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TA 11.WN05 Service Reservoirs Business Case

September 2018
Version 1.0

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1. Executive Summary

Name of technical annex	WN05 Service Reservoirs		
Context	<p>We have 207 service reservoirs (including 10 water towers) A number of our treated water storage assets are reaching the end of useful asset life leading to increased CRI risk. These structures are between 120 and 180 years old and will need to be decommissioned between 2023 and 2030 based on asset condition assessments taken from recent structural inspections. With a greater focus on resilience, we need to resolve the challenges of having five geographically discrete areas with little inter-connectivity. Without action these reservoirs will need to be removed from service, reducing storage capacity and reducing our resilience.</p>		
Customer and stakeholder views	<p>We specifically asked customers and stakeholders whether they supported the construction of 8 new water service reservoirs and the decommissioning of 30 reservoirs to increase resilience. Customers said they expect us to be ensuring that future generations have access to the same level of wastewater and water services as we do today and are willing to invest now to ensure that there is no deterioration in services in the future. More broadly our Strategic Environment Panel members supported the Network 2030 approach of which transforming our service reservoir asset base is a key component. This has shaped our AMP7 investment strategy for service reservoirs.</p>		
Our aim	Our aim is to ensure that long term compliance is improved with CRI improving to Quartile 1.		
Scope of this technical annex	All capital maintenance and base opex investment relating to service reservoir assets.		
	Botex	Enhancement	Total
Totex (£'m)	£ 31.9	£ 0	£ 31.9
Opex (£'m)	£ 0	£ 0	£ 0
Capex (£'m)	£ 31.9	£ 0	£ 31.9
Residual, post-AMP7 capex (£'m)	£ 0	£ 0	£ 0
20 year Whole life totex (£m) ¹	-	-	£ 50.9
20 year cost benefit (£m)	-	-	-
Materiality (% 5 year Totex for relevant price control)			3%
Relevant business plan table lines	WS1- 12		WS1 -12

¹ Our whole life costs and cost benefit figures have been calculated by extracting a 20 year portion of costs/benefits from a 60 year model. Further details are included in the Optioneering Technical Annex.

Botex

Overview of AMP7 proposals

We are investing £32m over AMP7 to improve the resilience and performance of our service reservoirs, resulting in improved CRI performance. This includes two main programmes of work. Increasing inspection frequencies from 10 years to a maximum frequency of 5 years by 2025 to comply with a DWI notice (SRN3923) = £14.4m.

The delivery of 2 new service reservoirs in AMP7 and starting the construction of 2 further service reservoirs which are delivered in early AMP8. Along with the completion of 4 others (started in AMP6). This will permit the rationalisation and decommissioning of 30 service reservoir structures which have reached the end of asset life by the end of AMP7. This forms a key component of the [Network 2030](#) transformational programme = £17.5m.

Why are the proposals the best programme-level option for customers

We considered a number of strategic options through the Southern Water Whole Life Cost Benefit Tool:
 Option 1 (Refurbish existing reservoirs) was discounted as this was less cost beneficial than Option 3 and would add cost to customer bills.
 Options 2 (Replace reservoirs like for like) was discounted as not being cost beneficial.
 Option 3 (Rationalise and build new reservoirs) is the preferred option for Service Reservoirs in AMP7 due to it being supported by WTP, meeting regulator expectations and reducing customer bills (this is the option presented in this technical annex).

What we would like to highlight

We plan to implement two key innovations in AMP7:
 Moving to a new risk-based model to determine inspection and cleaning frequency based on latest research from UKWIR (UKWIR Clean Water Storage Assets 2017).
 To understand the physical resilience of our supply system, we have developed a systematic method for measuring resilience across our asset base. We will publish the results of these assessments to give greater transparency of our short, medium and long term resilience to our stakeholders. Our AMP7 plans and long term strategy have been informed by this assessment, including all service reservoir investment.

Performance Commitments supported by this technical annex

PC	How relevant is this technical annex?	Comment
Water quality compliance	High	Significant improvement in CRI (this programme significantly 'de-risks' the treated water storage component).

Schemes and scheme-level options

Schemes over £10m	Options		
	Description	Cost	Selected option and rationale
None			

- WSR Construction Programme

Quality enhancements such as increasing raw water Nitrate levels or new connections are not covered by this technical annex. Other asset classes including Water Networks, Water Booster Stations and Impounding reservoirs are covered in other technical annexes.

3. AMP6 Strategy

3.1. Investment Strategy

Our AMP6 investment has kept water service reservoir asset health serviceability measures stable over the last two AMP periods. From 2010 to 2020 we are investing ~£40m in the reservoir inspection programme. We improved the average inspection frequency from 1 in 20 years to 1 in 15 years during AMP5, driving that to 1 in 10 years during the current AMP. This has significantly reduced treated water storage risk. Table 1 below summarise the total Capex and Opex spend for water service reservoirs in AMP6.

