ses WATER

# APPENDIX SES103

# PUMPING COST ADJUSTMENT CLAIM

# Contents

# APPENDIX SES103: PUMPING COST ADJUSTMENT CLAIM

## A. Introduction

1. As part of our Business Plan submission, we submitted a cost adjustment claim of £42 million over AMP8, for the additional, non-controllable costs associated with our greater pumping requirement, due to the topography of the area we serve. This claim was necessary as the impact of our unique topography is not fully reflected in Ofwat's base cost benchmarking models.
2. We separated our claim into the two wholesale price controls, in recognition that our pumping related costs were partially accounted for through the Treated Water Distribution (TWD) models, but not in the Water Resources Plus (WRP) models.
3. In its draft determinations, Ofwat has rejected both claims suggesting that we have failed to demonstrate our unique circumstances. Ofwat's precise arguments for rejecting both claims differ slightly but are broadly based on its view that the impact of our topography – to the extent it creates a unique impact on our relative costs – is adequately reflected in the existing suite of base cost benchmarking models.
4. Ofwat's assessment of our cost adjustment claim also objected to our inclusion of an energy price adjustment within our claim. Ofwat's view was that our claim should have focused on the impact of our pumping requirements on our power consumption.
5. We have commissioned an independent review of Ofwat's assessment of our PR24 plan pumping claim by NERA, which is included in Section F of this appendix.
6. In this document, we summarise NERA's conclusions, and provide further substantiation of the validity of our claim.
7. The rest of this document is structured as follows:
   - (a) In **Section B**, we summarise the value of our claim and explain our approach to the energy price adjustment;
   - (b) In **Section C**, we provide further substantiation on the need and efficiency of our claim, with respect to the WRP models;
   - (c) In **Section D**, we provide further substantiation on the need and efficiency of our claim, with respect to the TWD models; and
   - (d) In **Section E**, we conclude.

# B. Summary of our revised claim

8. In this section we set out the basis of our revised cost adjustment claim on pumping which forms part of our representations to Ofwat's draft determinations.

9. We have assessed the arguments raised by Ofwat within the draft determinations and reviewed the conclusions in NERA's report. We continue to conclude it is appropriate for Ofwat to make a company-specific cost adjustment for our additional pumping costs, given our circumstances *are* unique and given Ofwat's cost models do not adequately control for them.

10. As noted in the previous section, our original pumping claim also included adjustments for price effects related to the higher price of power that we expect to incur in AMP8. These effects were included in our claim at Business Plan submission, which was appropriate given uncertainties in how Ofwat would treat this energy price effect in its base cost modelling.

11. It is necessary for an energy price adjustment to be applied to our pumping claim, either within the pumping claim itself or as part of the wider energy price adjustment and ex-post true-up mechanism, given our unique topography means that:

    **(a)** We consume a higher volume of power, relative to other companies due to our pumping requirements; *and*

    **(b)** Because of that, we are more exposed to movements in electricity prices relative to other companies.

12. In light of the approach that Ofwat has taken to apply an energy price adjustment in its draft determinations, we have removed these price effects from our pumping cost adjustment claim. Nevertheless, it is important that our greater exposure to power price movements is reflected in the setting of our base cost allowance. As set out in Appendix SES005: Energy Prices, we consider Ofwat should account for these price effects as part of its wider energy price adjustment, by ensuring that:

    **(a)** Our power share of totex includes our pumping costs; *and*

    **(b)** The energy price adjustment is applied to all wholesale base cost allowances (i.e. including pumping costs) rather than just the base cost allowances from Ofwat's benchmark models.

    Ofwat's approach does not currently do this.

13. Following the removal of the energy price adjustment, we have reduced the size of our claim to £17.14 million, in line with the conclusions in NERA's report. Consistent with the cost adjustment accepted by Ofwat at Final Determinations for PR19 this reflects solely the relatively high volume of power we consumer due to the topography of our supply area and the mix of water resources that we rely upon.

14. The table below provides a breakdown of the claim into WRP and TWD.

**Table 1: SES Water's Cost Adjustment Allowances for pumping (£m, 2022/23 prices)**

| | 2025-26 | 2026-27 | 2027-28 | 2028-29 | 2029-30 | AMP8 |
|---|---|---|---|---|---|---|
| WRP | 1.58 | 1.59 | 1.61 | 1.63 | 1.65 | **8.07** |
| TWD | 1.77 | 1.79 | 1.81 | 1.84 | 1.86 | **9.07** |
| **WW** | **3.35** | **3.39** | **3.43** | **3.47** | **3.51** | **17.14** |

*Source: NERA analysis of Ofwat data.*

# C. Water Resources Plus

## There is clear engineering rationale for why our circumstances are unique, which NERA has also demonstrated empirically.

15. Ofwat claims that while we abstract a relatively high proportion of water from groundwater sources such as boreholes, other companies also abstract a large proportion of their water from groundwater sources. Ofwat uses this to suggest that our circumstances are not unique and the need for our adjustment claim is not justified.

16. We consider this a simplistic assessment of our circumstances. The combination of our groundwater sources, the location of our treatment plants and reservoir, and the topography of the area we serve, is what makes our circumstance unique. And this combined effect is what is driving our higher pumping requirement and our associated higher pumping costs.

    **(a)** The locations and type of our groundwater sources require significant pumping in order to reach our treatment plants. And our only reservoir is pumped storage (as opposed to an impounding), therefore also requiring significant pumping requirements. Our abstraction, treatment and distribution configurations are outside of our control, and instead are driven by the locations of raw water availability, suitable sites for water treatment and customer bases.

    By contrast, the only other water company with a similar dependency on groundwater sources, Portsmouth Water, has a high proportion of its groundwater fed from natural springs, by virtue of where they are located on or close to the South Downs meaning that its groundwater sources have a reduced need for pumping.

    **(b)** Over 90% of our groundwater abstraction comes from boreholes, whereas other companies also abstract a large proportion from springs. Whereas the former requires significant pumping, the latter is naturally pressurised and so, requires less pumping.

17. Ofwat also claims that while we may be exposed to higher pumping costs, we also benefit from lower capital maintenance costs versus a company with a relatively high number of raw water reservoirs. On this basis, Ofwat argues that our higher pumping costs related to the topography of the area we serve, is offset by other factors.

18. Again, we do not consider that this statement can be justified from an engineering nor an empirical perspective:

    **(a)** Ofwat, in its own empirical analysis, has found that explanatory variables related to reservoirs have no statistically significant impact on costs, whereas its own analysis shows the Average Pumping Head (APH) WRP is a statistically significant driver of WRP costs. This is confirmed by NERA in its assessment:

> "We also show that SES Water does not have lower capital maintenance costs due to having fewer reservoirs than an average company that offsets its high pumping costs. Both Ofwat's own assessment and our econometric analysis shows there is no cost saving from having fewer reservoirs, or lower share of DI from impounding reservoirs."[1]

    **(b)** From an engineering perspective, reservoirs are effectively static civil structures requiring little of no capital maintenance on a yearly or even five-yearly basis. They

[1] NERA (2024): 'Review of Ofwat's assessment of SES Water's Power Cost Claims', p. 23.

will have design lives up to 100 years and aside from periodic inspection, require little if any regular capital maintenance.

(c) As noted above, the set-up of our network means that we have a single pumped storage reservoir. It is noted that there are very wide variances across companies regarding the size of reservoirs. For example, Severn Trent Water, who supply roughly 12-times more water than us, have 15 reservoirs. A quarter of these are less than one-third the size of Bough Beech.

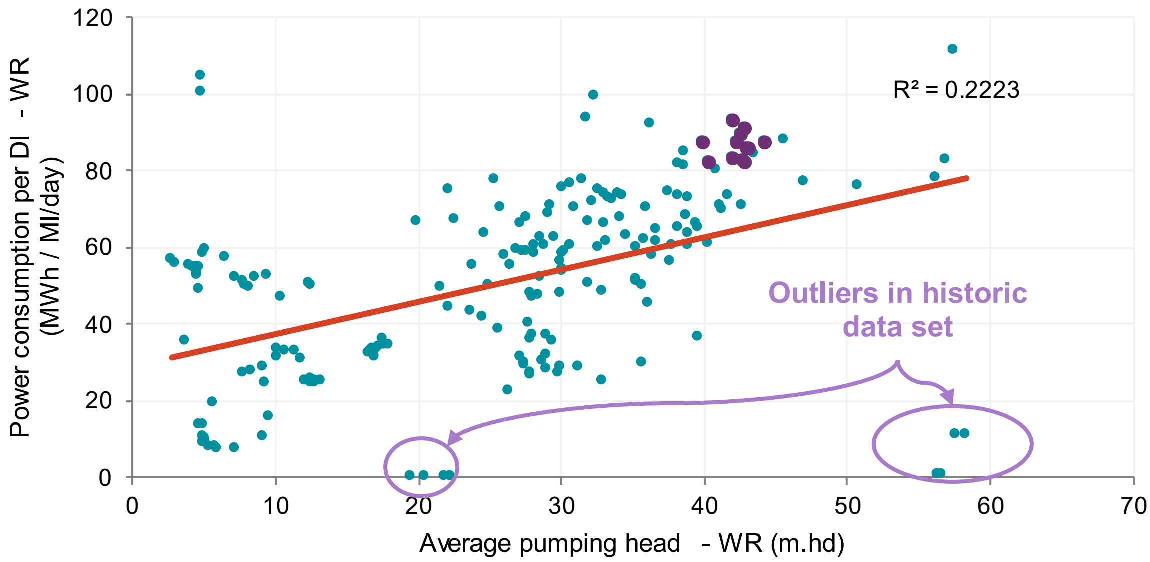
(d) This pumped storage reservoir incurs pumping costs in order to recharge it. As a demonstration of the practical impact of this, the abstraction permit for our Bough Beech reservoir limits us to only pump during the winter months (Oct-April) where seasonal power prices tend to be 10-20% higher than summer season prices (or 5-10% higher than annual average prices). Conversely, impounding reservoirs have little to no pumping costs and may benefit from offsetting income from hydro power generation.

19. Finally, Ofwat point to APH water resources (WR) not being statistically significant in the water resources plus models, to imply that it is not a material driver of costs when considered in-the-round against the reservoir-related capital maintenance cost savings.

20. We consider this ignores issues related to data quality on APH. The poor quality of historic data on APH leads to attenuation bias within the base cost models, serving to reduce its significance as a cost driver in the models. From an engineering perspective, it is apparent that the lack of significance of APH in the models, is due to data quality issues rather than APH not being a material cost driver.

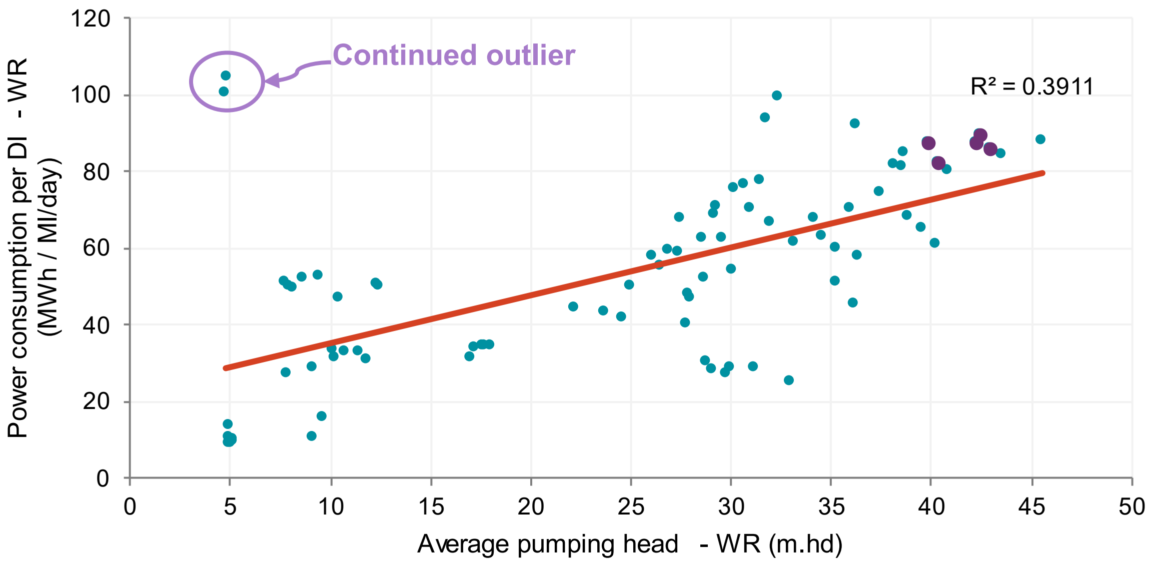
21. To illustrate, we present the two figures below. Figure 1 shows the correlation between APH WR and normalised WR power consumption, using data from 2011/12 to 2022/23. Figure 2 shows the same correlation using data from 2018/19 to 2022/23 only.

**Figure 1: Correlation between power consumption per distribution input and average pumping head - Water Resources (2011/12 to 2022/23)**




*Source: SES analysis of APR data*

**Figure 2: Correlation between power consumption per distribution input and average pumping head - Water Resources (2018/19 to 2022/23)**




*Source: SES analysis of APR data*

22. A comparison of these two figures shows a much stronger correlation between APH and normalised power consumption within water resources when using more recent industry data. The figures also show clear outliers that will affect the results of any base cost modelling.

## NERA has estimated the size of our claim using the same approach that Ofwat accepted in PR19.

23. Despite the issues around historic APH data quality, NERA has found that APH within the WRP value chain has a positive and statistically significant effect on WRP totex. In its report, NERA demonstrates that including APH WRP as a cost driver in Ofwat's WRP models, results in positive and statistically significant coefficients in all the models. As a result, NERA has used APH WRP data to estimate the size of our cost adjustment claim within the WRP value chain.

24. NERA also comments on the relationship between the APH WRP cost driver and the treatment complexity cost drivers:

> "Ofwat claims that the APH WRP captures differences in water treatment complexity rather than differences in pumping requirements, as the inclusion of APH reduces the statistical significance of treatment complexity variables. However, our analysis suggests that the APH WRP is not correlated with the two measures of water treatment complexity that Ofwat uses. Therefore, there is no reason to believe that the change in the statistical significance of the water complexity variables is due to the inclusion of the APH WRP. Moreover, water treatment complexity and energy requirements for pumping are two separate drivers of water companies' costs that are not necessarily related."[2]

25. NERA has estimated the size of the claim by including APH WRP as a cost driver in each of the models and calculating the resultant impact on our base totex allowance. As shown

[2] Ibid., p. ii

in Table 1 above, NERA has estimated the size of our cost adjustment claim to be £8.07 million for the WRP value chain, after accounting for any implicit allowances.

26. The approach NERA has taken is in line with the approach we took, and Ofwat accepted, in PR19. We consider this approach is prudent and likely understates the true value of our cost adjustment, given the impact of attenuation bias.

# D. Treated Water Distribution

## Ofwat's rejection of the uniqueness of our claim does not account for the cumulative impact of our APH and number of booster pumping stations

27. Our high pumping requirements to distribute water to our customers relates to the topography of the area we serve. Once our water is treated, we are required to pump water our customer base, which primarily resides in the South London population centres. Given these are around 40-50 metres above sea level, our distribution of treated water requires significant pumping.

28. Importantly, while our topography necessitates a significant pumping requirement, as measured by APH, it does not necessitate a large number of booster pumping stations given the configuration of our distribution network.

29. From an engineering perspective, power consumption is more directly driven by APH than it is by the number of booster pumping stations. Booster pumping stations necessarily vary by size and as such, one large station can often pump the same volume as several smaller stations. As such, APH has a stronger engineering rationale.

30. From an empirical perspective, NERA confirm that the number of booster pumping stations act as a poor proxy for power consumption:

> "Regression analysis shows that the number of boosters per length of main is a poor proxy for companies' power costs for WW, since its coefficient is both negative (contrary to intuition) and statistically insignificant. On the other hand, APH TWD / APH WW can explain variation in companies' power costs."[3]

31. In rejecting the uniqueness of our claim based on us not being an outlier with regards to APH within TWD, Ofwat is not considering the combined effect of us having relatively high APH within TWD *and* very low numbers of booster pumping stations. And it is not accounting for the impact of us being an outlier in terms of the number of booster pumping stations given our topography-related pumping requirements.

32. As NERA demonstrates, our unique circumstances relate not just to our high APH, but also our low numbers of booster pumping stations, which serves to reduce our implicit allowance for power consumption despite the topography of the area we serve.

