PR24 CMA Redetermination

Our Response to the CMA's Consultation: Base Costs Modelling – Working Paper

Thames Water Utilities Limited

1 Introduction and Executive Summary

(1) This submission sets out the response of Thames Water Utilities Limited ("Thames Water") to the Competition and Markets Authority's ("CMA's") consultation on the Base Costs Modelling Working Paper ("Base Costs WP") dated 18 December 2025 in relation to the PR24 price controls for the five disputing companies (the "Disputing Companies").

(2) As the CMA is aware, on 14 February 2025, Thames Water announced that it had asked Ofwat to refer its final determination ("FD") to the CMA for a redetermination, after Thames Water's Board of Directors concluded that the FD is not in the interests of Thames Water's customers, communities and the environment. Following constructive discussions, Thames Water and Ofwat agreed on 18 March 2025 to defer making Thames Water's reference to the CMA.[1] This deferral was subsequently extended on 18 July 2025[2] and on 21 October 2025.[3] This is on the basis that discussions together with Ofwat, other regulators and our senior creditors (the London and Valley Water Consortium) hold out the prospect of unlocking a market-led solution for the recapitalisation of the company to support the company's turnaround. This would be in the interests of all relevant stakeholders. Unless and until our FD is referred to the CMA by Ofwat, Thames Water remains a third party in relation to the redetermination process.

(3) The Base Costs WP outlines the CMA's updated thinking in relation to the novel econometric modelling approach to wholesale water and wastewater base cost allowances that the CMA had proposed in its Provisional Determinations published on 9 October 2025 (the "PDs") and provides an opportunity for interested parties to comment on technical aspects of the approach. We welcome the opportunity to comment on the Base Costs WP and the CMA's recognition that further consideration of, and consultation on, the base cost assessment is required in light of the significant and widespread concerns raised by stakeholders in relation to the CMA's base cost modelling approach in the PDs.

(4) We recognise that the CMA has refined its proposed base cost models to address certain of the specific issues identified by stakeholders. However, we remain concerned that the CMA's updated modelling approach does not engage with the fundamental concerns that Thames Water and many other stakeholders raised with the CMA's novel econometric modelling approach at PDs. As currently proposed in the Base Costs WP, the modelling approach is not fit for purpose and creates a flawed and unsound framework to regulate the sector and determine base cost allowances. The output of this modelling will have a direct and adverse impact on the services that companies can deliver for customers, as well as on the financeability of the sector and its attractiveness for investors.

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[1] Thames Water, CMA and Equity Raise Update (18 March 2025): https://www.thameswater.co.uk/news/2025/mar/equity-raise-update.

[2] Thames Water, CMA Reference Deferral Update (18 July 2025): https://www.thameswater.co.uk/news/2025/jul/cma-reference-deferral-update.

[3] Thames Water, CMA Reference Deferral Update (21 October 2025): https://www.thameswater.co.uk/news/2025/oct/thames-water-cma-deferral-october.

(5)   The remainder of this submission provides Thames Water's more detailed views on the CMA's Base Costs WP. This submission is structured as follows:

(i)   **Section 2** explains why the Base Costs WP approach is not fit for purpose and should not be used. In particular, the econometric modelling approach does not engage with fundamental concerns raised in response to the PDs. In addition, the CMA's radical departure from established policy and precedent, given the circumstances facing the sector and without fulsome consideration of concerns identified by relevant stakeholders or real world cross-checks, is contrary to the best principles of regulatory practice and is not aligned with the statutory duties that apply to the CMA.

(ii)   **Section 3** sets out why the base allowances proposed by the CMA are clearly insufficient, noting in particular that:

(a)   The Base Costs WP modelling approach results in a substantial reduction in the wholesale water and wastewater base cost allowances across Disputing Companies (of 4.8%) relative to Ofwat's FD and implies allowances that would be 7.1% lower for the sector. This critical underfunding is divorced from the reality of a sector that is lacking in financial resilience.

(b)   In applying a more data-driven approach at the expense of economic and engineering rationale, the approach is antithetical to the conclusions of the Independent Water Commission ("IWC"), which highlighted that an overemphasis on economic benchmarking without due consideration of company-specific factors has "*led to sub-optimal outcomes for the sector*."[4]

(iii)   **Section 4** sets out Thames Water's position in relation to the continued use of the Least Absolute Shrinkage and Selection Operator ("LASSO") algorithm. It is Thames Water's view that the use of the LASSO algorithm in this context and circumstances is not appropriate. In particular:

(a)   In small sample settings, machine learning techniques are inherently problematic which leads to a loss of robustness and transparency.

(b)   LASSO is typically adopted in high-dimensionality settings, where the sparsity assumption is assumed to hold. This is not the case here, and LASSO is therefore neither appropriate nor necessary in dealing with the issues at hand.

(c)   LASSO does not provide a stable, well-understood cost benchmark which companies can engage with and challenge themselves over time. This, in turn, works to undermine the efficiency incentives set out through the price control.

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4   IWC Final Report (21 July 2025), page 193, paragraph 417.

(iv)   **Sections 5 to 9** set out Thames Water's additional concerns with the novel methodological approaches adopted by the CMA in the Base Costs WP, notably:

(a)   We disagree that the Principal Component Analysis ("PCA") is the most appropriate approach to deal with collinearity in this case. The approach is non-transparent, unstable, and introduces an unnecessary layer of complexity to an already complex approach (**Section 5**).

(b)   We explain why the models set out in the Base Costs WP contain counterintuitive coefficient estimates which undermine trust in these models (**Section 6**).

(c)   We consider that the approach set out in the Base Costs WP does not appropriately recognise the panel structure of the data, which undermines the reliability of its results (**Section 7**).

(d)   We note that the Base Costs WP lacks model triangulation, which increases the risk of material errors (**Section 8**).

(e)   We disagree with the decision to place full reliance on a single model to set a highly material catch-up challenge and demonstrate the sensitivity of the catch-up challenge to dynamic variants of the models (**Section 9**).

(v)   **Section 10** sets out Thames Water's proposed recommendations. Given that the Base Costs WP fails to address the significant concerns that have been raised by Thames Water, the Disputing Companies and other stakeholders, we urge the CMA to:

(a)   return to a more conventional approach that represents regulatory best-practice, amending the specification of Ofwat's models according to the CMA's consideration of the merits of the arguments presented by the Disputing Companies and third parties;

(b)   apply more thorough consideration of cost adjustments to be applied to base cost allowances, in particular accounting for company-specific factors. This would be consistent with the recommendations of the IWC;

(c)   make use of model triangulation by adopting a set of plausible models of different specifications and levels of granularity. This will also remove the need for non-transparent and unstable PCA variables;

(d)   soften the catch-up challenge, given the evidence that the models are unreliable; and

(e)   use methods that recognise the panel structure of the data (such as the random effects methods for estimating models' coefficients).

(vi)   **Appendices 1 and 2** provide estimation results as applied to the CMA's proposed models to support arguments made below. It is not an endorsement or acceptance of the CMA's proposed model specifications.

