UV / CRYPTO PROJECT REVIEW

For Portsmouth Water

30236048-ARC-ZZZ-XX-TN-PE-0012 P02 S3

22/8/2024

By [redacted]

[redacted]

Purpose

- To evaluate the existing documentation and understand the decision making process for the UV / Crypto Strategy in Portsmouth Water.
- To determine if the final determination by Ofwat can be challenged and conclude if the OFWAT challenges and concerns can be addressed.
- To provide 3rd party assurance and benchmarking for some of the conclusions reached

Documents Reviewed

PRT 07.02 : Raw Water resilience enhancements (Disinfection)

PR24-DD-W-Raw-water-quality-deterioiration.xls

SW1044 PW PR24 Chapter 1 Tenderbook_issue1_drop1.xls : by Trant (Includes various quotations)

PRT09_Appendix-B_PR24-submission-09_UV – fast deployment arrangements

PRT08_Appendix-B_PR24-submission-08_UV Plant Enhancements

Cryptosporidium - Background

- Cryptosporidium has been found throughout the company (and UK) supplies based on historic / current land usage leading to aquifer contamination.
- Various Portsmouth Water sources have previously been identified as having had Crypto identified or at high risk of future Crypto outbreaks. This cause appears to be from the contaminated surface water getting into fissured chalk aquifers and the Crypto making their way through the fissures to the abstraction borehole.
- Historically, Portsmouth Water have reacted by either closing off the source and pumping to waste until clear or installing a temporary UV system when Crypto has been identified in a source borehole.
- The temporary UV system at [redacted] was put in following identifying Crypto in the water during AMP7. This installation was ‘rushed’ to maintain resilience. Other works, e.g. [redacted] and [redacted] have been isolated from the network while flushing through which obviously reduces resilience. [redacted] has been offline after high turbidity was detected and a Crypto event in 2017.
- Historic events show that it is unlikely that two abstraction sites suffer with the sporadic events with Crypto in the groundwater at the same time. [redacted] required the UV due to strategic importance and appearing to have multiple Crypto events in short succession.

Cryptosporidium Control options - discussion

Taken from : ***[Cryptosporidium - Drinking Water Inspectorate (dwi.gov.uk)]***
Cryptosporidium poses a challenge to water treatment, because of its **small size** and **resistance to chlorine**. However, most investigations of outbreaks have shown that they happen only when some aspect of water treatment is inadequate, or on rare occasions where contamination enters the distribution network. There is good evidence that careful risk assessment, design and operation of water treatment, affords a very high level of protection against exposure to the parasite.
Water companies must assess the risk of Cryptosporidium in its water sources, and design and continuously operate a water treatment process to remove the parasite or render it inactive.

Crypto

Catchment Management

- Education of farmers / stakeholders
- Protection of around known fissures and vulnerable points in catchment

- Portsmouth Water are already taking on catchment management and education as part of their Drinking Water Safety Plans.

Treatment - Removal

- Sand Filtration
- Cartridge filtration (1µm)
- Membrane Filtration

- Sand filtration – large amount of space needed including backwash system and waste handling. The sites identified do not have the space, power required or sewer connection making it a high cost / low value option. Plant is fixed in one location and requires operating continuously.
- Cartridge filters – smaller space with no backwashing. It does mean disposal of cartridges once clogged, with associated waste disposal to landfill. Can be isolated and only used when required minimizing usage to high turbidity or Crypto events.
- Membrane Filtration – Large space requirement. Permanent installation requiring backwash, waste and chemical handling equipment. The identified sites do not have space, power required and sewer connections. Access for chemical deliveries maybe problematic. Plant required to operate continuously.

