COST CHANGE

PROCESS

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ASSET HEALTH INVESTMENT CASE – BOREHOLES

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. Therefore, at PR24, we chose to 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. We are continuing to improve our understanding and identification of needs, and 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 our business plan (NES35), we noted that boreholes are among the most critical assets – but there is some degree of short-term resilience (and so asset failure does not always lead to immediate permanent repair). We have continuously been increasing our spending on boreholes, but we said we did not expect to spend significantly more than our historical expenditure in AMP8. However, since 2023, in seeking to improve our asset health understanding we have surveyed our boreholes and found that in addition to the two borehole refurbishments in our AMP8 plan, there are several others in condition grade 4 and 5 that should be refurbished or replaced in AMP8 and AMP9.

6. This means that we are proposing boreholes among four programmes of work beginning from 2027/28 (and including some base expenditure that has already started):

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

- An £95.5m programme for replacing **service reservoirs** (as set out in our DD24 representations in NES35A); and to refurbish two **water towers** (part of what was set out in our business plan for PR24, for water assets in NES35).
- An £84.2m programme for replacing and refurbishing **specific civil assets at wastewater treatment works** (as set out in our PR24 business plan in NES35).
- A £146.3m programme for rehabilitating and replacing **more gravity sewers**; and
- A £53.9m programme for replacing and rehabilitating **boreholes** (this is presented for the first time in this case).

7. In this document, we set out the business case for this expenditure on **boreholes**, including why this is needed; how we have identified the right options; how we know our costs are robust and efficient; how customers will be protected; and how this will be delivered.

2. NEED FOR STEP CHANGE IN INVESTMENT

8. In this section, we show that a step-change investment is needed for boreholes. A systematic, proactive programme of renewals for boreholes can help to mitigate the risks from asset deterioration, demand growth and licensing restrictions now – and help to keep pace with future asset deterioration and other future risks such as climate change.

9. We demonstrate that although we are spending our base allowances in this area, the implicit allowance for rehabilitating or replacing boreholes is very low and does not allow for any proactive renewals (section 2.2). We also show that we are overspending this implicit allowance in AMP8 already (2.2.3), and so further funding would be needed to deliver a programme of proactive renewals.

10. We describe the current risks (2.3), including the need to avoid service failures and to increase the reliability of supply systems. This is particularly relevant for boreholes in Suffolk, where our Water Resources Management Plan 2024 (WRMP24) shows the need for water supply schemes to mitigate pressures from an increasing population and abstraction licence reductions. We also explain how we have identified asset health risks for specific boreholes, using new insights from our asset maintenance approach.

11. If a borehole fails, there would be a significant risk to operational performance and customer service. As many supply areas are standalone systems with no alternative source, a failure could immediately interrupt water supply. In addition, a borehole failure increases the likelihood of water quality issues, including potential ingress and contamination, which can compromise the safety and integrity of the drinking water.

12. We also assess the future risk, including asset deterioration modelling (section 2.4). This shows that in addition to addressing the current risk, we will likely need to address around 3 boreholes per AMP in the future to match deterioration rates (that is, around 3 boreholes will move into CG4 in each AMP). We note that climate change may

increase this future need, due to increasing demand on aquifers and risks of saline intrusion (section 2.4.3). This adaptation to climate change is central to our long-term asset class strategy in this area, and we expect this to increase above the forward-looking deterioration rate in future as our most recent assessments are incorporated into our forward looking plan (2.5).

13. We propose asset health investment in **19 additional boreholes** for this cost change process, with all schemes being delivered by 2032/33 (we expect that the replacement projects will take six years to complete). Figure 1 outlines our prioritised schemes, their asset health scores and the action we have proposed. This is in addition to the work already in our base plan, which is set out in Figure 9 and Figure 10.

14. The boreholes identified in this case all have a critical asset health score and therefore run the risk of failure, for example through collapse or water quality degradation. This can impact our service to customers as the borehole can run dry or cannot meet demand, collapsed walls can pump sediment or contaminated water through the system, failing water quality standards and we can end up with forced shutdown or restrictions on the water area.

FIGURE 1: PROPOSED MEASURES FOR ASSET HEALTH REOPENER

Site	Current asset health score	Action
Syleham Crag	5 (3.75 E)	Drill replacement offsite borehole to allow the Crag and Bleach Green boreholes to be acidised or mains swabbed without affecting the deployable output at Syleham WTW (that is, to allow these to be taken offline).
Holton Valley Farm	4	Drill an additional production borehole to produce the full licenced flow into Holton WTW. Holton Bore No 3 and No 4 are in poor condition- failure on either bore would reduce Holton WTW by approx 50%. Walpole can support Holton by using the North Halesworth/Holton res inlet valve, but this adds additional demand on Walpole. In periods of high demand, Walpole storage would be at risk.
Mendlesham Works	4	Drill new standby borehole. Current borehole is in poor condition - riser or pump is lodged in casing and has moved on occasions. This has caused elevated turbidities and the site has been shut down on these occasions.
		Carry out pending remediation work following construction of new standby borehole.
Bleach Green	4	Acidise borehole to clean casing and increase flow. This is needed because boreholes are iron rich and yield drops off due to iron deposits.
Saxmundham	4	Drill new borehole on site. Abandon existing (unusable) borehole. Boreholes are in poor condition, originally drilled in 1905. We currently have a project in progress to send Saxmundham Borehole water to Benhall to improve resilience in the Blyth area.
Halesworth	5 (4.5 C)	Drill new remote borehole. Current borehole has been relined 2 x times, and the liner is in poor condition. Failure of Halesworth would reduce Walpole deployable output by 33% (20l/sec). In periods of high demand, Walpole storage would be at risk.
Waveney Chalk	5	Drill & establish a replacement borehole on site. Abandon existing borehole. The borehole lining is in poor condition, and this borehole is used when the river Waveney has high nitrates. Failure of this borehole would reduce Barsham WTW's overall output.
Puddingmoor	5 (3 D)	Drill additional borehole. Current borehole is in poor condition – in 2025, turbidity spikes have been an issue. Voids on site caused crane to tip over - work ongoing to rectify issue. Borehole is currently out of supply.
Barsham Shipmeadow	4 (4.5 C)	Drill additional borehole. The yield from this borehole has dropped off. We have completed acidisation on several occasions, but the flow does not fully recover after acidisation. Failure affects Barsham WTW DO.

Site	Current asset health score	Action
Barsham Hall	4	Drill additional borehole. The current borehole lining is in poor condition - affects Barsham WTW DO.
Holton	4	Drill additional borehole - required to allow for remedial work to completed on existing boreholes without affecting the DO of Holton WTW. Holton Bore No 3 and No 4 are in poor condition - failure on either bore would reduce Holton WTW by approx 50%. Walpole can support Holton by using the North Halesworth/Holton res inlet valve, but this adds additional demand on Walpole. In periods of high demand, Walpole storage would be at risk.
Bungay	5	Drill additional borehole to allow existing CG5 borehole to be abandoned. The other existing borehole at Bungay could be cleaned and maintained, and if quality is acceptable allowing for a duty/standby arrangement to continue with the new borehole.
Fowberry Mains A	4	Headworks refurbishment (grout annulus)
Fowberry Borehole treatment 1	5	Drill additional (standby) borehole
Fowberry Mains B	4	Acidise borehole to clean casing and increase flow
Thornton Bog	4	Refurbish borehole casing to combat high turbidity
		Perform surveys to assess borehole condition once turbidity is lowered.
Felkington	5	Refurbish borehole casing to combat high turbidity
		Perform surveys to assess borehole condition once turbidity is lowered.
Fulwell	5	Perform surveys to assess borehole condition, contamination, and second shaft access
Benhall	4	Relining borehole No 4 would add additional resilience on site at Benhall wtw.

Note: Bracketed scores are scores assessed specifically for the AH Roadmap Condition Grade selections, inclusive of headworks, hence why some scores may aggregate towards a better condition grade due to headworks being in better condition (i.e., aggregated score).

15. The measures in Figure 1 would cost an additional £47.1m (see section 4). In section 2.2.4, we explain our total proposal of £53.9m – this includes this additional £47.1m but also takes into account our AMP8 base plan (see 2.2.3) and the implicit allowance we estimate from base totex models (see 2.2.4 for the total calculation).

2.1. HISTORICAL INVESTMENT AND CHANGE OVER TIME

16. The data we provided to Ofwat in November 2025 (the workload and expenditure dataset) showed that we had 191 activities and £3.33m in capex maintaining borehole assets over the 10-year timeframe. This data only shows the direct capital maintenance of these assets; we note that we still invested in other elements of these systems. For example, we have built new treatment assets to mitigate deteriorating ground water quality, where we are experiencing increasing nitrates and turbidity – in the Fowberry and Berwick systems, we have invested an additional £25m in developing such new treatment assets to filter out turbidity and sustain water supply. Our boreholes in different areas have different issues as the geology impacts the raw water quality: in the North East, we have invested in turbidity treatment; in Essex & Suffolk we are instead using multi-stage treatment to remove predominantly iron and manganese. This reflects pressures from climate change and increasing water quality requirements (compared to when boreholes were drilled), but there is also some impact from asset health (see 2.3.1) which must be managed.

17. We schedule all wells and boreholes to be inspected every five years, or at the recommended increased frequency following guidance in the previous inspection reports. We have agreed this frequency of inspection with the Drinking Water Inspectorate (DWI). Our asset investment and tactical planning teams work with any key stakeholders to produce a candidate list for the planned inspection work based on risk and specialist knowledge.

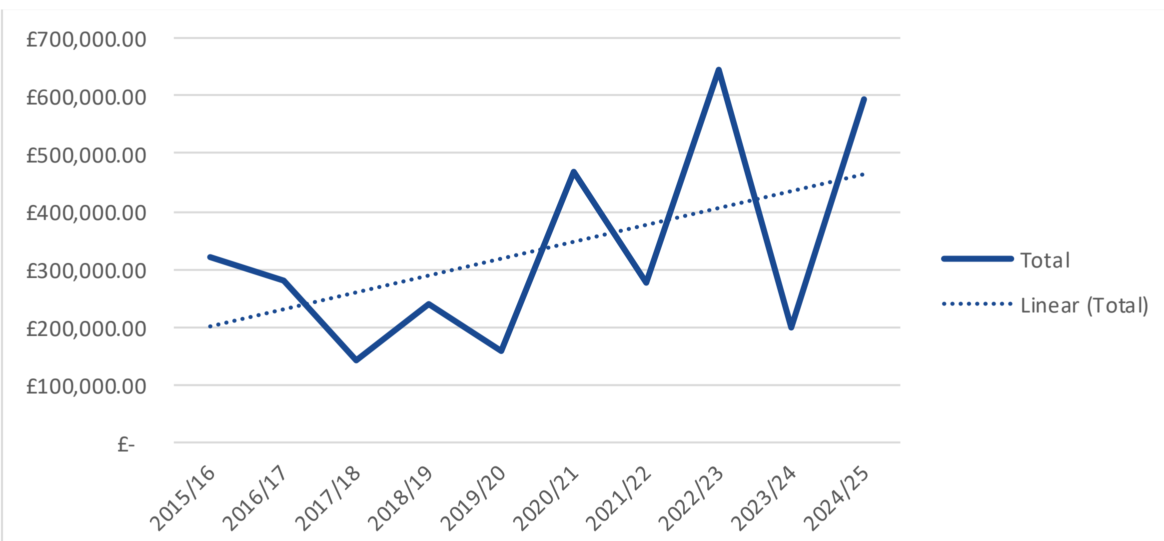
18. Following these inspections, we identify any need for minor works by raising an "investment need" in our Copperleaf system. Any issues identified can then be prioritised for investment within the budgets allocated from base expenditure. This produces a candidate list of planned work for the following year.

19. While we have historically had an ongoing and robust programme for assessing all boreholes, we did not use the quantifiable scoring system (that is, matching the new Ofwat/Binnies condition grading system) for this until our most recent review. There has not been time (since this new grading system was set) to review all historical reports to match the new system, and so we have outlined our investment in the past in this document. Our most recent and future investments will have grade scores.

20. This data only shows the direct maintenance of those assets and there is additional expenditure that is relevant and should be considered here.

21. Figure 2 outlines the spending per year on boreholes over the last 10 years. This shows a consistent increase in our investment over AMP6 and AMP7.

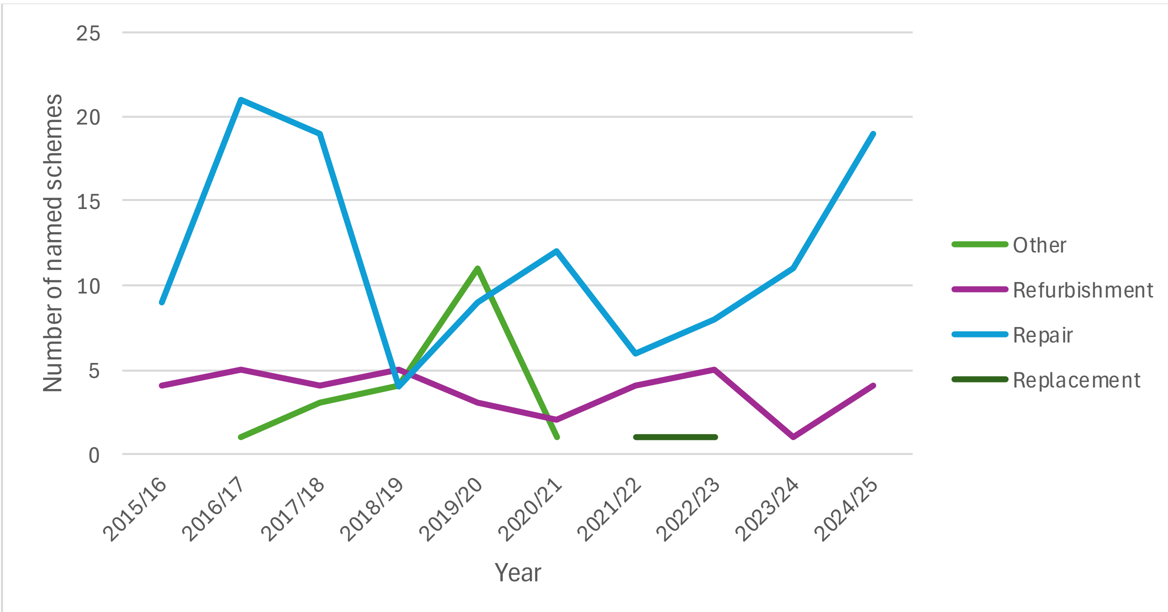
FIGURE 2: DEDICATED HISTORIC BOREHOLES INVESTMENT



22. We can break down the workload and expenditure information down to show the types of work this includes. Figure 3 shows that repair work has consistently been the most common type of work we undertake. This matches our experience of the challenges we find in carrying out proactive maintenance due to the limited base expenditure available (see section 2.2) and the licensing limitations (see section 2.3.3). This means that most works are reactive

and often more costly. This will only continue to increase if we do not carry out more work to replace and refurbish our boreholes.