(6)   **Annex 1** to this Submission provides a report by Professor Weeks of the University of Cambridge. We commissioned Professor Weeks to carry out an independent review of the Base Costs WP proposals jointly with Northumbrian Water. Professor Weeks argues that LASSO is inappropriate in our regulatory context, that the CMA's approach introduces significant computational uncertainties, and that the refinements in the Base Costs WP do not address the fundamental concern raised in response to PDs. He further opines that the CMA's approach "*represents a shift toward an even more algorithmic, data-driven approach e.g. replacing expert judgment in variable selection with automated cross-validation procedures. This moves the methodology further from, rather than closer to, the IWC's recommendation for greater attention to company-specific operational circumstances*".[5]

(7)   This Submission is intended to assist the CMA by providing Thames Water's perspective on the CMA's proposed base cost models, as a matter which is both relevant to the sector and Thames Water specifically. It is without prejudice to future submissions that Thames Water would make in a statement of case or thereafter should a reference to the CMA be made. For the avoidance of doubt, this submission does not purport to set out the issues, arguments and evidence that Thames Water would make in its statement of case if a referral of our FD to the CMA is made. In particular, given the well-publicised operational and financial challenges that Thames Water is experiencing and the region-specific challenges to which it is subject, the CMA's approach in the Base Costs WP would be wholly unsuitable for setting cost allowances for Thames Water and would leave us critically underfunded to deliver our functions and comply with our core legal and regulatory obligations. It is therefore imperative that the CMA's consideration of the base cost assessment for the Disputing Companies does not in any way prejudice or predetermine any (possible) redetermination by the CMA for Thames Water.

2   The novel econometric modelling contained in the Base Costs WP is not fit for purpose and should not be used

2.1   The Base Costs WP does not engage with the foundational concerns raised by Disputing Companies and other stakeholders

(8)   The CMA states that it has improved and refined its base cost assessment to reflect concerns raised by stakeholders and that "*our proposed updated approach has a number of important benefits that should outweigh any residual concerns*".[6] In particular, the CMA notes that its approach has (a) addressed technical implementation issues identified in its PDs; (b) taken steps to mitigate the concerns raised around model stability and conducted extensive stability and robustness checks; and (c) taken steps to mitigate the concerns raised around model treatment of correlation between cost drivers.[7]

(9)   It is notable, however, that the CMA's Base Costs WP focuses on the technical feedback from stakeholders and does not engage with the foundational concerns relating to the

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[5]   Annex 1, Section 2.2.

[6]   Base Costs WP, paragraph 1.6.

[7]   Ibid., paragraph 1.8.

CMA's approach raised by Thames Water, Disputing Companies and a plethora of third parties (a subset of which are set out in the table below). These concerns notably related to the use of LASSO, the inconsistency of the CMA's approach with principles of regulatory best practice and the IWC recommendations, and the unexplained and counterintuitive nature of the changes in cost allowances given the industry backdrop.

(10)   As this Section demonstrates, we consider that many of these concerns have been perpetuated and exacerbated by the CMA's approach at PD. These issues must be addressed by the CMA so that its approach to base cost modelling at FD is fit for purpose.

Table 1: Third party feedback on the CMA's approach to wholesale water and wastewater base cost allowances

Third Party	Feedback	Reference
Fionn Cliffe[8]	"…it is also my belief that the use and implementation of LASSO in this specific context is inappropriate".	Page 1, paragraph 4
	"…it appears as if the CMA is really using LASSO as an attempt to inform dimension-increase of Ofwat's PR24 FD cost models...This might seem like a subtle difference, but in my experience runs counter to best practice when using LASSO or other machine learning variable selection techniques."	Page 3, paragraph 2
	"The issues highlighted herein cast into doubt the likelihood of producing unbiased estimates of efficient costs using the proposed models."	Page 6, paragraph 1
Portsmouth Water	"…the LASSO approach taken by the CMA represents a substantial departure from the Final Determinations without recognising the limitations and sufficiently justifying the CMA's choices."	Page 1, paragraph 2
	"The use of LASSO has the potential to establish harmful regulatory precedent…"	Page 1, paragraph 2
	"The use of LASSO in this context reduces transparency in regulatory decision-making."	Page 4, paragraph 3
	"In our view, the CMA's use of LASSO represents a step away from the direction of reform advocated by the IWC, diminishing the role of expert supervisory judgement in designing models and interpreting results."	Page 5, paragraph 6
Severn Trent	"…the engineering rationale for the CMA's base cost models is significantly reduced compared with Ofwat's models."	Page 2, paragraph 1
	"…the new base cost models find that the industry should be spending less on base costs: £36.7bn versus £41.1bn at PR24... This goes against the views of the National	Para 2, paragraph 5

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[8]   Fionn Cliffe is a doctoral researcher at Loughborough University focusing on developing cost assessment methodologies for performance measurement of wastewater systems. Note that Cliffe's research is partly funded by Anglian, but it did not fund this submission.

Third Party	Feedback	Reference
	Infrastructure Commission, Ofwat through its Asset Health Roadmap process and the Cunliffe review."	
	"…we are concerned about the stability of the base cost models. The LASSO approach is likely to prioritise different variables as new annual data is added... This could lead to significantly different models and base cost allowances for companies."	Page 2, paragraph 6
South Staffs Water	"The large swings across the sector compared to Ofwat's models have not been explained, and the robustness from a fundamental engineering and economics standpoint has not been evaluated."	Appendix 1, page 1, paragraph 1
	"These substantial changes in assessed cost efficiency are unexplained and counterintuitive, and cast doubt on the validity or bias of the model selection process more generally."	Appendix 1, page 1, paragraph 2
United Utilities	"This is a novel and untested approach in the context of setting cost allowances for utility sectors."	Page 2, paragraph 4
	"The change of approach also runs counter to the general principle of regulatory consistency and predictability, and if it were to be adopted at future price controls, we consider it would likely lead to suboptimal outcomes for customers and the environment by misallocating the resources required by companies to deliver their functions in delivering a vital public service."	Page 2, paragraph 4
	"The reduction of base allowances across the water industry relative to Ofwat's PR24 Final Determinations by around £4.3bn, at a time when the Independent Water Commission (IWC) has called for a greater focus on asset health and resilience."	Page 2, paragraph 6
	"…we believe there are fundamental issues with the new models that mean they would be unsuitable for use at future price reviews for the purpose of setting base costs allowances."	Page 3, paragraph 4
Yorkshire Water	"The LASSO approach represents an even more econometric, top-down approach, which is detached from engineering principles."	Page 4, paragraph 3
	"…while we acknowledge the analytical potential of the LASSO technique, we have reservations about the models' implication that base allowances for the industry should be lower. This perspective does not appear to align with the available evidence or the broader consensus that assets require increased rather than reduced funding. Therefore, we question the reliability and validation of the models at this stage."	Page 4, paragraph 4

2.2 The CMA's Base Costs WP approach is inconsistent with principles of best regulatory practice

(11) In our response to the PD, we highlighted concerns that the use of LASSO represented a fundamental departure from Ofwat's FD, in circumstances where predictability and regulatory consistency are of pivotal importance for investor confidence.[9]

(12) We have set out before that, in the course of making its redeterminations, the CMA must have regard to principles of best regulatory practice, including the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed.[10]

(13) The radical departure from established regulatory practice that has been proposed in the PDs and the Base Costs WP is inappropriate given the context of the CMA's redeterminations and the minimal scope for detailed consultation with Disputing Companies and other stakeholders. It is also incongruent with the CMA's approach in other areas (such as the "*limited adjustments to performance targets and incentive rates [made by the CMA] within Ofwat's Outcomes framework*" and, as explained further below, is also inconsistent with the recommendations of the IWC).[11]

(14) Econometric models and their underlying methodologies typically require years to create and refine – for example, Ofwat's approach to base cost modelling has been subject to detailed industry-wide consultation over successive price reviews and is well understood by stakeholders. That the CMA has developed a radically new set of models within the necessarily compressed timeframe of the redetermination process (which affords limited scope for consultation) and notwithstanding the significant opposition of many stakeholders, is neither appropriate nor proportionate given the materiality of the potential impact on the Disputing Companies' allowances and the services delivered to customers. It is further concerning in this regard that the Base Costs WP provides very limited economic or engineering rationale for its approach; which is a departure from principles of best regulatory practice in relation to cost modelling and incentive mechanisms.

