Portsmouth Water

PRT 07.08 PFAS RESILIENCE ENHANCEMENT

CONTENTS

1. SUMMARY

This investment proposal relates to the provision of an additional treatment process to manage Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) at Fishbourne Borehole and Water Treatment Works which supplies the Lavant South Water Supply Zone (WSZ).

The need arises from the presence of PFAS in groundwater supplies that have the potential to hinder the supply of water from the Fishbourne Borehole source to the Lavant South WSZ. There is potential for groundwater PFAS levels to increase to an unacceptable standard, or for wholesome drinking water acceptability limits to decrease, which could limit Portsmouth Waters ability to supply water to our customers.

Fishbourne Borehole is a critical supply point for the Lavant South WSZ which is supplied from four interconnected sources. It is theoretically possible to supply the WSZ from the alternate sources, however, this requires them all to be continuously running at peak production output. It is for this reason that all four sources are considered critical to ensuring the continuity of supply to our customers.

The overriding need is to make the water supply to Portsmouth Water's customers more resilient to fluctuations in PFAS concentration, thereby protecting public health, ensuring safe sustainable drinking water, and mitigating long-term environmental impacts. Proactive measures implemented now will prevent more costly and complex remediation efforts in the future, safeguarding both the environment and our customers. The work is necessary to secure the outputs of Fishbourne Borehole into the future, and to protect against environmental factors over which Portsmouth Water has no, or very limited, influence or control.

Following longlisting and shortlisting of options, the preferred solution has been identified as a new Reverse Osmosis (RO) Treatment Process built in line with the existing Fishbourne Water Treatment Works. The RO treatment process would be capable of treating the maximum demand of 13.6Ml/day, so that all treated water from the Fishbourne Water Treatment Works is within or below the Tier 1 PFAS concentration of <0.01 µg/L, as designated by Drinking Water Inspectorate (DWI) guidance.

A summary of AMP8 costs related to the preferred solution are tabled below:

Category	Cost (£)
CAPEX Delivery Cost	£8,194,184
Change in Annual OPEX Cost	£234,202
Tier 2 Catchment Study Costs	£444,733

The solution to introduce a specific PFAS treatment process at source would provide Portsmouth Water with enhanced network resilience, which provides a defence against the risk of water quality deterioration and subsequent water supply outages caused by an increase in PFAS concentrations within groundwater sources and/or a change in the regulatory wholesome limits for PFAS.

The whole of the work will be carried out within AMP8, with the enabling work carried out early in the period. Where possible, work will be integrated with other project work to minimise plant outages and to provide delivery efficiencies. Much of the enabling work can be carried out without planned outages. Where resilience improvements are necessary to reduce the loss of supply risk to customers, consequent on undertaking the improvements, then this will be factored into the delivery program.

The proposal provides societal benefit by ensuring customers are protected, so far as is reasonably practicable, against known PFAS risks within the catchment. The utilisation of RO treatment to manage and reduce PFAS concentrations is widely recognised as a practical and cost-efficient approach. The option provides the greatest Benefit-Cost ratio and provides the optimal solution for lowest cost.

The work is presented as an enhancement proposal since the need is driven by exogenous deteriorations in raw water quality along with the ongoing investigation and regulatory development surrounding PFAS. The proposal provides resilience against these factors, and the known need for such improvement as the supply and demand balance becomes more challenging in the future, as related in the Portsmouth Water's WRMP24.

2. NEEDS

A. Overview

The need arises from the presence of Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS) in groundwater supplies that have the potential to hinder Portsmouth Waters ability to supply wholesome water to customers within the Lavant South Water Supply Zone (WSZ). Whilst the company has not failed to supply because of this risk, there is potential for groundwater concentration levels to increase and/or for drinking water acceptability limits to decrease, which could impact on Portsmouth Waters ability to supply water from the Fishbourne Borehole source. This Borehole currently produces an average supply of 10.2 Ml/day and a peak demand of 13.6 Ml/day.

Fishbourne Borehole is a critical supply point for the Lavant and Littleheath water supply system that supplies the Lavant South WSZ. It is theoretically possible to supply both the Lavant WSZs from the Funtington, Lavant and Brickkiln sources, however, this requires all these sources to be continuously running at peak production output. It is for these reasons that Fishbourne, like Lavant, Brickkiln and Funtington are all essential to ensuring the continuity of supply to Chichester and the surrounding area.

The DWI provided an acceptance notice in June 2024 (see Appendix A – Ref PRT-2023-00008) lending their support to Portsmouth Waters AMP8 PFAS Strategy. The acceptance notice outlines that the DWI are satisfied that Portsmouth Water can continue to supply water from all water supply systems (raw water assets, water treatment works and treated water assets) listed in the Annex to the notice, which may be at risk of breaching the wholesomeness standards due to PFAS concentrations. This is conditional that the following key proactive steps are undertaken by Portsmouth Water:

- *For all sources that fall into tier 1, design a basic mitigation plan, which can be implemented should concentrations increase, or toxicological or other information change that requires mitigation be delivered.*
- *For all sources that fall into tier 2, companies should design a proactive and systematic risk reduction strategy implementing a prioritised mitigation methodology to progressively manage PFAS concentrations in drinking water.*
- *For all sources that fall into tier 3, design, develop and implement mitigation to reduce PFAS concentrations in drinking water to at least tier 1 concentrations, with a high priority.*

Water quality sampling undertaken from 2022 onwards indicates that Fishbourne groundwater sources rise consistently above the Tier 1 threshold of 0.01 µg/L, which places it into the Tier 2 category. Therefore, it is Portsmouth Waters duty to design a proactive and systematic risk reduction strategy, implementing a prioritised mitigation methodology to progressively manage PFAS concentrations.

Sample results obtained for all other water sources supplying the Lavant South WSZ indicate that PFAS concentrations are below the limit of detection, thereby making Fishbourne Borehole the only asset requiring a PFAS management strategy at this time.

As this is an emerging risk where exposure continues to be defined, there is limited historic data to trend PFAS contamination in each catchment. With the uncertainty around the health and environmental impacts of PFAS, there is a risk of an increase in ground water concentrations above the DWI Tier 2 threshold, and/or the regulatory wholesome limits being tightened. It is a DWI requirement for all Tier 2 supplies to 'prepare measures' to prevent the supply of water to consumers with >0.1 µg/L (Tier 3) PFAS concentrations. Therefore, the mitigation methodology and consideration for investment needs to be made at this time.

PFAS originates from the catchment and whilst catchment management processes are in place to minimise the problem, a residual risk remains, necessitating mitigation measures. The overriding need is to make the water supply to Portsmouth Water's customers more resilient to PFAS, thereby protecting public health, ensuring safe sustainable drinking water, and mitigating long-term environmental impacts. Proactive measures implemented now will prevent more costly and complex remediation efforts in the future, safeguarding both the environment and our customers.

B. Supporting our Vision

The Business Plan has been informed and shaped through insights gained through our Engagement Strategy and triangulation process which has been embedded from 2020 and continues to inform and adapt our service delivery plans.

In all phases of engagement, which link into our Vision, Long Term Delivery Strategy and Business Plan, our customers and stakeholders have supported the need for a secure and reliable water supply. This is consistent across all areas of engagement.

The vision described by Portsmouth Water and supported by its customers is comprised of four key pillars which are listed below:

Figure 1: Our Vision and Priorities

This investment proposal supports the first, third and the final components of the Portsmouth Water vision. The proposal represents a progressive plan to ensure that the resilient service that is required by our customers is achieved at the lowest possible cost.

The proposal to manage PFAS within supplies is an essential step to protect public health, ensure safe sustainable drinking water, and mitigate long-term environmental impacts. Proactive measures now will prevent more costly and complex remediation efforts in the future, safeguarding both the environment and our customers.

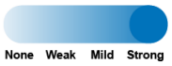
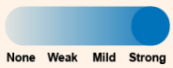
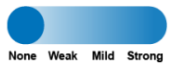
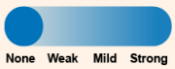
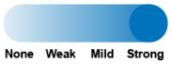
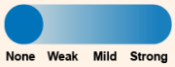
C. Supporting Performance Commitments

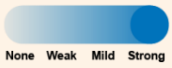
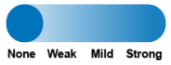
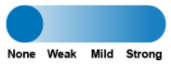
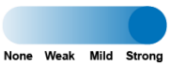
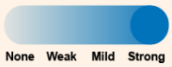
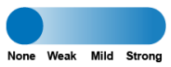
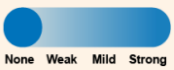
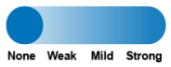
Table 1 defines linkages to common performance commitments and to additional commitments felt important by Portsmouth Water.

The relationships may be interpreted as follows:

Strong	Weak	None
		
The proposal has the potential to directly and significantly impact the performance commitment or the corporate priority. The impact will not, by itself, improve current performance, though may, if the risks surface, significantly and negatively affect current performance.	The proposal has very limited impact on the performance commitment or corporate priority.	There is no perceived impact on the performance commitment or corporate priority.

Table 1: Common Performance Commitments

Performance Commitment	Relationship	Notes
Water Supply Interruptions		Loss of deployable output from critical water treatment plant for extended period. Inability to support demand with source offline.
Compliance Risk Index (CRI)		Ensure that PFAS limits are satisfactory and ultimately that the WQ parameters are achieved.
Per Capita Consumption (PCC)		There is no relationship with PCC.
Leakage		There is no relationship with Leakage.
Unplanned Outages		Failure of critical assets to supply can directly lead to unplanned outages.
Mains Repairs		There is no relationship with Mains Repairs.
Pollution Incidents		There is no relationship with Pollution incidents.

Performance Commitment	Relationship	Notes
CMex, Dmex, BR-Mex		Customer Service is dependent on our ability to reliably supply wholesome water.
Customer Contacts WQ		Proposal does not minimise Customer Contacts on Water Quality
Greenhouse Gas Emissions		Proposal does not minimise embedded and operational carbon
Biodiversity Index		The proposal has no effect on biodiversity
Carbon Footprint		Proposal does not minimise embedded and operational carbon
Low Customer Bills		Proposal minimises cost to customer whilst enabling Deployable Outputs to be achieved.
Corporate Responsibility		Strong belief in competent stewardship and managing emerging risks in Water Quality.
Electricity Usage		Proposal requires additional operational plant and therefore additional electricity usage.
Materials Usage		Proposal requires additional operational plant and therefore additional materials usage.
Community Partnerships		There is no relationship to community partnerships.

D. Regulatory and Statutory Compliance

The Drinking Water Inspectorate (DWI) issued updated guidelines on PFAS in drinking water in July 2022. These guidelines aimed to ensure the safety and quality of drinking water by setting out specific measures for monitoring and managing PFAS contamination.