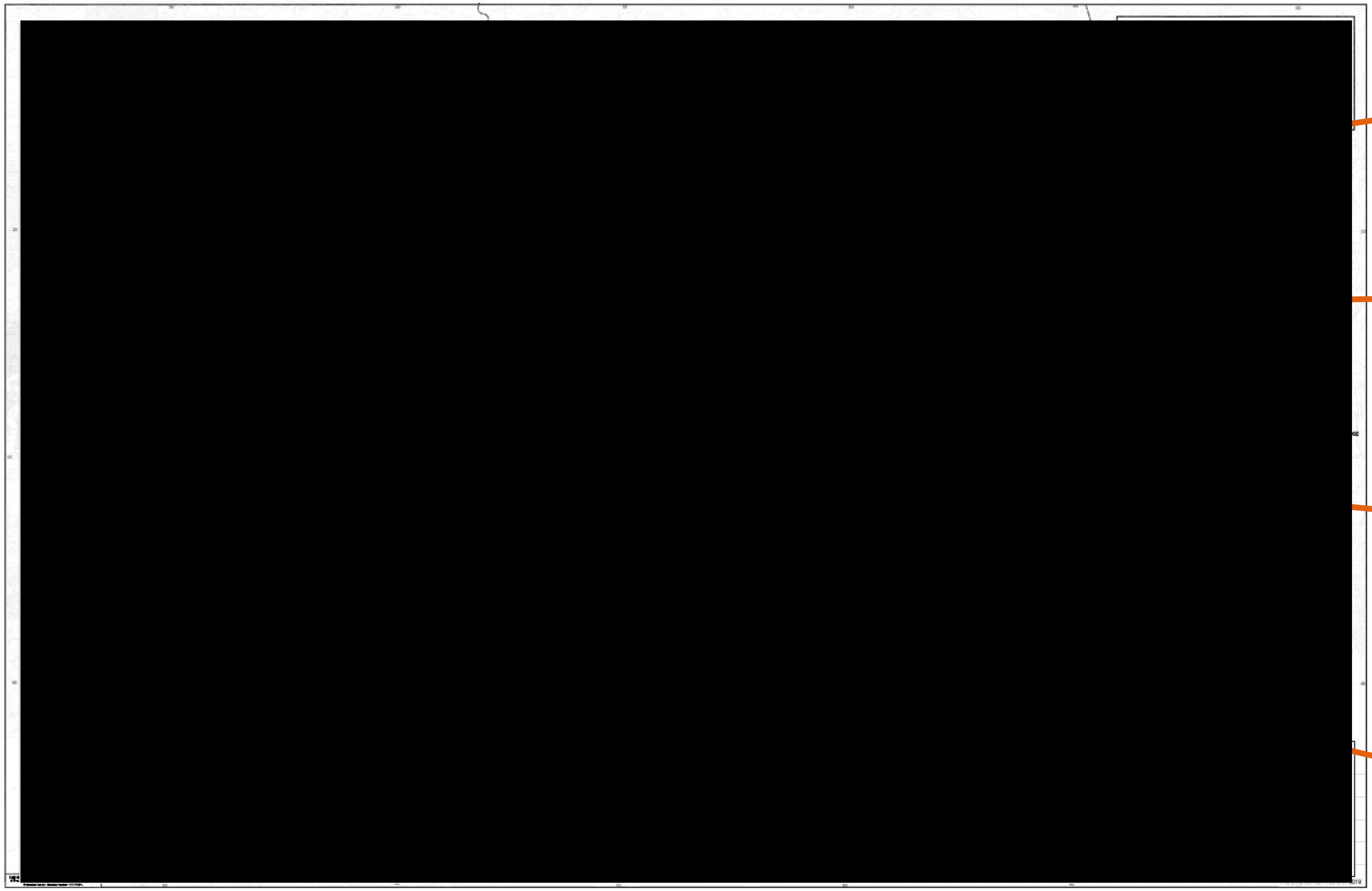
Treatment - Inactivation

- UV

- UV is cost effective method of inactivation provided the turbidity is low enough to get the effective dose. The units are compact and can be used when there is a crypto event minimizing operational costs. May require power upgrade on site but produces no waste and requires no chemicals or washing. Will require a site run to waste for start up / shut down.

Area of interest

There are four distinct sites requiring improvements to disinfection and highlighted as



[redacted]

[redacted]

Rural borehole site that experiences Crypto events.