Table 1 - AMP6 Final Actuals

	AMP6 Actual					
	2015/16	2016/17	2017/18	2018/19	2019/20	AMP6 Total
TOTEX	4.562	4.321	8.106	7.620	8.401	33.010
CAPEX	4.562	4.321	8.106	7.620	8.401	33.010
Water service reservoirs Capex	4.562	4.321	8.106	7.620	8.401	33.010
Water service reservoirs Schemes Capex						
OPEX	0	0	0	0	0	0

Source: Technical Annex Investment Data Lockdown 4

In line with the DWI notice, our expenditure plan span AMP6 and AMP7, taking us to a 1 in 5-year inspection frequency by 2025³. This will bring us to industry best practice standard (UKWIR 2017) in line with DWI expectations for treated water storage integrity.⁴

3.2. Customer Benefits and Resilience

Our AMP6 investment delivered stable serviceability, with performance remaining around the reference level and between the upper/lower control limits) for the following water service reservoir specific performance measures:

- Asset Health - Turbidity
- Asset Health - Discolouration
- Mean Zonal Compliance (MZC)

However, a number of significant changes in performance measures and relative measurement in AMP7 mean current performance will no longer meet customer or regulators' expectation. Focussing on metric specific to service reservoirs, these include:

- Legacy investment that focussed on long term stable serviceability over relative performance improvement.
- The introduction of the DWI Compliance Risk Index (CRI) metric and phasing out of MZC/Turbidity/Discolouration metrics. We are currently a top quartile company for MZC. The transition to CRI makes us a 2nd quartile company.

³ DWI Notice SRN08

⁴ DWI Long Term Planning Guidance (2017)

outlines Southern Waters performance in terms of the Compliance Risk Index and our projection for the rest of AMP6 into AMP7.

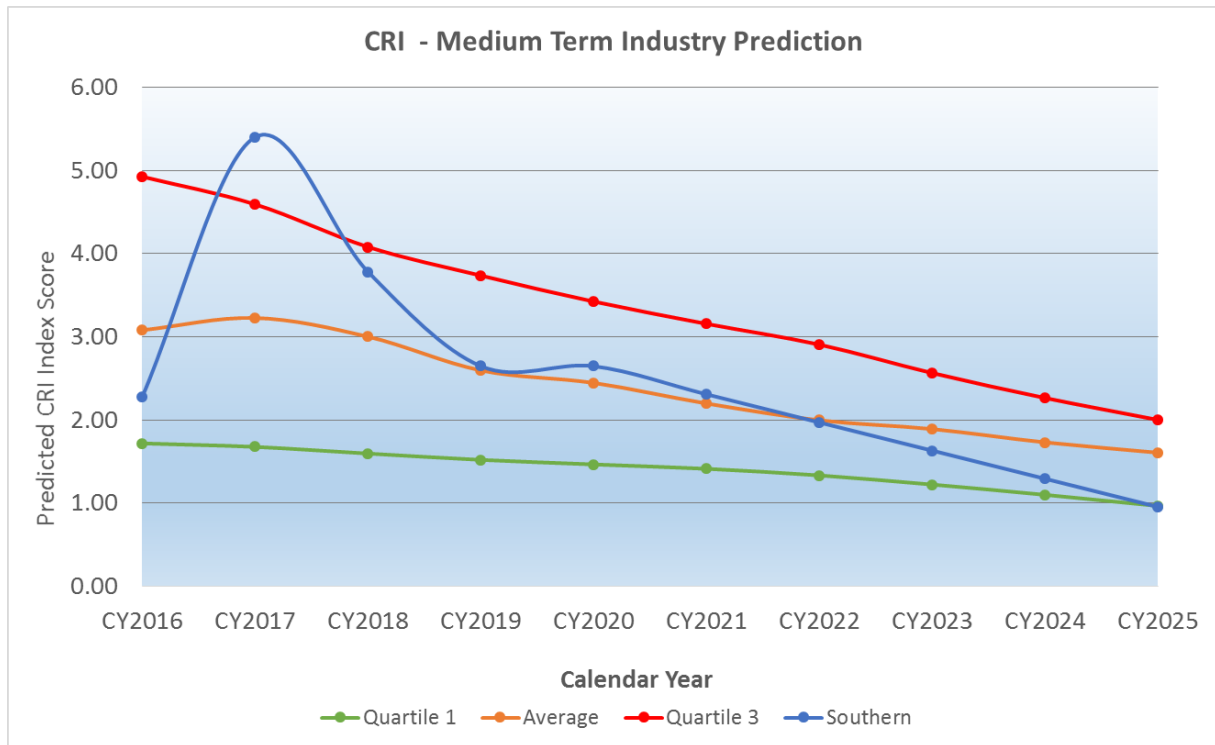


Figure 1 - CRI Performance⁵

4. Drivers for change

4.1. Customer and Stakeholder Views

We have developed a deep and granular understanding of the views and priorities of our customers. All insight gathered from our customer and stakeholder engagement programme can be found in [TA 04.04 Research and Engagement Deliverables](#)

Customers view safe and high quality water as a top priority

Customers say that providing clean, safe, high quality water is an absolute basic of any water company in the UK, and they see that as one of the most important parts of our job.