(15) While Thames Water appreciates that the CMA has afforded the opportunity to comment on its updated approach in the Base Costs WP and welcomes that opportunity, we note that there have been significant revisions to the CMA's approach compared to the PDs (both in terms of methodologies and the model's output). Several new elements have been introduced. In this context, we do not consider that the Base Costs WP (produced *ex-post* to the PDs with a short deadline for comment) represents an adequate consultation to underpin such a fundamental redesign of the base cost modelling approach that may have implications for the future of the regulatory framework. As explained in Sections 3 to 9 of this Submission below, we maintain significant concerns with many aspects of the methodology in the Base Costs WP.

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[9] Thames Water Third Party Submission (November 2025), page 7, paragraph 19.

[10] Water Industry Act 1991, Part I, section 2(4).

[11] CMA PD – Summary (9 October 2025), paragraph 41: https://assets.publishing.service.gov.uk/media/68e743b7750fcf90fa6fff78/Provisional_determinations___summary.pdf.

# 3 The base cost allowances contained in the Base Costs WP are clearly insufficient

3.1 The allowances implied by the CMA's models are unrealistic and would not allow companies to deliver their services at the required standards

(16) Base allowances are an extremely important and material component within water companies' total expenditure ("Totex") allowance. In line with the statutory duties that apply to it in this redetermination, the CMA must act in a manner best calculated to ensure that water companies can properly carry out their functions – which implies sufficient allowances for an efficient company to deliver the requisite level of service for customers and the environment.

(17) Our response to the CMA's PDs highlighted a material concern that, were the proposed base cost models applied to all companies, they would result in aggregate modelled base cost allowances less than Ofwat determined in its FDs and the results for some companies would therefore be extreme.[12] The Base Costs WP proposes base cost allowances that are significantly lower than even the allowances in its PDs. Overall, the proposed allowances are lower than Ofwat's FD24 allowances (by c. 7%)[13] and significantly lower than what companies had forecasted in their business plans for the period 2025-30.

(18) The material change in allowances between the PDs and the Base Costs WP is a cause for concern, indicating a lack of checks and corroboration and the absence of an in-the-round assessment drawing on economic and engineering rationale. This concern is amplified by the fact that the proposed allowances implied by the Base Costs WP are simply too low to pass a real-world sense-check. This is apparent when comparing them to companies' ongoing levels of base expenditure. For the Disputing Companies individually, the results are material. Northumbrian Water experiences an overall percentage change of -8.3% versus it's FD24, while Anglian Water and Wessex Water are also subject to decreases in excess of 5%.

(19) Figures 1 and 2 show, for water and wastewater respectively, that the CMA's proposed base expenditure per property (orange bar), are lower than actual base expenditure in the 2020-25 period ("AMP7") (blue bar) and significantly lower than companies' forecast base expenditure. The figures are for the sector total (left panel) and Thames Water (right panel).

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[12] Thames Water Third Party Submission (November 2025), paragraph 16: https://assets.publishing.service.gov.uk/media/6941882558a21370f58f303b/Thames_Water_17.12.25.pdf.
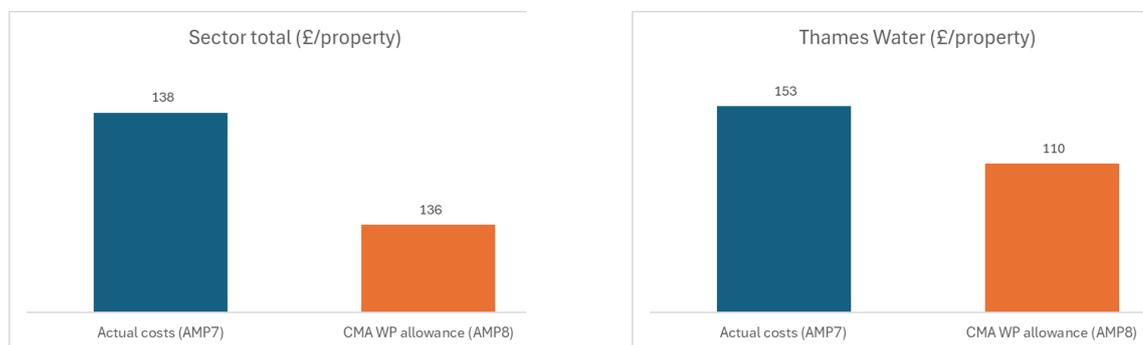
[13] Base Costs WP, paragraph 1.9.

Figure 1: AMP7 outturn versus AMP8 forecast wholesale water base expenditure (£/property of 2022–23)
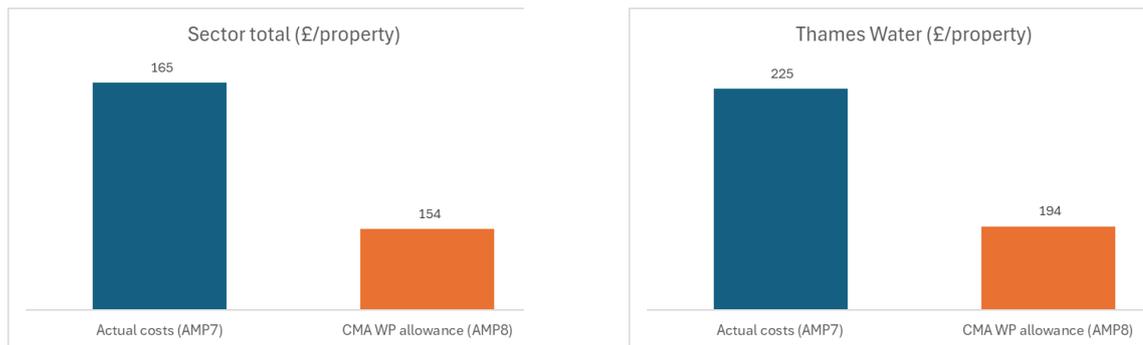
Source: Thames Water analysis based on PR24 feeder model 3 and inputs from the CMA working paper.

Figure 2: AMP7 outturn versus AMP8 forecast wholesale wastewater plus base expenditure (£/property of 2022–23)

Source: Thames Water analysis based on PR24 feeder model 3 and inputs from the CMA working paper.

(20)   On average for the sector, the CMA's model predicted allowance per property would be 6.6% and 11.2% lower than AMP7's historical average for water and wastewater, respectively. The respective figures of funding gaps for Thames Water are 14% for water and 20% for wastewater network plus. This is neither realistic nor sustainable for the sector to deliver base services to the expected standard.

(21)   The low unit cost allowed by the CMA's proposed models compared to AMP7 rates, should be assessed against findings in Ofwat's Water Company Performance Report (October 2025).[14] During AMP7, 15 of the 17 companies referenced incurred often substantial base cost overruns (that is, their allowed base costs were insufficient to deliver their services).[15] Moreover, despite the cost overruns, companies generally did not manage to meet their performance commitments, which, in turn, are largely expected to be funded from base expenditure.[16] This resulted in more than £700 million returned to customers over the

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[14]   Ofwat, Water company performance report 2024–25 (October 2025), ("Ofwat Water Company Performance Report"): https://www.ofwat.gov.uk/wp-content/uploads/2025/10/WCPR-24-25.pdf.

