PRT 07.02
RAW WATER RESILIENCE ENHANCEMENTS (DISINFECTION)

CONTENTS

1. SUMMARY

This investment proposal relates to the provision of Ultra-Violet (UV) Treatment plants and on-site emergency connection facilities for the treatment of Cryptosporidium, and, in one case ([redacted]), Ct support.

There are four solutions presented, the preferred outcome is to carry out all four.

Technical information to support the application was submitted to the Drinking Water Inspectorate (DWI) in March 2023 as part of the 'appendix B' submission. [redacted] This supporting information can be supplied on request.

The proposals were submitted to the DWI as two separate cases. PRT8 proposed the work at [redacted], and the provision of a 'mobile emergency UV plant; here included as solutions 1,2 &3. PRT9 proposed 'UV fast deployment arrangements'; here included as 'solution 4'. Both cases are supported by the DWI and their letters of support are appended (PRT07.02.01 & 02). The scope of PRT9, when subjected to the internal PR24 customer value and affordability challenge process, was subsequently reduced from four sites to one.

The work is necessary to secure the outputs of Water Treatment Works (WTW) into the future, and to protect against environmental factors over which Portsmouth Water has no, or very limited, influence or control.

The preferred solution provides a defence against risk. [redacted]

The whole of the work will be carried out within AMP8, with the enabling work [redacted] carried out early in the period. Where possible, work will be integrated with other project work on sites to minimise plant outages and to provide delivery efficiencies. Much of the enabling work can be carried out without site outages. Where resilience improvements at other sites 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 proposals, taken as a whole, provide societal benefit by ensuring customers are protected, so far as is reasonably practicable, against known biological risks within the catchments. The use of UV to protect against cryptosporidium is widely recognised as the most environmentally acceptable since there are no chemicals used in the control or cleaning process, and there is no waste byproduct that requires environmentally costly disposal.

The work is presented as an enhancement proposal since the need is driven by the exogenous deteriorations in raw water quality and supply and demand balance in drought conditions. The proposals provide 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 historical record of cryptosporidium events that have hindered Portsmouth Waters ability to supply water. Whilst the company has not failed to supply because of these events, we have come very close to not being able to do so. The microbiological and supply risks are identified in our section 28 reports (appendix PRT07.02.05) which have been reviewed by the DWI, as part of their appendix B process, before lending their support to these solutions.

Where these risks have manifested themselves as events, then this has resulted in Water sources being out of supply for extended periods.

Cryptosporidium was carried forward from the catchment and a cryptosporidium contravention occurred at [redacted]

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Cryptosporidium originates from the catchment and whilst catchment management processes are in place to minimise the problem (appendix PRT07.02.04 defines the methodology), a residual risk remains, necessitating treatment.

The overriding need here is to make the water supply to Portsmouth Water's customers more resilient to cryptosporidium events.

In addition, the water treatment site at [redacted] requires disinfection support, (only) when it is required to operate at elevated flows, under drought conditions. This is required to protect against potential microbiological components in the water abstracted for the sites boreholes. The level of disinfection support necessary (and the other process enhancements) were the subject of an independent study by Atkins (see appendix PRT07.02.03). UV treatment was identified as the most cost-effective solution. The other options are summarised in PRT07.03 where UV is identified as the most cost effective solution and the broader investment proposals for [redacted] are detailed.

The needs are as follows:

1. To make permanent the temporary containerised UV plant installed at [redacted].
    a. [redacted]

2. To make available, a mobile emergency treatment facility that allows a fast response to Cryptosporidium events or elevated Cryptosporidium risks at any site.
   - [redacted]
   - [redacted]
3. [redacted]
   - [redacted]
4. To enable [redacted] to operate at elevated flows under drought conditions.
   a. [redacted]
      - [redacted]
      - [redacted]
      - [redacted]
5. The provision of pre-installed facilities at [redacted], that will enable the mobile, containerised UV system (in 2 above) to be deployed very quickly in reaction to a water quality (cryptosporidium) event, or an elevated risk of such an event.

B. Supporting Our 'Vision'

The vision described by Portsmouth Water and supported by its customer comprises four key pillars. They are to:

Figure 1: Our Vision and Priorities

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

The proposal to relocate assets, as needs dictate, not only reduces capital and operational costs but also reduces the embedded and operational carbon that would otherwise be expended in procuring and maintaining plant that is only required under specific and rarely encountered operating conditions.

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:

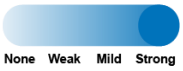
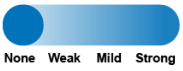
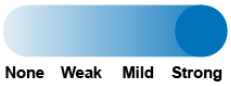
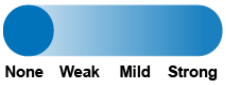
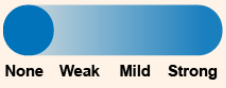
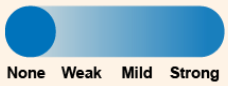
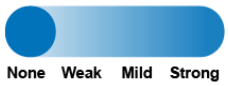
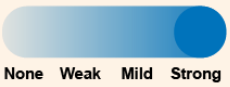
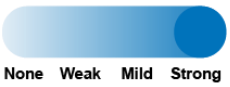
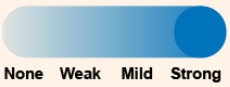
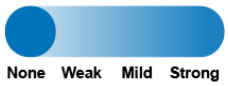
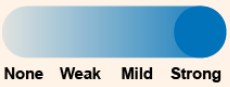
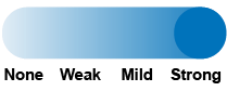
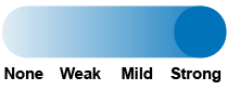
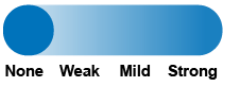
Strong	Weak	None
		
The proposal has the potential to directly and significantly impact the performance commitment or the corporate priority. The impact will not, by itself, improve current performance, though may, if the risks surface, significantly and negatively affect current performance.	The proposal 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: Links to performance commitments

