COST CHANGE

PROCESS

NORTHUMBRIAN WATER *living water* | ESSEX&SUFFOLK WATER *living water*

ASSET HEALTH INVESTMENT CASE – SERVICE RESERVOIRS AND WATER TOWERS

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1. EXECUTIVE SUMMARY

1. In our PR24 business plan, we set out our concern that there is insufficient investment in asset maintenance and replacement across the sector[1]. We also recognised that this was a complex problem and that there was a clear need to understand the issues and challenges better and consistently at a sector level through a common framework for assessing and independently verifying levels of asset health. At PR24, we put forward investment proposals focused on "no regrets" activities where we did not think we could wait for that new framework to be in place.

2. Since 2024, Ofwat has taken steps to gain greater insight about asset condition in the water sector – to identify priority assets and to deliver a robust asset condition and workload dataset for these priority assets. Ofwat has discussed the findings and solutions with the sector and has proposed an in-period adjustment process to reflect the need for greater investment in the AMP8 period. This document contains our evidence for that process.

3. We acknowledge that this complex problem has not yet been solved, and that doing so also requires some of the changes recommended in the Independent Water Commission report on asset health (such as asset health standards and forward-looking metrics). We welcome the roadmap process as an important first step and we understand why this is limited to the priority asset groups in 2026. However, we also welcome the commitment from Ofwat to consult on the inclusion of wider asset classes and how these might be funded.

4. For the 2026 process, we have put forward all investments that meet two criteria:

   - Investments that were already identified as priorities in our PR24 business plan; and
   - Investments that are limited to those priority assets in Ofwat's roadmap process (and therefore are eligible for the 2026 process).

5. In addition to this, our programme of gravity sewers has historically been much higher than other companies in the sector (at an average 0.19% since 2012, compared to a sector average of 0.07%). This has brought benefits for reducing pollution incidents, sewer flooding, and infiltration. We consider that there is a need to invest at this level – and higher – in future, both to deliver benefits to the environment and customers in reducing pollutions and sewer flooding risks, but also to prevent further deterioration in condition. This is (mostly) not funded within base models at PR24.

6. Finally, since our PR24 business plan, we have carried out further asset inspections at boreholes. This shows that there are risks from asset health that should be addressed now.

7. In this document, we set out the business case for this expenditure at **service reservoirs** and **water towers**, including: why this is needed; how we have identified the right options; how we know our costs are robust and

[1] A3-21 Asset health investment – enhancement case (NES35)

efficient; how customers will be protected; and how this will be delivered. We propose the replacement of four service reservoirs (over six years) and the refurbishment of two water towers (over three years). All of these investments were included as priorities identified in our PR24 business plan (as updated at DD24) and are priority assets in Ofwat's roadmap process.

2. NEED FOR STEP CHANGE IN INVESTMENT

8. While service reservoirs are civil structures with a long asset-life and our approach to maintenance includes refurbishment and life extension, the age profile of our service reservoir portfolio is such that a large number of assets are at, or approaching, end-of-life. While historically, we have invested at an industry median level, and above allowances to maintain our water network non-infra assets, we have identified the need for AMP8 and beyond to invest in service reservoir replacements at a much higher rate than has been necessary to date, to efficiently manage asset health, supply resilience and water quality.

9. We have also extracted two schemes relating to water towers from our civils structures asset health business case at PR24 (NES35). These two schemes totalled **£1.7m**, part of the 81 original **water** elements of the civils structures asset health case.

10. We did not include this investment in our original business plan for 2025-30 (except for the smaller water towers element) due to the need to balance investment and affordability, and so we explained that we planned to progress this investment in 2030. We engaged with customers throughout the development of our plan, and they were supportive of including these investments. Following our detailed affordability and acceptability testing, we made the decision not to include them at this stage to ensure the overall plan remains affordable for customers alongside other essential investments.

11. However, following the draft determination, which resulted in lower forecast bills than our business plan in the North East, we identified a further opportunity to bring forward this "no regrets" and critical investment from AMP9, which will reduce risks to customers and smooth bill increases over the longer term.

12. We set out this enhancement case originally in NES35a, as submitted with our DD representations. We noted that this was not seeking to suggest that we are different to other companies in the water industry, as we expected the issues discussed and evidenced within this case for Northumbrian Water to be similar to those experienced by other companies across the sector. We said that we expected that the whole sector would need to increase expenditure on service reservoir replacement in the coming years. However, because we were proposing bill increases at the lower end of the industry range; and it was affordable due to reductions in statutory requirements elsewhere since BP24; and our customers supported investing in AMP8 – we put this case forward at DDR to begin addressing this issue earlier than other companies.

13. This would have allowed us to achieve a sustainable rate of replacement more proactively, while tempering future bill increases for our customers in line with our long-term strategy. This is still possible if we can start this programme in 2027 instead.

FIGURE 1 - SUMMARY OF SERVICE RESERVOIRS AND WATER TOWERS (£M, 2022/23 PRICES)

Site name	Capex (£m)	Total (£m)
Auton Stile	15.971	15.971
Blakelaw	6.162	6.162
Ryhope	29.835	29.835
Stoneyg[ate	31.330	31.330
Total service reservoirs	**83.298**	**83.298**
Bedingfield	1.147	1.147
Eye	0.602	0.602
Total water towers	**1.749**	**1.749**
AMP8 base plan	27.521	27.521
Implicit allowance (subtract)	-16.498	-16.498
Maintenance savings (subtract)	-0.553	-0.553
Total	**95.517**	**95.517**

14. We summarise the enhancement costs associated with the service reservoirs and water towers we put forward in this case in Figure 1. Through our optioneering and costing approach we have calculated project costs for our four AMP8 priority sites to derive an overall AMP8 capex. We have then subtracted the implicit allowance and maintenance savings costs to calculate the AMP8 capex for our adjustment claim.

15. In the rest of section 2, we explain the historical investment in these asset classes (2.1); assess “what base buys” (2.2); explain the current and future risks (2.3 and 2.4); and summarise our long-term asset class strategy (2.5) and engagement (2.6). This shows that we have spent more than the base allowance in the past, and that we expect the need to increase to at least this level of investment and beyond in the long term.

16. We are proposing a programme that extends into AMP9 for service reservoirs in order to deliver the project to an achievable deadline, due to the size and scope of the proposed project. This would not be possible to deliver by 31 March 2030.

17. We have made the case for this to be an in-period adjustment separately from this document, so that our asset health submissions can be assessed together with our Bran Sands LSO large scheme gated process submission.

18. In summary, there are three reasons why the service reservoir investment is needed now.

19. Each of the four populations fed by the service reservoir sites is **at increased risk** of a significant interruption of supply or widespread boil water advice. While collapse and complete loss of the asset is unlikely, the need for immediate isolation following a poor water quality result, is more likely than most of our other structures. The DWI

makes it clear that quality of the water supply balances with sufficiency and in instances of high microbiological risk, a significant failed sample, immediate isolation or imposition of a boil water advice would be our only recourse. These sites do not currently impact our ITS or water quality performance now, but they are significant risks we want to mitigate.

20. Although we continue to demonstrate we are capable of keeping the replacement sites in a condition to continue to provide satisfactory potable water for the population they supply, it is **becoming increasingly expensive** to do so. One site has had an internal membrane fitted three times, these are expensive and environmentally wasteful, and they are the option of last resort for a reservoir. The three masonry structures in our case (Ryhope, Blakelaw Road and Auton Stile) were built in a different era of water supply and the maintenance requirements of masonry to meet the current water quality needs of a modern water supply network, is no longer sustainable. Increased risk of microbiological failure and sudden unexpected outage needs are unacceptable risks to water quality and sufficiency.

21. The age profile of our service reservoirs and water towers is such that **more of these structures will need extensive refurbishment, or replacement** in the coming years. The protracted projects to refurbish structures leave the volume water they normally contain, out of supply, this reduces the areas resilience and often makes the flows across the network very difficult to manage and increases our operational risk. To manage this, we carefully choose times for inspection and maintenance, but this only works if other water network storage assets are in service to provide resilience. Without an ongoing programme of replacement, we will eventually find our maintenance needs gridlocked, we will become unable to remove structures because the role they fulfil is only backed up by another structure that also needs refurbishment or replacement. This is already the case for Stoneygate SR, where an older structure collapsed in 2006 and now the refurbishment needs for Stonegate No2 cannot be met without a new structure on site. The only significant backup for Stoneygate No2, while it is out of supply is Ryhope SR, one of the high-risk masonry structures highlighted in paragraph 20.

22. In the case of the two water tower sites, the refurbishment proposal is the best way to prolong the existing asset life. As they present no current risk to our performance, the need to prioritise our base funding means that they will not be addressed in AMP8 without this extra asset health funding. This delay will allow further deterioration; and it is likely that such deterioration would mean that we can no longer refurbish these assets, and so we would have to decide whether to abandon or replace. Abandonment would mean a loss of resilience for customers; but replacement costs would be significantly higher than the refurbishment we propose.

2.1. HISTORICAL INVESTMENT AND CHANGE OVER TIME

23. We have 304 service reservoir sites, comprising 541 compartments. Compartments can either be separate structures on the same site or may be co-joined compartments within the same overall structure. Our service reservoirs perform a supply demand balancing function within the potable water network. They store treated water, ideally near to where it is needed, to meet the diurnal demands of the customers. They also provide a level of resilience to maintain customer supplies during scheduled or non-scheduled outage events. These treated water structures are required to meet statutory regulations:

- Reservoirs Act 1975[2].
- Health and Safety at Work etc. Act 1974[3].
- Water Supply (Water Quality) Regulations 2016[4] and associated guidance[5].

24. Historical industry spend on service reservoirs is primarily driven by maintenance rather than replacements (the sector spent just £135m on replacements in the last ten years, of the total £988m spent on this asset class). These maintenance costs are increasing – our costs are now around £50m of base capex in each AMP, a rise from £25m in AMP6 to forecast £50m in AMP8 (see 2.3). Our intervention costs are increasing because of material costs and limited specialist contractors; and the proportion of reservoirs requiring investment after inspections has increased from 50% to 90%. In AMP7, it has been a challenge to absorb these costs – through efficiency and re-prioritisation as well as previous historical overspending of allowances.

25. We have replaced one service reservoir under base allowances since 2010 – our Hebron service reservoir, due to asset health – and built one new reservoir in resilience enhancement (Springwell). Replacement costs due to aging assets are not generally captured in Ofwat's base models which use historical expenditure – as there have not been many replacements in the period used for historical base costs, these allowances do not include sufficient funding to allow new replacements for service reservoirs. The step change in base maintenance compounds the funding challenge to replace service reservoirs.

26. Ofwat's asset health dataset shows our historical expenditure on these asset classes has been higher than the average for the sector. The data in Figure 2 compares our historical expenditure from that dataset to the equivalent sector average spend. This data includes all costs in the dataset (that is, including expenditure on repairs); in our later section on "what base buys" we exclude expenditure on repairs so that this only represents the implicit allowance for refurbishment/replacements. However, it is appropriate here to consider all costs included in base

[2] https://www.legislation.gov.uk/ukpga/1975/23/contents
[3] https://www.hse.gov.uk/legislation/hswa.htm
[4] https://www.legislation.gov.uk/uksi/2016/614
[5] https://www.dwi.gov.uk/water-companies/guidance-and-codes-of-practice/guidance-on-implementing-the-water-supply-water-quality-regulations/

expenditure because this reflects different company decisions about whether to continue repairing service reservoirs, or to replace them.

FIGURE 2 - NORTHUMBRIAN WATER HISTORICAL EXPENDITURE

Expenditure	All years (2015-2025), £m 2022/23	AMP7 (2020-2025), £m 2022/23
Northumbrian Water	66.380	41.743
Sector spend – normalised for comparison to Northumbrian Water (sector average % multiplied by NES base expenditure)	63.757	36.247

27. Our maintenance strategy for AMP7 – and our original business plan for AMP8 – was to deliver interventions to extend the lifespan of service reservoirs. Some of these repairs, such as “overbanding” to repair leaking structures, have a lifespan limited to around 15 years. Asset deterioration and best practice guidance for using the types of products that are approved for use in overbanding has meant that these repairs can only be carried out three times, and then replacement is needed. In the past, we have used liners as a last resort for extending the life of service reservoirs – but UKWIR issued guidance in 2017[6] which increased the assessment of risk of deterioration for reservoirs with liners, stating that where there is risk of ingress behind a liner, the structure should be assessed as Grade 5 (poor). Liners are therefore considered inappropriate in conditions where ingress due to wall and floor deterioration is a risk and therefore significantly limits the application of liners for refurbishment of end-of-life assets. As such, liners are omitted from Section 9.4 of the UKWIR guidance which covers best practice.

28. Our long-term asset class strategy includes replacing our service reservoirs that have a masonry construction due to higher risk and a higher likelihood of failure. These four particular service reservoirs are old (mostly Victorian-era), have reached the end of their lives and require excessive maintenance. As we describe in section 2.6, the DWI supports our long-term plan to replace service reservoirs with masonry construction.

29. We expect to continue with a multi-AMP approach to replace service reservoirs, and we are working on the longer-term replacement plan, including inspections. The pace and extent of the asset replacement plan will depend on what we expect to be increasingly stringent expectations from DWI and the evolution of requirements for reservoir inspections for smaller reservoirs – as well as developing the evidence on long term deterioration of asset health. We provide evidence of the link between asset condition and age/maintenance cost, to show the future impact of this requirement.

30. The standards that we use for the build, operation and maintenance of service reservoir assets are:

- BS EN 1508:1999 Water Supply. Requirements for systems and components for the storage of water;

[6] https://ukwir.org/treated-water-storage-assets-good-practice-for-operation-management-version-2

- BS EN 805:2000 Water Supply. Requirement for systems and components outside buildings;
- National Principle of Water Supply Hygiene and relevant technical guidance notes, and
- Research material: UKWIR Treated Water Storage Assets: Good Practice for Operation and Management Version 2 (the UKWIR Good Practice document).

31. BS EN 1508:1999 and the UKWIR Good Practice document sets out that reinforced concrete is the preferred material for treated water storage structures. Both this and our own experience supports the abandonment or replacement of masonry structures as they are prone to ingress from all the joints between masonry and are reaching the point where there are no further feasible options for the frequent repairs required to maintain structural integrity.

2.1.1. Water Quality Compliance

32. Our water quality compliance is represented through Compliance Risk Index (CRI). We maintain our service reservoirs to ensure that we are able to maintain CRI performance. The element of our CRI score attributable to service reservoirs (water storage) demonstrates good compliance – with an average of 0.18 between 2017 and 2023.

33. We follow a sampling regime to ensure that our service reservoirs are meeting water quality compliance requirements, notifying the DWI of any anomalies. The structures require periodic inspections every 3 or 5 years (dependent on condition grade found in the prior inspection), this typically results in over 100 compartment inspections annually. The findings and remedial work recommended through these inspections are captured and prioritised for action, our base expenditure budget should fund the inspection, maintenance, repair and refurbishment within a funding envelope. The asset inspections enable us to take a risk-based approach to asset intervention. However, we note that the rising cost of reservoir repairs on poor condition and end-of-life assets will put increasing pressure on maintenance budgets if a long-term sustainable approach to asset replacement is not implemented. The following section summarises our service reservoir asset condition, explaining how the maintenance need for these assets is changing over time.

34. Our service reservoir compartments are inspected, and the condition grade of the core components is graded as per our condition grade scoring criteria, which are based on UKWIR Good Practice for Service Reservoirs (UKWIR 19-RG-05-05). This is specific to each component, an example of this for ‘walls and/or roofs’ is shown in Figure 3 below.

FIGURE 3 - CONDITION GRADE CRITERIA

Material	Condition Grades				
	1	2	3	4	5
Brick & Masonry	As new	Pointing recessed up to 5mm and/or staining/ discolouration to masonry	Pointing recessed more than 10mm and/or cracking <1mm over approx. 25% of area	Pointing significantly recessed and/or cracking >1mm over approx 40% of area or greater	Visible or known ingress/egress
Concrete	As new	Cracks <0.2mm wide and/or Friable concrete up to 1mm deep on internal surface.	Cracks 0.2 to 0.5mm wide but no ingress. Friable concrete up to 10mm deep on internal surface. Some corrosion staining from reinforcement.	Cracks >0.5mm wide but no ingress. Friable concrete 10 to 25mm deep. Significant corrosion of exposed reinforcement.	Visible or known ingress/egress
Steel (riveted, welded or 'boiler plate')	As new	Paint flaking over areas <100 x 100mm. Light corrosion	Area of coating failure >100 x 100mm. Mill scale rusted away, slight surface pitting	Notable loss of section from corrosion, but no ingress	Visible or known ingress/egress. Perforation due to any mechanism and/or corrosion deposits in bottom of tank
GRP/Plastic	As new	Discoloured	Exposed fibres externally	Visible cracking or movement / exposed fibres internally	Visible or known ingress/egress. Holes (daylight from inside)
HDPE (e.g. Wheolite)	As new	Discolouration	Signs of age, surface starting to roughen, becoming brittle	Poor condition but no leakage	Visible or known ingress/egress. Split or punctured

Source: NWL Condition Grading methodology

35. Our condition grading approach is based directly on UKWIR's good practice guidance, taken from the 2017 UKWIR Report (No.19/RG/05/50)[7]. The UKWIR Condition Grades are as follows:

1	'As new' condition except for tolerable cosmetic defects, highly unlikely to impact on H&S, WQ, security of supply or structural integrity.
2	Deterioration starting to show but very unlikely to impact on H&S, WQ, security of supply or structural integrity.

[7] UKWIR Treated Water Storage Assets: Good Practice for Operation and Management (2017)

3	A defect or deterioration that is unlikely to impact on H&S, WQ, security of supply or structural integrity. Defect / deterioration should be monitored at next inspection.
4	A defect or notable deterioration that could impact on H&S, WQ, security of supply or structural integrity. May require planned investment at or before next inspection.
5	A defect or severe deterioration that will almost certainly impact on H&S, WQ, security of supply or structural integrity. The defect/deterioration should be rectified immediately.

36. As the asset base ages, there is an increase in the number of asset components moving to poorer condition grades where the options for remedial work become limited. Refurbishment of structures becomes unfeasible from both a water quality and health and safety perspectives.

