Econometric base cost models for PR24 Southern Water's response

12 May 2023

from Southern Water

1.Overview

Thank you for the opportunity to respond to the consultation on econometric models for PR24.

While it is clear that Ofwat has reviewed a very large number of candidate models as part of its process to arrive at the preferred suite of models included in the consultation, there are a number of areas where we do not support Ofwat's conclusions. In particular:

- The inclusion of a **coastal population variable** in the sewage treatment models is essential to capture the material costs associated with serving a coastal population. We set out below further reasoning for its inclusion in the preferred suite of models. On the basis that we continue to believe strongly that the variable should be included in the models, we are not proposing to submit a cost adjustment claim as part of the early submission in June 2023. However, should Ofwat conclude not to include the variable, we would expect to include an additional cost adjustment claim in our October business plan.
- The decision to only capture the impact of an ammonia consent (which will principally apply in respect of river discharges) is disappointing. There is a strong engineering rationale for taking account of all tight consents and not doing so within the model could distort efficiency assessments and company funding.
- We disagree with the exclusion of **metering penetration** as a cost driver in the proposed Retail models. It is well established that there are additional costs associated with serving metered customers – meter reading, data management, additional contact volumes and more complex customer contacts – and Ofwat has recognised the existence of these additional costs in a number of contexts historically (including PR14 and PR19 cost models, and the tariff differential test). We believe the driver should be reinstated in the retail models, but if it is not then we would expect Ofwat to propose a symmetrical off-modelling adjustment to recognise these costs.

There are two very material issues for PR24 models which Ofwat is silent on in the consultation. These are the treatment of energy prices, which will be materially under-estimated in the model dataset given the recent materially above-inflation price increases not reflected in the historic dataset, and the clear need to recognise the trend in asset maintenance requirements, which reflects the growing and aging asset base of the sector. We expand on each below.

Treatment of energy costs
The water sector is a major user of energy, with energy costs representing roughly 11% of wholesale base costs. The market price of energy has risen by significantly more than CPIH in recent years (35% above CPIH in Q2 of 2022).

While Southern Water, like the rest of the sector, has taken steps to hedge against the risk of energy price increases, these hedging instruments are time limited, and as we move in to AMP8 we will have to procure electricity at the prevailing market rate. We forecast that our energy costs in year 5 of AMP7 (2024-25) will increase by 148% as the hedges expire.

None of the proposed PR24 models include a time variable, and as such they will essentially provide funding for energy costs based on the average market price over the modelled period (2011-12 to 2022-23). It is expected that the prices that we will face in AMP8 will be significantly higher than this historical average.

Without any adjustment we will face a very significant gap between the modelled view of energy costs and the market rates that we can procure energy at. Indeed, this could even be magnified if Ofwat were to apply energy price RPEs in AMP8, based on forecast falling market prices, as these would be applied to a modelled cost that did not reflect the prevailing market rates at the start of AMP8.

In recognition of the materiality of the issue we worked with a number of other companies to commission from KPMG a review of the options for managing this issue. KPMG has identified modelling issues that arise when energy price inflation is not appropriately treated in base cost models. KPMG has concluded that without some form of adjustment, Ofwat's cost models may not provide appropriate cost allowances. KPMG has identified two feasible options for this adjustment – inclusion of an energy cost driver in the wholesale models or a pre-modelling adjustment to energy costs, based on a market index (rather than adjusting all costs by CPIH). Our view is that the adjustment based on an inclusion of a cost driver, an outturn energy prices index, would be preferable as it more directly addresses the issue, is more transparent and less complex. We recognise that the adjustment alone will not mitigate risks of the future wedge between inflation, and it may need to be complemented by an appropriate RPE framework. However, the adjustment is a first and crucial step to ensure that we are provided with an appropriate starting point for the cost allowance. A copy of KPMG's report is provided with this response.

Future capital maintenance requirements

Ofwat's approach to capital maintenance has changed over time. Before PR14, Ofwat had a separate assessment of capital maintenance and an explicit consideration of future maintenance requirements and associated service level ("serviceability"). Since PR14, Ofwat has moved to a top-down econometric approach, assessing capital maintenance not on its own, but as part of its botex-plus models, relying on historical investment without an explicit consideration of future capital maintenance requirements.