[15]   Ibid., page 43 (Base expenditure).

[16]   Ofwat's Water Company Performance Report states that companies have underperformed on outcomes. Delivery has fallen short of performance commitment levels, most notably for pollution incidents, leakage and supply interruptions, with pollution incidents deteriorating by 27% despite a commitment to a 30% reduction (Foreword, Key messages, and Sector performance assessment).

2020–25 period due to underperformance payments.[17] This evidence suggests that the efficient costs required to deliver AMP7 performance commitment levels are, on average, higher than the actual costs incurred by the sector. The costs required to maintain and deliver yet higher standards in AMP8 would be higher again. This is clearly in stark contrast to the outcome of the approach to base expenditure allowances proposed by the CMA in the Base Costs WP, which takes the wrong direction.

3.2 The results are counterintuitive considering the widespread recognition that the sector has been historically underfunded and is lacking in financial resilience[18]

(22) The scale of the reduction in base cost allowances is inconsistent with sector-wide evidence of asset health pressures, recent overspends, and investment needs. The magnitude of the negative changes does not reconcile with real-world operational and financial evidence.

(23) The low base expenditure allowances are proposed at a time that the water sector is under sustained upward cost pressure due to increasing challenges in addressing climate change, more stringent environmental standards, an urgent need to improve the health and resilience of its assets and stretching PCL targets. The IWC's report highlighted the need for focus on asset health and resilience for the sector and recognises that the activities dealt with through base costs should be better funded (in particular because of the important role that the water sector plays in facilitating and supporting economic growth).[19]

(24) Many of these pressures are common across the sector, but the impact differs materially by company, reflecting geography, asset condition, population trends, and environmental exposure. For this reason, benchmarking must be interpreted carefully and supplemented by company-specific evidence when assessing efficient costs. We have previously detailed to the CMA the findings made by the IWC that there has been an overemphasis on economic benchmarking in previous price control cycles without due consideration of company-specific factors. The IWC considered that this has led to sub-optimal outcomes for the sector: "*over-reliance on [a data-driven, econometric] approach, and its over-development, have over the years led to sub-optimal outcomes for the sector, for customers, for investors and for the environment*." [20] The findings of the IWC are clearly a relevant consideration and it is wrong for the CMA to disregard the IWC's concerns and adopt an approach which is at odds with its findings.

(25) Even if some of the performance improvements above are initially funded as enhancement, over time they are expected to be funded through base expenditure. The regulatory framework is designed around the principle that once an improvement is funded and

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[17] Ibid., page 2 (Foreword).

[18] In Ofwat's Monitoring Financial Resilience Report 2024-5 (November 2025), page 7, it states that it had some concerns (or potential concerns) with the financial resilience of three of the Disputing Companies with the remaining two Disputing Companies having been identified as requiring specific action to strengthen financial resilience: https://www.ofwat.gov.uk/wp-content/uploads/2025/11/The-Monitoring-Financial-Resilience-Report_2024-25.pdf.

[19] IWC Final Report, page 205, recommendation 19; page 390, Section 7.3: https://assets.publishing.service.gov.uk/media/687dfcc4312ee8a5f0806be6/Independent_Water_Commission_-_Final_Report_-_21_July.pdf.

[20] Ibid., page 193, paragraph 417.

delivered, possibly through enhancement, maintaining that higher standard becomes a "base" expenditure. By its own definition, enhancement expenditure results in a permanent increase or step change in service to a new 'base' level. This transition effectively integrates the outcomes of previous enhancement projects into the routine, year-on-year operations of water companies.

(26)   The low allowances resulting from the models demand evidence of significant scrutiny, triangulation and assurance from the CMA regarding their proposed outcome. Such evidence has not been provided in the Base Costs WP. On the contrary, the outcome is based on a single model and a single catchup challenge. The outcomes are also based on an untested machine learning algorithm, applied in a small sample setting. The application of machine learning techniques in small sample settings is universally recognised as inherently problematic, unstable, and often unjustified.

(27)   Moreover, the Base Costs WP's proposals have a direct adverse impact on industry financeability. Holding all other things equal, a 7% or £3 billion cut to base allowances reduces adjusted interest cover by approximately 0.2 times. This would normally equate to a one notch downgrade in a typical company's credit rating.

(28)   The CMA's current approach could have material second-order effects on both financeability and investability. As the CMA will be aware from the findings of the IWC report, one of the key factors weighing down on the sector's credit quality and attractiveness to investors at the current time is the loss of predictability and stability in the water industry's regulatory regime.[21] A decision by the CMA to adopt a radically new base cost assessment methodology notwithstanding the significant concerns expressed by a range of stakeholders, would very likely be perceived as an additional source of risk to investor capital in the water industry compared to other industries.

(29)   In Thames Water's specific case, as the company that would be most adversely affected by the CMA's new modelling specifications if adopted on an industry-wide basis, a ~13% loss of base funding could reduce our interest cover by around 0.4 times. This burden on our credit metrics would make our refinancing, financial turnaround and the restoration of our investment-grade credit ratings an order of magnitude more difficult than it already is, with consequent prolongation of risks to investment, efficiency, performance and service delivery for customers and the environment.

4   LASSO is not fit for purpose for the CMA's proposed usage case

(30)   Thames Water has previously set out in its submissions of 11 June 2025 and 11 November 2025 that econometric models produced using the LASSO technique are ill-suited for the present usage case.[22] Thames Water submitted independent expert reports to support

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[21]   Ibid., page 319, paragraph 747.

[22]   Thames Water Third Party Submission (June 2025):
      https://assets.publishing.service.gov.uk/media/684ff3399d538361ad2da716/Thames_Water_Response_to_Approach_and_prioritisation.pdf.
      Thames Water Third Party Submission (November 2025).

these submissions. These concerns were echoed in responses by the Disputing Companies and multiple third parties.

(31) In this section we explain our three fundamental objections to the use of LASSO in the specific context of this redetermination.

4.1 LASSO is unsuitable given the small sample

(32) In small sample settings, machine learning techniques are inherently problematic and often unjustified. Most machine learning methods are data-hungry by design; they rely on large volumes of observations to reliably distinguish true signal from noise and stabilise parameter estimates. However, when data are scarce, models tend to overfit - capturing idiosyncratic features of the sample rather than underlying relationships - thereby delivering apparently strong in-sample performance but poor out-of-sample generalisation. Small samples also undermine the effectiveness of cross validation techniques, and exacerbate sensitivity to modelling choices, hyper-parameters, and random initialisation. The result is a loss of robustness and transparency, with predictions that are highly unstable and difficult to interpret or defend. In such contexts, simpler statistical approaches grounded in theory and prior knowledge are typically more reliable and proportionate than machine learning models whose advantages often materialise in with the availability of larger data.

4.2 LASSO is neither appropriate nor necessary in dealing with the issues at hand

(33) LASSO is typically adopted in high dimensionality settings, where the sparsity assumption is assumed to hold. High dimensionality refers to the number of potential explanatory variables relative to observations, or, in our case, the number of candidate cost drivers relative to the number of observations. If the number of candidate cost drivers is very large and we assume that only a small number is needed for a sufficiently accurate model (this is the sparsity assumption), then LASSO can be an effective tool.