> "While Ofwat states that SES Water is not an outlier in APH TWD, we find that SES Water is indeed an outlier in terms of its boosters per length of main given its APH. Not only SES Water has less boosters per length of mains than any other company in the industry, but its number of booster pumping stations per length of mains to APH ratio is around half the industry average, clearly showing SES Water's unique circumstances. Because the extent to which SES Water is disadvantaged by Ofwat's use of the boosters per length of main driver depends on its ratio of booster pumping stations per length of mains to APH relative to other companies in the industry, Ofwat's use of the number of boosters per length of main in its models disadvantages SES Water in particular."[4]

33. We demonstrated this in our original cost adjustment claim. We calculated in our claim that our implicit allowance for power consumption within the models that included boosters as a cost driver, was significantly negative – ranging from -£17.6 million

[3] Ibid. p. 38
[4] Ibid. p. 38

to -£20.5 million in the TWD models and from -£27.3 million to -£38.3 million in the WW models.[5] Ofwat does not appear to have addressed this issue in its assessment of our claim.

34. We recognise that Ofwat's approach to triangulating between models that use APH and those that use booster pumping stations within its base cost models, is a pragmatic step to reflect the trade-offs between both cost drivers. However, this should be separate from Ofwat's assessment of our cost adjustment claim. While the triangulation between the two sets of models may work well in the round for the sector as a whole, it serves to disadvantage us given we are an outlier in terms of the number of booster stations we have.

## NERA has estimated the size of our claim using Ofwat's own set of base cost models.

35. NERA has used Ofwat's own models to estimate the size of our cost adjustment claim related to the TWD value chain. NERA estimates our claim based on the impact of fully weighting the APH models and netting off the implicit allowance from triangulating the full set of models. As shown in Table 1, the net value of our claim for treated water distribution is £9.07 million.

36. We consider the use of Ofwat's existing models the most neutral and prudent approach to estimating the size of our claim. While again, data quality issues in the historic dataset are likely to serve to reduce the size of our claim, we do not reflect this in our estimate.

[5] SES Water (2023) Cost Adjustment Claim: Pumping Costs. Appendix SES027, Table 11. Available at https://seswater.co.uk/-/media/files/seswater/about-us/publications/pr24/appendices/ses027-cost-adjustment-claim---pumping-costs.pdf

# E. Conclusion

37. We commissioned an independent review of Ofwat's assessment of our PR24 plan pumping claim by NERA, which is included later in this appendix.

38. NERA conclude that we use more energy and spend more on power to abstract and supply water to our customers relative to the majority of the industry. This is because we need to pump relatively more water due to the topography of our supply area and the mix of water resources that we rely upon.

39. NERA conclude that the base cost models that Ofwat has used to set the proposed wholesale expenditure allowances in its draft determinations fail to fully and properly account for these characteristics. They also identify several issues with Ofwat's assessment of our pumping claim and show that Ofwat's reasoning for the rejection of our cost adjustment claim is unfounded.

    **(a)** For water WRP (which includes water resources, raw water transport and water treatment) NERA conclude that by "*failing to include a driver that controls for companies differing pumping requirements, Ofwat's models do not control for variations in companies' pumping costs in WRP*".

    **(b)** For Ofwat's treated water distribution (TWD) and wholesale water (WW) models, NERA conclude that we "*face unique circumstances that necessitate a cost adjustment*" and that several of Ofwat's base cost model specifications undermine "*its models' ability to control for the specific characteristics of SES Water that cause it to have unusually high power costs*."[6]

40. NERA conclude that a cost adjustment allowance of c. £17.14 million for our WW power costs is needed over AMP8.

41. Based on the findings of NERA's report, we continue to conclude it is appropriate for Ofwat to make a company-specific cost adjustment for our additional pumping costs as its cost models do not adequately control for them. We have reduced the size of our pumping claim to £17.14 million to align with the conclusions in NERA's report. Consistent with the cost adjustment accepted by Ofwat at final determinations for PR19 this reflects solely the relatively high volume of power we consumer due to the topography of our supply area and the mix of water resources that we rely upon.

42. Our original pumping claim also included adjustments for price effects related to the higher price of power that we expect to incur in AMP8. These effects were included in our claim at Business Plan submission given uncertainties in how Ofwat would treat this energy price effect in its base cost modelling.

43. In light of the approach that Ofwat has taken to apply an energy price adjustment in its draft determinations, we have removed these price effects from our pumping cost adjustment claim. Instead, we set out how we consider Ofwat should account for these price effects in our representations on Ofwat's energy cost adjustment.

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[6] In particular, Ofwat's use of boosters per length of main as a variable in a selection of its models.

# F. NERA Review of Ofwat's Assessment of SES Water's Power Costs Claim

# Review of Ofwat's Assessment of SES Water's Power Costs Claim

Prepared for SES Water

22 August 2024

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# Contents

# Executive Summary

Amongst the English and Welsh water companies, SES Water's energy consumption per megalitre of distribution input (DI) is among the highest in wholesale water (WW).[1] The company explains in its cost adjustment claim that its high power costs are due to its high pumping requirement, which is not under management control as it is driven by the company's network topography and the nature of its water resources.

Because the pumping requirment is not controlled for in the majority of Ofwat's cost assessment models for WW, the company has requested a post-modelling cost adjustment allowance of £42 million (2022/23 prices), claiming allowances for power costs, real price effect (RPE) adjustment for power, and the additional maintenance and investment costs associated with the company's high pumping requirements.[2] This includes a requested adjustment of £16.5 million for water resources plus (WRP) and £25.5 million for treated water distribution (TWD).

While Ofwat accepted a similar claim of the company at PR19 on power costs only and granted the company the requested £10 million allowance in full, it has provisionally rejected SES Water's claim at PR24 Draft Determinations.

SES Water has commissioned NERA to review Ofwat's decision in the PR24 Draft Determinations on the company's cost adjustment claim relating to its power costs, focusing on the power costs associated with the high pumping requirement only. SES Water has prepared a separate representation submission on RPEs (SES105 Energy Prices), which is therefore not in the scope of this report.

## The Ability of Ofwat's WRP Models to Control for Companies' Energy Requirements

SES Water's power costs in water resources (WR) and WRP (i.e., including water resources, raw water transport and water treatment) are higher than the average, and it has the second highest average power costs per property in WW amongst the industry.

SES Water explains in its cost adjustment claim that average pumping head (APH) and the volumes of water extraction are the two main drivers of water companies' power consumption.[3]

Statistical evidence suggests that the APH variable is a major driver of companies' power costs. We find that there is a positive correlation between APH and companies' power costs in WR and WRP. The coefficients on APH WRP are also statistically significant when included in Ofwat's WRP models. These findings support SES Water's claim that the higher pumping requirement it faces due to its network topography has led to higher power costs.

1 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 12.

2 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 2.

3 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 16.

However, Ofwat has not included this driver in its WRP models:

- Ofwat argues that APH WR is not a material driver of companies' WRP costs, since it is not statistically significant in the WRP models. However, Ofwat's evaluation uses inconsistent data, as it tries to explain variations of companies' total WRP power costs with a driver (i.e. APH WR) that can only capture pumping requirements for a subset of the value chain modelled.
- While Ofwat does find the coefficient on APH WRP to be statistically significant in its WRP models, it asserts that this is the result of a spurious relationship as it is driven by APH water treatment, which in turn is weakly correlated with power costs. However, SES Water has shown a clear engineering rationale that APH is an important driver of its power costs, which suggests that this is not a spurious relationship, as Ofwat alleges.[4] Also, contrary to Ofwat's assertion, our analysis shows a positive relationship between APH and companies' power costs in water treatment.
- Ofwat claims that the APH WRP captures differences in water treatment complexity rather than differences in pumping requirements, as the inclusion of APH reduces the statistical significance of treatment complexity variables. However, our analysis suggests that the APH WRP is not correlated with the two measures of water treatment complexity that Ofwat uses. Therefore, there is no reason to believe that the change in the statistical significance of the water complexity variables is due to the inclusion of the APH WRP. Moreover, water treatment complexity and energy requirements for pumping are two separate drivers of water companies' costs that are not necessarily related.
- Further, Ofwat argues that SES Water has lower capital maintenance costs due to having fewer reservoirs than an average company, which offsets the company's high pumping costs. While this supposed trade-off between pumping and reservoir maintenance costs is unsubstantiated, both Ofwat's assessment and our econometric analysis show no evidence of cost savings from having fewer reservoirs, or a lower share of DI from impounding reservoirs.

By failing to include a driver that controls for companies' differing pumping requirements, Ofwat's models do not control for variations in companies' pumping costs in WRP. Given the intuitive and statistically proven relationship between pumping requirements and companies' power costs, failing to control for companies' varying pumping requirements in WRP, either via the WRP models or through company-specific adjustments, would cause Ofwat's cost assessment to understate SES Water's efficient costs.

## The Efficient Costs of SES Water in Ofwat's TWD and WW Models

Ofwat includes APH TWD in half of its TWD models and WW models. In the other half of the models, Ofwat uses the number of boosters per length of main as an alternative measure of companies' pumping requirements.

In its response to SES Water's cost adjustment claim, Ofwat considers that the company has failed to justify its unique characteristics. It notes that SES Water is not an outlier in either the number of

4 SES Water (1 April 2019), PR19 Business Plan Resubmission: Cost Adjustment Claim for Wholesale Electricity Usage, p. 4.

boosters per length of main, or the APH TWD. However, our analysis suggests that SES Water does face unique circumstances that necessitate a cost adjustment, as explained below.

SES Water has relatively high power costs given its number of boosters per length of main. Despite ranking 2nd on power expenditure per DI, SES Water has the lowest number of boosters per length of main in the industry. In addition, SES Water has the highest power costs (i.e. per ML of DI) per unit of the booster pumping stations per length of mains variable, which is around twice the industry average.

The extent to which SES Water is disadvantaged by Ofwat's use of the boosters per length of main driver depends on its ratio of booster pumping stations per length of mains to APH, relative to other companies in the industry. While in general we find a positive relationship between companies' booster per length of mains and their APH TWD / APH WW, SES Water appears to be an outlier, as it has fewer boosters per length of main relative to its APH.

We perform regression analysis to compare the ability of the number of boosters per length of main relative to APH to explain variations in companies' power costs. We find that the number of boosters per length of main is a poor proxy for companies' power costs in WW, since its coefficient is both negative (contrary to intuition) and statistically insignificant. On the other hand, the APH TWD / APH WW variables can explain variation in companies' power costs.

These findings suggest that Ofwat's use of the boosters per length of main variable undermines its models' ability to control for the specific characteristics of SES Water that cause it to have unusually high power costs. This is recognised by Ofwat when explaining its reasons for accepting SES Water's cost adjustment claim at PR19, in which it states,

> "While having higher than upper quartile average pumping head, the company [SES Water] has the lowest number of booster pumping stations per lengths of main, which is the variable used in our TWD and WW econometric models to account for energy costs".[5]

We understand that Ofwat has concerns over the APH data quality.[6] Ofwat stated the same concern at PR19, but it accepted SES Water's cost adjustment claim that relied on APH data.[7] While Ofwat considers APH data quality has improved at PR24, any remaining data quality concern is likely to cause attenuation bias, thus *understating* the quantified relationship between APH and costs, thereby disadvantaging companies like SES Water that have relatively high APH.

While the concerns on APH data quality suggest that it may not necessarily be ideal to use APH data as a driver of companies' pumping requirements in all Ofwat's models, these data quality issues compound the need to make company-specific adjustments for companies whose high pumping requirements are not properly represented by the boosters per length of main variable.

5 Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

6 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 21.

7 Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

## Our Proposed Approach to Adjusting Allowances for SES Water's High Power Costs

We propose that Ofwat's Final Determination uses APH as a driver to estimate the required adjustments to be applied to SES Water's allowances. This is consistent with the approach that Ofwat accepted at PR19 when assessing the cost adjustment allowance required due to SES Water's high electricity consumption.[8]

First, we modify Ofwat's cost assessment models from the PR24 Draft Determination to control for variations in companies' pumping costs:

- For WRP, we include APH WRP in Ofwat's WRP models. The coefficient on the APH WRP variable is positive and statistically significant in all Ofwat's WRP models;
- For TWD and WW, we revise the calculation of allowances to only place weight on those models that use APH TWD as measure of companies' pumping requirements, placing no weight on the models that include boosters per length of main.

Second, we calculate what SES Water's cost allowance would have been if Ofwat's benchmarking models had been run following the approach outlined above. The resulting WW allowance at AMP8 for SES Water is £211.52 million.

Finally, we calculate SES Water's cost adjustment associated with its high pumping activities by taking the difference between this WW base cost allowance and Ofwat's estimate from applying the same approach used in the Draft Determination (i.e. £193.38 million). Our analysis suggests a cost adjustment allowance of around £17.14 million for SES Water's WW power costs over AMP8 (or £8.07 million in WRP and £9.07 million in TWD based on SES Water's ratio of submitted base costs in these two areas). Table 1 below shows the profile of the cost adjustment claim over AMP8.

We note that this adjustment does not consider any price effects related to power.

**Table 1: SES Water's Cost Adjustment Allowances, Annual Profile**

| | **2025-26** | **2026-27** | **2027-28** | **2028-29** | **2029-30** | **AMP8** |
|---|---|---|---|---|---|---|
| | £m | £m | £m | £m | £m | £m |
| WRP | 1.58 | 1.59 | 1.61 | 1.63 | 1.65 | **8.07** |
| TWD | 1.77 | 1.79 | 1.81 | 1.84 | 1.86 | **9.07** |
| WW | **3.35** | **3.39** | **3.43** | **3.47** | **3.51** | **17.14** |

*Source: NERA analysis of Ofwat data.*

8 (1) NERA (27 August 2019), Treatment of SES Water's Electricity Costs in the Cost Assessment, p. 19; (2) Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

# 1. Introduction

SES Water has commissioned NERA to review Ofwat's decision in the PR24 Draft Determinations on the company's cost adjustment claim relating to its power costs.

Amongst the English and Welsh water companies, SES Water's energy consumption per megalitre of distribution input (DI) is among the highest in wholesale water (WW) activities.[9] In its cost adjustment claim, SES Water explains that the high power consumption is driven by its unique network topography and are outside of management control. Due to the network topography of SES Water (e.g. groundwater sources in greensand and chalk aquifers located deep underground), it faces a higher pumping requirement than the industry average. SES Water notes that the higher pumping requirement is the main driver of its power costs, which depends on the depth of its ground water resources (WR) and the altitude and distance of its customers relative to its WR.

At PR19, the company requested an ex-post modelling adjustment to reflect its relatively high electricity consumption.[10] While initially rejected in Ofwat's Draft Determination, Ofwat subsequently approved the adjustment in its PR19 Final Determination, providing the company the funding in full, as the company provided "sufficient and convincing evidence to demonstrate the need for adjustment".[11]

As part of SES Water's PR24 submissions, the company requested a £42 million (2022/23 prices) ex-post modelling adjustment, claiming allowances for power costs, real price effect (RPE) adjustment for power, and the additional maintenance and investment costs associated with the company's high pumping requirements.[12] However, Ofwat's Draft Determination provisionally rejects the company's claim, stating SES Water "has failed the 'need for adjustment' and 'cost efficiency' criteria".[13]

In this report, we assess the need for an ex-post adjustment due to SES Water's relatively high power costs and review Ofwat's responses to SES Water's cost adjustment claim. SES Water has prepared a separate representation submission on RPEs (SES105 Energry Prices), which is therefore not in the scope of this report. The remainder of this report is set out as follows:

- Section 2 analyses SES Water's power consumption and costs;
- Section 3 reviews Ofwat's water resources plus (WRP) benchmarking models and the models' ability to control for SES Water's specific characteristics causing its relatively high power costs;
- Section 4 contains a similar assessment of Ofwat's treated water distribution (TWD) and WW benchmarking models;

9 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 12.

10 SES Water (1 April 2019), PR19 Business Plan Resubmission, Cost Adjustment claim for wholesale electricity usage.

11 Ofwat (December 2019), PR19 Final Determinations: SES Water Final Determination, p. 26.

12 Including a requested adjustment of £16.5 million for WRP and £25.5 million for TWD (2022/23 prices).
Source: (1) Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC1"; (2) Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC2".

13 Ofwat (July 2024), PR24 Draft Determinations: Total Expenditure Allowances – by Company, p. 69.

- Section 5 discusses our proposed approach to estimating the cost adjustment necessary to reflect SES Water's high power consumption and costs; and
- Section 6 concludes.

# 2. SES Water's Power Costs Relative to the Industry

## 2.1. SES Water Has Relatively High Power Requirements

SES Water has the highest energy consumption per property and the second highest energy consumption per distribution input DI in the industry:

- Figure 2.1 shows water companies' energy consumption in WW per unit of DI. For each unit of DI, SES Water consumes 35 per cent more than the industry average and 165 per cent more than the company with the lowest energy consumption (Portsmouth Water).
- Figure 2.2 shows water companies' energy consumption per 1,000 of properties in WW. SES Water has the highest power consumption per property, consuming 37 per cent more than the industry average and 169 per cent more than the company consumes the least (Portsmouth Water).