This approach does not give sufficient attention to capital maintenance and would fall short of adequately funding the long-term sustainable level of capital expenditure required at PR24 and beyond.

Capital maintenance costs are increasing due to multiple factors such as increasing operational resilience and asset health standards; cyber security resilience; higher performance standards (e.g., less leakage, interruptions, pollution and flooding); increasing environmental outcomes; climate change, etc. At the same time, historical replacement rates, which the assessment approach is relying on, include rates that are too low to be relevant to future replacement needs.

In light of these factors, it is crucially important to consider future capital maintenance requirements. In its PR19 redeterminations, the CMA acknowledged that "Ofwat's cost assessment is backward looking and that potential issues with capital maintenance may be forward looking" and that "[capital maintenance] is a complex issue, which, going forward, may become more important. We therefore suggest that Ofwat considers developing indicators to track this issue and to enable it to enhance its analysis with a forward-looking element that will assist in triangulating results from its econometric modelling of historic costs."[1]

The consultation does not address the issue of increasing capital maintenance costs, and the need to consider forward-looking capital expenditure requirements, within the proposed models. Continuing to rely on unsustainably low historical replacement rates to set forward looking capital maintenance expenditure risks perpetuating these inappropriately low replacement rates with inevitable consequences to asset health, service resilience and performance.

Southern Water is forecasting a significant increase in its asset replacement rate at PR24 to deliver the high service expected by its customers and the environment. This increase must be efficiently funded through the models or the wider approach to cost assessment. Future capital maintenance requirements are a concern for many water companies. We urge Ofwat to further develop its approach in this area.

[1] CMA's PR19 redeterminations, Final report, 17 March 2021, para 4.293, page 185.

2. Consultation questions

Wholesale water

Q3.1) Do you agree with our proposed set of wholesale water base cost models?

See comments below.

Q3.2) Do you agree with the inclusion of average pumping head in a sub-set of treated water distribution and wholesale water models?

While we accept that there is a strong engineering logic for using APH, on balance, we do not agree with its use at this stage.

The quality of APH data remains a concern, as was found in the Turner and Townsend report.[2] The report found that while some companies report mainly measured data, others rely mainly on estimated data and that "Updating expectations about how much data should be measured is likely to result in a step-change in reported APH for some companies, especially those who have a high proportion of estimated data" (page 46). The widespread use of estimated, static (or near static) data, means that the data is necessarily wrong, inconsistent, and likely to be overestimated.

Ofwat specifically introduced a new principle for cost assessment at PR24, that "data used in our base cost assessment approach is good quality". The quality of the APH data does not appear to satisfy this principle.
While the average pumping head has sound engineering rationale on paper, in practice it has proven difficult to estimate consistently, so far. It would be odd to use data that is known to be wrong, when there is a tried and tested variable – the booster pumping stations – which has an equally sound engineering logic, performs well statistically, provides a direct observation on pumping assets, and whose data is reliable.

Q3.3) Do you agree with our approach to modelling population density? Which of the three proposed population density variables do you support?

- **a. Weighted average density – LAD from MSOA**
- **b. Weighted average density - MSOA**
- **c. Properties per length of mains**

Of the three proposed density variables we support the weighted average density – MSOA.

We consider that the weighted average density (WAD) concept was a good development at PR19. It captures intra-zonal variation in density, which are relevant for the purpose of capturing opportunities for economies of scale.

The properties per length of mains variable does not capture intra-zonal variations in density, which is an important driver of costs. We therefore consider that it is clearly inferior to the WAD and should not be used when a better variable is available. Water companies serve large areas. The simple (overall) average density is not very useful for such large areas and can be misleading. An area with large pockets of dense population, which can benefit from economies of scale or, on the other hand, incur some additional urbanity costs, would not be sufficiently different from an area without pockets of density but which is more uniformly populated.