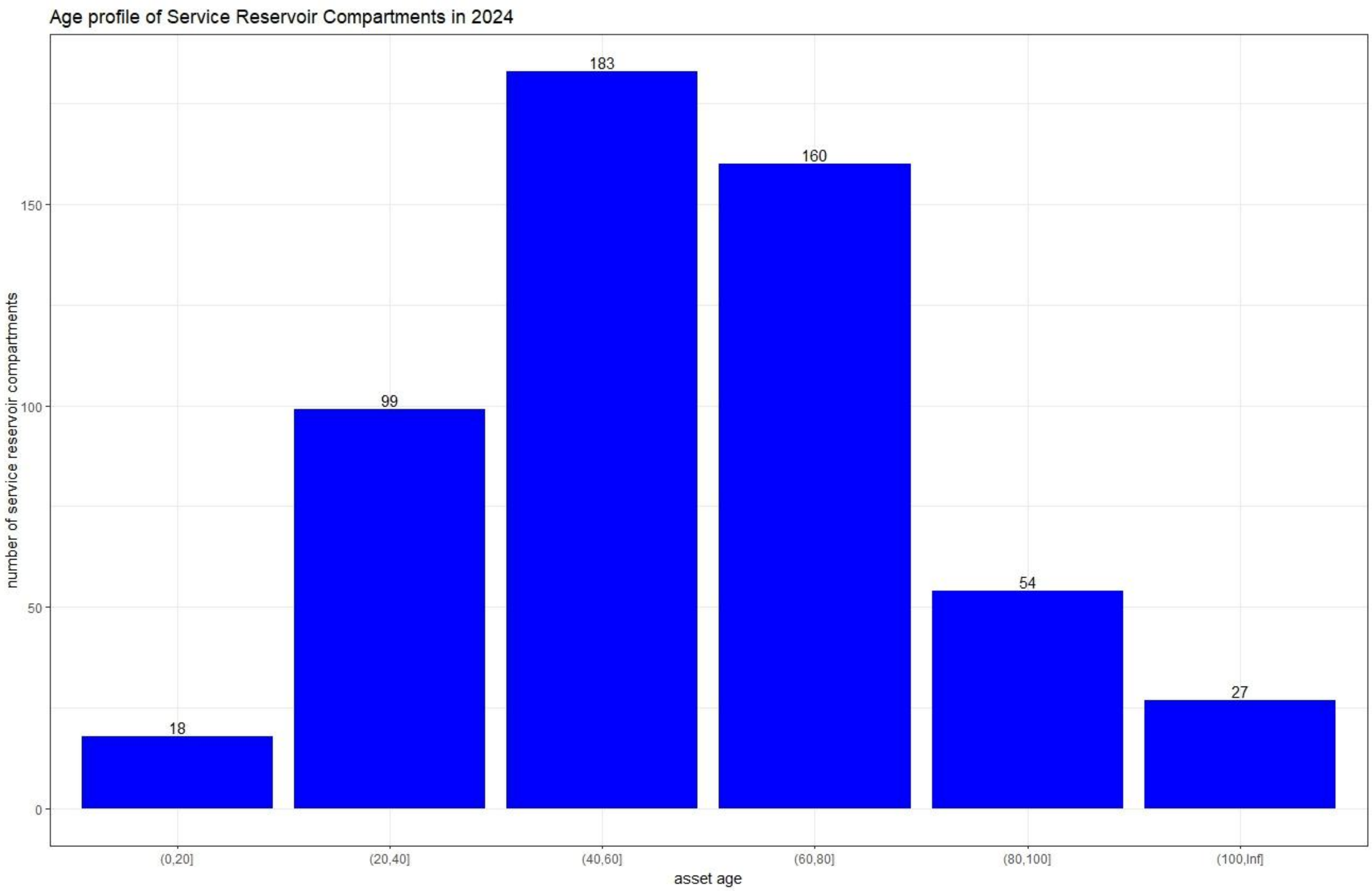
37. Some of our service reservoir assets can no longer sustain further refurbishment and need to be scheduled for replacement (Section 3.1 sets our prioritisation methodology for AMP8 replacement sites, which takes into account construction type, asset age and previous refurbishment interventions).

38. Due to the long life of service reservoirs, replacement of these assets has not occurred frequently in the past, with only 1 base maintenance replacement (Hebron SR) required in the last 15 years.

2.1.2. Age profile

39. The age profile of service reservoir assets can be seen in Figure 4.

FIGURE 4 - AGE PROFILE OF SERVICE RESERVOIR COMPARTMENTS (2024)



Source: NWL Service Reservoir asset data

40. The observed and forecast life expectancy for these assets varies dependent on the construction material. As of July 2024, 5% of our service reservoir assets are over 100 years old and a further 10% are between 80 and 100 years old.

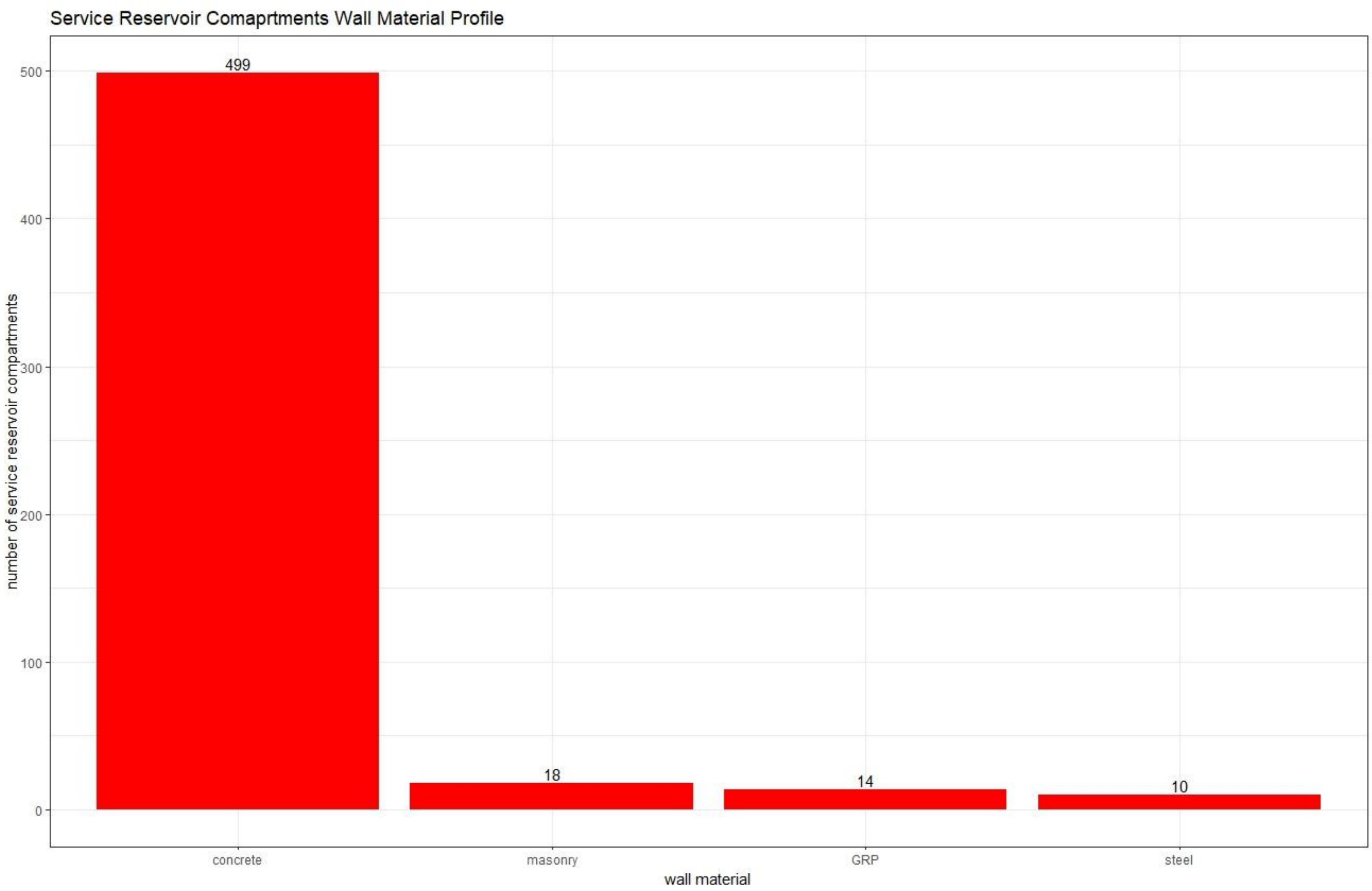
2.1.3. Material types

41. The material types of our service reservoir assets are shown in Figure 5. As per our long-term asset class strategy, our preferred material type is concrete and we highlight the need to replace assets with non-preferred material types, starting with our masonry assets. This is due to the health and safety risks and technical feasibility challenges associated with continuing to find refurbishments or repairs of these materials. Masonry assets make up 3.3% of the asset base (18 structures).

42. Masonry is not a preferred material for a potable water service reservoir. This is because there are far more joints to manage and guard against ingress compared to a more modern reinforced or mass concrete construction. They are

all old structures, usually built in the 19th or start of the 20th century, before reinforced or mass concrete became available. They are varied in construction - for example, Ryhope SR is dressed stone; Blakelaw Road is mixed stone and brick; Auton Stile SR is fired ceramic pavers laid over a puddled clay construction. They were also often built as open structures with roofs added much later. This was often without clear engineering regard for the structure they were being added to, with foundations for columns being cast into the floors of the existing structure and poor or nonexistent soffit seal provision. Due to their nature, these structures move and shift with temperature, height of water table and season – all of which exacerbate asset aging and risk unexpected ingress or structural changes. There are limited repair materials that we can use for masonry, as the majority of approved products for this purpose state instructions for how to prep and apply to concrete rather than masonry. When selecting products, we must ensure that the manufacturer has confirmed its suitability for masonry (otherwise we could be at risk of prosecution under the water supply regulations). As a group of structures, these were never designed to meet current water quality standards, and we regard them as being beyond their asset lives in engineering, maintenance requirements and asset performance.

FIGURE 5 - SERVICE RESERVOIR WALL MATERIAL



Source: NWL Service Reservoir asset data

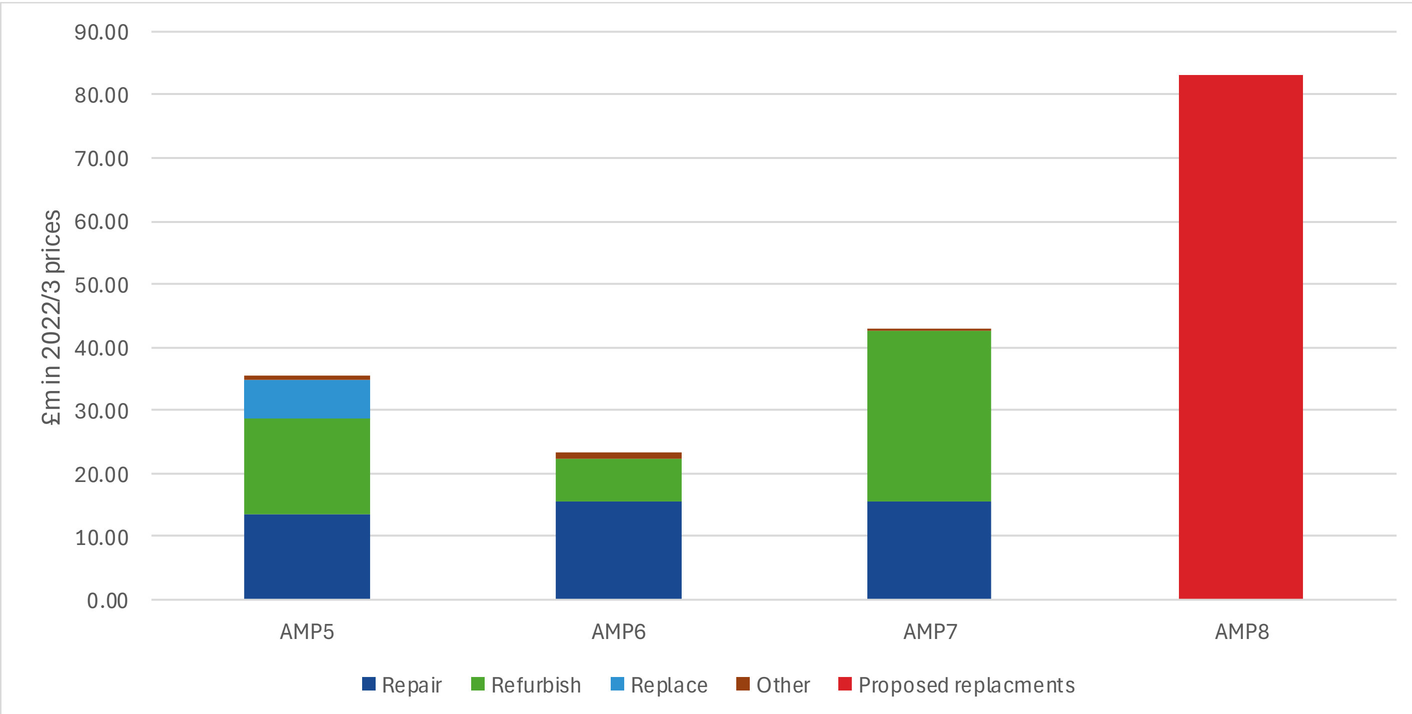
43. Components within a single service reservoir can be constructed of different materials. Figure 5 shows the wall material, as this is the largest component within the service reservoir and hence is the best representation of the overall asset material.

2.1.4. Condition grades

44. We have used our condition grade data, collected over time for each component of each service reservoir, to develop deterioration models for these assets. These models are built to show the deterioration rate over the next 25 years. We can assess the envelope of asset life of a service reservoir to help determine asset population replacement time and cost, to plan efficient interventions. Once asset components are assessed as grade 4, they are scheduled for intervention, and all interventions are targeted at returning the asset to a minimum of condition grade 3. Our service reservoirs that have any component assessed as condition grade 5 are all in the age band 60+.

45. Service reservoirs are long life civil assets. Our service reservoir asset strategy follows the principles of repair, refurbishment, then replacement. We included an early version of Figure 6 below in our original enhancement case NES35a, we have now updated it with the data developed for the workload and expenditure data. This shows that over a 15-year period (forecast up to 2024/5 end of AMP7), we have funded service reservoir maintenance, repairs, refurbishments and replacement at an average of £6.67m per year (average of £33.36m per AMP). Some estimation was involved in developing the repair, refurbish and replacement split for AMP5 data between maintenance categories, the overall total is based on submitted APR data.

FIGURE 6 - SERVICE RESERVOIR MAINTENANCE INVESTMENT



Source: NWL Service Reservoir maintenance cost data

46. We have funded the construction of one service reservoir through base expenditure since the start of AMP5. This equates to an average of 1 every 15 years. Our analysis shows the need to implement a step-change in AMP8, shown by the red bar which represents the four proposed AMP8 service reservoir replacements. The modelling also shows this will need to be followed by a further step up in future AMPs to achieve a long-term sustainable replacement rate.

2.2. WHAT BASE BUYS

47. Historically Northumbrian Water's rate of replacement for service reservoirs has been low; we have replaced one service reservoir since the start of AMP5 (2010). A further one has been largely constructed in AMP7, funded as resilience enhancement expenditure at PR19. This has been because lower cost maintenance options have been viable in the past, such as patch repairs, lining and other refurbishments. These lower cost options have historically been the efficient approach to maintaining these assets in the best interests of customers.

48. This is also the case across the sector, with just £135m spent on service reservoir replacements over the last ten years. Several companies spent nothing on this in the ten-year period.

49. Since 2010, our expenditure on service reservoir assets has increased, and the future required spend is increasing still, as shown in section 2.1. For the oldest reservoirs in the poorest condition, further rehabilitation will not deliver stable improvements to serviceability. This is evidenced by high spend rates on poorer condition assets as shown in section 2.3.3. When reservoirs have undergone an increasing number of refurbishments, we have observed that the rate of failure of these previously effective solutions has increased.

50. In our PR24 case (NES35a) we estimated "what base buys" using the data available to us – that is, our own disaggregated costs and the published sector-wide information about "water distribution non-infra capital maintenance". This was the most disaggregated data available to us (and to Ofwat) before the asset health roadmap. We explain this analysis in 2.2.1 below, for reference. We note that this approach looked at *replacement* only, rather than rehabilitation and replacement (as under the latest Ofwat guidance), and uses only our data. We include this method only to compare to our PR24 assessment which we carried out in the absence of wider data; we are not proposing this method for this submission as it would be inconsistent with Ofwat's guidance.

51. With the asset health roadmap data, we can disaggregate expenditure on service reservoirs directly. In 2.2.2 and 2.2.3 below, we explain our updated assessment based on this data. In estimating what base buys, we considered the two approaches as described in Table 5 of Ofwat's asset health assessment guidance – that is, adjusting historical capital maintenance expenditure for AMP8 allowances; and removing historical costs using PR24 econometric benchmarking models. As set out in section 6 of the "Northumbrian Water – cost change submission" document, we think the first of these approaches is the superior method and have based our estimates of what base buys on this approach.

52. This approach estimates the implicit allowance for replacement and rehabilitation of service reservoirs, rather than just the allowance for replacing service reservoirs (as we estimate in 2.2.1). So, in 2.2.5, we explain how we plan to spend more than our PR24 implicit allowance in AMP8 on service reservoirs and water towers *before* the four replacements and two refurbishments we propose in this case.

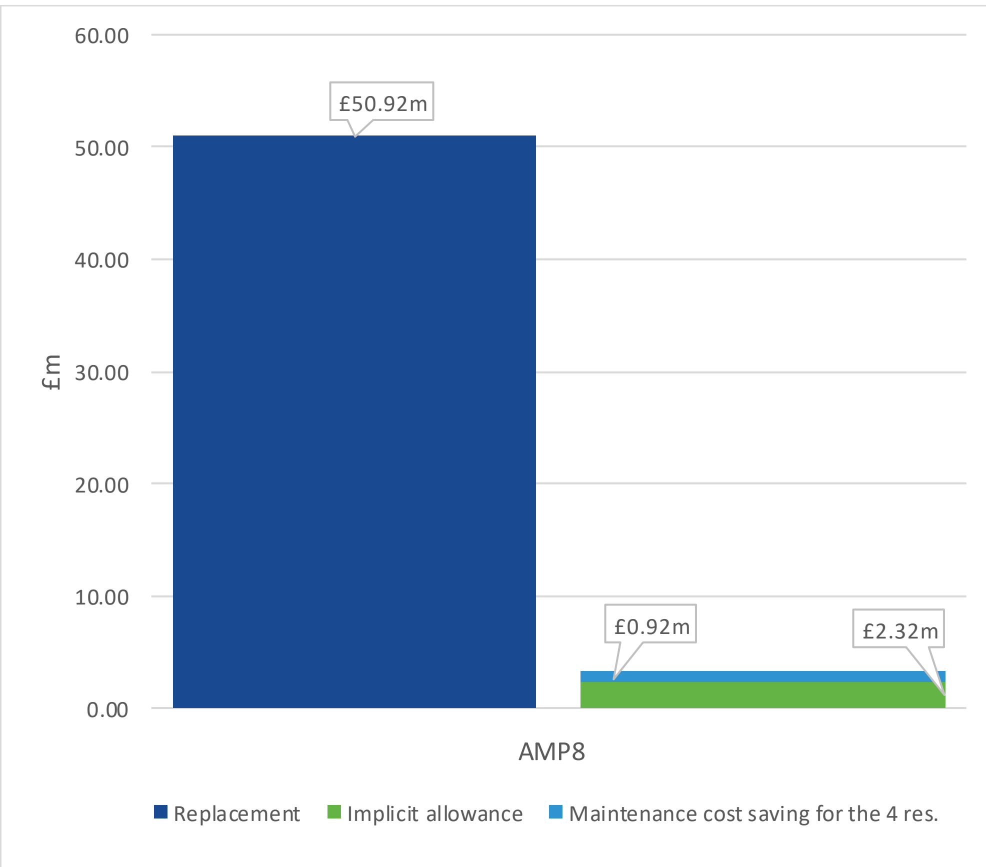
53. This shows why we already considered this asset class to be a concern before the cost change process as there was already a clear need for additional expenditure beyond what base buys.

2.2.1. Our PR24 assessment

54. Based on the level of replacement funding over the last 15 years, we calculated the implicit allowance for service reservoir replacements in our PR24 case to be £0.463m per year (£2.32m per AMP). In addition, we calculated an annual maintenance saving of £184k associated with the four priority sites. This was based on analysis of our actual maintenance costs for Auton Stile, Blakelaw, Ryhope and Stoneygate during AMP5, AMP6 and AMP7, which we used to generate an annual average of £0.184m (£0.921m for AMP8).

55. Our forecast cost for the required four schemes in AMP8 in NES35a was £50.92m. The difference between the required expenditure less the implicit allowance and reduced maintenance costs was therefore £47.68m, as shown in Figure 7 below.

FIGURE 7 - AMP8 INVESTMENT VS BASE ALLOWANCE (FROM NES35A)



Source: NWL iMOD costs (proposed investment) and historic maintenance costs

56. Figure 7 highlights the difference between the implicit allowance and the required expenditure, based on the historic information relating to our expenditure (in 2022/23 prices).

57. In NES35a, we compared this to the sector through an analysis of water distribution non-infra capital maintenance spend, on both a "per household" basis and normalised by the length of network (in km). This broad category of investment, which includes service reservoirs, was the lowest level of disaggregation we had at the time.

58. This analysis showed that we had invested close to the median level of investment on a "per household" basis (£0.7m less than the median over the 12-year period 2011-12 to 2022-23). On a "length of mains" basis, we had spent more than the median over the same period.