Performance commitment	Relationship	Notes
Water Supply Interruptions		Loss of deployable output from critical water treatment plants for many months. Inability to support drought order needs.
Compliance Risk Index (CRI)		Though protected by Automatic Shutdown Systems (ASD) UV plans ensure disinfection arrangements 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 can directly lead to unplanned outages. Reduction in unplanned outage from this enhancement case is set out

Performance commitment	Relationship	Notes
		in **PRT05: Delivering Outcomes for Our Customers.**
Mains Repairs		There is no relationship with Mains Repairs.
Pollution incidents		There is no relationship with Pollution incidents.
CMex, DMex, BR-Mex		Customer Service is dependent on our ability to reliably supply water.
Customer Contacts WQ		Customer contacts increase significantly when pressures are reduced or the water supply fails
Greenhouse Gas emissions		Proposal minimises embedded and operational carbon whilst enabling DO to be achieved.
Biodiversity Index		The proposal has no effect on biodiversity.
Carbon Footprint		Whilst enabling the required Deployable Outputs to be achieved, the proposal minimises embedded and operational carbon, through minimising the procurement and operating regimes of necessary plant and equipment.
Low customer bills		Proposal minimises cost to customer whilst enabling DO to be achieved.
Corporate responsibility		Strong belief in competent stewardship.
Electricity usage		The proposal minimises the quantum of operational plant and makes existing plant (slightly) more efficient.

Performance commitment	Relationship	Notes
Materials usage		The proposal minimises the quantum of operational plant and avoids stranded assets.
Community partnerships		There is no relationship to community partnerships.

D. Historical Perspective

One cryptosporidium contravention has occurred at [redacted]

One contravention has occurred at [redacted]

The risk from cryptosporidium exists at abstractions due to sources of cryptosporidium existing within the catchments. This originates from faecal contamination consequent on animal grazing and, combined with the hydrogeological pathways, enables oocysts to travel to abstraction boreholes. The Chalk can be inherently vulnerable in certain locations due to the presence of karstic features in the Chalk, in the form of swallow holes/sink holes at the surface, and fissure flow within the saturated zone of the Chalk aquifer.

The presence of cryptosporidium oocysts in the catchment cannot be controlled as we have limited control of catchment activities. The Catchment and Environment team engage with local landowners, farmers, and relevant stakeholders, on best practice in high-risk catchments. See appendix PRT07.02.04.

Drinking Water Safety Plan (DWSP) site audits are undertaken across all Portsmouth Water's abstraction and treatment works via a risk-based programme. These audits include visual inspections of the borehole headpits and wellheads, reviewing any potential ingress routes for hazards. Operators are on-site during audits to answer any site-specific questions.

Catchment walkovers are undertaken on a risk-based programme, a minimum of every 3 years across each individual Portsmouth Water catchment. The methodology is defined in Appendix PRT07.02.04. These walkovers are undertaken by the Catchment Management team in collaboration with the Drinking Water Safety Plan (DWSP) team and local Environment Agency office. This programme allows greater catchment conceptualisation through documentation of land use practices that may result in loading of microbiological hazards and cryptosporidium oocysts. Further information considered as part of the hazard identification and risk characterisation process include:


Site geology/ hydrogeology;


Immediate surrounding land use;


Incoming high-risk abstraction hazardous events;


Site schematics – reviewed pre and post audit;


Historic information regarding any relevant events (e.g., flooding, sewerage leaks etc.);


Site and contractor procedures (e.g., cesspit drainage procedures);


Asset condition and history (e.g., cesspit installation date);


Maintenance records;


Staff training records.

Risk scores vary across the individual hazards and individual assets. The Regulation 28 reports, required under legislation, by the Drinking Water Inspectorate, define individual risk scores for each site.

Microbiological hazards exist at most sites – where Faecal Indicator Organisms (FIO) are observed in the raw water, it is not possible to determine the exact source since contamination may be introduced anywhere across the catchment where animals may be present. Cryptosporidium risks across sources have been identified from catchment land use activities, over which Portsmouth Water have very little control.

The risks of 'No Supply' across [redacted] is currently 'high' due in part to issues associated with the Management and Training Notice (PRT-2021-00001). Enhanced cryptosporidium controls are required on these critical sites to ensure resilience of supply across Portsmouth Water's supply systems.

[redacted] has been identified, in the WRMP24, as a critical site for increased DO during drought conditions. The current CT is appropriate to mitigate any microbiological hazards in current pumping conditions. Forecasting CT based upon increased DO has highlighted that this site would not meet CT under its current design. See PRT07.03 and appendix PRT07.02.03).

The site identified for 'fast (UV) deployment arrangements' has limited controls available in the event of a cryptosporidium detection. This site would currently need to be taken out of service for a significant period, until appropriate controls were in place, increasing pressure on the resilience of Portsmouth Water's supply systems.

Due to the timescales associated with design, procurement, and site installation, sites are off for extended periods. Despite an 'emergency response' [redacted]

Such extended site outages are becoming increasingly untenable as the supply and demand balance ratio moves towards adverse, as identified within Portsmouth Water's WRMP24.

The emergency solutions are expensive since 3rd parties must be mobilised quickly under emergency contracts with limited scope for negotiation of costs associated with design, procurement, or installation. Furthermore, the need to reinstate sites into supply quickly also necessitated compromises in the technical design, which have increased Opex. For example, the hydraulic design can increase pumping costs beyond that which an optimal design could otherwise achieve.

New or enhanced control measures are required to mitigate risk to disinfection during future drought condition pumping regimes. No Supply and Cryptosporidium hazards are currently at a high risk due to issues highlighted in Portsmouth Water's company-wide Management and Training Notice (PRT-2021-00001). Enhanced controls are currently under development to reduce the risks associated with this Notice.