Customers infer quality from the taste, smell and appearance of water. While household customers have reported issues around chalky/cloudy/discooured water, it was generally accepted as momentary and occasional.

Customers want access to water that is as natural as possible; they don't want too many chemicals to be added to their water supply. For example customers would like softer water, but have stated that they would be less accepting of softer water if it had been treated with additional chemicals. Although customers do not want excess chemicals in their supply, they acknowledge that chemicals are sometimes necessary to ensure water safety.

Customers of the future are more concerned with protecting and enhancing the environment. They believe high quality and safe water is a medium priority.

⁵ Source for all graphs: PR19 Data Table App1 & TA.11.01 Water AMP7 Comparative Industry Performance Assessment

Stakeholders believe safe and high quality water is a low priority

Stakeholders believe that providing clean, safe, high quality water is a given and so do not view it as a significant area of interest.

Customers believe water resilience is a medium priority

Our customers view water as a precious, natural resource to be looked after and used wisely. They are concerned about their water supply being at risk due to a growing population, increasing demand and diminishing resources. They expect us to ensure that future generations have access to the same level of water services as today, and are willing to invest now to prevent future deterioration in services. Customers prefer lower carbon lower environmental impact approaches while ascribing higher priority to operational issues that may affect them in the short term. Therefore, they believe water resilience is a medium priority.

Stakeholders believe water resilience is a high priority

Government and stakeholders want to see resilient water resources plans. Stakeholders see us playing a vital role in delivering necessary improvements, by pioneering new projects and seeking reform from government.

However, some stakeholders believe that many necessary resilience improvement measures are outside our remit, and rest with government and regulators.

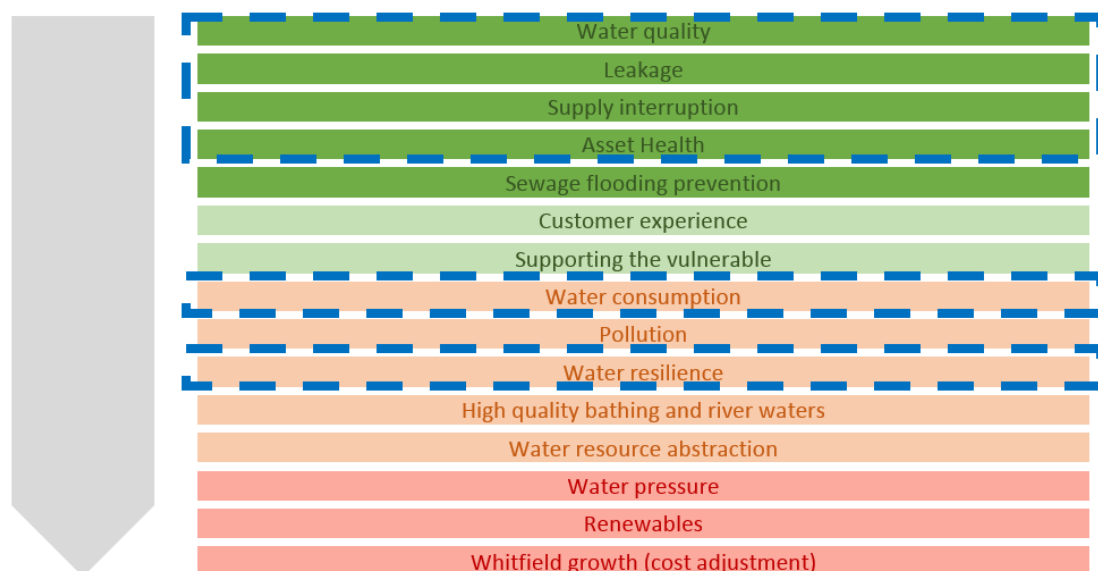


Figure 3: Relative priority of services according to our customers

By understanding customer and stakeholder priorities we have defined a set of performance commitments and investment proposals, and validated and refined these over the course of our programme of customer engagement. Our success at delivering on these priorities will be measured by the performance commitments outlined in this technical annex.