59. We also examined Ofwat's cost models, showing that these funded Northumbrian Water at a level less than the median. For example, in 2022/23 the median level of predicted costs from Ofwat's models is £80/household, whereas the model funded us at £72 per household (10% less). This means that between 2011/12 and 2022/23, we had invested at or above the industry median level of capital maintenance in the "water distribution non-infra capital maintenance" but had been funded below the industry median level.

60. This approach overestimated the implicit allowance for replacements. The asset health dataset shows that using the same parameters as this NES35a analysis tried to estimate (that is, a ten-year median for service reservoir replacements only, excluding rehabilitations), we would see an implicit allowance for Northumbrian Water of **£1.7m** for AMP8. This is because the industry median spend is only 0.12% of modelled base spend over the ten year period from 2015 to 2025. Using the industry mean spend would have increased this to **£4.4m** for AMP8.

61. This suggests that our analysis at PR24 was broadly correct (estimating £2.3m for AMP8). However, this could just be chance – this looked at a different time period, at replacements only (not rehabilitation), and it could not use sector average data at the time.

62. This analysis also shows that investment in service reservoir replacements has been "lumpy", with specific investments (particularly SVE from 2015/16 to 2018/19, and WSH from 2019/20 to 2022/23) driving the difference between the median and mean. We observe that replacing just these two examples of WSH and SVE with the long-term average for those companies would reduce the industry mean spend from 0.31% to 0.19% - this highlights the risk of using the mean for this analysis, and the importance of a long-term average. This analysis also shows that historical allowances from base expenditure have not been sufficient to replace service reservoirs.

63. Our own PR24 analysis, repeated for the 2015-2025 period, would have resulted in an implicit allowance of zero because the lumpy investment of replacing a service reservoir happened to be in the 2012/13 to 2014/15 period. This illustrates the challenge of relying only on modelling estimates for small categories of investment.

2.2.2. Asset health roadmap – comparison of total spend on service reservoirs

64. The data that Ofwat has collected under the asset health roadmap helps us to estimate an implicit allowance (or "what base buys" for service reservoirs in particular, rather than inferring from our own data and the available data and level of disaggregation from published sources (as we did in 2.2.1).

65. This data shows that we spent more than the sector median in both AMP7, and over the longer term. Figure 8 shows that we spent 2.5% of our allowance on service reservoirs, compared to 1.4% for the sector. The data shows our expenditure increasing over time. Figure 8 includes **all** capital maintenance expenditure on service reservoirs, including repairs, to illustrate the total impact. This evidence supports our PR24 analysis that showed we had spent more than or equivalent to the median on "water distribution non-infra capital maintenance", and shows that we spent significantly more than the median on capital maintenance for this specific asset class.

FIGURE 8 - PERCENTAGE OF BASE SPEND ON SERVICE RESERVOIRS

Company	% of base modelled spend, 2015-2025	% of base modelled spend, AMP7 only
AFW	1.0%	1.0%
ANH	1.1%	1.3%
BRL	1.0%	0.9%
NES	2.2%	2.5%
PRT	1.2%	0.6%
SES	0.1%	0.2%
SEW	3.1%	4.5%
SRN	5.2%	4.9%
SSC	1.9%	1.2%
SWB	0.4%	0.4%
TMS	1.2%	1.5%
UUW	5.1%	5.2%
WSH	2.6%	3.4%
WSX	2.4%	2.4%
YKY	1.4%	1.4%
SVH	4.2%	4.3%
Industry median	**1.7%**	**1.4%**

2.2.3. Implicit allowance for service reservoirs

66. We discuss our overall approach to what base buys in section 6 of the "Northumbrian Water – cost change submission" document where we set out the options we considered and why we used this approach.

67. The expenditure and activity dataset includes capital maintenance on each asset class. For each company, we calculated the industry historical percentage share of spend on each asset – we did this using several methods as outlined in Figure 9 below. We calculated these percentages as a share of actual base modelled costs as per the FD model definitions. This includes replacement and refurbishment expenditure only.

FIGURE 9 - APPROACHES TO CALCULATING INDUSTRY HISTORICAL PERCENTAGE SHARES

Approach	Data Used	Rationale
Method 2a (10-year)	2015/16 to 2024/25 industry data	Uses full length of workload and expenditure data
Method 2b (9-year)	2015/16 to 2023/24 industry data	Only uses data that overlaps with PR24 FD models
Method 2c (5-year)	2019/20 to 2023/24 industry data	Only uses data that overlaps with PR24 FD UQ period

68. Across the sector, our calculations show that for service reservoirs, these are similar – with the largest differences reflecting the change from median to average (Figure 10). This increase is not as clear as when we examined replacements only (as in the analysis in 2.2.1), because the data is much less lumpy when we include refurbishments too.

FIGURE 10 - PROPORTION OF BASE COST SPENT ON SERVICE RESERVOIRS UNDER EACH METHOD 2A TO 2C

Company	2a (10 years)	2b (9 years)	2c (5 years)
ANH	1.1%	1.1%	1.3%
NES	1.0%	0.9%	1.1%
UUW	3.2%	3.4%	3.9%
SRN	4.4%	4.3%	4.3%
SVH	3.0%	2.8%	2.3%
SWB	0.2%	0.2%	0.3%
TMS	0.6%	0.6%	0.6%
WSH	2.1%	1.8%	2.6%
WSX	1.7%	1.8%	1.7%
YKY	1.3%	1.4%	1.5%
AFW	0.2%	0.3%	0.3%
BRL	0.6%	0.7%	0.6%
PRT	0.2%	0.3%	0.0%
SES	0.1%	0.1%	0.2%
SEW	1.7%	1.7%	2.6%
SSC	1.3%	1.4%	0.9%
Sector median	**1.2%**	**1.2%**	**1.2%**
Sector average	**1.4%**	**1.4%**	**1.5%**

69. We provide full tables for this method in our separate "Northumbrian Water – cost change submission" document.

70. As we have set out previously in asset health cases, we think that AMP7 data is the most relevant because there is no reason to believe that this reduction is due to short-term pressures (such as energy costs) or that this should

return to a long-term average capital maintenance rate – indeed, our data in section 2.4 shows that we would expect the pressure on capital maintenance budgets to increase significantly over time. As Ofwat notes, however, using long-term averages and the median rather than the mean can help to smooth out lumpy investments. For this asset class in particular, this is important because we can see that replacements have been very lumpy (this asset class is characterized by a relatively small number of long life assets – compared to, for example, water mains or gravity sewers).

71. Our proposed approach as set out in the separate "Northumbrian Water – cost change submission" document is to use the mean of the 10-year and 5-year UQ period estimates calculated using an industry median. In this case, there is not much difference between the long term and the short-term values as they are both 1.2% of base spend.

72. This means an implicit allowance in AMP8 of **£16.1m** for our service reservoirs.

2.2.4. Implicit allowance for water towers

73. We include two water towers in this case. Although these were also included in our PR24 business plan (NES35), we did not separately calculate an implicit allowance for these – so we do not replicate that original estimate here.

74. However, we have carried out the same analysis for water towers as outlined in 2.2.3 and 2.2.4 above. We provide the full table of results in Figure 11 below (we do not repeat our description of the method, as it is the same).

FIGURE 11 - PROPORTIONS OF BASE COST SPENT ON WATER TOWERS UNDER EACH METHOD 2A TO 2C

Company	2a (10 years)	2b (9 years)	2c (5 years)
ANH	0.79%	0.80%	0.54%
NES	0.03%	0.03%	0.04%
UUW	0.14%	0.15%	0.25%
SRN	0.38%	0.32%	0.25%
SVH	0.02%	0.01%	0.02%
SWB	0.00%	0.00%	0.00%
TMS	0.04%	0.04%	0.04%
WSH	0.00%	0.00%	0.00%
WSX	0.02%	0.02%	0.04%
YKY	0.03%	0.03%	0.02%
AFW	0.02%	0.02%	0.03%
BRL	0.14%	0.16%	0.28%
PRT	0.00%	0.00%	0.00%
SES	0.16%	0.18%	0.00%
SEW	0.10%	0.11%	0.19%
SSC	0.09%	0.10%	0.03%

Company	2a (10 years)	2b (9 years)	2c (5 years)
Sector median	0.03%	0.03%	0.03%
Sector average	0.12%	0.12%	0.11%

75. These results illustrate the challenges of estimating an implicit allowance for a small asset class in general, as well as for the "removing historical costs" method. The dataset includes just £53m of historical costs, of which £35m is attributed to just two companies (Anglian Water and Southern Water). This leads to unusable results for "removing historical costs", and a very large difference between mean and median expenditure for the "using historical outturn costs" method.

76. For some asset classes, such as water towers, there are likely to be outlier companies – for example, Anglian Water has a very flat area and has more water towers than the majority of the sector (water towers are expensive, so these are generally used only when this is needed). Across all priority asset classes (except ASP), the mean is higher than the median and sometimes much higher; this is likely to reflect the differences between companies. It seems sensible to use median to reflect the approach taken in cost models to limit outliers. The adoption of the mean (which is around 4 times the level of the median) would imply that half the sector would need to at least quadruple its level of activity to deliver that level of investment. This is clearly not representative of what base has bought historically for the typical company. This suggests that the median is better than the mean as it results in investment levels that are much more representative of the typical company.

77. For water towers, we estimate an implicit allowance of **£0.4m** for AMP8 (average of the 10-year and 5-year UQ period estimates calculated using an industry median).

2.2.5. Our AMP8 base plans for capital maintenance for service reservoirs and water towers

78. The asset health dataset shows that we spent £24.7m in this area in AMP6 and £41.7m in AMP7, reflecting an increasing need for maintenance in this area – so this is consistent with historical spend too.

79. In our AMP8 base plan, we have set out two elements of capital maintenance expenditure which are relevant to this area – our general inspections and maintenance budget, and 12 "named schemes" (which are larger and more likely to be refurbishments). We note that we have not historically seen service reservoirs and water towers as separate asset classes for the purpose of setting budgets or organising internally.

80. Our budget for inspection and carrying out minor work is **£38.903m** for service reservoirs and towers together (the exact amount spent on each will depend on the results of inspections but could be allocated for the purposes of this determination).

FIGURE 12 - WATER STORAGE BASE EXPENDITURE (£M, 2022/23 PRICES)

Network storage type	2025/26	2026/27	2027/28	2028/29	2029/30
Service reservoirs	4.390	6.859	3.349	3.912	3.830
Water towers	0.224	1.660	1.838	0.729	0.729
Contact tanks	0.250	0.224	0.217	0.205	0.205
Final water tanks	0.872	0.455	0.245	0.232	0.232
Total	**5.736**	**9.197**	**5.649**	**5.078**	**4.997**

Source: NWL tactical planning

81. The costs for our 12 "named schemes" (that is, larger projects which are not covered by a general sub-programme for smaller and reactive tasks) are currently forecast as set out in Figure 13 below. We note that some of these costs are indicative at this stage, and some investments are not yet updated for the most recent costs as these schemes are developed further. This is normal for short-term projects under base expenditure, which are subject to changes and reprioritisation across the whole programme. We would usually only confirm this plan for refurbishments one year in advance, but we have prepared our best current forecast of expenditure based on our prioritisation tools. The base refurbishment programme should remain flexible enough to tackle the highest priority issues within the AMP.

FIGURE 13 - WATER STORAGE "NAMED SCHEMES"

Scheme name	Costs (2022/23 prices)	Comments
WT - Caister Water Tower	£2.438m	Inspections have identified that work is needed to the internal division wall of the tower. Note, in addition to this there is £1.6m of "other" expenditure to isolate the structure.
WT - London Road Pakefield Tower	£1.062m	Refurbishment to address vertical cracks and other issues
WT - Framlingham	£0.884m	Refurbishment due to age related deterioration
WT - Dennington Tower	£0.442m	Refurbishment and roof repairs
SR – Chirton Grange North No 1	£1.222m	Internal liner
SR – Herongate Res No 2	£1.070m	Membrane replacement due to age
SR – Plessey No 2 East	£0.693m	
SR – Longnewton West No 2	£0.456m	Maintain structural integrity of tank and water quality
SR – Spring Hill	£0.431m	Install membrane (masonry reservoir)
SR – Frosterley South	£0.327m	Foundations work
SR - Highshield	£0.318m	Replace old liner
SR - Mickleton	£0.211m	Address structural failures

Source: NWL tactical planning

82. The remainder of our base programme for these assets is a more flexible subprogramme that allocates spend as needed – that is, £17.613m for service reservoirs, and £0.354m for water towers.

83. This gives an AMP8 base plan total as:

- Service reservoir refurbishments - **£22.341m**
- Water tower refurbishments - **£5.18m**

84. This is slightly more than the implicit allowance of £16.1m for service reservoir replacements and refurbishments, and significantly more than the £0.4m implicit allowance for water towers.

2.2.6. Conclusion on WBB

85. We have explored different approaches to estimating what base buys – including comparing these methods to our original NES35a case. We know that Ofwat will have additional information from water company submissions, but we have provided our own analysis of the complete workload and expenditure dataset which we have used to help inform our assessment (in the separate “Northumbrian Water – cost change submission” document).

86. We also calculated an estimated saving in maintenance costs for the four service reservoirs (£0.921m for AMP8, or £0.553m for the three years from 2027/28 to 2029/30). Although we do not expect to complete these projects in AMP8, we would expect a reduction in maintenance costs as we would no longer need to extend the life of these assets. In section 2.2, we show that taking repair and other costs into account, we have historically spent much more than the sector median on these assets – and in section 2.3, we show that we expect this trend to continue.

87. We calculate the total costs as follows:

FIGURE 14 - TOTAL COST FOR OUR PROPOSED SERVICE RESERVOIRS

Site name	Capex (£m)	Total (£m)
Auton Stile	15.971	15.971
Blakelaw	6.162	6.162
Ryhope	29.835	29.835
Stoneygate	31.330	31.330
Total service reservoirs	**83.298**	**83.298**
Bedingfield	1.147	1.147
Eye	0.602	0.602
Total water towers	**1.749**	**1.749**
AMP8 base plan	27.521	27.521
Implicit allowance (subtract)	-16.498	-16.498
Maintenance savings (subtract)	-0.553	-0.553
Total	**95.517**	**95.517**

88. In section 4, we explain that some of this expenditure will be in AMP9 – that is, a six-year programme for delivering these service reservoirs.

2.3. CURRENT RISKS

89. In section 2.1, we explained that our maintenance strategy has been to deliver interventions which extend the lifespan of service reservoirs. Some of these repairs, such as "overbanding" to repair leaking structures, have a lifespan limited to around 15 years and can only be carried out three times. We have previously used liners as a last resort for extending the life of service reservoirs, but this is not considered best practice (see 2.1). Around 5% of our service reservoir assets are over 100 years old (27 structures).

90. In addition to this risk, we have identified masonry structures as a particular risk in our long-term asset class strategy. This is because these have both a higher risk for water quality, and a higher likelihood of failure. Masonry assets make up 3.3% of the asset base (18 structures). Based on our observed condition grade across the core components of our service reservoirs we developed deterioration models and profiled the need for future replacement of our service reservoir assets. We provided this analysis in our NES35a case and replicate this here.

2.3.1. Age of assets

91. From this analysis of current risks and condition, we can see that age is a major factor in determining condition grades – particularly for the roof and walls of service reservoirs. Our analysis shows that the risk of being in condition grade 4 or 5 increases rapidly after about 75 years for the roof, and after about 100 years for walls. Two of the service reservoirs in this case are much older than this (Ryhope is 156 years old; Blakelaw is 170 years old). At three of our priority sites in particular, age has been a major factor in selecting these sites (for Stoneygate, the construction on a geological fault is a specific issue).

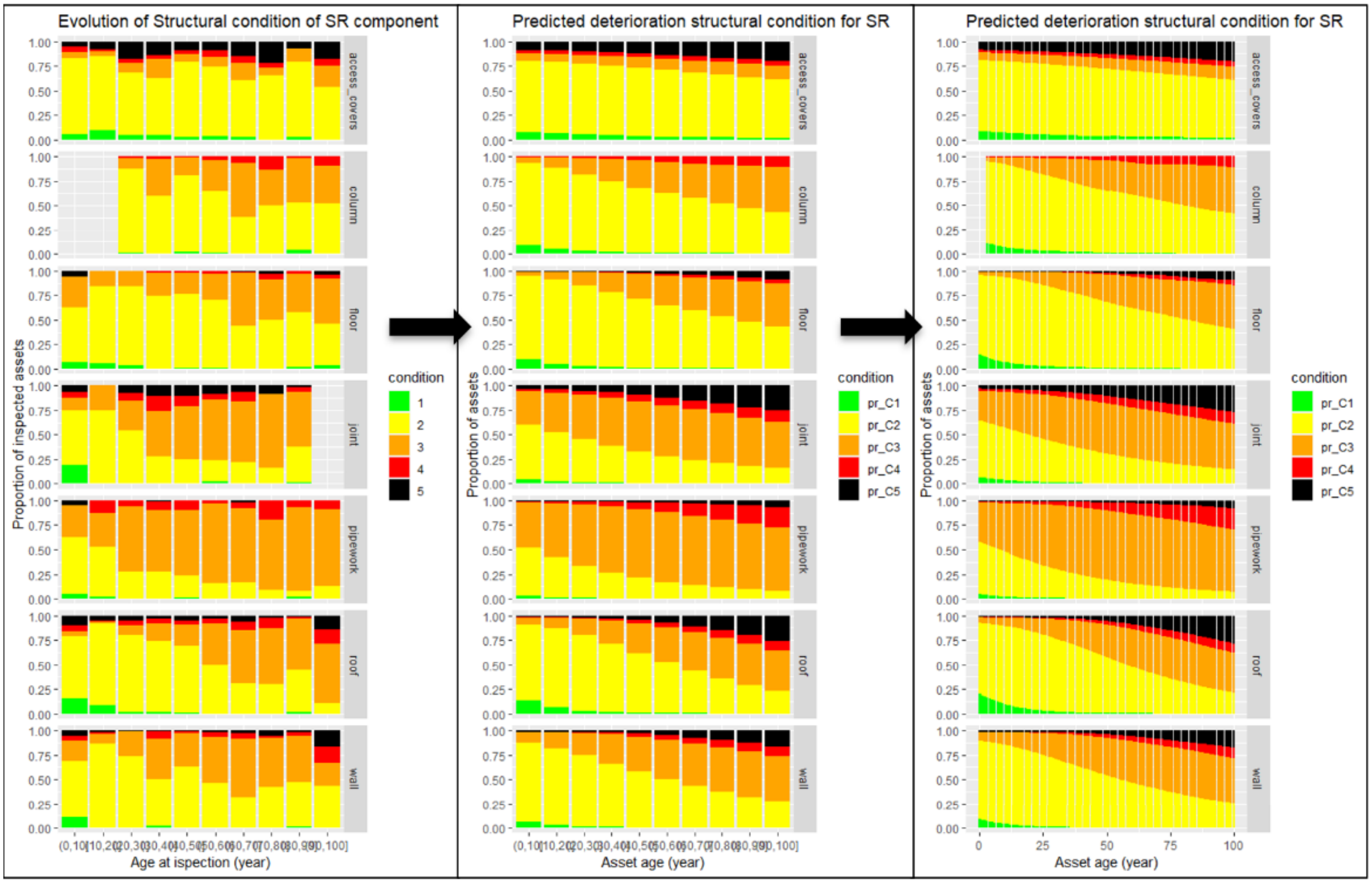
FIGURE 15 - PRIORITY SERVICE RESERVOIR SITES FOR AMP8 INVESTMENT

Reservoir	Capacity	Age	Construction Type	History / Condition
Auton Stile	10.5 MLD	Constructed in 1918	Stone, masonry jointing, single compartment	Poor condition due to age. Liner option not feasible due to ground conditions (high water table). Ingress risk.
Blakelaw	1.5 MLD	Constructed in 1854	Masonry, single compartment	Has been relined in the past. Liner now deteriorated. Unfeasible to reline.
Ryhope	16.5 MLD	Constructed in 1870	Masonry walls, concrete roof, single compartment	Concrete relining applied in the past - stripped out and relined with membrane following water quality failures in 2019 but lining compromised and at risk due to high water table.
Stoneygate	22 MLD	Original construction early 20th Century, roof added in 1950s. Expanded 1981.	Concrete, single compartment	Originally constructed on a geological fault line. Susceptible to cracking caused by ground movement.