[redacted]

Borehole treatment site in rural area critical to serving North of area. High risk for Crypto in DWSP

[redacted]

Small site usually operating at 2.5Ml/d but drought plan calls for this to rise to 11Ml/d. Existing disinfection system is insufficient for required drought flow

[redacted]

drought plan provision mutually exclusive operation to [redacted]

Site experiences turbidity, disinfection and crypto events as well as requiring increased production capacity during drought order

[redacted] WTW Option Evaluation

[redacted] has a capacity of up to 14Ml/d and supplies water to three reservoirs for distribution into four distribution zones. The DWSP hazards identified are a failure of the disinfection system and Crypto events. Water is taken by borehole pumps from Chalk Aquifers that contain fissures.

Crypto events in 2019 and 2021 led to [redacted] being shut down for periods. In 2021, emergency work was carried out to install a temporary UV in a containerised unit as the risk of further Crypto events could not be ignored.

A permanent solution needs to be installed to ensure the operation of the site and resilience maintained in the network. Options are:

1. Do nothing – maintain current temporary UV
   - The existing system was installed in an emergency and does not have all the required functionality for best practice operation. The site is in an urban area and the container is visible from the site boundary. Local residents have made complaints to staff about the visual appearance of the container and pipework connections.
2. Refurbish existing UV
   - Correcting the concerns on the existing installation by the addition of permanent pipework and refurbishing the container. The controls will need full integration into the site SCADA system. There are concerns with constructability of this option and trying to maintain disinfection during the refurbishment. Likely solution is to hire in a temporary UV system to allow the works to be carried out. Without making this a permanent installation (inside a building) local residents are likely to continue to raise complaints.
3. Install purpose designed UV and re-allocate the temporary unit to another site
   - Construct new facility offline using the existing emergency installation for disinfection and Crypto inactivation during design and construction. The new UV would be designed and built to best practice and incorporated into the site SCADA and contain start up / shut down functionality. Duty / (assist) / standby would provide turndown and resilience to provide optimal power consumption to match the 5:1 turndown of the site throughput.
4. Install barrier filtration traditional sand filters
   - The site is in an urban area and there is limited space on site for either pressure filters or gravity filters with the backwash systems. Wastewater would be costly to dispose of and this solution wouldn't help with the disinfection. Sand filtration is notably less effective at removing Crypto than other barriers. Cost would be in the order of £5m
5. Install barrier filtration – cartridge filters
   - This will require c. 1000 cartridges to process the flow leading to considerable operational time to change the cartridges on a regular basis. These would have to be disposed of to landfill. At this scale, cartridges are not seen as time efficient or an environmentally sound selection
6. Install barrier filtration – membranes
   - Under REACH regulations, and the urban location, if there is an option that does not require the hazardous chemicals then the alternative should be favoured. The cost is c.£6m for the installation without the additional requirements for chemical protection and a sewer connection for the waste

[redacted] WTW– Long list selection

Options Considered	Defined Solution	Resolves Problem	Technically Feasible	Able to Construct	Long term Operation Feasibility	KPI Risk Impact	Network Resilience Impact	Customer Impact	Enviro Impact	Carbon Impact	Biodiversity Impact	Total	Ranking
Do Nothing	5	1	1	5	1	1	3	1	3	3	3	27	5
Refurbish Existing UV	3	4	2	3	3	2	3	2	3	3	3	31	4
New UV	4	5	4	5	4	5	3	5	4	4	3	46	1
Barrier – Sand Filters	3	3	1	2	1	3	3	2	2	2	3	25	6
Barrier – Cartridge Filters	4	5	3	4	1	4	3	5	2	1	3	35	3
Barrier - Membranes	4	5	3	3	1	4	3	5	3	2	3	36	2

Score based on 0 to 5 relative to overall impact with a higher score being more favourable. A score of 0 is only used when a solution is not possible.

Notes:

1. Doing nothing is not an option due to the level of risk around long term operation of the existing emergency installation with having no remote control and being unable to start / stop the unit when necessary. However, it is preferable to do nothing than look at barrier sand filtration due to the constructability, space constraints and waste water disposal posed by this option making it very expensive in terms of capex and opex.
2. The installation of a new UV is made simpler by being able to construct offline. It will use the least power as it can be optimised for the site when compared to refurbishing the emergency UV. Compared with barrier techniques, it has no waste (chemicals or solid) to be disposed of. A run to waste system is required. A UV solution would require a relatively small footprint making construction and site conditions more favourable. Hence the solution scores significantly higher relative to the other options at this site for these conditions.
3. Cartridge filters become impractical at this size and flowrate simply due to the time, cost and disposal of the number of cartridges.