4.2. Future trends & pressures

Future trends and pressures on the water service reservoirs assets base can be broadly grouped into:

- Industry wide trends
- Regionally specific issues
- Company specific issues

Industry wide trends include:

- A significant change in regulatory performance expectations beyond 2020. Maintaining historic levels of performance is no longer acceptable. The introduction of new measures such as the Compliance Risk Index (CRI) and Event Risk Index (ERI) by the DWI are good examples (see above).⁶
- Government focus on the long-term asset health of UK infrastructure, exemplified in the DEFRA commissioned UKWIR paper 'Long Term Investment in Infrastructure (2017). The report highlights the need to double UK water industry infrastructure renewal spending by 2030 and double this again by 2050 to maintain current levels of serviceability/affordability⁷. Our deterioration model trends support this proposal.
- Resilience performance. There is currently no common quantifiable metric for resilience. Ofwat and DWI expect companies to quantify and demonstrate current and future resilience (beyond the Security of Supply Index) from asset level upwards. This underpins our transformational programme **Network 2030**⁸.

Region-specific issues include:

- Continuing significant population growth of 10.5%⁹ by 2030 and associated network infrastructure pressures, i.e. water storage assets and vital downstream trunk main systems (upstream assets investment comes under the WRMP and these are discussed in detail in the **TA.11.WN01-Supply Demand Balance**).¹⁰
- Climate Change, and in particular water stress, adding pressure to our treated storage asset base.

Company specific issues include:

- Raw water deterioration (in particular Nitrate). We cover the investment to mitigate this emerging risk in technical annex **TA.11.WN02-Nitrate** and the transformational programme **Network 2030**.
- Legacy network configuration of five geographically discrete areas, resulting in intrinsically lower resilience compared to a larger/single geographic area asset base.
- Number of treated water storage assets reaching block obsolescence and the end of useful asset life. This includes 43 of 93 pre-1900 brick reservoir structures in UK Water Industry service (see figure 2). These 120-180 year old assets need to be decommissioned between 2023 and 2030.

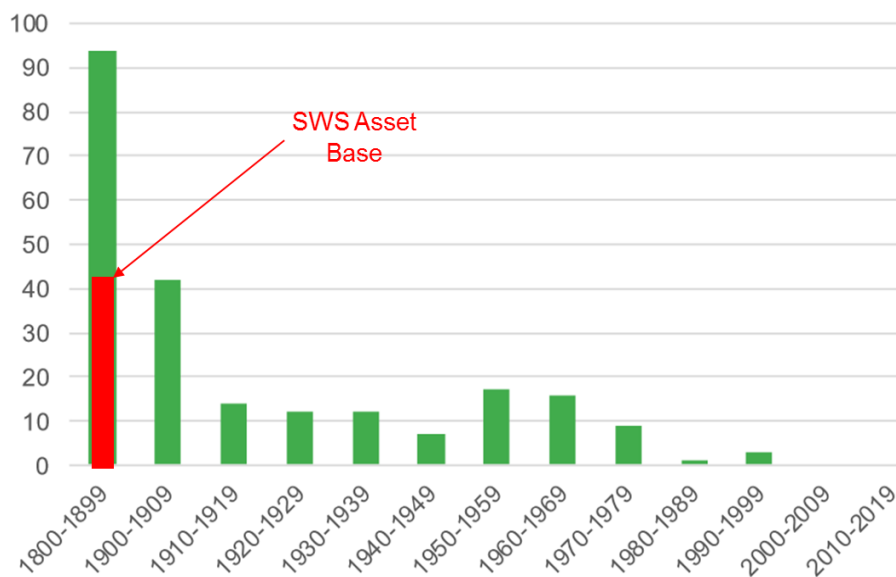
⁶ OFWAT Delivering Water 2020 – PR19 Final Methodology (2018)

⁷ UKWIR paper 'Long Term Investment in Infrastructure (2017)

⁸ TA.11.02 Water Horizons

⁹ PR19 Data Table WS3

¹⁰ National Infrastructure Commission Report 'Preparing for a drier future: England's water infrastructure needs (2018)



- Based on industry data from 16 companies, 93 pre-1900 Brick & Masonry WSR structures are currently in service.

- SWS has 46x pre-1900 Brick & Masonry WSR structures in service.

- The SWS asset base of pre-1900 WSR accounts for ~ 50% of all pre-1900 Brick & Masonry WSR structures in UK Water Industry service.