Source: NWL Asset data records

92. We have built deterioration models based on our understanding of our assets from the observed condition grades for each component. Figure 16 shows how we take the condition grade for each component against age at inspection. We use this to further predict condition grade across future age, and to establish the predicted deterioration curves for each of the structural components.

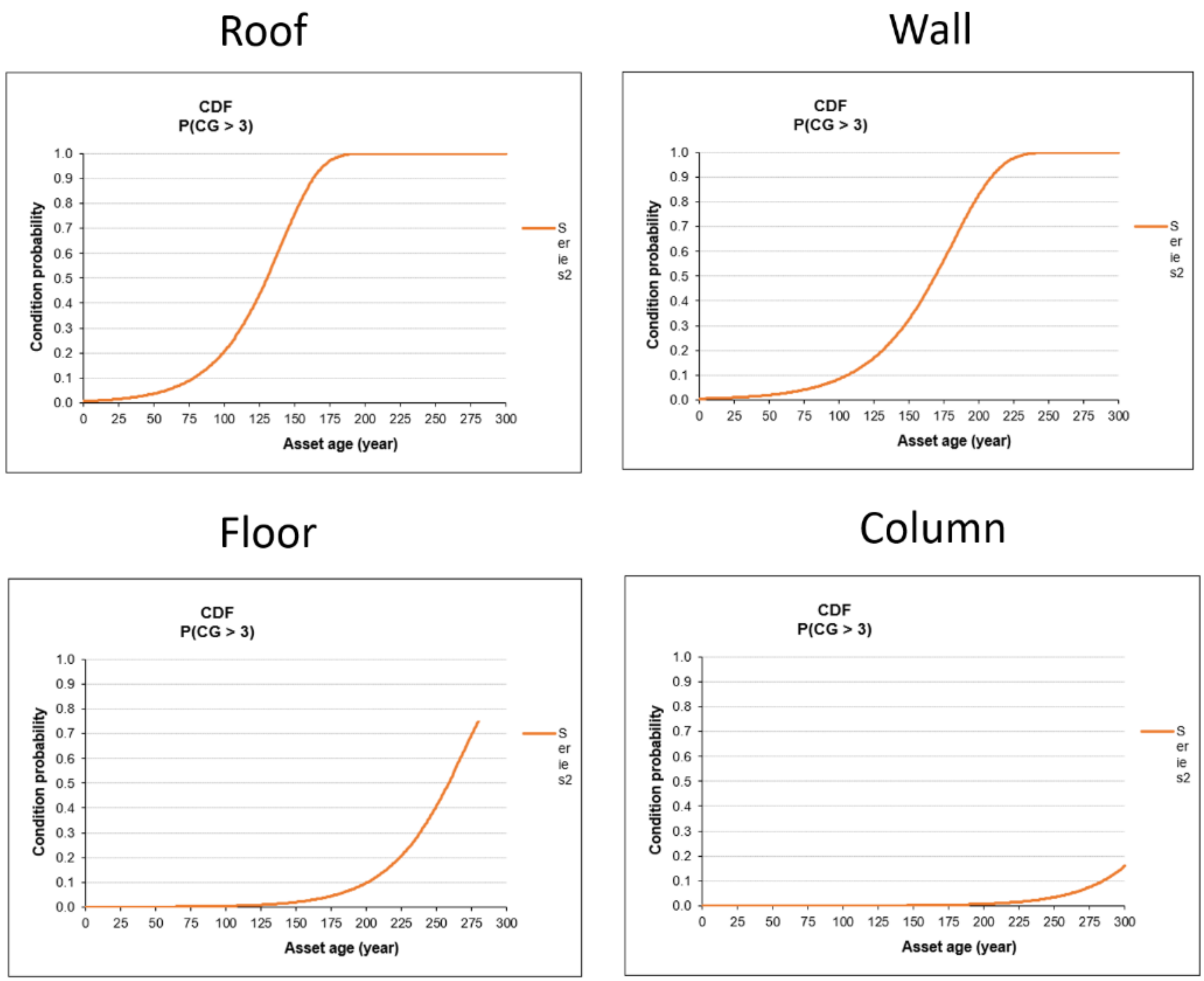
FIGURE 16 - CONDITION GRADE LED DETERIORATION CURVES



Source: NWL deterioration analysis

93. We then take these deterioration curves and turn them into 'survival curves' as shown in Figure 17 for the 4 main components of the service reservoir structures. These curves show the cumulative distribution of components reaching grades 4 and 5, and therefore in need of intervention.

FIGURE 17 - SERVICE RESERVOIR COMPONENT SURVIVAL CURVES



Source: NWL deterioration model detail

94. For example, for roof components, 50% of these components are predicted to reach grade 4 or 5 by the time they are 130 years old. It should not be surprising that service reservoirs that are up to 170 years old (for example Blakelaw Road) are beyond their serviceable asset life.

2.3.2. Increasing need for intervention

95. We have shown how our service reservoir assets move through condition grades and deteriorate over time. As more of our assets are moving beyond condition grade 3, we have seen an increase in the remedial work required as a

result of the inspections. This increase over time can be seen for NWL in Figure 18 below, and the comparative trend for Essex & Suffolk region in Figure 19.

FIGURE 18 - INCREASING MAINTENANCE REQUIREMENT (NORTHUMBRIAN WATER)

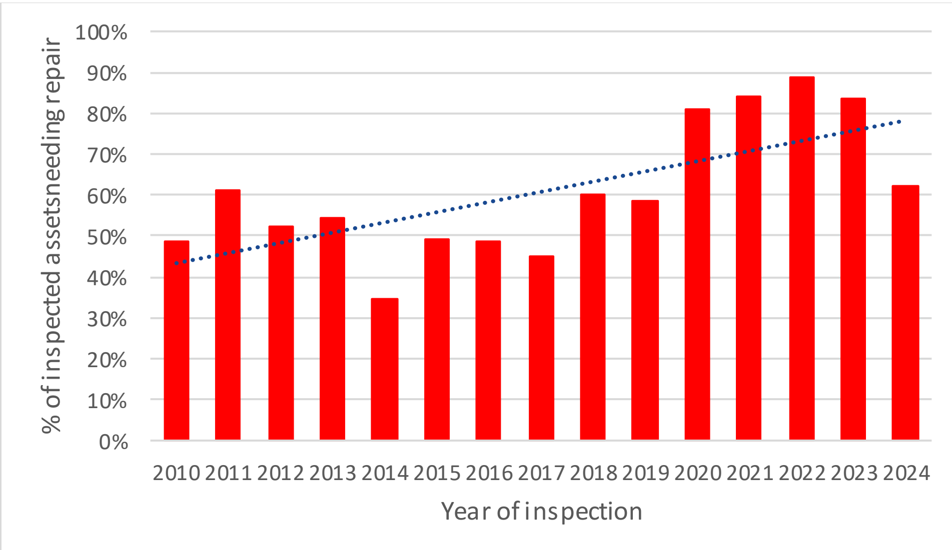
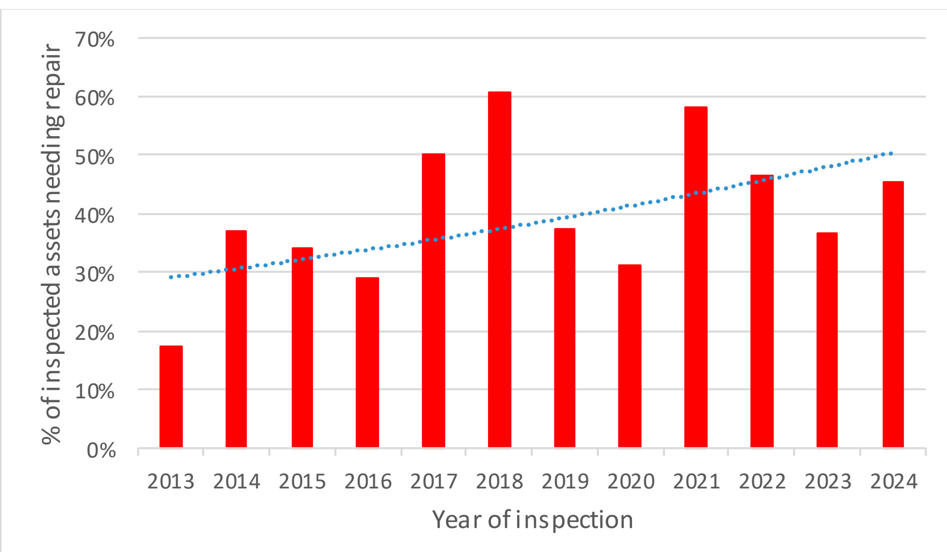


FIGURE 19 - INCREASING MAINTENANCE REQUIREMENT (ESSEX & SUFFOLK)

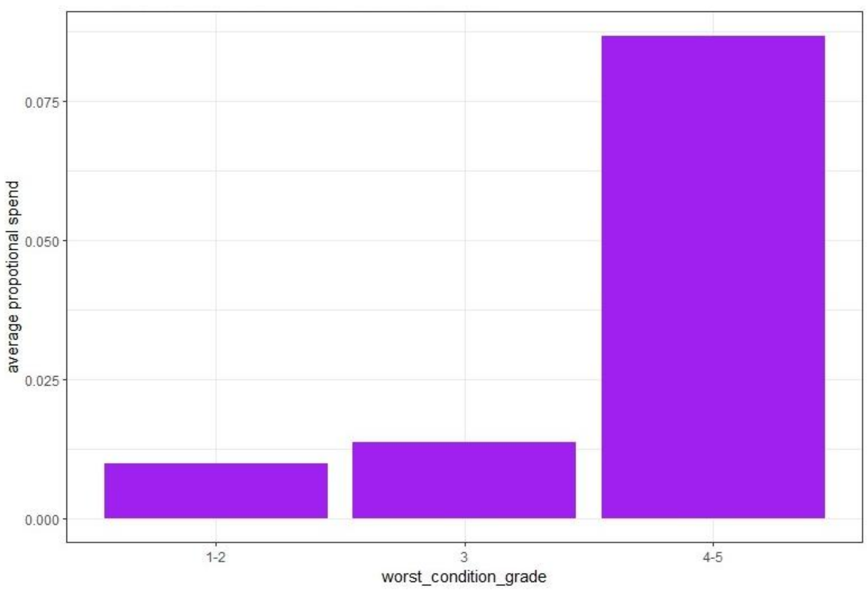


Source: NWL Service Reservoir inspection and maintenance data (dotted line is an average trend)

2.3.3. Increasing cost of intervention

96. The average cost of maintenance and repair for assets beyond condition grade 3 (grade 4 and 5) is over 5 times higher than the average cost for assets in condition grade 1 or 2, as shown in Figure 20. The more assets that reach condition grade 4 or 5, the higher the maintenance, repair and refurbishment costs are across the service reservoir asset base.

FIGURE 20 - AVERAGE SPEND PER CONDITION GRADE



Source: NWL Service Reservoir condition, inspection and maintenance data

Note: Y-axis is average repair spend as a percentage of total compartment replacement cost. For grades 4 and 5 repairs cost approximately 7.5% of the replacement cost compared to approximately 1% of the replacement cost for a grade 3 compartment. The replacement cost is estimated based on the compartments capacity and a basic cost curve.

97. As more of our assets age, there is a greater proportion of assets reaching condition grades 4 and 5 and requiring an intervention. The greater quantity of interventions is increasing the amount we need to spend (on repair costs) and this is increasingly becoming impractical from an operational delivery perspective, due to the operational impact of intrusive repair and refurbishment approaches. More extended time with assets out of service for repairs creates a loss of system resilience at a time when resilience is becoming more critical due to climate change. We need to act now to start a rolling replacement process to minimise future activity for deteriorating assets – or we will see repair costs increase further.

2.3.4. Prioritising our investments based on risk

98. We carefully manage the risk relating to our service reservoir assets, as demonstrated through our inspection frequency and required repair information. We need to invest in replacing our highest priority service reservoirs now to avoid putting our customers at a higher risk of loss of supply. If any of our service reservoirs were to fail, on a

typical day, there would be an alternative supply solution. However, in the event of a secondary factor, such as an extreme demand scenario or a critical main burst, it is more likely that there will be a supply issue. Hence by not investing in these assets within AMP8, our level of risk would increase.

99. For our Service Reservoir assets, we prioritise investment on a risk-based approach informed by the outputs of statutory inspections, assets condition assessments and deterioration modelling.

100. We assess all our water storage assets using the ALFA approach (Assessment of Low Failing Assets modelling methodology), which provides a tendency to fail (TTF) assessment based on failure modes and asset attributes, and a consequence of asset failure. Since PR09, this method has been embedded in our asset management approach to identify future issues and prioritise activities for asset groups which fail very rarely in practice and for which there is insufficient historical failure data to build performance relationships.

101. We prioritise inspections using a tool that takes elements of the ALFA modelling in combination with more operational considerations such as water quality sample results, history of ingress and overall asset size. This differentiates between sites that may have equal time between inspections and allows us to plan interventions proactively. The outputs of the inspections generate a task list of investment needs. All water quality needs are addressed before assets are returned to service, but some asset needs can be addressed during future inspections.

102. For our Service Reservoir assets, we examine the task list of investment needs that remain after water quality work has been carried out, as part of the risk-based approach.

103. In addition, our deterioration modelling adopts the UKWIR best-practice model developed specifically for service reservoirs through the industry funded project Treated Water Storage Assets: Good Practice for Operation and Management[8]. This ensures our assumptions related to asset lives, common failure modes, risk of failure and benefits of interventions are based on industry research. We use the service reservoir model developed by UKWIR to forecast rates of deterioration and plan the timing of interventions to manage risk to service.

104. To prioritise our service reservoir interventions, multiple factors are taken into account, including:

- age – many of our service reservoir assets are well beyond standard asset-life assumptions and are of a primitive or outdated design;
- condition – condition assessment is a key part of the statutory inspection process and outputs. We also monitor asset condition as part of routine operational activity;
- water quality risk – we monitor the CRI risk associated with reservoir condition and performance;

[8] UKWIR Project 19/RG/05/50 (2017)

- construction method – we operate a range of reservoir types, each with characteristics and risk factors specific to the design and construction method - e.g. masonry structures are particularly susceptible to deterioration and potential ingress/egress resulting in water quality issues, and
- criticality/zone resilience – the criticality of network storage is related to network configuration and ability to supply from other sources as well as size and number of customers served.

105. We assessed these factors to identify the four priority service reservoirs for investment in AMP8 (see Figure 15). Most were constructed over 100 years ago and have already received a number of maintenance interventions aimed at extending asset life by slowing deterioration and mitigating water quality risk. Three sites are of a masonry type construction. In the case of Stoneygate, the reservoir was constructed on a geological fault (unknown at the time) which is a key driver of the condition and risk score and why this is a priority site even though it is not masonry construction. Auton Stile is constructed from stone slabs on puddle clay, which due to the jointing is also classed as a masonry structure. The tank is >100 years old, and because it is located in an area of high water-table, options to reline to extend the asset life are not feasible (see Section 2.1).

106. We will continue to monitor and assess these risk factors and apply the same prioritisation methods to determine the target reservoirs for replacement in future AMPs.

2.4. FORECAST OF FUTURE ASSET HEALTH AND RISKS

107. Our asset deterioration models (see Section 2.3.1) show how we have quantified risk over time, including using survival curves to indicate the relationship between age and asset condition for service reservoirs. This shows the increasing risk over time for individual assets.

108. For PR24, we devised with the Water Industry Commission for Scotland and Scottish Water a methodology for projecting asset population replacement time and cost using:

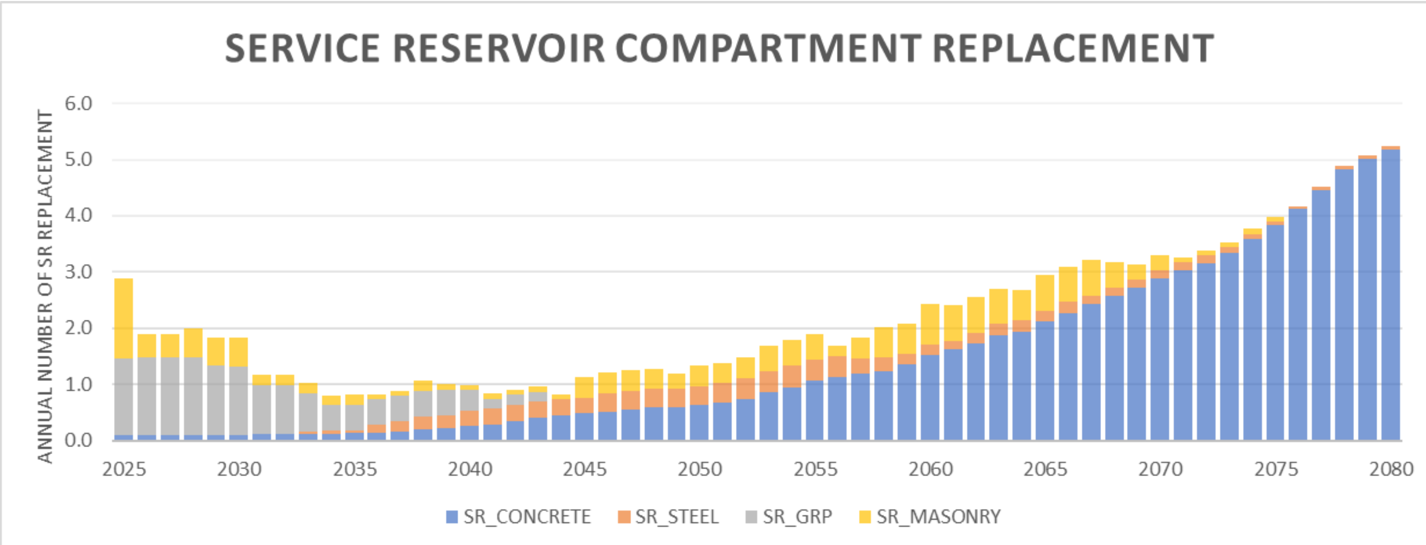
- Asset life expectancy
- Asset population age distribution
- Asset replacement cost.

109. This simple approach allows for rough estimates of investment needs and profiles to be made. We have adapted this approach to help relate our known asset deterioration curves and survival rates, to life expectancy. We combine the component data for the assets to create a single life distribution for service reservoir compartments. To show alternative approaches, we have modelled two scenarios.

- Simulation A: ‘First past the post’ models the time for one component to reach grade 4 or 5.
- Simulation B: ‘First past the post plus 30 years’ models the time for one component to reach grade 4 or 5, plus assumes a life extension of 30 years can be achieved through repairs. This 30-year life extension has been validated by expert engineering judgement.

