2 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on treatment options and agreed sustainability reductions	R	Does not meet S and NS requirements
2	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects.	R	Does not meet S and NS requirements
3	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river)	R	Does not meet S and NS requirements
4	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river)	C	See Options Evaluation spreadsheet
5	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river)	C	See Options Evaluation spreadsheet
6	Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
7	Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)	C	See Options Evaluation spreadsheet
8	Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	R	Does not meet S and NS requirements
9	Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Does not meet S and NS requirements
10	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
11	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC)	P	See Options Evaluation spreadsheet

	C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)		
12	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	C	See Options Evaluation spreadsheet
13	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	C	See Options Evaluation spreadsheet
14	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
15	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)	P	See Options Evaluation spreadsheet
16	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
17	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	P	See Options Evaluation spreadsheet
18	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
19	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial	P	See Options Evaluation spreadsheet

	targeting using CAfW and DWSP WQ heat maps)		
20	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
21	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Disproportionate, expensive and deliverability issues

6.2 Constrained List

Eleven options have been selected from the original 21. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 2) is presented below to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 3. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
Revitalising Chalk Rivers (RCR) option 2	**NNN**	**YYY**	**YYY**	**YYY**
Revitalising Chalk Rivers (RCR) option 3	**NN**	**YYY**	**Y**	**NNN**
Resilient Chalk Catchments (RCC) C&NBS option B	**NN**	**YY**	**YYY**	**YYY**
Revitalising Chalk Rivers (RCR) option 1 - Standard and Resilient Chalk	**N**	**Y**	**YYY**	**YYY**

Catchments (RCC) C&NBS option B				
Revitalising Chalk Rivers (RCR) option 1 - Standard and Resilient Chalk Catchments (RCC) C&NBS option C	N	Y	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option B	YYY	YY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option C	YYY	YYY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option D	YYY	YY	Y	Y
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option B	YYY	YYY	N	NN
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option C	YYY	YYY	N	NN
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option D	YYY	YYY	NN	NNN

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

Our final set of three feasible options are:

1. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes) –
2. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)
3. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)

6.3.1 Option 0: Do Nothing

No C&NBS (river restoration or catchment management schemes). Focus solely on treatment options and agreed sustainability reductions. This is discounted as a feasible option.

6.3.2 Option 1: Preferred, Best Value, Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments RCC C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues engagement process. The proposed option includes:

RCR – The best value option has been developed building on our extensive experience of delivering river improvement works in chalk stream catchments in AMP6 and AMP7. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. The experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs.

A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. Examples of a small project could include:

- Tree works to allow more light into the river channel.
- encouraging the development of new habitat through growth of macrophytes (plants)
- Fencing along the riverbank to prevent livestock or horses from damaging the riverbanks and channel, thus reducing sediment input and allowing vegetation to establish along the river margins and in the channel.
- Planting of native aquatic macrophytes where these are absent and unlikely to colonise naturally.

A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of a large project could include:

- Removal of a weir or structure and regrading of river channel up and downstream.
- Creating chalk stream habitat.
- Bypassing of a weir or structure to allow fish passage and help establish typical chalk stream features.
- Restoring the river channel to its original location in the flood plain/valley bottom.

RCC – the best value option includes a programme of land management focused C&NBS that will be spatially and temporally targeted to:

- Protect and restore natural assets in the operational catchments identified through the Catchment Assets for Water project detailed above to improve water resource and chalk stream resilience in this operational catchment.
- Implement appropriate C&NBS measures upstream of river improvement works under the RCR to ensure greater resilience of those schemes and maximise environmental benefits through a holistic catchment management approach.
- Deliver multiple benefits for water quality, resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Cover crops
- Herbal leys
- Resurfacing of farm gateways
- Arable reversion
- Chalk grassland restoration
- Tree/woodland planting
- Regenerative agriculture measures such as reduced/no tillage

Total cost (FY2022/23 cost base) - not including partnership co-funding phased across AMP8 and AMP9 as per the WINEP =

AMP8 totex costs	**£4.157m**
AMP9 costs	**£4.697m**

6.3.3 Option 2: Least Cost Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 and AMP9 totex costs	**£8.437m**

The least cost option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to enhance water resources for groundwater (CAfW) and not targeted upstream of RCR projects to deliver multiple benefits and wider environmental outcomes.

6.3.4 Option 3: Alternative Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 and AMP9 totex costs	**£11.680m**

Alternative option is similar in scope to the best value option for river improvement works (RCR) but proposes a significant increase in the scale of developing a programme of land management C&NBS without spatial targeting with measures being funded and implemented across the whole operational catchment. This option will prioritise the risks and issues identified in the Stage 2 WINEP risks and issues engagement process, but also contribute to achieving wider environmental outcomes to meet the 25 Year Environment Plan.

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER) as detailed in Table 4 below. It demonstrates a significant increase in ambition compared to AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes, including lessons-learned such as joining up river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits.

6.4.2 Option 2: Least Cost Option

The least cost feasible option has a **medium level** of confidence in the achieving the WINEP wider environmental outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes. This option takes a less holistic approach to delivering C&NBS and is less likely to address many of the reasons for not achieving good ecological status for the associated chalk streams caused by land management activities within the Colne operational catchment.

6.4.3 Option 3: Alternative Feasible Option

Option 3 has a **high**-level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits. This option shows a significant increase in ambition and financial investment in C&NBS. However, the less targeted approach to delivering C&NBS and greater level of intervention required may not deliver the best value for investments in nature-based solutions for our customers. This option could also lead to deliverability issues due to the scale of intervention required.

Table 5: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the Colne Operational Catchment

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. RCR/RCC C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	The PR24 programme must include actions to improve water body status to ensure that moderate status is achieved by 2030 as a minimum and improve further where technology allows	RCR schemes developed in partnership with EA and associated C&NBS measures will support meeting moderate status.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Water body status	Water companies should apply the fair share approach when developing measures to address nutrients	Funding of C&NBS to mitigate nitrate leaching to groundwater will also take account of wider ecosystem services benefits.
Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures using CAfW spatial mapping will target opportunities for more resilient water resources and mitigate deterioration of water bodies.
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures will be deployed in the DrWPA to reduce pollution losses from land management activities (nutrients and pesticides) into chalk streams and improve water quality for downstream Thames Water surface abstractions
Drinking Water Protected Areas	Groundwater bodies must also meet good groundwater chemical status and upward pollutant trends should be reversed.	C&NBS measures will be deployed in groundwater SgZ's to mitigate nitrate pollution of groundwater and associated impact in chalk stream quality

Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for nitrate in groundwater delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	RCC C&NBS primary focus on arable farming building on AMP6 and AMP7 catchment management schemes.
Environment Bill	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits
Environment Bill	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits including biodiversity
Environment Bill	Anticipated that water companies will need to have regard to the priorities set out in the LNRS covering their operational area when agreeing PR24 priorities.	AWL engaging with HCC, HMWT and NE on priorities of LNRS.
Environment Bill	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnership Working section 5.2 Strategic Partnership with HMWT established.
SSSI	We expect water companies to contribute to maintaining or achieving SSSI favourable condition both on their own land and in the catchments they operate in.	RCR and RCC C&NBS will prioritise opportunities for measures delivered on SSSI's within Colne Operational Catchment as appropriate.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	RCR and RCC C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.
NERC Act 2006	Sustainable abstraction, reducing demand for water and reducing pollution, particularly from storm overflows are key actions water companies should take to protect and enhance chalk streams. In line with CaBA Chalk Stream Restoration Strategy 2021, water companies should lead on behaviour change around water resources, encouraging customers to use and pollute less. Water companies should drive innovation solutions and lead the way on water supply issues, demand management, sewerage and sewage treatment.	RCR schemes will protect and enhance chalk streams, particularly supporting sustainability reductions. RCC C&NBS measures will seek to reduce pollution for enhanced chalk stream resilience. Flagship CaBA Chalk Stream Restoration projects in the Beane (Lee) and Chess (Colne).
Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.

Healthy and resilient fish stocks	Water companies should identify measures to improve abstractions and outfalls to prevent the entrainment of fish and to address barriers to passage of fish factoring in the wider benefits of fish pass solutions such as improved geomorphology. Removal of barriers should always be considered as first option.	RCR schemes designed and developed to improve fish passage (e.g. weir removal) and improve geomorphology.
Eels	Water companies must comply with the requirement of the Eels regs 2009 to support the recovery of the European eel stock.	RCR schemes designed and developed to support eel migration (e.g. weir removal) and improve geomorphology to support recovery.
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Natural environment	Help create climate resilient places and improve the resilience of communities to droughts, floods and coastal change by implementing cost-effective co funded solutions	RCR and RCC C&NBS measures within this scheme will support more resilient chalk stream catchments to flood and drought.
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	RCR and RCC C&NBS measures within this scheme will support resilient chalk stream catchments and sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	RCR and RCC C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance chalk stream habitats.
Flood resilience	Water companies should contribute to partnership schemes to reduce flood risk to communities and themselves	This scheme will align with EA Colne2100 vision.
drainage resilience	Water companies and other risk management authorities should work together to manage water in a more integrated way to improve flood resilience, enhance the natural environment and deliver value for customers	RCC C&NBS measures within this scheme will identify opportunities to use NFM measures to slow flow and hold more water in headwaters of chalk stream catchments.
Water supply and environmental resilience	Water company plans should protect and improve the environment, considering both current and future challenges. This could mean tighter environmental protection for some sensitive habitats such as chalk streams, to meet env objectives.	RCR and RCC C&NBS measures within this scheme will seek to protect chalk streams in the Colne Operational Catchment.
Water supply and environmental resilience	WCs should consider whether their abstractions are truly sustainable looking across a catchment as a whole and consider investment in integrated catchment schemes to improve drought resilience and WQ.	RCR and RCC C&NBS measures in this scheme integrated alongside SR programme.

Climate Change	Water companies are expected to adopt nature based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2
Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature based solutions	Experience of this through AMP6 and AMP7 river restoration programmes. AMP7 C&NBS measures co-funded through EnTrade and LENS. Experience and lessons-learned adopted for PR24.
Climate Change	Water companies should invest in the restoration of natural form and function of the catchments and wider landscapes in which they operate to contribute to resilience to the impacts of climate change	RCR and RCC C&NBS measures within this scheme will seek to protect, restore and enhance chalk stream catchments in the Colne Operational Catchment.
Climate Change	WCs should improve the natural resilience of the catchments in which they operate by restoring their natural function. Water companies should ensure that solutions build resilience of biodiversity in catchments, river systems and water bodies.	RCR and RCC C&NBS measures within this scheme will seek to create more resilient chalk stream catchments in the Colne Operational Catchment with focus on delivering multiple benefits including biodiversity.

6.4.4 Can the Option Provide Net Benefits?

Option 1: Preferred, Best Value, Option

By aligning C&NBS measures upstream of river restoration and habitat enhancement schemes, the best value option can provide the following net environmental benefits:

- enhanced resilience for the effectiveness of delivered river restoration schemes (e.g. reduction in sediment and pollutant loading) and increased likelihood of achieving overall Good Ecological Status (GES).
- Provide greater connectivity of habitats in priority areas for RCR/RCC measures to support achievement of non-statutory requirements such as the HMWT State of Nature targets for creating 30% more habitat by 2030.
- Provide greater flood and drought resilience through more sustainable land management practices.
- Improved water quality to support chalk stream ecology.

Option 2: Least Cost Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process and deliver net benefits. This option takes a less holistic approach to implementing land management focused C&NBS alongside river improvements works and thus not realising additional net benefits described in the other options.

Option 3: Alternative Feasible Option

In addition to the net environmental benefits stated in the best value option, by implementing wider C&NBS measures at the 'whole catchment' scale there is an increased likelihood of a net benefit contribution to achieving wider environmental outcomes for biodiversity, climate change regulation, surface and groundwater quality and increased likelihood of achieving overall Good Ecological Status (GES) across all waterbodies in the Colne.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support the achievement of meeting the WINEP wider environmental outcomes. Some examples are shown below, but not limited to:

Natural Environment Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Colne operational catchment which provide greater habitat and supporting ecology for priority species such as water voles.

Catchment Resilience Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Colne operational catchment with support C&NBS measures to provide greater chalk stream resilience to land management pressures such as reduction in upstream sediment losses.

C&NBS measures targeted using CAfW outputs to hold more water on the land to enable improved infiltration and aquifer recharge, slower flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

Access, Amenity, and Engagement Outcomes

River restoration and habitat enhancement schemes to improve the chalk streams in the Colne operational catchment can provide greater connectivity between the precious chalk streams and their local communities, enhancing access and recreation opportunities.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes.

This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. It will utilise the modelling outputs from the CAfW project and water quality risk review to identify priority areas for C&NBS measures to achieve the greatest benefit for water resources and water quality, as well as aligning with wider priorities and non-statutory drivers.

There is also a greater co-design and co-funding approach to this option as it will seek align with wider partner projects, support and co-fund future Environmental Land Management Schemes (ELMS), catchment partnership plans and Local Nature Recovery Strategy (LNRS) and Colne2100 vision (natural flood management) projects.

The proposed river restoration and habitat enhancement programme (RCR) will be adaptive and developed in partnership with the EA and catchment partnerships and use a Natural Capital assessment framework to ensure the greatest environmental benefit is derived for every pound invested.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but without targeting of C&NBS measures upstream of RCR projects. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements, but increases the likelihood that river improvement works project do not deliver longer term environmental benefits they will not be delivered holistically with land management C&NBS designed to increase the resilience of river improvement works and deliver multiple environmental benefits to support meeting GES and the wider environmental outcomes.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but with less spatial targeting of C&NBS measures. This option will seek to invest in a significantly larger number of measures and will require a greater level of investment. This option is less appropriate to the size and complexity of the environmental risks and issues and could create

duplication with wider environmental programmes such as ELMS and is less adaptive than the best value option.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business Cases by PR24 Red Team
    b. Review of Business Cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 4 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 5.

Our economic analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We also use our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

7.2 Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. For both the RCR and RCC options, a bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes that we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1

7.3 Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.233m** in partnership funding contributions towards the non-statutory tertiary driver aspects Upper Lea C&NBS WINEP scheme across AMP8, with further partnership funding contribution estimated for AMP9. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Participate as a buyer in the Landscape Enterprise Network East Anglia and work closely with our buyers of ecosystem services to target and co-fund measures in our priority areas in the Colne. We have successfully achieved this in AMP7 as a pilot in the Upper Lea catchment.
- Establish an AMP8 5-year formal partnership agreement with the CaBA Colne Catchment Partnership hosts, Groundworks and Chilterns Conservation Board. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Identification, scoping and co-funding/co-delivery of river improvement works.
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Working in partnership with neighbouring water companies and water and sewerage companies that overlap our supply area to identify co-funding opportunities that mutually benefit each company.
- Work with key stakeholders to explore options with working with farm cluster groups in the Colne to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

7.4 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the rivers that we are restoring are unique in nature and therefore of higher environmental value to society.

7.5 Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The Business case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g., hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

7.6 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. This experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs. Additionally, our experience of delivering a range of large and small projects has enabled a good understanding of the true costs of delivering such projects. In AMP6 and AMP7, the mean average cost of delivering a river restoration project unit (equivalent to one small project) was £124,245 not including monitoring

costs and actual costs at time of implementation (cost range 2016-2022). Our unit cost model cost for this proposed scheme has been estimated at £160,871 per unit in 2022/23 price base (not including monitoring costs). This increase also includes associated overheads and is reflective of the increased ambition and scale of the river restoration programme, and associated resource requirements. This will result in an increased reliance on our supply chain for aspects of delivery including stakeholder engagement, design and construction elements, where internal resource would have been used previously.

7.7 Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

8.1 Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement water quality, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

8.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the river restoration investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable

Air quality	Monetised as per WINEP and impacted by the natural capital investments
Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the River Colne will improve to some extent from Poor to Moderate status as a result of our restoration activities.
- We have calculated the total length of the Bulbourne, Chess, Colne (Confluence with Chess to River Thames), Colne (from Confluence with Ver to

Gade), Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC), Gade (from confluence with Bulbourne to Chess), Misbourne, Upper Colne and Ellen Brook, and Ver to be 197 km.

- We have assumed that the whole length is currently in Poor condition as per Catchment Data Explorer.
- We have assumed that the water quality benefits will be realised after 7 years. this is based on the AMP7 Frogmore Park scheme NC evaluation carried out by Atkins (see section 4.5).
- We have assumed that both our river restoration and natural capital activities will make a proportional start to improving the water quality and that further, future activities will be required to achieve full Moderate status for the whole river system. Because the natural capital activities will change in the options, we have assumed that the least cost option will only deliver a 5 % improvement towards Moderate status; the best value option 10 % and the alternative option 12.5%. Our previous river restoration projects suggest that these are conservative estimates. We have selected these conservative values due to the dependency on flow to support these improvements. We also recognise similar activities from other partners including river groups, the EA and catchment partnerships to support the improvement to Moderate Status in addition to our proposed activities.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

Air Quality Pollution Reduction and CO2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 10-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we have to assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g. cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

- We have assumed that the preferred option will impact a total of 6,000 hectares, comprising of: 3,016 ha of enclosed farmland; 28 ha of freshwaters, open waters, wetlands and floodplains; 2,360 ha of semi-natural grasslands; and 596 ha of woodlands.
- We have reduced these values to 4,250 ha for the least cost option and increased the value by 15,750 ha for the alternative option, assuming the same profile of land use

8.4 Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is highly cost beneficial for both the river restoration and natural capital activities. Jointly these activities will provide significant environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a positive NPV of **£10.715m**, and a strong benefit / cost ratio of **2.36**. The benefit / cost ratio is higher than both the least cost and the alternative options, demonstrating best value. We have assumed a 10 % increase in water quality in the analysis. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. For example, our recent river restoration on the River Beane has delivered biodiversity net gains across the different areas in river units between 16% and 49%, with a weighted average of 28% based on river length. There is also a corresponding average improvement of the habitat units of 6%. Similarly, our cover cropping scheme realised a river water quality benefit of over 40%; CO2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 3 % would result in cost benefits. This provides a high-level of confidence that the scheme will be cost beneficial.

The natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

8.5 Least Cost Option

The least cost option is cost beneficial with an NPV of **£2.269m** and a benefit / cost ratio of **1.3**. This is logical because the preferred option has the additional natural capital activities to fully build upon the river restoration work to optimise the overall environmental benefits.

8.6 Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, with a forecast NPV of **£14.978m**. However, the benefit / cost ratio is similar to the preferred option, **2.36**. It should be noted that there are uncertainties in the benefit estimation in the options. It is prudent to work on the preferred option initially and monitor progress; to better understand how best to invest in the future; and then to secure on-going environmental improvements, where we have a higher level of confidence of benefit realisation.

8.7 Non-Monetised Information

We have rigorously applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Flooding reduction from woodlands
- Arable production
- Livestock production (dairy and meat)
- Timber removal
- Recreation

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least cost option; all in proportion to the number of hectares set aside for the production. There will clearly be some benefits from arable and livestock production, but these are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

8.8 Wider Environmental Outcomes

8.8.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.8.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o

8.9 Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Estimates of the benefits have been made and the scheme is clearly cost beneficial in terms of both river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis has been benchmarked against the Natural Capital evaluation carried out by Atkins of the river improvement works completed on the River Beane detailed in section 4.5. Additionally, from our Natural Capital Evaluation of the EnTrade Cover Crop Scheme in 2021, also detailed in section 4.5 has demonstrated that greater environmental net gain benefits can be derived from our C&NBS measures targeted effectively. We will review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**2.36** compared to **1.3**). The alternative option of doing more does offer additional benefit but has higher delivery risks and is therefore not preferred.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. Our sensitivity analysis shows that the river restoration will be cost beneficial if there is more than a 3 % increase in river water quality and ignoring the natural capital benefits. When this is considered with our conservative assumptions, this assessment has determined the project is worthwhile and will be beneficial to customers, the environment and society.

The best value option aligns with the WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments and will be delivered alongside our AMP8 and AMP9 Sustainability Reductions programme to maximise the benefits of abstraction reductions on the chalk streams we are seeking to protect and restore.

9 Delivery Considerations

9.1 Related Projects

This project is similar to our other river restoration and catchment improvement schemes. Collectively they form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in several of our groundwater sources in the operational catchment and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25 years.

The effectiveness of river improvement works is also dependent upon the effectiveness of sustainability reductions and/or impacts of land management activities and climate change in terms of providing additional flow. The prioritisation of C&NBS schemes delivered by this project will be aligned with our current and future sustainability reductions programme and targeted in the headwater areas of the catchments (subject to landowner agreement and participation) to hold more water in upper reaches in order to maximise the benefits of C&NBS and any reduction or cessation of abstraction. River improvement works, where appropriate, will be targeted further down the catchments where greater ecological benefits can be derived.

Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 river restoration and catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to an operational catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our extensive experience of delivering small and large river improvement works has enabled us to better understand the risks, issues and opportunities that can arise and how to develop the programme more efficiently as well as an increased understanding of the true cost of delivering these types of schemes.
- Our experience of engaging with landowners and local environmental groups and knowledge of the chalk stream catchments where future schemes are proposed for AMP8 and AMP9 will allow us to deliver an ambition programme drawing on partnership support and contributions.
- The Natural Capital evaluation of our river improvement works completed to date in the River Beane catchment has been really useful in understanding

the potential benefits of these type of schemes and informing this benefits assessment.

- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits.

9.2 Delivery Risk Management

We have already delivered similar river improvement works and catchment management schemes, and therefore have a strong understanding of the delivery risks and how best to manage these. However, the most significant risk to the project is delivering the ambitious target for river restoration projects and associated units due to permitting and landowner permission constraints. To mitigate this we have proposed phasing of the best value option across AMP8 and AMP9 in recognition of the long lead in time for delivery of some projects and the number of projects that do not progress beyond detailed design as a consequence of permitting constraints such as Flood Risk Activity Permits (FRAP), Impoundment licensing requirements for the removal or modification of structures and landowners not wishing to proceed. A further significant risk to the project is securing partnership funding. This is beyond our control, being dependent on partnership funding (e.g., through catchment partnership, financial contributions through catchment-trading mechanisms (e.g. agricultural supply chain) and other government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

The following risks and mitigations have been identified for this project:

- Delays in delivering river improvement works due to delays and/or limitations from permitting/flood risk modelling outcomes.
    - Our RCR partnership with the EA and regular engagement can help manage risks and issues around permitting/flood modelling.
    - We will commence permitting applications at the earliest possible stage and engage with the EA in a timely manner with an understanding of timescales.
- Lack of permission from landowners to carry out river improvement works.
    - We will use an adaptive management approach to identify wider opportunities for projects in alternative reaches.
    - We will utilise our Agricultural Advisory specialists and other partners in the catchment to engage with landowners.
    - Opportunities through schemes such as ELMS to work constructively with landowners and generate additional funding streams.
- Uncertainties around climate change and associated flood, drought and other impacts.

    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8 and AMP9.
- Increasing demand at a national level for specialist contractors to deliver river improvement works leading to delays in overall programme delivery.
    - We have an established framework with a number of the specialist contractors already delivering projects on our behalf which will build on for AMP8 and AMP9.
- Increasing cost of resources to deliver projects.
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs.
- Farmers and land managers unwilling to engage with us on land management C&NBS.
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable Agricultural Advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes.
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS.
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

9.3 Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits we will undertake the following activities alongside our abstraction impact assessment monitoring included in our Water Resources Business case:

- Baseline monitoring and long-term benefits monitoring for river improvement works in catchment, alongside our sustainability reduction programme including the following:
    - Flow gauging
    - Macrophyte and macroinvertebrate surveys
    - Groundwater level monitoring
    - Rain gauge monitoring
- Chalk stream monitoring linked to our land management C&NBS including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring

- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the Option Development Report and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 9 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott McDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each investigation we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on investigations carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each investigation will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, km of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

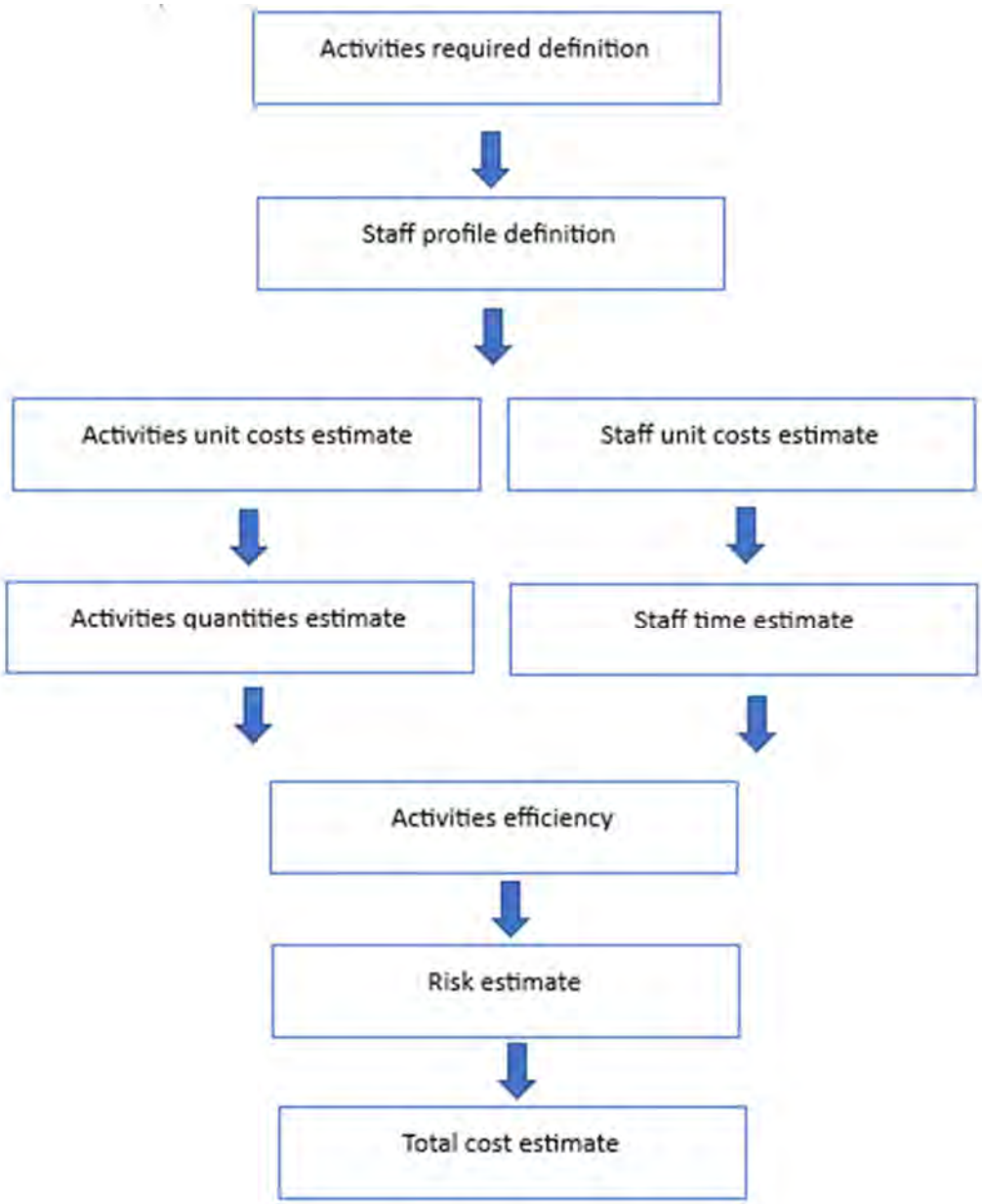

Figure 9 Cost Estimate workstream diagram

Activities quantities estimate: for each activity we determined the most likely quantities based on the agreed objective of the investigation. The quantities have been calculated using maps tools here appropriate (e.g. km of watercourse) as well as experience gained from previous AMPs schemes. Where possible, significant attention has been paid to make efficiency across investigations. For instance, quantities of field monitoring rounds required for a catchment scheme have been reduced if a nearby scheme included larger monitoring rounds.

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar schemes undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of

hours for the task. Project Management role time and Project Director time have been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – Affinity Water WINEP Stage 2 Risks and Issues Register v1.0

Appendix 2 – Colne catchment Options Evaluation v1.0

Appendix 3 – AWL River Restoration Project Examples AMP6-AMP7

Appendix 4 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 5 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Dour and Little Stour Catchments

Catchment and nature-based solutions (inc. River restoration)

August 2023

Contents

1 Summary

This report sets out the detailed PR24 WINEP options development process and outcomes for our proposed Dour operational catchment programme of catchment and nature-based solutions (C&NBS) for AMP8. Additionally, it includes additional scoping, costs and benefits assessment to continue the programme into AMP9 as part of a longer-term planning horizon and phasing of the best value option. It sets out to address the following challenges:

- Manage the drinking water quality pressures for our groundwater sources (nitrate and microbiological) including, but not limited to the following Safeguard Zone:
    - GWSGZ0220 – Kingsdown
- Contribute towards mitigation of the impacts of climate change at the catchment-scale to create more resilient catchments for water resources
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and reasons for deterioration (RFD) in the following waterbodies:

    - GB40701G501500 - East Kent Chalk – Stour (Groundwater)
    - GB107040019490 - Upper Dour
    - GB107040073310 - Dour from Kearsney to Dover
    - GB107040019590 - Nailbourne and Little Stour

The 'best value' option described in this business case defines a landscape-scale programme of C&NBS for the Dour and Little Stour surface catchments and East Kent Chalk groundwater catchment. This includes river improvement works on the waterbodies listed above and a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater; improved soil health; greater water-holding capacity on land for flood and drought resilience; net zero benefits and biodiversity enhancements.

We have followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our preferred solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed support for the proposed environmental improvements. We have learnt from our previous river restoration and natural capital improvement projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. Based upon our conservative estimates, the preferred option only offers small NPV benefits with a benefit cost ratio of 0.86. The project will deliver the statutory and non-statutory drivers and will build

the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water.

Conservative estimates of the benefits have been made and the scheme has been assessed as marginally not cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We consider that our analysis is conservative and there will be other environmental benefits, which provides the confidence that the scheme is viable and should go ahead. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The best value option will be delivered under a catchment strategy for the Dour operational catchment developed following the principles of our environmental strategy and existing Catchment Based Approach (CaBA) catchment plans. The prioritisation and delivery of the programme will be developed with the Environment Agency and alongside our sustainability reduction programme to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS

Each project will utilise a range of C&NBS targeted spatially and/or temporally to deliver the greatest environmental benefits.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence

To determine the best value option, an extensive options development process was undertaken with 21 unconstrained options, 7 constrained options reviewed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration

To determine the best value option, we have carried out a detailed risks and issues identification process with key stakeholders including the Environment Agency, Natural England, Kentish Stour Catchment Partnership and South East Rivers Trust. We have also developed our proposed solutions with input and feedback with key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	10 August 2023
Report Title	Dour and Little Stour C&NBS PR24 Business Case
Options Assessment Report (WINEP)	08AF100013_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030 (AMP8) and 31/03/2035 (AMP9)
WINEP Spreadsheet ID	
WINEP Action ID	08AF100013
WINEP Drivers	WFDGW_ND (S) (Primary) WFD_IMP_Flow (S+) (Primary) NERC_IMP (S+) (Secondary) EDWRMP_IMP (S+) (Secondary) 25YEP_IMP (NS) (Tertiary)
Scale of Action Delivery	Within Operational Catchment
Location of Delivery	GB40701G501500 - East Kent Chalk – Stour GB107040019490 - Upper Dour GB107040073310 - Dour from Kearsney to Dover GB107040019590 - Nailbourne and Little Stour

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.17	0.30	0.38	0.38	0.39	**1.62**
Totex (£m)	0.17	0.30	0.38	0.38	0.39	**1.62**
3rd Party Funding	0.02	0.03	0.05	0.05	0.05	**0.20**

Drivers	
100%	Water Framework Directive

Benefits					
Water Quality of Natural Water Bodies (km)					
Sequested Carbon (tonnes CO_2e)					
Air Quality Pollution Reduction (tonnes)					
Economic Analysis					
NPV Costs (£m) (2025-55)	**3.0**	NPV Benefits (£m)(2025-55)	**2.6**		
NPV (£m) (2025-55)	**-0.4**	Benefit / Cost Ratio	**0.9**		
Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This business case describes the WINEP scheme developed to address the challenges within the East Kent Chalk groundwater catchment (Figure 1) and the Dour (Figure 2) and Little Stour (Figure 3) waterbody catchments

Figure 1. East Kent Chalk groundwater catchment (source: Catchment Data Explorer)

Figure 2. Catchment areas of the Dour operational catchment (source: Catchment Data Explorer)

Figure 3. Catchment areas of the Nailbourne and Little Stour catchments (source: Catchment Data Explorer)

The challenges are to:

- Manage the drinking water quality challenges for our groundwater sources in the East Kent Chalk catchment.
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and reasons for deterioration (RFD) in the following waterbodies:
    - Upper Dour
    - Dour from Kearsney to Dover
    - Nailbourne and Little Stour

The 'best value' option described in this Business case defines a landscape-scale programme of Catchment and Nature-Based Solutions (C&NBS) for this Business case including:

Revitalising Chalk Rivers (RCR)

Chalk streams are rare ecosystems that are important to protect. 85% of all chalk streams are in England, mainly in the south and east of the country. Many of these chalk streams in this operational catchment are considered to be impacted by our abstraction for public water supply. Consequently, reduced flows potentially caused by abstraction, are also leading to the natural river processes not taking place impacting the habitat and ecology of the river. Alongside abstraction impacts which are being addressed through our sustainability reductions programme, it is important to ensure that our chalk streams are more resilient to different

environmental conditions like drought and flooding. These rivers are ultimately failing to meet Good Ecological Status (GES) under the Water Framework Directive and therefore action needs to be taken to address this, unless assessed to be disproportionately costly.

Our programme of chalk stream river improvement works, and habitat enhancement schemes commenced in AMP6, and this document proposes as expansion of river improvement works within the rivers listed above and associated riparian zone. This builds on the existing programme developed in partnership with the EA referred to in this document as Revitalising Chalk Rivers (RCR).

Undertaking river channel modifications (e.g. installation of deflectors, channel re-profiling to create a low flow profiled channel) can help increase in-channel velocities which are known to be a key element in the ecological requirements of a river. These channel enhancements and modification works will be delivered alongside our sustainability reductions programme, further abstraction impact assessments, and wider C&NBS schemes to maximise the benefits and support achievement of the WINEP wider environmental outcomes, 25-Year Environment Plan and Environmental Destination requirements. In order to achieve GES these rivers need to be a properly functioning ecosystem.

Some of the benefits of such river improvement works include:

- Ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding.
- Restoring the rivers back to a more natural state by removing barriers to fish, re-meandering, reconnecting them to groundwater and re-establishing chalk stream characteristics.
- Healthy chalk stream systems can also lead to improved water quality and support greater ecological diversity.
- To meet our environmental objectives and targets as a company to ensure we are improving the local environments while maintaining high quality drinking water supply.
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 1 - End unsustainable abstraction from chalk groundwater sources.
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions).
    - Strategic Focus 3 - Deliver a net gain in natural capital.

River improvement works that form the best value option in this document will be prioritised and profiled over AMP8 and AMP9. This is done through a process of prioritisation with the EA detailed later in the document and to align with our sustainability reductions (SR) programme.

Resilient Chalk Catchments (RCC)

Delivered in combination with the RCR programme, Resilient Chalk Catchments (RCC) is land management focused programme of C&NBS. This programme will work in partnership with landowners, farmers, businesses, environmental NGO's, regulators, catchment partnerships and river groups to target C&NBS spatially and temporally at the operational catchment scale (Dour and Little Stour) to achieve the following outcomes:

- Enhanced infiltration / aquifer recharge
- No deterioration of groundwater quality (nitrates)
- Habitat enhancement for priority species
- Chalk stream protection and resilience from land management pressures (sediment, pesticides, nutrients etc.)
- Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams
- Connecting wildlife corridors and creation of habitats in partnership with local stakeholders
- Wider biodiversity benefits e.g., to priority habitats and species
- Support achieving a number of our 'strategic focus' areas in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital

This programme builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes which were focused on water quality no deterioration schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality, and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

3.1 Environmental Risk and Issues

As detailed in the EA Catchment Data Explorer for the Stour Management catchment, There are a number of significant water management issues in the Dour and Little Stour which are attributed to a number of business sectors including the water industry determined as the RNAG status. These include:

- Changes to the natural flow and level of water
- Physical modifications
- Pollution from rural areas
- Pollution from towns, cities and transport
- Pollution from wastewater

Several of these issues, including pollution from rural and urban areas, also affect the groundwater quality of water abstracted for public water supply, in addition to the waterbodies within the catchment.

3.2 Baseline Assessment

To support the baseline assessment, a Risk and Issues log (Appendix 1) has been developed for both the operational catchment and at the waterbody level which has been captured the available data on Catchment Data Explorer and through consultation with a range of stakeholders including:

- EA
- Natural England (NE)
- Catchment partnerships
- Wildlife Trusts
- River groups

The process has identified a list of risks and issues in each waterbody, and collectively in the catchment as a whole, which this project and associated projects/Business cases) will seek to address. These include:

- Abstraction
- Low flows
- River morphology
- Diffuse and point source pollution
- Water quality
- Land management pressures
- Climate change
- Loss of habitat and wildlife

In addition, an assessment of groundwater quality issues through our Drinking Water Safety Plans (DWSP) has been undertaken to determine the issues that this project

will seek to prevent, namely deterioration and seek improvements in water quality through catchment-based C&NBS. Figures 4 and 5 show risk maps covering the East Kent Chalk (Stour) alongside our public water supply sources where C&NBS measures will be targeted under the best value option.

Figure 4. Nitrate water quality risk score heat map

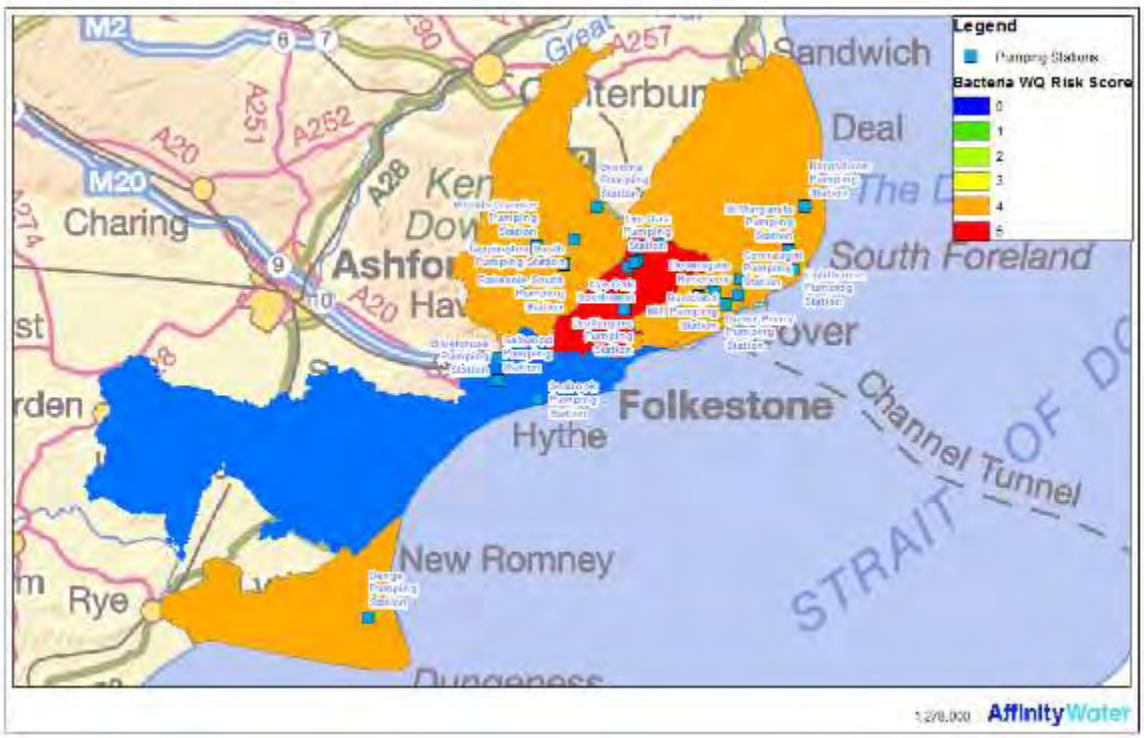

Figure 5. Microbiological water quality risk score heat map

3.3 Drivers for the scheme

3.3.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 4 in section 7.4.3

2) The Drinking Water Directive

The standard for nitrate is (50mg/l NO^3)

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP)

- South East River Basin Management Plan

The specific WINEP Drivers relevant to this scheme are:

- WFDGW_ND (S) = Groundwater prevent deterioration action relating to water resource or water quality
- EDWRMP_IMP (S+) = Actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements.
- WFD_IMP_Flow (S+) = Actions to improve ecological status (surface water)
- NERC_IMP (S+) = Actions that contribute towards biodiversity duties, requirements and priorities

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Relevant Safeguard Zones
    - Kingsdown
    - Ottinge
    - Additional candidate safeguard zones
        - Broome
        - Drellingore
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies.
- AW0031 Affinity Water Strategic Direction Statement.

- Catchment Based Approach (CaBA) chalk stream strategy and implementation plan.
- Blueprint for Water – Blueprint for PR24.

3.3.3 Stated Need

East Kent is one of the driest parts of the country. Groundwater supplies most of the areas drinking water and also provides important base-flow to the river systems. The groundwater quality across the catchment is poor status under WFD. Rivers in the catchment suffer from low flows influenced by groundwater abstractions for public water supply and irrigation for agriculture. Additionally, there is a legacy issue relating to historic industrial use of the river leading to many obstructions to fish passage and riparian ownership issues.

Protecting and enhancing our nation's water environment is a priority for the government. One of the government's key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats such as chalk streams. To address these challenges within the Dour and Little Stour, Affinity Water are required to invest through PR24 under the following regulatory / statutory drivers:

- **WISER** – requirements including, but not limited to:
    - Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
    - Must include actions to improve water body status to ensure 'moderate' status as a minimum is achieved by 2030.
    - Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
    - Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
    - Create, restore and enhance habitats.
    - Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this Business case please see the 'Level of Confidence of Achieving the WINEP Outcomes' section 7.4.3

Water Framework Directive (WFD)

Restoring Good Ecological Status (GES) / Good Ecological Potential (GEP) to chalk streams.

WINEP

The Environment Agency (EA) expects that the 'best value' option defined in this Business case takes account of the following wider environmental outcomes:

- Natural environment outcomes: Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats
- Catchment resilience outcomes: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources
- Net zero outcomes: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of
- Access, amenity, and engagement outcomes: Contributions to improving access to, amenity of, and engagement with the natural environment to support customer and community wellbeing.

DWI Long-term Planning Guidance Expectation

Catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all source-to-tap risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness and acceptability of water supplies.

There are many drivers to improve the overall quality of the groundwater and rivers in this Business case, with solutions that also support the wider community in terms of achieving net zero, and access and amenity benefits.

3.4 Allocation of Costs

This business case is 100% enhancement opex, and all costs are allocated to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

We have extensive experience over multiple AMP / WINEP cycles in developing and delivering river restoration and catchment management measures. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

Revitalising Chalk Rivers (RCR) Programme – Natural Capital Evaluation of Completed Schemes in the River Beane Catchment (2022)

In 2022, we commissioned Atkins to carry out a Natural Capital Assessment for five of Affinity Water's River Improvement Works (RIW) projects in the River Beane catchment in Hertfordshire. This evaluation sought to quantify and (where possible

and appropriate) value the ecosystem services benefits of our RIW projects completed in AMP6 and AMP7. The purpose of the evaluation is to support our WINEP options development and assessment submissions using evidence from projects that have already been implemented on the ground. The evaluation has helped us understand the wider ecosystem services value of their investments in RIW to support business planning.

The evaluation was undertaken using data sources and assessment methods recommended by the EA's WINEP guidance and supplemented by other recognised tools such as FARMSCOPER. GIS desk-top mapping, site survey information, and site-specific data provided by Affinity Water were combined to quantify changes in ecosystem services by comparing pre- and post-project land cover and in-channel management. The 5 projects evaluated were all of differing size and scale including a small weir removal, in-channel improvements and construction of a large bypass channel.

The results, shown as an overview in Figure 6 from the report, have enabled us to benchmark the range of potential RIW projects to be delivered within this scheme in AMP8 and AMP9. This has helped us ensure our benefits assessment for the programme of measures for each of the feasible options are conservative and comparable with this assessment of a range of completed projects.

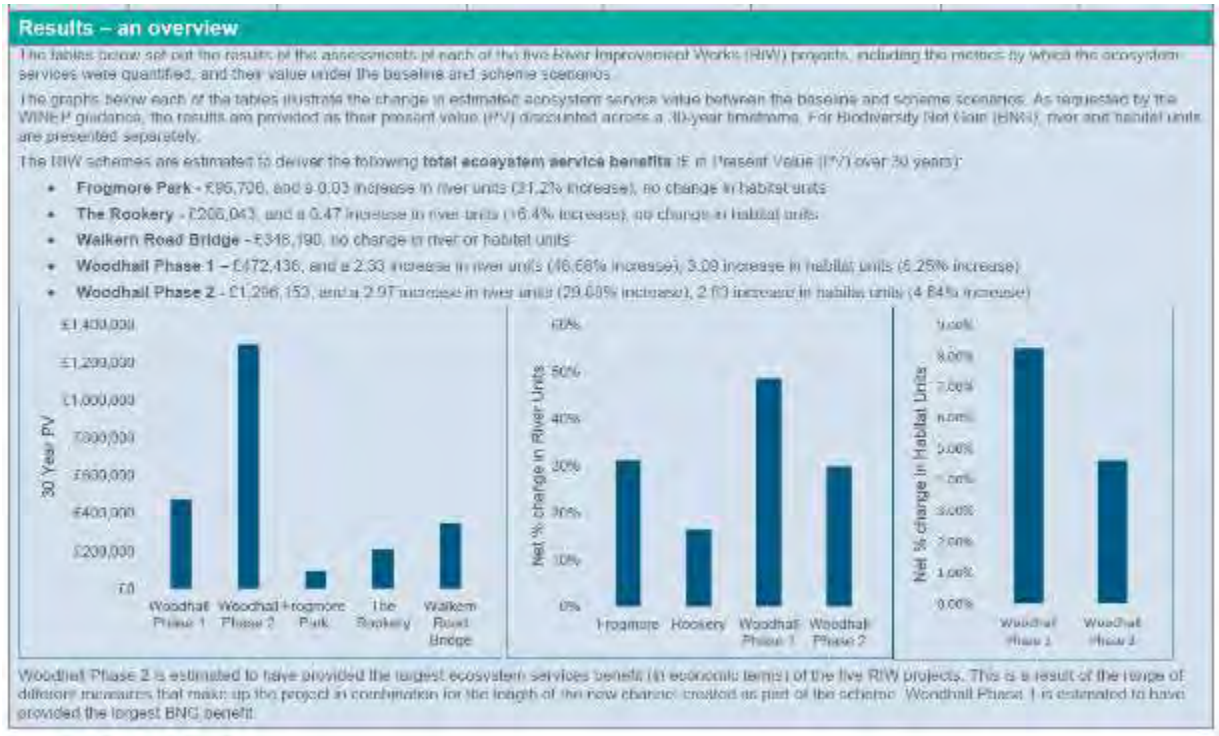

Figure 6. Excerpt from Natural Capital evaluation report on completed RIW projects on the River Beane highlighting the ecosystems services benefits in Present Value over 30 years

Resilient Chalk Catchments (RCC) C&NBS for water resources – Catchment Assets for Water project

To support the development of C&NBS options for this scheme, we are working with the South East Rivers Trust (SERT), through their Catchment Assets for Water (ProWater) project. The primary aim of ProWater approach is to support the valuation of the contribution of natural assets to water resources and resilient catchments at both site and catchment scales. This includes the targeting of nature-based solutions for water, and the tracking and reporting of change in the contribution of various assets to water-related ecosystem services.

The methodology was developed by SERT through the Interreg ProWater project for which Affinity Water were an industry partner. The modelling and output mapping, which was developed through a pilot in the Little Stour catchment, focuses on identifying the current contribution of habitats in the catchment to the ecosystem service of water supply and quality but does not provide a volumetric or monetary quantification. However, a volumetric quantification of the impact of some measures is attempted in the land use change scenario modelling. The latter approach allows the comparison between scenarios by changing habitat type or condition indicating a reduction or increase in an asset's value/score, and the comparison of different areas within the catchment based on the current value/score. It can be viewed at field and catchment scales. This allows the user to assess potential interventions on a site, as well as understand their context in the wider landscape.

An important benefit of catchment scale maps and this methodology is to identify the potential role of each parcel of land in the wider context of the catchment. This has an important role to play in supporting collaboration on a landscape scale, helping to guide and inform scheme design beyond holding boundaries and bringing scientific evidence to play in discussions.

To support this, the model has been developed as a collaboration between a range of local stakeholders including EA, NE, Catchment Partnership hosts, Wildlife Trust, Farmers and other local catchment experts. The model outputs produced a series of 'opportunity maps' which identify target areas to 'protect' and 'restore' where the greatest water resource benefits can be derived. These priority areas, alongside the C&NBS options and modelled benefits using the InVEST model developed by Stanford University. Through this scheme, we will work in partnership with SERT to identify targeted C&NBS that will deliver environmental benefits for the catchment and water environment.

This approach has a number of benefits:

- Methodology and approach are aligned with the catchment options for our draft water resource management plan (WRMP).

- Can be updated and refined to support an adaptive planning approach and/or investigate and develop options for specific issue or need.
- Spatial prioritisation and targeting of C&NBS using scientific evidence and local stakeholder input can support targeted investment to achieve the best value outcomes.
- Taking a Natural Capital (NC) approach can help identify wider benefits and support the investment case for implementation of C&NBS.
- All outputs of the modelling and mapping have been provided to all partners to support co-creation and co-funding of projects as well as join up wider initiatives (e.g. Environmental Land Management schemes)
- Output NC maps can be used as tools for engagement with landowners, land managers and farmers.

RCC C&NBS for Water Quality

Natural Capital Evaluation of the EnTrade Cover Crop Scheme (2021)

To better understanding the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. 12 ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in

present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 7.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6:1 Natural Capital benefit ratio.

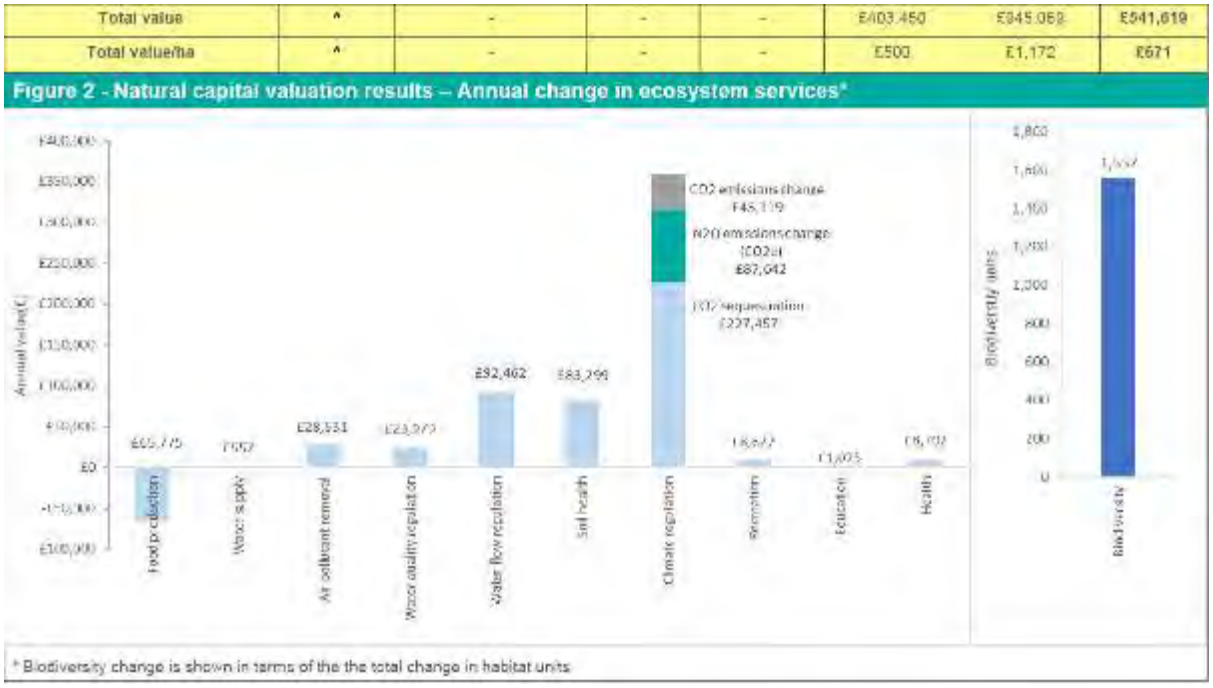

Figure 7. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen Release from Cover Crops (NiCCs) Field Trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil

    - effect of contrasting cover crop destruction methods e.g. glyphosate & minimum tillage vs mechanical destruction & minimum tillage
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was then tracked post-cover crop destruction under different management regimes and subsequent cash crops. This was used to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit and effective uptake of nitrogen for more sustainable arable farming.

4 Partnering

4.1 Evidence of Customer Preferences and Support

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.1 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views

and priorities. Their concerns over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considerd it would have a positive impact on wildlife for the future. Some people considerd that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.2 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.1.3 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we have a suitable balance between customers' wish to have

manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.2 Collaboration and Partnering

4.2.1 Engagement with Stakeholders and Partners

We continue to work with a wide range of stakeholders to develop joint solutions. We described the many pilots and research projects that we are currently working on in the areas in a previous section. We are engaging with The Kentish Stour Catchment Improvement Partnership, local river groups, SERT, White Cliffs Countryside Partnership. This has been an ongoing process throughout AMP6 and AMP7.

WINEP Stage 2 – Collaboratively identifying risks and issues

To support the development of the proposed solutions for the risks and issues included in this Business case, we have undertaken a detailed review of risks and issues for each waterbody catchment. We have taken a collaborative approach to define the PR24 WINEP scope and develop the feasible options and ultimately determine the best value option. As part of this process, carried out between May and August 2022, we have completed the following activities:

- Early engagement with the EA and Natural England (workshops at area level) and follow up meetings meetings/correspondence with Driver leads).
- Reviewed, discussed and incorporated Natural England's Nature Recovery List for our region.
- Detailed review of Catchment Data Explorer, CaBA Catchment Plans, River Group meetings, stakeholder workshops and meetings alongside discussions with neighbouring water companies.
- Documented all risks and issues register collated through this process and used to develop the proposed solution described in this business case.

WINEP Stage 3 – Proposing solutions

As part of the development of our proposed solutions to contribute to addressing the risks and issues described in this business case, we have undertaken the following engagement and drawn on experience through our AMP7 WINEP programme delivery to explore options around developing, co-designing, and co-delivering schemes which have formed the basis of the feasible options.

We continue to work with a wide range of stakeholders to develop joint solutions. We described the many pilots and research projects that we are currently working on in the areas in a previous section. We are engaging with South East Rivers Trust Catchment Partnership hosts, and EA. This has been an ongoing process throughout AMP6 and AMP7, but additional workshops have been coordinated during the

Stage 2 Risks and Issues phase with these stakeholders to identify co-funding/co-creation/co-delivery opportunities for river restoration and wider C&NBS.

4.2.2 Co-design and Co-delivery

Affinity Water and Environment Agency Revitalising Chalk Rivers Prioritisation Methodology

As the competent authority for the Water Framework Directive, we propose that the Environment Agency (EA) will act in an advisory role for proposed river improvement works actions delivered through the best value option. The EA role will be to advise Affinity Water on whether a proposed project is expected to contribute to improving the ecological status of the waterbody or improve resilience. This is an established process we have developed with the Hertfordshire and North London Area Team for AMP6 and AMP7 river restoration schemes.

The prioritisation is designed to help the EA to advise Affinity Water on whether projects are suitable to meet the ecological objectives of the river restoration programme. It is expected that other factors will also be considered by Affinity Water when deciding which projects to progress, for example funding, requirements of local groups and feasibility.

A river walkover will be undertaken with EA and relevant catchment partners. This walkover will be an opportunity to identify reach by reach unconstrained river restoration actions. These actions will then be scored for their environmental benefit and feasibility (as defined below). These scores will then be used to prioritise the river restoration actions (projects) identified from the walkover.

Environmental Benefit

- Use technical expertise to rank actions based on their predicted benefit to ecology.
- Ecology = biological elements as assessed under the Water Framework Directive (fish, invertebrates, plants).
- Feasibility of actions should not be considered (this will be assessed separately as defined below).
- One way of judging benefit is to assess the current impact of modifications on ecology and the degree to which these will be rectified by the proposed action.
- The assessment will be on a scale of 1-10 (decimals are allowed where necessary to differentiate between actions).
- Whilst directly comparable benefit scores between catchments would be nice to have, it is not vital.
- The objective is a prioritised list for each catchment to form a work programme for Affinity Water.
- Projects must be designed to benefit the agreed depleted reaches.

Feasibility

- Score of 1 = project very unlikely to be feasible, leave these off the work programme.
- Score of 2 = project may be feasible. Some significant difficulties anticipated but the project is worth pursuing.
- Score of 3 = project likely to be feasible.

Wider Stakeholders/partners

We are currently co-designing solutions with the following:

- AMP6/7 Revitalising Chalk Rivers programme delivered in partnership with the EA and South East Rivers Trust.
- Farming and Wildlife Advisory Group (FWAG SE) and Natural England on C&NBS for diffuse rural pollution impacting river and groundwater quality.
- Stakeholder consultation with River groups and catchment partnership hosts. Feedback has included:

> *"At the moment multiple organisations (including the CCSP) are planning and delivering restoration projects with little overview of how all the pieces fit together. Catchment partnerships would like to see a return to a more collaborative approach with a working group for each catchment set up to provide oversight and ensure more joined up approach.*
>
> *In future, we would like to see Affinity work more collaboratively with local catchment delivery partners like the CCSP and Groundwork South, who can deliver small to medium scale river restoration projects cost effectively and engage local communities. This will increase Affinity's capacity to delivery its WINEP targets in a more cost-effective manner whilst securing greater engagement and support from local communities.*
>
> *Could a catchment-scale approach help you to target eg. which weirs are the best to remove for sediment transport / fish migration between restored reaches? This would also help with presenting rationale for individual projects to landowners and local communities."*
>
> **Allen Beechey, ColneCAN Catchment Partnership host (Chilterns Chalk Stream Project)**

As part of the development of schemes under the best value option we will seek to establish working groups for which co-design and co-delivery options key stakeholders can be explored and partner funding opportunities can be identified.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this Business case.

5.2 Catchment Strategy

This business case is aligned with the Catchment Options development as set out in our draft Water Resources Management Plan and will inform the development of our Dour and Little Stour Catchment Strategy which is currently under development.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation of this scheme are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS and river improvement works projects, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS. The scheme can adapt to:

- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g., Wastewater company schemes, Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities (e.g., offsetting).
- Types of measures implemented can adapt and evolve based on future scientific evidence.
- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships, Rivers Trusts.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options: the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 2 – Dour and Little Stour catchment Option Evaluation v1.0

We have then assessed these further, with additional information; by developing hybrid solutions that take the best actions from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

6.1 Unconstrained List

Our options include a combination of land management focused C&NBS referred to as Resilient Chalk Catchments (RCC) and a river restoration / river improvement works options referred to as Revitalising Chalk Rivers (RCR). For the RCR options we have defined the options into a series of 'small' and 'large' projects. A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of both RCC and RCR C&NBS options are described for the best value option, with further examples of AMP6 and AMP7 river improvement works can be observed in Appendix 3 – AWL River Restoration project examples AMP6-AMP7

Unconstrained options documented in Table 1 that are chosen to either 'Proceed' or 'Clarify' are then included in our constrained list with additional screening using Options Evaluation spreadsheet. Options that are 'Rejected' due to not meeting Statutory and Non-Statutory requirements do not proceed beyond the unconstrained list below.

Our unconstrained list of options are:

Table 1 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on treatment options and agreed sustainability reductions	R	Does not meet S and NS requirements
2	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects.	R	Does not meet S and NS requirements
3	Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river)	R	Does not meet S and NS requirements
4	Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour)	R	Does not meet S and NS requirements
5	Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river)	R	Does not meet S and NS requirements
6	Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
7	Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)	C	See Options Evaluation spreadsheet
8	Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	R	Requires a river restoration option to be combined
9	Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Disproportionate, expensive and deliverability issues
10	Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and RCC C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
11	Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and RCC C&NBS option B (Spatial	P	See Options Evaluation spreadsheet

	targeting using SERT ProWater outputs and DWSP WQ heat maps)		
12	Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
13	Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Disproportionate, expensive and deliverability issues
14	Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
15	Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)	P	See Options Evaluation spreadsheet
16	Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
17	Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Disproportionate, expensive and deliverability issues
18	Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements

19	Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)	P	See Options Evaluation spreadsheet
20	Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
21	Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Disproportionate, expensive and deliverability issues

6.2 Constrained List

Seven options have been selected from the original 21. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 2) is presented below to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 2. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)	**N**	**YY**	**YYY**	**YYY**
Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient	**Y**	**N**	**YYY**	**YYY**

Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)				
Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	Y	YY	YYY	YYY
Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)	YYY	YY	YYY	YYY
Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	YYY	YYY	YYY	YYY
Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)	YYY	Y	NN	NN
Revitalizing Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	YYY	YY	NN	NN

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

Our final set of three feasible options are:

1. Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)
2. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using SERT ProWater outputs and DWSP WQ heat maps)
3. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)

6.3.1 Option 0: Do Nothing

No C&NBS (river restoration or catchment management schemes). Focus solely on treatment options and agreed sustainability reductions. This is discounted as a feasible option.

6.3.2 Option 1: Preferred, Best Value, Option

Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and Resilient Chalk Catchments RCC C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues engagement process. The proposed option includes:

RCR – The best value option has been developed building on our extensive experience of delivering river improvement works in chalk stream catchments in AMP6 and AMP7. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. The experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs.

A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. Examples of a small project could include:

- Tree works to allow more light into the river channel.
- encouraging the development of new habitat through growth of macrophytes (plants).
- Fencing along the riverbank to prevent livestock or horses from damaging the riverbanks and channel, thus reducing sediment input and allowing vegetation to establish along the river margins and in the channel.
- Planting of native aquatic macrophytes where these are absent and unlikely to colonise naturally.

A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of a large project could include:

- Removal of a weir or structure and regrading of river channel up and downstream.
- Creating chalk stream habitat.
- Bypassing of a weir or structure to allow fish passage and help establish typical chalk stream features.
- Restoring the river channel to its original location in the flood plain/valley bottom.

RCC – the best value option includes a programme of land management focused C&NBS that will be spatially and temporally targeted to:

- Protect and restore natural assets in the operational catchments identified through the Catchment Assets for Water project detailed above to improve water resource and chalk stream resilience in this operational catchment.
- Implement appropriate C&NBS measures upstream of river improvement works under the RCR to ensure greater resilience of those schemes and maximise environmental benefits through a holistic catchment management approach.
- Deliver multiple benefits for water quality (nitrate and microbiological), water resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Cover crops
- Herbal leys
- Resurfacing of farm gateways
- Arable reversion
- Chalk grassland restoration
- Tree/woodland planting

- Regenerative agriculture measures such as reduced/no tillage

Total cost (FY2022/23 cost base) - not including partnership co-funding phased across AMP8 and AMP9 as per the WINEP =

AMP8 totex costs	**£1.615m**
AMP9 costs	**£1.550m**

The best value option has been phased across AMP8 and AMP9 in accordance with our third release of the WINEP in July 2023. This reflects deliverability challenges agreed with the EA. For further information see section 10 of this business case.

6.3.3 Option 2: Least Cost Option

Revitalizing Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Streams (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)

The least cost option is similar in scope to the best value option but proposes a reduced programme of river improvement works on the River Dour compared to the best value and alternative option.

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 and AMP9 totex costs	**£2.728m**

6.3.4 Option 3: Alternative Option

Revitalizing Chalk Rivers (RCR) option 2 - Enhanced (1 small project and 1 large project on the Little Stour and 2 small and 2 large projects on the Dour) and RCC C&NBS option B (Spatial targeting using ProWater outputs and DWSP WQ heat maps)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 and AMP9 totex costs	**£2.813m**

Alternative option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to enhance water resources for groundwater (ProWater) and water quality drivers and not targeted upstream of RCR projects to deliver multiple benefits and wider environmental outcomes.

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER) as detailed in Table 4 below. It demonstrates a significant increase in ambition compared to AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes, including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits.

6.4.2 Option 2: Least Cost Option

The least cost feasible option has a **medium level** of confidence in the achieving the WINEP wider environmental outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes. This option includes a reduced number of river improvement works on the River Dour reducing the likelihood of achieving good ecological status, and the wider benefits such improvement works can deliver.

6.4.3 Option 3: Alternative Feasible Option

Option 3 has a **high**-level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes. However, this option takes a less holistic approach to delivering C&NBS and is less likely to address many of the reasons for not achieving good ecological status (GES) for the associated chalk streams caused by land management activities within the East Kent Chalk catchment that impact on river health.

Table 3: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the East Kent Chalk, Dour and Little Stour catchments

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. RCR/RCC C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	The PR24 programme must include actions to improve water body status to ensure that moderate status is achieved by 2030 as a minimum and improve further where technology allows	RCR schemes developed in partnership with EA and associated C&NBS measures will support meeting moderate status.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Water body status	Water companies should apply the fair share approach when developing measures to address nutrients	Funding of C&NBS to mitigate nitrate leaching to groundwater will also take account of wider ecosystem services benefits.
Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures using SERT ProWater spatial mapping will target opportunities for more resilient water resources and mitigate deterioration of water bodies.
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures will be deployed to reduce pollution losses from land management activities (nutrients and microbiological) into chalk streams and improve water quality
Drinking Water Protected Areas	Groundwater bodies must also meet good groundwater chemical status and upward pollutant trends should be reversed.	C&NBS measures will be deployed in groundwater SgZ's to mitigate nitrate pollution of groundwater and associated impact in chalk stream quality

Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for nitrate in groundwater delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	RCC C&NBS primary focus on arable farming building on AMP6 and AMP7 catchment management schemes.
Environment Act 2021	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits
Environment Act 2021	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits including biodiversity
SSSI	We expect water companies to contribute to maintaining or achieving SSSI favourable condition both on their own land and in the catchments they operate in.	RCR and RCC C&NBS will prioritise opportunities for measures delivered on SSSI's within Dour and Little Stour catchments as appropriate.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	RCR and RCC C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.
NERC Act 2006	Sustainable abstraction, reducing demand for water and reducing pollution, particularly from storm overflows are key actions water companies should take to protect and enhance chalk streams. In line with CaBA Chalk Stream Restoration Strategy 2021, water companies should lead on behaviour change around water resources, encouraging customers to use and pollute less. Water companies should drive innovation solutions and lead the way on water supply issues, demand management, sewerage and sewage treatment.	RCR schemes will protect and enhance chalk streams, particularly supporting sustainability reductions. RCC C&NBS measures will seek to reduce pollution for enhanced chalk stream resilience. Flagship CaBA Chalk Stream Restoration projects in the Beane (Colne) and Chess (Colne).
Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.
Healthy and resilient fish stocks	Water companies should identify measures to improve abstractions and outfalls to prevent the entrainment of fish and to address barriers to passage of fish factoring in the wider benefits of fish pass solutions such as improved geomorphology. Removal of barriers should always be considered as first option.	RCR schemes designed and developed to improve fish passage (e.g. weir removal) and improve geomorphology.

Eels	Water companies must comply with the requirement of the Eels regs 2009 to support the recovery of the European eel stock.	RCR schemes designed and developed to support eel migration (e.g. weir removal) and improve geomorphology to support recovery.
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Natural environment	Help create climate resilient places and improve the resilience of communities to droughts, floods and coastal change by implementing cost-effective co funded solutions	RCR and RCC C&NBS measures within this scheme will support more resilient chalk stream catchments to flood and drought.
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	RCR and RCC C&NBS measures within this scheme will support resilient chalk stream catchments and sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	RCR and RCC C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance chalk stream habitats.
Flood resilience	Water companies should contribute to partnership schemes to reduce flood risk to communities and themselves	This scheme will align with work in collaboration with the EA and LLFA
drainage resilience	Water companies and other risk management authorities should work together to manage water in a more integrated way to improve flood resilience, enhance the natural environment and deliver value for customers	RCC C&NBS measures within this scheme will identify opportunities to use NFM measures to slow flow and hold more water in headwaters of chalk stream catchments.
Water supply and environmental resilience	Water company plans should protect and improve the environment, considering both current and future challenges. This could mean tighter environmental protection for some sensitive habitats such as chalk streams, to meet env objectives.	RCR and RCC C&NBS measures within this scheme will seek to protect the Dour and Little Stour
Water supply and environmental resilience	WCs should consider whether their abstractions are truly sustainable looking across a catchment as a whole and consider investment in integrated catchment schemes to improve drought resilience and WQ.	RCR and RCC C&NBS measures in this scheme integrated alongside SR programme.
Climate Change	Water companies are expected to adopt nature based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2

Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature based solutions	Experience of this through AMP6 and AMP7 river restoration programmes. AMP7 C&NBS measures co-funded through EnTrade and LENS. Experience and lessons-learned adopted for PR24.
Climate Change	Water companies should invest in the restoration of natural form and function of the catchments and wider landscapes in which they operate to contribute to resilience to the impacts of climate change	RCR and RCC C&NBS measures within this scheme will seek to protect, restore and enhance the Dour and Little Stour chalk streams
Climate Change	WCs should improve the natural resilience of the catchments in which they operate by restoring their natural function. Water companies should ensure that solutions build resilience of biodiversity in catchments, river systems and water bodies.	RCR and RCC C&NBS measures within this scheme will seek to create more resilient chalk stream catchments in the Dour and Little Stour with focus on delivering multiple benefits including biodiversity.
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. RCR/RCC C&NBS measures consider and support RBMP objectives and measures.

6.4.4 Can the Option Provide Net Benefits?

Option 1: Preferred, Best Value, Option

By aligning C&NBS measures upstream of river restoration and habitat enhancement schemes, the best value option can provide the following net environmental benefits:

- enhanced resilience for the effectiveness of delivered river restoration schemes (e.g. reduction in sediment and pollutant loading) and increased likelihood of achieving overall Good Ecological Status (GES).
- Provide greater connectivity of habitats in priority areas for RCR/RCC measures to support achievement of non-statutory requirements such as the HMWT State of Nature targets for creating 30% more habitat by 2030.
- Provide greater flood and drought resilience through more sustainable land management practices.
- Improved water quality to support chalk stream ecology.

Option 2: Least Cost Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process and deliver net

benefits. This option includes a reduced number of river improvements works and thus not realising additional net benefits described in the other options.

Option 3: Alternative Feasible Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process and deliver net benefits. This option takes a less holistic approach to implementing land management focused C&NBS alongside river improvements works and thus not realising additional net benefits described in the other options.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support the achievement of meeting the WINEP wider environmental outcomes. Some examples are shown below, but not limited to:

Natural Environment Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Dour operational catchment and Little Stour which provide greater habitat and supporting ecology for priority species such as Brown Trout.

Catchment Resilience Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Dour operational catchment with support C&NBS measures to provide greater chalk stream resilience to land management pressures such as reduction in upstream sediment losses.

C&NBS measures targeted using ProWater outputs to hold more water on the land to enable improved infiltration and aquifer recharge, slower flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

Access, Amenity, and Engagement Outcomes

River restoration and habitat enhancement schemes to improve the chalk streams in the Dour operational catchment and Little Stour can provide greater connectivity between the precious chalk streams and their local communities, enhancing access and recreation opportunities.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes.

This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. It will utilise the modelling outputs from the ProWater project and water quality risk review to identify priority areas for C&NBS measures to achieve the greatest benefit for water resources and water quality, as well as aligning with wider priorities and non-statutory drivers.

There is also a greater co-design and co-funding approach to this option as it will seek align with wider partner projects, support and co-fund future Environmental Land Management Schemes (ELMS), catchment partnership plans and Local Nature Recovery Strategy (LNRS) and EA natural flood management projects.

The proposed river restoration and habitat enhancement programme (RCR) will be adaptive and developed in partnership with the EA and catchment partnerships and use a Natural Capital assessment framework to ensure the greatest environmental benefit is derived for every pound invested.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but with a reduced number of river improvement works and associated level of investment in C&NBS. The least cost option can deliver the required statutory requirements but increases the likelihood that river improvement works project do not support meeting GES and the wider environmental outcomes.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but without targeting of C&NBS measures upstream of RCR projects. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements but increases the likelihood that river improvement works project do not deliver longer term environmental benefits they will not be delivered holistically with land management C&NBS designed to increase the resilience of river improvement works and deliver multiple environmental benefits to support meeting GES and the wider environmental outcomes.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business cases by PR24 Red Team
    b. Review of Business cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 4 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 5.

Our economic analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We also intend to use our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

7.2 Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. For both the RCR and RCC options, a bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes that we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1.

7.3 Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.196m** in partnership funding contributions towards the non-statutory tertiary driver aspects of the Dour and Little Stour C&NBS WINEP scheme across AMP8, with further partnership funding contribution estimated for AMP9. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Establish an AMP8 5-year formal partnership agreement with the South East Rivers Trust. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Identification, scoping and co-funding/co-delivery of river improvement works.
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Working in partnership with neighbouring water companies and water and sewerage companies that overlap our supply area to identify co-funding opportunities that mutually benefit each company.
- Work with key stakeholders to explore options with working with local farm cluster groups in East Kent to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

7.4 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are

less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the rivers that we are restoring are unique in nature and therefore of higher environmental value to society.

7.5 Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The business case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g., hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

7.6 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. This experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs. Additionally, our experience of delivering a range of large and small projects has enabled a good understanding of the true costs of delivering such projects. In AMP6 and AMP7, the mean average cost of delivering a river restoration project unit (equivalent to one small project) was £124,245 not including monitoring costs and actual costs at time of implementation (cost range 2016-2022). Our unit cost model cost for this proposed scheme has been estimated at £160,871 per unit in 2022/23 price base (not including monitoring costs).

7.7 Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

8.1 Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement water quality, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

8.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the river restoration investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable

Air quality	Monetised as per WINEP and impacted by the natural capital investments
Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the River Dour and Little Stour will improve to some extent from Poor to Moderate status as a result of our restoration activities.

- We have calculated the total length of the Upper Dour, Dour from Kearsney to Dover and Nailbourne and Little Stour to be 31 km.
- We have assumed that the whole length is currently in Poor condition as per Catchment Data Explorer.
- We have assumed that the water quality benefits will be realised after 7 years. this is based on the AMP7 Frogmore Park scheme NC evaluation carried out by Atkins (see section 4.5).
- We have assumed that both our river restoration and natural capital activities will make a proportional start to improving the water quality and that further, future activities will be required to achieve full Moderate status for the whole river system. Because the natural capital activities will change in the options, we have assumed that the least cost option will only deliver a 5 % improvement towards Moderate status; the best value option 10 % and the alternative option 10 %. Our previous river restoration projects suggest that these are conservative estimates. We have selected these conservative values due to the dependency on flow to support these improvements. We also recognise similar activities from other partners including river groups, the EA and catchment partnerships to support the improvement to Moderate Status in addition to our proposed activities.
- We have also assumed that there is an on-going 4 % per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

Air Quality Pollution Reduction and CO2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 10-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we have to assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g., cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.
- We have assumed that the preferred option will impact a total of 3,950 hectares, comprising of: 1,986 ha of enclosed farmland; 18 ha of freshwaters,

open waters, wetlands and floodplains;1,554 ha of semi-natural grasslands; and 392 ha of woodlands.

- We have reduced these values to 3,100 ha for the alternative option, and maintained the value for the least cost option, always assuming the same profile of land use.

8.4 Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is, however, only marginally cost beneficial for both the river restoration and natural capital activities. Overall, considering the conservative assumptions and the other, non-quantified benefits, we consider the project to be worthwhile. Jointly these activities will provide environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a small negative NPV of -**£0.429m**, and a benefit / cost ratio of **0.86**. This is higher than both the least cost and the alternative options, which are also not cost beneficial. However, this benefits assessment does not account for the benefits to groundwater as there is not currently a developed metric through the NCRAT tool. We have assumed a 10 % increase in water quality in the analysis. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. For example, our recent river restoration on the River Beane has delivered biodiversity net gains across the different areas in river units between 16% and 49%, with a weighted average of 28% based on river length. There is also a corresponding average improvement of the habitat units of 6%. Similarly, our cover cropping scheme realised a river water quality benefit of over 40%; CO2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 9.5 % would result in cost benefits. This provides a level of confidence that the scheme will be cost beneficial.

The natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised, which is why this option has been chosen as the best value option compared to the alterative option 1. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

8.5 Least Cost Option

The least cost option is not cost beneficial with an NPV of -**£0.702m** and a benefit / cost ratio of **0.73.** This is logical because the preferred option has the additional natural capital activities to fully build upon the river restoration work to optimise the overall environmental benefits.

8.6 Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, but only has a forecast NPV of -**£0.322m**. The benefit / cost ratio is similar to the preferred option, **0.88,** showing that the return on investment is consistent with the preferred option but does not offer the same catchment resilience as the best value option. However, this benefits assessment does not account for the benefits to groundwater as there is not currently a developed metric through the NCRAT tool.

8.7 Alternative Option 2

There was no second alternative option in this analysis.

8.8 Non-Monetised Information

We have rigorously applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

Flooding reduction from woodlands

Arable production

Livestock production (dairy and meat)

Timber removal

Recreation

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least

cost option; all in proportion to the number of hectares set aside for the production. There will clearly be some benefits from arable and livestock production, but these are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

8.9 Wider Environmental Outcomes

8.9.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.9.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-

Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	V
Not assessed within options development and appraisal	O

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	Preferred Option	Λ
	Least Cost Option	Λ
	Alternative Option 1	Λ
	Alternative Option 2	O
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	Preferred Option	Λ
	Least Cost Option	Λ
	Alternative Option 1	Λ
	Alternative Option 2	O
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	Preferred Option	Λ
	Least Cost Option	Λ
	Alternative Option 1	Λ
	Alternative Option 2	O
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	Preferred Option	Λ
	Least Cost Option	Λ
	Alternative Option 1	Λ
	Alternative Option 2	O

8.10 Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option, albeit only marginally cost beneficial. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Estimates of the benefits have been made and the scheme is considerd to be cost beneficial in terms of both river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis has been benchmarked against the Natural Capital evaluation carried out by Atkins of the river improvement works completed on the River Beane detailed in section 4.5. Additionally, from our Natural Capital Evaluation of the EnTrade Cover Crop Scheme in 2021, also detailed in section 4.5 has demonstrated that greater environmental net gain benefits can be derived from our C&NBS measures targeted effectively. We will review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**0.86** compared to **0.73)**. The alternative option of doing more does not offer better value with a similar benefit / cost ratio of **0.88,** along with a lower likelihood of delivering the desired environmental outcomes.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. Our sensitivity analysis shows that the river restoration will be cost beneficial if there is more than a 9.5 % increase in river water quality and ignoring the natural capital benefits. When this is considered with our conservative assumptions, this assessment has determined the project is worthwhile and will be beneficial to customers, the environment and society.

The best value option aligns with the WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments and will be delivered alongside our AMP8 and AMP9 Sustainability Reductions programme to maximise the benefits of abstraction reductions on the chalk streams we are seeking to protect and restore.

9 Delivery Considerations

9.1 Related Projects

This project is similar to our other river restoration and catchment management schemes. Collectively they form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in several of our groundwater sources in the operational catchment and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25-years.

The effectiveness of river improvement works is also dependent upon the effectiveness of sustainability reductions and/or impacts of land management activities and climate change in terms of providing additional flow. The prioritisation of C&NBS schemes delivered by this project will be aligned with our current and future sustainability reductions programme and targeted in the headwater areas of the catchments (subject to landowner agreement and participation) to hold more water in upper reaches in order to maximise the benefits of C&NBS and any reduction or cessation of abstraction. River improvement works, where appropriate, will be targeted further down the catchments where greater ecological benefits can be derived

Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 river restoration and catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to an operational catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our extensive experience of delivering small and large river improvement works has enabled us to better understand the risks, issues and opportunities that can arise and how to develop the programme more efficiently as well as an increased understanding of the true cost of delivering these types of schemes.
- Our experience of engaging with landowners and local environmental groups and knowledge of the chalk stream catchments where future schemes are proposed for AMP8 and AMP9 will allow us to deliver an ambition programme drawing on partnership support and contributions
- The Natural Capital evaluation of our river improvement works completed to date in the River Beane catchment has been really useful in understanding

the potential benefits of these type of schemes and informing this benefits assessment.

- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits.

9.2 Delivery Risk Management

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

We have already delivered similar river improvement works and catchment management schemes, and therefore have a strong understanding of the delivery risks and how best to manage these. However, the most significant risk to the project is delivering the ambitious target for river restoration projects and associated units due to permitting and landowner permission constraints. To mitigate this, we have proposed phasing of the best value option across AMP8 and AMP9 in recognition of the long lead in time for delivery of some projects and the number of projects that do not progress beyond detailed design as a consequence of permitting constraints such as Flood Risk Activity Permits (FRAP), requirements for also securing impoundment licensing and landowners not wishing to proceed.

A further significant risk to the project is securing partnership funding. This is beyond our control, being dependent on partnership funding (e.g., through catchment partnership, financial contributions through catchment-trading mechanisms (e.g., agricultural supply chain) and other government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

The following risks and mitigations have been identified for this project:

- Delays in delivering river improvement works due to delays and/or limitations from permitting/flood risk modelling outcomes.
    - Our RCR partnership with the EA and regular engagement can help manage risks and issues around permitting/flood modelling.
    - We will commence permitting applications at the earliest possible stage and engage with the EA in a timely manner with an understanding of timescales.
- Lack of permission from landowners to carry out river improvement works.
    - We will use an adaptive management approach to identify wider opportunities for projects in alternative reaches.
    - We will utilise our Agricultural Advisory specialists and other partners in the catchment to engage with landowners.

    - Opportunities through schemes such as ELMS to work constructively with landowners and generate additional funding streams.
- Uncertainties around climate change and associated flood, drought and other impacts
    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8 and AMP9.
- Increasing demand at a national level for specialist contractors to deliver river improvement works leading to delays in overall programme delivery.
    - We have an established framework with a number of the specialist contractors already delivering projects on our behalf which will build on for AMP8 and AMP9.
- Increasing cost of resources to deliver projects.
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs.
- Farmers and land managers unwilling to engage with us on land management C&NBS.
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable Agricultural Advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes.
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS.
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

9.3 Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits we will undertake the following activities alongside our abstraction impact assessment monitoring in our Water Resources business case:

- Baseline monitoring and long-term benefits monitoring for river improvement works in catchment, alongside our sustainability reduction programme including the following:
    - Flow gauging
    - Macrophyte and macroinvertebrate surveys
    - Groundwater level monitoring
    - Rain gauge monitoring
- Chalk stream monitoring linked to our land management C&NBS including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring

- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the Option Development Report and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 9 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott McDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each scheme we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on schemes carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each investigation will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, km of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

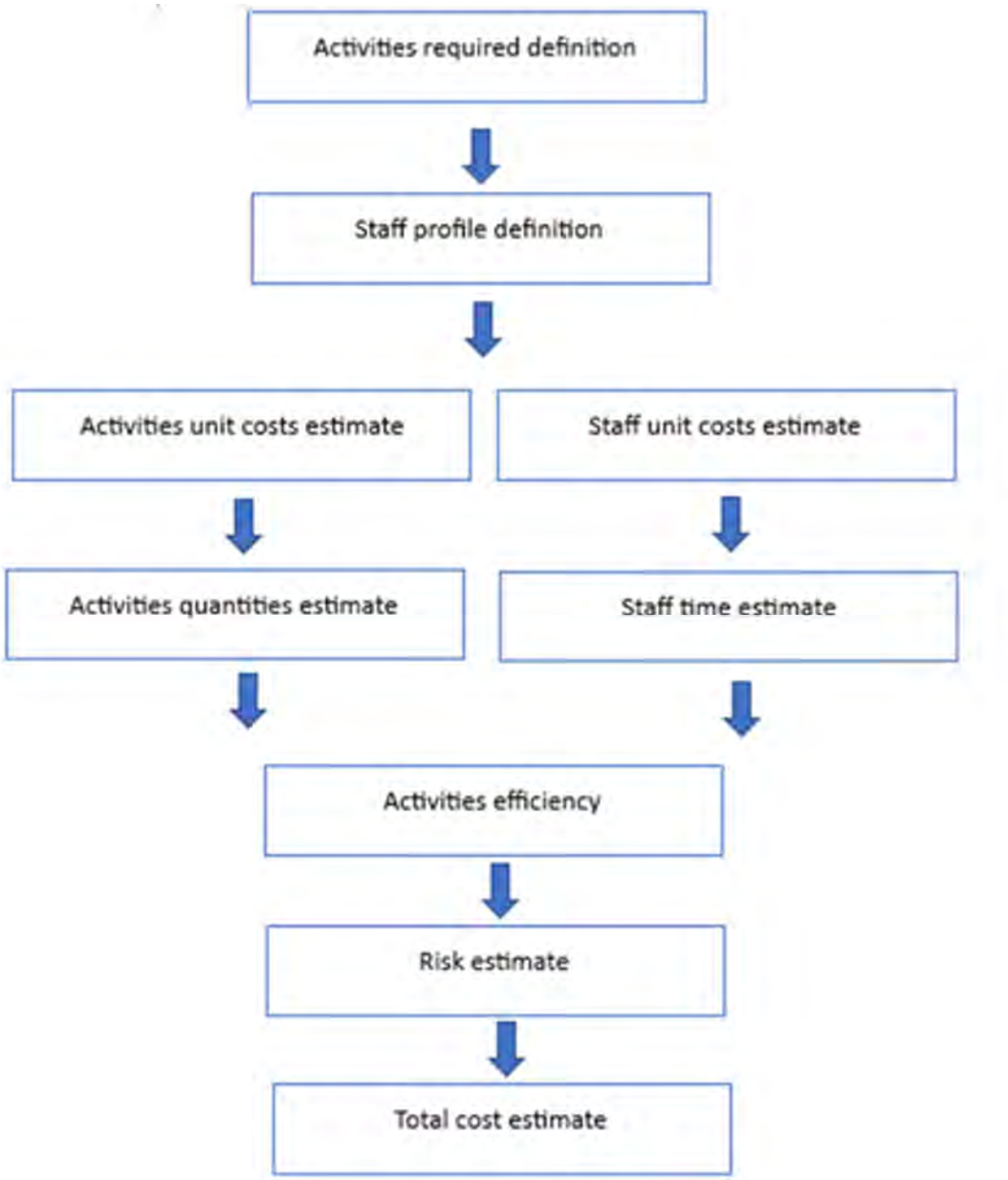

Figure 7 Cost Estimate workstream diagram

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar schemes undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director time have been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Activities efficiency: where possible, significant attention has been paid to make efficiency across investigations. For instance, field monitoring rounds estimated for a

small investigation have been incorporated into a nearby larger investigation monitoring activity, so that time and resources spent are minimised.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – Affinity Water WINEP Stage 2 Risks and Issues Register v1.0

Appendix 2 – Dour and Little Stour Options Evaluation v1.0

Appendix 3 – AWL River Restoration Project Examples AMP6-AMP7

Appendix 4 –– Atkins PR24 WINEP Assurance Report November 2022

Appendix 5 –– PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Upper Lea Catchment

(not including River Beane)

Catchment and nature-based solutions (inc. River restoration)

August 2023

Contents

1 Summary

This business case sets out the detailed PR24 WINEP options development process and outcomes for our proposed Upper Lea operational catchment programme of catchment and nature-based solutions (C&NBS) for AMP8 delivered through the Water Industry National Environment Programme (WINEP). Additionally, it includes additional scoping, costs and benefits assessment to continue the programme into AMP9 as part of a longer-term planning horizon and phasing of the best value option. It sets out to address the following challenges:

- Manage the drinking water quality pressures for our groundwater sources including, but not limited to, Safeguard Zones including:
    - GWSGZ0158 – Kings Walden
    - GWSGZ0274 - Chipping
- Contribute towards mitigation of the impacts of climate change at the operational catchment-scale to create more resilient catchments for water resources.
- Deliver C&NBS projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and the reasons for deterioration (RFD) under the Water Framework Directive in the following waterbodies:

    - GB40601G602900 - Upper Lea Chalk (Groundwater)
    - GB106038033392 - Upper Lea
    - GB106038033460 Mimram (Whitwell to Codicote Bottom)
    - GB106038033270 Mimram (Codicote Bottom to Lea)
    - GB106038040130 Stort (at Clavering)
    - GB106038033281 Stort and Navigation, Bishops' Stortford to Harlow
    - GB106038033282 Stort and Navigation, Harlow to Lea
    - GB106038040140 Rib (upper stretches, above confluence with the Quin)
    - GB106038033360 Rib (from confluence with Quin to Lea Navigation)
    - GB106038040100 Ash (from Meesden to confluence with Bury Green Brook)
    - GB106038033290 Ash (from confluence with Bury Green Brook to Lea)

The 'best value' option described in this Business Case defines a landscape-scale programme of C&NBS for the Upper Lea operational catchment. This includes river improvement works on the waterbodies listed above and a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater, improved soil health, greater water-holding capacity on land for flood and drought resilience, net zero benefits and biodiversity enhancements.

We have rigorously followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our preferred solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high degree of support for the

proposed environmental improvements. We have learnt from our previous river restoration and natural capital improvement projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. Based upon our conservative estimates, the preferred option offers NPV benefits of **£5.164m** with a benefit cost ratio of **1.81**. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water.

Conservative estimates of the benefits have been made and the scheme has been assessed as cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements.

The best value option will be delivered under a catchment strategy for the Lea operational catchment developed following the principles of our environmental strategy and existing Catchment Based Approach (CaBA) catchment plans. The prioritisation and delivery of the programme will be developed with the Environment Agency and alongside our sustainability reduction programme to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain
River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital
Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS
Each project will utilise a range of C&NBS targeted spatially and/or temporally to deliver the greatest environmental benefits.

Proportionality
The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider

environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence
To determine the best value option, an extensive options development process was undertaken with 21 unconstrained options, 11 constrained options reviewed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration
To determine the best value option, we have carried out a detailed risks and issues identification process with key stakeholders including the Environment Agency, Natural England, and catchment partnerships. We have also developed our proposed solutions with input and feedback with key stakeholders to inform the best value option for this scheme.

Base Information	
Report Date	08 August 2023
Report Title	Upper Lea Catchment C&NBS – PR24 business case
Options Assessment Report (WINEP)	08AF100010_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030 (AMP8) and 31/03/2035 (AMP9)
WINEP Spreadsheet ID	
WINEP Action ID	08AF100010
WINEP Drivers	WFDGW_ND (S) (Primary) EDWRMP_IMP (S+) (Secondary) WFD_IMP_Flow (S+) (Primary) NERC_IMP (S+) (Secondary) 25YEP_IMP (NS) (Tertiary)
Scale of Action Delivery	**Operational catchment**
Location of Delivery	GB40601G602900 - Upper Lea Chalk (Groundwater) GB106038033392 - Upper Lea GB106038033460 Mimram (Whitwell to Codicote Bottom) GB106038033270 Mimram (Codicote Bottom to Lea) GB106038040130 Stort (at Clavering) GB106038033281 Stort and Navigation, Bishops' Stortford to Harlow GB106038033282 Stort and Navigation, Harlow to Lea GB106038040140 Rib (upper stretches, above confluence with the Quin) GB106038033360 Rib (from confluence with Quin to Lea Navigation) GB106038040100 Ash (from Meesden to confluence with Bury Green Brook)

	GB106038033290 Ash (from confluence with Bury Green Brook to Lea)

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.35	0.67	1.00	1.07	1.22	**4.31**
Totex (£m)	0.35	0.67	1.00	1.07	1.22	**4.31**
3rd Party Funding	0.03	0.05	0.08	0.08	0.08	**0.32**

Drivers	
100%	Water Framework Directive

Benefits
Water Quality of Natural Water Bodies (km)
Sequested Carbon (tonnes CO^2e)
Air Quality Pollution Reduction (tonnes)

Economic Analysis			
NPV Costs (£m) (2025-55)	**6.4**	NPV Benefits (£m) (2025-55)	**11.6**
NPV (£m) (2025-55)	**5.1**	Benefit / Cost Ratio	**1.8**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This Business Case describes the WINEP scheme developed to address the challenges within the Upper Lea operational catchment (Figure 1). The River Beane, Mimmshall Brook (North Mymms WTW) and Essendon Brook (Essendon PS) sub-catchments are out of scope of this project and are covered in separate Business Cases:

- 08AF100012 Beane Catchment Flagship Project Business Case v1.0
- 08AF100015 WINEP Business Case - Karstic Groundwater Sources v1.0

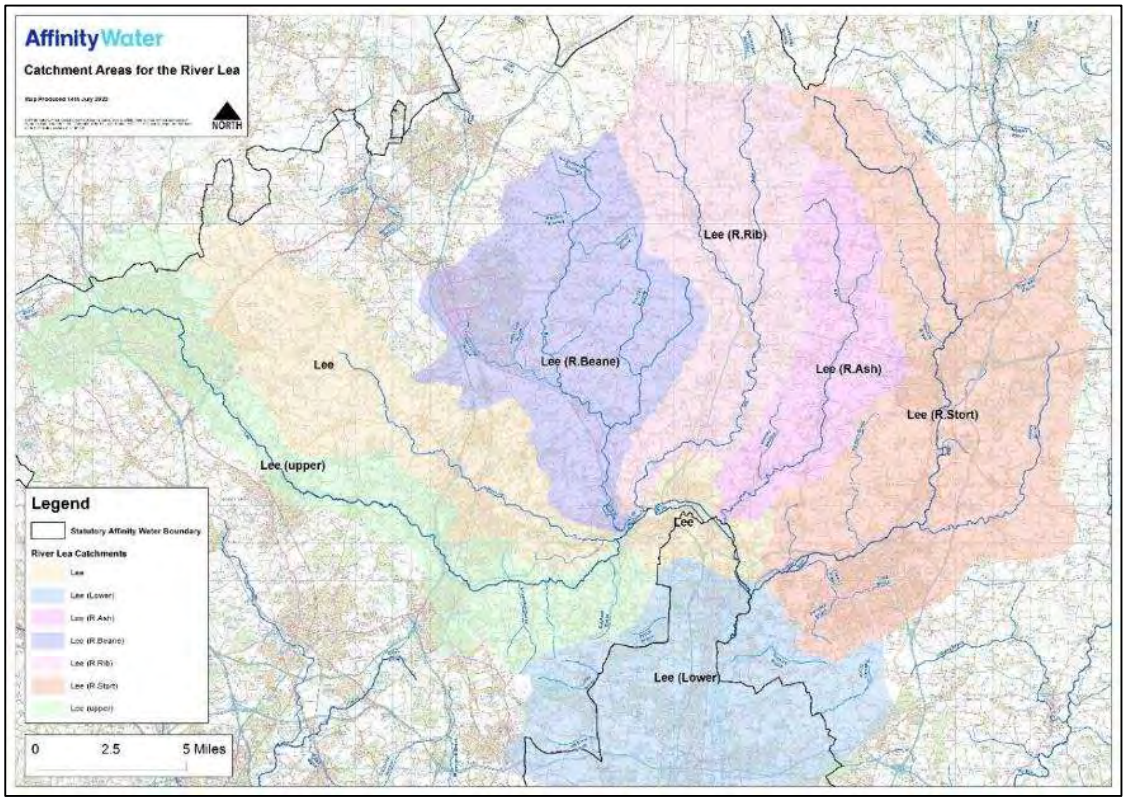

Figure 1. Catchment areas of the Upper Lea operational catchment

The challenges are to:

- Manage the drinking water quality pressures for our groundwater sources.
- Mitigate the impacts of climate change at the operational catchment-scale to create more resilient catchments for water resources.
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and the reasons for deterioration (RFD) in the following waterbodies:
    - GB40601G602900 - Upper Lea Chalk (Groundwater)
    - GB106038033392 - Upper Lea
    - GB106038033460 Mimram (Whitwell to Codicote Bottom)
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- GB106038040100 Ash (from Meesden to confluence with Bury Green Brook)
- GB106038033290 Ash (from confluence with Bury Green Brook to Lea)

The 'best value' option described in this Business Case defines a landscape-scale programme of Catchment and Nature-Based Solutions (C&NBS) for the Upper Lea operational catchment including:

Revitalising Chalk Rivers (RCR)

Chalk streams are rare ecosystems that are important to protect. 85% of all chalk streams are in England, mainly in the south and east of the country. Many of these chalk streams in this operational catchment are considered to be impacted by our abstraction for public water supply. Consequently, reduced flows potentially caused by abstraction reductions, are also leading to the natural river processes not taking place impacting the ecology of the river. Alongside abstraction impacts which are being addressed through our sustainability reductions programme, it is important to ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding. These rivers are ultimately failing to meet Good Ecological Status (GES) under the Water Framework Directive and therefore action needs to be taken to address this, unless assessed to be disproportionately costly.

Our programme of chalk stream river improvement works, and habitat enhancement schemes commenced in AMP6, and this document proposes as expansion of river improvement works within the rivers listed above and associated riparian zone. This builds on the existing programme developed in partnership with the EA referred to in this document as Revitalising Chalk Rivers (RCR).

Undertaking river channel modifications (e.g. installation of deflectors, channel re-profiling to create a low flow profiled channel) can help increase in-channel velocities which are known to be a key element in the ecological requirements of a river. These channel enhancements and modification works will be delivered alongside our sustainability reductions programme, further abstraction impact assessments, river support and wider C&NBS schemes to maximise the benefits and support achievement of the WINEP wider environmental outcomes, 25 Year Environment Plan and Environmental Destination requirements. In order to achieve GES these rivers need to be a properly functioning ecosystem.

Some of the benefits of such river improvement works include:

- Ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding.

- Restoring the rivers back to a more natural state by removing barriers to fish, re-meandering, reconnecting them to groundwater and re-establishing chalk stream characteristics.
- Healthy chalk stream systems can also lead to improved water quality and help with groundwater recharge for greater catchment resilience to climate change.
- To meet our environmental objectives and targets as a company to ensure we are improving the local environments while maintaining high quality drinking water supply.
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 1 - End unsustainable abstraction from chalk groundwater sources
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital

River improvement works that form the best value option in this document will be prioritised and profiled over AMP8 and AMP9. This is done through a process of prioritisation with the EA detailed later in the document and to align with our sustainability reductions (SR) programme.

Resilient Chalk Catchments (RCC)

Delivered in combination with the RCR programme, Resilient Chalk Catchments (RCC) is land management focused programme of C&NBS. This programme will work in partnership with landowners, farmers, businesses, environmental NGO's, regulators, catchment partnerships and river groups to target C&NBS spatially and temporally at the operational catchment scale (Upper Lea) to achieve the following outcomes:

- Enhanced infiltration / aquifer recharge
- No deterioration of groundwater quality (nitrates)
- Habitat enhancement for priority species
- Chalk stream protection and resilience from land management pressures (sediment, pesticides, nutrients etc.)
- Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams
- Connecting wildlife corridors and creation of habitats in partnership with local stakeholders
- Wider biodiversity benefits (e.g., to priority habitats and species)
- Support achieving a number of our 'strategic focus' areas in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital.

This programme builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes which were focused on water quality no deterioration schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality, and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

3.1 Environmental Risk and Issues

As detailed in the EA Catchment Data Explorer for the Upper Lea operational catchment, here are a number of significant water management issues which are attributed to a number of business sectors including the water industry determined as the Reason for not achieving good status (RNAG) status. These include:

- Changes to the natural flow and level of water
- Invasive non-native species (INNS)
- Physical modifications
- Pollution from rural areas
- Pollution from towns, cities and transport
- Pollution from wastewater

Several of these issues, including pollution from rural and urban area, also affect the groundwater quality of water abstracted for public water supply, in addition to the waterbodies within the catchment.

3.2 Baseline Assessment

To support the baseline assessment, a Risk and Issues log (Appendix 1) has been developed for both the operational catchment and at the waterbody level. Data has been captured from Catchment Data Explorer and through consultation with a range of stakeholders including:

- EA
- Natural England (NE)
- Catchment partnerships hosted by Hertfordshire and Middlesex Wildlife Trust
- Wildlife Trusts
- River groups

The process has identified a list of risks and issues in each waterbody, and collectively in the operational catchment, which this project and other associated projects will seek to address. These include:

- Abstraction
- Low flows
- River morphology
- Diffuse and point source pollution
- Water quality
- Land management pressures
- Climate change
- Loss of habitat and wildlife
- INNS

In addition, an assessment of groundwater quality issues through our Drinking Water Safety Plans (DWSP) has been undertaken to determine the issues that this project will seek to prevent. These are deterioration and to seek improvements in water quality through catchment-based C&NBS.

Figure 2, 3 and 4 show risk maps covering the Lea operational catchment alongside our public water supply sources where C&NBS measures will be targeted under the best value option. This will build on the lessons learned from our nitrate WFDGW_ND schemes and investigations delivered in AMP7. It should be noted that the high-risk area identified around our North Mymms group of sources is detailed under a separate Business Case and Options Assessment Report (08AF100015).

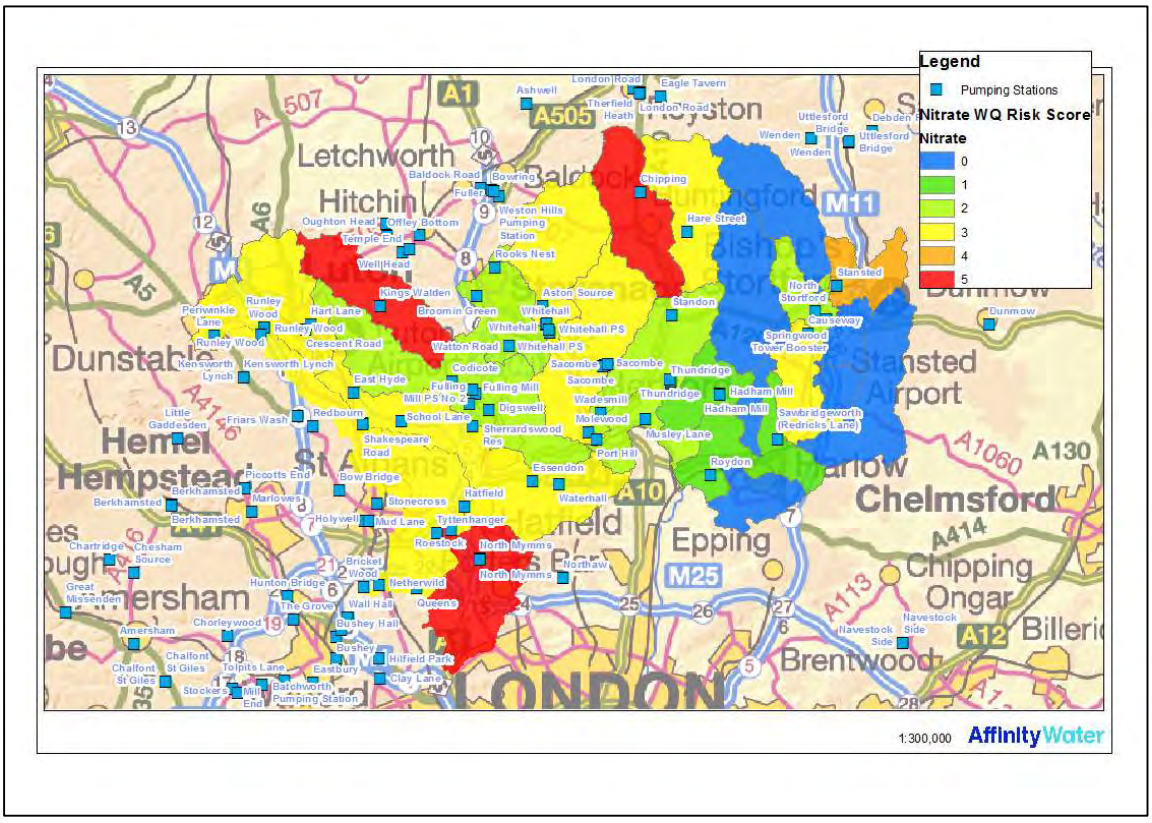


Figure 2. Nitrate water quality risk score heat map

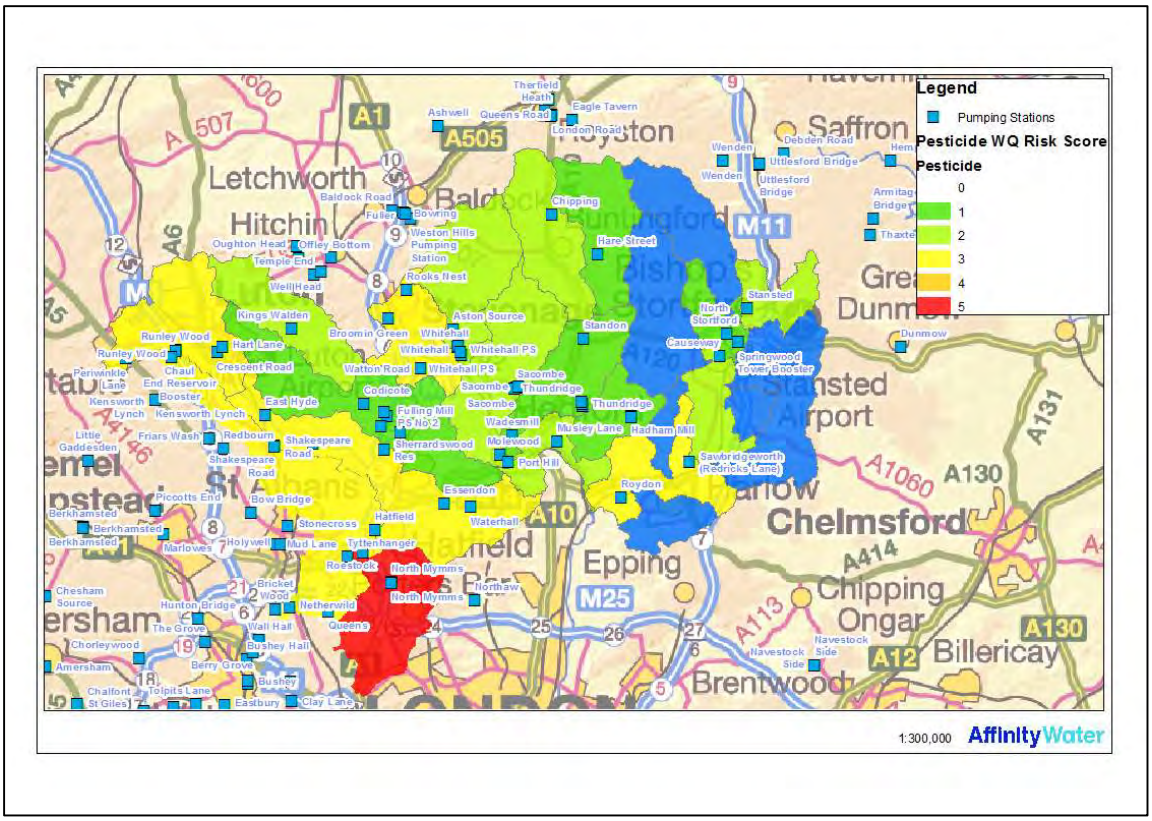


Figure 3. Pesticide water quality risk score heat map

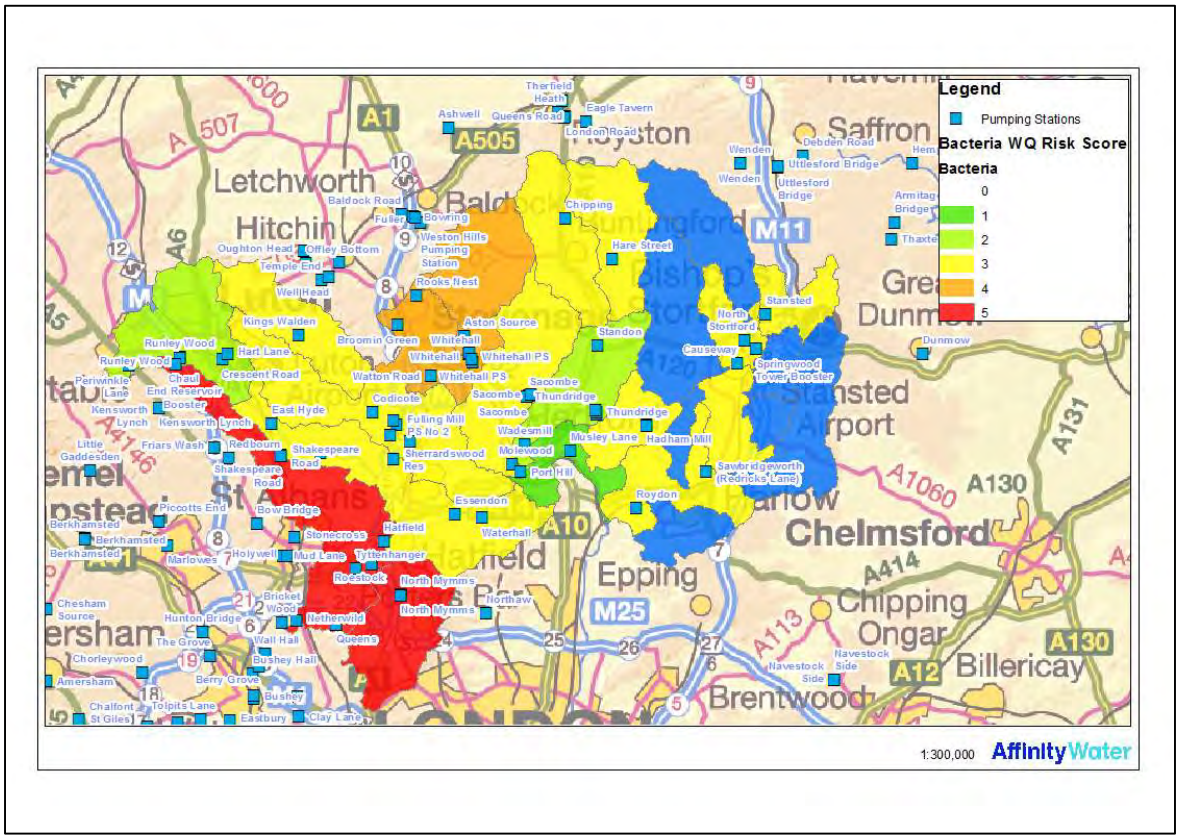


Figure 4. Microbiological water quality risk score heat map

3.3 Drivers for the scheme

3.3.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 4 in section 7.4.3

2) The Drinking Water Directive

The Drinking Water Directive standard for nitrate is (50mg/l NO^3) and for pesticides is (0.1µg/l).