[redacted] WTW Option evaluation

	New UV	Barrier – Membrane filtration
Scope summary	Construct new UV offline while continuing to use existing emergency UV. Incorporate necessary controls and RTW facilities in new system. Optimise system to accommodate turndown to minimise power consumption.	Package UF plant built off site and delivered complete with necessary cleaning chemicals. Small waste neutralisation plant and connection to sewer for waste disposal.
Technical Risks	Buried mains and contact main give challenge to construction and service diversions therefore land acquisition included. Disposal of run to waste water for start up / shut down while lamps are reaching the correct conditions	Location of a containerised treatment package plant on the site and then connecting into it where site is already conjected. The UF needs chemical cleaning and chemical deliveries. Need to have REACH justification for the introduction of new chemicals on the site although small volumes. Poor access for deliveries due to rural location.
Relative Capital Cost	c.£6.2m quoted. Includes extending the existing building to house optimised UV equipment with standby generator, necessary controls and run to waste for start up / shutdown.	c.£8.5m based on previous schemes Arcadis have complete for other water companies. Includes packaged UF treatment, chemical storage and waste neutralisation system with associated civil works
Relative Operational Cost	Cost related to power consumption which should be less than using the existing emergency UV as the system can be optimised for the turndown.	Operating cost will be higher due to the use of chemicals to clean which needs to be neutralised prior to disposal to sewer. As Portsmouth Water do not own the sewer or treatment works this disposal will cost at commercial rates. The power consumption will be equivalent to the UV option.
Carbon Assessment	Embedded carbon will be in the construction of the building. This will be small due to size of units. Operating carbon will be minimised with an optimal design.	Package treatment unit will be steel construction with minimal concrete but larger than UV building. Operating carbon will be greater than UV option due to transporting the chemicals to the site.
Customer Impact	None. Construction of a small building and removal of existing container will reduce local complaints and UV has no residual impact on the water in distribution. No waste increase.	Membrane filtration has no residual impact on the water in distribution. Increased vehicle movements around the site for chemical deliveries. Waste sent to sewer will not impact customers.
Environmental Impact	None – site is in rural area. Land acquisition included. Surrounding land is pasture with no environmental benefit. Hedgerows are left wild to increase screening to reduce customer complaints but also adding biodiversity	None – site is in built up area and all work is within the boundary of the site
Resilience Impact	More reliable optimised UV system with automatic and remote control should improve treatment resilience.	Automatic UF system with built in redundancy should provide treatment resilience
Performance Indicator Impact	Viable Crypto counts should be eliminated. Improved disinfection	Viable Crypto counts should be eliminated. Improved disinfection
Overall Conclusion	Work to be done on the design to ensure optimal performance. Provides best overall value for money and gives best technical outcome to protect customers.	Feasible alternative, but addition of chemicals on site give operational downsides that aren't necessary if UV option selected.

[redacted] WTW & [redacted] WTW Option Evaluation

[redacted] WTW has a normal maximum output at 2.5Ml/d with good quality water. It is included in the drought plans as being able to increase capacity to 11Ml/d during droughts with some provisions elsewhere in the system. The normal treatment is chlorine gas disinfection as the water quality is generally good. The existing disinfection cannot treat the 11Ml/d in the drought plan. [redacted] WTW has also been identified as been identified as a possible future Crypto event risk due to the nature of the chalk aquifer.

[redacted] WTW has also been identified in the DWSP as being at risk of future Crypto events. The site has a normal maximum capacity of 19Ml/d and averages 12.7Ml/d. The water is good quality with disinfection provided by chlorine gas.