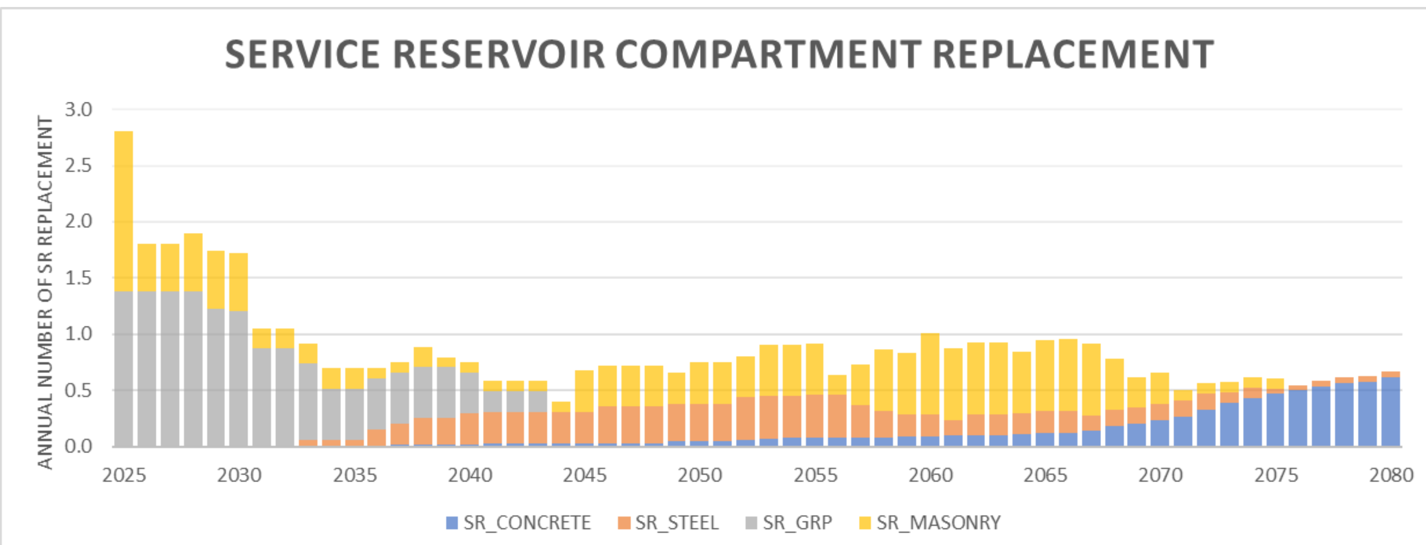
110. Figure 21 and Figure 22 show the resulting output for these two scenarios.

FIGURE 21 - SIMULATION A: 'FIRST PAST THE POST'



Source: NWL asset deterioration modelling output

FIGURE 22 – SIMULATION B: 'FIRST PAST THE POST PLUS 30 YEARS'



Source: NWL asset deterioration modelling output

111. Simulation B, shown in Figure 22, is the most conservative view of replacement need out of the two model simulations. This assumes that we are able to extend the life expectancy by 30 years through repairs and

refurbishments, without asset replacement. This simulation shows the annual profile of number of reservoir compartment replacements required over a 55-year time horizon.

112. The replacement number of compartments for AMP8 (2025-2030) indicated by the model is more than 8 in AMP8 – and then this reduces to between 4 and 5 from AMP9 onwards. We had previously concluded in our PR24 business case that we should take a slightly conservative view for AMP8, because: there are likely to be some constraints to acceptability and deliverability and so it is challenging to step up this investment immediately; we should rely on known risks and concerns rather than using the modelling directly (in accordance with customer priorities); and these are long-life assets where some smoothing of investment should be possible. We note that since the PR24 business case, the asset health roadmap and the Cunliffe Review have suggested that

113. Three of our four priority sites are single compartments. Our asset standards require that any new compartment is available for maintenance at any time, so we are proposing to replace all priority sites with dual compartment reservoirs in this asset health case. The prioritisation approach and detail of these assets is covered in Section 3.

114. Under any scenario, we are likely to need to replace more service reservoirs over time than we are proposing in this enhancement case. This means that our proposed step-change in investment will be sustained in order to prevent further deterioration.

2.5. SUMMARY OF LONG-TERM ASSET CLASS STRATEGY

115. In our long-term asset class strategy, which we published at PR19, we said:

> "Service Reservoirs are often the subject of competing objectives: turnover vs resilience and quality, maintenance and availability. We want a better long-term visibility of their ageing process and its implication on the water quality and the civil structure, to anticipate and plan for their replacement.
>
> "To replace the existing set of service reservoirs over say a 100-year period, the cost to NWL would be approximately £140m per AMP. This is unlikely to be affordable. We do recognise however that our existing rate of replacement for service reservoirs is inadequate and that the current age profile of these assets is predominately 80+ years. There is a need to create more informed tendency tree analyses to determine the service reservoir inspection frequency rate, and where engineering assessments signal significant asset deterioration within a 5–10-year period, we would plan to replace or abandon. Other principles which form part of the strategy include:

- All fill and draw tanks will be re-engineered to remove this type of operation.
- All tanks constructed from brick or masonry will be removed from service and replaced.
- Age profile will be considered within the tendency tree assessment, with an option for a cut-off point agreed dependent on construction material.

- Age of water from source to customer to be assessed across a system and not just isolated to design residency in single tanks.

"The sensitivity behind any risk prioritisation process is dependent on the quality of data around asset condition and performance. We will therefore enhance our current service reservoir risk models by embedding the latest industry's thinking and combine it with CFD modelling and our own innovative techniques such as flow cytometry. The latter provides a risk index for any given tank from sampling data which in turn provides an indication of the likelihood of a coliform failure. This ground-breaking application of a traditional technique is forcing NWL to think more readily about how we can run systems optimally to keep the water fresh for customers and protect those tanks at the end of any given system from potential biofilm growth.

"Within the AMP7 plan, we will also be adding to the existing service reservoir asset base. As well as the new tank construction at Barsham in Suffolk [note, this refers to a PR19 resilience enhancement at a WTW, not a service reservoir], we are also constructing a new service reservoir in the Central area at Springwell to improve resilience, water quality compliance whilst reducing risk of outages. The 62Ml storage tank will bridge storage deficits in the area and will be sited on the Washington leg from Mosswood WTW. DWI has provided this scheme a PR19 'commend for support' for inclusion in our final business plan, and the £17m project will also include duplication of the outlet main to provide opportunity to link supplies from Carr Hill on the Tyneside system."

116. We updated this assessment in 2022. In our resilience appendix at PR24 (**NES09**), we explained the work we had done on asset health across our business - this included service reservoirs. Investment to replace concrete tanks at service reservoirs were considered a high priority by our customers[9] – along with water treatment works and wastewater treatment works – as they relate to the main function of the company to provide a safe, continuous water supply. As a result of our customer research, we looked at potential options for balancing affordability against an increased investment in asset health.

117. This challenge led to us removing our business case for service reservoirs from our draft plan and including mains replacement without changing the overall level of investment for asset health – and so remaining close to the level of investment that our customers supported in our qualitative research.

118. In our PR24 long-term strategy for service reservoir and treated water storage assets, we said that:

"beyond 2030, we consider that capital maintenance expenditure will need to increase further" [10]

[9] **Pre-acceptability research Part B**, NES, 2022
[10] '**Shaping our future: Our Long-term strategy 2025-2050**', NES_LTDS, NWL, October 2023, p.91.

119. For our core pathway, we used an estimate of a 40% increase in investment from 2020-25 levels, starting in 2030. This was a conservative view that represented a minimum "no regrets" increase. We noted that "the required level of investment could be significantly higher". We said that the decision point for this would be 2028, ready for investment from 2030 onwards, and decisions would be made at each subsequent price review to determine the most appropriate level of capital maintenance investment. Since our long-term strategy in 2023, we initiated and led work to examine the evidence and best approach for future regulation to enable this – working with other companies, regulators, and stakeholders to begin these conversations. This supported the inception of the asset health roadmap in December 2024.

120. In July 2024, we included service reservoirs in our business plan in response to the draft determination. We explained that with lower forecast bills than our business plan in the North East, we had a further opportunity to bring forward some "no regrets" investment from AMP9. In NES35a, we explained how this "no regrets" investment would support our long-term asset class strategy – that is:

- Our maintenance strategy for AMP7 (and also our original business plan for AMP8) was to deliver interventions to extend the lifespan of service reservoirs. Some of these repairs, such as "overbanding" to repair leaking structures, have a lifespan limited to around 15 years. Asset deterioration and the instructions for use of approved products has meant that these repairs can only be carried out three times, and then replacement is needed. In the past, we have used liners as a last resort for extending the life of service reservoirs – but UKWIR issued guidance in 2017[11] which increased the assessment of risk of deterioration for reservoirs with liners, stating that where there is risk of ingress behind a liner, the structure should be assessed as Grade 5 (poor). Liners are therefore considered inappropriate in conditions where ingress due to wall and floor deterioration is a risk and therefore significantly limits the application of liners for refurbishment of end-of-life assets. As such, liners are omitted from Section 9.4 of the UKWIR guidance which covers best practice.
- Our long-term asset class strategy is to replace our service reservoirs that have a masonry construction due to a higher likelihood of microbiological sample failure and increased cost to mitigate this risk. These particular service reservoirs are old (mostly Victorian-era), have reached the end of their lives and require excessive maintenance. The DWI supports our asset group strategy for service reservoirs, supplied to them in 2022 as part of our DWI notice for service reservoirs. This included replacing service reservoirs with masonry construction.
- We had previously replaced one service reservoir under base allowances since 2010 – our Hebron reservoir – and built one new reservoir in enhancement (Springwell). Replacement costs due to aging assets had not generally been captured in Ofwat's base models which use historical expenditure – these allowances do not

[11] UKWIR Good Practice for Service Reservoirs (UKWIR 19-RG-05-05)

include new replacements for service reservoirs [this assessment is now also supported by the analysis of sector-wide data about what base buys].

121. We explained that we had originally planned to replace five reservoirs in AMP9, at an early estimated cost of £62.4m. We considered including this investment in our AMP8 plan and discussed this with customers – who agreed they would invest now if it would deliver value and reduce future step increase in prices [12]. However, we did not include this in our business plan because other investments were considered higher priority (and some customers expressed concerns about overall affordability. At DD24, with a shift in affordability since the business plan due the scaling down of some programmes including wastewater monitoring, we could now bring the majority of this forward to AMP8. This aligned with decisions to delay some investment in wastewater monitoring to AMP9 (which will, in turn, increase our AMP9 plan – and so bringing forward service reservoirs would help to mitigate this too).

122. We also explained that we expect to continue with a multi-AMP approach to replace service reservoirs, and we are working on the longer-term replacement plan, including inspections. We said that the pace and extent of the asset replacement plan will depend on what we expect to be increasingly stringent expectation from DWI and the evolution of requirements for reservoir inspections for smaller reservoirs – as well as developing the evidence on long term deterioration of asset health. We provided evidence of the link between asset condition and age/maintenance cost, to show the future impact of this requirement.

123. Our original asset health case NES35, submitted in 2023, contained a list of water assets in need of refurbishment, two of those were the two water towers that form part of this case.

124. In early 2025, our Statement of Case as submitted to the CMA included the same four service reservoirs that we included at DD24.

125. We have updated our long-term asset strategy since then, and we are working further on a more comprehensive update to our long-term plan for our decision point in 2028 (that is, for the PR29 business plan and long-term strategy). We expect this to include more details about the modelling of concrete deterioration for service reservoirs over the long term, but the clear focus on service reservoirs made from brick or masonry will remain the highest priority in the short term. This case reflects this priority, with three masonry service reservoirs and one concrete service reservoir (which has a specific risk due to a nearby geological fault).

126. Our modelling shows clearly that after some short-term urgent need (in AMP8 and AMP9), we would expect the replacement rate to stay at broadly this level (under the most conservative scenario, which assumes we will be able to extend the life of these assets further) or increase (under a more realistic scenario to maintain asset health). The

[12] Pre-acceptability research Part B, NES, 2022

next update to our modelling of concrete deterioration will help us to understand the long-term replacement rate – however, under any scenario this work is needed now.

127. We note that climate change and demand uncertainties would have a limited impact on our conclusions in the short term, and on the design of the assets themselves. That is, the capacity for these service reservoirs is not forecast to need to change under any scenario. These may, however, have some relevance for longer term planning such as how these might affect the deterioration rate of concrete. We have considered how future concerns about water quality risks might change as regulators tighten up requirements – these drive an even stronger focus on non-preferred materials in the short term. We note that we expect growth to be substantially higher than we set out in our PR24 forecast, and we expect to include a submission on this in the 2027 cost change process. This would not affect the need for these service reservoirs or change the scope of these designs.

2.6. ENGAGEMENT WITH STAKEHOLDERS AND CUSTOMERS

128. The DWI has supported our long-term plan to replace our service reservoirs, and we note that DWI guidance drives our prioritisation and selection of reservoirs – for example, the DWI considers linings to be a temporary solution to extend asset life and not generally repeatable once the lining has deteriorated (this is relevant for Blakelaw and Ryhope).

129. We have asked the DWI for support on this asset health case for these specific service reservoirs and water towers. Although these are not directly related to a water quality risk, the DWI has expressed an interest. They will provide a separate letter of support to Ofwat.

130. There are no wider relevant stakeholders for this investment, and there are no wider risks to the environment or customers.

131. Customers support this investment, as we describe in section 3.5.

2.7. WHAT IS NOT INCLUDED HERE?

132. In our PR24 case, we included civil assets at WTWs – we know that these are out of scope for the 2026 process, but these are still important. This includes raw water storage at WTWs – such as at Langford (this is a "balancing reservoir" at a WTW, so is out of scope). We considered **rapid gravity filters**, as these are in scope for the 2026 process and we had some of these in our PR24 case – but on its own, this is not material. We will return to this in 2027.

133. Our PR24 enhancement case also noted the highest risks in other asset classes outside the priority asset classes:

- **Raw water storage reservoirs** are some of the most critical assets and there is very limited scope to defer investment in some circumstances (for example, due to mandatory inspections). These investments, when required, are likely to be very large and not readily comparable between companies – as reservoirs and raw water distribution networks are quite different depending on geography and decisions made long before privatisation. We do not anticipate any "in period" cases for this asset class, but this is likely to be an important area for AMP9 and beyond.

134. We did not set out any plans in AMP8 for boreholes – because we did not expect there to be a significant need to increased maintenance expenditure in this asset class, and we did not expect this to trend upwards. However, since our PR24 business plan, we have inspected these assets and refreshed our long-term boreholes strategy. We explain our case for increased investment in this area in our separate asset health case.

3. BEST OPTION FOR CUSTOMERS

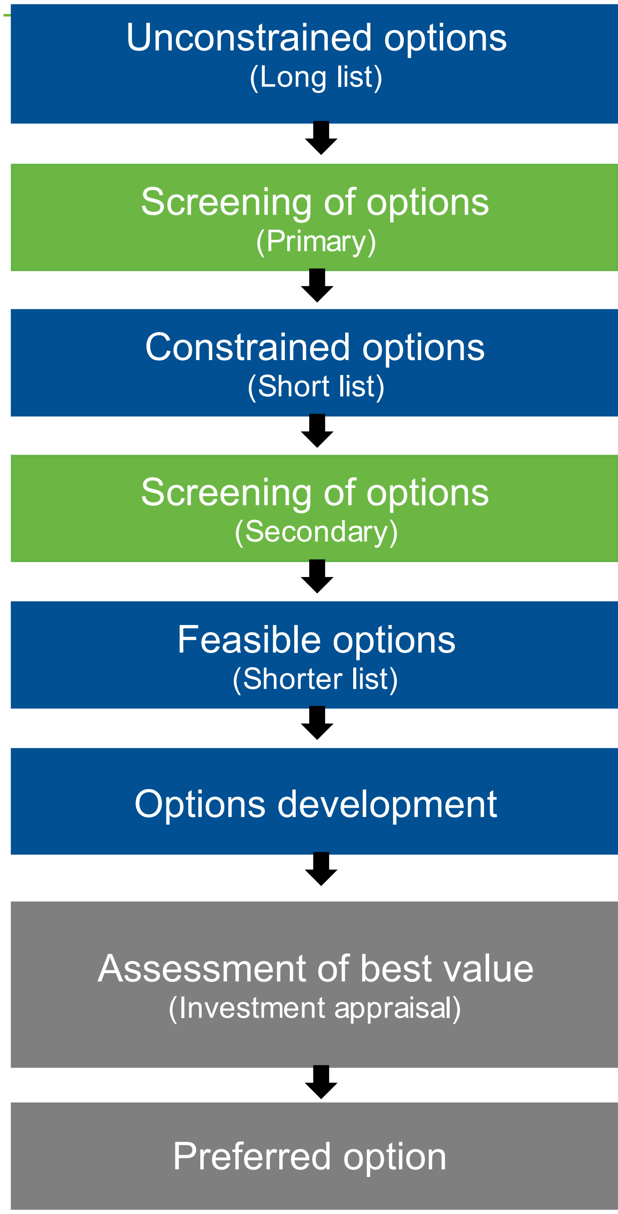
135. In our NES35a enhancement case, we described our optioneering process for addressing the needs at the four sites described in Section 2. We replicate this below.

3.1. OPTIONEERING

136. To determine the best option for customers to address the need, we carried out an options identification and screening process as outlined in Figure 23. Our process for identifying the best option for customers is based on the principles of The Green Book: Central Government Guidance on Appraisal and Evaluation produced by HM Treasury.[13] A description of each step and the output from it is contained in the following sections.

[13] The Green Book: Central Government Guidance on Appraisal and Evaluation, HM Treasury, 2022

FIGURE 23 - PROCESS FOR DEVELOPING OPTIONS



Unconstrained list of technology options (section 3.1.1)

We have developed a broad range of options through cross business options development workshops.

Constrained list of technology options (section 3.1.2)

We have screened the unconstrained list of technology options against:
1) expected to meet statutory obligation, and
2) technically feasible in accordance with health and safety requirements and technology application.

Options development (section 3.1.3)

For the constrained list of options, we developed the scope up to Level 3 where possible to enable more detailed cost estimates. With more detailed scope information we have measured the benefits, including carbon emissions, for each option.

Assessment of best value (section 3.2)

We have undertaken an assessment of benefits and net present value for each of the options from the constrained list at each site.

We have also assessed each option against a deliverability assessment as part of our benefits assessment.

Preferred option (section 3.3)

We have selected the preferred option based on the outcomes of the best value assessment to maximise value for customers while achieving the regulatory requirement for each need.

Source: NWL PR24 Optioneering methodology

3.1.1. Broad range of options

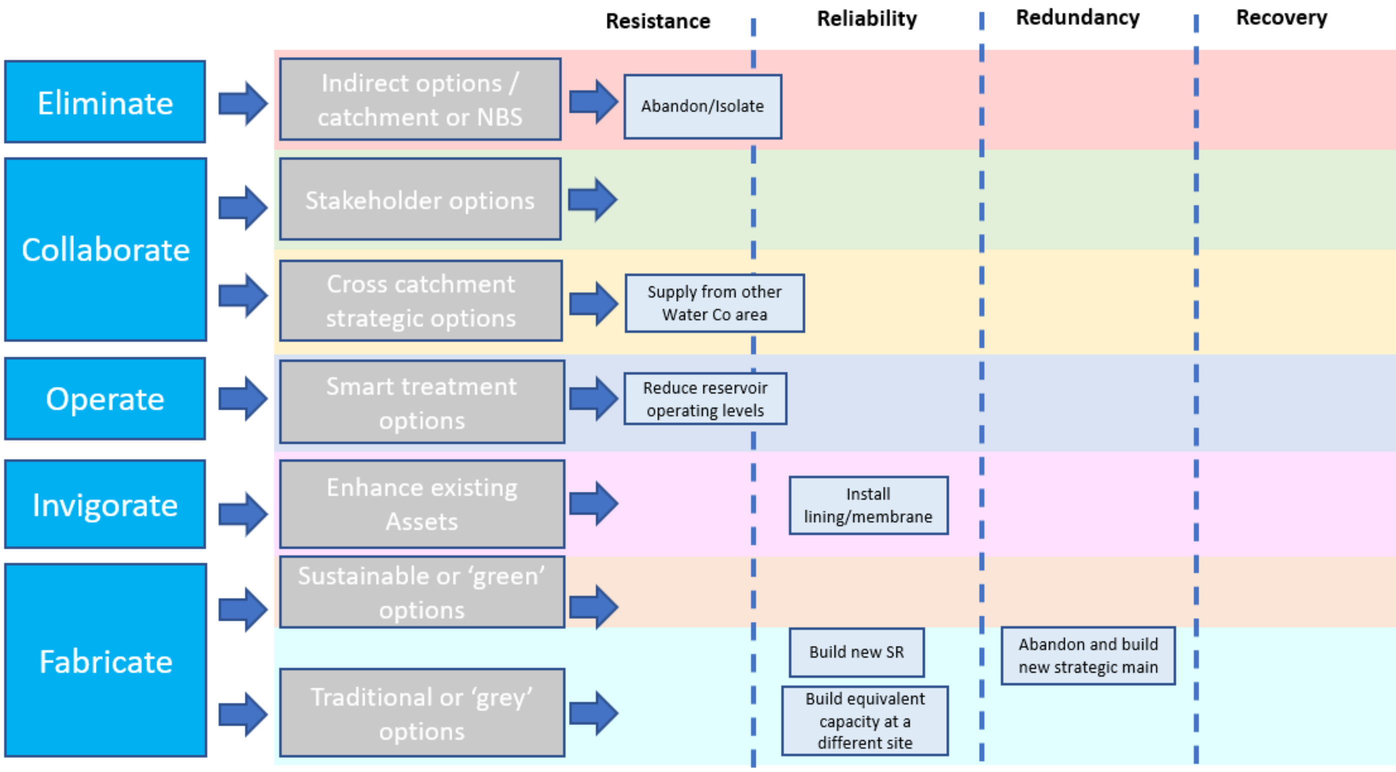
137. We have developed a range of 7 options, categorised according to the 4 Rs of Resilience.

