A review of cost adjustment claims for PR24

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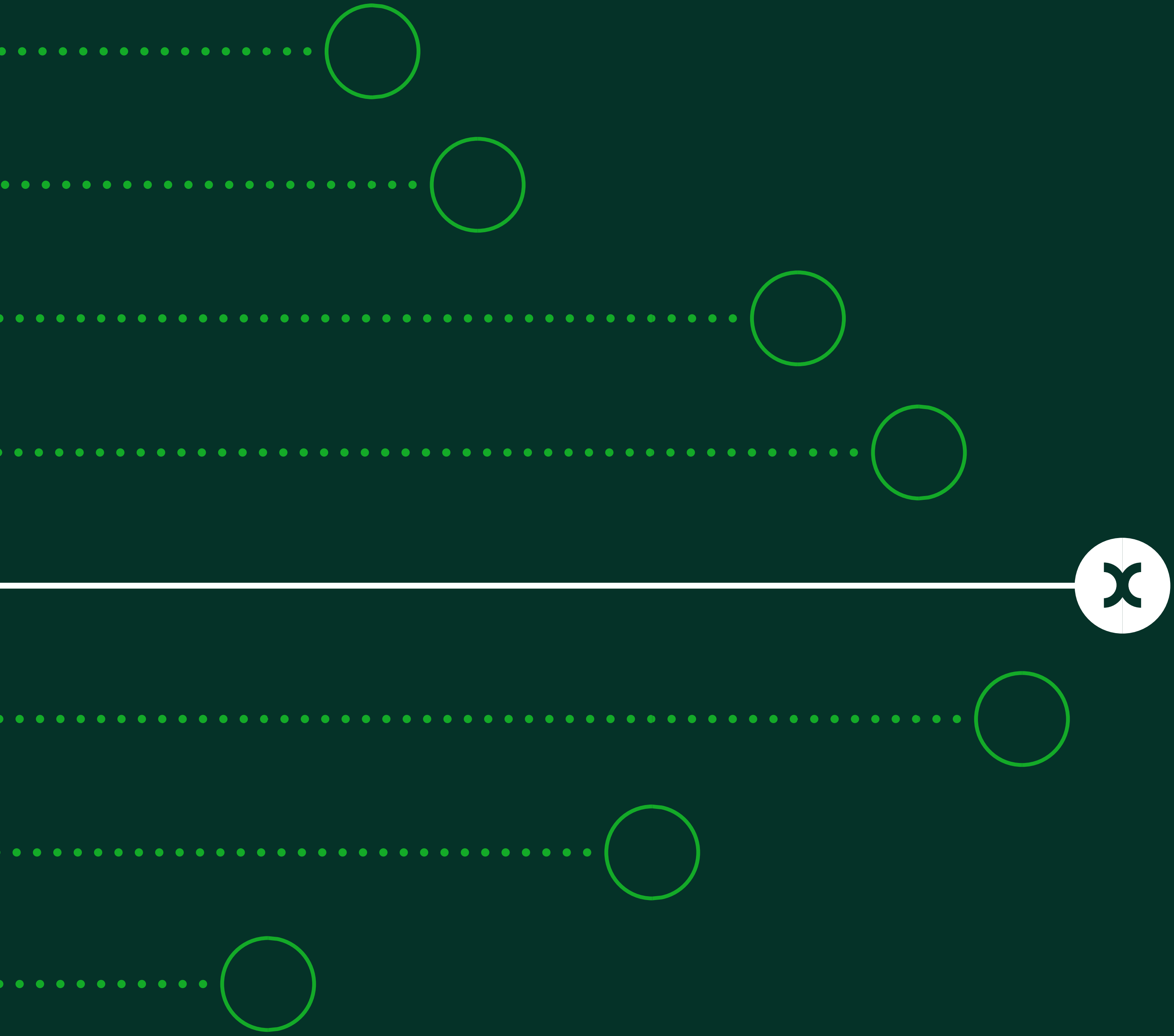
Prepared for South East Water

9 June 2023



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1 Introduction

Ofwat uses econometric modelling of costs as the principal instrument to assess companies' efficient base expenditure requirements.