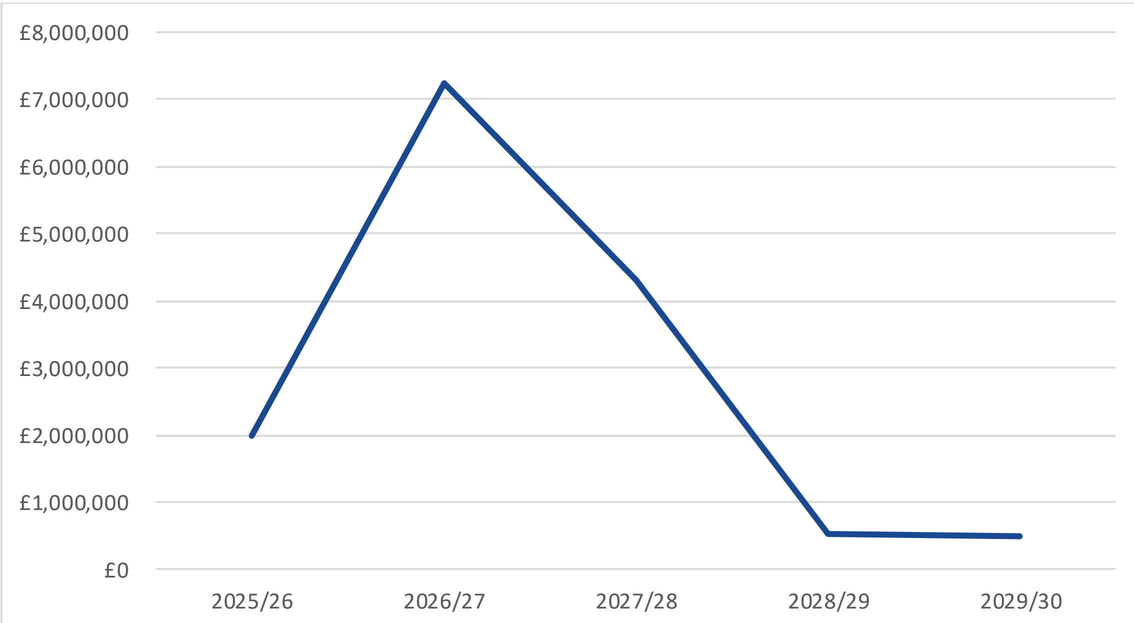
FIGURE 3: DISTRIBUTION OF HISTORIC WORKTYPE



23. In section 2.3, we describe the increasing importance of our groundwater assets and how this creates more risk than in the past. Figure 4 shows that we have identified significant need for borehole works in AMP8 and have therefore committed to a range of projects at a much higher level of investment than previously. We note that the implicit allowance for refurbishments and replacements (as calculated in section 2.2) is just £0.36m per year.

24. We provide more details about our historical spend in section 2.2. However, it is important to note that this funding profile is still very limited compared to our business need due to consecutive financial restraints from base expenditure allowances. We would ideally spend significantly more.

FIGURE 4: PLANNED SPEND PROFILE (2022/23 PRICES)



25. In total for AMP6 and AMP7, we spent more than our implicit allowance (an average of £0.437m per year in AMP7, compared to the annual implicit allowance in AMP8 of £0.360m per year (2022/23 prices) – that is, £1.8m for the whole AMP). However, in AMP8 we expect to spend an average of £1.7m per year (this is our current base programme, before any additional expenditure proposed in this case). This is not just a particular peak in AMP8 – as we explain in sections 2.3 and 2.4, we expect that at least this level of expenditure on replacements and rehabilitation will be needed just to keep pace with asset deterioration. This need for expenditure is growing over time.

2.2. WHAT BASE BUYS

2.2.1. Asset health roadmap – comparison of total spend on boreholes

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

27. This data shows that we spent less than the sector median on boreholes over AMP7 and in the longer term. This is a very small part of sector expenditure (we spent on average 0.1% of our base allowances, compared to a sector median of 0.2%). However, it is clear from the dataset that there is a large amount of variability in expenditure, with ten companies spending between 0% and 0.2% and the remaining seven companies spending an average of 0.8%.

28. We would expect this variability for boreholes, because although these make up around 30% to 35% of the total public water supply, dependency on boreholes varies significantly by region and specific water company.

29. For Northumbrian Water, just 7% of our water is derived from groundwater[2]. This compares to 27% for Severn Trent, 50% for Anglian Water, and 67% for Southern Water. Each of these companies has spent a higher proportion of its base expenditure on boreholes than we have in the last ten years, and it seems very likely that this is partly because these companies rely much more on boreholes. We note that some of our areas are 100% groundwater derived with limited mitigation capability from other sources, and in those areas these assets are critical – however, the “company level” statistics are important for the purposes of comparing “what base buys”.

30. This is unusual among the priority asset classes, as we would not see such a strong effect for assets such as water mains, gravity sewers, or civil assets at wastewater treatment works (all companies have these, broadly speaking). We would expect to see this effect to some extent for service reservoirs and water towers, but this is not as pronounced (for example, Anglian Water has 0.26 service reservoirs and 0.13 water towers per Ml/d of potable water delivered; but Southern Water has 0.48 service reservoirs and 0.02 water towers. Northumbrian Water has 0.31 service reservoirs and 0.04 water towers.)

31. We think this is an inherent problem with using comparative data to estimate implicit allowances for each asset class individually – there will always be some asset classes like boreholes, where some companies will naturally spend more on an asset class where they have more assets. Estimating the implicit allowances individually and only allowing additional expenditure when it is beyond the implicit allowance would mean that overall, companies would receive more money than they would need for asset health (because this does not take into account where companies have an efficient spend which is less than the implicit allowance). Similarly, it would look like companies had not spent their historical base allowance on particular asset classes, but this would likely not have been needed (and would not have been efficient to do so). In our case for civil assets at wastewater treatment works, we proposed grouping the assets to compare spending across companies to help mitigate this effect (we have still calculated implicit allowances separately).

32. We cannot see an obvious way to overcome this difficulty while still using a comparative approach across the sector. We explored the use of normalization, using indicators such as the distribution input attributed to boreholes, to understand if this would give a clearer picture for each company. However, this does not seem to work particularly well, perhaps due to lumpy investment in a few years in the dataset.

33. Nevertheless, in sections 2.2.2 and 2.2.4 we have used the expenditure and activity dataset to estimate the implicit allowance – with the assumption that this method would be appropriate. We already plan to spend at least the

[2] PR24 business plan tables, CW5

implicit allowance estimated below in AMP8 in base expenditure (as demonstrated by Figure 9 and Figure 10), so this does not make a great deal of difference in demonstrating that we need additional funding.

34. We note that we did not spend our implicit allowance in AMP6[3]. As we explain above, this does not mean we have not spent our allowance efficiently – simply that we have other priorities to spend this on, with relatively few boreholes compared to other companies. This is part of the same inherent problem with using comparative data to estimate implicit allowances, and we know that (for example) Economic Insight has done some work for Water UK that illustrates this uncertainty more clearly across the sector. For the priority assets, we have overspent our implicit allowances *in aggregate*, and we have previously shown in PR24 that we spent our capital maintenance allowances (post cost sharing) over the long term. This does not allow us to automatically conclude that we have spent efficiently in previous AMPs; but the relatively low proportion of boreholes for Northumbrian Water suggests that we should be spending less than some other companies on boreholes. We note that we did spend more than our implicit allowance in AMP7, and because of this, we spent more than our implicit allowance over the ten-year period from 2015/16 to 2024/25 in the asset health dataset.

2.2.2. Implicit allowance using historical outturn spend

35. We explain our approach to estimating what base buys and the implicit allowance for Northumbrian Water in section 6.2 of the separate "Northumbrian Water - cost change submission" document. Here we present a summary of the findings as it relates to boreholes, but more detail can be found in that document including, for example, why we did not place any reliance on the econometric approach.

36. 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 5 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 5 - 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

[3] Strictly speaking, this implicit allowance is based on AMP8 only so we have not calculated the equivalent AMP6 or AMP7 implicit allowance from the approaches used then. However, the comparison is still worth examining as it indicates the level of investment that might be included from base.

37. Across the sector, our calculations show that the share of base cost spent on boreholes can be very different under the different options – the largest differences reflect the change from median to average; but we also observe a large difference between long-term and short-term calculations (Figure 6). The share doubles between median and mean. For median values, the share halves when moving from long-term to short-term average.

FIGURE 6 – PROPORTIONS OF BASE COST SPENT ON BOREHOLES UNDER EACH METHOD 2A TO 2C

Company	2a (10 years)	2b (9 years)	2c (5 years)
ANH	0.6%	0.7%	0.9%
NES	0.1%	0.1%	0.1%
UUW	0.8%	0.8%	0.8%
SRN	0.8%	0.9%	0.0%
SVH	1.6%	1.6%	2.0%
SWB	0.0%	0.0%	0.1%
TMS	0.2%	0.2%	0.2%
WSH	0.2%	0.2%	0.1%
WSX	0.8%	0.9%	0.8%
YKY	0.1%	0.1%	0.1%
AFW	0.3%	0.3%	0.3%
BRL	0.0%	0.0%	0.0%
PRT	0.0%	0.0%	0.0%
SES	0.0%	0.0%	0.0%
SEW	0.5%	0.5%	0.5%
SSC	0.1%	0.1%	0.0%
Sector median	**0.2%**	**0.2%**	**0.1%**
Sector average	**0.4%**	**0.4%**	**0.4%**

38. This is due to the variability that we observed in section 3.2.1 – the median spend over 10 years is 0.2% of base allowances, but the mean is 0.4%; similarly, the median drops from 0.2% over the long-term to 0.1% over five years.

39. We think the median provides a more appropriate measure here, because this is less sensitive to a few large results. Figure 6 shows the variability in this data, and the expenditure in this asset class is dominated by a few companies (particularly ANH, SEW, SRN, UUW, WSX, and SVE). For some companies, the difference between AMP7 and ten-year expenditure is striking – for example, Southern Water had expenditure in just one year of the ten year period. However, the investment is still quite lumpy even when the two data series are similar (for example, two-thirds of Severn Trent's investment falls into the four year period from 2018/19 to 2021/22; more than 80% of United Utilities' investment falls into the three year period from 2018/19 to 2020/21 – together, these two investment periods make up almost half the sector's investment). It is not clear that comparative data can provide a particularly good estimate of the implicit allowance here.

40. As we have previously set out in asset health cases, we think that 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 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 can help to smooth out lumpy investments. For this asset class, we can see that replacements have been moderately lumpy.

41. We note that although there is a difference between long-term and short-term median here, this difference would disappear if we were to include "repair" and "other" expenditure data in the calculation of WBB (a median of 0.4% of base expenditure under either method). This suggests that although replacement and refurbishments have been displaced in AMP7, the total expenditure has stayed constant because repair activity has increased.

42. In the circumstance we think an appropriate compromise between Ofwat's desire to use the longest time span of data versus the closer link between more recent data and UQ allowances, and likely deteriorating quality as you go back in time is to triangulate between the two approaches.

43. For the reasons stated above, our proposed approach is to use the mean of the 10-year and 5-year UQ period estimates calculated using an industry median. This means an implicit allowance in AMP8 of **£1.8m** for Northumbrian Water.

2.2.3. What is in our AMP8 base plan already?

44. Figure 7 outlines the distribution of spend across the AMP within our wells and bores base programme totaling £6.3m and Figure 8 outlines the distribution in our sub-programme totaling £2.4m. We make this distinction because our £2.4m sub-programme is a capital maintenance budget allocation to this asset class, which allows flexibility to spend on different projects depending on need, rather than a specific list of projects. This flexibility is needed to deal with issues arising in period.

FIGURE 7: WELLS AND BORES NAMED SCHEMES SPEND OVER AMP8 (2022/23 PRICES)

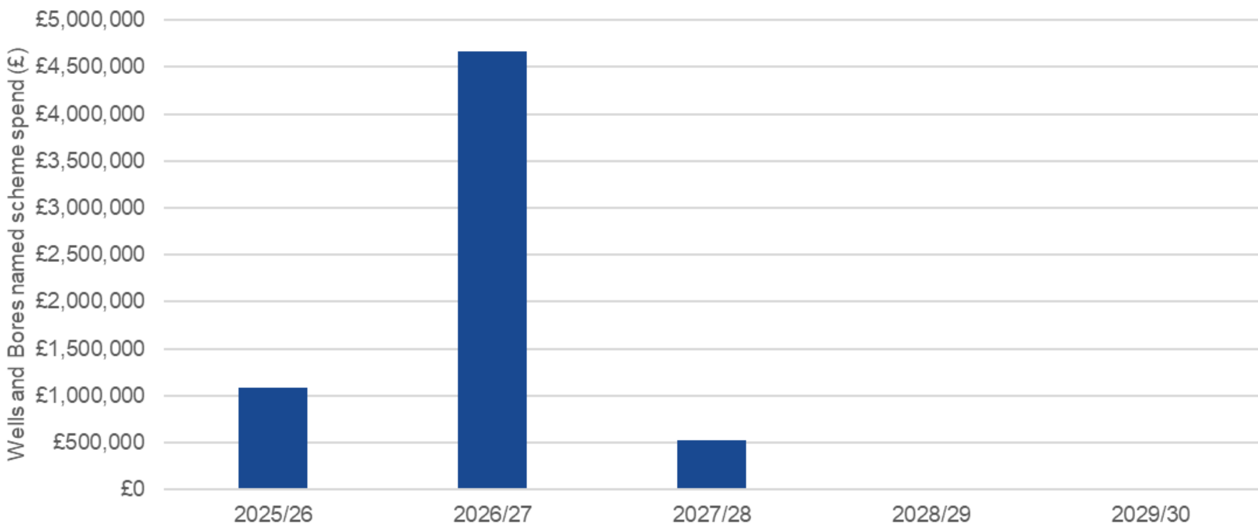
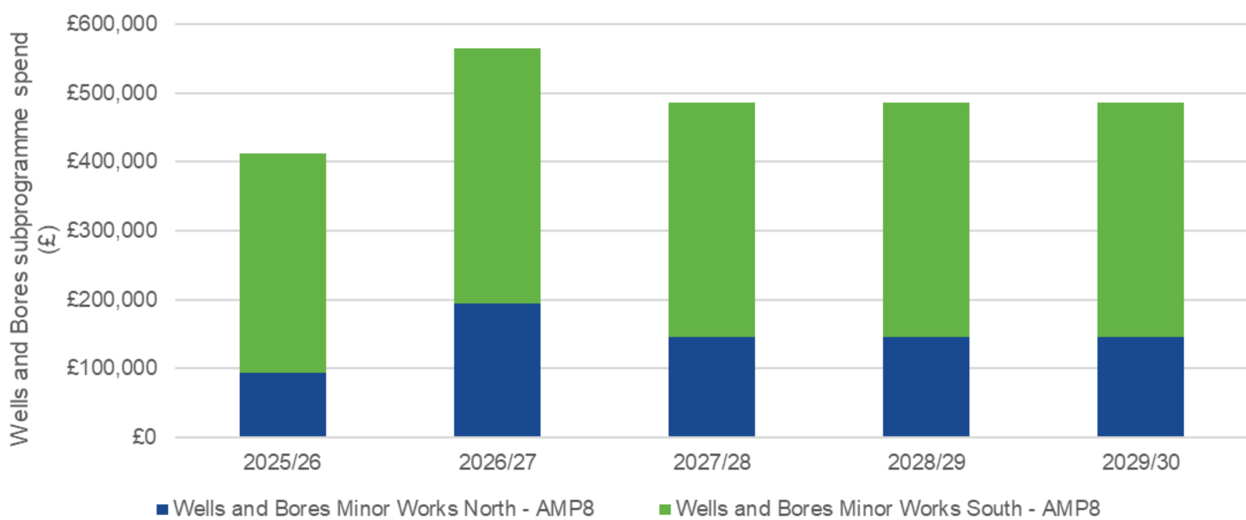


FIGURE 8: WELLS AND BORES SUBPROGRAMME OVER AMP8 (2022/23 PRICES)



45. Figure 10 outlines the distribution of the planned expenditure on boreholes and wells for AMP8 – including the programme we propose to complete if this case is accepted.

46. This spending is vital to asset health on our network. In addition to this, we are confident in our delivery and previous programmes have delivered outcomes that offer unquantifiable (or immediate financial) benefit, including:

- Boreholes installed under *Project Groundwater Northumbria* provide essential data for mapping groundwater behaviour and identifying flood-risk areas, improving predictive capability for climate-driven groundwater challenges.