A solution is sought for both sites to mitigate the Crypto event risk in the future and provide disinfection at [redacted] WTW during drought operation. Options are:

1. Do nothing
   - Both sites will remain at risk of a Crypto event in the future and [redacted] WTW will not have suitable disinfection during drought production.
2. Provide separate permanent Crypto barrier at each site and increased disinfection capacity [redacted] WTW
   - These sites are on a similar scale to [redacted] and therefore the same preferred barrier solution would be required for both. This would mean two membrane filtration plants. [redacted] would then require an additional gas disinfection system with a >10:1 turndown to account for the variation in flowrates. This is a very expensive option for both capex and opex with more operators required to operate the plants.
3. Provide separate UV for each site
   - Installation of new UV plants at both site would mitigate the Crypto and provide the additional disinfection required at [redacted] WTW during the drought period usage. The UV would be optimised for the site flowrate and would have remote start / stop functionality with auto changeover for improved resilience.
4. Provide a new common temporary UV system
   - The development of a trailer mounted UV system that could be moved to either site if a Crypto event was identified or [redacted] WTW was in drought production capacity where it could provide the additional disinfection as required. Additional benefit is that the trailer could be diverted to any other site if any further sites also experience a Crypto event.
5. Provide refurbished common temporary UV system from [redacted]
   - Utilise the equipment currently [redacted] to develop a trailer mounted UV system that can be moved between sites as per option 4. The [redacted] emergency UV has a nominal capacity of 16Ml/d. [redacted] WTW would be within range but [redacted] would have to be down rated although 16Ml/d is above the average production for the site.

[redacted] and [redacted] WTW– Long list selection

Options Considered	Defined Solution	Resolves Problem	Technically Feasible	Able to Construct	Long term Operation Feasibility	KPI Risk Impact	Network Resilience Impact	Customer Impact	Enviro Impact	Carbon Impact	Biodiversity Impact	Total	Ranking
Do Nothing	5	0	1	5	3	0	1	1	3	3	3	25	5
2 x Barrier membrane plants	3	2	4	2	2	4	4	2	2	1	3	29	4
2 x Permanent UV systems	4	5	5	5	4	4	5	3	2	2	3	42	2
New trailer mounted temporary UV	4	5	4	5	5	4	5	3	2	2	3	42	2
Repurpose [redacted] emergency UV as trailer mounted temporary UV	4	5	4	5	5	4	5	3	4	2	3	44	1

Score based on 0 to 5 relative to overall impact with a higher score being more favourable. A score of 0 is only used when a solution is not possible.

Notes:

1. Do nothing is not an option as the risk to the business due the need for [redacted] WTW as a drought relief site. Some form of disinfection has to be provided.
2. The cost of barrier filtration at two sites for potential future events is not cost effective and does not warrant the cost expenditure (capex or opex) as the benefits are marginal. Portsmouth Water does not have operators stationed at these works to operate a membrane plant successfully and neither site has a sufficient sewer connection for ongoing waste water disposal.
3. UV is clearly the preferred technology to resolve the problem as it can provide Crypto inactivation and additional disinfection capacity. By providing an optimised new UV system at [redacted] it frees up the existing emergency unit to be repurposed and refurbished as a common emergency UV trailer. If the preferred option is not delivered for [redacted] WTW then a new trailer mounted UV system would give better value for money over two new UV systems permanently installed as it provides additional resilience[redacted] The difference being that 2x UV systems would be more resilient and favoured if the risk of Crypto was realised regularly (as with [redacted] WTW) but while it is unrealised, then a mobile unit is preferred. Deployment of the mobile unit would mean the boreholes shutdown while the unit was deployed, but this should be a short period if available.