E. Regulatory and Statutory Compliance

All the noted works are considered mandatory 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 a drought order.
- The need to ensure customers' expectations and priorities are met.
- The need to provide water that supports the assumptions of the WRMP24.
- The need to mitigate the circumstances leading to DWI notices precluding the use of the sites for water supply purposes.

F. Customer Support

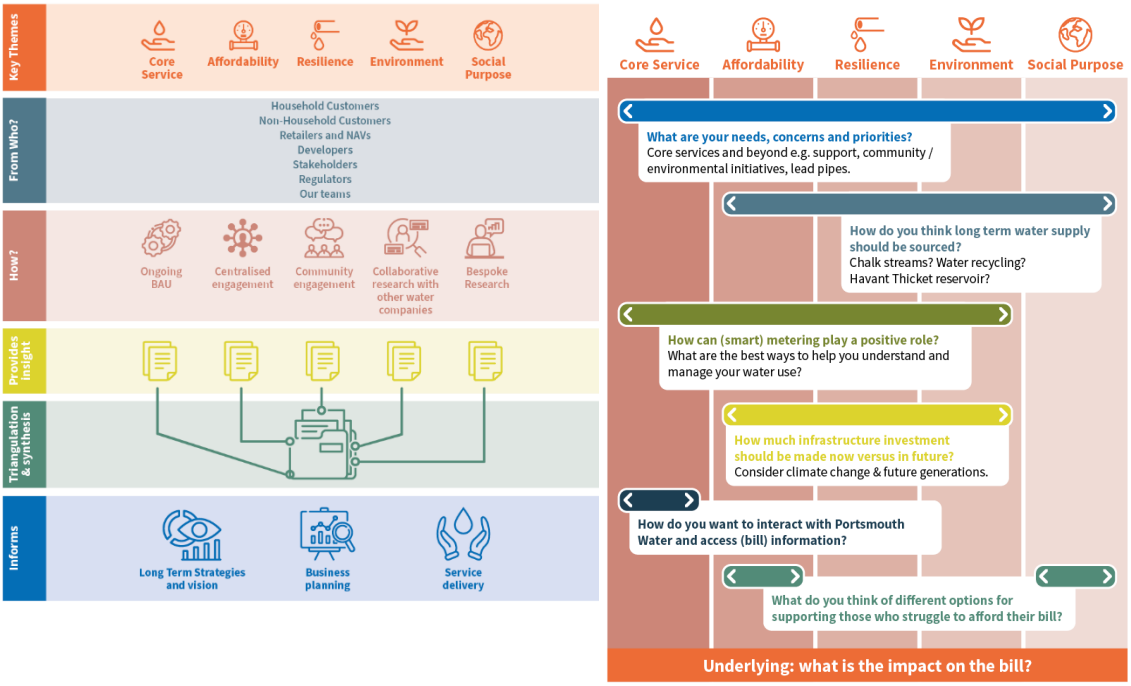
This business plan has been informed and shaped through insights gained through our Engagement Strategy and triangulation process which has been embedded from 2020 and continues to inform and adapt our service delivery plans.

In all phases of engagement our customers and stakeholders across our Vision, Long Term Delivery Strategy and for this plan have supported the need for a secure and reliable water supply.

This is consistent across all phases of our engagement right through to achieving a great result in our Acceptability and Affordability testing with customers.

This 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 through two key elements of:

Our Engagement Strategy (represented on the left below) and our Big Conversation Framework (represented on the right below).



In all phases of engagement our customers and stakeholders feeding into our Vision, Long Term Delivery Strategy and this plan have supported the need for a secure and reliable water supply. This is consistent across all engagement right through to achieving a great result in our Acceptability and Affordability testing with customers.

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

Customers really supported the need for us to maintain a secure and reliable water service across a number of 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.

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 research findings.

The proposal relates an enhancement case since it responds to exogenous factors including raw water quality and climate, over which Portsmouth Water have little or no control.

3. SOLUTIONS

A. Overview

The solutions considered relate to the extent of the work for which approval is sought and are not presented as technical options. All the solutions presented are considered essential if Deployable Outputs are to be achieved or continue to be maintained and represent value in terms of the resilience of plants and reducing the risk to the continuous supply of water to customers. A summary is provided in table 2.

Table 2: Summary of solutions

Solution	Category	Description
1	Essential	Making permanent the [redacted]
2	Essential	Procuring and installing new UV for [redacted] (interchangeable with [redacted])
3	Essential	Improving overall resilience through repurposing and providing a temporary mobile UV plant
4	Essential	Improving resilience through reducing mitigation times by providing fast deployment arrangements for the mobile unit above, at a high-risk site

B. Solution 1

Description

A UV plant was installed at [redacted] as an emergency measure, following a cryptosporidium event, in 2021. The procurement, design, and installation was necessarily expeditious to recover the site to an operational state. A second-hand mobile plant was procured from another water company and fitted in a temporary shipping container.

This solution relates to making the process plant permanent, by replacing the UV reactors and the associated control and instrumentation, and housing all the process components in an appropriate and permanent structure. The redundant UV plant would then be repurposed, re-engineered, and used in Solution 3 (above).

The work would be carried out early in AMP8, to:

- Release the existing plant for repurposing and reengineering.
- Mitigate against customer complaints at [redacted] that relate to the containerised nature of the existing plant. Noting that the temporary plant at [redacted] has already been in place for over two years and is not considered by adjacent residents to be ‘temporary’.
- Minimise the damage to the existing equipment, currently being experienced due to the inadequate environmental arrangements and protections to the existing temporary plant.

- Maximise the reduction in electricity and carbon benefits associated with an improved hydraulic design.

The current unit at [redacted] would remain in place until the permanent solution is installed.