- Data from monitoring boreholes helps Northumbrian Water and partners understand and manage groundwater flood risks following significant groundwater flood events (e.g., 2016), contributing to long-term resilience.
- We have used borehole drilling to understand and mitigate water quality issues in sensitive coastal areas. For example, at Cullercoats Bathing Water, 17 monitoring boreholes are being drilled to understand groundwater contamination contributing to deteriorating bathing water quality. This supports evidence-based interventions and ensures we can demonstrate responsibility for impacts.
- Boreholes allow continuous monitoring throughout the bathing season, strengthening water quality protection and compliance with environmental expectations.
- While not always explicitly labelled as “borehole investment,” groundwater and borehole monitoring play a central role in our broader resilience strategy.
- Northumbrian Water remains one of the environmentally stronger performers in the sector (consistent 3–4 EPA stars in recent years), partly supported by greater understanding of groundwater interactions and risks, which borehole monitoring helps provide.
- At Ovingham Raw Water Pumping Station, refurbishment and overhaul of the submersible borehole pump and 3.3kV motor were critical to maintaining supply to Newcastle and Tyneside, especially during high-demand periods.
- At Murton WTW, borehole-related turbidity problems and ageing treatment processes previously forced reliance on tankering to maintain supply. Investment in treatment renewal improved resilience and reduced supply disruptions.
- Many NW groundwater sources serve large zones (e.g., Murton WTW supplying Berwick and surrounding properties). Renewed assets reduce the risk of cascading service failures.
- In our WRMP24, we commit to ensuring reliable supplies for 25 years; resilient groundwater sources remain central to this strategy.

FIGURE 9: AMP8 SUB-PROGRAMME FOR WELLS AND BORES (2022/23 PRICES)

	AMP8 total	Comments
Wells and Bores Minor Works North - AMP8	£724,882	Asset group strategy has highlighted under-investment in these areas historically so there has been an uplift to AMP8 budget.
Wells and Bores Minor Works South - AMP8	£1,707,970	
Total	**£2,432,852**	

Note: this table shows only costs for minor refurbishment and replacements works

47. As we describe in paragraph 44 above, this sub-programme does not have specific named schemes as this depends on priorities in-period. Figure 10 below shows the specific named schemes that we have planned from our base expenditure. In total, our base programme is £8.7m – that is, the £6.3m in Figure 10 and the £2.4m in Figure 9 together.

48. In section 5, we do not propose specific PCD elements for our £2.4m subprogramme but instead propose that spending this budget should be a condition of meeting the PCD. We propose specific PCD elements for the larger named schemes that are listed in Figure 10.

FIGURE 10: AMP8 NAMED SCHEMES FOR WELLS AND BORES (2022/23 PRICES)

	AMP8 total	Comments
Benhall 1 replacement	£1,192,367	The existing bore on site has deteriorated and is in poor condition, this scheme is to replace that asset.
Felkington Borehole replacement	£73,552	Felkington bore has issues and a new bore to replace Felkington has been drilled with most project spend occurring in AMP7. However, the new bore is not successful, and future spend will be required. This is evidence of the risks that drilling boreholes is not guaranteed and there is risk and uncertainty. This is the tail end of the expenditure which caried overo Y1 AMP8.
North Dalton Refurbishment (HazRev)	£3,982,138	Investment to install new pumping control assets (vsd) and filtration to improve quality/reduce turbidity.
Rickinghall Bore replacement	£54,724	Works on new bore and treatment at Rickinghall in AMP7, this is the tail end of the expenditure which spilled into Y1 AMP8.
Stifford Well refurbishment (HazRev)	£971,075	Asset out of service, refurbishment required to bring it into service, £value is to get full definition to project Gate Way 4 it is not the full project cost.
Sunderland GWS Refurbishment	£8,820	A programme of work was carried out on a number of the bores and WTW assets in Sunderland GWS. This is the tail end of AMP7 multi-site expenditure.
Total	**£6,282,676**	

Note: this table shows only costs for larger refurbishment and replacement works (“named schemes”). We note that the “Benhall 1 replacement” scheme in Figure 10 relates to a different borehole to the “Benhall” scheme proposed as additional expenditure – the current base scheme replaces “Benhall 1” with a new “Benhall 5”; whereas the “Benhall” scheme proposed in Figure 27 is to reline “Benhall 4”. Similarly, the “Felkington borehole replacement” scheme described above was to create “Felkington 2”, whereas the “Felkington” scheme proposed in Figure 27 is to refurbish “Felkington 1”.

2.2.4. Conclusion on WBB

49. We have explored different approaches to estimating what base buys. We know that Ofwat will have additional information from water company submissions, but we have provided our analysis of the complete workload and expenditure dataset which we have used to help inform our assessment.

50. In section 2.2.3, we explain our AMP8 capital maintenance plan in these areas and show that we are already planning to spend more than the implicit allowance for refurbishment and replacements of boreholes.

51. So, we calculate the total costs as follows in Figure 11. This calculation includes the additional borehole expenditure of £47.1 (see section 4 for cost build-up) and the base plan from Figure 9 and Figure 10. This then deducts the implicit allowance.

FIGURE 11 - TOTAL COSTS (2022/23 PRICES)

Site name	Capex (£m)	Total (£m)
Total additional borehole expenditure	**47.1**	**47.1**
AMP8 base plan	8.7	8.7
Implicit allowance (subtract)	1.8	1.8
Maintenance savings (subtract)	0	0
Total	**53.9**	**53.9**

2.3. CURRENT RISKS

52. We have 113 bores or wells, and the majority are in good operational condition. However, a small number of assets (19) have poorer asset health and have been identified as condition grade 4 or 5. We provide our inspection reports for these boreholes with this submission, which show that work is required.

53. There are several risks posed by these assets. Some present poor water quality, such as challenging levels of manganese, turbidity or iron. For others, there are also physical defects which ultimately could cause an interruption to supply if a bore lining were to collapse.

54. The assets in poor condition are also required to deliver a continuous supply of water to meet customer demand, which means that lengthier maintenance activities cannot be carried out. There are a range of reasons for this, and in a large number of cases this is due to policy, legislative or regulatory change. For example, in the case of our Hartismere WRZ, a change in planning policy has led to a step change in non-household growth from the pig and poultry farming and meat processing sectors which we must now manage the impacts of. This supply system does not have sufficient headroom or surplus to allow extended periods of maintenance for boreholes.

55. Of the nineteen boreholes in this case, our preferred solution (as identified in section 3) for eleven of these is to drill a new bore to create duty and standby assets to ensure that all future maintenance can be undertaken while meeting customer demand. This is because we cannot undertake this maintenance while these boreholes are in operation.

56. New boreholes to provide duty / standby arrangements will need to be on a different site to the current production borehole. This allows maintenance such as borehole acidisation to clean borehole casings (slotted lining or well screen) and clean and develop chalk fissures. The remaining eight assets have varying preferred solutions specific to their asset needs (these are outlined in section 3).

57. We routinely carry out borehole inspections every 5 years for assets currently in service and more frequently where early signs of asset deterioration (e.g. well screen) are identified. We operate a routine programme of work for wells and bores to ensure that the bores are surveyed and any issues or defects identified. Smaller issues can be opportunistically managed at the time of the inspection and larger more complex issues are subsequently planned and coordinated to ensure that there are no customer service consequences

58. Historically, we have maintained a sub-programme of inspections for boreholes. This sub-programme produced survey reports for all boreholes. Only a handful of boreholes fitted outside of the regular programme circulation, due to resilience and supply issues. The reports have consistently detailed and commented on the condition and health of the boreholes, with evidenced logs and imagery, however, up until the Asset Health Roadmap project, we had not quantified this data into a value.

59. For the purposes of this project, we have reviewed and quantified Ofwat's selection of boreholes. In future, we will add the condition grade as a value to historic and future reporting to quantify the baseline in line with the Ofwat condition grades.

60. The following sections describe the three key risks to boreholes – asset health (2.3.1), demand and growth (2.3.2), and licensing (2.3.3).

2.3.1. Asset health – risk to supply

61. We have carried out regular inspections on boreholes since ~2000 as part of our wells and bores inspections sub-programme. Since the Ofwat Asset Health Roadmap, we have implemented the numerical scoring system in line with Ofwat's guidance. We reviewed historical surveys and reports to provide accurate graded conditions for the wells selected by Ofwat in its sample data, and to understand the boreholes in worst condition. This work has identified a number of grade 4 and 5 boreholes which need action.

62. In section 2.2.3, we list the projects we are already committed to in AMP8 from base expenditure, which will work to deliver improvements across the network for those boreholes that we determined are most in need of investment. This programme is already much larger than the implicit allowance from base expenditure. However, we consider that we should proactively take action for all boreholes at condition grade 4 or below – because without further

investment we will remain at risk of asset failure which will cause significant disruption to our network and supply. Figure 11 outlines the current demand profiles of our proposed schemes and so highlights the number of properties that would be at risk of failure or loss of supply from the category 4 and 5 boreholes. Figure 12 and Figure 13 show the distribution of household and non-household demand each borehole supplies, and their peak flows.

63. In addition, failure of borehole assets would force us to adopt short-term, costly or carbon-intensive mitigation activities. This reactive approach is not good value for customers.

FIGURE 12: BOREHOLE ASSET HEALTH SCHEME DEMAND PROFILES

Scheme	Treatment works	No. of properties fed from Treatment works	No. of non-household properties	No. of Household Daily Consumption (m³/d)	No. of Non-Household Daily Consumption (m³/d)	Treatment works Max Flows (Ml/d)	Borehole Average Abstraction 2025 (Ml/d)	Borehole Current Daily Licence (Ml/d)
Syleham Crag	Syleham	5218	456	1328	819	6.12	3.14	5.364
Holton Valley Farm	Holton	623	39	255	1464	2.04	0.79	2.46
Mendlesham Works	Mendlesham	705	63	178	93	1.74	0.51	0.9
Bleach Green	Syleham	5218	456	1328	819	6.12	1.6	2.592
Saxmundham	Benhall	7425	1487	3538	2273	8.58	n/a	0.909
Halesworth	Walpole	12583	834	2140	2569	5.5	1.56	2.27
Waveney Chalk	Barsham	38142	2702	9849	5406	12.1	2.44	13
Puddingmoor	Barsham	38142	2702	9849	5406	12.1	1.77	2.27
Barsham Shipmeadow	Barsham	38142	2702	9849	5406	12.1	0.66	2.27
Barsham Hall	Barsham	38142	2702	9849	5406	12.1	2.33	3.41
Holton	Holton	623	39	255	1464	2.04	0.79	2.46
Bungay	Broome	1122	47	371	68	2.3	1.45	3.28
Fowberry Mains A	Fowberry	2649	416	809	1089	2.88		
Fowberry borehole treatment 1	Fowberry	2649	416	809	1089	2.88	2.65	3.64
Fowberry Mains B	Fowberry	2649	416	809	1089	2.88		
Thornton Bog	Murton	7761	683	2547	1319	1.56	0.64	0.576
Felkington	Murton	7761	683	2458	1319	2.88	1.07	2.02
Fulwell	Fulwell	10800	Supply is blended with Downhill			4	2.93	5.5
Benhall	Benhall	7425	1487	3538	2273	8.58	1.588	4.55

Note that Fowberry mains are on a combined licence and the avg abstraction is taken as a total combined

64. We note that this high demand means that it is not possible to take boreholes out of supply. For example, we can see that the demand at Barsham treatment works means that none of the boreholes that feed this works could be taken out of supply.

FIGURE 13: DEMAND PROFILES FOR BOREHOLE SITES

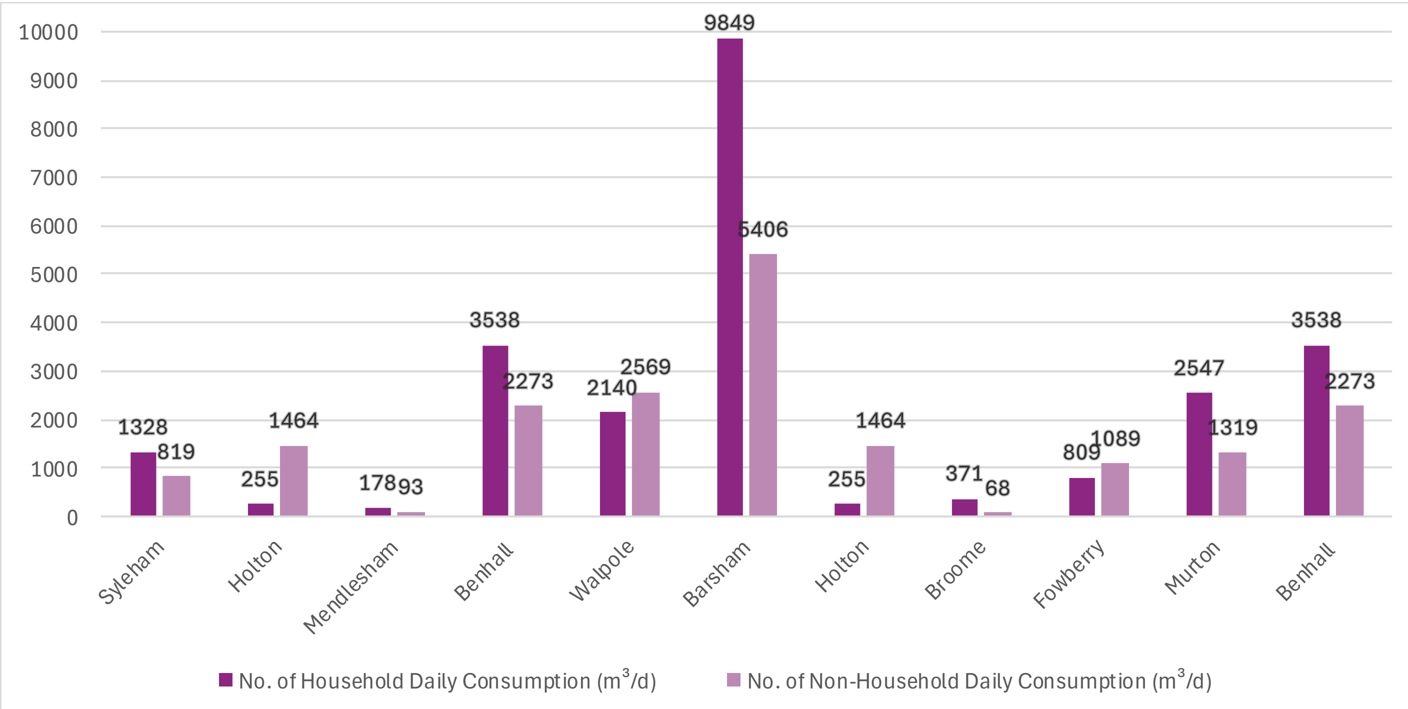
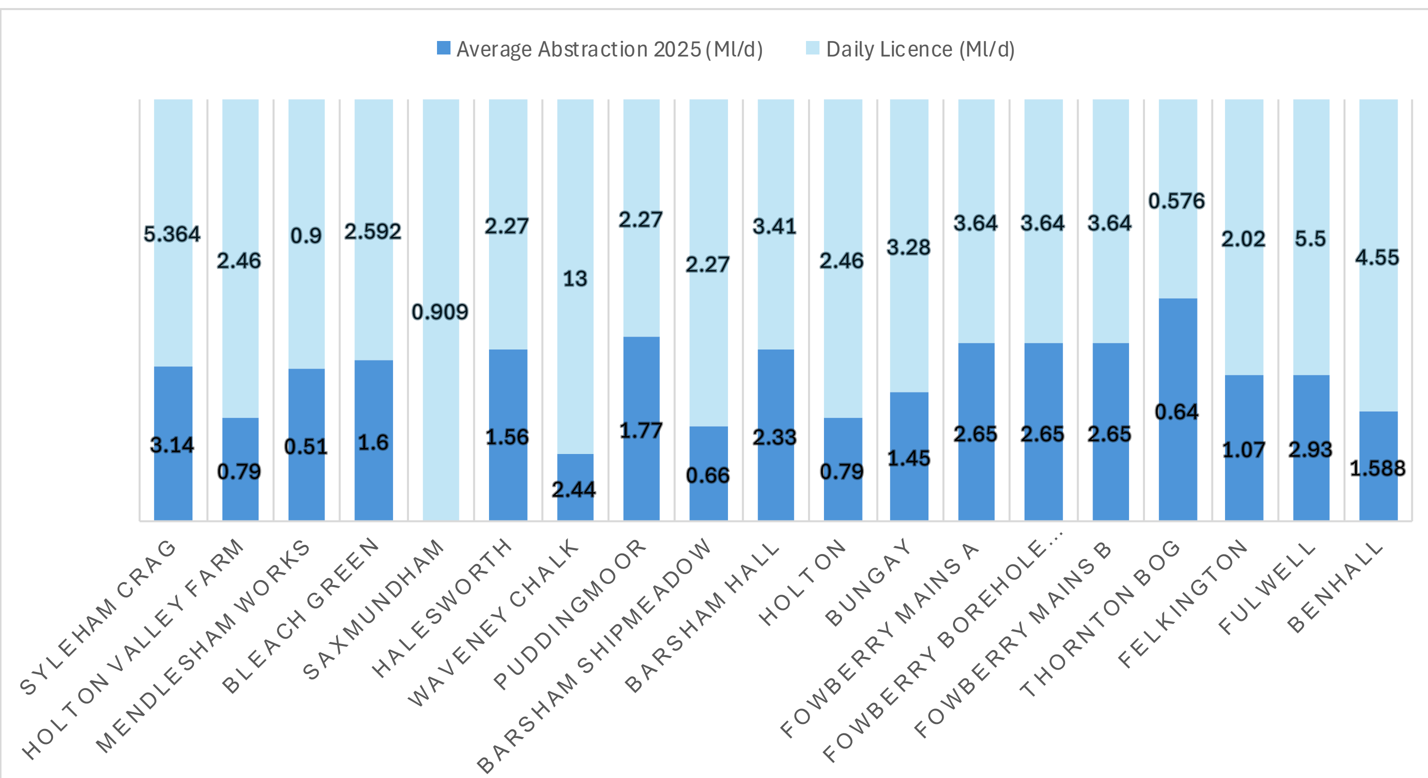