Source: UKWIR Report: Industry Treated Water Storage Assets (2017)
Figure 2 - Extract from SWS Analysis of UKWIR Study

Our response to these challenges has shaped our AMP7 and beyond approach to 2045. This has led to further evolution and refinement of our AMP6 approaches, culminating in three key transformational programmes:

- **Target 100:** cutting Per Capita Consumption (PCC) to 100 l/h/d by 2040, requiring a PCC reduction to 120 by end of AMP7. Target 100 will be key in meeting our environmental and totex challenges to deliver a resilient water future over the next 25 years.
- **Network 2030:** consolidating our water supply zones into a resilient and integrated modern network. We will retire 72 reservoirs and open 17 new ones. We will decommission 20 treatment works, combining Deployable Output at new works. We will improve zonal connectivity with better automation through new sensor installation to monitor more determinants.¹¹
- **Catchment First:** We will deliver or protect environmental standards on a holistic whole catchment basis, bringing water quality and quantity together, reducing treatment burden, avoiding much engineering, delivering social and environmental benefits and breaking the raw water deterioration/greater treatment vicious circle.

(Please see technical annex TA.11 WR03-Catchment Management Solutions).

Section 5 describes how the AMP7 investment strategy meets these future trends/pressures and how the individual investment programme lines are delivered as part of our transformational programmes.

5. AMP7 Strategy

¹¹ TA.11.02 Water Horizons

5.1. Investment Strategy

Our AMP7 reflects our identified trends and pressures, while building on our AMP6 approach with a greater level of programme integration to maximise cost/benefits.

Table 2 - Breakdown of Water Service Reservoir AMP7 Expenditure by Programme (£'m)

	AMP7			
	Price	QBEG	Ofwat Table	AMP7 Total
TOTEX				31.974
CAPEX				31.974
Water service reservoirs Capex	Water	Base Main -	WS1 12	14.433
Water service reservoirs Schemes Capex	Water	Base Main -	WS1 12	17.541
OPEX				0

Source: PR19 Data Table WS1

Water Service Reservoirs Capex (Inspection Programme)

We are required to carry out a programme of inspection and maintenance for our treated water storage assets by the DWI. This is a key activity in maintaining coliform compliance performance at our service reservoirs (a key component of CRI). A further DWI notice requires us to reduce inspection frequency from a 1 in 10 years maximum to a 1 in 5 years maximum to reflect relevant UKWIR Treated Water Storage Report recommendations, with inspection frequency dictated by a more sophisticated risk methodology. The programme will also ensure all reservoirs in the inspection programme are brought up to our enhanced standard, also based on the recommendations of the UKWIR report.¹²

This enhanced inspection programme will equate to 525 reservoir cell inspection and repairs in AMP7 at an average cost of £27k per cell, compared to 269 reservoir cell AMP6 inspection and repairs in AMP6 at a cost of £120k per cell. The difference is due to the cost of enabling works in AMP6 (approx. £85k per cell) which will now be in place when the reservoirs require subsequent inspection in AMP7. We also anticipate lower remedial repair costs (£27k versus £35k in AMP6) due to shorter inspection interval less than 10 years versus 17 years at the beginning of AMP6). Resulting in a programme value of £ 14m for the inspection programme¹³.

Water Service Reservoirs Schemes Capex (Construction Programme)

As described in Section 4.1, 16 of our service reservoirs will become life expired in AMP7 based on recent inspection reports, (a further 28 structures reach the end of service life in AMP8¹⁴):

- Southover WSR (built 1841 – due for decommissioning in 2023).
- Windmill WSR (built 1852 – due for decommissioning in 2023).
- St Anne’s WSR (built 1860 – due for decommissioning in 2024).
- Dyke Road WSR (built 1866 – due for decommissioning in 2025).
- Lewes Road WSR (built 1852 – due for decommissioning in 2023).
- Deal Low WSR (built 1879 – due for decommissioning in 2025).
- Beacon Hill WSR (built 1863 – due for decommissioning in 2024).
- Broadfields WSR (built 1849 – due for decommissioning by in 2021).
- Southdown WSR (built 1885 – due for decommissioning in 2025)

¹² UKWIR Report: Industry Treated Water Storage Assets (2017)

¹³ AMP6 and AMP7 Reservoir Investment Programmes Data

¹⁴ SWS WSR Database

- Alvington Mid WSR (built 1870 – due for decommissioning in 2024).
- Alvington Low WSR (built 1860 – due for decommissioning in 2024).
- Greatwoods WSR (built 1895 – due for decommissioning in 2025).
- Cooks Castle WSR (built 1981 – due for decommissioning in 2025 due to geo-hazards).
- Shalcombe WSR (built 1875 – due for decommissioning in 2024).
- Brook WSR (built 1875 – due for decommissioning in 2024).
- Rill WSR (built 1898 – due for decommissioning in 2025).

Our Network 2030 Strategy¹⁵ proposes centralising our storage (with optimal capacities) in fewer more robust structures, improving Whole Life Cost Analysis. This requires the following schemes to commence in AMP7:

- Houndean No.2 WSR (to replace Southover, Windmill, St Anne’s, Lewes Road and Dyke Road).
- Southdown WSR.
- Alvington High No.2 WSR (to replace Broadfields, Alvington Mid and Alvington Low).
- Wroxall WSR (to replace Greatwoods, Cooks Castle, Shalcombe, Rill and Brook).