The existing emergency UV plant currently at [redacted] incurs operating costs in power, and other operating and maintenance costs. These costs have been absorbed into Portsmouth Water's base costs. Replacing the plant with a new permanent unit would not increase, or measurably decrease this Opex. Some very marginal reduction in energy costs is expected through improved hydraulic efficiency, however this is considered offset by the increased cost of incorporating the unit into a permanent structure with attendant heating, lighting, and security. The net Opex of this solution is hence considered zero.

A sub-option to make permanent the existing plant has been considered and discounted since:

- Much of the cost is associated with re-locating and re-housing the unit within a permanent structure. In addition, the cost of re-engineering the existing emergency unit would result in similar total costs to the cost of its replacement.
- The existing unit would not be then available for the mobile plant in Solution 3 (above).
- Any hydraulic improvements would be limited by the design of the existing second-hand unit.
- The outage at [redacted] would be of much greater duration and this would result in additional pumping and other operating costs.

Where the mitigation of risk from contaminants other than cryptosporidium is not required, the use of UV to mitigate the risk from cryptosporidium is accepted best practice in the UK water industry. [redacted] has no other driver which warrants more extended treatment processes such as ultra-filtration (membrane) plants, or similar. Since all other process options are well understood to be more expensive in both capital and operational costs, and, being more complex, are inherently less reliable, these options have not been explored.

Implementation of this option meets the obligation to the DWI to provide permanent UV treatment at this site.

Long-term Delivery

- The investment would be wholly within AMP8.
- All the Deployable Output of [redacted] relies on the continued satisfactory operation of an ultra-violet treatment facility. Loss of the UV plant results in total loss of the sites output.
- Portsmouth Water's WRMP24 relies on the continued operation of [redacted] into the foreseeable future. Loss of [redacted] significantly affects the resilience of the Portsmouth Water network. Indeed, as the supply and demand balance position deteriorates, greater emphasis is placed on the reliable operation of single sites.
- The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since all the sites and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

Figure 2: Long term delivery

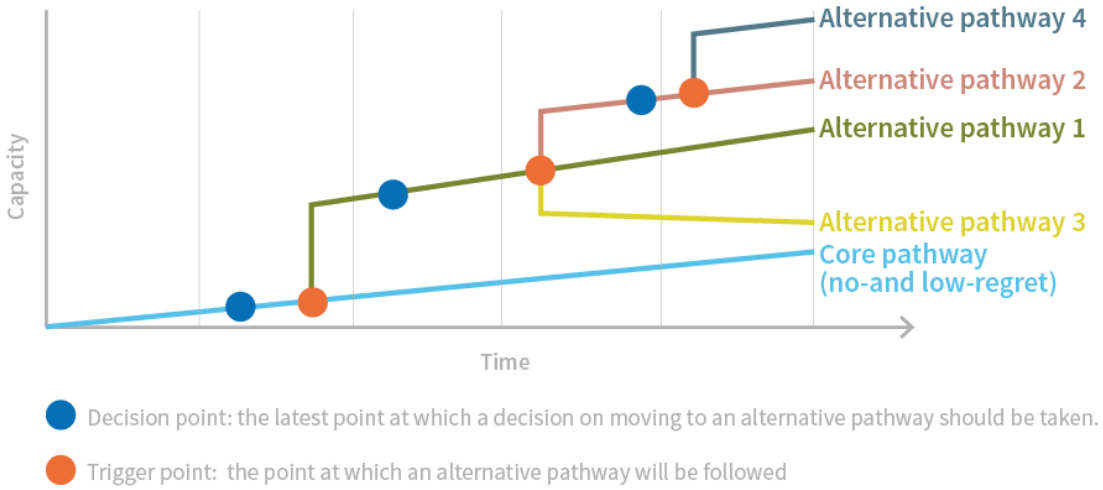


Table 3 summarises the costs associated with solution 1.

Table 3: Summary costs – replacing the temporary UV plant at [redacted]

Component	Capex £M	Opex £M p.a.	Cost source
Design & Build new UV Plant at [redacted] site complete with electric, heating and lighting services.	9.6	0	Trant
Risk/Contingency allocation	0.5	0	Internal
Management and overheads.	1.5	0	Internal
Subtotals	11.5	0.0	
Intrinsic allowance (deduction)	0.0	0	Internal
Delivery efficiency target (deduction)	1.7	0	Internal
Totals	9.8	0.0	

Costs are presented on a 22/23 price basis.

Costs are derived from engineering estimates provided by Trant Engineering Ltd. Rushington House, Totton, Southampton SO40 9LT, and exclude Portsmouth Water risk and overheads.

The capital costs are considered a one-off cost with no associated operating costs (see above).

The confidence associated with estimates is believed to be within +/-10%.

The costs are considered enhancement costs since they relate to a deterioration in raw water quality through entirely exogenous factors.

There are no intrinsic costs associated with the proposal.

Benefits

The proposal provides customers with an enhanced resilience in their water supply through ensuring that this critical process components is installed on a permanent basis.

The proposal meets the obligation to the DWI in providing UV treatment at this site for the foreseeable future.

The proposal provides customer benefit at least cost.

The proposal contributes toward the long-term reliability of a critical process component and helps ensure the requirements of the WRMP24 are met into the future.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since all the sites and processes are required for the duration of the LTDS, then the proposal falls on all adaptive pathways within the LTDS.

The proposal frees-up an asset, that would otherwise suffer early failure, to be re-purposed and provide further customer benefit, in the form of a flexible plant, that can be quickly deployed, according to need, at other water treatment facilities in the Portsmouth Water region.

C. Solution 2

Description

[redacted] is a water treatment site that is out of service following a cryptosporidium event. The water treatment cannot be placed back into supply until the whole of the sites deployable output is provided with cryptosporidium control.

The proposal links to the existing Drinking Water Inspectorate's notice for [redacted]:

The notice, [redacted] includes the requirements to:

- 2. Produce a Long-Term Action Plan for [redacted] to address the risk of cryptosporidium.
- 4. Complete the planning, design and procurement of an effective treatment process for the removal or inactivation of cryptosporidium to comply with recognised industry good practices and recommendations and to secure the long-term protection of human health of those consumers receiving water from the associated supply system(s).
- 5. Complete the construction, installation, and commissioning into supply of the chosen solution identified…….to mitigate the risk from cryptosporidium.