Water companies are required to monitor for a range of PFAS compounds in drinking water. They are expected to conduct risk assessments to understand the sources and potential risks of PFAS contamination in supply systems. Based on the findings, companies should implement management strategies to mitigate PFAS levels, including optimising treatment processes and controlling sources of contamination.

The guidelines emphasise the importance of protecting public health by ensuring that PFAS levels in drinking water remain below the specified guideline values. Companies are advised to communicate transparently with the public about PFAS levels and measures being taken to address any concerns.

The DWI guidance follows a 3-tiered approach with a guideline value of 0.1 micrograms per litre, which is equivalent to 0.1 parts per billion. An overview of the guidance for each tier is detailed below:

- Tier 1 is less than 0.01 µg/L. The guidance suggests that water companies continue to monitor for PFAS. Initially this may be as frequently as quarterly, until a baseline of data is established which accounts for temporal variation, and a robust risk assessment is complete, at which point the frequency could be reduced to a level sufficient to periodically validate that risk assessment.
- Tier 2 is less than 0.1 µg/L. The guidance suggests that PFAS monitoring continues. For medium risk sites which may not yet be tier 2, and tier 2 sites, a frequency between monthly and quarterly sampling should be sufficient to enable predictive modelling. Frequencies may need to be increased if tier 3 is predicted to be breached. The guidance suggests the review of any control measures, (such as blending with alternate sources) and to prepare measures to prevent the supply of water to consumers with >0.1 µg/L PFAS concentration.
- Tier 3 is greater than or equal to 0.1 µg/L wholesomeness concentration exceeded in final water. The guidance suggests that any results greater than or equal to 0.1 µg/L in water supplied to consumers, or any raw water results that are likely to produce results >0.1 µg/L in water supplied to consumers are notified as an event. Contingency measures would need to be enacted if the control measures employed become inadequate to prevent the supply of water to consumers with greater than >0.1 µg/L concentration. All necessary actions to investigate the source of the PFAS contamination and reduce concentrations to less than <0.1 µg/L in water supplied to consumers must be taken by the water supply company.

The DWI guidance states that for all sources that fall into tier 2, companies should design a proactive and systematic risk reduction strategy, implementing a prioritised mitigation methodology to progressively manage PFAS concentrations in drinking water.

All the noted works outlined in this investment case are considered mandatory by Portsmouth Water to maintain water quality and provide resilience, and variously support:

- The need to maintain water quality and water sufficiency.
- The need to adequately supply water in the event of deterioration in water quality.
- The need to ensure customers' expectations and priorities are met.
- The need to provide water that supports the assumptions of the WRMP24.

1. The need to mitigate the circumstances leading to DWI notices precluding the use of the sites for water supply purposes.

E. Revised DWI Guidance

The DWI's Drinking Water 2023 – Public Supplies England – Annual Report highlights that additional PFAS guidance will be issued in Summer 2024. The revised guidance will consolidate and supersede previous guidance, and confirm the Inspectorates expectations for AMP8 and beyond.

While the full details of the revised guidance are yet to be confirmed, the Annual Report highlights the potential inclusion of an additional compound, and the application of the tiers to any PFAS chemical detected in raw and final water where no treatment is in place. This may result in the application of a new total PFAS limit.

Once details of the revised guidance have been confirmed we will complete a risk review that may identify the need to design and implement further control measures. We will also review and amend the current DWI Undertaking to ensure it meets the requirements of the revised guidance. This may trigger the need for the expansion of this enhancement case to cover further control measures at additional sites.

F. Compliance Risk Index (CRI)

The Compliance Risk Index (CRI) is a measure designed to illustrate the risk arising from treated water compliance failures, and it aligns with the current risk-based approach to regulation of water supplies used by the Drinking Water Inspectorate (DWI). All compliance failures are assessed by DWI using the provisions of the Water Industry Act 1991.

Portsmouth Water has undertaken a high-level analysis of a potential CRI Impact associated with PFAS concentrations. This enables the calculation of a CRI impact and the Outcome Delivery Incentive (ODI) impact of a failure, to identify a potential monetary risk of compliance which can then be used as a basis to calculate investment benefits and identify benefit to cost ratios for each shortlist option.

This calculation is based purely upon theoretical application of CRI as currently PFAS are not listed as a compliance measure. The calculation assumes that PFAS is a compliance measure and equates it to a health risk parameter to give a reflective CRI parameter score. It also assumes that the DWI undertaking would give a 'covered by legal instrument' score under DWI Inspector Assessment.

The following provides narrative on the assumptions used as a basis for the CRI and ODI calculation.

Parameter Score:

Compliance failures for different parameters do not pose equal risk to consumers. The standards in the Regulations are based on different criteria: whilst some are set on a human health basis, others are based on aesthetic concerns, as indicators or for other reasons. This means that the risk posed from non-compliance with a parameter standard varies depending on the reason for the standard.

The CRI Parameter score reflects this difference and the scores determined for each are listed below:

Basis for standard	Score
Health Risk	5
Health Risk Indicator	4
Aesthetic	3
Regulatory Impact	2
Non Health Risk Indicator	1

For the purpose of the calculation, the following assumptions have been made:

For Tier 2 PFAS concentrations, a score of 4 will be used as PFAS has a 'potential impact to health'. For Tier 3 PFAS concentrations, a score of 5 will be used as this is the wholesome limit applied by the DWI which would constitute a 'Health impact'. There is more concern and elevated response for Tier 3 PFAS concentrations, which would suggest a higher score would be applied.

Assessment Score:

All compliance failures are assessed to ensure that the wellbeing and interests of consumers were protected by best practice in management of compliance failures. A well-managed response to a compliance failure with appropriate and speedy mitigation action poses a lower risk to consumers. The DWI also considers the root cause of the failure and whether the company's actions led to or increased the likelihood of the failure, and whether further remedial action is necessary.

The DWI Inspector's Assessment has been assigned a score for CRI as shown below:

Score	DWI Inspector assessment
5	Enforce
4	Covered by legal instrument
4	Enforcement considered
3	Recommendations made
2	Suggestions made
1	Satisfactory investigation did not identify cause

For the purpose of the calculation, the following assumption has been made:

A score of 4 ('Covered by legal instrument') has been used for both Tier 2 & Tier 3 PFAS concentrations to reflect the current DWI undertaking in place.

CRI & ODI Calculation:

A CRI score is calculated for every individual compliance failure. The annual CRI for a company, for any given calendar year, is the sum of the individual CRI scores for every compliance failure reported during that year.

The CRI score for 'Supply Points and treatment works' is calculated using the following formula:

Supply Points and treatment works:

$$CRI = \frac{\text{Parameter Score x Assessment Score x volume supplied } (m^3/day)}{\text{Total daily volume supplied by the company } (m^3/day)}$$

The following variables have been used as a basis for calculation:

- ***Parameter Score: 4***
- ***Assessment Score: 4***
- ***Volume Supplied (from Fishbourne): 10.2 Ml/d (average)***
- ***Volume Supplied (by the company): 174 Ml/d (average)***
- ***PR24 DD CRI ODI Penalty Rate: £104,318 per unit.***

For ease of calculation, this assumes that the company is already in penalty and disregards the deadband.

On this basis, a single Tier 2 failure would equate to a CRI score of 0.938 unit points. Multiplied by the CRI ODI Penalty Rate of £104,318 per unit equates to an **ODI penalty of £97,843 per failure**.

Historically, there has been a maximum of 11 Tier 2 samples recorded in a rolling 12 months, so the **maximum calculated risk exposure for ODI penalties is approximately £1,076,274 per annum**. This equates to £5,381,137 over the course of a 5-year AMP period.

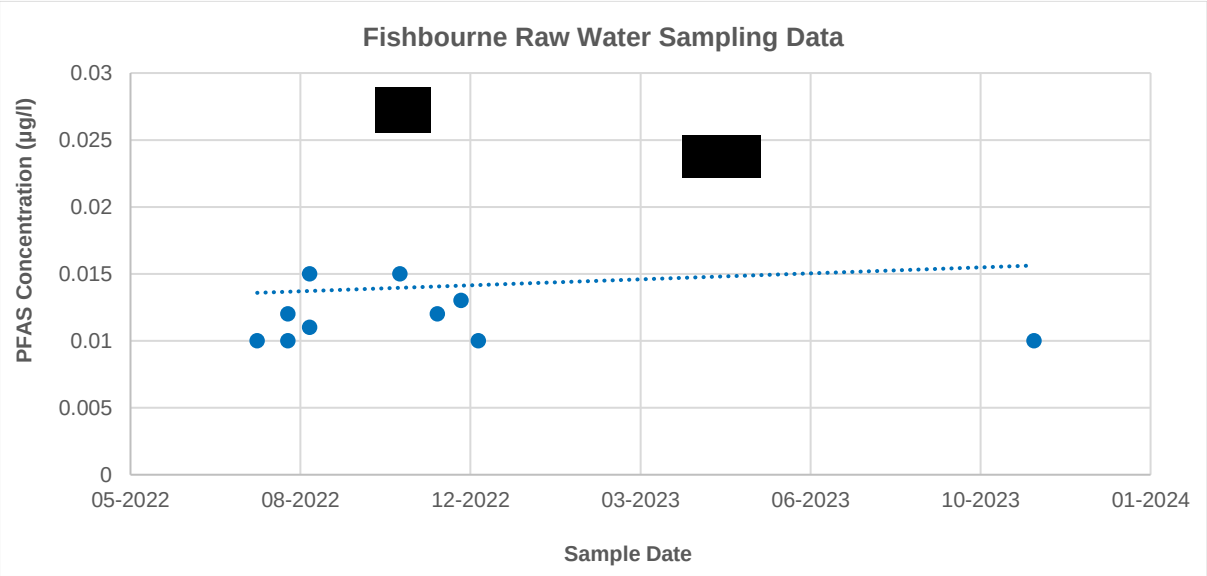
This provides Portsmouth Water with a potential monetary risk of compliance which can then be used as a basis to calculate investment benefits and identify benefit to cost ratios for each shortlisted option.

G. Historical Perspective

PFAS Water Quality Sampling

Water quality sampling undertaken from 2022 onwards has indicated that groundwater sources at Fishbourne Borehole and Water Treatment Works consistently rise above the Tier 1 threshold of 0.01 µg/L, which places it into the Tier 2 category. A summary of raw water sampling data for Fishbourne Borehole (for all samples greater than >0.01 µg/L) is shown in Figure 2 below:

Figure 2: Fishbourne PFAS Water Quality Sampling Data



This data shows sporadic increases in PFAS concentration levels (>0.01 µg/L) throughout the sample period. The data shows an average upward trend in PFAS concentrations which breach the Tier 2 (0.01 µg/L) threshold, with some intermittent results being significantly higher than the average exceedance of 0.014 µg/L. The peak recorded PFAS concentration was 0.027 µg/L in October 2022.