**Figure 2.1: Energy Consumption per DI in WW, Average between 2011/12 – 2022/23**


*Source: NERA analysis of Ofwat data.*

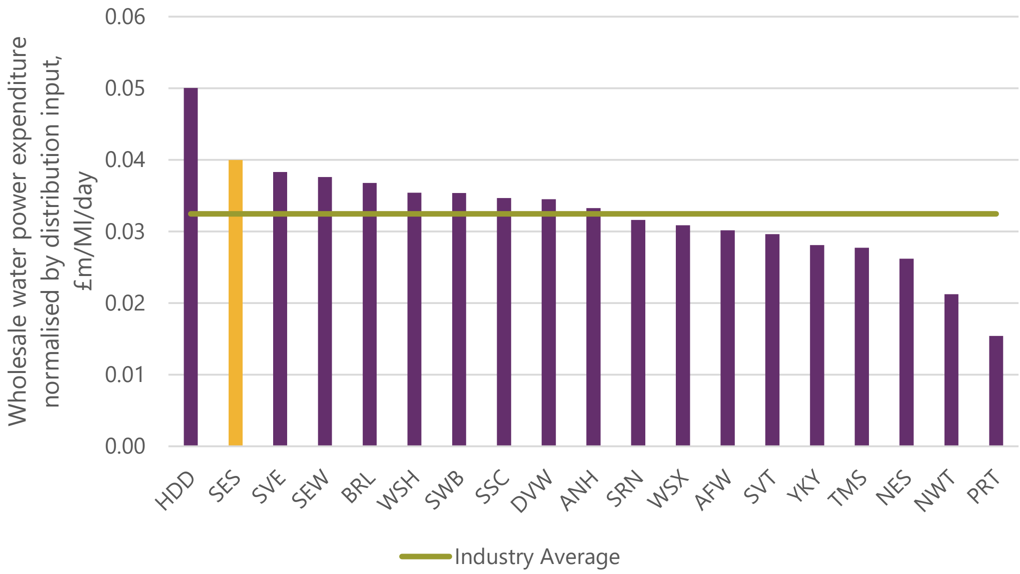
**Figure 2.2: Energy Consumption per Property in WW, Average between 2011/12 – 2022/23**


*Source: NERA analysis of Ofwat data.*

These higher energy requirements cause SES Water to have higher costs to purchase power when compared to the industry average:

- Figure 2.3 shows water companies' power expenditure in WW, per unit of DI. By this measure, SES Water consumes 35 per cent more than the industry average and 165 per cent more than the company with the lowest energy consumption (Portsmouth Water); and
- Figure 2.4 shows water companies' power expenditure per property in WW. SES Water has the second highest power expenditure per property, spending 25 per cent more than the industry average and 163 per cent more than the company spending the least (Portsmouth Water).

**Figure 2.3: Power Expenditure per DI in WW, Average between 2011/12 – 2022/23**



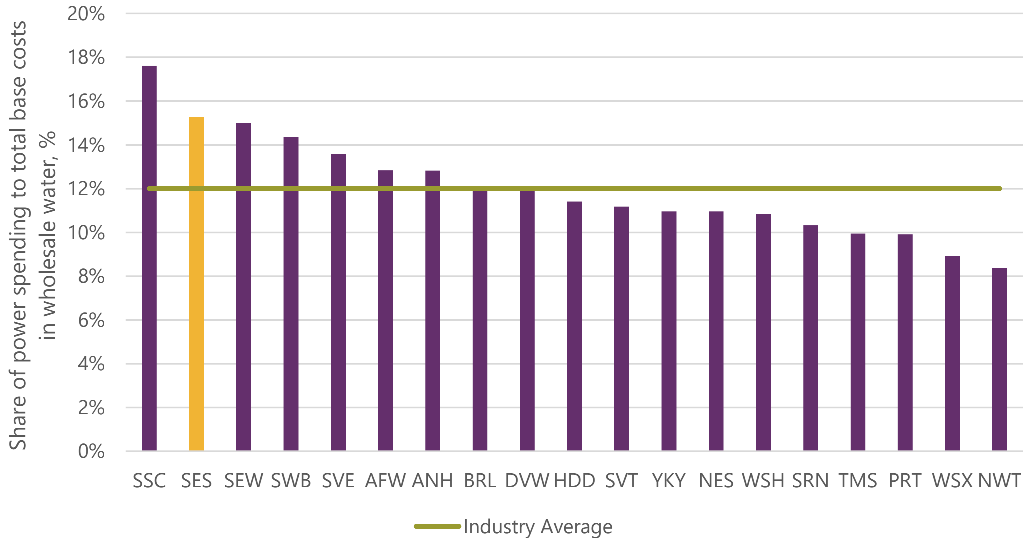

*Source: NERA analysis of Ofwat data.*

**Figure 2.4: Power Expenditure per Property in WW, Average between 2011/12 – 2022/23**


*Source: NERA analysis of Ofwat data.*

These power costs comprise a considerable amount of SES Water's total base costs in WW. As shown in Figure 2.5 below, SES Water spends on average 15 per cent of its total WW base costs on power, ranking 2nd in the industry by this measure, above the industry average of 12 per cent.

**Figure 2.5: Companies' Share of Power Costs to Total Base Costs in WW, Average between 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

## 2.2. SES Water's Electricity Unit Costs are Relatively Low

While SES Water has high energy consumption and therefore incurs high expenditure to purchase electricity, it has relative low unit costs of power procurement. This suggests that SES Water's high power expenditure is attributable to its high electricity requirement, instead of more expensive energy procurement:

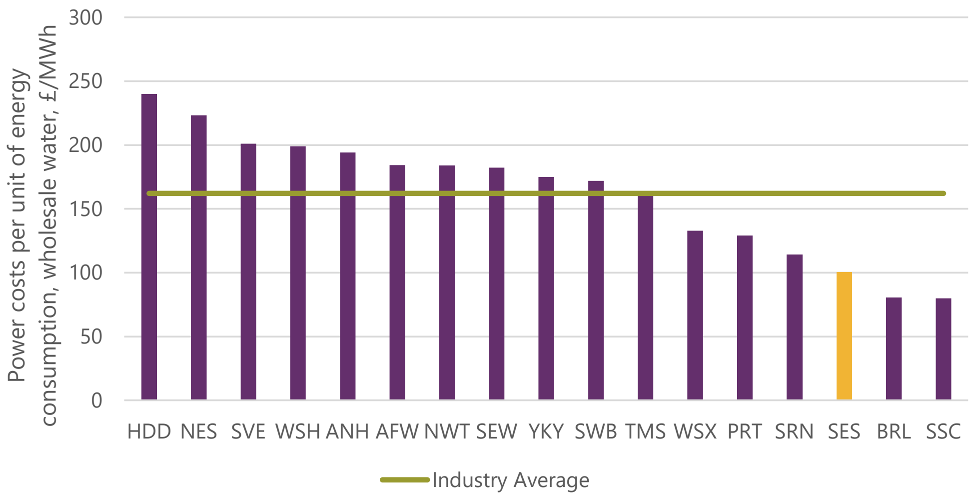
- We show in Figure 2.6 that SES Water has average power costs per megawatt-hour of consumption that are below the average for all water companies over the period 2011/12 – 2022/23. SES Water has the fourth lowest power unit cost in the industry, spending 9 per cent less than the industry average, and 36 per cent less than the company with the highest average unit cost (i.e. Hafren Dyfrdwy); and

- Figure 2.7 presents water companies' average forecast power costs per unit of consumption, over the period 2023/24 – 2029/30. SES Water has the third lowest power unit cost in the industry, spending 61 per cent less than the industry average, and 139 per cent less than the company with the highest average unit cost (i.e. Hafren Dyfrdwy).

**Figure 2.6: Average Power Costs per Unit of Energy Consumption, 2011/12 – 2022/23**


*Source: NERA analysis of Ofwat data.*

**Figure 2.7: Average Power Costs per Unit of Energy Consumption, 2023/24 – 2029/30 Forecast**




*Source: NERA analysis of Ofwat data.*
*Note, no forecast data is available for DVW and SVT in the Ofwat dataset.*

# 3. Evaluating the Ability of Ofwat's WRP Models to Control for Companies' Energy Requirements

## 3.1. SES Water's Initial Claim and Ofwat's Response

SES Water explains in its cost adjustment claim that average pumping head (APH) and the volumes of water extraction are the two main drivers of water companies' power consumption.[14] SES Water notes that, while Ofwat includes at least the APH driver in half of its TWD and WW models, none of Ofwat's WRP (WRP) models include the APH variable.

SES Water notes that 85 per cent of its water supply is from abstraction from groundwater sources in greensand and chalk aquifers located deep underground,[15] and it also needs to distribute and pump the water across the North Downs to customers' properties.[16] This unique network topography, and in particular the depth of its WR, leads SES Water to have a higher pumping requirement and higher power consumption than the industry average. SES Water's remaining abstraction comes from a pumped storage reservoir, which we understand also requires significant pumping. Therefore, the company considers the exclusion of the APH driver in Ofwat's WRP models would cause the models to understate its efficient costs. Hence, it requested a cost adjustment:

> "This [WRP] is the part of the value chain where we are most exposed to higher power costs relative to the rest of the industry [...] The nature of our water sources means that we have much higher water abstraction APH than others in the industry. As a result, the inclusion of treated water distribution APH within the treated water distribution cost model does not tackle the issue of higher pumping associated with the abstraction and transport of raw water".[17]

In its PR24 Draft Determination, Ofwat rejects SES Water's claim. Ofwat's reasons are as follows:[18]

- While the company has the second highest proportion of DI from boreholes that may lead to higher pumping costs, "the company benefits from lower capital maintenance costs versus a company with relatively high number of raw water reservoirs"; and

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14 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 16.

15 While Portsmouth Water also has a significant share of water supply from groundwater and surface water sources (i.e., average of 88 per cent between 2011/12 and 2022/23 based on Ofwat data), we understand from SES Water that Portsmouth Water has a different network topography from SES Water, which does not require a significant amount of energy consumption because: (i) Portsmouth Water pumps the surface water from the river and treats the water immediately, it hence does not need storage or impounding reservoirs like SES Water; (ii) over 40 per cent of the water supplied by Portsmouth Water comes from springs that only are pressurized at ground level, which does not require significant energy; and (iii) the majority of Portsmouth Water's customer base is at or very close to sea level, Portsmouth Waster hence does not need significant pumping for water distribution.

16 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 14.

17 SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, paras. 24-25.

18 Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC1".

- Ofwat does not consider the inclusion of the APH driver in the model to be appropriate. Ofwat has tested the inclusion of either the APH WR or the APH WRP in its WRP models, but it argues that:
  - The APH WR driver is not statistically significant, which "suggests it is not a material driver of costs when considered in-the-round against the capital maintenance cost savings SES Water achieve versus a company with a relatively high number of raw water reservoirs";
  - The APH WRP driver (i.e. the sum of APH in water resources, raw water transport and water treatment), while significant, "is driven by APH water treatment which is very weakly correlated to power costs, suggesting a spurious relationship"; and
  - The "APH water resources plus also reduces the statistical significance of the water treatment complexity variables, which suggests it is capturing differences in water treatment complexity rather than differences in pumping requirements. We consider our water treatment complexity variables (e.g. % of water treated at high complex treatment works) are superior as they directly use water treatment works complexity data".

Because of the above, Ofwat does not provide any cost adjustment allowances in relation to SES Water's WRP costs in its PR24 Draft Determinations.

In the sections below, we evaluate whether Ofwat's above positions are reasonable.

## 3.2. Companies' Energy Requirements Highly Correlated with WRP Costs

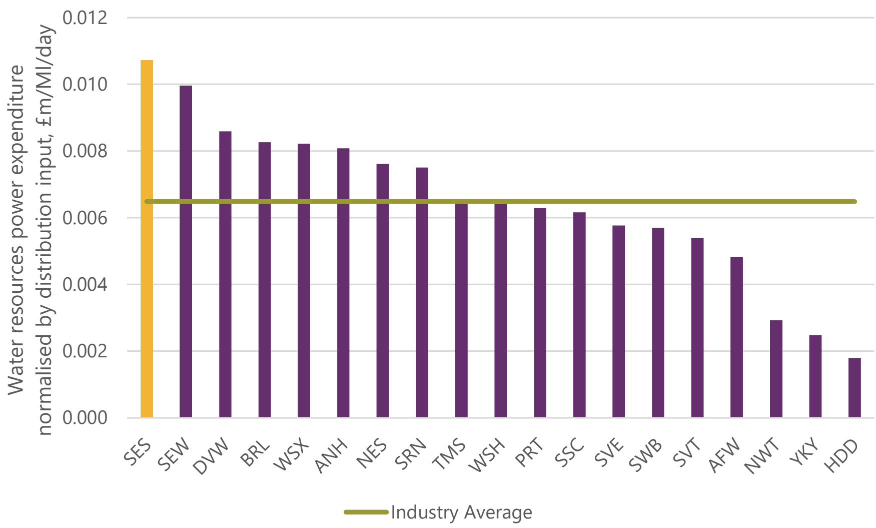
We understand it is uncontroversial from a technical perspective that companies with higher pumping requirements will have higher energy consumption and therefore higher power costs, and Ofwat does not challenge this position. Hence, below we compare SES Water's power costs in WRP to those of other companies, and then perform statistical analysis to examine the relationship between water companies' power costs and the APH variable.

### 3.2.1. SES Water has higher power expenditure in WR and WRP than other companies

Consistent with its high power expenditure in WW activities (see Figure 2.3 and Figure 2.4 above), SES Water also has higher power expenditure in WR / WRP than the industry average.

We show below in Figure 3.1 water companies' power expenditure in WR per unit of DI. SES Water ranks first, with power expenditure per unit of DI that is 65 per cent higher than the industry average. Figure 3.2 shows water companies' power expenditure in WRP per unit of DI. While SES Water ranks fourth, it still incurs costs 33 per cent higher than industry average.

**Figure 3.1: Power Expenditure per DI in WR, Average between 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

**Figure 3.2: Power Expenditure per DI in WRP, Average between 2011/12 – 2022/23**

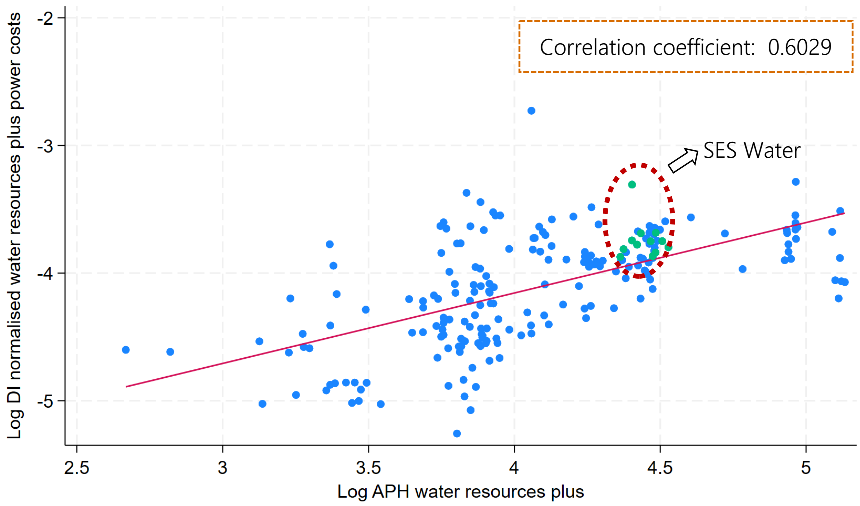

*Source: NERA analysis of Ofwat data.*

### 3.2.2. There is a positive correlation between power costs and APH in companies' WRP / WR activities

Our analysis shows that, consistent with the technical evidence that pumping requirements drive energy costs, there is a positive relationship between companies' power costs and the APH driver in WRP / WR activities.

We show in Figure 3.3 the correlation between water companies' WRP power costs per unit of DI and APH in WRP. There is a positive relationship between the companies' WRP power costs and their APH WRP, with a correlation coefficient of 0.60.

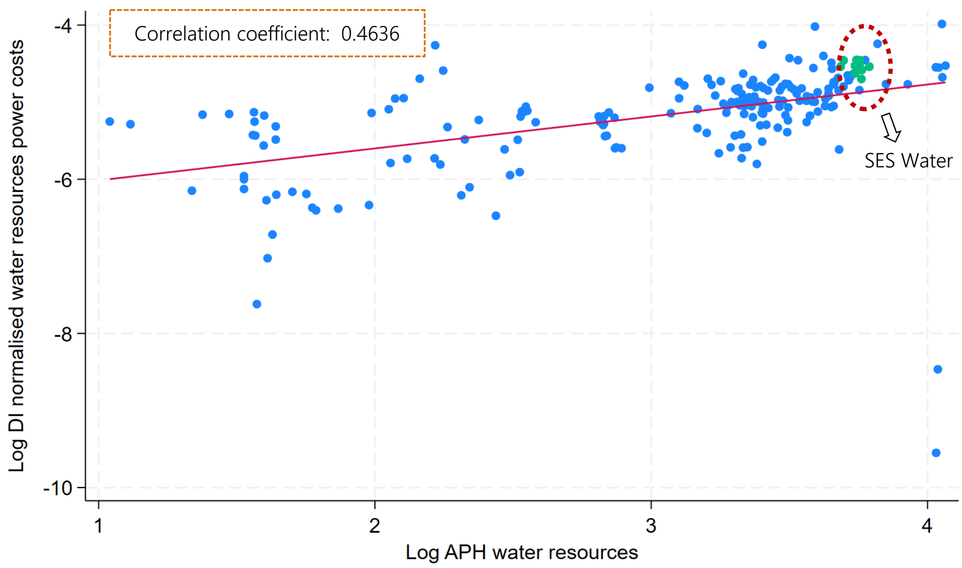
**Figure 3.3: Relationship between Water Companies' WRP Power Costs (Normalised by DI) and APH WRP, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

We also show in Figure 3.4 below the correlation between water companies' WR power costs per unit of DI and the APH WR. Again, there is also a positive relationship between the companies' WRP power costs and their APH WRP, with a correlation coefficient of 0.46.