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP)

- Thames River Basin Management Plan

The specific WINEP Drivers relevant to this scheme are:

- WFDGW_ND = Groundwater prevent deterioration action relating to water resource or water quality (S)
- EDWRMP_IMP (S+) = Actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements.
- WFD_IMP_Flow (S+) = Actions to improve ecological status (surface water)
- NERC_IMP (S+) = Actions that contribute towards biodiversity duties, requirements and priorities

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Government's strategic priorities for Ofwat – Policy paper February 2022.
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies.
- AW0031 Affinity Water Strategic Direction Statement.
- Catchment Based Approach (CaBA) chalk stream strategy and implementation plan.
- Blueprint for Water – Blueprint for PR24.
- Relevant Safeguard Zones (Kings Walden and Chipping).
- Lea CaBA Partnership catchment plan.
- Hertfordshire and Middlesex Wildlife Trust (HMWT) State of Nature 2020 report and associated targets.

- Hertfordshire County Council (HCC) Sustainable Hertfordshire Strategy.

3.3.3 Stated Need

The Upper Lea operational catchment is an area of water stress, where the average daily water use is amongst the highest in the country. Groundwater and rivers supply water for local people, and 90% of water abstracted is used for this purpose. This groundwater abstraction impacts on the amount of water available to the environment. In particular, this impacts the rivers in the catchment, especially the globally rare chalk streams, which depend on groundwater baseflow.

Protecting and enhancing our nation's water environment is a priority for the government. One of the government's key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats such as chalk streams. To address these challenges within the Upper Lea, Affinity Water are required to invest through PR24 under the following regulatory and statutory drivers:

WISER: expectations including, but are not limited to:

- Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
- Must include actions to improve water body status to ensure 'moderate' status as a minimum is achieved by 2030.
- Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
- Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
- Create, restore and enhance habitats.
- Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this Business Case please refer to the 'Level of Confidence of Achieving the WINEP Outcomes' in section 7.4.3

Water Framework Directive (WFD)

Restoring good ecological status (GES) to chalk streams.

WINEP: The Environment Agency (EA) and Ofwat expects that the 'best value' option defined in this Business Case takes account of the following wider environmental outcomes:

- **Natural Environment Outcomes**: Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.

- **Catchment Resilience Outcomes:** Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
- **Net Zero Outcomes:** Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of.
- **Access, Amenity, and Engagement Outcomes**: Contributions to improving access to, amenity of, and engagement with the natural environment to support customer and community wellbeing.

DWI long-term Planning Guidance: Expectation that catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all source-to-tap risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness and acceptability of water supplies.

There are many drivers to improve the overall quality of the river with solutions that also support the wider community in terms of achieving net zero, and access and amenity benefits.

3.4 Allocation of Costs

This business case is 100% enhancement and all costs are allocated to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

We have extensive experience over multiple AMP/WINEP cycles in developing and delivering river restoration and catchment management measures. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

Revitalising Chalk Rivers (RCR) Programme – Natural Capital Evaluation of Completed Schemes in the River Beane Catchment (2022)

In 2022, we commissioned Atkins to carry out a Natural Capital Assessment for five of Affinity Water's River Improvement Works (RIW) projects in the River Beane catchment in Hertfordshire. This evaluation sought to quantify and (where possible

and appropriate) value the ecosystem services benefits of our RIW projects completed in AMP6 and AMP7. The purpose of the evaluation is to support our WINEP options development and assessment submissions using evidence from projects that have already been implemented on the ground. The evaluation has helped us understand the wider ecosystem services value of their investments in RIW to support business planning.

The evaluation was undertaken using data sources and assessment methods recommended by the EA's WINEP guidance and supplemented by other recognised tools such as FARMSCOPER. GIS desk-top mapping, site survey information, and site-specific data provided by Affinity Water were combined to quantify changes in ecosystem services by comparing pre- and post-project land cover and in-channel management. The 5 projects evaluated were all of differing size and scale including a small weir removal, in-channel improvements and construction of a large bypass channel.

The results, shown as an overview in figure 5 from the report, have enabled us to benchmark the range of potential RIW projects to be delivered within this scheme in AMP8 and AMP9. This has helped us ensure our benefits assessment for the programme of measures for each of the feasible options are conservative and comparable with this assessment of a range of completed projects.

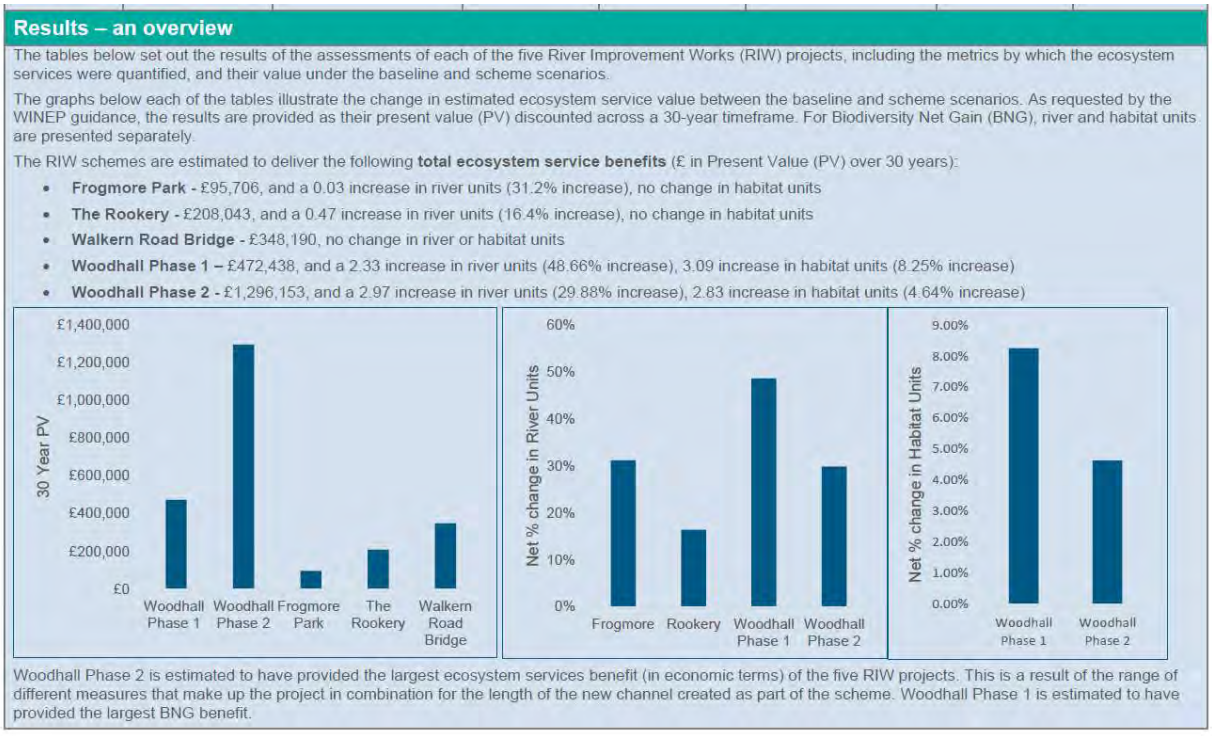


Figure 5. Excerpt from Natural Capital evaluation report on completed RIW projects on the River Beane highlighting the ecosystems services benefits in Present Value over 30 years

Resilient Chalk Catchments (RCC) C&NBS for Water Resources – Catchment Assets for Water Project

To support the development of C&NBS options for the Lea Operational Catchment, we have commissioned a partnership project with South East Rivers Trust (SERT), Catchment Assets for Water (CAfW). The primary aim of CafW approach is to support the valuation of the contribution of natural assets to water resources and resilient catchments at both site and catchment scales. This includes the targeting of nature-based solutions for water, and the tracking and reporting of change in the contribution of various assets to water-related ecosystem services.

The methodology was developed by SERT through the Interreg ProWater project for which Affinity Water were an industry partner. The modelling and output mapping here focuses on identifying the current contribution of habitats in the catchment to the ecosystem service of water supply and quality but does not provide a volumetric or monetary quantification. However, a volumetric quantification of the impact of some measures is attempted in the land use change scenario modelling. The latter approach allows the comparison between scenarios by changing habitat type or condition indicating a reduction or increase in an asset's value/score, and the comparison of different areas within the catchment based on the current value/score. It can be viewed at field and catchment scales. This allows the user to assess potential interventions on a site, as well as understand their context in the wider landscape.

An important benefit of catchment scale maps and this methodology is to identify the potential role of each parcel of land in the wider context of the catchment. This has an important role to play in supporting collaboration on a landscape scale, helping to guide and inform scheme design beyond holding boundaries and bringing scientific evidence to play in discussions.

To support this, the model has been developed as a collaboration between a range of local stakeholders including EA, NE, Catchment Partnership hosts, Wildlife Trust, HCC and other local catchment experts. The model outputs have produced a series of 'opportunity maps' (see Figure 6 and 7), which identify target areas to 'protect' and 'restore' (hatched areas on the maps) where the greatest water resource benefits can be derived. Table 1 below shows the priority 'restore' areas shown in Figure 6 with the different habitats and their respective area (ha). These priority areas, alongside the C&NBS options and modelled benefits using the InVEST model developed by Stanford University, have been used to inform the costs and development of the best value option.

This approach has a number of benefits:

- Methodology and approach have been aligned with the catchment options for our water resource management plan.
- Can be updated and refined to support an adaptive planning approach and/or investigate and develop options for specific issue or need.

- Spatial prioritisation and targeting of C&NBS using scientific evidence and local stakeholder input can support targeted investment to achieve the best value outcomes.
- Taking a Natural Capital (NC) approach can help identify wider benefits and support the investment case for implementation of C&NBS.
- All outputs of the modelling and mapping have been provided to all partners to support co-creation and co-funding of projects as well as join up wider initiatives (e.g. Herts Sustainability Strategy, Local Nature Recovery networks, Biodiversity New Gain, Local Development Plans and Environmental Land Management schemes).
- Further refined at the individual waterbody catchment-scale (this has been piloted as part of the River Beane CaBA Flagship scheme).
- Output NC maps can be used as tools for engagement with landowners, land managers and farmers.
- Revisited throughout AMP8 with the priority areas refined and condition assessments revisited once C&NBS measures have been implemented.

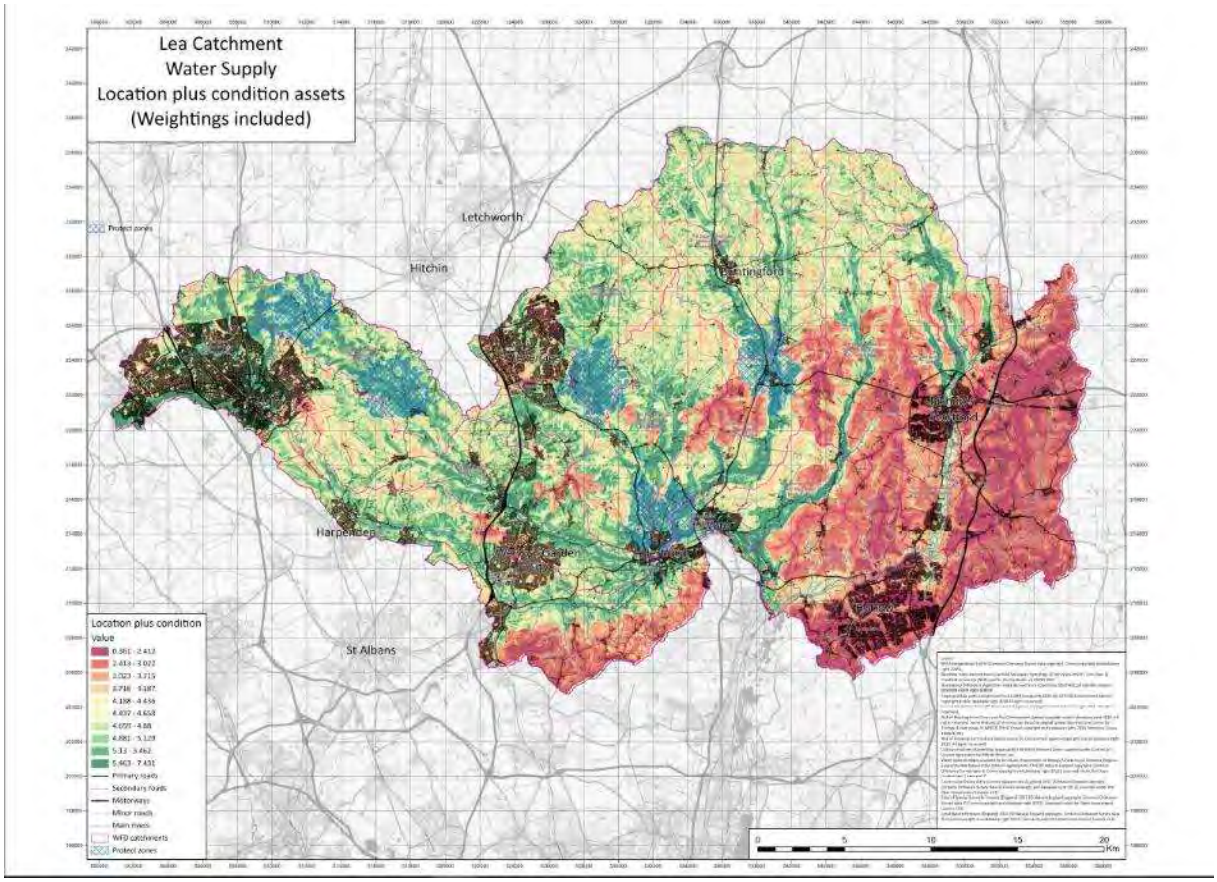


Figure 6. CafW 'protect' NC map with priority areas highlighted for the Upper Lea operational catchment (source: South East Rivers Trust).

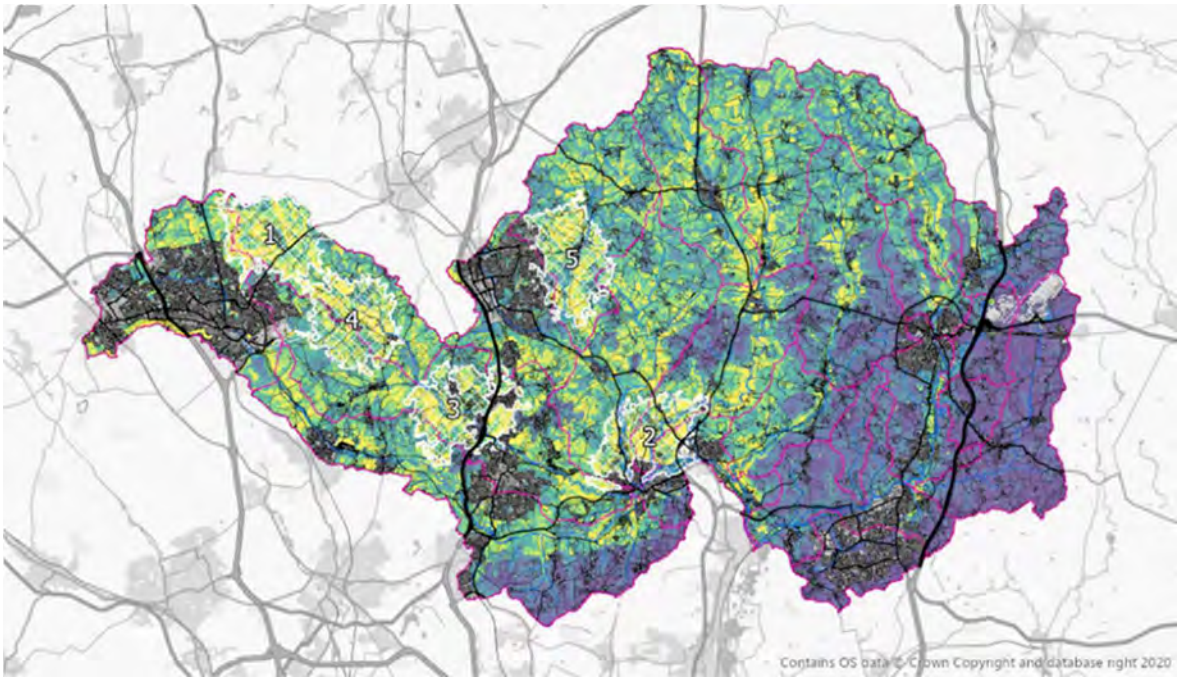


Figure 7. CAfW 'restore' NC map with priority areas highlighted for the Upper Lea operational catchment (source: South East Rivers Trust)..

Table 1: Habitat types and associated area (ha) for CAfW 'restore' priority areas 1-5 with potential C&NBS measures identified in Figure 5

Habitats across all 5 'Restore' clusters	Area (ha)	Estimated possible NbS opportunities for different types*	Area (ha) covered by NbS
Arable and horticulture	6,410		
of which in high impact areas	2177	20% conversion to grassland	368
		40% soil health improvement (cover crops, herbal leys, min. till, ...)	736
of which on dry hilltops and slopes (infiltration priorities)	642	50% soil health improvement	321
		30% conversion to grassland	192.6
of which in both high impact and infiltration areas	337	50% conversion to grassland	168.5
Broadleaved mixed and yew woodland	1,084		
of which in high impact areas	412	10% conversion to wet woodlands (on heavier soils, within local depressions)	29.6
of which on dry hilltops and slopes (infiltration priorities)	233	5% conversion to grassland (on light soils)	5.8
of which in both high impact and infiltration areas	116	20% conversion to grassland (on light soils)	23.2
Built-up areas and gardens	484	Investigate use of SuDS where appropriate	
Coniferous woodland	20		
of which in high impact areas	17	5% conversion to grassland	0.55
		20% conversion to broadleaved woodland	2.2
of which on dry hilltops and slopes (infiltration priorities)	8	100% conversion to broadleaved woodland	8
of which in both high impact and infiltration areas	6	100% conversion to broadleaved woodland	6
Improved grassland	2,159		
of which in high impact areas	64	10% conversion to semi-natural grassland (on light soils and slopes)	5.9
		40% soil health improvement (rotation, species rich leys, ...)	23.6
		5% restoration to wet grasslands incl. features such as scrapes	2.95
		10% conversion to broadleaved woodland (on heavy soils)	5.9
of which on dry hilltops and slopes (infiltration priorities)	177	30% conversion to semi-natural grassland	53.1
of which in both high impact and infiltration areas	5	100% conversion to semi-natural grassland	5
Inland rock	14	NA	
Stream network (DRN) (km)	39.5		
(note - overlap with below)		10% introduce LWDs and similar retention measures on smallest streams	4 km
		50% widen buffer by 2m	4
Riparian corridor (15m from centre of channel)	201		
of which in arable	58	50% convert to buffer strip	29
of which in grassland	102	50% restore wet grassland / floodplain mosaic	51
of which in broadleaved woodland	27	30% restore wet woodland	8.1

** The estimated areas of uptake are based on assumed landowner willingness and engagement with the measures suggested. This is based on experience and previous discussion for similar measures and schemes carried out by SERT, Affinity Water and other partners, but is only a first estimate.*

RCC C&NBS for Water Quality

Natural Capital Evaluation of the EnTrade Cover Crop Scheme (2021)

To better understanding the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. 12 ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 8.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6:1 Natural Capital benefit ratio.

Total value	^	-	-	-	£403,450	£945,069	£541,619
Total value/ha	^	-	-	-	£500	£1,172	£671

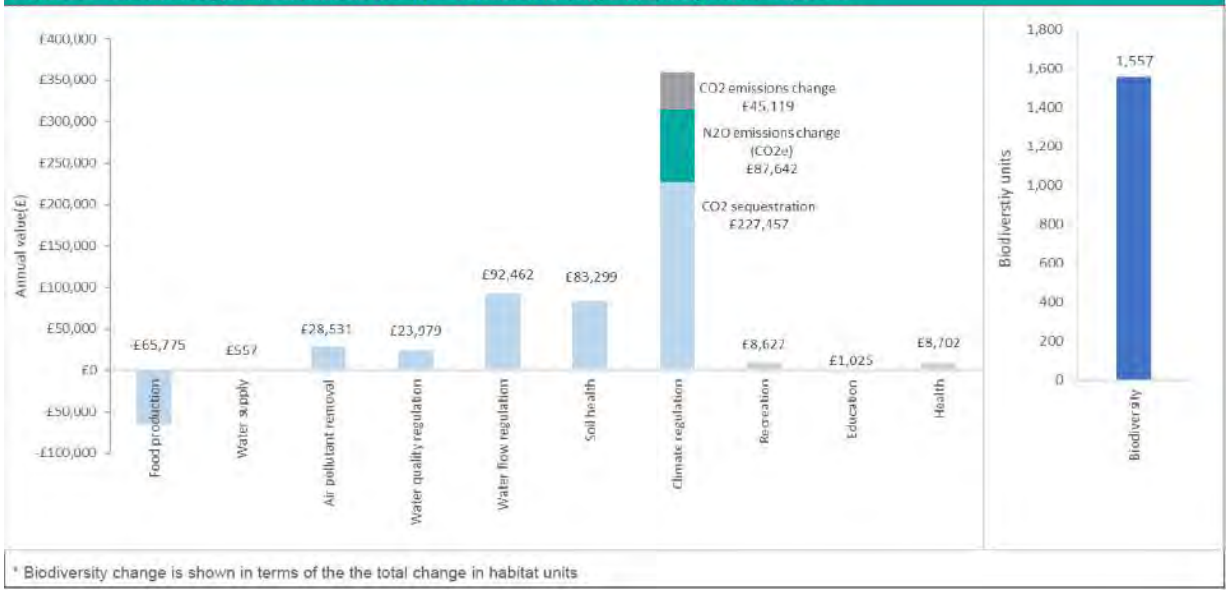


Figure 8. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen Release from Cover Crops (NiCCs) Field Trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil
    - effect of contrasting cover crop destruction methods e.g., glyphosate & minimum tillage vs mechanical destruction & minimum tillage
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was then tracked post cover crop destruction under different management regimes and subsequent cash crops to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit and effective uptake of nitrogen for more sustainable arable farming.

4 Partnering

4.1 Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and

environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concern over costs is, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considered it would have a positive impact on wildlife for the future. Some people considered that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.1.3 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.1.4 Biodiversity

It has been well received by customers that biodiversity and improving river flows will be a priority for Affinity Water, as it shows that Affinity Water are doing more than just offering the required services. During our preferences research, customers

repeatedly chose environmental options that not only achieved the statutory minimum in terms of reducing abstraction, but also has additional benefits from catchments under-going ecological and biodiversity improvements. Customers have also shown support for increasing biodiversity and improving the environment when building large infrastructure schemes.

Our household customers valued the following biodiversity projects most highly: specialist habitats created for wildlife at £3.87 annually; new wetland areas at £3.24 annually; and space provided for sustainable agriculture at £2.61 annually. The households' average valuation of any project addition was considerably higher in the environmental area (£3.05), than either the economic area (£1.19) or the social area (£1.16).

4.1.5 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.2 Collaboration and Partnering

4.2.1 Engagement with Stakeholders and Partners

WINEP Stage 2 – Collaboratively identifying risks and issues

To support the development of the proposed solutions for the risks and issues included in this Business Case, we have undertaken a detailed review of risks and issues for each waterbody catchment. We have taken a collaborative approach to define the PR24 WINEP scope and develop the feasible options and ultimately determine the best value option. As part of this process, carried out between May and August 2022, we have completed the following activities:

- Early engagement with the EA and Natural England (workshops at area level) and follow up meetings meetings/correspondence with Driver leads).
- Reviewed, discussed and incorporated Natural England's Nature Recovery List for our region.

- Detailed review of Catchment Data Explorer, CaBA Catchment Plans, River Group meetings, stakeholder workshops and meetings alongside discussions with neighbouring water companies.
- Documented all risks and issues register collated through this process and used to develop the proposed solution described in this Business Case.

WINEP Stage 3 – Proposing solutions

As part of the development of our proposed solutions to contribute to addressing the risks and issues described in this Business Case, we have undertaken the following engagement and drawn on experience through our AMP7 WINEP programme delivery to explore options around developing, co-designing, and co-delivering schemes which have formed the basis of the feasible options.

We continue to work with a wide range of stakeholders to develop joint solutions. We described the many pilots and research projects that we are currently working on in the areas in a previous section. Through the Revitalising Chalk Rivers partnership with the EA, we are engaging with Catchment Partnership hosts, local river groups, Hertfordshire County Council's Countryside Management Services, and other partners. This has been an ongoing process throughout AMP6 and AMP7, but additional workshops have been coordinated during the Stage 2 Risks and Issues phase with these stakeholders to identify co-funding/co-creation/co-delivery opportunities for river restoration and wider C&NBS.

In addition, we also have a strategic partnership with Herts and Middlesex Wildlife Trust (HMWT) for which quarterly meetings identify opportunities and ensure that delivery of our schemes support delivery of the wider Catchment Plan for the Upper Lea.

4.2.2 Co-design and Co-delivery

Affinity Water and Environment Agency Revitalising Chalk Rivers Prioritisation Methodology

As the competent authority for the Water Framework Directive the Environment Agency will act in an advisory role for proposed river improvement works actions delivered through the best value option. The Environment Agency role will be to advise Affinity Water on whether a proposed project is expected to contribute to improving the ecological status of the waterbody or improve resilience.

The prioritisation is designed to help the Environment Agency to advise Affinity Water on whether projects are suitable to meet the ecological objectives of the river restoration programme. It is expected that other factors will also be considered by Affinity Water when deciding which projects to progress, for example funding, requirements of local groups, feasibility, etc.

A river walkover will be undertaken with both Environment Agency and Affinity Water present. This walkover will be an opportunity to identify reach by reach unconstrained river restoration actions. These actions will then be scored for their environmental benefit and feasibility (as defined below). These scores will then be used to prioritise the river restoration actions (projects) identified from the walkover.

Environmental Benefit

- Use technical expertise to rank actions based on their predicted benefit to ecology.
- Ecology = biological elements as assessed under the Water Framework Directive (fish, invertebrates, plants).
- Feasibility of actions should not be considered (this will be assessed separately as defined below).
- One way of judging benefit is to assess the current impact of modifications on ecology and the degree to which these will be rectified by the proposed action.
- The assessment will be on a scale of 1-10 (decimals are allowed where necessary to differentiate between actions).
- Whilst directly comparable benefit scores between catchments would be nice to have, it is not vital.
- The objective is a prioritised list for each catchment to form a work programme for Affinity Water.
- Projects must be designed to benefit the agreed depleted reaches.

Feasibility

- Score of 1 = project very unlikely to be feasible, leave these off the work programme.
- Score of 2 = project may be feasible. Some significant difficulties anticipated but the project is worth pursuing.
- Score of 3 = project likely to be feasible.

In addition to the prioritisation methodology above, we are also engaging with wider partners through the following:

- EA and Natural England through Stage 2 Risks and Issues workshops held in June 2022
- Catchment partnership hosts and other key stakeholders through risks and issues review (stage 2)
- Catchment Assets for Water (CAfW) stakeholder led project detailed above
- Stakeholder consultation with River groups and catchment partnership hosts. Feedback has included:

> *'Asks' for plans – just to engage as much as possible to ensure the wider public understands the issues and their role in the issues and how to make improvements. As you would expect, funding is always going to be a restricting factor for the partnership and financial support would be gratefully received and would allow much greater planning and impact rather than the annual wait to be informed whether we have any funds. We would like to see the design and delivery of projects by yourselves continue as this has been a key way to get improvements completed.* [redacted] **Luton Lea Catchment Partnership host (Groundworks)**

- Landscape Enterprise Networks (LENS) East Anglia:

Affinity Water alongside Anglian Water and a number of companies within the agricultural supply chain including Nestlé Purina and Cargill are co-funding C&NBS measures in the Upper Lea operational catchment with a focus on regenerative agriculture measures to deliver a range of ecosystem services including: soil health, biodiversity, carbon and water quality. We are working with 3Keel and the investment partners to further develop the scheme for future years which will support our 20% aspirational partnership funding contribution.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

5.1 Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this Business Case.

5.2 Catchment Strategy

This business case is aligned with the Catchment Options development as set out in our draft Water Resources Management Plan and will inform the development of

our Upper Lea Catchment Strategy which is currently under development. This will align with existing catchment plans for the Lea catchment partnerships and CaBA chalk stream restoration strategy implementation plan for the River Beane.

C&NBS will be prioritised in areas of the catchment identified as priorities within our CAfW modelling and align with our sustainability reduction programme, particularly our cessation of abstractions at Codicote and Kings Walden pumping stations and where no deterioration licence capping is taking place. Priority will also be given to river improvement works in the waterbodies where reductions or cessations of abstraction have already taken place.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation of this scheme are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS and river improvement works projects, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS. The scheme can adapt to:

- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g., Wastewater company schemes, Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities (e.g., offsetting)
- Types of measures implemented can adapt and evolve based on future scientific evidence.
- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships, Rivers Trusts.

6 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

We have followed a structured process to identify a wide range of potential options captured in the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 2 – Upper Lea catchment Option Evaluation v1.0.

We have then assessed these further, with additional information; by developing hybrid solutions that take the best actions from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

6.1 Unconstrained List

Our options include a combination of land management focused C&NBS referred to as Resilient Chalk Catchments (RCC) and a river restoration / river improvement works options referred to as Revitalising Chalk Rivers (RCR). For the RCR options we have defined the options into a series of 'small' and 'large' projects. A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of both RCC and RCR C&NBS options are described for the best value option, with further examples of AMP6 and AMP7 river improvement works can be observed in Appendix 3 – AWL River Restoration project examples AMP6-AMP7.

Unconstrained options documented in Table 2 that are chosen to either 'Proceed' or 'Clarify' are then included in our constrained list with additional screening using Options Evaluation spreadsheet. Options that are 'Rejected' due to not meeting Statutory and Non-Statutory requirements do not proceed beyond the unconstrained list below.

Our unconstrained list of options are:

Table 2 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on treatment options and agreed sustainability reductions	R	Does not meet S and NS requirements
2	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects.	R	Does not meet S and NS requirements
3	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river)	R	Does not meet S and NS requirements
4	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river)	C	See Options Evaluation spreadsheet
5	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river)	C	See Options Evaluation spreadsheet
6	Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
7	Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)	C	See Options Evaluation spreadsheet
8	Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	R	Does not meet S and NS requirements
9	Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Does not meet S and NS requirements
10	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
11	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC)	P	See Options Evaluation spreadsheet

	C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)		
12	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	C	See Options Evaluation spreadsheet
13	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	C	See Options Evaluation spreadsheet
14	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
15	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)	P	See Options Evaluation spreadsheet
16	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
17	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	P	See Options Evaluation spreadsheet
18	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
19	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial	P	See Options Evaluation spreadsheet

	targeting using CAfW and DWSP WQ heat maps)		
20	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
21	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Disproportionate, expensive and deliverability issues

6.2 Constrained List

Eleven options have been selected from the original 21. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 2) is presented below in Table 3 to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 3. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
Revitalising Chalk Rivers (RCR) option 2	**NNN**	**YYY**	**YYY**	**YYY**
Revitalising Chalk Rivers (RCR) option 3	**NN**	**YYY**	**Y**	**NNN**
Resilient Chalk Catchments (RCC) C&NBS option B	**NN**	**YY**	**YYY**	**YYY**
Revitalising Chalk Rivers (RCR) option 1 - Standard and Resilient Chalk Catchments (RCC) C&NBS option B	**N**	**Y**	**YYY**	**YYY**

Revitalising Chalk Rivers (RCR) option 1 - Standard and Resilient Chalk Catchments (RCC) C&NBS option C	N	Y	YYY	YYY
Revitalising Chalk Rivers (RCR)) option 2 and Resilient Chalk Catchments (RCC) C&NBS option B	YYY	YY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option C	YYY	YYY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option D	YYY	YY	Y	Y
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option B	YYY	YYY	N	NN
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option C	YYY	YYY	N	NN
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option D	YYY	YYY	NN	NNN

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

Our final set of three feasible options are:

1. River restoration (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)
2. River restoration (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)
3. River restoration (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)

No C&NBS (river restoration or catchment management schemes). Focus solely on treatment options and agreed sustainability reductions. This is discounted as a feasible option.

6.3.1 Option 1: Preferred, Best Value, Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues engagement process. The proposed option includes:

RCR – The best value option has been developed building on our extensive experience of delivering river improvement works in chalk stream catchments in AMP6 and AMP7. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. The experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs.

A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. Examples of a small project could include:

- Tree works to allow more light into the river channel.
- Encouraging the development of new habitat through growth of macrophytes (plants)

- Fencing along the riverbank to prevent livestock or horses from damaging the riverbanks and channel, thus reducing sediment input and allowing vegetation to establish along the river margins and in the channel.
- Planting of native aquatic macrophytes where these are absent and unlikely to colonise naturally.

A large project would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of a large project could include:

- Removal of a weir or structure and regrading of river channel up and downstream.
- Creating chalk stream habitat
- Bypassing of a weir or structure to allow fish passage and help establish typical chalk stream features.
- Restoring the river channel to its original location in the flood plain/valley bottom.

RCC – the best value option includes a programme of land management focused C&NBS that will be spatially and temporally targeted to:

- Reduce nitrate leaching to groundwater in priority areas identified through modelling carried out in AMP6 and AMP7 and build on the AMP7 nitrate WFDGW_ND schemes and investigations in this operational catchment.
- Protect and restore natural assets in the operational catchments identified through the Catchment Assets for Water (CAfW) project detailed above to improve water resource and chalk stream resilience in this operational catchment.
- Implement appropriate C&NBS measures upstream of river improvement works under the RCR to ensure greater resilience of those schemes and maximise environmental benefits through a holistic catchment management approach.
- Deliver multiple benefits for water quality, resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Cover crops
- Herbal leys
- Resurfacing of farm gateways
- Arable reversion
- Chalk grassland restoration
- Tree/woodland planting
- Regenerative agriculture measures such as reduced/no tillage

Total cost (FY2022/23 cost base) - not including partnership co-funding phased across AMP8 and AMP9 as per the WINEP =

AMP8 totex costs (£m)	**£4.314m**
AMP9 costs (£m)	**£2.428m**

The best value option has been phased across AMP8 and AMP9 in accordance with our third release of the WINEP in July 2023. This reflects deliverability challenges agreed with the EA. For further information see section 10 of this Business Case.

6.3.2 Option 2: Least Cost Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using CAfW and DWSP WQ heat maps)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£6.323766m**

The least cost option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to enhance water resources for groundwater (CAfW) and water quality drivers and not targeted upstream of RCR projects to deliver multiple benefits and wider environmental outcomes.

6.3.3 Option 3: Alternative Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 totex costs (£m)	**£11.053171m**

Alternative option is similar in scope to the best value option for river improvement works (RCR) but proposes a significant increase in the scale of developing a programme of land management C&NBS without spatial targeting with measures being funded and implemented across the whole operational catchment. This option will prioritise the risks and issues identified in the Stage 2 WINEP risks and issues

engagement process, but also contribute to achieving wider environmental outcomes to meet the 25 Year Environment Plan.

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high-**level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER) as detailed in Table 4 below. It demonstrates a significant increase in ambition compared to AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP/WINEP programmes, including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits.

6.4.2 Option 2: Least Cost Option

The least cost feasible option has a **medium** level of confidence in the achieving the WINEP wider environmental outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes. This option takes a less holistic approach to delivering C&NBS and is less likely to address many of the reasons for chalk streams caused by land management within the Lea operational catchment.

6.4.3 Option 3: Alternative Feasible Option

Option 3 has a **high**-level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP/WINEP programmes including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits. This option shows a significant increase in ambition and

financial investment in C&NBS. However, the less targeted approach to delivering C&NBS and greater level of intervention required may not deliver the best value for investments in nature-based solutions for our customers. This option could also lead to deliverability issues due to the scale of intervention required.

Table 4: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the Lea Operational Catchment

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. RCR/RCC C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	The PR24 programme must include actions to improve water body status to ensure that moderate status is achieved by 2030 as a minimum and improve further where technology allows	RCR schemes developed in partnership with EA and associated C&NBS measures will support meeting moderate status.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Water body status	Water companies should apply the fair share approach when developing measures to address nutrients	Funding of C&NBS to mitigate nitrate leaching to groundwater will also take account of wider ecosystem services benefits.
Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures using CAfW spatial mapping will target opportunities for more resilient water resources and mitigate deterioration of water bodies.
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures will be deployed in the DrWPA to reduce pollution losses from land management activities (nutrients and pesticides) into chalk streams and improve water quality for downstream Thames Water surface abstractions

Drinking Water Protected Areas	Groundwater bodies must also meet good groundwater chemical status and upward pollutant trends should be reversed.	C&NBS measures will be deployed in groundwater SgZ's to mitigate nitrate pollution of groundwater and associated impact in chalk stream quality
Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for nitrate in groundwater delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	RCC C&NBS primary focus on arable farming building on AMP6 and AMP7 catchment management schemes.
Environment Bill	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits
Environment Bill	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits including biodiversity
Environment Bill	Anticipated that water companies will need to have regard to the priorities set out in the LNRS covering their operational area when agreeing PR24 priorities.	AWL engaging with HCC, HMWT and NE on priorities of LNRS.
Environment Bill	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnership Working section 5.2 Strategic Partnership with HMWT established.
SSSI	We expect water companies to contribute to maintaining or achieving SSSI favourable condition both on their own land and in the catchments they operate in.	RCR and RCC C&NBS will prioritise opportunities for measures delivered on SSSI's within Lea Operational Catchment as appropriate.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	RCR and RCC C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.
NERC Act 2006	Sustainable abstraction, reducing demand for water and reducing pollution, particularly from storm overflows are key actions water companies should take to protect and enhance chalk streams. In line with CaBA Chalk Stream Restoration Strategy 2021, water companies should lead on behaviour change around water resources, encouraging customers to use and pollute less. Water companies should drive innovation solutions and lead the way on water supply issues, demand management, sewerage and sewage treatment.	RCR schemes will protect and enhance chalk streams, particularly supporting sustainability reductions. RCC C&NBS measures will seek to reduce pollution for enhanced chalk stream resilience. Flagship CaBA Chalk Stream Restoration projects in the Beane (Lea) and Chess (Colne).

Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.
Healthy and resilient fish stocks	Water companies should identify measures to improve abstractions and outfalls to prevent the entrainment of fish and to address barriers to passage of fish factoring in the wider benefits of fish pass solutions such as improved geomorphology. Removal of barriers should always be considered as first option.	RCR schemes designed and developed to improve fish passage (e.g. weir removal) and improve geomorphology.
Eels	Water companies must comply with the requirement of the Eels regs 2009 to support the recovery of the European eel stock.	RCR schemes designed and developed to support eel migration (e.g. weir removal) and improve geomorphology to support recovery.
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Natural environment	Help create climate resilient places and improve the resilience of communities to droughts, floods and coastal change by implementing cost-effective co funded solutions	RCR and RCC C&NBS measures within this scheme will support more resilient chalk stream catchments to flood and drought.
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	RCR and RCC C&NBS measures within this scheme will support resilient chalk stream catchments and sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	RCR and RCC C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance chalk stream habitats.
Flood resilience	Water companies should contribute to partnership schemes to reduce flood risk to communities and themselves	This scheme will align with EA Lea2100 vision.
drainage resilience	Water companies and other risk management authorities should work together to manage water in a more integrated way to improve flood resilience, enhance the natural environment and deliver value for customers	RCC C&NBS measures within this scheme will identify opportunities to use NFM measures to slow flow and hold more water in headwaters of chalk stream catchments.
Water supply and environmental resilience	Water company plans should protect and improve the environment, considering both current and future challenges. This could mean tighter environmental protection for some sensitive habitats such as chalk streams, to meet env objectives.	RCR and RCC C&NBS measures within this scheme will seek to protect chalk streams in the Lea Operational Catchment.

Water supply and environmental resilience	WCs should consider whether their abstractions are truly sustainable looking across a catchment as a whole and consider investment in integrated catchment schemes to improve drought resilience and WQ.	RCR and RCC C&NBS measures in this scheme integrated alongside SR programme.
Climate Change	Water companies are expected to adopt nature based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2
Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature based solutions	Experience of this through AMP6 and AMP7 river restoration programmes. AMP7 C&NBS measures co-funded through EnTrade and LENS. Experience and lessons-learned adopted for PR24.
Climate Change	Water companies should invest in the restoration of natural form and function of the catchments and wider landscapes in which they operate to contribute to resilience to the impacts of climate change	RCR and RCC C&NBS measures within this scheme will seek to protect, restore and enhance chalk stream catchments in the Lea Operational Catchment.
Climate Change	WCs should improve the natural resilience of the catchments in which they operate by restoring their natural function. Water companies should ensure that solutions build resilience of biodiversity in catchments, river systems and water bodies.	RCR and RCC C&NBS measures within this scheme will seek to create more resilient chalk stream catchments in the Lea Operational Catchment with focus on delivering multiple benefits including biodiversity.

6.4.4 Can the Option Provide Net Benefits?

Option 1: Preferred, Best Value, Option

By aligning C&NBS measures upstream of river restoration and habitat enhancement schemes, the best value option can provide the following net environmental benefits:

- Enhanced resilience for the effectiveness of delivered river restoration schemes (e.g. reduction in sediment and pollutant loading) and increased likelihood of achieving overall Good Ecological Status (GES).
- Provide greater connectivity of habitats in priority areas for RCR/RCC measures to support achievement of non-statutory requirements such as the HMWT State of Nature targets for creating 30% more habitat by 2030.
- Provide greater flood and drought resilience through more sustainable land management practices.
- Improved water quality to support chalk stream ecology.

Option 2: Least Cost Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process and deliver net benefits. This option takes a less holistic approach to implementing land

management focused C&NBS alongside river improvements works and thus not realising additional net benefits described in the other options.

Option 3: Alternative Feasible Option

In addition to the net environmental benefits stated in the best value option, by implementing wider C&NBS measures at the 'whole catchment' scale there is an increased likelihood of a net benefit contribution to achieving wider environmental outcomes for biodiversity, climate change regulation, surface and groundwater quality and increased likelihood of achieving overall Good Ecological Status (GES) across all waterbodies in the Upper Lea.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support the achievement of meeting the WINEP wider environmental outcomes. Some examples are shown below, but not limited to:

Natural Environment Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Lea operational catchment which provide greater habitat and supporting ecology for priority species such as water voles.

Catchment Resilience Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Lea operational catchment with support C&NBS measures to provide greater chalk stream resilience to land management pressures such as reduction in upstream sediment losses.

C&NBS measures targeted using CAfW outputs to hold more water on the land to enable improved infiltration and aquifer recharge, slower flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

Access, Amenity, and Engagement Outcomes

River restoration and habitat enhancement schemes to improve the chalk streams in the Lea operational catchment can provide greater connectivity between the precious chalk streams and their local communities, enhancing access and recreation opportunities.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes.

This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. It will utilise the modelling outputs from the CAfW project and water quality risk review to identify priority areas for C&NBS measures to achieve the greatest benefit for water resources and water quality, as well as aligning with wider priorities and non-statutory drivers.

There is also a greater co-design and co-funding approach to this option as it will seek align with wider partner projects, support and co-fund future Environmental Land Management Schemes (ELMS), catchment partnership plans and Local Nature Recovery Strategy (LNRS) and Lee2100 vision (natural flood management) projects.

The proposed river restoration and habitat enhancement programme (RCR) will be adaptive and developed in partnership with the EA and catchment partnerships and use a Natural Capital assessment framework to ensure the greatest environmental benefit is derived for every pound invested.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but without targeting of C&NBS measures upstream of RCR projects. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements but increases the likelihood that river improvement works project do not deliver longer term environmental benefits they will not be delivered holistically with land management C&NBS designed to increase the resilience of river improvement works and deliver multiple environmental benefits to support meeting GES and the wider environmental outcomes.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but with less spatial targeting of C&NBS measures. This option will seek to invest in a significantly larger number of measures and will require a greater level of investment. This option is less appropriate to the size and complexity of the environmental risks and issues and could create duplication with wider environmental programmes such as ELMS and is less adaptive than the best value option.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business Cases by PR24 Red Team
    b. Review of Business Cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 4 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 5.

Our economic and analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted and marked as 'proceed' in our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We have also used our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

7.2 Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. For both the RCR and RCC options, a bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes that we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1.

7.3 Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.323m** in partnership funding contributions towards the non-statutory tertiary driver aspects of the Upper Lea C&NBS WINEP scheme across AMP8, with further partnership funding contribution estimated for AMP9. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Participate as a buyer in the Landscape Enterprise Network East Anglia and work closely with our buyers of ecosystem services to target and co-fund measures in our priority areas in the Upper Lea. We have successfully achieved this in AMP7 as a pilot in the Upper Lea catchment.
- Establish an AMP8 5-year formal partnership agreement with the CaBA Lea Catchment Partnership hosts, Herts and Middlesex Wildlife Trust. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Identification, scoping and co-funding/co-delivery of river improvement works.
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Working in partnership with neighbouring water companies and water and sewerage companies that overlap our supply area to identify co-funding opportunities that mutually benefit each company.
- Work with key stakeholders to explore options with working with farm cluster groups in the Upper Lea to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

7.4 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics, and if these materially impact the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the rivers that we are restoring are unique in nature and therefore of higher environmental value to society.

7.5 Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The Business Case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g. hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

7.6 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. This experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs. Additionally, our experience of delivering a range of large and small projects has enabled a good understanding of the true costs of delivering such projects. In AMP6 and AMP7, the mean average cost of delivering a river restoration project unit (equivalent to one small project) was £124,245 not including monitoring

costs and actual costs at time of implementation (cost range 2016-2022). Our unit cost model cost for this proposed scheme has been estimated at £160,871 per unit in 2022/23 price base (not including monitoring costs). This increase also includes associated overheads and is reflective of the increased ambition and scale of the river restoration programme, and associated resource requirements. This will result in an increased reliance on our supply chain for aspects of delivery including stakeholder engagement, design and construction elements, where internal resource would have been used previously.

7.7 Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

8.1 Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement water quality, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

8.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the river restoration investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable

Air quality	Monetised as per WINEP and impacted by the natural capital investments
Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the River Upper Lea will improve to some extent from Poor to Moderate status as a result of our restoration activities.

- We have calculated the total length of the Upper Lea, Mimram, Rib, Ash and Stort to be 126 km. This does not include the Beane which is captured in the Beane flagship project business case.
- We have assumed that the whole length is currently in Poor condition as per Catchment Data Explorer.
- We have assumed that the water quality benefits will be realised after 7 years. this is based on the AMP7 Frogmore Park scheme NC evaluation carried out by Atkins (see section 4.5).
- We have assumed that both our river restoration and natural capital activities will make a proportional start to improving the water quality and that further, future activities will be required to achieve full Moderate status for the whole river system. Because the natural capital activities will change in the options, we have assumed that the least cost option will only deliver a 5% improvement towards Moderate status: the preferred option 10% and the alternative option 12.5%. Our previous river restoration projects suggest that these are conservative estimates. We have selected these conservative values due to the dependency on flow to support these improvements. We also recognise similar activities from other partners including river groups, the EA and catchment partnerships to support the improvement to Moderate Status in addition to our proposed activities.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

Air Quality Pollution Reduction and CO_2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 10-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we have to assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g. cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

- We have assumed that the preferred option will impact a total of 9,300 hectares, comprising of: 4,675 ha of enclosed farmland; 43 ha of freshwaters, open waters, wetlands and floodplains; 3,659 ha of semi-natural grasslands; and 923 ha of woodlands.
- We have reduced these values to 7,450 ha for the least cost option and increased the value by 22,800 ha for the alternative option, assuming the same profile of land use.

8.4 Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is highly cost beneficial for both the river restoration and natural capital activities. Jointly these activities will provide significant environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a positive NPV of **£5.164m,** and a good benefit / cost ratio of **1.81**. The benefit / cost ratio is higher than both the least cost and the alternative options, demonstrating best value.

We have assumed a 10 % increase in water quality in the analysis. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. For example, our recent river restoration on the River Beane has delivered biodiversity net gains across the different areas in river units between 16% and 49%, with a weighted average of 28% based on river length. There is also a corresponding average improvement of the habitat units of 6%. Similarly, our cover cropping scheme realised a river water quality benefit of over 40%; CO_2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 4% would result in cost benefits. This provides a high-level of confidence that the scheme will be cost beneficial.

The natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

8.5 Least Cost Option

The least cost option is cost beneficial with an NPV of **£0.757m** and a benefit / cost ratio of **1.13**. This is logical because the preferred option has the additional natural capital activities to fully build upon the river restoration work to optimise the overall environmental benefits.

8.6 Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, with a forecast NPV of **£6.996m**. However, the benefit / cost ratio is not as high as the preferred option, **1.63**, showing that the return on investment is not as high as for the preferred option. It should be noted that there are uncertainties in the benefit estimation in the options. It is prudent to work on the preferred option initially and monitor progress; to better understand how best to invest in the future; and then to secure on-going environmental improvements, where we have a higher level of confidence of benefit realisation.

8.7 Alternative Option 2

There was no second alternative option in this analysis.

8.8 Non-Monetised Information

We have applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Flooding reduction from woodlands
- Arable production
- Livestock production (dairy and meat)
- Timber removal
- Recreation

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least cost option; all in proportion to the number of hectares set aside for the production. There will clearly be some benefits from arable and livestock production, but these

are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

8.9 Wider Environmental Outcomes

8.9.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.9.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v

Not assessed within options development and appraisal		o
Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o

8.10 Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Estimates of the benefits have been made and the scheme is clearly cost beneficial in terms of both river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis has been benchmarked against the Natural Capital evaluation carried out by Atkins of the river improvement works completed on the River Beane. Additionally, from our Natural Capital Evaluation of the EnTrade Cover Crop Scheme in 2021, detailed in section 4.5 has demonstrated that greater environmental net gain benefits can be derived from our C&NBS measures targeted effectively. We will review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**1.81** compared to **1.13**). The alternative option of doing more does not offer better value as the costs do not provide as much additional benefit, with a benefit / cost ratio of **1.63**.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. Our sensitivity analysis shows that the river restoration will be cost beneficial if there is more than a 4% increase in river water quality and ignoring the natural capital benefits. When this is considered with our conservative assumptions, the project is worthwhile and will be strongly beneficial to customers and society.

The best value option aligns with the WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments and will be delivered alongside our AMP8 and AMP9 Sustainability Reductions programme to maximise the benefits of abstraction reductions on the chalk streams we are seeking to protect and restore.

9 Delivery Considerations

9.1 Related Projects

This project is similar to our other river restoration and catchment improvement schemes. Collectively they form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in several of our groundwater sources in the operational catchment and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25 years.

The effectiveness of river improvement works is also dependent upon the effectiveness of sustainability reductions and/or impacts of land management activities and climate change in terms of providing additional flow. The prioritisation of C&NBS schemes delivered by this project will be aligned with our current and future sustainability reductions programme and targeted in the headwater areas of the catchments (subject to landowner agreement and participation) to hold more water in upper reaches in order to maximise the benefits of C&NBS and any reduction or cessation of abstraction. River improvement works, where appropriate, will be targeted further down the catchments where greater ecological benefits can be derived.

9.2 Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 river restoration and catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to an operational catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our extensive experience of delivering small and large river improvement works has enabled us to better understand the risks, issues and opportunities that can arise and how to develop the programme more efficiently.
- Our experience of engaging with landowners and local environmental groups and knowledge of the chalk stream catchments where future schemes are proposed for AMP8 and AMP9 will allow us to deliver an ambition programme drawing on partnership support and contributions.
- The Natural Capital evaluation of our river improvement works completed to date in the River Beane catchment has been really useful in understanding

the potential benefits of these type of schemes and informing this benefits assessment.

- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits beyond the primary groundwater nitrate (WFDGW_ND) driver.

9.3 Delivery Risk Management

We have already delivered similar river improvement works and catchment management schemes, and therefore have a strong understanding of the delivery risks and how best to manage these. However, the most significant risk to the project is delivering the ambitious target for river restoration projects and associated units due to permitting and landowner permission constraints. To mitigate this we have proposed phasing of the best value option across AMP8 and AMP9 in recognition of the long lead in time for delivery of some projects and the number of projects that do not progress beyond detailed design as a consequence of permitting constraints such as Flood Risk Activity Permits (FRAP), planning permission, impoundment licensing requirements and landowners not wishing to proceed.

A further significant risk to the project is securing partnership funding. This is beyond our control, being dependent on partnership funding (e.g., through catchment partnership, financial contributions through catchment-trading mechanisms (e.g., agricultural supply chain) and other government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

The following risks and mitigations have been identified for this project:

- Delays in delivering river improvement works due to delays and/or limitations from permitting/flood risk modelling outcomes.
    - Our RCR partnership with the EA and regular engagement can help manage risks and issues around permitting/flood modelling.
    - We will commence permitting applications at the earliest possible stage and engage with the EA in a timely manner with an understanding of timescales.
- Lack of permission from landowners to carry out river improvement works.
    - We will use an adaptive management approach to identify wider opportunities for projects in alternative reaches.
    - We will utilise our Agricultural Advisory specialists and other partners in the catchment to engage with landowners.

    - Opportunities through schemes such as ELMS to work constructively with landowners and generate additional funding streams.
- Uncertainties around climate change and associated flood, drought and other impacts.
    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8 and AMP9.
- Increasing demand at a national level for specialist contractors to deliver river improvement works leading to delays in overall programme delivery.
    - We have an established framework with a number of the specialist contractors already delivering projects on our behalf which will build on for AMP8 and AMP9.
- Increasing cost of resources to deliver projects.
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs.
- Farmers and land managers unwilling to engage with us on land management C&NBS.
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable Agricultural Advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes.
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS.
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

9.4 Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits we will undertake the following activities alongside our abstraction impact assessment monitoring in our Water Resources business case:

- Baseline monitoring and long-term benefits monitoring for river improvement works in catchment, alongside our sustainability reduction programme including the following:
    - Flow gauging
    - Macrophyte and macroinvertebrate surveys
    - Groundwater level monitoring
    - Rain gauge monitoring

- Chalk stream monitoring linked to our land management C&NBS including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring
- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the Business Case and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 9 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott McDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each scheme we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on schemes carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each investigation will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, km of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

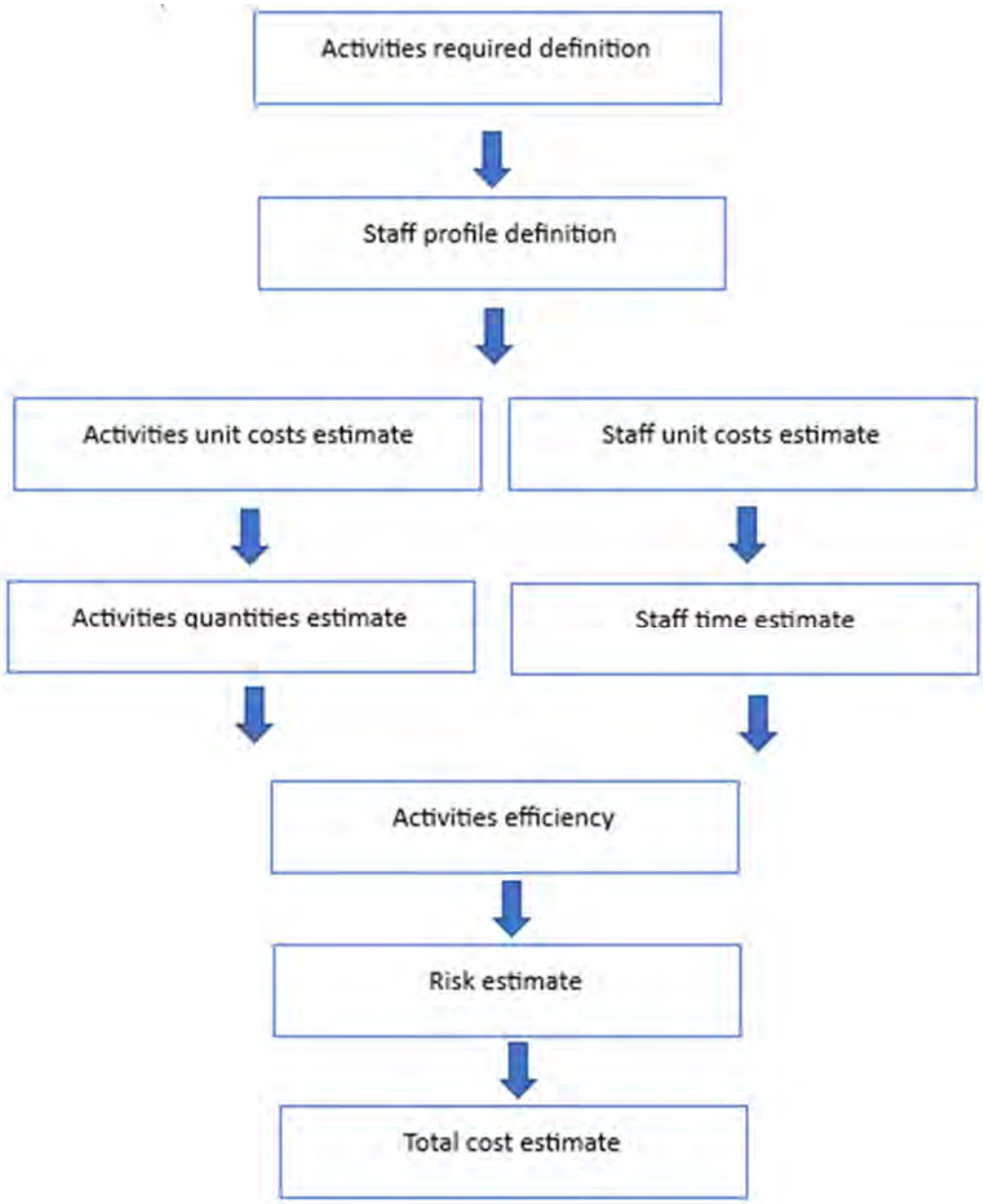


Figure 9 Cost Estimate workstream diagram

Activities quantities estimate: for each activity we determined the most likely quantities based on the agreed objective of the investigation. The quantities have been calculated using maps tools here appropriate (e.g. km of watercourse) as well as experience gained from previous AMPs investigations. Where possible, significant attention has been paid to make efficiency across investigations. For instance, quantities of field monitoring rounds required for a scheme have been reduced if a nearby scheme included larger monitoring rounds.

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar schemes undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director time have

been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Activities efficiency: where possible, significant attention has been paid to make efficiency across investigations. For instance, field monitoring rounds estimated for a small investigation have been incorporated into a nearby larger investigation monitoring activity, so that time and resources spent are minimised.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – Affinity Water WINEP Stage 2 Risks and Issues Register v1.0

Appendix 2 – Upper Lea catchment Options Evaluation v1.0

Appendix 3 – AWL River Restoration Project Examples AMP6-AMP7

Appendix 4 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 5 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Ivel and Cam catchments

Catchment and nature-based solutions (inc. River restoration)

August 2023

Contents

1 Summary

This business case sets out the detailed PR24 WINEP options development process and outcomes for our proposed Ivel operational catchment and Cam, Rhee Granta operational catchment programme of catchment and nature-based solutions (C&NBS) for AMP8. Additionally, it includes additional scoping, costs and benefits assessment to continue the programme into AMP9 as part of a longer-term planning horizon and phasing of the best value option. Affinity Water operates in the upper parts of these operational catchments, so this report refers specifically to the waterbodies listed below.

The best value option sets out to address the following challenges:

- Manage the drinking water quality pressures for our groundwater sources including but not limited to the following Safeguard Zones:
    - GWSGZ0271 - Slip End
    - GWSGZ0272 - Oughton Head
    - GWSGZ0273 - Offley Bottom
- Contribute towards mitigation of the impacts of climate change at the operational catchment-scale to create more resilient catchments for water resources.
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and the reasons for deterioration (RFD) in the following waterbodies:

    - GB40601G603000 - Upper Bedford Ouse Chalk
    - GB40501G400500 - Cam and Ely Ouse Chalk
    - GB105033037720 - Ivel (US Henlow)
    - GB105033037700 - Hiz (DS Hitchin)
    - GB105033037680 - Hiz (through Hitchin)
    - GB105033037480 - Cam (US Newport)
    - GB105033037550 - Cam (Newport to Audley End)
    - GB105033037590 - Cam (Audley End to Stapleford)

The 'best value' option described in this business case defines a landscape-scale programme of Catchment and Nature-Based Solutions (C&NBS) for the waterbodies listed above including the River Cam, part of the Cam Rhee and Granta operational catchment, and River Ivel and River Hiz (including River Oughton) that form part of the Ivel operational catchment within our supply area. This includes river improvement works through our Revitalising Chalk Rivers partnership and a programme of spatially and temporally targeted land management measures that can deliver multiple benefits including reduced pollution in surface and groundwater; improved soil health; greater water-holding capacity on land for flood and drought resilience; net zero benefits and biodiversity enhancements.

We have rigorously followed the WINEP methodology to develop options and then select the best value option using economic analysis. As we have developed our best value solution, we have worked closely with the EA and other stakeholders. We have engaged with customers who have showed a high degree of support for the

proposed environmental improvements. We have learnt from our previous river restoration and natural capital improvement projects to design, cost and value or project. We submitted our PR24 WINEP in November 2022 and this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

The project is part of a longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. Based upon our conservative estimates, the preferred option offers NPV benefits of £0.870m with a benefit cost ratio of 1.18. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements. We have included a co-funding target for this scheme towards delivering the non-statutory tertiary driver actions for this scheme. We will also seek further co-funding across the wider scheme to support achievement and maximise the benefits towards the wider environmental outcomes of Defra's 25 Year Environment Plan and Plan for Water.

Conservative estimates of the benefits have been made and the scheme has been assessed as clearly cost beneficial in terms of river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements.

The best value option will be delivered under a catchment strategy for the Cam Rhee and Granta and Ivel operational catchments. developed following the principles of our environmental strategy and existing Catchment Based Approach (CaBA) catchment plans. The prioritisation and delivery of the programme will be developed with the Environment Agency and alongside our sustainability reduction programme to maximise wider environmental benefits. It has been developed following the WINEP options development principles including:

Environmental and Biodiversity Net Gain

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain, with a stretch target determined for each scheme. A Natural Capital baseline assessment and post-project evaluation will be used to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

Natural Capital

Each feasible option for this scheme has gone through a Natural Capital benefits assessment process following the WINEP methodology. A similar approach will be implemented for each project within the scheme both as a baseline assessment and post-project benefits evaluation.

C&NBS

Each project will utilise a range of C&NBS targeted spatially and/or temporally to deliver the greatest environmental benefits.

Proportionality

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes. It has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding.

Evidence

To determine the best value option, an extensive options development process was undertaken with 21 unconstrained options, 12 constrained options reviewed through our options evaluation process and 3 feasible options subject to a detailed benefits assessment.

Collaboration

To determine the best value option, we have carried out a detailed risks and issues identification process with key stakeholders including the Environment Agency, Natural England and catchment partnerships. We have also developed our proposed solutions with input and feedback with key stakeholders to inform the best value option for this scheme. In addition, we will also work in partnership with both Anglian Water and Cambridge Water to align our plans in adjacent and overlapping catchments, building on partnership and collaboration in AMP7 described in this report.

Base Information	
Water Company	Affinity Water
Report Date	14 August 2023
Report Title	WINEP: Ivel and Cam catchments C&NBS – PR24 business case
Water Company Contact Details	[redacted]
Options Assessment Report (WINEP)	08AF100014_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030 (AMP8) and 31/03/2035 (AMP9)
WINEP Spreadsheet ID	
Action ID	08AF100014
WINEP Drivers	WFDGW_ND (S) (Primary) WFD_IMP_Flow (S+) (Primary) EDWRMP_IMP (S+) (Secondary) NERC_IMP (S+) (Secondary) 25-YEP_IMP (NS) (Tertiary – AMP9)
Scale of Action Delivery	Operational catchment
Location of Delivery	GB40601G603000 - Upper Bedford Ouse Chalk GB40501G400500 - Cam and Ely Ouse Chalk GB105033037720 - Ivel (US Henlow) GB105033037700 - Hiz (DS Hitchin) GB105033037680 - Hiz (through Hitchin) GB105033037480 - Cam (US Newport) GB105033037550 - Cam (Newport to Audley End) GB105033037590 - Cam (Audley End to Stapleford)

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Opex (£m)	0.28	0.74	1.00	1.00	0.94	**3.96**
Totex (£m)	0.28	0.74	1.00	1.00	0.94	**3.96**
3rd Party Funding	0.01	0.02	0.03	0.03	0.03	**0.11**

Drivers	
100%	Water Framework Directive

Benefits
Water Quality of Natural Water Bodies (km)
Sequested Carbon (tonnes CO_2e)
Air Quality Pollution Reduction (tonnes)

Economic Analysis			
NPV Costs (£m) (2025-55)	**4.8**	NPV Benefits (£m) (2025-55)	**5.7**
NPV (£m) (2025-55)	**0.9**	Benefit / Cost Ratio	**1.2**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This business case describes the WINEP scheme developed to address the challenges within the River Cam, part of the Cam Rhee and Granta operational catchment, and River Ivel and River Hiz (including River Oughton) that form part of the Ivel operational catchment.

The challenges are to:

- Mitigate the impacts of climate change at the waterbody scale to create more resilient catchments for water resources.
- Manage the drinking water quality pressures for our groundwater sources including but not limited to the following Safeguard Zones:
    - GWSGZ0271 - Slip End
    - GWSGZ0272 - Oughton Head
    - GWSGZ0273 - Offley Bottom
- Contribute towards mitigation of the impacts of climate change at the operational catchment-scale to create more resilient catchments for water resources.
- Deliver projects alongside wider stakeholders and partners to address reasons for not achieving good (RNAG) status and the reasons for deterioration (RFD) in the following waterbodies:

    - GB40601G603000 - Upper Bedford Ouse Chalk
    - GB40501G400500 - Cam and Ely Ouse Chalk
    - GB105033037720 - Ivel (US Henlow)
    - GB105033037700 - Hiz (DS Hitchin)
    - GB105033037680 - Hiz (through Hitchin)
    - GB105033037480 - Cam (US Newport)
    - GB105033037550 - Cam (Newport to Audley End)
    - GB105033037590 - Cam (Audley End to Stapleford)

The 'best value' option described in this Business case defines a landscape-scale programme of Catchment and Nature-Based Solutions (C&NBS) including:

Revitalising Chalk Rivers (RCR)

Chalk streams are rare ecosystems that are important to protect. 85% of all chalk streams are in England, mainly in the south and east of the country. Many of these chalk streams in this operational catchment are considered to be impacted by our abstraction for public water supply. Consequently, reduced flows potentially caused by abstraction, are also leading to the natural river processes not taking place impacting the habitat and ecology of the river. Alongside abstraction impacts which are being addressed through our sustainability reductions programme, it is important to ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding. These rivers are ultimately failing to meet Good Ecological Status (GES) or Good Ecological Potential (GEP) under the Water

Framework Directive (WFD) and therefore action needs to be taken to address this, unless assessed to be disproportionately costly.

Our programme of chalk stream river improvement works, and habitat enhancement schemes commenced in AMP6, and this document proposes as expansion of river improvement works within the rivers listed above and associated riparian zone. This builds on the existing programme developed in partnership with the EA referred to in this document as Revitalising Chalk Rivers (RCR).

Undertaking river channel modifications (e.g. installation of deflectors, channel re-profiling to create a low flow profiled channel) can help increase in-channel velocities which are known to be a key element in the ecological requirements of a river. These channel enhancements and modification works will be delivered alongside our sustainability reductions programme, further abstraction impact assessments, and wider C&NBS schemes to maximise the benefits and support achievement of the WINEP wider environmental outcomes, 25 Year Environment Plan and Environmental Destination requirements. In order to achieve GES/GEP these rivers need to be a properly functioning ecosystem.

Some of the benefits of such river improvement works include:

- Ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding
- Restoring the rivers back to a more natural state by removing barriers to fish, re-meandering, reconnecting them to groundwater and re-establishing chalk stream characteristics
- Healthy chalk stream systems can also lead to improved water quality and support greater ecological diversity
- To meet our environmental objectives and targets as a company to ensure we are improving the local environments while maintaining high quality drinking water supply
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 1 - End unsustainable abstraction from chalk groundwater sources
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital

River improvement works that form the best value option in this document will be prioritised and profiled over AMP8 and AMP9. This is done through a process of prioritisation with the EA detailed later in the document and to align with our sustainability reductions (SR) programme.

Resilient Chalk Catchments (RCC)

Delivered in combination with the RCR programme, Resilient Chalk Catchments (RCC) is land management focused programme of C&NBS. This programme will work in partnership with landowners, farmers, businesses, environmental NGO's, regulators,

catchment partnerships and river groups to target C&NBS spatially and temporally at the operational catchment scale (Great Ouse) to achieve the following outcomes:

- Enhanced infiltration / aquifer recharge
- No deterioration of groundwater quality (nitrates)
- Habitat enhancement for priority species
- Chalk stream protection and resilience from land management pressures (sediment, pesticides, nutrients etc.)
- Improved catchment resilience to drought and flood pressures for land managers, drinking water supply and chalk streams
- Connecting wildlife corridors and creation of habitats in partnership with local stakeholders
- Wider biodiversity benefits e.g., to priority habitats and species
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital

This programme builds on our experience and lessons learned from our AMP6 and AMP7 catchment management schemes which were focused on water quality no deterioration schemes. We recognise that C&NBS, such as cover crops, can offer wider benefits beyond water quality, and can help mitigate or address many of the issues identified through our Stage 2 risks and issues identification process.

3 Project Development

3.1 Environmental Risk and Issues

As detailed in the EA Catchment Data Explorer for the Ivel and Cam Rhee and Granta operational catchments subject to this Business case, there are a number of significant water management issues which are attributed to a number of business sectors including the water industry determined as the Reason for not achieving good status (RNAG) status. These include:

- Changes to the natural flow and level of water
- Physical modifications
- Pollution from rural areas
- Pollution from towns, cities and transport
- Pollution from wastewater

Several of these issues, including pollution from rural and urban areas, also affect the groundwater quality of water abstracted for public water supply, in addition to the waterbodies within the catchment.

3.2 Baseline Assessment

To support the baseline assessment, a Risks and Issues Register (Appendix 1) has been developed for both the operational catchment and at the waterbody level. Data has been captured from Catchment Data Explorer and through consultation with a range of stakeholders including:

- EA
- Natural England (NE)
- Catchment partnerships
- Wildlife Trusts
- River groups

The process has identified a list of risks and issues in each waterbody, and collectively in the catchment, which this project and other associated projects will seek to address. These include:

- Abstraction
- Low flows
- River morphology
- Diffuse and point source pollution
- Water quality
- Land management pressures
- Climate change
- Loss of habitat and wildlife
- Invasive and Non-Native Species (INNS)

In addition, an assessment of groundwater quality issues through our Drinking Water Safety Plans (DWSP) has been undertaken to determine the issues that this project will seek to prevent. These are deterioration and to seek improvements in water quality through catchment-based C&NBS.

Figures 1, 2 and 3 show risk maps covering the Cam Rhee and River Ivel operational catchments alongside our public water supply sources where C&NBS measures will be targeted under the best value option. This will build on the lessons learned from our nitrate WFDGW_ND schemes and investigations delivered in AMP7.

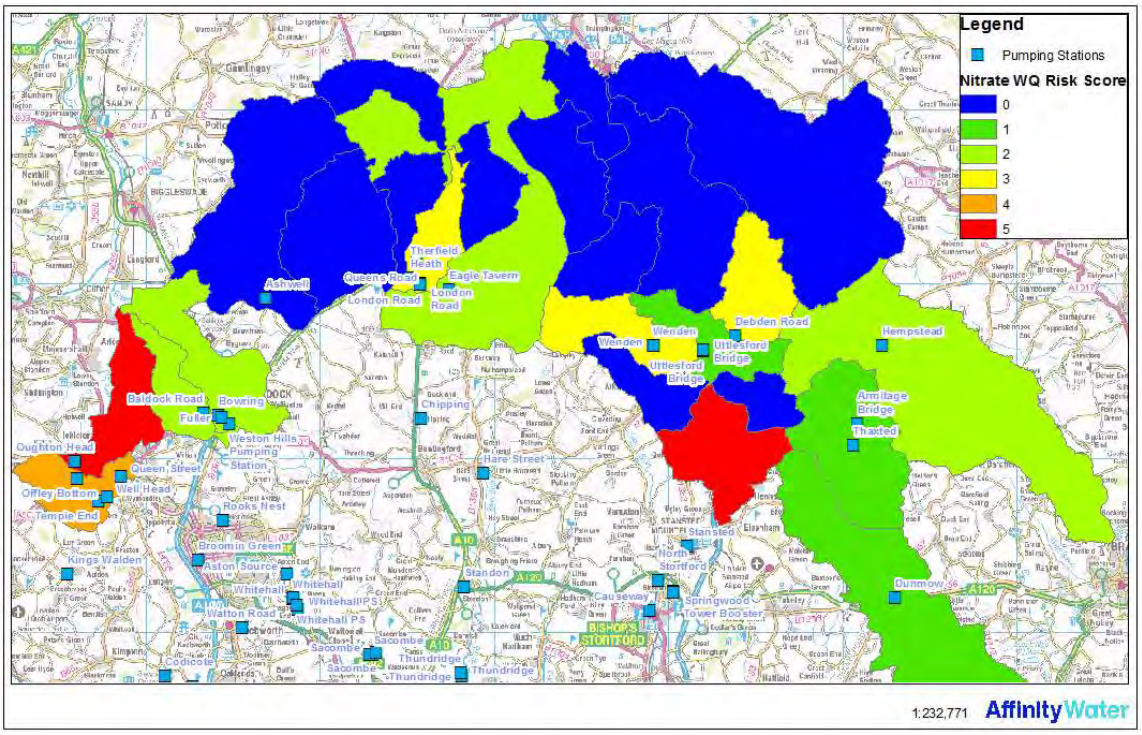


Figure 1. Nitrate water quality risk score heat map

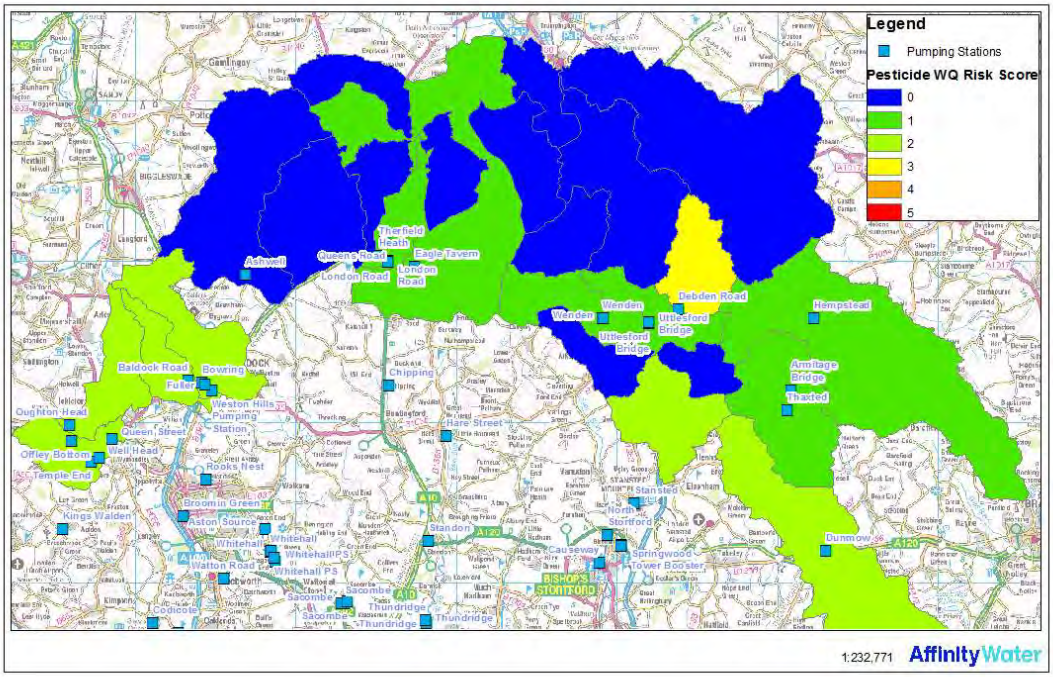


Figure 2. Pesticide water quality risk score heat map

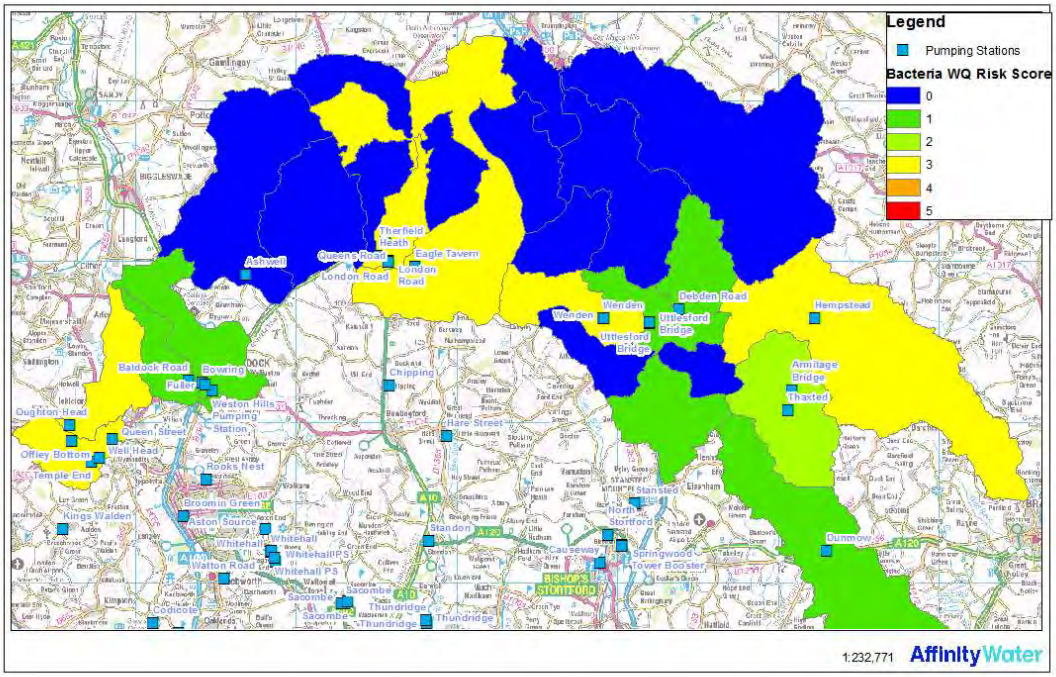


Figure 3. Microbiological water quality risk score heat map

3.3 Drivers for the scheme

3.3.1 Statutory Drivers

The statutory drivers are:

1) Water Industry Strategic Environmental Requirements (WISER)

See WISER cross-referencing Table 4 in section 7.4.3

2) The Drinking Water Directive

The standard for nitrate is (50mg/l NO^3) and for pesticides is (0.1µg/l)

3) Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP)

- Anglian River Basin Management Plan

The specific WINEP Drivers relevant to this scheme are:

- WFDGW_ND (S) = Groundwater prevent deterioration action relating to water resource or water quality
- EDWRMP_IMP (S+) = Actions identified within the WRMP to meet regional planning requirements that do not fit with WFD driver requirements.
- WFD_IMP_Flow (S+) = Actions to improve ecological status (surface water)
- NERC_IMP (S+) = Actions that contribute towards biodiversity duties, requirements and priorities.

3.3.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Relevant Safeguard Zones
    - GWSGZ0271 - Slip End
    - GWSGZ0272 - Oughton Head
    - GWSGZ0273 - Offley Bottom
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies.
- AW0031 Affinity Water Strategic Direction Statement
- Catchment Based Approach (CaBA) chalk stream strategy and implementation plan.
- Blueprint for Water – Blueprint for PR24.

- Upper and Bedford Ouse Catchment Partnership (UBOCP) catchment plan
- Hertfordshire and Middlesex Wildlife Trust (HMWT) State of Nature 2020 report and associated targets
- County Council Sustainability Strategies
- Forthcoming Local Nature Recovery Strategies

3.3.3 Stated Need

The River Ivel operational catchment (including the Rivers Hiz and Oughton) is bounded by the Chiltern Hills to the south and Greensand Ridge to the North. The River Ivel and some tributaries, rise from springs in the Chiltern chalk. The River Ivel headwaters are dominated by the North Hertfordshire towns of Hitchin, Letchworth and Baldock. Other towns are Ampthill, Biggleswade and Sandy in Bedfordshire. Elsewhere the catchment is rural with agriculture and horticulture. The catchment is noted for its angling interest, water vole and otter populations and important wetland habitats. Groundwater abstraction for public water supply has been identified to impact groundwater levels in the area of the Ivel Springs and historic investigations have identified abstraction impacts on spring heads of the Rivers Hiz and Oughton. River support schemes are in place on the Hiz and Oughton and is currently being implemented on the Ivel to help protect chalk stream habitats under low groundwater conditions.

The Cam, Rhee and Granta operational catchment covers the region south of Cambridge. It comprises the upper reaches of the River Cam, flowing north from Saffron Walden, and its major tributaries the River Rhee, which rises at Ashwell Springs in Hertfordshire. The catchment is predominantly rural with an agricultural land use. The catchment has important wetland Sites of Special Scientific Interest. The rivers and tributaries are important for priority biodiversity species including white-clawed crayfish, otter, water vole and brown trout. Groundwater abstraction for public water supply impacts on the amount of water available to the environment and river support schemes are in place on both the Rhee (Ashwell Springs) and Upper Cam to help protect chalk stream habitats and the designated Ashwell Springs SSSI under low groundwater conditions.

Protecting and enhancing our nation's water environment is a priority for the government. One of the government's key priorities for water companies for PR24 is to maintain, restore, and enhance protected sites and priority habitats such as chalk streams. To address these challenges within the waterbodies included in this business case, Affinity Water are required to invest through PR24 under the following regulatory and statutory drivers:

WISER: expectations including, but are not limited to:

- Must make sure that our activities will support achieving the water body objectives set out in the 2022 river basin management plans.
- Must include actions to improve water body status to ensure 'moderate' status as a minimum is achieved by 2030.

- Undertake catchment actions to reduce pollution reaching water abstractions from surface waters or groundwater.
- Land management approaches designed to minimise pollution at source instead of paying for measures to remove the same pollutants downstream will be supported where this provides value to their customers.
- Create, restore and enhance habitats.
- Work with stakeholders and catchment partnerships to explore integrated solutions and to achieve multi-functional benefits at a catchment scale.

For cross-referencing of WISER in relation to the 'best value' option for this Business case please refer to the 'Level of Confidence of Achieving the WINEP Outcomes' in section 7.4.3

Water Framework Directive (WFD)

Restoring good ecological status (GES) and/or good ecological potential (GEP) to chalk streams

WINEP: The Environment Agency (EA) and Ofwat expects that the 'best value' option defined in this business case takes account of the following wider environmental outcomes:

- **Natural Environment Outcomes**: Improvements to the natural environment, in addition to those required by specific drivers, through the protection restoration and enhancement of the environment, biodiversity, and habitats.
- **Catchment Resilience Outcomes:** Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources.
- **Net Zero Outcomes:** Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere. The net embedded and operational GHG emissions of actions should be taken account of.
- **Access, Amenity, and Engagement Outcomes**: Contributions to improving access to, amenity of, and engagement with the natural environment to support customer and community wellbeing.

DWI long-term Planning Guidance Expectation

- Catchment management schemes to address both point source and diffuse pollution should remain the first consideration of all source-to-tap risk assessments to reduce risks prior to treatment and ultimately mitigate all significant risks to public health, wholesomeness, and acceptability of water supplies.

3.4 Allocation of Costs

This business case is 100% enhancement, and all costs are allocated to enhancement expenditure.

3.5 Research, Pilots, and Technology Development

We have extensive experience over multiple AMP / WINEP cycles in developing and delivering river restoration and catchment management measures. Throughout AMP7, we have number of research and pilot projects to support development of our holistic approach to C&NBS being proposed as our best value option. Examples of this include:

Revitalising Chalk Rivers (RCR) Programme – Natural Capital Evaluation of Completed Schemes in the River Beane Catchment (2022)

In 2022, we commissioned Atkins to carry out a Natural Capital Assessment for five of Affinity Water's River Improvement Works (RIW) projects in the River Beane catchment in Hertfordshire. This evaluation sought to quantify and (where possible and appropriate) value the ecosystem services benefits of our RIW projects completed in AMP6 and AMP7. The purpose of the evaluation is to support our WINEP options development and assessment submissions using evidence from projects that have already been implemented on the ground. The evaluation has helped us understand the wider ecosystem services value of their investments in RIW to support business planning.

The evaluation was undertaken using data sources and assessment methods recommended by the EA's WINEP guidance and supplemented by other recognised tools such as FARMSCOPER. GIS desk-top mapping, site survey information, and site-specific data provided by Affinity Water were combined to quantify changes in ecosystem services by comparing pre- and post-project land cover and in-channel management. The 5 projects evaluated were all of differing size and scale including a small weir removal, in-channel improvements and construction of a large bypass channel.

The results, shown as an overview in figure 4 from the report, have enabled us to benchmark the range of potential RIW projects to be delivered within this scheme in AMP8 and AMP9. This has helped us ensure our benefits assessment for the programme of measures for each of the feasible options are conservative and comparable with this assessment of a range of completed projects.

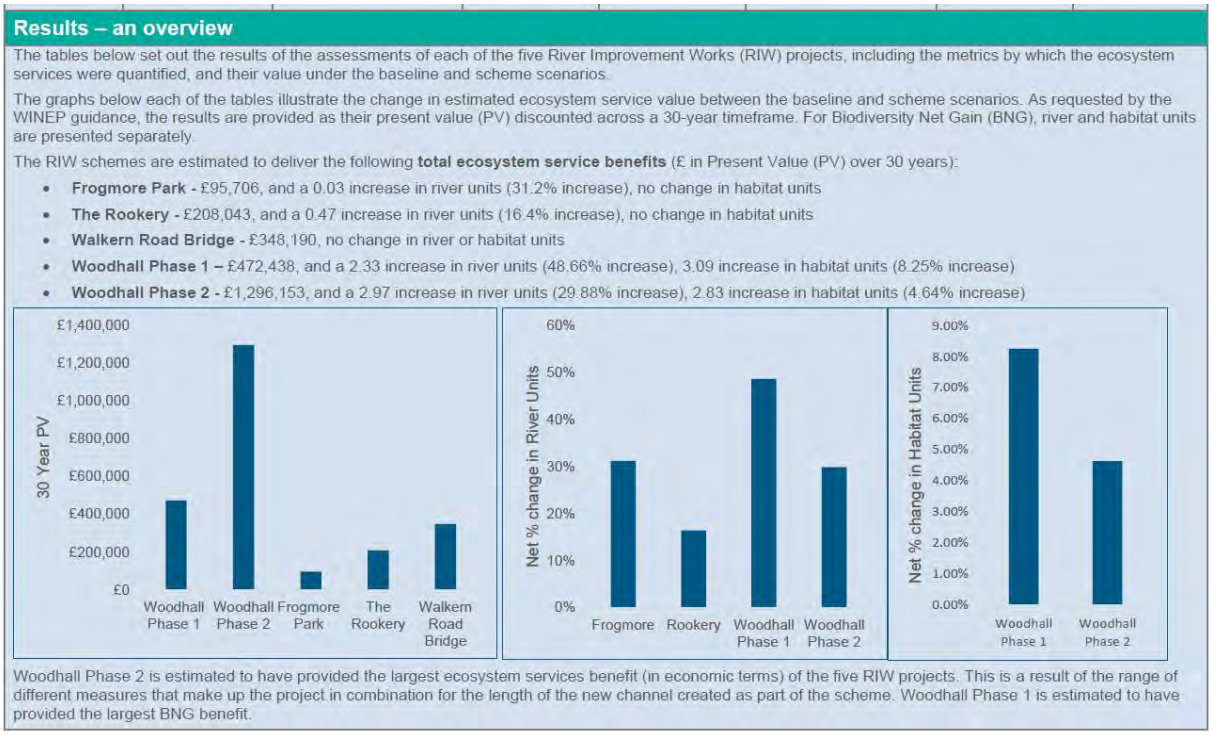


Figure 4. Excerpt from Natural Capital evaluation report on completed RIW projects on the River Beane highlighting the ecosystems services benefits in Present Value over 30 years

Resilient Chalk Catchments (RCC) C&NBS for Water Resources – Catchment Assets for Water Project

We have commissioned a partnership project with South East Rivers Trust (SERT), Catchment Assets for Water (CAfW). The primary aim of CAfW approach is to support the valuation of the contribution of natural assets to water resources and resilient catchments at both site and catchment scales. This includes the targeting of nature-based solutions for water, and the tracking and reporting of change in the contribution of various assets to water-related ecosystem services.

The methodology was developed by SERT through the Interreg ProWater project for which Affinity Water were an industry partner and was initially piloted in a number of catchments including our Little Stour catchment in East Kent. We are now developing the approach further with SERT through additional projects in our Upper Lee and Colne operational catchments.

The modelling and output mapping focuses on identifying the current contribution of habitats in the catchment to the ecosystem service of water supply and quality but does not provide a volumetric or monetary quantification. However, a volumetric quantification of the impact of some measures is attempted in the land use change scenario modelling. The latter approach allows the comparison between scenarios by changing habitat type or condition indicating a reduction or increase in an asset's value/score, and the comparison of different areas within the catchment based on the current value/score. It can be viewed at field and catchment scales. This allows

the user to assess potential interventions on a site, as well as understand their context in the wider landscape.

An important benefit of catchment scale maps and this methodology is to identify the potential role of each parcel of land in the wider context of the catchment. This has an important role to play in supporting collaboration on a landscape scale, helping to guide and inform scheme design beyond holding boundaries and bringing scientific evidence to play in discussions.

To support this, the model has been developed as a collaboration between a range of local stakeholders including EA, NE, Catchment Partnership hosts, Wildlife Trust, HCC and other local catchment experts. The model outputs have produced a series of 'opportunity maps' which identify target areas to 'protect' and 'restore' (hatched areas on the maps) where the greatest water resource benefits can be derived. These priority areas, alongside the C&NBS options and modelled benefits using the InVEST model developed by Stanford University, have been used to inform the costs and development of the best value option in the Lee and Colne catchments. We intend to extend this approach into the Ivel and Cam Rhee Granta operational catchments to develop our C&NBS programme for AMP8 and AMP9.

This approach has a number of benefits:

- Methodology and approach have been aligned with the catchment options for our water resource management plan.
- Can be updated and refined to support an adaptive planning approach and/or investigate and develop options for specific issue or need.
- Spatial prioritisation and targeting of C&NBS using scientific evidence and local stakeholder input can support targeted investment to achieve the best value outcomes.
- Taking a Natural Capital (NC) approach can help identify wider benefits and support the investment case for implementation of C&NBS.
- All outputs of the modelling and mapping have been provided to all partners to support co-creation and co-funding of projects as well as join up wider initiatives (e.g., Local Nature Recovery networks, Biodiversity New Gain, Local Development Plans and Environmental Land Management schemes).
- Output NC maps can be used as tools for engagement with landowners, land managers and farmers.
- Revisited throughout AMP8 with the priority areas refined and condition assessments revisited once C&NBS measures have been implemented.

RCC C&NBS for Water Quality

Natural Capital Evaluation of the EnTrade Cover Crop Scheme (2021)

To better understanding the wider benefits of winter cover cropping across a wide range of ecosystem services, we undertook a pilot Natural Capital assessment for our EnTrade cover cropping scheme for nitrate during the 2020-21 autumn/winter period. The study focuses on 807 hectares of arable land across 62 fields south of the town of Royston in North Hertfordshire and South Cambridgeshire. The purpose of this work was to demonstrate how the wider ecosystem services benefits of cover cropping can be quantified and monetised using a natural capital approach. The results have been used to inform our PR24 WINEP C&NBS development and benefits assessment. Analyses have been included for hypothetical arable reversion and one year fallow schemes to enable cover cropping to be compared with alternative catchment management interventions.

The assessment was undertaken using Atkins' rapid valuation tool, Natural Capital Studio (NCS). The tool is aligned with latest best practice and industry guidance, and uses a value transfer approach, adopting estimates from other sites as reported in authoritative government datasets and scientific literature. Combined with GIS mapping and site-specific data provided by Affinity Water, ecosystem services were quantified to compare pre- and post-scheme land management scenarios. 12 ecosystem services were identified as being most material to Affinity Water's catchment management and wider company priorities, and these were "screened in" for assessment.

The additional benefits estimated to be delivered by the Affinity Water Cover Cropping scheme highlight the potential ecosystem services value of this catchment management measure, if applied at scale.

Although the original objective of the Affinity Water cover crop scheme was to reduce leaching of nitrate to groundwater, this natural capital assessment has estimated broader benefits across a range of additional ecosystem services. In total, this estimated added value is equivalent to £541,619 per year or £4,662,088 in present value (PV) over 10 years. This equates to an estimated benefit of cover cropping of £671 per hectare per year as shown in Figure 5.

The assessment identified that the largest estimated increase in monetised ecosystem services value relates to climate regulation with notable improvements also estimated for biodiversity (not valued in monetary terms). The climate regulation benefit is considered significant due to reductions in carbon dioxide and nitrous oxide emissions from land management activities, and enhanced storage and sequestration of carbon. Notable increases in the value of other services were also estimated such as water flow regulation, soil health (erosion), and air quality regulation, as well as the primary objective of water quality regulation. Overall, the assessment identified a £671 per hectare benefit compared to £109 per hectare invested, an overall a 6/1 Natural Capital benefit ratio.

Total value	^	-	-	-	£403,450	£945,089	£541,619
Total value/ha	^	-	-	-	£500	£1,172	£671

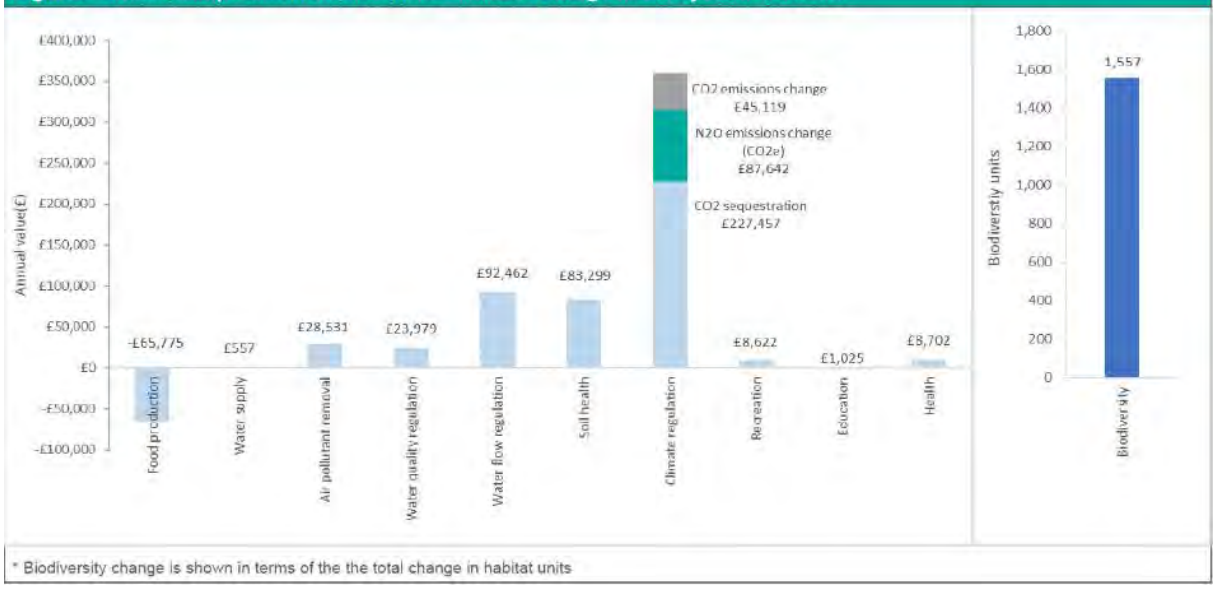


Figure 5. Excerpt from the Atkins' Natural Capital studio results from the 2020/21 AWL cover crop scheme showing the annual change in ecosystem services and total value per ha

ADAS Nitrogen Release from Cover Crops (NiCCs) Field Trials

This research project co-funded by Affinity Water and Portsmouth Water has the following objectives:

- To quantify the impact of contrasting cover crop mixes and destruction techniques on over winter nitrate leaching, soil nitrogen supply (and hence crop nitrogen fertiliser requirements) and performance of the following cash crop. In particular to determine the:
    - effect of contrasting cover crop species mixes on the quantity and timing of nitrogen returned to the soil.
    - effect of contrasting cover crop destruction methods e.g., glyphosate & minimum tillage vs mechanical destruction & minimum tillage.
- To determine the timing of nitrogen release from cover crops and potential legacy (year 2) effects on nitrate leaching and crop performance.

Two field trial sites (Hertfordshire and West Sussex) were selected and drilled with two different cover crop mixes and one with no cover (weedy stubble). Nitrate leaching concentrations were measured throughout the growing period. The fate of nitrogen was then tracked post-cover crop destruction under different management regimes and subsequent cash crops. This was used to determine the optimum management regime to ensure highest nitrogen uptake and reduced leaching to water. The outcomes of this project will be used to inform and most effectively incentivise future cover crops to achieve the greatest water quality, environmental benefit and effective uptake of nitrogen for more sustainable arable farming.

4 Partnering

4.1 Our Customer Engagement Activities

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.2 Evidence of Customer Preferences and Support

4.2.1 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concerns over costs is, however, mixed; with some finding any increase

to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considerd it would have a positive impact on wildlife for the future. Some people considerd that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback.

4.2.2 River Restoration and Catchment and Nature-Based Solutions

The general consensus of opinion was that core activities are important, but that there should be room to help the wider community too. Cleaning up rivers was regarded highly as this showed Affinity Water wanted to be a pillar to the community.

The idea of restoring rivers to a more natural state is a popular one, and there is some appetite to pay for this wider benefit as it links to customers wanting to do the right thing for the environment.

The solutions themselves were seen as being beneficial, not just for water quality, but also for consumer lifestyle. Future customers were especially keen on nature-based solutions for the positive impact they would have on vegetation and local wildlife. However, concerns were raised about the implementation costs of the nature-based solutions, particularly by those in vulnerable circumstances. With the backdrop of the cost-of-living pressures, participants wanted to know how Affinity Water would be spending the money and some thought that correcting past mistakes sounded like it would be especially costly. However, others were willing pay more, thinking about the work that needed to be done now to preserve the environment for their grandchildren and beyond.

4.2.1 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

As such, there is clear support for our proposed, preferred, option that firstly meets the statutory requirements; and then goes beyond where it makes economic sense to do so and where the impacts on our customers' bills is reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we

have a suitable balance between customers' wish to have manageable bills against their desire to improve the environment beyond statutory requirements, where it is justifiable to do so.

4.3 Collaboration and Partnering

4.3.1 Engagement with Stakeholders and Partners

Through the development of our current river restoration programme, we have been engaging and developing relationships with the EA, Catchment Partnership hosts, local river groups, local authorities, and other partners. This has been taking place during AMP7, but additional workshops have been coordinated during the Stage 2 Risks and Issues phase with these stakeholders to identify co-funding/co-creation/co-delivery opportunities for river restoration and wider C&NBS.

In addition, we also have a strategic partnership with Herts and Middlesex Wildlife Trust (HMWT) for which quarterly meetings identify opportunities and ensure that delivery of our schemes support delivery of the wider Catchment Plan for the upper River Hiz, River Oughton, and River Ivel (which just fall within the Hertfordshire boundary). We also holding regular engagement meetings with the EA and the RevIvel river group to discuss options and propose solutions that will underpin decision making for schemes in the Ivel catchment. We will build on this engagement alongside working collaboratively with the Upper Bedford Ouse Catchment Partnership (UBOCP). For the Cam, Rhee and Granta operational catchment, we will work closely with the Cam Upper Reaches Action Team (CURAT) to explore options for river improvement works in the Upper Cam along with co-funding and co-delivery opportunities to be delivered alongside our planned sustainability reduction at Uttlesford Bridge to support CURAT's aspirations to restore the upper reaches of the Cam.

4.3.2 Co-design and Co-delivery

Affinity Water and Environment Agency Revitalising Chalk Rivers Prioritisation Methodology

As the competent authority for the Water Framework Directive, we propose that the EA will act in an advisory role for proposed river improvement works actions delivered through the best value option. The EA role will be to advise Affinity Water on whether a proposed project is expected to contribute to improving the ecological status of the waterbody or improve resilience. This is an established process we have developed with the Hertfordshire and North London Area Team for AMP6 and AMP7 river restoration schemes, which we are keen to replicate with the East Anglia Area Team.

The prioritisation is designed to help the EA to advise Affinity Water on whether projects are suitable to meet the ecological objectives of the river restoration programme. It is

expected that other factors will also be considered by Affinity Water when deciding which projects to progress, for example funding, requirements of local groups and feasibility.

A river walkover will be undertaken with both EA and Affinity Water present. This walkover will be an opportunity to identify reach by reach unconstrained river restoration actions. These actions will then be scored for their environmental benefit and feasibility (as defined below). These scores will then be used to prioritise the river restoration actions (projects) identified from the walkover.

Environmental Benefit

- Use technical expertise to rank actions based on their predicted benefit to ecology.
- Ecology = biological elements as assessed under the Water Framework Directive (fish, invertebrates, plants).
- Feasibility of actions should not be considered (this will be assessed separately as defined below).
- One way of judging benefit is to assess the current impact of modifications on ecology and the degree to which these will be rectified by the proposed action.
- The assessment will be on a scale of 1-10 (decimals are allowed where necessary to differentiate between actions).
- Whilst directly comparable benefit scores between catchments would be nice to have, it is not vital.
- The objective is a prioritised list for each catchment to form a work programme for Affinity Water.
- Projects must be designed to benefit the agreed depleted reaches.

Feasibility

- Score of 1 = project very unlikely to be feasible, leave these off the work programme.
- Score of 2 = project may be feasible. Some significant difficulties anticipated but the project is worth pursuing.
- Score of 3 = project likely to be feasible.

Water companies

We have worked in partnership with both Anglian Water's and Cambridge Water's catchment management teams throughout AMP7 delivering co-funded land management interventions to contribute to addressing water quality challenges including nitrate. Examples include:

- Co-funded delivery between Affinity Water and Cambridge Water of an EnTrade environmental trading platform scheme to fund cover crops across Hertfordshire and South Cambridgeshire (see case study in section 4.6).
- Co-funded and co-delivered field trials in the Grafham Reservoir catchment with Anglian Water to explore approaches to reduce diffuse agricultural

pollution losses into water and methods of reducing the dose rate of pesticides in high-risk areas.

Our C&NBS programme for these catchments will be developed in collaboration with our neighbouring water companies along with co-funding opportunities to deliver wider environmental benefits.

Wider Stakeholders/partners

In addition to the prioritisation methodology above, we are also engaging with wider partners to further define the risks and issues and inform our proposed solutions through the following:

- EA and Natural England through Stage 2 Risks and Issues workshops held in June 2022
- Catchment partnership hosts and other key stakeholders through risks and issues review (stage 2)
- Technical workshops held at our Head Office with representatives of the EA, RevIvel river group, CaBA chalk stream steering group and our technical specialist exploring options for the Upper Ivel catchment including river restoration.
- Meetings with representatives of RevIvel and our Agricultural Advisor to discuss and explore the potential for land management C&NBS to support the Upper Ivel
- Stakeholder consultation with River groups and catchment partnership hosts during Stage 3 (Proposing solutions). Feedback has included:

> *"At the moment multiple organisations (including the CCSP) are planning and delivering restoration projects with little overview of how all the pieces fit together. Catchment partnerships would like to see a return to a more collaborative approach with a working group for each catchment set up to provide oversight and ensure more joined up approach.*
>
> *In future, we would like to see Affinity work more collaboratively with local catchment delivery partners like the CCSP and Groundwork South, who can deliver small to medium scale river restoration projects cost effectively and engage local communities. This will increase Affinity's capacity to delivery its WINEP targets in a more cost-effective manner whilst securing greater engagement and support from local communities.*
>
> *Could a catchment-scale approach help you to target e.g. which weirs are the best to remove for sediment transport / fish migration between restored reaches? This would also help with presenting rationale for individual projects to landowners and local communities."*
>
> **Allen Beechey, Chilterns Chalk Stream Project**

Landscape Enterprise Networks (LENS) East Anglia:

Affinity Water alongside Anglian Water and a number of companies within the agricultural supply chain including Nestlé Purina and Cargill are co-funding C&NBS measures in numerous catchments across East Anglian with a focus on regenerative

agriculture measures to deliver a range of ecosystem services including soil health, biodiversity, carbon and water quality. We are working with 3Keel and the investment partners to further develop the scheme for future years which will support our 20% aspirational partnership funding contribution. This could potentially be expanded into the Ivel operational catchment and Cam Rhee Granta operational catchment.

5 Strategy Development

5.1 Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this Business case.

5.2 Catchment Strategy

This business case is aligned with the Catchment Options development approach as set out in our draft Water Resources Management Plan and will inform the development of our River Great Ouse Catchment Strategy which is currently under development. This will align with existing catchment plans for the relevant partnerships, including the Upper and Bedford Ouse Catchment Partnership and Great Ouse Rivers Trust.

C&NBS will be prioritised in areas of the catchment identified as priorities through modelling and monitoring and align with our sustainability reduction programme, particularly our future reduction in abstraction at Uttlesford Bridge, increased river support scheme and where no deterioration licence capping is taking place. Priority will also be given to river improvement works in the waterbodies where reductions or cessations of abstraction have already taken place.

5.3 Adaptive Strategy

This project is no regrets due to its adaptive, evidence-based approach. Delivery and implementation of this scheme are adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The best value option does not set out specific C&NBS schemes in specific locations. It identifies priority areas for the targeting of C&NBS and river improvement works projects, and priority areas agreed with the EA which can be adaptive based upon any constraints during the options appraisals. The project will also be underpinned by a monitoring plan and programme to establish baseline data to determine the need and scope of interventions. Continued monitoring throughout AMP8 and beyond identify risks and issues through this adaptive planning approach to ensure the greatest benefit and outcomes for the investment in C&NBS. The scheme can adapt to:

- Specific water quality challenges as they occur or change during the AMP and other new or emerging issues.
- Allow for co-creation / co-funding of measures and align with other opportunities identified with wider partners/stakeholders (e.g., Wastewater company schemes, Local Nature Recovery Schemes, Landscape Recovery Schemes, Nature Recovery Networks.
- Challenges with landowner / stakeholder buy-in to specific C&NBS schemes and allows flexibility in the type, scale and location of where measures are deployed.
- Specific C&NBS measures can be prioritised to support wider environmental targets and objectives, net zero and / or Biodiversity Net Gain priorities (e.g., offsetting).
- Types of measures implemented can adapt and evolve based on future scientific evidence.

- Continual monitoring and NC evaluations of delivered C&NBS (current and future) will enable continual refinement of this project to ensure the greatest outcomes achieved.
- C&NBS measures within the best value option can be delivered in-house, through framework partners or through funding and technical support to external partners including catchment partnerships, Rivers Trusts.