[redacted] WTW and [redacted] WTW Option evaluation

	Repurpose [redacted] emergency UV to mobile UV system	New mobile UV system	2 x new Permanent UV systems
Scope summary	Once [redacted] is operational, the existing 16Ml/d emergency UV units can be removed and taken offsite to install on a trailer / containerised self contained UV system for deployment on either site as required.	New self contained trailer / containerised 20 Ml/d UV system procured for deployment on either site as require	A permanent and optimised UV system for each site sized to the installed prior to final disinfection
Technical Risks	Deployment based on results, therefore plant offline while trailer deployed	Deployment based on results, therefore plant offline while trailer deployed	None
Relative Capital Cost	c.£1.1m	c.£3.5m	c.£10m
Relative Operational Cost	Not optimised for specific site, but LOW overall operating cost as only used when required.	Not optimised for specific site, but LOW overall operating cost as only used when required.	Highest operating cost as a permanent installation, the UV would have to be operating continuously.
Carbon Assessment	Re-using existing equipment saving embedded carbon. The operating carbon is related to frequency of moving between sites and power during operation.	Embedded carbon for new equipment but no permanent installation so no concrete required. The operating carbon is related to frequency of moving between sites and power during operation.	Highest embedded carbon with permanent installation requiring some concrete and twice the UV units. Highest operation carbon as continuous running requires greater power consumption.
Customer Impact	During a Crypto event, the unit will not be employed immediately. Maybe some impact between identification of event and deployment	During a Crypto event, the unit will not be employed immediately. Maybe some impact between identification of event and deployment	None – Crypto event will be dealt with immediately as UV will inactivate Crypto.
Environmental Impact	No impact	No Impact	No impact
Resilience Impact	Improved allowing for deployment delay	Improved allowing for deployment delay	Improved
Performance Indicator Impact	Reduced down time of water source during Crypto [redacted] output during drought	Reduced down time of water source during Crypto event and increasing [redacted] output during drought	Reduced down time of water source during Crypto event and increasing [redacted] output during drought
Overall Conclusion	This is the preferred solution based on overall cost and value for money. Relies on [redacted] emergency UV becoming available	Good value for money as it improves resilience and has same benefits as the preferred option. Does not rely on [redacted] emergency UV	The risk of Crypto events does not warrant the capital spend of new UV at both plants when the events are all intermittent and likely not to be mutual.

[redacted] WTW Option Evaluation

[redacted] has a capacity to produce 7Ml/d, it is currently out of supply and has been since 2017 due to high turbidity leading to a potential breach of the drinking water regulations and a Crypto event. The current treatment on site is with chlorine gas for disinfection only. [redacted] WTW experienced a Crypto event in 2017 and is in the DWSP as a site with a further Crypto risk. There is no treatment for turbidity or Crypto.

A permanent solution is required to bring the site back into service and reduce both the turbidity and the risk of a Crypto event impacting the network. Options are:

1. Do nothing / lose abstraction
   - As the plant has been offline since 2017, the network has already network has already demonstrated resilience. However, with climate change predicting drier periods for the region, losing an abstraction source is not seen as a viable long term solution to maintain resilience and customer supply.
2. Install sand filtration and UV
   - A traditional treatment option for turbidity is sand filtration. This is costly in terms of initial capital equipment cost and will require land acquisition. Single stage sand filtration is not a complete barrier to Crypto making UV a requirement. There is no characterisation of the turbidity, although chalk aquifers usually produce colloidal solids making sand filtration only partially viable and likely to require some form of coagulant to be effective.
3. Install membrane filtration
   - UF membranes will remove colloidal solids and Crypto in a single stage allowing the existing chlorine to be used for disinfection. The membranes will require cleaning with chemicals and a waste neutralisation plant will be required. Chemical deliveries to the site are likely to be problematic due to remote location and poor access. Additional land is likely to be required for the treatment building.
4. Install UV
   - A UV unit will only work if the UV transmissivity is sufficient to provide a sufficient dose to inactivate the Crypto and assist with the disinfection of the water. Further work on the turbidity and UVt has to be undertaken to determine feasibility of this option. With the works not operational, there is no data to base any positive assumption on that this option will resolve the problem.
5. Install Cartridge filters and UV
   - This will need approximately 160 cartridges in 4 housings that will require replacing periodically. It does not require any backwash system and may be constructed within the boundaries of the existing treatment works. Depending on the solids characteristics and loading, the cartridges chosen may have to be larger than the 1micron needed to remove the Crypto else changing the cartridges would be too frequent. Therefore, a separate UV is included after the cartridge filters for additional disinfection and Crypto inactivation.

[redacted] WTW– Long list selection

Options Considered	Defined Solution	Resolves Problem	Technically Feasible	Able to Construct	Long term Operation Feasibility	KPI Risk Impact	Network Resilience Impact	Customer Impact	Enviro Impact	Carbon Impact	Biodiversity Impact	Total	Ranking
Do Nothing	3	0	3	5	0	1	1	2	3	4	4	26	5
Sand filter & UV	2	2	5	3	3	4	4	2	2	2	3	32	3
Membrane treatment	3	5	5	3	4	4	4	3	2	2	3	38	1
UV only	2	2	2	5	3	2	3	3	3	4	3	32	3
Cartridge Filter & UV	3	5	5	4	3	4	4	4	2	1	3	38	1

Score based on 0 to 5 relative to overall impact with a higher score being more favourable. A score of 0 is only used when a solution is not possible.