- Resistance – prevent disruption by providing measures to resist the hazard such as options that reduce the likelihood of asset failure or service impact.
- Reliability – measures to ensure the ongoing reliability of assets, including refurbishment or replacement.
- Redundancy – backup measures that can be implemented when required to manage risk and ensure continuity of service.
- Response and recovery – fast and effective response to, or recovery from, disruptive events. We did not identify any appropriate options that can be used in response to or to recover from age-related deterioration of Service Reservoir assets.

138. Our unconstrained list considers options in line with our Totex Hierarchy, with differing levels of costs and benefits categorised as follows:

- **Eliminate** – identification of processes or practices that eliminate the risk of Service Reservoir failure. This includes the option to abandon, isolate or bypass service reservoir assets.
- **Collaborate** – working with stakeholders to re-assign the issue or co-fund to address it. Costs can be shared with third parties either to deliver the same or an additional level of social and environmental benefit. In this case, the only viable option would be to consider cross-boundary supply options, by agreement with neighbouring water companies. However, none of our priority sites for AMP8 are close enough to the boundary of our operational area to make this a viable option. This will be considered in future AMPs, based on the geographical location of priority service reservoir sites.
- **Operate** – this would involve improving our operational management practices to reduce the risk of age-related failure of service reservoir assets.
- **Invigorate** – this would involve investing in existing infrastructure to improve performance. These options will provide an increased level of benefit but may be of a lower cost than fabricate options. In this case, options are limited to refurbishment or re-lining of service reservoir structures. It should be noted that our priority sites have previously been refurbished, with linings applied (in some cases multiple times) to extend the asset life and provide best value for customers. As per the DWI's guidance, linings are a temporary solution to extend asset life and not generally considered repeatable once the lining has deteriorated.
- **Fabricate** – investing in new assets to augment or replace existing assets to address the need. While these options are likely to have the highest capital costs, a new service reservoir will likely have an asset life > 100 years. Therefore, timely replacement of old and deteriorated assets can be better value for customers than frequent and increasingly costly refurbishment interventions.

FIGURE 24 - THE UNCONSTRAINED LIST OF OPTIONS AND ALIGNMENT TO THE TOTEX HIERARCHY CATEGORIES AND 4RS OF RESILIENCE



Source: NWL PR24 Optioneering process

3.1.2. Options screening

139. We have screened our unconstrained list of options for the four priority AMP8 Service Reservoir sites to determine whether the intervention:

- is technically feasible,
- addresses the need identified in Section 2.

140. Options that did not satisfy both criteria were rejected with remaining options carried forward to secondary screening, as shown in Figure 25.

Secondary screening of the constrained list of options involved determining the costs, carbon impacts and benefits for each option. This process produced a feasible list of options for each need, which is shown in Figure 26. We identified three feasible options for Blakelaw, two for Auton Stile and one for Stoneygate and Ryhope.

141. Our assessment of benefits for the options is included in Section 3.2 and our approach to costing is outlined in Section 4. This has been used to inform the cost benefit appraisal to determine the preferred option.

FIGURE 25 - OPTIONS SCREENING

Totex Hierarchy	Options		Technically Feasible?	Addresses AMP8 risk?	Resilience approach	Notes
Eliminate	1	Abandon and bypass Service Reservoir	No	No	Resistance	**Rejected:** Reduction in SR capacity in the network impacts supply resilience
Collaborate	2	Abandon SR and supply from other Water Co area	No	No	Resistance	**Rejected:** Not feasible due to the locations of the 4 priority reservoirs.
Operate	3	Reduce operating levels	No	No	Resistance	**Rejected:** Reduces water available for supply with no reduction in water quality or asset failure risk
Invigorate	4	Install lining/membrane	Yes	No	Reliability	**Rejected:** Priority sites have already been lined at least once. Short term solution and complex to execute where previous linings have deteriorated.
Fabricate	5	Build new Service Reservoir (like for like replacement)	Yes	Yes	Reliability	**Carried Forward:** Land purchase necessary to allow construction alongside existing asset and retain continuity of supply
	6	Abandon and build new equivalent capacity at a different site	Yes	Yes	Reliability	**Carried Forward:** Feasible where nearby sites have space to accommodate equivalent capacity.
	7	Abandon and feed from alternative site with Pumping and network upgrade	Yes	Yes	Reliability	**Carried Forward:** Only feasible where SRs are close to alternative site with appropriate capacity
	8	Abandon and build new strategic main extension to replace supply	Yes	Yes	Redundancy	**Carried Forward:** Only feasible where SRs are close to existing strategic mains, otherwise likely to be prohibitively expensive.

Source: NWL PR24 Optioneering process

FIGURE 26 - CONSTRAINED LIST OF OPTIONS FOR OUR PRIORITY SITES

Totex Hierarchy Categories	Options		Resilience approach	Priority Sites
Fabricate	5	Build new Service Reservoir (like for like replacement)	Reliability	Auton Stile, Blakelaw, Stoneygate
	6	Abandon and build new equivalent capacity at a different site	Reliability	Ryhope, Blakelaw
	7	Abandon and feed from alternative site with Pumping and network upgrade	Reliability	Blakelaw
	8	Abandon and build new strategic main extension to replace supply	Redundancy	Auton Stile

Source: NWL PR24 Optioneering process

3.2. DECISION MAKING

142. For each option carried forward to this stage we have completed a benefits assessment using our Value Framework[14] which contains a wide range of benefits that reflect measures relating to performance commitments or other social and environmental values. Our Value Framework is embedded into our portfolio optimisation tool, Copperleaf. Figure 27 shows the range of benefits (value measures), including their quantification and monetisation values, that we have used for the assessment of the shortlisted options.

FIGURE 27 - RANGE OF BENEFITS IDENTIFIED FOR RAW WATER DETERIORATION

Value measures	Description	Unit	Value	Aligned to a performance commitment?
Interruption to Supply	Cost of reducing interruptions to supply events	£/interruption duration per property per year	Value derived from lookup table based on scale and duration of event	Yes
Reduced Unplanned Outage	Cost of reducing the number of unplanned outages	£/Ml	Value calculated based on lookup table of event duration and population affected	Yes
CRI Score	Reduction of instances of Drinking Water Inspectorate (DWI) noncompliance	CRI Score	Non-monetised, but £ value is captured in Water Quality Compliance model (below)	Yes
Water Quality Compliance	Number of water quality non-compliance events	£/Non-compliance event	Value derived from lookup table depending on event type and scale	No – captured in CRI score (above)
Operational Emissions	t/CO_2e / year	tCO_2e	£256.20 [15]	Yes
Embedded Emissions	t/CO_2e / year	tCO_2e	£256.20 [14]	Yes

Source: NWL Copperleaf Value Models

[14] Northumbrian Water Limited Value Framework Definition Document, v1.16, Copperleaf Technologies Inc., 2002
[15] £ value per tonne of CO_2e in 2025/26, annual increase (varying rate) reaching £378.6/t CO2e in 2054/55

143. For the benefits assessment, we score the impact of the 'do nothing' option as a baseline, and then score the benefits associated with each of the alternative options. Annual benefits are scored over a 30-year time horizon.

144. The value measures in Figure 27 cover water quality risk, water supply interruption risk and both the operational and embedded carbon impacts. These use our PR24 value framework.

3.2.1. Cost benefit appraisal to select preferred option

145. For each of the feasible options we have carried out a robust cost benefit appraisal within our portfolio optimisation tool to select the preferred option. This calculates a net present value (NPV) over 30 years, using the Spackman discounting approach in accordance with the PR24 Guidance, and the cost to benefit ratio for each option. The ratio is calculated by dividing the present value of the profile of benefits by the present value of the profile of costs over the appraisal period of 30 years.

146. Costs and benefits have been adjusted to 2022/23 prices using the CPIH[16] Index financial year average. The impact of financing is included in the benefit to cost ratio calculation. Capital expenditure has been converted to a stream of annual costs, where the annual cost is made up of depreciation / regulatory capital value (RCV) run-off costs and allowed returns over the life of the assets. Depreciation (or run-off) costs are calculated using straight-line depreciation over the appraisal period. To discount benefits and costs over time, we have used the social time preference rate set out in The Green Book[17].

147. The NPVs generated by our portfolio optimisation tool are included in Figure 28. We note that the NPVs for all options are negative. However, our benefits assessment has been limited by available value models, and so our NPV is not a true reflection of all benefits that will be delivered through these options (most obviously, none of the options include the direct benefits of service reservoirs which are required to meet our statutory obligations to supply water). Regarding the limitations of the NPV figures generated, we note that:

- This investment relates to replacement of existing end-of-life assets to maintain existing levels of service, and therefore the benefit relates only to the avoidance of service impact through degradation-related asset failure. Calculated benefits in our Copperleaf system are therefore relatively small.
- Therefore, the NPV calculation is predominantly driven by the project capex and carbon costs, with little monetised benefit calculated over the 30-year NPV period to offset those costs.

148. The benefit:cost ratios have the same limitation.

[16] Consumer Prices Index including owner occupiers' housing costs.
[17] The Green Book: Central Government Guidance on Appraisal and Evaluation, HM Treasury, 2022

FIGURE 28 - BENEFIT TO COST RATIO AND THE PREFERRED OPTIONS FOR SERVICE RESERVOIRS

Site	Option	Net Present Value (30 years) (£m)	Benefit: Cost	Type of Option
Auton Stile	Do nothing	-£0.41	0.0	Alternative
	Build like for like replacement on adjacent land (10.5 MLD)	-£10.718	0.02	Preferred
	Abandon and duplicate South Derwent main from Mosswood WTW to Auton Stile	-£73.610	0.00	Alternative
Blakelaw	Do nothing	-£0.03	0.0	Alternative
	Build like for like replacement on adjacent land (1.5 MLD)	-£2.598	0.03	Preferred
	Abandon and feed from West Swansfield (upgrade Camphill PS & network)	-£4.120	0.3	Alternative
	Abandon and build 1.5 MLD capacity at Shilbottle Grange (new 7.8km main)	-£15.003	0.01	Alternative
Ryhope	Do nothing	-£0.31	0.0	Alternative
	Build like for like replacement (16.5 MLD) at Dalton WTW site with Pump Station to lift into existing main	-£16.037	0.06	Preferred
	Build replacement at Dalton site with 25 MLD capacity to replace both Ryhope and Mill Hill service reservoirs	-£28,046	0.04	Alternative
Stoneygate	Do nothing	-£0.0	0.0	Alternative
	Build like for like replacement on adjacent land ((22 MLD)	-£19.653	0.01	Preferred
	Build like for like replacement on same land – includes temporary measures to maintain supply during construction	-£22.367	0.01	Alternative

Source: NWL Copperleaf output

149. In all cases, the data shows the replacement option to have the most favourable NPV compared to the alternative solutions considered.

3.3. INDEPENDENT ASSESSMENT OF OUR OPTIONS APPRAISAL PROCESS

150. As part of our Statement of Case to the CMA in 2025, we asked Aqua Consultants to carry out a review of our optioneering process for service reservoirs (see Appendix 1).

> "Aqua found that NWL's approach to optioneering here closely aligns to the Service Planning Framework approach in NES04 [our business plan summary]. **Aqua recognise this is an example of best practice asset management** because ensuring all investment options are selected in a consistent approach, with similar controls and data behind them, helps NWL optimise better across the plan as scenarios can be applied in a more precise way."[18]

151. This review looked at how we prioritised our list of service reservoirs, and how we went about each stage of the optioneering process. The review document also explains each step in more detail, and why Aqua Consultants recognised this as best practice.

3.4. PROPOSED SOLUTION

152. For each of the four reservoirs, we set out our preferred option in Figure 28 above. In each case, this is to build a like-for-like replacement on adjacent land.

153. In the case of Ryhope Service Reservoir, we already have a proposed site plan which uses an existing site (at Dalton WTWs) – and we provide this as Figure 29.

[18] Appendix 1, p43

FIGURE 29 - DALTON SR PROPOSED SITE PLAN

3.5. OPTIONEERING FOR WATER TOWERS

154. Our PR24 asset health case (NES35) showed the need for investment at the two water towers that we put forward in this case – at Eye WTR and Bedingfield WTR.[19] This summarised the condition of these assets:

- At Bedingfield: "Condition Grade 4b – large cracks and concrete spalling across the tower structure affecting columns, beams, walls, plus stains and exposed rebar. Scaffolding in place to protect operatives from falling concrete – obvious H&S risk".

[19] nes35.pdf, Figure 74

- At Eye: "Condition Grade 4a – supporting beams and underside of tank in poor condition with exposed rebar, damp patches, staining and efflorescence. Spalling concrete may be a H&S risk to operatives".

155. These were the only water towers we identified in our PR24 case as being in Condition Grade 4 or 5. We cannot abandon these towers as they are required for water supply, and so this left only three options:

- **Do nothing** – we do not consider this a viable option, as the risk to health and safety as well as the potential risk to customers is unacceptable in the long term.
- **Refurbish** (invigorate) – if feasible, refurbishment was identified to be less expensive than replacement and would provide similar benefits. The PR24 case advocated this as the preferred option in AMP8 for these assets because it would be more expensive in future to replace these assets if they deteriorated further.
- **Replace** (fabricate) – if necessary, we would have to replace these water towers. At the time of the business plan (in 2023), we identified a risk that particularly at Bedingfield, the water tower could be beyond normal repairs and might be required to be replaced. This was a more expensive option.

156. Since the PR24 business plan, we have carried out more detailed work and our supplier quotes for both Bedingfield and Eye show that these assets can be refurbished. This is therefore our preferred option, as this is strictly cheaper than replacing the water towers. Taking action now could avoid the risk of needing to replace these in future.

3.6. CUSTOMER ENGAGEMENT

157. In our PR24 business plan[20], we set out how we engaged with our customers on asset health in general, and service reservoirs specifically. We explained our understanding of customer preferences and our customer engagement in our PR24 enhancement case (NES35) and in our Line-of-Sight summary of our decisions:

> "Our customers described the decision about phasing as a "dilemma between a short-term fix and a long-term plan". Some customers were cautious about spending money before it is necessary and noted that the future was uncertain. They prioritised affordability over asset health. The majority of customers thought we should do more, noting that this could prevent costs and problems escalating in future years. They also valued safe, clean spaces for workers and communities (enhancements and other service area summaries, NES43). In the North East, customers were more likely to favour bill reductions.
>
> "Customers asked for a "hybrid, middle ground" option, that focuses on where we know exactly where work is necessary now, and where this has an immediate impact on service (and safe, clean spaces). This middle ground would be more affordable now, without taking too much risk on problems escalating in future years (enhancements and other service area summaries, NES43).

[20] Appendix A7.1, Line of Sight (NES45)

"Investments to replace concrete tanks at service reservoirs, water treatment works and wastewater treatment works were viewed as a high priority for respondents across all regions as they relate to the main function of the company - to provide a safe water supply. Most customers included asset health in their "ideal plan" (enhancements and other service area summaries, NES43).

"In our Affordability and Acceptability Testing qualitative research, customers supported our "medium" investment in asset health – seeing this as keeping pace with the required level of work, while allowing a high level of investment in other areas.

"In Essex and Suffolk, customers often preferred a higher phasing option – which included increasing our mains replacement in this area."[21]

158. We developed our PR24 plan based on the criteria from customer engagement – that is, to focus on areas where we know exactly what work is necessary now, and where this has an immediate impact on service.

159. For service reservoirs, we had detailed inspections that show asset conditions, and we understand the impact of failures. This means these met the criteria set from our customer engagement, as well as matching the areas where service impacts are most likely to affect customers (through supply interruptions).

160. This was more difficult for mains replacement, where we had less detailed information about the condition of these assets (as they cannot be readily visually inspected) and where it was more difficult to estimate the benefits of replacing a given main (or to have confidence that this targeting is effective). We prioritised civil assets at service reservoirs and treatment works in our customer engagement throughout our planning process, as these improvements were better value for customers.

161. As a result of our customer engagement, we increased our expenditure on mains replacement in 2020-25 to increase the rate of replacement. The impact on service levels was less clear for individual replacements, as it is more difficult to inspect these assets directly, but it was clear that the implied asset life was much too high, and the replacement rate would need to increase. The Water Forum challenged us to consider a higher replacement rate of 1% per year, as this more closely matched a realistic asset life.

162. As a result of our customer research at PR24, we looked at potential options for balancing affordability against an increased investment in asset health. We explored the costs of a smaller uplift in mains renewal, as well as challenging our costs and implicit allowances for our investments in treatment works and service reservoirs. This challenge led to us removing our enhancement need for service reservoirs in the PR24 plan and so allowing us to include some mains replacement without changing the overall level of investment for asset health – and so remaining close to the level of investment that our customers supported in our qualitative research. Our customers

[21] Appendix A7.1, Line of Sight (NES45), p25

had challenged us to go further to tackle potential future problems including for mains replacement, and so we included this in our investment plans for 2025-30. In our PR24 business plan, we put forward this balanced package of asset health investment that we had developed through customer engagement – including civil assets at treatment works and mains replacement (but not service reservoirs, which we deferred until AMP9).

163. Following the draft determination, which resulted in lower forecast bills than our business plan in the North East, we identified a further opportunity to bring forward this "no regrets" and critical investment from AMP9, which will reduce risks to customers and smooth bill increases over the longer term.

164. This matched customer preferences, as we had tested customer views about phasing in our published "**pre-acceptability research**" with our business plan. A strong majority (70% in the North East and 91% in Essex & Suffolk) of respondents in this research supported investments in service reservoirs now to avoid service failures, with some preferring to push back due to the cost-of-living crisis and weighing up its importance against other investments. This was the preferred option for service reservoirs, compared to just 10% of respondents who suggested that this could be pushed back beyond 2030.

165. After Ofwat's Draft Determination in July 2024, which ruled out asset health allowances in these areas in AMP8, we **asked customers** if we should accept or challenge Ofwat's decision to exclude investments on civil assets at treatment works. The majority of customers in the North East said that we should challenge Ofwat's decision, highlighting that this seemed "shortsighted" and that they didn't want "the repercussions of them breaking down in the short term". These customers felt that a small increase in bills now would reduce the risk of a higher cost in future if the systems were to fail completely.

166. Other customers felt that we should not challenge Ofwat's decisions, because they felt that Ofwat were well placed to make an educated decision on these investments and had the best interests of customers at heart.