6 Optioneering

We have followed a structured process to identify a wide range of potential options: the unconstrained list. We have then assessed these options against a comprehensive set of criteria, based upon the WINEP coarse screening criteria and Ofwat's requirements, to develop a shorter, constrained list. Details of the criteria and the options evaluation assessment are included in Appendix 2 – Ivel and Cam catchments Option Evaluation v0.2.

We have then assessed these further, with additional information; by developing hybrid solutions that take the best actions from others; and checking for technical feasibility, to produce our feasible list. The feasible list is then used for a much more detailed assessment, including economic assessment to select our best value option.

6.1 Unconstrained List

Our options include a combination of land management focused C&NBS referred to as Resilient Chalk Catchments (RCC) and a river restoration / river improvement works options referred to as Revitalising Chalk Rivers (RCR). For the RCR options we have defined the options into a series of 'small' and 'large' projects. A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. A large project, equivalent to two project units (as defined in our unit cost model), would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of both RCC and RCR C&NBS options are described for the best value option, with further examples of AMP6 and AMP7 river improvement works can be observed in Appendix 3 – AWL River Restoration project examples AMP6-AMP7.

Unconstrained options documented in Table 1 that are chosen to either 'Proceed' or 'Clarify' are then included in our constrained list with additional screening using Options Evaluation spreadsheet. Options that are 'Rejected' due to not meeting Statutory and Non-Statutory requirements do not proceed beyond the unconstrained list below.

Our unconstrained list of options are:

Table 1 – Unconstrained options list

No.	Option Description	Proceed (P) / Reject (R) / Clarify (C)	Commentary on Rejected Options
1	Do nothing option. Focus solely on treatment options and agreed sustainability reductions	R	Does not meet S and NS requirements
2	Catchment management awareness and engagement. No implementation of C&NBS, focus on stakeholder engagement, awareness raising of issues, newsletters, low level funding support for external partner projects.	R	Does not meet S and NS requirements
3	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river)	R	Does not meet S and NS requirements
4	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river)	C	See Options Evaluation spreadsheet
5	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river)	C	See Options Evaluation spreadsheet
6	Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
7	Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using DWSP WQ heat maps)	C	See Options Evaluation spreadsheet
8	Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	R	Does not meet S and NS requirements
9	Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	R	Does not meet S and NS requirements
10	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and RCC C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
11	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC)	C	See Options Evaluation spreadsheet

	C&NBS option B (Spatial targeting using DWSP WQ heat maps)		
12	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	C	See Options Evaluation spreadsheet
13	Revitalising Chalk Rivers (RCR) option 1 - Standard (1 small and 1 large project on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	C	See Options Evaluation spreadsheet
14	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (delivering 2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
15	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (delivering 2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using DWSP WQ heat maps)	P	See Options Evaluation spreadsheet
16	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (delivering 2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
17	Revitalising Chalk Rivers (RCR) option 2 - Enhanced (delivering 2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	P	See Options Evaluation spreadsheet
18	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option A (Pilot sub-catchment)	R	Does not meet S and NS requirements
19	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using DWSP WQ heat maps)	P	See Options Evaluation spreadsheet

20	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)	P	See Options Evaluation spreadsheet
21	Revitalising Chalk Rivers (RCR) option 3 – Enhanced + (delivering 3 small and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)	C	See Options Evaluation spreadsheet

6.2 Constrained List

Twelve options have been selected from the original 21. The results of the optioneering as defined using the WINEP coarse screening criteria utilising our Options Evaluation spreadsheet (Appendix 2) is presented below to show how the options meeting the statutory obligations and/or non-statutory requirements or not, and other feasibility, deliverability criteria.

Table 2. Coarse screening criteria and assessment summary for constrained options

Option	Expected to meet statutory obligation(s) or meet non-statutory requirements	Contribute to the WINEP wider environmental outcomes *	Technically feasible	Deliverability
Revitalising Chalk Rivers (RCR) option 2	NNN	YYY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 3	NN	YYY	Y	NNN
Resilient Chalk Catchments (RCC) C&NBS option B	NN	YY	YYY	YYY
Revitalising Chalk Rivers (RCR) - Standard and Resilient Chalk Catchments (RCC) C&NBS option B	N	Y	YYY	YYY
Revitalising Chalk Rivers (RCR) - Standard and Resilient Chalk Catchments (RCC) C&NBS option C	N	Y	YYY	YYY

Revitalising Chalk Rivers (RCR) option 1 - Standard and RCC C&NBS option D	N	Y	YYY	N
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option B	YYY	YY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option C	YYY	YYY	YYY	YYY
Revitalising Chalk Rivers (RCR) option 2 and Resilient Chalk Catchments (RCC) C&NBS option D	YYY	YY	Y	Y
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option B	YYY	YYY	N	NN
Revitalising Chalk Rivers (RCR) option 3 and Resilient Chalk Catchments (RCC) C&NBS option C	YYY	YYY	N	NN
Revitalising Chalk Rivers (RCR) option 3 and RCC C&NBS option D	YYY	YYY	NN	NNN

The coarse screening as part of our wider screening criteria has been used to select the feasible options. These meet the statutory requirements and are technically feasible and can be delivered. They also score highly in the other criteria.

6.3 Selected Feasible Options

Our final set of three feasible options are:

1. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes) –
2. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using DWSP WQ heat maps)
3. Revitalising Chalk Rivers (RCR) option 2 - Enhanced (2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)

6.3.1 Option 0: Do Nothing

No C&NBS (river restoration or catchment management schemes). Focus solely on treatment options and agreed sustainability reductions. This is discounted as a feasible option.

6.3.2 Option 1: Preferred, Best Value, Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (delivering 2 small projects and 2 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option C (Spatial targeting plus wider landscape measures upstream of River restoration (RCR) schemes)

The best value option seeks to deliver a holistic programme of prioritised and spatially targeted C&NBS which addresses the risks and issues documented in the Stage 2 WINEP risks and issues engagement process. The proposed option includes:

RCR – The best value option has been developed building on our extensive experience of delivering river improvement works in chalk stream catchments in AMP6 and AMP7. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. The experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs.

A small project (as defined in our unit cost model), is one that does not require hydraulic (flood risk) modelling and therefore involves more minor works. Examples of a small project could include:

- Tree works to allow more light into the river channel.
- encouraging the development of new habitat through growth of macrophytes (plants)

- Fencing along the riverbank to prevent livestock or horses from damaging the riverbanks and channel, thus reducing sediment input and allowing vegetation to establish along the river margins and in the channel.
- Planting of native aquatic macrophytes where these are absent and unlikely to colonise naturally.

A large project, equivalent to two project units, would require significant work on existing river channel or creation of a new channel, for example to bypass a structure allowing fish to migrate up and downstream. It is assumed that a large project would require flood modelling to inform project design. Examples of a large project could include:

- Removal of a weir or structure and regrading of river channel up and downstream.
- Creating chalk stream habitat.
- Bypassing of a weir or structure to allow fish passage and help establish typical chalk stream features.
- Restoring the river channel to its original location in the flood plain/valley bottom.

RCC – the best value option includes a programme of land management focused C&NBS that will be spatially and temporally targeted to:

- Reduce nitrate leaching to groundwater in priority areas identified through modelling carried out in AMP6 and AMP7 and build on the AMP7 WINEP nitrate WFDGW_ND schemes and investigations.
- Protect and restore natural assets in the operational catchments identified through the Catchment Assets for Water project detailed above to improve water resource and chalk stream resilience in this operational catchment.
- Implement appropriate C&NBS measures upstream of river improvement works under the RCR to ensure greater resilience of those schemes and maximise environmental benefits through a holistic catchment management approach.
- Deliver multiple benefits for water quality, resources, climate change regulation and biodiversity.

A range of C&NBS will be delivered through the best value option, including, but not limited to:

- Cover crops
- Herbal leys
- Resurfacing of farm gateways
- Arable reversion
- Chalk grassland restoration
- Tree/woodland planting
- Regenerative agriculture measures such as reduced/no tillage

Total cost (FY2022/23 cost base) - not including partnership co-funding phased across AMP8 and AMP9 as per the WINEP =

AMP8 totex costs	**£3.965m**
AMP9 costs	**£1.316m**

The best value option has been phased across AMP8 and AMP9 in accordance with our third release of the WINEP in July 2023. This reflects deliverability challenges agreed with the EA. For further information see section 10 of this business case.

Option 2: Least Cost Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option B (Spatial targeting using DWSP WQ heat maps)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 and AMP9 totex costs	**£5.195m**

The least cost option is similar in scope to the best value option but proposes a reduced programme of land management C&NBS measures that are only targeted to enhance water resources for groundwater and water quality drivers and outcomes and not targeted upstream of RCR projects to deliver multiple benefits and wider environmental outcomes.

Option 3: Alternative Option

Revitalising Chalk Rivers (RCR) option 2 - Enhanced (between 1 and 3 small projects and 1 and 3 large projects on each river) and Resilient Chalk Catchments (RCC) C&NBS option D (Whole catchment)

Total cost (FY2022/23 cost base) - not including partnership co-funding =

AMP8 and AMP9 totex costs	**£6.840m**

Alternative option 3 is similar in scope to the best value option for river improvement works (RCR) but proposes a significant increase in the scale of developing a programme of land management C&NBS without spatial targeting with measures being funded and implemented across the whole operational catchment. This option will prioritise the risks and issues identified in the Stage 2 WINEP risks and issues

engagement process, but also contribute to achieving wider environmental outcomes to meet the 25 Year Environment Plan.

6.4 Level of Confidence of Achieving the WINEP Outcomes

6.4.1 Option 1: Preferred Option

The best value option has a **high**-level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER) as detailed in Table 4 below. It demonstrates a significant increase in ambition compared to AMP7, whilst using a range of techniques to balance cost versus wider environmental benefits to ensure the maximum benefit from targeted investment to support meeting the WINEP wider environment outcomes. It addresses the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP/WINEP programmes, including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits.

6.4.2 Option 2: Least Cost Option

The least cost feasible option has a **medium** level of confidence in the achieving the WINEP wider environmental outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration experience developed by Affinity Water during AMP6 and AMP7 NEP / WINEP programmes. This option takes a less holistic approach to delivering C&NBS and is less likely to address many of the RNAG for chalk streams caused by land management within these river catchments.

6.4.3 Option 3: Alternative Feasible Option

Option 3 has a **high**-level of confidence in the achieving the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER). It seeks to address the risks and issues identified in Stage 2 of the WINEP development process, builds on the extensive river restoration and catchment management experience developed by Affinity Water during AMP6 and AMP7 NEP/WINEP programmes including lessons-learned such as combining river restoration schemes with wider upstream C&NBS measures to provide greater resilience and environmental benefits. This option shows a significant increase in ambition and financial investment in C&NBS. However, the less targeted approach to delivering

C&NBS and greater level of intervention required may not deliver the best value for investments in nature-based solutions for our customers. This option could also lead to deliverability issues due to the scale of intervention required.

Table 3: Cross-referencing of Water Industry Strategic Environmental Requirements against feasible options for the Great Ouse Operational Catchment

Heading	WISER Description	Comment
Water body status	Water companies should take an adaptive management approach ensuring actions are resilient to the likely impacts of extreme weather and climate change (2-4°C) as well as population growth	See Adaptive Strategy in section 6.3
Water body status	Water companies must have regard to the relevant RBMPs in undertaking their duties. This includes taking account of and considering the environmental objectives and summary of measures contained within the 2022 plans.	Risks and issues aligned with RBMP. RCR/RCC C&NBS measures consider and support RBMP objectives and measures.
Water body status	Water companies should assess and develop a programme to meet RBMP requirements by 2027, based on a consistent methodology for assessing costs and benefits across the sector.	Feasible options subject to cost and benefits assessment consistent with WINEP methodology.
Water body status	The PR24 programme must include actions to improve water body status to ensure that moderate status is achieved by 2030 as a minimum and improve further where technology allows	RCR schemes developed in partnership with EA and associated C&NBS measures will support meeting moderate status.
Water body status	Water companies should work with stakeholders and catchment partnerships to explore integrated solutions and delivery of multi-functional benefits at a catchment scale.	See Collaboration and Partnership Working section 5.2
Water body status	Water companies should apply the fair share approach when developing measures to address nutrients	Funding of C&NBS to mitigate nitrate leaching to groundwater will also take account of wider ecosystem services benefits.
Drinking Water Protected Areas	Water companies need to protect and ensure the future resilience of water resources. Climate change impacts, future demand and deterioration caused by emerging and current substances need to be mitigated.	C&NBS measures using CAfW spatial mapping will target opportunities for more resilient water resources and mitigate deterioration of water bodies.
Drinking Water Protected Areas	Water companies must put in place actions to avoid deterioration in raw water quality, which could lead to the need for additional treatment. This is normally through catchment measure to reduce pollution reaching raw water abstractions from either surface water or groundwater. Water companies can put in place actions to reduce the levels of treatment over time.	C&NBS measures will be deployed in the DrWPA to reduce pollution losses from land management activities (nutrients and pesticides) into chalk streams and improve water quality

Drinking Water Protected Areas	Groundwater bodies must also meet good groundwater chemical status and upward pollutant trends should be reversed.	C&NBS measures will be deployed in groundwater SgZ's to mitigate nitrate pollution of groundwater and associated impact in chalk stream quality
Drinking Water Protected Areas	Water companies should take an active role in the development of the SgZ Action Plan and agreeing the actions needed to protect and improve the DrWPA	SgZ Action Plans for nitrate in groundwater delivered through this scheme.
Drinking Water Protected Areas	To achieve drinking water protected area objectives water companies are encouraged to: work with farmers and landowners to change land use; reduce nitrate, pesticides and concentrations of mobile substances; implement other innovative solutions.	RCC C&NBS primary focus on arable farming building on AMP6 and AMP7 catchment management schemes.
Environment Act 2021	Water companies should shape and support nature recovery through LNRSs and the use of nature-based solutions, contributing to wider socio-economic benefits.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits
Environment Act 2021	LNRSs support delivery of mandatory biodiversity net gain and provide focus for a strengthened duty on all public authorities to conserve and enhance biodiversity.	RCR and RCC C&NBS will align with LNRS with focus on delivering multiple ecosystem services benefits including biodiversity
Environment Act 2021	Anticipated that water companies will need to have regard to the priorities set out in the LNRS covering their operational area when agreeing PR24 priorities.	AWL engaging with HCC, HMWT and NE on priorities of LNRS.
Environment Act 2021	Water companies should explore collaboration opportunities where their ambitions overlap with NRNs and LNRSs.	See Collaboration and Partnership Working section 5.2
SSSI	We expect water companies to contribute to maintaining or achieving SSSI favourable condition both on their own land and in the catchments they operate in.	RCR and RCC C&NBS will prioritise opportunities for measures delivered on SSSI's within these catchments as appropriate.
NERC Act 2006	We expect water companies to develop measures during PR24 to contribute to biodiversity priorities and obligations on their own land or in the catchments they influence or operate in.	RCR and RCC C&NBS measures within this scheme will focus on delivering multiple ecosystem services benefits including biodiversity.
NERC Act 2006	Sustainable abstraction, reducing demand for water and reducing pollution, particularly from storm overflows are key actions water companies should take to protect and enhance chalk streams. In line with CaBA Chalk Stream Restoration Strategy 2021, water companies should lead on behaviour change around water resources, encouraging customers to use and pollute less. Water companies should drive innovation solutions and lead the way on water supply issues, demand management, sewerage and sewage treatment.	RCR schemes will protect and enhance chalk streams, particularly supporting sustainability reductions. RCC C&NBS measures will seek to reduce pollution for enhanced chalk stream resilience. Flagship CaBA Chalk Stream Restoration projects in the Beane (Lee) and Chess (Colne) will inform approaches in these catchments.

Healthy and resilient fish stocks	Multiple benefits should be sought when designing and implementing actions particularly where customer support placed added value on the presence of healthy and resilient fish stocks.	RCR schemes designed and developed to support healthy and resilient fish stocks in chalk streams.
Healthy and resilient fish stocks	Water companies should identify measures to improve abstractions and outfalls to prevent the entrainment of fish and to address barriers to passage of fish factoring in the wider benefits of fish pass solutions such as improved geomorphology. Removal of barriers should always be considered as first option.	RCR schemes designed and developed to improve fish passage (e.g. weir removal) and improve geomorphology.
Eels	Water companies must comply with the requirement of the Eels regs 2009 to support the recovery of the European eel stock.	RCR schemes designed and developed to support eel migration (e.g. weir removal) and improve geomorphology to support recovery.
Natural environment	Water companies should have clear understanding of the full range of risks related to the services they provide both now and in the future. They should use adaptive approaches to maintain a focus on the long term and they should work with others to take a systems view to analyse risks and identify, develop, fund and deliver schemes to improve resilience and deliver wider benefits.	See Adaptive Strategy in section 6.3
Natural environment	Help create climate resilient places and improve the resilience of communities to droughts, floods and coastal change by implementing cost-effective co funded solutions	RCR and RCC C&NBS measures within this scheme will support more resilient chalk stream catchments to flood and drought.
Ecosystem and natural function	The long term functioning of ecosystems as well the natural assets the water industry and people rely on should be protected maintained and enhanced.	RCR and RCC C&NBS measures within this scheme will support resilient chalk stream catchments and sustainable land management.
Natural environment resilience	Water company activity should restore, re-connect and enhance freshwater habitats and species.	RCR and RCC C&NBS measures within this scheme will identify opportunities to restore, re-connect and enhance chalk stream habitats.
Flood resilience	Water companies should contribute to partnership schemes to reduce flood risk to communities and themselves	Land management C&NBS schemes aim to increase water-holding capacity of the land to reduce flood risk
drainage resilience	Water companies and other risk management authorities should work together to manage water in a more integrated way to improve flood resilience, enhance the natural environment and deliver value for customers	RCC C&NBS measures within this scheme will identify opportunities to use NFM measures to slow flow and hold more water in headwaters of chalk stream catchments.
Water supply and environmental resilience	Water company plans should protect and improve the environment, considering both current and future challenges. This could mean tighter environmental protection for some sensitive habitats such as chalk streams, to meet env objectives.	RCR and RCC C&NBS measures within this scheme will seek to protect chalk streams in these catchments.

Water supply and environmental resilience	WCs should consider whether their abstractions are truly sustainable looking across a catchment as a whole and consider investment in integrated catchment schemes to improve drought resilience and WQ.	RCR and RCC C&NBS measures in this scheme integrated alongside SR programme.
Climate Change	Water companies are expected to adopt nature based solutions as much as possible and monitor their success and share learning with partners to build an evidence base.	See Collaboration and Partnership Working section 5.2
Climate Change	Water companies are encouraged to work with others to overcome challenges around sharing and accepting risk around nature based solutions	Experience of this through AMP6 and AMP7 river restoration programmes. AMP7 C&NBS measures co-funded through EnTrade and LENS. Experience and lessons-learned adopted for PR24.
Climate Change	Water companies should invest in the restoration of natural form and function of the catchments and wider landscapes in which they operate to contribute to resilience to the impacts of climate change	RCR and RCC C&NBS measures within this scheme will seek to protect, restore and enhance chalk stream catchments in these catchments.
Climate Change	WCs should improve the natural resilience of the catchments in which they operate by restoring their natural function. Water companies should ensure that solutions build resilience of biodiversity in catchments, river systems and water bodies.	RCR and RCC C&NBS measures within this scheme will seek to create more resilient chalk stream catchments in the Ivel and Cam Rhee and Granta operational catchments with focus on delivering multiple benefits including biodiversity.

6.4.4 Can the Option Provide Net Benefits?

Option 1: Preferred, Best Value, Option

By aligning C&NBS measures upstream of river restoration and habitat enhancement schemes, the best value option can provide the following net environmental benefits:

- enhanced resilience for the effectiveness of delivered river restoration schemes (e.g., reduction in sediment and pollutant loading) and increased likelihood of achieving overall Good Ecological Status (GES).
- Provide greater connectivity of habitats in priority areas for RCR/RCC measures to support achievement of non-statutory requirements such as the HMWT State of Nature targets for creating 30% more habitat by 2030.
- Provide greater flood and drought resilience through more sustainable land management practices.
- Improved water quality to support chalk stream ecology.

Option 2: Least Cost Option

This option can meet the statutory requirements and address the risks and issues documented as part of Stage 2 of the WINEP development process. The other feasible options can deliver the additional environmental benefits described.

Option 3: Alternative Feasible Option

In addition to the net environmental benefits stated in the best value option, by implementing wider C&NBS measures at the 'whole catchment' scale there is an increased likelihood of meeting wider environmental outcomes for biodiversity, climate change regulation, surface and groundwater quality and increased likelihood of achieving overall Good Ecological Status (GES) across all waterbodies in the relevant catchments in this business case.

6.4.5 Contribution to the WINEP Wider Environmental Outcomes

The best value option 1 and alternative option 3 support the achievement of meeting the WINEP wider environmental outcomes. Some examples are shown below, but not limited to:

Natural Environment Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Hiz, Ivel and Cam catchments which provide greater habitat and supporting ecology for priority species such as water voles.

Catchment Resilience Outcomes

River restoration and habitat enhancement schemes on chalk streams across the Hiz, Ivel and Cam catchments with support C&NBS measures to provide greater chalk stream resilience to land management pressures such as reduction in upstream sediment losses.

C&NBS measures targeted for water resource and water quality benefits can slow the flow of water from the land to enable improved infiltration and aquifer recharge, slower flow for flood risk mitigation and holding more water in the soil for drought resilience.

Net Zero Outcomes

C&NBS measures such as cover crops and arable reversion contributing to carbon storage and sequestration. The best value option can provide carbon in-setting investment opportunities to support our Net Zero commitments and those of agriculture in our catchments.

Access, Amenity, and Engagement Outcomes

River restoration and habitat enhancement schemes to improve the chalk streams in the Hiz, Ivel and Cam catchments can provide greater connectivity between the precious chalk streams and their local communities, enhancing access and recreation opportunities.

6.5 Proportionality

Option 1: Preferred Option

The best value option provides the greatest balance between investment and meeting the Water Industry Strategic Environmental Requirements (WISER), addressing the risks and issues identified in Stage 2 and supporting the WINEP wider environmental outcomes.

This option has been developed with an adaptive planning approach to ensure sufficient flexibility to scope, design and implement measures where opportunities are available, particularly around co-design and co-funding. It will utilise the modelling outputs from our water quality risk review to identify priority areas for C&NBS measures to achieve the greatest benefit for water resources and water quality, as well as aligning with wider priorities and non-statutory drivers.

There is also a greater co-design and co-funding approach to this option as it will seek align with wider partner projects, support and co-fund future Environmental Land Management Schemes (ELMS), catchment partnership plans and Local Nature Recovery Strategy (LNRS) and natural flood management projects.

The proposed river restoration and habitat enhancement programme (RCR) will be adaptive and developed in partnership with the EA, river groups and catchment partnerships and use a Natural Capital assessment framework to ensure the greatest environmental benefit is derived for every pound invested.

Option 2: Least Cost Option

Option 2 adopts a similar approach to option 1, but without targeting of C&NBS measures upstream of RCR projects. This option will require a reduced level of investment in land management measures. The least cost option can deliver the required statutory requirements but increases the likelihood that river improvement works project do not deliver longer term environmental benefits they will not be delivered holistically with land management C&NBS designed to increase the resilience of river improvement works and deliver multiple environmental benefits to contribute to meeting Good Ecological Status and the WINEP wider environmental outcomes.

Option 3: Alternative Feasible Option

Option 3 adopts a similar approach to option 1, but with less spatial targeting of C&NBS measures. This option will seek to invest in a significantly larger number of measures and will require a greater level of investment. This option is less appropriate to the size and complexity of the environmental risks and issues and could create duplication with wider environmental programmes such as ELMS and is less adaptive than the best value option.

6.6 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP business cases by PR24 Red Team
    b. Review of business cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 4 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 5.

Our economic analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023. This included acceptance of the proposed phasing of the best value option across AMP8 and AMP9 which have been reflected in this business case.

7 Option Assessment Approach

7.1 Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We also intend to use our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed the WINEP methodology in all areas.
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits.
- Use of the RCV and the Spackman approach for capitalisation.
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy.

7.2 Cost Estimation

We have developed a comprehensive cost estimating system for the WINEP type activities. Costs have been collated from historic schemes to develop a set of unit costs for different activities. For both the RCR and RCC options, a bespoke unit cost spreadsheet and scheme builder have been utilised with quotes and historic costs from measures delivered in AMP7 and wider schemes that we have participated in to develop the costs for the feasible options. Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23 for the WINEP options assessment).

A summary of our cost estimating system is in Supporting Information section 11.1.

7.3 Partnership funding and third party working

For the best value option for this business case, we have estimated the generation of **£0.112m** in partnership funding contributions towards the non-statutory tertiary driver aspects of the Ivel and Cam catchments C&NBS WINEP scheme across AMP8, with further partnership funding contribution estimated for AMP9. However, our ambition is to generate further funding with an aspirational target of 20% external funding contribution towards maximising the wider environmental outcomes of all aspects of this scheme across AMP8.

We intend to maximise potential partnership and third-party funding through the following mechanisms:

- Participate as a buyer in the Landscape Enterprise Network East Anglia and work closely with our buyers of ecosystem services to target and co-fund measures in our priority areas in the Upper Lea. We have successfully achieved this in AMP7 as a pilot in the Upper Lea catchment.
- Establish an AMP8 5-year formal partnership agreement with the CaBA Catchment Partnership hosts and/or the Great Ouse Rivers Trust. As part of this formal agreement, an annual work programme will be agreed that will include, but not limited to:
    - Identification, scoping and co-funding/co-delivery of river improvement works.
    - Engagement with landowners and identification of C&NBS projects in priority areas.
    - Identification of third party and/or grant funding opportunities with support on bid development.
- Working in partnership with neighbouring water companies and water and sewerage companies that overlap our supply area to identify co-funding opportunities that mutually benefit each company.
- Work with key stakeholders to explore options with working with farm cluster groups to develop Landscape Recovery bids under the Environmental Land Management scheme (ELMS).

7.4 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits such as cost savings, and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons: firstly, to ensure no double counting of benefits; and secondly, because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the rivers that we are restoring are unique in nature and therefore of higher environmental value to society.

7.5 Natural Capital Impacts

We have also considered other environmental benefits that are used in the NCRAT approach. However, these are stated separately, and with commentary, as there is a risk of double counting. The business case for the scheme has been developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g., hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

7.6 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways to deliver the outcomes that we require. We have an experienced in-house team who lead on the RCR programme and an established Framework of contractors to deliver the design and construction elements of the projects. This experience will enable us to deliver the ambition of the best value option efficiently and to manage the associated costs. Additionally, our experience of delivering a range of large and small projects has enabled a good understanding of the true costs of delivering such projects. In AMP6 and AMP7, the mean average cost of delivering a river restoration project unit (equivalent to one small project) was £124,245 not including monitoring costs and actual costs at time of implementation (cost range 2016-2022). Our unit cost model

cost for this proposed scheme has been estimated at £160,871 per unit in 2022/23 price base (not including monitoring costs).

7.7 Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

8 Option Assessment

8.1 Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost, and alternative options. We have supplemented this with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement water quality, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality status.

The primary objectives of the project are to improve river water quality and the natural capital of the associated catchment. Our economic assessment focuses on these two benefits.

8.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the river restoration investments
Water supply	Not applicable
Climate regulation	Monetised as per WINEP and impacted by the natural capital investments
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable
Air quality	Monetised as per WINEP and impacted by the natural capital investments

Hazard regulation – flood	Applicable but not monetised
Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Applicable but not monetised
Livestock (dairy and meat) (ha)	Applicable but not monetised
Timber production (ha)	Applicable but not monetised
Social health (ha)	Applicable but not considered

8.2.1 Catchment and Nature Based Solutions

Outcome	Option	Included
Option includes a catchment and nature-based solution	**Preferred Option**	**Yes**
	Least Cost Option	**Yes**
	Alternative Option 1	**Yes**
	Alternative Option 2	**N/A**

8.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- We expect that the whole length of the following waterbodies to improve to some extent from Poor to Moderate status as a result of our restoration activities.
- We have calculated the total length of these waterbodies to be 60km.
- We have assumed that the whole length is currently in Poor condition.

- We have assumed that the water quality benefits will be realised after 7 years. this is based on the AMP7 Frogmore Park scheme NC evaluation carried out by Atkins (see section 4.5).
- We have assumed that both our river restoration and natural capital activities will make a proportional start to improving the water quality and that further, future activities will be required to achieve full Moderate status for the whole river system. Because the natural capital activities will change in the options, we have assumed that the least cost option will only deliver a 5% improvement towards Moderate status; the preferred option 10% and the alternative option 12.5%. Our previous river restoration projects suggest that these are conservative estimates.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.

- We have adopted the river water quality valuations for the Upper Lee, with a Moderate status, as the chalk streams in this project are in the headwaters of these operational catchment on the boundary between the Anglian and Thames River Basins. As such are considered similar in nature to chalk streams in the Upper Lee catchment.

Air Quality Pollution Reduction and CO_2 Sequestration

- We have assumed that the planned C&NBS measures are funded over the 10-year period with a deliverable and achievable spend profile, and then funding will cease. Our objective would be to fund such measures with farmers on an on-going basis over multiple AMPs, but we have to assume that this might not materialise.
- We have assumed that our measures deliver a single-year benefit for the period of which the measure is deployed, e.g. cover crops and that this is proportional to the investment in the year.
- We have reduced the residual benefit from the investment to 50% of the last years' benefit to reflect the on-going benefits of improvements to woodlands and grasslands.
- We have also assumed that there is an on-going 4% per year depreciation in the benefits realised because of climate change; land use change; and pollution factors impacting the habitat type (freshwater). Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.
- We have assumed that the preferred option will impact a total of 2,750 hectares, comprising of: 1,382 ha of enclosed farmland; 13 ha of freshwaters, open waters, wetlands and floodplains; 1,082 ha of semi-natural grasslands; and 273 ha of woodlands.

- We have reduced these values to 2,450 ha for the least cost option and increased the value by 9,300 ha for the alternative option, assuming the same profile of land use.

8.4 Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is cost beneficial for both the river restoration and natural capital activities. Jointly these activities will provide significant environmental benefits, as part of our wider and longer-term programme of work to improve our river catchments.

The economic assessment forecasts a positive NPV of **£0.870m**, and a good benefit / cost ratio of **1.18.** The benefit / cost ratio is higher than both the least cost and the alternative options, demonstrating best value.

We have assumed a 10 % increase in water quality in the analysis. We consider that this is conservative value, which we expect to be higher in practice, based upon our experience of similar projects. For example, our recent river restoration on the River Beane has delivered biodiversity net gains across the different areas in river units between 16% and 49%, with a weighted average of 28% based on river length. There is also a corresponding average improvement of the habitat units of 6%. Similarly, our cover cropping scheme realised a river water quality benefit of over 40%; CO_2 sequestration of over 70%; air pollutant removal of 35%; and many other significant benefits such as soil condition, flow regulation and recreation.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that any improvements above 7 % would result in cost benefits. This provides a high-level of confidence that the scheme will be cost beneficial.

The natural capital benefits are directly related to the areas impacted by the project and are significantly cost beneficial for each hectare worked on. Essentially, the larger the area impacted; the more benefits are realised. We have used conservative estimates for the areas impacted, which reflect the limitations of getting local support for the schemes. We expect to be able to increase the areas impacted and hence the overall cost benefit of the scheme.

8.5 Least Cost Option

The least cost option is not cost beneficial with an NPV of -**£1.553** and a benefit / cost ratio of **0.67**. This is logical because the preferred option has the additional land management focused C&NBS to provide additional resilience to the river improvement works to optimise the overall environmental benefits.

8.6 Alternative Option 1

The alternative option considers additional investment and increases the overall benefits, with a forecast NPV of **£2.516m** and a slightly higher benefit / cost ratio compared to the preferred option, **1.38**. It should be noted that there are increased deliverability risks associated with this option that could lead to the benefits not being fully realised. It is prudent to work on the preferred option initially and monitor progress; to better understand how best to invest in the future; and then to secure on-going environmental improvements, where we have a higher level of confidence of benefit realisation.

8.7 Alternative Option 2

There was no second alternative option in this analysis.

8.8 Non-Monetised Information

We have applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to identify and understand these benefits. The use of NCRAT has had the additional use of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Flooding reduction from woodlands
- Arable production
- Livestock production (dairy and meat)
- Timber removal
- Recreation

Arable and livestock production are forecasted by NCRAT to be significant benefits. As these values are proportional to the change in land-use, we expect the alternative option to provide the most benefit, then the preferred and then the least cost option; all in proportion to the number of hectares set aside for where C&NBS measures would be implemented. There will clearly be some benefits from arable and livestock production, but these are difficult to quantify at this stage of the project. We will look to maximise production from the changing land-use where it is appropriate to do so.

For example, we recognise that many of the C&NBS options for farmland will be focused on regenerative agriculture principles, which seek to move from an intensive farming system to a less intensive one. This can potentially lead to decreased yields over the short/medium term, with benefits realised over a longer period. The best value option will target these measures where the greatest benefit can be realised over the long term but have not included this in our monetised assessment.

We also consider that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them as this stage of the planning process.

River restoration, river improvement works and habitat enhancement schemes within the best value option will aim to deliver a minimum of 10% environmental net gain. We will use a Natural Capital baseline assessment and post-project evaluation process to quantify the environmental and biodiversity net gain benefits for each project developed in this programme.

8.9 Wider Environmental Outcomes

8.9.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

8.9.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below.

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity and habitats	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Preferred Option**	^
	Least Cost Option	^
	Alternative Option 1	^
	Alternative Option 2	o

8.10 Justification of the Preferred, Best Value, Option

The project is part of our longer-term goal to improve the environment of our local river catchments. The economic assessment of the different options has shown that the preferred option is the best value option. The project will deliver the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Estimates of the benefits have been made and the scheme is clearly cost beneficial in terms of both river water quality improvements and natural capital benefits, particularly for carbon sequestration and air quality improvements. We have used conservative metrics in our analysis and consider that there are other un-quantified benefits to be realised. Our economic analysis has been benchmarked against the Natural Capital evaluation carried out by Atkins of the river improvement works completed on the River Beane detailed in section 4.5. Additionally, from our Natural Capital Evaluation of the EnTrade Cover Crop Scheme in 2021, also detailed in section 4.5 has demonstrated that greater environmental net gain benefits can be derived from our C&NBS measures targeted effectively. We will review the benefits as the project progresses and when we have better estimates of the different benefit metrics.

The best value option is better than the least cost option in terms of having a higher benefit / cost ratio (**1.18** compared to **0.67**). The alternative option of doing more does have slightly higher benefit / cost ratio of **1.38,** but with significantly increased risks around deliverability and associated benefits realisation.

There are inherent uncertainties in the assessment, and it is therefore sensible to initially focus on the preferred option where we have more confidence in the realisation of the benefits, and then learn and improve our approach to get more and longer-term benefits over time. Our sensitivity analysis shows that the river restoration will be cost beneficial if there is more than a 7% increase in river water quality and ignoring the natural capital benefits. When this is considered with our conservative assumptions, this assessment has determined the project is worthwhile and will be beneficial to customers, the environment and society.

The best value option aligns with the WISER requirements, supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our draft Water Resource Management Plan through C&NBS measures that create more resilient catchments and will be delivered alongside our AMP8 and AMP9 Sustainability Reductions programme to maximise the benefits of abstraction reductions on the chalk streams we are seeking to protect and restore.

9 Delivery Considerations

9.1 Related Projects

This project is similar to our other river restoration and catchment improvement (C&NBS) schemes. Collectively they form a long-term programme to improve all of our river catchments over time.

The catchment improvements aim to improve raw water quality in several of our groundwater sources in the operational catchment and will support, inform, and in some cases, reduce the need for future treatment and blending projects over the next 25 years.

The effectiveness of river improvement works is also dependent upon the effectiveness of sustainability reductions and/or impacts of land management activities and climate change in terms of providing additional baseflow. The prioritisation of C&NBS schemes delivered by this project will be aligned with our current and future sustainability reductions programme and targeted in the headwater areas of the catchments (subject to landowner agreement and participation) to hold more water in upper reaches in order to maximise the benefits of C&NBS and any reduction or cessation of abstraction. River improvement works, where appropriate, will be targeted further down the catchments where greater ecological benefits can be derived.

Lessons Learnt

We have learnt many lessons from our previous AMP6 and AMP7 river restoration and catchment management schemes which have helped with project definition, cost estimating, delivery and working with partners and stakeholders. For example:

- Our AMP7 catchment management schemes for nitrate using the LENS and EnTrade environmental catchment trading approaches have enabled us to learn how to upscale measures to an operational catchment-scale. They have also enabled us to generate partner funding contributions through a catchment-trading approach.
- Our extensive experience of delivering small and large river improvement works has enabled us to better understand the risks, issues and opportunities that can arise and how to develop the programme more efficiently.
- Our experience of engaging with landowners and local environmental groups and knowledge of the chalk stream catchments where future schemes are proposed for AMP8 and AMP9 will allow us to deliver an ambition programme drawing on partnership support and contributions
- The Natural Capital evaluation of our river improvement works completed to date in the River Beane catchment has been really useful in understanding the potential benefits of these type of schemes and informing this benefits assessment.

- Our Pilot Natural Capital Assessment of Affinity Water's Cover Cropping Scheme undertaken between 2020 and 2021 provided measurable benefits from natural capital improvements across a range of ecosystem services. This has been invaluable in determining the scope of future schemes, quantifying multiple benefits beyond the primary groundwater nitrate (WFDGW_ND) driver.

9.2 Delivery Risk Management

We have already delivered similar river improvement works and catchment management schemes, and therefore have a strong understanding of the delivery risks and how best to manage these. However, the most significant risk to the project is delivering the ambitious target for river restoration projects due to permitting and landowner permission constraints. To mitigate this, we have proposed phasing of the best value option across AMP8 and AMP9 in recognition of the long lead in time for delivery of some projects and the number of projects that do not progress beyond detailed design as a consequence of permitting constraints such as Flood Risk Activity Permits (FRAP), requirements for also securing impoundment licensing and landowners not wishing to proceed.

A further significant risk to the project is securing partnership funding. This is beyond our control, being dependent on partnership funding e.g., through catchment partnership, financial contributions through catchment-trading mechanisms (e.g. agricultural supply chain) and other government funding streams. We may have to adapt our approach if we are unable to secure the supporting funding and support. However, we have strong established partnerships in each of the catchments and will work with all partners to identify and secure wider funding opportunities.

The following risks and mitigations have been identified for this project:

- Delays in delivering river improvement works due to delays and/or limitations from permitting/flood risk modelling outcomes.
    - Our RCR partnership with the EA and regular engagement can help manage risks and issues around permitting/flood modelling.
    - We will commence permitting applications at the earliest possible stage and engage with the EA in a timely manner with an understanding of timescales.
- Lack of permission from landowners to carry out river improvement works.
    - We will use an adaptive management approach to identify wider opportunities for projects in alternative reaches.
    - We will utilise our Agricultural Advisory specialists and other partners in the catchment to engage with landowners.
- Uncertainties around climate change and associated flood, drought and other impacts.
    - We will use an adaptive management approach to develop C&NBS that are resilient to changing climate change scenarios throughout AMP8 and AMP9.

- Increasing demand at a national level for specialist contractors to deliver river improvement works leading to delays in overall programme delivery
    - We have an established framework with a number of the specialist contractors already delivering projects on our behalf which will build on for AMP8 and AMP9
- Increasing cost of resources to deliver projects
    - We will work closely with our established partnerships to generate partnership funding contributions and where possible utilise local catchment partnerships and volunteers to manage costs
- Farmers and land managers unwilling to engage with us on land management C&NBS
    - We have an established catchment management programme funding and incentivising measures. We have knowledgeable Agricultural Advisors and have experience engaging with the agricultural supply chain to generate interest and uptake in our current schemes
- Risk of negative public perception leading to reduced opportunities to implement projects/schemes and incentivised C&NBS
    - We will work closely with catchment partnerships, local river and fishing groups, and NGO's such as the Farming and Wildlife Advisory groups to provide advocacy support and intermediary advice and engagement in support of this scheme.

9.3 Monitoring and Reporting of Benefits

As part of the monitoring and reporting of benefits from the C&NBS schemes delivered in these catchments, we will undertake the following activities alongside our abstraction impact assessment monitoring captured in a separate business case (Water Resources):

- Baseline monitoring and long-term benefits monitoring for river improvement works in catchment, alongside our sustainability reduction programme including the following:
    - Flow gauging
    - Macrophyte and macroinvertebrate surveys
    - Groundwater level monitoring
    - Rain gauge monitoring
- Chalk stream monitoring linked to our land management C&NBS including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring
- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

10 Supporting Information

Our supporting information is included in the business case and associated appendices.

10.1 Summary of cost estimate methodology

Section 8.2 of this Business Case indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 6 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott MacDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each scheme we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on investigations carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each scheme will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, km of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

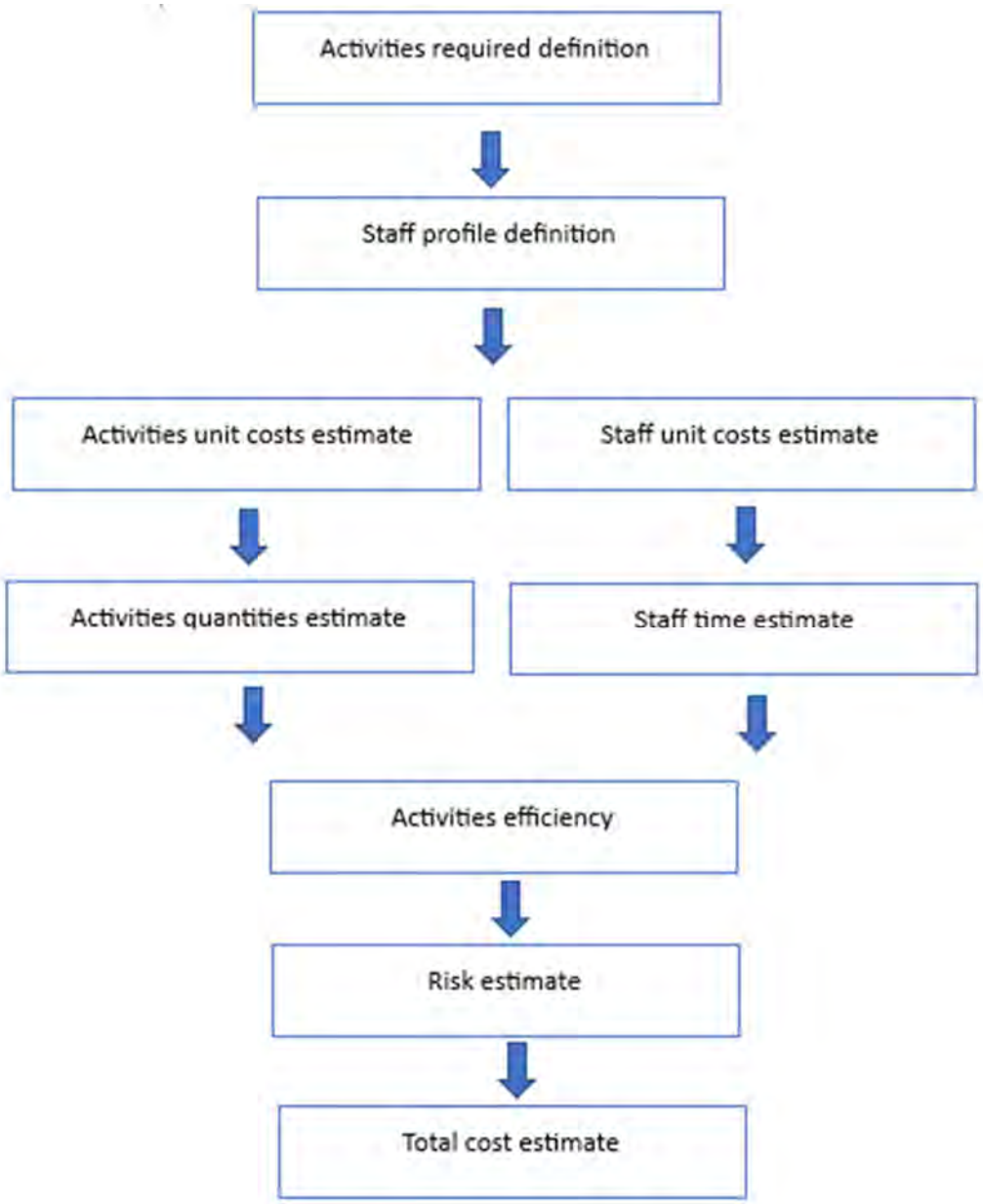


Figure 6 Cost Estimate workstream diagram

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar investigations undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director time have been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Activities efficiency: where possible, significant attention has been paid to make efficiency across schemes. For instance, field monitoring rounds estimated for a small

scheme have been incorporated into a nearby larger scheme monitoring activity, so that time and resources spent are minimised.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of a scheme is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

10.2 Appendices

All appendices can be made available upon request.

Appendix 1 – Affinity Water WINEP Stage 2 Risks and Issues Register v1.0

Appendix 2 – Ivel and Cam catchments Options Evaluation v0.2

Appendix 3 – AWL River Restoration Project Examples AMP6-AMP7

Appendix 4 –– Atkins PR24 WINEP Assurance Report November 2022

Appendix 5 –– PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Sustainability Reductions

August 2023

Contents

1 Summary

This business case sets out the detailed PR24 WINEP process and outcomes for our proposed AMP8 Sustainability Reductions. Sustainability Reductions are decreases in water company deployable output (DO), aiming to improve the condition of waterbodies whilst meeting the legislative requirements as set out in the Water Framework Directive (WFD), River Basin Management Plans (RBMP) and the Habitats Directive.

Following extensive discussions with the Environment Agency (EA), we are planning to implement the following SRs in AMP8:

- Sustainability Reductions comprising a mixture of cessations and reductions to average (15.06 Ml/d) and peak (3.35 Ml/d) deployable outputs.
- No Deterioration Reductions, comprising reductions (5.33 Ml/d) to average deployable outputs to meet WFD No Deterioration requirements.
- Average Deployable Output (ADO) Relocation, comprising a decrease in groundwater abstraction (ADO) of 14.11 Ml/d in the upper catchments of a number of chalk streams and concurrent increase in abstraction by an equivalent amount at four downstream sources.

The primary driver for the sustainability reductions and ADO relocation is WFD_IMP_WRFlow and the primary driver for the No Deterioration reductions is WFD_ND_WRFlow.

It is our responsibility to provide a wholesome and resilient water supply and without the interventions set out in this business case, the AMP8 sustainability reductions will cause water resources deficits and pose unacceptable risks to our customers.

We have used a water supply systems-based approach to identify the options needed to safely implement the AMP8 sustainability reductions. We have used the supply demand balance output from the revised draft Water Resources Management Plan 2024 (dWRMP24) at water resource zone level and identified the network reinforcements and asset modifications required to deliver the AMP8 sustainability reductions.

These are set out in this business case and is our best value option. This option aligns with and supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also forms part of our wider dWRMP24 programme (and is required to deliver the SRs requirements of dWRMP) and will be delivered alongside our AMP8 and AMP9 river restoration and natural capital improvements programme. We submitted our PR24 WINEP in November 2022 and all elements of this proposed scheme has been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the EA in July 2023.

The economic assessment has shown that the preferred option is not cost beneficial (cost benefit ratio of 0.87). However, the Net Present Value benefits are significant (£64m) and the longer the length of river impacted, the higher the benefits. Even though the AMP8 Sustainability Reductions programme has been assessed as not

cost beneficial, the EA have advised it is a statutory requirement to contribute to WFD targets.

We have strong support from customers to improve our chalk streams, and they perceive reductions to our groundwater abstractions as a positive. We are committed to ending unsustainable abstraction and this aligns with this programme of works.

In selecting the optimum solution to enable delivery of each sustainability reduction, assessment has been made to ensure that each of the following key drivers has been addressed:

- The ability of existing assets (network and production) to meet the required changes to Deployable Outputs.
- The ability to meet the required changes to Deployable Outputs without deterioration of supply resilience (network and production).
- The ability of existing assets (network and production) to meet the required changes to Deployable Outputs without any deterioration to existing water quality.
- Consideration of Opex implications for different water treatment solution options and additional pumping requirements.

Using the best available information, the sustainability reduction related solutions have been coordinated with other PR24 programmes of works, such that where possible, combined solutions are identified.

The project is part of a longer-term goal to improve the environment of our local chalk stream catchments, and our PR24 WINEP also includes a programme of catchment and nature-based solutions which are required alongside the sustainability reductions to meet WFD objectives.

The AMP8 investigations and associated monitoring will provide the information to take evidence-based decisions as part of our adaptive plan. This will be used to help quantify the environmental and biodiversity net gain benefits and help inform the location and volume of any future sustainability reductions.

2 Project Details

This business case sets out the detailed PR24 WINEP business case process and outcomes for our proposed AMP8 Sustainability Reductions. Sustainability Reductions are decreases in water company deployable output (DO), aiming to improve the condition of waterbodies whilst meeting the legislative requirements as set out in the Water Framework Directive (WFD), River Basin Management Plans (RBMP) and the Habitats Directive.

We have engaged with the EA to prioritise AMP8 abstraction reductions which are believed to have the greatest environmental sensitivity, whilst noting the limitations to the speed at which we can replace sources of water which are lost to us. We have worked with the EA to plan reductions until 2040 and beyond (beyond AMP10). This plan is adaptive and subject to change, based on the monitoring data which we are planning to collect. This will drive improvements to the EA groundwater models and improve our confidence in their results/assessments, as well as helping to guide us as to the best locations to implement abstraction reductions in the future, to maximise cost efficiency.

Coupled with our programme of abstraction reductions, we are going to implement a programme of morphological improvements as well as undertake catchment management activities within our catchments. By combining the abstraction reductions with our wider programme of Catchment and Nature Based Solutions (C&NBS) (See Section 3), we will be able to maximise environmental improvements in our chalk stream catchments and make a greater contribution towards achieving WFD targets. We have significant experience in-house with designing and delivering both large programmes of abstraction reductions but also in delivering C&NBS. Both of these factors increase our confidence that our preferred option will achieve the WINEP outcomes.

Base Information	
Report Date	August 2023
Report Title	WINEP Sustainability Reductions – PR24 business case
Options Assessment Reports (WINEP)	08AF100044_OAR; 08AF100045_OAR; 08AF100046_OAR
Start Date	01/04/2025
Completion Dates	31/03/2030
WINEP Spreadsheet ID	
WINEP Action IDs	08AF100044 a, b, c, d, e, f, g, h, i, j 08AF100045 a, b, c, d, e, f, g, h, i, 08AF100046 a, b, c, d, e, f, g, h
WINEP Drivers	**WFD_IMP_WRFlow** Action to improve ecological status (surface water) **WFD_ND_WRFlow** Action to protect / ensure No Deterioration in status (surface water)
Scale of Action Delivery	Within Water Company boundary
Location of Delivery	**Groundwater bodies** • Upper Lee Chalk: GB40601G602900 • Mid Chilterns Chalk: GBGB40601G601200 **Surface Water bodies** • Mimram (Codicote Bottom to Lee): GB106038033270 • Mimram (Whitwell to Codicote Bottom): GB106038033460 • Misbourne: GB106039029830 • Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC): GB106039029900 • Gade (from confluence with Bulbourne to Chess): GB106039029860 • Ver: GB106039029920 • Stort (at Clavering): GB106038040130 • Stort and Bourne Brook: GB106038033340 • Stort and Navigation, B Stortford to Harlow: GB106038033281

	• Rib (from confluence with Quin to Lee Navigation): GB106038033360 • Rib (upper stretches, above confluence with the Quin): GB106038040140 • Beane (Source to Stevenage Brook): GB106038040110 • Beane (from confluence with Stevenage Brook to Lee): GB106038033310 • Lee (from Luton Hoo Lakes to Hertford): GB106038033392 • Lee (from Luton to Luton Hoo Lakes): GB106038033391 • Lee Navigation (Hertford to Fieldes Weir): GB106038033240 • Colne (Confluence with Chess to River Thames): GB106039023090 • Colne (from confluence with Ver to Gade): GB106039029840 • Colne (upper east arm including Mimmshall Brook): GB106039029850 • Bulbourne: GB106039029890

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	18.74	25.00	31.23	25.00	25.00	**124.97**
Opex (£m)	0.76	0.76	0.76	0.75	0.75	**0.38**
Totex (£m)	19.50	25.76	31.99	25.75	25.75	**125.35**

Drivers	
100%	Water Framework Directive

Benefits
Water Abstraction Reduction (Ml/d)
No deterioration licence capping (Ml/d)
ADO relocation volume (Ml/d)
Loss of Supply Capacity (Ml/d)

Economic Analysis			
NPV Costs (£m) (2025-55)	**110.1**	NPV Benefits (£m) (2025-55)	**87.1**
NPV (£m) (2025-55)	**-23.0**	Benefit / Cost Ratio	**0.8**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

3 Business Case Description

The aim of this business case is to identify the required production and network asset modifications/reinforcements which will allow the AMP8 SRs to be delivered without impacting on the quantity or quality of the water we provide to our customers. The AMP8 SRs requirements agreed with the EA (EA) fall into three categories, which are detailed later in this chapter:

- SRs (this is also a statutory requirement and contributes towards WFD flow improvement, primary driver WFD_IMP_WRFlow)
- WFD No Deterioration (this is a statutory requirement to prevent deterioration of waterbody status, primary deriver WFD_ND_WRFlow)
- Average Deployable Output[1] (ADO) relocation (this will also contribute to WFD flow improvement requirements, primary driver WFD_IMP_WRFlow).

Our experience of planning and delivering SRs in AMP6 and AMP7 has been used to inform the development of our PR24 WINEP.

Sustainability Reduction Schemes

Our planned SR schemes comprise the following:

- Reductions to ADO
- Reductions to peak deployable output (PDO)
- Switching off pumping stations (licence cessations)

In total, SR schemes will reduce our ADO by 15.06 Ml/d and PDO by 3.35 Ml/d.

Table 1: Summary of AMP8 Sustainability Reductions by Source

		End of AMP7 1 in 200 DO		End of AMP8 1 in 200 DO Post SRs		SR net impact	
Source	**Intervention**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**
KINGS WALDEN	Cessation	1.1	1.3	0	0	1.1	1.3
CODICOTE	Cessation	0.6	0.65	0	0	0.6	0.65
AMERSHAM	Reduction	2	7	0.5	7	1.5	0
GERRARDS CROSS	Reduction	4.51	4.51	0.75	4.51	3.76	0
GT MISSENDEN	Reduction	1	5.68	0.5	5.68	0.5	0
PICCOTTS END	Reduction	5.72	10.72	4.26	10.72	1.46	0
REDBOURN	Cessation	0.6	1.4	0	0	0.6	1.4
KENSWORTH LYNCH	Reduction	4.3	4.3	1	4.3	3.3	0
CHALFONT ST GILES	Reduction	4	4.5	3	4.5	1	0
MARLOWES	Reduction	8.34	8.34	7.1	8.34	1.24	0
	Total Reductions	32.17	48.4	17.11	45.05	**15.06**	**3.35**

[1] The capability of sources to yield water against a design drought event is undertaken through an assessment of deployable output (DO). This is reported under both average and peak conditions.

No Deterioration Schemes:

No Deterioration investigations were undertaken during AMP7 and determined the risks of deterioration for the waterbodies investigated and identified measures (licence reductions) required to be implemented in AMP8 within our Central region. Licence reductions following No Deterioration investigations apply to ADO only.

To address the risk of deterioration, agreement was reached with the EA at a meeting on 6 May 2022 to implement the following capping limits:

- Original Max peak (based on maximum annual value within the period Apr 2005 to Mar 2016), applicable only for the EA East Anglia area sources.
- Operational Max peak (based on maximum annual value within the period Apr 2010 to Mar 2016).
- Recent Actual (based on average of the annual values within the period Apr 2010 to Mar 2016).

Capping abstraction licences to Recent Actual is the most restrictive and has the greatest potential to impact on 1:200 ADO (i.e. reduce the 1:200 ADO where this is higher than the Recent Actual rate). This business case includes the interventions and modifications required to implement licence capping which reduces the 1:200 ADO. The capping of licences where the 1:200 DO is already lower than the agreed Original/Operational Max Peak are not expected to require infrastructure upgrades.

The Recent Actual capping is the most restrictive (being the lowest) and it will be implemented on a six-year rolling licence basis. This will not impact our operations until early AMP9 and for this reason it has not been considered in this business case.

Our planned No Deterioration licence reductions in AMP8 are shown in Table 2. In total, No Deterioration licence reductions will reduce our ADO by 5.33 Ml/d but will not impact PDO.

Table 2: Summary of AMP8 No Deterioration licence capping and reduction in DO by source

		End of AMP7 1 in 200 DO		End of AMP8 1 in 200 DO Post SRs		SR net impact	
Source	**Intervention**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**
CHALFONT ST GILES	No Det Cap	4.00	4.50	3.38	4.50	0.62	0.00
CAUSEWAY	No Det cap	4.20	4.70	3.06	4.70	1.14	0.00
HARE STREET	No Det cap	1.30	1.50	1.15	1.50	0.15	0.00
STANDON	No Det cap	3.80	4.90	3.75	4.90	0.05	0.00
SACOMBE	No Det cap	13.60	13.64	13.03	13.64	0.57	0.00
PORTHILL	No Det cap	1.70	1.90	1.42	1.90	0.28	0.00
CRESCENT ROAD	No Det cap	28.13	29.30	26.12	29.30	2.01	0.00
WATERHALL	No Det cap	1.00	1.30	0.60	1.30	0.40	0.00
NORTH MYMMS	No Det cap	6.80	7.60	6.69	7.60	0.11	0.00
	Total No Det	64.53	69.34	59.20	69.34	**5.33**	**0.00**

Average Deployable Output (ADO) Relocation Schemes

A number of sources have been identified for ADO Relocation in AMP8. This will comprise abstraction reductions at four sources in the upper catchments of the Bulbourne, Misbourne and Gade catchments, which will be matched by abstraction increases at four downstream sources in the Colne valley. This will not impact ADO or PDO but provides an opportunity for an accelerated delivery of abstraction reductions in the headwaters of a number of chalk streams, by increasing abstraction at less environmentally sensitive downstream sources.

Our planned ADO relocation scheme volumes in AMP8 are shown in Table 3.

Table 3: Summary of AMP8 ADO Relocation Schemes

		End of AMP7 1 in 200 DO		End of AMP8 1 in 200 DO Post SRs		SR net impact	
Source	**Intervention**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**
BERKHAMSTED	Reduction	4.37	6.00	1.00	6.00	3.37	0.00
CHALFONT ST GILES	Reduction	2.38	4.50	1.00	4.50	1.38	0.00
PICCOTTS END	Reduction	4.26	10.72	1.00	10.72	3.26	0.00
MARLOWES	Reduction	7.10	8.34	1.00	8.34	6.10	0.00
	Total ADO Reductions					**14.11**	**0.00**
Source	**Intervention**	**Average**	**Peak**	**Average**	**Peak**	**Average**	**Peak**
NORTHMOOR	Increase	12.22	17.74	15.87	17.74	-3.65	0
WEST HYDE	Increase	16.80	19.94	20.46	20.46	-3.66	-0.52
BLACKFORD	Increase	16.20	18.10	20.00	20.00	-3.80	-0.19
THE GROVE	Increase	18	18	21.00	21.00	-3.00	-3
	Total ADO Increases					**-14.11**	**0.00**

4 Business Case Development

4.1 Drivers

Water companies have a statutory obligation to set out how they will ensure that they have sufficient water resources to meet the current and future demands of their customers, over a minimum 25-year period while looking forwards 75 years.

Our dWRMP24 outlines how we plan to provide a reliable, resilient, efficient, and affordable water supply to our customers between 2025 and 2075 and sets out how we intend to maintain the balance between water supply and demand.

Chalk streams are rare ecosystems that are important to protect. 85% of all chalk streams are in England, mainly in the south and east of the country. Many of these chalk streams in our supply area are considered to be impacted by our abstraction for public water supply. These rivers are failing to meet Good Ecological Status (GES) or Good Ecological Potential (GEP) under the Water Framework Directive and therefore action needs to be taken to address this, unless assessed to be disproportionately costly.

In AMP6 we started our programme of chalk stream river improvement works and habitat enhancement schemes; these interventions continued in AMP7 and represent fundamental measures to improve WFD status of the surface waterbodies, in those reaches where flows have potentially been reduced by the impact of groundwater abstractions.

Some of the benefits of the SR programme include:

- Healthy chalk stream systems can also lead to improved water quality and support greater ecological diversity.
- To meet our environmental objectives and targets as a company to ensure we are improving the local environment while maintaining high quality drinking water supply.
- Support achievement of a number of our 'strategic focus' in our 2025-2050 Strategic Direction Statement including:
    - Strategic Focus 1 - End unsustainable abstraction from chalk groundwater sources
    - Strategic Focus 2 - Achieve net zero carbon by 2045 (and 2030 for our operational emissions)
    - Strategic Focus 3 - Deliver a net gain in natural capital.

We will implement a twin-track approach to delivering these SRs alongside our proposed AMP8 and AMP9 programme of catchment and nature-based solutions (C&NBS), including Revitalising Chalk Rivers (RCR), which are detailed under the following WINEP Action ID's:

- 08AF100010 – Upper Lee operational catchment C&NBS
- 08AF100011 – Colne operational catchment C&NBS

- 08AF100013 – Dour operational catchment and Little Stour C&NBS
- 08AF100014 – Cam Ely Ouse and Upper Bedford Ouse C&NBS
- 08AF100015 – Karstic Groundwater Sources (C&NBS (water quality resilience)
- 08AF100016 – Lower Thames Drinking Water Protected Area C&NBS (water quality resilience)

By delivering C&NBS measures in chalk stream catchments alongside these reductions we can further contribute to achieving GES and support achievement of the WINEP wider environmental outcomes. Benefits include, but are not limited to:

- Ensure that our chalk streams are more resilient to different environmental conditions like drought and flooding.
- Create more resilient catchments to climate change, population increase and associated demand for potable water.
- Restoring the rivers back to a more natural state by removing barriers to fish, re-meandering, reconnecting them to groundwater and re-establishing chalk stream characteristics.
- Healthy chalk stream systems can also lead to improved water quality and support greater ecological diversity.

4.1.1 Statutory Drivers

The statutory drivers are:

Water Framework Directive (WFD) / Water Industry National Environment Programme (WINEP)

- Thames River Basin Management Plan
- Anglian River Basin Management Plan

The specific WINEP Drivers relevant to this scheme are:

- WFD_IMP_Flow (S+) = Actions to improve ecological status (surface water)
- WFD_ND_WRFlow (S) = Action to protect / ensure No Deterioration in status (surface water)

4.1.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-Year Environment Plan
    - 25YEP_IMP (NS) = Water company actions contributing to meeting 25YEP goals
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Government's strategic priorities for Ofwat – Policy paper February 2022
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies
- AW0031 Affinity Water Strategic Direction Statement

- Catchment Based Approach (CaBA) chalk stream restoration strategy
- Blueprint for Water – Blueprint for PR24
- CaBA Catchment Partnerships catchment plans such as:
    - Colne Catchment Action Network (ColneCAN)
    - Lea Catchment Partnership
    - Upper Bedford Ouse Catchment Partnership (UBOCP)
- Hertfordshire County Council (HCC) Sustainable Hertfordshire Strategy

4.2 Environmental Background

The Water Framework Directive (WFD) requires waterbodies to achieve good ecological status (GES) or potential (GEP). This includes a requirement not to cause deterioration in status through abstraction. The WFD is implemented in England and Wales by the Water Environment (Water Framework (England and Wales) Regulations 2017 (WFD Regs)).

We have been working with the EA and its predecessor since 1990 to improve flows in local Chalk streams and have already implemented SR schemes in a number of catchments.

A SR is a reduction in water company deployable output to aid in the protection or improvement of internationally or nationally designated conservation sites or species, to protect or improve locally important sites (undesignated sites) or to deliver WFD environmental objectives in River Basin Management Plans (RBMP) (EA, 2017). SRs aim to improve river flow and ecology and meet legislative requirements, included under the WFD objectives in RBMPs and the Habitats Directive.

In AMP6, we delivered 42.09Ml/d (average) and 39.06Ml/d (peak) of SRs and are currently on target to deliver a further 33.71Ml/d (average) and 21.06Ml/d (peak) in our Central region in AMP7 (by December 2024).

4.3 Baseline Assessment

The requirement to take a long-term view on the need to reduce groundwater abstractions from the environment was initially identified in 'Meeting our Future Water Needs: a National Framework for Water Resources' (EA, 2020). The National Framework environmental scenarios use thresholds to define the minimum amount of water which needs to remain in the environment and therefore how much is available for public water supply abstraction.

For surface water bodies, the National Framework used the Environmental Flow Indicator (EFI) as a default. For groundwater bodies, the National Framework used the four WFD groundwater sustainability tests, which includes the groundwater balance test (quantitative status test). Both surface water flow target and groundwater quantitative status tests indicate the pressure induced by current and

future predicted abstractions on the environment, when combined with climate change and demand scenarios.

Baseline assumptions for the National Framework also included:

- Waterbodies that were at Good Ecological Status (GES) in 2016 will remain at good.
- Planned implementation schemes as part of the AMP7 WINEP will enable those specific waterbodies, which are failing, to achieve GES by 2027.

These assumptions were then reviewed and amended by the local EA Area offices. The following points note the changes made by the Area offices to refine the National Framework scenarios and provide better data where available. This resulted in the generation of four scenarios (BAU, BAU+, Adapt and Enhance) which were included in our dWRMP.

4.4 Methodology and strategy

The methodology and resulting long term needs for the Environmental Destinations have been derived through the structured, policy-based EA methodology. Subsequent to this, discussions with the EA have taken place to determine the speed at which reductions should be implemented, based on how quickly water can be replaced and which catchments or parts of catchments should be prioritised.

For the Central Region (WRZs1-6), our strategy had to contain plausible descriptions of the location, quantity, and time of implementation. We developed this in accordance with the following set of principles:

- **Affinity Water is committed to progressively ending unsustainable abstraction, where this is identified.** Where there are potential environmental impacts, based on current knowledge and conceptual understanding, then the respective abstraction sources are scheduled for reduction (or average deployable output (ADO) relocation) in AMP8 (2030), where practicable. Beyond this timeframe, our strategy is designed to allow for investigation and reduction of perceived unsustainable abstraction across all catchments that have been identified by the EA Environmental Destination work.
- **The strategy is adaptive and designed in the way that abstractions are reduced on a progressive, catchment by catchment basis**; this allows us to take decisions based on the observed results from previous interventions, whilst the programme progresses, and the environmental flow targets are further refined. This approach will ensure measures for continuation, reduction or cessation are implemented on a focused basis, based on the best available information.
- **By using an adaptive approach, the strategy is intended to provide a balance between the pace at which we end unsustainable abstraction and**

affordability. This will allow it to incorporate monitoring data and learning so that we only reduce abstractions where it will have a meaningful benefit on Chalk stream health, and we do so in a manner that ensures risks such as groundwater emergence, aquifer quality deterioration and carbon footprint impacts can be managed.

Using the principles above, we engaged in an iterative liaison process with the EA to identify sources and catchments to be prioritised, alongside the overarching strategy for the pace of implementation. The liaison process determined that:

- **AMP8 (2025-2030)** abstraction reductions are limited by the amount of water that we can deliver in that timeframe to replace lost licences. We have agreed to focus our efforts on certain Colne tributary catchments. We also identified the potential to accelerate the interventions through the ADO relocation approach (Section 3). This is believed to be a relatively low-cost solution, allowing us to partially implement principles of the 'Chalk Streams First' strategy.
- For the **AMP9 and AMP10** timeframe (**2030-40**), our dWRMP included reductions on further tributary catchments of the Colne, (meaning that we will have reduced abstraction in every Chiltern Chalk stream catchment in which we abstract), the Upper Cam, Upper Hiz and Upper Ivel. We have also proposed that reductions in this timeframe are made to groundwater abstractions in the tributary catchments of the Lee, with the intention to quantify their benefit before moving onto the medium to high environmental destination scenarios in AMP11 (2045) and onwards.
- **Beyond AMP10 (2040+)**, any interventions carry high levels of uncertainty. Either the need and benefits are much less quantifiable, or the reductions are related to sources where the current information suggest there is likely to be less benefit. We have therefore included catchments where the current quantification of abstraction impact is less robust, or where previous WINEP investigations suggested limited potential benefit.

Figure 1 below shows the proposed changes in deployable output for the 1 in 200 drought scenario, as a result of the proposed AMP8 SRs.

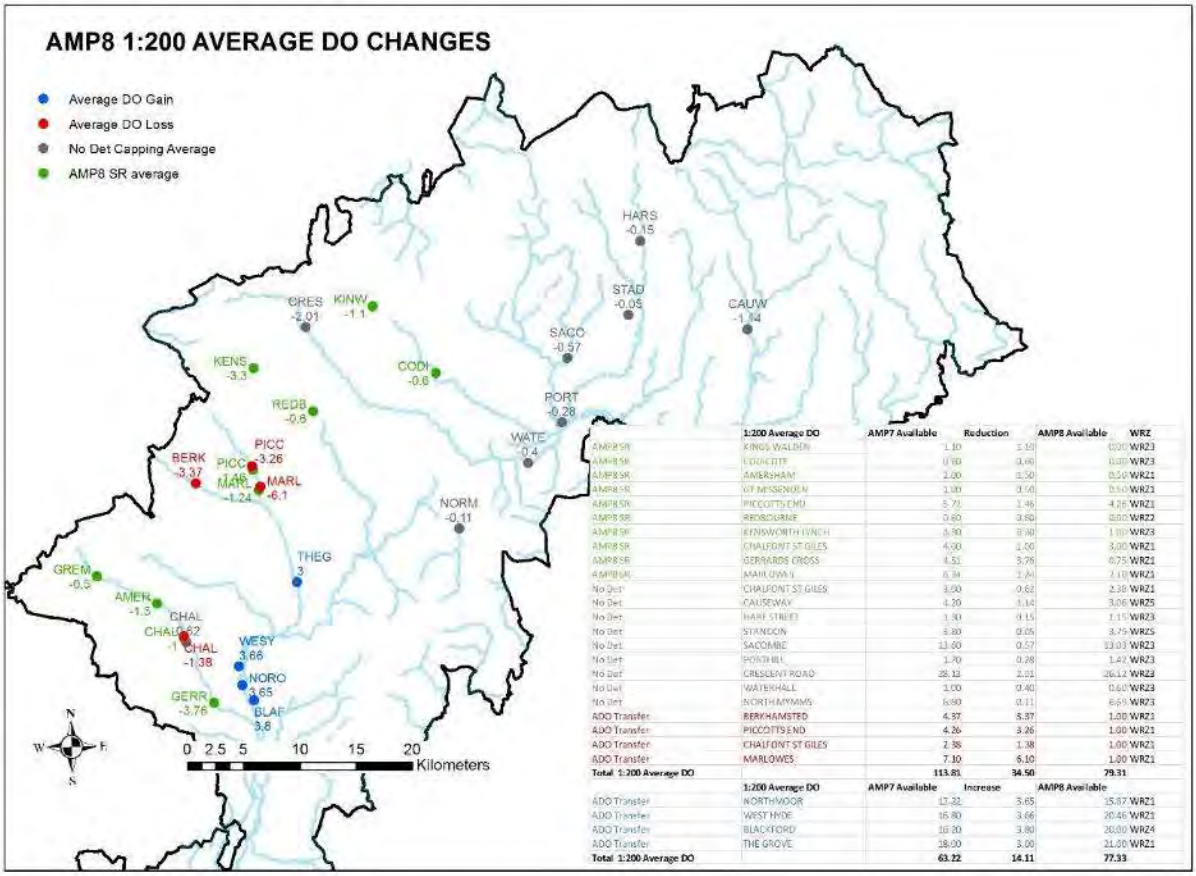


Figure 1 Overview of AMP8 Sustainability Reductions

4.5 Allocation of Costs

Enhancement expenditure is defined by Ofwat as 'generally being where there is a permanent increase or step change in the level of service to a new 'base level''. The schemes set out in this business case are required to maintain our current level of service whilst we implement sustainability reductions, which marks a step change to meet environmental improvements with statutory obligations. As a result, this business case is 100% enhancement, and all costs are allocated to enhancement expenditure.

4.6 Research, Pilots, and Technology Development

To help inform our cost benefit assessment, we have looked at the implementation of previous sustainability reductions. A case study for a natural capital evaluation of the AMP6 SR at Whitehall is described below.

Natural Capital evaluation of the Whitehall pumping station Sustainability Reduction

We commissioned Atkins in 2022 to undertake a natural capital evaluation of the SR implemented at Whitehall in April 2017 (Table 4). This evaluation aimed to quantify and (where possible and appropriate) value the ecosystem services benefits of our groundwater abstraction reduction in the River Beane catchment. The purpose of this assessment was to understand at a strategic level the natural capital and ecosystem services value of our abstraction reduction at Whitehall. It also aimed to help inform how other abstraction related projects could be assessed in future using the new WINEP options development and assessment process.

The Whitehall source had previously been voluntarily reduced to a maximum of 15 Ml/d (average) in 2014; the 2017 reductions further decreased the annual average abstraction from 15Ml/d to 2Ml/d. This equated to a reduction in deployable output from AMP5 of 16.16Ml/d at average and 18Ml/d at peak. The expectation was that the reduction would help increase baseflow in the River Beane particularly during low flow periods.

The End of AMP6 NEP report (2020) produced by Affinity Water, identified clear groundwater benefits from the SR, with observed groundwater recovery in the Chalk aquifer along the valley, both upgradient and downgradient of Whitehall Pumping Station. The report and subsequent analysis have suggested quantifiable improvements to flow of between 2 and 4 Ml/d when flow in the Beane is above Q40 (just below average). Following the SR, low flow events and periods of drying are likely to have been shortened within the immediate cone of depression by up to 2 months, although it has not yet been possible to quantify this.

As there was evidence of limited improved baseflow within the Beane only under average and above average groundwater level conditions as a result of the SR at Whitehall, this assessment was conducted on a hypothetical basis, which produced per unit (km) value results. Natural capital benefits and the results of the NCA reported are not yet realised. Nonetheless, the results are useful as potential per km benefits which can then be scaled to a SR on the Beane should future monitoring data demonstrate that there have been sufficient improvements to flow, particularly during low flow conditions, as a result of the SR.

A number of limitations were identified during this process of assessing SR's using the WINEP methodology:

- SR methods provide large groundwater benefits; however, they are not yet accounted for in natural capital accounting tools.
- The WINEP recommended methodology only considers the area of woodland or wetland habitat for providing flood storage and thus in relation to hazard regulation (flood protection) ecosystem service benefits. Therefore, the potential decrease in flood protection caused by increased flows from the SR, would not be captured in the assessment.
- Natural capital evaluation tools (specifically the WINEP methods) are mainly focused on terrestrial land cover changes. As the SR impacts are in the channel rather than terrestrial, this restricts the number of WINEP metrics (ES) which were scoped into the assessment and narrows the lens of benefits realised from the SR within the NCA. Therefore, regardless of the level of flow improvements, BNG and water quality are likely to be only metrics relevant. It is likely that some benefits of the scheme have been missed due to the inability of natural capital assessment tools to assess the benefits.

The natural capital evaluation has provided insight to inform our WINEP options development and assessment process, particularly in terms of screening of metrics, and has informed our assumptions for the cost benefit assessment for the SR programme in this business case. This has helped develop our understanding of the wider ecosystem services value of investments in SR for business planning. The assessment was undertaken using WINEP recommended data sources and methods.

Table 4 Natural Capital valuation results for Whitehall SR – 30-year PV

Natural capital valuation results for Whitehall SR– 30-year PV											
Watercourse: Beane (from confluence with Stevenage Brook to Lee)											
Ecosystem service	**Change in service provision**	**Metric**	**Physical Flow Account (per km)**			**Monetary Flow Account (per km)**			**30 Year PV (per km)**		
			Baseline	**Scheme**	**Change**	**Baseline**	**Scheme**	**Change**	**Baseline**	**Scheme**	**Change**
Biodiversity	^	Number of biodiversity units	6.9	9.05	2.15	Not currently recommended for monetary valuation					
Water purification by habitats	Scoped out of this assessment										
Water quality*	^		n/a	n/a	n/a	n/a	n/a	£10,331	n/a	n/a	£196,668
Water supply	Scoped out of this assessment										
Climate regulation	Scoped out of this assessment										
Recreation	Scoped out of this assessment										
Recreation – angling	Scoped out of this assessment										
Food – shellfish	Scoped out of this assessment										
Air Quality	Scoped out of this assessment										
Hazard regulation	Scoped out of this assessment										
Volunteering	Scoped out of this assessment										
Education	Scoped out of this assessment										
Total value		-	-	-	-	-	-	£10,331	-	-	£196,668
* See Appendix B for full NWEBS outputs.											

5 Partnering

5.1 Evidence of Customer Preferences and Support

5.1.1 Our Customer Engagement Activities

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers have been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

5.1.2 Support for Environmental Protection and Improvements

We know from our customer engagement activities for PR24, that our customers are conscious of the need to protect the environment for the future, and that

environmental projects are seen as having significant public and moral value. However, the cost-of-living crisis and Ukraine war have impacted customer views and priorities. Some customers are concerned about costs, some find any increase to a bills unacceptable but others feel that the small, planned increases to bills are negligible in comparison to other price increases.

Focus group responses and other research suggests that customers think that fixing leaks is the most important thing that we can do to protect the environment, although there is continued support for environmental protection and improvements. Customers strongly approved of the existence of our plans for WINEP, however most customers wanted us to exceed what was seen as the statutory minimum. Customers' wanted clear proof as to why the investment is beneficial.

This view has been corroborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements, if there was proof that this money would be spent on WINEP projects and not shareholders' dividends. Some customers supported a higher discretionary annual bill increase of between £5 and £10. Non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why it was happening.

The four areas of priority SRs; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

There is general support for reducing abstractions that are considered to be impacting on chalk streams. Participants wanted more information to better understand chalk stream catchments however there were some concerns about how future water demands would be met if abstraction were reduced. There is

varying research on public perception of reducing abstraction. A recent CCW survey ranked reducing abstraction as the 9th top priority for customers out of 10. In contrast, our more recent priorities work has shown that leaving the environment in a sustainable and measurable improved state ranks 4th.

5.1.3 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, comprising SRs, river restoration, catchment and nature-based solutions and biodiversity improvements.

As such, there is clear support for our proposed, preferred, option. This meets the statutory requirements and goes beyond where it makes economic sense to do so and where the impacts on our customer's bills are reasonable. Our other options are also supported by customers as they essentially deliver benefits in the same areas, albeit to different levels. We have designed the preferred option to ensure that we have a suitable balance between manageable bills and improving the environment beyond statutory requirements, where it is justifiable to do so.

5.2 Collaboration and Partnering

5.2.1 Engagement with Internal Stakeholders

Assessment of the solutions required for delivery of the AMP8 SRs was carried out in two phases:

- Strategic Assessment of Network Level Solutions
- Site Specific Assessment of Individual Source Solutions

Strategic Assessment of Network Level Solutions was carried via the following review process:

- Initial use of Miser (our HDZ level model) to establish initial Network Reinforcement schemes required to deliver the agreed Deployable Output reductions from a 'mass balance' perspective.
- Review of the initial Network Reinforcement schemes with Control Operations to confirm feasibility from an operability perspective.

Site specific assessment of individual source solutions was carried out via the following review process:

- Desktop review of existing abstraction, pumping and treatment assets and assessment of capability
- Review with key Affinity Water stakeholders: Water Quality, Production, Network Operations and Control Operations. Review sessions and site visits:
    - Confirmation of existing assets and operation
    - Review of impact of SR changes
    - Identification of solution options to address these impacts

- Workshop Sessions: Review and development of solution options
- Review of solution options against other PR24 business streams
- Development of solution options

5.2.2 Co-design and Co-delivery

The AMP8 SRs were identified and agreed in collaboration with the EA Herts & North London and East Anglia (West Area) teams. The ADO relocation proposal has also been discussed with Natural England (NE) due to the proximity of a number of designated sites in the vicinity of some of the proposed downstream increases in abstraction.

6 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

6.1 Long-term Delivery Strategy Alignment

Our Strategic Direction Statement (SDS) sets out our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "working with our communities to create value for the local economy and society". These are aligned with efficient delivery of our statutory obligations under WINEP and are supported by our preferred option in this business case.

Our Long Term Delivery Strategy (LTDS) builds upon our ambitions as set out in our Strategic Direction Statement and includes a multi-AMP programme of measures informed by the dWRMP and WINEP investigations, ceasing abstraction and No Deterioration abstraction licence capping of chalk groundwater sources, alongside associated investments in our infrastructure, delivered in partnership with the EA through the Restoring Sustainable Abstraction programme.

This strategy is a "no regrets" investment and has been developed as a best value plan, taking an adaptive, evidence-based approach. It is required to achieve the supply and demand balance and implements the SRs agreed with the EA to support our long-term strategy.

The delivery and implementation of the SR's and the C&NBS is adaptive and can change to address risks, challenges and opportunities that arise throughout the 25-year planning horizon. The WINEP investigations, options appraisals and associated monitoring will provide the information to derive evidence-based decision making to inform the adaptive plan.

6.2 WRMP Strategy

The AMP8 SR works outlined in this business case are required to ensure security of customer supply and are closely aligned with Supply 2050. Supply 2050 is an enabler for our dWRMP, which outlines our plans to provide a reliable, resilient, efficient, and affordable water supply to our customers between 2025 and 2075 and sets out how we intend to maintain the balance between water supply and demand.

The Supply 2050 scope includes Connect 2050 and the WINEP SR required investments in AMP8 to meet 2029 planning horizon in our dWRMP.

Our dWRMP has considered the Water Resources National Framework Environmental Destination and we have set out a number of scenarios and a phased approach to

deliver against this. We also plan to undertake AMP8 Environmental Destination investigations to confirm the most beneficial places to make the next phase of abstraction reductions. Our C&NBS programme will align with these activities, providing evidence to inform our future 'Environmental Destination strategy' and delivering multiple environmental benefits targeted at mitigating the impacts of these future scenarios.

We are committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

6.3 Adaptive Strategy

Our dWRMP has been developed as a best value plan and on a 'no regrets' basis, by taking an adaptive, evidence-based approach. Delivery and implementation is adaptive and can change to address risks, challenges and opportunities that arise during AMP8. The investment in AMP8 is described as 'no regrets' as it is required to achieve the supply demand balance and implement the AMP8 sustainability abstraction reduction agreed with the EA, whilst supporting our long-term strategy.

The AMP8 investigations and associated monitoring will provide the information to take data-based decisions as part of the adaptive plan. In particular, at present, uncertainties remain about the ecological flow targets of many of our catchments (particularly in the Affinity Water Central region).

During AMP7, we have been actively collaborating with the EA to decrease these uncertainties, looking at alternative flow targets definition with a pilot study in one of our catchments. For AMP8, the planned catchment investigations will include the Environmental Flow Indicators (EFI) review for all the other catchments not looked at in AMP7. This will provide an opportunity to confirm and refine flow targets across all our regions and will in turn help inform the need, location and scale of future SRs.

Our Long Term Delivery Strategy has adopted the current EFI's as a default, whilst the refinement works are in progress. The AMP8 investigations and monitoring data we collect will help inform the adaptive strategy and the decision-making process of the water resources management plan (WRMP29) for AMP9 and beyond.

7 Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

Assessment of the solutions required for delivery of the AMP8 SRs was carried out in two phases, as an integrated part of the dWRMP development:

- Strategic Assessment of Network Level Solutions
- Site Specific Assessment of Individual Source Solutions

The following optioneering processes were implemented:

7.1.1 Strategic Assessment of Network Level Solutions

The strategic level assessment was carried out utilising a holistic approach that aimed to address both the dWRMP24 needs, as set out in the Connect 2050 technical annex[2], and the requirements relating to the implementation of SRs under WINEP (Figure 2).

Use of Pywr and MISER modelling: A series of different time horizons were identified to reflect the key challenges associated with phases of SRs, Environmental Destination (the reductions needed to ensure abstraction is sustainable, now and in the future (2050)), and delivery of primary and secondary Strategic Resource Options (SROs) for Affinity Water. This provided the ability to understand the points at which our network is likely to be under the most stress and modifications and reinforcements required to maintain customer supplies. Four time horizons were identified for modelling in Pywr and then in Miser to identify initial solution options:

1. 2027 – Initial baseline, post AMP7 delivery
2. 2029 – Implementation of AMP8 SRs as per dWRMP
3. 2034 – Potential earliest delivery of an SRO
4. 2050 – Delivery of a secondary SRO, and to test different levels of environmental destination scenarios

Use of Optimizer modelling: Optimizer was used to select the most cost effective and sustainable options to size trunk mains and booster pump assets, identified through the Pywr and MISER modelling outputs. Please see Figure 3 as an example output of the Optimizer options assessment.

Use of Continuum: Further optioneering evaluation of route options and potential risks was then carried out using a combination of Continuum analysis and in house assessment using ArcGIS and Affinity Water Asset Information Centre (AIC).

[2] Full details of the Connect 2050 optioneering process are detailed in relevant business case.

Use of Infoworks modelling: Assessment for some more localised network reinforcement was carried out using Infoworks (our detailed network model).

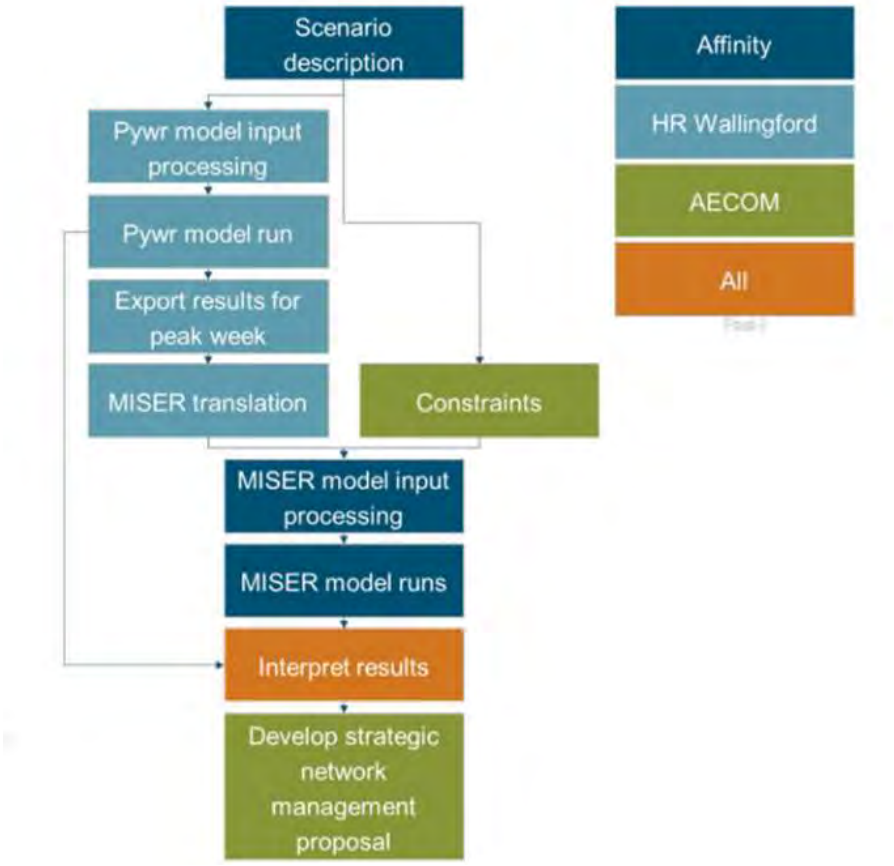


Figure 2 Strategic Level Optioneering Process dWRMP Inclusive of SRs

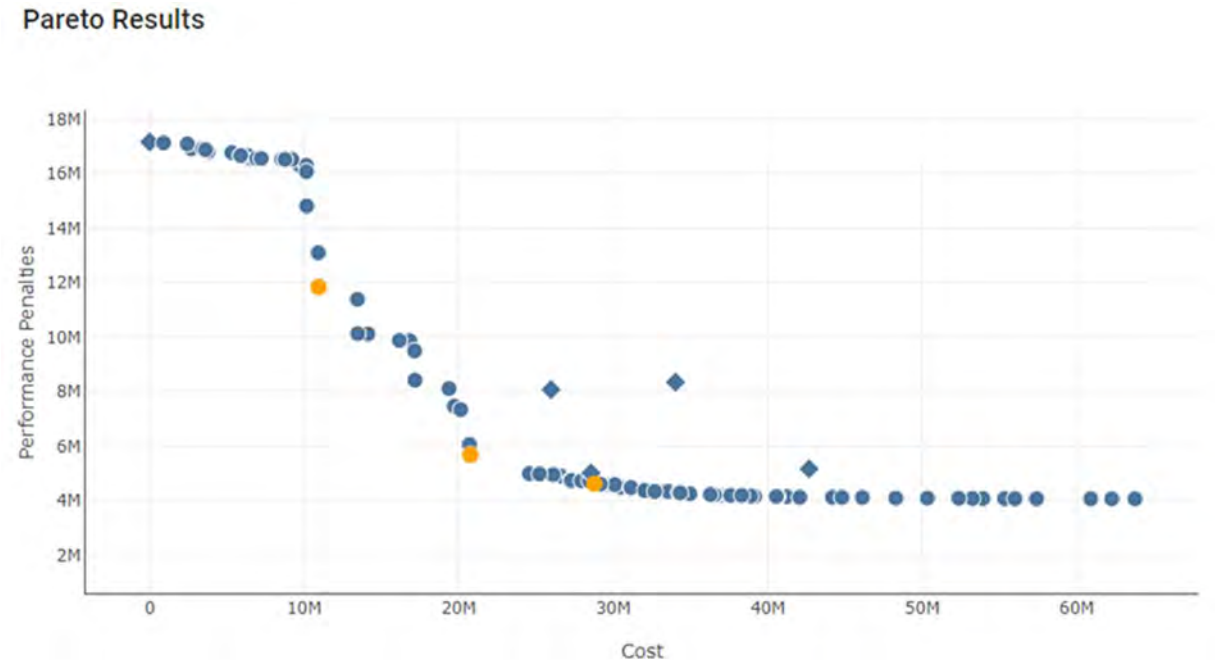


Figure 3 Example Optimizer Output

7.1.2 Site Specific Assessment of Individual Source Solutions

Identification of Risk

We have identified a potential for water quality to be impacted by relocating ADO via two main areas:

Changes to Strategic Transfers

Where the ADO is to be increased as part of the ADO relocation, there is a risk that this may result in source waters of a different chemical composition being distributed to different areas of the network to those under current operation, with potential to impact on wholesomeness of water.

It is our responsibility under the Water Industry Act section 68 to ensure that there is No Deterioration of the quality of the water, which is supplied to customers, it remains wholesome and for us to always plan to meet our water quality obligations.

The ADO relocation has the potential to pose challenges where water quality challenges are currently addressed by a mixture of treatment and blending. Increased abstraction from a site with water quality challenges currently managed by blending may alter the ratio of blending with water from other sites that do have appropriate treatment.

This may raise concentrations in parts of the distribution network and necessitate additional treatment at source.

Site / Source specific Operational Changes

Where the abstraction rate is changing as part of the ADO relocation, the following potential risks were identified:

- Increased risk of turbidity arising where output is increased.
- Increased risk of turbidity or more regular spikes in turbidity, at sites where the peak deployable output is being retained but there is a reduction in average deployable output. In this scenario, changes to pumping may be required that result in more periods of downtime and/or more stop/start activities that have greater potential to cause turbidity.
- Increased reliance on the remaining sources. Due to us implementing SRs across the Affinity Water company area, the criticality of the sources included as ADO Relocations has increased. This further reduces the allowable downtime for these sites to address turbidity events arising from events such as periods of heavy rainfall, which would previously have been able to be managed more easily by run to waste solutions or similar. The allowable downtime for planned and unplanned work to take place is also reduced.
- Risk that the size of the existing treatment no longer matches the required AMP8 outputs. Where increased output is required, there is potential for existing treatment streams to be undersized. Although systems will have been designed to meet peak output, they may not be designed with appropriately sized storage to meet a continuous peak output.

Where a decreased output is required, there is potential for issues around treatment chemical storage times and deterioration which may impact treatment effectiveness and ultimately water quality.

7.1.3 Approach to Solution Assessment

The following methodology has been utilised in order to establish the optimum solution to address the above risks and issues relating to water quality.

Changes to Strategic Transfer

Hydraulic Analysis work has been carried out to identify new strategic water mains and map the overall transfer of water between sources, storage, and distribution.

This has then been cross-referenced against water quality parameters for all the affected sources, to identify any areas when there is potential for a deterioration in the existing water quality parameters at any given location.

Where risks have been identified, an optioneering process has taken place to assess the options for treatment, either at source or elsewhere within the network to ensure there is No Deterioration to the water quality.

Changes to Site Specific Operation

For each of the impacted sites the following key activities have been carried out:

- Review of historical operation of the site, establishment of existing water quality baseline and identification of all known risks and issues.
- Assessment of capability of existing abstraction, treatment, and distribution assets to meet the required AMP8 output changes. Assets including:
    - Boreholes: achievable yield and susceptibility to turbidity
    - Borehole Pumps: capacity and variable speed drive (VSD) operation
    - Disinfection treatment stream capacity inclusive of chemical storage
    - Any other site-specific treatment streams capacity
    - Contact Tank: capacity
- Identification of required asset replacements or upgrades based on the above assessment. Process of solution development workshop sessions with Water Quality Team, Operations Centre, and all key internal stakeholders addressing the following items:
    - Optimisation of pumping profiles to minimise turbidity risk at source wherever feasible.
    - Review of available treatment options to address remaining turbidity water quality issues.
    - Optimisation of treatment solution to address sites with multiple different water quality issues.

7.2 Unconstrained, Constrained and Feasible Options

Because of the methodology used for optioneering and the need to integrate the SRs with both the dWRMP and WINEP options, the unconstrained options and constrained options have not been assessed using our option assessment spreadsheet. Instead, we have focused on the preferred option that satisfies the needs of dWRMP and WINEP based on the list of sources for reductions.

By using our Risk and Value methodology to address the greatest risk to customers (measured via the Service Measure Framework), it enables us to select investments that deliver the greatest value to customers. We have a range of demand-side and supply-side investments that we can potentially use to address these deficits. The Water Resource Planning Guidelines (WRPG) describe the methods and assumptions that need to be followed when compiling our plan. We therefore need to decide on our best value investments in a way that is transparent and complies with all the requirements of the Water Resources Planning Guidelines. There are two key

requirements from the guidance that have underpinned our decision-making process:

- We have developed a set of 'best value principles' that we have used to decide on our preferred plan. This means that, whilst the plan needs to be 'cost efficient,' it is not necessarily the lowest cost option, but should consider the trade-offs between costs, environmental and social objectives. It should also account for other aspects such as the reliability and deliverability of options, in a way that reflects customer and stakeholder feedback.
- The investment models that we have used inherently include adaptive planning within the assessment. This means we consider a wide range of future conditions and select the plans that provide the best balance between near-term affordability and longer-term risk management, given the scale and delivery times associated with our key options.

The constrained options have been developed for each site using the approach above, and the best options have been selected to form the overall preferred programme. Details of the options developed at this stage are given below.

The following sites were assessed for SRs related works:

- Uttlesford Bridge: ADO + PDO Reduction (licence condition)
- Kings Walden: Cessation
- Codicote: Cessation
- Amersham: ADO Reduction
- Great Missenden: ADO Reduction
- Piccotts End: ADO Reduction
- Redbourn: Cessation
- Kensworth Lynch: ADO Reduction
- Gerrards Cross: ADO Reduction
- Chalfont St Giles: ADO Reduction
- Marlowes: ADO Reduction

The following sites were assessed for No Deterioration related works:

- Chalfont St Giles: ADO Reduction
- Causeway: ADO Reduction
- Hare Street: ADO Reduction
- Standon: ADO Reduction
- Sacombe: ADO Reduction
- Porthill: ADO Reduction
- Crescent Road: ADO Reduction
- Waterhall: ADO Reduction
- North Mymms: ADO Reduction

Note: Chalfont St Giles and Piccotts End are also included in the ADO Relocations.

A summary of the preferred option for each source is shown in Table 5.

Table 5 Preferred options for each of the AMP 8 SRs

Source	Summary of preferred option
Uttlesford Bridge	Defer the ADO and PDO reduction to AMP9, as agreed with the EA.
Kings Walden	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Delivery and implementation of Network Reconfiguration to supply from Sundon-Preston Trunk Main. Delivery of site decommissioning works.
Codicote	Interdependent dWRMP network reinforcement schemes. Decommissioning Works, Network Reconfiguration to supply from Sundon-Preston Trunk Main + Dual Main to Address Single Point of Failure (SPoF)
Amersham	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation - Utilisation of New Pumps Optimised for new ADO / PDO Delivery
Great Missenden	No changes required, can be accommodated within current operational regime
Piccots End	See Piccotts End ADO Relocation
Redbourn	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Decommissioning Works, Valve Operations and Network Upgrades
Kensworth Lynch	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Network Reinforcement, Site Specific Reconfiguration of operational assets.
Gerrards Cross	This option comprises provision of an Amazon Filter based Filtration installation sized for peak DO, along with replacement of existing pumps to match the varying flow requirements between average and peak DO and further reduce risk associated with turbidity on start-up.
Chalfont St Giles	See Chalfont St Giles ADO Relocation
Marlowes	See Marlowes ADO Relocation
Chalfont St Giles	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation - Utilisation of New Pumps Optimised for new ADO / PDO Delivery.
Causeway	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation.
Hare Street	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation.
Standon	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets
Sacombe	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.
Port Hill	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.
Crescent Road	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.
Waterhall	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.
North Mymms	Interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.

7.2.1 Uttlesford Bridge Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14 in Section 10. Delivery of site-specific reconfiguration works.

Solution Scope:

- Delivery of multiple dWRMP network reinforcement schemes, comprising a mixture of trunk mains, storage, and Booster Pumping Stations (BPS).
- Onsite reconfiguration works – water main alterations, flushing facilities, cutting & capping works etc. to enable the required operational changes to be implemented.
- Strategic testing and commissioning activities tied in with change of operation from this and other dWRMP and SRs schemes.

7.2.2 Uttlesford Bridge Least Cost Option 2, Preferred

Option 2 consisted of deferring the ADO and PDO reduction to AMP9; this has been agreed as the preferred option after discussions with the EA (meeting on 8th March 2023 with HNL and EAN area teams). This option has therefore no costs.

7.2.3 Uttlesford Bridge Alternative Option 3

Solution Summary: Uttlesford Bridge Northern Trunk Main Reinforcement

Solution Scope:

- Total of 41.9km of Trunk Main Reinforcement
- Wicker Hall Northern Link Main Pump Upgrades
- Hitchin Area Sources Increased Outputs and Reconfiguration of Network Operation
- Ancillary Pressure Control Schemes (PRVs)
- Trunk Mains Flushing / Ice Pigging Programme (to address velocity increases and flow reversals)

Option 3 above has been included to demonstrate an initial high-level optioneering assessment carried out prior to utilising the Optimiser software. Option 3 was ruled out on grounds of cost and due to a need to increase output of the Hitchin area sources which will potentially be subject to future SRs.

7.2.4 Kings Walden Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in. Table 14 Delivery and implementation of Network Reconfiguration to supply from Sundon-Preston Trunk Main. Delivery of site decommissioning works.

Solution Scope:

- Delivery of multiple dWRMP network reinforcement schemes, comprising a mixture of trunk mains, storage, and Booster Pumping Stations (BPS).
- Network Reconfiguration to supply from Sundon-Preston Trunk Main.
- Decommissioning Works at Kings Walden Site:
- Cut & Cap of 2 No. 8" CI Mains and 2 No. 6" CI mains into existing tanks
- Decommissioning of Aeration System Assets
- Decommissioning of Nitrates Ion Exchange Plant
- Decommissioning of Chlorination and De-chlorination Assets
- Installation of 450m of new 250mm HPPE Main (to dual existing supply from the Sundon-Preston Trunk Main which will be the sole supply following cessation of the Kings Walden source).

7.2.5 Kings Walden Least Cost Option 2

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14. Decommissioning Works, Network Reconfiguration to supply from Sundon-Preston Trunk Main. No dual main to address single point of failure (SPoF).

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Decommissioning Works at Kings Walden Site:
- Cut & Cap of 2 No. 8" CI Mains and 2 No. 6" CI mains into existing tanks
- Decommissioning of Aeration System Assets
- Decommissioning of Nitrates Ion Exchange Plant
- Decommissioning of Chlorination and De-chlorination Assets

Option rejected due to unacceptable impact on customer supply resilience.

7.2.6 Codicote Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes. Decommissioning Works, Network Reconfiguration to supply from Sundon-Preston Trunk Main + Dual Main to Address Single Point of Failure (SPoF).

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Decommissioning Works at Codicote Site:
- Cut & Cap of 4"CI Main
- Decommissioning of UV Assets
- Decommissioning of Chlorination Assets

- PRV Installation (to address increase to maximum network pressure resulting from rezone)
- Network Operations: Rezoning Works and Associated Flushing Programme.
- 260m of 90mm HPPE Main to maintain DG2 pressures after rezone.
- Installation of two section of new reinforcement main (twinning of SPoF sections of main):
- 1.1 km of 315mm HPPE main
- 3.1km of 180mm HPPE main
- Network Investigations and hydraulic modelling work

7.2.7 Codicote Least Cost Option 2

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes. Decommissioning Works, Network Reconfiguration to supply from Sundon-Preston Trunk Main. No dual main to address SPoF.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Decommissioning Works at Codicote Site:
- Cut & Cap of 4"CI Main
- Decommissioning of UV Assets
- Decommissioning of Chlorination Assets
- PRV Installation (to address increase to maximum network pressure resulting from rezone)
- Network Operations: Rezoning Works and Associated Flushing Programme.
- 260m of 90mm HPPE Main to maintain DG2 pressures after rezone.

Option rejected due to unacceptable impact on customer supply resilience.

7.2.8 Amersham Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 8. Changes to Pump Operation - Utilisation of New Pumps Optimised for new ADO / PDO Delivery

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Replacement of 2 No. Borehole Pumps for optimised pumping at new reduced ADO.
- Pump tests / telemetry software changes / commissioning works

7.2.9 Amersham Least Cost Option 2

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 8. Changes to Pump Operation - Utilisation of Existing Pumps

Solution Scope: Utilisation of existing assets to deliver ADO through intermittent pumping at PDO

Option rejected due to negative impact on operational control, flexibility and resilience.

7.2.10 Great Missenden Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 8. Changes to Pump Operation - Utilisation of Existing Pumps

Solution Scope:

- Pump Tests / Telemetry Software Changes / Commissioning and Monitoring of new Pumping Profiles

Great Missenden currently operates with a significant difference between ADO and PDO. The site pumps start and stop daily operating for a few hours at peak).

The change to the ADO in AMP8 is relatively small and should be able to be accommodated within the current operational regime - with a slight reduction to the duration that the pumps run at PDO.

7.2.11 Great Missenden Least Cost Option 2

No alternative option available, as existing assets are to be utilised. Initial assessment with Production team is that this should be achievable, however, testing of the new operating profiles will be necessary for this to be confirmed.

7.2.12 Piccotts End Preferred, Option 1

Solution Summary: See Piccotts End ADO Relocation Options below

7.2.13 Redbourn Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14. Decommissioning Works, Valve Operations and Network Upgrades

Solution Scope:

- Decommissioning Works at Redbourn Site:
- Cut & Cap of 225mm Main at Junction of Dunstable Road (A5183) / Meadow View
- Decommissioning of UV Assets
- Decommissioning of Chlorination Assets
- Cross-Connection 1: 180mm cross-connection to Tower Inlet main at Redding Wood Water Tower
- Cross-Connection 2: 180mm cross-connection off the 300mm Friars Wash-Bow Bridge Trunk Main
- Network Reconfiguration 1: Open DM6803. Install Washouts as Enabling Works. Assume meter replacement required.
- Network Reconfiguration 2: Fully Open Hemel Hempstead Road Valve (HHRV).

7.2.14 Redbourn Least Cost Option 2

In this instance, there is not an alternative or least cost option available as all works detailed in Option 1 are required to replace the existing output from the site and maintain the current level of resilience and water quality.

7.2.15 Kenworth Lynch, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14. Network Reinforcement, Site Specific Reconfiguration of operational assets.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump Tests / Software Changes / Commissioning and Monitoring of new Pumping Profiles
- 3.2km of new 250mm Main from Friars Wash-Chaul End Trunk Main to the Kensworth Lynch site
- Associated connection of reinforcement main at tank inlet at Kensworth Lynch

7.2.16 Kensworth Lynch Least Cost Option 2

In this instance, there is not an alternative or least cost option available as all works detailed in Option 1 are required to replace the existing output from the site and maintain the current level of resilience and water quality.

7.2.17 Gerrards Cross, Option 1, Preferred

Solution Summary: This option comprises provision of an Amazon Filter based Filtration installation sized for peak DO, along with replacement of existing pumps to match the varying flow requirements between average and peak DO and further reduce risk associated with turbidity on start-up.

Solution Scope:

- Procurement and installation of 4 No. Variable Speed Pumps
- Pump Tests / Software Changes / Commissioning and monitoring of new Pumping Profiles
- Procurement, installation and commissioning of cartridge filtration system (Amazon or similar) sized for peak flow.

7.2.18 Gerrards Cross, Least Cost Option 2

This option comprises only the pump replacement element detailed for Option 1 above and is dependent on pump testing exercise proving that turbidity issues do not require a filtration solution. This is considered to be unlikely based on assessment of current performance of the boreholes at this site.

7.2.19 Chalfont St Giles, Option 1

Solution Summary: See Chalfont St Giles ADO Relocation Options below

7.2.20 Marlowes, Option 1

Solution Summary: See Marlowes ADO Relocation Options below.

7.2.21 Chalfont St Giles, Option 1, preferred

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14**Error! Reference source not found.**. Changes to Pump Operation - Utilisation of New Pumps Optimised for new ADO / PDO Delivery.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump Tests / Telemetry Software Changes / Commissioning and Monitoring of new Pumping Profiles.
- Procurement and Installation of 2 x New Pump (optimised for delivery of lowered 1 Ml/d ADO)

7.2.22 Chalfont St Giles Least Cost Option 2

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 8. Changes to Pump Operation - Utilisation of Existing Pumps

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Telemetry Software Changes / Commissioning and Monitoring of new Pumping Profiles

This option was rejected on the grounds that use of existing pumps would necessitate changes to pumping profiles that could negatively impact on water quality and resilience and represent a deterioration on current levels. This arises principally from increased stop/start operation. There is also the additional disbenefit of inefficient operation and the negative impact on energy use and carbon.

7.2.23 Causeway Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14**Error! Reference source not found.**. Changes to Pump Operation.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Telemetry Software Changes / Commissioning and Monitoring of new Pumping Profiles

7.2.24 Causeway Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.25 Hare Street Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes. Changes to Pump Operation.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.26 Hare Street Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.27 Standon Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14**Error! Reference source not found.**. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.28 Standon Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.29 Sacombe Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.30 Sacombe Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.31 Porthill Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14**Error! Reference source not found.**. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.32 Porthill Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.33 Crescent Road Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.34 Crescent Road Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.35 Waterhall Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14**Error! Reference source not found.**. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.36 Waterhall Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.2.37 North Mymms Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in **Error! Reference source not found.**Table 14. Changes to Pump Operation. Utilise Existing Abstraction and Treatment Assets.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.2.38 North Mymms Least Cost Option 2

No alternative option available following internal review, as existing assets are to be utilised.

7.3 Selected Options: ADO Relocations

The following sites were assessed for ADO Relocations related works (Table 6):

Table 6 Summary of AMP8 ADO Relocation Scheme Drivers

Source Name	ADO Increase / Decrease (Ml/d)	Key Needs / Drivers
Northmoor	+ 3.65	Meet AMP8 increased ADO (borehole yield and pump sizing). Address increased risk of turbidity from higher flows and increased impact of turbidity on resilience.
Blackford	+ 3.80	Meet AMP8 increased ADO (borehole yield and pump sizing). Address increased risk of turbidity from higher flows and increased impact of turbidity on resilience.
West Hyde	+ 3.66	Meet AMP8 increased ADO (borehole yield and pump sizing). Address increased risk of turbidity from higher flows and increased impact of turbidity on resilience.
The Grove	+ 3.0	Pump changes required to meet new flow rates. Address increased turbidity risk from increased flow rate and increased impact of turbidity on resilience.
Berkhamsted	- 3.37	Increased risk of turbidity from changes to pump operation. Increased impact of turbidity on resilience.
Chalfont St Giles	- 1.38	Increased risk of turbidity from changes to pump operation. Increased impact of turbidity on resilience.
Piccotts End	- 3.26	Increased risk of turbidity from changes to pump operation. Increased impact of turbidity on resilience. Impact on chemical storage.
Marlowes	- 6.10	Increased risk of turbidity from changes to pump operation. Increased impact of turbidity on resilience.