No contributing factors have been identified which explain the immediate increases and subsequent decreases in concentration, therefore indicating that the groundwater source is volatile in respect to fluctuating PFAS concentration. There is therefore a heightened risk of PFAS sample results breaching the Tier 3 (>0.1 µg/L) concentration threshold which would require an immediate contingency response from Portsmouth Water.

The DWI requires water supply companies to 'prepare measures' for Tier 2 sites, continue monitoring and prevent the supply of water from breaching a Tier 3 limit of >0.1 µg/L for total PFAS.

All other sources that supply the Chichester Water Supply System, namely Funtington, Lavant and Brickkiln are routinely sampled for PFAS. These sample results have been returned indicating that all collected samples are below the limit of detection, thereby making Fishbourne Borehole the only asset requiring a PFAS management strategy at this time.

Water Supply Resilience:

Fishbourne Borehole and Water Treatment Works are a critical supply point for the Chichester Water Supply System. Fishbourne produces 10.2 Ml/day on average and 13.6 Ml/day at peak demand. It pumps into an open network supplying the Lavant South Water Supply Zone (WSZ). Therefore, most of the water produced at Fishbourne is used within the Lavant South WSZ and minimal flows from this source enter the Lavant Reservoir for storage. Figure 3 provides an overview of asset connectivity within the Chichester Water Supply System.

Figure 3: Chichester Water Supply System

It is theoretically possible to supply both Lavant WSZs from the Funtington, Lavant and Brickkiln supplies, however, this requires all sources to be continuously running at peak production output. Therefore, the following factors can present Portsmouth Water with a heightened risk of supply failure:

- The water quality from these chalk boreholes can vary significantly and this has historically resulted in borehole pumps being taken offline as a precautionary measure at Lavant and Brickkiln, particularly during the winter period when there can be increases in raw water turbidity and/or colony counts.
- Each of the above listed sources need to be taken offline for minor and major planned maintenance. As an example of this, the Funtington source has been offline since January 2024 whilst UV plant is installed to mitigate a Cryptosporidium risk and the other supply sources therefore need to make up this shortfall in production output.
- In addition, Portsmouth Water undertake power demand shedding between 1600 and 1930 each day during the autumn, winter and spring period, which then requires a higher production output from the other supplies to recover reservoir levels overnight.
- The listed sites can encounter unplanned outages, including but not limited to power shortfalls, dosing equipment failures, drifting of WQ instruments, PLC and sensor failures, etc. There needs to be adequate contingency measures in place for such eventualities, and for worst case scenarios such as a borehole collapse, a contamination event or a fire, which could limit production for a prolonged period.

It is for these reasons that Fishbourne, like Lavant, Brickkiln and Funtington are all considered essential to ensuring continuity of supply to the Chichester Water Supply System.

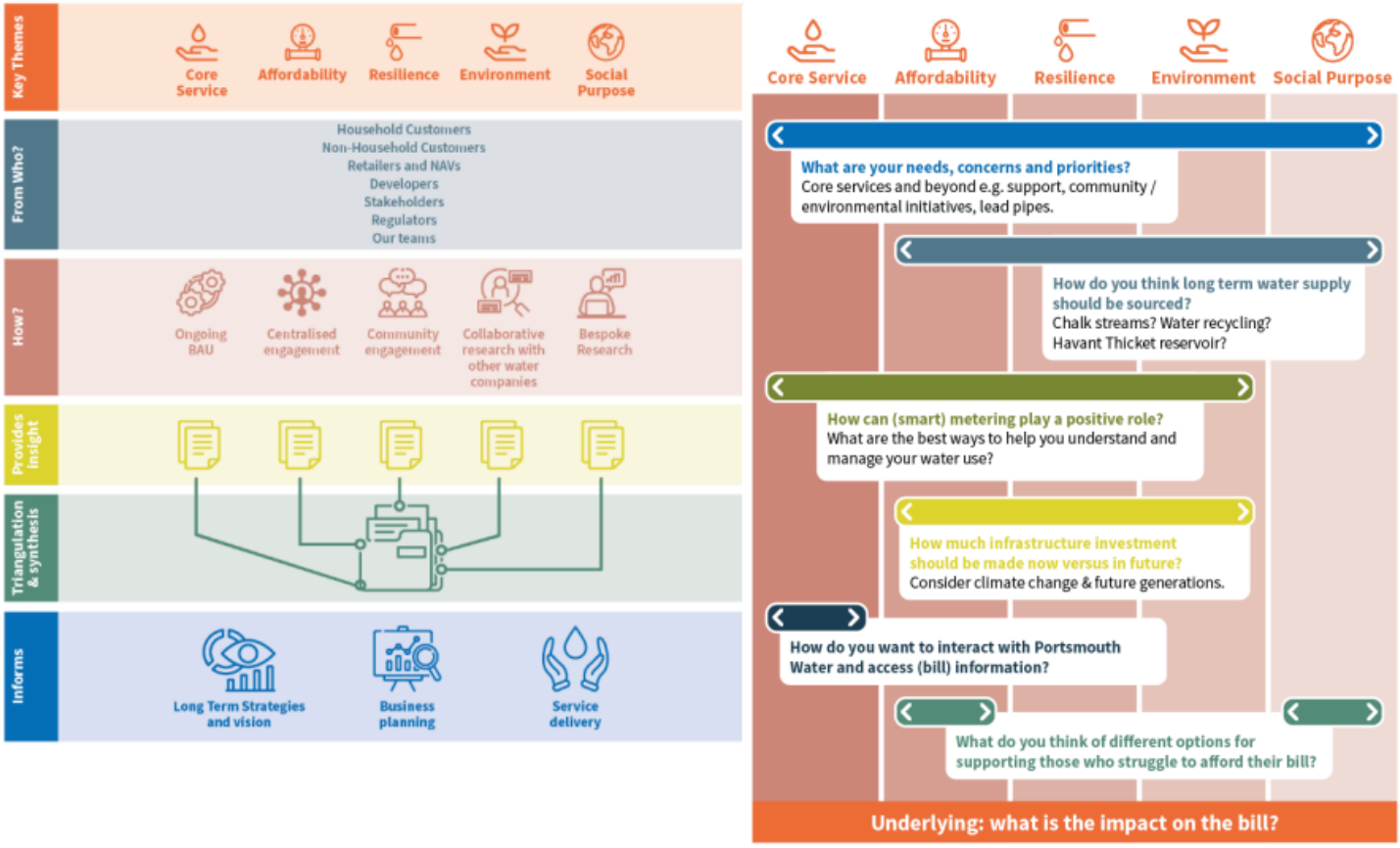
H. Customer Support

The Business Plan has been informed and shaped through insights gained through our Engagement Strategy and triangulation process which has been embedded from 2020 and continues to inform and adapt our service delivery plans.

In all phases of engagement, which link into our Vision, Long Term Delivery Strategy and Business Plan, our customers and stakeholders have supported the need for a secure and reliable water supply. This is consistent across all areas of engagement.

An overview of our 'Engagement Strategy' is represented on the left in Figure 4, and an overview of our 'Big Conversation Framework' is represented on the right in Figure 4.

Figure 4: Engagement Strategy & Big Conversation Framework



Our engagement approach for supporting the Business Plan is set out in PRT03: Engaging with our Customers and Communities. Alongside this we have published all research on our website.

Customers have really supported the need for us to maintain a secure and reliable water service across all phases of engagement. In phase 1 we focused on understanding priorities for our customers and our range of research alongside Ofwat's own ODI research ranked these areas of company activity in importance. A summary of this is shown in Figure 5 below.

Figure 5: Customer Research - Key Areas of Importance

Insight we gained

The research established three key areas of:

Service Aspect Area	Importance
Water supply interruptions	High
Appearance, taste and smell of tap water	High
Do not drink notice	High
Boil water notice	Medium
Leakage	Medium
Pollution incidents	Medium
River water quality	Medium
Biodiversity	Medium
Carbon	Low
Customer satisfaction	Low
Hose pipe ban	Low
Severe drought	Low
Non-essential use ban	Low

Water quality and continuity of supply featured in the top elements of all research findings.

This investment case is focused directly on ensuring the quality and availability of supplies, ensuring they meet our customers ongoing priorities. In selecting the preferred and proposed solutions, we have aligned its response to our customers priorities.

I. Cost Adjustment

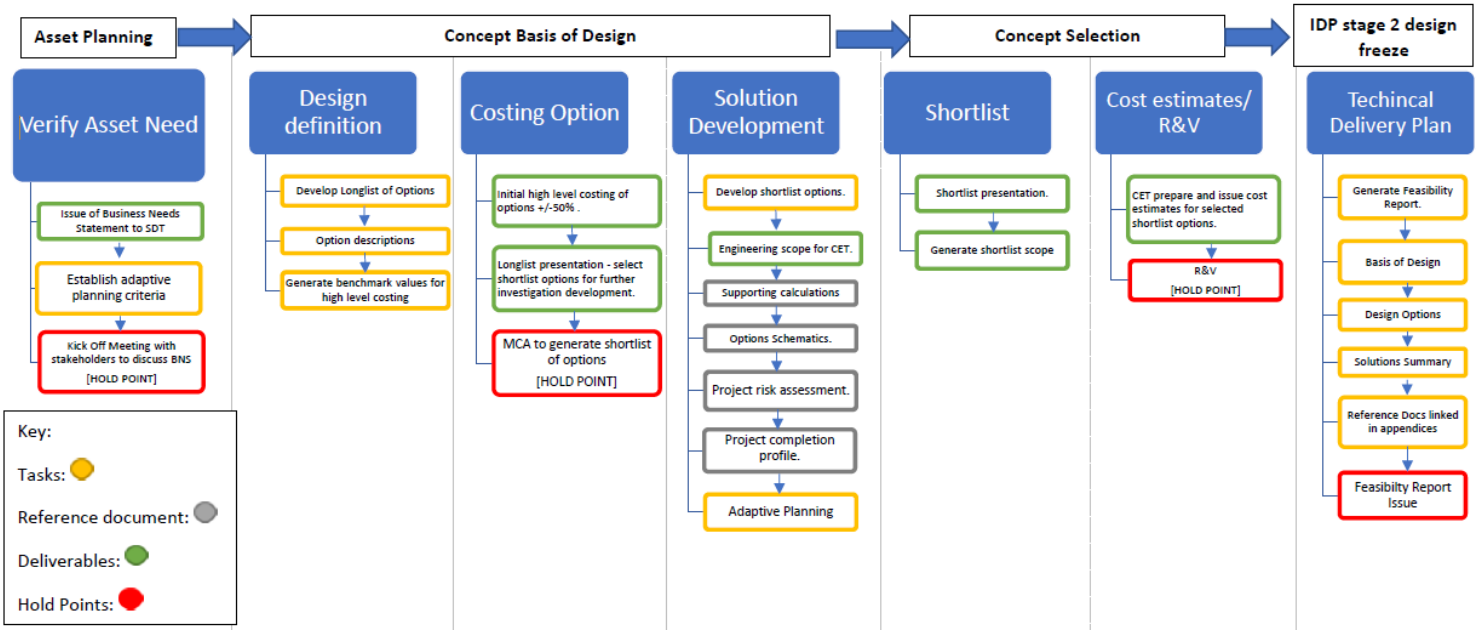
The proposal relates as an enhancement case since it responds to exogenous factors including raw water quality and ongoing regulatory investigation and development surrounding PFAS, over which Portsmouth Water have little or no control. As such, there is no case for cost adjustment.