The wholesale cost models that Ofwat has developed as part of the PR24 base cost modelling consultation seek to account for the heterogeneity across the industry with respect to scale, treatment complexity, pumping requirements and population density.

However, it is well-understood that some drivers (old, recurring and new) of company expenditure may not be sufficiently accounted for in the cost assessment models. In turn, a company could appear to be inefficient (or efficient) on the basis that it suffers (or benefits) from a characteristic that is not properly accounted for.

As such, Ofwat's cost adjustment claim (CAC) process enables it to make post-modelling adjustments to companies' estimated efficient expenditure requirements to reflect well-evidenced characteristics that are omitted or inappropriately reflected in the models.

Ofwat has provided some guidance as to how it will assess CACs at PR24, as well as the type of evidence that companies need to gather in support of their claims. For example, companies are required to demonstrate that the CAC is necessary (i.e. because the models do not adequately account for some characteristic that is driving increased expenditure) and that the proposed adjustment is cost efficient.[1] Ofwat has also stated that companies should use its PR24 consultation models[2] as the basis for their CACs.[3]

South East Water (SEW) has commissioned Oxera to review the evidence relating to three base modelling claims relating to:

- increased meter renewal activity in AMP8;
- inability of the PR24 consultation models to compensate for network reinforcement requirements;
- economies of scale at the water treatment works (WTW) level.

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[1] See Ofwat (2022), 'Creating tomorrow, together: Our final methodology for PR24 Appendix 9 – Setting expenditure allowances', December, p. 29.
[2] See Ofwat (2023), 'Econometric base cost models for PR24', April.
[3] The CAC submission template can be found here: https://www.ofwat.gov.uk/wp-content/uploads/2023/04/Early-cost-adjustment-claim-template-v1.xlsx.

This report presents the initial evidence relating to the CACs above based on the current dataset and PR24 models. Ahead of SEW's business plan submission, the analysis may be expanded upon by (among other things) including additional outturn data as it becomes available and testing modelling assumptions and sensitivity analysis.

We do **not** consider the following aspects as part of this report, as they are reserved for consideration in refining the CACs for SEW's final business plan.

- **Benchmark efficiency challenge.** Ofwat asks that all CACs are estimated on an 'efficient cost' basis. This requires evidence on the appropriate benchmark to apply to Ofwat's cost assessment models. The selection of the benchmark requires a careful assessment of the quality of the models, focusing on uncertainty and biases. In turn, this requires (among other things) an assessment of the ability of the models to predict forward-looking allowances, for which detailed business plan information is required.
- **Ongoing efficiency challenge.** Similar to the above, Ofwat may expect companies to apply an ongoing efficiency challenge to their CACs. This efficiency challenge relates to the expected productivity improvements that the most efficient companies can achieve. As this is the subject of work that is currently underway, we do not apply an ongoing efficiency challenge to the CACs presented in this report.
- **Real price effects (RPEs).** The value of the CACs in this note may need to be adjusted to reflect the impact of (real) input price pressure in AMP8. As with the ongoing efficiency challenge, we understand that SEW is currently reviewing the input price pressure that it will face in AMP8, so we do not apply an RPE adjustment in this report.
- **Materiality.** The CACs that SEW submits are expected to pass Ofwat's materiality threshold, which is based on a fixed percentage of SEW's AMP8 TOTEX in the relevant price control. As SEW's business plan expenditure has not been finalised yet, we assess materiality against the provisional figures.

Table 1.1 below shows the provisional materiality thresholds across the two wholesale water price controls.

Table 1.1 Materiality thresholds

	AMP8 TOTEX (£m)	Materiality (%)	Materiality (£m)
Water resources	330	6%	20
Network plus	1,677	1%	17

Source: Oxera analysis of SEW data.

The remainder of this report is structured as follows.

- Section 2 presents SEW's claim relating to meter renewal activity.
- Section 3 presents SEW's claim relating to network reinforcement requirements.
- Section 4 presents SEW's claim relating to WTW-level economies of scale.