Though other treatment options exist, for example: Membrane filtration. UV treatment is the only cost-effective solution. Membrane treatment plants are installed elsewhere within Portsmouth Water where treatment is required for a range of parameters, though including cryptosporidium. This more complex equipment is known to be substantially higher in capital and operating costs, with a higher carbon footprint. Such plants also require a greater spatial footprint as well as producing significant waste and requiring hazardous cleaning chemicals. These options have not been considered since Ultraviolet treatment is a standard approach within the water industry where treatment for cryptosporidium (only) is required.

[redacted] cannot operate under drought conditions since groundwater falls below acceptable levels during dry weather.

[redacted] is a water (borehole) source with chlorine treatment. The site is licensed to supplying 2.5ML/d. The higher flow rates required and licensed (on application) during drought conditions are precluded by its disinfection capability.

[redacted] There is not an existing Cryptosporidium Notice in place.

The required output at [redacted], and the 'drought emergency' license arrangements can permit this increased flow for up to one year.

Disinfection at [redacted] is limited by the physical constraints of the contact main and in order to provide the required disinfection at [redacted] some additional disinfection is required to maintain eCT5. Disinfection at this higher flowrate can practically be achieved by a fixed installation placed in service only during the higher flow rates.

Note that: to achieve [redacted] further investment in turbidity control and other infrastructure is required and this is dealt with under PRT07.03 (Raw Water and Drought Capacity Improvements). For the sake of clarity, this proposal includes only the cost of the UV plant components which will primarily serve [redacted]. The enabling infrastructure and other process components at [redacted] are included in PRT07.03 and that proposal **excludes** the cost of this UV plant reactor and its associated components.

[redacted] are exclusively interoperable under drought condition. That is: [redacted] is only required to be operated at [redacted] when aquifer conditions do not permit the use of [redacted] This allows some interchangeability of UV disinfection equipment between the two sites.

This solution describes the procurement and installation of a UV treatment plant that, under normal circumstances, will provide cryptosporidium control at [redacted], but can be relocated, under the 1 in 200-year drought condition, to provide the necessary disinfection at [redacted].

The current draft proposal is for a duty/ duty assist containerised unit capable of providing a minimum of 40mJ/cm2 dose. This will be capable of providing suitable dose for the highest instantaneous flow recorded between the two sites with the addition of a safety factor.

The normal mechanical provisions for cleaning and maintenance would be provided. The plant would be validated to UV Euro / US UVDGM (2006) and be DWI / WIMES 801(b) compliant. Dual UVT monitors and control units from the supplier will ensure a validated dose at all times.

The arrangement would be constructed and designed to give the aesthetic appearance of a permanent structure at [redacted] and subject to planning conditions, whilst allowing provision for its short-term deployment at [redacted].

As part of Portsmouth Water's ongoing catchment management strategy, issues around cryptosporidium and other contaminants are regularly discussed with farmers in the above two catchments. The methodology is fully described in Appendix PRT07.02.04.

Portsmouth Water would operate and maintain the plants, transport may be subcontracted under the supervision of Portsmouth Water staff.

Long-term Delivery

The investment would be wholly within AMP8.

Reinstating the [redacted] site to an operational condition is a necessary component to maintain water supply resilience and the Deployable Output from [redacted] forms a component of the assumed conditions within the WRMP24.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since all the sites and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

Costs

Table 4 summarises the costs associated with this solution.

Table 4: summary costs – UV plant for [redacted] translocatable to [redacted]

Component	Capex £M	Opex £M p.a.	Cost source
UV Container Solution	1.641	0.000	Trant
Civils	0.701	0.000	Atkins
Mechanical/electrical Connections	0.185	0.000	Atkins
Design, 3rd Party Costs and Misc	0.298	0.000	Atkins
Opex	0.000	0.050	Atkins
Risk/Contingency allocation	0.141	0.000	Internal
Management and overheads.	0.444	0.000	Internal
Subtotals	**3.410**	**0.050**	
Intrinsic allowance (deduction)	0.000	0.000	Internal
Delivery efficiency target (deduction)	0.511	0.003	Internal
Totals	**2.898**	**0.047**	
[redacted] civils,mechanical and electrical included in PRT0703			

Costs are presented on a 22/23 price basis.

Costs are derived from engineering estimates provided by Trant Engineering Ltd. Rushington House, Totton, Southampton SO40 9LT, and include Portsmouth Water risk and overheads.

The capital costs are a one-off cost with attendant operating costs at [redacted] (only).

No operating costs are proposed for the operation and maintenance of the UV plant at [redacted] since:

- Costs will be incurred only in the rare condition of a drought order being imposed.
- The additional costs incurred during drought order running at [redacted] will be net the savings of not running normal operation at [redacted]
- Relocation costs are negligible and rarely incurred.
- There are no intrinsic costs associated with the proposal.

The accuracy associated with these estimates, being derived from 3rd party engineering contractors, is believed to be within 10%.

The costs are considered enhancement costs since they relate to a deterioration in raw water quality, or / and through climatic conditions, both being entirely exogenous factors.

The relationship and interdependency with the overall strategy for the '[redacted] sites, of which [redacted] forms part, should be noted. PRT07.03 refers. For clarity: the costs for the infrastructure work at [redacted] necessary to support the UV plant relocation are contained in that proposal since PRT07.03 refers more generally to the [redacted] and describes other costs associated with enhancing the Deployable Output at [redacted].

Cost breakdowns are available on request.

Benefits

The proposal provides customers with an enhanced resilience in their water supply through ensuring that the necessary output from [redacted] is restored on a permanent basis.

The proposal meets the terms of the DWI notice by providing UV treatment at this site for the foreseeable future.