3. LONGLIST OPTIONS

A. Overview

A series of options were developed against key project drivers following the Design Process Flow shown in Figure 6. A series of longlisted options were developed, with a Multiple Criteria Assessment (MCA) completed for each of the longlist options.

Figure 6: Design Process Flow



Portsmouth Water engaged Aqua Consultants to review this case and assess the available options.

Nine different options were longlisted, with each option reviewed against its ability to meet project drivers and regulatory compliance, whether it provides a long term and technically feasible solution to Portsmouth Water, along with an assessment on environmental impact, deliverability and cost (Capex & Opex). The identified options were investigated, scoped, and provided with +/-50% cost estimates. The outputs were issued to Portsmouth Water in a Long List Presentation (LLP).

The longlist options and MCA were presented at a longlist workshop with Portsmouth Water stakeholders to identify the shortlist options which were to be further developed for Risk and Value review. The longlist workshop identified drivers, site conditions, available options and the preferred solutions. It was agreed that options 4, 5, 6 & 9 would be taken forward to shortlisting for detailed review and costing.

Figure 7 below provides a screenshot of the MCA summary, showing how each longlist option was scored in their respective categories. Cells coloured green indicate a high score, and cells coloured red indicate a low score. Given the overriding need to protect DW quality, it is appropriate that cost is not a strong driver of solution choice.

Table 2 provides an overview of each longlist option, including their scoring performance with regards to the criteria, and whether the option was progressed to shortlisting. A high-level commentary on each longlist option is included in the following sub sections.

Figure 7: Screenshot of MCA Summary

MCA

aquaconsultants
An Adler and Allan company

Scheme ID	Option Nr		Ability to meet project drivers and regulatory compliance.				Provide a long term solution to Portsmouth Water			Providing Green solutions				
			Regulatory Complexity	Problem Resolution	Exisitng Asset performance during construction	Failure Risk	Business Acceptability	Catchment resilience	Access, amenity and engagement	Net Zero	Environmental impact	Carbon Capture	Natural Capital	Bioiversity Impact
		Option Description/ Weight	0.35				0.20			0.10				
2633	1	Do Nothing & Monitor treated water for PFAS	3.00	1.00	5.00	2.50	2.00	3.00	3.00	5.00	5.00	1.00	5.00	1.00
2633	2	Drill a completely new borehole on site with catchment study	3.00	1.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	3.00	1.00
2633	3	Drill a completely new borehole off site, Transfer License with catchment study	2.50	1.00	2.00	2.00	2.00	3.00	3.00	3.00	3.00	2.00	3.00	1.00
2633	4	Track and eliminate potential source in catchment	2.50	1.00	5.00	3.00	2.50	3.00	3.00	5.00	5.00	1.00	5.00	1.00
2633	5	GAC full flow treatment with catchment study	4.00	5.00	3.00	4.00	5.00	4.00	3.00	3.00	3.00	2.00	3.00	1.00
2633	6	RO full flow treatment with catchment study	4.00	5.00	3.00	4.00	5.00	4.00	3.00	3.00	3.00	2.00	3.00	1.00
2633	7	IEX full flow treatment with catchment study	3.50	3.00	3.00	4.00	5.00	3.50	3.00	3.00	3.00	2.00	3.00	1.00
2633	8	AOP full flow treatment with catchment study	3.50	1.00	3.00	3.50	2.00	3.00	3.00	3.00	3.00	2.00	3.00	1.00
2633	9	Network blending with catchment study	3.50	3.00	3.00	4.50	4.00	3.00	3.00	5.00	4.00	1.00	4.00	1.00

Scheme ID	Option Nr		Technically Feasibility			Deliverability			Cost		Total Weighted Score	Ranking	Selected For Shortlist Solution
			Technology Development Status	Construction/ Buildability	H&S in Operation	Client Acceptability	Resourcing	Complexity	Capex	Opex			
		Option Description/ Weight	0.15			0.10			0.10				
2633	1	Do Nothing & Monitor treated water for PFAS	3.00	5.00	5.00	5.00	5.00	3.50	5.00	5.00	3.48	6	N
2633	2	Drill a completely new borehole on site with catchment study	3.00	3.00	3.00	5.00	5.00	3.00	3.50	4.00	2.73	7	N
2633	3	Drill a completely new borehole off site, Transfer License with catchment study	3.00	3.00	3.00	5.00	5.00	3.00	3.50	4.00	2.69	8	N
2633	4	Track and eliminate potential source in catchment	3.00	5.00	5.00	5.00	5.00	4.00	5.00	5.00	3.53	4	Y
2633	5	GAC full flow treatment with catchment study	5.00	5.00	3.00	4.00	5.00	3.50	3.00	3.00	3.81	1	Y
2633	6	RO full flow treatment with catchment study	5.00	5.00	3.00	4.00	5.00	3.50	3.00	2.00	3.76	2	Y
2633	7	IEX full flow treatment with catchment study	4.00	5.00	3.00	4.00	5.00	3.50	3.00	3.00	3.50	5	N
2633	8	AOP full flow treatment with catchment study	1.00	3.00	3.00	3.00	5.00	1.00	2.50	2.00	2.61	9	N
2633	9	Network blending with catchment study	4.00	4.00	4.00	4.00	5.00	4.00	4.00	5.00	3.68	3	Y

Table 2: Summary of Longlist Options

Option	Description	Long List Project Cost	Well Scored Criteria	Poor Scored Criteria	Score	Shortlist Option
1	**Do nothing & monitor treated water for PFAS**	**£120,482**	• Deliverability. • Cost. • Technical feasibility. • Providing green solutions.	• Potential to provide a long-term solution to PW.	**3.48**	**N**
2	**New borehole on site with catchment study**	**£3,332,744**	• Deliverability.	• Potential to provide a long-term solution to PW.	**2.73**	**N**
3	**New borehole off site with catchment study and obtain abstraction license**	**£3,378,088**	• Deliverability.	• Potential to provide a long-term solution to PW.	**2.69**	**N**
4	**Identify PFAS source in catchment**	**£239,475**	• Deliverability. • Cost. • Technical feasibility. • Providing green solutions.	• Potential to provide a long-term solution to PW	**3.53**	**Y**
5	**Granular Activated Carbon (GAC) full flow treatment with catchment study**	**£12,096,886**	• Potential to provide a long-term solution to PW • Technical feasibility		**3.81**	**Y**
6	**Reverse Osmosis (RO) full flow treatment with catchment study**	**£10,052,860**	• Potential to provide a long-term solution to PW • Technical feasibility.		**3.76**	**Y**
7	**Ion Exchange (IEX) full flow treatment with catchment study**	**£10,492,860**	• Potential to provide a long-term solution to PW • Technical feasibility.		**3.50**	**N**
8	**Advanced Oxidation Process (AOP) full flow treatment with catchment study**	*		• Potential to provide a long-term solution to PW. • Technical feasibility. • Deliverability.	**2.61**	**N**
9	**Network blending with catchment study**	**£239,475**	• Deliverability. • Cost. • Providing green solutions.		**3.68**	**Y**

* AOP is not widely used in the application of treating PFAS due to its complexity and as such no longlisting cost was obtained. Please refer to section 3-I below for further information on Option 8.

B. Option 1 – Do nothing & monitor treated water

✓***Make no changes to current operation and introduce enhanced monitoring for PFAS.***

This option provides the lowest cost solution but carries the highest risk. Continual monitoring of PFAS in the treated water supply (assumed monthly) would allow Portsmouth Water to collect data, identify long-term trends and calculate the residence time in the aquifer.

However, if the regulatory requirements change or any sudden elevation in PFAS groundwater levels were to occur, then this would leave the business vulnerable to providing a contingency response and still needing to introduce a specific PFAS treatment process. There would be no change to the existing deployable output and therefore no additional resilience would be achieved.

Direct work	£50,000
Contractor overhead	£39,544
Project overhead	£30,937
Project Cost	**£120,482**

Total Weighted Score = 3.48

C. Option 2 – New borehole on site

✓***Drill a new borehole at a different location on the same site.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

This option would provide an alternative abstraction source on the existing site which could be used to blend or replace the existing source to lower PFAS concentration. However, this assumes that catchment management tasks are ongoing to prevent further increase in PFAS levels and that there is sufficient land on site to locate a new borehole.

The key disadvantage of this solution is that a new borehole may not provide the required quality or yield to meet demand. It is likely that a borehole located on the same site would utilise the same aquifer, which is likely to be contaminated with the same PFAS concentration. Therefore, there is a high risk that this solution will not provide the required output and a PFAS treatment process would still be required.

Direct work	£1,463,877
Contractor overhead	£1,013,078
Project overhead	£855,788
Project Cost	**£3,332,744**

Total Weighted Score = 2.73

D. Option 3 – New borehole off site

✓***Find a new site/location to abstract water from and drill a new borehole.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

This option would provide an alternative abstraction source off site which could be used to blend or replace the existing source. However, this option also assumes that catchment management tasks are ongoing to prevent further increase in PFAS levels and that there is sufficient land available nearby to locate a new borehole.

As per the previous option described, the key disadvantage of this solution is that a new borehole may not provide the required quality or yield to meet demand. A new abstraction licence would need to be granted by the Environment Agency in a water stressed area, which may provide further risks and

challenges. There is a risk that a new borehole located off site may not be practical and may not provide the required output. Therefore, a PFAS treatment process would still be required.

Direct work	£1,484,121
Contractor overhead	£1,026,534
Project overhead	£867,431
Project Cost	**£3,378,088**

Total Weighted Score = 2.69

E. Option 4 - Identify PFAS source in catchment

✓ ***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓ ***Monitor treated water for PFAS.***

This solution would aim to conduct a geological study and catchment assessment to try and identify the source of PFAS. If the source of the PFAS contamination is found, then next steps will be identified at that point to determine the appropriate course of action, if one is to be taken. Removal of the contaminant at source is always preferable, however once PFAS have entered the environment, it is challenging to remove them from groundwater without treatment.

It is hard to measure PFAS in drinking water as they include many individual compounds with typically low concentrations. Therefore, detecting and preventing them from entering the environment would be beneficial, however, the contamination is already evident, and therefore a form of removal from the groundwater would likely still be a requirement.