2 Meter renewals

Box 2.1 Summary of claim

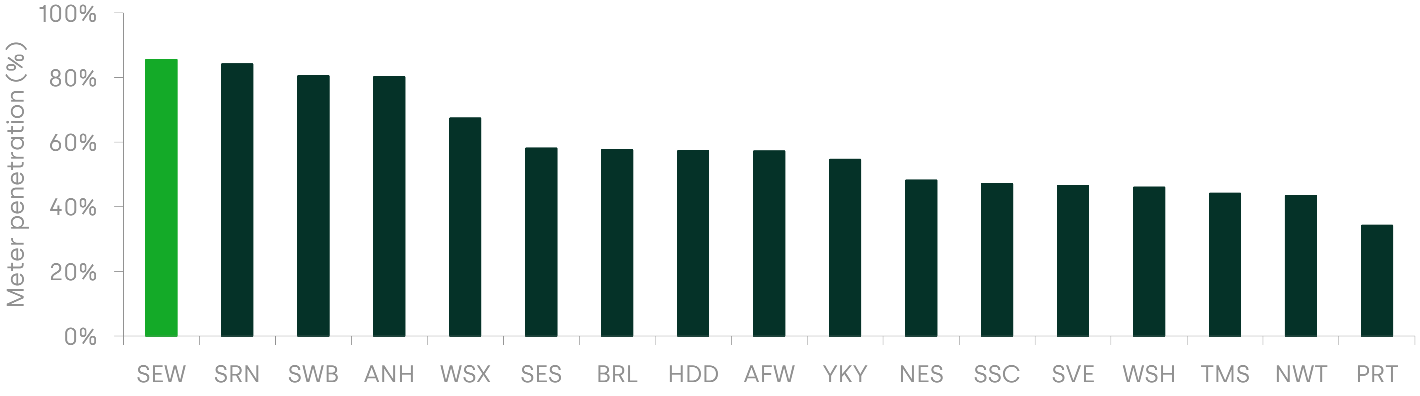
- As a result of meters reaching the end of their useful lives, SEW is anticipating a significant increase in their meter renewal programme to meet consumer needs.
- SEW's anticipated meter renewal rate in AMP8 (c. 5.4% p.a.) is materially higher than the meter renewal rate implicitly funded through the PR24 cost models (either c. 1.4% p.a. or c. 2.1% p.a., depending on the method chosen). Therefore, much of SEW's planned meter renewal programme is not funded by the PR24 models.
- The value of this underfunding is c. £25.4m in AMP8, which is higher than the c. £17m network plus materiality threshold.
- The impact of this CAC for SEW on other companies' cost allowances will largely depend on their meter renewal programmes—where companies are anticipating an increase in meter renewal activity beyond the implicit allowance, a positive CAC adjustment may be warranted.

Source: Oxera

2.1 Introduction

As a result of a significant meter installation programme in the last decade, SEW has the highest meter penetration rate in the industry in the last five years (2018–22), as shown in the figure below.

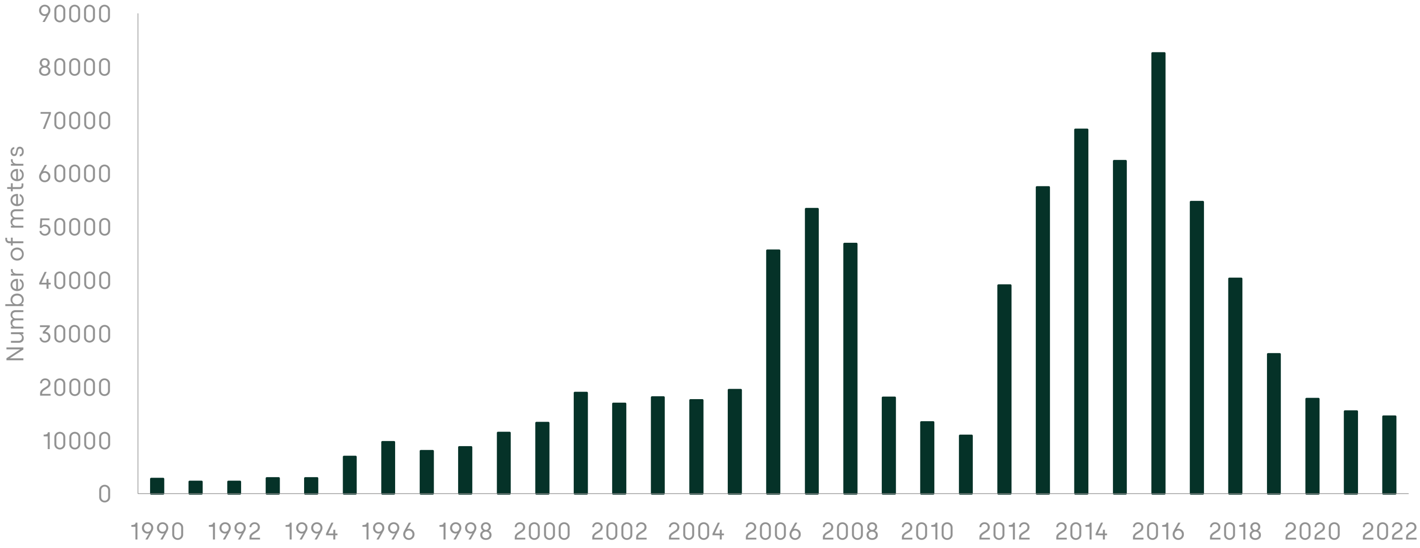
Figure 2.1 Meter penetration across the sector