[2] Average Pumping Head: data quality improvement. Final report to Ofwat. Turner & Townsend, 24 March 2022

We see the WAD – MSOA as a welcome improvement to the WAD - LAD. The fact that MSOA boundaries change less frequently than LAD boundaries is quite an important advantage of the MSOA measure. Not only does it enhance the accuracy of the variable at each point in time, it also enhances its consistency over time. We also consider that the MSOA, with its smaller and more consistent size, is a more appropriate geographical unit to capture economies of scale than the LAD. LADs vary in size a lot more than MSOAs. They tend to be smaller in the South East compared to the South West and North East. Some large LADs coincide with County boundaries (e.g. Cornwall, Dorset and others). In these cases, the average density over the LAD can severely understate the correct measure of density, by averaging dense and sparse regions within the LAD thereby diluting information on local concentrations of demand which allow companies to benefit from economies of scale. MSOA density would provide more accurate, consistent and relevant information on opportunities for economies of scale across water company service areas.

For the reasons above, we consider that the WAD – MSOA is the preferred density measure amongst the three measures proposed in the consultation. We think that the WAD – MSOA should be the only density measure used. Using other measures in triangulation would detract from the quality of the modelling suite in this case.

Q3.4) Do you agree we should collect additional data on the number of reservoirs that are designed as high-risk by the Environment Agency and Natural Resources Wales? Do you have a view on the appropriateness of capturing a variable for reservoir inspection and maintenance requirements under the Reservoir Act 1975 in the water resources plus models?

We do not support the collection of additional data on the number of reservoirs that are designated as high-risk. There are significant costs associated with the collection of additional data are high and we have seen no evidence to suggest that the costs associated with inspection of such reservoirs are material in the context of overall botex.

In respect of investment requirements associated with reservoirs, these are likely to be lumpy in nature. At PR19 Ofwat allowed for costs associated with compliance with the Reservoir Act 1975 as part of its assessment of enhancement totex, with cases for investment out forward by a number of companies and assessed within Ofwat's 'Wholesale Water Enhancement feeder model: Freeform.

Wastewater network plus

Q4.1) Do you agree with our proposed set of wastewater network plus base cost models?

See comments below.

Q4.2) Do you agree with our approach to modelling economies of scale at sewage treatment works? Which of the three proposed explanatory variables do you support?

- **a. Percentage of load treated in STWs bands 1 to 3**
- **b. Percentage of load treated in STWs serving more than 100,000 people**
- **c. Weighted average sewage treatment works size Econometric base cost models for PR24 68**

We support the weighted average sewage treatment works size (WATS) as an explanatory variable to control for economies of scale at sewage treatment works (STWs). The WATS represents an improvement on the variables used at PR19. Given its strengths compared to the other measures, we consider that it should replace them as the only measure of economies of scale at STWs.

The percentage of load treated in STWs bands 1-3 makes a strong assumption that all STWs at bands 1-3 provide the same economies of scale benefits (dis-benefits in this case), whether it is a very small STW at band 1 or a medium size STW at band 3. Perhaps a stronger assumption implicit in this variable is that all STWs at band 4 and above provide the same economies of scale benefits. This is not supported by the evidence obtained from the other two measures, which shows that large STWs at band 6 have significantly larger economies of scale benefits than smaller STWs. We also note that this variable is not statistically significant.

The percentage of load treated in STWs serving more than 100,000 people suffers from similar issues to the variable above. It lumps together all STWs that serve less than 100,000 people thereby assuming they have the same economies of scale dis-benefits, whereas all STWs that serve more than 100,000 have the same economies of scale benefits. Justifying this variable requires evidence that shows that the 100,000 threshold is appropriate, and that no other threshold has material effects.

The two variables above impose a somewhat arbitrary grouping of bands, thus neglecting potentially different economies of scales at different bands within the assumed group or threshold.

The PR19 approach of using each of the above variables in a separate model and then triangulating the models was a pragmatic necessity. Ideally, both variables should be included in the same model, but the small sample was not enough to estimate them both robustly in the same model. Ofwat therefore split the variables across two separate models, recognising that each would be inaccurate[3], but that triangulation should mitigate the overall error. This was a necessary compromise which we do not need to repeat given the welcome development of the WATS.