**Figure 3.4: Relationship between Water Companies' WR Power Costs (Normalised by DI) and APH WR, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

## 3.3. APH is a Significant Driver of Companies' WRP Costs

Building on the analysis shown above in Section 3.2 suggesting APH is a material driver of companies' WRP costs, we have performed statistical analysis regarding the materiality and statistical significance of the link between the APH variable and companies' WRP costs.

We find that APH for WRP is statistically significant when added to the existing WRP models, as we show in Table 3.1. While statistically significant, the estimated coefficients also show the relationship has real, commercial significance for water companies. The coefficients of between 0.301 to 0.369 indicate that a 1 per cent increase in APH WRP increases WRP costs by over 0.3 per cent.

**Table 3.1: Ofwat's WRP Models with the Additional APH WRP Explanatory Variable**

| **Model Index** | **WRP** | | | | | |
|---|---|---|---|---|---|---|
| **Explanatory Variable** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Connected Properties (log) | 1.112*** | 1.112*** | 1.096*** | 1.097*** | 1.095*** | 1.094*** |
| Water treated at complexity levels 3 to 6 (%) | 0.004*** | | 0.004** | | 0.004*** | |
| Weighted average treatment complexity (log) | | 0.286 | | 0.25 | | 0.287 |
| LAD from MSOA - Weighted average density (log) | -1.614*** | -1.564** | | | | |
| LAD from MSOA - weighted average density (log) - squared | 0.108*** | 0.104** | | | | |
| MSOA - weighted average density (log) | | | -5.180*** | -5.269** | | |
| MSOA - weighted average density (log) - squared | | | 0.324*** | 0.329** | | |
| Properties per length (log) | | | | | -11.808*** | -11.563*** |
| Properties per length (log) - squared | | | | | 1.352*** | 1.321*** |
| **APH WRP (log)** | **0.307**** | **0.301***** | **0.350***** | **0.341***** | **0.369***** | **0.358***** |
| Constant | -6.930*** | -7.132*** | 7.831 | 8.181 | 12.788*** | 12.301** |
| R^2 | 0.923 | 0.916 | 0.923 | 0.918 | 0.931 | 0.924 |

*Note: *10% significance level **5% significance level ***1% significance level.*

*Source: NERA analysis of Ofwat data.*

## 3.4. Flaws in Ofwat's Examination of the Link Between APH and WRP Costs

Ofwat also performed statistical analysis to examine the link between APH and WRP costs, but its assessment is flawed for the reasons outlined below. Its arguments provide no basis to contradict the clear technical evidence that APH drives companies' energy requirements, which in turn have a material impact on companies' WRP costs.

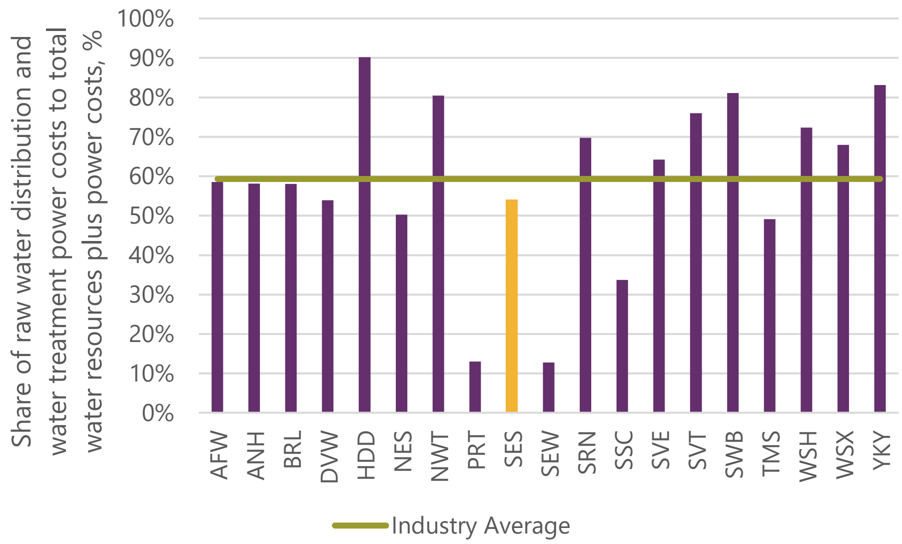
### 3.4.1. Ofwat's evaluation of the APH variable uses inconsistent data

Ofwat decides to exclude the APH variables from its WRP models based on its finding that APH for WR is not statistically significant in its WRP models, which suggests "it is not a material driver of WR base costs when considered in-the-round against capital maintenance cost savings a company with a relatively high number of boreholes achieves versus a company with a relatively high number of raw water reservoirs".[19]

We return to the question of whether there are trade-offs between reservoir capital maintenance and energy costs in Section 3.6 below. However, Ofwat's conclusions appear to be based on an inconsistent definition of costs and the APH driver when regressing WRP costs on the APH for WR only. Water resources plus includes water resources, raw water treatment, and water treatment activities. When regressing companies' WRP costs on APH WR, Ofwat has included costs across several components of the value chain, but only included APH driver in one component of the value chain.

In fact, based on the average data between 2011/12 – 2022/23, companies' power costs in raw water transport and water treatment account for 59 per cent of their total WRP power costs, as shown in Figure 3.6. The industry average share of APH WR to APH WRP is 63 per cent, as shown in Figure 3.6.

**Figure 3.5: Share of Power Costs in Raw Water Transport and Water Treatment to Total Power Costs in WRP, Average between 2011/12 -2022/23**




*Source: NERA analysis of Ofwat data.*

19 Ofwat (July 2024), PR24 Draft Determinations: Expenditure Allowances - Base Cost Modelling Decision Appendix, p. 23.

**Figure 3.6: Share of APH in WR to APH WRP, Average between 2011/12 -2022/23**


*Source: NERA analysis of Ofwat data.*

Hence, when regressing WRP costs on APH for WR only, Ofwat's regressions attempt to explain variation in companies' total WRP power costs with a driver that can only capture pumping requirements (i.e. APH WR) for a subset of the value chain modelled (i.e. on average 63 per cent of the total APH WRP).

### 3.4.2. The relationship between power costs and APH is not spurious as Ofwat claims

Ofwat did find the coefficients on APH WRP are statistically significant in the WRP models.[20] However, Ofwat asserted this relationship is mainly driven by APH water treatment which, according to the regulator, is weakly correlated with power costs. On this basis, Ofwat concludes the statistically significant relationship between companies' WRP costs and APH WRP is "spurious".[21]

A spurious correlation refers to a situation in which two variables are correlated but unrelated.[22] However, this problem does not apply here, as there is clear engineering rationale showing that APH drives companies' power costs.[23] Ofwat has ignored the underlying engineering rationale when making the above assertion.

In addition, as Figure 3.7 below shows, there is a positive relationship between APH for water treatment and companies' power costs in water treatment, with a correlation coefficient of 0.6775.

[20] Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC1".

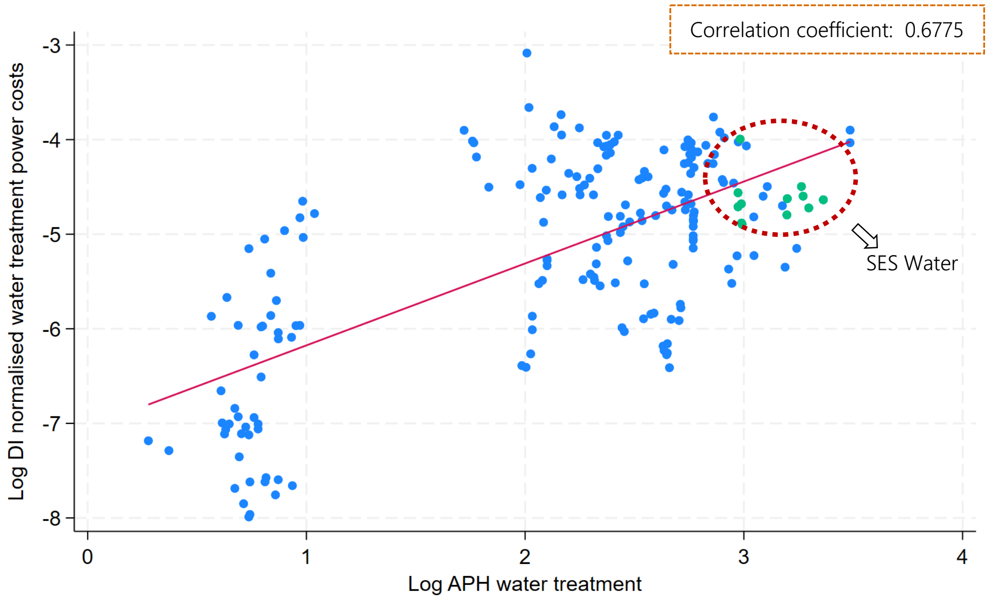
[21] Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC1".

[22] A spurious correlation is defined as a relationship between two variables $X$ and $Y$ that is really due to other unobserved factors that affect $Y$ and also happen to be correlated with $X$. See J. Wooldridge, Introductory Econometrics (2009), p.51.

[23] See for example, SES Water (1 April 2019), PR19 Business Plan Resubmission: Cost Adjustment Claim for Wholesale Electricity Usage, p. 4.

The correlation coefficient between the APH for water treatment and power costs in WRP (both in log terms) is 0.5797. Therefore, Ofwat's assertion that APH water treatment "is very weakly correlated to power costs" is not supported by the data.[24]

**Figure 3.7: Relationship between Water Companies' Water Treatment Power Costs (Normalised by DI) and APH Water Treatment, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

Ofwat's claim that the statistically significant relationship between APH WRP and companies' WRP costs is driven by a "spurious" relationship is therefore inconsistent with the technical evidence.

### 3.4.3. APH WRP is not correlated with the water treatment complexity variables

Ofwat claims that the inclusion of APH in the WRP model reduces the statistical significance of the water treatment complexity variables, from which Ofwat concludes that the APH variable captures "differences in water treatment complexity rather than differences in pumping requirements".[25]

It is reasonable to hypothesise that both APH and water treatment complexity drive companies' WRP costs, albeit for different reasons. Higher APH drives energy costs to move water, whereas higher treatment complexity requires capital maintenance in treatment works and may also drive operating costs such as staff, energy and chemicals to operate multiple treatment processes. However, this simple rationale provides no quantification or testing of the significance and materiality of these relationships, which requires empirical testing.

As we show in Section 3.3 above, the statistical evidence suggests that APH WRP is an important driver of companies' WRP costs. This relationship suggests that energy costs due to pumping

24 Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC1".

25 Ofwat (July 2024), PR24 Draft Determinations: Expenditure Allowances - Base Cost Modelling Decision Appendix, p. 23.

requirements need to be controlled for in the cost assessment, either via the WRP models or through company-specific adjustments.

The variable "Water treated at complexity levels 3 to 6 (%)" is also statistically significant, suggesting evidence that water treatment complexity does drive costs. While the "Weighted average treatment complexity (log)" variable is not statistically significant, the coefficient is positive, so if Ofwat is content the coefficient is intuitive and consistent with engineering logic, it could still be included.

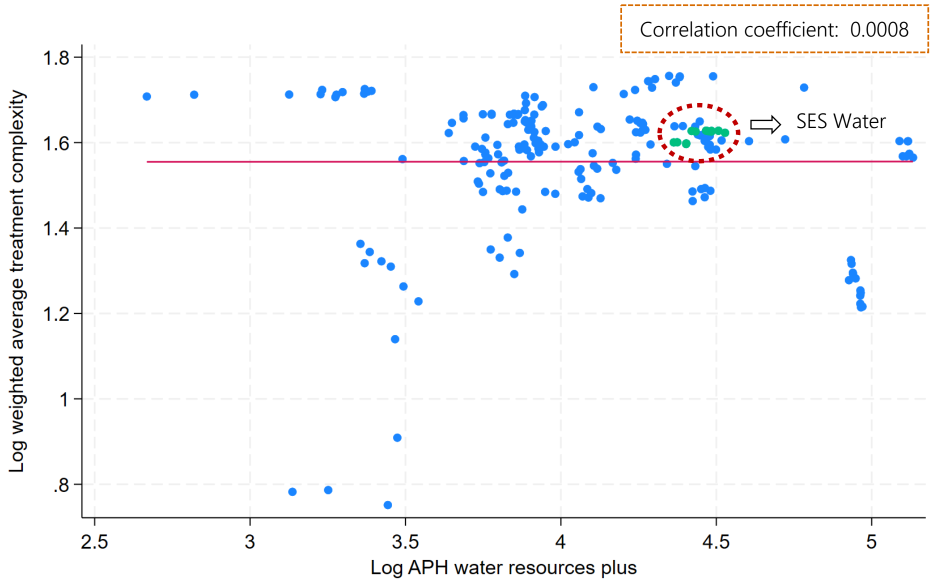
There is no evidence to suggest the estimated relationships between WRP costs and treatment are distorted from the inclusion of APH in the model. Estimated relationships between an explanatory variable and a dependent variable can become imprecise where explanatory variables are highly correlated with each other (i.e. an econometric problem known as multicollinearity), but this problem does not apply in this case:

- Figure 3.8 shows the relationship between APH for WRP and weighted average treatment complexity. The correlation coefficient between the two variables is almost zero (0.0008).
- Figure 3.9 shows the relationship between APH for WRP and the percentage of water treated at complexity levels 3 to 6. The correlation coefficient between the two variables is 0.0166.
- Ofwat tests for the presence of multicollinearity by using the Variance Inflation Factor (VIF), that measures how much of the variance of the different drivers in the model are "inflated" by the existence of correlation among them. Ofwat argues that "[a]s a rule of thumb, a VIF >4 indicates medium risk and VIF >10 indicates harmful collinearity.[26] We test for the presence of multicollinearity when we add APH WRP to Ofwat's regressions (see Table 3.1 for the resulting coefficients). As shown in Table 3.2 below, in all WRP models the VIF for both APH and water treatment complexity drivers is well below Ofwat's rule of thumb, suggesting no presence of multicollinearity.

Therefore, it is reasonable to believe that the APH WRP variable is capturing a different effect on costs from the one controlled for by the water complexity variables in the WRP regressions. Therefore, there is no reason to think the change in the statistical significance of the water complexity variables due to the inclusion of APH in the models is anomalous, as Ofwat suggests.

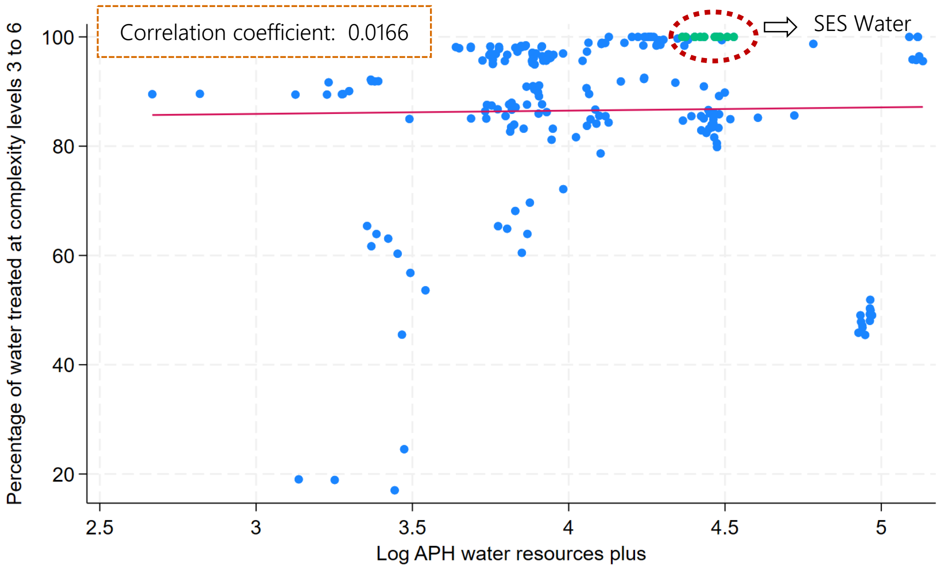
[26] Ofwat (July 2024), PR24 Draft Determinations: Expenditure Allowances - Base Cost Modelling Decision Appendix, p. 74.