(34) However, this is not the case here. We do not have a high dimensionality problem - the key cost drivers are few and known. Ofwat's models are already sparse (in terms of parsimony). The CMA is not faced with a problem of reducing a large set of candidate cost drivers to obtain a sparse model. The CMA is faced with having to make 2 to 3 decisions on which measure of a cost driver is the most appropriate. LASSO, with its significant complexity and limitations in small data, is not the most appropriate tool.

(35) Furthermore, selecting between different measures of a variable is often based on characteristics that are not assessed by LASSO. For example, Thames Water presented compelling evidence against the Booster Pumping Stations ("BPS") cost driver in water models and proposed the more intuitive, and statistically better-behaved variable, Booster Pumping Capacity ("BPC").[23] The LASSO algorithm is not designed to capture a clear deficiency such as the one we highlighted about the BPS variable. Instead, LASSO selects to leave it in the model based on its predictive value.

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[23] Thames Water Third Party Submission (April 2025), page 6, paragraph 21: https://assets.publishing.service.gov.uk/media/68131d2f0a8696a367e727df/Thames_Water.pdf.

4.3 LASSO undermines efficiency incentives

(36) LASSO does not provide a stable, well-understood cost benchmark which companies can engage with and challenge themselves over time. The algorithm has proven to yield models that are difficult to interpret (indeed, the CMA does not provide an economic interpretation to its models). This includes: PCA variables with uninterpretable coefficients; the absence of U-shaped relationship between density and costs; the presence of variables with highly insignificant coefficients; and the presence of a regional wage variable in the water model (and not the wastewater model) despite the fact that wastewater has a higher labour share than water.[24] The lack of a robust and stable efficiency benchmark is not conducive to yardstick competition. For example, the range difference between PD and base WR changes from 0.52 to 0.64, with substantial changes as between companies in the water efficiency scores.

(37) In summary, the CMA has effectively delegated regulatory judgment on a key part of the price review to a machine learning algorithm that is not effective in the circumstances of the current case (and without adequate cross-checks). We do not have a large sample, and we do not have high dimensionality, namely, a large set of candidate cost drivers to apply sparsity to. Indeed, LASSO does not 'select' anything. The only selection involves the removal of the wage index from the wastewater model, which creates an uncomfortable and unintuitive asymmetry between the water and wastewater models.

(38) LASSO replaces expert-led model design, triangulation, and economic reasoning with automated variable selection driven by RMSE minimisation and disregard for statistical significance and economic rationale. This is inconsistent with best regulatory practice, previous CMA decisions, and the recommendations of the IWC to move away from excessive reliance on econometrics.

(39) In addition, LASSO introduces unnecessary complexity, instability, and a lack of transparency. Although presented as automated and "objective", the machine-learning econometric framework embeds a substantial number of discretionary modelling choices, creating an illusion of automation rather than a genuinely neutral analytical process. The choice of penalty parameter lambda (λ), cross-validation approach, and candidate variable set all involve discretionary decisions that materially affect outcomes. Yet, they are not easily interpretable or explainable to stakeholders. This undermines accountability and makes the resulting allowances difficult to scrutinise or justify, undermining the CMA's contention that it has adopted a "*transparent data-driven approach*".[25]

(40) In our view, the cost assessment process does not gain from the unnecessary and misplaced introduction of LASSO—on the contrary, it loses reliability and effectiveness. We strongly recommend that the CMA reverts to model averaging and a qualitative and economic assessment of the few representations regarding model specification.

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[24] The labour cost share for water and wastewater base expenditure is 33.5% and 36.4% respectively. Source: Ofwat, PR24 Final Determinations: Expenditure allowances, page 273, Table 33 "Labour RPE at PR24 final determinations": https://www.ofwat.gov.uk/wp-content/uploads/2024/12/9.-PR24-final-determinations-Expenditure-allowances.pdf.

[25] Base Costs WP, para 1.6.

5   The use of PCA is a poor alternative to model averaging

(41)   The PD's base cost models included highly correlated variables in a single model, such as the different density measures. Respondents to the PDs raised the issue of high multicollinearity in the CMA's proposed models as a serious empirical and regulatory concern.[26] The criticisms focused on how the presence of highly correlated variables undermine interpretability, robustness, and regulatory credibility.

(42)   The presence of highly correlated variables in a single model was a symptom of the overall approach: a full reliance on automated procedures, such as LASSO, which fails to penalise multicollinearity, and generally selects inconsistently among highly correlated variables across small data perturbations. Standard econometric diagnostics (such as variance inflation factors or coefficient stability checks) were not used as gating criteria, allowing models with severe multicollinearity to be preferred purely because they marginally improved fit.

(43)   In response to concerns above, the CMA decided to use another data-driven approach: PCA. PCA is a statistical technique used to reduce the number of variables while retaining as much of the original information as possible. It does this by transforming the correlated variables into a smaller set of new, uncorrelated variables called principal components, which are ordered by how much variation in the data they explain. For example, the CMA has used PCA to calculate the principal components of the three highly correlated density measures and used the first principal as a new variable in its model instead of the previous set of correlated density variables.

(44)   We do not agree that PCA is the most appropriate approach to deal with collinearity in the present case. PCA addresses a different analytical question from that required when setting efficient allowances for all companies in a price control. Setting price control allowances requires the identification of variables that are economically justified as proxies for scale and density within a cost function. In contrast, the PCA identifies the linear combination of variables that explains the greatest proportion of variance in the data. Therefore, the approach is statistically motivated based on an algorithm that emphasises spread over economic suitability and the identification of variables that are the most relevant and accurate drivers of cost (for example, like LASSO, it would not discern whether a specific measure of density is inherently inferior to others—human intervention is required for that).

(45)   Crucially, PCA is known to be unstable. The weights, which the algorithm determines for the different measures of scale and density, can be materially sensitive to small changes in the data and to the presence of outliers. Being a purely data-driven, non-parametric approach, PCA requires enough observations to reliably estimate the covariance matrix. In small-sample settings, components can be unstable and highly sensitive to noise. This introduces instability across samples and over time, which is inconsistent with the requirements of a stable, structural cost model used for regulatory determinations.

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[26] See Anglian Water PD Response (11 November 2025), paragraph 337: https://assets.publishing.service.gov.uk/media/6941920af06510882253757d/Anglian_-_PD_Response.pdf.

(46)   Lastly, PCA unnecessarily adds complexity to an already complex approach and reduces transparency. The resulting principal components are difficult to interpret, because they are a combination of several variables rather than a directly meaningful measure. As a consequence, the coefficient of the PCA variable is practically uninterpretable, and the transparency and confidence in the model are reduced.

(47)   PCA has not been used in similar regulatory applications.[27] Instead, alternative approaches such as model averaging or the use of a Composite Scale Variable ("**CSV**") have been used by regulators historically to deal with multi-collinearity (including by the CMA in all previous redeterminations). These approaches are more stable and transparent.

(48)   It is true that these approaches require regulatory judgement in determining the relative weight of different models or variables. However, data-driven approaches, such as the PCA, do not remove the need to rely on assumptions. These assumptions are built into the algorithm and are often based on criteria that are not optimised for small samples and regulatory decisions. In that sense, data-driven approaches provide false comfort (what Professor Melvyn Weeks terms "*the illusion of automation*").[28]

(49)   For example, as noted above, PCA assumes that directions with the largest variance contain the most meaningful information. This is a controversial assumption because high variance does not always correspond to economic relevance, or predictive value—especially in noisy or small sample contexts.

(50)   The range of assumptions used by PCA explains why it is best viewed as an exploratory, descriptive tool, rather than a robust dimensionality-reduction method for addressing multicollinearity.[29] For these reasons, we consider that its usage in the current context is inappropriate and that model averaging with well-understood, industry-established cost drivers is a clearly preferable approach.