Direct work	£100,600
Contractor overhead	£77,382
Project overhead	£61,492
Project Cost	**£239,475**

Total Weighted Score = 3.53

F. Option 5 - Granular Activated Carbon (GAC) full flow treatment

✓ ***New inline 13.6 Ml/day GAC process unit, inclusive of ancillary equipment, MCC, ICA requirements, power supply and communication cabling.***

✓ ***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓ ***Monitor treated water for PFAS.***

GAC filters use activated carbon to adsorb PFAS from water. Water passes through the granular carbon, which captures and holds the contaminants. GAC is effective for long-chain PFAS compounds and can remove a significant portion of PFAS contaminants. The advantage of this solution is that it is a well-established technology, relatively cost-effective, and widely used.

However, its limitations are that the carbon requires regular replacement or regeneration as it becomes saturated with PFAS. Its effectiveness can vary with shorter-chain PFAS compounds.

Direct work	£5,424,223
Contractor overhead	£3,566,401
Project overhead	£3,106,260
Project Cost	**£12,096,886**

Total Weighted Score = 3.81

G. Option 6 – Reverse Osmosis (RO) full flow treatment

✓ ***New inline 13.6 Ml/day RO process unit, inclusive of ancillary equipment, MCC, ICA requirements, power supply and communication cabling.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS***.

RO uses a semi-permeable membrane to remove contaminants from water by applying pressure to force water molecules through the membrane, leaving PFAS and other impurities behind. It is highly effective in removing virtually all PFAS compounds, including short-chain variants. It has the advantage of providing comprehensive contaminant removal, not only the removal of PFAS.

However, its limitations are higher operational and maintenance costs, along with the possible requirement for pre-treatment (to prevent membrane fouling) and the production of wastewater (concentrate) that requires disposal.

Direct work	£4,494,565
Contractor overhead	£2,976,902
Project overhead	£2,581,392
Project Cost	**£10,052,860**

Total Weighted Score = 3.76

H. Option 7 – Ion Exchange (IEX) full flow treatment

✓ ***New inline 13.6 Ml/day IEX process unit, inclusive of ancillary equipment, MCC, ICA requirements, power supply and communication cabling.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

Ion exchange resins are charged materials that attract and bind specific ions, including PFAS. Water passes through a resin bed, which captures PFAS molecules. It is particularly effective for removing a broad range of PFAS, including both long-chain and short-chain compounds.

It has an advantage of having a high affinity for PFAS, and using regenerable resins it can be used in combination with other treatments. However, its limitations include higher initial costs and high complexity in managing resin regeneration and disposal.

Direct work	£4,694,459
Contractor overhead	£3,104,025
Project overhead	£2,694,376
Project Cost	**£10,492,860**

Total Weighted Score = 3.50

I. Option 8 – Advanced Oxidation Process (AOP) full flow treatment

✓ ***New inline 13.6 Ml/day AOP process unit, inclusive of ancillary equipment, MCC, ICA requirements, power supply and communication cabling.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

Advanced Oxygenation Process (AOP) is a treatment process that employs hydroxyl radicals (·OH) to breakdown contaminants in water. The radicals are generated in situ using an oxidant and/or energy source or a catalyst. Typical examples include ozone or hydrogen peroxide, and UV light.

Whilst there are benefits to the AOP process, such as the destruction rather than removal of the contaminant, it is a relatively new process and still under much investigation. The process can use high volumes of chemicals and/or power. The process' non-selective nature means that additional reactions may need to be factored into a sizing which would add to the operational costs.

AOP is not widely used in the treatment of PFAS. For all water treatment applications, it is a relatively new technology, and whilst there is much investigation there is a limited level of confidence, especially when compared to GAC and RO, that a particular AOP solution could achieve the desired PFAS removal. Considering these issues, and the lack of installation ready technologies for this application to evaluate, the process was not costed or taken further into the shortlist.

Total Weighted Score = 2.61

J. Option 9 – Network blending with catchment study

✓***Provide a dedicated trunk main from Fishbourne Water Treatment Works to Lavant Reservoir blending with Funtington, Lavant and Brickkiln water sources.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

This solution would aim to alter the existing network configuration so that all treated water from Fishbourne Borehole and Water Treatment Works is directed to the Lavant Reservoir where it can be blended with other supplies from Funtington, Lavant and Brickkiln water sources. This would change the current network configuration whereby it is currently pumped directly into distribution without storage.

Sample results obtained for the Funtington, Lavant and Brickkiln water sources currently indicate that PFAS concentrations are below the limit of detection, thereby making a blended supply arrangement a potential option to reduce water into supply to a minimum of Tier 1 concentration.

This option would provide Portsmouth Water with an increase in deployable output and therefore provide enhanced network resilience, thereby decreasing the requirement to introduce a specific PFAS treatment process at source.

Direct work	£385,683
Contractor overhead	£281,297
Project overhead	£230,441
Project Cost	**£897,422**

Total Weighted Score = 3.68

4. SHORTLIST OPTIONS

A. Overview

Following the MCA Longlist Review, Portsmouth Water selected four options to be progressed to shortlist, where a more in-depth engineering solution was developed and priced to a more accurate +/- 30% estimate.

The following options were shortlisted following the MCA Longlist Review:

- ***Option 4: Identify PFAS source in catchment***
- ***Option 5: Granular Activated Carbon (GAC) full flow treatment with catchment study***
- ***Option 6: Reverse Osmosis (RO) full flow treatment with catchment study***
- ***Option 9: Network blending with catchment study***

Within the MCA Longlist Review, it was identified that each of the four options taken forward to shortlisting would need to incorporate catchment studies at all other supply systems listed as Tier 2 within the Annex of the DWI undertaking (Appendix A). A summary of the cost for catchment studies for each Tier 2 site is included in Table 3 below. These costs will be the same for each shortlisted option and will therefore be added to the total solution cost once a preferred option is selected.

Table 3: Summary of Catchment Study Costs

Site Name	Monitoring	Catchment Assessment	Client Overhead (17%)	Risk (10%)	Total cost
Aldingbourne	£9,000	£50,600	£8,602	£5,920	£74,122
Farlington (Bedhampton & Havant Springs)	£9,000	£50,600	£8,602	£5,920	£74,122
Lovedean	£9,000	£50,600	£8,602	£5,920	£74,122
Northbrook	£9,000	£50,600	£8,602	£5,920	£74,122
Walderton	£9,000	£50,600	£8,602	£5,920	£74,122
Worlds End	£9,000	£50,600	£8,602	£5,920	£74,122
					£444,733

The following sections provide an overview of each shortlisted option, listing the advantages and disadvantages, the adaptive planning considerations, the basis of calculations and any identified risks or opportunities.

B. Option 4 – Identify PFAS source in catchment

Description

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

As part of the undertaking from the DWI for PFAS, Portsmouth Water must do the following:

PRT-2023-00008 AMP8_PFAS_Acceptance_Notice [Appendix A]

4. Where there are new PFAS detections, or a change in the detected levels, conduct operational monitoring; sampling (and analysis) extended upstream of abstraction points into catchments and sub-catchments where applicable, and downstream through different stages of water treatment to the final water sampling location, to identify the source, concentration and fate of PFAS compounds

6. Undertake catchment characterisation and identification of PFAS sources (minimum requirements defined in DWI guidance), for example, product usage (existing data available and data gathering), catchment modelling with analysis of weather, surface and groundwater flows, catchment walkovers, identification of high-risk locations.

Therefore, this solution would aim to conduct a geological study and catchment assessment to try and identify the source of PFAS. As part of this solution weekly PFAS monitoring will take place at Fishbourne to detect PFAS concentration pre and post existing treatment. If the source of the PFAS contamination is found, then next steps will be identified at that point to determine the appropriate course of action, if one is to be taken. Removal of the contaminant at source is always preferable, however once PFAS have entered the environment, it is challenging to remove them from groundwater without treatment.

It is hard to measure PFAS in drinking water as they include many individual compounds with typically low concentrations. Therefore, detecting and preventing them from entering to the environment would be beneficial, however, the contamination is already evident, and therefore a form of removal from the groundwater would likely still be a requirement.

Timescales

- It is envisaged that weekly samples will be taken at Fishbourne WTW both pre and post water treatment for at least a year.
- The catchment study is likely to take 15 – 20 days.

Long-term Delivery

- The investment would be wholly within AMP8.
- No adaptive planning processes have been used.

Costs

Category	Cost (£k)				
CAPEX Delivery Cost	59				
Change in Annual OPEX Cost	50.00				
Project Cost Profile	Year 1	Year 2	Year 3	Year 4	Year 5
	59				
Project Start Year	Apr-25				
Whole Life Cost	1,514				
Benefit to Cost Ratio	0.00				

- This option does not have a benefit to cost ratio as it does not mitigate the PFAS concentration.
- Costs are presented on a 22/23 basis.
- Costs are derived from engineering estimates provided by Aqua Consultants Ltd and include Portsmouth Water risk and overheads.
- The accuracy associated with estimates is within +/- 30%.
- The costs are considered to be enhancement costs since they relate to protection against deterioration in water quality.
- AMP8 and project delivery costs are captured in the table above. The whole life cost and NPV calculations have taken repeat CAPEX into account to accommodate regular planned maintenance.
- The operating costs proposed for this solution will be a one off-cost to cover the weekly sampling for 1 year.

Benefits

This option helps ensure that the DWI guidance for all sources that fall into tier 2 is met.

This option will possibly help determine the source of PFAS contamination which could provide long term protection of the aquifer.

C. Option 5 – Granular Activated Carbon (GAC) full flow treatment with catchment study

Description

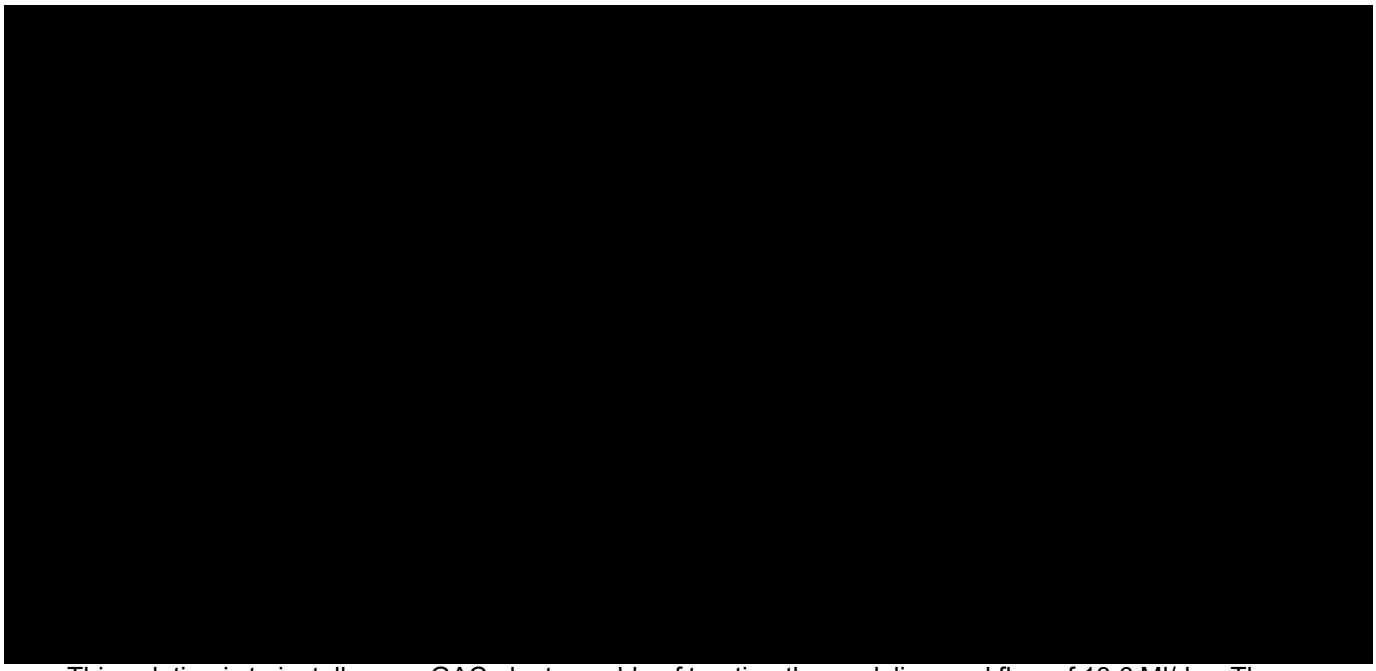
✓ ***New inline 13.6 Ml/day GAC process unit, inclusive of ancillary equipment, MCC, ICA requirements, power supply and communication cabling.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