Note: Piccotts End and Chalfont St Giles are also included in the No Deterioration and SRs works.

7.3.1 Northmoor Preferred, Option 1

Solution Summary: Borehole Remediation Works, Pump Upsize, New Turbidity Treatment and Pump Optimisation. Plus, Pump Testing / Investigation Works. Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14.

Solution Scope:

- Yield Testing / Pump Flow Tests on all 3 boreholes, including environmental impact assessment monitoring requirements captured in Section 10.4)
- Installation of new upsized BH1 pump from 6 Ml/d to 10 Ml/d capacity
- Installation of Amazon Filters or Similar Filtration System
- Installation of 2 x new pumps optimised for new ADO

There are three operational boreholes at Northmoor. Borehole 1 (BH1) and Borehole 2 (BH2) are linked by a heading. Currently, normal operation is to run Borehole Pumps 2 & 3 as Duty with Borehole Pump 1 being Standby for Borehole Pump 2 only.

The standby scenario of Borehole 1 and Borehole 3 Pumps would be able to deliver 646 m^3/hr, meeting the new ADO requirement (613 m^3/hr).

There is insufficient resilience to meet the new ADO if BH3 is not available - BH1 can only act as Standby to BH2. Therefore, allowance has been made to upsize the replacement pump for BH1.

A workshop review meeting was held with the Hydrogeology, Production and Water Quality teams, which confirmed there was a need to optioneer treatment for the levels of turbidity that we have historically seen at the site (3NTU).

Assessment of historical data suggests that turbidity stems from the chalk rather than from iron or manganese. Therefore, allowance has been made for installation of a cartridge filter treatment solution sized for the new AMP8 ADO.

7.3.2 Northmoor Least Cost Option 2

Solution Summary: Borehole Remediation Works, Pump Upsize, New Turbidity Treatment. Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in 7.

Solution Scope:

- Yield Testing / Pump Flow Tests on all 3 boreholes
- Installation of new upsized BH1 pump from 6 Ml/d to 10 Ml/d capacity
- Installation of Amazon Filters or Similar Filtration System

Least Cost Option 2 is the same as for Preferred Option 1 but without the replacement of all boreholes pumps to allow for optimised pumping efficiency (only the pump upsize in BH1 required to achieve the yield). This would result in sub-optimal pump operation and efficiency and pose a risk to resilience, given the increased reliance on Northmoor following the AMP8 SRs.

7.3.3 Blackford Preferred, Option 1

Solution Summary: Borehole Remediation Works, Pump Upsize, New Turbidity Treatment and Pump Optimisation. Pump Testing / Investigation Works. Delivery and

implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14.

Solution Scope:

- Yield Testing / Pump Flow Tests on all 3 boreholes
- Borehole 3 Re-drilling and Re-lining works
- Borehole 3 Replacement Pump Procurement and Installation Activities: Project Management, Health and Safety, Welfare Delivery, Supervision, Site Preparation, Electrically Disconnect Pump, Removal, Installation, Electrically Connect Pump, Test and Run to Waste, Commissioning.
- Upsize of Bulk Hypochlorite Tanks to match increased ADO / storage requirements.
- Installation of Pressure Filter System for Manganese Related Turbidity Treatment
- Replacement of old pump with equivalents sized for optimum efficiency to deliver new ADO.

Borehole 3 has a smaller pump than Borehole 1 and Borehole 2 and in order to meet the continuous delivery of 20 Ml/d, it is necessary to ensure there is the resilience of three 10 Ml/d capacity boreholes available at all times.

Historically we have achieved a consistent 19.2Ml/d from the site (during the period 02/05/2011 to 27/11/2011). This is understood to have been met by using BH1 and BH2. This emphasises that, as a minimum, upgrade works will be needed to allow 10Ml/d to be achieved from BH3 to provide the necessary resilience to BH1 and BH2 and allow the PDO of 20Ml/d to be delivered continuously and hence achieve the new ADO. As part of this work, the ability of BH3 to yield 10 Ml/d will need to be proven, and allowance is made for the potential re-drilling and re-lining of BH3, in addition to upsizing the pump to meet the new 10 Ml/d output.

The existing bulk hypochlorite tanks require upsizing to meet the increased chemical use which will arise from continuous running at 20 Ml/d rate.

It should be noted that the water treatment element of the above solution is required as part of the wider SRs work, regardless of whether the ADO Relocations package of abstraction changes goes ahead or not. This is due to the increasing criticality of the Blackford source. If we do not have the current ADO (16Ml/d) available to us due to frequent outages occurring, we would undermine our supply resilience due to implementing SRs elsewhere. The ADO relocation proposes to uplift the ADO to 20Ml/d to help meet upstream abstraction reductions, hence the site and the need to maintain resilience is even more pressing.

7.3.4 Blackford Least Cost Option 2

Solution Summary: Borehole Remediation Works, Pump Upsize, New Turbidity Treatment. Pump Testing / Investigation Works. Delivery and implementation of interdependent dWRMP network reinforcement schemes.

Solution Scope:

- Yield Testing / Pump Flow Tests on all 3 boreholes
- Borehole 3 Re-drilling and Re-lining works
- Borehole 3 Replacement Pump Procurement and Installation Activities: Project Management, Health and Safety, Welfare Delivery, Supervision, Site Preparation, Electrically Disconnect Pump, Removal, Installation, Electrically Connect Pump, Test and Run to Waste, Commissioning.
- Upsize of Bulk Hypochlorite Tanks to match increased ADO / storage requirements.
- Installation of Pressure Filter System for Manganese Related Turbidity Treatment

Scope requirements are as per Preferred Option 1 but without replacement of existing High-Lift pumps to allow for optimised pumping efficiency. Assessed as being unacceptable given increased criticality of the Blackford site in the context of the overall AMP8 SR impact.

7.3.5 West Hyde Preferred, Option 1

Solution Summary: New borehole (assuming insufficient capacity in BH1 to accommodate 2nd pump for resilience due to increased criticality of source and based on known performance of the borehole) and New Pump.

Installation of new turbidity treatment.

Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14**Error! Reference source not found.**.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14.
- Yield Testing / Pump Flow Tests on all 3 boreholes
- Installation of New Borehole and New Pump
- Installation of New Turbidity Treatment (Pressurised Sand Filters)

Increased abstraction is required from Borehole 1 in order to meet the continuous delivery of 20 Ml/d. Resilience of three 10 Ml/d capacity boreholes is required to be available at all times. The yield and space to accommodate a second pump within Borehole 1 needs to be confirmed by investigation works and so allowance has been made for development of a new borehole in the event that it is confirmed that the required yield cannot be achieved from the existing borehole.

The nature of the turbidity at West Hyde is believed to be largely organic iron based. There is concern that the larger particle size of the iron would end up binding cartridge filters, making them an ineffective solution. This issue has been identified at other sources in the Colne operational catchment.

Investigation works similar to those carried out for Hunton Bridge will need to be carried out, to establish the full extent of organic iron related turbidity issues. However, based on assessment of known water quality data, allowance has been made for installation of a pressure filter type treatment stream to address the organic iron-based turbidity.

7.3.6 West Hyde Least Cost Option 2

Solution Summary: Yield Testing / Pump Flow Tests on all 3 boreholes

Installation of New Borehole and New Pump

Necessary upgrades required for retention and extended use of HS2 Membrane Treatment

Delivery and implementation of interdependent dWRMP network reinforcement schemes as detailed in Table 14.

Solution Scope:

- Yield Testing / Pump Flow Tests on all 3 boreholes
- Installation of New Borehole and New Pump
- Necessary upgrades required for retention and extended use of HS2 Membranes Treatment
- Delivery and implementation of interdependent dWRMP network reinforcement schemes.

There is potentially an option to retain existing membrane treatment installed at the West Hyde site as part of HS2 mitigation works. However, there are concerns around this option relating to uncertainty of this membrane filter solution to address the organic iron related issues at the site once the increased continuous ADO output is in place.

There is contractual uncertainty regarding retention of the membrane assets beyond the anticipated 5-year operation period. Following review with the Programme Manager for HS2 works, an initial estimate of the cost of retention has been taken as £5M for the purpose of this optioneering assessment.

7.3.7 The Grove Preferred, Option 1

Solution Summary: Pumps Upsize for all 3 boreholes (to allow delivery of 21 Ml/d ADO from 2 boreholes) and Turbidity Treatment (Sand Filters).

Plus, Pumping Test / Investigation Works.

Solution Summary:

- Installation of 3 No. Replacement BH Pumps each sized for 10.5 Ml/d
- Installation of cartridge filters

This option requires new upsized pumps in all three boreholes but due to the issue with turbidity from increased draw-down at higher abstraction rates, requires installation of a cartridge filter treatment system.

Due to the uncertainty around the extent of turbidity and the potential that the required AMP8 yield will not be able to be achieved from only two boreholes, this option carries a risk and will be reassessed following on-site borehole pumping tests.

7.3.8 The Grove Least Cost Option 2

Solution Summary: See Preferred, Option 1 above.

Solution Scope: See Preferred, Option 1 above.

7.3.9 The Grove Alternative Option 3

Solution Summary: New Additional Borehole and Pump, Use of existing BH pumps plus use of existing run to waste (RTW) facility as backup to Turbidity Treatment.

Plus, Pump Testing / Investigation Works.

Solution Scope:

- Installation of New Borehole and Pump
- Use of existing run to waste (RTW) facilities

Discussion with our Hydrogeology and Water Quality teams has confirmed that we are likely to experience turbidity issues resulting from additional drawdown when abstracting at 21 Ml/d ADO from 2 of the 3 boreholes (with 3rd borehole acting as standby/resilience).

An additional BH will allow the ADO to be delivered from the 3 existing boreholes with minimal turbidity risk (which can be managed by the existing RTW facility) with the new BH providing the necessary strategic resilience.

This option was ruled out due to the strategic supply criticality of the Grove source and the risk that development of a new borehole would require an unacceptably long outage of the site.

7.3.10 Berkhamsted Preferred, Option 1

Solution Summary: Changes to Pump Operation - Utilisation of New Pumps Optimised for new ADO / PDO Delivery. Delivery and implementation of interdependent dWRMP network reinforcement schemes.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.

- Procurement and Installation of 1 x New Pump (optimised for delivery of lowered 1 Ml/d ADO)
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.3.11 Berkhamsted Least Cost Option 2

Solution Summary: As for Preferred, Option1 above

Solution Scope: As for Preferred, Option1 above

7.3.12 Chalfont St Giles Preferred, Option 1

Solution Summary: Changes to Pump Operation - Utilisation of New Pumps Optimised for new ADO / PDO Delivery. Delivery and implementation of interdependent dWRMP network reinforcement schemes.

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Procurement and Installation of 2 x New Pump (optimised for delivery of lowered 1 Ml/d ADO)
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)

7.3.13 Chalfont St Giles Least Cost Option 2

Solution Summary: As for Preferred, Option 1 above

Solution Scope: As for Preferred, Option 1 above

7.3.14 Piccotts End Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes.

Pump / VSD Upgrades and Additional Treatment

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Alteration to Pump Operation (Intermittent Pumping at PDO to achieve new lowered ADO)
- Installation of new OSEC Treatment to replace existing Bulk Storage Chlorine System

- Installation of Variable Speed Drives (VSD) to address any turbidity issues on start-up (as result of intermittent pumping profile)

7.3.15 Piccotts End Least Cost Option 2

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes.

Utilise Existing Pumps and current RTW facility and Additional Treatment

Solution Scope:

Implementation of Ickenham to Harrow Scheme Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- 2 x New Cross-Connections at Strategic PRV locations
- Piccotts End Site Specific Scope:
- Alteration to Pump Operation (Intermittent Pumping at PDO to achieve new lowered ADO)
- Installation of new OSEC Treatment to replace existing Bulk Storage Chlorine System
- Use of RTW to address any turbidity issues on start-up (as a result of intermittent pumping profile)

Option discounted on grounds of RTW on its own being insufficient to address turbidity risk / outage duration, in the context of the increased criticality of the site due to overall AMP8 SRs.

7.3.16 Marlowes Preferred, Option 1

Solution Summary: Delivery and implementation of interdependent dWRMP network reinforcement schemes. Pump Upgrades

Solution Scope:

- Delivery and implementation of interdependent dWRMP network reinforcement schemes.
- Pump (flow) Tests for Existing Assets / Software Changes / Commissioning and Monitoring of New Pumping Profiles (on site and in network)
- Use of RTW to manage any turbidity issues on start-up (as result of intermittent pumping profile)
- Procurement and Installation of 2 x New Pump (optimised for delivery of lowered 1.00 Ml/d ADO) and to mitigate turbidity related outage durations.

7.3.17 Marlowes Least Cost Option 2

Solution Summary: As for Preferred, Option 1 above

7.4 Options for Further Economic Assessment

We have only considered our preferred option for further economic analysis, as this also represents least cost option, as alternative options have been screened out (see sections 7.2 and 7.3). This option has already been optioneered as part of dWRMP to find the best overall option to meet the dWRMP and WINEP objectives. The abstraction reduction sites have been selected with the EA and focussed to have the greatest chance of providing environmental benefits. In addition, the options for each site have been developed and selected to form the overall programme of works for AMP8.

Costs detailed in Table 7, Table 8 and Table 9 are derived from a combination of site-specific requirements and wider network reinforcement requirements. There are interdependencies between these schemes, and they should not be treated in isolation. These interdependencies are detailed in Section 10.

The purpose of the economic assessment is therefore, to determine the cost benefit- of this option. The preferred option consists of the following schemes.

Table 7 Summary of SR Schemes Solution Capex Costs

Sustainability Reductions	
Scheme	**Solution Cost**
Kings Walden	£10,916,633
Codicote	£5,209,668
Amersham	£3,068,471
Gerrards Cross	£891,442
Great Missenden	£996,764
Piccotts End	£2,906,687
Redbourn	£5,143,435
Kensworth Lynch	£13,645,249
Total Scheme Cost (Inc. of Risk)	**£42,778,348**

Table 8 Summary of No Deterioration Schemes Solution Capex Costs

No Deterioration Reductions	
Scheme	**Solution Cost**
Chalfont St Giles	£1,325,762
Causeway	£18,515,062
Hare Street	£1,438,685
Standon	£481,009
Sacombe	£5,456,145
Porthill	£2,680,840
Crescent Road	£19,234,947
Waterhall	£3,829,617
North Mymms	£1,054,312
Total Scheme Cost (Inc. of Risk)	**£54,016,378**

Table 9 Summary of ADO Relocation Schemes Solution Capex Costs

ADO Relocations	
Scheme	**Solution Cost**
Berkhamsted	£53,204
Chalfont St Giles	£92,293
Piccotts End	£60,805
Marlowes	£99,894
Northmoor	£571,131
West Hyde	£13,889,554
Blackford	£12,550,762
The Grove	£854,525
Total Scheme Cost (inc. of Risk)	**£28,172,167**

Note: Scheme totals in tables 5, 6 and 7 above, are based on cost values rounded to the nearest £1K. This accounts for a small (£1000k) discrepancy between these totals and the total Capex value detailed in the Section 2 Project Details table (which is based on unrounded values).

It should be noted that there are multiple interdependencies between schemes, and they must be considered in conjunction with the wider dWRMP supply-demand balance and our WINEP programme of river restoration and catchment improvements. We have identified solutions and investment needs for AMP8, but they are also an important component of our LTDS to improve the environment, whilst ensuring we continue to supply high quality drinking water to customers.

7.5 Level of Confidence of Achieving the WINEP Outcomes

There is a high level of confidence that the preferred option will achieve the WINEP outcomes. This option meets the Water Industry Strategic Environmental Requirements (WISER), aligns with our dWRMP and delivers the programme of SRs agreed with the EA.

Implementation of the AMP8 SRs will require a step change in investment following the AMP6 and AMP7 SR programme. SRs implemented between 2015 and 2025 have reduced headroom at local groundwater sources, our surface works and of our Grafham import. This makes implementing further SRs more complicated and expensive, as there is a need to move water greater distances around the network to ensure we continue to supply high quality water to customers, whilst placing increased criticality on sources not subject to reductions.

By combining the abstraction reductions with our wider programme of Catchment and Nature Based Solutions (C&NBS) (See Section 3), we will be able to maximise environmental improvements in our chalk stream catchments and make a greater contribution towards achieving WFD targets. We have significant experience in-house with designing and delivering both large programmes of abstraction reductions but also in delivering C&NBS. Both of these factors increase our confidence that our preferred option will achieve the WINEP outcomes.

7.5.1 Can the Option Provide Net Benefits?

By aligning the SRs with our C&NBS measures upstream of river restoration and habitat enhancement schemes, the preferred option can provide the following net environmental benefits:

- enhanced resilience for the effectiveness of delivered river restoration schemes and increased likelihood of achieving overall Good Ecological Status (GES)
- Provide greater connectivity of habitats in priority areas in associated chalk stream catchments to support achievement of non-statutory requirements under Defra's 25 Year Environment Plan and Plan for Water
- Improved water quality to support chalk stream ecology.

Please refer to our business cases for our C&NBS for further information on wider net benefits:

- 08AF100010 WINEP Options Development Report – Upper Lee
- 08AF100011 WINEP Options Development Report – Colne
- 08AF100014 WINEP Options Development Report – Ivel and Cam, Rhee Granta

7.5.2 Contribution to the WINEP Wider Environmental Outcomes

The preferred option supports the achievement of meeting the WINEP wider environmental outcomes. Some examples are shown below, but not limited to:

Natural Environment Outcomes

Abstraction reductions in chalk stream catchments have been identified as being required by the EA to meet Water Framework Directive requirements and contribute to the environmental ambition set out in the National Water Resources Framework. Please refer to Environmental Destination technical appendices of our revised dWRMP. The implementation of SRs alongside river restoration and habitat enhancement schemes on chalk streams across the respective operational catchments will also provide greater habitat and supporting ecology for priority species such as water voles.

Catchment Resilience Outcomes

The SRs will leave more water in the environment and contribute to wider catchment resilience under drought conditions. This will also contribute to greater resilience for chalk streams, priority habitats and species within these catchments that are inter-dependent on river flows and groundwater levels.

Net Zero Outcomes

Our Net Zero Strategy takes account of the impact of the SRs on our operational carbon emissions. Current assessment has been carried out at a high level based on best available information. This represents a relatively minor disbenefit, however further, more detailed assessment will be carried out as solutions are developed. This carbon disbenefit will be considered in the context of the wider natural capital benefits detailed elsewhere in this document.

Access, Amenity, and Engagement Outcomes

As identified through our Stage 2 Risks and Issues process, abstraction impacts and low flow in our chalk streams are a key concern of our stakeholders and is also reflected in the CaBA Chalk Stream Restoration Strategy. The implementation of the AMP8 SRs will therefore help contribute towards addressing this issue.

7.6 Proportionality

Our dWRMP presents our Best Value Plan and incorporates delivery of the proposed AMP8 SR programme. Investment needs at a WRZ level have been included within the draft Plan and the AMP8 SRs Programme addresses HDZ and local requirements to ensure we can continue to supply customers with high quality water. The programme addresses the Water Industry Strategic Environmental Requirements (WISER), the risks and issues identified in Stage 2 and supports the WINEP wider environmental outcomes.

In parallel with the delivery of the SRs, we have proposed an AMP8 river restoration and habitat enhancement programme (RCR). This is required to ensure that we maximise the environmental benefit derived on our investment. A monitoring programme to measure the benefit on the environment of the planned AMP8 schemes has also been included. The monitoring activity forms part of the AMP8 investigations and also river restorations programmes, under the assumption that the catchments where we will deliver the SRs also correspond to the areas where we will carry out the AMP8 investigations and river restorations. This provides the most efficient way to monitor the expected changes of the waterbodies towards WFD objectives.

7.7 Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business Cases by PR24 Red Team
    b. Review of Business Cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads or for infra and non-infra schemes by Capital Delivery programme managers and Head of Asset Planning
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We have discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised.

We have commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP

methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 1 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 2.

Our economic and analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

The proposed schemes were accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023.

8 Option Assessment Approach

8.1 Economic Assessment

We have rigorously followed the WINEP methodology for the economic analysis and uses the 'UK HM Treasury Green Book (2020)' approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We also use our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit, and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base
- Benefit valuations and metrics have followed the WINEP methodology in all areas
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits
- Use of the RCV and the Spackman approach for capitalisation
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy

8.2 Cost Estimation

Cost estimation has been made utilising a number of available sources:

- Actual cost information from equivalent schemes delivered by Affinity Water. Wherever possible, costs from recent schemes have been used, with appropriate adjustments made to account for any site-specific considerations and also for inflation.
- PR24 Cost Models have been utilised for some items, with cross-checks being made against costs from recent schemes with equivalent assets and activities.
- Allowance has been made for risk associated with the proposed solutions. A number of the sites require further investigation works to confirm detailed

requirements and these investigation activities have been included in the cost estimate.

Quotes used for each unit cost have been uplifted to the appropriate CPIH financial year average (2022/23).

8.3 Benefit Estimation

We have focused our benefit quantification on the use of the WINEP environmental and community benefit metrics and have used the associated benefit valuations published in the WINEP methodology.

We have also considered other benefits (such as cost savings) and other performance metrics where they are applicable. In most cases we have not attempted to monetise the additional benefits for two reasons, to ensure no double counting of benefits and because many of these are difficult to quantify. We have however discussed these qualitatively in our assessment.

The supporting metrics for the benefits quantification have been determined using the WINEP methodology or based on an assessment of studies from similar projects. In some areas, we have had to estimate the metrics. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? We have used this to develop a profile for each benefit over time.

We have supplemented our economic assessment with an additional assessment to understand the sensitivity of the key assumption on the proportion of the water quality improvement that will be realised as a result of our activities. We understand that our work will contribute to the improvement of water quality, by potentially increasing groundwater baseflow to the neighbouring chalk streams, but the overall water quality will require activities by other parties and on-going investment to achieve the final desired water quality (and WFD) status.

For the river water quality improvement valuations, we have used the original source data values for specific rivers, rather than the averaged values quoted in the WINEP methodology. This is because the chalk river catchments where we are making abstraction reductions are unique in nature and therefore of higher environmental value to society.

8.4 Natural Capital Impacts

We have also considered other environmental benefits that are used in the natural capital register and account tool (NCRAT) approach, however, these are stated separately and with commentary, as there is a risk of double counting. The Options Development Report for the scheme submitted as part of our WINEP submission was developed solely on the monetisation of the WINEP benefits, and with consideration of the other potential environmental benefits. We have used the NCRAT spreadsheet assessment to check and verify our WINEP benefit valuations where appropriate, e.g., hazard flooding reduction by woodlands. We note that there are minor differences between the air quality calculations due to the different methodology used in NCRAT.

8.5 Efficiency

We have used our experience of delivering similar projects over the last ten years to improve our cost estimating and efficient delivery. As we have become more mature, we have utilised frameworks, partnerships, and better ways of working to deliver the outcomes that we require. This has been utilised to assess the relative risks associated with each scheme and identify those schemes which are complex, resource heavy or carry specific risks that could impact delivery.

Where possible, actual costs for equivalent solutions delivered by Affinity Water previously, have been utilised as the basis of the cost estimate for the AMP8 solutions.

On sites such as Blackford, where multiple water quality issues have been identified, further solution requirements have been captured under the appropriate programme.

The risks associated with these priority schemes will be mitigated by measures such as the following:

- We are engaging with our larger construction partners early to ensure the design is both deliverable and affordable.
- Where appropriate, a dedicated programme team will be assigned to the schemes. This will focus the attention on delivery of these key projects.
- On schemes which require planning permission, existing good working relationships with local planning authorities will be utilised and early engagement undertaken to minimise risk.
- Where there is potential overlap with the work of other Utility Companies, we will liaise with local councils to advise of forthcoming works and agree the windows that these can be undertaken.
- In order to mitigate against project uncertainties and to avoid potential double-counting we have integrated of all of our infrastructure business cases

with our over-arching network strategy to identify synergies and delivery efficiencies.

- Costs are subject to inflation, but we will set prices early by placing contracts within the agreed framework, to reduce the risk of costs spiralling upwards.

8.6 Uncertainties and Sensitivity Analysis

Table 10 Uncertainties and sensitivity analysis

Uncertainty	Sensitivity analysis/actions to reduce uncertainty
There are a number of sites within the ADO Relocation sources, where the ability of the existing source boreholes to meet the new increased ADO has not been proven. Optioneering and solution selection has been carried out based on best available information from in-house assessment of the level of risk around yield and water quality.	Further investigation works, including pumping tests, are required to determine the exact solution requirements.
In some cases, there is uncertainty over the level of investment required (i.e. is a new borehole required to be drilled?)	Allowance has been made in this Options Development Report for the cost of the necessary investigation works to be carried out.
Risk of HS2 Works Impact at Blackford (manganese)	Baseline pump test to confirm current water quality status and close monitoring to determine treatment needs.
Potential for other emerging contaminants	To be covered in a separate Options Development Report for our draft PR24 business plan submission. Potential risks to groundwater quality deterioration will also be investigated and where required actions proposed
Benefit metrics, valuations and the timing and duration of the benefits.	We have used the WINEP valuations in all cases and focused our attention on the metrics and the benefit profiles. We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis. We use the 'goal seek' function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.
Risk of unintended consequence (i.e. groundwater emergence)	We have included within our PR24 WINEP Water Resources Investigations programme 08AF100033 (a,b), a scheme to assess risk associated with implementing the AMP8 reductions.

Deliverability of schemes on time/budget	Our experience in delivering our AMP6 and AMP7 SRs programmes provides us with confidence in identifying and delivering the necessary schemes for AMP8. Delivering such large-scale reinforcement and upgrade schemes in the five-year AMP timeframe requires pre-planning and early engagement with framework contractors/customers, supply chain, internal and external stakeholders to help ensure smooth delivery. The importance of an integrated approach covering both Infra and Non-Infra teams to ensure efficient delivery and commissioning of new assets, is well understood.

9 Option Assessment

9.1 Commentary on the Economic Assessment

We have primarily assessed the preferred option to determine the cost benefit associated, solely with the SRs programme. However, because the SRs are part of the much wider dWRMP and WINEP programmes, it also needs to be considered more holistically. Please refer to our dWRMP24 which presents our Best Value Plan based on regional water resources planning (WRSE).

The primary objective of the project is to improve WFD status and hence river water quality, and so our economic assessment has focussed on this benefit. We also appreciate that the SRs will increase Opex costs and operational and embedded carbon, and these must be considered in the analysis.

9.2 Benefit Screening

We screened each feasible option to understand the potential benefits. These are captured in the following table and then used in the analysis. The benefits are either monetised if they are WINEP benefits, or not monetised if not.

Table 11 Screened benefits

Benefit	Commentary
WINEP Benefits	
Biodiversity	Considered but not measured
Water purification by habitats	Not applicable
Water quality	Monetised as per WINEP and impacted by the river restoration investments
Water supply	Monetised as per WINEP and impacted by the river restoration investments
Climate regulation	Not applicable
Recreation	Applicable but not monetised
Recreation – angling	Applicable but not monetised
Food – shellfish	Not applicable
Air quality	Not applicable
Hazard regulation – flood	Not applicable

Volunteering	Applicable but not monetised
Education	Applicable but not monetised
Other Benefits	
Food production (ha)	Not applicable
Livestock (dairy and meat) (ha)	Not applicable
Timber production (ha)	Not applicable
Social health (ha)	Not applicable
Dis-Benefits	
Additional pumping	Monetised based on AW costs
Additional treatment costs	Monetised based on AW costs
Additional treatment power	Monetised based on AW costs
Additional operational carbon from additional power usage	Monetised based on AW costs and standard carbon valuations
Additional embedded carbon from construction activities	Applicable but not monetised
Additional traffic disruption from construction activities	Applicable but not monetised

9.3 Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions. Our assumptions are detailed below:

River Water Quality

- The SR schemes impact on the tributaries of the Upper Lee and Colne catchments. Some of these schemes cease or make significant abstraction reductions and these are assumed to improve river water quality. Others are expected to have a lower impact and are forecast to maintain the river water quality status over time by preventing deterioration.

- In total we have calculated that 37 km of the Upper Lee catchment will be improved, and 91 km maintained. We have calculated that 137 km of the Colne catchment improved, and 8 km maintained.
- We have assumed that the whole length of the Lee and Colne tributaries are currently in Poor condition as per Catchment Data Explorer.
- The length of the river improved for the sources with allocated SR, No Deterioration and ADO transfer schemes have been accounted for once, to avoid the double counting the benefit.
- We have assumed that our abstraction activities will make a proportional start to improving the water quality and that further, future, activities will be required to achieve full Moderate status for the whole river system. These include our river restoration and natural capital schemes. We have assumed a 10% improvement towards Moderate status. Our objective is to take additional measures over multiple AMPs to maintain and increase the benefits over the long-term, but we have assumed that this might not be funded in our analysis.
- Our work on the River Beane and the abstraction reductions has shown that biodiversity and water quality benefits are likely to be realised. However, we were unable to determine the improvement in water quality as this requires more time, over several years, to monitor different flow conditions.
- We have assumed an annual rate of deterioration of 1% that can be addressed by our investments. This equates to the relevant length of river moving to Bad status in 100 years without any intervention. If the actual deterioration rate is lower, then we expect to see some water quality improvements. Because this is a conservative estimate, we expect that our interventions should be able to manage higher deterioration rates.
- The water abstraction benefits are based on the overall abstraction reduction of 20.39 Ml/d and have been profiled to start in 2030 and phased in over three years.

Dis-benefits

- Our work on the Beane abstraction reductions has shown the importance of understanding the dis-benefits of these type of schemes.
- We have assessed the additional pumping power and costs that will be required to transfer water resources from other sources. We have also assessed the reduction in power and pumping from the reduced abstraction and then determined the overall net effect.
- Similarly, we have also determined the net impact on treatment costs (labour, materials, and chemicals), and the power usage and costs.
- The additional costs have been added to the total scheme costs and start in AMP9, then ramp up over three years.
- We have calculated the estimated total change in power from the calculations above and then determined the operational carbon impact. The carbon impact has been programmed to start in AMP9 and again phased in over three years.

Other Key Assumptions

- We have assumed that around 30% of the water volume that is not abstracted will result in increased flow to the river catchments downstream from the abstraction points. We have also assumed that these will take time to materialise as per our assumptions above. The impact of the increase in river flow over time are present unknown.
- The recommended upgrades identified for SR schemes required to meet the increased ADO are based on current AMP8 SR volumes and locations, reviewed, and agreed with the EA. It is understood that these volumes and locations are subject to review and change.
- At a number of sites where there are increases to the abstraction pumping from boreholes, the proposed increased flows have not previously been proven and carry a risk of either the required yield not being able to be achieved or not being able to be achieved without an issue with turbidity. Assumptions for required borehole related works have therefore been made on a site-by-site basis using the following:
    - Review of historical operation of the sites with Affinity Water Production staff, in order to identify past turbidity and outage incidents and their causes, and any indicators of likely impact of the AMP8 changes to abstraction.
    - Review with Affinity Water Hydrogeology team of known information on borehole condition and performance, and identification of any indicators of ability of boreholes to meet the required AMP8 yields.
    - Review with Affinity Water Hydrogeology team included assessment of any risk of potential changes to chemical composition of the source water resulting from increased draw-down rates.
    - Review with Affinity Water Hydrogeology team also included assessment of any risk of potential increases in turbidity resulting from increased abstraction rate or from increased draw-down, as well as from any changes to a more start/stop mode of pump operation necessitated by the reduction in AMP8 ADO.

9.4 Preferred Option

Our economic analysis has shown that the preferred option is not cost beneficial. We forecast an NPV of minus -£22.967m, and a benefit / cost ratio of 0.79. The NPV benefits are significant (£87.148m) and the longer the length of river impacted, the higher the benefits. We have worked with the EA to select sites for abstraction reductions which maximise the length of river benefiting from the reduction. Our work following abstraction reductions and river restoration in the River Beane catchment reductions has shown that river water quality, biodiversity and natural capital improvements can be expected, but that at present, we are not able to quantify these benefits to any degree of certainty. This is expected to improve over the next few years, as different flow conditions are monitored, and improvements are made to the benefit assessment methodology.

We have assumed a 10% increase in water quality in the analysis. We believe that this is a reasonable value. Our recent river restoration on the River Beane has delivered biodiversity net gains across the different areas in river units between 16% and 49%, with a weighted average of 28% based on river length. There is also a corresponding average improvement of the habitat units of 6%. Similarly, our cover cropping scheme realised a river water quality benefit of over 40%, CO_2 sequestration of over 70% and air pollutant removal of 35%, as well as delivering many other significant benefits such as soil condition, flow regulation and recreation. However, the impact on river flows are currently unknown.

We have also calculated the % value of improvement required to make the scheme cost beneficial. The results show that water quality improvements of more than 27% as well as no worsening of other tributaries would be required for the scheme to be cost beneficial. We also undertook sensitivity analysis by changing the deterioration rates. This analysis showed that maintaining 'No Deterioration' was not sufficient to ensure a cost beneficial scheme.

The scheme has significant Capex and Opex costs when compared to our river restoration programme, which offers much better value for money. When accounting for the Capex and significant additional Opex costs, the benefits have to be significant. The SRs provide about 40% of the required benefit to ensure overall cost benefit. The river water quality must provide the additional benefits of the scheme, and valuations show that significant improvements must be realised. The impact of the abstraction reductions on river flows and then river water quality is uncertain and are unlikely to be sufficient to provide a cost beneficial programme. This may change when more environmental monitoring and analysis has been undertaken.

9.5 Non-Monetised Information

We have applied the WINEP benefits as per the methodology and have not added any additional environmental benefits in the economic analysis as per the guidance. We are, however, aware that there are likely to be additional benefits that should be considered, albeit not in a monetised way. As such, we have used the NCRAT methodology to help identify and understand these benefits. The use of NCRAT has had the additional benefit of confirming the valuations for the WINEP measures used in our analysis.

We have also used our previous work to identify these additional benefits and to estimate their impact on this project. The benefits considered are:

- Recreation
- Education
- Volunteering

We also believe that there will be recreational benefits from the project, and these will be in proportion to the investment undertaken. We will look to maximise these benefits when we design the final schemes but have decided not to include them at this stage of the planning process.

We have also identified potential dis-benefits that we have not been able to monetise. The programme requires significant construction works, that will increase embedded carbon and result in temporary traffic disruption in our communities.

9.6 Wider Environmental Outcomes

9.6.1 Biodiversity

Biodiversity has not been monetised in the assessment, as per the WINEP methodology. However, biodiversity is expected to be positively impacted by the project, in accordance with the type of habitats impacted and the quantity of hectares.

9.6.2 Wider Environmental Outcome Assessment

We have undertaken an assessment of the project on the four WINEP outcomes. The observations are presented below (Table 12 and Table 13).

Table 12 WINEP Outcome assessment key

Impact Key	
Positive impact: noticeable benefits from relevant ecosystem services have been identified	^
Marginal / Neutral impact	-
Negative impact: noticeable dis-benefits from relevant ecosystem services have been identified	v
Not assessed within options development and appraisal	o

Table 13 WINEP outcome assessment

Outcome	Option	Impact
Natural Environment: Improvements to the natural environment through the protection restoration and enhancement of the environment, biodiversity, and habitats	**Best value Option**	^
	Least Cost Option	^
	Alternative Option 1	o
	Alternative Option 2	o
Net Zero: Contributions to achieving a balance between the amount of greenhouse gas (GHG) emissions put into, and the amount taken out of, the atmosphere	**Best value Option**	v
	Least Cost Option	v
	Alternative Option 1	o
	Alternative Option 2	o
Catchment Resilience: Contributions to catchment flood and or drought resilience, better surface, and groundwater management, restoring or increasing environmental capacity, and securing sustainable alternative water resources	**Best value Option**	^
	Least Cost Option	^
	Alternative Option 1	o

	Alternative Option 2	**O**
Access, Amenity, and Engagement: Contributions to improving access to, amenity of and engagement with the natural environment to support customer and community wellbeing	**Best value Option**	**^**
	Least Cost Option	**^**
	Alternative Option 1	**O**
	Alternative Option 2	**O**

9.7 Justification of the Preferred Option

The project is part of our longer-term goal to improve the environment of our local river catchments, whilst protecting our ability to supply drinking water to customers. Extensive optioneering of the different options undertaken as part of the dWRMP and WINEP programmes has shown that the preferred option is the best value option. The preferred option aligns with and supports the WINEP wider environmental outcomes and will deliver a significant environmental net gain. It also supports our dWRMP and will be delivered alongside our AMP8 and AMP9 river restoration and natural capital improvements programme.

The project will deliver against the statutory and non-statutory drivers and will build the foundations for additional future catchment improvements.

Reasonable estimates of the benefits have been made and the scheme is clearly not cost beneficial. The scheme has significant Capex and Opex costs (NPV of £101.8m) and the benefits (£87.1m), albeit significant, are unlikely to be sufficient to ensure an overall cost benefit. However, it is important to note that the river water quality benefits are currently difficult to estimate, and that this could change and alter the benefit calculation as any abstraction reductions are monitored in the future.

More importantly, the SR programme should not be considered in isolation. It forms an integral part of a long-term strategy to both deliver water resources security for customers whilst protecting the environment for society and future generations. Customers' have indicated great support for improving the chalk streams and perceive that abstraction reductions are a good thing. When considered holistically, implementing SRs alongside our Catchment and Nature Based Solutions will deliver wider benefits.

10 Delivery Considerations

10.1 Related Projects

10.1.1 WRMP Projects

Blackford Water Treatment: It is understood that there may be issues with emerging water quality risks in Blackford raw water that could necessitate installation of new treatment streams (additional to the manganese treatment stream detailed in this business case). Design work will need to be coordinated between the SRs driven Manganese treatment stream and any other additional treatment streams, with particular consideration to impacts on power, MEICA (Mechanical Electrical Instrumentation Control and Automation) and pumping elements of the design.

Delivery of AMP7 Sustainability Reduction Schemes: In delivering the AMP8 abstraction reductions works, we will build on our experience of delivering SRs, following AMP7 reductions at Amersham, Holywell, Mud Lane, Digswell, Periwinkle Lane, Runleywood Chalk, Newport, Chartridge and Chesham. The AMP7 SRs also marked a step change to meet environmental improvements with statutory obligations, but their delivery did not include funding for the AMP8 SRs.

HS2 Related Temporary Treatment Schemes: There are a number of temporary HS2 related treatment and pumping schemes that will need to be considered within the delivery of the SR schemes. These HS2 schemes are located at The Grove, Northmoor and West Hyde. Uncertainties also remain over any medium to long term impact of HS2 construction on source yield and water quality, that once known will need to be appropriately addressed.

Dependence on successful delivery of Sundon Treatment Works: As part of our current AMP7 programme we are constructing a new conditioning plant a Sundon service reservoir to ensure we can maintain the wholesomeness of drinking water and allow Grafham-derived water to be distributed more widely within our network. We need to maximise our Grafham import to deliver the AMP7 SRs and maintain our supply-demand balance and levels of service.

We have historically observed changes in taste, odour and discolouration of supplies when we have substituted our groundwater-fed supply zones with surface derived waters, particularly from Grafham Water Treatment Works. Work has commenced on the construction of the conditioning plant, and it is on track for completion in 2024. There remain some risks associated with this scheme, as whilst the treatment technology has been tested using a pilot rig, it has never been used at this scale. We are mitigating these risks by planning a gradual and phased approach to bringing the plant online, with concentrated customer communication campaign and an enhanced sampling programme for the duration of the transition. Alongside the construction and commissioning, a programme of customer engagement will also take place.

Dependence on achieving AMP8 Leakage targets and reduced Customer Demand targets: The AMP8 SRs schemes are predicated on the demand management assumptions included in our dWRMP24.

Delivery of AMP8 Network Reinforcement (Supply 2050) schemes: A number of the SR schemes are dependent on network reinforcement schemes being implemented to allow elements of the work to be completed e.g., pump changes.

Table 14 Summary of dWRMP Interdependent Schemes

SR Scheme	Interdependent dWRMP Network Reinforcement (NR) Scheme
Amersham	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Great Missenden	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Redbourn	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • ST12 Markyate BPS • Ickenham to Harrow TM and New BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade • Redbourn Resilience
Kings Walden	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade

	• Kings Walden Resilience
Codicote	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade • Codicote Resilience
Kensworth Lynch	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • ST12 Markyate BPS • Ickenham to Harrow Trunk Main and New BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade • Kensworth Lynch Resilience
Hare Street	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Sacombe	
	• Transfer water from Egham to Harefield inc. BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Tunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Porthill	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade

Crescent Road	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Waterhall	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
North Mymms	
	• Transfer water from Egham to Harefield including. BPS upgrade • Hatton Cross 2 BPS upgrade including. pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Uttlesford Bridge	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade • Hadham Mill 20 Ml cells • Hadham to Silverleys + BPS • Silverleys to Dunmow + BPS
Causeway	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade

	• Hadham Mill 20 Ml cells • Hadham to Silverleys + BPS
Standon	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
West Hyde	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Blackford	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Northmoor	
	• Heronsgate to Bovingdon Trunk Main + BPS • Grove Park Link BS (Grove Licence increase)
The Grove	
	• Heronsgate to Bovingdon Trunk Main + BPS • Grove Park Link BS (Grove Licence increase)
Piccotts End	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Grove Park Link BS (Grove Licence increase) • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade

Chalfont St Giles	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Grove Park Link BS (Grove Licence increase) • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Berkhamsted	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Grove Park Link BS (Grove Licence increase) • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade
Marlowes	
	• Transfer water from Egham to Harefield including BPS upgrade • Hatton Cross 2 BPS upgrade including pipe laying to Harefield Umbrella • Ickenham to Harrow Trunk Main and New BPS • Heronsgate to Bovingdon Trunk Main + BPS • Grove Park Link BS (Grove Licence increase) • Increase DO Egham/Chertsey/Walton • Midway North BPS upgrade

10.1.2 WINEP River Restoration and Catchment Improvement

This programme of works, alongside our river restoration and catchment improvement schemes, is part of a long-term programme to improve all of our river catchments over time. Please see the following business cases for more information:

- WINEP Upper Lee Catchment and River Restoration Business Case
- WINEP Colne Catchment and River Restoration Business Case
- WINEP Ivel and Cam, Rhee Granta Catchment and River Restoration Business Case

10.2 Delivery Risk Management

The main risks that the programme could face are outlined below:

Risk 1: Other programmes of work (E.g. Environmental Enhancement programme and the Developer Services Strategic reinforcements programme) requiring the installation of large mains and pumping and storage schemes, affecting programme planning and resourcing. **Mitigation**: Early engagement with Capital Delivery team and Framework Partners to establish resourcing availability and opportunities for combining / coordinating works across the delivery programme.

Risk 2: Contractor resource and willingness to provide a cost-effective design and construction proposal. **Mitigation**: This is considered one of the most significant risks to successful delivery of the AMP8 SRs programme. Early engagement with supply chain is essential, as is leveraging our existing contractor relationships.

Risk 3: Materials costs and availability: Risk of issues with lead-in times and increasing costs. **Mitigation**: Early engagement with Supply Chain to review AMP8 requirements and programme.

Risk 4: Commercial or operational risks with principal contractors underperforming. **Mitigation**: Early engagement with Framework Contractors to establish resource availability. Application of clear performance monitoring process.

Risk 5: Normal operational constraints such as the ability to take mains out of service apply during construction. **Mitigation**: Advanced liaison with Operations Centre, to review proposed AMP8 delivery programme and coordinate with other planned activities. Schedule works with consideration to normal seasonal constraints and potential drought risk constraints.

Risk 6: Legal or regulatory constraints to the organisation. **Mitigation**: Usual constraints such as compliance to health and safety and water quality regulations will be adhered to in the design and construction stages.

Risk 7: Internal and operational resource availability. **Mitigation**: Early engagement with Capital Delivery and Framework Partners to establish resourcing availability and opportunities for combining / coordinating works across the delivery programme.

Risk 8: Change in priority caused by new information of which assets need replacing. **Mitigation**: In depth assessment of existing asset condition and performance has been undertaken during the initial optioneering phase, in order to identify and address requirements for all assets.

Risk 9: Change in contractor if costs seen as unaffordable - manage transition and ensure benefits outweigh any change. **Mitigation**: Early engagement with framework contractors to establish costs and any issues as early as possible. Optioneering has been carried out to develop solutions with a clear scope and as few unknowns / risks as feasible.

Risk 10: Accuracy of Costings. **Mitigation**: Use of best available cost information on a site-specific basis. This comprises a mixture of recent equivalent scheme costs and PR24 cost models developed by Mott McDonald and validated by Affinity Water Investment Optimisation & Costs Management Team.

Risk 11: The scope and the scale of the programme is a significant step change compared to the AMP7 programme. **Mitigation**: Early engagement with framework contractors to establish costs and any issues as early as possible

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

10.3 Monitoring and Reporting of Benefits

Assessment of benefits delivery will be carried out by Affinity Water in conjunction with EA assessment works to determine the level of improvement in river flows resulting from implementation of the AMP8 SRs.

The mechanism for abstraction reductions translating through to improved river flows is complex and may be impacted by multiple factors that are not directly within Affinity Water's control, such as antecedent weather condition or drought.

The assessment of benefits, therefore, needs to be made over a period of a number of years due to the need to compare groundwater levels and river flows in like for like conditions to those for which there is historical data.

Affinity Water will carry out in-house assessments of the response to the abstraction reductions using groundwater and river level monitoring data and spot gauging data to determine river flows. Ecological surveys (macroinvertebrates and macrophytes) will also be undertaken but it is recognised that the responses by the ecology can take many years to materialise. This information will then be used in conjunction with data from EA's monitoring network, including permanent river flow gauging stations, to collectively assess the responses and update the EA's regional groundwater models.

We recognise that there is a degree of uncertainty with regard to the environmental response to the proposed SRs, in terms of both flow and ecological responses over a range of flow conditions. There is also uncertainty in the EFI values adopted and the current calibration status of the EA regional groundwater models. We are working with the EA to refine and improve the groundwater models in our regions, using our observed data obtained following the implementation of SRs in AMP6 and AMP7, as well as looking to refine the EFI, where appropriate, with bespoke flow targets. This will feed into the monitoring plan described above. We will also work with expert academics in the field of Chalk hydrogeology, to ensure that our assessment methods are robust, and that further ways to explore the anticipated benefits are identified and documented.

In order to achieve the WFD targets, wider catchment, and nature-based solutions will be required. For example, river restoration, habitat enhancement and catchment initiatives are also key to address water quantity and quality. We will build our PR24 WINEP submission based on a holistic and integrated catchment approach.

We propose to follow a continuous improvement approach of Plan, Do, Check, Act, through utilising our environmental monitoring network to refine the need, volume and location of further SRs in AMP9 and beyond. We will work with the EA and other stakeholders to incorporate the best available evidence and make reductions that will provide the greatest environmental benefit.

As part of the monitoring and reporting of benefits we will undertake the following activities alongside our abstraction impact assessment monitoring:

- Baseline monitoring and long-term benefits monitoring for river improvement works in catchments, alongside our SR programme including the following:
    - Flow gauging
    - Macrophyte and macroinvertebrate surveys
    - Groundwater level monitoring
    - Rain gauge monitoring
- Chalk stream monitoring linked to our land management C&NBS including:
    - Pesticide sampling
    - Nutrient sampling
    - Turbidity monitoring
- Natural Capital baseline assessment as part of the development of each project and associated detailed design.
- A post-project completion Natural Capital evaluation to determine the overall ecosystem services benefits.

11 Supporting Information

11.1 Affinity Water Resources Management Plan

Link to Affinity Water Website:

https://affinitywater.uk.engagementhq.com/wrmp

Key Documents:

- dWRMP – Main Document
- Appendix 5.4 – Environmental Destination (SEMD)

11.2 Appendices

All appendices can be made available upon request.

Appendix 1 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 2 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

WINEP: Water Resources investigations

August 2023

Contents

1 Summary

This business case includes a total of fourteen schemes under the umbrella of the Water Resource investigations. The investigations spread across nine groundwater bodies and fifty-three surface water bodies, in our Central and Southeast regions. No investigations have been included for our East region, as these have been completed in AMP7.

The schemes are a combination of investigations and options appraisal that, in broad terms, aim to determine reasons for groundwater and surface water bodies in our catchments currently failing to meet the Water Framework Directive targets. Some of the core investigations into reasons for such failures have been undertaken in AMP6-AMP7 and the planned AMP8 investigations will complement these studies focussing on the areas that have not been looked at before. In Central region the AMP7 investigations indicated very large deficits of water potentially linked to our groundwater abstractions. The AMP8 WINEP schemes will therefore include regional scale options appraisal to identify any necessary solutions, in the wider context of the Water Resource East and Water Resource South East framework.

Where identified in collaboration with the EA and Natural England schemes will also include investigations into abstraction impacts and risks for biodiversity and ecology associated with groundwater dependant habitat and Sites of Special Scientific Interest (SSSI). The Water Resources Investigations also include schemes linked to long term hydrological, hydrogeological, and ecological conceptualisations of the catchments from which we abstract, to inform Environmental Destination and future Water Resource Strategy.

All schemes have statutory primary driver and have been agreed with the local Environment Agency area teams. We submitted our PR24 WINEP in November 2022 and all investigations within this business case have been accepted with the status of 'proceed' in the third release of our PR24 WINEP issued by the Environment Agency in July 2023.

Base Information	
Report Date	August 2023
Report Title	Water Resources Investigations & Options Appraisals – PR24 Business Case
Options Assessment Report (WINEP)	Action ID_OAR 08AF100026a, b, c, d, e, f, g 08AF100027a 08AF100028a 08AF100029a 08AF100030a 08AF100032a, b, c 08AF100033a, b 08AF100034a,b 08AF100036a,b,c,d 08AF100037a 08AF100038a,b 08AF100039a,b 08AF100040a
Start Date	01/04/2025
Completion Dates	Variable between 31/12/2026 and 30/04/2027
WINEP Spreadsheet ID	
WINEP Action IDs	08AF100026a, b, c, d, e, f, g 08AF100027a 08AF100028a 08AF100029a 08AF100030a 08AF100032a,b,c 08AF100033a, b 08AF100034a,b 08AF100036a,b,c,d 08AF100037a 08AF100038a,b 08AF100039a,b 08AF100040a
WINEP Drivers	WFDGW_INV WFD_INV_WRFlow WFD_NDINV_WRFlow SSSI_INV NERC_INV EDWRMP_INV WFD_INV_WRHMWB
Scale of Action Delivery	Within WFD Waterbody Within SSSI Within River Basin District

Locations of Delivery	SURFACEWATER BODIES • Bulbourne GB106039029890 • Chess GB106039029870 • Colne (Confluence with Chess to River Thames) GB106039023090 • Colne (from Confluence with Ver to Gade) GB106039029840 • Colne (upper east arm including Mimmshall Brook) GB106039029850 • Gade (Upper stretch Great Gaddesden to confluence with Bulbourne / GUC) GB106039029900 • Gade (from confluence with Bulbourne to Chess) GB106039029860 • Misbourne GB106039029830 • Upper Colne and Ellen Brook GB106039029820 • Ver GB106039029920 • Ash (from Meesden to confluence with Bury Green Brook) GB106038040100 • Ash (from confluence with Bury Green Brook to Lee) GB106038033290 • Beane (Source to Stevenage Brook) GB106038040110 • Beane (from confluence with Stevenage Brook to Lee) GB106038033310 • Lee (from Luton Hoo Lakes to Hertford) GB106038033392 • Lee (from Luton to Luton Hoo Lakes) GB106038033391 • Lee Navigation (Hertford to Fieldes Weir) GB106038033240 • Mimram (Codicote Bottom to Lee) GB106038033270 • Mimram (Whitwell to Codicote Bottom) GB106038033460 • Quin GB106038040120 • Rib (from confluence with Quin to Lee Navigation) GB106038033360 • Rib (upper stretches, above confluence with the Quin) GB106038040140 • Stanstead Brook GB106038040090 • Stevenage Brook GB106038033410 • Stort (at Clavering) GB106038040130 • Stort and Bourne Brook GB106038033340 • Stort and Navigation, B Stortford to Harlow GB106038033281 • Dour from Kearsney to Dover GB107040073310 • Upper Dour GB107040019490 • Brett GB105036040930 • Nailbourne and Little Stour GB107040019590 • North and South stream at Eastry GB107040019730 • North and South stream at Northbourne GB107040019720 • North and South stream in the Lydden valley GB107040019550 • Chelmer (d/s confluence with Can) GB105037033530 • Chelmer (u/s Gt. Easton) GB105037041220 • Bulbourne GB106039029890 • Ivel US Henlow GB105033037720 • Hiz through Hitchin GB105033037680

	• Hiz DS Hitchin GB105033037700 • Cat Ditch GB105033037740 • Cam US Newport GB105033037480 • Cam Newport to Audley End GB105033037550 • Cam Audley End to Stapleford GB105033037590 • Debden Water GB105033037490 • Wicken Water GB105033037540 • Slade GB105033037580 • Wendon Brook GB105033037560 • Rhee US Wendy GB105033038100 GROUNDWATER BODIES • Upper Lee Chalk GB40601G602900 • Mid-Chilterns Chalk GB40601G601200 • Upper Bedford Ouse Chalk GB40601G603000 • East Kent Chalk - Stour GB40701G501500 • North Essex Chalk GB40501G400700 • Cam and Ely Ouse Chalk GB40501G400500 • Cam and Ely Ouse Woburn Sands GB40501G445700 • Upper Bedford Ouse Woburn Sands GB40501G402200 • North Mymms tertiary GB40602G401200

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	1.50	3.00	3.00	1.50	1.00	**10.00**
Opex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Totex (£m)	1.50	3.00	3.00	1.50	1.00	**10.00**

Drivers	
100%	Water Framework Directive

Benefits
N/A

Economic Analysis			
NPV Costs (£m) (2025-55)	**8.3**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★ ★	★ ★			★	★

2 Project Description

This business case includes a combination of investigations and options appraisal schemes that have been developed across our Central and Southeast supply areas. The schemes have been grouped together as they are all associated with Affinity Water groundwater (GW) abstractions and their effects on the environment. In broad terms, the schemes aim to determine:

- Reasons for groundwater (GW) bodies currently failing to meet the Good quantitative or chemical status and an associated options appraisal.
- Reasons for Surface Water (SW) bodies currently failing to meet Good Ecological Status or Good Ecological Potential and an associated options appraisal.
- The risk of deterioration of GW and SW bodies current WFD status and associated options appraisal.
- The impact of GW abstraction on, and risk to biodiversity and ecology associated with groundwater dependant habitat and SSSI areas and the identification of mitigation measures.
- The risks of water quality deterioration and groundwater emergence associated with planned future Sustainability Reductions and an associated options appraisal to address or mitigate any identified impacts.
- Hydrological, hydrogeological and ecological conceptualisations of the catchments to inform Environmental Destination and future Water Resource Strategy and determine reasons behind the observed environmental response to previous Sustainability Reductions.
- Additional and alternative groundwater resource availability for AMP9 and beyond.

Figure 1 provides the spatial distribution of the main groundwater bodies and associated surface water bodies under investigation in AMP8. In total there are nine groundwater bodies and 53 surface water bodies in our regions. This business case includes 14 investigations and options appraisals, as listed on Table 1 and Table 2 to deliver against these requirements.

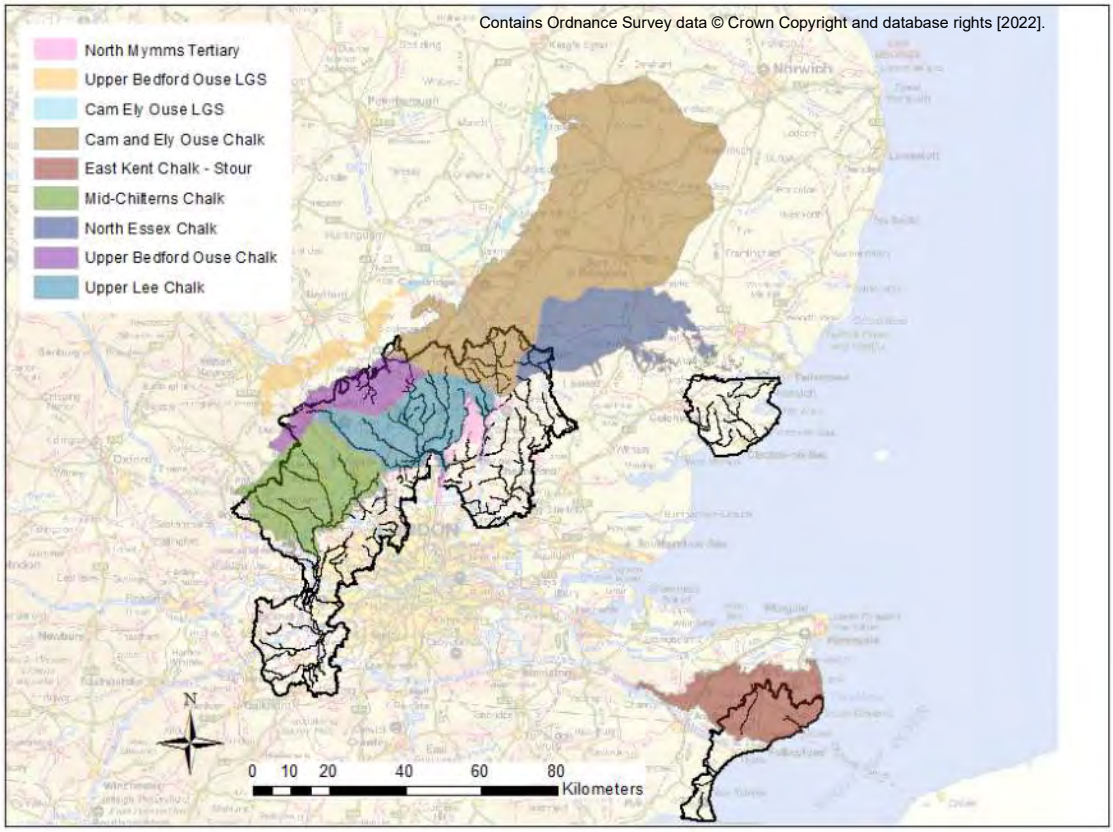


Figure 1 Groundwater bodies and surface water bodies in the areas of investigations

Affinity Water has investigated the influence of groundwater abstractions on river baseflows since the 1990's and has subsequently implemented a series of interventions to mitigate the effects of abstractions, notably groundwater abstractions reductions and river restorations. By the end of AMP7, Affinity Water will have reduced groundwater abstraction from chalk catchments by circa 100 Ml/d compared to levels in the early 1990's. This includes a 42 Ml/d reduction in AMP6, 38 Ml/d in AMP7, additional sustainability reductions planned for AMP8 of 21 Ml/d, coupled with proposed abstraction relocation from upstream to downstream catchment of up to 14. Ml/d.

An extensive river restoration programme was started in AMP6 delivering 11 projects. This was continued in AMP7 (total of 21 project between AMP6 and Y3 AMP7), with additional river restoration works planned for AMP8 under our Catchment & Nature Based WINEP schemes.

The majority of the investigations and options appraisals proposed in this business case fall within the hydrological regime drivers; relate to actions to protect and improve the hydrological regime of water bodies to meet objectives as set out in accordance with Water Environment Regulations 2017; or are linked to the Water Framework Directive (WFD). The WFD requires all waterbodies to meet good ecological status / potential and it is aligned with our commitment to leave more water in the environment whilst we ensure supply for our customers.

The WFD status classification of the waterbodies includes a series of physio-chemical measures and ecological measures. The hydrological regime measure is directly linked to the water abstracted within the waterbody and it is directly related to this water resource business case. The current EA guidelines assign threshold flow conditions to classify the hydrological regime of surface waterbodies (support / does not support Good). These establish the minimum amount of water needed to be present in the environment to support the ecology. The remainder of the water, out of the total available, can be utilised for abstractions. In a similar way, for groundwater bodies, the guideline assigns a threshold to the water balance to determine the minimum amount of groundwater resources being available at all times. Both the surface water flow target and the groundwater balance test provide indications of the pressure induced by the current and future predicted abstractions on the environment.

Despite the significant reductions in groundwater abstractions over the last decades, the majority of the rivers and streams in our supply area still fail to meet Good Ecological Status (GES). The surface water (river) failures of the WFD classification is mostly related to the failure of the hydrological regime element of GES. However, there is also a significant element linked to the current morphology of the channels, which are inadequate to support GES, irrespective of the water quantity. The groundwater bodies are also failing to meet the balance test thresholds and to a much lower extent the other tests related to water quality.

We have agreed a series of interventions with the Environment Agency (EA). These start from the no deterioration licence capping solutions to longer term solutions grouped under the umbrella of the Environmental Destination driver. For example, linked to Environmental Destination, one initial intervention planned for AMP8 will be implemented in the Colne Valley and it will consist of transferring 14 Ml/d average groundwater abstractions from the upstream tributary catchments to the downstream Colne Valley. A SSSI driver is linked to this proposal to confirm the feasibility of the transfer with regards to the designated areas.

An additional secondary driver included in this business case is linked to the Government's 25-Year Environmental Plan, for improving the environment within a generation and leaving it in a better state than found. Specifically, the 25-YEP secondary driver is applied to a couple of investigations aiming to find supplementary sources of groundwater to reduce impact in chalk stream catchments. The driver is also linked to additional investigation into effects of groundwater abstractions on the biodiversity of a site.

In order to select the investigations required to be undertaken in AMP8, we have considered the current pressure of each groundwater body, included all surface water bodies draining from them within the regions, and engaged through a consultation process with a range of stakeholders, including:

- EA
- Natural England (NE)
- Catchment partnerships

- Wildlife Trusts
- River groups

The consultation process, combined with the current WFD status, identified the most relevant risks and issues. These include:

- Abstraction
- Low flows
- River morphology
- Diffuse and point source pollution
- Water quality
- Land management pressures
- Climate change
- Loss of habitat and wildlife
- INNS

From the identified risks and issues Abstraction and Low flow conditions are those most directly linked to the investigations and option appraisals included in this business case for AMP8. For Central Region we have identified the following investigations and option appraisals, which cover both WFD groundwater bodies (GW) and surface water bodies (SW). Table 1 below shows the proposed schemes and the related catchments, specifying whether the investigation will be primarily on the surface water body or the groundwater body elements.

Table 1 Proposed Schemes in Central region

No.	Catchment	Waterbody	Outline Scope
1	Upper Cam	SW	Investigation into impact of abstracting from Debden Road, Wenden and Newport sources at times when the Uttlesford Bridge river support is not in use due to cessation clause being enacted
2	Hiz	SW	To investigate impact of our PWS GW abstractions on the flow of the River Hiz and identification of solutions to improve flow to EFI or alternative flow objective
3	Oughton Head Common	SW	Investigation / Options appraisal into impact of abstraction on Oughton Head Common local wildlife site
4	Stanstead Brook	SW	To investigate impact of our PWS GW abstractions on the flow of the Stanstead Brook and identification of solutions to improve flow to EFI or alternative flow objective

5	Denham Lock Wood, Frays Farm and Old Rectory Meadow	SW	Investigation on the effect of Average Deployable Output transfer on Denham Lock Wood, Frays Farm and Old Rectory Meadow SSSI
6	Mid Chilterns	GW	Investigation into risk of groundwater emergence, fluvial flood and aquifer water quality deterioration induced by planned SR. Regional Scale Options Appraisal of the Mid Chilterns GW body no deterioration assessment, in relation to the failure of groundwater balance test
7	Upper Lee	GW	Investigation into risk of groundwater emergence, fluvial flood and aquifer water quality deterioration induced by planned SR. Regional Scale Options Appraisal of the Upper Lee GW body no deterioration assessment, in relation to the failure of groundwater balance test
8	SR WQ and flood risks	GW	Investigation into risk of groundwater emergence, fluvial flooding and aquifer water quality deterioration for the Cam Ely Ouse and Upper Bedford Ouse GW bodies
9	Ivel US Henlow	SW	Investigation into the Lower Greensand aquifer in the Upper Ivel area
10	Lower London Tertiary	SW	Investigations on the role of Lower London Tertiary and superficial deposits on the baseflow contribution
11	Hydrological behaviour of Chalk Streams	SW	Characterisation of the hydrological behaviour of the Chalk Streams with focus on the non-perennial reaches

For the Southeast Region we have identified the following schemes.

Table 2 Proposed Schemes in Southeast region

No.	Catchment	Waterbody	Outline Scope
12	Seabrook Stream	SW	Investigation on the risk of deterioration of the Seabrook Stream and OA
13	Nailbourne	SW	Investigation on the risk of deterioration of the Nailbourne at the North & South Streams catchments and OA, following the new AMP7-8 monitoring data
14	Dour	SW	Investigation on the risk of deterioration of the Dour & Little Stour and OA, following the new AMP7-8 monitoring data and licence changes

The Affinity Water East region was investigated in AMP6 and AMP7, followed by an option appraisal. By the end of AMP7 we will have implemented the selected option and therefore the AMP8 programme will require only some routine monitoring activity to confirm whether the outcome is in line with the predicted results.

3 Project Development

Environmental Risk and Issues

The investigations listed above are statutory requirements and have been requested by the EA and Natural England.

The additional investigations are linked to our WRMP, environmental destination strategy, ADO transfer, and builds on the Chalk Streams First concept.

There are a number of environmental risks that are detailed in our Risk and Issues log which can be made available on request.

Baseline Assessment

The projects included in this business case will not need to go through optioneering assessment because they consist of investigations and options appraisal of the possible mitigation measures, as specified in the WINEP options development guidance document, Annex 4 p.37.

Problem Statement and Stated Need / Driver

3.1.1 Statutory Drivers

Water Framework Directive (WFD) and the Water Industry National Environment Programme (WINEP) drivers relevant to this scheme are:

- WFD_INV_WRFlow = Investigations to determine impact of abstractions and appraisal of options for effective solutions to achieve good ecological status (surface water) (S)
- WFD_NDINV_WRFlow = Investigations to determine the likelihood that future abstractions will cause deterioration in any of the elements affecting the ecological status of a waterbody and identify effective solutions (S)
- WFDGW_INV = Groundwater GES investigation relating to water resources or water quality (S)
- WFDGW_NDINV = Groundwater prevent deterioration investigation related to water resource or water quality (S)
- NERC_INV = Investigations and / or options appraisal for changes to permit or licences and/or other actions that contribute towards biodiversity duties, requirements and priorities
- EDWRMP_INV = Water company contribution to reducing abstraction to meet the regional plan
- SSSI_INV = Maintain or restore SSSI's to favourable conditions (S+)
- WFD_INV_WRHMWB = Implement mitigation measures in a catchment to meet water framework directive objectives in designated WRA/HMWBs

3.1.2 Non-statutory Drivers

There are also a number of non-statutory drivers for investment:

- 25-YEP_INV = investigations into locally significant environmental issue not eligible under any other driver, but with clear evidence of customers support (NS)
- Defra's Plan for Water: our integrated plan for delivering clean and plentiful water - policy paper April 2023.
- Government's strategic priorities for Ofwat – Policy paper February 2022.
- Drinking Water Inspectorate (DWI) - Guidance Note: Long-term planning for the quality of drinking water supplies.
- AW0031 Affinity Water Strategic Direction Statement.

3.1.3 Stated Need

Affinity Water Central Region

1 Upper Cam (08AF100026_OAR)

Waterbodies: Cam US Newport and Cam from Newport to Audley End

Primary driver: WFD_NDINV_WRFlow

Secondary driver: WFD_INV_WRFlow

Tertiary driver: EDWRMP_INV

In the Anglian region, the Cam Ely Ouse Chalk groundwater body balance test is currently supporting GES, as well as the groundwater dependant terrestrial ecosystems test. However, the dependant surface water bodies regime test is failing, despite the presence of a series of flow conditions in the associated groundwater abstraction licences. For this reason, we have agreed with the EA (email of 17 March 2022) the need to review the current risk of deterioration in Upper Cam catchment.

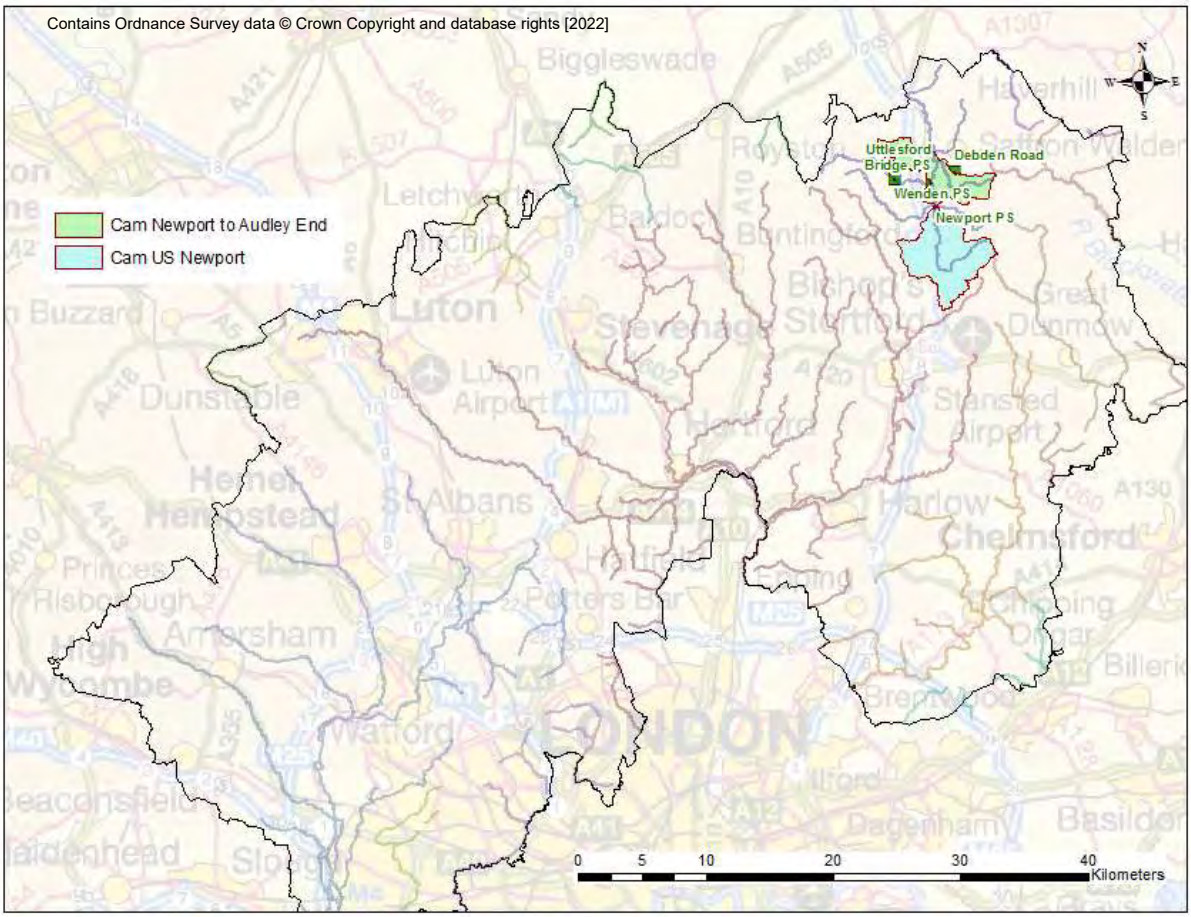


Figure 2 Cam US Newport and Cam from Newport to Audley End

The AMP6 WINEP investigation determined that the river support from Uttlesford Bridge would provide mitigation for some of the effects of the abstractions from the other pumping station in the catchment. In AMP7 we are going to implement the licence capping to prevent deterioration of the waterbodies. In AMP9, a provision in the licence will enforce abstraction and river support cessation if the hands-off flow target at the gauging station is not sustained. Under that specific circumstance, there is a potential for the other groundwater abstractions in the catchment to adversely impact the river flow. For this reason, we have agreed with the EA the need to investigate the impact of Wenden, Newport and Debden Road groundwater abstractions at times when the Uttlesford Bridge source is not in use if the cessation clause were enacted in the future (Figure 2).

2 Hiz (08AF100027_OAR) Waterbody: Hiz Through Hitchin

Primary driver: WFD_INV_WERHMWB

Secondary driver: NERC_INV

Tertiary driver: EDWRMP_INV

The Upper Bedford Ouse Chalk groundwater body balance test is supporting GES, as well as the groundwater dependent terrestrial ecosystem test. However, the dependant surface water bodies regime test is failing, despite the presence of a series of flow conditions on the associated groundwater abstraction licences in the upper catchment.

A recent study undertaken by the EA suggested that the current river support scheme operated by us, and the EA is inefficient and ineffective to maintain adequate flow in the Hiz through Hitchin surface water body. The river support was designed several decades ago to mitigate the effect of our Chalk groundwater abstractions in the catchment. As such, we have agreed with the EA the need (email of 17 March 2022) to investigate the impact of our groundwater abstractions (Temple End and Well Head PS) on the flow of the River Hiz and identify solutions to improve flow to meet the Environmental Flow Indicator (EFI) or an alternative agreed flow objective (Figure 3).

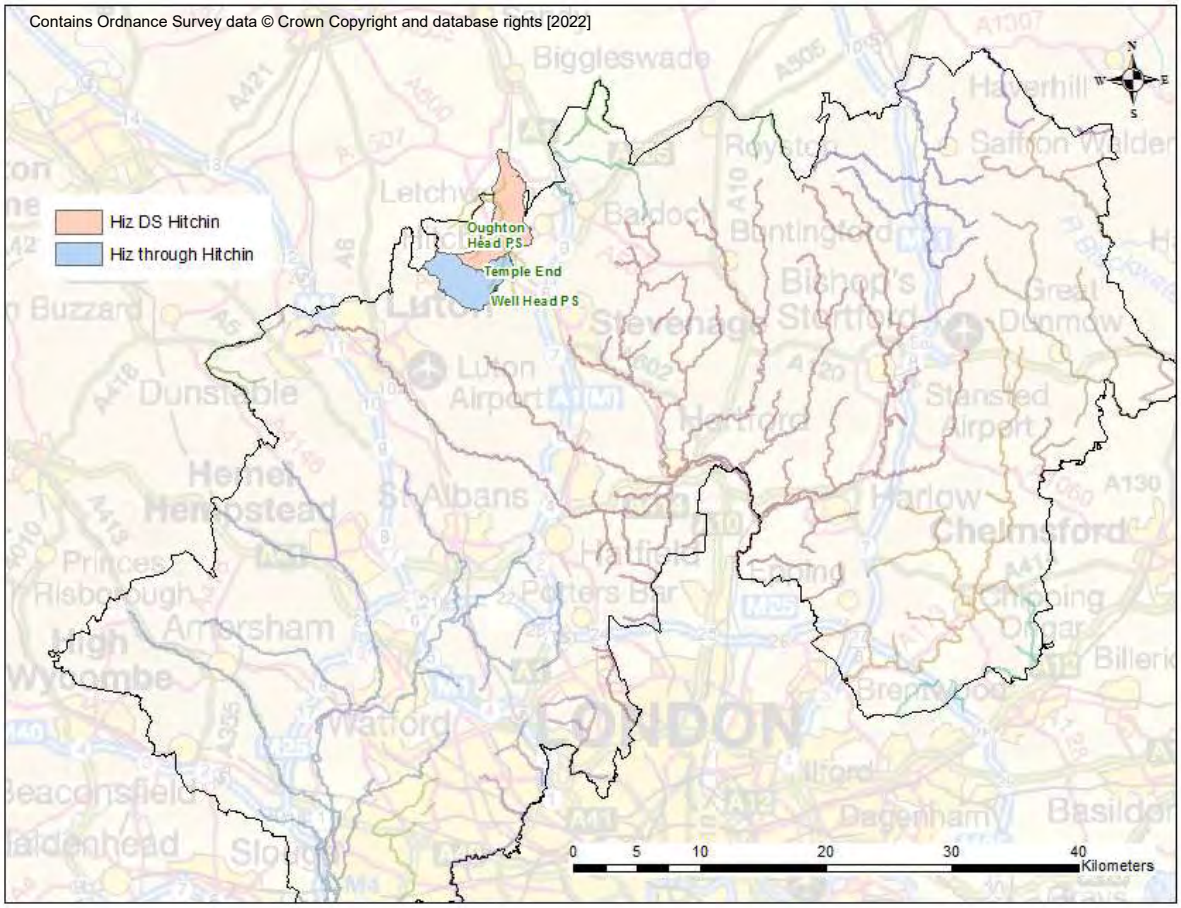


Figure 3 Hiz through Hitchin and Hiz DS Hitchin

3 Oughton Head Common (08AF100028_OAR)

Waterbody: Hiz DS Hitchin

Primary driver: NERC_INV

Secondary driver: 25YEP_INV

Similarly to the Hiz through Hitchin, the Upper Bedford Ouse Chalk groundwater body balance test is supporting GES, as well as the groundwater dependent terrestrial ecosystem test. However, the dependant surface water bodies regime test is failing, despite the presence of a series of flow conditions in the abstraction licences. In addition to that, there are concerns that our groundwater abstraction from the Chalk from Oughton Head PS could detrimentally affect the local wildlife of the Oughton Head Common. As such, we have agreed with the EA (emails 17 March 2022 and subsequent email of 23 May 2022) to carry out an investigation in AMP8 (Figure 3).

4 Stanstead Brook (08AF100030_OAR)

Waterbody: Stanstead Brook

Primary driver: WFD_INV_WRFlow

Secondary driver: WFD_NDINV WRFlow

Tertiary driver: NERC_INV

The Stanstead Brook is a tributary of the River Stort. The Stanstead Brook catchment has not been investigated before. The EA requested an investigation (email 6 September 2022) into the potential risk of deterioration of the surface water body induced by the groundwater abstractions at Stansted PS and nearby abstractions, based on the outcomes of the AMP7 investigations on the River Stort at Clavering and Stort and Bourne Brook.

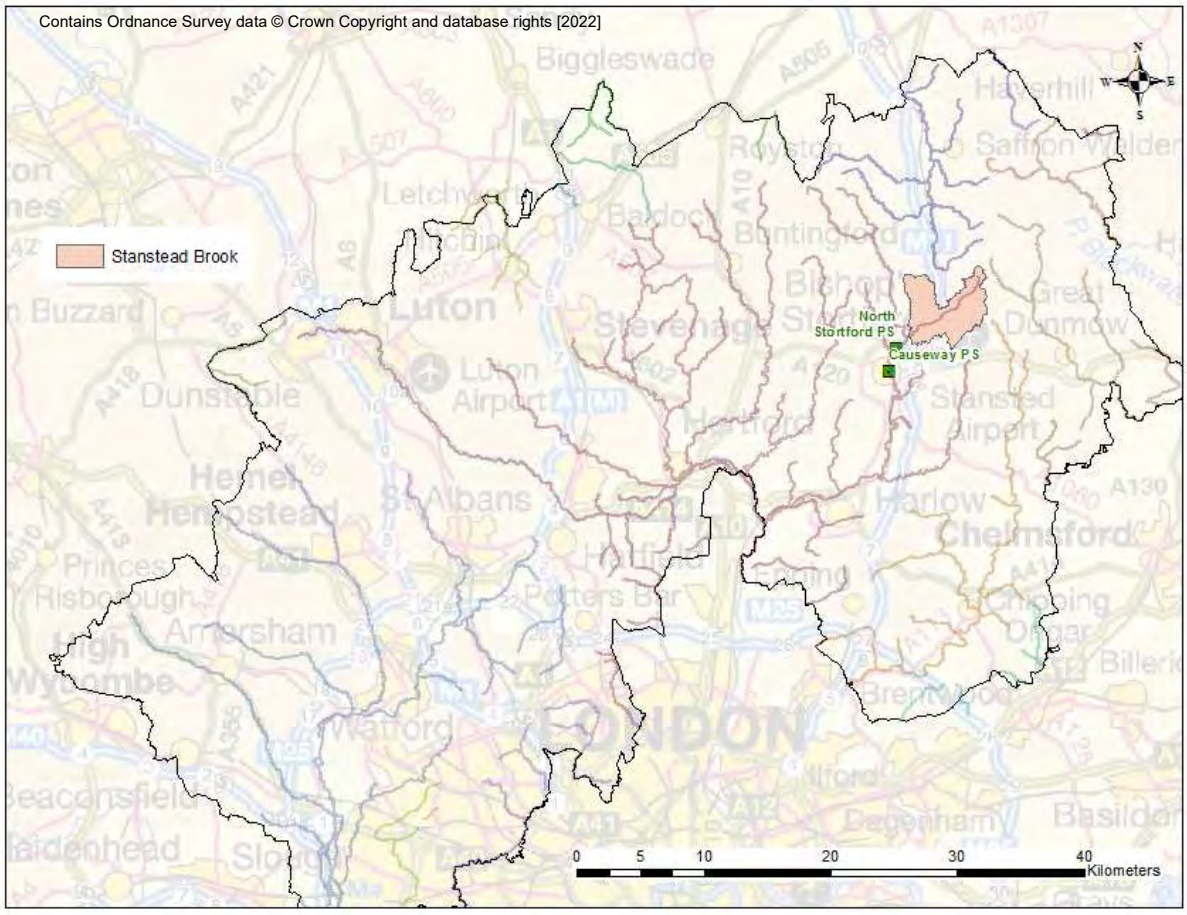


Figure 4 Stanstead Brook

5 Denham Lock Wood, Frays Farm and Old Rectory Meadows SSSI (08AF100032_OAR)

Waterbody: Colne from Chess to Thames

Primary driver: SSSI_INV

Secondary Driver: EDWRMP_INV

The interventions proposed under the Environmental Destination Strategy and included in our revised draft WRMP consist of average deployable output (ADO) transfer from groundwater sources in the upstream sub-catchments to the downstream reaches of the River Colne. This proposal will implement a decrease of groundwater abstractions on an annual basis in the Gade, Misbourne and Bulbourne of 14 Ml/d balanced by an equivalent increase of groundwater abstractions at annual average basis in the Colne Valley. The 14Ml/d increase in average deployable output will be distributed amongst the groundwater abstractions of the Blackford Group of sources (West Hyde, Blackford, Northmoor) and The Grove Pumping Station in the lower Gade catchment. Given the proposed increase in abstraction in the Colne Valley, there is a need to assess any potential impact on a number of environmentally sensitive areas. Natural England have identified Denham Lock Wood, Frays Farm and Old Rectory Meadows SSSI to be

potentially at risk from increased groundwater abstraction associated with the ADO relocation. The SSSIs lies within the Colne (Confluence with Chess to River Thames) surface water body and Misbourne surface water body. The investigation in AMP8 will determine whether there is any risk from this abstraction relocation; will quantify these; and identify any necessary mitigation measures through an options appraisal (Figure 5).

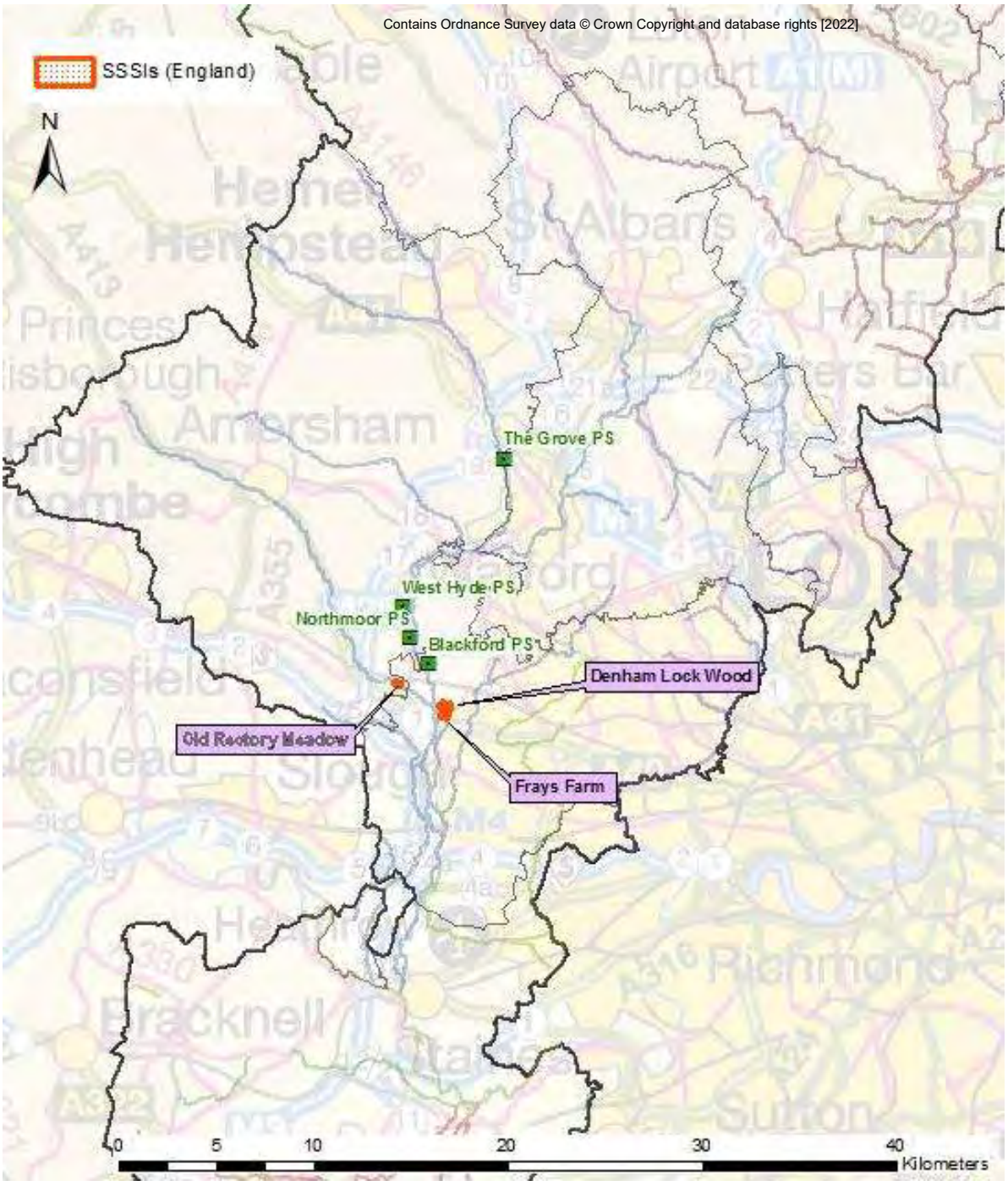


Figure 5 Denham Lock Wood, Frays Farm and Old Rectory Meadows SSSI

6-7 Mid-Chilterns and Upper Lee groundwater bodies (08AF100033_OAR)

Waterbodies: Mid Chilterns and Upper Lee Chalk

Primary driver: WFDGW_INV

Secondary driver: EDWRMP_INV

The AMP7 investigations into the risk of deterioration in WFD status of the SW and GW bodies concluded that there is a large deficit in the water balance test for the groundwater bodies (Upper Lee and Mid-Chilterns Chalk GW bodies) draining towards the London Basin (Figure 6). This conclusion is based on the results of the regulatory EA regional GW model (Hertfordshire Chalk Groundwater Model). The EA, in collaboration with the water companies is working on an update and review of the current version of the regulatory model due to known issues with the model.

The current environmental flow target assigned to each SW body and the aquifer recharge input in the EA regulatory model have the potential to affect the results of the balance test. The model update and refinement works are expected to increase confidence in the assigned flow threshold and model results.

The scale of interventions linked to the replacement of the currently defined deficit is unprecedented, as well as the magnitude of costs associated with them. The required changes to the current abstraction licences will therefore be linked to the delivery of long-term strategic resource options (SRO). The SRO include a series of options that essentially consists of large imports of water from other regions through new infrastructure and it is coordinated at regional level (WRE and WRSE), as such a large deficit cannot be compensated from elsewhere within the Affinity Water supply area.

Whilst the long-term strategic options are being considered through the RAPID process, as an interim measure, the initial AMP7 options appraisal identified a series of no regrettable solutions, to mitigate the current impacts and improve resilience. These include the AMP8 no deterioration licence capping, and the transfer of average deployable output mentioned in the project: 6 (Denham Lock SSSI). The capping to prevent deterioration of the WFD status of the surface water bodies will consist of 5.33 Ml/d reduction of annual average licences across the Central Region. Additional sustainability reductions of 15.06 Ml/d have also been agreed in light of the last AMP6 and AMP7 knowledge of the catchments and account to a total of 20.39 Ml/d sustainability reductions.

Future reductions, aiming to reduce the deficit, will need to be aligned with the regional scale solutions, with the latter currently being in the definition process. Whilst the groundwater model is refined and the selected strategic options identified, it is necessary to carry out an option appraisal in AMP8 for the Central region encompassing reductions of groundwater abstractions within both Mid-Chilterns and Upper Lee Chalk groundwater bodies (EA communication March 2022)). The option appraisal is expected to determine which groundwater abstractions sites will be prioritised first in the reduction process, so that the environment will benefit. In

addition to that, there is a need to investigation any potential secondary effect of the sustainability reductions with regard to groundwater emergence risk and aquifer groundwater quality deterioration. These will start with those catchments currently considered to be most affected and it will then look at the effects on the distribution network in line with the strategic options selected.

8 SR Flood and WQ risks (08AF100034_OAR)

Waterbodies: Upper Bedford Ouse and Cam Ely Ouse Chalk

Primary driver: WFDGW_INV

Secondary driver: WFDGW_NDINV

Tertiary Driver: EDWRMP_INV

The AMP6 and AMP7 sustainability reductions highlighted the need to consider secondary effects that can arise with reduction of groundwater abstractions in terms of groundwater emergence, fluvial flooding and risks of aquifer water quality deterioration.

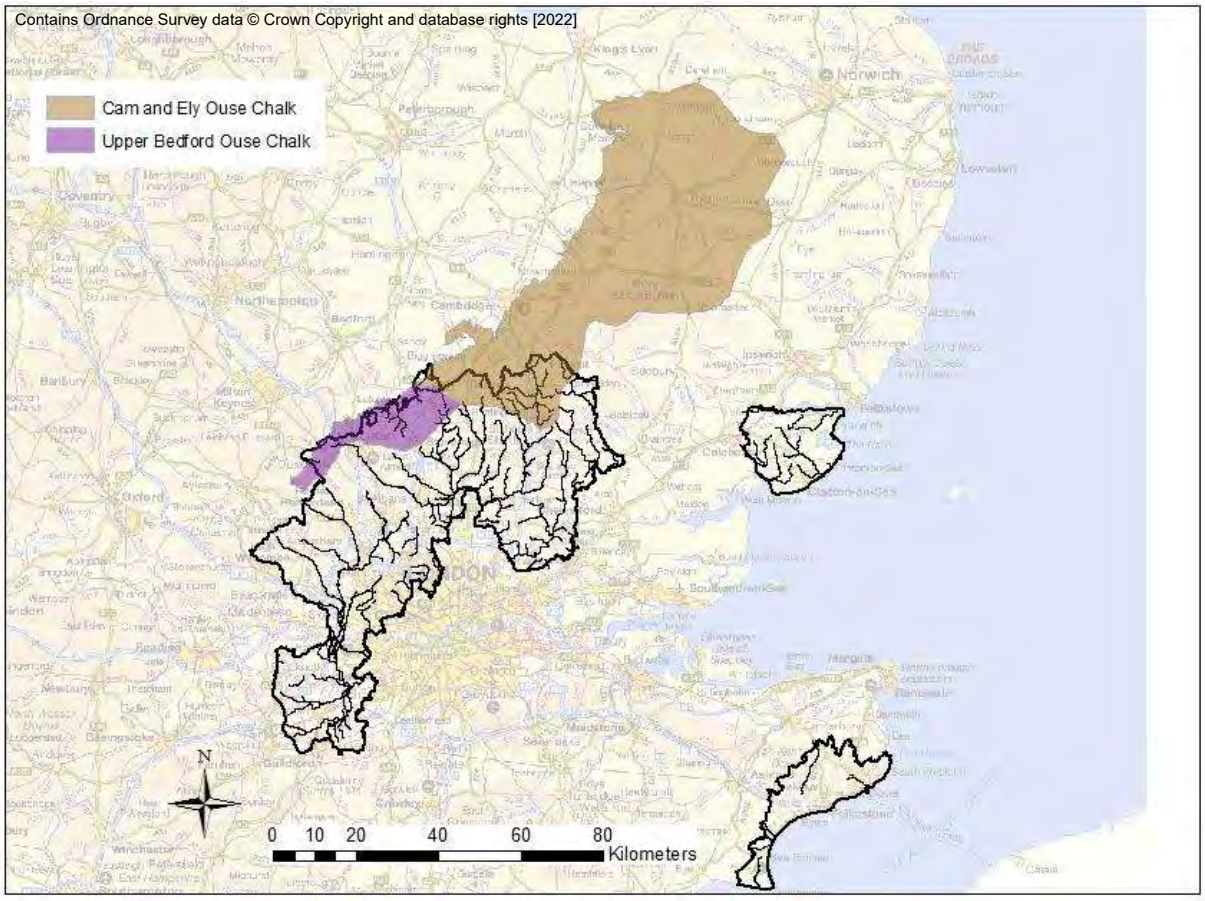


Figure 6 Upper Bedford Ouse and Cam Ely Ouse Chalk GW bodies

In line with the needs mentioned in projects 7-8: (Mid Chilterns and Upper Lee Groundwater bodies), for all of the planned abstraction reductions (not only the reduction in deployable output but also the reduction in licence terms) in the Upper Bedford Ouse and Cam Ely Ouse groundwater bodies, we will need to carry out investigations aiming to determine whether those risks are present and identify, where needed, the mitigation measures that could be adopted. Based on the current known risks of flooding and aquifer contamination, we anticipate the need to investigate the Upper Bedford Ouse and Cam Ely Ouse Chalk. Additional groundwater bodies might need to be investigated. The Mid Chilterns and Upper Lee investigations (projects 7-8 above) include this element already. This investigation package refers only to Upper Bedford Ouse and Cam Ely Ouse.

The investigation will be carried out as a mixture of regional groundwater modelling desk study evaluations and field data collection for contaminant concentrations trends. The study will need to link the expected changes in groundwater levels with hydraulic modelling for flood prevention available from Environment Agency and local authorities. The study is also expected to link changes in groundwater quality with presence of third-party receptors such as private supply boreholes and groundwater dependent ecosystems. We plan to partner with the EA in terms of work contribution, both Water Resource and Flood Risk teams (meeting with EA 3rd February 2022 and 23rd April 2021), as well as engage with local planning authorities (meeting with Local Planning and Health Authorities on 22nd September 2022 with 20 local authorities including Borough Councils, County Councils and District Councils).

9 Ivel US Henlow (08AF100029_OAR)

Waterbody: Ivel US Henlow

Primary driver: EDWRMP_INV

Secondary driver: NERC_INV

The AMP6 investigation determined that our local groundwater abstractions have an influence on the Ivel Spring area and the options appraisal identified a river support scheme and river restoration as mitigation measures. These mitigation measures are going to be implemented during AMP7. Also, by the end of the AMP7, a licence capping to prevent deterioration of the waterbody WFD status will also have been implemented for the Letchworth Group sources.

For AMP8 we have agreed with the EA (meeting 27 September 2022) and other stakeholders (Anglian Water, CaBA and local river group RevIvel meetings on 8 June and 21 October 2022) to investigate alternative sources of supply in the area. The investigation will aim to determine the feasibility of transferring some of the groundwater deployable output to the downstream areas of the aquifer, specifically to the Lower Greensand aquifer (Figure 7), as well as comparing this option to others such as the import of water from other regions, and / or the use of additional

Grafham imports made available by groundwater river support scheme and treated effluent diversion.

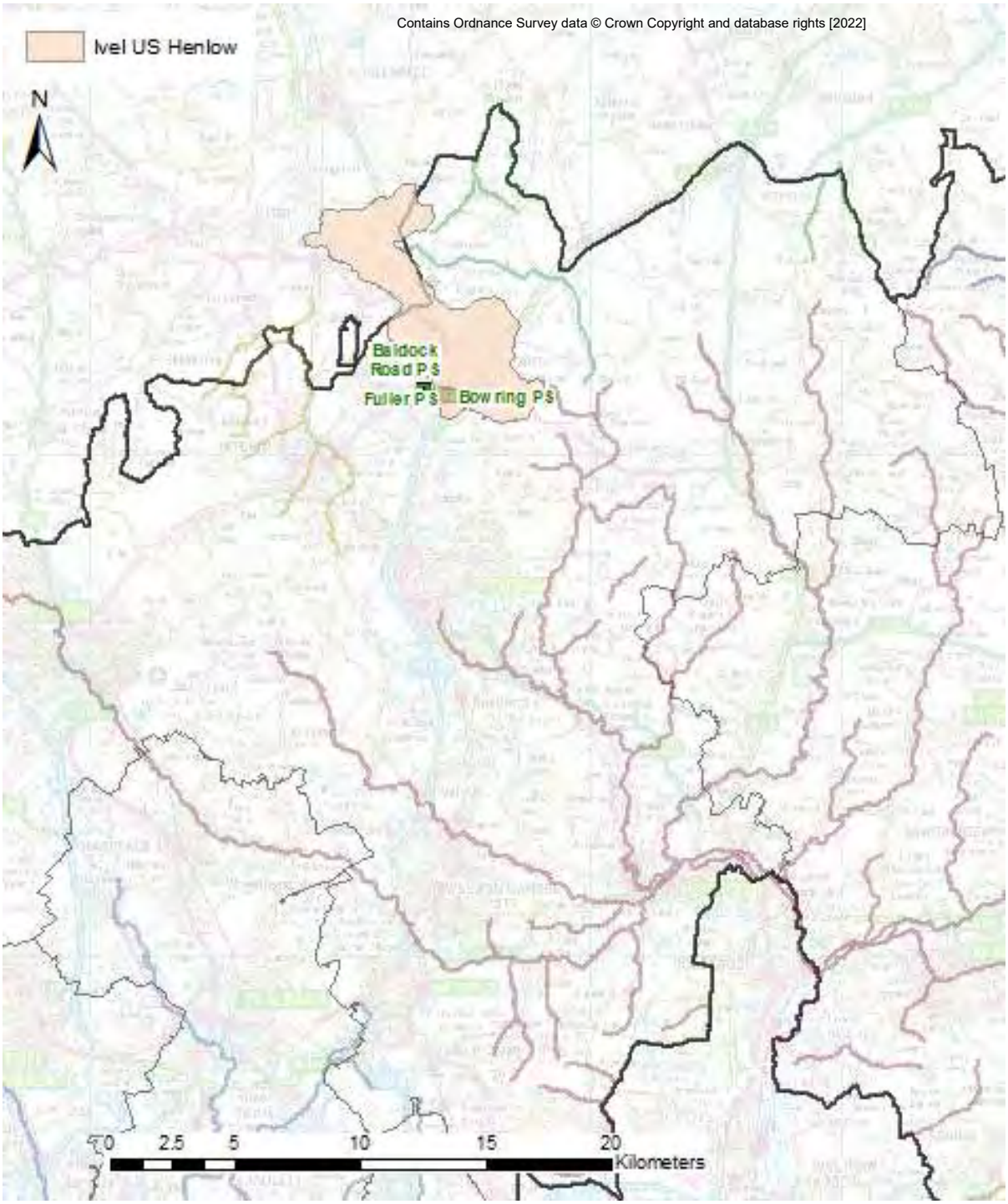


Figure 7 Ivel US Henlow

10 Lower London Tertiary investigation (08AF100040_OAR)

Waterbodies: Rib, Ash, Stort

Primary driver: WFDGW_INV

Secondary Driver: EDWRMP_INV

The majority of our groundwater abstractions take place in the Chalk aquifer and the aquifer contributes to the majority of the baseflow of the rivers in our regions.

There are Tertiary deposit materials above the Chalk of different composition and significant thickness, that are geologically grouped together under the Lower London Tertiary (LLT). The LLT are represented as North Mymms tertiary waterbody in the Lee catchment area, where they are considered to be particularly relevant for the catchments located east of the Stevenage glacial channel, Rib, Ash and Stort (Figure 8).

There is field evidence of perched aquifer conditions above the Chalk suggesting the contribution of the LLT to the streams baseflow can be significant. At the moment those materials are not represented in the EA regulatory model and the quantification of their role within the overall water balance is very uncertain. Historically the research and monitoring work has been concentrated on the Chalk and the LLT only marginally considered.

In conjunction with the EA (meeting on 20th April 2021 with several representatives to discuss future strategy of the Herts Chalk regulatory groundwater model) we plan to undertake field works to set up monitoring points and undertake measurements in the field to quantify the LLT contribution to the baseflow, particularly in the Rib, Ash and Stort catchment. This work is framed in the context of the improvement of the regulatory groundwater model and feeds the long-term water resource strategy. It is expected to provide additional supporting elements to the planned AMP8 investigations (no deterioration assessments, sustainability reductions secondary effects on flood and water quality, and ultimately contribute to the achievement of the Good Ecological Status of the waterbodies in the Upper Lee area.

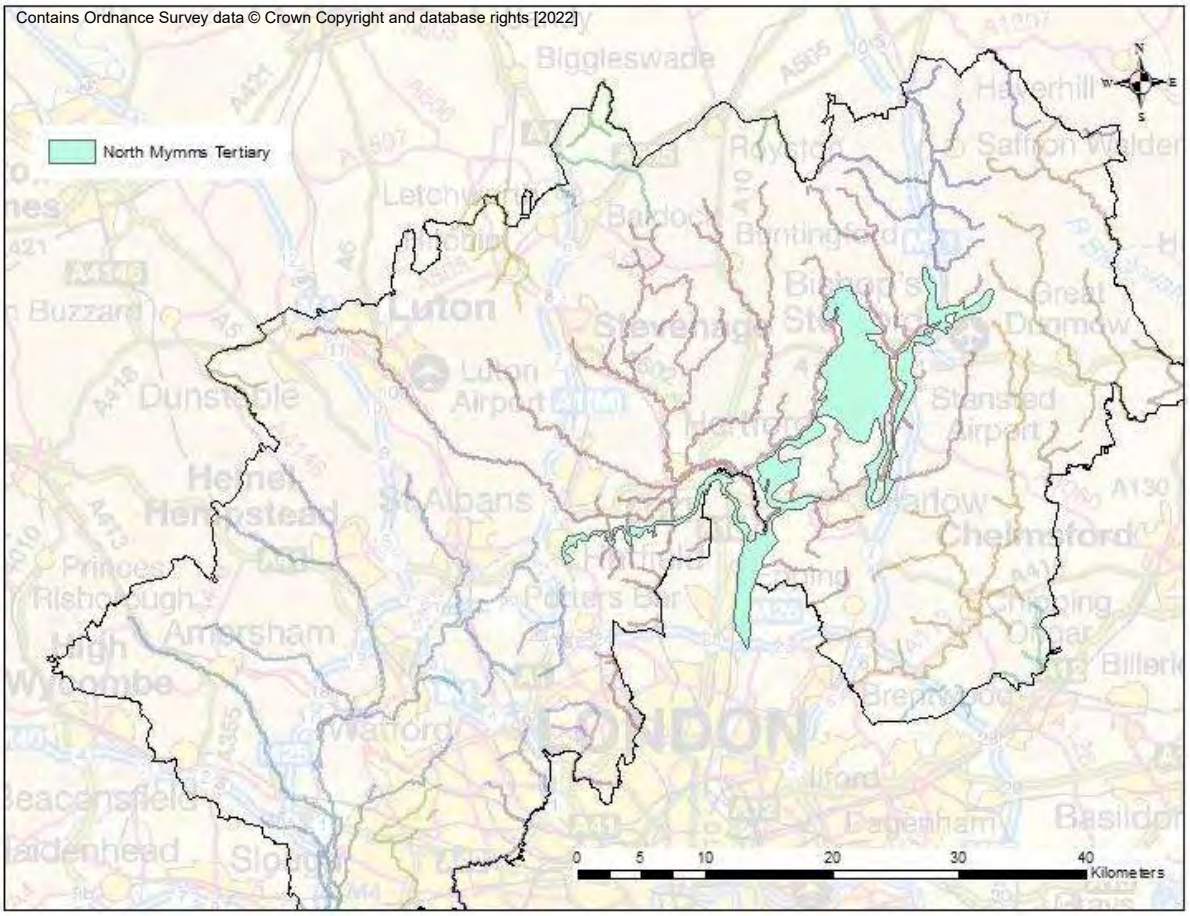


Figure 8 Lower London Tertiary in the Rib, Ash and Stort catchments

11 Hydrological behaviour of Chalk Streams (08AF100039_OAR)

Waterbodies: Ver, Cam, Granta, Beane

Primary driver: NERC_INV

Secondary Driver: EDWRMP_INV

The behaviour of non-perennial chalk river catchments is complex and poorly understood, and their management is based upon hydrological characterisations and environmental standards developed for perennial rivers. We intend for the project to be delivered by the UK Centre of Ecology and Hydrology. One of the key outcomes of the project will be to characterise the hydrological behaviour of non-perennial chalk rivers using data sources across the contributing water companies. The project will target four chalk stream catchments across three water companies: Affinity Water, Cambridge Water and Anglian Water. The proposed catchments are the River Beane (Lea catchment), River Ver (Colne catchment), River Cam (Cam-Ely-Ouse catchment) and the River Granta (Cam-Ely-Ouse catchment). These catchments have been selected due to the high spatial and temporal resolution of data available. If data gaps are identified, we will aim to address these through additional hydrological monitoring. A second outcome will look to incorporate

citizen science by working alongside local communities to better understand and communicate how their rivers behave. In addition to the collaboration between the partners, we will consult and engage with the Environment Agency and the relevant river groups throughout the development of this project so they can make informed decisions and responses to the future management of chalk streams.

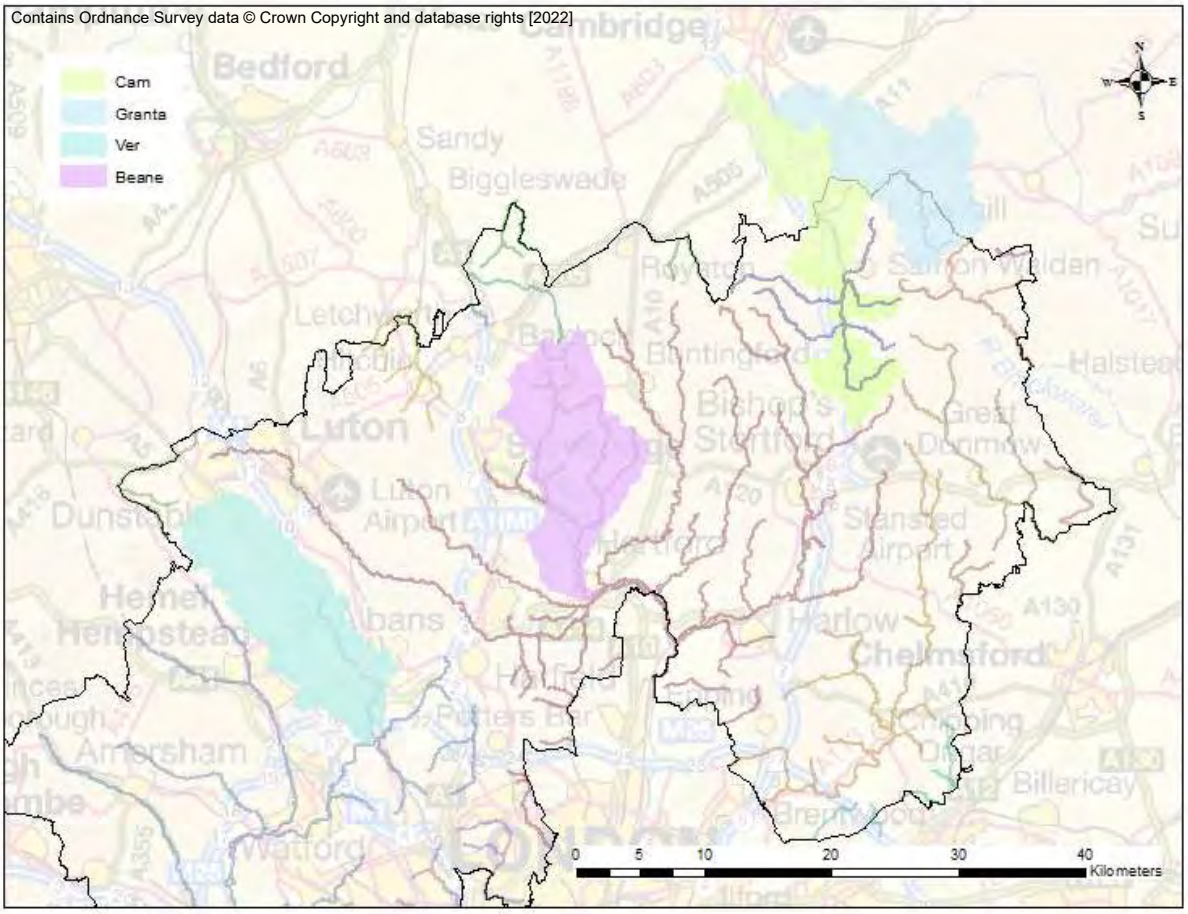


Figure 9 Cam, Granta, Ver and Beane catchments

12 Seabrook Stream (08AF100037_OAR)

Waterbody: Seabrook Stream

Primary driver: WFD_INV_WRFlow

Secondary driver: WFD_NDINV WRFlow

The Seabrook Stream has recently been introduced as surface water body and the latest ecological assessment classified this as Moderate status, whilst the hydrological regime in Cycle 3 assessment supported GES.