Compared to these two measures above, the WATS captures more fully the impact of economies of scale on STWs, without the imposition of assumptions on which size bands to lump together. The variable has a stronger economic/engineering rationale and a stronger statistical performance than the alternatives. This is summarised in Table 1, where we also colour coded the performance of each variable.

Table 1: Comparison of model performance

	SWT1 (% load treated at STWs band 1-3)	SWT2 (% load treated at STWs above 100k people)	SWT3 (WATS)
Statistical significance of economies of scale driver	0.029 {0.211} Not significant	-0.008*** {0.007}	-0.242*** {0.000}
Model fit (R-squared)	0.854	0.869	0.911
RESET Test	0.056	0.272	0.849
Range of efficiency scores	0.68	0.53	0.33
Strength/weaknesses of the driver	Imposes the assumption that all STWs at bands 1-3 are equal and—more inadequately—that all STWs at bands 4 and above are equal in terms of economies of scale.	Imposes the assumption that all STWs above 100,000 people have the same economies of scale, and likewise for all STWs below 100,000 people.	Does not require making assumptions on which bands to group together. Provides a more accurate measure of economies of scale at STWs.

We consider that the WATS is clearly a better cost driver than the alternative measures. In this case, using the WATS to replace the weaker alternative measures is a more appropriate approach than keeping all variables in triangulation.

[3] e.g. due to an omitted variable bias or a general mis-specification

Q4.3) Do you agree with our approach to modelling population density? Which of the three proposed explanatory variables do you support?

a. Weighted average density – LAD from MSOA
b. Weighted average density - MSOA
c. Properties per sewer length

Please refer to our answer to Q3.3 above.

Q4.4) Do you agree with our proposal to assume a linear relationship between population density and sewage collection base costs?

We agree with Ofwat's proposal to assume a linear relationship between density and sewage collection. We don't believe that a squared term is particularly significant and we think that the main non-linear effects apply solely to sewage treatment rather than sewage collection.

Q4.5) Do you agree with the inclusion of urban rainfall in our sewage collection and wastewater network plus models?

We do not support the inclusion of urban rainfall in the sewage collection and wastewater network plus models.

As Ofwat note, while it is exogenous, forecasting the variable well enough for it to be used in the PR24 models would be very difficult. Any forecasting approach will result in arbitrary winners and losers based on future weather patterns.

We also believe that the 'urban' element of the rainfall variable is already captured in the density variables. As the table below shows, and in line with expectations, the proposed new variable is strongly correlated with the density variables. We consider this to be a strong correlation on the basis that at PR19 Ofwat concluded that the correlation between population density and wage of 58-60% was strong.

Table 2: Correlation between density measures and urban rainfall

Correlation	Density	WAD MSOA	WAD LAD from MSOA
Urbanarea_MSOA	0.585517	0.554755	0.573813

Table 3: Correlation between density measures and urban rainfall (logged)

Correlation	lnDensity	lnWAD MSOA	lnWAD LAD from MSOA
lnUrbanarea_MSOA	0.628405	0.506022	0.456371

Given the strong correlation, we believe a better option would be to remove the urban element. We have tested rainfall per length of sewer and it works well. We present the results in the two tables below.

The performance of the models with and without the urban element is very similar. In the wholesale models, the reset test fails for some specifications, but, as argued elsewhere, only the WATS measure of economies of scale should be used. Then, the remaining specification is even more robust to the reset test than the specification with urbanity.

In all, we would omit any rainfall variable due to the difficulty of forecasting it, but if it is used then we believe that the urban effect is already represented by the population density variable so this should be excluded.

Table 4: The effect of rainfall per sewer length on WWW compared to urban rainfall per length