**Figure 3.8: Relationship between Water Companies' Weighted Average Treatment Complexity and APH WRP, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

**Figure 3.9: Relationship between Water Companies' Percentage of Water Treated at Complexity Levels 3 to 6 and APH WRP, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

**Table 3.2: Testing for Multicollinearity - Variance Inflation Factor (VIF)**

| **Model Index** | | | **WRP** | | | |
|---|---|---|---|---|---|---|
| **Explanatory Variable** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Water treated at complexity levels 3 to 6 (%) | 1.06 | | 1.07 | | 1.06 | |
| Weighted average treatment complexity (log) | | 1.14 | | 1.17 | | 1.13 |
| **APH WRP (log)** | **1.90** | **1.96** | **1.79** | **1.84** | **1.94** | **2.01** |

*Source: NERA analysis of Ofwat data.*

## 3.5. The Absence of an Explanatory Variable to Control for Pumping Costs Necessitates a Cost Adjustment for SES Water

Since Ofwat's WRP models do not include APH WRP (or alternative drivers that capture variation in companies' power costs) as an explanatory variable, our analysis shows that these models fail to control for an important variable that explains companies' costs.

This omission will tend to disadvantage companies with higher power expenditure in Ofwat's comparative benchmarking modelling. Given SES Water's relatively high power costs in WRP (see Section 3.2.1), the effect of omitting the APH variable in the WRP models would be more material to SES Water than the average water company, requiring a cost adjustment for power costs if the models remain unchanged in the Final Determination to avoid a material understatement in SES Water's efficient costs.

Ofwat acknowledged this issue with its WRP model at PR19, when it used regression models including drivers as properties, water treatment complexity and population density, but not APH.[27] When evaluating its PR19 models, Ofwat recognised that its models did "not capture the need for pumping related to WR where SES Water's high energy costs originate", which led it to accept SES Water's cost adjustment claim.[28]

This issue remains at PR24, since Ofwat's WRP models still do not have a variable to capture the power posts associated with the need for pumping. Ofwat's PR24 Draft Determination recognises SES Water has high power costs relative to the industry, stating "SES Water abstracts a relatively high proportion of water from groundwater sources (2nd highest % of distribution input from boreholes), which may lead to relatively high pumping costs to get the water from the boreholes to the network".[29]

However, Ofwat does not control for this material driver of SES Water's costs, either using a regression driver or by allowing a cost adjustment claim in the Draft Determination. In addition,

27 Ofwat (December 2019), PR 19 Final Determinations Securing Cost Efficiency Technical Appendix, Table A2.1 Econometric models for wholesale water activities.

28 Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

29 Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC1".

while Portsmouth Water has the highest percentage of DI from boreholes, it has a different network topography from SES Water as it does not require significant pumping costs (see footnote 15 for further details). Therefore, Portsmouth Water is less affected by the omission of the driver for pumping costs than SES Water.

## 3.6. Any Trade-off between Reservoir Capital Maintenance and Energy Costs is Immaterial

Ofwat suggested that SES Water benefits from lower capital maintenance costs as it has fewer reservoirs than an average company, which offsets its high pumping costs.

### 3.6.1. Ofwat's analysis shows companies' share of water from reservoirs is not an important driver of companies' botex

Ofwat's argument is largely based on assertion rather than evidence. Ofwat has provided no quantitative evidence to demonstrate the materiality of reservoir capital maintenance costs, and how these compare to the energy and capital maintenance costs associated with pumping from deep boreholes.

In fact, Ofwat seems to have assessed these reservoir capital maintenance costs to be immaterial. Ofwat considered some form of explanatory variable in its WRP models to capture companies' share of reservoirs, but it decided not to include them in the WRP models, since "the estimated coefficients on the reservoir variables were positive and small in magnitude, but were not statistically different from zero".[30]

Hence, in contrast to Ofwat's assessment of SES Water's claim regarding power costs, Ofwat has found that explanatory variables related to reservoirs have no statistically significant impact on costs, whereas its own analysis shows the APH WRP is a statistically significant driver of WRP costs.[31] Based on discussions with SES Water, we understand that Ofwat's finding that reservoirs have no statistically significant impact on costs is intuitive. Indeed, reservoirs often have long asset lives (up to 100 years) and, aside from annual inspections, require little or no capital maintenance on a yearly or even five-yearly basis.

### 3.6.2. Our econometric analysis shows there is no cost saving from having a lower share of DI from impounding reservoirs

We perform our own econometric analysis to assess whether companies with more reservoirs incur higher costs. We describe below our approach:

- We run regressions in which companies' WR base costs is the dependent variable, since Ofwat is concerned about the trade-offs between reservoirs' maintenance costs and the pumping costs from abstracting water from boreholes; and

30 Ofwat (July 2024), PR24 Draft Determinations: Expenditure Allowances - Base Cost Modelling Decision Appendix, p. 26.

31 Ofwat (July 2024), PR24 Draft Determinations: Expenditure Allowances - Base Cost Modelling Decision Appendix, p. 23.

- We add a number of drivers to the set of variables Ofwat includes in its own WRP models:
  - The number of APH WR;
  - The proportion of DI derived from impounding reservoirs;
  - The proportion of DI derived from pumped storage reservoirs;
  - The proportion of DI derived from boreholes; and
  - The proportion of DI derived from other means except river abstractions (i.e. artificial recharge water supply schemes, and aquifer storage and recover water supply schemes).[32]

We distinguish between the proportion of DI taken from pumped storage reservoirs and that from impounding reservoirs, as pumped storage reservoirs require companies to incur significant pumping costs, and therefore higher power costs.[33] Hence, it would not be logical to expect a trade-off between reservoir maintenance costs for this water source and energy costs for pumping.

Table 3.3 below shows the regression results. Across all models, we find that:

- The coefficients on APH WR (in log terms) are statistically significant and positive, suggesting that companies with higher pumping requirements in WR do tend to incur higher costs. The models predict that, on average, a 1 per cent increase in a company's APH WR will be associated with a 0.11 to 0.14 per cent increase in its base WR costs;
- The coefficients on the proportion of DI derived from impounding reservoirs are not statistically significant, suggesting that a company moving 1 per cent of its water supply from river abstraction (i.e. the reference group) to impounding reservoirs does not increase its WR costs; and
- The coefficients on the proportion of DI derived from boreholes are also statistically insignificant, suggesting that a company moving 1 per cent of its water supply from river abstraction to boreholes does not increase its WR costs, beyond the impact on power costs that would be controlled for through the APH variable in the regression.

[32] Note, because for each company the sum of the proportion of DI derived from the different sources is equal to 1, we do not include in the regression the proportion of DI derived from river abstractions in the model to avoid a perfect linear relationship between the variables (i.e. perfect multicollinearity problem). In this case, the proportion of DI derived from river abstractions represents the reference group.

[33] SES Water (2023), PR24 Business Plan Resubmission Appendix SES027 Cost Adjustment Claim: Pumping Costs, para. 14.

**Table 3.3: Regression of Companies' WR Costs on Sources of Water Supply and APH WR, NERA Modification Based on Ofwat's WRP Models**

| Model Index | WR | | | | | |
|---|---|---|---|---|---|---|
| **Explanatory Variable** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Connected Properties (log) | 1.055*** | 1.035*** | 1.041*** | 1.027*** | 1.046*** | 1.031*** |
| Water treated at complexity levels 3 to 6 (%) | 0.007** | | 0.006* | | 0.007** | |
| Weighted average treatment complexity (log) | | 0.593 | | 0.589 | | 0.597* |
| LAD from MSOA - Weighted average density (log) | -1.665 | -1.537 | | | | |
| LAD from MSOA - weighted average density (log) - squared | 0.114 | 0.105 | | | | |
| MSOA - weighted average density (log) | | | -4.808 | -4.705 | | |
| MSOA - weighted average density (log) - squared | | | 0.301 | 0.294 | | |
| Properties per length (log) | | | | | -14.136*** | -13.785*** |
| Properties per length (log) - squared | | | | | 1.625*** | 1.583*** |
| **Proportion of DI from impounding reservoirs** | 0.323 | 0.333 | 0.355 | 0.377 | 0.395 | 0.403 |
| **Proportion of DI from pumped storage reservoirs** | 0.175 | 0.1 | 0.162 | 0.087 | 0.258 | 0.17 |
| **Proportion of DI from boreholes** | 0.138 | 0.028 | 0.175 | 0.085 | 0.166 | 0.062 |
| **Proportion of DI from other means, except river abstractions** | -8.561*** | -8.270** | -9.034*** | -8.742*** | -8.216*** | -7.692*** |
| **APH WR (log)** | 0.111* | 0.127** | 0.113* | 0.129** | 0.128** | 0.144** |
| Constant | -7.065 | -7.584 | 6.27 | 5.725 | 17.636* | 16.749* |
| R^2 | 0.913 | 0.914 | 0.911 | 0.912 | 0.923 | 0.923 |

*Note: *10% significance level **5% significance level ***1% significance level.*

*Source: NERA analysis of Ofwat data.*

We also perform statistical testing to assess whether the coefficients on the proportion of DI derived from impounding reservoirs and the coefficients on proportion of DI derived from boreholes are statistically different from each other. As shown in Table 3.4 below, we cannot reject the null hypothesis that the coefficients on the two variables are equal across the models. Thus, the statistical evidence suggests that, after controlling for differences in companies' pumping requirements, companies deriving more DI from impounding reservoirs do not incur higher costs than companies deriving more DI from boreholes.

**Table 3.4: Statistical Test against the Null Hypothesis that Coefficients of the Proportion of DI Derived from Impounding Reservoirs and those of the Proportion of DI Derived from Boreholes are Equal**

| | | | | WR | | |
|---|---|---|---|---|---|---|
| Null hypothesis: the coefficient on the proportion of DI derived from impounding reservoirs is not statistically different from the coefficient of the proportion of DI derived from boreholes | | | | | | |
| **Model Index** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Chi-squared | 0.39 | 1.11 | 0.38 | 1.1 | 0.79 | 1.88 |
| P-value | 0.53 | 0.29 | 0.54 | 0.29 | 0.37 | 0.17 |
| Statistical test result | Fail to reject the null hypothesis | Fail to reject the null hypothesis | Fail to reject the null hypothesis | Fail to reject the null hypothesis | Fail to reject the null hypothesis | Fail to reject the null hypothesis |

*Note: *10% significance level **5% significance level ***1% significance level.*
*Source: NERA analysis of Ofwat data.*

Therefore, Ofwat's assertion that SES Water benefits from cost savings by having fewer reservoirs is not supported by the data. Our regression analysis finds no evidence that having a higher share of DI from reservoirs changes companies' costs. On the other hand, the positive and significant coefficients on APH WR suggest higher pumping activities do increase companies' WR base costs.

## 3.7. Conclusion

In this section, we assess whether Ofwat's cost assessment for WRP remunerates SES Water's efficient energy costs. Our analysis shows that SES Water has relatively high power costs in WRP and in WR on a per unit of DI basis vs. the industry average.

Statistical evidence suggests that the APH variable drives companies' power costs. We find that there is a positive correlation between APH variables and companies power costs in WR and WRP. The APH WRP also has statistically significant coefficients when we include it in Ofwat's WRP models. These findings support SES Water's claim that the higher pumping requirement it faces due to its network topography and nature of its water resources lead it to have relatively high power costs.

Ofwat also finds the APH WRP to be a statistically significant driver in its WRP models but, while recognising the importance of this variable in explaining companies' pumping requirements, has decided to exclude it:

- Ofwat argues that APH WR is not a material driver of companies' WRP costs, since it is not statistically significant in the WRP models. However, Ofwat's evaluation uses inconsistent data as it tries to explain variation in companies' total WRP power costs with a driver that can only capture pumping requirements (i.e. APH WR) for a subset of the value chain;

- While Ofwat does find the coefficient on APH WRP to be statistically significant in its WRP models, it asserts that this is the result of a spurious relationship as it is driven by APH water treatment, which in turn is weakly correlated with power costs. However, SES Water has shown a clear engineering rationale that APH is an important driver of power costs, which suggests that this is not a spurious relationship, as Ofwat suggests. Also, contrary to Ofwat's assertion, our analysis shows a positive relationship between APH and companies' power costs in water treatment; and
- Ofwat claims that APH WRP captures differences in water treatment complexity rather than differences in pumping requirements, as the inclusion of it reduces the statistical significance of treatment complexity variables. However, our analysis suggests that the APH WRP is not correlated with the two measures of water treatment complexity that Ofwat uses. Therefore, there is no reason to believe that the change in the statistical significance of the water complexity variables is due to the inclusion of the APH WRP.

Therefore, for Ofwat's cost assessment to control for companies' efficient pumping requirements, either an adjustment to the WRP models would be required, or additional allowances through company-specific adjustments.

We also show that SES Water does not have lower capital maintenance costs due to having fewer reservoirs than an average company that offsets its high pumping costs. Both Ofwat's own assessment and our econometric analysis shows there is no cost saving from having fewer reservoirs, or lower share of DI from impounding reservoirs.

# 4. SES Water's Efficient Costs Are Underestimated in Half of the TWD and WW Models

## 4.1. SES Water's Initial Claim and Ofwat's Response

In its request for an ex-post modelling adjustment to reflect its relatively high electricity consumption, SES Water also argues that the costs associated with higher pumping requirements are only partially accounted for in Ofwat's proposed TWD and WW models. SES Water explains that pumping costs are driven by APH which is not included in half of Ofwat's models that use the number of booster pumping stations to control for pumping costs, and thus fail to reflect its high energy costs.

Ofwat's Draft Determination rejects SES Water's claim, claiming the company has not demonstrated its unique circumstances. While the company ranks 16th out of 17 companies in boosters per length of mains, it argues there are six other companies with higher APH in TWD.

In addition, Ofwat's argues that "APH treated water distribution is included in half of the treated water distribution and wholesale water models" and it does "not consider appropriate to remove the models containing booster pumping stations per network length from the modelling suite". While it recognises the engineering rationale behind APH, Ofwat has "some concerns with data quality, with estimated data still being used in some cases". Therefore, it has considered that "triangulating between models that use APH treated water distribution and booster pumping stations per network length is a pragmatic step forward and reflects the trade-offs of both measures".[34]

## 4.2. Ofwat Controls for Pumping Costs Using Boosters per Length of Main in Half of its TWD and WW Models

In its Draft Determination, Ofwat considered two alternative measures to capture companies' network topography for both TWD and WW models: (1) booster pumping stations per length of mains, and (2) APH TWD.[35]

Ofwat argues there are merits and drawbacks associated with each measure. Explaining its introduction of the APH into the PR24 models, Ofwat notes that "APH has a better engineering rationale as it is a more direct measure of pumping requirements [than boosters per length of main] But APH data quality remains lower than booster pumping stations despite improvements made since PR19" as not all APH data is measured but part of it is estimated by companies.[36]

The number of booster pumping stations per length of mains is the measure Ofwat used previously at PR19. Ofwat considers that "Booster pumping stations has better data quality than

34 Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC2".

35 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 20.

36 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 21.

APH […] But it has weaker engineering rationale than APH as it only counts the number of boosters" and it "is used as an imperfect proxy for pumping requirements".[37]

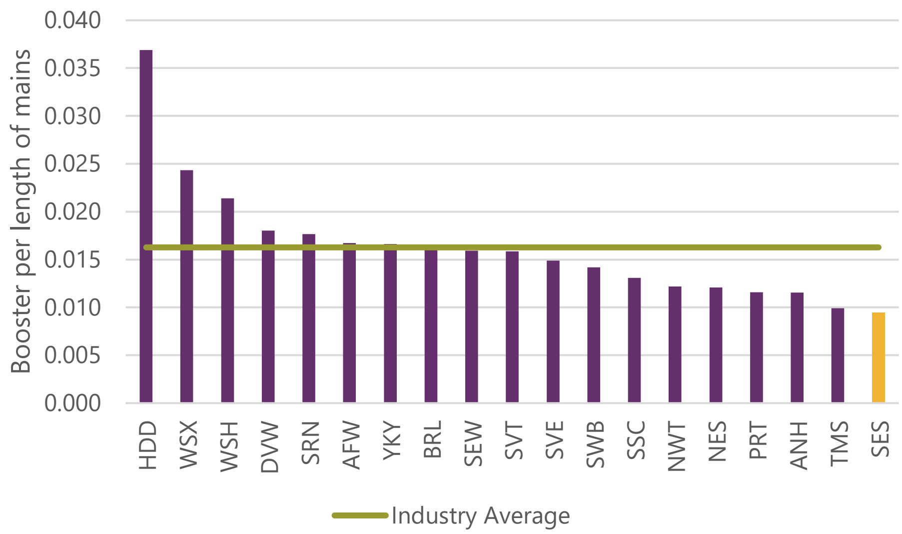
Based on these considerations, Ofwat includes each measure in a subset of its proposed TWD and WW models, and triagulates the modelling results from the respective models to form a view on companies' efficient WW base costs, placing a 50 per cent weight on models using each measure to control for pumping costs.