FIGURE 14: AVG FLOWS PER BOREHOLE AGAINST LICENCE



2.3.2. Future demand and growth

65. In addition to the risks from asset deterioration, we have identified growth pressure as a key driver in needing to act sooner. This means that the risk from asset deterioration is greater – because the consequences of failure are greater when there is already pressure on water supplies.

66. Northumbrian Water Limited's Water Resources Management Plans (WRMP24) confirm that groundwater sources contribute to overall deployable output (DO). In the case of our Berwick, Blyth and Hartismere Water Resource Zones (WRZs), which currently only have borehole sources, their zonal DO is constrained by the sum of the DO for the individual boreholes source. Risks to these sources reduce water available for use (WAFU) and so a loss of borehole capacity would directly reduce available supply in affected Resource Zones and could impact resilience or even security of supply where supply headroom is low.

67. WRMP24 also identifies the need to maintain supply demand balance even in severe drought (this standard has now moved to 1 in 500 in NW and 1 in 200 in ESW moving to 1 in 500 in the 2030s). Losing a borehole would compromise this, especially in zones where groundwater forms a key component of supply. This is particularly relevant in the Suffolk Water Resource Zones now, as our WRMP24 has significant water supply investments for these areas to address supply demand balance – and it is likely that there will be further requirements in Berwick from WRMP29 onwards.

68. In addition to current pressure on our borehole outputs, we know that population growth is going to continue to increase and demand more of our assets. For our areas:

- Currently population covered in our ESW region is 1.8m Essex and 288,000 in Suffolk. Our ESW WRMP24 demand forecasts predict a total population growth of 21% by 2049/50, which includes a 22% increase in Essex population and a 13% increase in Suffolk population.
- Our NW region covers 2.8m, with the NW WRMP24 demand forecasts predict a total population growth of 12% by 2049/50, which includes a 14% increase in Berwick population and an 12% increase in Kielder population.

69. This adds increasing pressure to our current assets, with increased demand and higher dependence on peak flows, we need more than ever to ensure asset health is maintained. As a consequence of this water resources position, we consider that Condition Grade 4 should now be the threshold for intervention for boreholes.

2.3.3. Licensing

70. The borehole assets that we operate are typically in remote and rural locations with assets serving a local network with limited connectivity with adjacent networks. Each borehole has a specific abstraction licence for a defined daily and annual licenced abstraction volume. Some of our licences in the Berwick & Fowberry water resource zone

(Berwick zone) have already been reduced. The annual licenced quantities in all our Suffolk groundwater licences will be reduced in 2030 or earlier and on renewal for time limited licences to meet sustainability targets.

71. At the same time our resources are required to meet growing household and non-household demand. The government's latest housing targets mean that household growth in our Berwick zone will be in excess of our WRMP24. In our Blyth water resources zone, we are working with the Sizewell C Water Supply Technical Working Group to see how we can provide an interim supply to the construction site prior to our long-term supply scheme in 2033.

72. Additionally, domestic demand is increasing from Sizewell C employees and contractors with a peak of approximately 8,000 people working onsite of which circa 2,400 will live in the onsite campus and the remainder likely living in our ESW supply area either in the "Pakefield village' or in rented accommodation. In our Hartismere water resources zone, following a change in planning policy, we have seen significant growth in AMP7 from the pork and poultry meat processing sector and from the associated farm supply chain. This has led to all our supply surplus being used. Our WRMP24 includes licence reductions in the supply (Water Available for Use) forecast. Specifically, the Suffolk licence reductions cause significant supply deficits and so we are developing new supply schemes to be delivered in AMP9 to maintain a supply surplus and our ability to supply all existing and forecast household and non-household demand. The new schemes will not be in supply until after 2030 and so we will require Environment Agency derogations to defer the licence changes.

73. Once the new supply schemes are operational, all our borehole assets will remain critical to supply resilience. They will continue to be used to provide a base supply albeit at a lower daily rate than is currently the case given the reduced annual licenced quantity. Additionally, the boreholes will be critical in meeting peak demands as the daily licence will not be changed. Together this results in severely reduced operational headroom and flexibility, with continuous supply required more frequently and for longer periods. This means that the periods of lower utilization, required to take assets out of supply for maintenance, are becoming limited and particularly prior to delivery of the new supply schemes in AMP9. A step up in investment would allow us to carry out the asset health improvement works needed to deliver a sustainable and resilient water supply network for our customers. In summary, additional funding is required to strengthen borehole resilience as sustainability-driven abstraction licence reductions coincide with accelerating household and non-household growth, leaving boreholes as critical assets whose availability is essential to maintaining secure and resilient customer supplies until new strategic schemes are delivered.

74. We do not have a duty standby bore in many locations to allow the production borehole to be taken out of supply for maintenance whilst optimising utilisation of our abstraction licences. Often, there is a single bore to achieve the licenced abstraction at that location.

75. Sustainability reductions have already been applied to our Berwick and Fowberry water resource zone sources. These reductions, combined with continued increased demand, have significantly reduced our ability to remove these assets from supply for maintenance. This means that assets are degrading but are unable to be made

available for maintenance activities, such as acidization, as an outage cannot be sustained for the required maintenance period.

76. Remedial work often takes longer than headroom and asset outage can allow, constraining our ability to maintain our assets. There are limited and unsustainable options to enable this maintenance work - for example, we can use tankering operations, but this would not be possible for a longer period such as required to fully rehabilitate a borehole.

77. Licensing changes that impact on our cases are as follows:

- In our Berwick system (covering Thornton Bog and Felkington) the licence has been reduced from a maximum of 17.3 Ml/d to 8.4 Ml/d with a further reduction in December 2026 to 7.84Ml/d.
- Fowberry boreholes sit within the Berwick and Fowberry WRZ, but in practice these operate as a separate system. They are on one combined Fowberry licence, which is due to reduce from an annual average abstraction of 3.178M/d to 2.219Ml/d on 1 April 2027. This would leave us unable to support the Fowberry system during peak demand.

78. The latest position we have agreed with the Environment Agency (ESW / EA Senior Managers Meeting on 26/03/26) is that all WFD abstraction licence sustainability reductions will be applied to the annual and not the daily licenced quantity. This is aligned with planning assumptions in our WRMP24. This position also applies to Habitats Regulations sustainability reductions, although the need for reductions to daily licenced quantities cannot be completely ruled out until after the Environment Agency has completed its investigations.

79. All our boreholes will remain critical to meeting peak daily demands. The annual average supply deficits caused by the sustainability reductions will be resolved by the new Suffolk supply schemes including but not limited to the Suffolk Strategic Network and Lowestoft Advanced Water Recycling Centre which are collectively being delivered through a Development Consent Order (DCO). Once the new supply schemes have been delivered (i.e. treated water is imported into Blyth and Hartismere from Northern Central via the new Suffolk Strategic Network pipelines), we will be able to reduce the base demand on all existing boreholes to ensure we comply with the new annual licenced quantities following sustainability reductions.

80. The new lower base load will be set at a level that will still allow peak abstraction to current daily licenced quantities to allow us to meet peak demands both during the summer and following freeze-thaw events. So, regardless of sustainability reductions, all our borehole assets remain critical to meeting future demand and so will still be critical assets.

FIGURE 15: SUPPLY AND ABSTRACTION DATA

Treatment works	Scheme	Single borehole on site?	Single Source of Supply?	Single asset on abstraction licence?	Comments
Barsham	Waveney Chalk	Yes	No	No	New borehole needed to ensure a sufficient supply of water.
Barsham	Puddingmoor	Yes	No	No	Supplies the Barsham Bores process.
Barsham	Barsham Shipmeadow	Yes	No	Yes	Offsite borehole with individual licence.
Barsham	Barsham Hall	Yes	No	Yes	Offsite borehole with individual daily licence.
Benhall	Saxmundham	No	No	No	Benhall WTW supplied by two onsite boreholes on the same licence.
Benhall	Benhall	No	No	No	Two sources in the same aquifer, out of commission due to no treatment process.
Murton	Felkington	Yes	No	No	One of six satellite boreholes feeding the discrete Murton system.
Broome	Bungay	Yes	Yes	No	Single borehole feeding WTW. The licence is combined with Bleach Green but these cannot support the Bungay area demand.
Wooler	Fowberry Mains A	No	No	No	One of three operational boreholes (out of a total of four) feeding the discrete Wooler system.
Wooler	Fowberry borehole treatment 1	No	No	No	One of three operational boreholes (out of a total of four) feeding the discrete Wooler system.
Wooler	Fowberry Mains B	No	No	No	The fourth, non-operational, borehole feeding the discrete Wooler system.
Fulwell	Fulwell	Yes	No	Yes	Combined source/treatment system. Feeds directly into network. Network can be fed from Mosswood/Lumley if source is out of supply.
Holton	Holton Valley Farm	Yes	No	No	Single offsite source to provide Holton with resilience, replacing the current bores as duty.
Holton	Holton	No	No	No	Two offsite sources supplying Holton with individual licences, both required to meet demand. No standby source to meet peak demand.
Mendlesham	Mendlesham Works	Yes	Yes	No	Single source borehole with no standby.
Syleham	Syleham Crag	No	No	No	Three crag boreholes onsite at Syleham with only two operational. Additional onsite bore required to maintain supply and provide a standby source. All three crag boreholes on single group licence.
Syleham	Bleach Green	No	No	No	Two offsite boreholes under a group licence.
Murton	Thornton Bog				One of six satellite boreholes feeding the discrete Murton system.
Walpole	Halesworth	Yes	No	Yes	Walpole WTW also supplied by onsite bores. Halesworth is offsite source with its own daily licence.

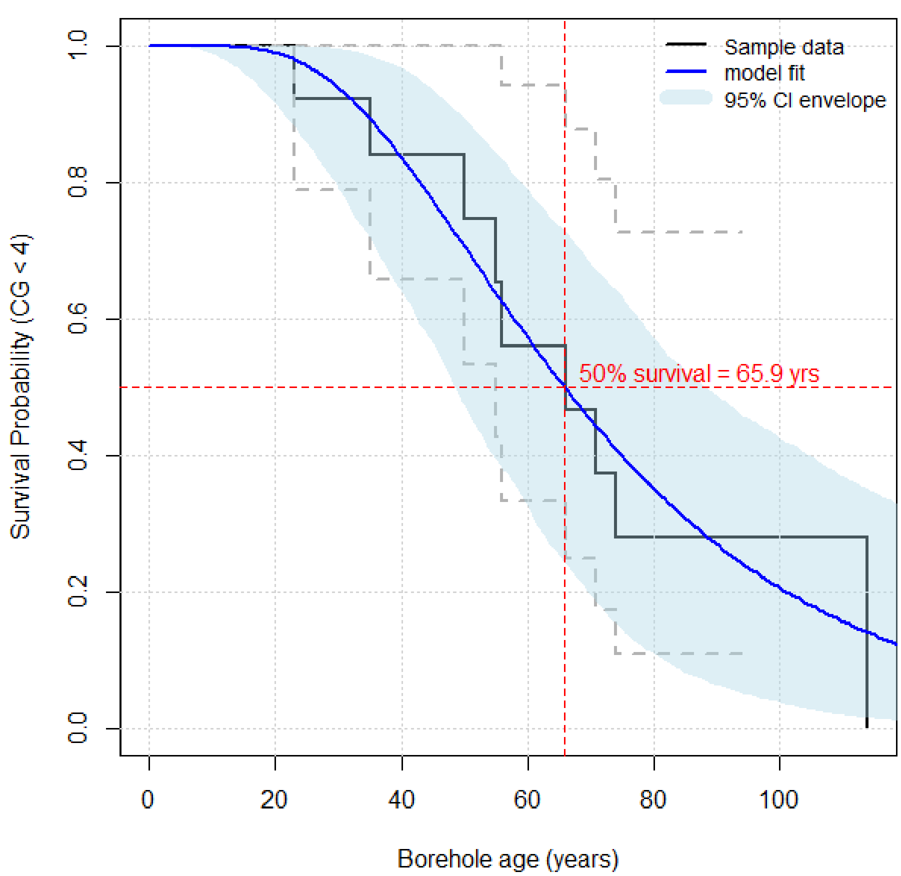
2.4. FORECAST OF FUTURE ASSET HEALTH AND RISKS

81. To demonstrate the need for this investment, we have carried out deterioration modelling. This provides the quantitative basis to justify proactive interventions and demonstrate efficient long-term modelling.

2.4.1. Survival curves

82. Figure 16 shows the survival curve for our modelled boreholes. This survival curve identifies a clear deterioration with age. The fitted model shows that 50% of boreholes are likely to be in CG4 or worse by the age of 66. This has a relatively high confidence interval due to a small sample size (that is, the range is from 49 to 89 years at a 95% confidence level).

FIGURE 16: BOREHOLE SURVIVAL CURVE KAPLAN-MEIER VS FITTED MODEL



Uncertainty is high due to the small sample size (n = 13)

83. In section 2.4.2, we will continue to use this model to predict current and future condition. We show that this high uncertainty does not matter much to the results when we extrapolate this to the asset base. This data could be improved with more samples from other water companies, and we do not rely directly on this predicted age for determining interventions.

2.4.2. Extrapolation to the asset base

84. Using the survival curve set out in 2.4.1, it is possible to extrapolate to the rest of the asset base using the construction year. When we use our data to extrapolate to the whole asset base, the headline results are:

- We can see a deterioration with age (as we might expect).
- We would expect 50% of boreholes to reach CG4 or worse by the age of 66.
- Using only the modelled life expectancy, we would estimate there are 21 boreholes currently in CG4 or 5.
- Looking ahead, we predict that about 3 boreholes every AMP will reach CG4 or 5. This would increase the number of boreholes in bad condition to 30 by 2040, if there were no interventions made.