The proposal provides customer benefit at least cost.

The proposal contributes toward the long-term operation of a critical WTW and helps ensure the assumptions of the WRMP24 are met into the future.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since both sites and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

The proposal makes use of an asset that would otherwise be 'out of service' for the duration of a rare but foreseeable and potentially extended event. Hence avoiding capital and operating costs.

D. Solution 3

Description

This solution describes the intent to repurpose the redundant UV plant from solution 1 above and utilise it as a mobile unit that may be deployed at short notice and for short durations at other WTWs that suffer cryptosporidium events.

The proposal is to re-engineer the containerised plant. In principle, separating into a second container all the electrical, instrumentation, and control components, currently in the one container, into a container with a more suitable environment. Further engineering is then required to the UV reactor container which will include the replacement of some structural components and improved moisture control.

The two containers would be stored at a suitable Portsmouth Water site and kept ready for use. The mothballing and maintenance would be appropriate to ensure it is kept 'ready to deploy', and the scheduling of maintenance would be integrated into the corporate planned maintenance system that currently operates.

It is expected that some engineering design will need to be done and some adaption made as part of the repurposing. Whilst there can be no compromise made on its disinfection performance, it is recognised that the output of a site might be limited by the temporary UV capability. Such limitations would be short-lived whilst decisions are made concerning the longer-term. Measures would be taken to ensure the containerised units are made aesthetically more acceptable than the current design.

The mobile plant could be fitted at any Portsmouth Water site in the event of a risk to water quality through cryptosporidium.

All Portsmouth Water's treatment sites are located in rural locations, subject to various agricultural activities. Despite the catchment management activities (described in appendix PRT07.02.04), microbiological hazards exist at most sites – where Faecal Indicator Organisms (FIO) are observed in the raw water, it is not possible to determine the source. Cryptosporidium risks across sources have been identified from catchment land use activities, over which Portsmouth Water have very little control.

This proposal provides an opportunity to respond quickly should a cryptosporidium risk manifest itself.

Long-term Delivery

The investment would be wholly within AMP8.

The investment is dependent on the acceptance of solution1., though could be achieved without solution 1 at greater cost.

The WRMP24 relies on the continued operation of water treatment plants with limited headroom for their long-term loss. This places increasing reliance on their satisfactory operation. This solution mitigates against known and proven risks and events, that have, in recent history, interrupted supplies from various sites.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since all the sites and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

Costs

Table 5: Summary costs – containerising the redundant UV plant as a mobile spare.

Component	Capex £M	Opex £M p.a.	Cost source
Refub Existing UV Plant	0.1	0.0	Trant
Installation of new Generator	1.1	0.0	Trant
Supply of new LPG fuel tank	0.2	0.0	Trant
Installation of new LPG fuel tank	0.3	0.0	Trant
Panel/HMI/PLC works	0.1	0.0	Trant
Contingency	0.0	0.0	Internal
Risk allocation	0.1	0.0	Internal
Management and overheads.	0.3	0.0	Internal
Subtotals	2.0	0.0	
Intrinsic allowance (deduction)	0.0	0.0	Internal
Delivery efficiency target (deduction)	0.4	0.0	Internal
Totals	1.6	0.0	

Costs are presented on a 22/23 price basis.

Costs are derived from engineering estimates provided by Trant Engineering Ltd. Rushington House, Totton, Southampton SO40 9LT, and include Portsmouth Water risk and overheads.

The capital costs are considered a one-off cost with no attendant operating costs.

No operating costs are proposed for the operation and maintenance of the UV plant since:

- Operating costs are incurred only rarely and for limited duration if the units are deployed.
- Any costs incurred whilst the units are deployed would be met by Portsmouth Water through efficiencies elsewhere.
- Maintenance associated with ensuring the plant is kept ‘ready to deploy’ would be absorbed within current operational maintenance regimes.
- There are no storage costs.

- There is no reduction in operating costs as a result of the proposal.
- There are no intrinsic costs associated with the proposal.

The accuracy associated with estimates, being derived from a 3rd party engineering contractor, is believed to be within 10%.

The costs are considered enhancement costs since they relate to protection against deterioration in raw water quality which is an entirely exogenous factor.

Benefits

The proposal provides customers with an enhanced resilience in their water supply through ensuring that the necessary output from Water Treatment Works can be maintained following a cryptosporidium event,

The proposal provides customer benefit at least cost.

The proposal utilises an asset already owned by Portsmouth Water and repurposes it for future use.

The proposal contributes toward the secure long-term operation of Water Treatment Works, whilst minimising stranded assets and unnecessary investment in permanently installed plant.

By providing a solution that can be deployed widely across the Portsmouth Water estate, the proposal helps ensure that the assumptions of the WRMP24, in respect of Deployable Output and production margins, are achieved into the future.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since all the sites and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

The proposal is supported by the DWI.

E. Solution 4

Description

This solution describes the installation of permanent ‘fast deployment’ facilities at the [redacted] water treatment plant. [redacted] has been identified as a site at particular risk from cryptosporidium risk and a potential cryptosporidium event. The fast deployment facilities would allow the emergency mobile plant described in 3 (above) to be installed very quickly in the event of a parameter failure or risk of failure.

The proposal is limited to the design and installation of the necessary pipework and pipe fittings, and the associated groundworks, The proposal also includes the necessary operating manuals and operating instructions to allow the UV plant to be installed with the minimum of delay and plant outage.

The proposal is to use prefabricated pipework including spool pieces and blank flanges to redirect process water through the UV plant, though without introducing ‘dead-legs’, redundant pipework, or similar risk. Prefabricated pipework and components stored at each site would be disinfected according to normal procedures prior to use, and the installation process documented in site manuals with appropriate check lists, tests, and sampling strategies.

The DWI notice [redacted]

The proposal is supported by the DWI. DWI supported such installations at four sites. By proceeding with one site Portsmouth Water will carry the risk if the facilities are necessarily fitted at any of the other three sites.