To review the significant whole life cost advantages of this approach, the AMP7 options have been assessed via the Southern Water Whole Life Cost Model (see section 5.2).

In addition to the above programme of work, the construction of 4 new service reservoirs has commenced in AMP6 and will complete in AMP7:

- Yewhill B WSR
- Knightsfield No.2 WSR
- Vinings B WSR
- Winchester WSR

The combined expenditure for reservoir construction in AMP7 is £17.5m. This delivers lower risk (as measured by CRI), more resilience than existing assets/configuration (same amount of storage in new more robust structures) and at better value (lower whole life cost).

Figure 4 describes our long term strategic direction to 2070, derived from a bottom-up assessment of our asset inventory based on UKWIR methodologies and guidance.

In AMP7 we will replace a number of assets approaching the end of useful life (based on condition assessment by structural engineers). Over the medium term (2025 to 2035) we will continue this pattern, with a significant rationalisation of the asset base, 25 new assets completed by the end of 2035 and the total asset base reduced by 62% in terms of total number of assets while maintaining total storage capacity.

In the long term (2035 to 2070) rationalisation and new build will continue at a more gradual pace based on the predicted end of useful asset life for the current structures. By the end of 2070 the current projection shows an asset base at approx. 50% the size of the 2020 asset base with the equivalent amount of storage (less in volumetric terms due to reductions in per capita consumption and leakage).

¹⁵ TA.11.02 Water Horizons

Figures 5 describe the long-term totex trend for WSRs. This demonstrates a clear benefit of the rationalisation approach versus the alternative of refurbish/rebuild with totex being lower in every AMP to 2070 and so representing the most affordable proposition for our customers.

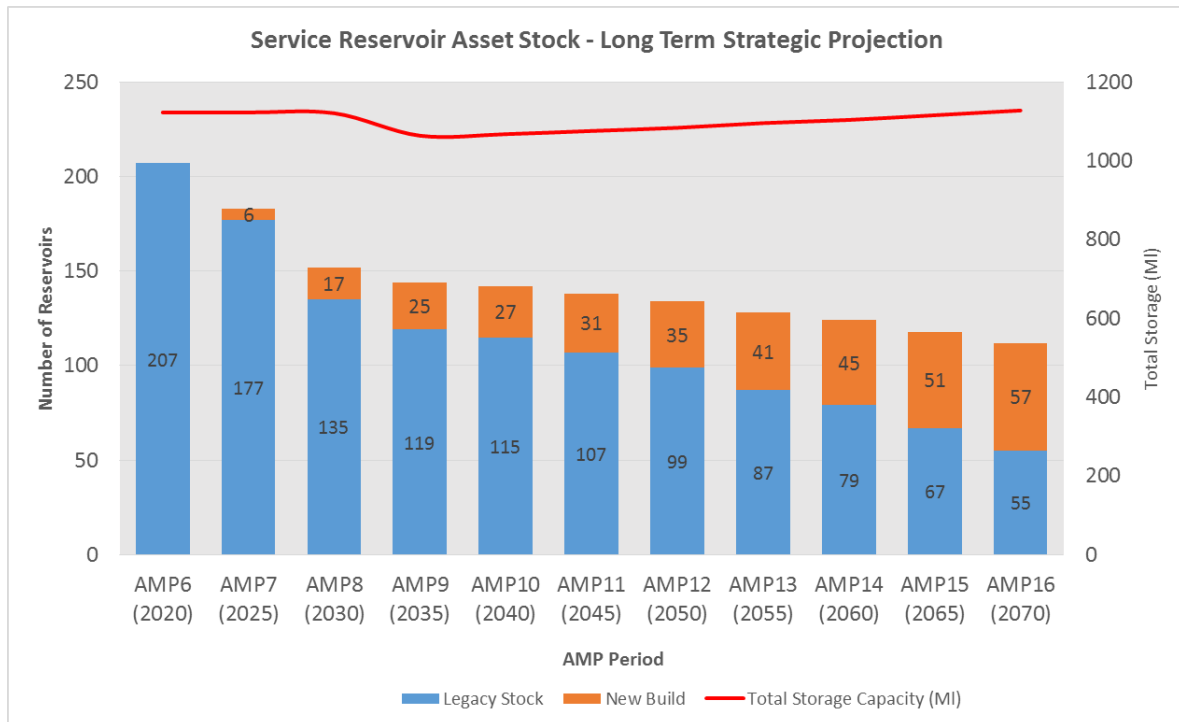


Figure 4 - Service Reservoir Asset Stock 2015 to 2070

Source: Asset Deterioration Assessment (March 2018)