Notes:

1. By doing nothing, the site would have to be abandoned which does not solve the problem or give a long term solution to the resilience in the network. The problem is not sufficiently difficult to treat to warrant abandoning the boreholes and 7Ml/d of water from the network.
2. Land is available adjacent to the existing site boundary, but this would have to be acquired by Portsmouth water and will impact both the time to deliver and the overall cost. Therefore, options requiring additional land have been scored lower.
3. Membrane filtration can provide a suitable solution but significant testing is required by the suppliers to provide guarantees of performance. With the plant not in operation, long term test data is going to be difficult to achieve. For the equivalent problem for cartridge filters, the option includes a UV which allows the cartridge pore size to be increased and minimise change frequency whilst still maintaining the effectiveness against Crypto events.

Maindell WTW Option evaluation

	Membrane Treatment	Cartridge filters with UV
Scope summary	A new membrane treatment building constructed off site and installed on adjacent land. New access and infrastructure required for chemical delivery and neutralised waste disposal.	Two built offside kiosks, one containing the cartridge filters and the other the UV would be installed within the existing site boundary.
Technical Risks	No testing carried out on membrane performance, particularly run times and flux through the membranes. As such there are significant risks to what the ongoing operational cost is likely to be	With c.160 cartridge elements this will require significant operational time to change the cartridges on a regular basis. The pore size of the cartridges would need to be determined to reduce turbidity without requiring changing too often.
Relative Capital Cost	c.£6.3m	c.5.7m
Relative Operational Cost	Operational cost is likely to be higher due to power and chemicals consumed by the cleaning of the membranes. Despite being automated, this is likely to require more operator involvement. There is also the cost of waste disposal to be included.	The operating cost is made up of power for the UV, replacement cartridges, the additional operator time to change the cartridges and the waste disposal costs. It is likely to be lower than the membrane option.
Carbon Assessment	The embedded carbon is related to the steel frame construction and delivery of the offsite treatment building and the concrete required to install it. This will be greater than the cartridge / UV option. Operational carbon is related to the power, chemical consumables and the chemical deliveries.	The embedded carbon for the kiosks and associated foundations will be less than the membrane option as the physical size is less. The operational carbon is related to the power for the UV and the replacement cartridges.
Customer Impact	The customer should not see any change to the water in the network. The local stakeholders will see an additional building and increased traffic with chemical deliveries.	The customer should not see any change to the water in the network. The local stakeholders will see additional kiosks and increased operator visits
Environmental Impact	Mature trees border the site which could be impacted by construction	Using small kiosks on the existing site should have minimal impact on the actual ecology in the area.
Resilience Impact	Resilience will be improved as [redacted] WTW can be brought back online	Resilience will be improved as [redacted] WTW can be bought back online
Performance Indicator Impact	With improved resilience and improved treatment, customer contacts and other company KPIs should improve	With improved resilience and improved treatment, customer contacts and other company KPI's should improve
Overall Conclusion	Although a better technical solution, the higher cost and the lack of data for predicting performance make this option slightly higher risk and less value for money.	This is the preferred option as it can be deployed quicker with less risk and it addresses both the turbidity and the Crypto challenge. The lower capital cost makes this better value for money to solve the solution.

Summary of Preferred Options Carried Forward to Business Plan

[redacted] WTW

The preferred option is the installation of a new permanent UV system incorporated into the existing treatment works control system to allow remote start / stop and to be optimised for power consumption and the flowrate / turn down. Due to the existing site having buried services and contact main, land is required adjacent to the existing site. A new power upgrade required for additional c.40kW UV system and a standby generator on site for power continuity. The existing MCC is not rated for the additional load induced by the UV and shall be replaced. Due to local resident complaints, the new equipment shall be housed in a new purpose built building which will be subject to local planning conditions. There will need to be service diversions, below ground connections and new chambers constructed to connect the new process units to the existing systems. It is expected that the existing borehole pumps can achieve the revised duty point and do not require changing.