GAC filters use activated carbon to adsorb PFAS from water. Water passes through the granular carbon, which captures and holds the contaminants. GAC is effective for long-chain PFAS compounds and can remove a significant portion of PFAS contaminants. The advantage of this solution is that it is a well-established technology, relatively cost-effective, and widely used.

However, its limitations are that the carbon requires regular replacement or regeneration as it becomes



This solution is to install a new GAC plant capable of treating the peak licenced flow of 13.6 Ml/day. The GAC plant will be installed to the southeast of the WTW as shown in the site schematic above. This is the only viable location identified on site.

New MCC and site power upgrades have been allowed for in this option along with the relevant ancillary equipment (including valves, flowmeters and cabling).

This option includes all the monitoring and catchments assessments proposed as part of option 4. It has been identified that these assessments and monitoring are an essential part of any option taken forward and must still be undertaken to ensure a comprehensive analysis of the PFAS situation.

Timescales

- The investigation phase of projects of this type would be expected to take approximately 10 months.
- The design and procurement phase of this type of project would be expected to take approximately 12 months.

- The construction phase of this type of project would be expected to take approximately 12 months.

Long-term Delivery

- The investment would be wholly within AMP8.
- No adaptive planning processes have been used.

Costs

Category	Cost (£k)				
CAPEX Delivery Cost	11,098				
Change in Annual OPEX Cost	232.58				
Project Cost Profile	Year 1	Year 2	Year 3	Year 4	Year 5
	740	2,497	7,861		
Project Start Year	Apr-25				
Whole Life Cost	20,931				
Benefit to Cost Ratio	0.47				

- Costs are presented on a 22/23 basis.
- Costs are derived from engineering estimates provided by Aqua Consultants Ltd and include Portsmouth Water risk and overheads.
- The accuracy associated with estimates is within +/- 30%.
- The costs are considered to be enhancement costs since they relate to protection against deterioration in water quality.
- AMP8 and project delivery costs are captured in the table above. The whole life cost and NPV calculations have taken repeat CAPEX into account to accommodate regular planned maintenance.
- The operating costs proposed for this solution are related to power consumption and maintenance and are expected to be regular ongoing OPEX costs.
- The operating costs related to the sampling aspect of this solution will be a one off-cost to cover the weekly sampling for 1 year.

Benefits

This option provides customers with an enhanced resilience in their water supply through providing a permanent form of PFAS removal from the groundwater.

This option contributes towards the long-term operation of a critical WTW for the Lavant South WSZ and helps ensure that the DWI guidance for all sources that fall into tier 2 is met.

This option will possibly help determine the source of PFAS contamination which could provide long term protection of the aquifer.

D. Option 6 – Reverse Osmosis (RO) full flow treatment with catchment study

Description

✓ ***New inline 13.6 Ml/day RO process unit, inclusive of ancillary equipment, MCC, ICA requirements, power supply and communication cabling.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS***.

RO uses a semi-permeable membrane to remove contaminants from water by applying pressure to force water molecules through the membrane, leaving PFAS and other impurities behind. It is highly effective in removing virtually all PFAS compounds, including short-chain variants. It has the advantage of providing comprehensive contaminant removal, not only the removal of PFAS.

However, its limitations are high operational and maintenance costs, along with the possible requirement for pre-treatment (to prevent membrane fouling) and the production of a significant amount of wastewater (concentrate) that requires disposal.

This solution is to install a new RO plant capable of treating the peak licenced flow of 13.6 Ml/day. The RO plant will be installed to the southeast of the WTW as shown in the site schematic above. This is the only viable location identified on site.

New MCC and site power upgrades have been allowed for in this option along with the relevant ancillary equipment (including valves, flowmeters and cabling).

This option includes all the monitoring and catchments assessments proposed as part of option 4. It has been identified that these assessments and monitoring are an essential part of any option taken forward and must still be undertaken to ensure a comprehensive analysis of the PFAS situation.

Timescales

- The investigation phase of projects of this type would be expected to take approximately 10 months.

- The design and procurement phase of this type of project would be expected to take approximately 12 months.
- The construction phase of this type of project would be expected to take approximately 12 months.

Long-term Delivery

- The investment would be wholly within AMP8.
- No adaptive planning processes have been used.

Costs

Category	Cost (£k)				
CAPEX Delivery Cost	8,194				
Change in Annual OPEX Cost	234.20				
Project Cost Profile	Year 1	Year 2	Year 3	Year 4	Year 5
	546	1,844	5,804		
Project Start Year	Apr-25				
Whole Life Cost	16,684				
Benefit to Cost Ratio	0.63				

- Costs are presented on a 22/23 basis.
- Costs are derived from engineering estimates provided by Aqua Consultants Ltd and include Portsmouth Water risk and overheads.
- The accuracy associated with estimates is within +/- 30%.
- The costs are considered to be enhancement costs since they relate to protection against deterioration in water quality.
- AMP8 and project delivery costs are captured in the table above. The whole life cost and NPV calculations have taken repeat CAPEX into account to accommodate regular planned maintenance.
- The operating costs proposed for this solution are related to power consumption and maintenance and are expected to be regular ongoing OPEX costs.
- The operating costs related to the sampling aspect of this solution will be a one off-cost to cover the weekly sampling for 1 year.

Benefits

This option provides customers with an enhanced resilience in their water supply through providing a permanent form of PFAS removal from the groundwater.

This option provides the customer benefit at least cost.

This option contributes towards the long-term operation of a critical WTW for the Lavant South WSZ and helps ensure that the DWI guidance for all sources that fall into tier 2 is met.

This option provides an additional opportunity to remove the existing UF treatment currently in place for cryptosporidium removal. This is because RO processes can effectively remove cryptosporidium from water. This would save on long term operational costs for the site by having one singular treatment for both PFAS and cryptosporidium. This could also allow the existing building to be reused (although temporary treatment would be required during technology changeover).

This option will possibly help determine the source of PFAS contamination which could provide long term protection of the aquifer.

E. Option 9 – Network blending with catchment study

Description

✓***Provide a dedicated trunk main from Fishbourne Water Treatment Works to Lavant Reservoir blending with Funtington, Lavant and Brickkiln water sources.***

✓***Conduct a geological study and catchment assessment to try and identify the source of PFAS.***

✓***Monitor treated water for PFAS.***

This solution would aim to alter the existing network configuration so that all treated water from Fishbourne Water Treatment Works is directed to the Lavant Reservoir where it can be blended with other supplies from Funtington, Lavant and Brickkiln water sources. This would change its current configuration whereby it currently is pumped directly into supply without storage.

This option would provide Portsmouth Water with an increase in deployable output and therefore provide enhanced network resilience, thereby decreasing the requirement to introduce a specific PFAS treatment process. This solution would require communication to ensure there is always another site running to provide the required level of dilution to ensure water in service remains below Tier 1 levels.

The solution is to supply Lavant Reservoir directly by making use of the existing 600mm trunk main from Funtington WTW to Lavant Reservoir. This would require around 4505m of new 500mm main to be laid based on the route marked in red in the diagram below.

This route runs along the A259 from Fishbourne WTW to Blackboy Lane, then runs upwards where it crosses the railway line to Clay Lane, it then runs along Clay Lane and over the A27 to Moutheys Lane, and then on up to Lye Lane where it would meet the 600mm main from Funtington.

New pumping stations at both Funtington and Fishbourne WTWs have been allowed for to ensure the pumps will run efficiently. There is a risk that the existing 600mm main may not have the capacity to handle the additional flow from Fishbourne and this would need to be investigated further should this option go forward.

New MCC's and site power upgrades have been allowed for in this option along with the relevant ancillary equipment (including valves & flowmeters) and cabling.

This option includes all the monitoring and catchments assessments proposed as part of option 4. It has been identified that these assessments and monitoring are an essential part of any option taken forward and must still be undertaken to ensure a comprehensive analysis of the PFAS situation.

Timescales

- The investigation phase of projects of this type would be expected to take approximately 10 months.
- The design and procurement phase of this type of project would be expected to take approximately 12 months.
- The construction phase of this type of project would be expected to take approximately 12 months.

Long-term Delivery

- The investment would be wholly within AMP8.
- No adaptive planning processes have been used.

Costs

Category	Cost (£k)				
CAPEX Delivery Cost	12,818				
Change in Annual OPEX Cost	60.04				
Project Cost Profile	Year 1	Year 2	Year 3	Year 4	Year 5
	855	2,884	9,079		
Project Start Year	Apr-25				
Whole Life Cost	15,291				
Benefit to Cost Ratio	0.41				

- Costs are presented on a 22/23 basis.
- Costs are derived from engineering estimates provided by Aqua Consultants Ltd and include Portsmouth Water risk and overheads.
- The accuracy associated with estimates is within +/- 30%.
- The costs are considered to be enhancement costs since they relate to protection against deterioration in water quality.
- AMP8 and project delivery costs are captured in the table above. The whole life cost and NPV calculations have taken repeat CAPEX into account to accommodate regular planned maintenance.
- The operating costs proposed for this solution are related to power consumption and maintenance and are expected to be regular ongoing OPEX costs.
- The operating costs related to the sampling aspect of this solution will be a one off-cost to cover the weekly sampling for 1 year.

The shortlist costs have increased from the longlist stage due to the identification of complex road and railway crossings, along with the identification of the need for the provision of new pipework and pumping stations.