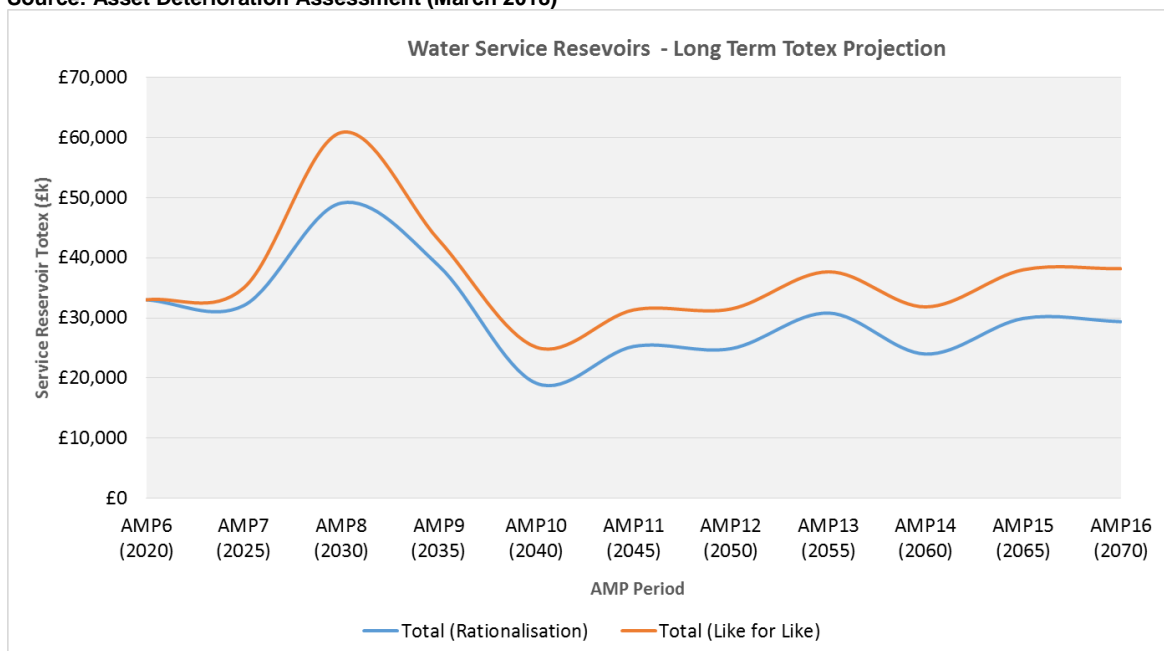


Figure 5 - Service Reservoir Scenario Comparison

Source: Asset Deterioration Assessment (March 2018)

5.2. Plan Options

We reviewed options through the Southern Water Whole Life Cost Benefit Tool, basing the assessment on the 20 year Whole Life Cost and customer Willingness To Pay (WTP). This is shown graphically in figure 6 with subsequent commentary on the selection of the preferred option.