## 4.3. SES Water's High Energy Costs Per Booster

In response to Ofwat's concern that SES Water has "not fully demonstrated its unique characteristics", we show in Section 2 that SES Water ranks 2nd in terms of power expenditure per DI, and ranks 1st / 2nd in energy consumption depending on the measures (i.e. per property or unit of DI).

If the boosters per length of main is a proxy that reasonably captures SES Water's required energy for pumping, then we would expect SES Water to have relatively high boosters per length of main as well. However, despite having relatively high power costs in WW, SES Water appears to have fewer booster pumping stations per length of main than any other company, as shown in Figure 4.1. The industry's average number of booster per length of main is 71 per cent larger than SES Water's, while Hafren Dyfrdwy has 289 per cent more booster pumping stations per length of mains. Therefore, SES Water does not rank 16th out of 17 companies in boosters per length of mains as suggested by Ofwat, but it ranks last by this metric.[38]

**Figure 4.1: Companies' Number of Boosters per Length of Main, Average between 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

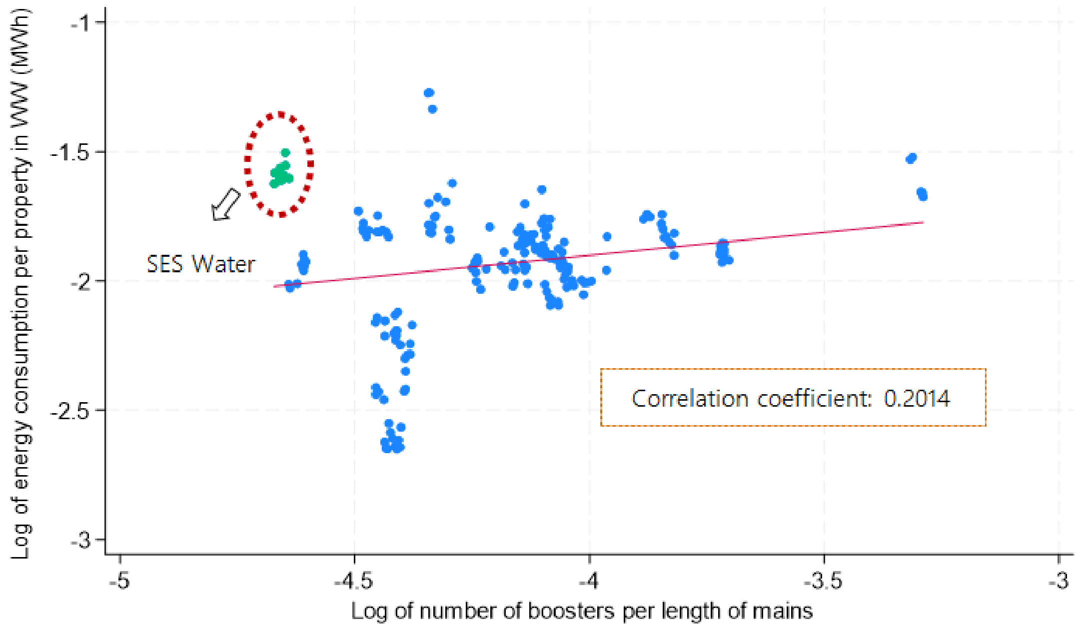
37 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 21-22.

38 Ofwat (July 2024), PR24 Draft Determinations Base Cost Adjustment Claim Feeder Model – SES Water, tab "SES_CAC2".

The number of boosters in the distribution network cannot control for the fact that SES Water requires a significant amount of pumping to extract water from deep aquifers and pump it through its network. Even in the distribution network, the number of boosters is also a poor guide to companies' electricity costs, because boosters will vary in size (one large booster could substitute for several smaller ones), and their utilisation may also vary, which are likely to differ between companies, for instance, due to historical differences in network configuration.

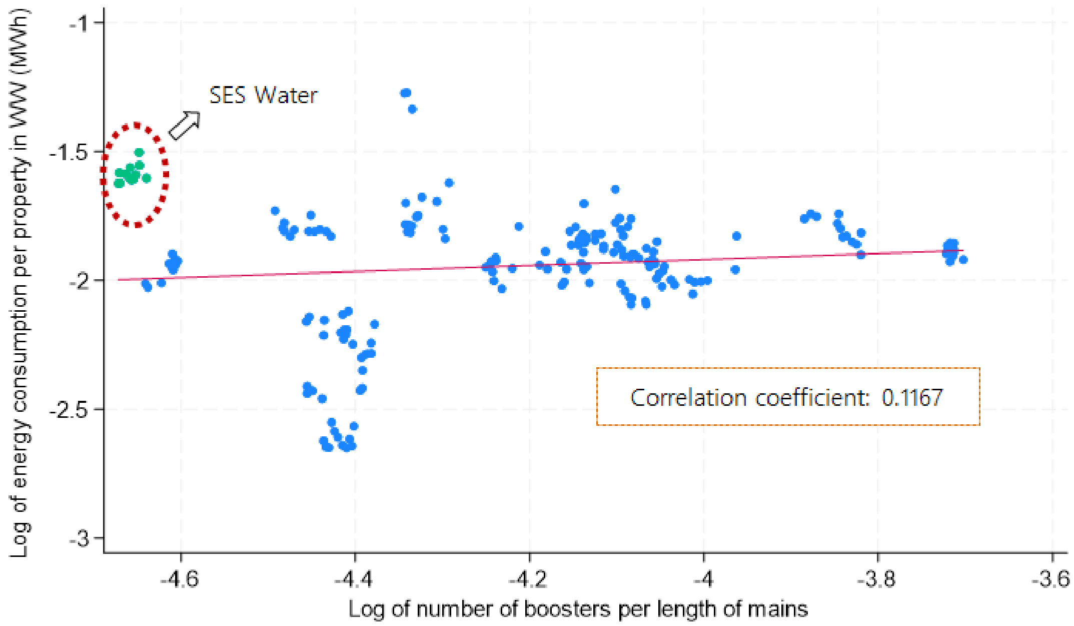
As Figure 4.2 shows, the statistical relationship between WW power consumption per property and the number of boosters per length of main is extremely weak (correlation coefficient equal to 0.2). This weak positive relationship is driven by Hafren Dyfrdwy and its high energy consumption (see Figure 2.2 above) and number of boosters per length of main (127 per cent more than the industry average as shown in Figure 4.1). Once Hafren Dyfrdwy is removed from the sample (i.e. on the basis that it is an outlier), the correlation between WW power consumption per property and the number of boosters per length of main becomes even weaker and the line of best fit becomes flat (see Figure 4.3). Thus, based on this simple correlation analysis, boosters per main appears to be a poor proxy for electricity consumption in WW.

**Figure 4.2: Relationship between Power Consumption and Number of Boosters in WW, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

**Figure 4.3: Relationship between Power Consumption and Number of Boosters in WW, HDD Excluded from Sample 2011/12 – 2022/23**

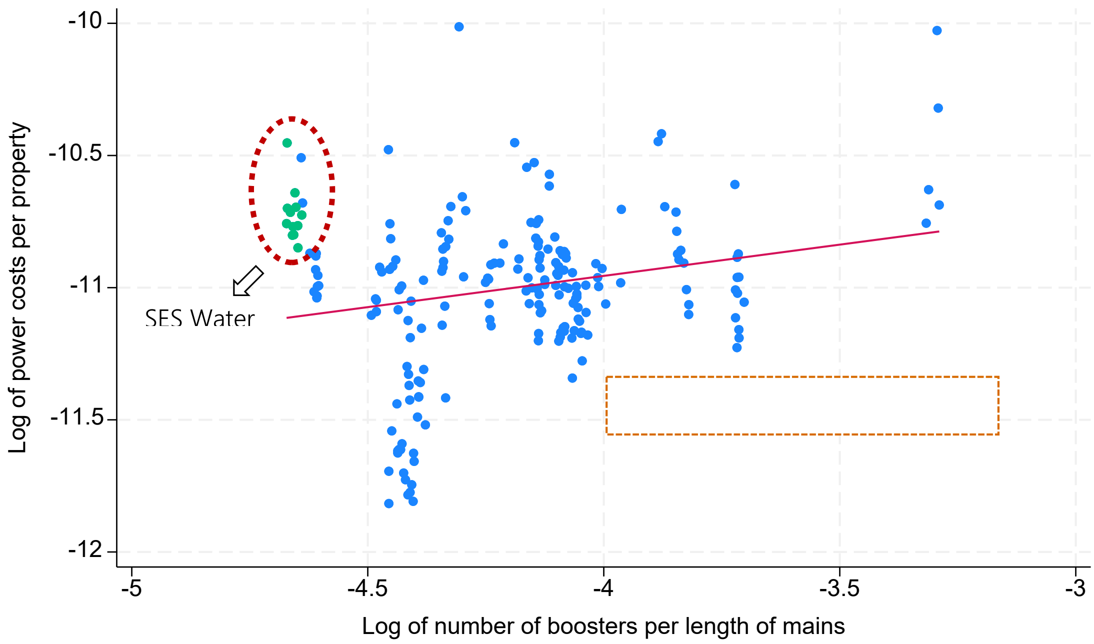



*Source: NERA analysis of Ofwat data.*

We also see that SES Water has higher power costs than most companies with a higher number of boosters per length of main, as shown in Figure 4.4. While it has the highest power consumption per property (as we discuss in Section 2.1), it has the lowest number of boosters per length of mains. Hence, Ofwat's use of what it refers to as "an imperfect proxy for pumping requirements" disadvantages SES Water in particular, given its low number of boosters and high pumping costs.[39]

Figure 4.4 also shows that there is a weak positive relationship between power costs per property and the number of boosters and, as in the case of the relationship between power consumption and the number of boosters, this is driven by Hafren Dyfrdwy. Once Hafren Dyfrdwy is removed from the sample the line of best fit becomes flat with a correlation coefficient equal to 0.1067.

**Figure 4.4: Relationship between Power Costs per Property and Number of Boosters in WW, 2011/12 – 2022/23**

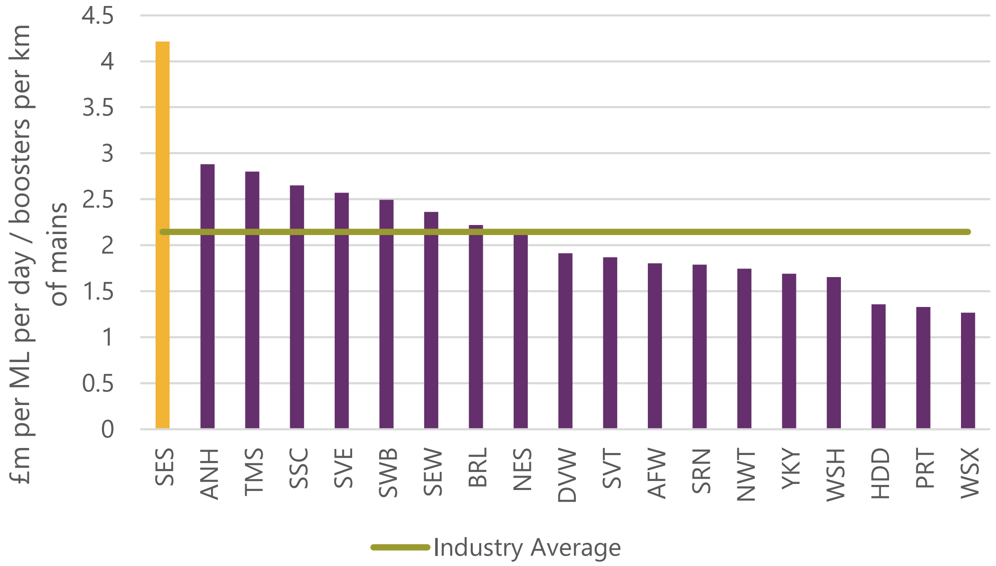



*Source: NERA analysis of Ofwat data.*

Finally, we also show that SES Water has the highest power costs (i.e. per ML of DI), as a ratio to the number of booster pumping stations per length of mains. This ratio, which captures the impact from the use of the less meaningful proxy of power costs, is around twice the industry average, and 50 per cent larger than Anglian Water, the second highest company (see Figure 4.5). We find a similar result in TWD, as Figure 4.6 shows, albeit SES Water ranks only 2nd by this metric.

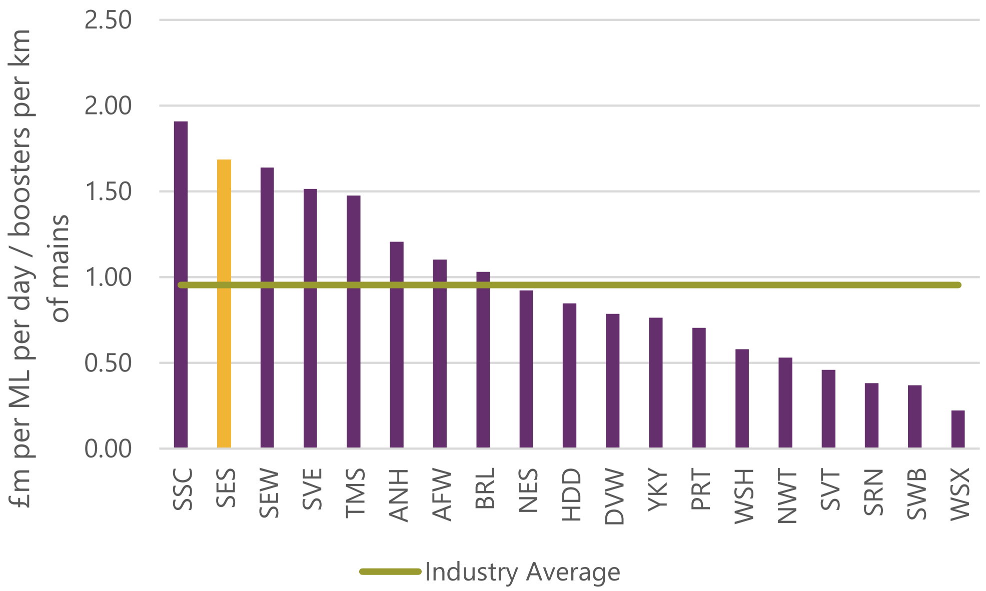
[39] Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 22.

**Figure 4.5: DI Normalised WW Power Costs per Booster per Length of Main, Average between 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

**Figure 4.6: DI Normalised TWD Power Costs per Booster per Length of Main, Average between 2011/12 – 2022/23**

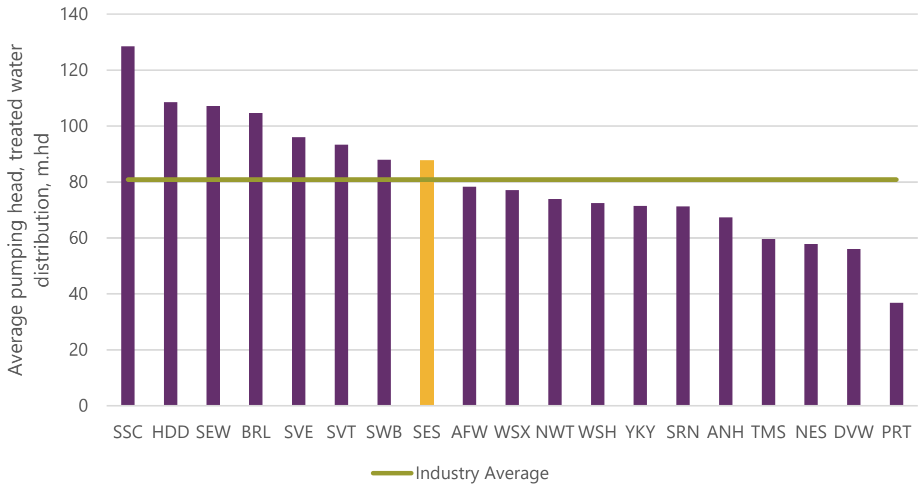



*Source: NERA analysis of Ofwat data.*

## 4.4. SES Water's Low Number of Boosters Relative to its APH

While Ofwat notes that SES Water is not an outlier in APH for TWD, the company's APH is still 8 per cent higher than the industry average, as shown in Figure 4.7 below.