Long-term Delivery

The investment would be wholly within AMP8.

Though there is some limited benefit if this solution is carried forward in isolation, maximum benefit is achieved if the proposal in solution 3 is accepted.

The WRMP24 relies on the continued operation of water treatment plants with limited headroom for their long-term loss. This places increasing reliance on their satisfactory operation. This solution mitigates against known and proven risks and events, that have, in recent history, interrupted supplies from various sites.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since all the sites and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

Costs

Table 6: Summary costs – provision of (UV) fast deployment arrangements

Component	Capex £M	Opex £M p.a.	Cost source
Installation of UV fast deployment arrangements at [redacted]	0.537	0.0	Trant
Risk /Contingency allocation	0.054	0.0	Internal
Management and overheads.	0.089	0.0	Internal
Subtotals	**0.680**	**0.0**	
Intrinsic allowance (deduction)	0.000	0.0	Internal
Delivery efficiency target (deduction)	0.136	0.0	Internal
Totals	**0.544**	**0.0**	

Costs are derived from engineering estimates provided by Trant Engineering Ltd. Rushington House, Totton, Southampton SO40 9LT, and include Portsmouth Water risk and overheads.

The capital costs are considered a one-off cost with attendant operating costs.

No operating costs are proposed since the proposal relates only to the installation of pipework and minor civil provisions. Furthermore

- Costs will only be incurred only in the case of a cryptosporidium event.
- There are no maintenance costs associated with the proposal.
- Any additional costs associated with the use of the fast deployment arrangement would relate only to minor efficiency losses associated with fluid hydraulics.
- ‘On-event’ Implementation costs are negligible and would be absorbed into existing operational resourcing.
- There is no reduction in operating expenditure as a result of the proposal.

The accuracy associated with estimates, being derived from a third party engineering contractor, are believed to be within 10%.

The costs are considered enhancement costs since they relate to protection against deterioration in raw water quality which is an entirely exogenous factor.

Benefits

The proposal provides customers with an enhanced resilience in their water supply through ensuring that the necessary output from Water Treatment Works can be quickly restored following a cryptosporidium event.

The proposal provides a pre-engineered and installed facility that avoids the delays and design compromises associated with an emergency response.

The proposal reduces the potential downtime associated with a cryptosporidium event from 26 weeks to less than one week.

The proposal avoids the high cost of engaging consultants and contractors and mobilising such at very short notice.

The proposal enables a treatment facility that can be installed by existing Portsmouth Water operators within their day-to-day activities, without reliance on third parties.

By providing a solution that can be deployed quickly across the Portsmouth Water estate, the proposal helps ensure that the assumptions of the WRMP24, in respect of Deployable Output and production margins, are achieved into the future.

The proposal contributes towards the core pathway of the LTDS for Portsmouth Water. The proposal forms part of the no-regrets pathway, and since the [redacted] site and processes are required for the duration of the LTDS, the proposal falls on all adaptive pathways within the LTDS.

4. ANALYSIS OF SOLUTIONS

Technology choices

Ultraviolet control of cryptosporidium is widely accepted as a standard approach where the treatment of any other parameter deficiency is not required. Membrane treatment is practicable, though is more expensive. Portsmouth Water experience suggests that capital costs for the membrane process plant could be expected to be three to four times higher, whilst operating costs could be expected to be some five times higher. UV treatment hence represents the best value treatment process for Portsmouth Water customers.

Membrane technology requires a significantly larger footprint and may require land purchase at some sites. A membrane plant at [redacted] could not be readily accommodated within the existing site footprint.

Membrane technology introduces cleaning requirements that can rely on high and low PH chemicals for regular cleaning cycles. Unnecessarily introducing such chemicals into water treatment processes is undesirable.

Membrane technology, with many valves, actuators and other electro-mechanical components does not lend itself to long-term periods of no-operation. It is hence less suitable as standby plant.

Though membrane technology can be made transportable, it is a much more complex process and the installation time and cost is unlikely to be accommodated within existing budgets.

Proposed solutions

Table seven summarises the proposal, relating need to the proposed solution.

Table 7: summary of needs and proposed solutions

Solution	Description of need	Solution
1	The existing emergency plant at [redacted] will suffer increasingly higher high failure rates unless action is taken soon to mitigate the environmental degradation.	Replace / rehouse
1	The shipping container currently housing the emergency plant at [redacted]s aesthetically inappropriate in the semi-rural area and unacceptable to residents	Rehouse
1	The hydraulic installation of the emergency plant at [redacted] is not suitable for a permanent installation.	Rehouse and re-engineer
2	[redacted] requires cryptosporidium control before the plant can be allowed back into service.	Provide

Solution	Description of need	Solution
2	[redacted] requires additional disinfection to support contact times only when the site is operated at elevated outputs.	Provide
2	[redacted] does not require UV treatment when the plant is unable to operate due to subterranean conditions. [redacted] is required to operate at elevated levels under these conditions.	[redacted]
3	Various sites are likely to follow the sites that have suffered cryptosporidium events in AMP 7 and further events are entirely foreseeable and expected.	Provide emergency UV plant
4	The installation of UV plants can take very many months due to the groundworks, and other infrastructure that must be procured and installed	Provide

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.

Work at [redacted] must be carried out early in the program, both to release the current temporary plant for re-use, and to ameliorate the customer complaints. Once completed and commissioned, the currently installed plant can be re-purposed as a mobile spare unit.

Work at [redacted] can be largely considered as independent, though work at [redacted] must be planned to coordinate with the proposals contained in PRT07.03.

Preferred outcome

The outcome favoured by Portsmouth Water is to proceed with all four solutions presented in the paper, since:

- Only all four solutions meet our obligations to customer in providing resilient facilities that can efficiently respond to predictable events.
- Only all four solutions provide water supply security at the minimum cost to customers.
- Only all four solutions support the vision presented by Portsmouth Water to its customers.