The EA has requested an AMP8 investigation to determine whether there is any link with the Affinity Water groundwater abstractions located in the upper catchment and the moderate ecological status (meeting with EA 15 July 2022 and email of 8 November 2022) (Figure 10).

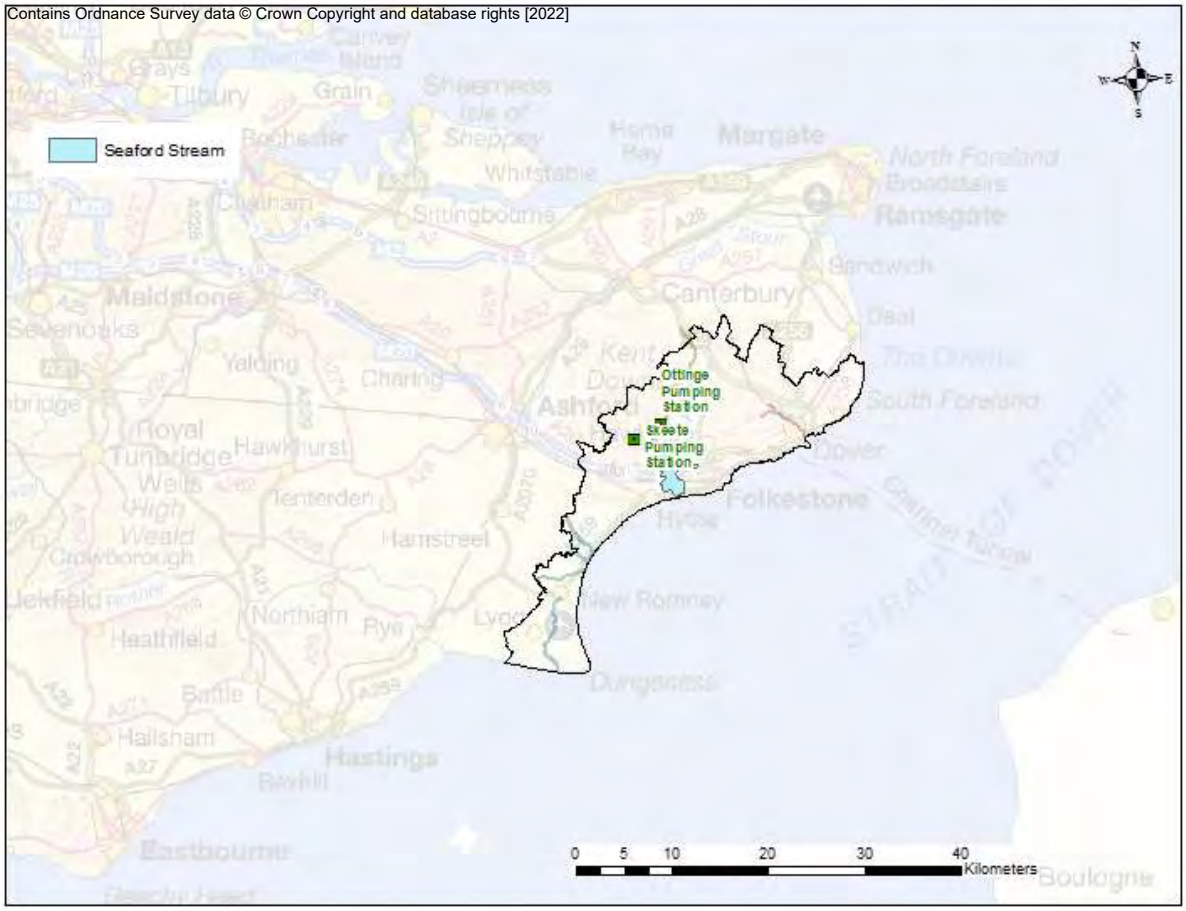


Figure 10 Seaford Stream

13 Nailbourne, North & South Streams (08AF100036_OAR)

Waterbodies: Nailbourne, North & South Streams at Northbourne, Eastry and Lydden valley

Primary driver: WFD_INV_WRFlow

Secondary driver: WFD_NDINV_WRFlow

The AMP7 investigation on the Nailbourne catchment concluded that under future predicted and fully licensed abstraction rates, the risk of deterioration on the upper Nailbourne is low. However the investigation also identified a new risk downstream of the Affinity Water region. In AMP8 there will be a need to extend the study to the area of the coast situated off the Affinity Water distribution area and downstream of the Nailbourne catchment, named North and South Streams. Currently, there is lack of monitoring in the area and the groundwater model is not sufficiently refined for this assessment purpose.

In line with the WINEP guidance that requires any new risk catchments to be assessed in AMP8 (priority C of Table 2 of the EA risk of deterioration guidance), we have agreed the need to investigate the coastal area of the North and South

Streams with the local EA colleagues (meeting with Stephen Barrow and Ian Humphreys on 15th July 2022). The investigation will need to establish an adequate level of measurements to determine any possible influence of abstractions on the North and South Streams catchment and to gather feedback the monitoring data to the regional EA model for further analysis (Figure 11).

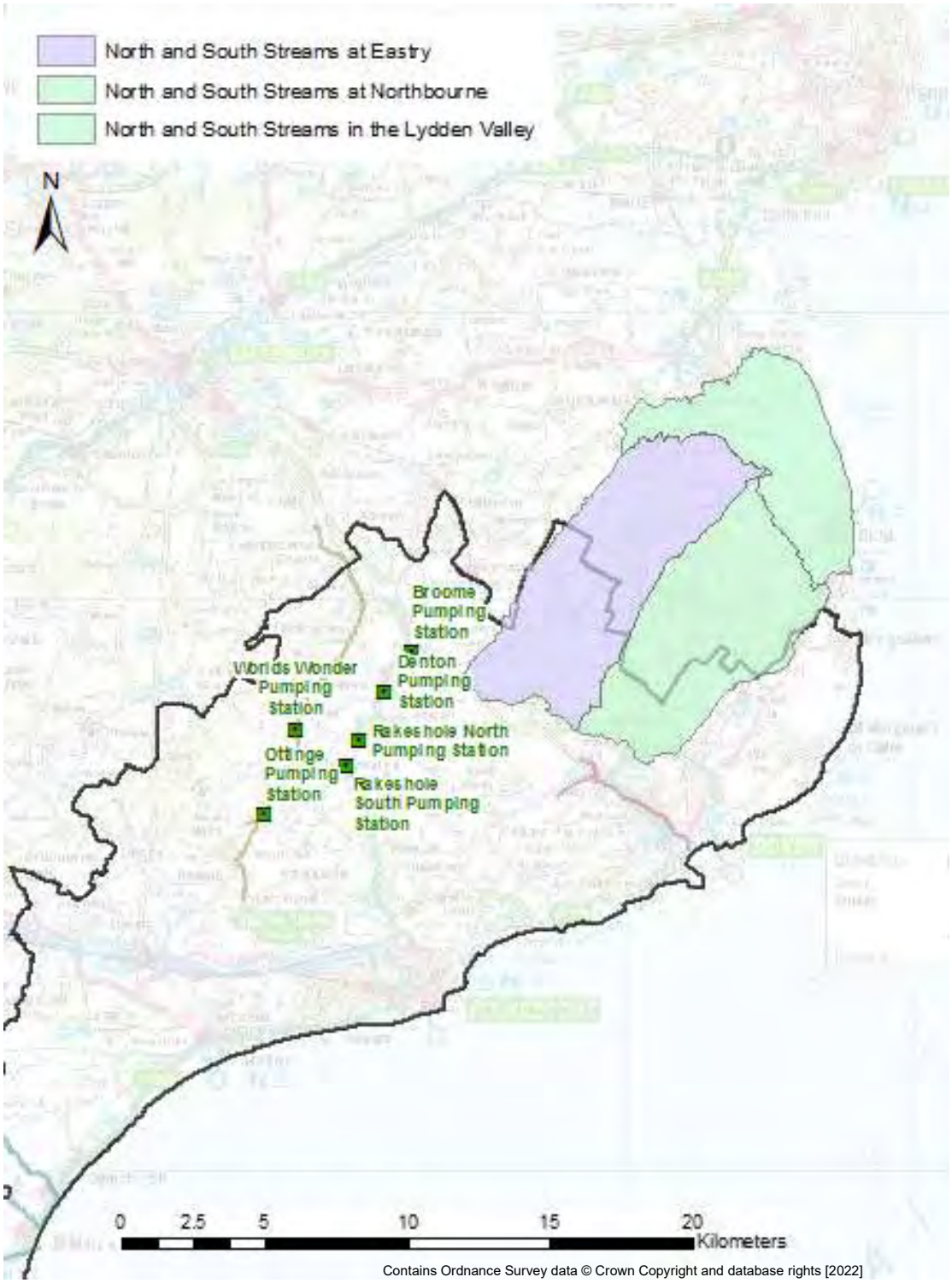


Figure 11 Nailbourne

14 Dour (08AF100038_OAR)

Waterbodies: Upper Dour, Dour from Kearnsey to Dover

Primary driver: WFD_NDINV_WRFlow

Secondary Driver: WFD_INV_WRFlow

The investigation into the risk of deterioration for the Dour catchment carried out in AMP7 concluded that there is currently low risk, based on the current available data and knowledge of the catchment. We have subsequently agreed not to cap abstraction licences in AMP8 (EA email 30 August 2022). However, the AMP7 investigation identified the need for a new investigation to collect monitoring data on the coast to assess the risk of saline intrusion.

Therefore, in line with the WINEP Guidance we have agreed, with the EA, the need to review risks of deterioration in AMP8 following new available monitoring data and conceptualisation (Figure 12).

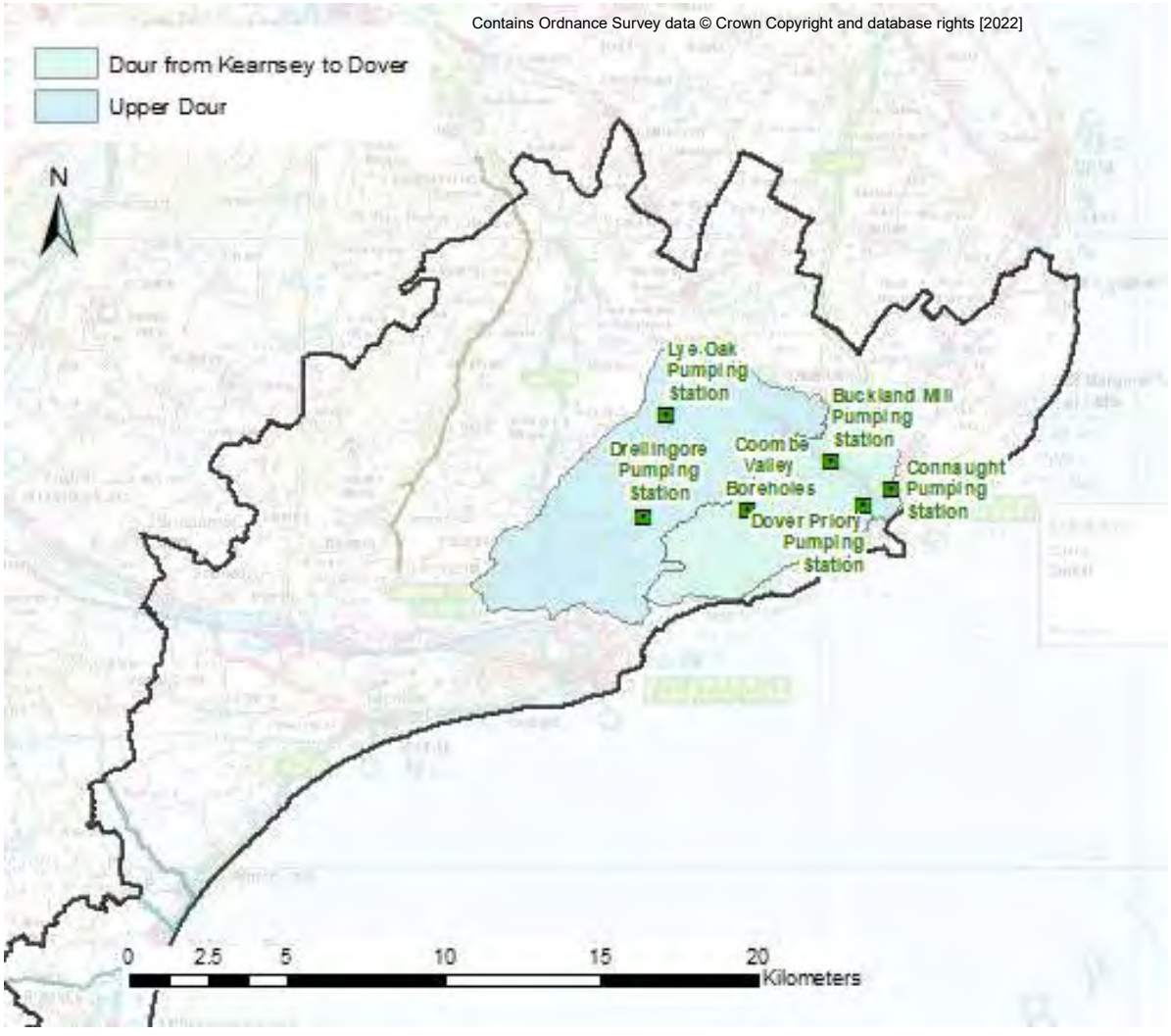


Figure 12 Dour

Affinity Water East Region

Our East region has been investigated in AMP6 and 7 followed by an option appraisal. By the end of AMP7, we will have implemented the selected option. For this reason, the AMP8 programme will require only post-implementation monitoring works to confirm whether the outcome is in line with the predicted results and quantify the benefits.

Allocation of Costs

This business case is 100% enhancement, and all costs are allocated to enhancement expenditure.

Research, Pilots, and Technology Development

We have extensive experience over multiple AMP and WINEP cycles in developing and delivering water resource investigations. Throughout AMP7, we have number of research and pilot projects to support our holistic approach. Our studies will use a combination of field data collection and desk-based analysis. The monitoring data and background studies will form the basis of initial conceptualisations of the catchments, upon which the numerical models will be created.

The projects will have iterative features, as more data is added, and the models are progressively refined. As part of the field data collection and conceptualisation phase, for the planned AMP8 investigations, we aim to include some more innovative interventions such as:

- Review of the conventional Environmental Flow Indicator (EFI) as a flow target, through a series of hydro-ecological assessments and triangulation exercises of several different methods at catchment scale, made in collaboration with EA national and area teams. We have already started to engage with EA national team (meeting 2 November 2022) and EA local colleagues (4 July 2022)
- Undertaking tracer testing using a series of innovative techniques to determine links between groundwater and spring flows, groundwater flow directions and regional groundwater movements. We have established partnership with the British Geological Survey, and we aim to continue the collaboration works with the University of Leeds (meeting regarding future tracer testing works on 24 October 2022 and 26 July 2023)
- Geological surveys and geophysical surveys through a series of passive seismic profiles to characterise the geometry and extension of the different geological bodies, with particular focus of glacial infilling of buried valleys (collaborative works with BGS)

We have been supporting MSc and PhD students in most of our research projects during the last few AMPs, building on our established academic partnerships. We plan to continue such partnership in AMP8 and beyond as we consider it is an effective way of delivering investigations and utilising and developing innovative approaches.

4 Partnering

Evidence of Customer Preferences and Support

4.1.1 Our Customer Engagement Activities

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

The insight and testing of our business plan with customers has been integral to its development. The voice of the customer is used throughout the process to shape and challenge the plan across its development and at each stage.

The triangulated customer insight has shaped and informed the overall strategy, informing each business case and the solution options within them. The triangulated customer valuations have populated the Service Measures Framework used to prioritise investments.

The consultation and testing phases of engagement allowed us to 'check-back' with customers and stakeholders to ensure we had the right mix and balance and test overall acceptability and affordability of the business plan. We have shared our assured findings both across the business and publicly to ensure transparency.

4.1.2 Support for Environmental Protection and Improvements

Through our customer engagement activities for PR24, we are determining that our customers are conscious of needing to protect the environment for the future, and environmental projects are seen as having significant public and moral value. However, recent events have changed things, to some extent, and it is now clear

that the cost of living and the war in Ukraine are starting to impact customers views and priorities. Their concerns over costs are, however, mixed; with some finding any increase to a bill untenable; whilst others feeling that the small planned increases are negligible in comparison to other price increases.

When we asked our focus groups, what actions Affinity Water should prioritise to protect the environment, the responses clearly favoured fixing leaks above all else. Other research also supports this as being customers' priority. Even so, there is continued support for environmental protection and improvements, but customers' need clear proof as to why the investment is beneficial.

Meeting the statutory minimum is not considered to be enough, and most people continue to consider that Affinity Water should be going beyond. When we informed customers of our plans for WINEP, they strongly approved of its existence. However, it was felt to be the bare minimum and customers wanted Affinity Water to exceed them. This view has been collaborated by a cross-company willingness to pay study, where environmental-based projects are accepted at higher bill increases than non-environment linked projects.

"If the rivers and the environment, are part of what you do, which it is, because it's water, then you have to go above and beyond don't you, you can't just meet the expected level, and not think about the future." Domestic Customer

In general, we have found that most customers would be happy to pay a small amount (circa £3 per year) to support going beyond statutory requirements. Although this was strongly conditional on having proof that the money would be spent on the WINEP projects and not shareholders' dividends. There was an appetite to go higher still, with some participants supportive of a larger increase of between £5 and £10 a year if this meant that the process could be sped up. However, it was acknowledged that a higher amount would be difficult for low-income households to afford and that therefore, perhaps any increase above £3 should be voluntary. Our non-household customers were the least willing group to accept the £3 bill increase, stating that Affinity Water should be funding these improvements by investing their own profits. Participants agreed that any cost increase would need to be communicated to customers, with an explanation of why there were doing it.

The four areas of priority sustainable reductions; river restoration and catchment and nature-based solutions; working for the wider good; and going beyond statutory minimums were discussed with customers. We found that there was little difference between the options in terms of priority. All areas were considered important, especially given a potential bill increase of only an extra £3 a year.

"I wouldn't mind personally but houses on my street may not be able to afford it and I don't think they should be penalised because of it. That's why I think that there should be some sort of donation thing where people can donate if they want." Domestic customer

Restoring rivers to a more natural state was the most popular by a small margin, especially with our younger respondents as they considered it would have a positive impact on wildlife for the future. Some people considered that correcting past mistakes would be too costly, whereas others were happy to pay more to preserve the environment for future generations. Our "Wider Good" programmes such as education and working with farmers were only slightly less popular, especially those with a focus on education. Our panel members wanted to see Affinity Water working with other companies to keep waterways clear and clean; managing flood risk; as well as working with governments on regulations. They expect to see us educating people on what actions can be taken, through visits to schools and community groups, and through the use of social media and advertising. Reducing river abstraction and going beyond the government minimums both came a close third in the feedback. In this context, it is important to consider that the results of the investigation proposed in the business case will underpin the definition and success of future sustainability reductions, river restorations and catchment & natural based solutions.

4.1.3 Sustainability Reductions

There is general support for reducing abstraction that are considered to be impacting on chalk streams. This was seen as a good idea overall, although few participants were knowledgeable about what chalk streams were or how they are created. Participants wanted more information to better understand chalk stream catchments. There were some concerns, however, about how future water demands would be met if abstraction were reduced, especially in the light of the earlier population growth and climate change forecasts discussion. This programme of investigations will help identify the location and volume of future sustainability reductions.

The support for reduced abstraction in chalk stream catchments does, however, have to be put in context of other priorities. A recent CCW survey only ranked it as the 9th top priority for customers out of 10. In contrast, our more recent priorities work conducted has shown that leaving the environment in a sustainable and measurable improved state ranks 4th.

Going beyond the minimum standards for chalk groundwater abstraction reductions has some support from customers but there is a limit to the amount in which they will fund this. The overall reaction to having minimum standards, was that these should be viewed as the absolute minimum and that Affinity Water should always strive to do better. This was especially true amongst the future customers, although they re-iterated an earlier point that this should not have an impact on the bill. Several participants wanted to see higher minimum standards set by the government itself, and for increased collaboration between Affinity Water and other companies.

4.1.4 Customer Supported Options

Our research has shown that there is a strong overall level of support for environmental improvements, whether this is for sustainability reductions; river restoration, catchment and nature-based solutions, biodiversity improvements or combinations of the above.

Collaboration and Partnering

4.1.5 Engagement with Stakeholders and Partners

We recognise our role as a public water supply abstractor within the context of the CaBA Chalk Streams Restoration Strategy and implementation plan. We consider there is still a large degree of uncertainties that need to be addressed through the planned AMP8 investigations to ensure we make further abstraction reductions in the locations that will have most benefit to the environment. Given the scale of the uncertainties and the high-level objective of the works, a common effort undertaken in the same direction of travel by all stakeholders is needed. As such, we have continuously liaised with all stakeholders; seeking collaboration, support and advice on the matter.

We have established relationships with academics, government organisations and water industry consultants. We also have an established partnership with river groups and local residents' associations. We pro-actively promoted events and workshops to bring all the stakeholders together to develop a fully integrated approach. Many of these activities go beyond the statutory obligations. The AMP8 programme will include a similar approach to stakeholder engagement, but we foresee the need to increase frequency and level of engagement, in line with the changes required in the catchments to address the environmental issues. In particular we foresee the need to maintain high level of communication with key stakeholders as the investigations progress, so that they are all kept informed about the results. These are likely to be:

- Environment Agency (HNL, EAN, Thames, KSL and national team)
- CaBA Chalk Stream group
- Herts and Middlesex Wildlife Trust
- Local river groups including, but not limited to: ReviveI, River Chess Association, River Beane Restoration Association, Ver Valley Society, Misbourne Valley Society, Cam valley Forum, CURAT, SERT, White Cliffs, Up on the Downs

We also plan to seek contribution from such key stakeholders to inform catchment conceptualisation, based on their local knowledge and their presence in the area. Often the river groups are engaged in Citizen Science and field monitoring activities that contribute to the datasets we use for our analysis and interpretation. These extra activities are valuable, and we plan to actively encourage, support and mentor groups to help ensure quality of data and build a shared understanding of our catchments.

5 Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

We are confident that our proposed WINEP programme for PR24 represents no regrets investments, when considering the optimal pathway to meet our statutory obligations. Our LTDS builds upon our ambitions as set out in our Strategic Direction Statement, within which our stakeholder-informed strategic focuses and targets relating to "leaving the environment in a sustainable and measurably improved state" and to "work with our communities to create value for the local economy and society" are aligned with efficient delivery of statutory obligations under WINEP.

As part of our wider pathway development and scenario testing work for the LTDS, we have mapped out our statutory obligations across WINEP drivers out to 2050 and have created an initial core pathway of phased investments, that balances efficient costs and affordability with the material uncertainties we face. Thinking on this longer-term planning horizon has been a key in the formation of our PR24 WINEP. For example, we forecast that Water Framework Directive driven investments will account for up to 80% of WINEP driven investments over the 25-year period, in large part due to our Sustainability Reductions to protect chalk streams in our region. In recognition of this high potential cost burden on our future customers, our PR24 WINEP includes significantly increased levels of investigation to better understand the relationship between levels of abstraction reductions we undertake, and the benefits realised in the targeted waterbodies. In addition to this we are significantly increasing our investment in catchment and nature-based solutions to support our future abstraction reductions and maximise the wider environmental benefits and support the WINEP and 25-Year Environment Plan. In doing so, we aim to ensure our long-term investment pathway represents the best possible value for the environment and our customers, reflecting this in both our WRMP and LTDS pathways.

We are also committed to achieving our net zero targets, including meeting the Water UK 2030 net zero operational carbon target.

The achievement of these objectives is supported by best value option in this business case.

Adaptive Strategy

Our dWRMP24 is an adaptive plan. The plan includes the possibility to select different strategic options from now to 2050 based on the latest knowledge and

conceptualisation of our catchments, in particular with regards to the environmental benefits delivered by the reductions of groundwater abstractions. The investigations and associated monitoring will provide the information to derive data-based decision of the adaptive plan. In particular, we recognise that at the present time, uncertainties remain over ecological flow targets of many of our catchments (particularly in our Central region).

During this AMP7, we are actively collaborating with the EA in decreasing these uncertainties, looking at alternative flow targets definition with a pilot study in one of our catchments. For AMP8, the planned catchment investigations will include the Environmental Flow Indicators review for all the other catchments not looked in AMP7. This will provide opportunity to confirm and refine flow targets across all our regions and ensure future abstraction reductions are targets in locations that will have greatest environmental benefit.

6 Solution Development

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

Third Party Assurance and Audit Trail

A three-tier approach to assurance has been followed as set out below:

1) Tier 1
    a. Review of WINEP Business Cases by PR24 Red Team
    b. Review of Business Cases by Head of Water Resources & Environment
    c. Review of costings by AMP7 WINEP leads
2) Tier 2
    a. Presented to EMT 16 November 2022
    b. Review and signoff by Director of Regulation & Strategy and Director of Asset Strategy & Capital Delivery
3) Tier 3
    a. External Assurance by Atkins
    b. Board Assurance statement for WINEP Stage 3 PR24 submission

We discussed our approach with Ofwat and the EA in September 2022 through the WINEP pre-draft submission meeting, and made the minor recommended changes as advised to our draft PR24 WINEP submission in November 2022.

We commissioned Atkins as our external, independent assurance auditor to carry out a programme of audits across our proposed WINEP throughout October and November 2022. These audits confirmed we have followed the WINEP methodology in order to determine the preferred, best value option detailed in this business case. The Assurance report produced by Atkins is Appendix 1 of this business case and the associated WINEP Stage 3 Board Assurance Statement included as part of our WINEP submission is Appendix 2.

Our economic and analysis and the associated spreadsheet has been fully checked and assured and compared with other similar systems by our consultants Eftec and ICS Consulting, who have extensive expertise in economic analysis and who have supported the EA with the environmental benefit values and metrics.

In addition, we have a rigorous internal audit trail and assurance process to check all numbers and assumptions made.

We received formal feedback from Ofwat on our WINEP submission on 25 May 2023. A number of comments and feedback were received and aspects applicable to this business case have been accounted for and addressed within the wider document.

This proposed scheme was accepted as part of our PR24 WINEP by the EA as part of the third release of the WINEP issued in July 2023 and the relevant WINEP lines marked as 'proceed'.

Cost Estimation

The investigations will be carried out with methodologies and approaches that follow established previous WINEP investigations. As such, the level of confidence on the cost estimate is high. There are innovative elements that undoubtedly carry a higher degree of uncertainty, but overall they do not significantly impact on the total budget. Additionally, as the projects consist of investigations, they intrinsically bear a certain degree of uncertainties regarding the minimum amount of works and hours necessary to reach sound conclusions.

The costs estimate for each project has been undertaken through the following process:

- Determining the type of activity needed, based on previous similar investigations and the overarching scope.
- Estimating unit costs for each activity based on the latest quotes or previous quotes incremented through the RPI metric.
- Determining the quantity of the activities and hours based on the length of the river, area of the catchments, area of the groundwater bodies or number of activities undertaken in similar works for similar scope.
- Apply efficiency by integrating activities across different investigations where applicable.

Further details on how the costs have been calculated are included in Section 8

Efficiency

Efficiency measures have been applied where possible. In particular:

- Field monitoring rounds have been grouped together or added to existing rounds to maximise the efficiency and reduce associated costs.
- Where possible, activities have been assigned as internal work, decreasing the number of administrative tasks required when a contractor is involved.
- Where historic background information is available and assessed to be sufficient, and with no additional background studies have been added.
- Validation hours have been added only for those projects embedded a larger degree of uncertainties, either because they involve a completely new study area or because they embedded new innovative procedures.

Uncertainties and Sensitivity Analysis

No cost benefit assessment is required for this business case; therefore, the uncertainties are linked to the quantity and the extent of the activities and hence costs needed to reach the defined scope for each project.

As previously mentioned, the investigations have a degree of uncertainty and therefore, the exact number of monitoring points, new observation boreholes to be drilled and field tests will be defined as the investigations progress. From experience, using the river length to work out the quantities might not always be representative of the total extent of the investigation area. In certain conditions, where the abstraction is located in the downstream end of the catchment this method could lead to under-estimation of cost. Conversely, for low abstraction volumes located at the top of the catchment, the method could over-estimate the cost. To overcome this issue, we undertook a validation of the quantities based on the current knowledge of the catchments.

The AMP8 Options Appraisal for the Mid-Chilterns and Upper Lee Chalk groundwater bodies, will follow the AMP7 investigations, expected to be finalised by March 2025. At this time, we have estimated the AMP8 costs using the current EA groundwater model results. The model refinement is expected to provide only minor changes to the current results and therefore marginally change the investigation outcomes and subsequent AMP8 costs.

Assumptions Made

A series of assumptions in the cost estimates have been taken. These include:

- **Study Areas and Length of the Waterbodies:** We have identified the surface water catchments and the length of the main waterbodies as the initial delineation reference of investigations. However the studies are likely to go beyond the catchment watersheds to include all those elements that have potential to influence the natural processes. This is particularly relevant for most of the investigations that involve groundwater elements.
- **Uncertainty:** There are several elements of the investigations that cannot be established in advance with sufficient accuracy. One of these is linked to the amount of groundwater abstraction sources to be assessed. The number of groundwater abstraction sources has the potential to influence the extent and costs of the investigations. Notably for signal tests costs, OBH drilling and groundwater model scenarios. Our assumptions have been based on the best current knowledge of the area and will need to be confirmed through the investigation itself.
- **Consultants' Collaboration:** Some of the planned activities will be undertaken through consultant services. We have assumed full availability with regards of

time and resources, as well as level of competencies in line with the current framework conditions.

- **EA Collaboration:** The investigations will rely on a series of data that is going to be collected by third parties, mostly the Environment Agency. These data collection activities have not been costed, under the assumption that the EA will continue to commit to undertake the field monitoring in line with the current AMP7 plan.
- **EA Regulatory Groundwater Models:** We have assumed that the EA will continue updating and refining the regional regulatory groundwater model, using a combination of EA and water company monitoring data and analysis, in line with the current AMP7 approach. It is also assumed that the models will be made available to us to be used, either directly or through consultancy services.
- **Landowners**: Will give permission to drill observation boreholes, measure flow in the river and carry out surveys and tests within their landholdings.

All field activities can be directly affected by weather conditions (particularly the ability to measure baseflow in the river when there is consistent rainfall pattern). Similarly, the environmental monitoring data should be representative of all range of conditions (high, average and low groundwater levels) so that collected data can be incorporated into numerical models for predictions. Uncertainties will remain over the weather conditions that we might experience in AMP8.

Economic Assessment

Economic assessment is not applicable for this business case.

Meeting Affinity Water's Outcomes

The results of the investigations included in this business case are expected to form the basis of the long-term strategic decision process for our water resource management plan. These are expected to provide data and evidence for the volume and location of reductions in groundwater abstractions that will be incorporated into our future WRMP supply demand balance requirements.

7 Delivery Considerations

Lessons Learnt

During AMP6 and AMP7, we have identified the need to update and improve the EA regulatory groundwater models. Despite the planned model update and refinement expected to conclude by March 2025, further model works will be required in the future, as new monitoring data is collected, and more abstractions are reduced. Monitoring data collection, analysis and interpretation and regulatory model refinement should form part of a continuous iterative process, for which each element is fundamental. The EA is planning to move the current regulatory models into MODFLOW 6 platform and introduce more layering in the aquifer to better represent the hydrogeological conditions (particularly within the Herts Chalk Model). In order to complete this, additional environmental data is needed. We will continue to work closely with the EA and other stakeholders to maintain the iterative process currently in place and make all the information we collect as part of the investigations available for them. Our recently launched Environmental Monitoring Data WebPortal will be used to assist with this data sharing.

It is also important to consider that in order to undertake a robust assessment of previous water resource interventions (abstraction reductions) several years of observed data are required, to capture the full range of hydrological conditions (drought, flood and average). These circumstances often require more than one AMP cycle to enable monitoring under all conditions.

Delivery Risk Management

The data collection will be at the base of the data analysis and interpretation for all the investigation activities. We anticipate that there will be risks associated with the supply chain of equipment required for the monitoring, such as loggers, flow gauging equipment and water quality sensors. During this AMP7, we experienced issues and changes with how suppliers operate due to the electric components of the instruments. This is likely to lead to increase in costs and extended lead times for delivery.

We also anticipate potential risks linked to consultant availability to carry out the required investigative works due to competing challenges of resources within the supply chain due to the scale of WINEP requirements across England and Wales. This is anticipated to cause an increase in costs and extend delivery times.

The monitoring activities are largely carried out on private land. There is an embedded risk that landowner do not give consent to enter their land and undertake the works. Such circumstances usually are overcome by identifying alternative locations; however this can result in additional costs and delays and could result in not being able to monitor in the most efficient way.

In broad terms, all the investigations will consist of environmental data collection, interpretation and quantitative assessment of the influence of groundwater abstractions on river flow and ecology and aquifers (groundwater levels and quality). Following completion of a robust assessment, an options appraisal will be undertaken to identify the most favourable option to manage the water resources. The complexity of aquifer- river interaction in our supply regions will require technical expertise and we will use our links with universities and academic institutions to support the investigations.

We have included within this business case the most appropriate list of activities that can be foreseen based on previous experience in delivering WINEP investigations and have allowed time to review and assess data, in order to reach consensus across all stakeholders. This will be achieved through workshops, data sharing and third-party peer review.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

The environmental monitoring activities included in the investigation projects are expected to provide new data, whose analysis will form the bulk of the investigations and will allow reaching the scope of the project. As the projects in this business case are investigations, we are not expected to generate tangible benefits but rather inform the other business cases on which implementation works need to be planned for AMP9.

8 Supporting Information

The table below includes the costs breakdown for each scheme, calculated on the 2022-2023 baseline.

No.	Catchment	Costs (£m)
1	Upper Cam	0.794
2	Hiz	0.611
3	Oughton Head Common	0.459
4	Stanstead Brook	0.340
5	Denham Lock Wood	0.212
6	Mid Chilterns	1.914
7	Upper Lee	1.969
8	SR WQ and flood risks	0.548
9	Ivel US Henlow	0.976
10	Lower London Tertiary	0.416
11	Hydrological behaviour of Chalk Streams	0.320
12	Seabrook Stream	0.401
13	Nailbourne	0.549
14	Dour	0.494
	Total	**£10.004m**

The predicted expenditure plan includes 15% of the costs to be used in Y1, 30% of the costs to be used in Y2 and Y3; in Y4 additional 15% and the remainder 10% to be used in the last financial year. The default WINEP deadline for most of the investigation is currently set to December 2026 or March 2027. This is likely to be very tight. Additional costs beyond the WINEP deliverable deadline will be necessary to account for monitoring activities, model refinement works and analysis and conceptualisation refinements. Those activities form part of the adaptive approach we considered for our long-term water resource strategy and are fundamental to steer future decisions and inform key stakeholders including the EA on the results of the previous interventions.

Summary costs assessment methodology

Section 7.2 of the Business Case for Water Resources indicates the principles of the cost estimate approach adopted. This summary information sheet has been compiled to describes in detail how the costs have been calculated.

Figure 13 shows the workstream followed for each investigation estimate, both for internal and supplier chain, whilst the paragraphs below include detailed explanation of the tasks. We used a bespoke 'scheme builder' spreadsheet developed by Mott MacDonald with pre-defined drop-down fields and associated macros that has been successfully audited during the WINEP process. This guaranteed uniform approach and consistency across estimates.

Activities required definition: for each investigation we determined the kind of activities needed to be carried out to achieve the objectives. The activities have been determined based on investigations carried out in previous AMPs, accounting for lesson learnt and efficiency adjustments, where applicable. We also introduced some innovative activities that undoubtedly carry a higher degree of uncertainties, bearing in mind the detailed scope of each investigation will be agreed with the Environment Agency through the Action Specification Forms.

Staff Profile definition: based on the activity types, we determined the staff profile required to carry out the tasks. As general rule, we assigned a combination of Asset Scientist, Project Manager and Project Director roles. For the subcontracted activities, we embedded the subcontracted staff cost into the subcontracted costs, adding internal staff roles for supervision and approval.

Activities unit costs estimate: for each activity we determined the most likely costs based on same or very similar activities costs spent in the past. For each previous quotes available, we worked out the unit costs by dividing the total for the most appropriate unit quantity specific of the activity; for instance, kilometre of river investigated for a river walk over survey, number of monitoring rounds for river flow spot gauging works, number of boreholes for observation borehole drilling etc.

The unit costs associated with each previous quote have then been uplifted to the 2022/23 cost base. All previous quotes used for such estimate have been stored in dedicated folders for reference and audit purposes.

Staff unit costs estimate: for each internal staff role profile, we determined the costs per hour as per 2022/23 cost base.

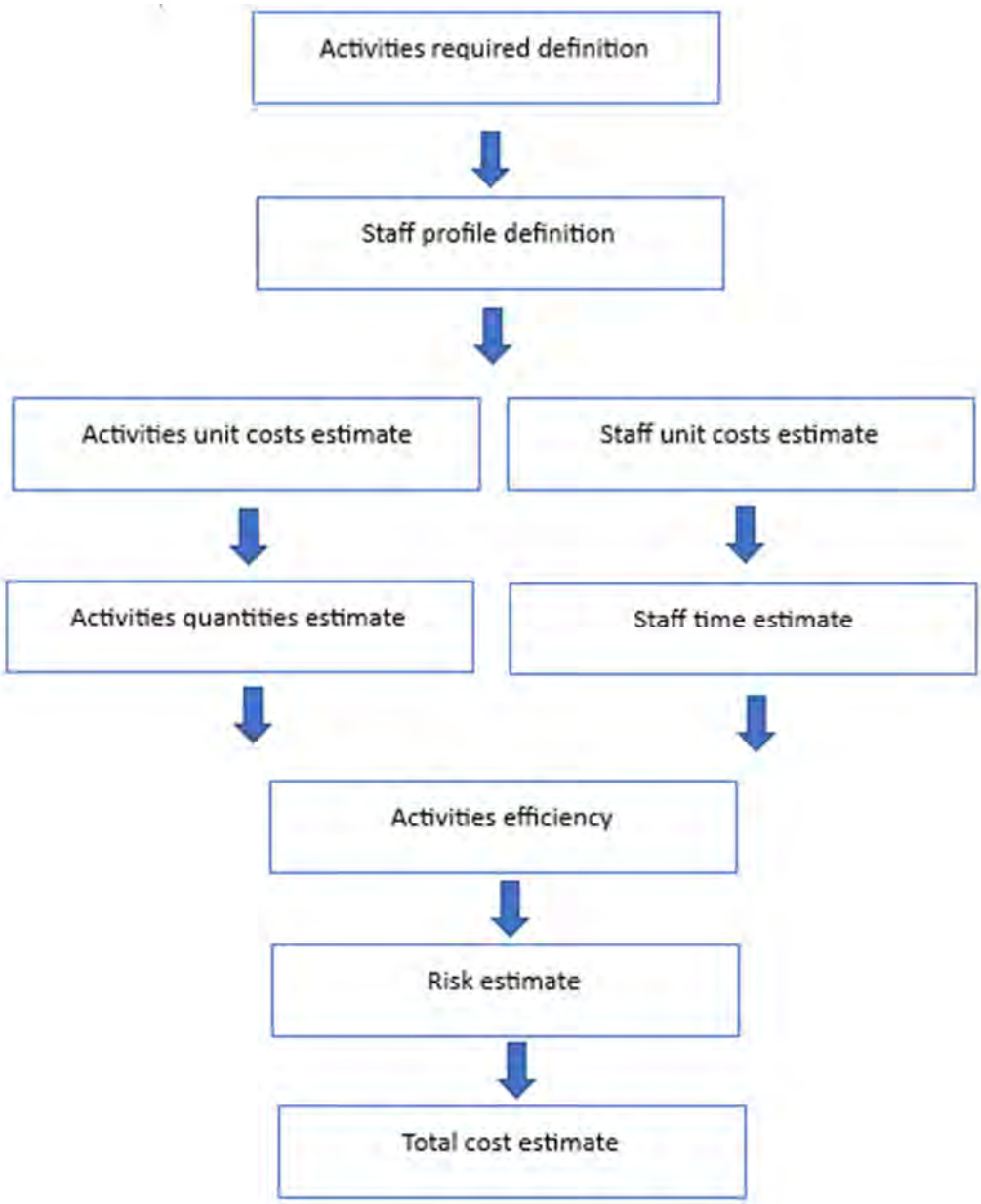


Figure 13 Cost Estimate workstream diagram

Activities quantities estimate: for each activity we determined the most likely quantities based on the agreed objective of the investigation. The quantities have been calculated using maps tools here appropriate (e.g. kilometre of watercourse) as well as experience gained from previous AMPs investigations. Where possible, significant attention has been paid to make efficiency across investigations. For instance, quantities of field monitoring rounds required for a small investigation have been reduced if a nearby investigation included larger monitoring rounds.

Staff time estimate: for each activity we determined the internal staff time required to undertake the task based on similar investigations undertaken in the past. As general rule, the field activities are assigned to Asset Scientist, bearing the larger amount of hours for the task. Project Management role time and Project Director

time have been allocated to supervision and approval processes only. A minimum internal staff time has also been assigned for the subcontracted activities, to ensure there is sufficient allowance for coordination, revision and approval. The external staff time for subcontracted activities is included in the total cost and it has not been estimated.

Activities efficiency: where possible, significant attention has been paid to make efficiency across investigations. For instance, field monitoring rounds estimated for a small investigation have been incorporated into a nearby larger investigation monitoring activity, so that time and resources spent are minimised.

Risk estimate: 10% risk has been applied on a flat profile across all activities; we consider this is consistent with previous AMPs investigation costs.

Total cost estimate: the total cost of an investigation is calculated by summing up all activity costs. For each internal activity, the cost is determined by multiplying activity unit cost for the estimated quantity and summing up unit time staff multiplied for time quantity. For subcontracted activities, the cost is calculated by multiplying the unit cost for the activity quantity. Risk is then applied uniformly across all activities.

Appendices

All appendices can be made available upon request.

Appendix 1 – Atkins PR24 WINEP Assurance Report November 2022

Appendix 2 – PR24 WINEP Stage 3 Submission Board Assurance Statement

Affinity Water

South-East Strategic Reservoir Option (SESRO) SRO

September 2023

Contents

Summary

The South East Strategic Reservoir Option (SESRO) is one of 17 national Strategic Regional water resource Option (SRO) projects that were funded in Price Review 2019, to meet the requirements of RAPID (an alliance of OFWAT, Environment Agency and Drinking Water Inspectorate). In simple terms, the scheme consists of a major raw water storage reservoir in the upper River Thames catchment, with shared resource use by Thames Water, Affinity Water (via the Thames to Affinity Transfer SRO) and Southern Water (via the Thames to Southern Transfer SRO).

At PR19 Ofwat announced a £469 million ring-fenced development fund for companies to investigate and develop strategic water resource solutions that benefit customers, protect and enhance the environment and benefit wider society. This funding provides companies with the ability and certainty to accelerate the development of solutions to be 'construction ready' for the 2025-2030 period; it encourages joint working, enables additional analysis where required and provides outputs with greater certainty than would be available without it. Delivery of these solutions is subject to a formal gated process where decisions are made on delivery penalties and solution funding progression. Affinity Water was funded in AMP7 for the work expected to be required in the delivery of Gates 1 – 4. The submission for Gate 2 was issued to RAPID on 14th November 2022.

The Gate 2 submission documented the feasibility, costs, environmental issues, planning strategy and procurement approach for six potential reservoir options of different sizes. There were options for 4 single phase schemes (75, 100, 125 and 150 Mm^3 of live storage) and 2 phased options (30 + 100 and 80 + 42 Mm^3).

The SESRO options are part of the feasible options set considered by Affinity Water in deriving their best value Water Resources Management Plan (WRMP24) and by the Water Resources South East (WRSE) in deriving their draft Regional Plan. A 'Best Value' water resource plan is one that delivers wider benefits to society and the environment. It considers a range of factors alongside economic cost in the identification of the preferred water resource programme that will form the basis of the plan. The development of a best value plan is promoted by the EA, Ofwat and Natural Resources Wales in the Water Resources Planning Guideline.

WRSE has carried out best value analysis to develop the Best Value Regional Plan. The Affinity Water WRMP is cascaded from and fully aligned with the WRSE Regional Plan, and so the same best value metrics have been considered in both plans. Best value metrics have been determined for the SRO scheme. The metrics considered in addition to cost and carbon emissions are Natural Capital (NC), Biodiversity Net Gain (BNG), SEA benefit, SEA disbenefit, resilience: reliability, evolvability and adaptability, and customer preference.

In the draft WRMP best value plan, the 100 Mm^3 single phase option is selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The scheme is selected for delivery by 2040, with resources shared between Thames Water (approx. 40%), Affinity Water (approx. 30%) and Southern Water (approx. 30%).

SESRO provides the additional resource into the River Thames during periods of drought, which facilitates the use of the T2AT transfer to Affinity Water. Therefore, in combination with the T2AT, SESRO represents a critical part of the best value plan within Affinity Water's draft WRMP, ensuring that the supply-demand balance is maintained.

In order to facilitate efficient delivery of the scheme, given the numerous constraints and risks with the development of a scheme the size, scale and complexity of SESRO, the Gate 2 submission proposed that work continue on SESRO towards RAPID Gate 3 in January 2025, a DCO submission in the second half of 2026 and an aspiration to start on site in 2029. Therefore, investment is required in AMP8 to maintain progress on the project with a view to starting construction in year 5.

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	5.74	5.74	11.45	6.28	0.00	**29.21**
Opex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Totex (£m)	5.74	5.74	11.45	6.28	0.00	**29.21**

Drivers	
100%	Strategic Regional Resource (Additional Driver)

Benefits
N/A

Economic Analysis			
NPV Costs (£m) (2025-55)	**24.3**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★	★ ★ ★	★	★ ★ ★		★

Project Description

The South East Strategic Reservoir Option (SESRO) is an 'off-line', fully bunded raw water storage reservoir in the upper catchment of the River Thames. Water would be abstracted from the River Thames during periods of high flow and stored in a reservoir, to be released back into the River Thames when there is a need to augment the flows in the River Thames. Water released from SESRO could be re-abstracted by existing or new infrastructure further downstream to supply customers of Thames Water and Affinity Water. An overview of the key elements of the scheme can be seen in
Figure 1 below.

The key components or assets required to deliver the scheme are as follows:

- Provision of a fully bunded raw water storage reservoir in Oxfordshire, 5km south-west of Abingdon.
- Pumping station at the toe of the embankment (on the north-east side of the reservoir) including both inflow pumps and outflow energy-recovery turbines.
- Conveyance tunnel to transfer flows via the pumping station to and from the intake / outfall structure on the River Thames near Culham.
- Auxiliary drawdown channel (ADC) linking the reservoir siphons to the River Thames, to allow drawdown of the reservoir in emergency scenarios.
- Main access road into the site (from A415, Marcham Road) and diversion of the existing East Hanney to Steventon Road.
- Temporary rail siding to facilitate delivery of certain construction materials by freight train.
- Public access, parking and recreation facilities, public education facilities, landscaping and creation of aquatic / grassland habitats.
- Local stream channel diversion to both the east and the west of the reservoir and construction of compensatory floodplain.

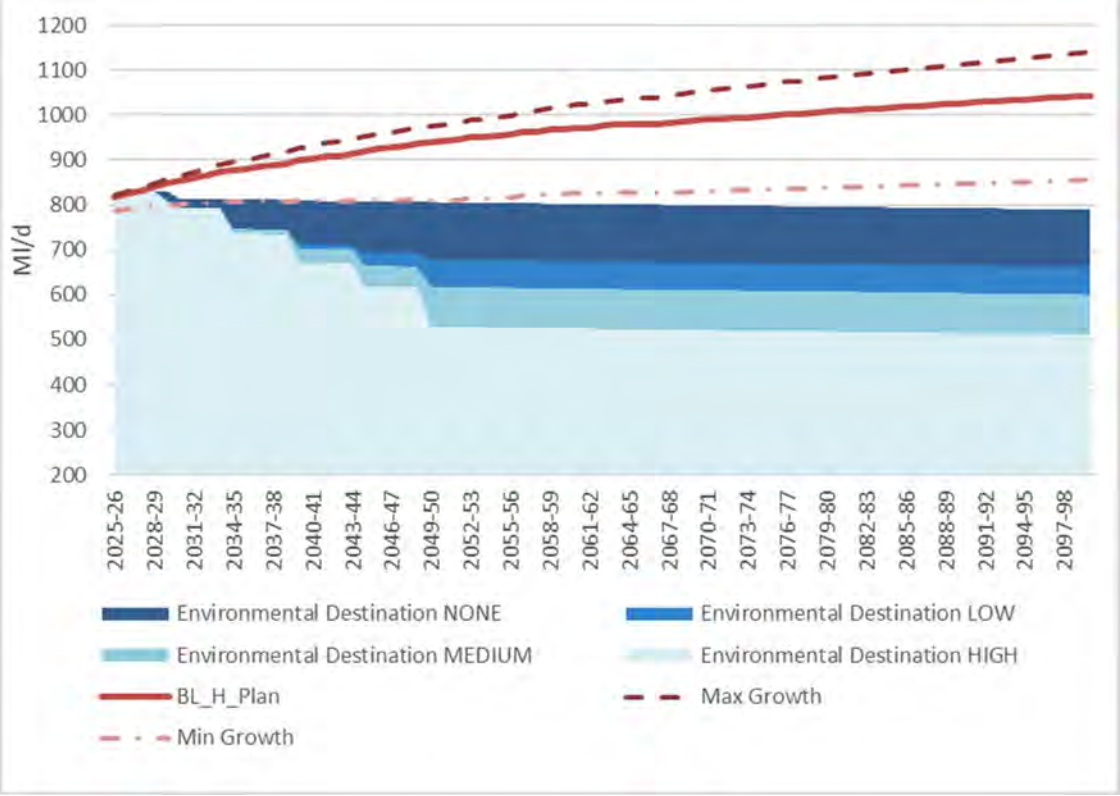
Figure 1 Scheme overview plan (source: SESRO, Gate 2 main report, November 2022)

Project Development

Baseline Assessment

The draft WRMP24 (section 6) reports the baseline forecast supply-demand balance for Affinity Water. This represents the position in a 'Do Nothing' scenario. Figure 6.3 of the draft WRMP24 is reproduced in Figure 2 below, showing the forecast difference between available supply and projected demand for drinking water in Affinity water's Central Region (WRZ 1- 6).

Figure 2 Baseline supply demand and supply for Affinity Water Central region (Figure 6.3 from draft WRMP24)



This is further quantified in the draft WRMP24 as a range of uncertainty, depending on the extent of future growth and future reductions in existing abstraction licences that are required due to environmental pressures. Overall, this uncertainty is quantified as a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050.

This loss of supply needs to be met by a combination of new demand saving and water efficiency measures and by new supply-side options such as SESRO, providing resources into Affinity Water via the Thames to Affinity Transfer.

Problem Statement and Stated Need / Driver

The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below. These are all analysed at regional level by WRSE and then translated down to Affinity Water for incorporation in the WRMP.

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[1]. The impacted companies have a statutory duty to plan for this level of future growth.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively. t
Improved drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved using drought orders and drought permits up to 2040, but reducing reliance on these measures thereafter.

These drivers for additional water supply are considered after the implementation of reductions to leakage and to water consumption, as prescribed by the Environment Agency's National Framework for Water Resources2. The framework requires a 50% reduction in leakage by 2050 and planning for a domestic water consumption of, on average, 110 litres per person per day by 2050, while also reducing non-household demand. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply.

Overall, the SESRO options are part of the supply-side options set that could be used to meet the combined overall need across the south-east of England for an additional 1 billion litres of new water supply per day by 2040, increasing to a maximum of 2.6 billion by 2100 under the highest scenario. These needs drive the

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline?msclkid=88cab670c08011ecb284fa54ecf9127d
[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources?msclkid=245c3d5bc08211ec8b961853f7da9bae

imbalance between available supply of water and projected future demands, and why supply-side improvements are required to achieve a supply-demand balance.

Risks, Issues and Requirements

SESRO is a highly complex project. The key risks are noted below, with further information on risk management and mitigation available within the Gate 2 submission to RAPID.

- The scheme would be categorised as a Nationally Significant Infrastructure Project (NSIP) due to the nature and scale of the storage volume and hence consented through a Development Consent Order (DCO) under the requirements of the Planning Act 2008. This is a highly complex, and extensively regulated process, overseen by the Planning Inspectorate (PINS). This requires an extensive amount of technical analysis, design development and, particularly early stakeholder engagement ahead of consent submission and hence a high level of uncertainty about the cost and duration of all required activities.
- The DCO process requires extensive consultation ahead of consent application, including a Statutory Consultation process to be followed. Although the regulatory requirements of this are clear, the likelihood of objection and negative PR from affected stakeholders is high. A highly motivated and vocal opposition group is already well established within the local community surrounding the reservoir site.
- The scheme is likely to require the acquisition of a large area of land, which is not currently owned by any of the water companies involved. The compulsory acquisition powers could be achieved under the DCO, but this is another highly complex and risky process, which requires very careful management and long durations of work, if it is to be successful.
- The feasibility work completed thus far for RAPID has not identified any unresolvable planning or environmental constraints, but it is expected that the scheme would require formal Environmental Impact Assessment to support the consenting process. This requires extensive land access for survey purposes prior to consent submission. For a scheme such as SESRO, where the promoters do not currently own or control all of the site, statutory powers of access can be secured but this requires approval from the Secretary of State, making the process for environmental survey and data collection even more complex and lengthy than for other schemes.
- There is a risk that the scheme might cause unacceptable impacts on a number of watercourses across the site, due to implications under the Water Framework Directive. Extensive work in the run up to Gate 2 to better understand the impacts, in close liaison with the Environment Agency, has reduced this risk, but it remains live until the scheme design and environmental mitigation plan has been finalised.
- The scheme is currently expected to be delivered via Direct Procurement for Customers (DPC) or through the Significant Infrastructure Provider Regulations

(SIPR), which should deliver better value for customers at lower risk than in-house delivery. This requires submission of prescribed information and documentation to Ofwat and progression through a series of Control Points, before any contracts can be let and extensive commercial analysis and negotiation. The choice of a route under SIPR may also require changes to existing legislation for it to be applicable.

Allocation of Costs

100% of the costs would be enhancement.

Research, Pilots, and Technology Development

The project currently has plans for a clay compaction trial in AMP7, as part of the investigations proposed within the RAPID gated process, to investigate the impact of settlement and pore water pressure changes on the nature of the materials that will form the main structural embankment. This information will help to validate and enhance the Finite Element (FE) modelling undertaken as part of the structural design.

There are plans for a full trial embankment, with associated instrumentation and monitoring, but this would be undertaken as part of the main works contract, after the end of AMP8.

As noted in the Gate 2 submission, there are various opportunities to incorporate emerging low-carbon and renewable energy technologies into the construction and operational phases of the scheme. We will continue to explore these as the design progresses.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

For RAPID Gate 1, Affinity Water participated in a research programme coordinated by WRSE, involving nine water companies, to examine customers' understanding of water resources and the need for regional solutions. This coordinated approach ensured feedback was comparable across regions and solutions and was cost efficient. The research provided evidence on customers' understanding of the need for regional water resource solutions and the level of support for sharing water resources.

For RAPID Gate 2, Affinity Water's collaborative customer research[3] has progressed on the themes we identified at Gate 1:

- Firstly, exploring through the regional engagement what customers view as 'best value', how they weight those metrics and prioritise – enabling us to assess how different schemes 'perform' in terms of the customers' preferences.

- Secondly, looking at how we can make schemes more acceptable to customers, we looked to dive deeper on views regarding public value – exploring with customers what they mean by the term, their preferences, whether their views alter dependent on their proximity to the scheme and how much they would be willing to pay for a range of possible 'added value' options for a scheme.

- Finally, we looked how customers perceive, understand and ultimately how we need to engage customers when we change their source of water. We explored this immersively, including through taste testing.

Evidence of Customer Preferences

For Gate 2, over 300 household customers were engaged to explore their preferences regarding the 'best value' criteria developed by WRSE. In general, customers place more weight on the delivery of secure supply of water, followed by cost of environmental improvements, with resilience placed on the lower end of the scale. SESRO provides a secure supply of water, given the nature of the scheme.

[3] We have undertaken an efficient and collaborative programme of customer engagement across several water companies to support the SROs. Where practical we have utilised regionally led work. For other areas we have formed 'club' projects with other SRO teams – maximising the expertise across the companies.

The research project into public value was collaborative across 11 SROs. The key aims were to understand what preferences and added value our customers perceive is important, as part of infrastructure development. Of particular relevance to SESRO, the majority of participants were in favour of the inclusion of 'added value' additions to the project (environmental, economic and social). When costs and bill impacts were raised, customers consider that cost-benefit considerations should play a major role in future planning. The other key findings of the public value research were as follows, against each we have identified our current response:

- The disruption to daily life during the long construction period and cost leads to doubts about how worthwhile investment in a reservoir is as a solution.
- The large amounts of space required to build reservoirs also raises concerns about the destruction of local habitats and damage to the environment.
- Learning about the creation of new habitats and green spaces in the construction phase goes some way in addressing these concerns, leading to a perception that they have a 'net-positive' impact on the environment.
- Additional benefits (e.g. leisure spaces, education opportunities) created through reservoirs further build on this view of net-benefit once constructed.

The research study into customers' views on changing their water source was also collaborative across 11 SROs. 1,400 customers and 200 non-households were engaged during the quantitative phase.

- Customers say they are unlikely to engage with communications on source change, and taste tests indicate that most are not able to detect differences at the level that might be expected in a source change. However, there is still a need to communicate to explain the rationale for the change, alleviate taste concerns and provide clear guidance on the impact.

- The product sample tasting reassured customers that water transferred from other areas will not necessarily taste noticeably different.

The indicative Gate 2 Master Plan for SESRO already incorporates a number of these additional benefits. As with feedback from previous and future engagement and consultation exercises, we will refine the scheme to reflect these research findings and engage proactively with the local community as the design develops during subsequent stages.

At this stage, we believe that we have aligned our approach and the current conceptualisation of the scheme with Ofwat's public value principles and these customer research findings, as follows:

- The concept design for the SRO has sought to create further social and environmental value as part of the delivery of our core services, beyond the minimum required to meet statutory obligations. We have considered a holistic Master Plan for the scheme that can deliver enhanced biodiversity net gain and natural capital value, including carbon sequestration and have assessed the societal value that this conceptual scheme could deliver, across areas such as

education, economy, public health and wellbeing and climate. This is reported in Section 8 of the Gate 2 Report. This will be considered further as the design develops beyond Gate 2, as required by the Gate 3 Guidance.

- We have tried to ensure that the social and environmental benefits that we have identified would be measurable, lasting and important to customers and communities. This would be further tested through engagement, consultation and design development as the scheme progresses.

- We ensured that the information and insights we have provided in our Gate 2 submission are open and transparent with regard to operational performance and both positive and negative impacts. We hope that future plans for engagement and consultation on scheme choices will help to identify further opportunities for delivering additional social and environmental value.

- We have assessed customer response and willingness to pay for different societal and environmental benefits, through our SRO customer research projects. As the design progresses, this insight will help to guide the development and design of the future scheme, help shape the design principles that guide it and ensure that the delivery of social and environmental value outcomes will have customer support. We have also ensured that such solutions would be cost-effectively and efficiently delivered, and our proposals for competitive procurement as outlined at Gate 2 will further help meet this aspiration.

- Throughout the Gate 2 process, we have collaborated widely with others to maximise benefits and try to align stakeholder interests. For example, we have engaged extensively with the Environment Agency, with regard to the potential for shared flood risk management benefits, with Oxfordshire County Council, with regard to the layout and configuration of road and Public Rights of Way networks and with the Wilts and Berks Canal Trust, with regard to the share use of the Auxiliary Drawdown Channel as a navigable canal. These discussions will continue as the scheme is developed, including exploration of shared funding where relevant.

- Throughout, we have taken account of our capability, performance and circumstances when considering how SESRO could deliver greater social and environmental value, especially in how we might procure and operate the scheme.

All of these aspects will be developed as the design develops through future engagement and consultation and in line with RAPID Gate 3 guidance.

Partnering

Collaboration and Partnering

We developed our approach to engagement in line with RAPID's guidance for Gate two (August 2022). We have built on the foundation of stakeholder and customer feedback received prior to gate one, activity completed through gate one, the representations made to RAPID at gate one, and direct feedback from RAPID and other regulators.

To ensure clarity, consistency and efficiency of the engagement activity with our customers and stakeholders, we have coordinated the engagement regarding SROs with that on Regional Plans, company WRMPs and company 2024 price review (PR24) Business Plan submissions. This approach to customer and stakeholder engagement activities has ensured there is a flow of insight through the process, as illustrated in Figure 3 below.

Figure 3 Insight flow from customer and stakeholder engagement

Engagement with Stakeholders and Partners

The AMP7 funding for the SESRO project is shared with Thames Water (on a 33/67 basis). Therefore, all of the work to inform the RAPID gated process has been done on a wholly collaborative basis, shared between these two partner companies, including a shared Project Steering Group (at Executive level), a shared Programme Management Board for day-to-day governance and a single Programme Manager accountable to both partners. Procurement has been approached on the basis of 'best person for the job' with competitive procurement being applied across both partner companies to select the best supply chain possible. This has resulted in a number of co-funded technical tasks, that have been delivered on behalf of both partners, including assurance, legal support and planning and land advisory services.

Engagement with key stakeholders has been undertaken through a series of Technical Liaison Groups (TLGs). These groups were designed to provide a collaborative discussion forum between the SRO delivery team and key 'tier 1' stakeholders and regulators such as the Environment Agency, Natural England, affected Local Planning Authorities and County Councils and key others, such as the North Wessex Downs AONB Board. We have also established key engagement forums with key infrastructure providers with whom the project will need to engage, such as Network Rail, National Highways and Scottish and Southern Electric. The groups have met regularly since project inception, enabling discussion and agreement of factors such as options, possible alternative solutions, technical methodologies, datasets, survey requirements and assessment conclusions.

Co-design and Co-delivery

The concept design for the scheme has been undertaken with collaboration between the partner companies. Both Thames Water and Affinity Water has interfaces into the scheme that will affect the operational aspects. This includes the operational interface and shared use of the Lower Thames Reservoir system, to provide the raw water for the T2AT transfer to Affinity Water.

Commercial aspects of the project have been considered in collaboration with Thames Water, to enable clearer understanding of the operational interfaces and commercial 'hand-offs' required to successfully deliver the scheme and shared use of the resources.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

This scheme is a key part of the draft WRMP reported pathway, hence integral to the best value plan which was issued for consultation in November 2022. This plan is built upon 9 adaptive pathways. SESRO is selected in 8 of the 9 future situations modelled required from 2040 onwards, hence integral to the future management of uncertainty in the supply-demand balance across a range of possible futures.

WRMP Adaptive Strategy

The position of the SESRO SRO within the WRSE draft Regional Plan and draft WRMP24 is summarised as follows. Further information and justification of the reported pathway and associated sensitivity analysis may be found within Affinity Water's draft WRMP24 (Section 9):

- In the best value plan, the 100 Mm3 option for SESRO is selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The scheme is selected for delivery by 2040. This same option is selected in 8 of the 9 pathways, only not being required in the very lowest (least challenging) future demand scenario.

- This 100 Mm3 option is smaller than that chosen in previous iterations of the plan (which selected the 150 Mm^3 option), providing a better balance in the best-value plan with improved environmental metrics at a lower cost. However, the smaller scheme provides slightly less resilience for the more challenging (higher demand) futures.

Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

The options appraisal process for SESRO has been undertaken as series of linked studies, spread across successive WRMP periods, to screen the options down to a preferred shortlist. This process has included:

- Identification and appraisal of the feasibility of different sized alternative reservoir sites within the Thames Valley. This was a staged process, which resulted in the different sized options that have been identified for SESRO, along with a number of alternative, generally smaller, reservoir sites that have also been considered by Thames Water within their draft WRMP options appraisal process. This process is reported within Thames Water's draft WRMP.

- All 6 shortlisted options for SESRO were costed for the purposes of the Gate 1 submission to RAPID and were passed to WRSE to include a feasible options within the regional modelling 'best value planning' process.

- The regional modelling, in parallel with further options appraisal to re-confirm the Gate 1 conclusions, resulted in the selection of the largest of the SESRO options (150 Mm3) within the WRSE emerging plan in January 2022. This initial plan was based upon a simple 'least-cost' optimisation.

- Further technical appraisal and refinement has developed the SESRO options for the Gate 2 submission, through further design development, integrated master planning and environmental appraisal. The same options have been re-costed and appraised for RAPID Gate 2.

- Further sensitivity analysis and best value modelling was undertaken by WRSE to develop the draft Regional Plan, which then feeds into the draft WRMP. This draft plan optimises the selection of options to create a best value plan, based upon additional decision-making criteria beyond 'least-cost' including carbon costing and a series of environmental, resilience and customer preference metrics. It is this best value plan which has selected the 100 Mm^3 SESRO option within the reported pathway.

It should be noted that the options cannot be simply analysed against each other. The critical aspect is to understand whether they could form part of the best-value solution for the south-east of England as a whole. This requires comparison against all other demand and supply options, and considered over the full planning time horizon to 2100. This is the reason why the strategic choice of options is undertaken at a regional level and not just at scheme or company level.

Selected Options

Do Nothing, Option 0

This is not considered a viable option, due to the nature of the planning problem to be solved. The WRMP and the retention of an acceptable Security of Supply Index are statutory obligations.

Preferred, Best Value, Option 1

SESRO, 100 Mm³ live storage

This option delivers 185 Ml/d as an annual average deployable output during a 1 in 500 year drought.

Least Cost Option

SESRO,30 Mm³ live storage

The smallest option considered for SESRO, which is the first phase of one of the two-phase concepts, is the 'least-cost' as it requires the lowest capex and opex costs. However, it also delivers the smallest deployable output (only 65 Ml/d) at one of the highest unit costs.

Alternative Options

The available storage volume of the other SESRO options considered, along with associated 1 in 500 year dry year annual average deployable output for each, are summarised in Table 1.

Table 1 List of SESRO options in draft WRMP

Option	1 in 500 year DYAA DO (Ml/d)
150 Mm³	271
125 Mm³	229.5
100 Mm³	184.6
75 Mm³	149.2
30 + 100 Mm³	65.5 + 173.1
80 + 42 Mm³	155.1 + 68.9

Option Assessment Approach

Economic Assessment

Economic assessment has been done in two key ways:

- The WRMP and WRSE options appraisal processes use complex optimisation modelling tools to calculate the least cost combination of options to solve the given water resources planning problem across the south-east. This is based upon an NPV approach, based upon the base capex of the scheme, fixed and variable opex, carbon costs and modelled utilisation over the planning period.

- For comparison at Gate 2, simple comparison of options has been done via the calculation on Net Present Value (NPV) and an Average Incremental Cost (AIC) for each of the leading options. NPV and AIC has been estimated using the standard methodology developed for all SROs at Gate 2, based on HM Treasury Green book with a declining schedule of discount rates (HMT Green Book: Annex 6, Table 8) and an 80-year assessment period. Utilisation is based upon the estimated operational profile of the scheme, which amounts to an annual average utilisation of approximately 38%, and the investment profile is spread across an estimated 15 year programme for planning, development and construction and commissioning.

Cost Estimation

Capex estimates were derived using a combination of Thames Water's Asset Planning System standard cost curves and bottom-up cost estimates based upon the Gate 2 concept design. The scheme costs were benchmarked at Gate 1 and then subjected to peer review and assurance for Gate 2.

Capex estimates

The current capital cost estimates for the SESRO variants are based on a bottom-up estimate originally developed during the design work for the 150Mm^3 size variant as part of the WRMP09 submission, alongside adjustments made to this for some of the key scheme components carried out for the WRMP19 and RAPID gated submissions. The WRMP19 adjustments also allowed for high level estimates for land acquisition. The estimate was reviewed and assured for the Gate 1 and Gate 2 submissions.

Quantities for all SESRO size variants have been estimated, typically by prorating from 150Mm^3 variant quantities. These quantities have then been used alongside the rates from WRMP09 and WRMP19 with inflation to a 2020/21 cost base (as described in Supporting Document A-2 to the SESRO Gate 2 submission) to develop base capital cost estimates for all SESRO variants.

Quantity Estimates

At Gate 2, the bottom-up cost estimate is formed of approximately 300 cost items as set out during the WRMP09 and WRMP19 design development.

While there have not been significant adjustments to the overall layout for the 150Mm^3 scheme since the design development in WRMP09, quantity estimates for key components have been revisited. Examples include (but are not limited to):

- The volume of excavation of clay from the borrow pit and subsequent use of the excavated material as structural fill for the reservoir embankments is based on an updated model.
- The estimate of the volume for riprap and riprap bedding material (required for protection of the inner face of the embankment against wave erosion) is based on an updated assessment that takes wind modelling into account.
- Updates to the SESRO masterplan have resulted in changes to the alignments of the access road, the conveyance tunnel and the various watercourse diversions. Lengths of these components have therefore been updated for use in the Gate 2 cost estimate.

As well as updating quantity estimates for key components of the 150Mm^3 scheme, the quantities for the other SESRO size variants have been estimated for all cost items. For many components, quantities are the same regardless of the size variant, for example the access road, road diversion, the river intake / outfall structure and the pumping station. However, for other items quantities have been estimated for each variant, or scaled from the 150Mm^3 scheme, for example:

- The volume of excavation of clay from the borrow pit and subsequent use of the excavated material as structural fill for the reservoir embankments is based on high-level models for each SESRO variant.
- The volume of riprap and riprap bedding material has been estimated for the other SESRO variants by scaling the quantity for the 150Mm^3 scheme by the ratio of the inner face embankment area.
- The number of main inlet / outlet towers and secondary outlet towers varies for the dual phase SESRO variants.

Rates

As noted above, the bottom-up capital cost estimate originates from the design work carried out for the WRMP09 submission of the 150Mm^3 scheme, alongside adjustments made to some key items for the WRMP19 submission.

During WRMP19 the rates associated with the bottom-up capital cost estimate which were used in WRMP09 were brought to a 2017 cost base by inflating by 38.4% based on RPI (Retail Price Index).

To present the cost estimate in a 2020/21 cost base for WRMP24 and RAPID Gate 2 submissions, the rates have been inflated by a further 12.9%. The rate for inflation from the 2017 cost base to the 2020/21 cost base was based on inflation indices

provided from the Water Resources South East (WRSE) regional investment modelling.

The rates are also increased by a fixed percentage to account for client and contractor indirect costs. This includes, for example: design cost, construction management, and surveys / investigations.

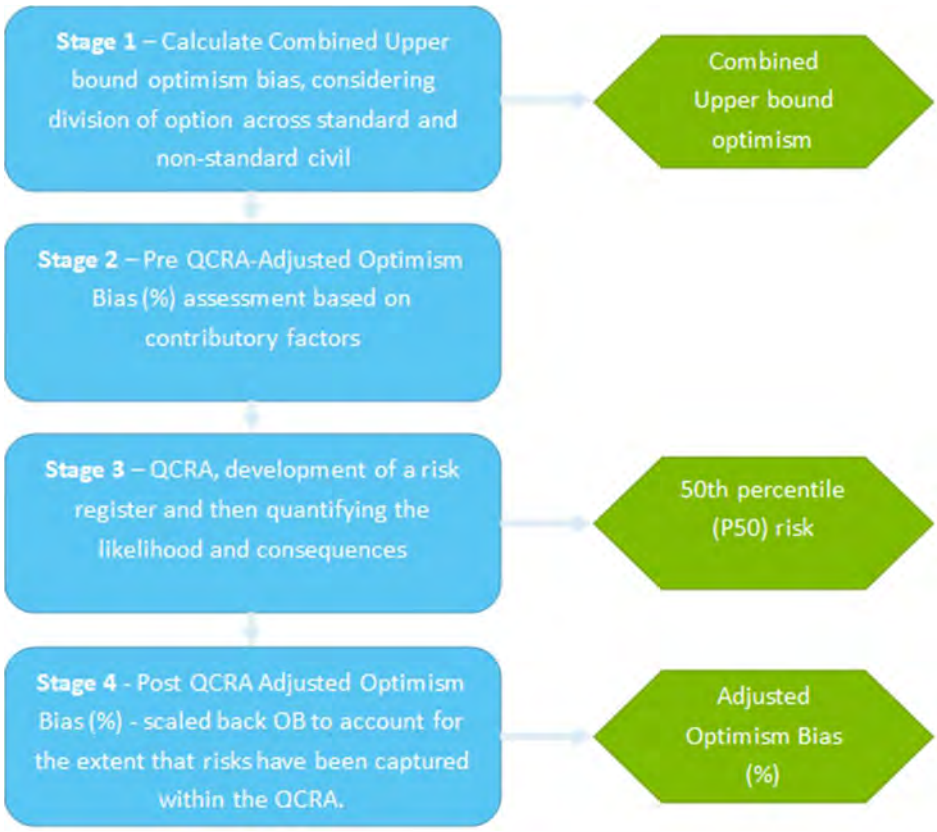
Benchmarking

At Gate 1 the capital costs for a selection of the items were benchmarked against independent cost intelligence. Over 70% of the principal items associated with the scheme were benchmarked. The capex costs for the options were found to be within 5% of the average benchmark costs.

The same approach to the bottom-up cost estimate has been used at Gate 1 and Gate 2, and therefore the benchmarking carried out at Gate 1 is still considered applicable to the Gate 2 cost estimate.

Optimism Bias and Risk

A consistent multistage approach (see figure below) to risk and optimism bias has been applied based upon the approach recommended by the HM Treasury Green Book.



Both Optimism Bias (OB) as a percentage of Capex estimates (excluding land costs) and costed risk have been assessed to cover the risk of cost increases that may occur during the development and delivery of the selected option. To ensure a

degree of consistency across the different SROs, guidance and a spreadsheet template has been issued across all SROs by a cross-company working group, for capturing the Quantitative Costed Risk Assessment (QCRA) and calculating OB.

Total Capex

Estimated Capex (2020/21 cost base) for 100Ml/d and 50Ml/d ADO alternatives are shown in the figure below, showing the split between base capex, optimism bias and costed risk.

Table 2 Capex, Opex, optimism bias and costed risk for the SESRO options (2020/21 prices)

Option Name	Units	150 Mm3	125 Mm3	100 Mm3	75 Mm3	30 + 100 Mm3	80 + 42 Mm3
Option Benefit	MLD	271	230	185	149	239	224
Capex (20/21 prices)							
Base Capex	£m	1,455	1,363	1,244	1,144	1,563	1,554
Costed Risk	£m	335	314	286	263	359	357
Optimism Bias	£m	406	380	347	319	436	434
Total Gate 2 Capex	£m	2,195	2,057	1,878	1,726	2,358	2,345
OPEX (20/21 prices)							
Gate 2 Fixed	£m/ annum	3.80	3.74	3.66	3.57	4.38	4.36
Gate 2 Variable	£/ML	10.06	9.52	9.11	8.03	11.10	10.28

NPV and AIC

Table 3 Summary of NPV and AIC for leading alternatives for SESRO (2020/21 prices)

80 year planning period costs and benefits	Units	150 Mm3	125 Mm3	100 Mm3	75 Mm3	30 + 100 Mm3	80 + 42 Mm3
Option Benefit (DYAA)	MLD	271	230	185	149	239	224
Option Benefit (DYAA)	Ml	1,587,370	1,344,286	1,121,504	906,438	855,567	1,131,941
Capex NPV	£m	1,398	1,316	1,230	1,137	1,240	1,341
Estimated Utilisation (38%) *							
Opex NPV	£m	67	65	65	62	63	72
Total NPV	£m	1,465	1,381	1,294	1,199	1,302	1,413
AIC	£/m³	0.92	1.03	1.15	1.32	1.52	1.25
Maximum Utilisation (100%) **							
Opex NPV	£m	76.907	72.829	71.152	66.645	68.117	78.671
Total NPV	£m	1,475	1,389	1,301	1,204	1,308	1,420
AIC	£/m³	0.93	1.03	1.16	1.33	1.53	1.25

Note * 38% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, based upon output of long-term water resources modelling. There is no comparative AIC for Gate 1 as these utilisation calculations were not available at Gate 1.

Note ** 100% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, and estimated maximum variable operating cost.

AMP8 costs – for preferred 100 Mm^3 option

AMP8 cost estimates are based on the assumption that the scheme(s) selected in the draft WRMP continue to be promoted at the same capacity and timing in the Final WRMP, planned for publication late 2023. If this changes, then the funding requirements may need to be adjusted accordingly, as alternative strategies may carry different implications on the option selection, scale or cost.

The estimated costs for AMP8 are derived on the basis of the programme presented in the Gate 2 submission, namely:

- RAPID Gate 3 submission at the end of AMP7 in January 2025
- RAPID Gate 4 submission in mid 2026
- DCO award by mid 2028, with land acquisition to follow in AMP8, Year 4
- Contract award and mobilisation to start in 2029 (AMP8, Year 5)

In accordance with the PR19 Final Determination for SROs, the costs to deliver the SRO project scope of work within AMP7 (Gates 1 and 2 and Gate 3) are considered included within the overall scheme capex estimate and associated planning and development costs. Hence, these are deducted from the estimated Planning and Development cost allowances to determine the AMP8 requirements.

The summary of the cost breakdown for Affinity Water is shown in Table 4 below. The data is inflated from the values quoted in the Gate 2 submission, which are 2017/18 for actual incurred costs and 2020/21 for capex estimates, using the standard PR24 inflationary factors noted below Table 4. Affinity Water share of the costs is calculated on the basis of 33% share of costs to RAPID Gate 4, based upon PR19 Final Determination allowance, and a 30% share of costs thereafter based upon the estimated share of resources from SESRO.

At present, due to the residual uncertainty regarding the procurement route for the SESRO project and the preferred route via SIPR, construction phase costs are not included in the AMP8 enhancement case, which is limited to costs up to DCO award.

The AMP8 costs are based upon an estimate of the costs required to deliver Gate 4 and associated DCO activities. To maintain continuity with PR19, the Gate 4 estimate is based on the PR19 Development Allowance. The remaining spend between Gate 4 and DCO award is estimated as being similar to the Gate 4 allowance as the timescales are very similar (G3 to G4 is estimated as 18 months to mid-2026, and G4 to DCO award is estimated as 21 months to Q1 2028) and scope of works of a similar magnitude. Accordingly, an allowance of £45M (2017/18 prices) is included, with a 30% share of this assigned to Affinity Water.

For context, the land acquisition and early construction activities that would be required in AMP8 are costed at just under £360M (2022/23 prices), of which Affinity Water's 30% share would amount to £107.9M.

Table 4 Summary of Affinity Water funding required in AMP8 (2022/23 prices)

Spend category / year	Capex (£M)	Comments / reference / source
Total capex	£633.64	Source: SRO Gate 2, Supporting Document A2: cost report
Allowance for Development and Planning to Gate 4	£38.50	Source: Gate 2 submissions to RAPID (expenditure profile)
Gate 4 to DCO award	£15.90	Source: Estimated spend for post Gate 4 activities, benchmarked to G4 allowance
TOTAL for AMP7 and AMP8	**£54.40**	
SRO costs to end AMP7		*Pre-feasibility studies, but included in Planning and Development costs overall, hence deducted from AMP8*
Gate 1	£0.59	Note: costs reported to RAPID in 17/18 prices, inflated here to 2022/23 prices for comparison with AMP8 forecast
Gate 2	£2.81	
Gate 3	£16.19	Source: SRO Gate 1 and 2, Main Reports
TOTAL	**£19.59**	
Proposed AMP8 profile		
Year 1	£9.46	RAPID Gate 4
Year 2	£9.46	RAPID Gate 4
Year 3	£15.90	DCO examination
Year 4		*Land acquisition - not included in AMP8 EC*
Year 5		*Mobilisation and construction start - not included in AMP8 EC*
TOTAL	**£34.81**	

PR24 inflationary factors:

- *RAPID Gate costs are inflated from 17/18 prices to 2022/23 using CPIH*
- *Capex, enabling and other costs are inflated from 20/21 prices to 2022/23 using CPIH*

	CPIH	*RPI*
2017/18 - Actual	*104.2*	*274.9*
2018/19 - Actual	*106.4*	*283.3*
2019/20 - Actual	*108.2*	*290.6*
2020/21 - Actual	*109.1*	*294.2*
2021/22 - Actual	*113.1*	*311.2*
2022/23 Forecast - CPIH is PR24 base Year price	*122.7*	*347.4*

Please note that the costs in the Business Case include all AMP7 carry over cost.

Benefit Estimation

The scheme is planned for commissioning in 2040. Therefore, no benefits will occur in AMP8, whether through water resource resilience, additional DO or environmental enhancement. However, once the scheme is commissioned, then benefits will be seen, in terms of water resource enhancement and the potential for environmental gain. The benefits analysis for the options is based around three key elements – the provision of water resource benefits, the calculation of the natural capital assessment and the socio-economic benefit of the scheme.

Water Resource Benefits

The water resource benefits of the scheme are outlined in Table 1. These benefits are built into the assessment of the options by the WRSE best-value planning process.

Natural Capital Assessment

Further details of the benefits assessment completed for the SESRO options may be found in the RAPID Gate 2 submission.

Overview

The Natural Capital Assessment (NCA) focuses on the changes to natural capital stocks and the benefits derived from the ecosystem services that they provide. The results of the NCA have been in translated into 'Natural Capital Metrics'. The approach enables the quantitative assessment and monetisation of various ecosystem services to show the benefits (positive) or disbenefits (negative) of each option, and hence comparison between them.

Based upon this assessment, the following key conclusions may be drawn:

- All SESRO options demonstrate an overall positive impact; the most substantial benefits are likely to come from the recreational and amenity value of the scheme.
- Based on central transfer values, the 75Mm^3 SESRO option is expected to yield the largest natural capital benefit. This is likely due the scaling of habitat types to estimate the future habitat baseline, which was underpinned by the assumption that smaller reservoir footprints allow a greater proportion of habitats to be created.

Carbon sequestration

The NCA analysis also includes an assessment of the impacts of the reservoir proposals on carbon sequestration. In qualitative terms, arable land is generally considered to be a source of carbon emissions rather than a sink. Each option involves a substantial area of land, particularly arable and horticulture, being taken out of agricultural use and partially replaced with land capable of sequestering carbon. Woodland is likely the most substantial carbon store and carbon sequestering habitat present. Net losses of woodland habitat are expected under each option, though the carbon impacts are likely to be counteracted by the

potential for the creation of new habitats, such as the substantial area of floodplain wetland mosaic and native species-rich hedgerow with trees.

Quantitative assessment and monetisation of the natural capital value of this change estimates that the present value benefit would be positive for each SESRO option. This increase is based on the conversion of arable land to habitats with a greater capacity for carbon sequestration, such as woodland, floodplain wetland mosaic and hedgerows. On this measure alone, the smallest SESRO option is predicted to provide the largest benefit, valued at £3.1M, and the largest SESRO option the lowest at £1.9M (central estimates).

Recreational benefits

A study into the potential conservation, access and recreational (CAR) opportunities for SESRO has been completed for Gate 2 (see Supporting Document B3: CAR). This outlines the process undertaken to identify and explore potential uses of SESRO beyond the basic supply of raw water for supply.

The CAR Strategy presents three potential future scenarios for SESRO (high, medium and low) which include different conservation, access and recreation options. The low visitor scenario would provide an attractive recreational asset enjoyed primarily by the local community, while the high scenario would be considered a tourism destination, which may attract visitors from further afield. At this stage of the RAPID Gated process the CAR Strategy has not identified a preferred scenario. However, the proposed scenarios are intended to influence the concept design of SESRO as part of the Gate 2 submission. We will develop the recreational uses of the site once the size of the preferred scheme is confirmed by WRMP24 and as we progress more local, community engagement on the specific design and use of SESRO.

Future studies will also include analysis of how each aspect could be funded, either direct by TW customers if considered a critical aspect for scheme consenting or else via other funding or partnering arrangements. These options have not yet been explored for Gate 2 whilst the scale and detail of the scheme is still being finalised.

Wider socio-economic cost and benefits assessment

The wider benefits (and disbenefits) assessed here include Economic Activity, Health, Education, Financial Asset Value and Customer Bills. The Six Capitals framework[4] is used for this assessment.

Further details of the methodology and outcomes of the assessment may be found in the RAPID Gate 2 submission (Section 10 of Supporting Document B2: Terrestrial Environmental Appraisal Report). The summary findings of this assessment are included in Table 5 below. Ultimately, the opportunities created at SESRO should lead to long-term benefits of a far greater magnitude than the short-term disbenefits. There will be significant employment, economic activity, education, and health benefits.

[4] Value Reporting Foundation, 2021. International <IR> Framework.

Table 5 Summary of SESRO socio-economic cost - benefit appraisal

Workstream	Key activities
Overview	SESRO will provide a broad range of long-term benefits in Oxfordshire, providing opportunities to improve physical health, access to STEM learning opportunities, provide employment and grow the local economy.
Employment	Employment provided by SESRO during the construction and operation will lead to further benefits for the economy through more jobs being created. ▪ 4,297 full-time equivalent employment years created by SESRO's construction ▪ 2,741 are estimated to be created through further economic activity. An estimated 56 jobs would be created in total due to SESRO's operation.
Gross Value Added (GVA)	The benefits to the economy in the form of additional employment can also be expressed in terms of GVA as it shows SESRO's contribution to the economy. An estimated £252m of GVA over 10 years construction is significant given the size of Berkshire, Buckinghamshire and Oxfordshire's construction sector.
Health and Wellbeing	The increased range of physical activities at SESRO will propose significant health benefits to the visiting population locally and in Oxfordshire. More people use SESRO than the existing site for physical activities and it would create a more inclusive and accessible environment. The net health benefit of SESRO annually equates to £3,117,000.00 which, over a 60-year period discounted in accordance with Green Book health guidance, equals £125,993,000.
Education	The education value of SESRO has been quantified in terms of the potential annual willingness to pay by educators to visit the facility with school children for STEAM field trips. This value should not be considered solely indicative of the total benefits of education, a much greater economic value will be felt with the long-term economy.
Cost of living	As the area has low levels of deprivation it is likely that only a small proportion of the population will be significantly affected by a change in cost of living. This can be addressed through targeted mitigation.
Local community disbenefit	From this assessment, it is expected that SESRO will generate some disbenefits for local communities. Potential short term disbenefits include disturbance to a small number of local businesses. However, initial desk-based investigation suggests that most of these could be relocated to a new site and operate as normal due to the nature of the businesses. Suitable compensation and mitigation packages will be developed for all affected. There is also a potential long term disbenefit of an increase to customer bills, which may affect Thames Water customers as part of securing future water supply.

Efficiency

At present, due to the early stage of the scheme design, there are limited efficiencies built into the scheme costing. We will be developing the cost efficiencies during the remainder of AMP7 and AMP8, as we develop the scheme design, including:

- Optimisation of the earthworks design, to minimise volumes of material to be moved and optimised materials handling;
- Optimisation of the wave protection arrangements, to minimise volumes of riprap stone protection required;
- Optimisation of the inlet tunnel and auxiliary drawdown arrangements to optimise the overall design to the most cost-effective and cost-beneficial combination of options;
- Consideration of rail delivery terminal and how materials handling could be optimised to reduce the cost, complexity and scale of this element of the temporary works; and

- Consideration of the inlet / outfall arrangements, to optimise tunnel costs and configuration.

The savings from these potential opportunities have not been quantified at this early stage in the design process.

Assumptions Made

The key assumptions associated with the need for the scheme and the size / timing are those inherent within the draft WRMP24, associated with future demands for water. These are not repeated here but may be found in the WRMP24 documentation.

The other key assumptions associated with the scheme capex are:

- Land values are based upon the indicative site selected in the SRO Gate 2 working solution, which will be subject to change as the site selection is reviewed and more detailed appraisal of the sites is completed at the next stage.
- The inlet and outfall capacity and pumping arrangements are defined by the environmental constraints imposed at Gate 2, based upon detailed liaison with the Environment Agency.
- Operational utilisation as per demand profile developed for Gate 2, which is derived from WRSE PyWR water resources simulation model.
- The water industry in the UK has developed specifications that have been agreed across water companies. These include the Civil Engineering Specification for the Water Industry (CESWI) and the Water Industry Mechanical and Electrical Specification (WIMES). Each Water Company has generated their own amendments to these documents. In the case of SESRO, it is the Thames Water amendments that will be applicable.

Uncertainties and Sensitivity Analysis

The key uncertainties identified at this stage are taken from the top 10 risks in the costed risk register for the preferred option (see SRO Gate 2, Supporting Document A2: Cost Report). The current risk register considers 75 different risks covering a range of different aspects of the scheme. Risks that contribute most significantly to the costed risk estimate are listed in Table 6 below.

Table 6 Summary of top 10 risks from base capex analysis (taken from SRO Gate 2 submission)

Aspect	Description
Reservoir Embankment	Poor weather conditions inhibit placement of fill to form the reservoir embankment.
Off-site compensation / On-site improvements	Biodiversity Net Gain (BNG) requirements result in a need for further onsite habitat creation and / or offsite land purchase.

Reservoir Borrow Pit	Excessive groundwater or surface water is encountered in the borrow pit excavation requiring extensive dewatering measures and works to dry out clay prior to placement.
Construction Plant	Use of low-carbon plant may cause a significant increase in rates used in the current capital cost build-up.
Material Delivery by Rail	Increased traffic on the railway line restricts ability to import construction materials by rail.
Inflation	Above-RPI inflation of key materials, particularly fuel for earthmoving plant.
Reservoir Embankment	The available clay in the borrow pit is less suitable for embankment construction than expected, requiring modification of the embankment design or processing of the clay.
Renewable Energy	More extensive renewable energy generation may be developed as part of scheme (above the currently included hydropower turbines).
Reservoir Embankment	Foundation of the perimeter embankment is weaker than expected requiring a modification to the section and increased cut and fill volumes.
Recreational Use	Recreation facilities are more costly than currently estimated.

Overall, as shown by Table 2 above, the total costed risk on the preferred 100 Mm^3 option is £286M (2020/21 prices).

Optimism bias of 27.91% is also included, based upon a standard SRO methodology, to account of unknown uncertainties, and then combined with costed risk and base capex to form the total capex estimate for the scheme. Overall, as shown by Table 2 above, the total optimism bias on the preferred option is £347M (2020/21 prices).

Sensitivity analysis has not been completed on this project. The option has been used within the WRMP24 options appraisal process, which is subject to various sensitivity and optimisation analyses to choose the draft WRMP24 reported plan.

Third Party Assurance and Audit Trail

All of the Gate 2 documents for the SRO have been through 'three lines' of assurance. 1st line assurance was provided by the consultancy teams who provided the technical reports and 2nd line assurance by member of the partner company teams from across Thames Water and Affinity Water.

3rd line independent technical assurance was completed by Atkins. This included assurance of the main Gate 2 document as well as all of the Supporting Technical Documents such as the concept design report, cost and carbon reports and environmental appraisal reports. Their formal assurance report provided part of the assurance evidence presented to secure Board level approval for the SRO Gate 2 submission.

Option Assessment

Commentary on the Economic Assessment

The economic assessment of the SESRO options has been undertaken within the Water Resources South East (WRSE) best value planning process, the methodology of which is published[5]. This approach assesses the best combination of options to meet the regional need for water in the south-east between 2025 and 2100, taking account of cost (including carbon), environmental metrics, resilience and customer preference. The draft WRSE Regional Plan selects the SESRO 100 Mm^3 option within the reported pathway (i.e. selected as preferred). This regional strategy is included within the draft WRMP24 reported pathway.

Various sensitivity analysis has been completed on this, looking at various alternative option configurations, which is all reported in Section 9 of the draft WRMP.

Preferred, Best Value, Option

The SESRO 100 Mm^3 option, providing resources to Thames Water, Southern Water and Affinity Water. This option provides a total of 185 Ml/d benefit, after 2040. Further discussion of the rational for the selection of the best value plan (and the benefits of this strategy over those rejected) may be found in the draft WRMP, sections 9 and 10.

Least Cost Option

The least cost option would be the 30 Mm^3 option. This is not selected by the WRSE draft regional plan as part of the best-value regional strategy.

Alternative Options

The alternative options are not selected by the WRSE draft regional plan as part of the best-value regional strategy.

Meeting Affinity Water's Outcomes

The preferred solution (100 Mm^3) forms part of the reported pathway in the draft WRMP24. Therefore, it is an integral part of maintaining the future supply demand balance and Security of Supply Index (SOSI).

[5] https://www.wrse.org.uk/media/sy1bu4to/method-statement-best-value-planning.pdf

Justification of the Preferred Option

The selected SESRO option is:

- Selected in the draft WRSE best value planning strategy to 2100 and draft WRMP24 reported pathway, for delivery by 2040
- A resilient supply of new water resources in the River Thames, which helps to ensure the provision of resources into the Thames to Affinity SRO transfer.
- Critical to maintaining Affinity Water's supply – demand balance helping manage the multiple pressures forecast from growth, climate change and loss of existing abstraction licences for environmental protection.

Delivery Considerations

Related Projects

- T2AT SRO – will use the source of water provided by SESRO for the transfer to Affinity Water, hence forms a critical dependency that is built into the delivery programme.

Delivery Risk Management

The top 10 risks that have been included in the development of the scheme base capex are listed in Table 6. In addition to this costed risk register, the SRO also maintains a register of major delivery risks, which are actively managed to ensure mitigation of risk. These are listed in Appendix 1 below.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

During AMP8, the scheme will still be under development and hence no benefits will be achieved. Benefits will accrue in the longer term, once the scheme is commissioned and operational.

The WRMP, once finalised and published, is subject to annual reporting and 5-yearly updates. The annual reporting will reflect any changes to the need for or feasibility of SESRO. Once developed and operational after 2040, SESRO would be incorporated into annual reporting of deployable output for the water resource zones within Affinity Water's Central Region.

The SESRO SRO is subject to regular reporting to RAPID. Gates 1 and 2 have been submitted (formal approval and assessment of Gate 2 is currently awaited). A timeline for Gate 3 has been agreed with RAPID. At this point, any changes to the need for the scheme or the timing of when it is required, as a result of consultation feedback on the draft WRMP, can be built into the future delivery programme for the scheme.

Supporting Information

- Draft WRMP24
- Draft WRSE Regional Plan
- SESRO SRO, Gate 2 Submission to RAPID

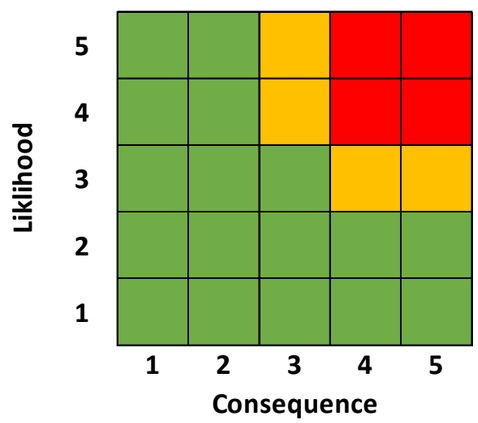
Appendix 1 – Summary of SRO risk register for SESRO

Summary of highest (pre-mitigation) risks within qualitative risk register and associated mitigation proposals

Details	Pre-mitigation Risk	Proposed Mitigation	Post-Mitigation Risk
Dependency between Final WRMP24 publication and statutory DCO consultation - Final WRMP24 should be published (or direction to publish received from SoS) before statutory consultation progressed for subsequent DCO.		Mitigated via proactive stakeholder engagement for WRMP24 and close alignment of the scheme need, timing and scale to Regional (WRSE) Plan and WRMP24. Current critical path programme analysis suggests that delay on final WRMP24 to Mar '25 will not delay subsequent DCO.	
There is a risk to hydromorphology and aquatic receptors due to the discharge effect from reservoir flow.		The effect of the discharge to be assessed through 1D and 2D hydrodynamic modelling and velocity analysis and continued development of design of abstraction / discharge structure to minimise localised impacts. Consideration of water quality management and mitigation for reservoir, informed by complex CFD and algal bloom predictive modelling.	
There is a risk in attaining WFD compliance in either the River Thames water body or the River Ock waterbodies.		Ongoing water quality and aquatic ecology monitoring; Hydrodynamic modelling and water quality assessment will help update mitigation strategy and WFD assessment, as appropriate	
Abstraction and discharge impacts from SESRO might have impacts on fish habitat and migration habits in the affected reaches		Ongoing water quality and aquatic ecology monitoring; Hydrological and water quality assessment and modelling; Continued development of design of abstraction / discharge structure to minimise localised impacts. Fisheries impact assessment at Gate 2 as explicit part of Aquatic Environmental Appraisal Report.	
Challenges in ensuring that scheme can deliver the required BNG.		Work completed for Gate 2 suggests that sufficient ditch habitat can be created on-site to manage this BNG risk without the need for off-site works, but to be confirmed as site baseline data is extended in next phase of works. Further assessment of BNG requirements will be required as scheme design progresses to determine exact length of linear terrestrial habitat required and incorporate into scheme requirements.	
Stakeholder perceptions on landscape impacts		Initial landscape and visual impact assessment, including close liaison with Natural England and North Wessex Downs AONB to ensure design sympathetic to AONB management strategy. Development of initial landscape and visual impact assessment for Gate 2 and build principles into Master Plan, in close liaison with OCC, VoWH and AONB landscape specialists.	
Failure to secure all of the powers and land rights sought in the DCO – which would render implementation more difficult at the very least.		The Book of Reference and Land Plans will be kept under regular review. A fully-articulated case will be made to justify the compulsory acquisition powers and land rights sought in the DCO.	
The DCO application is not accepted for examination.		Extensive pre-application engagements and consultation will be undertaken to pass the 'adequacy of consultation' test at the DCO acceptance stage. The DCO application will comprise a comprehensive array of documentation produced by experienced practitioners in accordance with relevant regulations including the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 and the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.	

* Assessment of risk in accordance with a standard 5 x 5 matrix of likelihood and consequence (red = high risk, amber = medium risk and green = low risk): Score of 1 is lowest for each category. Indicative definitions of likelihood and consequence listed below:

Score	Consequence	Likelihood
1	Negligible impact on project	Unlikely
2	Low or limited impact on project delivery or cost	Possible
3	Medium impact on project delivery or cost	Probable
4	High impact on project delivery or cost	Expected
5	Major impact on project delivery or cost	Definite



Affinity Water

Grand Union Canal (GUC) SRO

September 2023

Contents

Summary

The Thames to Affinity Transfer (T2AT) SRO is one of 17 national Strategic Regional water resource Option (SRO) projects that were funded in Price Review 2019, to meet the requirements of RAPID (an alliance of OFWAT, Environment Agency and Drinking Water Inspectorate). In simple terms, the scheme consists of a transfer of recycled effluent from Severn Trent Water's Minworth STW to Affinity Water's Central Region via the Grand Union Canal (GUC), with intermediate treatment and associated distribution into the Affinity Water network. A new pipeline and existing canal will be utilised to convey a source of raw water from Minworth STW *(this is a separate SRO project)* to Affinity Water. In the southern section of the GUC, water will be abstracted from the canal at Leighton Buzzard and treated – utilising a multiple barrier approach and final conditioning – prior to distribution to AfW customers.

At PR19 Ofwat announced a £469 million ring-fenced development fund for companies to investigate and develop strategic water resource solutions that benefit customers, protect and enhance the environment and benefit wider society. This funding provides companies with the ability and certainty to accelerate the development of solutions to be 'construction ready' for the 2025-2030 period; it encourages joint working, enables additional analysis where required and provides outputs with greater certainty than would be available without it. Delivery of these solutions is subject to a formal gated process where decisions are made on delivery penalties and solution funding progression. Affinity Water was funded in AMP7 for the work expected to be required in the delivery of Gates 1 – 4. The submission for Gate 2 was issued to RAPID on 14th November 2022.

The Gate 2 submission documented the feasibility, costs, environmental issues, planning strategy and procurement approach for a range of options for the conveyance and treatment of the scheme.

The GUC options are part of the feasible options set considered by Affinity Water in deriving their best value Water Resources Management Plan (WRMP24) and by the Water Resources South East (WRSE) in deriving their draft Regional Plan. A 'Best Value' water resource plan is one that delivers wider benefits to society and the environment. It considers a range of factors alongside economic cost in the identification of the preferred water resource programme that will form the basis of the plan. The development of a best value plan is promoted by the EA, Ofwat and Natural Resources Wales in the Water Resources Planning Guideline.

WRSE has carried out best value analysis to develop the Best Value Regional Plan. The Affinity Water WRMP is cascaded from and fully aligned with the WRSE Regional Plan, and so the same best value metrics have been considered in both plans. Best value metrics have been determined for the SRO scheme. The metrics considered in addition to cost and carbon emissions are Natural Capital (NC), Biodiversity Net Gain (BNG), SEA benefit, SEA disbenefit, resilience: reliability, evolvability and adaptability, and customer preference.

In the draft WRMP best value plan, 50 Ml/d of supply is required in 2031/32, with a potential requirement for a further 50 Ml/d by 2040 to 2050. This combination is

selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The GUC scheme therefore represents a critical part of the best value plan within Affinity Water's draft WRMP, ensuring that the supply-demand balance is maintained.

In order to facilitate efficient delivery of the scheme, the Gate 2 submission to RAPID recommends that work on the GUC scheme continue apace through AMP8. Gate 3 is therefore planned for 2024, Gate 4 in 2027 (after DCO award) with contract award and construction start in 2027, enabling scheme delivery by 2031. Therefore, investment is required in AMP8 to maintain momentum with the consenting and design of the project as well as for the initial years of construction, to ensure commissioning can be achieved by the required date in the draft WRMP of 2031/32.

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	3.25	3.25	3.25	0.00	0.00	**9.75**
Opex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Totex (£m)	3.25	3.25	3.25	0.00	0.00	**9.75**

Drivers	
100%	Strategic Regional Resource (Additional Driver)

Benefits
N/A

Economic Analysis			
NPV Costs (£m) (2025-55)	**8.3**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★	★ ★ ★	★	★ ★ ★		★

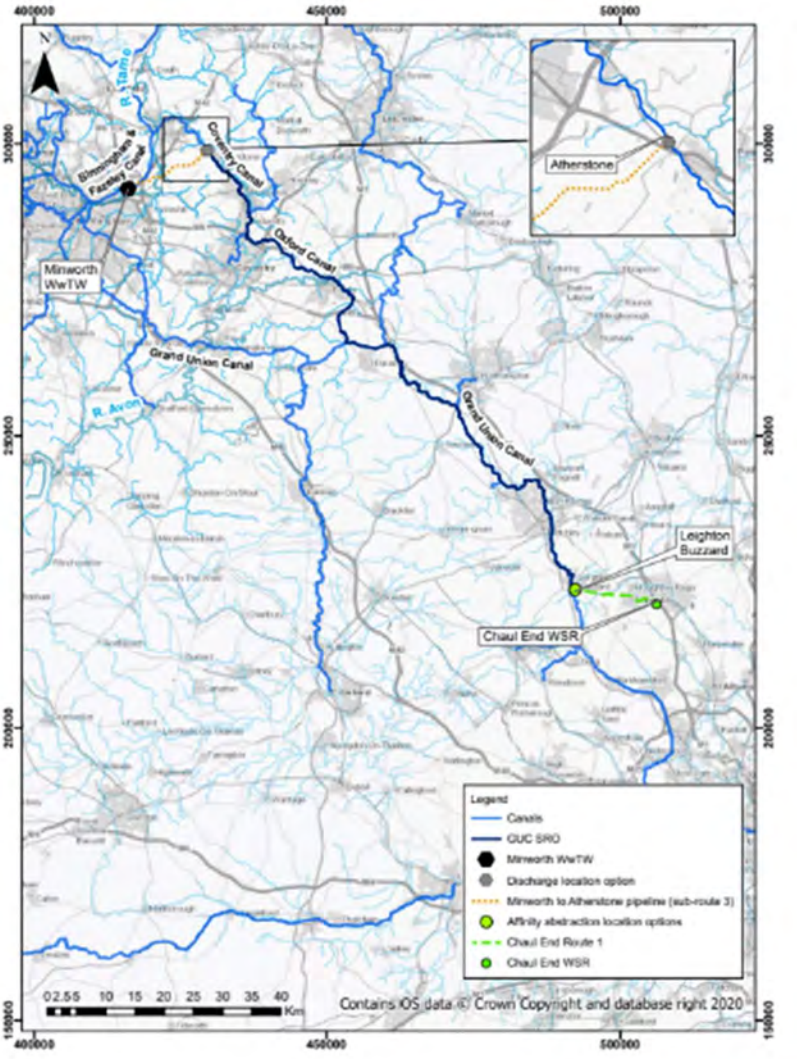
Project Description

A new pipeline and existing canal infrastructure - Coventry Canal, Oxford Canal and Grand Union Canal (GUC) - will be utilised to convey treated wastewater from Minworth SRO in STW's supply area to areas of water deficit in AfW's supply area. Water will be abstracted from the GUC and treated prior to distribution to customers. An overview of the scheme is shown in Figure 1 below.

The WRSE Regional Plan selects the GUC to meet the DO requirements of the region by 2031/32. The scheme has been sized and costed in two phases, each delivering 50 Ml/d of deployable output benefit. For the first 50 Ml/d, only 4km of canal bank and towpath will need to be raised out of a total canal length of 130km, with a further 50 km needing to be raised to accommodate the second 50 Ml/d.

The scheme has been sized for 57 Ml/d capacity to account for treatment process losses and AfW's limited treated water storage facilities, which means that summer demand must be managed without any raw water storage. Therefore a capacity of 57 Ml/d is required to provide an average ADO benefit of 50 Ml/d to AfW.

Figure 1 Scheme overview plan (source: GUC SRO, Gate 2 main report, November 2022)

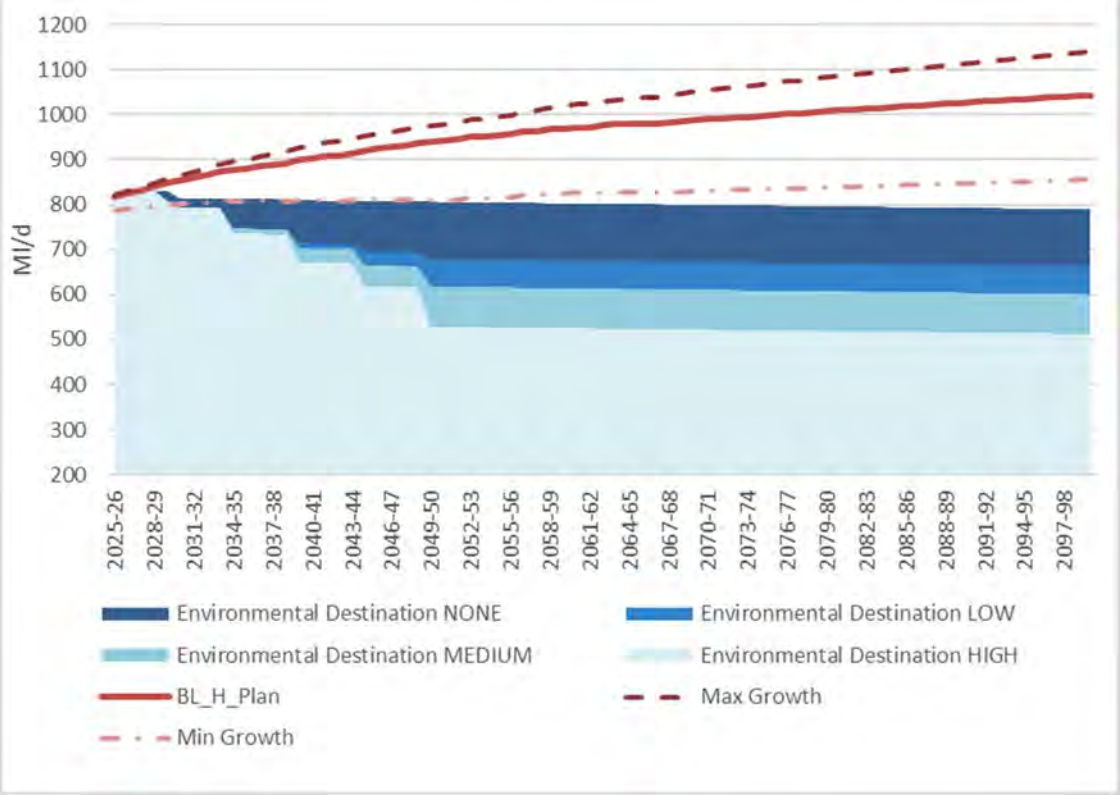


Project Development

Baseline Assessment

The draft WRMP24 (section 6) reports the baseline forecast supply-demand balance for Affinity Water. This represents the position in a 'Do Nothing' scenario. Figure 6.3 of the draft WRMP24 is reproduced in Figure 2 below, showing the forecast difference between available supply and projected demand for drinking water in Affinity water's Central Region (WRZ 1- 6).