Source: Oxera analysis.

The figure below shows SEW's historical meter installation activity by year.

Figure 2.2 Meter installation activity



Source: Oxera analysis of data provided by SEW.

Meters have a useful asset life of approximately 15 years and must be renewed at the end of their periods due to their significant deterioration in reliability. We understand that this is primarily due to the batteries within the single manufactured units of meters lasting between twelve to fifteen years. When these batteries reach the end of their lives, they are no longer active such that a reading can no longer be made. When these batteries are no longer functional, the entire unit requires replacement.

On the basis of meters' asset lives, SEW would need to renew the meters that were installed between 2010/11 and 2014/15 in AMP8. Given the acceleration in meter installation during this period, this could translate to a subsequent acceleration in renewals fifteen years later.

Table 2.1 below shows SEW's planned meter renewal activity in AMP8.

Table 2.1 SEW's anticipated meter renewal activity

Year	2025/26	2026/27	2027/28	2028/29	2029/30
Meter replacement volume	54,889	54,889	54,889	54,889	54,889

Source: Data shared by South East Water.

Given SEW's AMP8 meter renewal programme, it is anticipating to renew meters at a rate of c. 5.43% p.a.[4]

2.2 Why is an adjustment required?

Ofwat's PR24 models do not explicitly account for the costs associated with meter renewal activity. However, meter renewal is an activity that companies have undertaken (to varying degrees) in the historical data. The average meter renewal activity in 2011–2022 (i.e. the years available in the Ofwat cost assessment dataset) and in 2018–22 (i.e. the last five years of modelled data that Ofwat has used in the past to determine the benchmark) across the industry is shown in Figure 2.3 below.