6   The Base Costs WP's models contain counterintuitive coefficient estimates which undermine trust in the models

(51)   In Tables 3.2[30] and 4.2[31] of the Base Costs WP, the CMA presents the estimated coefficients of their respective models. Some of the coefficients appear counterintuitive. For example, the scale variable has a negative coefficient, implying that an increase in the scale of the company (e.g. an increase in the length of its network or customer base) reduces costs. This is clearly wrong.

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[27] PCA has been applied in regulatory benchmarking in limited circumstances where the underlying factor to be controlled for is not directly observable and is inherently multidimensional, for example by NHS Improvement to construct an index reflecting local population health. Source: https://www.england.nhs.uk/wp-content/uploads/2016/05/annx-b5-evidnc-efficiency-factor.pdf.

[28] Thames Water Third Party Submission (November 2025), Annex 1, Section 7 ("The Illusion of Automation").

[29] Jolliffe, I. T. (2016). Principal component analysis: a review and recent developments, National Center for Biotechnology Information (Section: "Principal component analysis as an exploratory tool for data analysis").

[30] Base Costs WP, page 19.

[31] Ibid., page 30.

(52) The Base Costs WP argues that due to remaining collinearity in the models "*the estimated coefficients may not always provide a clear or unique economic interpretation and are also not the goal of the modelling*",[32] but also asserts in the same paragraph that, "*Given that multicollinearity is relatively low, as measured by the maximum VIF score in Table 3.5, we consider that we can interpret the model coefficients*."[33]

(53) The interpretation of the estimated coefficients may not be the ultimate goal of our modelling, but their interpretability is crucial for transparency and trust in the model. Presenting an estimated negative coefficient to the scale variable is inappropriate. It undermines trust no matter what transformation may explain this oddity.

6.1 The CMA models do not exhibit a U-shaped relationship between density and costs

(54) A similar issue arises in relation to the density variables. In paragraph 3.6 of the Base Costs WP the CMA explains its approach to the density variable: "*We include it in the modelling in its level and square. The square term allows for a 'U-shaped' relationship between population density and wholesale water cost*s."[34]

(55) However, the modelling results contained in Table 3.2 of the Base Costs WP show that both the linear and squared terms have a positive coefficient, which means that the model fails to estimate the expected U-shaped relationship.[35] This result is counter to the economic/engineering *a priori* expectations of a U-shape relationship between density and cost. It is also counter to the relationship that has been well established in Ofwat's models in several price controls.

(56) The CMA does not comment on this result. It appears to accept it as a selection of LASSO without checks and balances of a-priori expectations.

(57) We note that, when estimating the model with density variables that are not PCA-transformed, but are in their original units instead, the U-shape relationship is restored. This, again, evidence that the application of PCA in this context is inappropriate (in particular given there are available alternatives to the PCA such as the use of the original variables via model averaging).

7 The Base Costs WP approach does not sufficiently recognise the panel structure of the data

(58) The base cost dataset is a panel: repeated observations on the same companies over time. In a panel data we typically find 'firm effects' within the model residuals. The presence of firm effects implies that observations are not independent, invalidating OLS as the most efficient estimator.[36] In such circumstances, standard econometric practice is to use panel estimators (fixed effects, random effects).

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[32] Ibid., page 19, paragraph 3.17.

[33] Ibid.

[34] Ibid., page 16, paragraph 3.6.

[35] Ibid., page 19.

[36] OLS is Best Linear Unbiased Estimator (BLUE) under the assumption that observations are independent and identically distributed (IID assumption).

(59)   The Base Costs WP approach treats the dataset as a pooled cross-section, in three related ways:

7.1   LASSO does not consider the panel structure of the data

(60)   LASSO is known to behave poorly when regressors are correlated, and observations are not independent, as in the case of panel data. Therefore, the fact that LASSO does not consider the panel structure of the data subjects its variable selection to instability and arbitrariness. In particular, the Leave-One-Out cross-validation method, used as part of the LASSO technique, leaves one company-year observation out of the sample for validation, instead of one company at a time. This provides false precision of the validation process. Professor Weeks discusses this issue further in his independent report submitted as part of our response to the PDs.[37]

7.2   Use of conventional standard errors instead of clustered standard errors

(61)   Clustered standard errors are used when observations can be grouped into clusters (e.g. firms) and errors may be correlated within those clusters, such as in a panel data setting. If errors are positively correlated within the clusters (as it would be in our case), the clustered standard errors would lead to larger standard errors than conventional or heteroskedasticity-robust ones. In our case, this indicates that the models are less accurate than one might have concluded on the basis of conventional standard errors. We discuss the implications in the next Section.

7.3   Use of pooled OLS after LASSO variable selection instead of a panel data method

(62)   After using LASSO to select the set of variables for the base cost models, the CMA has estimated the models using the pooled OLS estimator. The CMA has not justified its choice of estimator. Such justification would be expected given the panel structure of the data and warranted in particular given that several respondents to the PD questioned the OLS choice.

(63)   The Breusch-Pagan Lagrange Multiplier test is used to determine whether firm effects are significant in a panel data model. If the effects are significant, the random effects estimator would be more efficient than the OLS (i.e. it would have a lower variance and greater accuracy).

(64)   Our calculations show that for both the water and wastewater network plus models, the Breusch-Pagan Lagrange Multiplier test indicates the presence of significant random effects, and therefore the random effects estimator should be used rather than the OLS.

(65)   Using the random effects estimator is required not only from a technical econometric perspective. Our evidence indicates that it also improves the model's quality (e.g. improved Reset test result, lower RMSE) and is material for companies.

(66)   **Appendix 1** provides estimation results. This shows the results of the random effects estimator applied to the CMA's proposed models. It is not an endorsement or acceptance of the CMA's proposed model specifications.

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[37]   Thames Water Third Party Submission (November 2025), Annex 1, Section 5.1.

8   Lack of model triangulation

(67)   Triangulation, or model averaging, refers to combining results from a suite of plausible models - often differing in functional form, explanatory variable, or levels of aggregation - rather than selecting a single "best" model.

(68)   The CMA recognises that "*No econometric model will perfectly capture the complexities of the industry*".[38] The reality is that, given the small sample size, the nature of available data, the occurrence of outliers in the data, and the high level of heterogeneity across companies, benchmarking in the water sector (and similar regulated sectors) can have material errors. Using a suite of plausible models in triangulation reduces the risk that allowances are driven by one incorrect structural assumption.

(69)   This is particularly important in a price control context, where allowances must be accurate for all companies, not only 'on average' (accuracy 'on average' is the objective in many other contexts where econometrics is used). Indeed, in price controls the models must account for structural differences between companies.

(70)   Cost allowances are based on a model's average prediction (based on the model's estimated coefficients) plus an efficiency adjustment known as the catch-up challenge (based on the model's estimated residuals). Triangulation not only mitigates the risk of a large error in the model's prediction, but it also mitigates the risk of a large error in the catch-up challenge, as the challenge is no longer based on the residuals of a single model.

(71)   Ofwat says "*We triangulate across a set of models with different cost drivers and levels of cost aggregation to mitigate the risk of error and bias in any one model*."[39] We do not agree with all the models triangulated by Ofwat in the FD. We think that some variables should have been rejected as part of a pre-selection, which would have resulted in fewer models triangulated. Nonetheless, we support the principle of a balanced triangulation to mitigate the risk of material error that can result from a single model.