Figure 2 Baseline supply demand and supply for Affinity Water Central region (Figure 6.3 from draft WRMP24)



This is further quantified in the draft WRMP24 as a range of uncertainty, depending on the extent of future growth and future reductions in existing abstraction licences that are required due to environmental pressures. Overall, this uncertainty is quantified as a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050.

This loss of supply needs to be met by a combination of new demand saving and water efficiency measures and by new supply-side options such as the GUC SRO.

Problem Statement and Stated Need / Driver

The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below. These are all analysed at regional level by WRSE and then translated down to Affinity Water for incorporation in the WRMP.

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[1]. The impacted companies have a statutory duty to plan for this level of future growth.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively. t
Improved drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved using drought orders and drought permits up to 2040, but reducing reliance on these measures thereafter.

These drivers for additional water supply are considered after the implementation of reductions to leakage and to water consumption, as prescribed by the Environment Agency's National Framework for Water Resources2. The framework requires a 50% reduction in leakage by 2050 and planning for a domestic water consumption of, on average, 110 litres per person per day by 2050, while also reducing non-household demand. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply.

Overall, the GUC options are part of the supply-side options set that could be used to meet the combined overall need across the south-east of England for an additional 1 billion litres of new water supply per day by 2040, increasing to a maximum of 2.6 billion by 2100 under the highest scenario. These needs drive the imbalance between available supply of water and projected future demands, and why supply-side improvements are required to achieve a supply-demand balance.

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline?msclkid=88cab670c08011ecb284fa54ecf9127d

[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources?msclkid=245c3d5bc08211ec8b961853f7da9bae

Risks, Issues and Requirements

The GUC SRO is a highly complex project. The key risks are noted below, with further information on risk management and mitigation available within the Gate 2 submission to RAPID.

- The scheme would be likely to be categorised as a Nationally Significant Infrastructure Project (NSIP) and hence consented through a Development Consent Order (DCO) under the requirements of the Planning Act 2008. This is a highly complex, and extensively regulated process, overseen by the Planning Inspectorate (PINS). Planning options for Minworth SRO, which will provide the source of water to the GUC SRO transfer, are given in the Minworth SRO gate two submission, and consider either a Town and Country Planning Act (TCPA) planning application or "associated development" as part of the GUC SRO DCO application. Associated development is the preferred option; however, the option of TCPA will be considered, provided that a benefit to both schemes can be identified.

- The DCO process requires extensive consultation ahead of consent application, including a Statutory Consultation process to be followed. Although the regulatory requirements of this are clear, the likelihood of objection and negative PR from affected stakeholders remains a risk to be actively managed.

- The scheme is likely to require the resolution of a number of complex and interrelated land issues, including:
    1. The northern section of the scheme, a 20km pipeline, is routed mostly through agricultural land and will transfer water from Minworth WwTW to the Coventry Canal at Atherstone and, via the Oxford Canal, into the GUC. Easement agreements will need to be negotiated and established to route the pipeline, with small areas of land acquired for a pressure-break tank along the pipeline route.
    2. The middle section, the GUC, owned by the Trust, provides a water transfer conduit to AfW's supply area. Most of the construction work will be contained within land under the Canal and River Trust's ownership.
    3. In the southern section of the scheme, abstraction and treatment facilities will be provided along with a transfer pipeline to the AfW water distribution network at Chaul End WSR. At the site for abstraction, approximately 4ha will need to be acquired for bankside storage, and approximately 7ha as a site for treatment. The connection from the canal to this area will require the installation of a pipe under the River Ouzel and will require an easement agreement. From the treatment works, an easement agreement will be required for the 18.8km rising main to transfer treated water to the existing AfW Chaul End WSR.

4. Agreements will be required with highway and rail authorities to route pipelines under their infrastructure.

A DCO can include powers of compulsory acquisition, which is particularly relevant for the GUC SRO, where there are multiple land interests. Land acquisition and easement requirements will therefore be incorporated within the DCO application for the scheme.

- The feasibility work completed thus far for RAPID has not identified any unresolvable planning or environmental constraints, but it is expected that the scheme would require formal Environmental Impact Assessment to support the consenting process. These gate two assessments have not identified any regulatory barriers that would stop the scheme progressing to gate three. There is a minor increased risk for the spread of INNS within the canal, due to increased flow, but it is deemed very unlikely that any INNS lifeforms could survive the treatment processes at Minworth WwTW to be present within the initial pipeline transfer to the canal. The construction and operational activities will incorporate best biosecurity measures into the design and operational protocol to avoid introducing any further INNS risk.

- In order to provide the most efficient procurement, the scheme will be split up into separate packages, to be delivered by different parties. This is explored further in the uncertainties section of the options assessment section, below.

Allocation of Costs

100% of the costs would be enhancement.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

For RAPID Gate 1, Affinity Water participated in a research programme coordinated by WRSE, involving nine water companies, to examine customers' understanding of water resources and the need for regional solutions. This coordinated approach ensured feedback was comparable across regions and solutions and was cost efficient. The research provided evidence on customers' understanding of the need for regional water resource solutions and the level of support for sharing water resources.

For RAPID Gate 2, Affinity Water's collaborative customer research[3] has progressed on the themes we identified at Gate 1:

- Firstly, exploring through the regional engagement what customers view as 'best value', how they weight those metrics and prioritise – enabling us to assess how different schemes 'perform' in terms of the customers' preferences.

- Secondly, looking at how we can make schemes more acceptable to customers, we looked to dive deeper on views regarding public value – exploring with customers what they mean by the term, their preferences, whether their views alter dependent on their proximity to the scheme and how much they would be willing to pay for a range of possible 'added value' options for a scheme.

- Finally, we looked how customers perceive, understand and ultimately how we need to engage customers when we change their source of water. We explored this immersively, including through taste testing.

Evidence of Customer Preferences

The key findings from the Gate 1 research were as follows, supportive of the progression of the GUC scheme as a leading option for Affinity Water, when carefully designed, managed and communicated to customers:

[3] We have undertaken an efficient and collaborative programme of customer engagement across several water companies to support the SROs. Where practical we have utilised regionally led work. For other areas we have formed 'club' projects with other SRO teams – maximising the expertise across the companies.

- Proposals to share water between regions are seen in a positive light by customers.

- Customers have firmly established views on the priority of transfer options: less favoured than both demand options and supply options such as reservoirs, which customers feel bring added value to the community. Customers are less willing to see water transferred out of their region if the recipients are more wasteful.

- Largely, transfers via river or canal are preferred to pipeline options because they are perceived by customers to have wider benefits and fewer negative impacts. However, customers do have various concerns about transfers, including cost, construction disruption, environmental impacts, energy use and lack of benefits to local communities.

For Gate 2, over 300 household customers were engaged to explore their preferences regarding the 'best value' criteria developed by WRSE. In general, customers place more weight on the delivery of secure supply of water, followed by cost of environmental improvements, with resilience placed on the lower end of the scale. The GUC SRO provides a secure supply of water, given the nature of the scheme.

The research project into public value was collaborative across 11 SROs. The key aims were to understand what preferences and added value our customers perceive is important, as part of infrastructure development. Of particular relevance to the GUC scheme:

- Customers told us that most feel that the principle of transferring water from areas of abundance to areas of scarcity 'makes sense' and assume that this system is already in place in the UK. However, there are some concerns that arise when customers learn about the potential for contamination during the transfer process.

- These concerns are also reinforced by the idea that water coming from other areas might be 'worse' than that which people are used to i.e., in quality or characteristics such as hardness.

- A minority of customers living in areas that are perceived as less water-stressed (e.g. rural areas outside London) have hesitations about sending 'their water' elsewhere. Despite this, Water Transfer is largely considered a sensible option.

- For the majority of customers, there is a particular lack of clarity around infrastructure requirements for transfers – it is unclear what type of infrastructure will be involved (e.g., canals, pipes, rivers) and how much new

infrastructure will be required, which also makes it difficult to estimate the disruptive impact on local areas and natural environments.

- The willingness-to-pay surveys undertaken show that customers see value in opportunities to incorporate low-cost benefits associated with schemes similar to the GUC SRO, such as facilities for walkers, cyclists and kayakers, that provide access to exercise, fresh air and mental health benefits. In addition, customers see the potential for environmental additions such as habitat creation for wildlife, and appreciate the limited disruption associated with utilising existing infrastructure. The outcome of these surveys will be used to inform subsequent design stages in gate three onwards.

The research study into customers' views on changing their water source was also collaborative across 11 SROs. 1,400 customers and 200 non-households were engaged during the quantitative phase.

- Customers say they are unlikely to engage with communications on source change, and taste tests indicate that most are not able to detect differences at the level that might be expected in a source change. However, there is still a need to communicate to explain the rationale for the change, alleviate taste concerns and provide clear guidance on the impact.

- The product sample tasting reassured customers that water transferred from other areas will not necessarily taste noticeably different.

The outputs of the customer work have fed directly back into the technical teams to help prioritise and develop the design of the scheme for gate three as it moves forward.

Partnering

Collaboration and Partnering

Engagement with Stakeholders and Partners

We developed our approach to engagement in line with RAPID's guidance for gate two (August 2022). We have built on the foundation of stakeholder and customer feedback received prior to gate one, activity completed through gate one, the representations made to RAPID at gate one, and direct feedback from RAPID and other regulators.

To ensure clarity, consistency and efficiency of the engagement activity with our customers and stakeholders, we have coordinated the engagement regarding SROs with that on Regional Plans, company WRMPs and company 2024 price review (PR24) Business Plan submissions. This approach to customer and stakeholder engagement activities has ensured there is a flow of insight through the process, as illustrated in Figure 3 below.

Figure 3 Insight flow from customer and stakeholder engagement

We are committed to working openly and transparently, and have sought to achieve this by:

- Sharing information and providing regular updates to stakeholders on the programme of work and the studies underway, giving them the opportunity to comment.
- Working with regulators and stakeholders as part of the technical working groups to jointly define the scopes of work and technical methods, and to provide the outputs for technical assessments for review and challenge at an early stage of work.
- Engaging with stakeholder organisations with specialist technical knowledge or a specific interest, to share relevant information and provide opportunities to input to the work.
- Engaging with a wide range of stakeholder organisations to develop the plan for our long-term future water supply and the potential solutions at a formative stage of development of the plan, listening to feedback and taking it into consideration.
- Raising awareness around the challenge for water resources, the planning process and opportunities to shape long-term plans at a formative stage.

Engaging Stakeholders

The engagement approach through gate two has three main parts:

- Activity to inform the development of the WRSE Regional Plan to ensure stakeholders understand how GUC SRO, and other SROs, fit within the strategic planning framework.

- Engagement with regulators and strategic stakeholders on the scheme itself to inform the feasibility assessments and conceptual design of the scheme.

- Early engagement more locally: engaging the neighbouring local authorities along the canal, engaging Historic England and Highways England, and beginning to build a relationship with canal users.

Our engagement has been embedded throughout gate two, building on the gate one engagement with regulators and strategic stakeholders. It comprises meetings with regulators, the establishment of topic-specific technical working groups, one-to-one sessions, and activity to support WRSE and wider company engagement. The outputs and review comments have been used to shape the scope, assessment and initial mitigation measures developed for the preferred option at gate two.

Quarterly update meetings have been held with RAPID to discuss the programme, outputs, risks and issues. We have also hosted a visit along the canal route for RAPID and other interested stakeholders to help visualise the scheme.

Five technical working groups have been set up to enable collaborative working with regulators and stakeholders with specialist knowledge or a defined stake in the topic. The activity has included sharing data, discussion and agreement on the

scope of work and methodologies for technical assessment, and review and challenge of outputs.

We have also carried out one-to-one specialist engagement, including:

- Two workshops with the Canal Users Group (January 2022 and July 2022), a group of representatives of the different users of the GUC, such as boating, fishing, canoeing and wider environmental groups. We explained the work underway, heard their concerns, and set out the further activities and plans for engagement.

- Two key planning-led workshops (December 2021 and July 2022), including all the local authorities along the route and at the potential treatment works site, Historic England, and National Highways. At the workshop, we shared the screening methodologies used to shortlist route options, and explored participants' concerns.

Co-design and Co-delivery

Of particular relevance to the GUC SRO is the need to collaborate closely with the stakeholders associated with the supply of water into the transfer (namely Severn Trent Water at their Minworth STW) and those associated with the ownership and management of the canal system that will transfer the water (namely the Canal and Rivers Trust).

These partners have been integral to the development and assessment of the scheme options, the selection of the preferred option and the development of the proposed delivery strategy.

Based on the results of the procurement assessment that has been completed for RAPID Gate 2, we propose the following parties deliver each element of the preferred scheme:

- **Atherstone Transfer:** Given its size and interface with the Minworth WwTW, the delivery of the works should be considered alongside the delivery of assets comprising the Minworth SRO, and is best delivered by STW through a D&B contract, as part of the Minworth WwTW expansion to supply the GUC SRO.

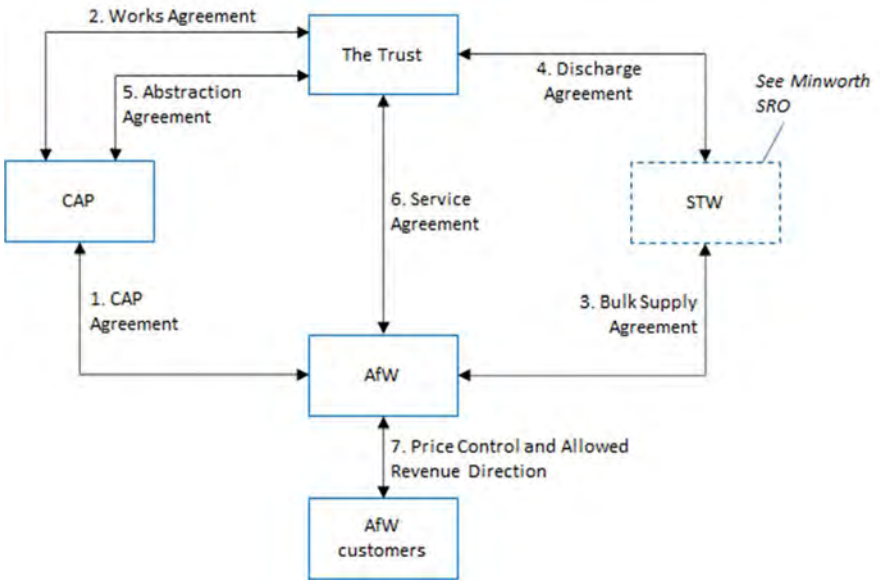
- **Southern Assets:** With the Southern Assets considered suitable for DPC and Affinity water being the sole beneficiary of the water, we recommend that Affinity Water be the appropriate contract counterparty for this Competitively Appointed Provider (CAP) award.

- **Canal enhancement works:** While the Canal and Rivers Trust will be required to operate the assets in order to meet its obligations to all users of the canal network, they may not be best placed to finance the construction works. As the CAP is specifically established to raise competitive finance, it may be better placed to fund the works. The CAP may also be best placed to undertake the works using its own contractors, which would help in

coordinating completion and ensure appropriate liquidated damages are available in the event of a delay. Such an arrangement would need to be tested through market engagement.

On this basis, we have conceptualised co-delivery of the scheme into a series of linked agreements. These are described below and illustrated in Figure 4, based on the delivery parties identified above.

Figure 4 Indicative contract structure



The principal purpose of each contract would be:

1. **CAP Agreement**: Sets out the services the CAP will deliver, and the basis on which they will be paid. The payment amount will be based on the bid during the competitive procurement process. Should the CAP be undertaking the construction work on the canal, the payment will be sized to include any associated funding costs.
2. **Works Agreement:** To allow the CAP to undertake work on canal assets, it will require the Canal and Rivers Trust to provide access, approve work risk assessments and method statements and provide permits to work. The agreement would also set out the basis on which the assets are transferred to the Trust on completion.
3. **Bulk Supply Agreement (BSA):** Any BSA between AfW and STW could be modified to include the provision of the capacity at Minworth WwTW and the Atherstone Transfer, alongside any payment for the water resource.
4. **Discharge Agreement:** Provision for STW to discharge water into the canal network, subject to the Trust's operational requirements, including coordination with the CAP's Abstraction Agreement.
5. **Abstraction Agreement:** Provision for the CAP to abstract water from the canal network, subject to the Trust's operational requirements, including coordination with STW's Discharge Agreement.

6. **Service Agreement:** Sets out the service the Trust will provide once it receives the assets from the CAP and the basis on which it will be paid (for the operation and maintenance, as the construction cost is recovered under the CAP Agreement).
7. **Price Control and Allowed Revenue Direction:** AfW would look to recover all the costs of the scheme from customers. While certain costs may be recoverable through the standard price control, other cost (in particular the CAP costs) would be recovered under an Allowed Revenue Direction granted by Ofwat.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

This scheme is a key part of the draft WRMP reported pathway, hence integral to the best value plan which was issued for consultation in November 2022. This plan is built upon 9 adaptive pathways. The first phase of GUC SRO is selected in 2031/32 with the second phase between 2040 and 2050, hence integral to the future management of uncertainty in the supply-demand balance across a range of possible futures.

WRMP Adaptive Strategy

In order to help manage the uncertainty associated with the second phase of the GUC SRO and to help maintain future adaptability and scalability of the scheme, various measures are built into the concept design, including:

- Planning for a 57 Ml/d scheme, with a potential increased of a further 57 Ml/d in the future, will entail the construction of transfer structures with capacity for 115 Ml/d scheme during the first phase. Additional mechanical and electrical equipment will be installed in the future when required.

- Canal bank and towpath raising will be constructed to meet phased requirements.

- The scheme will be designed in phase 1 for 115 Ml/d capacity, and land requirements for the 115 Ml/d scheme will be procured in the first phase.

- Modular works construction will be adopted for the treatment facilities to enable simple future expansion.

Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

The options appraisal process was carried out for the three sections of the scheme: the northern section transfer between Minworth STW and the canal, the middle section of the canal and the southern section, looking at options for abstraction and treatment.

In the northern section of the scheme, water from Minworth Wastewater Treatment Works (WwTW) will have received enhanced treatment and been transferred to the canal as part of Minworth SRO. Three transfer route options were shortlisted in gate one, and further appraised for gate two. The appraisal of alternatives took account of economic and carbon costs, environmental risks and overall efficiency of use of materials.

In the middle section, the canal network owned by the Canal & River Trust (the Trust) provides a water transfer conduit to AfW's supply area. The majority of the flow along the canal will be by gravity; however, a number of pumping stations are required.

In the southern section of the scheme, three possible locations for abstraction and treatment facilities were shortlisted. For the selection of the abstraction site, nine options were considered at Gate 1. Following appraisal, four options were taken forward for further consideration at Gate 2. These four potential abstraction locations were assessed alongside options for a transfer route into a suitable 'hub' for connection to the AFW distribution network.

The selection of the route option and site for abstraction and treatment were based on a set of criteria including engineering and design, construction risk, environmental and societal impacts, cost, and programme and wider benefits. The comparative assessment of options was qualitative, but considered a breadth of factors during construction and/or operation to allow differentiation between options. These factors include:

- **Engineering and design:** Potential to minimise material uses, hydraulic efficiency, construction risks and constructability issues, relative resilience to climate change, and the ability to accommodate mitigation measures.

- **Environmental impact:** Relative potential risk to sites with environmental and/or heritage designations, relative embedded and operational carbon for each alternative, and flood risk.

- **Social impact:** Impact and disruption to local communities, impacts on users of the canal network, and impacts on non-motorised users such as walkers, cyclists and equestrians.

- **Cost:** A comparison between the relative estimated costs for the alternative options.
- **Programme:** A comparison between how each of the alternative option might impact on the programme, considering their relative ease of construction

- **Value:** An initial review of opportunities to provide potential wider environmental and social benefits, considering how opportunities could align with national and regional policies and strategies.

Further information on the options assessment completed may be found in Annex A1.2 (Transfer Route Selection) and Annex A1.1 (Abstraction Site Selection) to the GUC SRO Gate 2 submission.

Selected Options

Do Nothing, Option 0

This is not considered a viable option, due to the nature of the planning problem to be solved. The WRMP and the retention of an acceptable Security of Supply Index are statutory obligations.

Preferred, Best Value, Option 1

The preferred option was identified through the options appraisal undertaken for gate two. It consists of:

Northern section: transferring flow from Minworth STW via a new pipeline over a distance of approximately 20km to a discharge point into the Coventry Canal at Atherstone.

Middle (canal) section: Majority of scheme under gravity flow, but seven pumping stations will be required to bypass "uphill" locks along the route, as well as eight by-passes to "downflow" lock flights.

Southern section: During gate two, a preferred option has been selected at Leighton Buzzard, with a transfer route to the AfW supply network at Chaul End Water Supply Reservoir (WSR). The decision to select this site was supported through engagement with the Environment Agency (EA).

At the abstraction point, the scheme will include a structure for removing water from the canal, storage, treatment and pumping facilities, followed by a transfer pipeline connection to the AfW network.

Least Cost Option 2

The preferred option is also the least cost option.

Alternative Option 3: alternative options for northern section

The alternative options considered for the northern section were:

- Route 1, which is a canal based option and has a small opex increase because flow is only lifted over a low head compared to alternative pipeline options
- Route 6, an alternative pipeline configuration into the canal network.

Alternative Option 4: alternative options for southern section

The alternative options considered for the southern section were abstraction and treatment facilities at:

- Tring
- The Grove
- Hemel Hempstead

These were all rejected as they were less cost effective once the interactions with the existing Affinity system were considered, and were deemed unacceptable by the EA Herts & North London area due to the potential for interaction with the River Bulbourne.

Option Assessment Approach

Economic Assessment

The economic assessment compared capex, opex, net present value (NPV) and took account of optimism bias (OB). The three leading northern transfer options and the four leading abstraction and treated water transfer main options were all costed for comparison.

Cost Estimation

The costs of the northern transfer options are shown in Table 1. The costs of the southern abstraction options (including treatment and the preferred treated water transfer main routing for each) are shown in Table 2, in 2020/21 cost base. Costing for option selection has been based upon cost curve data, with an overall OB percentage applied. All figures are rounded to the nearest multiple of 10. These figures exclude third-party OPEX prices for Minworth WwTW source water and the Canal and River Trust's assets.

Table 1 Comparison of options – Transfer route selection

Description	Units	Route 1[(1)]		Route 3		Route 6	
Option	Ml/d	57	115	57	115	57	115
CAPEX	£ (million)	160	250	100	180	290	350
OPEX[(2)]	£ (million)	300	320	230	480	670	830
NPV	£ (million)	230	330	160	290	420	540
NPV + OB	£ (million)	300	420	200	370	540	690

Notes:

(1) Route 1 is a canal based option and has a small opex increase because flow is only lifted over a low head compared to routes 3 and 6, which are pipeline option with greater head loss.
(2) OPEX calculated over 80 year period.

Table 2 Comparison of options – Site for abstraction, treatment and transfer

Description	Units	Leighton Buzzard		Tring		The Grove		Hemel	
Option	Ml/d	57	115	57	115	57	115	57	115
CAPEX	£ (million)	90	140	110	160	120	180	110	160
OPEX	£ (million)	540	680	570	1020	610	1160	580	1070
NPV	£ (million)	230	310	260	430	280	490	260	440
NPV +OB	£ (million)	310	410	340	570	380	650	340	580

Comparison of Options

Table 1 and 2 give net present value (NPV) summaries for the flow transfer and treatment options respectively for 57 Ml/d and 115 Ml/d schemes.

- The lowest overall cost for transfer is route 3, a transfer pipeline from Minworth WwTW to the canal at Atherstone.

- The lowest overall cost for abstraction, treatment and transfer is for a site at Leighton Buzzard, with a transfer pipeline to Chaul End SR.

Benefit Estimation

For the AMP8 period (2025 – 2030) the scheme will not deliver any direct benefits, as it is not scheduled to be commissioned until 2031. However, when completed the scheme will deliver a combination of water resource benefits, natural capital enhancement and recreational benefits, all realised during subsequent AMP periods.

Water resource benefits

Capacity requirements and utilisation profiles have been used by AfW to establish that the scheme will improve the ADO of the AfW system by providing a drought-resilient supply source of 50 to 100 Ml/d ADO that could be used year-round. This spare capacity can be utilised when demand increases or supply is lost, which means that new sources of water will only need to be fully utilised during the summer.

The scheme has been sized to take account of AfW's limited water storage facilities and to provide for any losses during the treatment process.

The scheme in the first phase will convey a year-round operational minimum turnover flow of 14 Ml/d (25% of 57 Ml/d) rising to 28 Ml/d in the second phase. At capacity, the scheme will deliver up to 100 Ml/d of new water supply to Affinity Water.

Customer benefits

The recommended treatment train is conservative in nature, with several layers of treatment to deliver a secure and wholesome supply of water.

The major positive resilience effects are identified in respect to climate change adaptation, as this scheme supports the provision of additional water resource to AfW. The scheme will assist the reliable transfer of water, reducing vulnerability and improving resilience to drought risks associated with climate change. This enhances AfW's resilience not only to drought events, but also to operational issues such as pollution or major outages, given this will be a new strategic import to the region.

The scheme reuses existing canal assets and therefore minimises construction and use of new materials, as well as delivering at a cost that is acceptable to customers.

Environmental and recreational benefits

There are opportunities at many locations along the canal to provide wider benefit to the environment and local communities and canal user groups. Advantage could be taken of remediation and upgrading work along the route to improve interaction between the canal and the wider environment, such as:

- Additional wetland habitats that enhance the environment and provide operational benefit to the scheme (e.g. around managing surge flows and weir discharges). These have the potential to provide flood alleviation, habitat creation, the introduction of rare plants and reedbeds, and realignment of the river channel.
- Protection and restoration of Priority Habitats (existing habitats of principal importance) and mitigation of carbon impacts, such as a series of wetland ponds, open mosaic habitats, living boundary wall and buffer planting, reedbeds, bird and bat boxes, and public access creation.

There are a number of improvement opportunities identified along the transfer route that could provide environmental and/or societal benefits as part of the GUC SRO engineering works. Seven case studies for improvements were created for the SRO Gate 2 submission, but each of these could be applied at many locations along the transfer route. These case studies have looked at a wide range of options, including improving the natural environment in the vicinity of the canal, making the canal more accessible for recreation, and renewable energy generation. One example is at the River Tove Lock Flight:

- At the River Tove Junction, there is a series of five locks that drops the water level of the canal by approximately 12m. To maintain safe operation of the locks, the transfer flow will bypass the locks by gravity pipework. The bypass is approximately 680m long.
- The canal has multiple side overflow (waste) weir connections to the River Tove, a sensitive but modified river (with culverted and straightened channel sections). During dry weather, the weirs do not operate but can collect large amounts of debris, floating vegetation and algae. During flow surges on the canal (e.g. from storm water inflows, upstream lock operations, etc.) this debris and lower-quality canal water is discharged into the river. The water level is expected to rise at this location by 20mm. The canal improvements will ensure no extra water is lost through the overflow weirs and could also create aquatic habitat through construction of buffer ponds, improvement of ecological status by capturing soil and algal build-ups, and power generation at the overflow points to help power locks.
- There are opportunities to take advantage of the construction works proposed to improve the interaction between the river and canal, and introduce additional wetland habitats that both enhance the environment

and provide operational benefit to the scheme (e.g. around managing surge flows and weir discharges).

- There is the potential to provide the following along the sections of the canal improved by the proposed scheme:
  - Flood alleviation.
  - Habitat creation.
  - Introduction of rare plants.
  - Reedbeds.
  - Realignment of the river channel.
  - Footpath creation.
- By providing these improvements, there would be a significant increase in biodiversity compared to the current conditions at the site. This initial improvement could then become the focus of further improvements in the future.

Societal benefits

There are opportunities at some locations to improve the functioning of the canal for boat users and other canal users.

Significant, long-term benefits of the scheme include the cleaning up and reuse of a valuable resource in the Minworth WwTW effluent, improvement of the water quality in the canal due to the injection of a high quality water and the resulting increased velocity and oxygenation, and the reuse and upgrades to the existing Grand Union Canal, which will extend the life and improve performance of this valuable heritage asset.

Efficiency

As can be seen in subsequent sections, the phasing of the scheme delivery is the main opportunity for efficiency. As the scheme is required in two phases, in accordance with draft WRMP, efficiencies can be derived through the phased delivery of different aspects of the scheme. As discussed below, we believe that a capital efficiency of approximately £90M is available if we construct the scheme with the full civil engineering requirements built to full capacity in phase 1 but the M&E requirements developed in two phases.

This approach will result in moderate additional spend into AMP8, but is more efficient overall. We do not think that the optimum solution is to develop the full capacity in phase 1, as there is a high degree of residual uncertainty with the final timing and capacity of Phase 2. This is driven by uncertainties with the delivery of other schemes and the success of the water efficiency and leakage strategies. If a proportion of the scheme is retained until a second phase then it can be adjusted in the future to suit detailed needs at the time of delivery. However, full construction of the main civils works in phase 1 is more efficient, despite this uncertainty.

Assumptions Made

Engineering and design assumptions may be found in Annex A1 (Engineering CDR) of the GUC SRO Gate 2 submission.

Uncertainties and Sensitivity Analysis

Treatment uncertainty

There is uncertainty around setting the requirement for the level of treatment to water from Minworth WwTW into the canal, with resulting cost uncertainty. This is a Minworth SRO risk, and is discussed in detail in the Minworth SRO gate two submission. Minworth SRO is working closely with the EA to resolve this uncertainty. This uncertainty is addressed by AFW through sensitivity modelling of the draft Regional Plan by WRSE.

Environmental uncertainty

There is potential for increased movement of Invasive Non-Native Species (INNS) from the northern section of the canal, due to increased flow. We are monitoring to understand the current prevalence of INNS, and carrying out pathway-based risk assessment as part of the ongoing SRO programme. The findings from this work will be used in gate three to propose ways of reducing the potential for INNS movement.

There is potential for increased flow in the GUC to cause mobilisation and transport of sediment from the base of the canal. Investigations in gate two have concluded that bed-level sediment will not be mobilised. During gate three, we will carry out further investigation into the chemical content of weak uppermost deposits and their potential for mobilisation.

Land uncertainty

The northern section of the scheme, a 20km pipeline, is routed mostly through agricultural land and will transfer water from Minworth WwTW to the Coventry Canal at Atherstone and, via the Oxford Canal, into the GUC. Easement agreements will need to be negotiated and established to route the pipeline, with small areas of land acquired for a pressure-break tank along the pipeline route.

The middle section, the GUC, owned by the Canal and Rivers Trust, provides a water transfer conduit to AfW's supply area. Most of the construction work will be contained within land under the Trust's ownership.

In the southern section of the scheme, abstraction and treatment facilities will be provided along with a transfer pipeline to the AfW water distribution network at Chaul End WSR. At the site for abstraction, approximately 4ha will need to be acquired for bankside storage, and approximately 7ha as a site for treatment. The connection from the canal to this area will require the installation of a pipe under the River Ouzel and will require an easement agreement. From the treatment works,

an easement agreement will be required for the 18.8km rising main to transfer treated water to the existing AfW Chaul End WSR.

Land referencing will consist of examination of sources of information from Land Registry and various data searches, to identify people with an interest in land, to establish any areas of concern, and to understand the number of ownerships and whether there are any obvious issues.

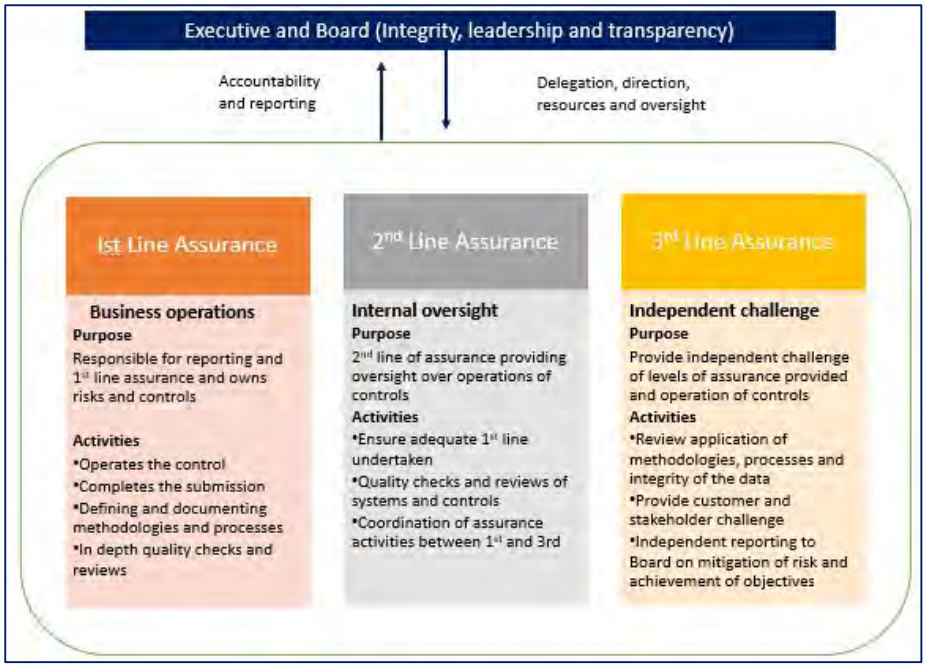
Agreements will be required with highway and rail authorities to route pipelines under their infrastructure.

A DCO can include powers of compulsory acquisition, which is particularly relevant for the GUC SRO, where there are multiple land interests. Land acquisition and easement requirements will therefore be incorporated within the DCO application for the scheme.

Third Party Assurance and Audit Trail

The assurance framework used for the GUC SRO Gate 2 submission has been developed jointly by STW and AfW. The risk-based assurance approach is consistent with that documented in the individual companies' statements of reporting risks, strengths and weaknesses, and our Business Plan for 2020 to 2025 (Appendix 11[4]), and is based on a shared understanding of the "three lines of assurance" model shown in Figure 5. It is also consistent with the assurance requirements laid out in Ofwat's Company Monitoring Framework[5].

Figure 5 Our risk assessment and assurance approach



[4] AfW: https://www.affinitywater.co.uk/docs/corporate/plans/appendix-11-governance-and-assurance.pdf
[5] The latest iteration of the Company Monitoring Framework can be found on the Ofwat website: http://www.ofwat.gov.uk/publication/company-monitoring-framework-final-position/

This approach provides an effective programme of assurance which considers areas that we know are of prime importance to our customers and regulators, or may have a significant financial value, alongside the likelihood of reporting issues. Areas of higher risk receive three lines of assurance while other areas, where the risk is lower, receive first- and second-line assurance only.

Following a competitive tender, we appointed an external assurer for our SRO Gate 2 submission. The third-line assurance statement confirms that the assurer is satisfied that, on the basis of the evidence presented and the limitations and scope of the assurance activities, the submission is suitable for progression through gate two. A board statement is supported by the assurance statement, and there were no outstanding material issues to be resolved prior to gate two submission.

We continually look to improve our assurance approach and will conduct a lessons-learned exercise before we finalise our assurance approach for the next stage of the SRO: gate three.

Option Assessment

Commentary on the Economic Assessment

WRSE Best Value Planning

The economic assessment has provided a means to select the preferred option for the GUC scheme. The benefits are largely similar across all options, and they could all deliver similar enhancement to average DO. Hence, the cost appraisal, combined with an assessment of environmental risks and carbon costs, provides the key differentiator between the options.

The preferred GUC options were assessed as part of the best-value framework applied by WRSE to select the draft best value regional water resources plan for the south east of England.

The GUC options are part of the feasible options set considered by Affinity Water in deriving their best value Water Resources Management Plan (WRMP24) and by the Water Resources South East (WRSE) in deriving their draft Regional Plan. A 'Best Value' water resource plan is one that delivers wider benefits to society and the environment. It considers a range of factors alongside economic cost in the identification of the preferred water resource programme that will form the basis of the plan. The development of a best value plan is promoted by the EA, Ofwat and Natural Resources Wales in the Water Resources Planning Guideline.

WRSE has carried out best value analysis to develop the Best Value Regional Plan. The Affinity Water WRMP is cascaded from and fully aligned with the WRSE Regional Plan, and so the same best value metrics have been considered in both plans. Best value metrics have been determined for the SRO scheme. The metrics considered in addition to cost and carbon emissions are Natural Capital (NC), Biodiversity Net Gain (BNG), SEA benefit, SEA disbenefit, resilience: reliability, evolvability and adaptability, and customer preference. Further details of the best-value planning framework can be found on the WRSE website: https://www.wrse.org.uk/media/sy1bu4to/method-statement-best-value-planning.pdf

In the draft WRMP best value plan, 50 Ml/d of suply is required in 2031/32, with a potential requirement for a further 50 Ml/d by 2040 to 2050. This combination is selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The GUC scheme therefore represents a critical part of the best value plan within Affinity Water's draft WRMP, ensuring that the supply-demand balance is maintained.

Preferred, Best Value, Option

The preferred option was identified through the options appraisal undertaken for gate two. As noted previously, it consists of:

- A northern transfer pipeline from Minworth STW to the Coventry Canal at Atherstone.
- Seven pumping stations and eight 'downflow' bypasses through the middle section of the GUC
- An abstraction point at Leighton Buzzard with a transfer route to the AfW supply network at Chaul End Water Supply Reservoir (WSR).

The Minworth to Atherstone pipeline option has the lowest environmental risk, with the lowest whole-life carbon, cost and use of materials compared to the other options for the northern section.

The Leighton Buzzard to Chaul End option has the lowest NPV (including optimism bias) of all of the options considered. In addition, the site at Leighton Buzzard provides good access to the preferred connection point within AfW's existing water infrastructure. Additionally, the site for the treatment works is close to the abstraction point, slightly raised from the river and canal and adjacent to an operational sand quarry (Grovebury Road).

The Leighton Buzzard site was included in response to external review by stakeholders and in consideration of the risk to water quality and flooding in the canal network south of the Tring summit.

The exact phasing of the scheme has yet to be finalised. Given the outcome of the draft WRMP, with the GUC scheme being selected in two phases that are relatively close together, options were considered for the optimum way to phase the delivery of the scheme. Three options were analysed for Gate 2:

- Construction of the scheme in a single phase, at full 115 Ml/d capacity, but with operational use ramping up after 2040.

- Construction of the civil engineering aspects of the scheme in a single phase, at full 115 Ml/d capacity, but with mechanical and electrical (M&E) equipment installed in a phased manner to enable full capacity operation only after 2040.

- Construction of the scheme in two phases at different times, each enabling 50% of the full capacity to be achieved.

The comparison of the costs of these options is shown in Table 3 below. This shows that the lowest overall NPV is from the second option, with the M&E equipment installation phased to match required utilisation.

Table 3 Comparison of costs for different phasing options for best-value solution (route 3 + Leighton Buzzard site), source: GUC SRO Gate 2 submission

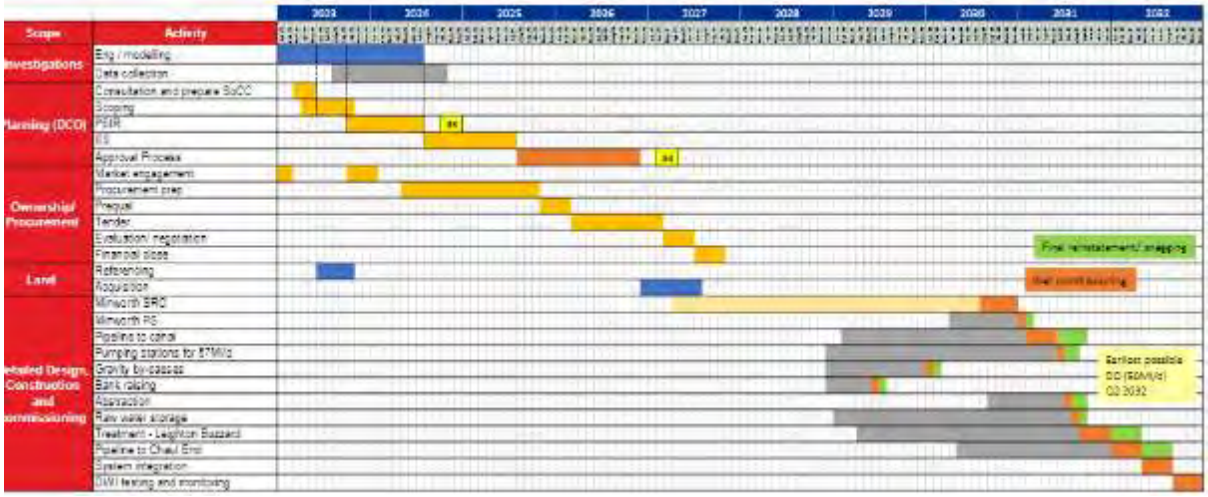
Scheme	CAPEX (£m)	OPEX (£m)	NPV (£m)	OB included (£m)
Full capacity	340	1,170	800	170
Phased M&E	360	1,120	610	160
Phased civil and M&E	450	1,250	690	220

Further analysis of the optimal configuration for the delivery of the scheme is planned for Gate 3 of the RAPID SRO process, to be informed by the finalisation of timing and need for the solutions in the Final WRMP.

AMP8 cost profile

For the chosen delivery configuration (i.e. phased, option 2 above), the scope of works were programmed in outline and then the relevant costs for each activity profiled accordingly. The outline programme used is shown in Figure 6 below.

Figure 6 Outline delivery programme for GUC (source: GUC SRO programme team)



This shows a small proportion of the planning and development costs being required at the start of AMP8, as the DCO application is made and examined, and the scheme contract documents prepared, tendered and awarded. Construction is planned to start in 2028, hence 2 years of construction activity in years 4 and 5 of AMP8, with the remainder being in AMP9. At present, due to the residual uncertainty regarding the procurement route for the GUC project, construction phase costs are not included in the AMP8 enhancement case, which is limited to costs up to DCO award.

The AMP7 and AMP8 costs are the same as the revised expenditure profile provided to RAPID as part of the Gate 2 submission on 20th December 2022, but inflated from 2017/18 prices to 2022/23, using the inflationary factors noted below.

The summary breakdown of the AMP7 and 8 costs is shown in Table 4.

Table 4 GUC SRO, AMP7 and AMP8 cost breakdown (£M, 2022/23 prices)

Item	AMP7 costs	AMP8 costs	AMP9 costs	Total
RAPID Gate 1 (actual)	1.85			**1.85**
RAPID Gate 2 (actual)	3.80			**3.80**
RAPID Gate 3 (forecast)	9.71			**9.71**
RAPID Gate 4 (forecast)	1.92	8.84		**10.76**
Capex		140.76	219.32	**360.09**
Opex			11.63	**380.57**
TOTAL CAPEX	**17.29**	**149.61**	**219.32**	**386.22**

Note:

- *RAPID Gate costs are inflated from 17/18 prices to 2022/23 using CPIH*
- *Capex, enabling and other costs are inflated from 20/21 prices to 2022/23 using CPIH*

	CPIH	*RPI*
2017/18 - Actual	*104.2*	*274.9*
2018/19 - Actual	*106.4*	*283.3*
2019/20 - Actual	*108.2*	*290.6*
2020/21 - Actual	*109.1*	*294.2*
2021/22 - Actual	*113.1*	*311.2*
2022/23 Forecast - CPIH is PR24 base Year price	*122.7*	*347.4*

Least Cost Option

The preferred, best value, option is also the lowest cost option.

Alternative Options

As can be seen in Table 1 and Table 2:

- The alternative options for the northern transfer route (routes 1 and 6) are £50M and £320M more expensive in terms of total NPV (including optimism bias) for the 115 Ml/d capacity scheme, but still deliver the same net water resources benefit.

- The alternative sites for the abstraction, treatment and treated water transfer (Tring, The Grove or Hemel) are between £160M and £240M more expensive in terms of total NPV (including optimism bias) for the 115 Ml/d capacity scheme, but still deliver the same net water resources benefit. The EA has also raised concerns about the interaction with the River Bulbourne if these sites are selected.

Therefore, these alternative options are not selected and not appraised within the WRSE best-value planning framework.

Meeting Affinity Water's Outcomes

The selected option will support the achievement of AFW's long-term outcomes and forms a key part of the draft WRMP24. Alongside demand management measures, this option will help to maintain a positive security of supply index during the next planning period (2025 – 2050) and enable targets associated with drought restrictions and levels of service to be achieved.

Justification of the Preferred Option

The preferred option provides the lowest overall NPV of all alternatives.

It is selected in the WRSE draft regional plan as part of the best-value plan for the south-east, which optimises cost, carbon, environmental risk, resilience and customer preference measures.

Delivery Considerations

Related Projects

The GUC project is related to the other projects to be delivered under the WRMP drivers. This includes:

- the other Affinity Water SROs, particularly the Thames to Affinity Transfer and the SESRO projects, the timing and scale of which does affect the ultimate phasing of the delivery of the GUC project

- the integrated demand management and leakage strategy, which underpins the whole WRMP strategy, helping secure reductions in the demand for water and hence deferring the need for new supply-side options

- Connect 2050, which enables the larger supply-side options (such as the SROs) to be distributed efficiently to Affinity Water customers through enhancement to the existing distribution network.

Delivery Risk Management

An initial assessment of project delivery risks has been completed for the RAPID Gate 2 submission. The key risks considered are noted below. These will continue to be managed proactively by the SRO project delivery team, overseen from a Project Management Board.

- Engagement with Natural England (NE), a key stakeholder, has been reduced due to the organisation's resource limitations. This is a key regulatory interface for the scheme and we are working closely with the National Appraisal Unit (NAU) to escalate this for resolution.

- In gate three, we will develop the scheme's design to allow environmental specialists to fully understand the implications of the development, and complete the data collection needed to complete an Environmental Impact Assessment (EIA). This will help identify the detailed environmental impacts from the scheme and enable the mitigation requirements to be developed in further detail.

- Wastewater from Minworth WwTW currently discharges to the River Tame and, in the event of a drought reducing river flow, this may result in a restriction to the flow available for the GUC. A number of options for mitigation are being considered, including the provision of water storage to supplement flow. Options considered so far include existing storage assets owned by the Trust, existing reservoirs (requiring expansion) owned by STW, and conversion of third-party assets into storage facilities. This work is being carried out under the Minworth SRO and will be concluded in gate three.

- There is a risk that the Regional Plans will not align, and that a difference will exist in the selection of SROs. We actively engage at monthly water regional group meetings, to better understand the regional reconciliation process and how the Regional Plans will link together. It is expected that final regional plans will be available in late 2023, which will then clarify the strategic position of the different options in terms of timing, need and utilisation.

- Interaction with the WRSE Regional Plan is also a significant risk. In accordance with the draft WRSE Regional Plan, a scheme DO of 50 Ml/d is required in 2031/32, with a potential requirement for a further 50 Ml/d by 2040 to 2050. There remains a risk that this requirement may change in the final Regional Plan, which is due for publication in December 2023.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

During AMP8, the scheme will still be under development and hence no benefits will be achieved. Benefits will accrue in the longer term (from 2031, AMP9), once the scheme is commissioned and operational.

The WRMP, once finalised and published, is subject to annual reporting and 5-yearly updates. The annual reporting will reflect any changes to the need for or feasibility of the GUC scheme. Once developed and operational after 2031, the GUC scheme would be incorporated into annual reporting of deployable output for the water resource zones within Affinity Water's Central Region.

Supporting Information

Draft WRMP24

Draft WRSE Regional Plan

GUC SRO, Gate 2 Submission to RAPID

Affinity Water

Thames to Affinity Transfer SRO

September 2023

Contents

Summary

The Thames to Affinity Transfer (T2AT) SRO is one of 17 national Strategic Regional water resource Option (SRO) projects that were funded in Price Review 2019, to meet the requirements of RAPID (an alliance of OFWAT, Environment Agency and Drinking Water Inspectorate). In simple terms, the scheme consists of a transfer of raw water from Thames Water to Affinity Water's Central Region, with intermediate treatment and associated distribution into the Affinity Water network.

At PR19 Ofwat announced a £469 million ring-fenced development fund for companies to investigate and develop strategic water resource solutions that benefit customers, protect and enhance the environment and benefit wider society. This funding provides companies with the ability and certainty to accelerate the development of solutions to be 'construction ready' for the 2025-2030 period; it encourages joint working, enables additional analysis where required and provides outputs with greater certainty than would be available without it. Delivery of these solutions is subject to a formal gated process where decisions are made on delivery penalties and solution funding progression. Affinity Water was funded in AMP7 for the work expected to be required in the delivery of Gates 1 – 4. The submission for Gate 2 was issued to RAPID on 14th November 2022.

The Gate 2 submission documented the feasibility, costs, environmental issues, planning strategy and procurement approach to the two preferred options for the T2AT – either:

- Option 1: a transfer from TW's Lower Thames Reservoir system to AFW, supported by new water resource from the South East Strategic Reservoir Option (SESRO) SRO or
- Option 2: a transfer from a new abstraction on the River Lee flood relief channel to AFW, dependent on recycled water being fed into the river by Thames Water from either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO.

Two different sizes of each option were considered: to deliver either 50 or 100 Ml/d of dry year annual average deployable output to Affinity water during a 1 in 500 year drought.

The T2AT options are part of the feasible options set considered by Affinity Water in deriving their best value Water Resources Management Plan (WRMP24) and by the Water Resources South East (WRSE) in deriving their draft Regional Plan. A 'Best Value' water resource plan is one that delivers wider benefits to society and the environment. It considers a range of factors alongside economic cost in the identification of the preferred water resource programme that will form the basis of the plan. The development of a best value plan is promoted by the EA, Ofwat and Natural Resources Wales in the Water Resources Planning Guideline.

WRSE has carried out best value analysis to develop the Best Value Regional Plan. The Affinity Water WRMP is cascaded from and fully aligned with the WRSE Regional Plan, and so the same best value metrics have been considered in both plans. Best

value metrics have been determined for the SRO scheme. The metrics considered in addition to cost and carbon emissions are Natural Capital (NC), Biodiversity Net Gain (BNG), SEA benefit, SEA disbenefit, resilience: reliability, evolvability and adaptability, and customer preference.

In the draft WRMP best value plan, Option 1 is selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The scheme is selected in two phases – 50 Ml/d by 2040 and a further 50 Ml/d in 2045. The first phase is selected in 7 of the 9 future situations modelled and the second phase in 5 of the 9 modelled futures. The implementation of Option 1 is supported by the development of the 100 Mm^3 South East Strategic Reservoir Option (SESRO) by 2040, providing additional resource into the River Thames catchment for sharing with Affinity Water. The T2AT therefore represents a critical part of the best value plan within Affinity Water's draft WRMP, ensuring that the supply-demand balance is maintained.

Option 2 is not chosen in the draft WRMP, except under the highest levels of environmental destination and, even then, not until 2057. Therefore, no further work is proposed on this solution.

In order to facilitate efficient delivery of the scheme, the Gate 2 submission to RAPID recommends that work on Option 1 be deferred until 2028, to enable the consenting process for the SESRO scheme to progress. Gate 3 is therefore planned for 2029, Gate 4 in 2031 and construction start in 2033, enabling scheme delivery by 2040. Therefore, investment is required in AMP8 to re-start the project, after the proposed deferral period, and take it through towards consenting via a future Development Consent Order.

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	1.34	2.67	2.67	**6.68**
Opex (£m)	0.00	0.00	0.00	0.00	0.00	**0.00**
Totex (£m)	0.00	0.00	1.34	2.67	2.67	**6.68**

Drivers	
100%	Strategic Regional Resource (Additional Driver)

Benefits
N/A

Economic Analysis			
NPV Costs (£m) (2025-55)	**5.2**	NPV Benefits (£m) (2025-55)	**N/A**
NPV (£m) (2025-55)	**N/A**	Benefit / Cost Ratio	**N/A**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★	★ ★ ★	★	★ ★ ★		★

Project Description

A transfer from TW's Lower Thames Reservoir system to AFW, supported by new water resource from the South East Strategic Reservoir Option (SESRO) SRO. The scheme delivers an annual average deployable output of 100 Ml/d and a peak capacity of 115 Ml/d. The scheme consists of use of the existing raw water tunnel from Thames Water's Wraysbury Reservoir to Iver WTW, a new connection into the raw water tunnel, a short length of raw water main, a new WTW adjacent to the existing Iver site and approximately 14km of treated water pipeline to Harefield SR.

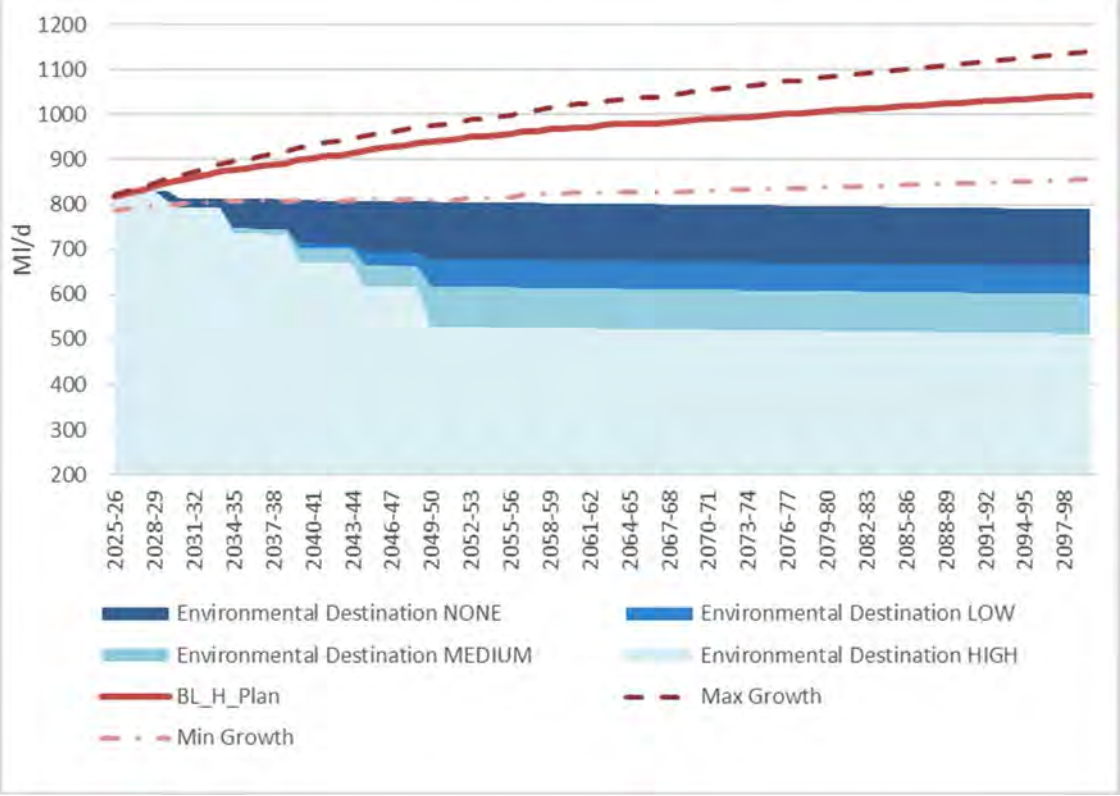
Figure 1 Scheme overview plan (source: T2AT SRO, Gate 2 main report, November 2022)

Project Development

Baseline Assessment

The draft WRMP24 (section 6) reports the baseline forecast supply-demand balance for Affinity Water. This represents the position in a 'Do Nothing' scenario. Figure 6.3 of the draft WRMP24 is reproduced in Figure 2 below, showing the forecast difference between available supply and projected demand for drinking water in Affinity water's Central Region (WRZ 1- 6).

Figure 2 Baseline supply demand and supply for Affinity Water Central region (Figure 6.3 from draft WRMP24)



This is further quantified in the draft WRMP24 as a range of uncertainty, depending on the extent of future growth and future reductions in existing abstraction licences that are required due to environmental pressures. Overall, this uncertainty is quantified as a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050.

This loss of supply needs to be met by a combination of new demand saving and water efficiency measures and by new supply-side options such as the Thames to Affinity Transfer.

Problem Statement and Stated Need / Driver

The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below. These are all analysed at regional level by WRSE and then translated down to Affinity Water for incorporation in the WRMP.

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[1]. The impacted companies have a statutory duty to plan for this level of future growth.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively. t
Improved drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved using drought orders and drought permits up to 2040, but reducing reliance on these measures thereafter.

These drivers for additional water supply are considered after the implementation of reductions to leakage and to water consumption, as prescribed by the Environment Agency's National Framework for Water Resources2. The framework requires a 50% reduction in leakage by 2050 and planning for a domestic water consumption of, on average, 110 litres per person per day by 2050, while also reducing non-household demand. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply.

Overall, the T2AT options are part of the supply-side options set that could be used to meet the combined overall need across the south-east of England for an additional 1 billion litres of new water supply per day by 2040, increasing to a maximum of 2.6 billion by 2100 under the highest scenario. These needs drive the

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline?msclkid=88cab670c08011ecb284fa54ecf9127d
[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources?msclkid=245c3d5bc08211ec8b961853f7da9bae

imbalance between available supply of water and projected future demands, and why supply-side improvements are required to achieve a supply-demand balance.

Risks, Issues and Requirements

The T2AT is a highly complex project. The key risks are noted below, with further information on risk management and mitigation available within the Gate 2 submission to RAPID.

- The scheme would be likely to be categorised as a Nationally Significant Infrastructure Project (NSIP) and hence consented through a Development Consent Order (DCO) under the requirements of the Planning Act 2008. This is a highly complex, and extensively regulated process, overseen by the Planning Inspectorate (PINS). There is a risk that the scheme would not be classified as an NSIP, due to the nature of the transfer (as treated rather than raw water) and a Direction from the Secretary of State might be required. If the scheme is not an NSIP, then a standard planning application route (under the Town and Country Planning Act) would be followed and applications to at least 2 Local Planning Authorities would be required due to the scale of the scheme.
- The DCO process requires extensive consultation ahead of consent application, including a Statutory Consultation process to be followed. Although the regulatory requirements of this are clear, the likelihood of objection and negative PR from affected stakeholders is high.
- The scheme is likely to require the acquisition of a larger area of land for the new WTW. The compulsory acquisition powers could be achieved under the DCO, but if a planning permission is required then separate compulsory purchase routes may need to be followed.
- The feasibility work completed thus far for RAPID has not identified any unresolvable planning or environmental constraints, but it is expected that the scheme would require formal Environmental Impact Assessment to support the consenting process. This requires extensive land access for survey purposes prior to consent submission.
- The scheme is currently expected to be delivered via Direct Procurement for Customers (DPC), which should deliver better value for customers at lower risk than in-house delivery. This requires submission of prescribed information and documentation to Ofwat and progression through a series of Control Points, before any contracts can be let and extensive commercial analysis and negotiation.

Allocation of Costs

100% of the costs would be enhancement.

Research, Pilots, and Technology Development

No pilot trials are planned for AMP8 or AMP9, although some degree of pilot trial might be useful in the longer term to confirm the process design prior to construction.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

For RAPID Gate 1, Affinity Water participated in a research programme coordinated by WRSE, involving nine water companies, to examine customers' understanding of water resources and the need for regional solutions. This coordinated approach ensured feedback was comparable across regions and solutions and was cost efficient. The research provided evidence on customers' understanding of the need for regional water resource solutions and the level of support for sharing water resources.

For RAPID Gate 2, Affinity Water's collaborative customer research[3] has progressed on the themes we identified at Gate 1:

- Firstly, exploring through the regional engagement what customers view as 'best value', how they weight those metrics and prioritise – enabling us to assess how different schemes 'perform' in terms of the customers' preferences.

- Secondly, looking at how we can make schemes more acceptable to customers, we looked to dive deeper on views regarding public value – exploring with customers what they mean by the term, their preferences, whether their views alter dependent on their proximity to the scheme and how much they would be willing to pay for a range of possible 'added value' options for a scheme.

- Finally, we looked how customers perceive, understand and ultimately how we need to engage customers when we change their source of water. We explored this immersively, including through taste testing.

Evidence of Customer Preferences

The key findings from the Gate 1 research were as follows, supportive of the progression of T2AT as a leading option for Affinity Water, when carefully designed, managed and communicated to customers:

- Proposals to share water between regions are seen in a positive light by customers.

[3] We have undertaken an efficient and collaborative programme of customer engagement across several water companies to support the SROs. Where practical we have utilised regionally led work. For other areas we have formed 'club' projects with other SRO teams – maximising the expertise across the companies.

- Customers have firmly established views on the priority of transfer options: less favoured than both demand options and supply options such as reservoirs, which customers feel bring added value to the community. Customers are less willing to see water transferred out of their region if the recipients are more wasteful.

- Largely, transfers via river or canal are preferred to pipeline options because they are perceived by customers to have wider benefits and fewer negative impacts. However, customers do have various concerns about transfers, including cost, construction disruption, environmental impacts, energy use and lack of benefits to local communities.

For Gate 2, over 300 household customers were engaged to explore their preferences regarding the 'best value' criteria developed by WRSE. In general, customers place more weight on the delivery of secure supply of water, followed by cost of environmental improvements, with resilience placed on the lower end of the scale. The T2AT provides a secure supply of water, given the nature of the scheme.

The research project into public value was collaborative across 11 SROs. The key aims were to understand what preferences and added value our customers perceive is important, as part of infrastructure development. Of particular relevance to T2AT:

- Customers told us that most feel that the principle of transferring water from areas of abundance to areas of scarcity 'makes sense' and assume that this system is already in place in the UK. However, there are some concerns that arise when customers learn about the potential for contamination during the transfer process.

- These concerns are also reinforced by the idea that water coming from other areas might be 'worse' than that which people are used to i.e., in quality or characteristics such as hardness.

- A minority of customers living in areas that are perceived as less water-stressed (e.g. rural areas outside London) have hesitations about sending 'their water' elsewhere. Despite this, Water Transfer is largely considered a sensible option.

- For the majority of customers, there is a particular lack of clarity around infrastructure requirements for transfers – it is unclear what type of infrastructure will be involved (e.g., canals, pipes, rivers) and how much new infrastructure will be required, which also makes it difficult to estimate the disruptive impact on local areas and natural environments.

The research study into customers' views on changing their water source was also collaborative across 11 SROs. 1,400 customers and 200 non-households were engaged during the quantitative phase.

- Customers say they are unlikely to engage with communications on source change, and taste tests indicate that most are not able to detect differences at the level that might be expected in a source change. However, there is still a need to communicate to explain the rationale for the change, alleviate taste concerns and provide clear guidance on the impact.

- The product sample tasting reassured customers that water transferred from other areas will not necessarily taste noticeably different.

Partnering

Collaboration and Partnering

We developed our approach to engagement in line with RAPID's guidance for Gate two (August 2022). We have built on the foundation of stakeholder and customer feedback received prior to gate one, activity completed through gate one, the representations made to RAPID at gate one, and direct feedback from RAPID and other regulators.

To ensure clarity, consistency and efficiency of the engagement activity with our customers and stakeholders, we have coordinated the engagement regarding SROs with that on Regional Plans, company WRMPs and company 2024 price review (PR24) Business Plan submissions. This approach to customer and stakeholder engagement activities has ensured there is a flow of insight through the process, as illustrated in Figure 3 below.

Figure 3 Insight flow from customer and stakeholder engagement

Engagement with Stakeholders and Partners

The AMP7 funding for the T2AT project is shared with Thames Water (on a 50/50 basis). Therefore, all of the work to inform the RAPID gated process has been done on a wholly collaborative basis, shared between these two partner companies, including a shared Project Steering Group (at Executive level), a shared Programme Management Board for day-to-day governance and a single Programme Manager accountable to both partners. Procurement has been approached on the basis of 'best person for the job' with competitive procurement being applied across both partner companies to select the best supply chain possible. This has resulted in a number of co-funded technical tasks, that have been delivered on behalf of both partners, including assurance, legal support and planning and land advisory services.

Engagement with key stakeholders has been undertaken through a series of Technical Liaison Groups (TLGs). These groups were designed to provide a collaborative discussion forum between the SRO delivery team and key 'tier 1' stakeholders and regulators such as the Environment Agency, Natural England and affected Local Planning Authorities. The groups have met regularly since project inception, enabling discussion and agreement of factors such as options, possible alternative solutions, technical methodologies, datasets, survey requirements and assessment conclusions.

Co-design and Co-delivery

The concept design for the scheme has been undertaken with collaboration between the partner companies. Both Thames Water and Affinity Water has interfaces into the scheme that will affect the operational aspects. This includes the operational interface and shared use of the Lower Thames Reservoir system, to provide the raw water for the transfer, as well as the integration required into the new resource planned for the upper River Thames (SESRO).

Commercial aspects of the project have been considered in collaboration with Thames Water, to enable clearer understanding of the operational interfaces and commercial 'hand-offs' required to successfully deliver the transfer including provision of new raw water storage in the River Thames, conveyance to Thames Water's existing Lower Thames Reservoir system, conveyance through the Affinity Water raw water tunnel to Iver, treatment via the new T2AT WTW and conveyance to Harefield and, finally, transfer into the existing Affinity Water network at Harefield SR. All of the appraisal of different delivery models (in-house, DPC or SIPR) have been considered as a co-funded task between the delivery partners.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

This scheme is a key part of the draft WRMP reported pathway, hence integral to the best value plan which was issued for consultation in November 2022. This plan is built upon 9 adaptive pathways. The first phase of T2AT is selected in 7 of the 9 future situations modelled and the second phase in 5 of the 9 modelled futures, hence integral to the future management of uncertainty in the supply-demand balance across a range of possible futures.

WRMP Adaptive Strategy

The position of the T2AT SRO within the WRSE draft Regional Plan and draft WRMP24 is summarised as follows. Further information and justification of the reported pathway and associated sensitivity analysis may be found within Affinity Water's draft WRMP24 (Section 9):

- In the best value plan, the Option 1 is selected in the preferred (reported) pathway, which corresponds to future situation 4 in the WRSE adaptive pathways. The scheme is selected in two phases – 50 Ml/d by 2040 and a further 50 Ml/d in 2045. The first phase is selected in 7 of the 9 future situations modelled and the second phase in 5 of the 9 modelled futures. The timing of the second phase does vary between 2042 (situation 1) and 2060 (situation 7).

- The implementation of Option 1 in the best value plan is supported by the development of the 100 Mm^3 South East Strategic Reservoir Option (SESRO) by 2040, providing additional resource into the River Thames catchment for sharing with Affinity Water.

- In this best value plan, the Option 2 is only selected in future situation 1 (which is the adaptive branch with the highest growth and enhanced Environmental Destination) for supply by 2056. Therefore, the scheme is not required within the current WRMP24 planning period (2025 – 2050). It is for this reason that this scheme is considered a 'back-up', with no further work proposed after Gate 2.

- In the least-cost planning scenario, the selection of the T2AT is largely the same as the best value plan, but the need for Option 2 and for the second phase of Option 1 is slightly deferred (but by <5 years).

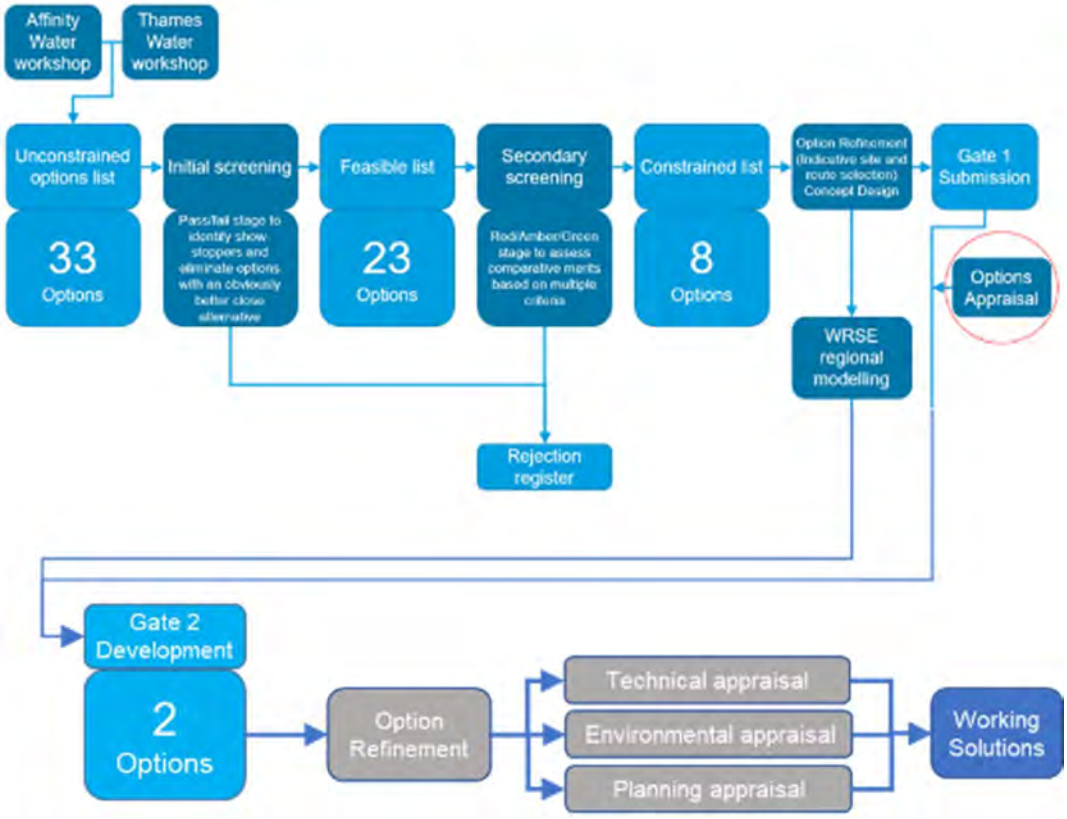
The key aspect that could help support changes to the adaptive pathways beyond AMP8 is the delivery of the scheme modular development, particularly the WTW. The first phase of the scheme (50 Ml/d) is required in 2040, but the timing a utilisation of the second phase does vary between the most extreme future pathways (2042) and the lower growth scenarios (2060). Hence, a modular approach to the construction phase of the scheme could be of benefit in the longer term, particularly around the WTW. These aspects should be considered during future design phases ahead of the DCO submission.

Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

The options appraisal process for T2AT was undertaken in a series of stages, as illustrated in the flow chart below, to screen the options down to a preferred shortlist.

- Firstly, an unconstrained options set was derived, identifying possible ways to transfer water from Thames Water (Thames basin) to Affinity Water Central Area. This resulted in the identification of 33 possible options.
- An initial screening process was applied, based upon the exclusion of any options that were deemed unsuitable because of obvious 'show-stopping' issues. This reduced the options set to 23 Feasible options.
- All of the feasible options were subject to a secondary screening process, to provide a 'Red/Amber/Green' appraisal against a number of technical feasibility, environmental and planning criteria. This resulted in a constrained list of 8 shortlisted options.
- All 8 shortlisted options were costed for the purposes of the Gate 1 submission to RAPID and were passed to WRSE to include feasible options within the regional modelling 'best value planning' process.
- The regional modelling, in parallel with further options appraisal to re-confirm the Gate 1 conclusions, resulted in the selection of two shortlisted options within the WRSE emerging plan in January 2022. These were the two options listed at the start of this enhancement case.
- Further technical appraisal and refinement has developed these two shortlisted options into the 'working solutions' that have been costed and appraised for RAPID Gate 2. Each solution was sized to deliver average DO of 50 and 100 Ml/d.



Selected Options

Do Nothing, Option 0

This is not considered a viable option, due to the nature of the planning problem to be solved. The WRMP and the retention of an acceptable Security of Supply Index are statutory obligations.

Preferred, Best Value, Option 1

Option 1: Lower Thames Reservoir or "LTR"

A transfer from TW's Lower Thames Reservoir system to AFW, supported by new water resource from the South East Strategic Reservoir Option (SESRO) SRO. This involves use of the existing raw water tunnel from Wraysbury Reservoir to Iver, new WTW at Iver, new drinking water transfer main to Harefield and new connection into the existing (to be refurbished) service reservoir.

Least Cost Option 2

Option 1: Lower Thames Reservoir or "LTR"

See above.

Alternative Option 3

Option 2: Beckton Reuse Indirect or "BRI"

A transfer from a new abstraction on the River Lee flood relief channel to AFW, dependent on recycled water being fed into the river by Thames Water from either the Beckton effluent reuse option or Teddington DRA option of the London Effluent Reuse SRO. This involves a new abstraction point on the River Lee flood relief channel, raw water transfer to a new WTW in the Lee Valley, high lift pumping station and drinking water transfer main to Brookmans Park, new connection into the existing service reservoir and onwards conveyance of residual flow, under gravity, to the existing booster pumping station in the vicinity of North Mymms.

Alternative Option 4

Option 3: Sunnymeads 2a

Alternative to Option 1, which might be required if the SESRO SRO is unsuccessful in consenting or delivery, which might then change the feasibility of sharing of resources from the Lower Thames Reservoir system. This alternative involves a new pumped raw water transfer from the existing Affinity Water abstraction point on the River Thames at Sunnymeads, transferring water to Iver. From Iver the scheme is the same as Option 1.

Option Assessment Approach

Economic Assessment

Economic assessment has been done in two key ways:

- The WRMP and WRSE options appraisal processes use complex optimisation modelling tools to calculate the least cost combination of options to solve the given water resources planning problem across the south-east. This is based upon an NPV approach, based upon the base capex of the scheme, fixed and variable Opex, carbon costs and modelled utilisation over the planning period.

- For comparison at Gate 2, simple comparison of options has been done via the calculation on Net Present Value (NPV) and an Average Incremental Cost (AIC) for each of the leading options. NPV and AIC has been estimated using the standard methodology developed for all SROs at Gate 2, based on HM Treasury Green book with a declining schedule of discount rates (HMT Green Book: Annex 6, Table 8) and an 80-year assessment period. Utilisation is based upon the estimated operational profile of the scheme, as shown by the green line in Figure 4 below, and the investment profile is spread across an estimated 11 year programme for planning, development and construction and commissioning, as shown in Figure 5.

Figure 4 Estimated utilisation profile used for cost estimation (source: T2AT SRO, Gate 2, Supporting Document A1: Concept Design Report)

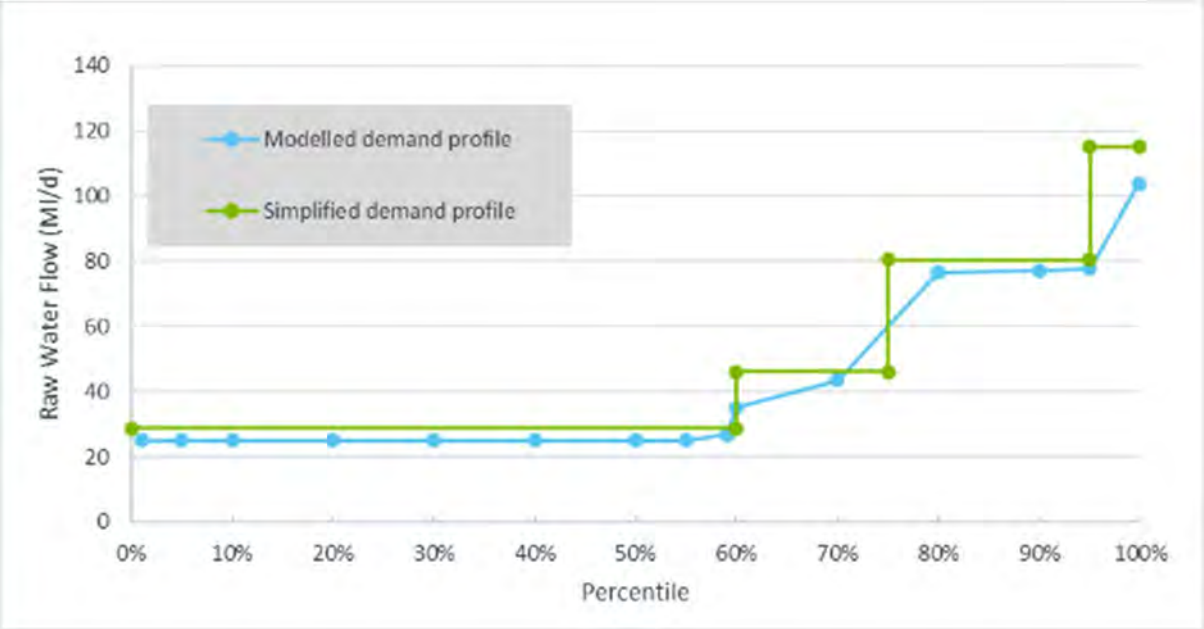
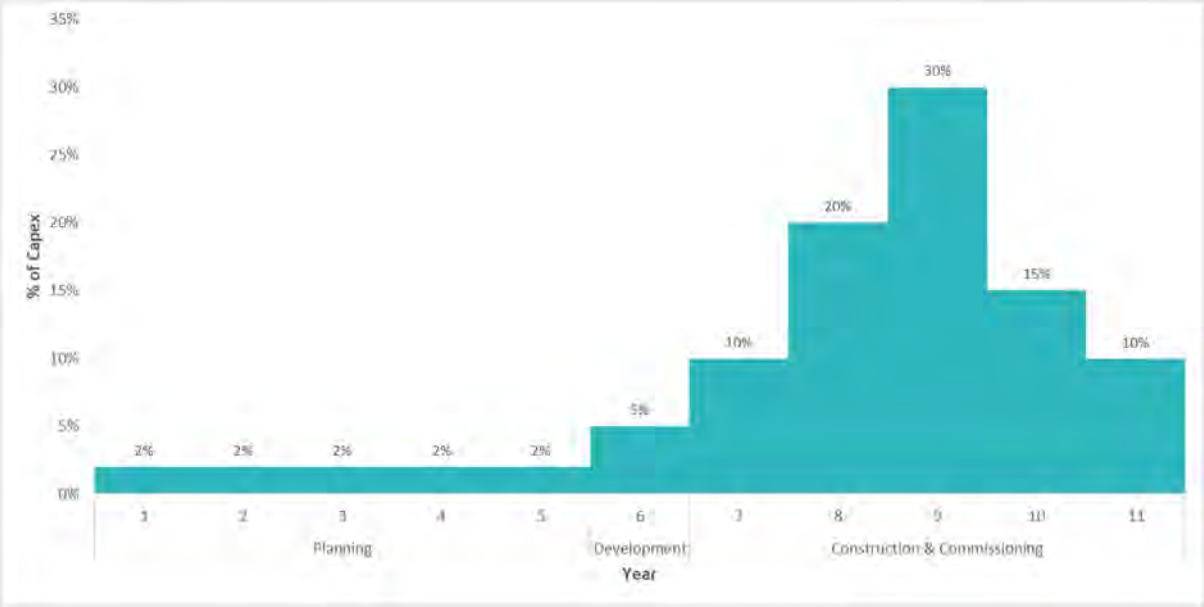


Figure 5 Estimated capex spend profile used for cost estimation (source: T2AT SRO, Gate 2, Supporting Document A1: Concept Design Report)



Cost Estimation

Capex estimates were derived using a combination of Affinity Water's Long-run Marginal Cost Sheet (LRMC) and bottom-up cost estimates based upon the Gate 2 concept design.

LRMC spreadsheets were completed for each of the following option components for each flow alternative.

- Raw Water Pumping Station
- Water Treatment Works

Bottom-up Costs have been produced for each of the following option components for each flow alternative.

- Raw Water Transfer Main
- Drinking Water Transfer Main

LRMC estimates

For each element of the components, the relevant cost curve was identified together with the appropriate input variables, derived from the concept design. This information was then entered into the LRMC spreadsheet tool to generate estimates of Capex and Opex.

The power consumption used to calculate Opex has been calculated separately to enable the application of incremental changes in energy.

The Capex cost base date for the LRMC sheets is 2017/2018. In order that all costs are reported against the same cost base (2020/21) a Capex inflation factor of 1.1

has been applied. The Capex inflation factor provided by WRSE has been applied across all SROs.

'Bottom-up' estimates

Where appropriate, bottom-up engineering cost estimates were made based on (a) Affinity Water's design partner's (Mott MacDonald) experience of implementing similar projects and (b) supplier quotes. Principal items included but were not limited to:

- The shaft associated with connecting to the existing tunnel
- Materials and works associated with the Raw Water Transfer Main and Drinking Water Transfer Main including any crossing requirements e.g., micro tunnelling under a railway
- Surge mitigation measures
- Land purchase and compensation
- Demolition and site clearance
- Sustainable drainage system (SuDS)
- Remediation of existing contaminated land.

As quotes have been received based on current day prices and in order that all costs are reported against the same cost base (2020/21) a deflation factor of 0.94 has been applied to all bottom-up costs. The deflation factor provided by WRSE has been applied across all SROs.

On-costs

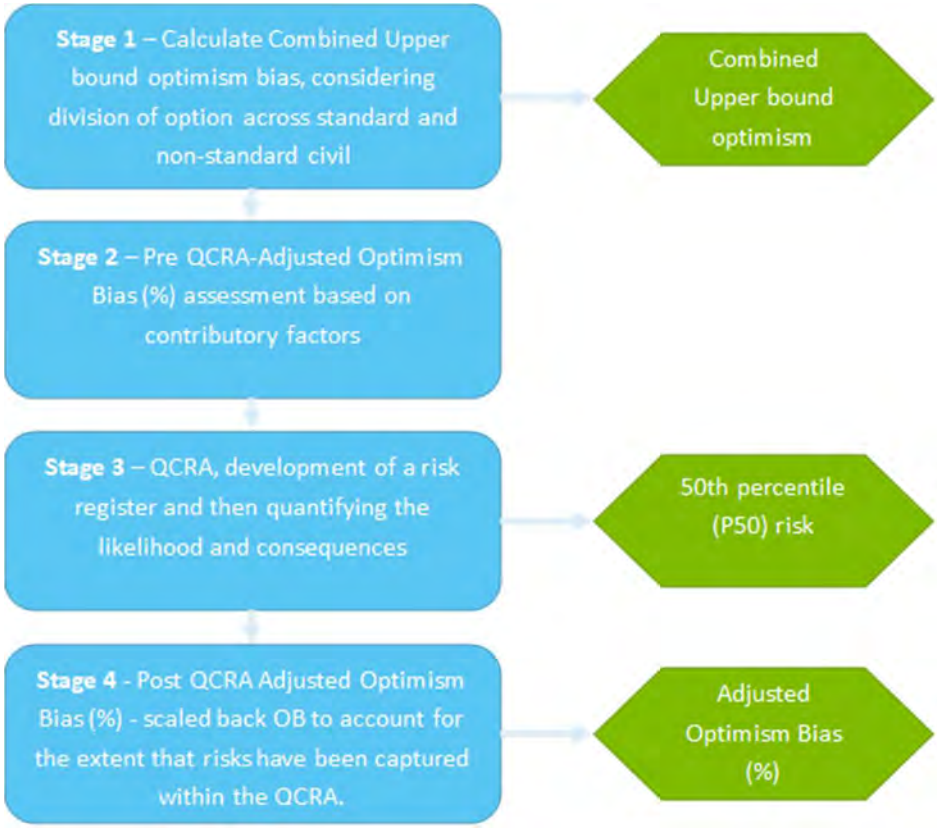
To ensure on-costs for LRMC and bottom-up items are applied consistently, bottom-up cost items had both client and contractor on-costs added to them whilst LRMC items remain unchanged. Affinity Water's LRMC cost curves are based on historic Affinity Water projects and incorporate 'all-in outturn' costs (construction costs, contractor and client on-costs, realised risk, plus project-related corporate overheads) for both whole new processes and periodic replacement of individual assets.

On-costs include items such as:

- Contractor on-cost
    - Staff & supervision
    - Design
    - Welfare, offices, services & facilities
    - Temporary compounds & access roads
- Client on-costs
    - Project / programme management
    - Company overheads
    - Indirect costs

Optimism Bias and Risk

A consistent multistage approach (see figure below) to risk and optimism bias has been applied based upon the approach recommended by the HM Treasury Green Book.



Both Optimism Bias (OB) as a percentage of Capex estimates (excluding land costs) and costed risk have been assessed to cover the risk of cost increases that may occur during the development and delivery of the selected option. To ensure a degree of consistency across the different SROs, guidance and a spreadsheet template has been issued across all SROs by a cross-company working group, for capturing the Quantitative Costed Risk Assessment (QCRA) and calculating OB.

Total Capex

Estimated Capex (2020/21 cost base) for 100Ml/d and 50Ml/d ADO alternatives are shown in the figure below, showing the split between base capex, optimism bias and costed risk.

These estimates are considered to be at the upper end of the range of expected costs, particularly with regard to land and compensation estimates associated with the current proposed site for the WTW. Further optioneering is required before a site can be confirmed and hence costed accurately. Therefore, the confidence grade assigned to these costs is 'Amber'. This uncertainty does not affect expected planning and development costs for AMP8.

Figure 6 Option 1 – "LTR" – total capex for 100 Ml/d option = £455M (2020/21 prices)

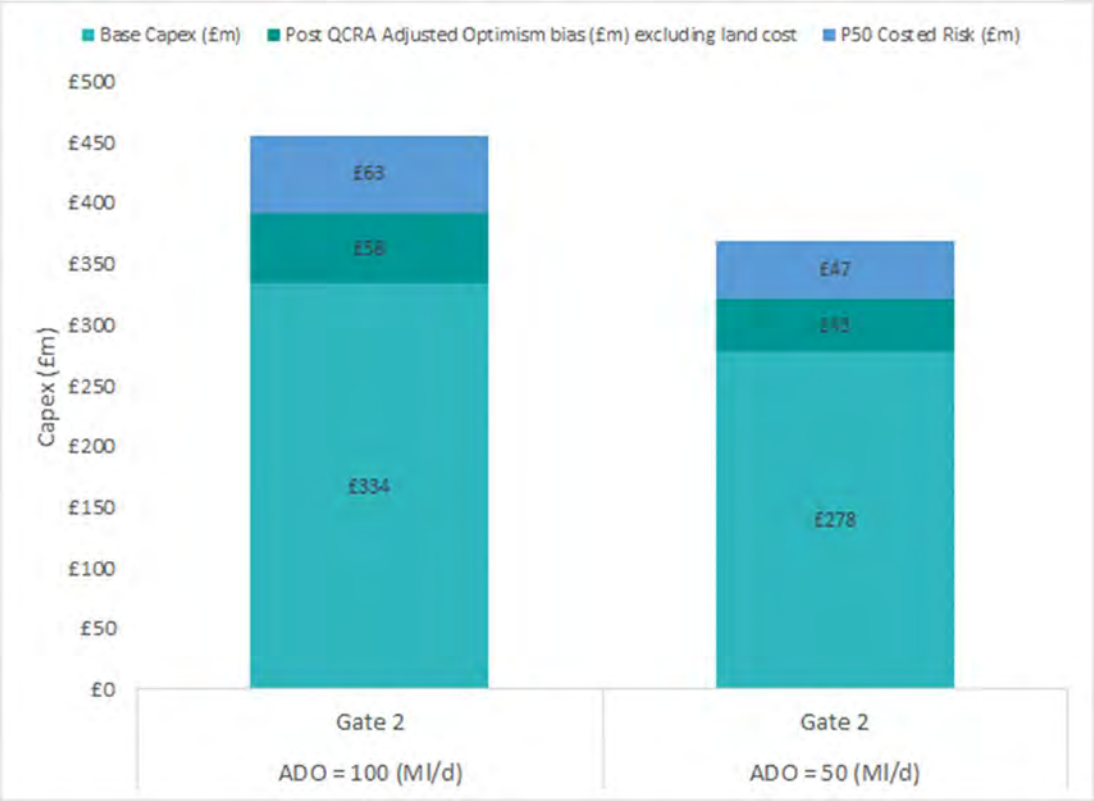
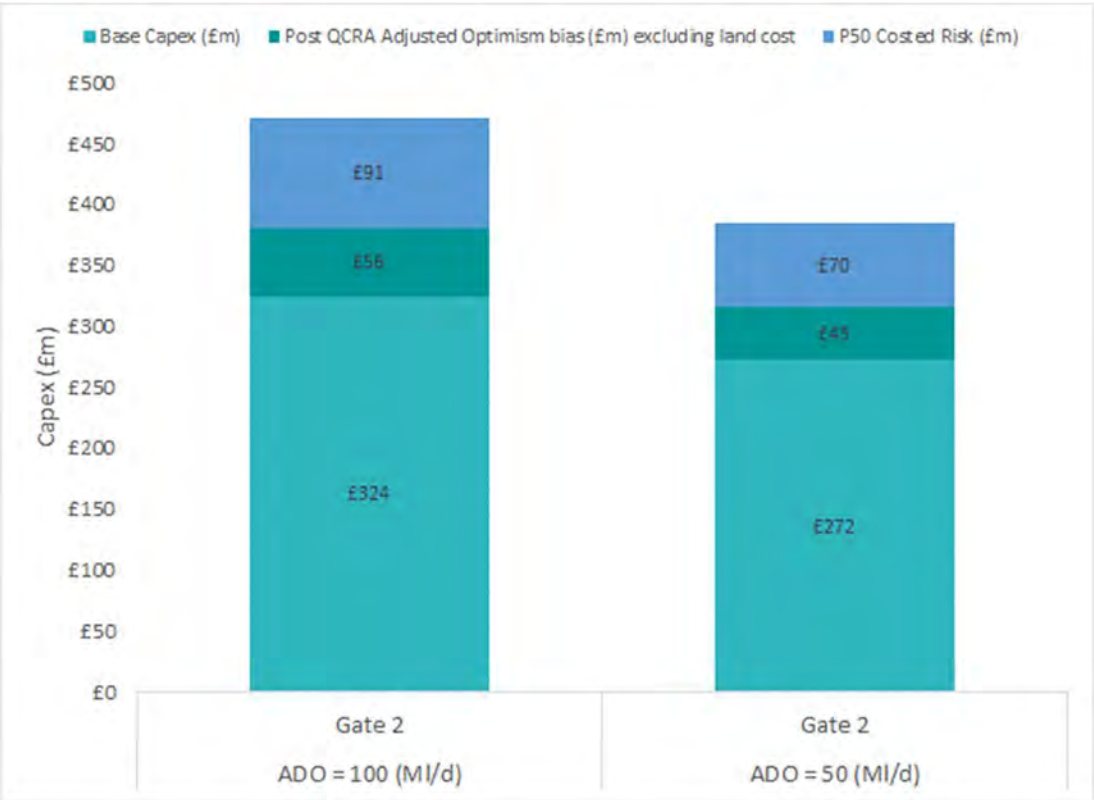


Figure 7 Option 2 – "BRI" – total capex for 100 Ml/d option = £471M (2020/21 prices)



NPV and AIC

Table 1 Summary of NPV and AIC for leading alternatives for T2AT (2020/21 prices)

Option Name	Units	LTR 50 Ml/d	LTR 100 Ml/d	BRI 50 Ml/d	BRI 100 Ml/d
Option Benefit (DYAA)	MLD	50	100	50	100
Total planning period benefit	Ml	340,000	680,000	340,000	680,000
Total planning period indicative capital cost (CAPEX NPV)	£M	304	380	318	394
Estimated Utilisation *					
Total planning period indicative operating cost (OPEX NPV)	£M	23	43	25	47
Total planning period indicative total cost (NPV)	£M	327	423	343	441
Average Incremental Cost (AIC)	p/m³	82	54	87	57
Maximum Utilisation (100%) **					
Total planning period indicative operating cost (OPEX NPV)	£M	43	82	47	90
Total planning period indicative total cost (NPV)	£M	347	462	365	484
Average Incremental Cost (AIC)	p/m³	88	60	94	63
Gate 1 AIC (20/21)	p/m³	58	45	65	51

Note * 40% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, and 40% of the estimated maximum variable operating cost, based upon output of long-term water resources modelling (see Section **Error! Reference source not found.**). There is no comparative AIC for Gate 1 as these utilisation calculations were not available at Gate 1.

Note ** 100% utilisation is assumed for these calculations to enable comparison between options: 1 in 500 year deployable output for 365 days / year, and estimated maximum variable operating cost.

AMP8 costs – for preferred 'LTR' option

AMP8 cost estimates are based on the assumption that the scheme(s) selected in the draft WRMP continue to be promoted at the same capacity and timing in the Final WRMP, planned for publication late 2023. If this changes, then the funding requirements may need to be adjusted accordingly, as alternative strategies may carry different implications on the option selection, timing and capacity of the T2AT.

The estimated costs for AMP8 are derived as the forecast capex percentage in the relevant years, in accordance with the profile shown in Figure 5 above. In accordance with the PR19 Final Determination for SROs, the costs to deliver the SRO project scope of work within AMP7 (Gates 1 and 2 and Gate 3 Checkpoint 1) are considered included within the overall scheme capex estimate and associated planning and development costs. Hence, these are deducted from the estimated Planning and Development cost allowances to determine the AMP8 requirements.

Overall, the project is expected to be re-started in AMP8, at the start of Year 4, in order to efficiently deliver the required scheme by 2040 (required start date in draft WRMP24). This means that 2 years of the Planning period could be expected in AMP8 (during years 4 and 5) with the remainder in AMP9.

The summary of the cost breakdown is shown in Table 2 below. The data is inflated from the values quoted in the Gate 2 submission, which are 2017/18 for actual incurred costs and 2020/21 for capex estimates, using the standard PR24 inflationary factors noted below Table2.

Table 2 Summary of funding required in AMP8 (2022/23 prices)

Spend category / year	Capex (£M)	Comments / reference / source
Total capex	£511.32	Source: SRO Gate 2, Supporting Document A2: cost report
Allowance for Development and Planning to Gate 4	£26.36	Source: Gate 2 submissions to RAPID (expenditure profile)
Re-mobilisation date (AMP8)	Sep-27	Source: SRO Gate 2, Main Report
Proposed spend AMP8	**£13.18**	**3 years, spread across AMP8, Year 3 – 5**
Estimated land costs ***RISK ITEM FOR AMP8***	£104 - 175	Source: SRO Gate 2, Supporting Document A2: cost report, excluding client on-costs and risk / OB
SRO costs to end AMP7		*Pre-feasibility studies, but included in Planning and Development costs overall, hence deducted from AMP8*
Gate 1	£1.01	Note: costs reported to RAPID in 17/18 prices, inflated here to 2022/23 prices for comparison with AMP8 forecast
Gate 2	£1.12	Note: costs reported to RAPID in 17/18 prices, inflated here to 2022/23 prices for comparison with AMP8 forecast Source: SRO Gate 1 and 2, Main Reports
Gate 3 CP1	£2.48	
TOTAL	**£4.61**	
Proposed AMP8 profile		
Year 1		No work planned
Year 2		No work planned
Year 3	£1.71	Mobilisation towards RAPID, Gate 3
Year 4	£3.43	RAPID Gate 3, year 2
Year 5	£3.43	RAPID Gate 3, year 3
TOTAL	**£8.57**	

PR24 inflationary factors:

- *RAPID Gate costs are inflated from 17/18 prices to 2022/23 using CPIH*
- *Capex, enabling and other costs are inflated from 20/21 prices to 2022/23 using CPIH*

	CPIH	*RPI*
2017/18 - Actual	*104.2*	*274.9*
2018/19 - Actual	*106.4*	*283.3*
2019/20 - Actual	*108.2*	*290.6*
2020/21 - Actual	*109.1*	*294.2*
2021/22 - Actual	*113.1*	*311.2*
2022/23 Forecast - CPIH is PR24 base Year price	*122.7*	*347.4*

AMP8 costs – land acquisition costs

In order to ensure the deliverability of the T2AT project, when required, and to avoid the risk of being 'held to ransom', the site for the proposed WTW may need to be acquired, or at least contracted under an option, within AMP8. We currently expect the scheme to be delivered via DPC, which would provide compulsory acquisition powers that would defer land costs until after DCO award (AMP9), but if a standard planning application route has to be followed then such powers would not be automatic.

The current working solution at Gate 2 has an estimated total land cost of between £121M and £199M (2022/23 prices), the higher of which is considered an upper estimate. However, the exact parcel of land to be secured and hence the resulting acquisition and compensation payments are unknown at this stage. Further work is planned within the next stage of the RAPID process to confirm the preferred site.

The land costs at Gate 2 are based upon an estimate of the value of the permanent land required (both purchase and compensation) and also the rental of temporary land for compounds, as detailed in Table 3 below.

Table 3 Summary of LTR land costs (Gate 2, working solution), 2022/23 prices (£M)

	Cost £/ ha for land purchase		Cost £/ ha for land purchase + compensation		Cost (£ / ha / year) for land rental				Total Land Costs	
Land Purposes	Lower bound	Upper bound	Lower bound	Upper bound	Lower bound	Upper bound	Construction period (years)	Area (ha)	Lower bound	Upper bound
Permanent works (land and compensation)	£ 13.95	£ 1.95	£ 17.32	£ 29.24				6	£ 103.92	£ 175.45
Temporary compounds (rental)					£ 1.39	£ 1.95	2.5	5	£ 17.43	£ 24.32
								TOTAL	**£ 121.35**	**£ 199.77**

Only the permanent land costs would be required in AMP8. Therefore, a risk allowance of between £103 and 175m (2022/23 prices) is shown in Table 2 above to reflect the level of risk this item may carry. If this early land acquisition were required, then a regulatory mechanism would be requested to enable this to be adjusted to the actual land value, up to £175M, if / when required, without risk to Affinity Water or its customers.

Benefit Estimation

The scheme is planned for commissioning in 2040. Therefore, no benefits will occur in AMP8, whether through water resource resilience, additional DO or environmental enhancement. However, once the scheme is commissioned, then benefits will be seen, in terms of water resource enhancement and the potential for environmental gain. The benefits analysis for the options is based around two key elements – the provision of water resource benefits and the calculation of the natural capital assessment for the schemes.

The overall water resource benefits are the same between the various options.

Water Resource Benefits

When commissioned, the preferred option will deliver a benefit of 100 Ml/d (annual average deployable output) to Affinity Water during a 1 in 500 year drought. This will

provide resilience to AFW's supply network, through enhanced drought resilience and access to a share of the new raw water storage in the upper Thames catchment.

The scheme will also provide 'baseload' resilience, enabling AFW to reduce existing abstractions at sites that impact negatively on vulnerable environmental receptors, such as chalk streams.

Environmental Benefits

The Natural Capital Assessment identified that both of the leading options could cause the temporary and permanent loss of natural capital stocks during construction. Stocks that are likely to be permanently lost include pasture, woodland and active floodplain. However, best practice mitigation (including the use of trenchless techniques) and reinstatement/compensation of habitat means that most natural capital stocks post construction will have no to little change.

An alternative route for both of the pipelines was established for Gate 2 (although not yet costed), based upon optimising natural capital (NC). This alternative would have less permanent loss of pasture and active floodplain. The assessment of BNG calculates that

- For Option 1, LTR, approximately 77 BNG habitat units could be lost due to the temporary removal of habitats during construction, reduced to 57 units for the alternative, optimised transfer route.
- For Option 2, BRI, approximately 129 BNG habitat units could be lost due to the temporary removal of habitats during construction, reduced to 113 units for the alternative, optimised transfer route.

The optimised pipeline routes will be developed further during the next phase. However, overall, the greatest opportunity for minimising the impact on natural capital stocks is available through Option 1.

Efficiency

At present, due to the early stage of the scheme design, there are limited efficiencies built into the scheme costing. However, the concept design of the preferred option does include some inherent efficiencies already in-built, which differentiate it from alternatives, including:

- Integration with Thames Water's Lower Thames Reservoir system, which drives a conjunctive use benefit of 50 Ml/d for Thames Water (see SRO Gate 2 Main Report, section 4) and also avoids the need for a new intake from the River Thames, with associated savings of cost and avoidance of environmental impacts.

- Integration with and shared use of the existing raw water tunnel from Wraysbury Reservoir to Iver WTW, which avoids the need for a new raw water

transfer for the lower 15km of the route (i.e. between the River Thames and Iver) with associated cost and impact benefits.

- Integration with the existing Harefield service reservoir. This is not fully utilised at present by Affinity Water; one compartment of reservoir number 3 is out of service to ensure that water is not retained in storage for too long, as this could give rise to water quality deterioration. It is therefore proposed that the T2AT pipeline feeds into reservoir number 3 and when the throughput of the reservoir rises sufficiently, the unused compartment is brought back into service. Recommissioning of the existing asset to use as part of the preferred option saves the need for a new build service reservoir and hence associated savings of cost, carbon and environmental impacts.

In addition, there are expected efficiencies that will be explored further during subsequent design phases, including:

- Optimisation of the site selection for the WTW to avoid the most costly sites and minimise land take,
- Optimisation of the pipeline route to minimise length,
- Optimisation of the pumping regime to minimise Opex and optimise the balance between peak flow and pipe diameter / pressure.

The savings from these opportunities have not been quantified at this early stage in the design process.

Assumptions Made

The key assumptions associated with the need for the scheme and the size / timing are those inherent within the draft WRMP24, associated with future demands for water. These are not repeated here but may be found in the WRMP24 documentation.

The other key assumptions associated with the scheme capex are:

- Land values are based upon the indicative site selected in the SRO Gate 2 working solution, which will be subject to change as the site selection is reviewed and more detailed appraisal of the sites is completed at the next stage.
- The capacity of the scheme is defined as 15% higher than the average deployable output to be delivered, to take account of differences between peak and average period use and allow for 5% process losses at WTW.
- Operational utilisation as per demand profile shown in Figure 4, which is derived from WRSE PyWR water resources simulation model.
- The water industry in the UK has developed specifications that have been agreed across water companies. These include the Civil Engineering Specification for the Water Industry (CESWI) and the Water Industry Mechanical and Electrical Specification (WIMES). Each Water Company has

generated their own amendments to these documents. In the case of T2AT, it is the Affinity Water amendments that will be applicable. Affinity Water have also developed their own suite of detailed standard specifications and design standards to supplement CESWI and WIMES. For some items a suitable standard specification was not available from Affinity Water. In these cases Thames Water standard specifications have been used for guidance

- Pipe diameter and material for the preferred solution is DN1200 ductile iron pipeline. It is assumed that the raw water transfer main between the raw water tunnel and new WTW will be laid entirely in open-cut trench.
- A conventional water treatment process is proposed consisting of fine screens, clarification, rapid gravity filtration (RGF), ozone conditioning, granular activated carbon (GAC) filtration and chlorination to provide residual disinfection. This treatment process has been confirmed by the water quality risk assessment completed for the SRO Gate 2 submission.
- For the drinking water pipeline section, a DN1200 cement lined ductile iron (DICL) pipeline is proposed. It is assumed that the transfer main will generally be buried with a minimum depth of cover of approximately 900mm in open land and 1,200mm under roads and trafficked areas. Isolation valves would be provided at regular intervals along the route. A drain valve and chamber or flushing point with hydrant will be provided at each low point on the pipeline and an air valve will be provided at each high point.
- A formal asset survey has not been completed at Harefield SR. From the basis of the desk-based assessment completed to date, it is currently assumed that the existing SR can be recommissioned as planned. The configuration of the existing inlet and outlet at SR has been assessed against good practice guidance and a new connection arrangement proposed. However, the final arrangement will need to be confirmed via modelling when flow rates are finalised, including an assessment of the possible impact on the existing system.

Uncertainties and Sensitivity Analysis

The key uncertainties identified at this stage are taken from the top 10 risks in the costed risk register for the preferred option (see SRO Gate 2, Supporting Document A2: Cost Report). They are as follows in Table 4 below.

Table 4 Summary of top 10 risks from base capex analysis (taken from SRO Gate 2 submission)

No	Description	Consequence
1	Land compensation: An unknown number of stakeholders and landowners to engage with for construction of WTW and pipeline.	Cost of stakeholder engagement and land acquisition / compensation is higher than anticipated. Local community challenges. Potential for delays in start of construction. Development may be obstructed leading to delays and extra costs or at worst, non-viability.

No	Description	Consequence
2	Delays to 3rd party granting permits / consents: Delays in obtaining (or failure to secure) discharge / abstraction consents.	Development may be obstructed leading to delays and extra costs or at worst, non-viability. Delays to processing crossing permissions or regulator consents could cause construction to be suspended at local points.
3	Unexpected below ground clashes or constraints applied by 3rd parties - Works within close proximity to other significant infrastructure which that utility deems high risk. Proposed design does not comply with restrictions imposed by the utility company.	Results in re-design, additional approvals, construction can be delayed and additional costs incurred. May alter proposed plans for crossings e.g., route, structural designs (e.g. thrust blocks), hydraulics and / or changes to land noticing. There may be protracted legal negotiations to agree risk liabilities and insurances, requiring additional trenchless crossings and / or re-design of existing.
4	Unexpected above ground point bottlenecks or constraints applied by 3rd parties. Current assumption is that all major crossings can be undertaken using no dig solutions, this may prove to be incorrect.	Results in re-design, programme delay and additional costs.
5	The extent and type of demolition works at the proposed site is not fully understood.	Results in re-design, programme delay and additional costs.
6	Unknown condition of existing assets / pipes: The asset(s) may not be in good condition, or the position / layout may not be as assumed.	Results in re-design (the asset(s) may have to be modified or repaired or the design altered to allow the proposed interface) programme delay and additional costs.
7	Failure to obtain power supply: planned power requirements prove to be inadequate to support the new development or the backup power provision. The estimate for the upgrade to the network is insufficient.	DNO needs to do upstream reinforcement work, on a site which may not have sufficient space to accommodate DNOs equipment and therefore may require more land. Results in re-design, programme delay and additional costs.
8	Integration of new and existing control systems (SCADA) for Thames and/or Affinity are incompatible.	The SCADA system may require to be modified to incorporate mimics of the new WTW. If the existing SCADA system is a legacy system, there is a possibility it would have to be replaced as the software/hardware might be obsolete. Results in re-design, programme delay and additional costs.
9	Stage 1 Preliminary Unexploded Ordnance (UXO) Desk Studies for LTR and BRI indicate the sites are at HIGH risk.	UXO encountered during intrusive ground investigation works or intrusive construction activities resulting in redesign, additional cost, and delay.
10	Unexpected Ground conditions: Currently limited GI available. The type of contaminated Land at WTW and along pipeline route is unknown. Assumption that most of the excavated material can be reused may not be overoptimistic.	Differential settlement due to heave may preclude the use of shallow foundations or require special measures. Current foundation design assumptions not valid. Additional remediation of ground contamination required. Contaminated material excavated from uncharted landfill sites requires suitable handling and disposal. Results in re-design, programme delay and additional costs.

Overall, as shown by Figure 6 above, the total costed risk on the preferred option is £63M.

Optimism bias of 27% is also included, based upon a standard SRO methodology, to account of unknown uncertainties, and then combined with costed risk and base capex to form the total capex estimate for the scheme. Overall, as shown by Figure 6 above, the total optimism bias on the preferred option is £58M.

Sensitivity analysis has not been completed on this project. The option has been used within the WRMP24 options appraisal process, which is subject to various sensitivity and optimisation analyses to choose the draft WRMP24 reported plan.

Third Party Assurance and Audit Trail

All of the Gate 2 documents for the SRO have been through 'three lines' of assurance. 1st line assurance was provided by the consultancy teams who provided the technical reports and 2nd line assurance by member of the partner company teams from across Thames Water and Affinity Water.

3rd line independent technical assurance was completed by Atkins. This included assurance of the main Gate 2 document as well as all of the Supporting Technical Documents such as the concept design report, cost and carbon reports and environmental appraisal reports. Their formal assurance report provided part of the assurance evidence presented to secure Board level approval for the SRO Gate 2 submission.

Option Assessment

Commentary on the Economic Assessment

The economic assessment of the T2AT options has been undertaken within the Water Resources South East (WRSE) best value planning process, the methodology of which is published[4]. This approach assesses the best combination of options to meet the regional need for water in the south-east between 2025 and 2100, taking account of cost (including carbon), environmental metrics, resilience and customer preference. The draft WRSE Regional Plan selects Option 1 of the T2AT within the reported pathway (i.e. selected as preferred). This regional strategy is included within the draft WRMP24 reported pathway.

Various sensitivity analysis has been completed on this, looking at various alternative option configurations, which is all reported in Section 9 of the draft WRMP.

Preferred, Best Value, Option

The T2AT Option 1, linked to the development of a 100 Mm3 raw water storage reservoir in the Upper Thames catchment (SESRO SRO) is a key part of the reported best value solution for Affinity Water. This option provides 100 Ml/d benefit for Affinity water, after 2040.

This is also the T2AT option with the lowest NPV.

Least Cost Option

The T2AT Option 1, linked to the development of a 150 Mm3 raw water storage reservoir in the Upper Thames catchment (SESRO SRO) is part of the least cost solution for the south-east. This option also provides 100 Ml/d benefit for Affinity water, after 2040. The T2AT option associated with this regional least cost strategy is the same as that for the best-value strategy.

This is also the T2AT option with the lowest NPV.

Alternative Option 1

The main alternative to T2AT Option 1 would be Option 2. This would be linked to the development of one of the London Recycling SRO schemes, at either Mogden or Beckton STW and would be required if the SESRO scheme or the STT could not be delivered by Thames Water.