**Figure 4.7: Companies' APH in TWD, Average between 2011/12 – 2022/23**



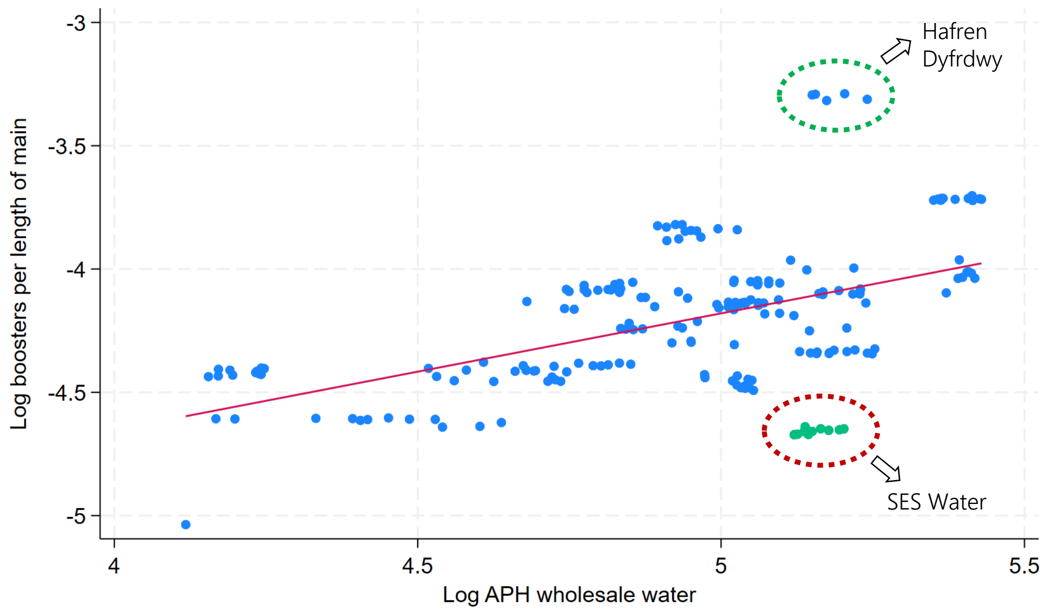

*Source: NERA analysis of Ofwat data.*

However, the extent to which SES Water is disadvantaged by Ofwat's use of boosters per length of main does not depend on SES Water's ranking in APH relative to the industry. The extent of the disadvantage to SES Water depends on its ratio of booster pumping stations per length of mains to APH, relative to other companies in the industry.

In general, there is a positive relationship between water companies' booster pumping stations per length of mains and APH WW, which may justify Ofwat's use of boosters per length of main as a proxy for the industry as a whole (see Figure 4.8). Hence, for most companies, using the boosters per length of main variable to approximate power costs has little impact, as compared to using the more relevant APH variable.

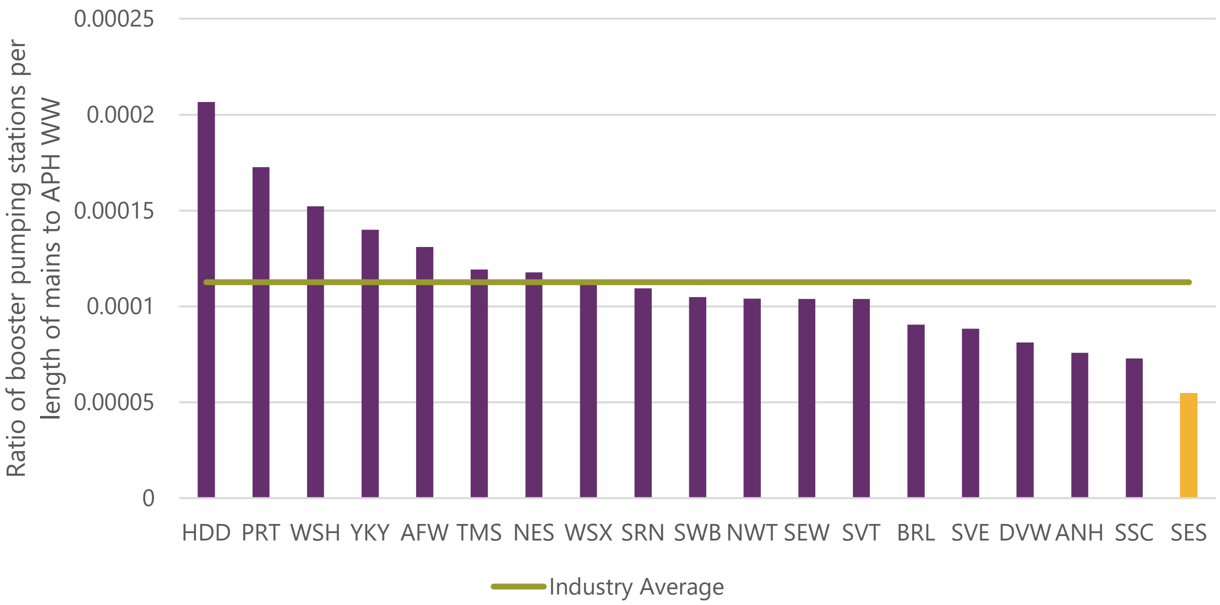
However, SES Water appears to be an outlier, in that it has fewer booster pumping stations per length of mains, *relative to its APH* for WW. On the other hand, Hafren Dyfrdwy also appears to be an outlier with a high number of booster pumping stations per length of mains (the highest in the industry) and high APH for WW. It therefore receives a considerable advantage from Ofwat's approach of using boosters per length of main to approximate pumping costs. SES Water's low number of booster pumping stations per length of main relative to APH is even more evident from Figure 4.9 below. SES Water has the lowest ratio of booster pumping stations per length of mains to its APH WW in the industry, 51 per cent lower than the industry average.

**Figure 4.8: Relationship Between Companies' Booster Pumping Stations per Length of Mains and APH WW, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

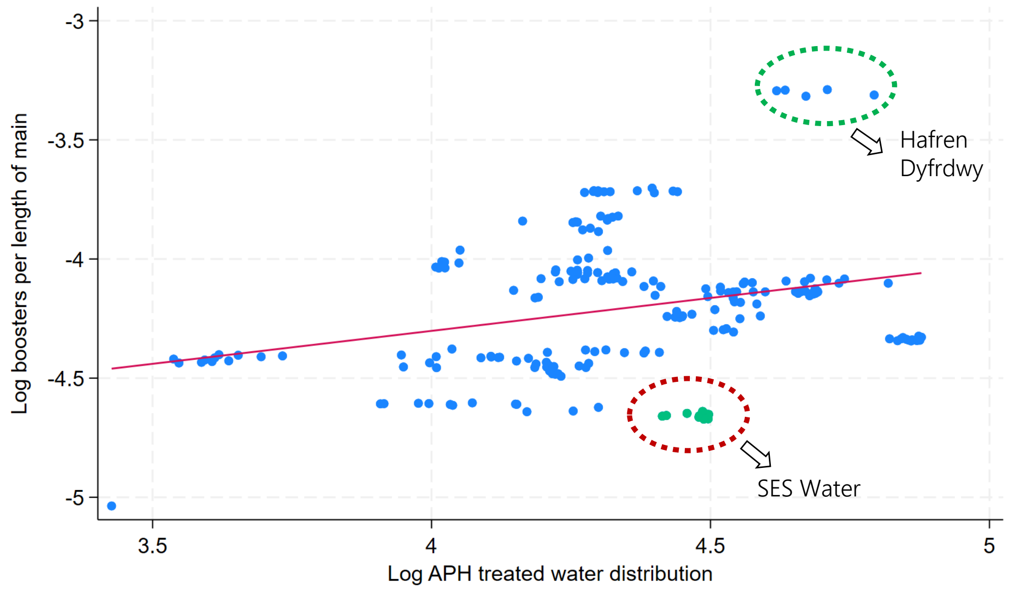
**Figure 4.9: Companies' Ratio of the Number of Booster Pumping Stations Per Length of Main to APH WW, Average between 2011/12 and 2022/23**




*Source: NERA analysis of Ofwat data.*

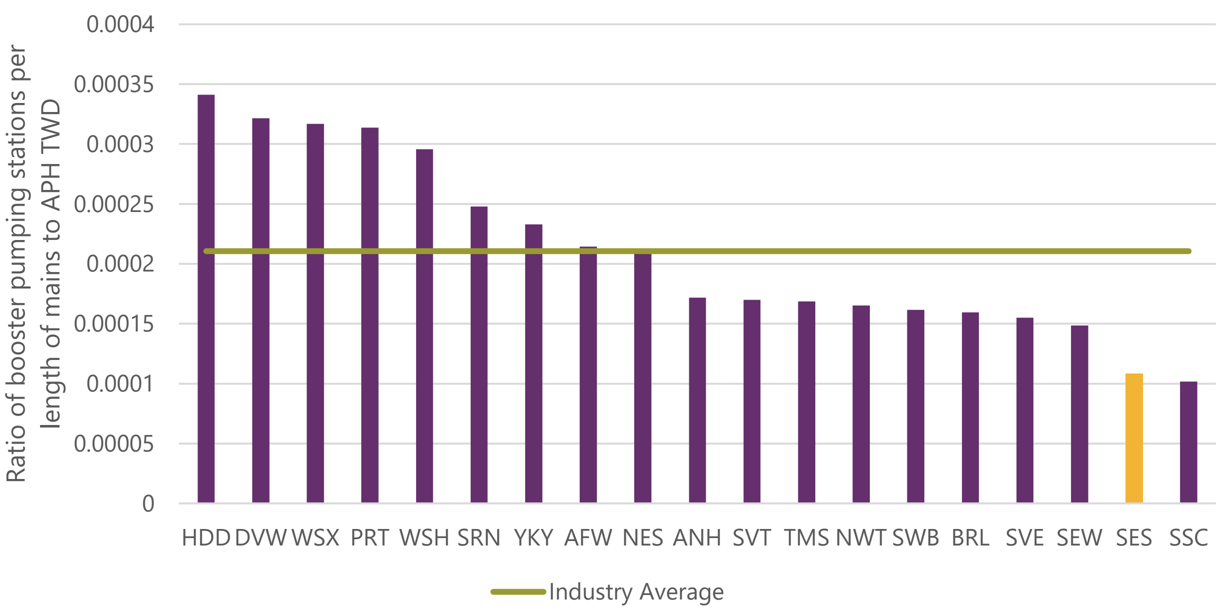
Because Ofwat includes APH TWD only in its models, instead of APH WW, we also show in Figure 4.10 the relationship between water companies' booster pumping stations per length of mains and their APH for TWD. While companies with more APH TWD tend to have more booster pumping stations per length of mains, SES Water is an outlier as it has lower booster pumping stations per length of mains than the average. Similarly, Hafren Dyfrdwy has the highest number of boosters per length of mains associated with high APH. Figure 4.11 below compares companies' ratio of booster pumping stations per length of mains to their APH TWD. SES Water has the second lowest ratio, and is 49 per cent below the industry average.

**Figure 4.10: Relationship Between Companies' Booster Pumping Stations per Length of Mains and APH TWD, 2011/12 – 2022/23**




*Source: NERA analysis of Ofwat data.*

**Figure 4.11: Companies' Ratio of the Number of Booster Pumping Stations Per Length of Main to APH TWD, Average between 2011/12 and 2022/23**




*Source: NERA analysis of Ofwat data.*

The figures show that, while Ofwat uses both boosters per length of main and APH as alternative measures to control for companies' pumping requirements, the two measures do not work equally well in picking up the network characteristics of SES Water and Hafren Dyfrdwy.

At PR19, Ofwat argued that "[w]hile having higher than upper quartile APH, the company has the lowest number of booster pumping stations per lengths of main, which is the variable used in our treated water distribution and wholesale water econometric models to account for energy costs", when explaining its reasons for accepting SES Water's cost adjustment claim.[40]

## 4.5. Regression Analysis on the Link between the Boosters Variable and Power Costs

We have also performed regression analysis to compare the ability of the number of boosters per length of main and APH to explain variations in companies' wholesale power costs, as shown in Table 4.1 below. We regressed WW power costs on connected properties to control for scale, as well as different combinations of boosters per length of main, APH in WW, and APH in TWD:

- The coefficient of boosters per length of main is both *negative* and not statistically significant across the different model specifications, suggesting that boosters per length of main is a poor proxy for the power costs associated with companies' pumping requirements;
- The coefficients of both APH TWD and APH WW are positive and statistically significant across the different model specifications, suggesting that these variables capture companies' costs associated with pumping requirements; and
- The R-squared term tends to increase when switching from boosters per length to either of the APH drivers, suggesting that APH is able to explain a slightly larger percentage of the variation in companies' power costs. However, the R-squared is high across all model specifications, driven by the scale measure (connected properties) explaining a large share of variation between companies' costs.

Therefore, boosters per length of main appears to be a poor proxy for companies' power costs associated with pumping. As we discuss further in Section 4.6, using boosters per length of main in Ofwat's cost assessment models would therefore tend to penalise those companies with high pumping requirements that have very few boosters per length of mains (i.e. SES Water).

40 Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

**Table 4.1: Regression of Companies' Wholesale Power Costs on APH and Boosters Per Length of Main**

| **Model Index** | **WW Power Costs** | | | | |
|---|---|---|---|---|---|
| **Explanatory Variable** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| Connected Properties (log) | 1.033*** | 1.077*** | 1.061*** | 0.998*** | 0.988*** |
| Booster per length of main (log) | -0.01 | | -0.178 | | -0.093 |
| APH TWD (log) | | | | 0.472*** | 0.496*** |
| APH WW (log) | | 0.643*** | 0.691*** | | |
| Constant | -11.482*** | -15.237*** | -15.998*** | -13.015*** | -13.366*** |
| R squared | 0.902 | 0.927 | 0.925 | 0.931 | 0.929 |

*Note: *10% significance level **5% significance level ***1% significance level.*

*Source: NERA analysis of Ofwat data.*

## 4.6. Ofwat's Approach Understates SES Water's Efficient Costs

Companies' power costs for pumping differ. Because, as demonstrated above, boosters per length of main is not able to capture the different pumping requirements of the companies, efficient pumping costs are not properly controlled for by Ofwat's models that use this driver.

This limitation of the models using boosters per length of main impacts companies' efficiency scores calculated when using Ofwat's TWD and WW models. As shown in 12￼, SES Water's efficiency scores deteriorate when boosters per length of mains is used as a control, as opposed to APH. This is particularly evident for the WW models as SES Water's high power costs are primarily driven by abstraction from deep boreholes rather than distribution.

**Figure 4.12: SES Water's Efficiency Materially Depends on the Choice of Driver Used to Control for Topography**

| | Models with Boosters per Length of Mains | | | Models with APH | | |
|---|---|---|---|---|---|---|
| | TWD1 | TWD2 | TWD3 | TWD4 | TWD5 | TWD6 |
| SES's Efficiency Score - TWD | 1.26 | 1.33 | 1.33 | 1.08 | 1.11 | 1.09 |

| | WW1 | WW2 | WW3 | WW4 | WW5 | WW6 | WW7 | WW8 | WW9 | WW10 | WW11 | WW12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SES's Efficiency Score - WW | 1.43 | 1.46 | 1.45 | 1.48 | 1.36 | 1.39 | 1.24 | 1.25 | 1.21 | 1.21 | 1.17 | 1.19 |

*Source: NERA analysis of Ofwat data.*

In Table 4.2, we report WOCs' and WaSCs' average efficiency scores for the TWD models that rely on the number of boosters per length of mains (TWD1-TWD3) and those that use APH TWD (TWD4-TWD6) and calculate the difference between them. Switching from APH to boosters per length of main has a larger, more detrimental effect on SES Water's efficiency scope than any other company in the industry, followed by South Staffs Water.

By contrast, for example, Portsmouth Water benefits from models that use the number of boosters per length of mains because of its low APH.

The apparent deterioration in SES Water's efficiency under the models with boosters per length of main is misleading. Indeed, SES Water efficiency reduction is driven by the misspecification of these models, which fail to include a driver to control for the variations in companies' energy requirements for pumping.