85. Out of 64 boreholes, the model predicts that 21 (33%) are expected to be in CG4 or worse given their age and are likely to require immediate attention. In practice, we have identified 19 using condition assessments. This suggests that the survival curve is broadly correct.

86. We do not intend to rely on this modelling[4], and so we will continue to monitor and assess our boreholes and identify any asset health needs. However, age and likely deterioration can be a useful indicator to target future inspections. We note that continued maintenance and works on our boreholes have enabled us to extend the life significantly of some assets beyond this age, for example, Fulwell borehole dates back to 1852 and our proposed intervention is simply to survey this borehole further.

87. Figure 17 and Figure 18 outline the long-term projections for our borehole asset base. This indicates that in addition to the 21 boreholes already in condition 4 or 5, a further three boreholes are likely to reach condition 4 or 5 in each AMP in the foreseeable future. So, we have updated our long-term strategy with a central estimate to intervene on around three boreholes per AMP – based on the costs for AMP8 interventions, we estimate that this would mean increasing allowances from base expenditure from £1.8m per AMP for rehabilitation and replacements, to around £7m to £10m (depending on which interventions we use). Our PR29 business plan will reflect this insight to ensure we are continuing to manage our assets appropriately and avoid unnecessary spending.

88. We found that 82% of the steel-based boreholes in the sample are in poor condition (4 or 5) due to corrosion. This is observed even on relatively 'young' assets – for example, our "Walpole Borehole 3" was installed after 2000 and is already CG5 due to corrosion.

[4] Rather than relying on modelling, we have used inspections to determine where work is needed now – as this gives the certainty that is needed. Our modelling helps us to understand how many borehole interventions are likely to be needed in future, so we can plan for a long-term profile (even though we don't know precisely how assets will deteriorate and so exactly which interventions are needed).

FIGURE 17: EVOLUTION OF BOREHOLE CONDITIONS

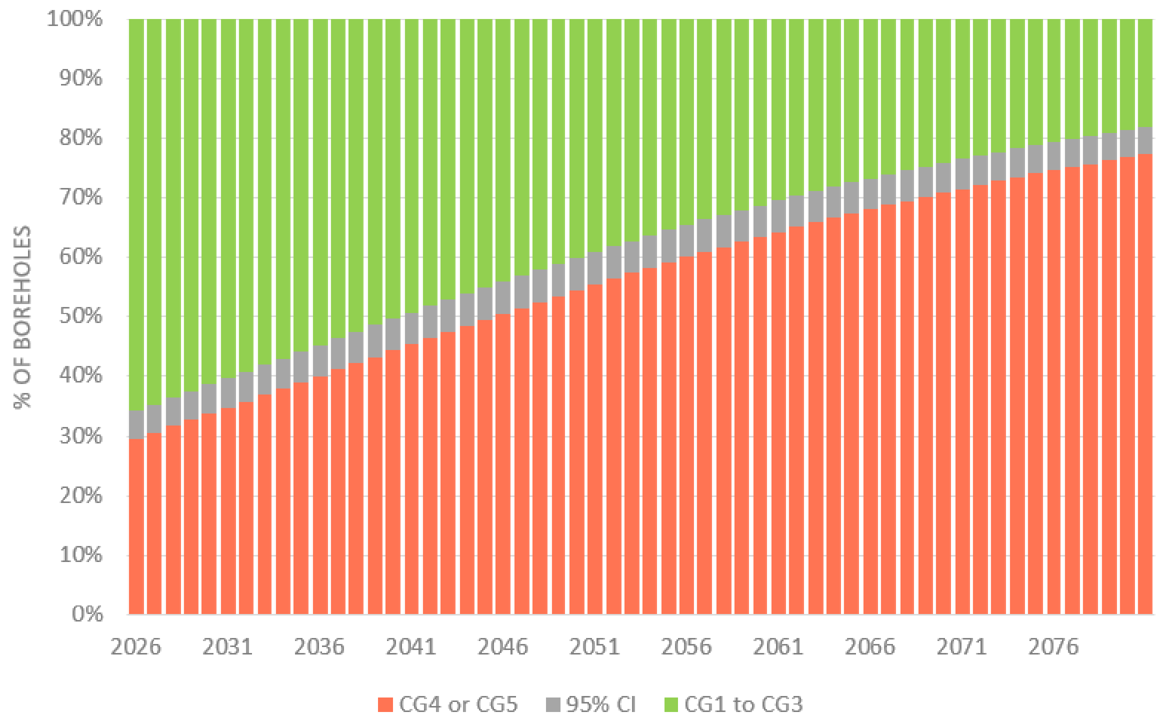
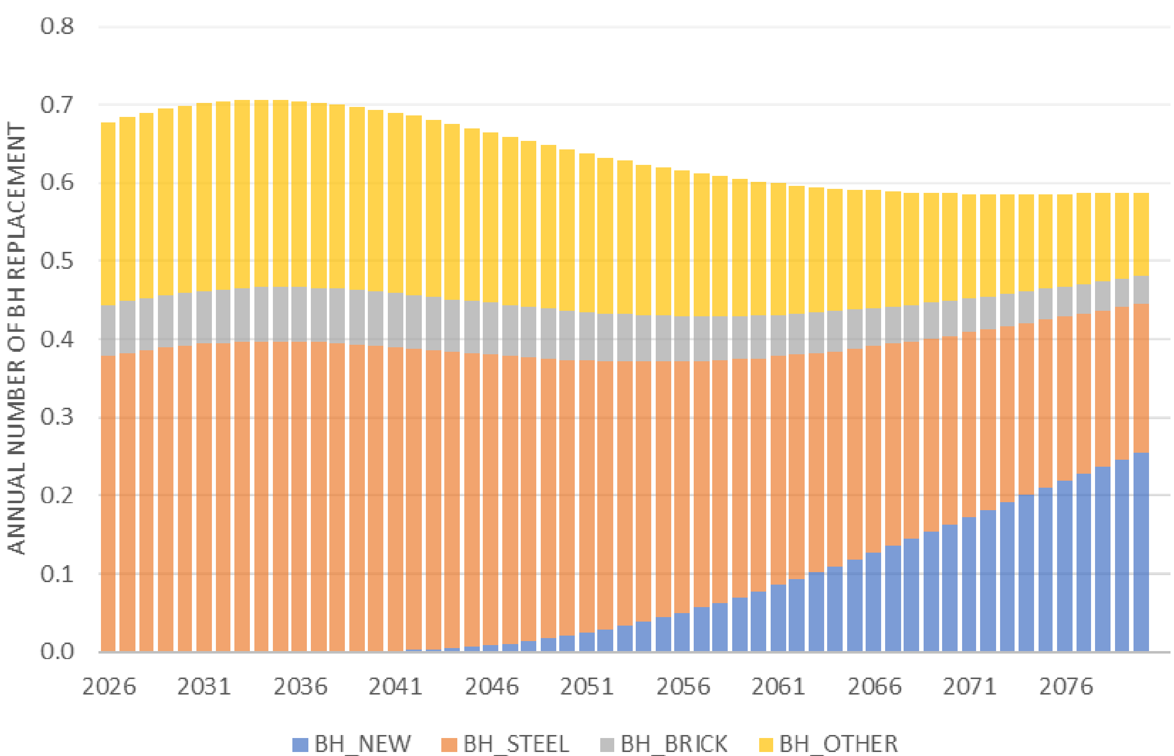


FIGURE 18: BOREHOLE REPLACEMENT NEEDS



89. We note that this modelling used a relatively small sample size (compared to other asset classes, which we have more of). This limits the confidence we can have in the borehole life expectancy at individual asset level. We also note that some construction years are approximate, and use twenty year bands. This suggests that the modelling is adequate to compute the overall number of assets in bad condition over time, but not to predict the specific condition of any individual borehole (instead, we use inspections to select these assets).

90. As we score more condition assessments, we can build a better model for boreholes – and we could use the condition assessment in long-term cohort modelling. We would like to share our data and carry out sector-wide modelling for boreholes to more accurately forecast asset life.

91. Finally, we note that the deterioration modelling cannot take into account rehabilitation work that has been done to extend asset life.

2.4.3. Identifying specific boreholes

92. Figure 19 outlines the age and proposed action of the boreholes that we have identified in Condition Grade 4 and 5. Boreholes are generally considered to be low maintenance assets with long design lives, as identified in our modelling we see around a 66-year average lifespan for our assets before reaching CG4. Ofwat recognised in their borehole technical guidance that there is little maintenance which can be considered 'business-as-usual' in the standard sense. Maintenance is typically reactive with routine monitoring identifying if performance is deteriorating[5].

93. Therefore, where we are looking to drill additional or new boreholes, we are doing this as the last resort because the asset has reached the end of its lifespan, in some of the cases in this submission we have managed the bore significantly longer than modelled due to maintenance and refurbishment (the average age for replacements is 66 years, coincidentally exactly the same age as our deterioration model suggests).

94. For the younger boreholes, we have identified asset management practices to continue the borehole functionality and improve performance (that is, rehabilitation work to address specific asset health risks to service). This is the best way to manage the asset health now rather than leave the borehole to continue to degrade and need replacement before its expected lifespan.

95. As outlined in the options section of the report, there are several rehabilitation techniques that can be used to extend asset life, depending on the specific problems identified with the borehole's performance. These actions can extend an asset's life by up to 30% dependent on the type and amount performed[5]. It is also important to note that other boreholes on the same site can be affected by maintenance activities, so it can be necessary to provide temporary treatment or take the whole site out of service for the duration of the works, we have considered this in any case

[5] Boreholes-Technical-guide.pdf

where we want to drill a new bore, and intend to keep bores in as stand by where we can, to reduce any disruption and build resilience to our network.

96. One example of refurbishment we assess is for relining, which can be used to replace/support a ruptured, corroded or perforated casing or screen, or correct a faulty design. Relining can extend a borehole asset's life by 50%[5], but could narrow the area of the bore, meaning as an activity it is only suitable once or twice before it then impacts the water supply too severely. For example, in our Fowberry Mains A case, this requires grouting of the annulus between the upper and lower casing to block a pathway for turbidity. At present, the pump depth has temporarily been reduced to partially mitigate the risk, however this reduces the deployable output of the source and is only a short-term solution.

97. Ofwat also recognises that for severely damaged boreholes, or those where the performance has deteriorated to an extent where it is not considered cost beneficial to rehabilitate, it may be more appropriate to abandon the borehole in favour of drilling a new one nearby. While each borehole has been individually assessed to identify the need, by both Northumbrian water asset health teams and Stantec separately, we note that any borehole younger than 40 years we will be taking refurbishment activities to extend lifespan. Those we suggest drilling have been identified as unsuitable for any other action and may have had refurbishment activities undertaken in the past, meaning there is no longer any other action that can be taken. For example, for our Halesworth borehole case, this borehole has been re-lined twice due to the poor condition of the plain casing, with the last relining being in 2010. We now have reached a point where refurbishment won't deliver for the bore and will need to replace this, at present the failure of Halesworth would reduce Walpole deployable output by 33% (20l/sec).

FIGURE 19: BOREHOLE AGE AND ACTION

Site	Drilled	Action
Syleham Crag	1981	Drill Replacement Offsite Crag No 2 Borehole on land bordering Syleham TWS
Holton Valley Farm	Bore 3 - 1967 Bore 4 - 1982	Drill an additional production borehole to produce the full licenced flow into Holton WTW
Mendlesham Works	1942	Drill new standby borehole
		Carry out pending remediation work following construction of new standby Borehole
Bleach Green	2001	Acidise borehole to clean casing and increase flow.
Saxmundham	1905	Drill new borehole on site. Abandon existing (unusable) borehole
Halesworth	1973	Abandon existing borehole. Drill new remote borehole
Waveney Chalk	1985	Drill & establish a replacement borehole on Site. Abandon existing borehole
Puddingmoor	1965	Drill additional borehole
Barsham Shipmeadow	1967	Drill additional borehole

Site	Drilled	Action
Barsham Hall	1970	Drill additional borehole
Holton	Bore 3 - 1967 Bore 4 - 1982	Drill additional borehole
Bungay	1933 (approx.)	Drill new borehole
Fowberry Mains A	1996	Headworks refurbishment (grout annuals)
Fowberry Borehole treatment 1	1966	Drill additional (standby) borehole
Fowberry Mains B	1996	Acidise borehole to clean casing and increase flow
Thornton Bog	1992	Refurbish borehole casing to combat high turbidity
		Perform surveys to assess borehole condition once turbidity is lowered
Felkington	1997	Refurbish borehole casing to combat high turbidity
		Perform surveys to assess borehole condition once turbidity is lowered
Fulwell	1852	Perform surveys to assess borehole condition, contamination, and second shaft access
Benhall	2014	Reline borehole

2.4.4. Climate change

98. Since PR24 we have carried out some further work on climate change to proactively understand our risk and set strategic direction for the organisation. This also helps us to identify our asset health needs and where they are going to be increasingly susceptible to the impacts of the changing climate. In this first instance, we have identified the risks to our northeast region and our southern region separately – in PR24, we showed that these would have different specific risks from climate change.

99. Our groundwater risks include:

- Increased demand on aquifers, especially during periods of drought, can exacerbate asset pressure and increase asset health risk and rates of degradation. This has been identified as a major risk in a high emissions scenario for both areas.
- With less summer rainfall, there will be less availability for aquifer recharge which will affect our groundwater sources and deployable output. Therefore, there is an increased need for borehole condition to be at a good level so we can utilise effectively and mitigate low water impacts. This is rated as minor for both areas.
- Rising sea level causes saline intrusion on groundwater assets. If not adequately managed can lead to abandonment of boreholes due to saline intrusion dramatically impacting asset heath. This is rated a major risk for the northern assets and a minor for southern.

100. We are developing a climate change adaptation strategy to embed future resilience and mitigation measures into our work. For the purposes of this reopener, however, it has enabled us to understand the increased need to increase investment now to protect asset health.

2.5. SUMMARY OF LONG-TERM ASSET CLASS STRATEGY

101. Our long-term strategy highlights the importance of groundwater assets and boreholes. Groundwater remains essential for security of supply in both the North East and the Essex & Suffolk regions, especially in serious water-stressed areas where catchment characteristics make groundwater indispensable.

102. Our long-term strategy outlines that boreholes must be maintained as high-reliability, flexible sources, especially as we plan for increasingly severe drought as the climate changes and provide 1-in-500-year resilience.

103. Long-term strategy commitments include:

- Ensuring existing boreholes remain environmentally compliant, avoiding water body deterioration under the Water Framework Directive.
- Upgrading or modifying borehole assets where environmental assessments indicate risk.
- Sustaining deployable output as part of long-term planning through maintenance, rehabilitation, and treatment improvements.

104. Our WRMP24 confirms that groundwater sources including boreholes remain a core component of long-term supply resilience, forming part of a 25-year plan to maintain reliable supplies under climate change, droughts and population growth. The plan states that we will have sufficient supplies over the next 25 years but must still manage and invest in efficient use of water and supply systems. We have implemented a moratorium on new non-household water connections in the Hartismere water resource zone, which includes the town of Eye and surrounding villages in Suffolk. This restriction is due to unprecedented, unforecasted non-household growth which if allowed, would exceed existing abstraction licence annual licenced quantities and treatment capacity. To protect supplies to existing household customers and non-house businesses, the non-domestic moratorium will be in place until all WRMP24 supply schemes are commissioned and fully operational.

105. The revised WRMP24 and environmental appendices confirm that new groundwater schemes—including new boreholes and associated treatment works—are part of long-term planning. For example, the Essex & Suffolk Water (ESW) region includes the construction of additional boreholes and a new groundwater treatment facility in Essex linked to the Linford Well scheme.