This would be part of an alternative regional strategy that does not involve additional storage in the upper Thames catchment, instead relying on solutions

[4] https://www.wrse.org.uk/media/sy1bu4to/method-statement-best-value-planning.pdf

associated with regional raw water transfer in addition to recycling or desalination treatment. These alternative regional solutions tend to be more expensive, especially for the more extreme future scenarios considered (see draft WRMP, section 9).

For T2AT in isolation, the NPV of this alternative solution is £18M more expensive (see Table 1). However, this does not take account of the purchase price of the water which would be expected to be significantly more expensive as recycling solutions tend to have higher variable operating costs than those associated with raw water storage.

Meeting Affinity Water's Outcomes

The preferred solution (Option 1) forms part of the reported pathway in the draft WRMP24. Therefore, it is an integral part of maintaining the future supply demand balance and Security of Supply Index (SOSI).

Justification of the Preferred Option

The selected T2AT option is:

- The lowest NPV of the assessed options
- Selected in the draft WRSE least cost strategy to 2100, for delivery by 2040
- Selected in the draft WRSE best value planning strategy to 2100 and draft WRMP24 reported pathway, for delivery by 2040
- Critical to maintaining Affinity Water's supply – demand balance helping manage the multiple pressures forecast from growth, climate change and loss of existing abstraction licences for environmental protection.

Delivery Considerations

Related Projects

- Connect 2050 – proposed network upgrades might affect the final design of the connection into the Affinity Water network at Harefield SR.

- SESRO SRO – will provide the source of water for the transfer to Affinity Water, hence forms a critical dependency that is built into the delivery programme.

Delivery Risk Management

The top 1o risks that have been included in the development of the scheme base capex are listed in Table 4. In addition to this costed risk register, the SRO also maintains a register of major delivery risks, which are actively managed to ensure mitigation of risk. These are listed in Appendix 1 below.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

During AMP8, the scheme will still be under development and hence no benefits will be achieved. Benefits will accrue in the longer term, once the scheme is commissioned and operational.

The WRMP, once finalised and published, is subject to annual reporting and 5-yearly updates. The annual reporting will reflect any changes to the need for or feasibility of T2AT. Once developed and operational after 2040, the T2AT would be incorporated into annual reporting of deployable output for the water resource zones within Affinity Water's Central Region.

The T2AT SRO is subject to regular reporting to RAPID. Gates 1 and 2 have been submitted (formal approval and assessment of Gate 2 is currently awaited). A timeline for Gate 3 Checkpoint 1 has been agreed with RAPID. At this point, any changes to the need for the scheme or the timing of when it is required, as a result of consultation feedback on the draft WRMP, can be built into the future delivery programme for the scheme.

Supporting Information

Draft WRMP24

Draft WRSE Regional Plan

T2AT SRO, Gate 2 Submission to RAPID

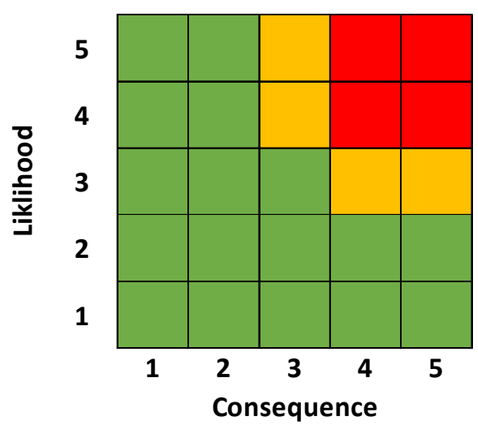
Appendix 1 – Summary of SRO risk register for T2AT

Summary of highest (pre-mitigation) risks within qualitative risk register and associated mitigation proposals

Risk Theme	Details	Pre-Mitigation Risk	Proposed Mitigation	Post-Mitigation Risk
Programme	Dependency between Final WRMP24 publication and statutory DCO consultation - Final WRMP24 should be published (or direction to publish received from SoS) before statutory consultation progressed for subsequent DCO.		Mitigated via proactive stakeholder engagement for WRMP24 and close alignment of the scheme need, timing and scale to Regional (WRSE) Plan and WRMP24. Current critical path programme analysis suggests that delay on final WRMP24 to March 2025 will not delay subsequent DCO submission due to proposed deferral.	
Environmental	Abstraction impacts from T2AT might have impacts on fish habitat and migration habits in the affected reaches in the River Thames or Lee.		Ongoing water quality and aquatic ecology monitoring; Hydrological and water quality assessment and modelling;	
	Abstraction activities/licencing will require impact assessment in accordance with EA guidance		Commence licensing / consenting strategy work, including assessment of required abstraction and discharge licences and collaborative review of Lower Thames Operating Agreement (LTOA) in close liaison with the Environment Agency (including joint scoping).	
	Loss of watercourse habitat and species, hedgerows and terrestrial habitats/impacts on species which provides challenge to achieve 10% Biodiversity Net Gain		Continued ecological survey of River Thames plus initial targeted Phase 1 habitat survey of potential sites and key areas along pipeline corridors	
Planning and Land	Failure to demonstrate a compelling case for the need of compulsory acquisition purposes through a reliable site selection process.		Site and scheme selection will be justified at the scale of the project overall and for the individual acquisition or land rights sought. This work will be supported by the options appraisal undertaken for Gate 2.	
	Failure to secure the Section 35 to treat the project as a NSIP. This may significantly extend the programme due to the large number of third parties involved in TCPA application.		Early engagement with Defra regarding nature and extent of development to include in s35 application and supporting evidence required after Gate 2. Liaising with stakeholders, including affected LPAs and GLA, to obtain support for s35 direction.	
	The DCO application is not accepted for examination.		Extensive pre-application consultations will be undertaken to pass the 'adequacy of consultation' test at the DCO acceptance stage. The DCO application will comprise a comprehensive array of documentation produced by experienced practitioners in accordance with relevant regulations including the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 and the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.	

* Assessment of risk in accordance with a standard 5 x 5 matrix of likelihood and consequence (red = high risk, amber = medium risk and green = low risk): Score of 1 is lowest for each category. Indicative definitions of likelihood and consequence listed below:

Score	Consequence	Likelihood
1	Negligible impact on project	Unlikely
2	Low or limited impact on project delivery or cost	Possible
3	Medium impact on project delivery or cost	Probable
4	High impact on project delivery or cost	Expected
5	Major impact on project delivery or cost	Definite



Affinity Water

Smart Metering

August 2023

Contents

Summary

The installation of smart water meters, to help encourage reductions in the demand for water are a critical part of Affinity Water's Water Resource Management Plan (WRMP) strategy. These underpin all future supply-side interventions.

For our chosen demand management strategy, we have selected our 'high+' strategy. This higher-end strategic approach is the only one that can provide the support required to allow for growth and environmental ambition within the Water Resources South East (WRSE) and Water Resources East (WRE) regions and support the key targets around overall demand, leakage and per capita consumption described in Chapter 4 of the draft WRMP24.

We have committed to challenging and ambitious regulatory targets, in both scale and timing, to achieve a Per Capita Consumption (PCC) of 110l/h/d, reduce Business Demand by 15% and Leakage by 50%, by 2050. To achieve our statutory obligations, we need to take a smart metering-led approach, which uses both company and government initiatives for household demand management alongside market innovation for non-household demand management and relies on investment in new methods for efficient leakage reduction.

The Smart Metering Programme will be a significant step change in terms of number of meters installed, technologies used, volume of meter readings received and as such, it should receive enhancement funding. The way we read our meters, the staggering volume of data we receive, the way we use that data to engage with our customers and drive behavioural change, and to detect and fix leaks will completely change. We'll introduce new customer journeys and upgrade our IT systems and use all that new data to improve our understanding of our network and become more efficient. Current processes and demand management activities will be transformed as the smart meter data will allow us to take a more targeted and effective approach.

This should be included in the AMP8 budget as it forms part of the Final WRMP, approved by Defra. The delivery of this programme within the period 2025 – 2030 is critical to maintain Affinity Water's supply-demand balance.

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	34.20	22.62	21.98	21.98	21.99	**122.77**
Opex (£m)	7.86	6.76	5.76	4.76	4.75	**29.89**
Totex (£m)	42.06	29.38	27.74	26.74	26.74	**152.66**

Drivers	
0.1%	New meters requested by existing customers (optants)
24.9%	New meters introduced by companies for existing customers
0.1%	New meters for existing customers - business
54.4%	Replacement of existing basic meters with AMI meters for residential customers
8.9%	Replacement of existing AMR meters with AMI meters for residential customers
6.9%	Replacement of existing basic meters with AMI meters for business customers
0.3%	Replacement of existing AMR meters with AMI meters for business customers
4.4%	Smart meter infrastructure

Benefits
N/A

Economic Analysis			
NPV Costs (£m) (2025-55)	**188.0**	NPV Benefits (£m)(2025-55)	**235.2**
NPV (£m) (2025-55)	**47.2**	Benefit / Cost Ratio	**1.3**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★	★ ★ ★	★	★ ★ ★		★

Project Description

This business case relates to the implementation of a strategy for the installation of smart water meters, which encompasses households and non-households (commercial properties). This strategy will underpin and inform all the demand management initiatives also proposed for AMP8.

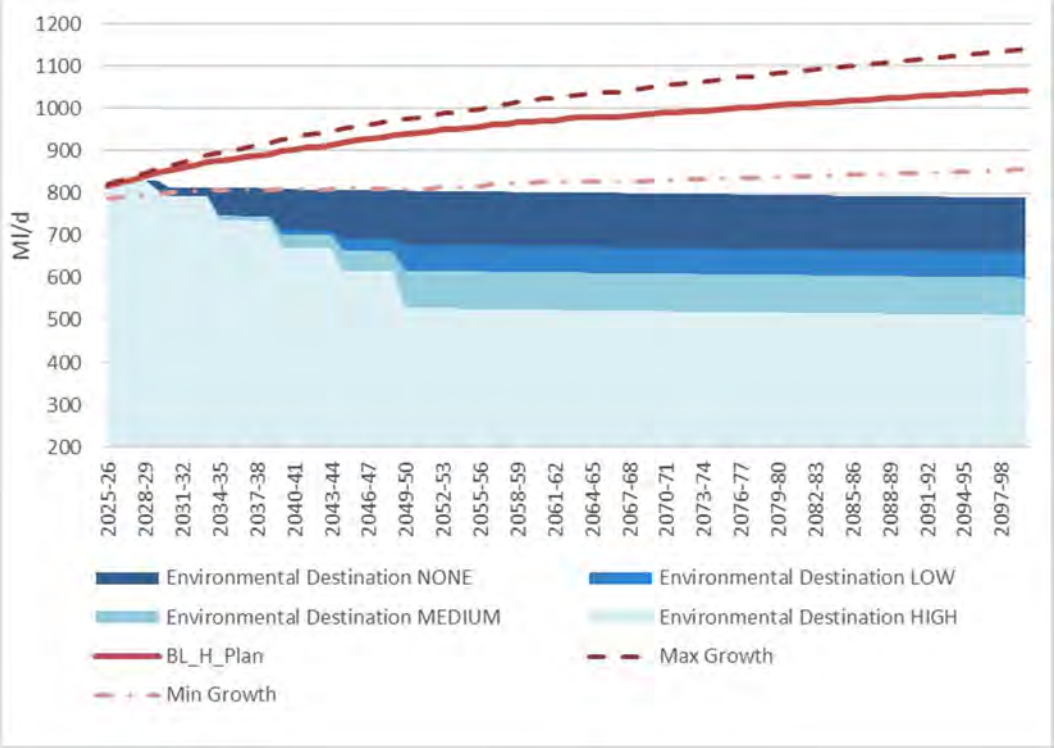
Part of the enhancement funding requested for the smart metering programme in AMP8 will be brought forward and allow us to install 20,000 smart meters in Year 5 of AMP7 through the Accelerated Infrastructure Delivery Project. By doing so, we are aiming to achieve 0.3 Ml/d in water savings, on top of any AMP8 savings, by increasing water efficiency but that will also allow us to learn more about the benefits of smart metering and reduce the delivery risks of our AMP8 rollout.

Project Development

Baseline Assessment

The draft WRMP24 (section 6) reports the baseline forecast supply-demand balance for Affinity Water. This represents the position in a 'Do Nothing' scenario. Figure 6.3 of the draft WRMP24 is reproduced in Figure 1 below, showing the forecast difference between available supply and projected demand for drinking water in Affinity water's Central Region (Water Resources Zones1- 6).

Figure 1 Baseline supply demand and supply for Affinity Water Central region (Figure 6.3 from draft WRMP24)



This is further quantified in the draft WRMP24 as a range of uncertainty, depending on the extent of future growth and future reductions in existing abstraction licences that are required due to environmental pressures. Overall, this uncertainty is quantified as a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050.

This loss of supply needs to be met by a combination of new demand saving and water efficiency measures and by new supply-side options.

Previous metering performance

In 2015, following the outcomes of our WRMP14, we commenced our Water Savings programme, a compulsory metering initiative within our Central communities, set to increase our metering penetrations from 50% to 78% over 10 years to enable us to continue to meet our supply-demand balance. The programme was not extended

to our Brett and Dour communities because metering penetration was already above 70% in both areas.

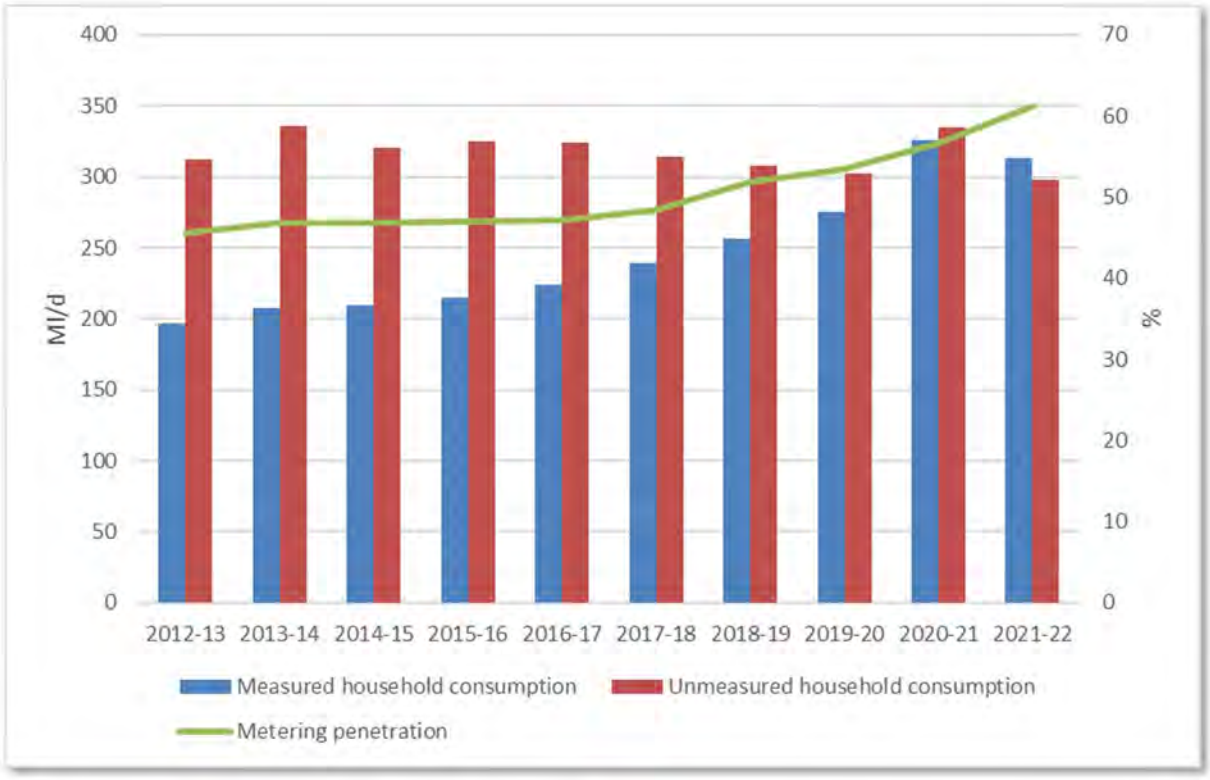
Our evidence shows that customers paying for water via a metered tariff use, on average, 12% less water than customers who are not billed based on their usage (see draft WRMP, section 4).

Figure 2 shows the increase in our metering penetration over the past 10 years. We have seen a shift between the volume of unmeasured consumption we estimate and the volume of measured consumption we have reported on an annual basis, which improves the accuracy of our reporting and forecasting of future consumption. It is worth noting that:

- The consumption in the last two years of the chart is impacted by the changes in demand following the Covid-19 pandemic as explained in the draft WRMP, section 4.

- We have not seen the same level of decrease in unmeasured consumption as we have in the increase in measured consumption because all newly connected properties have a meter installed, so their consumption is added to the measured consumption.

Figure 2 Increase in metering penetration over time and the change in consumption from measured and unmeasured households.



We have continued with our Water Savings Programme throughout AMP7 and aim to achieve at least 73% meter penetration by 2025. We have developed and are implementing our home water efficiency and 'concerted action on water efficiency' initiatives. Combined, these initiatives are seeking to reduce PCC to 132l/h/d by 2025. This reflects the same percentage savings identified in WRMP19, but results in a slightly higher final target due to our starting point in 2020.

Our strategy for AMP8 will be a significant step change in terms of both new smart meter installations which will improve our meter penetration but also smart meter installations in total which will provide us with informative consumptive data to help inform our demand management strategies and encourage behavioural change in our customer base.

Problem Statement and Stated Need / Driver

As mentioned above, there is a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050 and this loss of supply needs to be met by a combination of new demand saving and water efficiency measures and by new supply-side options. The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below. These are all analysed at regional level by WRSE and then translated down to Affinity Water for incorporation in the WRMP.

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[1]. The impacted companies have a statutory duty to plan for this level of future growth.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively. t
Improved drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline?msclkid=88cab670c08011ecb284fa54ecf9127d
[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources?msclkid=245c3d5bc08211ec8b961853f7da9bae

Driver	WRSE Implication
	using drought orders and drought permits up to 2040 but reducing reliance on these measures thereafter.

These drivers for additional water supply are considered after the implementation of reductions to leakage and to water consumption, as prescribed by the Environment Agency's National Framework for Water Resources. The framework requires a 50% reduction in leakage by 2050 and demonstrating our contribution towards a domestic water consumption of, on average, 110 litres per person per day by 2050, while also reducing non-household demand. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply.

Overall, the metering and demand management options are part of the options set that could be used to meet the combined overall need across the south-east of England for an additional 1 billion litres of new water supply per day by 2040, increasing to a maximum of 2.6 billion by 2100 under the highest scenario. These needs drive the imbalance between available supply of water and projected future demands, and why demand management improvements are required to achieve a supply-demand balance.

AMP8 targets

We have committed to challenging regulatory targets, in both scale and timing, to achieve a Per Capita Consumption (PCC) of 110l/h/d, reduce Business Demand by 15% and Leakage by 50%, by 2050. For AMP8, this translates to 25.7 Ml/d saving in household consumption, 2 Ml/d saving in non-household consumption and 22.4 Ml/d leakage reduction. However, these are stretching targets that cannot be achieved using current demand management activities. Smart metering will be the step change that will enable us to optimise existing processes, become more efficient and innovative and meet our supply-demand balance.

In order to achieve our long-term commitments, we need to start as soon as possible. According to our WRMP plan, if we do not start installing smart meters in AMP8, then we will not be able to achieve our 2038 and 2050 commitments. We have reviewed and analysed several smart metering delivery profiles based on costs and efficiencies, but they all start in AMP8. The importance of starting our programme in AMP8 and not delaying the realisation of any benefits is reflected on the fact that we've committed to start even earlier and install 20,000 smart meters in Year 5 of AMP7, through the Accelerated Infrastructure Delivery Project. This will allow us to test processes, update our IT systems and will position us in the best possible place for the full smart metering roll out in AMP8.

Also, results from our customer preference research – see next section, have shown that demand management, including leakage reduction and water efficiency initiatives, is the first preference for our customers in meeting the supply-demand balance. Although this is not as important to our customers as affordability and the

reliability of the plan, it is clear that, in terms of where we need to invest, there is a preference for demand management to be considered first.

This preference is reflected within political, regulatory and industry expectations, which have resulted in the following assumptions and targets being applied to our demand management strategies within the draft WRMP, where we are expected to:

- halve leakage by 2050 and monitor progress towards this (Water Resources Direction 2022, WRPG, Water UK)
- describe and account for our contribution towards reducing personal water consumption to 110 litres of water per head per day by 2050 (WRPG)
- reduce our Distribution Input by 20%, from 2020 levels, by 2037 (Environment Act consultation target)
- include the benefits of efficiency labelling of water-using goods within demand forecasts (DEFRA announcement in 2021)
- work with the water retailers and other stakeholders to contribute to the delivery of the Industry Action Plan to improve water efficiency in the business sector (joint EA-Ofwat open letter to the Water Efficiency Steering Group, 2021)
- consider the implications of different rates of delivery of smart metering (Ofwat PR24 Long-term Delivery Strategy Methodology)
- develop a consistent approach to address leakage on customers' own pipes (WRPG)

These targets and expectations were considered in reviewing the findings of the investment appraisal and confirming both our proposed long-term strategy and the investment required for AMP8.

Allocation of Costs

The costs of the AMP8 Smart Metering Programme described in this business case would be enhancement. This does not include:

- replacement of AMI meters with AMI meters
- meters installed through our reactive replacement and optant programmes, outside of the network which will not be AMI.
- meter and installation costs of meters installed, through our reactive replacement and optant programmes, inside our network which will be AMI (only the technology uplift will be enhancement)
- new meters installed in new developments.

DPC

We did appropriately consider the Smart Metering Programme to be delivered as Direct Procurement for Customers (DPC) and did an assessment based on OFWAT's criteria. However, a Technical Discreteness Guidance published by OFWAT in July 2023 made it clear that smart meter programmes are unlikely to be accepted through a DPC.

The relevant sections of that guidance are presented below:

"The guidance document reflected the responses raised by stakeholders in response to the consultation as well as issues raised by companies through company meetings.

Through the company meetings it became clear that companies were considering whether low value assets such as smart meters, river quality monitors, and SuDs should be bundled together to meet the DPC size threshold of £200m wholelife Totex. It had not been our intention for DPC to be used to deliver these sorts of programmes, for example, we had expected bundling to be applied to larger assets such as multiple smaller treatment works that alone might not meet the size threshold individually but combined would exceed it. Additionally, we had not expected companies to consider a programme of assets with much shorter asset lives than the expected contract length for a "standard" DPC contract.

Following the publication of the guidance document we have undertaken further work looking at the suitability of these sort of programmes for delivery via DPC. Through this work we have identified further criteria that companies should consider when applying the programme scalability test to projects:

- *Bundled project – individual asset value: where a company is proposing to bundle a large number of the same (or similar) type of assets for a DPC project, we would expect the cost of each discrete asset to be at least £5m-£10m. As explained above this is to capture that we expect bundling of multiple projects such as multiple treatment works, large pipelines etc. but are not expecting bundling of much smaller assets such as meters.*
- *Asset life versus contract life: where the average asset life of the project as a whole is materially less than the average expected life of a CAP agreement (i.e., 25 years plus construction) then we do not expect the project to be proposed as a DPC project. This includes smart meters, which have a materially shorter life than the average CAP agreement is expected to have.*

Note the above criteria are intended to be applied to bundled projects of the same (or similar) type of asset/project (e.g., smart meters, river quality monitoring, SuDs) and are not intended to capture assets that might be included as part of a system or as part of single project. "

Research, Pilots, and Technology Development

To help develop the strategy for AMP8, Affinity water commissioned various research studies to evaluate the preferred technological approach(es) to smart meter installation and resulting benefits of the smart metering led demand management strategy.

The evaluation of the preferred technological approach and costs is described in the Stantec Report 'PR24 Metering Strategy Review'. Due to the high cost and complexity of the smart metering programme, we also commissioned PA consulting

to carry out a peer review of those recommendations[3]. These reports concentrated on the following aspects of the potential strategy:

- The potential cost benefits and delivery/benefit risks associated with 'Automatic Meter Reading +' (AMR+) approaches in comparison to the more expensive 'Advanced Metering Infrastructure' (AMI) approaches.
- The level of maturity and reliability of different AMI technologies, and potential strategies that might be used to take advantage of developing more cost-effective methods.
- The feasibility and implications of different rates of delivery, testing strategies ranging from a single AMP (five years), through to a slower rollout over five AMPs (25 years)

Overall, both studies confirmed that 'Advanced Metering Infrastructure' (AMI) represents the best overall strategy. 'Automatic Meter Reading' approaches were only recommended where there is the potential that it could provide the immediate benefits required, whilst allowing some of the more cost efficient, but currently unreliable, AMI technologies to develop.

Detailed discussions with Anglian Water[4] identified the following issues and limitations associated with AMR+ approaches, such as those used by United Utilities:

1) Like Anglian, Affinity Water primarily uses below ground meters within 'APLAS' boxes. This has caused significant loss of data during the more extensive data packet downloads associated with leak alarms and daily use required to target wastage (plumbing losses) and suitable targets for home water efficiency checks (HWECs).
2) Data granularity is much lower, so wastage below 8 l/prop/hr (192 l/prop/d) cannot be reliably detected. This accounts for up to half of detectable leaks (by number). The reliability of detection for larger leaks is also lower, at around 70% compared with AMI.
3) Realistically we will not gain significant, timely insights to enable the extension of our behaviour change programme beyond that achieved in AMP7. The next phase of behaviour change is based on dynamic feedback with customers, which would not be possible using AMR+.

Overall, we estimate that we would only be able to achieve around 3.5Ml/d out of the 8Ml/d in household demand management if we pursue AMR+ rather than AMI in AMP8. This is only predicted to save £20m capex over AMP8, with circa £8m of additional Opex. This does not represent value for money as it would also affect the rollout of our market based non-household demand management strategy, which relies on AMI, and result in reduced leakage detection performance. This would reduce non-household and leakage benefits by 2-4Ml/d over AMP8 and AMP9. This decision aligns with the findings of the industry wide report 'Unlocking Benefits Through Data and Metering: A Case for Investment in AMI Smart Water Metering'[5],

[3] Report 'Affinity Water Metering Strategy Value Review' June 2022.
[4] Pers comm D Spencer, Anglian Water
[5] Frontier Economics & Artesia 2022. Confidential report.

which makes a compelling case in favour of AMI. The main findings are presented below:

"Finding 1: AMI can enable significantly greater benefits for water customers and wider society than AMR. Companies can therefore be more ambitious in both the scale and scope of benefits they expect to achieve through an AMI approach.

Finding 2: Evidence shows that there are also likely to be many wider benefits of AMI such as an improved customer experience, additional customer insight and in helping protect customers in vulnerable circumstances.

Finding 3: The benefits of AMI investments are resilient to high impact future scenarios and AMI shows greater adaptability than AMR.

Finding 4: AMI is a "low regret" investment under an adaptive planning framework."

PA Consulting identified the possibility of generating both customer value and efficiency through a 'hybrid' strategy, whereby the AMP8 period is used to trial and help develop Narrow Band-Internet of Things (NB-IoT) approaches by focusing on streamlining data downloads and enhancing battery life, to the point where it can be reliably used. NB-IoT is an AMI technology that has the potential to provide better coverage, higher quality of data, easier and quicker deployment, in a more competitive price. The remaining of our programme in AMP9 and AMP10 could then be delivered using this potentially more cost-effective strategy.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

Customer engagement has been embedded into our dWRMP24 through the WRSE decision-making process. This has been undertaken by methods described in Section 3 of the draft WRMP24 document, in advance of the formal consultation taking place on this dWRMP24. The preferences customers expressed about different options to solve the forecasted supply-demand deficit have been directly used by the WRSE investment model, and the weights customers attributed to the 'best value' criteria informed the selection of a preferred regional plan, which the dWRMP24 reflects. WRSE will also be conducting qualitative research with a representative sample of customers across the region to assess their overall acceptance of the regional plan in terms of affordability and ambition.

WRSE worked with Eftec, a leading market research agency, who are registered with the Market Research Society (MRS) and used a breadth of techniques to elicit customer views on water resources. They engaged a wide range of customer segments including hard to reach, future and non-household customers and retailers. The methods and sample sizes used were deployed in accordance with good industry practice and were considered by us to be appropriate to inform the production of the dWRMP24 in advance of formal consultation.

Evidence of Customer Preferences

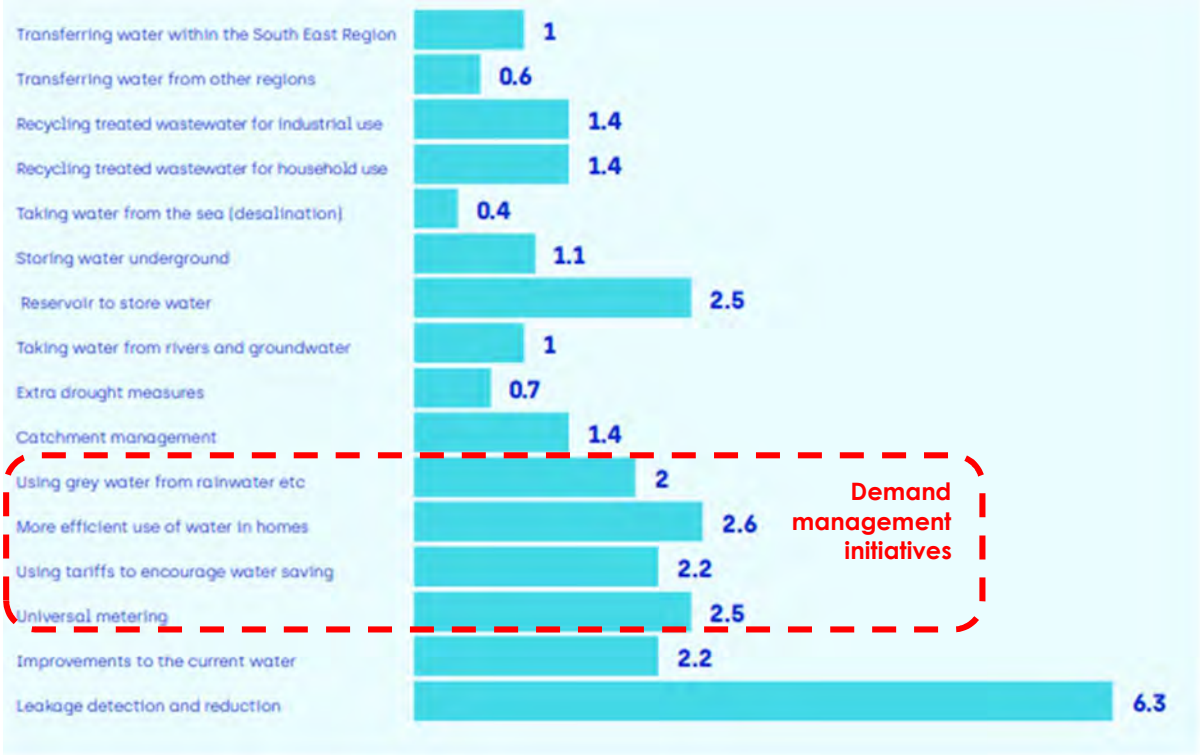
As documented more fully in Section 3 of the draft WRMP, the research showed that, in general, customers are supportive of demand management measures. Moreover, whilst there is support for efforts to save water and reduce usage customers feel that companies and other stakeholders have as much of a role to play as they do (including reducing leakage).

More detailed quantitative research has shown a clear priority order of supply and demand options for customers and the starting point identified that ensuring the current system is efficient was most important. Practically, this means reducing leaks and removing constraints in the water supply network. Secondly, efforts should be focused on being more efficient with the water that is currently supplied and helping customers use less water, along with actions that deliver wider benefits and public value, such as catchment management initiatives. New options to develop supply-side options were third priority.

Figure 3 below shows the results for Affinity Water customers, showing the clear preference for leakage detection and reduction, followed by demand management measures (which are highlighted on the figure, for ease of reference).

Therefore, it is clear that Affinity Water customers are supporting of a water resources strategy that includes prioritised elements of leakage reduction, metering, and demand management, ahead of the development of new supply-side options.

Figure 3 Option preference weighting for Affinity Water customers



Customer protection

The Smart Metering Programme is directly linked to three Performance Commitments: Leakage, PCC, and Business Demand. We have also put together a Price Control Deliverable (PCD) to describe in more detail what will be included in this programme. A PCD is also available for the 20k smart meters we will install in AMP7 through the Accelerated Infrastructure Delivery Project.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

The smart metering and associated demand management strategy is a critical part of the overall WRMP24 strategy. It forms the first part of the strategy, which aims to reduce customer demand prior to the implementation of new supply-side options.

The reduction of demand for water is a key part of the WRMP under all 9 of the adaptive pathways presented in the WRMP.

Adaptive Strategy

The WRMP is presented as a response to 9 adaptive pathways, with different 'futures' influenced by different levels of growth, climate change and future sustainability reductions to enhance environmental protection. The metering and demand management strategy is included in all future adaptive pathways.

As reported in the Thames to Affinity Transfer SRO Gate 2 submission, there is a high level of risk and uncertainty associated with the effectiveness and timing of government led water efficiency measures, on which the WRSE draft Regional Plan and draft WRMP24 are based. These will add pressure to demand if they are not delivered in line with WRSE assumptions. The adaptive pathways in the WRMP enable the success of different levels of metering and demand management to be simulated, to ensure that the future strategy is responsive and adaptable to such future change and uncertainty.

Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

When developing our demand management strategy to address supply-demand balance issues, we used four stages of evaluation to ensure that we developed a strategy that represents best value to customers and the environment, within the context of the WRMP, whilst seeking to meet government and regulatory expectations. This process comprised of the following four stages of assessment:

- **Stage 1:** broad evaluation of options and development of three candidate strategies for regional investment appraisal
- **Stage 2:** regionally based investment modelling to evaluate the cost efficiency of the three strategies.
- **Stage 3:** comparison of strategy cost appraisals against regulatory expectations and our AMP8 targets
- **Stage 4:** cost and delivery refinement of the preferred strategy

Stages 1 and 2: Options Appraisal and Initial Strategy Development

This stage began with the assessment of the range of options that could be available to us, which we analysed to generate broad strategies for investment appraisal.

This approach was different to the one used for our supply options. Individual demand options provide very small yields in comparison to supply options and are generally highly interactive. For example, the inclusion of metering, particularly smart metering, will allow for better targeting of other water efficiency options which in turn would significantly change the performance and cost. Given the number of different combinations of small options considering individual demand management options within the larger investment modelling has in the past caused the model to become unstable. Instead, a very similar process was taken to appraise the individual demand options but in an isolated, demand management optimisation model.

For demand management and leakage, we initially started with the WRMP19 extensive list of demand options (see draft WRMP, Appendix 4.5) and considered this alongside the latest technical guidance to identify a shortlist[6] of options based on the following criteria:

[6] See draft WRMP, Appendix 4.4 for further information on the initial options long listing and screening.

- Previously identified options - we reviewed previously identified unconstrained options and compiled a list of potentially feasible options, plus a rejection register of options not included in the feasible list.

- Local considerations and understanding from WRMP19 – for example, what has Affinity Water been funded for in AMP7, what were the feasible and rejected options in WRMP19, what fits with Affinity and the wider regional water resources strategy.

- Experience from recent projects – in particular, the Water UK project (delivered by Artesia) which considered long-term pathways for reducing demand, based on a shortlist of interventions agreed by a steering group, comprised of water industry and regulatory representatives.

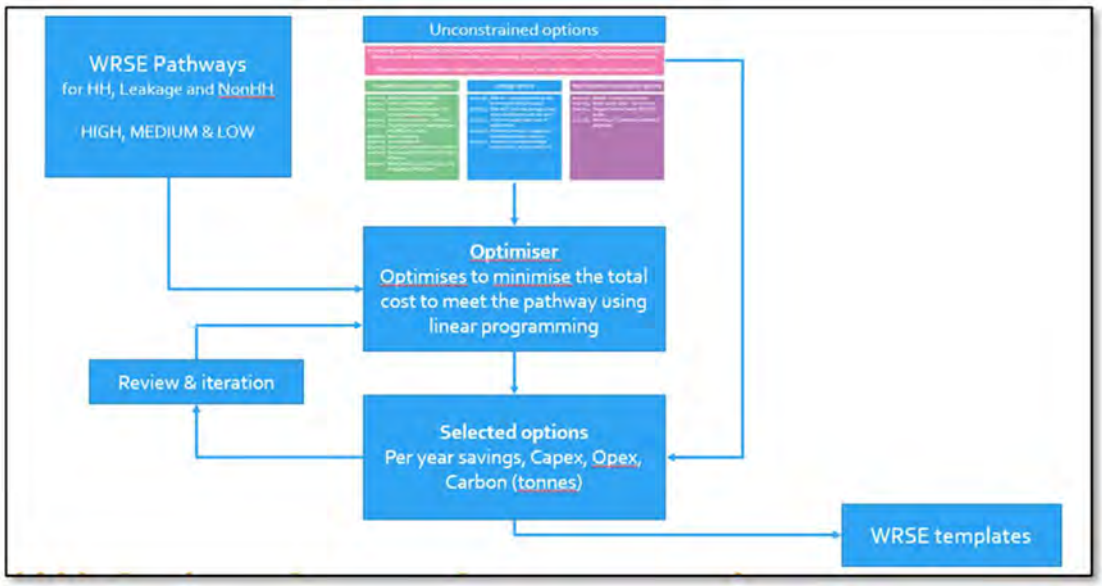
Draft WRMP24, Appendix 4.5 provides further information regarding the supporting work, including the appraisal stages and a summary of the options (including the option characteristics, how feasible the option is and the associated benefits).

This assessment identified the best combination of options that could be used to meet the 'high', 'medium' and 'low' demand management pathway targets (PCC and leakage) agreed with the WRSE and WRE regional groups. This stage was important to ensure that the strategies we generated for investment appraisal by the regional groups represented the most cost-efficient way of achieving the targets. The collation of options into strategies was facilitated by an 'Optimiser' tool built specifically for Affinity Water. This tool examined household demand management alongside leakage reduction benefits because many of the options (such as smart metering) affect both elements, therefore, they needed to be considered in an integrated assessment.

This Affinity Water Initial Demand Management Optimiser tool allowed us to evaluate component options based on total direct costs, and then societal and environmental costs (including carbon costs), with benefits (yield) based on the reduction in either household consumption or leakage that each option can deliver (as a volumetric saving). A summary of this process is provided in

Figure 4igure 4 below.

Figure 4 Summary of Initial Demand Strategy Optimisation



This analysis confirmed that better consumption information gathered through smart metering combined with some form of analytical intelligence is required to support the development of demand management options to the level required by policy makers and our supply-demand challenge. Smart metering data alone will not achieve the savings, and therefore needs to be interpreted to achieve the demand reductions. This common data and analytics process, integrated with the smart meters in combination with property and network data, will support intelligent demand reduction actions in households, District Metered Areas (DMAs) and the trunk main system.

For our non-household (NHH) customers, which include businesses and organisations that use water and can be supplied via retailers (as opposed to households, who are directly supplied by wholesale water companies) we initially considered a range of interventions that would be delivered directly by Affinity Water to save water. We currently supply 72,148 non-household properties and, of these, 61,389 are billed across 26 retailers. We also supply three major airports (Heathrow, Stansted, and Luton), football stadia, universities, care homes, shops, restaurants, and cafes, as well as large office complexes and industrial estates. Through smart metering, we will be able to target some properties for bespoke initiatives because of better information gained through the higher data granularity, an approach that is both efficient and collaborative and does reflect the market-led solutions that are being discussed through industry-wide NHH demand management groups. We therefore adopted an approach, where we install 20k NHH smart meters and deliver bespoke and targeted solutions, whilst implementing collaborative market-based approaches in the medium to long term.

Our leakage strategies were developed using the RPS Strategic Optimisation of Leakage Options for Water Resources (SoLow) tool. Similar to the process for the household demand strategy, the SoLow tool was used to find the cost optimal strategy required to deliver our Leakage targets, rather than to develop those

targets. This model represents industry best practice for leakage strategy development, and includes all options for active leakage control, customer-side leakage reduction from smart metering, mains replacement, DMA enhancement options and other associated activities.

Based on the above analysis, we developed three broad strategies for inclusion in the initial stages of the regional investment modelling. The options appraisal concluded that the most cost-effective way to deliver the three strategy levels, (low, medium, high) was through Integrated Demand Analytics (IDA) - i.e., smart metering with associated behavioural change and water efficiency visits. Critically, this modelling concluded that the IDA rollout should start in AMP8 (2025) and, in effect, the costs to reach the relevant targets were higher if IDA is delayed until AMP9 (2030).

The difference between the low, medium, and high+ scenarios effectively related to the degree of proactive activity (home visits, influencing initiatives) undertaken. We considered introducing new tariff strategies[7] as they could have some impact on WRZs 4, 5 and 6, but the benefits are very uncertain and small (<1Ml/d), with potential 'double counting' of savings we are already targeting through our AMP7 'super high users' initiative[8].

These three levels of effort and cost were developed to test the strategic level trade-off between affordability and achievement of different levels of demand management, based on least-cost modelling. Because the regulatory and customer expectations described in the customer research sections previously, it was clear that there were aspects of the 'low' and 'medium' strategies that would not meet those expectations. Nevertheless, all three strategies were tested within the regional WRSE investment model to determine whether the 'high' strategy represents a cost-efficient way of solving our supply-demand deficits.

The evaluation of the cost effectiveness of the three levels of demand management was carried out by WRSE using the investment tool described in Chapter 8 of the draft WRMP. This was carried out at a relatively early stage in the process, as part of the development of the emerging regional plan, which was consulted on in January and February 2022. This allowed us, via WRSE, to gather feedback via consultation on the findings of the least-cost investment appraisal, in relation to the three demand management strategies. This feedback was summarised in the WRSE Response to the emerging regional plan[9].

[7] 'Tariff strategies' involve pricing structures that increase the volumetric charge for water once household use passes certain thresholds. It is intended to discourage large summer use of water but can be difficult to design due to the need to avoid unintentionally penalising large families or vulnerable customers.

[8] The 'super high users' are household customers with very high consumption, which are theoretically a key target for tariff-based demand management. However, they tend to be wealthy, so tariffs are not necessarily effective. We are therefore using more collaborative approaches to try and reduce their water use and help meet our current 2025 PCC targets.

[9] Response to the emerging regional plan

As part of our SEA work, we have also undertaken an environmental assessment of these demand management strategies and further information can be found in our SEA report supporting the draft WRMP.

Stage 3: comparison to regulatory requirements and targets

We have derived a set of targets and expectations for AMP8, based upon our regulatory requirements and customers' preferences. These have been presented previously in the Project Statement and Drivers sections above. These targets and expectations were taken into account in reviewing the findings of the investment appraisal from Stage 2. We then used the appraisal outputs in the optimisation process described below.

Stage 4: Programme Optimisation

The final assessment of options available to inform the household demand management strategy involved both the triangulation of evidence to support our forecast benefits for the preferred strategy, and detailed options assessment of the supporting smart metering strategy to identify the best value approach for customers. We used a variety of data sources to evaluate the benefits of activities associated with smart metering, including:

- national studies carried out by UKWIR.
- savings evaluations from our AMP7 Water Saving Programme (metering programme, behavioural change, and home water efficiency checks) and AMR meter trial.
- savings evaluations from Anglian Water, Thames Water, Southern and South East Water.

A description of the evidence base used to refine our household strategy and define our preferred plan is provided as an Appendix to the draft WRMP. In summary, we divided the savings associated with the smart metering strategy into four main components:

1. **Behavioural change.** Evidence from other water companies that have been doing smart metering for a few years has shown that, on average, customers use less water when they are billed on a smart meter. The smart metering data will allow customers to understand their usage patterns better and will also enable them to reduce their consumption.

2. **Water reduction behavioural change campaign** will bring additional water saving benefits by harnessing the smart metering data and capabilities combined with the Com-B behavioural change campaign model. This will allow us to educate, empower, persuade, and target customers with tailored, motivational messaging and simple solution-based opportunities to participate in sustained water saving.

   Access to improved, timely, specific smart metering data will give us greater understanding of a customer's position on their water saving journey and allow us to use smart/hyper-targeting media techniques & platforms to plan, deliver, optimise, and track effectiveness of messaging and reductions in use.

The integrated communication campaign will be delivered across multiple channels including creative advertising (e.g., TV/radio/digital media/social media), PR, well-known credible ambassadors, influencers, campaigning partnerships, and eCRM.

We will also be able to harness this customer knowledge with additional behavioural insights and learnings (Kantar behavioural research & water reduction behaviour change campaign tracking research) to nudge and encourage them to make even more daily changes. The smart metering customer behavioural insights and learnings will also allow us to optimise and improve the effectiveness of the communication and messaging for the wider customer base as we roll out the smart metering programme through AMP8.

We will also be able to employ the data to support and ensure delivery of the benefits to the reduction targets in domestic plumbing loss programme. By identifying and delivering timely motivating messaging to customers likely to be losing water through plumbing losses and encouraging them to take steps to resolve the problem quicker.

3. **Reduction in wastage**, where we use smart metering data to identify customers that are likely to be losing water through plumbing losses, 'leaky loos' etc. The forecast savings are estimated using a realistic delivery rate that ensures totals do not exceed 25% (which is the maximum likely proportion of properties with significant leaks, identified through Thames Water and other data, combined with Thames Water data for benefits of leak repairs.

4. **In-home water efficiency,** which relates to the benefits of proactive contact and home visits to customers to educate them on water usage, help them understand their consumption patterns and install water-efficient devices. We have run a Home Water Efficiency Checks (HWECs) programme during AMP7 and have used customer segmentation by group to help target visits, but, as we increase the number of HWECs, we will need to move into less favourable groups. To maintain the same level of efficiency, we will use smart metering data that will provide us with better visibility of customers within water user groups that appear to be using more than the norm but also allow us to take a more targeted approach. Experience from Thames Water has shown that targeting customers with genuine high consumption compared to a blanket approach based on segmentation data can offer significant savings and efficiencies. We are expecting smart metering to transform the way we do our HWECs, as this will be a step change on how we deliver the programme but also on how we realise the benefits.

There is also a fifth component which relates to our Business Demand Management strategy:

5. **Business water efficiency,** which relates to the benefits of proactive contact and visits to our non-household customers. Our AMP7 pilots and the recent experience of Thames Water has shown that targeted audit-based approaches, where we work directly with certain types of large institutions or multiple sites for a single hospitality company, are effective at reducing

demand. These examples have shown that savings of up to 10,000 l/d are feasible, although the number of suitable organisations is limited. We have therefore allowed for 200 collaborative projects across AMP8, with an estimated 2% saving on non-household DI.

Clearly, the strategy for demand management must be considered and delivered in close integration with the smart metering strategy, as one can be seen to drive and influence the other. When refining the strategy, the evaluation concentrated on how cost-effective different approaches and technologies might be in relation to these three elements, and how practical and affordable different delivery rates and strategies might be. The technical reports used to support this assessment are referenced in the draft WRMP. They concentrated on:

- how well lower cost 'Automatic Meter Reading +' (AMR+) approaches[10] might be in relation to the three areas of saving, in comparison to the more expensive 'Advanced Metering Infrastructure' (AMI) approaches.

- the level of maturity and reliability of different AMI technologies, and potential strategies that might be used to take advantage of developing more cost-effective methods.

- the feasibility and implications of different rates of delivery, testing strategies ranging from a single AMP (five years), through to a slower rollout over five AMPs (25 years).

For our non-household strategy, we used two sources of information to define the short and long-term ambition and possible options:

- Our own experiences of sector partnership-based approaches (smarter holiday homes and beverages) to understand how these specific opportunities can be rolled out to relevant businesses within AMP8.

- A retailer engagement project for longer-term, market-led opportunities. During AMP7, we have carried out two pilot initiatives with large businesses in the entertainment and food and drink sectors, which have allowed us to understand how co-working with larger, sector-specific companies can be used to deliver effective reductions, based on the installation of water-saving devices.

Selected Options

Do Nothing, Option 0

In light of the customer research completed for WRMP24, ongoing and previous industry research, the requirements of the Environment Agency's Water Resource Planning Guidance and our experiences from highly successful metering initiatives

[10] AMR+ uses similar meter stock to AMI, and records key outputs such as daily usage, continuous night use (i.e., signs of plumbing losses). However, there is no infrastructure to allow automatic transmission of data to a central point, so the data must be collected through 'drive by' downloads.

during previous AMP periods, doing nothing to develop a smart metering strategy was not considered a viable alternative for AMP8. Therefore, this option was not considered.

Preferred, Best Value, Option 1

The "High +" Strategy

Our main analysis of alternatives and trade-offs focuses on the options available to us around smart metering and their role in the refinement of our 'high' household demand management strategy. We also consider the implications of potential government initiatives to support demand management, which transform our 'high' demand management strategy into the 'high+' strategies used by WRSE and WRE.

As described in Appendix 4.5 of the draft WRMP, our decision making to derive our preferred smart metering strategy considered the evidence from service providers and other water company experiences to date, and balanced this against affordability, opportunity, and delivery risks. A summary of the key alternatives that we considered are described in Table 1

Table 2 below. The resulting preferred strategy described below is derived from this appraisal.

Table 1 A summary of the smart metering alternatives considered.

Strategy Element	Alternatives Considered	Strategy Considerations and Trade-offs
Timescale for delivery and coverage	Delivery timescales between 5 years and 25 years. Meter penetration between 85% and 95%	Very fast delivery (5-10 years) may not be practical taking into account the large volume of meter installs (280k or 140k per year) and any supply chain (meter suppliers and installation contractors) limitations, but delivery over a very long time (20-25 years) may mean we lose the ability to defer large supply schemes and we will not be able to achieve our PCs. We are aiming for 90% meter penetration by the end of our Smart Metering programme in AMP10. Lower coverage means we will not be able to meet our targets while trying to achieve higher coverage will make this programme unsustainably expensive. Experience from the current programme indicates that there are 10% of properties that are very hard to meter and/or would likely require internal installations.
Approach to smart metering	Consider strategies based on AMR+ and AMI (see Chapter 4), with hybrid approaches based on deferral of AMI	AMR+ is lower cost and can theoretically support the water efficiency and wastage reduction benefits, only missing out on behavioural change benefits. However, detailed discussions with Anglian and Thames Water indicate that there are data download issues associated with our primarily below ground meter stock that mean benefits will not be as good as AMI based approaches.

Strategy Element	Alternatives Considered	Strategy Considerations and Trade-offs
Technology Preferences	Examined different types of 'fixed network' technologies as well as alternative NB-IoT approaches	Technology asset class strategy appraisals concluded that 'NB-IoT'[11] could be the most cost-effective approach, but there are concerns about reliability and whole life cost effectiveness due to battery life issues. Innovation is ongoing in this sector so this may change over time.

Given the alternatives assessment provided above, we determined that delivery should be phased over three AMP periods as the best value approach, for the following key reasons:

- It is a practical rate of delivery: c.75k smart meters per annum on average, based on the 377k we are planning to install in AMP8, although still at a significantly rate higher than we have achieved to date.

- Delivering over a period of 15 years is fast enough to ensure that the benefits are in place before the rate of delivery of environmental destination might be accelerated within the Central communities (2040-50), whilst at the same time it is conservative enough allowing us to take advantage of technological developments and hence reduce costs to customers (see below).

Based on our current experiences of customer engagement and access to properties, this proposed smart meter rollout would cover the 90% of customers targeted by the current manually read meter installation programme.

In terms of the approach, our cost effectiveness analysis showed that deferring AMI[12] would only save around £12m in AMP8 (2025-30), but with an opportunity loss of 5-9Ml/d savings, and risk of delay to the non-household programme. In other words, the amount of money saved per Ml/d of benefit lost is much smaller than other investments that we could do to make up the shortfall, so it is not cost effective to try and defer the programme. We have therefore adopted a full AMI strategy as our preferred programme.

With regards to the AMI network and communication technologies, we've engaged with meter suppliers, network providers, external consultants and industry experts and concluded that NB-IoT is not currently reliable or cost effective enough for rollout in AMP8 (2025-30). Our preferred final strategy therefore begins with fixed networks; Long Range Wide Area Network (LoRaWAN) or even a proprietary network (e.g., Flexnet or Wise) in that initial period, but at a slightly slower rate (c.377k meters) that concentrates on the District Metered Areas (DMAs) where fixed network approaches are likely to be most cost effective. This will improve affordability to customers and allow the development of our customer interface and information

[11] 'NB-IoT' refers to 'narrow band – internet of things' and effectively relies on devices that are installed on meters that connect directly to mobile phone networks. 'Fixed networks' rely on radio transmission to multiple receiving masts that are installed and dedicated to the smart metering network.
[12] Advanced Metering Infrastructure (AMI) refers to the ability for Automatic Meter Read (AMR) meters to automatically transfer data to a central point.

processes at a manageable rate. However, we will not be locked in a specific technology, and we'll continue engaging with the industry looking for new options and innovations. If NB-IoT becomes a more mature, proven, reliable, and cost-efficient technology, our plan is then to move over to NB-IoT for the remaining 10 years of the rollout.

Our preferred strategy for smart metering and associated demand management is shown in Table 2 below.

Table 2 draft WRMP24 smart metering and demand management strategy

Component	Delivery Period			
	AMP8	AMP9	AMP10	AMP11&12
Total AMI meters (nr)*	377,165	526,138	523,231	-
Newly metered properties (nr)*	72,602	71,752	71,718	all new households
Number of HWECs in period	76,800	90,000	90,000	170,000
Benefits of behavioural change (Cumulative Ml/d by end of AMP)	4.8	15.2	28	39.3
Benefits of HWECs (Cumulative Ml/d by end of AMP)	2.11	4.9	7.25	13.74
Benefits of wastage/ plumbing losses (Cumulative Ml/d by end of AMP)	0.87	2.4	4.26	6.4
Benefits of water reduction behavioural change campaigns (Cumulative Ml/d by end of AMP)	17.9	17.9	17.9	17.9
Total cumulative benefit (Ml/d at end of AMP)	25.7	40.4	57.4	83.3

On top of the PCC savings presented on the table above, in AMP8, there is an additional 1.82 Ml/d Leakage saving and 2Ml/d Business Demand reduction.

Alternative Options

The alternative metering options that were considered are all based around adjusting the speed of deployment of smart meters, to achieve the required level of penetration. Detailed cost and benefit assessment was carried out by Stantec, and peer reviewed by PA Consulting, looking to optimise any potential smart meter rollout and to assess the resulting leakage and PCC benefits associated with a range of scenarios. Such alternative scenarios included:

- Option 1: install 120k AMI ready meters in AMP7 and install and commission 200k household and non-household smart meters per AMP for 5 AMP periods.
- Option 2: install 120k AMI ready meters in AMP7 and install and commission full smart meter coverage over 5 AMP periods.

- Option 3: install 120k AMI ready meters in AMP7 and install and commission full smart meter coverage over 3 AMP periods.
- Option 4: install 120k AMI ready meters in AMP7 and install and commission full smart meter coverage over 2 AMP periods.
- Option 5: install 120k AMI ready meters in AMP7 and install and commission full smart meter coverage over 1 AMP periods.
- Option 6: install 120k AMI ready meters in AMP7 and install and commission full smart meter coverage over 4 AMP periods.
- Option 7 (preferred strategy): install 120k AMI ready meters in AMP7 and install and commission full smart meter coverage over 3 AMP periods in the ratio of 400k, 500k and 600k per AMP period respectively.

The results of that analysis, including costs against leakage and PCC benefits are presented in Table 3 further below.

Option Assessment Approach

Economic Assessment

We have rigorously followed a robust methodology for the economic analysis using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPV's and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies, and combine projects for analysis as necessary.

We also use our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit, and dis-benefit calculations.
- Net present values calculated over a 30-year period.
- Options presented in 2022/23 cost base.
- Benefit valuations and metrics have followed Ofwat's methodology for performance commitments, WINEP methodology for environmental and community benefits, and supported by industry standard sources for other areas.
- In a few areas we have used our own willingness to pay valuations based upon our own research and other published research. This is either where there is no other information, e.g., low pressure, or to support sensitivity studies.
- All benefit metrics and valuations are held in our Service Measure Framework
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits
- Use of the RCV and the Spackman approach for capitalisation
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy

Cost Estimation

Analysis of costs for all scenarios

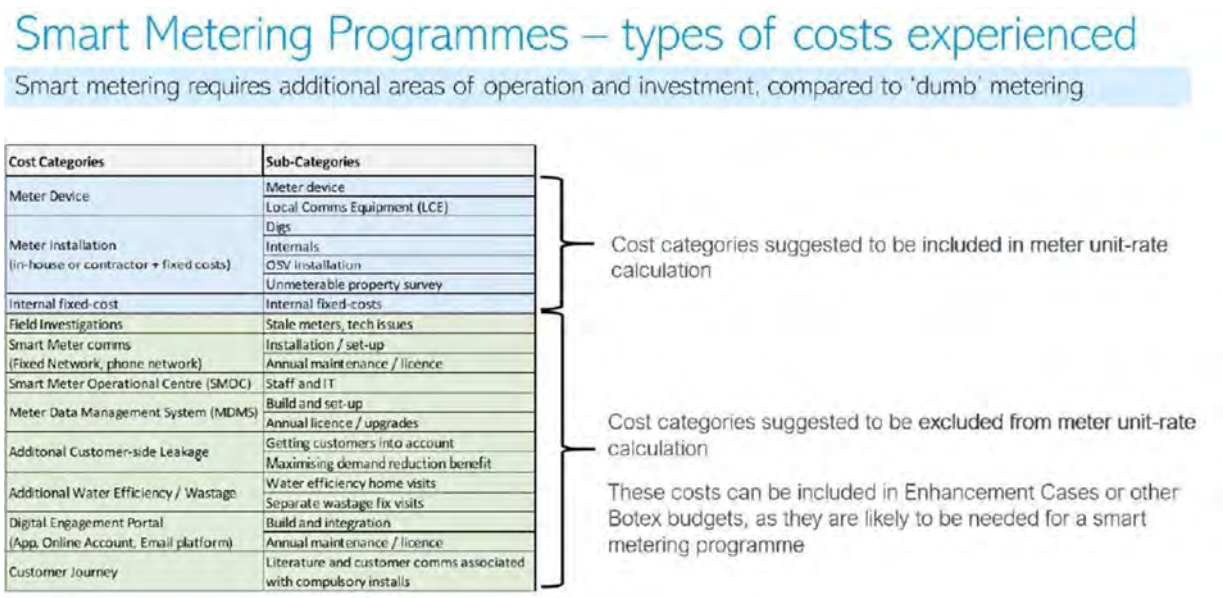
Costs were estimated for each of the scenarios developed as part of or WRMP. The estimates include all costs such as: product purchase; installation; battery life; expected failure rates for equipment; and the associated reactive replacement and

proactive replacement costs. They also include mobilisation costs for the long-term smart metering programme.

They are built-up from a wide-range of Affinity Water and wider industry experience of previous meter install programmes and are based upon the proposed technologies. We worked with Stantec on this analysis as they have experience from doing similar work and setting up smart metering programmes with other water companies Overall the costs are considered to have a high-level of confidence.

There will be a range of installation costs resulting from different locations, and building types etc. These are summarised below:

Figure 5 Range of costs analysed for smart meter programme (source, Stantec, Sept 2022)



The relative baseline costs of the different programmes (prior to peer review and subsequent adjustment) can be seen in Table 3 below.

Table 3 Leakage and PCC savings and unitised costs of the different smart meter strategies considered for AMP8 (source, Stantec, Sept 2022), cost base 2019/20 prices.

Scenario	ML/D Leakage saving	ML/D PCC Saving	Combined Cost per ML/D
1	28.66	13.21	£6,069,457.24
2	37.00	16.68	£6,003,584.80
3	37.96	17.19	£5,652,371.61
4	37.26	18.31	£5,529,499.62
5	38.30	18.15	£5,450,156.72
6	36.84	18.07	£5,766,445.21
7	37.26	18.06	£5,634,454.23

Analysis of costs for preferred scenario

Following peer review by PA Consulting (June 2022) and subsequent internal reviews, the costs of the smart meter programme were adjusted including the addition of some previous under-estimated or overlooked costs, such as for the 50% of newly metered properties and 35% or replacement jobs that would require a dig and new boundary box, based on our AMP6 and AMP7 performance. We also increased overheads to include procurement costs and resources and used updated costs from our current installation contractor and meter supplier.

The costs of the preferred strategy, as documented in the draft WRMP24 are summarised in Table 4 below. These are the enhancement costs and include household and non-household smart meter installations, smart meter infrastructure and the smart metering-based demand management initiatives.

Table 4 Costs of the preferred smart meter strategy (source, Affinity water, draft WRMP Demand Management Technical Appendix), all costs in 2022/23 prices

Component	Delivery Period			
	AMP8	AMP9	AMP10	AMP11&12
Total AMI meters(nr)	377,165	526,138	523,231	-
Newly metered HH properties (nr)	72,602	71,752	71,718	all new households
Cost of HWECs in period (m)	£6.5	£8.7	£9.1	£14.4
Cost of Plumbing/wastage fixes in period (m)	£1.8	£2.2	£2.7	£4.2
Cost of Behavioural change campaigns in period (m)	£11	£5	£5	£10
Total metering cost in period (m)	£152.67	£178.21	£179.12	£48.8

Specifically, for AMP8, there is a cost of £1.39m and £2m for Leakage and Business Demand reduction respectively, which are included in the total metering costs presented above.

It should be noted that costs associated with new properties were excluded from the enhancement expenditure, as this forms part of the developer services costs.

Benefit Estimation

We have focused our benefit quantification on the use of our Service Measure Framework benefit metrics and have used the associated benefit valuations published in the Ofwat and WINEP methodologies and other sources.

We have also considered other benefits such as cost savings, additional revenue, and other performance metrics where they are applicable. We have focused on identifying and estimating the most material benefits and used these to determine

the financial valuations. In general, the fewer material benefits are quantified or discussed. Therefore, our economic justification is intrinsically conservative by nature and simplistic and transparent in approach.

In some areas, we have had to estimate the major metrics. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits diminish over time? As such, we have developed a profile for each benefit over time.

The overall benefits delivered by our demand management strategy are shown in Figure 6 below. The impact from government-led initiatives is included where appropriate. This is forecast to result in a reduction of per-capita consumption (PCC) as shown in Figure 7.

Within AMP8, the proposed strategy is forecast to deliver a benefit of nearly 30 Ml/d by 2030, in combination with our leakage and metering strategies. This will drive a relatively small short-term reduction in PCC, but enroute towards meeting our 2050 targets.

Figure 6 Overall benefits from our demand management strategy (source: draft WRMP, section 9)

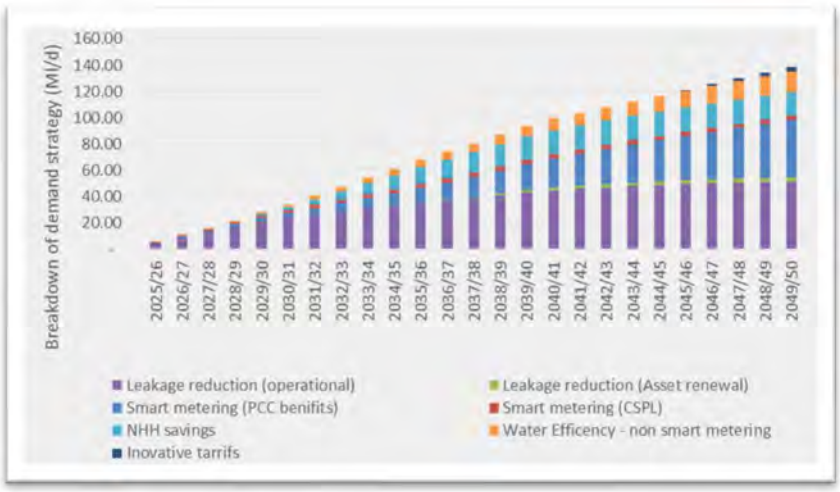
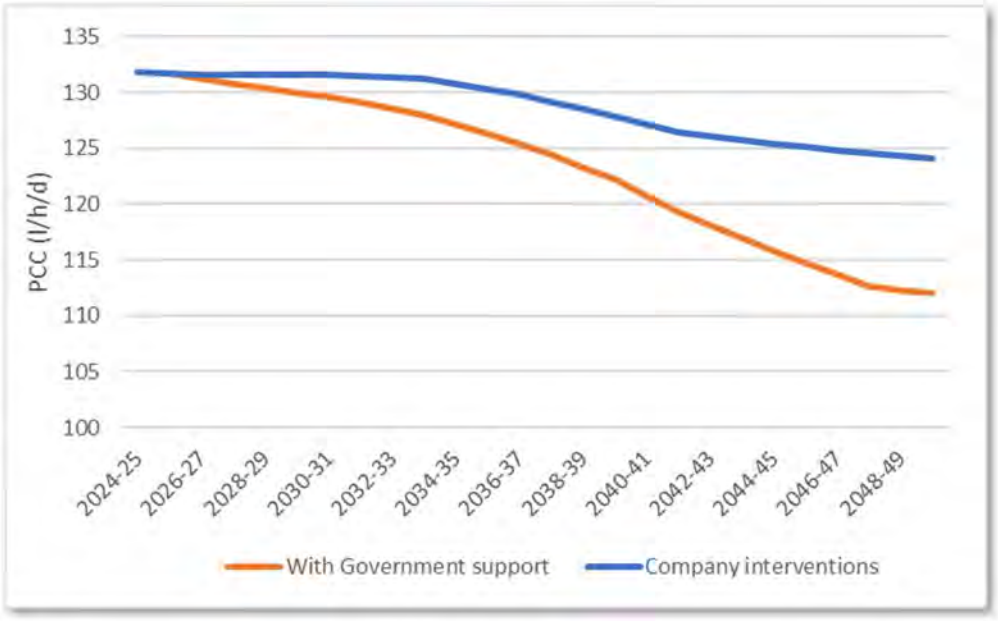


Figure 7 Company level NYAA PCC with and without government support (source: draft WRMP, section 9)



The overall benefit of the household smart metering strategy by 2050 totals 83.3Ml/d, once behavioural change, wastage reduction and home water efficiency checks have been included. This equates to a PCC reduction of 17.4l/h/d (assuming housing plan growth figures) compared to where PCC would otherwise be. The graph above only indicates an 8l/h/d absolute reduction, but that is because falling occupancy rates tend to drive an increase in PCC by just over 1l/h/d per AMP (6l/h/d by 2050).

The shift from AMR to AMI smart meter technologies carries a range of benefits. We believe these are crucial to helping adjust behaviours ands to drive down PCC in a long-term and sustainable way. The business case for the shift to AMI is noted in **Error! Reference source not found.** below, extracted from the Stantec Metering Strategy report (June 2022).

Figure 8 Benefits to the water company of switching to AMI from AMR meters – Stantec Report

Smart meters provide substantial service benefits for customers, helping them manage their water usage and reduce water bills. Smart meters give consumers accurate, real-time data about the amount of water they are using which, studies suggest, consumers currently underestimate substantially. Smart meters also benefit consumers by enabling better customer service from water providers through the real-time data provided. These benefits include: the ability to read meters remotely and on demand, such as when property's change owners, more accurate billing, and an improved ability to deal with general issues and enquiries. In addition, smart meters can record additional information, such as data relating to the quality and temperature of the water, which can help to give a more complete and in-depth understanding of overall water quality. Smart meters are particularly helpful for vulnerable customers, such as the elderly, who have specific usage needs. For example, the real-time data supplied by smart water meters can be used in combination with algorithms and other technologies to monitor remotely the consumption pattern of vulnerable users. When consumption differs from the normal pattern it may indicate the possibility that the user is unwell and care providers can then be notified.

Smart meters will also drive improved outcomes for the industry's operational resilience.

- The real-time information provided by AMI meters, in contrast to AMR meters which deliver data much more infrequently, make AMI systems far more effective in tackling issues with water supply and usage.
- AMI meters provide reports on the amount of water going into properties within the network on an hourly basis – data which is reported back over a radio network to the water company once or twice a day for analysis. This real-time information and accurate measurement of water across the delivery chain means leaks can be identified much more quickly, often within a 24- or 48-hour period.
- Supports delivery of ODIs and other KPIs such as C-MEX by identifying continuous flow, reducing leakage, water balance prioritising cost ALC cost efficiencies, data for PCC reduction campaigning and keeping customers informed of customer or network side serviceability issues.

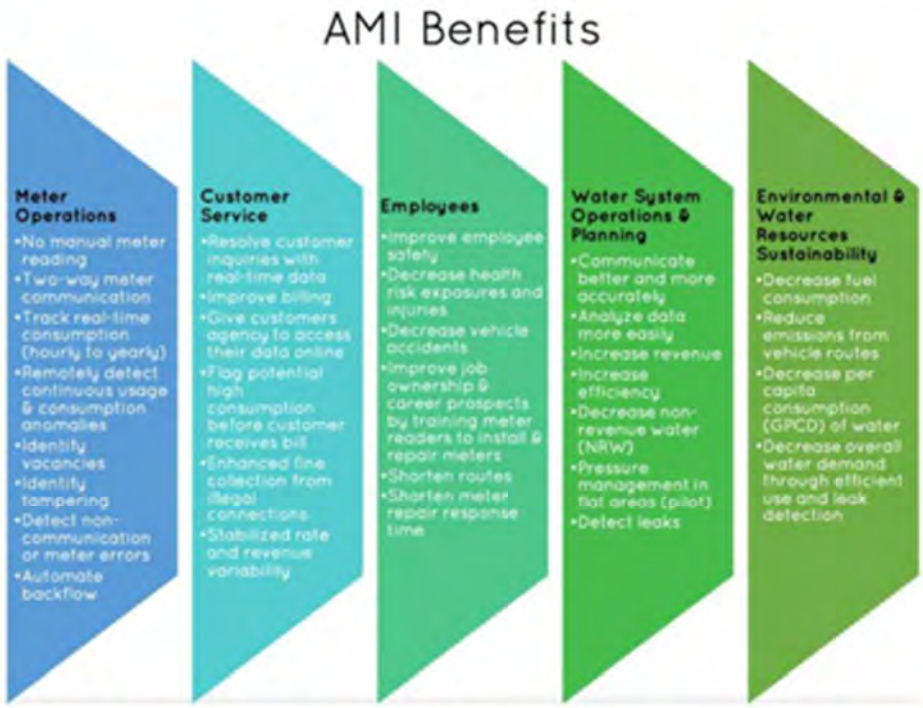


Figure 23: Benefits to the water company of switching to advanced metering infrastructure (AMI) from conventional or drive-by advanced meter reading open (AMR) meters.

Assumptions Made

We have made a number of assumptions in our economic analysis. These are designed to be conservative by nature to account for the significant uncertainties that are inherent in the benefit monetisation. By making conservative assumptions and undertaking sensitivity analysis, we can be confident that the overall analysis is sufficiently robust to support the investment decisions.

Uncertainties and Sensitivity Analysis

The most significant uncertainties are with the benefit metrics, valuations and the timing and duration of the benefits. We have used the Ofwat and WINEP valuations wherever possible and have focused our attention on the metrics and the benefit profiles.

We have made conservative estimates for when benefits will start and finish, and how they increase and decrease over time. As such, our economic analysis is inherently conservative by nature. We then consider the benefit metric for sensitivity studies as this becomes the most material uncertainty in the analysis.

Within our spreadsheet we use the goal seek function to determine the value of a metric of concern that would be required to make the scheme cost beneficial. This provides a sensitivity check on the metric and enables commentary on the reasonableness of the economic analysis. We have run sensitivity checks on all significant benefit metrics.

Third Party Assurance and Audit Trail

The metering strategy was originally derived by work undertaken by a contracted professional consultancy, Stantec. This was technically assured by Affinity water in-house technical experts.

A further peer review and update was commissioned by Affinity Water to verify the scope and costs of the metering strategy, by PA Consulting. This was again technically assured by Affinity water in-house technical experts. All the metering costs and installation numbers were entered in the OFWAT Data tables and were audited by PWC and Atkins respectively. The final strategy is considered, therefore, highly robust, and fully assured.

Option Assessment

Commentary on the Economic Assessment

The choice of the preferred smart metering strategy was developed as part of the integrated demand management strategy. A range of scenarios was considered, and a preferred strategy selected based on the relative balance between costs and benefits, but also taking account of deliverability.

The initial optioneering cost benefit analysis indicated that Scenarios 4 and 5 would provide the best benefit based on price, however, there are impracticalities in the scale of meter installation required to achieve these benefits over 1 or 2 AMP periods, largely due to logistical and resource constraints. The scenario that strikes the right balance between cost, benefits and deliverability is Scenario 7 which was identified to be the most beneficial and practical and would align with current regulatory expectations. As a result, Scenario 7 was selected as the preferred option going forward. This is a phased rollout of smart metering to achieve 90 % meter penetration by the end of AMP10 (2040). Scenario 7 was subsequently amended to improve its efficiency, align with the wider WRMP targets, and allow us to meet our PCC, Business Demand and Leakage Performance Commitments.

Scenario 7 (preferred strategy) is now as follows: install and commission full smart meter coverage over 3 AMP periods in the ratio of 377k, 526k and 523k per AMP period respectively.

This preferred strategy was considered as an option into the WRSE regional water resources Best Value planning process and for the draft WRMP. The best value planning process selects the best value combination of demand-side and supply-side options to resolve the supply-demand planning problem at a regional and at a company level from 2025 – 2100.

Our primary economic analysis has been to assess the preferred and least cost options from the wider WRMP and Smart Metering strategies. We understand that the smart metering programme will support the PCC and Business Demand reductions and will also reduce meter reading costs. We have identified other, secondary, benefits such as increased customer awareness on making demand reductions, improved customer service and satisfaction, energy savings from abstracting, treating, and distributing less volume of water, reduced CO2 emissions and fuel consumption from reduced car journeys to read meters, and reduced use of chemicals to treat the water. Our economic assessment focuses only on the reduced demand and costs to justify the investment.

Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It also shows that the initial AMP8 programme investments are highly cost

beneficial. The AMP8 programme should also be seen as a first step in a much longer programme which will deliver much more significant benefits over the long-term.

The economic assessment forecasts total NPV benefits of £235.19m compared to the NPV costs of £187.97m. The benefit cost ratio is 1.25 and the overall NPV is £47.21m.

The most significant cost element of the AMP8 programme is the number of installations that will require a dig. Approximately 50% of the household CAPEX is allocated to installation jobs requiring a dig because a new or replacement boundary box is required. Also, c.20% of all the installation jobs will be through our Universal Metering Programme (UMP) and a lot of the jobs will be difficult and above average expensive as we are approaching meter penetration rates above 75%. However, even though costs are high, the benefits clearly outweigh them. As mentioned above, this programme will transform our understanding of our network and the way we engage with our customers. The high granularity of meter readings and the timely manner in which we will receive them will allow us to improve all our demand management activities. The result of that will be a highly cost beneficial programme which will set us in the right path to meet our supply demand balance over the next 25 years.

The long-term viability of the smart metering programme has been assessed as part of our Long-Term Delivery Strategy and discussed further in the submission.

Least Cost Option

We looked at several different options and did a cost benefit analysis for each one of them. There is an almost linear relationship between the number of meters we install and the total cost of the programme. Essentially, the fewer meters we install, the lower the cost of the programme. However, the number of meters selected for our preferred option strikes the right balance between a programme that can be realistically delivered whilst ensuring that the meter penetration and PCC targets can be achieved. Anything less and we would fail our AMP8 Performance Commitments but also compromise our plan to achieve a sustainable supply-demand balance.

Alternative Option 1

There was no alternative option in this analysis.

Alternative Option 2

There was no second alternative option in this analysis.

Meeting Affinity Water's Outcomes

This business case supports Affinity Water's objectives to reduce demand over the long-term and to implement technology to reduce costs. Implementation of the preferred option is a key part of the smart metering strategy, which is in turn, a critical part of the draft WRMP. This integrated approach depends on all elements to be implemented to achieve Affinity Water's future water resources strategy.

The smart metering investment will reduce the PCC and Business Demand to help meet the short-term performance commitment targets and builds capability for future smart metering programmes to meet the longer-term targets.

Justification of the Preferred Option

This project is part of our much longer-term goal to ensure sustainable water resources. The economic assessment has shown that the preferred option is the best value option for customers, as it maximises the meter penetration and the demand reductions that are achievable within the AMP. It also builds capability for future smart metering activities to meet the longer-term performance commitment targets.

Conservative estimates of the benefits have been made. The analysis shows that the AMP8 programme is cost beneficial and will meet the regulatory targets for demand reduction and meter penetration. The investment includes significant mobilisation costs, which impact on the cost benefit of the AMP8 investment. When the longer-term programme is considered, then the overall programme will become even more cost beneficial, as the mobilisation costs are spread over the longer-term.

The programme consists of five fundamentally different types of investments, and these have different cost benefits:

- **Replacement of basic meters with smart meters:** Proactive replacement of existing aging and/or underperforming meters with smart meters. These are highly cost beneficial, due to the combination of reduced visual meter reading over the long-term, the reduction in demand and the increased accuracy of the meters. This includes both household and non-household installations.
- **New smart meters installed on new developments:** These are the most cost beneficial as we get the leakage and demand reduction benefits, and the costs are covered by the developers.
- **New optant smart meters installed for existing customers:** There is a low number of these installations, but they can be very expensive jobs requiring digs or modifications to customers' pipework.
- **New selective smart meters installed for existing customers:** These are the least cost-efficient installations. They usually provide the highest demand benefits but at least 50% of them require a dig, and a lot of them prove to be difficult to complete.

- **Upgrade of existing AMR meters**: These are also highly cost beneficial installations where we use existing assets and replace the AMR communication modules with AMI modules that allow the meters to connect to our network. This way we get all the benefits of a smart meter with minimal costs.

It is important to put the analysis into the context of the wider strategy and how best to achieve sustainable water resources. It makes strategic sense to reduce demand as much as possible and to do this in the most cost-effective way. Smart metering has been shown to reduce demand and hence ensure the long-term supply demand balance and in the most cost-effective way of all the available options.

As mentioned above, the preferred option is exactly the same as the least cost option. This shows that the preferred option is best value, as meter penetration is maximised, it allows us to achieve our regulatory requirements and has a high benefit realisation.

Overall, the preferred option, has been chosen as it will achieve the required meter penetration and the demand reductions. It will provide other benefits such as cost savings from less meter readings and enhanced awareness to customers to reduce demand. It is deliverable and builds the foundations to achieve the longer-term strategy for smart metering, demand reduction and sustainable water resources.

Delivery Considerations

Related Projects

The smart metering strategy is integrated with the Demand Management strategy. Delivery of the resulting PCC savings will require integration between the smart meter installation programme, the water efficiency strategy (HWECs, plumbing losses and non-household initiatives) and associated behaviour change programmes. The combination of these three elements will be required to deliver the overall forecast demand reductions.

Monitoring and Reporting of Benefits

The WRMP, once finalised and published, is subject to annual reporting and 5-yearly updates. The annual reporting will reflect any changes to the effectiveness of our integrated Demand Management programme. The resultant savings from demand management activity would be incorporated into annual reporting of supply-demand balance for Affinity Water.

Risks and special factors

This investment is not driven by factors outside of management control. There are known risks such as delays in network deployment due to council agreements or delays in meter manufacturing due to shortage of components and increased demand, but these are all inside management controls.

Also, we are not proposing any special factor adjustment for this enhancement case.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Supporting Information

Stantec, Sept 2022, "Affinity Water, PR24 Smart Metering Strategy Review", Final Report

Affinity Water, Nov 2022, draft WRMP, Demand Management Technical Appendix

PA Consulting, June 2022, "Affinity Water Metering Strategy Value Review"

Affinity Water

Connect 2050

September 2023

Contents

Summary

We have undertaken extensive customer research to support the development of our WRMP. We have found that our proposals to share water between regions are positively regarded by customers. Customers have firmly established views on the priority of transfer options. These are less favoured than both demand options and supply options such as reservoirs, which customers feel bring added value to the community. Largely, transfers via river or canal are preferred to pipeline options because they are perceived by customers to have wider benefits and fewer negative impacts.

However, customers do have various concerns about transfers, including cost, construction disruption, environmental impacts, energy use and lack of benefits to local communities. Overall, customers support the provision of additional water supplies, the transfer of water across the region and taking measures to reduce demand and leakage. We have used our research to optimise our WRMP programme against these views.

At its core, our WRMP strategy ensures a resilient supply of water for customers over the long-term. The WRMP process in the current cycle has seen a step change in approach by taking a much more regional approach, facilitated by the regional water resources planning groups. Aside from the basic ambition of the WRMPs to balance supply and demand in the longer term, an implicit ambition in this round is to work outside the traditional water company boundaries and where possible move water around the country from places of surplus to areas in deficit.

Our long-term resilience strategy is to ensure that our network and treatment facilities are resilient to a range of external risks including the impacts of climate change, pandemics, third-party activities etc. A first step in this process is to ensure that our asset health is sufficient to continue to operate and deliver service to customers. As such, we have developed a base investment programme to continue to maintain and improve the health of our existing assets. As part of this we have started to fully adopt Ofwat's Operational Resilience Framework and incorporate the principles and methods into our asset and corporate planning processes. We have already improved our asset health reporting, data capture and analysis, and we intend to make further significant improvements in this area in the future to improve how we identify and prioritise our future investments for resilience.

We have started base programmes of work to maintain the resilience of our assets, which continue to mitigate against the risks that we currently face. These works will continue through AMP8 and beyond as part of our long-term strategy.

Our Connect 2050 programme is a long-term programme of work that increases our ability to transfer water supplies across the region. It supports two key strategic drivers and aligns and integrates our WRMP, WINEP and resilience strategies.

Firstly, Connect 2050 is a critical part of our WRMP that ensures that we can supply to customers over the long-term and therefore meet our statutory obligations. In order

to support the fundamental changes in our strategic resources and our ambition for WINEP sustainable abstraction reductions, we need to start to implement our Connect 2050 programme in AMP8, to strengthen our network to transfer resources across our supply area.

Secondly, it provides an opportunity to strengthen the resilience of our water supply capabilities against the emerging risks of climate change and third-party risks, by providing additional storage capacity. We continue to invest in our base resilience programmes, but we have now been able to identify the emerging risks and where and how best we can enhance our assets for the future and have added these to our Connect 2050 Programme.

In essence, we can future proof the water supply against these emerging risks as we meet our WRMP and WINEP statutory requirements. As such, our Connect 2050 programme represents the most cost-efficient way to implement the network modifications required.

Our extensive modelling and optioneering has identified a discrete set of network enhancements, to ensure that the wider scale supply-side options can be successfully implemented to deliver the required supply resilience and security. These include network upgrades, capacity enhancements and treatment additions. Estimating the risks and how best to mitigate these is complex. We have, therefore, undertaken economic assessments in each area to select the best value solutions and optimise the level of investment in AMP8. Our economic analysis builds upon our Risk and Value workshops that undertake in-depth assessments to better understand the risks and how best, and when, to mitigate these.

We have assessed and optimised the Connect 2050 investments. We have selected the best value option, which is also the least cost option. We have shown that it is better to invest less and focus on the highest risk areas first, and then invest more in later AMPs when our understanding has improved. We have found that all of our preferred options are cost beneficial. We have considered options to increase the investment levels, but, although these are also cost beneficial, the uncertainties and level of benefits are not shown to be as attractive for customers.

We appreciate that it is difficult to forecast climate change and other risks and so our approach and investment has been conservative. We believe that the best way to mitigate against these risks is with an on-going long-term programme of work that focuses on the more immediate and highest risk areas and learns and adapts over time.

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	8.66	13.00	21.66	26.00	17.34	**86.66**
Opex (£m)	0.38	0.38	0.38	0.38	0.39	**1.91**
Totex (£m)	9.04	13.38	22.04	26.38	17.73	**88.57**
Drivers						
84.2%	Supply demand balance improvements delivering benefits starting from 2031					
15.8%	Resilience					
Benefits						
Loss of Supply Capacity (Ml/d)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**77.0**	NPV Benefits (£m) (2025-55)			**93.0**
NPV (£m) (2025-55)		**16.0**	Benefit / Cost Ratio			**1.2**
Six Capitals						
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**	
	★ ★ ★	★	★ ★		★	

Project Description

The Connect 2050 programme has been developed after assessing the ability of the existing supply network to handle water resource challenges in the short, medium and long terms. Its purpose is to recommend and implement any necessary enhancements in a timely and efficient sequence over the next 25 years. For clarity, the costs associated with Connect 2050 are divided between the Water Resources Management Plan (WRMP) and the Resilience driver.

These challenges drive Connect 2050 to consider how to incorporate new sources of water from the Strategic Regional Options (SROs), how population growth changes current operations and the impacts of sustainability reductions on moving water between existing demand centres. The Connect 2050 project aims to capture the impact of both the new environmental destination and SRO requirements, building on the previous Supply 2040 project. The options appraisal is holistic, adaptive, and aimed at providing the 'least regrets' investments for AMP8. It considers future uncertainties around growth, environmental destination, and climate change, and has been used in an iterative way with the WRMP investment modelling when considering the strategic development of new water resources.

Connect 2050 is crucial to the initial years of the WRMP, as it enables the transfer of surplus resource from WRZ6, which is predicted to be in surplus in AMP8, into WRZs 1-5, which have a forecast deficit of 38 Ml/d in AMP8. The strategic aim of the Connect 2050 may be summarised as:

- Increase the outputs of our Wey treatment works by 40 Ml/day
- Transfer an additional 38 Ml/day from Wey (WRZ6) to the rest of central region (WRZ1 – WR5)
- Improve strategic transfers by laying additional booster pumping stations and trunk mains interconnectors within WRZ1 to WR5 ((Misbourne (WRZ1), Colne (WRZ2), Lee (WRZ3), Pinn (WRZ4) and Stort (WRZ5)) so the deficits at local level are met
- Increasing storage capacity within WRZ5 and WRZ7

The Connect 2050 resilience projects in AMP8 include the addition of 20 Ml (total) of treated water storage, at two strategic locations in already vulnerable Water Resource Zones. These investments are resilience enhancement expenditures for AMP8. Additional storage is also part of our WRMP for AMP11 to support growth after the implementation of the AMP8 Connect 2050 scope. Our WRMP plans for additional storage at Hadham Mill in AMP11 are contingent on completing the 20Ml project in AMP8.

- The addition of 10Ml of treated water storage at the Hills site, alongside the existing single cell with a capacity of 18.2 Ml. The existing cell underwent substantial refurbishment during AMP7 under base funding. This would result in a total storage capacity of 28.2 Ml at the site
- The addition of 10Ml of treated water storage at the Hadham Mill site, in conjunction with the existing single cell of 2.3 Ml and the proposed WINEP SR driven 10Ml cell proposed in the WINEP business case. This would lead to a total proposed storage capacity of 22.3 Ml at the site

These investments fortify our water supply network and improve its ability to handle future challenges, ensuring a more resilient and sustainable water resource management system. The reason for proposing this investment in AMP8 is to mitigate the impact of climate change. This investment carries low regret, as it focuses on improving resilience in the weaker areas of our network. It is a prudent decision as we prioritise the lowest-cost option while continuously monitoring the impact of climate change on the service we provide to customers.

The investment has been accelerated to AMP8 to enhance resilience for customers within our two most vulnerable Water Resource Zones, in the event of extended period of high demand. Because of climate change, periods of high demand on the water distribution network can happen at any time throughout the year, triggered by events such as heatwaves or freeze-thaw conditions, often with limited advance notice

We have selected the most suitable carbon option in accordance with PAS2080 guidelines by leveraging our existing assets and considering the whole-life cost implications. Additionally, we have prioritised the most financially efficient route for new trunk mains while minimising the need for additional pumping.

Note: All the schemes under the umbrella name of Connect 2050 are necessary to meet our statutory WRMP and agreed Sustainability Reduction (WINEP) requirements, except for the Hills 10Ml Storage Cell, which serves 100% resilience purposes in AMP8.

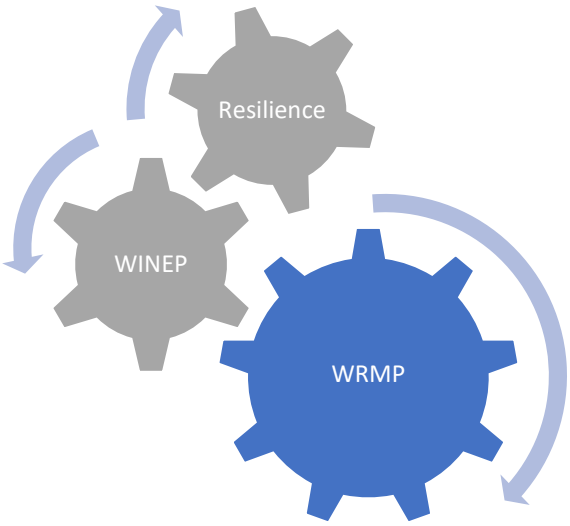


Figure 1: Connect 2050 - Optimised solution to deliver WRMP, WINEP sustainability abstraction reductions and Resilience needs

Table 1 - List of Connect 2050 Projects (the projects covered by this business case are highlighted in bold)

Ref.	Scheme Name	WRMP	WINEP Sustainable Reductions	Resilience	Main Driver	Business Case
WRZ6-DO	Increase DO Wey area	✓	✓	✓	WRMP	C2050-WRMP
IC 6-4 A	Egham to Iver Interconnector	✓	✓	✓	WRMP	C2050–WRMP
ST1	Midway North (Stanwell Moor) BPS upgrade	✓	✓	✓	WRMP	C2050–WRMP
IC 2-1A	Watford to Heronsgate interconnector	✓	✓	✓	WRMP	C2050–WRMP
WRZ1 – DO A	Blackford Group treatment requirements - PFAS	✓	✓	✓	PFAS – raw water	PFAS at Blackford
WRZ1 – DO B	Blackford Group treatment requirements – Turbidity	✓	✓	✓	WINEP	WINEP SR
U4A	Harefield to Harrow interconnector		✓	✓	WINEP	WINEP SR
U1A	Heronsgate to Bovingdon		✓	✓	WINEP	WINEP SR
WR3 - R	Local Resilience scheme WRZ3		✓	✓	WINEP	WINEP SR

Ref.	Scheme Name	WRMP	WINEP Sustainable Reductions	Resilience	Main Driver	Business Case
TWS-5 A	Treated Water Storage at Hadham Mill 50% of 20Ml (one 10Ml cell)		✓	✓	WINEP	WINEP SR
TWS-5 B	Treated Water Storage at Hadham Mill 50% of 20Ml (one 10Ml cell)			✓	Resilience	C2050-Resilience
TWS-7	Hills 10Ml Cell - Resilience			✓	Resilience	C2050-Resilience

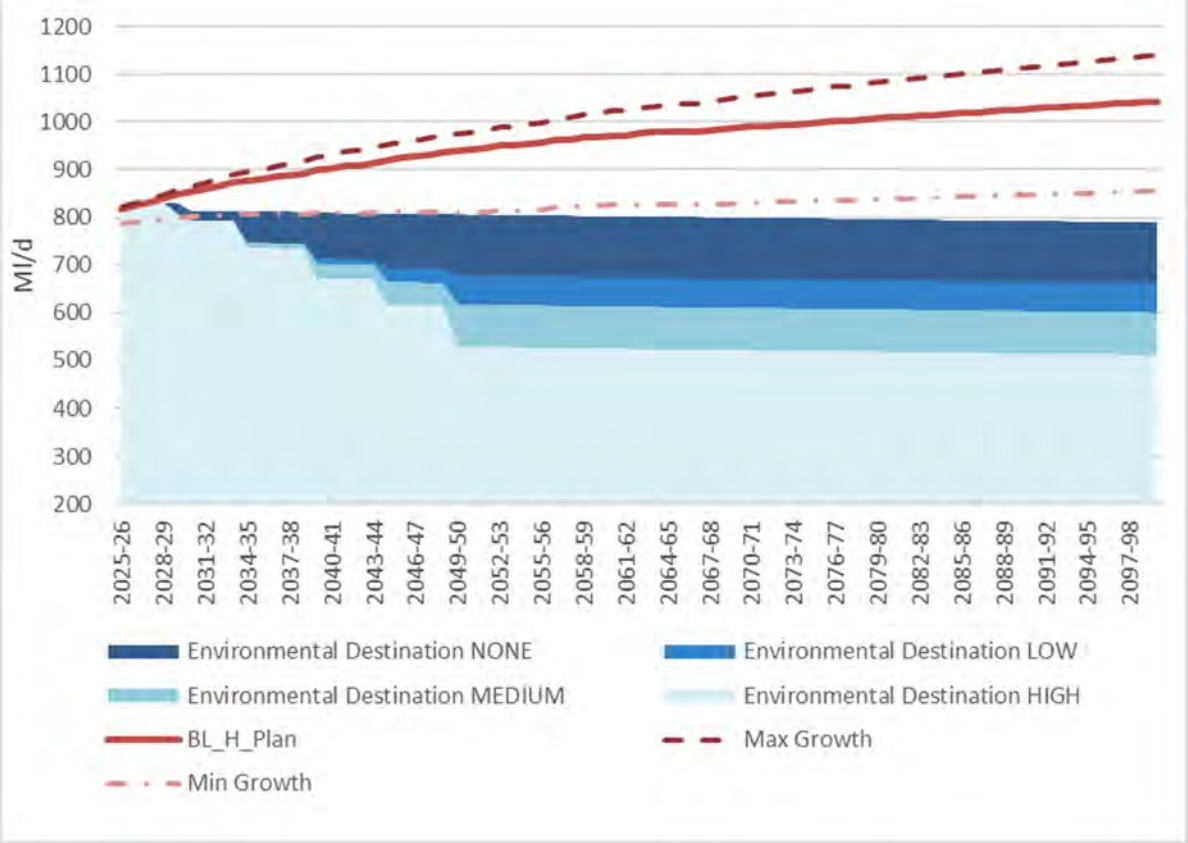
Project Development

Baseline Assessment

The baseline assessment for this enhancement case is based purely around the existing network. The case is associated with enhancing the network to ensure that future changes to existing and new sources of water can be efficiently accommodated within the distribution network to serve customers. Therefore, the baseline position that has been modelled is the current network, including funded AMP7 upgrades.

The baseline assessment of the supply-demand balance is provided by the WRMP. The WRMP24 (section 6) reports the baseline forecast supply-demand balance for Affinity Water. This represents the position in a 'Do Nothing' scenario. Figure 6.3 of the draft WRMP24 is reproduced in Figure 2 below, showing the forecast difference between available supply and projected demand for drinking water in Affinity water's Central Region (WRZ 1- 6).

Figure 2 Baseline supply demand and supply for Affinity Water Central region (Figure 6.3 from draft WRMP24)

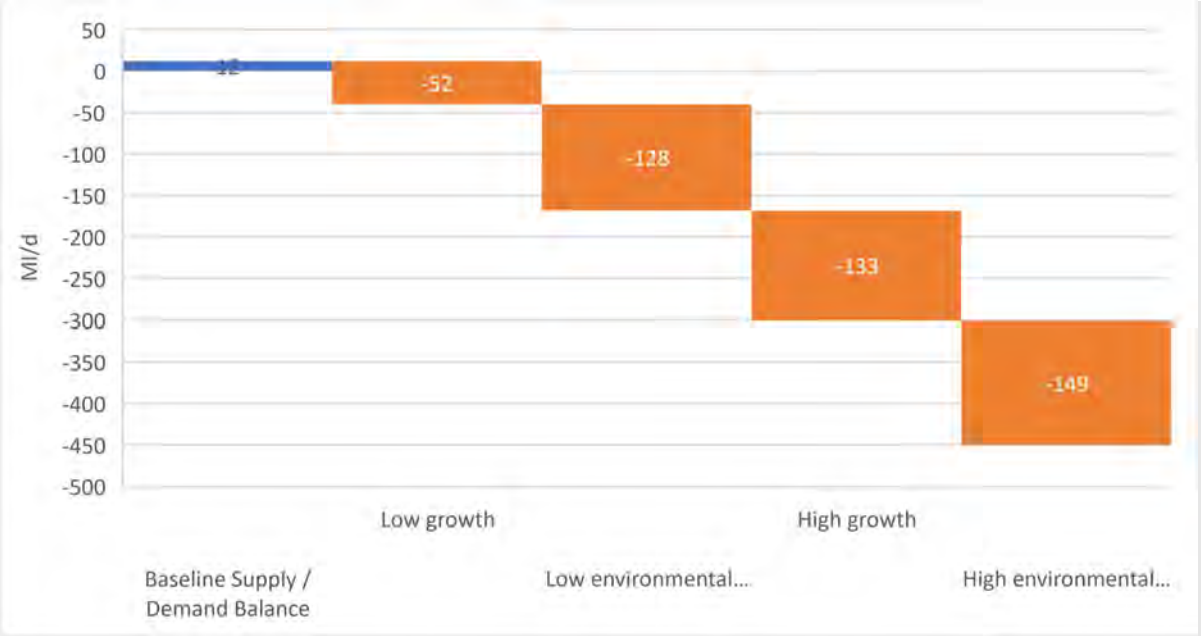


Note: The graph illustrates the supply-demand balance for the central region of Affinity Water from 2025 to 2100. By the end of AMP8, it shows that the demand has exceeded the available supply. As a result, our strategy is geared towards enhancing our capability to efficiently transfer water from where it is trapped to where it is needed most.

This is further quantified in the WRMP24 as a range of uncertainty, depending on the extent of future growth and future reductions in existing abstraction licences that are required due to environmental pressures. Overall, this uncertainty is quantified as a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050.

There is a high level of uncertainty for supply-demand associated with the future demand for water and available supply of water for Affinity Water. **Error! Reference source not found.** below show the range of uncertainty, showing that this is quantified as a loss of supply volume between 52 Ml/day and 149 Ml/day for Affinity Water's Central Region in 2050.

Figure 3: Supply and Demand Uncertainty Quantification for the Central Region in 2050



Surplus of water in the central region

Deficit of water in the central region

Problem Statement and Stated Need / Driver

The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below. These are all analysed at regional level by Water Resource Southeast (WRSE) and then translated down to Affinity Water for incorporation in the WRMP. We have also taken on board customers preferences and addressed OFWAT and DEFRA feedback.

It's important to note that in this business case there is no duplication or overlap with the already funded Level of Service (LOS) identified in previous price reviews.

The investment needs are driven by Water Resources Management Plan (WRMP), which is beyond our immediate management control. We have executed a multi-stage optimisation process to ensure effective cost control and the realisation of cost-saving opportunities.

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[1]. The impacted companies have a statutory duty to plan for this level of future growth.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline?msclkid=88cab670c08011ecb284fa54ecf9127d

Driver	WRSE Implication
	potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively.
Improved Statutory drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved using drought orders and drought permits up to 2040 but reducing reliance on these measures thereafter.

After implementing reductions to leakage and water consumption, as prescribed by the Environment Agency's National Framework for Water Resources[2], we carefully consider these drivers for additional water supply. The framework mandates a 50% reduction in leakage by 2050 and planning for a domestic water consumption of, on average, 110 litres per person per day by 2050, alongside a reduction in non-household demand. WRSE and the partner companies have adopted all these aspects, contributing to the overall estimation of future water supply demands.

Our WRMP outlines our plans to provide a reliable, resilient, efficient, and affordable water supply to our customers between 2025 and 2100 and sets out how we intend to maintain the balance between water supply and demand.

Our geography and customer base means there are several challenges we need to address in developing our WRMP. In summary, the key areas that drive the size and shape of our plan specifically are:

- A continued forecast of substantial population and housing growth, which will increase the demand for water within our region by around 10% by 2050
- We have 10% of globally rare chalk streams in our geographical area, which provide a particular habitat for both flora and fauna
- Our region is among the lowest in the UK for total annual average rainfall per person, with climate change increasing the chances of significant and challenging events such as the prolonged summer demand
- We have a groundwater-dominated supply (65%) and limited raw water storage of surface water
- A need to improve water connectivity across our communities
- A need to increase the resilience of our supply area to more severe drought

[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources?msclkid=245c3d5bc08211ec8b961853f7da9bae

- A need to be robust to face uncertainties in demand (such as the impact of the Covid19 pandemic in 2020)

Hence in AMP8, the Connect 2050 is the optimum solution from an environmental, whole life costs and resilience that fits with Water Resource Southeast (WRSE) regional plan and addresses the specific WRMP, Sustainable Abstraction Reduction and resilience needs for Affinity Water.

Risks, Issues and Requirements

The successful delivery of Connect 2050 faces various risks, primarily concentrated during the construction phase of the project. Additionally, uncertainties arise from the supply-demand position, such as the effectiveness of future demand management activities and the extent of future abstraction reductions for environmental protection. However, it is important to note that these uncertainties are more likely to impact the timing and necessity of future schemes (AMP9-AMP12), rather than the Connect 2050 schemes planned for in AMP8.

No further enhancement spending is required to mitigate risks. The risks, issues, and requirements outlined in this section are addressed through the measures detailed in the Delivery Considerations section. The delivery phase risks include:

- Implications on scheme routing and land access due to Heathrow expansion
- Health and safety risks during delivery of the schemes
- Optimisation of trunk main routes to avoid critical constraints such as Sites of Special Scientific Interests (SSSIs) or other similarly sensitive environments or historic landfills
- Issues with securing land access for survey and design purposes for trunk mains
- Issues with securing land acquisition for permanent infrastructure improvements
- Planning risks as the major trunk main schemes may require coincident planning permission from multiple Local Planning Authorities (LPAs)

All these risks might add cost or programme delay to the project and will be managed at a scheme level.

Allocation of Costs

Connect 2050 will span from AMP8 to AMP12, representing the seamless continuation of the Supply 2040 initiative launched during AMP7 in support of our WRMP19 strategy.

As part of this process, the programme's name has been revised to mirror its overarching goal more accurately. The primary objective is to establish additional interconnectors within the Affinity Water central region, enabling efficient water transfer from areas of surplus to regions experiencing deficits.

We have determined that there is no overlap of funding with previously funded investments under Supply 2040 or any other base or enhancement programmes. This conclusion was reached after conducting an assessment of the current network

performance, the AMP7 Sustainability Reductions, and the associated capital investment schemes that have been implemented. No deficits were observed in either of the Hydraulic Demand Zones (HDZs) during both average and peak periods in AMP7. Therefore, no base costs have been allocated.

Consequently, all costs related to the Connect 2050 project will be classified as enhancements, ensuring clear delineation of financial resources and maximising the programmes impact.

This programme aims to provide network upgrades and enhancements necessary to support the WRMP24 (Water Resources Management Plan 24) and its improved levels of service, thereby enhancing resilience against low probability but high impact events.

Assessment for Direct Procurement for Customers (DPC)

We assessed whether the programme of work met the DPC criteria and determined that it did not on the basis set out in the table below.

Table 2 - DPC assessment for Connect 2050

Scheme	Test 1 (Size) Is the scheme above £100m	Test 2 (Discreteness) Can the Scheme be considered "discrete" under DPC?	Test 3 (VFM) Does the scheme delivered under DPC represent value for money to customers against the as-is counterfactual?	Outcome
Connect 2050 **(WRMP + Resilience + Sustainability Reduction AMP8)**	Yes -Value of Work above £100m*	No - schemes are in various locations across Affinity Water	Non-Applicable as fails test 2	Not suitable for DPC
Connect 2050 only	No, Value of Work below £100m	No - schemes are in various locations across Affinity Water	Non-Applicable as fails test 1 and 2	Not suitable for DPC
Sustainability Reduction AMP8	Yes, Value of Work above £100m	No - schemes are in various locations across Affinity Water and individually all of them are below £100m	Non-Applicable as fails test 1 and 2	Not suitable for DPC

Even considering aggregation of; Connect 2050 – WRMP, Connect 2050 – Resilience, and Connect 2050 - WINEP Sustainability Reduction, we have determined this would still be still be inappropriate for DPC.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

For RAPID Gate 1, Affinity Water participated in a research programme coordinated by WRSE, involving nine water companies, to examine customers' understanding of water resources and the need for regional solutions. This coordinated approach ensured feedback was comparable across regions and solutions and was cost efficient. The research provided evidence on customers' understanding of the need for regional water resource solutions and the level of support for sharing water resources.

For RAPID Gate 2, Affinity Water's collaborative customer research[3] has progressed on the themes we identified at Gate 1:

- Firstly, through the regional engagement, exploring what customers view are as to 'best value', how they weight those metrics and prioritise – enabling us to assess how different schemes 'perform' in terms of the customers' preferences
- Secondly, looking at how we can make schemes more acceptable to customers, we looked to dive deeper on views regarding public value – exploring with customers what they mean by the term, their preferences, whether their views alter dependent on their proximity to the scheme and how much they would be willing to pay for a range of possible 'added value' options for a scheme
- Finally, we looked how customers perceive, understand and ultimately how we need to engage customers when we change their source of water. We explored this immersivity, including through taste testing

Evidence of Customer Preferences

The key findings from the Gate 1 research were supportive of the progression of the Connect 2050 project as a key part of the options for Affinity Water, when carefully designed, managed, and communicated to customers:

For Gate 2, over 300 household customers were engaged to explore their preferences regarding the 'best value' criteria developed by WRSE. In general, customers place more weight on the delivery of secure supply of water, followed by cost of environmental improvements, with resilience placed on the lower end of the scale. The Connect 2050 projects helps to provide a secure supply of water, given the nature of the scheme.

[3] We have undertaken an efficient and collaborative programme of customer engagement across several water companies to support the SROs. Where practical we have utilised regionally led work. For other areas we have formed 'club' projects with other SRO teams – maximising the expertise across the companies.

The research project into public value was collaborative across 11 SROs. The key aims were to understand what preferences and added value our customers perceive is important, as part of infrastructure development. Of particular relevance to Connect 2050:

- Customers told us that most feel that the principle of transferring water from areas of abundance to areas of scarcity 'makes sense' and assume that this system is already in place in the UK. However, there are some concerns that arise when customers learn about the potential for contamination during the transfer process
- These concerns are also reinforced by the idea that water coming from other areas might be 'worse' than that which people are used to i.e., in quality or characteristics such as hardness
- For the majority of customers, there is a particular lack of clarity around infrastructure requirements for transfers – it is unclear what type of infrastructure will be involved (e.g., canals, pipes, rivers) and how much new infrastructure will be required, which also makes it difficult to estimate the disruptive impact on local areas and natural environments

The research study into customers' views on changing their water source was also collaborative across 11 SROs. 1,400 customers and 200 non-households were engaged during the quantitative phase.

- Customers say they are unlikely to engage with communications on source change, and taste tests indicate that most are not able to detect differences at the level that might be expected in a source change. However, there is still a need to communicate to explain the rationale for the change, alleviate taste concerns and provide clear guidance on the impact
- The product sample tasting reassured customers that water transferred from other areas will not necessarily taste noticeably different

We have used the outputs of the customer feedback to help prioritise and develop the design of the Connect 2050. This was done at schemes level for the intra-AFW transfers.

Customer Protection

Customers will be protected through a Price Control Deliverable for this project. The measurement of this PCD will be based on the additional annual average transfer capacity (AATC) provided in Ml/d and Ml of storage capacity.

AATC refers to the daily maximum amount of water that can be reliably transferred through the zonal connectors on an annual basis. (1st of April to 31st of March).

We will validate the accuracy and reliability of the collected data through audits, modelling, inspections, and consultations with zonal connector operators and relevant stakeholders.

The AATC will be calculated by aggregating the transfer capacities of individual zonal connectors within the specified region.

The process will derive the benefit through comparison of the initial AATC against post project implementation AATC

The benefits proposed are transfer capacity, expressed in Ml/day. The benefits from this programme are to ensure future supply and to meet our WRMP objectives and targets; to enable the targeted sustainability reductions to be achieved.

The programme will also support other performance commitments including Low Pressure and Interruption to Supply, by ensuring that we can move water strategically when needed under the conditions set out in our WRMP.

There will be no third-party funding or delivery arrangements as part of this work.

Partnering

Collaboration and Partnering

Co-design and Co-delivery

We have assessed a wide range of options to explore best use of existing supplies, but these are not sufficient to meet the medium to longer term supply demand challenge. We therefore needed to assess a wider range of supply-side options.

Co-ordinating our WRMP options work with WRSE and WRE

We have listened to the feedback on our WRMP19 from regulators who wanted better consistency across water companies' approaches to optioneering; we have achieved this by co-ordinating our supply-side options work with the other water companies through the regional planning groups.

We share all our options data with WRSE who store it in the regional options database. This ensures a consistent single source of information across the regional plan and our dWRMP24. This outcome cannot be achieved in any other way. Whilst this approach was not adopted by WRE for their regional plan, we have ensured that our options identification and development work for the Brett zone was fully consistent with all our dWRMP24 options activities and is available to WRE.