The sub total cost for this carried forward to the business plan is £6.2m

[redacted] WTW & [redacted] WTW

To resolve the challenges at these sites, it is proposed to refurbish the emergency UV currently being used at [redacted] once the new permanent installation is complete. The UV units would be refurbished and installed in a new container / trailer system that can be taken to either site when required. The sites would have permanent infrastructure work to allow the temporary connection of the temporary UV system for fast deployment. As this would be deployed to sites without the necessary power infrastructure, there is a need to include a separate self-contained emergency generator that can be transported to the site. This generator would have to be low noise and secure for use on rural sites close to the road and neighbouring properties.

The two units (UV & generator) can be used on any site within Portsmouth Waters area requiring temporary UV. They would require site infrastructure work to incorporate the unit in the treatment process but would increase overall resilience of the treatment facilities.

The cost for this carried forward to the business plan is £1.6m

[redacted] WTW

To allow this water source to be re-utilised and address the turbidity and Crypto risk, it is proposed to add additional cartridge filters and UV kiosks to the treatment process. These can be installed on the existing site as a permanent solution. With the additional pressure differential across the cartridge filters and UV, the existing borehole pumps will need to be replaced with larger units. The MCC has no spare capacity and is undersized when accounting for the revised BH pumps, and the UV system so the MCC will require replacing. A new standby generator will also be required to account for increased site load. No site power upgrade is expected. The new equipment (cartridge filters and UV) can be housed in GRP kiosks manufactured and shipped to site for installation. There will need to be service diversions and below ground connections to connect in the new process treatment units.

The cost for this carried forward to the business plan is £5.7m

High Level Cost Build Breakdown

[redacted] WTW

UV process Units & RTW	£3.20m
Land acquisition and access improvements	£0.50m
Building	£0.50m
Power upgrade	£0.50m
Standby generator, fuel tank and bund	£0.75m
Site wide MCC	£0.25m
Service diversions / underground pipework	£0.50m
Sub Total	**£6.20m**

[redacted] WTW & [redacted] WTW

Refurbish existing UV	£0.20m
New MCC	£0.15m
Purchase and adapt trailer (with security)	£0.25m
Site infrastructure work [redacted] WTW)	£0.25m
Site Infrastructure work ([redacted] WTW)	£0.25m
Mobile generator	£0.50m
Sub Total	**£1.60m**

[redacted] WTW

Cartridge Filter process units	£1.10m
UV process Units & RTW	£2.60m
New borehole pumps	£0.50m
New site wide MCC	£0.25m
Standby generator, fuel tank and bund	£0.75m
Kiosks and off site build	£0.50m
Sub Total	**£5.70m**

Sub Total for UV / Crypto (3 schemes)	**£13.50m**
Risk and Contingency @10%	£1.35m
Project Management Overhead @15%	£2.03m
Sub-total	**£16.88m**
Delivery efficiency reduction @ -15%	-£2.53m
Grand Total (UV / Crypto Programme)	***£14.35m***

All three sites are independent although the transportable UV relies on [redacted] WTW UV releasing the existing emergency UV for refurbishment and reuse.

Ofwat benchmark comparison

From data in Ofwat determination spreadsheet (PR24-DD-W-Raw_water_quality-deterioration.xls) and tab UV Query data, the costing curve on LHS can be derived.

The UV / Crypto programme proposed has been created by reviewing on a Programme level rather than site asset level producing 3 distinct projects related to:

1. [redacted] WTW – 14 Ml/d
2. Temporary UV system – 16Ml/d
3. [redacted]l WTW – 7Ml/d

Using the curve, the benchmark for the total programme cost should be c.£7.28m.

The total cost of the UV elements for these schemes is approximately £6m based on the cost breakdowns.

The remaining cost of £8.35m is made up from site specific requirements that are necessary for the UV to be either feasible as a solution or functional / operational e.g.:

- standby generators,
- site power upgrades
- new site wide MCC's,
- land acquisition and improved access
- service diversions and below ground pipework connections / moving.

A total cost of £14.35m for the UV programme of work appears to align with the business case proposal of £14.87m.

The variation appears to be due differences in how costs are built up.