**Table 4.2: Difference in Efficiency Changes between TWD Models that Use Boosters and APH as Driver**

| | Average Efficiency Score TWD1-3 | Average Efficiency Score TWD4-6 | Percentage Point Difference in Efficiency Score, in absolute terms |
|---|---|---|---|
| ANH | 1.26 | 1.18 | 0.08 |
| HDD | 1.07 | 1.07 | 0.00 |
| NES | 1.00 | 1.07 | 0.06 |
| NWT | 0.92 | 0.91 | 0.01 |
| SRN | 1.01 | 1.14 | 0.12 |
| SVE | 1.06 | 1.02 | 0.03 |
| SWB | 0.86 | 0.78 | 0.08 |
| TMS | 1.04 | 1.00 | 0.04 |
| WSH | 1.11 | 1.21 | 0.10 |
| WSX | 1.14 | 1.21 | 0.07 |
| YKY | 1.19 | 1.29 | 0.10 |
| AFW | 1.18 | 1.25 | 0.07 |
| BRL | 1.26 | 1.23 | 0.03 |
| PRT | 0.78 | 0.93 | 0.15 |
| SES | 1.31 | 1.10 | 0.21 |
| SEW | 1.22 | 1.10 | 0.12 |
| SSC | 1.09 | 0.91 | 0.18 |

*Source: NERA analysis of Ofwat data.*

**Table 4.3: Difference in Efficiency Changes between WW Models that Use Boosters and APH as Driver**

| | Average Efficiency Score WW1-6 | Average Efficiency Score WW7-12 | Percentage Point Difference in Efficiency Score, in absolute terms |
|---|---|---|---|
| ANH | 1.04 | 0.97 | 0.07 |
| HDD | 1.05 | 1.09 | 0.04 |
| NES | 1.06 | 1.13 | 0.07 |
| NWT | 1.02 | 1.00 | 0.02 |
| SRN | 1.38 | 1.55 | 0.18 |
| SVE | 1.03 | 1.01 | 0.03 |
| SWB | 1.05 | 0.97 | 0.08 |
| TMS | 1.09 | 0.99 | 0.10 |
| WSH | 1.07 | 1.19 | 0.12 |
| WSX | 1.30 | 1.36 | 0.06 |
| YKY | 1.09 | 1.20 | 0.10 |
| AFW | 0.94 | 1.00 | 0.06 |
| BRL | 1.10 | 1.11 | 0.01 |
| PRT | 0.79 | 0.90 | 0.11 |
| SES | 1.43 | 1.21 | 0.22 |
| SEW | 1.04 | 0.95 | 0.09 |
| SSC | 0.81 | 0.68 | 0.13 |

*Source: NERA analysis of Ofwat data.*

Further, the negative impact of using the boosters per length of main variable on SES Water also affects the company's modelled costs / allowances. To show this, we test the impact of running the same regressions Ofwat has used in its Draft Determination, but removing the boosters per length of main driver. Thus, those TWD and WW regressions that relied on boosters per length as driver do not have a driver of companies' pumping requirements. After triangulating the models as Ofwat has done in the Draft Determination, SES Water's allowances increase by £8 million (see Table 4.4 below). This suggests that the use of boosters per length of mains, which Ofwat acknowledges is "an imperfect proxy for pumping requirements",[41] does not control for SES Water's topography and therefore materially understates SES Water's efficient costs.

41 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 21-22.

**Table 4.4: Calculation of the Impact of Using Boosters per Length of Main in the Cost Assessment on SES Water's WW Allowances**

| | SES Water's WW Allowances – Ofwat models | SES Water's WW Allowances – NERA modified TWD and WW models | Increase in Allowance |
|---|---|---|---|
| | (A) | (B) | (C) = (B) – (A) |
| £m | 193 | 201 | 8 |

*Note: Allowances before post-modelling adjustments and pre-frontier shift efficiency and real price effects.*
*Source: NERA analysis of Ofwat data.*

## 4.7. Ofwat's Concern Over APH Data Issues Further Exaggerate SES Water's Efficiency Gap

Ofwat suggests that, because of its concerns about APH data quality, it has kept boosters per length of main as the alternative measure for network topography in half of its TWD and WW models despite the weaker engineering rationale for its use as compared to APH.[42]

Ofwat also stated some concerns about the reliability with which companies report data on APH at PR19. At the time, boosters per length was the only control for differences in companies' pumping requirements, and APH was not part of the modelling suite. Despite its concern about data quality, Ofwat's accepted SES Water's cost adjustment claim that relied on analysis that used APH data. For example, Ofwat noted that NERA produced "a report which provides a detailed and replicable benchmarking exercise of the company's energy costs, thereby demonstrating the robustness and efficiency of its cost claim".[43] NERA's econometric analysis was based on the use of APH as a driver rather than boosters per length of mains to explain SES Water's power costs.

In the PR24 Draft Determination, Ofwat concluded that "APH data quality is better than at PR19" and its use is "supported by strong engineering rationale and performs well statistically".[44] As Ofwat accepted SES Water's econometric evidence based on APH data at PR19, it would be consistent with its approach at PR19 to do so in its assessment of SES Water's efficient power costs at PR24, given the quality of the data has improved.

In any event, Ofwat's concerns about data quality, whereby APH is observed imprecisely, are likely to understate the quantified relationship between APH and costs, thereby disadvantaging companies like SES Water that have relatively high APH:

- In econometrics, the challenge associated with the APH data quality problem is referred to as measurement error in the explanatory variable. If the measurement error (i.e. the distance between the measured and the true APH variable) is uncorrelated with the true unobserved

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42 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 21.

43 Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

44 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 21.

explanatory variable, then the estimated OLS coefficient on measured APH variable will be "attenuated".[45]

- This means that, if the true coefficient on APH is positive, the estimated coefficient will underestimate the true effect of APH on costs. Hence, the model will tend to understate the efficient costs of companies with relatively high pumping requirement (e.g. SES Water).
- Hence, if we had used more accurate data on APH data, the coefficients on pumping head would have likely been higher, thus reinforcing SES Water's claim that its relatively high pumping requirement leads to an increase in power costs, in a way that is not controlled for when using Ofwat's models that include boosters per length of main to control for pumping costs.

Therefore, while it may not necessarily be ideal to use APH data as a driver of companies' pumping requirements in all Ofwat's TWD and WW models due to the APH data quality concerns, these data quality issues compound the need to make company-specific adjustments for companies whose high pumping requirements are not properly represented by the boosters per length of main variable.

## 4.8. Conclusion

In this section, we evaluate the ability of Ofwat's cost assessment models to control for companies' pumping costs in TWD and WW. Ofwat includes APH TWD to control for companies' network topography in half of its TWD models and WW models. In the other half of the models, Ofwat uses the number of boosters per length of main as an alternative measure.

While Ofwat states that SES Water is not an outlier in APH TWD, we find that SES Water is indeed an outlier in terms of its boosters per length of main given its APH. Not only SES Water has less boosters per length of mains than any other company in the industry, but its number of booster pumping stations per length of mains to APH ratio is around half the industry average, clearly showing SES Water's unique circumstances. Because the extent to which SES Water is disadvantaged by Ofwat's use of the boosters per length of main driver depends on its ratio of booster pumping stations per length of mains to APH relative to other companies in the industry, Ofwat's use of the number of boosters per length of main in its models disadvantages SES Water in particular.

Regression analysis shows that the number of boosters per length of main is a poor proxy for companies' power costs for WW, since its coefficient is both negative (contrary to intuition) and statistically insignificant. On the other hand, APH TWD / APH WW can explain variation in companies' power costs. Therefore, Ofwat's decision to use boosters per length of main as an alternative control for companies' pumping requirements disadvantages SES Water. This is also recognised by Ofwat when explained its reasons for accepting SES Water's cost adjustment claim at PR19, in which it states,

45 See J. Wooldridge, Introductory Econometrics (2009), Chapter 9.

> "While having higher than upper quartile average pumping head, the company [SES Water] has the lowest number of booster pumping stations per lengths of main, which is the variable used in our TWD and WW econometric models to account for energy costs".[46]

Finally, Ofwat's concerns about data quality, whereby APH is observed imprecisely, are likely to understate the quantified relationship between APH and costs, thereby disadvantaging companies like SES Water that have relatively high APH.

46 Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

# 5. Our Proposed Adjustments

## 5.1. Our Proposal to Adjust for SES Water's High Power Costs

As set out above, modelling adjustment are required to ensure Ofwat's modelling reflects SES Water's relatively high power costs due to its high pumping requirements, and that its cost assessment process accurately remunerates the company's efficient costs. In this section, we propose an approach to making this adjustment.

As a first step, we modify Ofwat's cost assessment models from the PR24 Draft Determination to control for variations in companies' pumping costs.

- For the WRP cost assessment, we propose to include APH WRP in Ofwat's WRP models. We understand that SES Water's high electricity costs arise primarily from its WR pumping requirement. In the absence of a control variable for the pumping requirement in Ofwat's WRP modelling, this factor cannot be controlled for in the cost assessment. Adding APH WRP addresses this problem. As we show in Table 3.1, the APH WRP variable is positive and statistically significant in all Ofwat's WRP models.
- For TWD and WW cost assessment, we revise Ofwat's modelling to only place weight on those models that use APH TWD as measure of companies' pumping requirements, placing no weight on the models that include boosters per length of main.

Second, we calculate what SES Water's cost allowance would have been if Ofwat's benchmarking models had been run following the approach outlined above. To do so, we follow Ofwat's triangulation approach that combines the results from the WRP, TWD and WW models. However, since we exclude models that use boosters per length of main as a measure of companies' pumping requirements, we have set the weights on those TWD and WW models using that driver to zero, thus doubling instead the weights on the models that use APH TWD.

The resulting WW allowance at AMP8 for SES Water is £211.52 million. We calculate SES Water's cost adjustment by taking the difference between WW base cost allowance estimated as described above and Ofwat's estimate from applying the same modelling approach used in the Draft Determinations. As shown in Table 5.1 below, our analysis suggests a cost adjustment allowance of around £17.14 million for SES Water's WW power costs. Using SES Water's ratio of WRP submitted base costs and WW costs, we estimate a cost adjustment for WRP of £8.07 million. Similarly, we calculate a TWD cost adjustment of £9.07 million. Table 5.2 shows the profile of the cost adjustment claim over AMP8.

**Table 5.1: Calculation of SES Water's Cost Adjustment Allowances**

| | SES Water's WW Allowances – Ofwat models | SES Water's WW Allowances – NERA models | Cost Adjustment Allowance |
|---|---|---|---|
| | (A) | (B) | (C) = (B) – (A) |
| £m | 193.38 | 211.52 | 17.14 |

*Note: Allowances before post-modelling adjustments and pre-frontier shift efficiency and real price effects.*
*Source: NERA analysis of Ofwat data.*

**Table 5.2: SES Water's Cost Adjustment Allowances, Annual Profile**

| | 2025-26 | 2026-27 | 2027-28 | 2028-29 | 2029-30 | AMP8 |
|---|---|---|---|---|---|---|
| | £m | £m | £m | £m | £m | £m |
| WRP | 1.58 | 1.59 | 1.61 | 1.63 | 1.65 | **8.07** |
| TWD | 1.77 | 1.79 | 1.81 | 1.84 | 1.86 | **9.07** |
| WW | **3.35** | **3.39** | **3.43** | **3.47** | **3.51** | **17.14** |

*Source: NERA analysis of Ofwat data.*

We also note that using the APH data for this company-specific adjustment does not contradict the decision of the Competition Market Authorities (CMA) at PR19 redeterminations. Ofwat notes that the CMA supported its decision to not include APH in its base cost models due to concerns over the APH data quality.[47] However, the CMA's assessment and its decision at the time are not directly applicable to the SES Water's case here since,

- As stated by the CMA, its decision at PR19 redeterminations "aimed to model overall base costs, not only power costs".[48] Therefore, the CMA's objective is different from the assessment of a cost adjustment claim that *specifically concerns power costs*; and
- Despite the decision to exclude APH in base cost models, the CMA acknowledged that "APH performed reasonably well in explaining power costs".[49] This suggests that APH is a good driver for a company-specific adjustment related to power costs.

In addition, as we discussed above, Ofwat accepted SES Water's cost adjustment claim at PR19 Final Determinations which relied on APH data despite its concerns over the APH data quality.

Therefore, we consider our proposed approach to be consistent with the CMA's findings and precedent from PR19.

## 5.2. Adjusting Other Companies' Allowances

In its PR24 Final Methodology, Ofwat has stated that "the cost adjustment claim process at PR24 will be more symmetrical, to protect customers from the risk of a one-sided process".[50] Therefore, Ofwat requires "a company to indicate in its symmetrical cost adjustment claim submission how an upward adjustment to its modelled cost allowance would impact on cost allowances for other companies".[51]

47 Ofwat (July 2024), PR24 Draft Determinations Expenditure Allowances – Base Cost Modelling Decision Appendix, p. 20.

48 Competition and Markets Authority (March 2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited Price Determinations: Final Report, para. 4.82.

49 Competition and Markets Authority (March 2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited Price Determinations: Final Report, para. 4.82.

50 Ofwat (December 2022), PR24 Final Methodology Appendix 9 Setting Expenditure Allowance, p.32.

51 Ofwat (December 2022), PR24 Final Methodology Appendix 9 Setting Expenditure Allowance, p.32.

As shown in Table 5.3 below, if Ofwat applies the above approach to all companies, it would increase WW allowances for the industry by £311 million. This would in turn lead to a general increase in customers' bills.

Hence, there is no need for any offsetting adjustments to other companies' allowances to prevent the generality of customers' bills from rising as a consequence of SES Water's cost adjustment claim for power. We therefore recommend that the cost adjustment claim be used to adjust SES Water's allowances alone, to control for its particularly high pumping requirements. This approach is consistent with the approach that Ofwat accepted at PR19 to assessing the cost adjustment allowance for SES Water's high electricity consumption.[52]

If Ofwat were minded to make similar adjustments to other companies' allowances, Table 5.3 shows that – while SES Water is affected the most by the omission of APH drivers and the use of boosters per length of mains in Ofwat's models – other companies (e.g. South Staffs Water) may also be negatively impacted by these modelling choices, and may also have high pumping requirements.[53]

On the other hand, our analysis also shows that Ofwat's approach provides a benefit to some companies in particular, which have a relatively low APH but a larger number of boosters per length of mains, e.g. Portsmouth Water. Table 5.3 shows that our proposed approach to quantifying SES Water's cost adjustment claim would lead to a reduction of 12% in Portsmouth Water's allowances, if it were applied more widely.

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52 Sources: (1) NERA (27 August 2019), Treatment of SES Water's Electricity Costs in the Cost Assessment, p. 19; (2) Ofwat (December 2019), PR 19 Cost Adjustment Claim Feeder Model SES Water, tab "WN_electricity usage".

53 For example, we understand that South Staffs and Cambridge Water also requested post-modelling adjustment for its pumping costs as part of its PR24 submissions.

Source: South Staffs and Cambridge Water (9 June 2023), Cost Adjustment Claim for Topography.

**Table 5.3: Impact of Our Proposed Approaches on Companies' WW Allowances**

| | WW Allowances, Ofwat DD | WW Allowances, NERA Model | Change in Allowances | Percentage Change in Allowances |
|---|---|---|---|---|
| | £m | £m | £m | % |
| SES | 193 | 211 | 17 | 9% |
| SSC | 547 | 584 | 36 | 7% |
| ANH | 1757 | 1847 | 90 | 5% |
| SEW | 801 | 836 | 35 | 4% |
| WSX | 512 | 531 | 19 | 4% |
| SVE | 2862 | 2957 | 95 | 3% |
| TMS | 4625 | 4756 | 131 | 3% |
| BRL | 396 | 407 | 11 | 3% |
| SWB | 834 | 855 | 21 | 3% |
| NWT | 2487 | 2516 | 29 | 1% |
| SRN | 824 | 824 | 0 | 0% |
| AFW | 1227 | 1220 | -6 | -1% |
| NES | 1397 | 1365 | -32 | -2% |
| HDD | 132 | 127 | -5 | -3% |
| WSH | 1269 | 1224 | -45 | -4% |
| YKY | 1685 | 1621 | -64 | -4% |
| PRT | 189 | 167 | -22 | -12% |
| **Industry** | **21,736** | **22,046** | **311** | **1%** |

*Source: NERA analysis of Ofwat data.*

# 6. Conclusion

We show in this report that SES Water has high energy consumption and power expenditure in WW, relative to the industry, driven by its higher pumping requirements due to SES Water's network topography and water resource mix.

Ofwat's cost assessment models do not control for these characteristics of SES Water's network and WR:

- Ofwat's WRP models do not control for variation in companies' costs due to different pumping requirements, despite the positive relationship between the APH WRP and power costs in WRP; and
- Half of Ofwat's TWD models and WW models use the boosters per length of main as a measure for companies' network topography, which has very limited ability to capture variations in companies' pumping costs. The use of this variable causes Ofwat's models to understate SES Water's efficient costs, as it has relatively high pumping requirements but few boosters per length of main.

SES Water makes no material saving that offsets its high pumping costs. We have performed econometric analysis to show there is no significant link between WR plus costs and the share of water sourced from impounding reservoirs, showing that Ofwat's hypothesised trade-off between power costs and reservoir capital maintenance costs does not need to be considered when evaluating SES Water's cost adjustment claim for power.

Therefore, given the high pumping costs of SES Water and the omission of a driver that controls for companies' pumping costs in the majority of Ofwat's models, we find that a company-specific cost adjustment allowance is necessary. Ofwat's draft decision to reject SES Water's cost adjustment claim fails to grant SES Water an allowance for its efficient power costs.

To assess the efficient allowances for SES Water's power costs, we have re-estimated Ofwat's models to (1) include the relevant APH driver in the WRP models, and (2) place no weight on the TWD models and WW models using the boosters per length of main driver. These changes increase SES Water's WW base allowance by £17.14 million over AMP8, relative to Ofwat's Draft Determinations (post-modelling adjustments and pre-frontier shift efficiency and real price effects).

Our analysis therefore suggests that an additional cost adjustment allowance of £17.14 million for SES Water's power costs in WW would be needed to account for the unique circumstances facing SES Water.[54]

54 £8.07 million in WRP and £9.07 million in TWD, based on SES Water's ratio of SES Water's submitted base costs in these two areas.

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