	With urban element				Without urban element			
	WWNP1	WWNP2	WWNP3	WWNP4	WWNP5	WWNP6	WWNP7	WWNP8
Pumping capacity (log)	0.357*** {0.000}	0.370*** {0.000}	0.348*** {0.000}	0.276*** {0.000}	0.365*** {0.000}	0.379*** {0.000}	0.356*** {0.000}	0.274*** {0.000}
Urban rainfall per length (log)	0.075** {0.016}	0.077*** {0.010}	0.080** {0.012}	0.088** {0.010}				
Rainfall per length (log)					0.068** {0.041}	0.070** {0.028}	0.080** {0.019}	0.104*** {0.008}
Load (log)	0651*** {0.000}	0.732*** {0.000}	0.707*** {0.000}	0.722*** {0.000}	0.715*** {0.000}	0.800* {0.000}	0.793*** {0.000}	0.838*** {0.000}
Bands 1-3 (%)		0.023** {0.035}				0.023** {0.041}		
% Load with ammonia consent below 3mg/l	0.005*** {0.000}	0.005*** {0.000}	0.005*** {0.000}	0.005*** {0.000}	0.005*** {0.000}	0.005*** {0.000}	0.005*** {0.000}	0.005*** {0.000}
Works serving more than 100k (%)			-0.003 {0.102}				-0.003* {0.063}	
Weighted average treatment size (WATS)				-0.096*** {0.002}				-0.104*** {0.000}
Constant	-2.819*** {0.000}	-3.932*** {0.000}	-3.355*** {0.000}	-2.732*** {0.000}	-3.579*** {0.000}	-4.735*** {0.000}	-4.347*** {0.000}	-3.950*** {0.000}
Number of observations	110	110	110	110	110	110	110	110
R squared	0.953	0.959	0.956	0.964	0.951	0.957	0.955	0.964
RESET test (P value)	0.241	0.109	0.009	0.248	0.003	0.008	0.020	0.854
Range of efficiency scores	0.17	0.14	0.13	0.09	0.19	0.16	0.13	0.09

Table 5: The effect of rainfall per sewer length on SWC compared to urban rainfall per length

	With urban element			Without urban element		
	SWC1	SWC2	SWC3	SWC4	SWC5	SWC6
Sewer length (log)	0.842*** {0.000}	0.895*** {0.000}	0.873*** {0.000}	1.001*** {0.000}	1.077*** {0.000}	1.055*** {0.000}
Pumping capacity (log)	0.360*** {0.017}	0.562*** {0.000}	0.518*** {0.001}	0.364*** {0.002}	0.604*** {0.000}	0.556*** {0.000}
Density (log)	0.982*** {0.000}			1.034*** {0.000}		
WAD – LAD (log)		0.239*** {0.000}			0.214*** {0.005}	
WAD – MSOA (log)			0.385*** {0.000}			0.357*** {0.000}
Urban rainfall per length (log)	0.113*** {0.000}	0.152*** {0.000}	0.149*** {0.000}			
Rainfall per length (log)				0.151*** {0.000}	0.148*** {0.000}	0.152*** {0.000}
Constant	-7.809*** {0.000}	-6.424*** {0.000}	-7.492*** {0.000}	-9.459*** {0.000}	-8.084*** {0.000}	-9.088*** {0.000}
Number of observations	110	110	110	110	110	110
R squared	0.919	0.909	0.908	0.928	0.904	0.906
RESET test (P value)	0.172	0.345	0.321	0.344	0.355	0.382
Range of efficiency scores	0.24	0.28	0.26	0.20	0.30	0.29

Q4.6) Do you agree with our approach to capturing sewage treatment complexity in our proposed wastewater network plus base cost models?

What are your views on our proposed options to account for additional ongoing cost associated with P-removal?

a. Models with a P-driver (e.g. percentage of load with a P-permit <= 0.5mg/l) fixed at the 2024/25 level.

b. A post-modelling adjustment that funds efficient ongoing opex associated with P-removal using data provided by companies in APRs.

c. Cost adjustment claims.

We think that it is insufficient to represent sewage treatment complexity using only ammonia consents. Other consents – phosphorous, BOD and UV – are part of this complexity, with cost implications of their own.
We support the use of a composite complexity variable that captures the strictest consent levels of BOD (<7mg/l) and phosphorous (<0.5mg/l), and the ammonia below 3 ml/l.[4] These three consents appear to be the most relevant when tested individually in the model, each producing a plausible positive coefficient with a respectable statistical significance, even if not very strong. As P-removal consents become more prevalent, we would expect the significance to improve, and their inclusion in a composite variable would remove the need for post-model adjustments or cost adjustment claims.