(72)   We therefore disagree with the CMA's approach of using a single model (one for water and one for wastewater) and assuming that such a single model can reliably predict the level of efficient costs for water companies operating in materially different geographical and operational contexts.

(73)   It is unclear why the CMA decided to maintain its single model approach in the Base Costs WP. Many respondents to the PD criticised the CMA's reliance on a single modelling framework and the absence, or severe reduction, of triangulation[40] (not a single response supported this approach). These critiques did not frame it as a marginal or technical issue, but as a material flaw which increases regulatory risk. The Base Costs WP does not address these representations.

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[38] Base Costs WP, page 5, paragraph 1.7.

[39] Ofwat FD: Expenditure allowances – Base cost modelling decision appendix, page 1: https://www.ofwat.gov.uk/wp-content/uploads/2024/12/PR24-final-determinations-Expenditure-allowances-Base-cost-modelling-decision-appendix.pdf.

[40] See, for example, Northumbrian Water Response to CMA PDs (11 November 2025), paragraphs 140 and 360: https://assets.publishing.service.gov.uk/media/6941922658a21370f58f3044/Northumbrian_-_PD_Response.pdf.

(74) Lowry and Getachew (2009) state, "*The principal disadvantage of benchmarking is the potential that a model of poor quality can expose utilities to undue risk. While regulation must protect consumers from monopoly abuses, it must also not compromise the financial viability of regulated entities….and where inappropriate benchmarking methods are used for the type of performance under consideration can materially reduce the net benefits from benchmarking*".[41] Jamasb and Pollit (2003) state, "*A practical approach in the absence of consensus on the most appropriate technique, model specification, and variables is to combine the results from different models*."[42]

(75) We urge the CMA to reconsider its single model approach and revert to a triangulation of a suite of *plausible* models.

9 The reliance on a single piece of evidence for setting a highly material catch-up challenge is unsound

(76) The CMA puts full weight on a single model to determine the allocation of billions of pounds to water companies. A single model may (materially) overstate or understate the relative efficiency of any given company.

(77) If the model overstates the efficiency of the upper-quartile company, it can have very material implications for the entire sector, for companies, customers and the environment (assuming the upper-quartile company is used to set the efficiency benchmark).

(78) As we noted above, relying on a single model means that the catch-up challenge is based on a single set of residuals, without the checks and balances that can be obtained via triangulation of models. Such checks and balances are vital, particularly where the catch-up challenge is large, and the resulting allowances are low relative to historical spend or Ofwat's FD24 allowance.[43]

(79) It is widely accepted that the catch-up challenge should reflect the regulator's confidence in the model and its result.[44] For example, in its PR14 redetermination for Bristol Water, the CMA used the median, rather than the upper quartile, to set the catch-up efficiency benchmark, citing its lack of confidence in the model as a rationale.[45]

(80) We have already shown above in Section 5.3 that a variant of the CMA's models – one that appropriately uses the random effects rather than the OLS estimator – results in a more moderate upper quartile challenge.

(81) There are multiple alternative specifications that could be shown to result in materially different upper quartile challenges and higher base allowances. Below we show two

[41] Lowry, M. N., and Getachew, L. (2009). Statistical benchmarking in utility regulation: Role, standards and methods. Energy Policy, 37(4), 1323–1330, at p. 1325.

[42] Jamasb, T., and Pollitt, M. (2003). International benchmarking and regulation: an application to European electricity distribution utilities. Energy Policy, 31(15), 1609–1622, at p. 1621.

[43] A 7% catch-up challenge is high compared to previous catch-up challenges, for example, at PR19.

[44] See, for example, CMA PR19 Final Report (17 March 2021), page 210, paragraph 4.403: https://assets.publishing.service.gov.uk/media/60702370e90e076f5589bb8f/Final_Report_---_web_version_-_CMA.pdf.

[45] CMA PR14 Final Determination, Bristol Water plc (6 October 2015), page 117, paragraph 4.224: https://assets.publishing.service.gov.uk/media/56279924ed915d194b000001/Bristol_Water_plc_final_determination.pdf.

variations, which fall squarely within standard regulatory panel-data practice, yet they lead to material changes in the implied upper quartile position, with direct consequences for the scale of the resulting catch-up challenge.

(82) The first variation introduces time dummies to the CMA's model specification. Introducing time dummies to control for sector-wide shocks and common cost pressures materially improves model specification in both water and wastewater. Joint tests strongly reject the null that time effects are irrelevant (Wholesale Water: $\chi^2 = 119.4$, $p < 0.001$; Wastewater Network Plus: $\chi^2 = 209.1$, $p < 0.001$), confirming that common time-varying factors are an important feature of the data.

(83) Accounting for time effects leads to further movements in the UQ benchmark across both models. The largest shifts arise when time effects are introduced alongside firm-level heterogeneity. For wholesale water, moving from a random effects specification without time controls to one with time dummies increases the upper quartile efficiency score from around 0.94 to around 0.96, materially weakening the implied catch-up challenge. In Wastewater Network Plus, introducing time effects alongside firm-level heterogeneity also leads to an upward shift in the upper-quartile benchmark. While the numerical change is smaller than in wholesale water, the direction of the effect is the same: once common effects (e.g. sector-wide shocks) are absorbed, the implied upper quartile benchmark increases, indicating that part of the apparent inefficiency in the baseline model reflects unmodelled time effects rather than company-specific underperformance.

(84) Importantly, even within pooled OLS, the inclusion of time dummies leads to a change in the position of the upper-quartile benchmark in both models. This shows that the CMA's baseline specification is not invariant even to standard time controls, and that part of the residual variation used to define the catch-up challenge reflects unmodelled common shocks rather than company-specific inefficiency.

(85) We note also that in a model with time dummies the energy variable becomes highly insignificant. This suggests that the time dummies are better suited to pick up time effects, which include energy and other factors, than the energy price index. It is consistent with the following observations made in response to PD: (i) the energy price index is statistically correlated with overall cost increases that are not driven by energy, and therefore risks acting as a spurious proxy for unrelated inflationary pressures, and (ii) energy prices do not transmit uniformly across companies or over time due to hedging arrangements.

(86) The second variant adds a lagged dependent variable to the CMA's models' specifications.

(87) A central limitation of the CMA's static pooled OLS specification is that it conditions current costs solely on contemporaneous observed drivers, implicitly assuming that all relevant cost determinants are fully measured and adjust instantaneously. In practice, regulated network costs are influenced by a range of factors – such as prior investment decisions, operational circumstances (e.g. urban vs rural, coastal exposure, water scarcity), regulatory commitments (e.g. varying standards of performance), and evolving asset conditions (e.g. asset age, mains replacement rate) – that are not controlled for in the model (some may be only imperfectly observed or not observed at all in the available

dataset). In this context, a lagged dependent variable provides a reduced-form way of controlling for these omitted variables, capturing both observed and unobserved heterogeneity that varies over time but is not explicitly modelled in the static specification.

(88) Including a lagged cost term, therefore, helps mitigate omitted variable bias arising from the omission or incomplete measurement of cost drivers. Rather than attributing all unexplained variation to inefficiency, the dynamic specification allows part of this variation to be explained by systematic factors that are correlated with current costs but missing from the regressor set. While it is acknowledged that the lagged dependent variable may absorb some elements of inefficiency, it would be inappropriate to interpret the variation it captures predominantly in those terms. A more natural interpretation is that it reflects a combination of time-varying firm characteristics, evolving operating conditions, and common pressures that are not adequately controlled for in the static pooled OLS model.