Benefits

This option provides customers with a moderate resilience in their water supply through providing a permanent form of reduction in PFAS concentration through blending with other PFAS free water sources.

This option has the benefit of possibly reusing sections of existing mains pipelines.

This option contributes towards the long-term operation of a critical WTW for the Lavant South WSZ and helps ensure that the DWI guidance for all sources that fall into tier 2 is met.

This option will possibly help determine the source of PFAS contamination which could provide long term protection of the aquifer.

5. ANALYSIS OF OPTIONS

Following the MCA Longlist Review, Portsmouth Water selected four options to be progressed to shortlist, where a more in-depth engineering solution was developed and priced to a more accurate +/- 30% estimate.

The following (Figure 8 and Table 3) provide a high-level overview of the costs and benefits for each option that was shortlisted.

The benefit to cost ratio has been used to select the preferred option. The benefit to cost ratio is an indicator of the relationship between investment costs and investment benefits. The option with the highest benefit to cost ratio is the option which provides the highest overall value for money. In this case, the NPV was not used to determine the preferred solution as the focus is not on the absolute financial return of the project but on the relative efficiency of resource use and on maximising advantage relative to spend.

Option 6 - The installation of Reverse Osmosis (RO) full flow treatment with a supporting catchment study provides the highest Benefit to Cost Ratio of the four shortlisted options.

Figure 8: Summary of shortlisted options

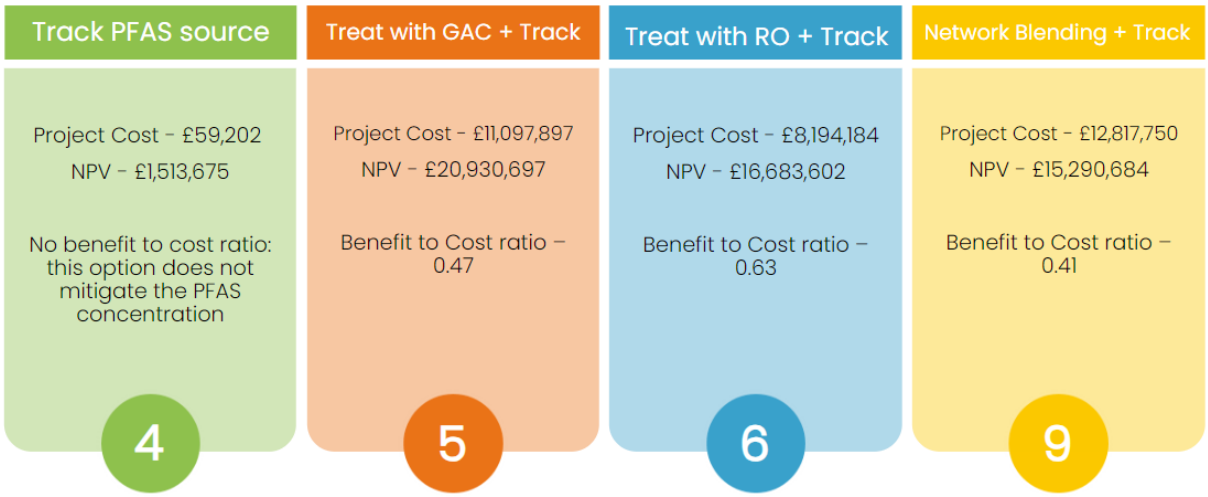


Table 3: Summary of shortlisted options benefit to cost analysis

Option no.	AMP8 delivery costs (£) *	Change in annual OPEX cost (£)	Investment Costs (£)	Investment benefits (£)	Net present value (£)	Benefit to cost ratio
Option 4	59,202	50,000	61,959	0	1,513,675	0.00
Option 5	11,097,897	232,578	11,544,006	5,381,370	20,930,697	0.47
Option 6	8,194,184	234,202	8,588,150	5,381,370	16,683,602	0.63
Option 9	12,817,750	60,045	13,177,854	5,381,370	15,290,684	0.41

A. Best Option

As set out within this document, it is Portsmouth Waters preference to mitigate the potential PFAS and subsequent supply risk through an enhancement scheme. The recommended solution based on the outputs of the Risk & Value modelling is Option 6 – The installation of Reverse Osmosis (RO) full flow treatment with a supporting catchment study.

This proposed solution has the advantage of optimising existing infrastructure to meet the drivers whilst enhancing network resilience.

The key residual risks following delivery of this project would be:

- for the acceptable regulatory limits for PFAS in drinking water supplies to decrease.
- a significant increase in raw water PFAS concentrations (beyond the design capabilities of the RO Treatment Plant)
- a significant increase to the licenced throughput of the Borehole (beyond the design capabilities of the RO Treatment Plant)

The outcome favoured by Portsmouth Water is to proceed with Option 6 – Installation of Reverse Osmosis (RO) full flow treatment with a supporting catchment study, since:

- it meets our obligations to customer in providing resilient facilities that can efficiently respond to predictable events.
- It provides water supply security at the minimum cost to customers.
- It supports the vision presented by Portsmouth Water to its customers.

Table 4: Summary Costs – Preferred Solution

Category	Cost (£k)				
CAPEX Delivery Cost	8,194				
Change in Annual OPEX Cost	234.20				
Project Cost Profile	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
	546	1,844	5,804		
Whole Life Cost	16,684				
Benefit to Cost Ratio	0.63				

As per section 4-A of this document, it was identified that the preferred solution would need to incorporate catchment studies at all other supply systems listed as Tier 2 within the Annex of the DWI undertaking (Appendix A). A summary of the additional cost for catchment studies for each Tier 2 site is included in the table 5 below. These costs would be additional to total preferred solution cost.

Table 5: Summary of Catchment Study Costs

Site Name	Monitoring	Catchment Assessment	Client Overhead (17%)	Risk (10%)	Total cost
Aldingbourne	£9,000	£50,600	£8,602	£5,920	£74,122
Farlington (Bedhampton & Havant Springs)	£9,000	£50,600	£8,602	£5,920	£74,122
Lovedean	£9,000	£50,600	£8,602	£5,920	£74,122
Northbrook	£9,000	£50,600	£8,602	£5,920	£74,122
Walderton	£9,000	£50,600	£8,602	£5,920	£74,122
Worlds End	£9,000	£50,600	£8,602	£5,920	£74,122
					£444,733

Table 6 below provides a summary of all AMP8 enhancement costs associated with the delivery of the preferred solution.

Table 6: Enhancement Summary Costs

Category	Cost (£)	AMP8 Total
AMP8 CAPEX Delivery Cost	£8,194,184	£8,194,184
Change in Annual OPEX Cost	£234,202	*£468,404
Catchment Study Costs	£444,733	£444,733
	Total:	**£9,107,321**

* Project delivered in year 3 of AMP8, therefore two years of OPEX costs have been included.

B. Delivery

Delivery would be wholly within AMP8.

Steps will be taken in the planning process to ensure there are no effects to the customers water supply. Outage planning for AMP8 is already underway to ensure that all AMP8 work is planned to avoid undue risk to customer supplies, and that all such work, at each site, is coordinated such that it may be carried out as efficiently as possible. The normal provisions around Process Risk Assessments and Water Hygiene protocols would be appropriately managed.

PRT08 identifies Portsmouth Waters general approach to the delivery of the AMP8 program and those measures would be applied to these solutions. In principle, Portsmouth Water would expect to 'package-up' work of a similar nature and use approved contractors to deliver the most cost-efficient programme. As much work as possible would be carried out off-site to reduce costs and outages.

C. Customer Impact

Customers within the Lavant North and South WSZ's can be assured that we will be able to supply sustainable wholesome water without interruptions to that supply. Customers can be assured that in the event of elevated PFAS concentrations within the Fishbourne Borehole, then Portsmouth Water have the capability to maintain a wholesome supply in a timely and secure manner, and without risk of supply failures. Customers can be assured that their bills are supporting an efficient and proactive approach to PFAS management and control.

6. ASSURANCE AND BOARD APPROVAL

Aqua Consultants were engaged to assist with the preparation of this business case, including the provision of supporting cost data, and it has been subject to their standard quality assurance processes. It has also been subject to a limited review by our technical assurers, Jacobs.

This comprised initial drafting by a Lead Author, under the direction of an Executive Owner who retains Executive responsibility for the document content including robustness and accuracy.

In addition, it has been subject to the following internal review and sign off.

I. Review by relevant Portsmouth Water subject matter experts and the Regulation Team
II. Executive review by the Chief Asset Officer and Chief Operating Officer
III. Sign off by the Chief Financial Officer and Chief Executive Officer on behalf of the Board

Supporting cost data has been provided by Aqua Consultants Ltd.

The Board has been fully engaged with the company's response to the Ofwat draft determination, including the decision to submit this additional investment case.

7. CONCLUSION

The paper presents cost effective solutions to present conditions associated with the management of PFAS within the Lavant South WSZ. Deterioration in PFAS concentration to Tier 3 status has the potential for DWI (improvement) notices to be issued under Regulation 28.

The paper presents solutions for the Fishbourne Borehole & Water Treatment Works that are known to be critical to the continued supply of drinking water and where such supply would be compromised if current practices resulted in PFAS elevating above permitted concentrations.

The paper presents a proactive approach to managing PFAS contamination within the catchment and supply area. Providing a mechanism to mitigate the impact of PFAS in drinking water supplies.

The proposal selects solutions that demonstrably provide the best customer value. The proposed solution provides the greatest Benefit-Cost ratio and provides the optimal solution for lowest cost. Reverse osmosis (RO) treatment is a reliable and well understood technology and is widely used across the water industry. The proposed solution enhances social value through increased reliability and availability of wholesome water and avoids the need for aggressive and environmentally damaging chemicals in the treatment process.

The proposal developed within this paper can be delivered by Portsmouth Water within the AMP8 period. Engineering and engineering planning will mitigate risks associated with the design, procurement, and execution of the schemes. Work will be carried out under contract with the normal contractual safeguards in place. Plant outages will be limited by planning, and timed to coincide with periods in the years when there is least stress on water supplies. Provision will be made to ensure the continuous supply of water to customers whilst the work is carried out, by diverting supplies from elsewhere during plant outages. Whilst elements of the approach are innovative, the underlying technology is simple, reliable and well-understood.

The proposal is developed with a clear understanding of our customers priorities, and their views expressed through the PR24 process. Portsmouth Water understands that the catchment risks are sufficient to present risks to water quality, which could result in a loss of water supply and further DWI action. These are proposals to mitigate that risk for the long term and maximise the long-term benefits to customers at the minimum achievable cost. They are consistent with our WRMP and our current long term delivery strategy, both of which reflect the need for enhanced levels of resilience at all our sites.

Portsmouth Water have learnt from the water supply compliance problems that the company has encountered during AMP7 relating to PFAS and other contaminants and have used this learning to inform this investment case, and the wider PR24 plan.