These three consents can be blended into a single composite variable that captures 'additional costs due to discharge consents' without loss of transparency and with a similar interpretation of the coefficient (and expectation of its magnitude) as when only the ammonia consent is used. If these three variables were used separately in a model, we would expect a somewhat similar order of magnitude for each of their coefficients. We would therefore expect a similar order of magnitude for the coefficient of the composite variable.

Ofgem has used a composite scale variable in its various price controls, with the interpretation that the variable captures scale and the coefficient should be close to 1, no matter the components included in the composite variable.

We are not clear why Ofwat argues that inclusion of a variable that captures BOD consent <=7ml/l in the models may lead to 'spurious results' due to low variability across the sector. 'Spurious results' is a term usually used when two variables are correlated only because of their correlation with a third variable, but not due to a direct association. This is not the case here. There is a clear engineering rationale why the tight BOD consent would have cost implications (i.e., direct association with costs). We also consider that there is sufficient variability in tight BOD consents across the sector, such that exclusion of this variable risks inaccurate result more so than its inclusion.

We are also unclear about Ofwat's statement that inclusion of tight phosphorous consent may lead to non-sensical allowances due to the low prevalence of this tight consent. We expect the low prevalence to have the appropriate effect on the model. Again, there is arguably higher risk that its exclusion would bias model parameters and lead to inaccurate allowances.

[4] The UV consent is slightly different in nature, affecting mainly seawater discharge, hence should not be included in the composite variable (we consider that the cost implications of the UV consent should be covered through our proposed 'coastal variable'). However, should the coastal variable not be included in the standard model forms and adjusted outside the core models, then the UV consent should be included in this specification

We do acknowledge that the difficulty in using a composite variable is assigning weights to its components. However, using only the ammonia consent is equivalent to assigning weights of zero to the phosphorous and BOD consents. In other words, by using only the ammonia consent in the model, Ofwat makes an implicit choice to assign a weight of zero to the other consents. If zero weighting of phosphorous and BOD consents is the wrong answer, then the model has omitted variables. Ofwat should explore the appropriate weight for each pollutant (with industry support) so that it can use a composite consent variable that does not omit any relevant cost driver. While arriving at the correct weights is not trivial, we consider that it is still preferred and more appropriate to estimating off-model adjustments.

We consider that in choosing to represent complexity using only an ammonia consent, Ofwat puts undue weight on statistical significance, and not enough weight on engineering rationale. It makes engineering sense that all consents should be included, not just the one that happens to be statistically significant. We also consider also that accounting for all three consents is more future proof, given the rapid tightening of different consents over time.

In light of the above, amongst the options to account for additional costs related to P-removal our preference is to account for it through a driver in the model. Our least preferred option is to leave it to the cost adjustment claims process. We consider that Ofwat should seek to minimise the need for cost adjustment claims, in particular for issues that are not unique to a single company, such as the additional costs of P-removal, which affect all companies.

Q4.7) Do you agree with Southern Water's proposal to include the percentage of population living in coastal areas in sewage treatment models?

Inclusion of a coastal population driver in sewage treatment models improves the efficiency assessment of treatment costs. This driver should be included in the modelling suite at PR24. Below we set out why.

In its consultation, "Assessing base costs at PR24", Ofwat explains that to introduce a new explanatory factor in base models, the following conditions should be met[5]:

- The suggested cost driver should align with Ofwat's cost assessment principles (e.g., clear engineering and economic rationale and outside the control of the company in the short term).
- Robust historical data is available or can be collected for all water companies back to 2011-12 on a consistent basis (between companies and over time).
- The suggested cost driver should improve the performance of wholesale base econometric cost models.

Inclusion of the coastal variable in sewage treatment models fulfils all these requirements.

- The driver aligns with Ofwat's cost assessment principles:
    - The cost driver has a strong engineering rationale. We provided extensive evidence on cost pressures associated with coastal STWs, such as requirements on effluent quality, space/planning constraints, pumping requirements, long sea outfalls and more.
    - The driver is exogenous (i.e., it is beyond management control). The inclusion of the coastal driver does not present econometric issues of 'endogeneity' nor a risk of perverse incentives.

[5] Assessing base costs at PR24, Ofwat, 2021 December, p.30.