Table 8: summary costs – total of preferred solution

Solution	Description	Capital cost £M	Operating cost £M p.a.	Type
1	[redacted]	9.817	0	Enhancement
2	[redacted]	2.898	0.047	Enhancement
3	Mobile containerised UV	1.606	0	Enhancement
4	Fast Deployment Arrangements	0.544	0	Enhancement
Total		**14.865**	**0.047**	

The proposals have been costed based on Portsmouth Waters document PRT09 – Securing value for money. The cost of the solutions has been built up from first principles using estimates from engineering contractors. Despite this, in line with PRT-09 Portsmouth Water have applied a program efficiency delivery factor to the estimates. These reflect an internal challenge to deliver coordinated programs of work efficiently.

Furthermore, in respect of solution four: Portsmouth Water originally identified four sites in their appendix b submission where the 'fast deployment arrangements were desirable on grounds of risk. Subsequent internal challenge, surrounding affordability and customer bill impacts has reduced this to one ([redacted]). Portsmouth Water will carry the financial risk if it subsequently transpires that the arrangements are necessary at the other sites. In this way the company shares risk with its customers.

Portsmouth Water are required by the DWI to formulate a statutory undertaking to deliver these outputs. This, in combination with the delivery efficiency factor will ensure that the program of work is delivered for customers during AMP8 and that the commercial risk lies with the company and its investors.

5. TECHNOLOGICAL OPTIONS

Membrane option

As previously noted, other process options have not been explored with engineering rigour since they are known not to be cost effective. For example, Portsmouth Water have experience of installing and operating membrane plants. Membrane technology does offer a technically viable solution for cryptosporidium control. The inflated capital costs incurred when four such plants were installed between 2003 and 2007 (for reasons other than cryptosporidium control) can be used as comparators, whilst the operating costs of these membrane plants today can be used to compare operating costs. Table 9 provides an approximation to demonstrate the best value of the solutions chosen.

Table 9: cost comparison with membrane technology

Solution	Description	Preferred solution Capital cost £M	Membrane solution Capital cost £M	Preferred solution Operating cost £M p.a.	Membrane Operating costs £M p.a.
1	[redacted]	9.8	15	0.05	0.5
2	[redacted]	2.9	15	0.043	0.5
3	Mobile containerised UV	1.6	1.6	0	0
4	Fast Deployment Arrangements	0.54	2.1	0	0
Total		**14.865**	**33.7**	**0.093**	**1**

6. CUSTOMER IMPACT

Customers can be assured that the [redacted] sites will be able to supply water free from cryptosporidium without interruptions to that supply.

Customers can be assured that in the event of a cryptosporidium failure at [redacted], then Portsmouth Water have the capability to restore output from that site 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 cryptosporidium management and control.

Table 6: Table 10: Annual costs and customer bill impacts

2022-23 prices	2025-26	2026-27	2027-28		2029-30	AMP8 total
Capex £k	3,599	7,199	3,599	234	234	14,865
Opex £k	-	-	-	-	47	47
TOTEX	3,599	7,199	3,599	234	281	14,912
Bill impacts (average HH bill) (£)	0.33	1.27	2.15	2.36	2.37	
Source: Table CW3, Rows 99 and 102 (these rows also include costs from PRT07.03)						

7. ASSURANCE AND BOARD APPROVAL

Production of this supporting document has been undertaken in accordance with internal governance and assurance procedures and processes. Third party assurance has also been provided by Jacobs Global Consultancy.

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.

The document has undergone three stages of internal review and third-party assurance before being signed off by the Board. Internally this has included:

i. Executive Owner, and subject matter experts for the Executive Owner,
ii. Nominated Executive,
iii. Internal Executive Review Team including the CEO and CFO.

Details of the third-party assurance, including findings/opinion, can be found in PRT15.04. This report specifically addresses the two issues which are identified in the report, options considered and customer's support. These have been enhanced post final assurance review.

Supporting cost data has been provided by Trant Engineering Contractors

The Board has been engaged in the development of the business plan and its content through subject specific discussions at monthly PR24 Steering Committee meetings that have taken place since late 2021. Minutes of relevant meetings are included in PRT15 Board Assurance, Appendix PRT15.01

8. CONCLUSION

The paper presents cost effective solutions to present conditions associated with raw water quality deterioration. Such deterioration has led to DWI (improvement) notices, under Regulation 28 at several sites.

The paper presents solutions to sites that are known to be critical to the continued supply of drinking water and where such supply would be compromised if current agricultural practices resulted in a cryptosporidium event or increased risk of such.

The paper presents an innovative solution to deploying UV only where it is needed and provides a mechanism to deploy the arrangements quickly, according to operational needs, using pre-engineered facilities.

The proposal selects solutions that demonstrably provide the best customer value.

The proposal suggests an innovative approach to 'asset sharing' which under the particular operating conditions found at two sites, allows a single asset to be shared according to the prevalent operating circumstance. This saves capital and operating costs and avoids and avoids the environmental consequences of the provision of essentially duplicate systems. The reuse and repurposing of second-hand equipment also demonstrates an innovative approach to maximising customer value.

The proposals 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, well-understood, and in use at other Portsmouth Water sites.

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.

The proposal enhances social value through better reliability and availability of wholesome water. The solutions chosen provide the most environmentally attractive options notwithstanding the lack of control Portsmouth Water has over agricultural and other land use practices in its rural localities. The choice of UV may, during the timeframe of the LTDS, become even more environmentally attractive if the current developments in Light Emitting Diode (LED) UV technologies bear fruit and become available for industrial applications. The proposals avoid the need for aggressive and environmentally damaging chemicals in the process, and the process produces no waste products.

Portsmouth Water have learnt from the water supply compliance problems that the company has encountered during AMP7 relating to cryptosporidium 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 all four solutions 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.

PRT07.02 APPENDIX


Portsmouth
Water