167. We provided this evidence to the independent Water Forum, when it was considering its own response to DD24. The Water Forum said in response to DD that:

> "We found a paucity of evidence or explanation of the extent to which Ofwat has assessed the level of customer engagement and challenge of the Business Plan, and, importantly, how it may have influenced the DD. Engaging customers is in our view of critical importance and given that it can be resource intensive, it should be at the heart of decision making, especially when customer resources are being squeezed: even more reason to elicit, and listen to, their views….
>
> "The Water Forum has seen that asset health is important to customers, and NWL's Business Plan reflected this. We want to see sufficient, affordable investment in asset health as a whole to enable

> customers' expectations to be met both now and in the future. A fresh look by the regulator at the approach to tackling this issue would be welcome."[22]

168. CCW also commented on asset health in its own response to DD24:

> "Discretionary investment is limited in this determination due to the high cost of the statutory investment programmes, as trade-offs have been made to protect customer affordability. However, this has mean that some customer support investment proposals have been delayed, reduced or cut, so we remain concerned that some issues such as "asset health – civil structures on treatment works" may not be fully addressed until PR29 or beyond.
>
> "In this context, Ofwat must ensure that companies provide assurance that any deferred investment does not lead to risk to service delivery in the intervening period, and indicate what future bill impacts may be when companies have to "catch up" at a later date. We also have a concern that deferred schemes may be more urgent and costly when it comes time to deliver them."[23]

169. In addition to this, we explained to customers that we expected bills to reduce after DD24 compared to our business plan – due to reductions in tax and changes in environmental regulations and guidance (our proposed bill was 1% lower than at BP24). We **asked them for their views** on additional investments, and whether we should reduce predicted bill increases or make additional investments. Customers had mixed views, with the majority of customers in Essex & Suffolk considering that we should make additional investments – this was lower in the North East (33%, compared to 40% preferring a reduced bill) due to specific concerns about the long sea outfall proposed at Bran Sands (for this investment, we followed customer preferences and pushed back on this – but the final option of a long sea outfall is statutory).

170. The investments we proposed in service reservoir replacements at DD24, and during the CMA appeal, are the same investments supported by customers in our business planning process, and where customers (and other stakeholders) asked us to challenge Ofwat further. We note that this includes the two water tower refurbishments we propose here, which were included within our PR24 case for civil assets at water treatment works.

171. Although Ofwat's **Consumer Involvement Rule** did not exist during the PR24 business planning process, we consider that this decision would be "likely to have a material impact on customer matters" and so we have tested this against the Rule.

[22] **Water Forum response to DD24**, August 2024
[23] **CCW response to NES DD24**, August 2024

FIGURE 30 - ASSESSMENT AGAINST OFWAT'S CONSUMER INVOLVEMENT RULE

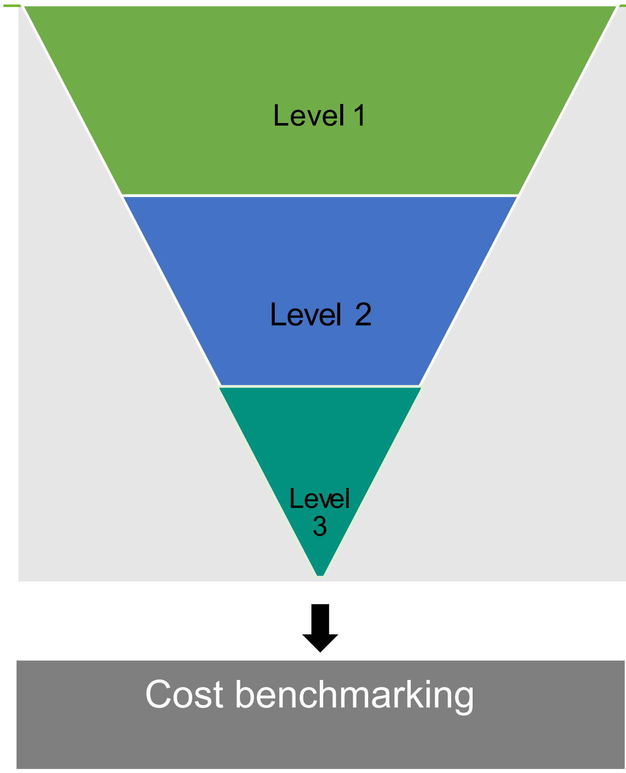
Requirement under the Rule	What did we do?
Component 1 – insight on views and preferences: To support delivery of the core requirement, undertakers must put in place, and follow, effective arrangements to appropriately understand the views and preferences of their consumers in relation to matters relevant to this rule. Such arrangements must include: • Surveys of consumers; or, • Qualitative research among their consumers; or, • Engagement with independent consumer experts; or, • Additional or alternative approaches which achieve the outcome in paragraph 7; or, • A combination of any of the above arrangements.	Our PR24 programme of customer research had effective arrangements for understanding the views and preferences of customers – we describe our strategy and approach, including triangulation, in our **business plan appendix A7**. This includes describing how we met the principles for good customer engagement. This programme included surveys of customers, qualitative (and deliberative) research, and engagement with the independent Water Forum and its Customer Engagement Panel (assessing quality of research). We published the reports from the independent **Water Forum** and **Customer Engagement Panel** with our business plan.
Component 2 – decision-making mechanisms: Undertakers must have arrangements in place at the appropriate levels of decision-making within the undertaker to deliver the core requirement. This means that undertakers must ensure that the views, experiences and preferences of consumers, including those understood as a result of component 1, are appropriately fed into, and taken into account, in the decision-making process for decisions that are likely to have a material impact on consumer matters. At Board level, in relation to decisions relevant to this rule, this must include: • Allocated time within the annual board cycle for discussions focusing regularly on consumer matters at meetings of the Board; or, • Arranging for the regular attendance of independent consumer experts at meetings of the Board; or, • Designating an independent non-executive Board member with specific responsibilities for involving consumers; or, • Holding open meetings of the Board which consumers are able to attend; or, • Additional or alternative approaches which achieve the outcome in paragraph 8 or, • A combination of any of the above arrangements.	We fully integrated customer preferences into our PR24 business planning process. Our **line-of-sight report** describes the top-down assessment from discussions at our Board, Water Forum and other similar forums (informed by our customer engagement); and our bottom-up assessment from our PR24 planning teams, reviewing a range of insights and making judgements on the findings to inform decisions through the business plan development process. This meant that the business plan proposals were continually refined using the full range of insights, not just at limited decision points. The light-of-sight report describes how we took customer views into account for each decision, including asset health. In addition to this, our **data, information and assurance appendix** describes how we made sure that we had fully met the requirements on customer research – and how our Board satisfied itself that our Business Plan really was supported by our customers (this was beyond the requirements for Board assurance). The Board sub-group met 17 times during the development of the plan; including Water Forum attendees at two meetings. Our Board nominated an independent non-executive member (Peter Vicary-Smith) as the Board lead on customer engagement, attending Water Forum meetings as required. Members of the Board sub-group attended customer engagement sessions, as well as operational colleagues, to seek to make sure that this was integrated into decision making culturally as well as practically. Ofwat confirmed through its PR24 QAA that this met its quality requirements on customer engagement and assurance.

Requirement under the Rule	What did we do?
Component 3 – Feedback on consumer experiences: In order to deliver the core requirement, undertakers must seek feedback from consumers on their experiences relevant to this rule, so that the impact on consumers of past decisions: • is understood; • is taken into account in decisions affecting current and future consumers; and • informs relevant future planning • for delivery of this rule.	The feedback component is not as relevant to this particular process, as this was about making decisions about future phasing and needs (that is, the impact of past decisions about asset health is simply that this has been delayed as much as possible by Government and regulators and there now needs to be more investment). We will repeat this research as we move towards PR29 and for other asset health in-period processes, including testing the decisions and criteria set by PR24 respondents.
Guiding considerations: Accessibility – making involvement as easy as possible for a range of audiences. • Independence – ensuring that views are not unduly influenced by the undertaker and reflect the genuine views of consumers. • Timeliness – considering consumers' views at a frequency and time that makes sense for the subject matter and allows for meaningful involvement. • Representativeness – involving a broad range of consumers or independent consumer experts that appropriately reflects the range of consumers the undertaker serves. • Transparency – being open and honest with consumers who are being involved in decisions, and being open about how consumers have been involved in decisions.	We met these requirements by: • Independence – we described in our Appendix A7 how we met the best practice principles, including using an independent research partner. The Customer Engagement Panel reported its independent views on the quality of our research. • Timeliness – we carried out this research during the business planning process, in time for these decisions to be made using customer preferences. We also asked customers how they wanted us to respond to DD24. This research is now >18 months old, but it is not appropriate to ask customers the same questions again as these preferences have not yet been acted upon. • Representativeness – we used representative customer panels for deliberative discussions, and a representative sample for our acceptability research

4. ROBUST AND EFFICIENT COSTS

172. We provided a full summary of our costing methodology in our Business Plan appendix A3 – Costs (NES04). This explained that we used a three-level estimating approach for developing our PR24 costs, as outlined in Figure 31.

FIGURE 31 - COST ESTIMATION



Level – 1 (confidence: – 50% to +100%)

Costing is carried out using Northumbrian Water's iMOD Express or Costing Tools, which utilise costing curves at the asset level. This enables order of magnitude estimating for rapid optioneering.

Level – 2 (confidence: - 50% to + 50%) – Chosen Approach

Costing is carried out using Northumbrian Water's iMOD cost estimating system, which utilises costing curves for the main items of scope. This provides detailed cost estimates for main scope items.

Level – 3 (confidence: - 20% to +30%)

Detailed bottom-up cost estimates are developed for all items within scope. This requires detailed scoping to enable more detailed cost to be established.

Cost benchmarking

We have benchmarked 100% of the preferred options against the available cost curves from other companies. Further detail is provided in Section 4.3.

Source: NWL PR24 cost benchmarking

173. We carried out costing of our service reservoir options to Level 2, using our iMOD system – our engineering scoping and cost estimating software system, which provides an integrated platform for project scope definition, whole life costing and tender evaluation. There are two estimating approaches within the iMOD system: iMOD Express and iMOD Engineering Scoping and Estimating. iMOD Express is an asset level cost triage system that provides high-level CAPEX and OPEX estimation based on a single overarching cost driver. We use this extensively for Level 1 estimations. We used the full iMOD estimation package to develop Level 2 costs for our short-listed service reservoir options.

174. The iMOD Engineering Scoping and Estimating comprises a suite of 50 engineering scoping models and a large and detailed cost database containing thousands of costing data-points on a range of components and assets. With minimum input criteria based on data that is readily available at project inception, the system can provide a detailed Capex, Opex and whole life costing for a range of interventions based on relevant cost curves. The cost estimates

have been produced using our internal Asset Policy Group (APG) Water specific cost curves for Process, Component, Contract, and Project Overheads.

4.1. PREFERRED OPTION COSTS – DD24

175. The iMOD Level 2 costs generated for the preferred options at our four priority sites are shown in Figure 32. Capex includes the engineering scope cost and overheads. These are the costs we submitted to Ofwat as part of our PR24 DD response – we note that we have updated these costs since then (see 4.2).

176. No opex costs are recorded against most sites as there will be no change from the current opex requirement. However, opex costs for Ryhope are included as the scope of the preferred solution is to build equivalent capacity at our Dalton WTW site which requires additional opex to power a new pumping station that will lift flows into the main. Therefore, the opex costs included for the Ryhope option reflect the delta between current opex costs and the calculated opex for the preferred option. AMP8 Opex costs have been calculated in line with the spend profile shown in, with only Year 5 incurring the additional opex costs on completion and commissioning.

FIGURE 32 - IMOD COSTS FOR PRIORTY SITES

Site	Preferred Option	Capex – excl. OH + risk (£m)	Capex – inc. OH + risk (£m)	Annual Opex (£m)	AMP8 Total Opex (£m)	Totex (£m)
Auton Stile	Build like for like replacement on adjacent land (10.5 MLD)	4.782	11.402	N/A	N/A	11.402
Blakelaw	Build like for like replacement on nearby land (1.5 MLD)	1.014	2.813	N/A	N/A	2.813
Ryhope	Build like for like replacement (16.5 MLD) at Dalton WTW site with Pump Station to lift into existing main	6.928	16.195	0.103	0.103 (2031/32)	16.298
Stoneygate	Build like for like replacement on adjacent land ((22 MLD)	8.865	20.507	N/A	N/A	20.507

Source: iMOD cost estimation

4.2. PREFERRED OPTION COSTS – UPDATED FOR THE COST CHANGE PROCESS

177. We undertook our costings above in 2023 and 2024 for previous submissions. For the cost change process, we have reviewed these estimates and identified some improvements to the approach to costing the service reservoir items to ensure that they better represent the scope of works that we would need to deliver at these sites.

178. In particular, we identified the following issues with the costing for the concrete structure:

- The cost curve for the roof was based on data for much smaller structures whereas these service reservoirs we will be delivering are five to eight times the size.
- There is a similar instance for the cost curve for the walls of the structure where one of the service reservoirs is significantly outside of the range of the projects included to fit the cost curve.

- The cost curve for the floor is based on data for much more general structures where for example data for above ground steel tanks are informing the costs when they are clearly not applicable in this instance.
- Overall, the scope of works was based on a pre-cast sectional design which is not feasible for a service reservoir and the ground conditions within which it must operate.

179. As a result of identifying these issues and lessons learnt from a project completed since the PR24 submission, we have updated the design for the new service reservoirs to be fully in-situ concrete, rather than a proposed pre-cast sectional design. This has resulted in recosting, using historical benchmark data from outturn projects of the same scope, and has resulted in an increase to the estimate. This change in method does not change the optioneering as this design would be used in each option (for example, the costs of building on site or on an adjacent site both change in the same way).

180. Our updated estimated costs for these projects for this case is **£83.298m**.

181. The capex spend profile for delivery of the four priority service reservoir projects is shown below in Figure 33. These figures are total estimated costs.

FIGURE 33 - OPTION TOTAL CAPEX PROFILE IN AMP8 & AMP9 (£M)

Site	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	Total
Auton Stile	1.32	2.69	2.73	2.86	2.87	3.51	**15.97**
Blakelaw	0.51	1.05	1.05	1.10	1.10	1.35	**6.16**
Ryhope	2.47	5.06	5.08	5.31	5.35	6.56	**29.83**
Stoneygate	2.61	5.34	5.36	5.47	5.64	6.92	**31.33**
Total	**6.91**	**14.14**	**14.22**	**14.74**	**14.96**	**18.34**	**83.30**

Source: iMod cost estimation

4.3. PREFERRED OPTION COSTS – WATER TOWERS

182. Our preferred option for these two water towers is refurbishment, and in our PR24 case (NES35) we used a three-point estimate of potential work that would be required. Rather than repeating these cost estimates, we have instead asked our framework contractor for a direct quote. Our contractor for this region (Stonburys) has carried out site visits and provided us with their quotes – which we provide with this submission.

183. We have then added project overheads and risk to these costs to provide the full build-up of these costs. We provide this calculation in the tables below.[24]

[24] Scope costs in the tables below have been converted from 2025/26 prices (as in Stonburys quote) to 2022/23 prices.

FIGURE 34: BEDINGFIELD WATER TOWER REFURBISHMENT COST BREAKDOWN (2022/23 PRICES)

	Costs	Note
Scope	£735,529	Stonburys quote
Project overheads	£146,832	Based on historical projects, 83% of total capex is for scope and 17% is for project overheads. These ratios have been used for this case. We have then applied 30% for risk and uncertainty allowance.
Risk and uncertainty	£264,708	
Total	**£1,147,069**	

FIGURE 35: EYE WATER TOWER REFURBISHMENT COST BREAKDOWN (2022/23 PRICES)

	Costs	Note
Scope	£385,778	Stonburys quote
Project overheads	£77,012	Based on historical projects, 83% of total capex is for scope and 17% is for project overheads. These ratios have been used for this case. We have then applied 30% for risk and uncertainty allowance.
Risk and uncertainty	£138,837	
Total	**£601,627**	

4.4. EFFICIENT COSTS

184. For this submission we have benchmarked all of the interventions covered in this submission, i.e. all 4 service reservoir projects and both of the water tower projects. The detailed results of this benchmarking are presented in our benchmarking report, attached to this submission[25].

185. The table below sets out the results of benchmarking the service reservoir projects.

FIGURE 36 -T&T SERVICE RESERVOIR COST BENCHMARKING (2022/23 PRICES)

	NWL Capex Costs (£)	T&T Benchmark (£)	Variance (£)	Variance (%)
Direct Costs	£30,988,734	£31,668,645	£679,911	2.19%
Contract Overheads	£18,593,240	£18,508,125	-£85,115	-0.46%
Project Overheads	£9,916,395	£9,073,250	-£843,145	-8.50%
Risk	£5,949,837	£3,948,500	-£2,001,337	-33.64%
Estimating Uncertainty	£17,849,511	£17,775,006	-£74,505	-0.42%
Total	**£83,297,717**	**£80,973,526**	**-£2,324,191**	**-2.79%**

[25] NWL Asset Health Benchmarking report, Cost Change Submission Appendix 1, page 8 and page 11.

186. This exercise found a small difference between our costs and the T&T benchmark, where the benchmark costs were 2.8% lower. This is a relatively small difference given the phase that these projects are at. T&T concluded that:

> "While some positive and negative variances have been identified between NWL's projects and relevant industry benchmarks, the overall assessment indicates that the costings of the service reservoirs are in line with industry standards at this stage of the project lifecycle. The estimates prepared for this sub-programme are considered robust and are underpinned by sound engineering and cost-estimating principles. Our re-pricing exercise identified only minor project-level variances, and confirms that the submission sits within the expected range of observed costs for comparable projects delivered by industry peers."[26]

187. Based on this benchmarking evidence we consider our service reservoir costs to be efficient and do not make any changes to them based on this.

188. For the water towers the results of the T&T benchmarking are set out below.

FIGURE 37: T&T WATER TOWER COST BENCHMARKING (2022/23 PRICES)

	NWL Capex Costs (£)	T&T Benchmark (£)	Variance (£)	Variance (%)
Scope	£1,121,062	£1,389,130	£268,068	23.91%
Contract Overheads	£0	£0	£0	0.00%
Project Overheads	£223,795	£277,309	£53,514	23.91%
Risk	£134,486	£166,644	£32,158	23.91%
Estimating Uncertainty	£268,971	£333,288	£64,316	23.91%
Total	**£1,748,314**	**£2,166,371**	**£418,057**	**23.91%**

189. T&T found their benchmark costs, using data from their benchmarking database, to be 23.9% higher than our estimated costs for these projects. We consider this shows that our cost estimates are efficient as they are below the benchmark based on projects delivered by other companies in the T&T database.

190. The Ofwat guidance asks us to show evidence of internal benchmarking. This is inherent in our approach to estimation – that is, the iMOD system contains historical costs for similar projects and individual items, and uses these cost curves to estimate the costs of future projects. This means that we do not need to separately benchmark these against similar projects. Our external benchmarking then allows us to extend this to a third party, independent comparison with other projects elsewhere (where we do not have access to costs for individual items from other water companies).

[26] NWL Asset Health Benchmarking report, Cost Change Submission Appendix 1, page 8.

191. For water towers, our cost estimates have not used iMOD and instead use contractor quotes. Although we have not benchmarked these costs against other internal projects directly, these contractor rates come from a competitive framework process which ensures that our costs are efficient. We have still used external benchmarking to compare this to projects elsewhere, and this shows that these costs are efficient.

4.5. DETAILED COST BREAKDOWN

192. In the tables below we set out the costs for the case as a whole across AMP8 base plan activities, the additional investment, the implicit allowance, and maintenance savings.

FIGURE 38: SERVICE RESERVOIR CASE COST BREAKDOWN (£M, 2022/23 PRICES)

	Capex	Opex	Total cost
Additional investment	83.3		83.3
AMP8 base plan	22.3		22.3
Implicit allowance	16.1		16.1
Maintenance savings	0.6		0.6
Total request	**89.0**		**89.0**

FIGURE 39: WATER TOWER CASE COST BREAKDOWN (£M, 2022/23 PRICES)

	Capex	Opex	Total cost
Additional investment	1.7		1.7
AMP8 base plan	5.2		5.2
Implicit allowance	0.4		0.4
Maintenance savings	0.0		0.0
Total request	**6.5**		**6.5**

FIGURE 40: COMBINED SERVICE RESERVOIR AND WATER TOWER CASE COST BREAKDOWN (£M, 2022/23 PRICES)

	Capex	Opex	Total cost
Additional investment	85.0		85.0
AMP8 base plan	27.5		27.5
Implicit allowance	16.5		16.5
Maintenance savings	0.6		0.6
Total request	**95.5**		**95.5**

193. Overall, our asset health case asks for **£96m** to undertake this proposed investment. The benchmarking shows that these are a good value way to meet the strong need for the investments to take place in order to maintain high quality water supplies into the future.