- Data for the driver is available for the entire modelling period from a reliable source, the ONS, and on a consistent basis. The data is available at local authority district (LAD) level and mapped to WaSC areas using Ofwat's mapping file.
- The inclusion of the driver improves the overall model performance: the variable is statistically significant; the adjusted R-squared improves significantly; the range of efficiency scores reduces to a more credible range, and the coefficient estimates of the scale driver assumes a more credible magnitude, similar to the magnitude in the other models.

Ofwat's consultant, CEPA, recognised the strong statistical performance of the coastal variable in SWT models. CEPA said: "For the sewage treatment models, the coastal driver substantially improves the models' explanatory power, and the variable was statistically significant in both sewage treatment models (p=0.025 for SWT1 Model 11, and p=0.003 in SWT2 Model 11)".

The only statistical concern with the suggested coastal driver raised by Ofwat is that the driver is sensitive to dropping Southern Water from the dataset. Ofwat said "The estimated coefficient turns negative and/or is not statistically significant when included in our proposed sewage treatment models. This suggests that the variable may be capturing a Southern Water specific impact, rather than an overall industry-wide impact of operating in coastal areas".

We understand this concern. However, we do not consider that it merits exclusion of the variable from the models, for the following reasons:

- At the moment, the models are 'biased' towards inland companies by capturing costs typically found for inland discharge (e.g. costs related to ammonia consents). The coastal variable provides an important balance to the models and improves the overall accuracy of efficiency assessment in the sector.
- Southern Water is in the sample, and the variable helps explain costs that we incur in the treatment process. Excluding the variable would mis-represent our relative efficiency and could bias the representation of efficiency across the sector due to an omitted variable bias.
- The coastline variable works reasonably well in SWT3 even when Southern Water is excluded. The coefficient remains positive with a similar magnitude to that obtained when Southern is included, and while it is no longer statistically significant, the significance is not extremely low (the p-value is 0.379). We consider that the performance of the coastline variable in SWT3 is particularly important, because this model, in our view, is better specified than the other two SWT models proposed (see our response to Q4.2). Thus, the performance of coastal driver is not too sensitive to the inclusion/exclusion of Southern Water in the most appropriately specified model amongst the three models proposed.
- Further to the above, as shown in Table 6 below, the inclusion of a coastal driver in SWT3 improves overall model performance even when Southern Water is excluded, despite the variable itself being insignificant:
    - the adjusted R-squared improves;
    - the range of efficiency scores becomes narrower and more plausible;
    - the magnitude of the coefficient estimate of the scale driver (load) becomes more plausible and comparable to the magnitude of the scale variable in other water and wastewater models, and
    - companies' efficiency scores generally move as expected (e.g. improvement in score for companies with a high proportion of coastal population such as South West Water and Welsh Water).

Thus, the importance of this variable to the integrity of the model does not rely on the inclusion of Southern Water in the model – the variable is not Southern Water specific. An exclusion of the driver may result in the model attributing the effect of sea discharge to other included drivers, which will lead to biased estimates, and/or to a distorted assessment of efficiency.

Table 6: The effect of the coastal variable on STW3 with and without Southern Water

	Full sample		Southern Water excluded	
	Ofwat's specification	+ coastline variable	Ofwat's specification	+ coastline variable
Coastline population (%)		0.006**		0.008 {0.379}
Load (log)	0.788***	0.873***	0.776***	0.927***
Weighted average treatment size (WATS)	-0.242***	-0.220***	-0.235***	-0.227***
Load with ammonia consent below 3mg/l (%)	0.006***	0.006***	0.006***	0.006***
Constant	-3.001***	-4.389***	-2.933***	-5.040**
Number of observations	110	110	99	99
R squared	0.911	0.922	0.924	0.934
RESET test (P value)	0.849	0.887	0.962	0.000
Range of efficiency scores	0.31	0.17	0.30	0.24

The coastal driver has engineering rationale, it is beyond management control and based on exogenous data from the ONS – a recognised independent source. It rebalances the models by recognising factors that affect inland and coastal discharge costs, and would allow a more accurate identification of relative efficiency across wastewater companies, thereby allowing to set a more credible and effective efficiency benchmark. We expect the 'inland' companies to support excluding this variable, as it is clearly in their interest to do so. However, the merits of the case need to examined on its own and we consider that the coastal driver improves Ofwat's suite of models.