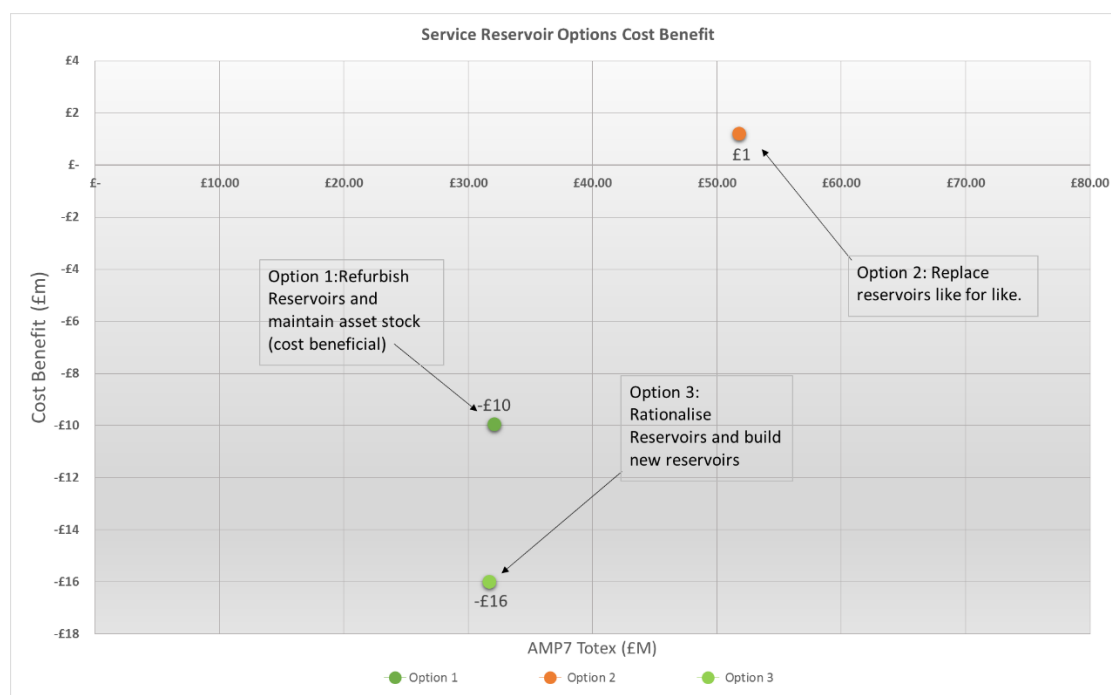


Figure 6. Plan Options (Totex vs CBA)¹⁶

Option 2 was discounted due to low cost/benefits. Option 1 was discounted due to marginally higher AMP7 cost with lower cost/benefits. Option 3 is therefore the preferred option for Service Reservoirs in AMP7 due to it being supported by WTP, meeting regulator expectations and reducing customer bills.

5.3. Innovation

We propose to build on our approaches from AMP6 and implement a number of key innovations as part of the AMP7 strategy for water service reservoirs:

- Moving to a new risk-based model to determine inspection and cleaning frequency based on latest research from UKWIR (UKWIR Clean Water Storage Assets 2017).
- To understand the physical resilience of our supply system, we have developed a systematic method for measuring resilience across our asset base. We use this to identify threats and optimum mitigations. We will publish the results of these assessments to give greater transparency of our short, medium and long term resilience to our stakeholders. This systematic assessment allow us to identify “households at risk” of long term interruptions to supply. Our AMP7 plans and long term strategy have been informed by this assessment, including all water networks investment.¹⁷

All of the above supports the transformational programme **Network 2030** to upgrade our ten water supply zones to become a more consolidated, resilient and integrated network.

¹⁶ Negative values = cost beneficial

¹⁷ TA.11.02 Water Horizons

5.4. Customer Benefits and Resilience.

The reservoirs programme of interventions ensure that we improve on AMP6 performance and end AMP7 as a Quartile 1 company for CRI and (see figure 7). The reservoir programme also contributes approximately a quarter of our Event Risk Index (ERI) performance. This AMP7 totex investment package acts as an initial phase to further improvements through the **Network 2030** and **Target 100** transformational programmes.

Performance commitment	Measure	End AMP 6 Performance	End AMP 7 Performance
Water quality compliance	CRI basket measure	2.65	0.95

Figure 7 - Summary of Projected Performance for AMP7

Source: PR19 Data Table App1

5.5. Value for Customers

Customers are not prepared to accept reductions in service in exchange for lower bills, and are willing to pay for improvements in service levels for our proposed water measures:

- The total amount that SW customers would be willing to pay for a reduction of 1 in the number of cases of “Non-ideal taste and smell of tap water for a few days” was £48,929 per year. This impacts CRI performance.

Our ODI research into willingness to pay for service level improvements indicated that our customers demand and are willing to invest in improvements to water quality. Full detail on our customer engagement findings can be found in *Chapter 4 – Customer and Stakeholder engagement*.

Table 3: Willingness to pay for Water measures

Service Attribute	Unit	WTP [£/Unit/Year]		
		Central	Low	High
Non-ideal TASTE AND SMELL of tap water for A FEW DAYS	Case/prop	£48,929	£37,588	£60,270

6. Costing Strategy

Please see Cost Efficiency / Optioneering technical annex.

7. Key Risks and Opportunities

7.1. Key Risks:

- There is a risk that as we start preparing for construction, or when we undertake our next WSR inspections, we will find more significant structural issues than we anticipated. This may be because since the previous inspections the exceptionally wet and then dry conditions in 2017-2018 could have caused exceptional ground movement or structural deterioration. This could lead to additional costs in AMP7.
- There is a risk that we encounter delays or restrictions when we seek to purchase land for new reservoir sites or seek appropriate planning permissions. There is a prospect that compulsory purchase may be needed and this could lead to unavoidable programme delays.

7.2. Key Opportunities:

- There is an opportunity that AMP7 enabling costs may be less than anticipated due to extensive enabling works already undertaken in AMP5 and AMP6.
- There is an opportunity that further AMP7 economies of scale above those we have already assumed may be realised through the use of zonal/regional procurement packaging of construction work.

Appendix 1: Schemes in AMP7

All figures £'m.

Scheme Name	PRN	Schemebuilder Reference	AMP7 Capex Total
Lewes Houndean WSR	730027	4731	3.204
Lewes Distribution Upgrades		4716	0.704
Cooks Castle WSR2 - Replacement	730036	4145	1.931
Southdown Halfway Houses WSR - Replacement	730037	4169	4.602
Alvington High WSR - Replacement	730050	4162	7.101