5. CUSTOMER PROTECTION

194. Ofwat challenged us at FD24 to "identify (how) outputs of investment could be tied to a price control deliverable" [27]. In response, we developed a PCD for service reservoirs as part of our Statement of Case for the CMA, using Ofwat's template from FD24 (neither Ofwat nor the CMA provided any specific feedback on this PCD). We have based this PCD on that template.

195. This PCD is also similar to other water PCDs, such as for raw water deterioration. This will support us in making sure that the PCD is consistent with the approach adopted in the PR24 final determinations – that is, based on a similar common framework; protecting customers if we fail to deliver funded improvements by returning the funding to customers; and incentivising us to deliver "on time" where appropriate.

196. In developing this PCD, we considered any impact on or overlaps with existing performance commitments and PCDs. There are no overlapping PCDs (with none relating to either service reservoirs, water towers or these specific sites). This investment does not have an impact on PCLs (interruptions to supply, unplanned outages, CRI, or water quality contacts) within the AMP8 period. These service reservoirs and water towers may have a very small individual impact on these PCLs because the likelihood of failure remains low for any given year; however, an individual failure which required the service reservoir or water tower to be placed out of service could have a very large impact. We cannot quantify these benefits, and these are not the driver for these investments.

197. We do not think that an adjustment is appropriate for PCLs. This will not apply in period – that is, the first outputs are not until 31 March 2030 - and any future change in performance would be very small in any case compared to the total size of the network (that is, these investments are about avoiding the low probability of high impact failures, not about improving performance).

198. We have set out the elements of PCD relating to service reservoirs to cover the whole six-year programme for replacing these service reservoirs (that is, to 2032-33) because we consider that it is more appropriate to link this to the delivery of benefits rather than to the price review cycle. Alternatively, we considered if Ofwat could set a PCD for the first three years of this programme, defined by achieving the appropriate gateway by the scheduled dates, and then consider a further PCD at PR29 for the delivery phase. This is possible, but it is important to commit to the funding for the full six-year programme (as the benefit would not be delivered before this) from the outset, and it seems appropriate to link the PCD to the delivery of benefits rather than an interim stage. Some PCDs already run beyond 2030, and this is likely to increase through in-period and gated determinations.

199. We considered whether any specific activities in the base programme should be included within the PCD. We have included the specific schemes from Figure 13 above, where these are known. We think the remaining reactive spend should remain flexible enough to be spent on projects as these arise in each year, and so we do not think this should be included in the PCD for specific deliverables.

[27] Ofwat, PR24 Final Determinations: Expenditure Allowances, p79

200. However, Ofwat could consider a slightly different mechanism – such as requiring that we spend at least this remaining base plan (set out in Figure 12) on these areas or return any gap in base funding to customers at PR29. This is similar to, for example, the network reinforcement PCD set at PR24. This is not easily implemented through PCDs, which would quickly become only a financial reconciliation mechanism (like cost sharing) rather than focusing on specific deliverables, and there may be a case for a separate mechanism for companies applying for asset health funding in period. Ofwat would also need to consider the impact of this on overall balance of risk and return, as this would interact with cost sharing mechanisms. We think this should be considered in the round during the determinations.

201. We considered time incentives for this PCD. There are only four deliverables for service reservoirs, and none of these are due to be completed within AMP8 – so there is no benefit to applying time incentives in-period (as nothing could be applied). This is similar for water towers, where the work is due to be finished by the end of AMP8. We also note that Ofwat's updated policy on PCDs means that this could be considered further at PR29 for the remaining programme if there are any concerns. There does not seem to be much benefit for customers in paying more for on-time delivery.

5.1. DELIVERY OF THE AMP8 PROGRAMME

202. Section 6.2 sets out how we are delivering our existing programme in AMP8. This shows that we are currently on track to deliver most of our programme, and the areas that we have identified as at risk of late delivery are for specific reasons (rather than a lack of capacity or effort to do so). In Section 2.2.3, we set out our AMP8 base plan for capital maintenance in this area and we confirm that we forecast to spend our base allowances in full (and exceed these).

203. Figure 13 shows that we are already using our AMP8 base allowances to refurbish the highest priority service reservoirs and water towers, and we are spending more than our implicit allowance on this. This demonstrates that we are using our AMP8 base allowance for these assets appropriately.

204. We can also demonstrate that we are efficient in delivering these types of projects. Our cost estimates for new service reservoir and water tower projects, based on our own historical costs through the iMOD estimations, are more efficient than our external benchmark (see section 4.3).

5.2. DELIVERABLE

205. This PCD will ensure the delivery of four new usable (live) treated water service reservoirs. The capacity (Megalitres, Ml) of the four new service reservoirs will replace the same existing capacity as the existing four service reservoirs. In addition to this, we will refurbish two water towers.

206. The service reservoirs to be replaced are set out in Figure 41 below, showing the capacity of storage to be built and the assigned costs (these costs are pre frontier shift and real price effects). The volume measurements refer to

usable capacity. We have also included our named schemes from base expenditure, which are all refurbishment schemes and so do not describe capacity.

207. The benefits of the service reservoir schemes will be to provide an equivalent level of storage – with improved asset health (and so remaining asset life) compared to the current service reservoirs. The benefit of the water towers schemes will be to improve asset health from current condition grade to condition grade 1 to 3 (with refurbishment in line with the activities in the proposed scope).

FIGURE 41 - PROPOSED SERVICE RESERVOIR PCD (COSTS PRE-FRONTIER SHIFT AND RPES)

Reservoir to be replaced	Unique Reference Number	Capacity of storage to be built (Ml)	Non delivery payment (£m)	Delivery Date
Blakelaw	BLKRE1	1.5	6.162	31 March 2033
Ryhope	RYHPE1	16.5	29.835	31 March 2033
Auton Stile	AUSTE2	10.5	15.971	31 March 2033
Stoneygate	STGTE2	22.0	31.330	31 March 2033

FIGURE 42 - PROPOSED SERVICE RESERVOIR PCD – BASE (COSTS PRE-FRONTIER SHIFT AND RPES)

Reservoir to be refurbished	Unique Reference Number	Non delivery payment (£m)	Delivery Date
Chirton Grange (internal liner)	CHG1	1.222	31 March 2030
Herongate (membrane replacement)	HRG1	1.070	31 March 2030
Plessey East	PLE1	0.693	31 March 2030
Longnewton West	LNW1	0.456	31 March 2030
Spring Hill	SPR1	0.431	31 March 2030
Frosterley South	FRO1	0.327	31 March 2030
Highshield	HIG1	0.318	31 March 2030
Mickleton	MIC1	0.211	31 March 2030

208. The water towers to be refurbished are set out in Figure 43 - Proposed water tower PCD (costs pre-frontier shift and RPEs) below. For water towers, we have not included a "capacity" figure as this relates to refurbishing two specific towers where the current capacity will be maintained.

FIGURE 43 - PROPOSED WATER TOWER PCD (COSTS PRE-FRONTIER SHIFT AND RPES)

Water tower to be refurbished	Unique Reference Number	Non delivery payment (£m)	Delivery Date
Bedingfield	BDF1	1.148	31 March 2030
Eye	EYE1	0.602	31 March 2030
Caister (base)	CAI1	2.438	31 March 2030

Water tower to be refurbished	Unique Reference Number	Non delivery payment (£m)	Delivery Date
London Road Pakefield Tower (base)	LRP1	1.062	31 March 2030
Framlingham (base)	FRA1	0.442	31 March 2030

209. Each intervention has been assigned a unique identifier in Figure 41, Figure 42 and Figure 43 to facilitate reporting.

210. The company will set out in its annual performance report each year of the 2027-28 to 2032-33 period, progress on delivery against the four structures which are being replaced and two that are being refurbished with a description of the work carried out at each location.

211. The update will also include cumulative spending over the 2027-28 to 2032-33 period.

212. We do not propose a mechanism to substitute the named schemes (or volumes) in the service reservoir asset health program, or the water towers that are to be refurbished.

213. Failure to carry out these named schemes will lead to the associated financial allowance at each of these service reservoirs being returned to customers at the end of the price control period.

5.3. MEASURING AND REPORTING

214. The company will report progress against deliverables as per the common reporting requirements set out by Ofwat. In addition to the common reporting, the companies shall comply with these additional reporting requirements:

- Completion status of interventions at each site.
- Updates on schemes being delayed or cancelled.
- Changes to scheme scope that results in a change to the volume of storage being delivered at a particular service reservoir.

215. Note that this reporting is for additional context and transparency for customers and relevant adjustment to allowances, non-delivery PCD payments apply if a scheme is reduced in size, excessively delayed or cancelled.

216. The provision of service reservoirs should be complete and fully operational by 31 March 2033. The water towers should be refurbished according to the scope set out in this case. For the scheme to be confirmed as complete, it must be fully commissioned, operational and in permanent use.

217. We note that our delivery programme includes milestone dates for each project, with GW4 for the four service reservoirs falling in Q1 2028. We considered if reaching this interim milestone would be a suitable PCD to set and/or assess in AMP8, but this is not consistent with the approach taken by Ofwat to PCDs so far – and so we do not propose this for this PCD. We recommend that instead, Ofwat could set these interim milestones as a baseline and

require reporting against these milestones in our Delivery Plan (using, for example, table DPW3 to report progress against milestones. Ofwat could consider this more widely for asset health programmes.

5.4. OTHER CONDITIONS

218. No additional conditions apply. We note that there are no third party funding or delivery arrangements that apply for this investment, and so customers do not require additional protection against third party funding risks.

5.5. ASSURANCE

219. Common assurance requirements apply as per Ofwat's Final Determination. In addition to the common requirements, independent third-party assurance should be provided on:

- The date that the scheme was fully commissioned, operational and in permanent use.
- That the solution delivered must be permanent and not temporary.
- That the new service reservoirs have been sized in line with the requirements set out in the Deliverables section above.

5.6. NON-DELIVERY PAYMENT

220. The non-delivery payment rate is based on the allowance assigned to each service reservoir and water tower, as defined in the 'Deliverable' section above.

221. The specific non-delivery payment will be returned to customers if the company fails to deliver any specific named scheme(s) defined in the 'Deliverable' section above by 31 March 2030 or 31 March 2033 as applicable (subject to the waiver in clause 14).

222. Non-delivery PCD payments will apply as per the formula below:

$$Non-delivery\ PCD\ payment = Sum\ of\ the\ scheme-specific\ patment\ rate\ for\ each\ site\ not\ delivered$$

6. INVESTMENT DELIVERY PLAN

223. In 2025, we asked Aqua Consultants to carry out an independent assessment of the feasibility and risks associated with the deliverability of our Service Reservoir Replacements enhancement case. We provide the full review as Appendix 7.

224. This review concluded that "the enhancement case is highly deliverable in AMP8, noting there have already been site specific considerations to understand land purchase and planning risks made even at the pre-concept design stage." This review was carried out in early 2025, when we sought funding from the CMA to begin this work from April 2026 – and so this assessed a four-year programme of work.

225. The review carried out a deliverability assessment, which identified a series of strengths and opportunities for improvements for each reservoir (including noting some potential delivery risks around land acquisition, ground conditions, and health and safety/environmental conditions, which we have taken forward to the programme risk register). This demonstrates that this programme is deliverable.

226. This assessment did not look at the wider aspects of deliverability – that is, supply chain availability, or the deliverability of the wider programme. We examined these wider aspects in our business plan, describing the steps our Board had taken to satisfy itself that the supply chain risk was manageable and delivery plans accounted for: the ability of NWL and its supply chain to expand its capacity and capability; the impact of similar levels of growth across the sector and any overall sector and supply chain capacity constraints; and key supply chain risks and capacity constraints. Appendix A6 of our Business Plan (**NES07**) describes the steps we took and the results of deliverability reviews – we revisited this briefly at DD24 when we included this case for service reservoirs for the first time.

227. In section 5 of our "Northumbrian Water – cost change submission" document, we revisit this wider supply chain risk and describe how we have made sure that sufficient resources are available for the design and delivery of our proposals in aggregate – that is, including our asset health proposals and our projects under the Large Scheme Gated Process (including Bran Sands in the 2026 cost change process). This shows that we have capacity within our supply chain to deliver the whole programme, including our cost change proposals. In section 6.1 below, we explain how this separate assessment is relevant to service reservoirs and water towers specifically.

228. In section 5 of our "Northumbrian Water – cost change submission" document, we also summarise our current delivery plan. Our existing AMP8 investment is on track, and we are confident that additional allowances can be delivered. Since this applies to all cases together, we provide the evidence for this separately in that document. In section 6.2 below, we comment on how this applies specifically to service reservoirs and water towers.

229. In section 6.3, 6.4, and 6.5 below we explain the design and delivery risks for this programme in particular, our specific stakeholder engagement needs, and our delivery programme. We provide our risk register separately as Appendix 4a and 4b.

6.1. SUPPLY CHAIN ENGAGEMENT

230. In our separate “Northumbrian Water – cost change submission” document, we describe our two primary delivery vehicles which differentiate our approach depending on the size, complexity, and technical input required of each project scope. This takes into account repeatability, opportunities to batch for efficiency, technologies, project duration, and cost.

231. We also describe how we monitor our overall supply chain capacity, and how we have confirmed that we have supply chain capacity for these programmes. This includes our service reservoir programme, which we propose to deliver over six years through our Living Water Enterprise (LWE); and our water towers programme, which we propose to deliver over three years through our Integrated Delivery Services route. Our Living Water Enterprise (LWE) is the partnership between NWL and our largest strategic, technical and delivery partners.

232. We have confirmed that the availability of materials for service reservoirs is not a high risk. As described in the individual cost breakdowns for each service reservoir (see Section 4), there are no non-standard materials required in the design. Our risk register shows that inflation or materials scarcity would likely lead to increases in costs, rather than placing the delivery of the programme at risk. In section 4.2, we explain how we have applied lessons from a previous project and explored specific design considerations to improve the deliverability (and effectiveness of design) for replacement service reservoirs since our previous submissions in 2023 and 2024.

6.2. 2025-30 (AMP8) DELIVERY

233. In section 6.3 or our separate “Northumbrian Water – cost change submission” document, we summarise our AMP8 delivery plan. This confirms that our existing AMP8 investment is on track to be delivered by the end of the 2025-30 period.

234. In our Delivery Plan Summary in November 2025, we raised some “red” and “amber” risks. Following the CMA determinations in March 2026, only one of those risks remains: that is, our **Linford WTW and borehole scheme**, which is currently behind schedule due to the inability to secure a land lease agreement, with competition from (and concerns about) other infrastructure projects.

235. This does not raise any general concerns about overall supply chain capacity. However, this is related to the general risk we raised in our Delivery Plan about planning and land acquisition. We have considered this for the service reservoirs programme in particular, which has some of these risks too. We address this in section 6.3 below.

6.3. DELIVERY RISKS

236. We have considered the design and delivery risks for this programme, and we provide our full risk register in Appendix 7.

237. We have considered a broad range of risks, based on our experiences with the Springwell service reservoir that is currently approaching completion, as well as the recommendations from our 2025 deliverability review and standard considerations for this type of project. This is a much larger service reservoir (42Ml), than any within this programme and has been completed in just over 5 years. We have adapted our preferred design for this service reservoirs proposal to take these lessons learned into account (see section 4.2).

238. Our highest risks relate to the availability of funding (as this is not affordable from base expenditure allowances), which will be mitigated through the evidence we provide in this enhancement case. The risk register considers planning permission and land availability, which may lead to delays in the early part of the project, as well as site ecology and archaeology (which will be considered further through surveys). The risk register includes the mitigation plans for addressing these risks. We note that this will be developed further at the launch of this project, including specific risks and mitigations for each site – and as each project moves into design and contract stages, this will be developed and costed further.

239. We have set out a six-year delivery programme for these service reservoir replacements, which is longer than our previous project at Springwell. This reflects the risks of land acquisition and planning, as well as potential wider supply chain risks (such as from the Iran war and other events).

6.4. STAKEHOLDER ENGAGEMENT

240. We discuss our engagement with DWI in section 2.6. This will continue through the design and construction of the new service reservoirs.

241. We do not yet have any engagement with local planning authorities, and any planning strategy will be developed in the first stage of the project itself (between GW1 and GW2). This engagement will be led by our project manager and should involve our selected contractor from LWE. We will also engage with local stakeholders – particularly where new reservoirs are to be constructed near other properties, such as for our Ryhope service reservoir illustrated in section 3.4, and where this might involve activities such as tree cutting. We will use **our Community Hub** to describe the projects and engage with stakeholders.

242. For water towers, we do not expect to have an extensive engagement plan in the same way. We will still engage with very local stakeholders where these works are expected to be disruptive, using our standard approach to such work.

6.5. DELIVERY PROGRAMME

243. We set out a five-year programme to construct these four reservoirs at PR24. In our Statement of Case for the CMA, we created a shortened four-year programme to deliver this in the remainder of AMP8. We think this shorter programme would be impractical given the likely further constraints on supply chain availability towards the end of the period (this risk is not specific to Northumbrian Water's supply chain, but we rely to some extent on national capacity).

244. As we describe in section 6.3, we have set out a six-year programme for our service reservoir replacements.

245. This means that we would expect to start this programme from April 2027 and complete construction by March 2033. We would like Ofwat to confirm funding for the first three years of this programme in-period, and then provisionally confirm that the last three years of funding will be included at PR29.

246. For our two water towers, we have set out a three-year programme. This means that we would expect to complete this by March 2030. We would like Ofwat to confirm this funding entirely within period.

247. We attach our delivery programme (including our outline plan) as Appendix 5.

7. ASSURANCE

248. We have provided separate technical and commercial assurance reports from our suitably qualified providers (the same providers as for our delivery plan and large scheme gated processes). These confirm that the proposed investment meets the requirement in the Ofwat guidance.

249. In response to this assurance, we have addressed issues raised by our assurance providers. There are no remaining red issues.

250. The assurance report closed some issues as "amber", mostly because there was not time for a final review of the information. We list these and explain what we have done in response (since the assurance report) in Figure 44.

FIGURE 44 - AMBER ISSUES

Issue	Action taken
The published assessment criteria / requirements and the examples of what good looks like from Ofwat require companies to cover all scope elements of the proposed expenditure in the proposed PCDs (i.e. investment delivered or covered by existing PR24 base expenditure allowances, and the investment delivered through requested additional allowances through the cost change process). Currently, the PCDs proposed including the list as per Figures 38 & 39 [now Figures 41 & 43] only covers £85.047m expenditure and not the entire £96.038m expenditure (the expenditure from the AMP8 base plan is not included).	Following the assurance, we included all "named schemes" for service reservoirs and water towers as specific items in base PCDs. In response, the assurance provider reduced this issue from "red" to "amber". This remains "amber" because a large part of the base expenditure is not covered in PCDs (£17.6m out of total £22.3). We explain this in Section 5, where we list the schemes currently in our base plan and the need for a reactive programme of investments that remains flexible. We suggest possible ways Ofwat could take this into account for setting PCDs.
Management confirmed that they will attach the full cost breakdowns from iMOD with the investment case submission. However, the assurance team noted that the cost breakdown for the named schemes pertaining to additional investment from AMP8 base plan are not provided.	We have attached the full cost breakdowns from iMOD for our service reservoirs. We have not provided cost breakdowns for the additional investment in the AMP8 base plan (that is, the schemes in Figure 13) because these costs are based on current project forecasts rather than iMOD cost build ups.
The investment case should be updated to clearly show the internal cost benchmarking and its outcomes. We understand that iMOD is not applicable for Water Towers.	In response to the original "amber" risk, we updated the case to include text related to iMOD and how it supports internal cost benchmarking. However, the assurance provider noted that this does not explain how this was done for water towers. In response, we added an additional paragraph to section 4.4 to explain this.

8. APPENDICES

1) Appendix 1 – Aqua Consultants Review of Northumbrian Water's Approach to Option Development
2) Appendix 2 – Service Reservoir NPVs
3) Appendix 3 – Site Options and Selection Process – NES35a Table 4 Expansion
4) Appendix 4a/4b – risk registers
5) Appendix 5 – Delivery Programme
6) Appendix 6 - SR and WT Costing Information
7) Appendix 7 – Aqua Consultants, Deliverability Report Service Reservoir