106. Borehole abstractions are explicitly assessed within the WRMP24 environmental and Water Framework Directive (WFD) reports. These include dedicated impact assessments for new and existing boreholes (e.g., "New Borehole at Duddo" in Berwick & Fowberry WRZ listed in WFD Level 1 tables).

107. WRMP24 requires planning for extreme drought resilience, which increases reliance on secure groundwater DO.

108. Our long-term strategy (2025–2050) prioritises adaptation to climate change, including protection from extreme droughts and weather events. Boreholes play a key role because groundwater responds differently to climatic variability and provides buffered, drought-resilient supply. Since the PR24 submission, we have started to develop our climate change risk assessment and associated adaptation plan, which includes borehole risks. The risk assessment has highlighted a greater need for intervention on groundwater assets, identifying that during periods of higher temperatures and drought, more pressure will be placed on groundwater assets to increase abstraction, exacerbating borehole asset health risks. These are marked moderate for NW and ESW, with the impact in the high emissions scenario rated 5/5.

109. The long-term strategy also emphasises delivering reliable services for generations to come, protecting water resources, and meeting regulatory obligations. This includes compliance with WFD, environmental protection, and customer expectations. Boreholes, as regulated abstractions, sit within this framework. We must therefore:

- Ensure abstraction remains environmentally sustainable.
- Enhance monitoring and data to guide groundwater decisions.
- Align borehole investment with long-term obligations and customer priorities for resilient water supply.

2.6. ENGAGEMENT WITH STAKEHOLDERS

110. We have engaged with the DWI on these schemes and shared our proposals with them. Although these do not directly address a water quality risk, they are still of interest to the DWI. They will provide a letter of support directly to Ofwat.

111. We describe our engagement with customers in section 3.4. Our customer research with our People Panels (on 23 April 2026) showed strong support for carrying out this investment in boreholes now, rather than waiting until 2030 – with all participants in the Essex & Suffolk Water area agreeing that we should do so.

2.7. WHAT IS NOT INCLUDED HERE?

112. 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 important. This includes raw water storage at WTWs, which we do not think will be in scope in 2027 either.

113. 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, when we expect other water treatment assets (such as clarifiers) will also be in scope.

114. 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.

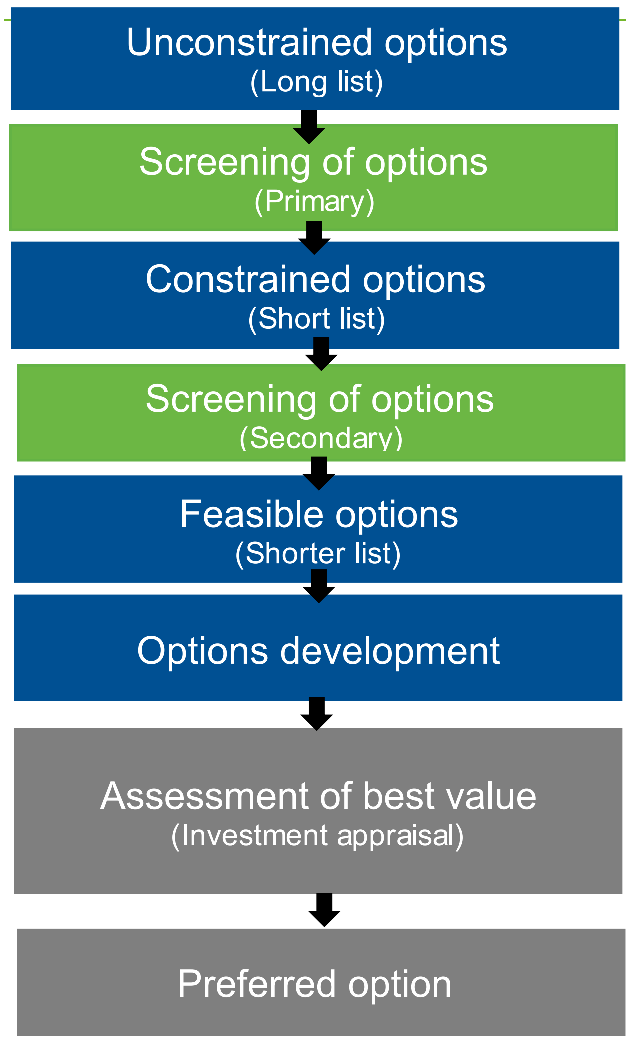
115. We set out our separate case for **service reservoirs and water towers** for the 2026 cost change process. We identified these as some of our highest risk asset classes at PR24.

3. BEST OPTION FOR CUSTOMERS

3.1. OPTIONEERING

116. To determine the best option for customers to address the need, we carried out an options identification and screening process as outlined in Figure 20. 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. A description of each step and the output from it is contained in the following sections.

FIGURE 20: 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 3.1.1)

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.

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

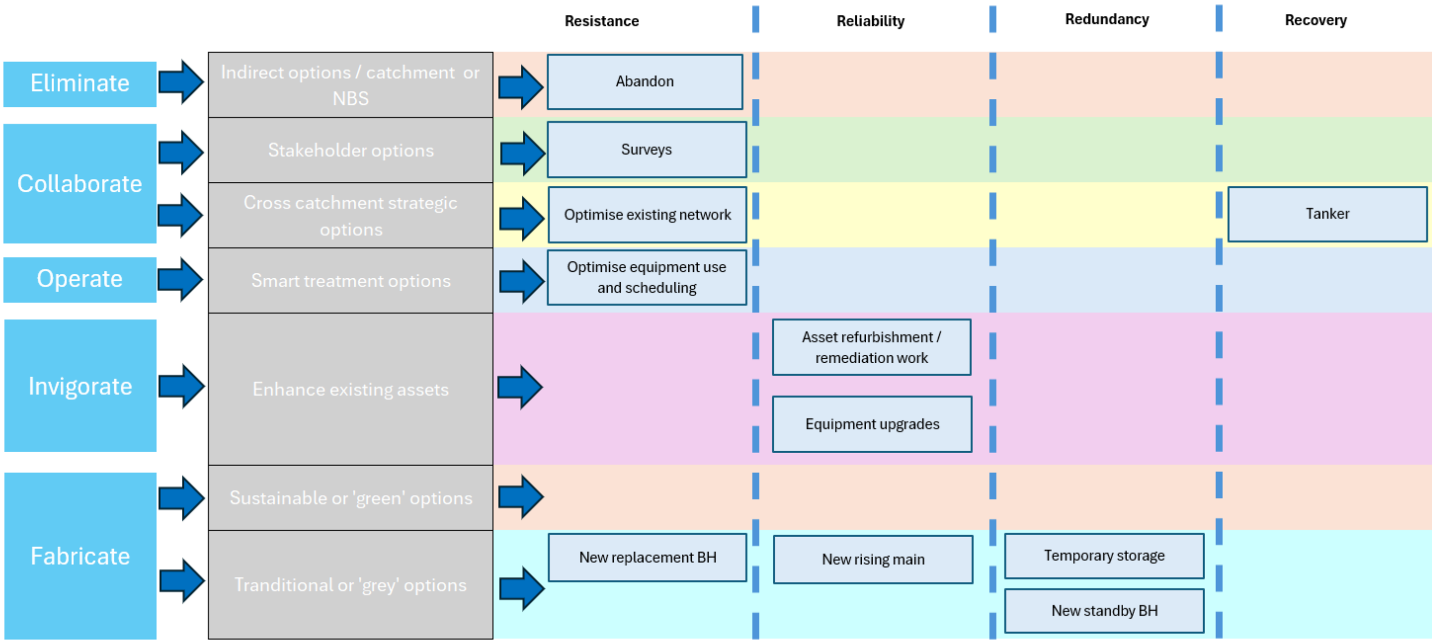
117. We have developed a range of 14 options, categorised according to the 4 Rs of Resilience.

- 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 borehole assets.

118. 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 borehole failure. This includes the option to abandon, isolate or bypass the borehole 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 neighboring 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 borehole sites.
- **Operate** – this would involve improving our operational management practices to reduce the risk of age-related failure of Borehole assets. This includes pump, pipework, and headworks operational practices.
- **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 Borehole structures. It should be noted that some of our priority sites have previously been refurbished, with linings (backfill applied (in some cases multiple times) to extend the asset life and provide best value for customers. It should be noted that for several borehole sites a refurbishment of the casing or lining may result in additional risk of loss of borehole. 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 borehole will likely have an extensive asset life with proper casing and ideal aquifer conditions. Therefore, timely replacement of old and deteriorated assets can be better value for customers than frequent and increasingly costly refurbishment interventions.

FIGURE 21: THE UNCONSTRAINED LIST OF OPTIONS AND ALIGNMENT TO THE TOTEX HIERARCHY CATEGORIES AND 4RS OF RESILIENCE



Source: NWL PR24 Optioneering process

Note: Asset "refurbishment/ remediation work" contains borehole refurbishment, cleaning borehole, rising main refurbishment, headworks refurbishment as subdivision in the Totex Hierarchy assessment.

3.1.2. Asset health scores

119. We assigned asset health scores for each borehole in accordance with the methodology set out under the Ofwat Asset Health roadmap framework. The scoring methodology applies standard condition scoring criteria to reflect the physical state and operational resilience of each borehole. The asset health reopener requires that civil structures borehole/ well and headworks are to be surveyed and reported at a minimum.

120. Condition grades (1-5), defect categories, and extent scores (A-E) were assigned to the borehole/ well and headworks components individually following guidance in Figure 23. An aggregated asset grade is then calculated for each borehole installation to provide an asset health score. The weighting is as follows:

- Borehole/ Well: 75%
- Headworks: 25%

121. This approach ensures critical components are appropriately represented in the overall condition grade while maintaining comparability across different sites.

122. The asset health scores derived using the methodology is presented in Figure 22.

FIGURE 22: ASSET HEALTH SCORES

Site	CG	Headworks Condition Score	Headworks Defect	Headworks Extent	Borehole Condition Score	Borehole Defect	Borehole Extent	Aggregated Asset health score
Syleham Crag	5	**	**	**	**	**	**	**
Holton Valley Farm	4	**	**	**	**	**	**	**
Mendlesham Works	4	3	Concrete Delamination	C	4	Metal Corrosion	E	3.75
Bleach Green	4	**	**	**	**	**	**	**
Saxmundham	4	**	**	**	**	**	**	**
Halesworth	5	3	Metal Corrosion	C	5	Metal Corrosion	E	4.5
Waveney Chalk	5	2	Other Materials – Material Degradation	A	5	Metal Corrosion	D	4.25
Puddingmoor	5	4	Brickwork Cracking	D	4	Metal other defects/ deformation	B	4
Barsham Shipmeadow	4	3	Concrete Delamination	C	5	Metal Corrosion	E	4.5
Barsham Hall	4	2	Other Materials – Material Degradation	A	5	Metal Corrosion	E	4.25
Holton	4	**	**	**	**	**	**	**
Bungay	5	**	**	**	**	**	**	**
Fowberry Mains A	4	**	**	**	**	**	**	**
Fowberry Borehole Treatment 1	5	**	**	**	**	**	**	**
Fowberry Mains B	4	**	**	**	**	**	**	**
Thornton Bog	4	**	**	**	**	**	**	**
Felkington	5	**	**	**	**	**	**	**
Fulwell	5	**	**	**	**	**	**	**
Benhall	4	**	**	**	**	**	**	**

Notes: ** represents where we do not have data corresponding to the specific level as detail/nomenclature in the headers currently. Whilst we do regularly inspect our boreholes and, for example, condition data can be seen from Figure 1, not all our boreholes have yet been assessed against the specific OFWAT scoring criteria. The missing data is being collected currently and will be ready for the Draft Determination in August review of data. Information on condition, at a higher level, can be taken from Figure 1.

3.1.3. Options screening

123. We have screened our unconstrained list of options for the 19 priority AMP8 borehole sites to determine whether the intervention:

- is technically feasible,
- addresses the need identified in Section 2 (that is, to restore asset health).

124. Options that did not satisfy both criteria were rejected with remaining options carried forward to secondary screening. The screening of each unconstrained option is shown in Figure 23.

FIGURE 23: OPTION SCREENING

Totex Hierarchy	Options	Technically Feasible?	Addresses AMPB risk?	Resilience approach	Notes
Eliminate	1. Abandon borehole	Yes	Yes	Resistance	Carried forward: Viable option if other supplies can reliably meet demand without compromising levels of service.
Collaborate	2. Investigative surveys	Yes	Yes	Resistance	Carried forward: Enables informed decision making by confirming asset condition, performance, and risks before intervention.
	3. Optimise existing network usage	No	No	Resistance	Rejected: Not technically feasible due to network configurations and inability to redistribute supply to mitigate identified risks
	4. Tanker operations	No	No	Recovery	Rejected: High operational costs and remote location constrain sustainability of this solution.
Operate	5. Optimise equipment use and scheduling	Yes	No	Resistance	Rejected: Does not address underlying asset condition risk.
Invigorate	6. Asset refurbishment (e.g. borehole re-lining, headworks refurb, etc.)	Yes	Yes	Reliability	Carried forward: Extends asset life and directly addresses deterioration of assets contributing to the AMPB risk.
	7. Clean borehole	Yes	Yes	Reliability	Carried forward: Can restore performance and mitigate water quality risks where deterioration is fouling related.
	8. Equipment upgrades	Yes	No	Reliability	Rejected: Equipment replacement alone does not mitigate borehole asset condition or source risks.
Fabricate	9. Construct replacement borehole	Yes	Yes	Resilience	Carried forward: Long term risk mitigation by replacing the failing asset providing reliable water source capacity.
	10. Construct new rising main	Yes	No	Reliability	Rejected: Provides no solution to identified borehole asset risks across affected sites.
	11. Construct temporary storage to allow for isolation work	No	No	Redundancy	Rejected: Not feasible as a long-term solution to mitigate underlying condition of water source risks.

Totex Hierarchy	Options	Technically Feasible?	Addresses AMPB risk?	Resilience approach	Notes
	12. Construct new standby borehole	Yes	Yes	Redundancy	Carried forward: Improves redundancy and resilience by providing alternative source capacity in the event of asset failure

Source: NWL PR24 Optioneering process

125. The constrained list of options is shown in Figure 24.

FIGURE 24: CONSTRAINED LIST OF OPTIONS FOR OUR PRIORITY SITES

Totex Hierarchy Categories		Options	Resilience approach
Eliminate	1	Abandon Borehole	Resistance
	2	Investigative Surveys	Resistance
Invigorate	6	Borehole refurbishment or remediation works	Reliability
	7	Clean Borehole	Reliability
Fabricate	9	Construct a replacement borehole and abandon existing (like-for-like replacement)	Resilience
	12	Construct new standby borehole	Redundancy

Source: NWL PR24 Optioneering process

126. For each option carried forward to this stage we have completed a benefits assessment using our Value Framework[6] 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 25 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 25: 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

[6] Northumbrian Water Limited Value Framework Definition Document, v1.16, Copperleaf Technologies Inc., 2002

Value measures	Description	Unit	Value	Aligned to a performance commitment?
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	tCO_2e / year	tCO_2e	£256.20[7]	Yes
Embedded Emissions	tCO_2e / year	tCO_2e	£256.20[4]	Yes

127. 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.

128. The value measures in Figure 25 cover water quality risk, water supply interruption risk and both the operational and embedded carbon impacts.

3.2. DECISION MAKING

3.2.1. Cost benefit appraisal to select preferred option

129. For our short list of options at each borehole, 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.

130. Costs and benefits have been adjusted to 2022/23 prices using the CPIH[8] 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[9].

131. We note that the NPVs for most 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. As we have set out in section 2.3 and 2.4, there are significant risks to water supply that cannot easily be quantified through a benefits assessment directly – and valuations based on smaller interruptions or non-compliance

[7] £ value per tonne of CO2e in 2025/26, annual increase (varying rate) reaching £378.6/t CO2e in 2054/55
[8] Consumer Prices Index including owner occupiers' housing costs.
[9] The Green Book: Central Government Guidance on Appraisal and Evaluation, HM Treasury, 2022

events cannot necessarily be applied in a simple way to the risk of asset failure (which could be longer term and have much greater consequences).