Portsmouth Water state its preferred outcome as being to proceed with the solution identified in the paper and propose an ODI associated with the deliverables identified in this document, noting that DWI also require statutory undertakings if the proposal is accepted.

Appendix A: DWI Acceptance Notice – Portsmouth Water AMP8 PFAS Strategy

Water Industry Act 1991 (as amended) ("the Act"): Section 19(1)(b)

Portsmouth Water Limited – AMP8 PFAS Strategy

Reference: PRT-2023-00008

Acceptance Notice:

The Drinking Water Inspectorate, on behalf of the Secretary of State for Environment, Food, and Rural Affairs:

1. Is satisfied that Portsmouth Water Limited "the Company" in supplying water from all water supply systems (raw water assets, water treatment works and treated water assets), which are for the time being listed in the Annex to this Schedule of Works which may be at risk of breaching the wholesomeness and no deterioration standards due to PFAS concentrations. This means that the Company is likely to contravene its duties under Sections 68(1)(a) and 68(1)(b) of the Act and the requirement set in regulation 4(2)(b) of the Water Supply (Water Quality) Regulations 2016 (as amended) ("the Regulations").
2. Has notified the Company on 22 November 2023 that the Secretary of State is considering making in relation to the company an enforcement order under Section 18 of the Act.
3. Notes that the Company has on 20 June 2024 given a new undertaking under Section 19 (1) (b) of the Act, to take the following steps by the dates shown.

Steps to be taken:

1. Ensure that PFAS have been assessed as a hazard, as part of the regulation 27 Risk Assessment for the supply systems listed in the Annex to this Schedule, according to a Drinking Water Safety Plan approach and the Inspectorate's latest guidance on the risk assessment of individual and total PFAS. Ensure that regulation 28 documents are reviewed (at least annually) and updates provided as necessary.
   Date: Ongoing for the duration of the undertaking
2. Keep under review the company's strategy for the protection of public health and for compliance with drinking water quality standards with respect to

Page 1 of 5

PFAS.
Date: Ongoing for the duration of the undertaking

3. Conduct surveillance, including sampling and analysis for PFAS in line with the Inspectorate's latest published guidance on PFAS.
   Date: Ongoing for the duration of the undertaking

4. Where there are new PFAS detections, or a change in the detected levels, conduct operational monitoring; sampling (and analysis) extended upstream of abstraction points into catchments and sub-catchments where applicable, and downstream through different stages of water treatment to the final water sampling location, to identify the source, concentration and fate of PFAS compounds.
   Date: Ongoing for the duration of the undertaking

5. Following on from step 2, continue to conduct risk-based, enhanced, investigatory sampling (and analysis), where PFAS are detected.
   Date: Ongoing for the duration of the undertaking

6. Undertake catchment characterisation and identification of PFAS sources (minimum requirements defined in DWI guidance), for example, product usage (existing data available and data gathering), catchment modelling with analysis of weather, surface and groundwater flows, catchment walkovers, identification of high-risk locations.
   Date: Ongoing for the duration of the undertaking

7. Initiate and maintain regular engagement with relevant stakeholders, to ensure that catchment risk assessments are current.
   Date: Ongoing for the duration of the undertaking

8. Participate in relevant research and development activities including industry working groups to ensure the company strategy is up to date.
   Date: Ongoing for the duration of the undertaking

9. Where PFAS are detected in a single final water (or downstream treated water) sample, or two or more raw water (water sampled from any point prior to the final treated water point at the water treatment works) samples in a supply system not currently listed in the annex to this undertaking, submit a change request to the Inspectorate to add the supply system to the annex, unless a mitigation plan has already been developed for this supply system.
   Date: Ongoing for the duration of the undertaking

10. Maintain and continually review the company's PFAS strategy.
    Date: Ongoing for the duration of the undertaking

11. For all sources that fall into tier 3, design, develop and implement mitigation to reduce PFAS concentrations in drinking water to at least tier 1

concentrations, with a high priority.
Date: Ongoing for the duration of the undertaking

12. For all sources that fall into tier 2, companies should design a proactive and systematic risk reduction strategy implementing a prioritised mitigation methodology to progressively manage PFAS concentrations in drinking water.
Date: Ongoing for the duration of the undertaking

13. For all sources that fall into tier 1, design a basic mitigation plan, which can be implemented should concentrations increase, or toxicological or other information change that requires mitigation be delivered.
Date: 31 March 2030

Reporting:

1. At regular intervals provide the Inspectorate with reports on progress made with carrying out the steps set out in the Action Plan. Reports to include at least the following details:
a) All sampling and analysis data from the monitoring of raw and treated water in the supply systems named in the annex.
b) Details of the remedial steps for that comprise the programme of work including commencement and completion dates for investigations, design, tendering, construction, and commissioning.
c) Current state of progress with the steps referred to in 4(d)b) above.
d) A summary of progress with the ongoing measures in section 4(c).
e) A statement of implications of any slippage of the programme and details of activities planned to bring programme back on target.
f) Whether the company has any other reason to believe it may not be able to meet any of the key dates set out in this Schedule of Work.
g) The latest version of the company's PFAS strategy.
h) Evidence of no PFAS detections above Tier 1 in a supply system for two years and evidence of the mitigation plan, in order to remove the supply system from the undertaking annex.
Date: Annually for the duration of the Undertaking. Reporting periods are Jan-Dec. Reports to be submitted **by 31 January each year** that the Undertaking is in place.

2. Continue to test at an enhanced frequency for PFAS for a period of 12 months following commissioning of any work associated with the Action Plan to demonstrate the effectiveness of the remedial measures taken.
Date: 31 March 2031

3. Provide a final report to the Inspectorate on the efficacy of the steps taken as part of this undertaking. Include, as evidence of closure for this scheme, appropriate documentation to confirm that the actions set out in this Schedule of Work have been completed satisfactorily.
   Date: 30 April 2031

Further Details of this Acceptance Notice:

4. The Secretary of State is satisfied that Northumbrian Water Limited has given and is complying with an undertaking to take all such steps as appear to the Secretary of State for the time being to be appropriate to secure or facilitate compliance with the requirement of regulation 4(2)(c) of the Water Supply (Water Quality) Regulations 2016 (as amended).

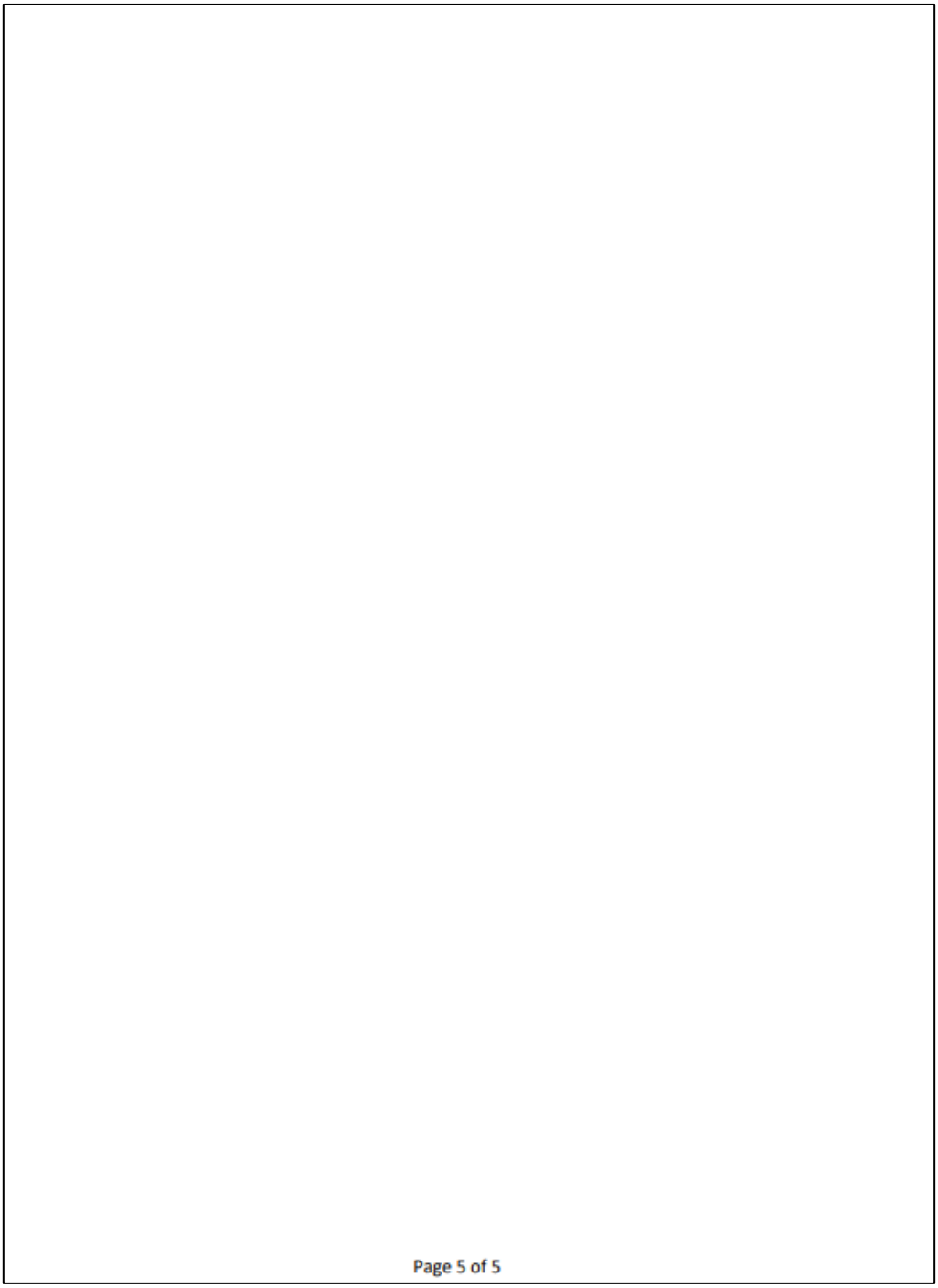
Authorised by the Secretary of State to sign in that behalf

[redacted]

Annex A to Schedule for PRT-2023-00008 – Portsmouth Water Limited

Undertaking in respect of PFAS

Supply System Name	Population of zones within system	Risk Assessment Reference (name of Regulation 28 Report or Supply System Reference)	Tier
Bognor	77,382	YWSP-BOG	**Tier 2**
Chichester	87,005	YWSP-CHI	**Tier 2**
Hoads Hill	147,453	YWSP-HSH	**Tier 2**
Lovedean	24,544	YWSP-LOV	**Tier 1**
Portsmouth	250,481	YWSP-POS	**Tier 2**
Walderton	50,018	YWSP-WAL	**Tier 2**
Worlds End	45,346	YWSP-WND	**Tier 2**


Page 5 of 5

Appendix B: Fishbourne Borehole & Water Treatment Works PFD


Portsmouth
Water