(89) From a specification standpoint, the risks associated with excluding a lagged dependent variable are greater than including it. A static pooled OLS model that omits relevant dynamic structure risks both biased coefficient estimates and residuals that systematically reflect unmodelled heterogeneity rather than inefficiency. By contrast, a richer specification that includes a lagged dependent variable may absorb a broader set of influences than strictly necessary, but in doing so reduces the risk that structural or time-varying factors are misclassified as inefficiency. This distinction is particularly important in a regulatory context where residuals are used directly to define an efficiency benchmark.

(90) The dynamic specifications presented here are not advanced as a preferred regulatory model, but as corroborative evidence that the CMA's static pooled OLS framework attributes a non-trivial share of unexplained cost variation to inefficiency that is more plausibly explained by omitted, time-varying heterogeneity. This reinforces the case for triangulation across specifications and caution when translating a single static model into binding efficiency targets.

(91) **Appendix 2** provides estimation results for the water and wastewater models with a lagged dependent variable. Diagnostic tests strongly support the validity of the dynamic specifications, including insignificant AR(2) tests and Hansen p-values comfortably above conventional thresholds.

(92) Table 2 shows the upper quartile efficiency challenge for the pooled OLS models and for the dynamic models with a lagged variable. We calculated the catch-up challenge for five consecutive years, where the figure of each year is based on the five preceding years. The table shows the systematic changes in efficiency scores.

Table 2: The upper quartile catch-up challenge in the CMA's model versus a dynamic model for five time periods*

End year for calculation of upper-quartile challenge	Pooled OLS (CMA)	+ Lagged dependent variable
2020	5.3%	4.2%
2021	3.8%	3.6%
2022	2.7%	2.3%
2023	4.7%	3.6%

2024	6.8%	3.6%
* In each year the calculation is based on the preceding five years (inclusive)		

(93) Two observations stand out. First, the dynamic model produces a consistently lower upper-quartile challenge than the static OLS model. Second, the pooled OLS path is both more volatile and markedly stiffer at the end of the window, with the 2024 upper quartile out of line with earlier years. This highlights the sensitivity of the static benchmark to the time period considered when dynamics are ignored.

(94) This Section evidences that the CMA's upper quartile catch-up challenge is not robust to modest, standard variations in model formulation. In these circumstances, triangulation across plausible model specifications and caution in the application of percentile-based benchmarks are warranted before imposing binding, multi-year, catch-up challenges.

10 Conclusion and Recommendations

(95) Thames Water welcomes this opportunity to comment on the Base Costs WP and the CMA's recognition through the Base Costs WP that further consideration of, and consultation on, the base cost assessment is required.

(96) We have reiterated in this Submission our concern that the CMA's updated modelling approach does not address the fundamental shortcomings that Thames Water and many other stakeholders have raised. The proposed modelling approach is not fit for purpose and creates a flawed and unsound framework to determine price control allowances. Given the materiality of the concerns we raise above in relation to the Base Costs WP's models, we recommend that the CMA should:

(i) return to a more conventional approach that represents regulatory best-practice, amending the specification of Ofwat's models according to the CMA's consideration of the merits of the arguments presented by the Disputing Companies and third parties;

(i) apply a more thorough consideration of cost adjustments to be applied to base cost allowances, in particular accounting for company-specific factors. This would be consistent with the recommendations of the IWC;

(ii) make use of model triangulation by adopting a set of plausible models of different specifications and levels of granularity. This will also remove the need for non-transparent and unstable PCA variables;

(ii) soften the catch-up challenge, given the evidence that the models are unreliable; and

(iii) use methods that recognise the panel structure of the data (such as the random effects methods for estimating models' coefficients).

(97) The base cost assessment is a crucial element of the CMA's redetermination and has a direct bearing on customer and environmental outcomes. We believe that the critical underfunding implied by the Base Costs WP's approach will have a direct and detrimental bearing on companies, customers and the environment. As such, we believe that the CMA

should give detailed and careful consideration to addressing the issues set out in this Submission and our proposed recommendations. We would be happy to discuss this with the CMA, should this be of assistance to the CMA's process.

Appendix 1

Table 1: The CMA water model specification fitted with the OLS and RE estimators

Variable	OLS (CMA original model)	Random Effects (clustered standard errors)
Combined Scale	0.683***	0.688***
	{0.000}	{0.000}
Combined density	0.054***	0.061***
	{0.000}	{0.001}
Combined density squared	0.027***	0.032***
	{0.000}	{0.000}
Weighted average treatment complexity	0.449***	0.198*
	{0.000}	{0.081}
Average pumping head – TWD	0.096**	0.182*
	{0.033}	{0.099}
Booster pumping stations per lengths of main	0.318***	0.215
	{0.000}	{0.119}
Labour costs	0.304	0.028
	{0.109}	{0.940}
Energy index	0.116**	0.186***
	{0.032}	{0.001}
Constant	3.819***	3.825***
	{0.000}	{0.001}
Adjusted R squared	0.971	0.971
RESET Test P Value	0.068	0.129
Heteroskedasticity P value	0.000	-
RMSE	0.167	0.140
Catch-up efficiency challenge (%)	7.258	6.015

Table 2: The CMA wastewater model specification fitted with the OLS and RE estimators

Variable	OLS (CMA original model)	Random Effects (clustered standard errors)
Combined Scale	0.307***	0.321***
	{0.000}	{0.000}
Pumping capacity per sewer length	0.467***	0.337*
	{0.000}	{0.093}
Weighted average treatment size	-0.017	-0.029
	{0.486}	{0.689}
Percent of load treated at bands 1-3	0.004	0.003
	{0.537}	{0.896}
	0.006***	0.004***

Percent of load treated with ammonia consent below 3mg	{0.000}	{0.000}
Urban rainfall per lengths of main	0.115***	0.111***
	{0.000}	{0.001}
Energy index	0.166***	0.193**
	{0.000}	{0.037}
Constant	5.024***	5.093***
	{0.000}	{0.000}
Adjusted R squared	0.95	0.95
RESET Test P Value	0.194	0.001
Heteroskedasticity P value	0.033	-
RMSE	0.167	0.102
Catch-up efficiency challenge (%)	6.824	6.365

Appendix 2

Table 1: Regression results from models including lagged dependent variable – Wholesale Water

Variable	Coefficients and Standard Errors
Lagged Real Botex	0.654***
	{0.136}
Combined Scale	0.233**
	{0.097}
Squared Combined Density	0.020**
	{0.009}
Squared Density	0.009*
	{0.005}
Weighted Average Treatment Complexity	0.168**
	{0.085}
Average Pumping Head - TWD	-0.013
	{0.062}
Booster Pumping Stations per Lengths of Main	0.067
	0.057
Labour Costs	0.029
	{0.145}
Energy Index	0.110***
	{0.035}
Constant	1.210**
	{0.469}

Table 2: Regression results from models including lagged dependent variable – Wholesale Wastewater

Variable	Coefficients and Standard Errors
Lagged Real Botex	0.490***
	{0.123}
Combined Scale	0.156***
	{0.045}
Pumping Capacity per Sewer Length	0.279***
	{0.095}
Weighted Average Treatment Size	0.003
	{0.033}
Percent of load treated at bands 1-3	0.005
	{0.007}
Percent of Load treated with ammonia consent below 3mg	0.003***
	{0.001}
Urban Rainfall per Length of Mains	0.043
	{0.032}
Energy Index	0.118***
	{0.036}
Constant	2.229***
	{0.671}