132. 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.

3.2.2. Additional Information Contributing to Preferred Option List

133. We supported our cost benefit analysis with some further sources of evidence and subject matter expert input. This included targeted engagement with hydrologist subject matter experts to validate the risks and how these options might apply to specific boreholes. These discussions included:

- Confirmation of the nature and magnitude of the borehole risks, aligning with relevant copperleaf investment categories
- Potential for alternative sources or network reconfiguration to supplement flows and mitigate any supply risks to subsequent water treatment and supply zones
- Operational performance of pumps, including historical interventions and reliability concerns
- Known issues relating to MEICA equipment and pipework
- Practical feasibility of tanker operations at each site, including access, logistical constraints, and costs
- Feasibility of implementing temporary on-site storage to enable remediation works
- Land availability and physical constraints affect the construction of replacement or additional boreholes.
- Professional opinion on the suitability of shortlisted Copperleaf investment options relative to the identified risk and discussion on the above items.

134. We also looked at the following evidence:

- **Site Schematics & Layout Drawings** – Reviewed to understand system configuration where provided, including the number of boreholes feeding each supply zone or treatment works, indicating opportunities for adjusting supporting water supply sources.
- **Abstraction licences** – Available abstraction licence information was reviewed to confirm permitted yields and operational constraints relevant to each borehole which may impact candidate option selection.
- **Borehole Inspection reports** – Assessed to understand structural condition, deterioration, and any integrity concerns influencing asset risk.

- **Copperleaf Investment** – Simulated Copperleaf investments were undertaken for some candidate options, including a “Do Nothing” baseline to provide NPV and whole-life TOTEX implications as described in the previous sections.
- **Water Quality Data (2021-2025)** – Data covered a wide range of expected water quality parameters such as coliform and turbidity. Reviewed by SMEs and no clear evidence of deteriorating raw water quality over this period was identified that would influence option selection at this stage.

135. Figure 26 contains high level details of options considered for each of the 19 borehole sites. Three types of option are outlined:

- Preferred- the option believed to be most effective at addressing risk
- Supplementary- the option believed to further address risk and is to be considered in addition to the preferred option.
- Alternative- an alternative option that has been assessed to be less cost effective than the preferred option or less effective at addressing risk.

FIGURE 26: BENEFIT TO COST RATIO AND THE PREFERRED OPTIONS FOR BOREHOLES

Site	Option	Net Present Value (30 years) (£m)	Benefit : Cost	Type of Option
Syleham Crag	**Drill Replacement Offsite Crag No 2 Borehole on land bordering Syleham TWS.**	-£2,295,688	0.12	Preferred (Commenced)
Holton Valley Farm	**Drill an additional production borehole to produce the full licenced flow into Holton WTW.**	-£10,107,401.46	0	Preferred
Mendlesham Works	**Drill new standby borehole**	-£5,435,739.82	0	Preferred
	Carry out pending remediation work following construction of new standby Borehole	-£267,118.55	-	Supplementary
Bleach Green	**Acidise borehole to clean casing and increase flow.**	£1,908,961.75	-	Preferred
	Drill new borehole and abandon existing borehole	-£4,248,503.5	0.31	Alternative
Saxmundham	**Drill new borehole on site. Abandon existing (unusable) borehole.**	-£3,826,872.48	0	Preferred
Halesworth	**Abandon existing borehole. Drill new remote borehole**	-£4,706,639.91	0.24	Preferred
Waveney Chalk	**Drill & establish a replacement borehole on Site. Abandon existing borehole.**	-£8,474,034.16	-0.76	Preferred
Puddingmoor	**Drill additional borehole**	-£2,693,756	0	Preferred
	Refurbish borehole – presents risk of total loss of borehole	-£5,610,852.56	-	Alternative
Barsham Shipmeadow	**Drill additional borehole**	-£5,610,783.29	0	Preferred
	Refurbish borehole – presents risk of total loss of borehole	n/a due to high risk	-	Alternative

Site	Option	Net Present Value (30 years) (£m)	Benefit : Cost	Type of Option
Barsham Hall	**Drill additional borehole**	-£5,599,107.16	0.01	Preferred
	Refurbish borehole – presents risk of total loss of borehole	n/a due to high risk	-	Alternative
Holton	**Drill additional borehole**	-£5,548,757.43	0	Preferred
	Refurbish borehole – presents risk of total loss of borehole	n/a due to high risk	-	Alternative
Bungay	Perform surveys to determine borehole condition	-£84,811.70	-	Alternative
	Refurbish borehole based on survey results	n/a due to undefined scope	-	Alternative
	Drill new borehole	-£4,676,108.15	-	Preferred
Fowberry Mains A	**Headworks refurbishment (grout annuals)**	-£267,118.55	-	Preferred
	Drill additional borehole	-£7,904,286.88	-	Alternative
Fowberry Borehole treatment 1	**Drill additional (standby) borehole**	-£922,140	0	Preferred
	Drill new borehole and abandon aged asset of unknown condition	-£5,665,592.83	-	Alternative
Fowberry Mains B	**Acidise borehole to clean casing and increase flow**	-£52,397.49	-	Preferred
Thornton Bog	**Refurbish borehole casing to combat high turbidity**	-£267,118.55	-	Preferred
	Perform surveys to assess borehole condition once turbidity is lowered.	-£83,593.44	-	Supplementary
	Drill new borehole and abandon existing	-£6,817,976.71	-	Alternative
	Drill new additional borehole	-£6,825,808.49	-	Alternative
Felkington	**Refurbish borehole casing to combat high turbidity**	-£267,118.55	-	Preferred
	Perform surveys to assess borehole condition once turbidity is lowered.	-£83,593.44	-	Supplementary
	Drill new borehole and abandon existing	-£7,407,955.16	-	Alternative
	Drill new additional borehole	-£7,372,650.90	-	Alternative
Fulwell	**Perform surveys to assess borehole condition, contamination, and second shaft access**	-£83,593.44	-	Preferred
	Abandon borehole	-£48,806.29	-	Alternative
	Optimise existing network usage to supplement loss of flow from this borehole	-£5,909,456.48	-	Alternative
Benhall	Clean borehole	-£109,903	0	Alternative
	Reline borehole	-£115,215.03		Preferred

Source: NWL IMOD and Copperleaf output

Note: the numbers for Bleach Green and Benhall were updated since our assurance report to correct an error in this table (see section 7).

3.2.3. Assumptions and Exclusions

136. Our PR24 optioneering methodology used only Copperleaf NPV calculations when constraining feasible options into preferred options. In this analysis, we also considered options which have not followed this methodology, primarily based on hydrologist and SME guidance regarding each borehole root cause and appropriate interventions. This strengthens the analysis compared to just using NPV.

137. We note that the 30-year NPV underrepresents the asset's overall value because the appraisal period captures only a portion of its lifespan. With an operational life two to three times longer than the NPV window, the asset will continue generating value and performance benefits that are not reflected in the current financial model.

3.3. PROPOSED SOLUTION

138. Following this analysis, our proposed solution for each borehole is as follows:

FIGURE 27: OUR PROPOSED SOLUTIONS

Site	Action	Comments
Syleham Crag	Drill Replacement Offsite Crag No 2 Borehole on land bordering Syleham TWS.	Land agreement in place
Holton 4	Drill an additional production borehole to produce the full licenced flow into Holton WTW.	Drilling at Hotlon Valley Farm to replace Holton 4
Mendlesham Works	Drill new standby borehole	Site selection undertaken
	Carry out pending remediation work following construction of new standby Borehole	
Bleach Green	Acidise borehole to clean casing and increase flow.	Require Syleham onsite bores to run at peak licence to enable remediation outage.
Saxmundham	Drill new borehole on site. Abandon existing (unusable) borehole.	
Halesworth	Drill new remote borehole	Move current borehole into 'standby' to deliver asset health resilience
Waveney Chalk	Drill & establish a replacement borehole on Site. Abandon existing borehole.	Move current borehole into 'standby' to deliver asset health resilience
Puddingmoor	Drill additional borehole	Move current borehole into 'standby' to deliver asset health resilience
Barsham Shipmeadow	Drill additional borehole	Move current borehole into 'standby' to deliver asset health resilience
Barsham Hall	Drill additional borehole	Move current borehole into 'standby' to deliver asset health resilience
Holton 3	Drill additional borehole	To replace Holton 3
Bungay	Drill new borehole	Licence variation submitted recently due to poor WQ, could use as river augmentation supply
Fowberry Mains A	Headworks refurbishment (grout annuals)	
Fowberry Borehole treatment 1	Drill additional (standby) borehole	Land to be purchased

Site	Action	Comments
Fowberry Mains B	Acidise borehole to clean casing and increase flow	
Thornton Bog	Refurbish borehole casing to combat high turbidity	
	Perform surveys to assess borehole condition once turbidity is lowered.	
Felkington	Refurbish borehole casing to combat high turbidity	
	Perform surveys to assess borehole condition once turbidity is lowered.	
Fulwell	Perform surveys to assess borehole condition, contamination, and second shaft access	
Benhall	Reline borehole to seal fissure	

3.4. CUSTOMER ENGAGEMENT

139. In our PR24 business plan[10], we set out how we engaged with our customers on asset health in general. 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).
>
> "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).

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

> "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."[11]

140. 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.

141. We did not include boreholes in our PR24 customer engagement, as we had no plans to increase investment in this area beyond base expenditure. However, we can apply the same principles:

- Like water treatment works, boreholes relate to the main function of the company (as customers describe it) – to provide a safe water supply.
- This should focus on where we know exactly where work is necessary now, and where this has an immediate impact on service (and safe, clean spaces).

142. We propose an investment in boreholes now rather than leaving this until AMP9. It is clear exactly where work is necessary now, and where this would have an immediate impact on service.

143. We carried out customer research on 23 April 2026 to test that these principles set at PR24 still apply and that customers support this specific investment. Customers strongly supported this investment now, rather than waiting until 2030, with all participants from Essex & Suffolk Water agreeing that this was the right approach. We attach the research report as Appendix 6.

144. 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.

FIGURE 28: 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,	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

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

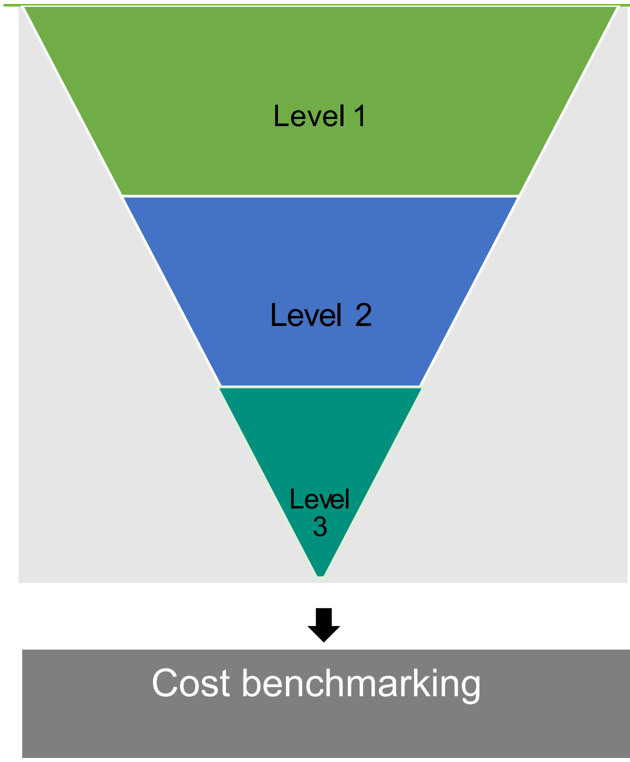
Requirement under the Rule	What did we do?
• Qualitative research among their consumers; or, • Engagement with independent consumer experts; or, • Additional or alternative approaches which achieve the outcome in paragraph 7; or, • A combination of any of the above arrangements.	with the independent 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.
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.

Requirement under the Rule	What did we do?
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

145. This section sets out the costing methodology we applied to these projects. The approach was fully aligned with our established PR24 estimating framework. Our approach ensures that our costs are robust, evidence based, efficient, and consistent with sector expectations.

FIGURE 29 - 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 using the Turner & Tonwnsend cost benchmarking database. Further detail is provided in Section 4.3.

Source: NWL PR24 cost benchmarking

146. We carried out costing of our borehole 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.

147. 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 Asset Policy Group (APG) Water specific cost curves for Process, Component, Contract, and Project Overheads.

4.1. PREFERRED OPTION COSTS

148. The iMOD Level 2 costs generated for the preferred options at our nineteen sites are shown in Figure 30 below. Totex includes the engineering scope cost and overheads. No opex costs are recorded against these sites.

FIGURE 30: BOREHOLE COSTING

Project ref	Scheme name	Underway	TOTEX Cost (£m, 2022/23 prices)
WT006966	Syleham Crag	Y	2.17
WT008038	Holton Valley Farm	Y	4.99
WT003554	Mendlesham Works	N	3.96
WT006324	Bleach Green	N	0.15
WT006368	Saxmundham	N	2.48
WT006992	Halesworth	N	3.83
WT008235	Waveney Chalk	N	4.09
WT100211	Puddingmoor	N	3.74
WT100212	Barsham Shipmeadow	N	3.79
WT100213	Barsham Hall	N	3.79
WT105077	Holton	N	3.74
WT105079	Bungay	N	3.62
WT113402	Fowberry Mains A	N	0.15
WT115910	Fowberry borehole treatment 1	N	3.81
WT006154	Fowberry Mains B	N	0.15
WT006653	Thornton Bog	N	0.18
WT006657	Felkington	N	0.18
WT119084	Fulwell	N	0.03
WT119782	Benhall	N	2.22
	Total		**47.1**

Source: iMOD cost estimation. Note: Fowberry Mains B cost is based on Bleach Green cost. Syleham Crag and Holton Valley Farm are underway in AMP8, and we have excluded these from the current base plan to avoid double counting. These costs have been converted from the Q4 2025 price base in our attached iMOD reports to 2022/23 prices using CPIH.

149. We note that this table does not include the schemes already identified in base expenditure (Figure 9 and Figure 10) – these are additional schemes to this list. This means that the total expenditure we propose is £53.9m: this is calculated as the £47.1m in this list; plus the existing base costs in Figure 9 and Figure 10; minus the implicit allowance calculated in section 2.2. This is consistent with the calculation in section 2.2.

150. We provide the full iMOD costs for each of these projects with this submission. These meet the Ofwat requirements because this is an established and transparent cost methodology, based on the use of historical costs of delivering similar solutions, and include all capital costs associated with the solution (including on costs and other overheads). We note that our CBA is informed by whole life capex and opex costs (see Figure 26).

151. The full iMOD costs provide the complete cost breakdown for individual schemes, clearly showing all aspects of cost build up. We provide our full set of iMOD costing schedules as attachments to this report. For some schemes, there is no separate iMOD schedule because we have used the same costings as another (identical) project.

4.2. EFFICIENT COSTS

152. To ensure that our costs are efficient we asked Turner and Townsend to benchmark our proposed costs against their benchmarking cost database which they used to develop cost curves for individual components based on the outturn costs from 5 different water companies. Their report is provided alongside this submission[12].

153. In total, T&T benchmarked 32 different interventions- this covered the preferred solutions for 19 projects and 13 additional options at these sites.

154. T&T carried out the following as part of benchmarking these interventions:

- Comparison of the direct costs of the interventions where the unit rates for the different project components were replaced with the cost curve unit rates from the T&T benchmarking cost database based on outturn project data from 5 other water companies.
- Comparison of indirect costs based on best practice industry norms.