Bioresources

Q5.1) Do you agree with our proposed set of bioresources cost models?

See comments below.

Q5.2) Do you agree we should use unit cost models to assess bioresources expenditure? Econometric base cost models for PR24

We do not believe there are strong reasons for preferring either a unit or total cost model – neither is obviously superior in terms of either engineering logic or statistical robustness. On balance we therefore agree that using a unit cost model, which aligns to the form of the bioresources price control, is preferable.

Residential retail

Q6.1) Do you agree with our proposed set of residential retail cost models?

See comments below.

In addition, it is important that Ofwat improve the method for forecasting real bills for PR24. For PR19 Ofwat used a linear trend to project bills forward using historical bill values. At PR24, there are likely to be significant bill increases across the industry from underlying changes (inflation and larger enhancement programmes) and these are likely to differ markedly between companies, based on their local requirements. It is important that the bills variable takes full account of the changes in modelled wholesale bills for AMP8.

Q6.2) Do you agree with our approach to modelling deprivation, and/or have any views on the selected variables?

We support the use of the new variable on County Court Judgements. The intuition behind the variable is an improvement on the previous two. It measures much more directly both the ability and the propensity of customers to pay their bills. The two alternative measures are more like latent variables in this sense, as they don't measure non-payment directly, and hence make less intuitive sense.

Q6.3) Do you agree with the inclusion of Covid-19 dummy variables in the residential retail cost models?

Yes, we agree that the use of dummy variables to account for the impact of Covid-19 is sensible and necessary. They improve the performance of the model. However, it is not yet clear whether there are lasting impacts from Covid-19 on performance of the industry, so our support is conditional on there being no evidence of an ongoing effect. Also, we acknowledge that other companies might have found better or supplementary ways of treating Covid-19 impacts.

Q6.4) Do you agree with the removal of transience from the residential retail cost models?

We support the removal of the transience variable from the models. It has very little impact and we don't think that it performs well in econometric terms, with coefficients that vary in sign, and are insignificant.

Q6.5) Do you agree with the removal of 'proportion of metered customers' from the residential retail cost models?

The removal of the 'metered customers' variable means that the retail models do not recognise additional costs associated with metered customers. We do not agree with that. There are clear additional costs associated with metered customers. There is a clear and distinct category of cost – meter reading costs – that is associated with metered customers only and which accounts for 4% of the industry's retail operating cost in 2022, and 8% when excluding doubtful debts and debt management. Metered customers also drive higher customer service costs as a result of more frequent contact with the water company compared to unmeasured customers. There is a wide variance in meter penetration rates between companies, ranging from 34% to 90%. Not recognising these costs either in the cost models or in the broader cost assessment framework would disadvantage highly metered companies. It would be wrong to knowingly exclude a well established and accurate variable that effectively explains differences between companies on a material cost item.

There may be multitude of reasons – primarily related to (inevitably) imperfect data and models – why the models may not pick up the effect of metering. But that does not mean that there are no additional costs which are material enough to be recognised and incorporated into comparative efficiency assessment and allowance setting.

Additional costs associated with metered customers have been recognised in previous price controls. At PR14 the ACTS approach specifically recognised and funded additional costs associated with measured customers.

At PR19 Ofwat used the proportion of metered customers in its models. In the 'Other retail cost' models, the variable had better theoretical and econometric justification than that of the proportion of dual customers, such that Ofwat decided to use the variable also in its 'Total retail cost' models, despite a lack of statistical significance. In this case, Ofwat was appropriately pursuing models that have an underlying logic, not just statistical significance.

We disagree with an approach to retail that does not recognise the additional costs associated with metered customers and breaks from established regulatory precedent that has stood up to independent CMA scrutiny. This will distort efficiency assessment and allowances, particularly for companies at the extreme of the variable's range. If the proportion of metred customers is not included in the models we would expect Ofwat to propose a set of symmetrical off-modelling adjustments for costs associated with metered customers.