The regional planning co-ordination task included the following activities in WRSE:

- The water companies undertook a review of the approach to rejecting options and aligned their approaches for consistency
- The identification stage of new options occurred both at regional and company level; WRSE identified the following options relevant to us:
  - 2 drought resilience options
  - 17 water transfers
  - 4 multi-sector options
- As part of our SRO work, we also developed new options, and these were included within the WRSE modelling as part of our WRMP information sharing

activity.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

Long-term Delivery Strategy Alignment

The Connect 2050 programme is essential to fulfil our statutory obligations in accordance with Water Resource Planning Guideline and therefore serves as the foundation for our Long-Term Development Strategy (LTDS), particularly concerning aspects impacting customer water supply. It is crucial to ensure an adequate water supply, which will help mitigate the risk of customers experiencing interruptions to their water supply.

This scheme is a key part of the WRMP reported pathway, hence integral to the best value plan which was issued for consultation in November 2022. This plan is built upon 9 adaptive pathways. Connect 2050 is an enabler for our WRMP which outlines our plans to provide a reliable, resilient, efficient, and affordable water supply to our customers between 2025 and 2100 and sets out how we intend to maintain the balance between water supply and demand.

The Connect 2050 project includes proposed network upgrades and enhancements across AMP8 – AMP12, which operate in accordance with a range of scenarios encompassing uncertainty in future population growth, levels of environmental protection and new strategic supply-side schemes.

These enhancements are integrated with the proposed programme for future supply-side options and changes to existing abstraction patterns, hence integral to the future management of uncertainty in the supply-demand balance across a range of possible futures.

Adaptive Strategy

The Connect 2050 project is, by nature, adaptive. It has been developed to identify and schedule the 'least regrets' approach to development of the network in response to the major changes to water resources that Affinity Water faces in the period to 2050.

It includes proposed network enhancements to ensure the supply-demand balance can be retained but phased over the forthcoming AMP periods. The project is defined in accordance with four key phases:

- 2027 – initial baseline, post AMP7 delivery

- 2029 – full set of AMP8 sustainability reductions implemented
- 2034 – just after delivery of the first potential SRO
- 2050 – delivery of a secondary SRO, and to test different levels of environmental destination scenarios

This phased approach to defining the network enhancements means that is can be flexible to future uncertainty and hence adaptive in its approach.

The initial tranche of enhancements in AMP8 can be implemented to facilitate the more certain, short-term requirements. Future requirements can then be subject to re-assessment during future Business Plan cycles, should circumstances change, reflective of the adaptive planning approach in the WRMP.

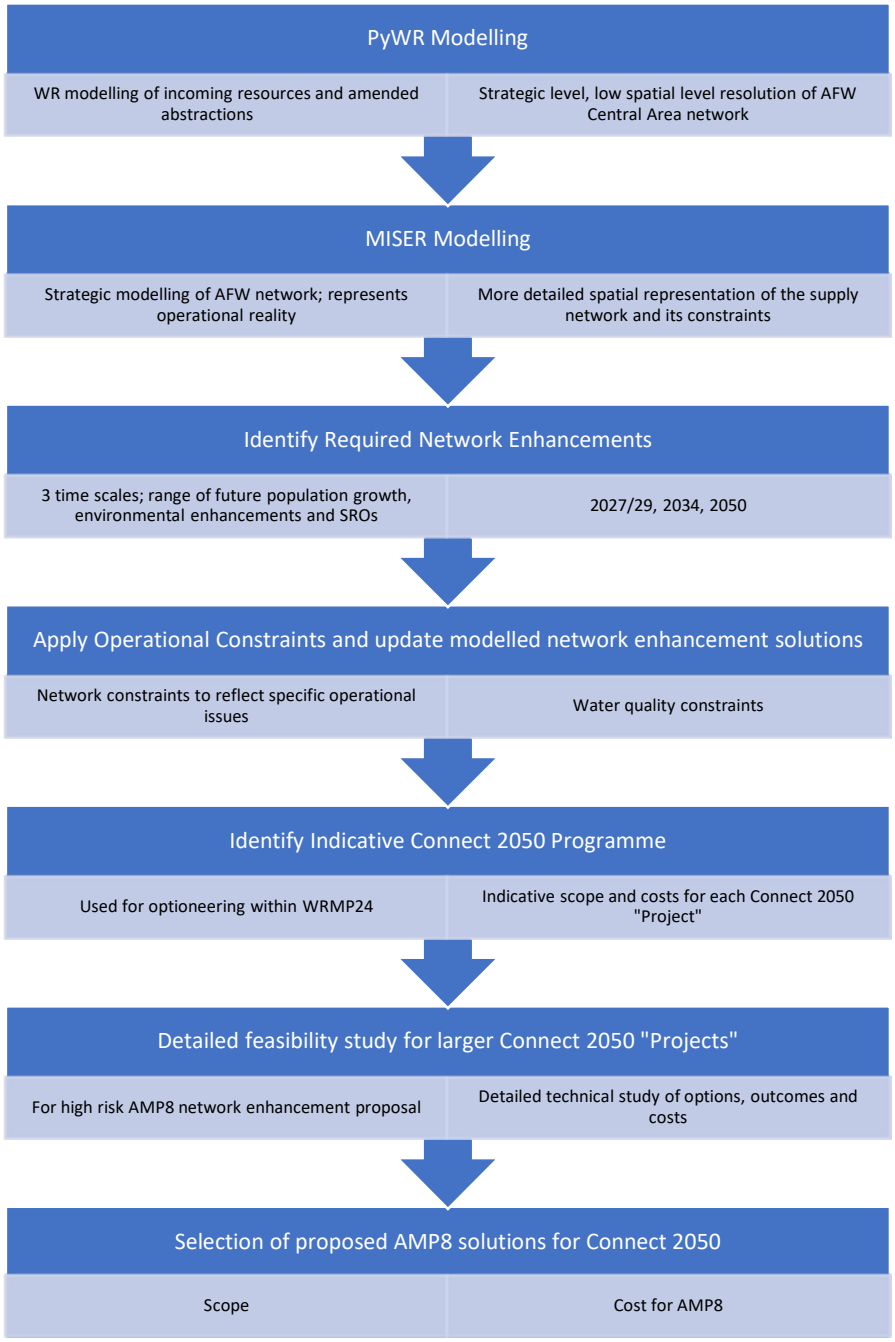
Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

The Connect 2050 programme has been derived using a holistic, 'in the round', tiered approach of extensive modelling and options appraisal. This is illustrated in

Figure 4 below.

Figure 4 Connect 2050 optioneering process.



Further information on the different stages of the modelling may be found in the supporting documents listed in an Appendix to this business case.

The PyWR model, at the Water Resources in the South East (WRSE) level, served to identify inter-company transfers, while the MISER model operates at the intra-company level, facilitating transfer capabilities across various scenarios. Together, these models enable a comprehensive assessment of water resources management, encompassing both transfers between different companies and transfers within the same company. This integrated approach allows for a thorough

analysis of diverse scenarios, ensuring effective water resource planning and utilisation across the region.

The approach was designed to identify the optimum combination of solutions that resolved the full range of scenarios. Ultimately, the MISER modelling, which provides an operationally realistic representation of the AFW network, was used to determine if any of AFW's supply zones are showing deficits of supply under any of the scenarios. Enhancement solutions could then be developed to address any such supply shortfalls. If other zones are in surplus, but the existing supply network is at capacity, then infrastructure can be identified to link up the areas of surplus water with those which are in deficit. The scenarios considered in developing this optimum solution set included:

- **Drought resilience:** As stated in the Water Resource Planning Guidelines (WRPG, April 2022) and in section 4 '*Pathway to resilience*' of the supplementary guidance, water companies are required to ensure their plans are designed to be resilient to a 1 in 500-year drought. Company specific knowledge identified that in more frequent 1 in 10 type drought events, infrastructure may also be required to ensure supply resilience:
    - 1 in 10 – these source capabilities would not consider the application of Temporary Use Bans (TUBs) nor Non-Essential Use Bans (NEUBs)
    - 1 in 500 – these source capabilities would have TUBs and NEUBs applied, given the severity of this drought event and AfW's level of service
- **Population Growth:** It was deemed essential that the scenarios covered different demand levels. This component of the scenario was aligned with the work undertaken to derive the draft Regional Plan by Water Resources South East (WRSE). We considered;
    - Central (Housing Plan) Demand Level – as per WRPG, this scenario looks to meet the needs of local authority planned growth
    - Housing Need Demand Level – an unconstrained assessment of the number of homes needed in an area and is often higher than local authority planned growth. An indication of the upper level of growth that may be realised
- **Sustainability Reductions:** In a similar manner to the demand levels, there is uncertainty involved in the sustainability reduction scenario and environmental destination futures. Therefore, it was understood to be appropriate to take a 'least regrets' approach and model a variety of environmental destination scenarios set our WRMP24
- **Strategic Resource Options and Different Long Term Supply Strategies (SROs):** The final consideration for the generation of scenarios was the SROs. The Connect 2050 project was required to understand the difference in infrastructure requirements generated by the introduction of each SRO, often at different volumetric imports. For the 2027 and 2029 scenarios, there were

- no SRO imports considered due to the lead times associated with these strategic imports

We compared a total of 45 scenarios using a combination of the parameters listed above and we compared one another and to enable an optimum solution set to be derived.

Selected Options

The selected option is the least costly approach that enables us to meet the WRMP (Water Resources Management Plan) needs. Our Central region Water Resource Zones (WRZs) are physically close together and are already partially connected through our strategic mains network. Therefore, utilizing any existing surplus capacity within individual WRZs is expected to represent the best-value option for addressing deficits.

While the main options appraisal includes intra-regional transfers wherever possible, the infrastructure evaluation required to support transfers of existing surplus is complex and was refined outside of the regional modelling.

As part of our options work, we are expediting those solutions that make the best use of existing resources. These solutions are designed to unlock trapped surplus and have shorter lead times. They include asset enhancements and network modifications, which can also provide additional resilience in terms of storage and distribution.

We have also explored several transfer and treatment options to identify ways of releasing trapped capacity at our River Thames abstractions, which is evident as an existing surplus in our Wey WRZ).

Do Nothing, Option 0

This is not considered a viable option, due to the nature of the planning problem to be solved. The WRMP and the retention of an acceptable Security of Supply Index are statutory obligations.

Preferred, Best Value, Option 1

The initial list of the indicative schemes within the Connect 2050 Programme are shown in Table 3 below. The indicative costs shown are based upon a high level assessment of pipeline length and infrastructure type and will be refined by subsequent detailed studies (in accordance with the optioneering process summarised in

Figure 4). This summary shows the schemes that make up Connect 2050 in AMP8, taking account of AMP7 upgrades and AMP8 sustainability reductions and projected population growth.

This best-value programme is also shown as a schematic map in

Figure 5. The preferred option was also the least cost option.

Table 3 Connect 2050 programme.

Scheme	Capacity	Indicative pipeline diameter	Indicative pipeline length
	(Ml/d or Ml for Storage Reservoirs)	(mm)	(km)
AMP8 schemes			
Transfer water from Egham to Harefield inc. Booster Pumping Station (BPS) upgrade. This will improve the connectivity between WRZ6 and WRZ1	38	700	26
Ickenham to Harrow transfer. This will improve the connectivity between WRZ1 and WRZ4	30 – 60	700	13
Ickenham to Harrow BPS. This will improve water transfer between WRZ1 and WRZ4	30	N/A	N/A
Grove Park Link BPS (Grove Licence increase). This will improve water transfer from WRZ2 to WRZ 1	25	450	0.2
Wey sources WTW upgrade (Egham, Chertsey, Walton)	40	N/A	N/A
Stanwell Moor BPS upgrade. This will improve water transfer between WRZ6 and WRZ4	17 – 25	N/A	N/A
Blackford Group Treatment requirements (Woodford area). This will increase water source availability in Affinity Water area	88 – 103	N/A	N/A
Hadham Mill. This will increase water storage capability in WRZ5	20	N/A	N/A
Hills. This will increase water storage capability in WRZ7	10	N/A	N/A
AMP9 schemes			
Transfer water from Luton South to Harpenden. This will improve water transfer between WRZ3 and WRZ2 *Only required if Grand Union Canal Strategic Resource Option(GUC) progresses*	50	600	8
Transfer water from Harpenden to Bulls Green. This will improve water transfer between WRZ2 and WRZ3. *Only required if GUC progresses*	20	500	15
Bulls Green (or Brookmans). This will increase water storage capability in WRZ3	50	N/A	N/A

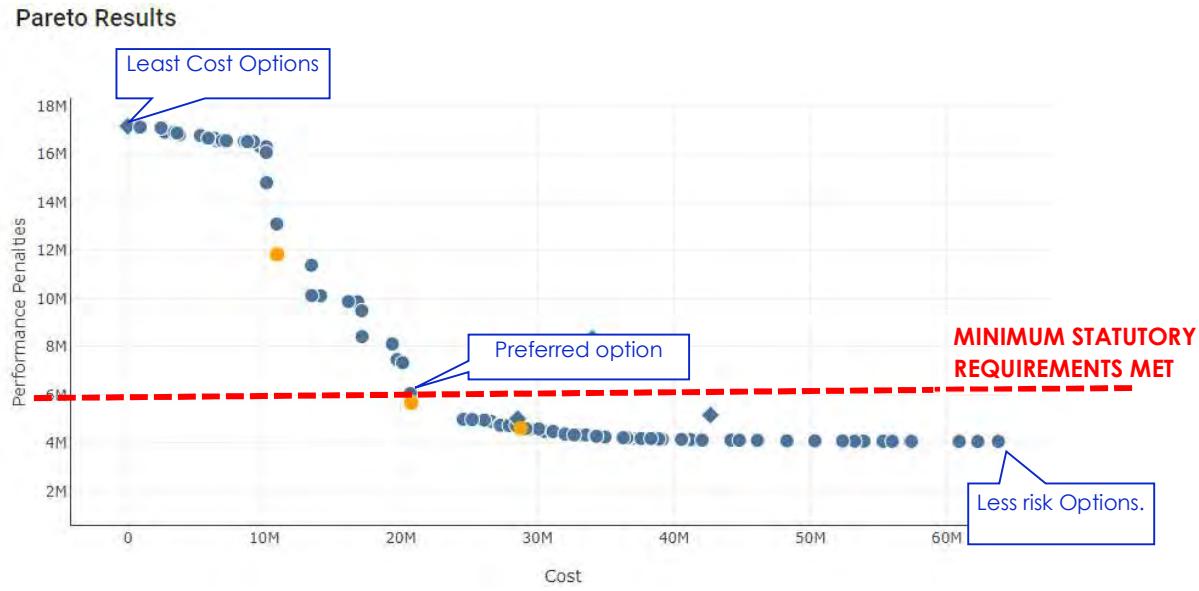
Scheme	Capacity	Indicative pipeline diameter	Indicative pipeline length
	(Ml/d or Ml for Storage Reservoirs)	(mm)	(km)
AMP10 schemes			
Transfer water from Bulls Green to Bishops Stortford (Hadham Mill to Sibleys). This will improve water transfer between WRZ3 and WRZ5	30	600	27
Transfer water from Bishops Stortford to Sibley (Sibleys to Dunmow). This will improve water transfer within WRZ5	20	500	9
Sibley's area strategic. This will increase water storage capability in WRZ5	40	N/A	N/A
AMP11 schemes			
Transfer water from Harefield to Oxhey. This will improve the connectivity between WRZ1 and WRZ2	40	700	6
Transfer water from Oxhey to Clay Lane. This will improve the connectivity within WRZ2	50	800	7
Transfer water from Clay Lane to Arkley. This will improve the connectivity between WRZ2 and WRZ4	30	600	8
Transfer water from Brookmans Park to Bulls Green. This will improve the connectivity within WRZ3. *Only required if GUC progresses*	25 – 50	600	14
Hadham Mill. This will increase water storage capability in WRZ5	2 x 20	N/A	N/A

Other Options Evaluated

After the regional modelling undertaking with PyWR model, we used MISER to identify the network constraints causing water to be trapped. Optimizer software from Optimatics - Suez was then used to select the most cost effective and sustainable options to size trunk mains and boosters pump assets identified to remove the network constraints.

For each of the selected investment proposal a minimum of 20,000 different options have been evaluated have been evaluated such as different reinforcement routes, pipe diameter, BPS site locations. The Pareto front is the set of optimal plans from the Optimizer run arranged given their objective values, with other alternatives rejected as providing less value. The "performance penalties" have been established to facilitate a fair and direct comparison of the performance among different solutions. The "Cost" represents the comprehensive whole-life cost of the proposed solution. This is illustrated in Figure 5.

Figure 6 Indicative results for one option proposal from optimiser, used to select best value combination of options.



Non-Traditional Options

We require the transportation of water from point A to point B (involving investments in pipes and pumps). Subsequently, storage facilities are needed (such as pre/post-treatment), and any surplus water must undergo treatment (Water Treatment Plant capacity). Non-traditional solutions to accomplish these tasks are not currently viable.

Option Assessment Approach

Economic Assessment

We have rigorously followed a robust methodology for the economic analysis using the UK HM Treasury Green Book (2020) approach as the basis for the calculations. We have developed a spreadsheet to undertake the analysis for the different options and to calculate the NPVs and benefit / cost ratios. The use of the spreadsheet enables a very flexible approach to be taken for the analysis, as we can develop several options for analysis, undertake sensitivity studies and combine projects for analysis as necessary.

We also use our Copperleaf system to replicate and consolidate different projects and programmes of work across the whole asset base for our PR24 submission. Copperleaf acts as the master for all of our investments and looks at the environmental and community and performance metrics across the whole investment portfolio. Copperleaf also acts as a check of some of the economic calculations.

The key features of our economic analysis approach include:

- Whole life costs, benefit and dis-benefit calculations

- Net present values calculated over a 30-year period
- Options presented in 2022/23 cost base
- Benefit valuations and metrics have followed Ofwat's methodology for performance commitments, WINEP methodology for environmental and community benefits and supported by industry standard sources for other areas
- In a few areas we have used our own willingness to pay valuations based upon our own research and other published research. This is where there is no other information, e.g. low pressure, to support sensitivity studies
- All benefit metrics and valuations are held in our Service Measure Framework
- Use of the Consumer Price Index with Housing Costs for indexation for costs and benefits
- Use of the RCV and the Spackman approach for capitalisation
- We have depreciated the financial costs using a Weighted Average Cost of Capital (WACC) of 2.92%, which is consistent with the value used for the development of our Long-Term Delivery Strategy

WRMP Optimisation and Economic Assessments

We carried out a detailed assessment for the AMP8 schemes needed to meet our WRMP and WINEP SR statutory requirements. The assessment was focused on identifying the optimum configuration (e.g., route, mains sizing, booster pumping station configuration etc.) to achieve the flow capacity outcomes identified by the MISER modelling. We have employed a multi-layered optimisation process to ensure that the need is satisfied with the lowest whole-life cost.

The economic assessment of the major network schemes was undertaken as a two-stage process:

- The first stage screened possible options to exclude those that did not meet network performance requirements, or which were clearly longer and more expensive to maintain a single preferred option that could be further optimised
- The second stage optimised the length and diameter of the mains for the preferred option to optimise costs, thereby providing the preferred solution for AMP8

The Wey group treatment solutions were taken through an options appraisal process to identify the least-cost combination of solutions at Egham, Chertsey, and Walton WTWs. For the elements of the programme where a network booster upgrade was considered sufficient or where additional storage was proposed, this was not subjected to further optioneering at this stage. As noted previously, these schemes were costed based on standard AFW cost curves, based upon the nature and capacity of the scheme.

These studies provide a more detailed appraisal of the options for each element of the programme, enabling comparison of whole life Totex costs and network performance to identify the optimised solution. We have followed the WRMP and WINEP requirements including the following for each scheme:

- Maintaining supply during peak demand

- Keep the same abstraction of existing sources to manage sustainability issues
- Ensure the minimum pressure above Level Of Service(LOS) and at the same time reduce the risk of over pressurising the network
- Maintaining the velocities in the existing network at the current levels, preventing excessive velocity increase
- Velocities in proposed mains maintained below 1.3 m/s, ideally at 1.0 m/s

Each study identifies the optimum solution for each aspect of the programme, minimising Capex costs whilst achieving the network performance requirements set above.

Connect 2050 Economic Analysis

The Connect 2050 programme was then subjected to additional economic assessment to assure the cost benefits and the final option selection.

Cost Estimation

The costs for each component of the program have been determined using Affinity Water's PR24 cost curves (2002/23 cost base) with an additional 10% contingency to account for Biodiversity Net Gain and risks inherent in large infrastructure projects within urban agglomerations. These risks include factors like traffic management, lane rental, engineering challenges such as railway crossings and motorway crossings (e.g., M25, M1 and M4), and are based on estimated pipeline length and diameter or expected capacity for booster pumping stations and water treatment upgrades. The breakdown of the costs for each element of the programme is shown in

Table 4.

Our PR24 cost models are aligned with industry standards and have been benchmarked against the outturns of current projects.

Table 4 Connect 2050 - WRMP, cost breakdown (£m, 2022/23 prices)

Scheme Name	Main Driver	AMP8 Capex (£m)	AMP8 Delta Opex (£m)	AMP8 TOTEX Scheme cost (£m)
Transfer water from Egham to Harefield inc. BPS Upgrade	WRMP	£61,438,744	£734,193	£62,172,937
Grove Park Link BS (Grove Licence increase)	WRMP	£2,882,256	£158,854	£3,041,110
Increase DO Egham / Chertsey / Walton	WRMP	£7,492,20	£210,000	£7,702,020
Midway North (Stanwell Moor) BPS Upgrade	WRMP	£1,123,803	£810,155	£1,933,958
TOTAL Connect 2050 - WRMP		**£72,936,823**	**£1,913,202**	**£74,850,025**

AMP8 Cost Profile

Costs are profiled across AMP8 in accordance with the urgency and complexity of each element of the programme. The proposed cost profile for AMP8 is shown in Table 5 below.

Table 5 Connect 2050, AMP8 cost profile (£M, 2022/23 prices)

Scheme Name	AMP8 Year 1	AMP8 Year 2	AMP8 Year 3	AMP8 Year 4	AMP8 Year 5	TOTAL
Transfer water from Egham to Harefield inc. BPS Upgrade	£6,143,874	£9,215,812	£15,359,687	£18,431,623	£12,287,749	£61,438,744
Midway North (Stanwell Moor) BPS Upgrade	£1,123,803	£-	£-	£-	£-	£1,123,803
Grove Park Link BS (Grove Licence increase)	£288,226	£432,338	£720,564	£864,677	£576,451	£2,882,256
Increase DO Egham / Chertsey / Walton	£749,202	£1,123,803	£1,873,005	£2,247,606	£1,498,404	£7,492,020
TOTAL	**£8,305,105**	**£10,771,954**	**£17,953,256**	**£21,543,906**	**£14,362,604**	**£72,936,825**

Benefit Estimation

We have focused our benefit quantification on the use of our Service Measure Framework benefit metrics based on the agreed performance commitments and have used the associated benefit valuations published in the Ofwat methodology.

We have also considered other benefits such as cost savings, additional revenue and other performance metrics where they are applicable. We have focused on identifying and estimating the most material benefits and used these to determine the financial valuations. In general, the less material benefits are quantified or discussed. Therefore, our economic justification is intrinsically conservative by nature, while simplistic and transparent in approach.

In some areas, we have had to estimate the major metrics such as the time required to restore supply to customers and the length of the disruption to the customers. If these have a material impact on the analysis, then we have undertaken sensitivity studies. Where the benefits are less material, we have, where possible, qualitatively assessed the benefits rather than include them in the economic analysis.

For each benefit, we have considered the timing of the benefit realisation and duration of the benefits over time. For example, is there is any lag before the benefit will start to materialise? Is there is a phased benefit realisation? And will the benefits

diminish over time? As such, we have developed a profile for each benefit over time.

This project has also been through a detailed Risk and Value assessment. This has helped identify the risks addressed by the project and hence support the quantification of the benefits.

Our Resilience Assessment Tool uses an Asset by Asset as well as a System Based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes that have been proposed to achieve the delivery of our Water Resources Management Plan.

The main benefit from the Connect 2050 schemes are related to the ability to provide supply capacity for customers. This has been used in the economic assessment as the primary benefit.

Carbon, Biodiversity and Natural Capital Assessments

To facilitate and effective and efficient process to look at the implications of the PR24 Business Cases on carbon (operational and embedded), biodiversity, including Biodiversity Net Gain and Natural Capital all Business cases were screened with relevant Business case leads to ascertain where there was potential for material impact on Carbon, Biodiversity or Natural Capital. Once the potential for an impact was identified the significance associated with that impact was explored with relevant specialists and business case leads.

Surgery sessions were held with business case leads to set out considerations for each of the three assessment areas. Criteria to assess significance of carbon impact included:

- A material increase or decrease in operational CO_2 emissions and/or
- An impact on capital carbon, e.g. identification of requirement for a physical build or change in capital maintenance resource use

Both the embedded carbon (resulting from construction activities) and operational carbon (resulting from energy and chemical use) were assessed using Affinity Water's bespoke asset carbon estimation tool which includes over 400 different carbon models covering the types of below ground and above ground assets we typically construct and operate. The outputs of the carbon assessment (as tCO2e) were fed into the cost benefit analysis for each business case option and monetized to inform assessment of the best value options.

Business Case Screening

		Connect 2050 - WRMP	
Scheme Name	**Case Area**	**Embedded carbon (DI Open cut) (kg CO2e)**	**Embedded carbon (HPPE Open cut) (kg CO2e)**
Transfer water from Egham to Harefield inc. BPS upgrade	WRMP	1,530,325	935,108
Grove Park Link BS (Grove Licence increase)	WRMP	10,002	10,002
Midway North (Stanwell Moor) BPS upgrade	WRMP	33,997	33,997

Scheme	Case Area	Embedded Carbon (kg CO_{2e})	Operational Carbon	Whole life carbon (kg CO2e)
Increase DO Egham / Chertsey / Walton	WRMP	1,325,227	14,071	1,339,298

Embedded carbon calculations are shown for each scheme using the Carbon Estimation Tool, accounting for pipelines, storage, and booster pumping stations. Two options are calculated for each scheme one for pipeline materials of ductile iron and HPPE using the Open cut technique. At this stage we do not know which sections of pipeline will be of each material. Using HPPE as the pipeline material has a significantly lower embodied carbon emissions then ductile iron. In practice the total embodied carbon will be between these two values depending on how much of the scheme uses of each material, this choice is dependent on the onsite conditions and the chosen route.

Capex Carbon per Scheme

Scheme required	Capex carbon (DI Open cut) (kgCO2e)	Capex Carbon (HPPE Direct Drill) (kgCO2e)
Kensworth + Periwinkle	1,963,324	720,615
Kings Walden	269,979	180,206
Redbourne	852,976	283,104
Rebourne & Kensworth + Periwinkle	3,577,720	945,723
Codicote	662,090	328,393
Ickenham to Harrow	7,922,782	4,110,946
Wey to Pinn	11,884,173	6,166,419
Capital carbon calculations are shown for ductile iron using the open cut technique and HPPE using the direct drill technique. At this stage we do not know which sections of pipeline will be of each material. Using the direct drill technique results in much lower carbon emissions and HPPE has considerably lower embodied carbon. In reality the capital carbon emissions will be a between these two values for each scheme depending on how much of each the scheme uses each material and technique, the choice of which will be dependent on-site conditions along the chosen route.		

Efficiency

We are confident that our solution offers the best whole-life cost and carbon reduction benefits. This is achieved through meticulous multi-layered optimisation, considering regional supply factors, and utilising the latest technology. The resulting schemes demonstrate the shortest feasible route for the main infrastructure, avoiding congested roads and environmental risks. Furthermore, our comprehensive solution minimises the amount of water that needs to be pumped by employing efficient pumping techniques. The sizing of our civil assets, such as trunk mains and treated water storage reservoirs, is based on projected requirements up to 2050. In case demand exceeds anticipated growth under the most likely scenario (planning plan p), there is flexibility to upgrade the assets. Shorter lifespan assets like booster pumping stations are sized accordingly for their expected operational lifespan.

Our evaluation also takes into account system performance during scheduled or reactive maintenance when assets are temporarily taken out of service. The sizing methodology for storage assets and water mains adheres to the guidelines that we have developed and agreed upon with the industry.

Considering the aforementioned factors, it is evident that Connect 2050 provides the most advantageous solution in terms of value, minimising customer, and environmental concerns. It offers superior efficiency, reduced carbon footprint, and

ensures a resilient water supply for our customers, with the least potential for future regrets.

Assumptions Made

The assumptions inherent in the PR24 costs, benefits and scope for Connect 2050 include:

- The policy towards targeting and scheme planning is one currently used, and the modelling used to determine criticality and condition is fit for purpose and validated
- The schemes have been selected and assessed without detailed hydraulic modelling studies in most instances and hence it is assumed that the final optimum solution will be closely aligned to the strategic level appraisal completed for PR24
- Results from trunk main walking is used to scope maintenance work
- The programme is managed through the delivery portfolio with support from the customer operation teams
- Resource requirements are based on current levels

Third Party Assurance and Audit Trail

Our LTDS Strategy is also external assured by KPMG. The scope and costs for the Connect 2050 programme have been subjected to external technical assurance, by Atkins, as part of the overall assurance programme for the WRMP24.

In addition to the above, the business case has been reviewed internally within Affinity Water through the steering group. Three revision cycles have been completed with senior leadership. During cycle one, an initial review of all investment needs was conducted. In cycle two, a detailed examination of the business cases was conducted, including the background issues of the programme, a comparison with the previous AMPs, an assessment of the needs and how the business case is linked to the performance commitments. Dependencies with other programme of works were also identified and further steps were agreed upon. The objective of cycle three was to assess the risks associated with not securing the desired level of funding, ensure alignment with the Long-Term Delivery Strategy, address changes from cycle two, evaluate the business impact and cost efficiencies of each option and ensure that all business cases meet the required quality and ambition.

Option Assessment

Commentary on the Economic Assessment

Our primary analysis has been to assess the preferred, least cost and some alternative options. We have supplemented this with an additional assessment to

understand the sensitivity of the key assumption on the proportion of the extreme supply interruption improvements that will be realised as a result of our activities.

Estimating the risks and how best to mitigate these is complex. We have, therefore, undertaken economic assessments in each area to select the best value solutions and optimise the level of investment in AMP8. Our economic analysis builds upon our Risk and Value workshops that undertake in-depth assessments to better understand the resilience risks and how best, and when, to mitigate these.

Preferred, Best Value, Option

Our economic analysis has shown that the preferred option is the best overall value option. It is also the Least Cost option as this was found to be best value. It is cost beneficial and the activities will provide significant performance benefits, as part of our wider and longer-term programme of work to improve our network resilience.

The economic assessment forecasts a positive NPV of £93m with a benefit / cost ratio of 1.2 for the Preferred / Least Cost Option, and which confirms the best value of the options considered.

The analysis has shown that focusing on the Least Cost option, will provide the best value for customers. Our strategy has been to focus on these areas in AMP8 and consider the alternative options of additional works in future AMPs as part of our longer-term strategy. This offers the best balance to customers of addressing the service risks against increasing customers' bills.

Least cost Option

The least cost option represents the minimal spend to achieve the WRMP and resilience objectives. This option has the lowest Capex of all the options considered. Our economic analysis has shown that this offers the best cost benefit for customers and has therefore been selected as our preferred option.

Alternative Options

Other alternative options from our wider planning activities were also assessed for cost benefit. Although these options are all cost beneficial, none of these offer the same level of cost benefit as the Least Cost / Preferred Option. This is because the different programmes have been prioritised to meet the statutory targets and resilience objectives at lowest cost. The analysis also shows that the programme should consider additional investments in future AMPs, and that we should further improve our understanding of these risks.

Meeting Affinity Water's Outcomes

The optimised projects in AMP8 under the Connect 2050 programme are crucial to meet WRMP. They address long-term population growth and existing abstraction

needs through cost-effective network improvements. They also enable effective distribution of new strategic supply options to prevent supply deficits in all zones.

In addition to fulfilling our duty to supply water to customers as outlined in the Water Resource Guideline (WRG), this proposed investment supports the delivery of the wider WRMP related Performance Commitments, as they directly impact supply-demand deficits:

- Interruption to Supply
- Average time properties experience Low Pressure
- Compliance Risk Index
- Event Risk Index

Justification of the Preferred Option

We have undertaken extensive customer research to support the development of our WRMP. We have found that our proposals to share water between regions are positively regarded by customers. Customers have firmly established views on the priority of transfer options. These are less favoured than both demand options and supply options such as reservoirs, which customers feel bring added value to the community. Largely, transfers via river or canal are preferred to pipeline options because they are perceived by customers to have wider benefits and fewer negative impacts.

However, customers do have various concerns about transfers, including cost, construction disruption, environmental impacts, energy use and lack of benefits to local communities. Overall, customers support the provision of additional water supplies, the transfer of water across the region and taking measures to reduce demand and leakage. We have used our research to optimise our WRMP programme against these views.

The primary objective of the regional (Water Resource Southeast) and WRMP options appraisal was to identify potential transfers from other companies and new regional resources that could enhance the supply capacities of each of our Water Resource Zones (WRZs). Our Connect 2050 programme is a critical investment that is requires to achieve these wider objectives and for us to meet our statutory obligations.

However, our programme goes further and utilises the opportunity of these investments to mitigate some of the more critical elements of our network and treatment facilities against future climate change and third-party events.

Our preferred option forms an optimised set of solutions that balance the minimisation of cost with meeting our statutory requirements and planning for future resilience. The solutions have been derived from strategic and operationally simulations of our network to ensure that the least-cost combination of schemes is selected overall. This strategic programme has then been optimised to 'real-world' network and water quality constraints before each project is subjected to an extensive optioneering process to select the final optimised programme.

Additionally, our preferred programme significantly reduces emissions compared to the alternative options.

Further economic analysis has been undertaken to confirm the cost benefits and the selection of the preferred option. Conservative estimates of the benefits have been made and the proposed programme is clearly cost beneficial in terms of the ability to supply water to customers. We have used conservative metrics in our analysis and believe that there are other un-quantified benefits to be realised. Our assessment has determined that the programme is worthwhile and will be beneficial to customers, the environment and society.

We could do more, but the cost benefits reduce and the uncertainty of gaining value for customers diminishes. We appreciate that it is difficult to forecast climate change any other risks and so our assessment has been conservative. We believe that the best way to mitigate against these risks is with an on-going long-term programme of work that focuses on the more immediate and highest risk areas and learns and adapts over time. We believe that this offers best values for customers by focusing on best value investments, being prudent on our activities and ensuring affordability to customers, whilst planning for the future.

Delivery Considerations

Related Projects

The scope and nature of many of the projects under Connect 2050 are very similar to many of those proposed under the Environment Agency's Water Industry National Environment Programme (WINEP). The WINEP specifically targets solutions to proposed abstraction reductions at existing AFW abstraction sites. The Connect 2050 scope has been optimised to ensure no overlap in scope or outcome with WINEP.

This programme will be shaped by the influence of several other programs, each playing a crucial role in its development and implementation. Funding requirements are clearly defined as each programme has a separated business cases in line with associated OFWAT drivers. There are no overlaps with base or previously funded Level of Service level.

These programmes include:

1. Developer Services Strategic Infrastructure: The strategic infrastructure initiatives related to developer services will contribute to the overall framework and objectives of this programme. These initiatives involve planning and implementing infrastructure projects to accommodate and support new developments
2. Non-Infra Capital Maintenance: The programme will be influenced by the non-infrastructure capital maintenance efforts. These activities focus on maintaining and improving existing assets and aim to preserve treatment works, pumping

stations, and storage facilities. This helps ensure the reliability and performance of the non-infrastructure components within the overall system

3. Infrastructure Capital Maintenance: The maintenance and enhancement of infrastructure assets will be a significant consideration in this programme. Infrastructure capital maintenance activities aim to preserve, renew and upgrade physical structures and systems, such as trunk mains, distribution mains, leakage management and pressure management assets
4. Single Point of Failure: Addressing the single points of failures will be a key factor influencing the program's design and implementation. This involves identifying and mitigating vulnerabilities within the supply system to minimise the risk of disruptions or failures that could impact water availability or service reliability

Delivery Risk Management

The following is a summary of the primary risks that the programme may encounter. However, it is important to note that these risks are effectively addressed through the BOTEX and Affinity Water governance processes.

- Other programmes of work for large mains affect programme planning and resourcing: Sustainability Programme and the Developer Services Strategic reinforcements programme. This will be mitigated through integrated delivery across Affinity Water's capital programme
- Commercial or operational risks with principal contractor currently under performing. This will be mitigated through appropriate contract structures and proactive contract management
- Normal operational constraints such as the ability to take mains out of service apply during construction. This will be mitigated through advance planning of outages and proactive planning of the whole programme to align with these constraints
- Legal or regulatory constraints to the organisation. Usual constraints such as compliance to safety, water quality regulations will be adhered in the design and construction stages. This is mitigated through standard management practices throughout the capital programme
- Internal and operational resource availability, mitigated through proactive planning and recruitment as required
- Contractor resource and willingness to provide a cost-effective design and construction proposal. Mitigated through intelligent procurement and shared incentives with delivery partners
- Change in priority caused by new information of assets needing replacing, which would be mitigated through early design and integrated design and delivery across Affinity Water's programme (to verify and align information and changes)
- Change in contractor if costs seen as unaffordable, which would be managed through transition and ensure benefits outweigh any change
- Commercial: Regional Contractors completing allocated work. Mitigated through intelligent procurement and shared incentives with delivery partners

- Accuracy of Costings, mitigated through regular cost-reappraisal during the design process and incentivised competitive procurement of both design and construction phases

The successful delivery of the Connect 2050 Resilience faces various risks, primarily concentrated during the project's construction phase. The AMP8 scope includes two additional storage units at Hadham Mills and Hills sites. It is worth noting that construction risks are limited because we have experience building these types of assets, having constructed storage units in AMP6 (second cells at Sibleys and Paddlesworth) and AMP7 (Farthing Common, and two additional cells in implementation at Preston and Chaul End). Additionally, uncertainties arise from the supply-demand position, such as the effectiveness of future demand management activities and the extent of future abstraction reductions for environmental protection. However, it is important to note that these uncertainties will not affect the necessity of the AMP8 Connect 2050-Resilience scope but are more likely to impact the timing and necessity of future schemes (AMP9-AMP12).

Monitoring and Reporting of Benefits

The WRMP, once finalised and published, is subject to annual reporting and 5-yearly updates. The annual reporting will reflect any changes to the supply-demand balance that is affected by the Connect 2050 programme and the success of the associated projects.

In addition to complying with the regulatory reporting obligations for WRMP and Annual Period Report (APR), the program's success will rely on consistent monitoring of performance and costs. This will be achieved through regular reporting on project progress and the fulfilment of performance commitments. Monthly Quadrant reports will be utilised to provide detailed insights and analysis, including metrics such as Water Available for Use, Low Pressure, and Interruptions to Supply. These comprehensive reports will contribute to effective monitoring and assessment of the program's performance and help ensure its overall success.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Supporting Information

- AECOM and HR Wallingford, June 2022, *"Connect 2050 – Strategic Network Management Proposal"*
- Affinity Water, Technical Annex to draft WRMP, *"Connect 2050 –Technical Annex"*.
- Affinity Water, October 2022, *"Supply 2050, Connect 2050, Egham to Harefield Hydraulic Demand Zone"*
- Stantec, May 2022, *"Wey Sites: Strategic Study"*

Appendix 1 – Resilience Assessment Tool – WRMP

Appendix 1.1 – Increase DO Wey area - Chertsey DO

Introduction

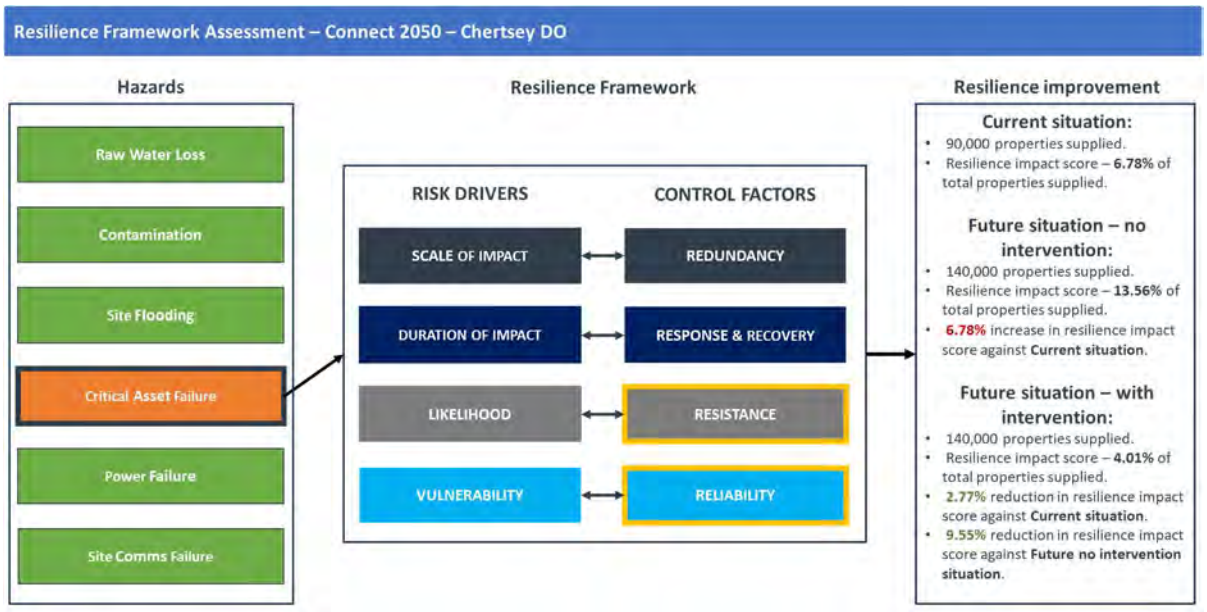
Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

Our Resilience Assessment Tool uses an asset by asset as well as a system-based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes.

The Chertsey DO project aims to maximise output from Chertsey Water Treatment Works (WTW) to offset Sustainability Reduction (SR) losses in other communities.

This project involves installing two new GAC tanks to boost output, enhance resistance and reliability, and enable the WTW to reach 70 Ml/d.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the asset and zonal resilience score against three scenarios:

- Current scenario
- Future AMP8 scenario if we do not implement proposed investment
- Future AMP8 scenario if we implement proposed investment

This approach helps us quantify resilience impact and assess the benefits of the proposed scheme by comparing the outcomes with and without the proposed investment.

We modelled this against various hazards in the tool. During the assessment, we pinpointed the **Critical Asset Failure** hazard as the most impactful for our analysis, given the nature of the scheme.

After calculating individual asset resilience, we assessed the impacted water routes and calculated the system resilience impact across three scenarios. The results yield a resilience impact score as a percentage for each scenario, along with the percentage change between scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

- Assessment done against three main scenarios
- Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme
- Routes of water have been simplified to focus on the affected assets
- Some deterioration of the assets was included to account for the time when the schemes are required
- Ratio of 2,000 properties per Ml/d was used to quantify the properties affected by the sites to keep consistency on all schemes
- Redundancy impact for AMP8 scenario on assets was kept as minimum of up to 10% to factor the overall impact of all Sustainability Reductions to the wider network and the reduction of number of local sources
- New proposed assets have been assumed to be in very good condition
- Treatment upgrade at Chertsey will maximise the output of site to 70 Ml/d
- All other AMP8 proposed Connect 2050 schemes to allow more water to be moved from Wey area will be completed

Data Used

For Trunk Mains (TM):

- GIS information such as size, material, age, burst history, number of crossings and connections to other TMS
- Burst rate from Pioneer
- TM mitigation and contingency reports
- Spare parts availability
- TM monitoring systems
- Maintenance strategy

For Above Ground Assets (AGA):

- Maximo list of assets and associated criticality
- Risk Based Approach classification for storage assets
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate

Results

Using the Resilience Assessment tool for the **current situation**, the tool indicates Resilience Impact score of **6.78%** from the 90,000 properties identified. This result is overall due to the Resistance and Reliability of the site.

In the **future scenario** the number of properties supplied by this system will increase to 140,000 properties due to the new deployable output requirement of 70 Ml/d to compensate for the losses due to Sustainability Reductions.

The current WTW has a reported sustainable flow of 45 Ml/d. This would mean that the site would not be able to meet the required DO without new investment.

Using our resilience tool, if we **do not do the investment proposed**, we can verify that the Resilience Impact Score increases to **13.56%** of the 140,000 properties now affected which is a **6.78%** increase when compared to the current situation.

When we introduce the **proposed investments** to the tool, the Resilience impact score will be **4.01%** of the 140,000 properties now affected which is a **2.77%** reduction when compared to the current situation or **9.55%** reduction when compared to the future situation without investment.

Appendix 1.2 – Increase DO Wey area – Walton DO

Introduction

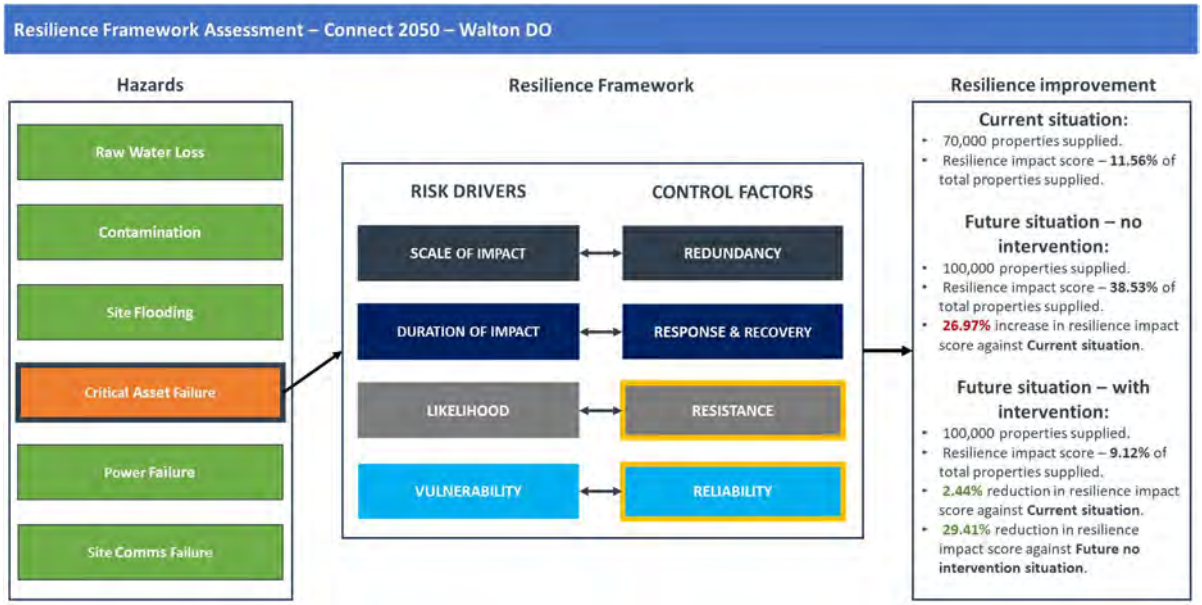
Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand, and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

Our Resilience Assessment Tool uses an asset by asset as well as a system-based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes.

The Walton DO project is a scheme that is looking into maximising the output from Walton Water Treatment Works (WTW) to compensate for the Sustainability Reduction (SR) losses in other communities.

The scope of this project includes installation a new GAC tank to increase the deployable output, improve Resistance and Reliability and enable the site to achieve 50 Ml/d capacity.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the Asset and Zonal resilience score against three scenarios:

- Current scenario
- Future AMP8 scenario if we do not do the proposed investment
- Future AMP8 scenario if we do the proposed investment

This approach allows us to quantify the impact on Resilience and understand the benefits of the proposed scheme by comparing what would happen if we did or not did the proposed investment.

We modelled this against various hazards in the tool. During the assessment, we pinpointed the **Critical Asset Failure** hazard as the most impactful for our analysis, given the nature of the scheme.

After calculating individual asset resilience, we assessed the impacted water routes and calculated the system resilience impact across three scenarios. The results yield a resilience impact score as a percentage for each scenario, along with the percentage change between scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

- Assessment done against three main scenarios
- Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme
- Routes of water have been simplified to focus on the affected assets
- Some deterioration of the assets was included to account for the time when the schemes are required
- Ratio of 2,000 properties per Ml/d was used to quantify the properties affected by the sites to keep consistency on all schemes
- Redundancy impact for AMP8 scenario on assets was kept as minimum of up to 10% to factor the overall impact of all Sustainability Reductions to the wider network and the reduction of number of local sources
- New proposed assets have been assumed to be in very good condition
- Treatment upgrade at Walton will maximise the output of site to 50 Ml/d
- All other AMP8 proposed Connect 2050 schemes to allow more water to be moved from Wey area will be completed

Data Used

For Trunk Mains (TM):

- GIS information such as size, material, age, burst history, number of crossings and connections to other TMS
- Burst rate from Pioneer
- TM mitigation and contingency reports
- Spare parts availability
- TM monitoring systems
- Maintenance strategy

For Above Ground Assets (AGA):

- Maximo list of assets and associated criticality
- Risk Based Approach classification for storage assets
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate

Results

Using the Resilience Assessment tool for the **current situation**, the tool indicates Resilience Impact score of **11.56%** from the 70,000 properties identified. This result is overall due to the Resistance and Reliability of the site.

In the **future scenario** the number of properties supplied by this system will increase to 100,000 properties due to the new deployable output requirement of 50 Ml/d to compensate for the losses due to Sustainability Reductions.

The current WTW has a reported sustainable flow of 35 Ml/d. This would mean that the site would not be able to meet the required DO without new investment.

Using our resilience tool, if we **do not do the investment proposed**, we can verify that the Resilience Impact Score increases to **38.53%** of the 100,000 properties now affected which is a **26.97%** increase when compared to the current situation.

When we introduce the **proposed investments** to the tool, the Resilience impact score will be **9.12%** of the 100,000 properties now affected which is a **2.44%** reduction when compared to the current situation or **29.41%** reduction when compared to the future situation without investment.

Appendix 1.3 – Egham to Iver Interconnector

Introduction

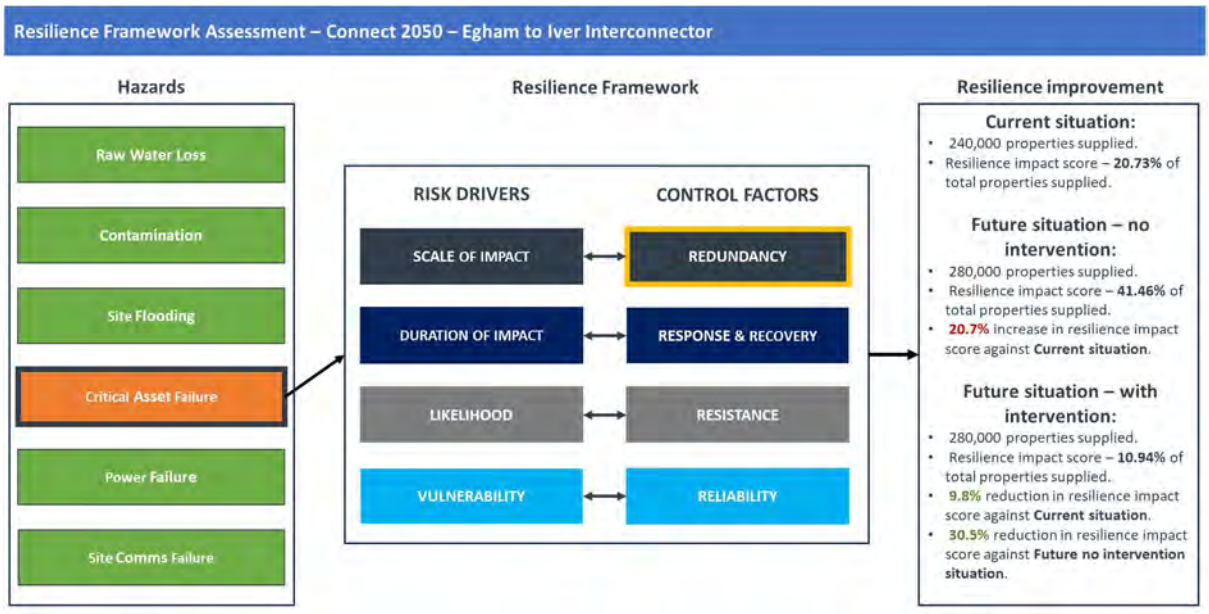
Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

Our Resilience Assessment Tool uses an Asset by Asset as well as a System Based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes that have been proposed to achieve the delivery of our Water Resources Management Plan.

The Egham to Iver Interconnector project is a scheme that is looking into transferring an additional 38 Ml/d volume from WRZ6 to WRZ4 to meet the supply deficit in the area forecasted in the future in line with the WRMP.

The scope of this project includes installation of new booster pumping station and new trunk main from Egham to Iver to move the additional 38 Ml/d up to Harefield reservoir, improving the redundancy of the system and meet the deficit in the area.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the Asset and Zonal resilience score against three scenarios:

- Current scenario
- Future AMP8 scenario if we do not do the proposed investment
- Future AMP8 scenario if we do the proposed investment

This approach allows us to quantify the impact on Resilience and understand the benefits of the proposed scheme by comparing what would happen if we did or not did the proposed investment.

This was then modelled against the different hazards that are part of the tool. During the assessment we identified that the Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme.

Once the individual Asset resilience was calculated, we determined the affected routes of water and proceeded to calculate the System resilience impact against the three scenarios. The outcome will provide a quantification in Resilience impact score as a percentage on all scenarios and a percentage change against the different scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

Assessment done against three main scenarios.

- Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme
- Routes of water have been simplified to focus on the affected assets
- Some deterioration of the assets was included to account for the time when the schemes are required
- Ratio of 2,000 properties per Ml/d was used to quantify the properties affected by the sites to keep consistency on all schemes
- Redundancy impact for AMP8 scenario on assets was kept as minimum of up to 10% to factor the overall impact of all Sustainability Reductions to the wider network and the reduction of number of local sources
- New proposed assets have been assumed to be in very good condition
- New booster and trunk main will be sized to meet the required 38 Ml/d
- All other AMP8 proposed Connect 2050 schemes to allow more water to be moved from Wey area will be completed

Data Used

For Trunk mains (TM):

- GIS information such as size, material, age, burst history, number of crossings and connections to other TMS
- Burst rate from Pioneer
- TM mitigation and contingency reports

- Spare parts availability
- TM monitoring systems
- Maintenance strategy

For Above Ground Assets (AGA):

- Maximo list of assets and associated criticality
- Risk Based Approach classification for storage assets
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate

Results

Using the Resilience Assessment tool for the **current situation**, the tool indicates Resilience Impact score of **20.73%** from the 240,000 properties identified. This result is overall due to not having the requirement of transferring water from WRZ6 area and the trunk main being used more for resilience than to transfer water.

In the **future scenario** the number of properties supplied by this system will increase to 280,000 properties due to the additional requirement of 38 Ml/d.

The current TM has a max capacity of 17 Ml/d and would not be enough to move the additional volume. This would mean that the additional 38 Ml/d requirement would not be able to be met without new investment.

Using our resilience tool, if we do **not do the investment proposed**, we can verify that the Resilience Impact Score increases to **41.46%** of the 280,000 properties now affected which is a **20.73%** increase when compared to the current situation.

When we introduce the **proposed investments** to the tool, the Resilience impact score will be **10.94%** of the 280,000 properties now affected which is a **9.79%** reduction when compared to the current situation or **30.52%** reduction when compared to the future situation without investment. The new scheme will allow to meet the future requirement of 38 Ml/d during Peak demand period also providing some redundancy in non-peak period should the existing supply route fail however this would not be sufficient to supply all customers within the supplied area.

Appendix 1.4 – Stanwell Moor BPS Upgrade

Introduction

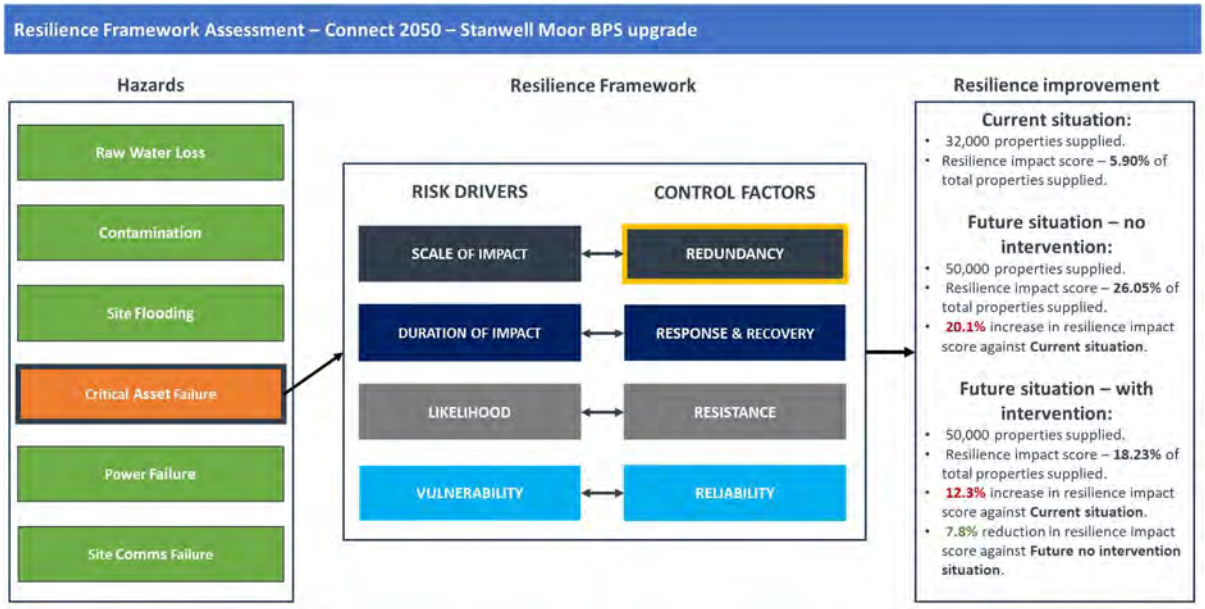
Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

Our Resilience Assessment Tool uses an Asset by Asset as well as a System Based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes that have been proposed to achieve the delivery of our Water Resources Management Plan.

The Stanwell Moor Booster Pumping Station project is a scheme that is looking into transferring an additional 25 Ml/d volume from WRZ6 to meet the supply deficit in the area forecasted in the future in line with the WRMP.

The scope of this project includes installation of new booster pumping station in the existing trunk main from Egham to Iver to move the additional 25 Ml/d up to Harefield reservoir, improving the redundancy of the system and meet the deficit in the area.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the Asset and Zonal resilience score against three scenarios:

- Current scenario
- Future AMP8 scenario if we do not do the proposed investment
- Future AMP8 scenario if we do the proposed investment

This approach allows us to quantify the impact on Resilience and understand the benefits of the proposed scheme by comparing what would happen if we did or not did the proposed investment.

This was then modelled against the different hazards that are part of the tool. During the assessment we identified that the Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme.

Once the individual Asset resilience was calculated, we determined the affected routes of water and proceeded to calculate the System resilience impact against the three scenarios. The outcome will provide a quantification in Resilience impact score as a percentage on all scenarios and a percentage change against the different scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

- Assessment done against three main scenarios
- Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme
- Routes of water have been simplified to focus on the affected assets
- Some deterioration of the assets was included to account for the time when the schemes are required
- Ratio of 2,000 properties per Ml/d was used to quantify the properties affected by the sites to keep consistency on all schemes
- Redundancy impact for AMP8 scenario on assets was kept as minimum of up to 10% to factor the overall impact of all Sustainability Reductions to the wider network and the reduction of number of local sources
- New proposed assets have been assumed to be in very good condition
- New booster will be sized to meet the required 25 Ml/d
- All other AMP8 proposed Connect 2050 schemes to allow more water to be moved from Wey area will be completed

Data Used

For Trunk mains (TM):

- GIS information such as size, material, age, burst history, number of crossings and connections to other TMS

- Burst rate from Pioneer
- TM mitigation and contingency reports
- Spare parts availability
- TM monitoring systems
- Maintenance strategy

For Above Ground Assets (AGA):

- Maximo list of assets and associated criticality
- Risk Based Approach classification for storage assets
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate

Results

Using the Resilience Assessment tool for the **current situation**, the tool indicates Resilience Impact score of **5.90%** from the 32,000 properties identified. This result is overall due to the affected assets not having the requirement of transferring water from WRZ6 area towards north and being used for resilience support to the WRZ6 instead of transfer of water.

In the **future scenario** the number of properties supplied by this system will increase to 50,000 properties due to the requirement to transfer 25 Ml/d from WRZ6 towards North to enable Sustainability Reductions and achieve the delivery of our the WRMP.

The current TM is currently used to bring water from Iver to Egham area and does not have the proper capability to transfer in the opposite direction where it will now be required. This would mean that it would not be able to meet the 25 Ml/d volume without new investment.

Using our resilience tool, if we do **not do the investment proposed**, we can verify that the Resilience Impact Score increases to **26.05%** of the 50,000 properties now affected which is a **20.15%** increase when compared to the current situation.

When we introduce the **proposed investments** to the tool, the Resilience impact score will be **18.23%** of the 50,000 properties now affected which is a **12.34%** increase when compared to the current situation or a **7.82%** reduction when compared to the future situation without investment. The new scheme will allow to meet the future requirement of 25 Ml/d during Peak demand period also providing some redundancy in non-peak period should the alternative supply route fail however this would not be sufficient to supply all customers within the supplied area.

Appendix 1.5 – Watford to Heronsgate Interconnector

Introduction

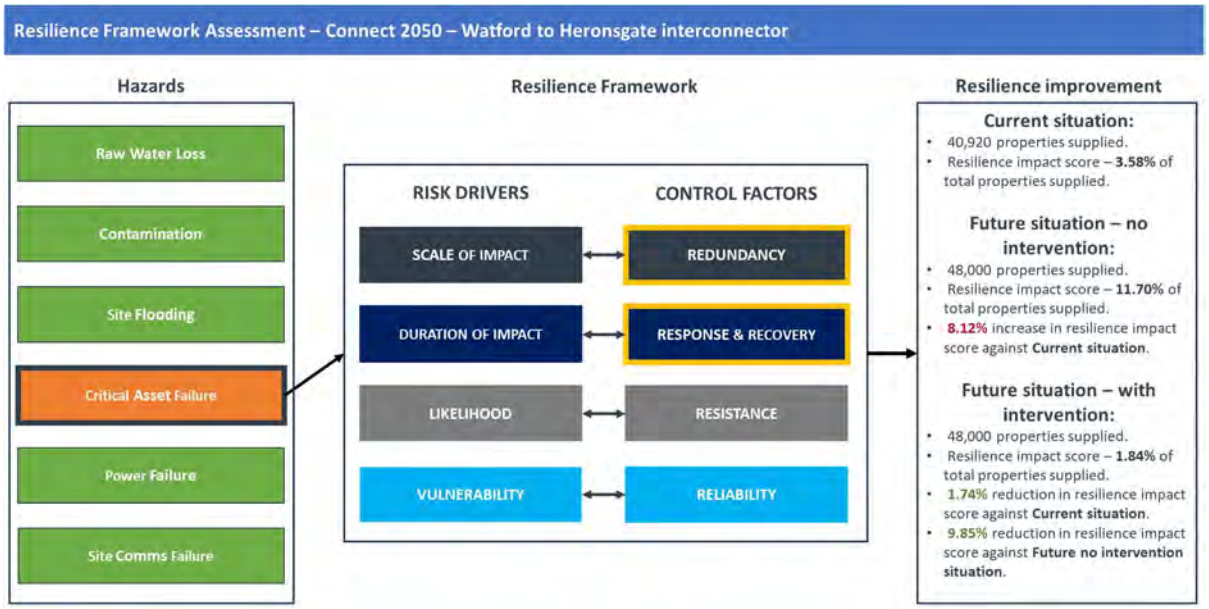
Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

Our Resilience Assessment Tool uses an Asset by Asset as well as a System Based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes that have been proposed to achieve the delivery of our Water Resources Management Plan.

The Watford to Heronsgate project is a scheme that is looking into transferring additional 4 Ml/d into The Grove Water Treatment Works (WTW) and transfer that additional volume to Heronsgate to compensate for the AMP8 Sustainability Reduction (SR) as part of the Deployable Output (DO) Relocation Schemes.

The scope of this project includes upgrading the borehole pumps at The Grove WTW to allow duty/standby capability for the new flow requirements and the installation of a new booster station at the Park Link main to allow transfer of the 4 Ml/d from the Grove WTW towards Heronsgate to compensate for the AMP8 SR's, improving the Redundancy and the Response and Recovery of the system.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the Asset and Zonal resilience score against three scenarios:

- Current scenario
- Future AMP8 scenario if we do not do the proposed investment
- Future AMP8 scenario if we do the proposed investment

This approach allows us to quantify the impact on Resilience and understand the benefits of the proposed scheme by comparing what would happen if we did or not did the proposed investment.

This was then modelled against the different hazards that are part of the tool. During the assessment we identified that the **Critical Asset Failure** Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme.

Once the individual Asset resilience was calculated, we determined the affected routes of water and proceeded to calculate the System resilience impact against the three scenarios. The outcome will provide a quantification in Resilience impact score as a percentage on all scenarios and a percentage change against the different scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

- Assessment done against three main scenarios
- Critical Asset Failure Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme
- Routes of water have been simplified to focus on the affected assets

- Some deterioration of the assets was included to account for the time when the schemes are required
- Ratio of 2,000 properties per Ml/d was used to quantify the properties affected by the sites to keep consistency on all schemes
- Redundancy impact for AMP8 scenario on assets was kept as minimum of up to 10% to factor the overall impact of all Sustainability Reductions to the wider network and the reduction of number of local sources
- New proposed assets have been assumed to be in very good condition
- New booster proposed at Park Link would be bidirectional
- New borehole pumps at the Grove WTW will allow Duty/Standby capability for the new required flows
- The Grove WTW is capable of achieving new proposed flows

Data Used

For Trunk Mains (TM):

- GIS information such as size, material, age, burst history, number of crossings and connections to other TMS
- Burst rate from Pioneer
- TM mitigation and contingency reports
- Spare parts availability
- TM monitoring systems
- Maintenance strategy

For Above Ground Assets (AGA):

- Maximo list of assets and associated criticality
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate

Results

Using the Resilience Assessment tool for the **current situation**, the tool indicates Resilience Impact score of **3.58%** from the 40,920 properties identified. This result is overall due to the Grove WTW being a significant single point of failure in the area due to a complex contingency requirement if the WTW fails.

In the **future scenario** the number of properties supplied by this system will increase to 48,000 properties.

Although the current WTW at the Grove can achieve the new flow, the borehole pumps do not have the standby capability at the new flow requirement. As such, the site will have to operate the pumps as Duty/Assist/Assist arrangement, increasing the number of Single Points of Failure in the system.

Additionally, without the new proposed booster station in the Park Link main, we would not be able to control the transfer of water towards Heronsgate reservoir,

limiting how much water we could move to meet the requirements of the Average Deployable Output Relocation.

To aggravate the situation, the current contingency for the loss of the Grove would be more complex, increasing the risk of interruptions to supply if the WTW fails.

Using our resilience tool, if we **do not do the investment proposed**, we can verify that the Resilience Impact score increases to **11.70%** of the 48,000 properties now affected which is a **8.12%** increase when compared to the current situation.

When we introduce the **proposed investments** to the tool, the Resilience Impact score will be **1.84%** of the 48,000 properties now affected which is a **1.74%** reduction when compared to the current situation or **9.85%** reduction when compared to the future situation without investment.

Appendix 2 – Resilience Assessment Tool – Resilience

Appendix 2.1 – Hills 10 Ml Cell - Resilience

Introduction

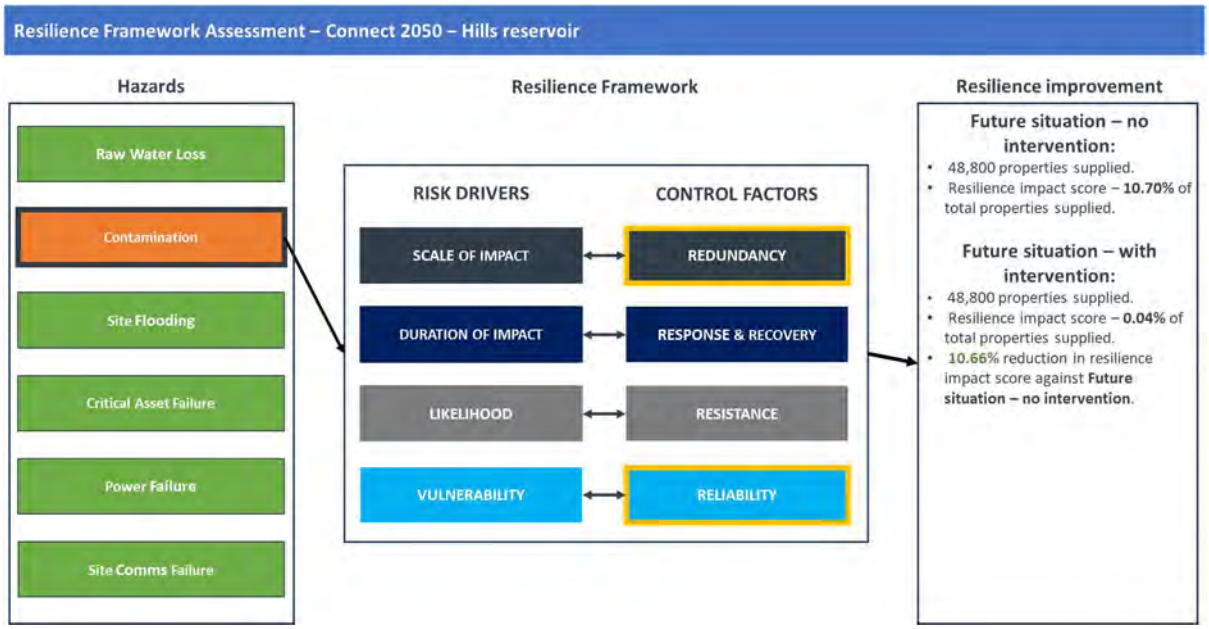
Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

Our Resilience Assessment Tool uses an Asset by Asset as well as a System Based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes that have been proposed to achieve the delivery of our Water Resources Management Plan.

The Hills Reservoir project is a scheme exploring the potential of increasing storage capacity at Hills reservoir.

The scope of this project includes the construction of a new 10 Ml reservoir at Hills reservoir providing duty/standby capability to the site in addition to increasing the storage capacity and improving the Redundancy and Reliability of the system by providing an additional storage capacity to the existing 18 Ml capacity.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the Asset and Zonal resilience score against two scenarios:

- Future AMP8 scenario if we do not do the proposed investment
- Future AMP8 scenario if we do the proposed investment

This approach allows us to quantify the impact on Resilience and understand the benefits of the proposed scheme by comparing what would happen if we did or not did the proposed investment.

This was then modelled against the different hazards that are part of the tool. During the assessment we identified that the **Contamination** Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme.

Once the individual Asset resilience was calculated, we determined the affected routes of water and proceeded to calculate the System resilience impact against the 2 scenarios. The outcome will provide a quantification in Resilience impact score as a percentage on all scenarios and a percentage change against the different scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

- Assessment done against two main scenarios
- Contamination Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme
- Routes of water have been simplified to focus on the affected assets

- Some deterioration of the assets was included to account for the time when the schemes are required
- Population affected was determined by hydraulic modelling
- New proposed assets have been assumed to be in very good condition
- New Reservoir will provide additional storage and maintain supply to the area without requiring complex outage procedures

Data Used

For Above Ground Assets:

- Maximo list of assets and associated criticality
- Risk Based Approach classification for storage assets
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate
- Storage inspection reports

Results

Using the Resilience Assessment tool for the **Future situation with no investment**, the tool indicates Resilience Impact score of **10.70%** from the 48,800 properties identified. This result is overall due to the poor Redundancy and Reliability of the site due to being a single cell storage asset with a complex outage procedure required to isolate the asset.

Using our resilience tool, the average Resilience Impact score for **Contamination** Hazard on our reservoir assets is **0.96%**. Hills Reservoir scores **11** times higher than the average score.

When we introduce the **proposed investments** to the tool, the Resilience impact score will be **0.04%** of the 48,800 properties affected which is a **10.66%** reduction when compared to the future situation without investment. This is due to an improvement in the Redundancy and Reliability of the site due to provision of duty/standby capability by having a new second structure that would allow the outage of each individual structure while being able to continue supplying all customers with safe drinking water with the other structure.

Appendix 2.2 – Treated Water Storage at Hadham Mill - 50% of 20 Ml (one 10 Ml cell)

Introduction

Affinity Water is committed to providing a resilient water supply that meets the needs of our customers now and in the future. Following on from our PR19 Resilience Action Plan, we developed our Integrated Resilience Framework and Resilience Assessment Tool to help us identify, understand and actively manage the risks to resilience that we face, ensuring all risks to resilience are approached consistently, with an understanding of the how the risk impacts outcomes and is applied through investment decision making, long-term adaptive planning to assess the best options to manage them.

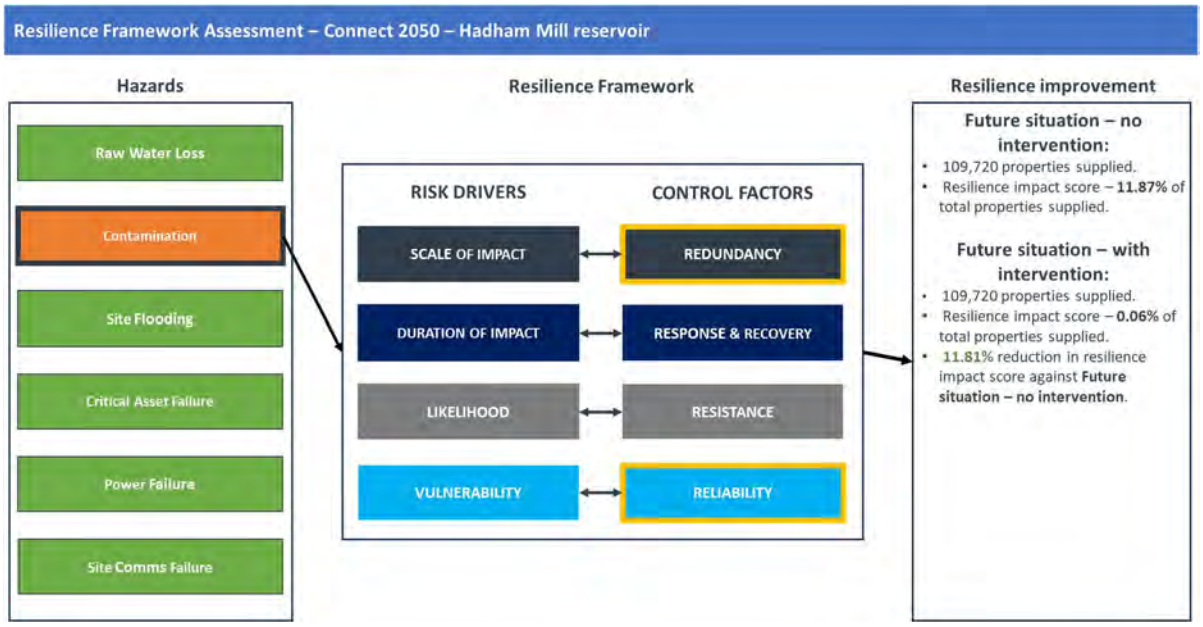
Our Resilience Assessment Tool uses an Asset by Asset as well as a System Based approach in line with the 4R's methodology and assesses the risks from a broad range of hazards. This tool has been used to demonstrate the resilience benefit and provide additional justification to the AMP8 Connect 2050 enhancement schemes that have been proposed to achieve the delivery of our Water Resources Management Plan.

The Hadham Mill reservoir project is a scheme exploring the potential of increasing storage capacity at Hadham Mill reservoir.

The scope of this project includes the construction of a new reservoir at Hadham Mill. This new additional cell is required to enable outage and inspection of the first 10 Ml cell to be constructed under the AMP8 Sustainability Reductions.

In addition, this scheme will increase the storage capacity and improving the Redundancy and Resistance of the system by providing an additional 10 Ml storage capacity to the proposed 10 Ml storage required under the AMP8 Sustainability Reductions.

Summary of Findings



How the Tool Was Used

Once all affected assets have been identified, we used our resilience tool to calculate the Asset and Zonal resilience score against two scenarios:

- Future AMP8 scenario if we do not do the proposed investment
- Future AMP8 scenario if we do the proposed investment

This approach allows us to quantify the impact on Resilience and understand the benefits of the proposed scheme by comparing what would happen if we did or not did the proposed investment.

This was then modelled against the different hazards that are part of the tool. During the assessment we identified that the **Contamination** Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme.

Once the individual Asset resilience was calculated, we determined the affected routes of water and proceeded to calculate the System resilience impact against the 2 scenarios. The outcome will provide a quantification in Resilience Impact score as a percentage on all scenarios and a percentage change against the different scenarios.

For more detail on how the scores are calculated see the Appendix AFW07 – Update on our Resilience Plan.

Assumptions Made

- Contamination Hazard was the most impactful for this analysis and our area of focus for the assessment due to the nature of the scheme

- Routes of water have been simplified to focus on the affected assets
- Some deterioration of the assets was included to account for the time when the schemes are required
- Population affected was determined by hydraulic modelling
- New proposed assets have been assumed to be in very good condition
- Future AMP8 situation without investment assumes that a new single cell reservoir of 10 Ml storage capacity was constructed to achieve the AMP8 Sustainability Reductions
- Outage/isolation requirements for this single cell structure will not be possible to perform without causing impact to customers supplies.
- The proposed additional new 10 Ml reservoir which is part of this resilience assessment will provide additional storage and maintain supply to the area

Data Used

For Above Ground Assets:

- Maximo list of assets and associated criticality
- Risk Based Approach classification for storage assets
- Base Asset Health score for site and associated assets
- Number of single Points of Failure within the site
- Contingency reports, Isolation reports
- Site monitoring systems
- Spare parts availability
- Asset Maintenance strategies and Maintenance completion rate.
- Storage inspection reports

Results

Using the Resilience Assessment tool for the **Future situation with no investment**, the tool indicates Resilience Impact score of **11.87%** from the 109,720 properties identified. This result is overall due to the poor Redundancy and Reliability of the site due to being a single cell storage asset with no feasible isolation without affecting customer supplies.

Using our resilience tool, the average Resilience Impact score for **Contamination** Hazard on our reservoir assets is **0.96%**. Hadham Mill Reservoir scores **12** times higher than the average score.

When we introduce the **proposed investments** to the tool, the Resilience impact score will be **0.06%** of the 109,720 properties affected which is a **11.81%** reduction when compared to the future situation without investment. This is due to an improvement in the Redundancy and Reliability of the site due to provision of duty/standby capability by having a new second structure that would allow the outage of each individual structure while being able to continue supplying all customers with safe drinking water with the other structure.

Affinity Water

Tappington South – Licence Variation

September 2023

Contents

Summary

This scheme involves the reinstatement of Tappington South, an existing (but disused) groundwater source within an existing licence group. There is a sequence of boreholes connected by an existing raw water main to the treatment works; Denton; Tappington North; and Rakesole North. Tappington South is not within this sequence currently and the option is to re-commission the borehole to provide resilience for the licence group (the group output is limited by licence / treatment works). For example, the Denton source has turbidity issues at higher pumping rates and the recommissioning of Tappington South would allow the rate at Denton to be reduced. Test pumping is required to confirm the yield that can be achieved and water quality.

Operational regime focus and DO benefit	Average	0.7 Ml/d (average)	0.7 Ml/d (peak)

Table 1: Key Opex information

Ofwat Site Categorisation:	SD
No. Processes:	3
Flow of Works:	0.7

Table 2: Total Opex Costs

Total Opex based on Ofwat Category (£):	£ 28,822
Total from Detailed Opex Modelling (£):	

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.13	0.16	0.18	0.16	0.00	**0.63**
Opex (£m)	0.00	0.00	0.00	0.00	0.03	**0.03**
Totex (£m)	0.13	0.16	0.18	0.16	0.03	**0.66**
Drivers						
100%	Supply-side improvements delivering benefits in 2025-30					
Benefits						
Production Capacity (Ml/d)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**5.8**	NPV Benefits (£m) (2025-55)			**0.9**
NPV (£m) (2025-55)		**-4.9**	Benefit / Cost Ratio			**0.2**

Six Capitals					
Natural	Social	Financial	Manufact.	Human	Intellectual
★ ★	★ ★ ★	★	★ ★ ★		★

Project Description

Affinity Water's WRMP19 submission stated that a new groundwater source would be required to meet the supply-demand balance in our Dour Community in 2035. This has now been confirmed through WRMP24, with a delivery date of 2031/32. Tappington South is a borehole re-instatement scheme that represents the Best Value solution for the WRZ according to the WRSE assessment methodology.

Project Development

Problem Statement and Stated Need / Driver

The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below (Figure 3). These are all analysed at regional level by WRSE and then translated down to Affinity Water for incorporation in the WRMP.

Figure 3 Four key drivers for WRMP

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK

Driver	WRSE Implication
	Government's Water Resources Planning Guidance. The impacted companies have a statutory duty to plan for this level of future growth.
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[1], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively.
Improved drought resilience	The Environment Agency's National Framework for Water Resources requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved using drought orders and drought permits up to 2040 but reducing reliance on these measures thereafter.

Risks, Issues and Requirements

The key risks are noted below, however it should be noted that further assessment including pumping tests are necessary to understand conditions before significant capital investment is committed:

Allocation of Costs

100% of the costs would be enhancement.

Research, Pilots, and Technology Development

This is an existing licenced borehole. Yield is relatively certain, but pump tests and possible borehole rehabilitation will be require before the pumps and mains can be installed.

Customer Engagement

Customer Engagement

Customer engagement is managed through WRMP project. We have undertaken extensive engagement with our customers to build a detailed understanding of their

priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

Partnering

Collaboration and Partnering

Engagement with Stakeholders and Partners

Engagement has been carried out with local customers and Local Authorities via the WRMP consultation process.

Co-design and Co-delivery

As this option currently only consists of initial investigations in AMP8, there are no co-creation or co-delivery proposals. Co-design and co-delivery will be undertaken with collaboration between the parties involved including Environmental Agency

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement.

This investigation forms the early stages of a longer term scheme identified in the rdWMP24 Best Value Plan. The Affinity Water rdWRMP24 submission concludes that even with the stretching demand management targets in the Environmental Improvement Plan, a small new source of water will be required to balance supply and demand in accordance with our statutory duties.

This note explains the known potential limitations of the options as well as the uncertainties associated with each, to demonstrate that out preferred option is the most suitable for further investigation in AMP8.

Option 1 –

Option Explanation

This scheme involves Tappington South, an existing (but disused) groundwater source within an existing licence group. There is a sequence of boreholes connected by an existing raw water main to the treatment works; Denton; Tappington North; and Rakesole North. Tappington South is not within this sequence currently and the option is to re-commission the borehole to provide resilience for the licence group (the group output is limited by licence / treatment works). For example, the Denton source has turbidity issues at higher pumping rates and the recommissioning of Tappington South would allow the rate at Denton to be reduced. Test pumping is required to confirm the yield that can be achieved at an acceptable water quality. This scheme would require a new abstraction borehole, which would be pumped and treated at the

existing group works to supplement the existing annual average surface water licence.

Uncertainties

The main uncertainty relates to water quality. This is currently unknown and for the purposes of affordability it has been assumed that modifications will not be required to the group treatment works.

The location of the scheme is unknown at this stage. Ideally the borehole would be located at the existing treatment works site on Affinity Water land, although the site is conjected and this may not be feasible.

Affinity Water has experience in dealing with these uncertainties, as described in the table below. The reduction of uncertainty is the focus of the AMP8 expenditure for the scheme.

Uncertainty	Mitigation/ Process
Currently unknown feasible yield.	OBH pump test
Currently unknown water quality.	OBH pump test
Currently unknown thickness/uncertainties with geology, grain size etc.	OBH pump test
Currently unknown potential for drawdown	OBH pump test
EA appetite for LGS licences/policy.	Initial regulator discussions

Option Assessment Approach

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

Cost Estimation

Total Capex

Total Capex cost is estimated at **£628,178**.

Total Opex

Total Opex cost is estimated at **£ 5,764 per annum.**

Benefit Estimation

The overall water resource benefits are the same between the various options.

Water Resource Benefits

When commissioned, the preferred option will deliver a benefit of maximum 0.7 ML/d (annual average deployable output) to Affinity Water.

Environmental Benefits

The Natural Capital Assessment identified that the option could cause the temporary and permanent loss of natural capital stocks during construction. Stocks that are likely to be permanently lost include pasture, woodland and active floodplain. However, best practice mitigation (including the use of trenchless techniques) and reinstatement/compensation of habitat means that most natural capital stocks post construction will have no to little change.

Efficiency

At present, due to the early stage of the scheme, there are limited efficiencies built into the scheme costing.

Assumptions Made

Costs are based on investigations of similar size and complexity.

Delivery Considerations

Delivery Risk Management

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Supporting Information

Revised Draft WRMP24 September 2023

Draft WRSE Regional Plan August 2023

Supply Side Options Appraisal August 2022

Appendix 1:

Affinity Water

HS2 Non-SESRO Perivale

September 2023

Contents

Summary

The Perivale transfer option consists of a transfer of potable wholesome water from Thames Water network to Affinity water network via storage tank and water pumping station.

The Perivale option forms part of the revised draft WRMP, as submitted to Defra, and needs to be continually live as per current arrangements to maintain Affinity Water's supply-demand balance.

The Perivale option is part of the feasible options set considered by Affinity Water in deriving their best value Water Resources Management Plan (WRMP24) and by the Water Resources South East (WRSE) in deriving their draft Regional Plan.

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	1.41	0.00	0.00	0.00	0.00	**1.41**
Opex (£m)	0.64	0.64	0.64	0.64	0.64	**3.20**
Totex (£m)	2.05	0.64	0.64	0.64	0.64	**4.61**
Drivers						
100%	Supply-side improvements delivering benefits in 2025-30					
Benefits						
Production Capacity (Ml/d)						
Economic Analysis						
NPV Costs (£m) (2025-55)		**4.2**	NPV Benefits (£m) (2025-55)			**3.1**
NPV (£m) (2025-55)		**-1.1**	Benefit / Cost Ratio			**0.7**
Six Capitals						

Natural	Social	Financial	Manufact.	Human	Intellectual
★ ★	★ ★ ★	★	★ ★ ★		★

Project Description

The Perivale connection between Thames Water and Affinity Water network has been developed and delivered by Affinity Water – Capital Delivery team in order to fulfil requirements associated to demand request for High Speed 2 Project. The new installed connection was planned to be disconnected after High Speed 2 - construction phase of the project is completed. However, for supply-demand balance, it is proposed to retain this connection.

The connection has been installed and will be put into commission during 2023. The transfer is capable of up to 10Ml/d potable water.

As this is a new potable water transfer that is already constructed the only costs relate to a possible re-payment to HS2 to refund the costs of not having to de-commission the transfer, and appropriate bulk supply payments to Thames Water.

Project Development

Baseline Assessment

The draft WRMP24 (section 6) reports the baseline forecast supply-demand balance for Affinity Water. This represents the position in a 'Do Nothing' scenario. Figure 6.3 of the draft WRMP24 is reproduced in Figure 1 below, showing the forecast difference between available supply and projected demand for drinking water in Affinity water's Central Region (WRZ 1- 6).

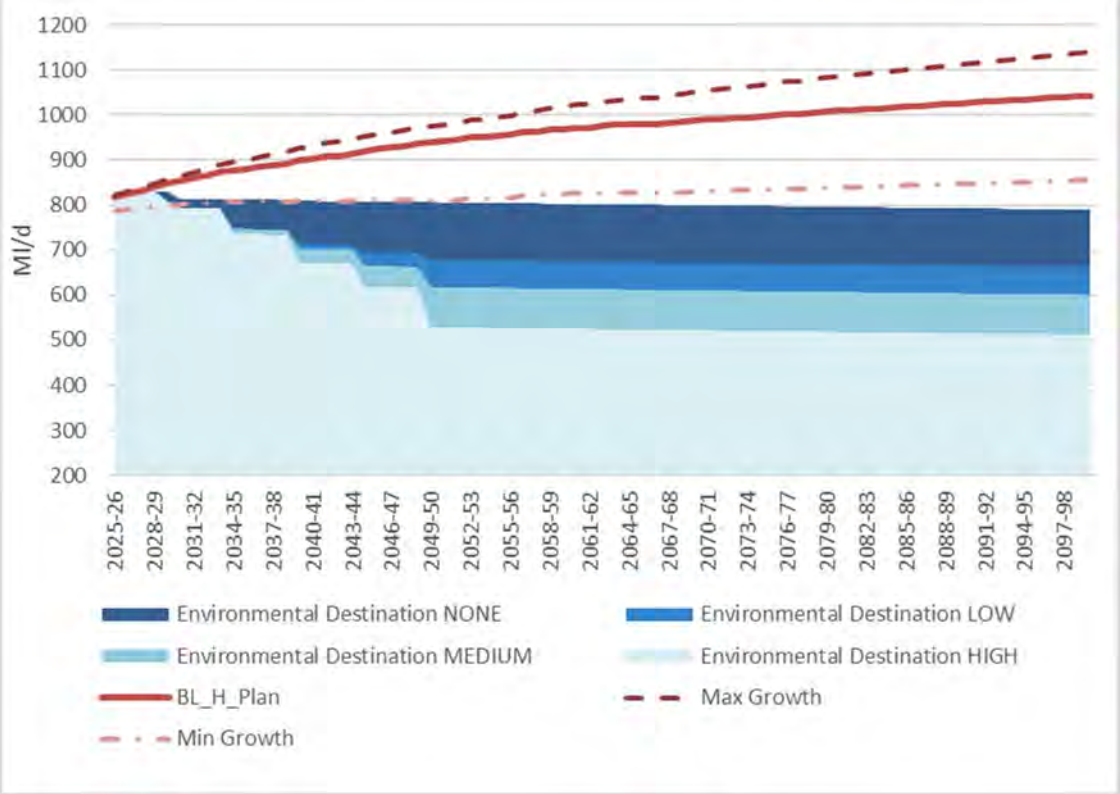


Figure 1 Baseline supply demand and supply for Affinity Water Central region (Figure 6.3 from draft WRMP24)

This is further quantified in the draft WRMP24 as a range of uncertainty, depending on the extent of future growth and future reductions in existing abstraction licences that are required due to environmental pressures. Overall, this uncertainty is quantified as a shortfall of potentially available supply of up to 450 Ml/d for Central communities by 2050.

This loss of supply needs to be met by a combination of new demand saving and water efficiency measures and by new supply-side options such as the GUC SRO.

Problem Statement and Stated Need / Driver

The water resource planning problem to be resolved by WRMP24 is driven by four key drivers, as noted in the table below. These are all analysed at regional level by WRSE and then translated down to Affinity Water for incorporation in the WRMP.

Driver	WRSE Implication
Future Population Growth	Results in the need to supply water to more customers. In WRSE as a region, the forecast methodologies are prescribed by the UK Government's Water Resources Planning Guidance[1]. The impacted companies have a statutory duty to plan for this level of future growth.

[1] https://www.gov.uk/government/publications/water-resources-planning-guideline/water-resources-planning-guideline?msclkid=88cab670c08011ecb284fa54ecf9127d

Driver	WRSE Implication
Impacts of climate change	May reduce available flows in rivers or groundwater recharge thereby reducing the amount of water that can be supplied from existing and potential new sources. In WRSE as a region, a median forecast of climate change is used as the basis of future estimated impacts.
Impacts of existing abstractions	Will result in reduced supply from existing water sources required to protect the more vulnerable environmental receptors, such as chalk streams. Under the Environment Agency's National Framework for Water Resources[2], regional water resource groups are required to explore and implement the steps required to achieve a shared Environmental Destination to reduce the most environmentally unsustainable abstractions. WRSE partner companies have worked closely with the Environment Agency to understand the sources affected and the level of abstraction reduction required and collectively. t
Improved drought resilience	The Environment Agency's National Framework for Water Resources[2], requires companies to plan for a higher level of resilience to drought, so that restrictions such as rota cuts and standpipes will be needed no more than once every 500 years on average by the 2030s. Within WRSE, this is achieved using drought orders and drought permits up to 2040, but reducing reliance on these measures thereafter.

These drivers for additional water supply are considered after the implementation of reductions to leakage and to water consumption, as prescribed by the Environment Agency's National Framework for Water Resources2. The framework requires a 50% reduction in leakage by 2050 and planning for a domestic water consumption of, on average, 110 litres per person per day by 2050, while also reducing non-household demand. These aspects are all adopted by WRSE and the partner companies, contributing to the overall future demands for water supply.

The Cockfoster connection is one of the supply side options that are available to balance the remaining need as described in the WRMP.

Risks, Issues and Requirements

The original plan was to remove the connection after HS2 project is completed, therefore the risk is that c £ 0.9 M needs to be refunded. This risk is low as we are already in conversation with HS2. This will be clarified during the commissioning contract arrangements phase.

The second significant risk is that works will need to be undertaken by Thames Water to their A406 trunk beyond 2025. Although there is a risk that a significant contribution c. £ 14-20 M towards the main upgrade project may be required, this is only needed if the transfer is constantly required and our water resource modelling indicates that this will not be the case, with utilisation only needed during dry

[2] https://www.gov.uk/government/publications/meeting-our-future-water-needs-a-national-framework-for-water-resources?msclkid=245c3d5bc08211ec8b961853f7da9bae

summer or emergency events. Any such costs will be incorporated as opex within the bulk supply agreement, within the Ofwat bulk supply agreement framework

Allocation of Costs

100% of the costs have been allocated to Enhancement. This represents a new supply need under the WRMP driver.

Research, Pilots, and Technology Development

No specific research or development has been required to support development of this investment case. However, there are various opportunities to incorporate emerging low-carbon and renewable energy technologies into the construction and operational phases of the scheme. We will continue to explore these as the design progresses.

Customer Engagement

Customer Engagement

We have undertaken extensive engagement with our customers to build a detailed understanding of their priorities and reflected these in this business case. For more detail on our customer engagement see AFW04 What Customers and Stakeholders Want.

All customer engagement has been carried out through the WRMP process and this option has been selected as part of the overall Best Value solution, as described within the WRMP.

Partnering

Collaboration and Partnering

Engagement with Stakeholders and Partners

This project is being delivered through negotiation with Thames Water and HS2.

Co-design and Co-delivery

This is not applicable for this scheme.

Strategy Development

All of our enhancement cases have been developed as part of our integrated investment portfolio that takes the first steps of our Long Term Delivery Strategy and achieving our ambitions as laid out in AFW03 Strategic Direction Statement. We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

Long-term Delivery Strategy Alignment

This project features as an AMP8 requirement across all branches of the LTDS adaptive strategy.

Optioneering

We have consistently proposed best value solutions using rigorous optioneering. For more detail on our approach is provided within AFW08 Our Investment Development Process.

As this is an adaptation of an existing connection, there are no 'local' alternative solutions. This option has been selected as part of the overall Best Value solution, as described within the WRMP.

Option Assessment Approach

Economic Assessment

This option has been selected according to the detailed investment modelling analysis described in Chapter 8 of the revised draft WRMP24 submission. It is selected both in the least cost Plan and the Best Value plan due to its low average incremental cost and minimal of environmental footprint.

Third Party Assurance and Audit Trail

The WRMP optioneering process has been subject to full third party external assurance, supported by the WRMP Board assurance statement, as provided in Chapter 10 of the WRMP.

Delivery Considerations

Related Projects

There are no related projects.

Delivery Risk Management

The main delivery risk is associated with negotiating the bulk supply agreement with Thames Water. Both parties have agreed to carry out the negotiations in accordance with the Ofwat bulk supply principles published in 2017.

Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

The benefits are already achievable, and have been confirmed by Thames Water through their network modelling assessment. The delivery of the benefits will be confirmed when the bulk supply agreement is signed.

Supporting Information

Perivale PS (pumping station) is located on Horsenden Lane South, just off the Western Avenue, London (51.53409,-0.32424 / 516328,183017)

Water supply enters our station from Thames Water's station, which is immediately adjacent as shown in Figure 2, below, and then is pumped into our 450mm / 18" main in Horsenden Lane South for onward distribution to customers.

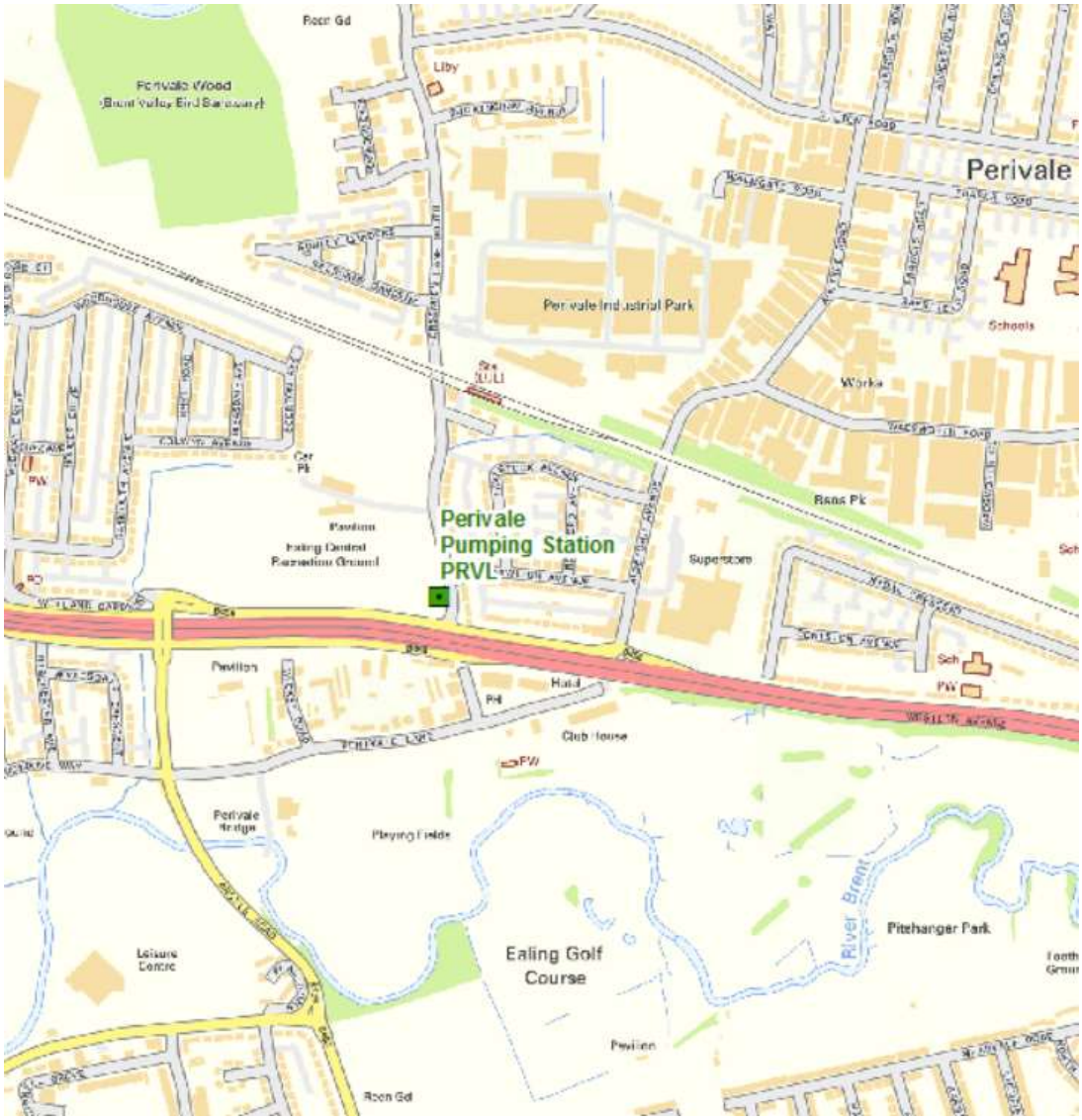
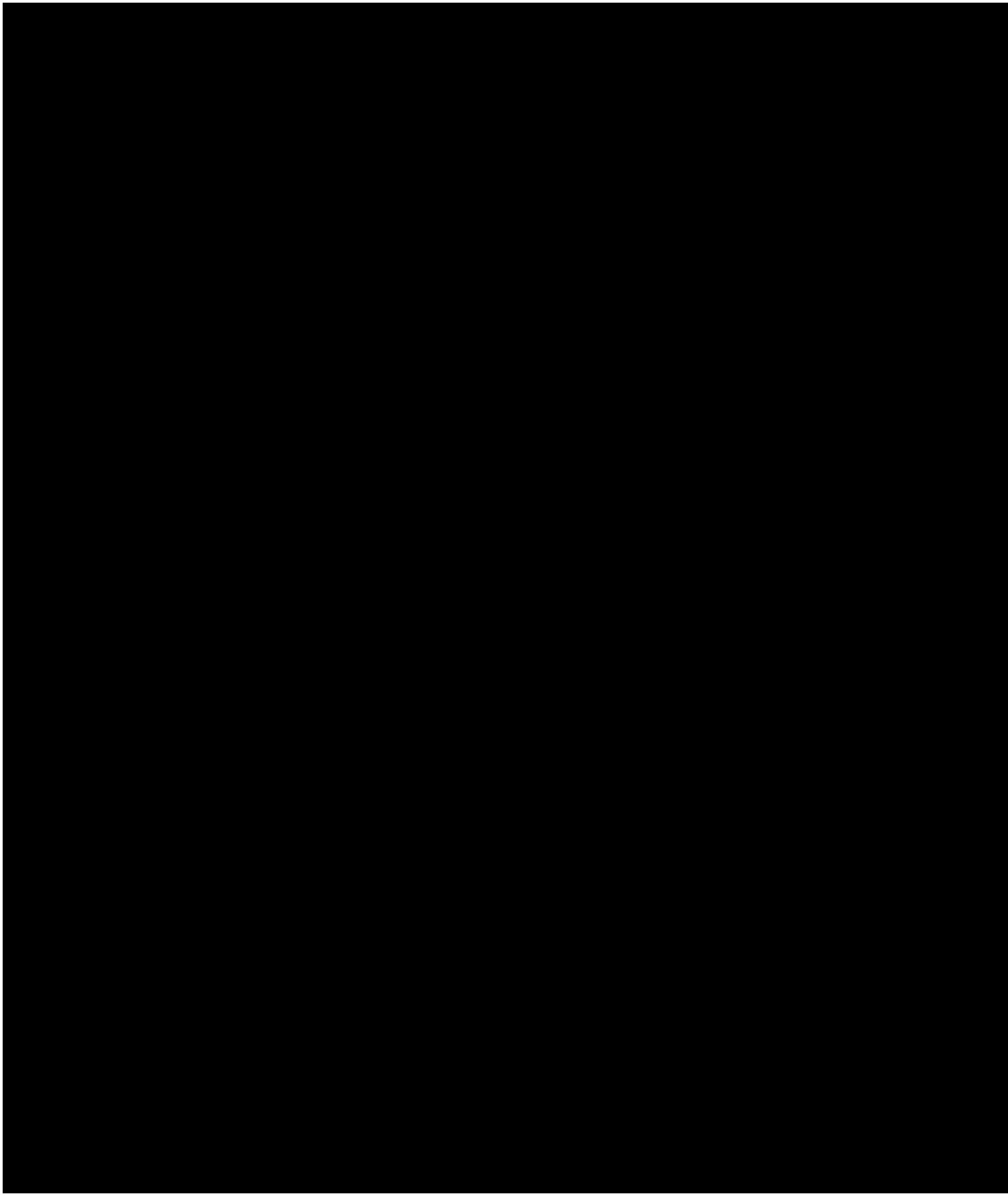


Fig. 1. Location of new Perivale import connection (Google view)



Affinity Water

HS2 Non-SESRO Cockfosters

September 2023

Contents

Summary

Cockfosters transfer option consists of a transfer of potable wholesome water from Thames Water network to Affinity water network via storage tank and water pumping station.

Cockfosters option should be included in the AMP8 budget as it forms part of the Final WRMP, approved by Defra, and needs to be continually live as per current arrangements to maintain Affinity Water's supply-demand balance.

The Cockfosters options are part of the feasible options set considered by Affinity Water in deriving their best value Water Resources Management Plan (WRMP24) and by the Water Resources South East (WRSE) in deriving their draft Regional Plan

Project Details

AMP8 Spend	2025-26	2026-27	2027-28	2028-29	2029-30	Total
Capex (£m)	0.00	0.00	0.00	0.00	1.10	**1.10**
Opex (£m)	0.00	0.00	0.00	0.00	0.43	**0.43**
Totex (£m)	0.00	0.00	0.00	0.00	1.53	**1.53**

Drivers	
100%	Supply-side improvements delivering benefits in 2025-30

Benefits
Production Capacity 5 Ml/d

Economic Analysis			
NPV Costs (£m) (2025-55)	**1.2**	NPV Benefits (£m)(2025-55)	**1.1**
NPV (£m) (2025-55)	**-0.1**	Benefit / Cost Ratio	**0.9**

Six Capitals					
Natural	**Social**	**Financial**	**Manufact.**	**Human**	**Intellectual**
★ ★	★ ★ ★	★	★ ★ ★		★

Project Description

The Cockfosters connection between Thames Water and Affinity Water network has been developed and delivered by Affinity Water – Capital Delivery team in order to fulfil requirements associated to demand request for High Speed 2 Project. Initially, the new connection was supposed to be disconnected after High Speed 2 - construction phase of the project is completed. However, for supply-demand balance, it is proposed to retain this connection.

The connection has been installed and will be put into commission during 2023. The transfer is capable of up to 5Ml/d potable water.

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Project Development

Baseline Assessment

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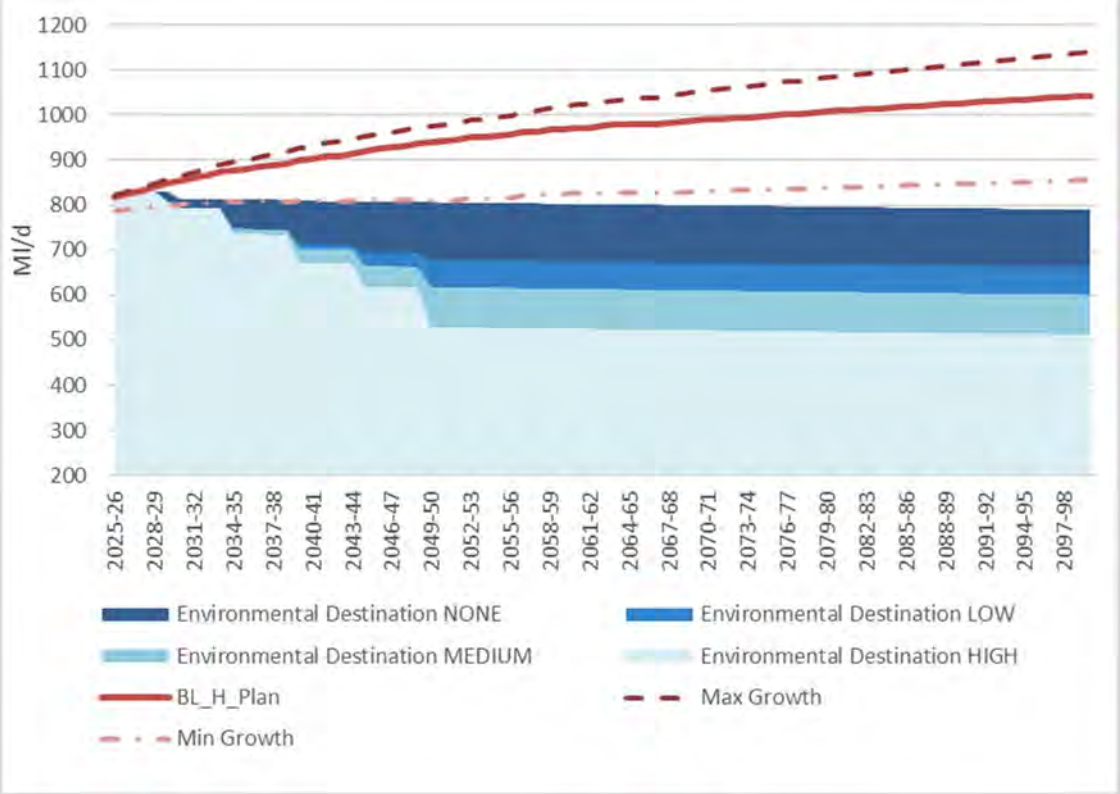

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Further detail regarding how we have ensured the deliverability of our full investment portfolio is provided within AFW 32 Deliverability of our Plans.

Monitoring and Reporting of Benefits

The benefits are already achievable, and have been confirmed by Thames Water through their network modelling assessment. The delivery of the benefits will be confirmed when the bulk supply agreement is signed.

Supporting Information

Cockfosters Tower is the location of the new import from Thames Water. A district meter is not yet recorded on GIS but one will be installed ,recording imported flow from Thames Water.

Cockfosters Tower is located on Cockfosters Road, just opposite of property no. 359 (called: Renaissance, EN4 0JT) (51.65875,-0.15248 / 527891,197167)