155. The results from this exercise are presented in Figure 31 below. These are based on the same scope as the benchmarked projects, so differences in direct costs reflect differences in efficiency.

FIGURE 31: T&T BOREHOLES BENCHMARKING RESULTS (2022/23 PRICES)

	NWL Capex Costs (£)	T&T Benchmark (£)	Variance (£)	Variance (%)
Direct Costs	17,411,683	20,120,455	2,708,772	15.56%
Contract Overheads	9,729,131	12,072,273	2,343,142	24.08%
Project Overheads	5,405,471	6,438,546	1,033,075	19.11%
Risk	4,876,466	3,863,127	-1,013,339	-20.78%
Estimating Uncertainty	9,725,513	11,589,382	1,863,869	19.16%
Total	**47,148,264**	**54,083,783**	**6,935,519**	**14.71%**

Note: benchmarked projects can sometimes treat contract overheads, project overheads, risk and estimating uncertainty slightly differently. In this case, the contract and project overheads are similar to the variance in direct costs, but the risk and estimating uncertainty are quite different (these cannot separately always be compared because for example, as projects develop, estimating uncertainty usually reduces and risk increases to reflect more understanding of project specific risks).

156. This shows that the T&T benchmark costs are 14.71% higher than our estimated costs covering both directs and indirects. The variation is greater for both the direct costs (15.56%) and indirect costs (14.21%). T&T considered that

[12] NWL Asset Health Benchmarking report, Cost Change Submission Appendix 1, page 6-7.

the uplifts we had applied for "indirect cost elements (contract overheads, project overheads, risk and estimating uncertainty) are acceptable in line with industry norms"[13].

157. We think this demonstrates the efficiency of our proposed costs as we are below the benchmark based on historical delivery costs of other water companies.

158. 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).

[13] NWL Asset Health Benchmarking report, Cost Change Submission Appendix 1, page 6.

5. CUSTOMER PROTECTION

159. Ofwat challenged us at FD24 to "identify (how) outputs of investment could be tied to a price control deliverable"[14]. 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).

160. We think a similar PCD should apply to boreholes, as these share some features – that is, it is a programme of self-contained small projects with clear outputs. This 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.

161. 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 boreholes or these specific sites), and no enhancement investment related to boreholes in AMP8.

162. This investment will not have an impact on PCLs (interruptions to supply or water quality contacts) within the AMP8 period. These boreholes would potentially have a very small individual long impact on these PCLs because the likelihood of failure remains low for any given year; however, an individual failure which required the borehole 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.

163. So, we do not think that an adjustment is appropriate for PCLs. This will not apply in period – that is, no investments are completed before 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).

164. We have set this PCD out to cover the five-year programme for replacing these boreholes (to 31 March 2033 for replacements; and by 31 March 2030 for refurbishment and surveys).

165. We considered time incentives for this PCD. There are only 22 deliverables, and none of these are due to be completed before the end of AMP8 – so there is limit benefit to applying time incentives in-period. We explain our proposed approach in 5.7.

5.1. DELIVERY OF THE AMP8 PROGRAMME

166. 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

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

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).

167. Figure 10 shows that we are already using our AMP8 base allowances to refurbish the highest priority boreholes, and we are spending more than our implicit allowance on this. In addition to those schemes, we note that we are already moving ahead with two other schemes (Syleham Crag and Holton Valley Farm) before this submission. This demonstrates that we are using our AMP8 base allowance for boreholes appropriately.

168. We can also demonstrate that we are efficient in delivering these types of projects. Our cost estimates for new borehole projects, based on our own historical costs through the iMOD estimations, are more efficient than our external benchmark (see section 4.2).

FIGURE 32: ANNUAL BASE SPEND - HISTORICAL VS FUTURE VS IMPLICIT ALLOWANCE

	£m (2022/23 prices)
Average AMP7 spend	0.33
Annual AMP8 implicit allowance	0.36
2025/26 actual spend	1.50
Annual AMP8 base plan	1.74

5.2. DELIVERABLE

169. This PCD will ensure the delivery of 19 new, surveyed or refurbished usable (live) boreholes. We do not propose decommissioning boreholes entirely. This also includes three projects funded from base expenditure (from Figure 10).

170. The borehole projects to be delivered are set out in Figure 33 below, showing the assigned costs (these costs are pre frontier shift and real price effects). This should provide the same as the existing capacity, for new boreholes drilled, or restore boreholes to condition grade 1-3 (or deliver the original scope where other work is specified).

FIGURE 33 - PROPOSED BOREHOLE PCD (COSTS AND PRE-FRONTIER SHIFT AND RPE)

Borehole	Project Type	Non delivery payment (£m)	Delivery Date
Syleham Crag	Drill borehole	2.17	31 March 2033
Holton Valley Farm	Drill borehole	4.99	31 March 2033
Mendlesham Works	Drill borehole & remedial work	3.96	31 March 2033
Bleach Green	Acidise	0.15	31 March 2030
Saxmundham	Drill borehole & abandon	2.48	31 March 2033

Borehole	Project Type	Non delivery payment (£m)	Delivery Date
Halesworth	Drill remote borehole	3.83	31 March 2033
Waveney Chalk	Drill borehole	4.09	31 March 2033
Puddingmoor	Drill borehole	3.74	31 March 2033
Barsham Shipmeadow	Drill borehole	3.79	31 March 2033
Barsham Hall	Drill borehole	3.79	31 March 2033
Holton	Drill borehole	3.74	31 March 2033
Bungay	Drill borehole	3.62	31 March 2033
Fowberry Mains A	Refurbishment	0.15	31 March 2030
Fowberry Borehole treatment 1	Drill borehole	3.81	31 March 2033
Fowberry Mains B	Acidise	0.15	31 March 2030
Thornton Bog	Refurbishment & survey	0.18	31 March 2030
Felkington	Refurbishment & survey	0.18	31 March 2030
Fulwell	Survey	0.03	31 March 2030
Benhall	Reline	2.22	31 March 2030
North Dalton Refurbishment (base)	Refurbishment	3.98	31 March 2030
Stifford Well refurbishment (base)	Refurbishment	0.97	31 March 2030
Benhall 5 new borehole (base)	Drill borehole	1.19	31 March 2030

171. 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 projects with a description of the work carried out at each location.

172. The update will also include cumulative spending over the 2027-28 to 2032-2033 period.

173. We do not propose a mechanism to substitute the named schemes in the boreholes asset health program.

174. Failure to deliver these named schemes will lead to the associated financial allowance at each of these boreholes being returned to customers at the end of the AMP8 price control period (for those with a 31 March 2030 delivery date) or at the end of the AMP9 price control period (for those with a 31 March 2033 delivery date).

175. We note that there are some investments that customers will fund under this proposal that are not covered by the PCDs above. That is, the Wells and Bores Minor Works described in Figure 9 (a cost of £2.4m) and three projects from Figure 10 (Felkington, Rickinghall, and Sunderland GWS; a total cost of £0.06m). We do not think it is sensible to set specific PCDs for this expenditure as there needs to be flexibility about the schemes delivered. So, we propose that spending at least a total of £2.46m in 2022/23 prices on this subprogramme (including these three specific schemes) should be a condition of the PCD. Any deficit in expenditure would be returned to customers.

5.3. MEASURING AND REPORTING

176. 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 borehole site.
- Updates on borehole schemes being delayed or cancelled.
- Changes to scheme scope that results in a change to the intervention being delivered at a particular borehole, including any change to borehole size (for new boreholes).

177. 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.

178. The provision of boreholes should be complete and fully operational by the dates set out in Figure 33. For the scheme to be confirmed as complete, it must be fully commissioned, operational and in permanent use.

179. In line with its FD24 position, Ofwat will continue to allow companies to request a waiver on the application of non-delivery PCD payments where the company has not delivered the benefit by the end of the control period but is on track to deliver the benefit within a few months from the proposed end date (for those deliverables due by 31 March 2030).

180. We will clearly record and communicate any circumstances that arise which will require this clause to be triggered with delivery to be completed within the first year of AMP9.

181. We note that our delivery programme includes milestone dates for each project, with GW4 for boreholes falling in Q1 2028 (for those boreholes to be delivered by 2033). 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

182. 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

183. 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 boreholes have been sized in line with the requirements set out in the Deliverables section above.

5.6. NON-DELIVERY PAYMENT

184. The non-delivery payment rate is based on the allowance assigned to each borehole, as defined in the 'Deliverable' section above.

185. 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 the date described in Figure 33 for each scheme (31st March 2030 or by 31st March 2033).

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

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

187. We note that this non-delivery payment is calibrated at the full cost of the scheme. It is likely that replacement schemes will incur some costs (such as for pilot drilling), which may lead to schemes becoming more complex or not required at all – this is a specific risk for this type of project. We have not reflected these costs by reducing the PCD payments, because we consider that this would be covered by Ofwat's PCD guidance[15] which allows companies to retain 6% of allowances to cover scheme development costs if this is no longer required.

5.7. TIME INCENTIVE PERFORMANCE PAYMENTS

188. We propose that time-incentive performance payments could apply to those borehole projects that are due to be completed by 31 March 2033. We consider that these should be set at PR29, to be consistent with policies that Ofwat sets then (including, for example, cost of capital and inflation policies).

189. However, we would expect these to be set at approximately the same as other similar payments. For example, for our gravity sewers investment, we have based this on the same percentage of the non-delivery payment as used as

[15] Price-control-deliverables-guidance-Feb-4-republishing.pdf, p15

PR24 (that is, the outperformance payment is set at 3.97% of the non-delivery payment; and the underperformance payment is set at a third of this). This would imply a range of time incentive payment rates.

190. We recommend that Ofwat consider setting a percentage rate for these types of projects, rather than individual £m rates. This will apply a consistent approach to all asset health expenditure.

191. We do not think a time incentive is needed for our projects which are due to be complete by 31 March 2030, as these are small and can be addressed by Ofwat's updated policy on PCD flexibility.

6. INVESTMENT DELIVERY PLAN

192. We examined supply chain availability and the deliverability of the wider programme 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.

193. In section 5.2 of the "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 boreholes specifically.

194. In section 5.3 of the "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 boreholes.

195. 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 3.

6.1. SUPPLY CHAIN ENGAGEMENT

196. 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.

197. 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 boreholes replacement programme, which we propose to deliver over six years through our Living Water Enterprise (LWE); and our boreholes refurbishment 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.

198. We have confirmed that the availability of materials for boreholes is not a high risk. 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. Instead, the key risk is likely to be planning and land; along with the specific challenges for boreholes outlined in section 6.3 below.

6.2. 2025-30 (AMP8) DELIVERY

199. In section 5.3 of the "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.

200. 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.

201. 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 boreholes replacement programme in particular, which has some of these risks too. The borehole at Linford is **not described** in this asset health case, as this is an entirely new project funded under enhancement expenditure at PR24, and is not a replacement or refurbishment. However, we describe this here because replacement boreholes elsewhere may have some similar risks where they require land purchases. We address this in section 6.3 below.

6.3. DELIVERY RISKS

202. We have considered the design and delivery risks for this programme, and we provide our full risk register in Appendix 3.

203. Delivering a new borehole is a multi-faceted process that involves technical, environmental, legal, and operational considerations. For each borehole we need to identify a suitable location based on hydrogeological potential, environmental constraints, and proximity to existing assets. Once a preferred site is identified, in many cases we must secure the land, either through purchase or lease, while completing legal checks, ensuring access rights, and putting in place the necessary agreements for construction and long-term operation. Alongside this, regulatory permissions such as planning consent and drilling approvals must be obtained, and environmental surveys carried out to ensure compliance and minimise impacts.

204. Our Borehole Drilling framework (under LWE) will be used to appoint contractors, with competitive tendering applied as appropriate and in accordance with the framework rules.

205. Specialist survey work will continue to be undertaken by experienced contractors specialising in geotechnical analysis who are familiar with our sites. This is to ensure effective delivery to the required standard and reliable advice is achieved. We will apply competitive tendering where this is appropriate.

206. We will carry out pilot drilling to confirm whether the site can deliver a reliable and sustainable water source. A small-diameter exploration borehole is drilled, geological logs are taken, and geophysical surveys are carried out to understand the aquifer structure. The pilot borehole is then test-pumped to assess yield, aquifer behaviour, and long-term sustainability, while water quality samples are analysed to determine suitability for treatment and supply.

207. All this information is brought together into a viability assessment that determines whether the site can progress to a full production borehole. Often the results are not adequate, and another borehole needs to be drilled.

208. This combination of land acquisition, regulatory approvals, technical investigation, hydrogeological testing, and detailed analysis makes borehole delivery a complex, multi-stage process requiring coordination across multiple disciplines, and so we need a significant amount of time to deliver effectively.

209. In addition, refurbishment, relining, surveying and cleaning of boreholes take much shorter periods of time to complete but often have specific needs. For example, off peak flow periods, seasonal weather requirements and other programme of works can impact delivery. This has been accounted for too in our planning.

210. We explain all of these risks in our risk register – including how we are mitigating each of these. For the programme itself, we will use this risk register as a "checklist" guide to explore individual risks. Not all risks will apply in exactly the same way, and some risks will only become apparent with more detailed design and further engagement.

211. We have set out a six-year delivery programme for the borehole replacements. This reflects the risk 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

212. We discuss our engagement with DWI in section 2.6. This will continue through the design and construction of replacement boreholes.

213. 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 engage with local stakeholders where this is relevant, including local land owners, but we note that this will not have as much impact as for example, the new Linford borehole. We will use our Community Hub to describe the projects and engage with stakeholders.

214. For borehole refurbishments, 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

215. As we describe in section 6.3, we have set out a six-year programme for our borehole replacements.

216. 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.

217. For our borehole refurbishments, 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.

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

7. ASSURANCE

219. 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.

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

221. 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 34.

FIGURE 34 - AMBER ISSUES

Issue	Action taken
Section 2.6 Engagement with stakeholders and customers - The section for engagement with stakeholders and customers with regards to the need assessment is incomplete and evidence of engagement has not been provided. This is a key requirement from Ofwat.	We had not completed our customer research at the time of the assurance review (the panels were on 23 April). We have since added this to section 2.6 and 3.4. We had not completed our discussions with DWI at the time of the assurance review. We have since added this to section 2.6.
The management confirmed that they will attached the full cost breakdowns from iMOD with the investment case submission. The cost breakdown for the named schemes pertaining to additional investment from the AMP8 base plan are not provided.	We note that we attach the full cost breakdowns from iMOD with the investment case submission. This does not include the three “named schemes” from base expenditure (North Dalton, Stifford Well, Benhall 5) as these are not based on iMOD cost breakdowns and are instead current project forecasts of costs. These three schemes are already underway.
Provide more clarity about the need to further mitigate abstraction reductions as part of the business case for asset health and why not covered by the WRMP.	In response to these issues (which relate to section 2.3.2 and 2.3.3) we have substantially rewritten and added to these two sections. However, this was too late for the final assurance review.
Including demand vs supply information in the figure for increased transparency on the numbers that are driving the issue.	
Please provide evidence of this increasing pressure that has resulted in BHs being unable to be taken out of service for refurb.	
Provide more information on the demand figures against the new total licence figures	
NPVs have not been given for all the preferred and alternate options… where the preferred option is showing a lower NPV the evidence/justification of this should be provided (e.g. Bleach Green, Benhall).	In response to this, we checked our table carefully – and corrected errors for Bleach Green (relining option) and Benhall (new bore option). This table is now correct.

8. APPENDICES

1) Appendix 1 - Table of sites, options and selection process, table of NPVs for options and preferred options
2) Appendix 2 – Workload and expenditure for Boreholes and wells programme
3) Appendix 3 – Boreholes risk assessment
4) Appendix 4 - Long term asset class strategy – boreholes
5) Appendix 5 – delivery plan
6) Appendix 6 – Customer research

We also provide individual iMOD reports for each borehole in this proposal.