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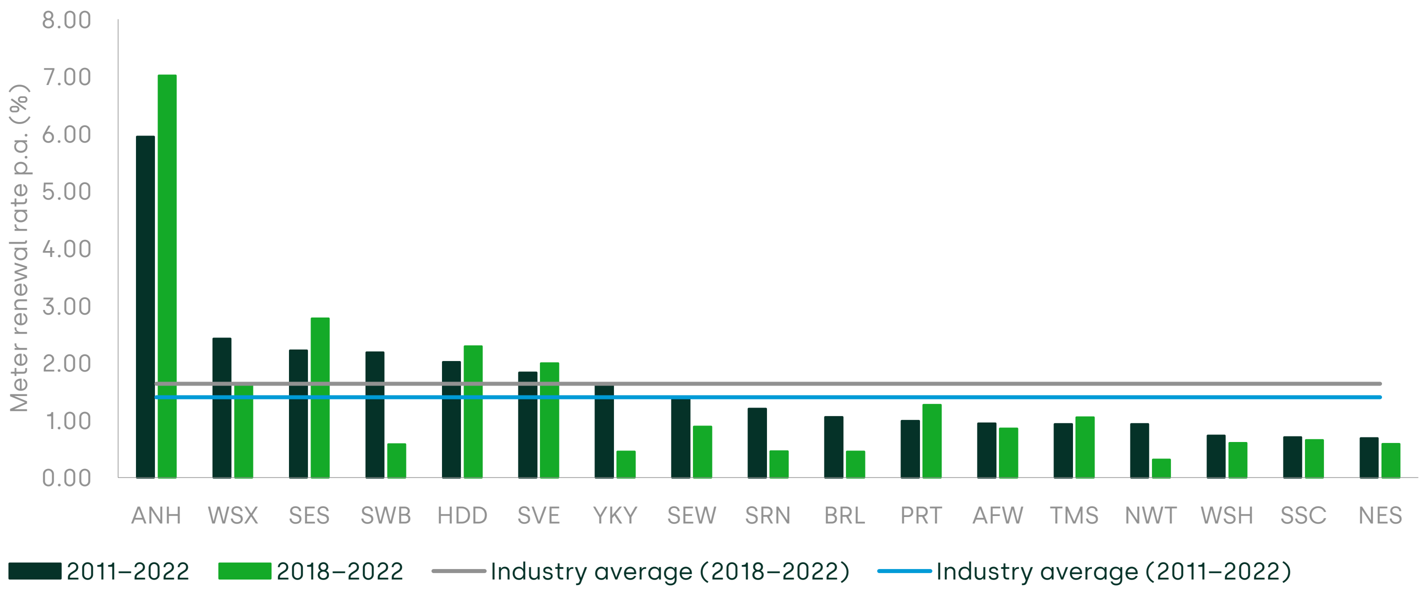
[4] This was calculated by comparing the forecasted meter replacement volume by the forecasted properties listed in Table 2.2.

Figure 2.3 Average meter renewals rate across the panel (2011–2022) and last five years (2018–2022)



Source: Oxera analysis.

The figure shows that the industry has on average renewed meters at a rate of c. 1.40% p.a. in the last five years. Therefore, if no correlation exists between meter renewal activity and the cost drivers included in Ofwat's PR24 models, it could be argued that all companies are funded to deliver a renewal rate of c. 1.40% p.a.

However, we find that meter renewal activity is correlated with some of the PR24 cost drivers, particularly population density (see appendix table A1.1). As such, the PR24 cost drivers may implicitly capture some of the cost-impact associated with meter renewal activity. On the basis of the regression analysis based on meter renewals against the PR24 cost drivers, the models may implicitly fund SEW to deliver a meter renewal rate of c. 1.92–2.47% p.a., depending on the model.[5] On a triangulated basis (assuming equal weights as per Ofwat guidelines), this produces an implicitly funded meter renewal rate of c. 2.09% p.a.

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[5] The implicit renewal rate is estimated by regressing meter renewal activity against the PR24 cost drivers. These regression results are presented in appendix tables 4.4A1.2, A1.3 and A1.4.

On the basis of this preliminary evidence, it appears likely that SEW is not funded to deliver all of its AMP8 meter renewal programme through Ofwat's PR24 cost models.

2.3 Empirical analysis

As meter renewal activity is currently omitted from the PR24 cost models, a direct method to account for the efficient costs associated with meter renewal activity is to include it as an additional cost driver in the models. However, the models do not perform well according to Ofwat's modelling criteria—the coefficient on meter renewals is often statistically insignificant, or of an unintuitive sign (i.e. indicates that increased meter renewal activity is associated with lower base costs). This is likely due to the limited amount of renewal activity that has been undertaken in the historical data (see Figure 2.3 above).[6]

Given this context, a more robust approach to estimating the CAC value is to apply a unit cost adjustment akin to Ofwat's post-modelling adjustment for growth enhancement expenditure at PR19. This involves the following steps.

1. Estimate the implicit meter renewal activity that is funded through the cost models, based on the historical correlation between meter renewal activity and the PR24 cost drivers.
2. The difference between the implicit meter renewal rate derived in step 1 and SEW's expected meter renewal rate, is the level of activity that is unfunded by the PR24 cost models.
3. An efficient unit cost can be applied to the unfunded maintenance activity (derived in step 2) to estimate the efficient level of expenditure that is unfunded by the cost models. This equates to the net value of the CAC.

We understand that SEW expects the cost of renewal to be £150.38 per meter (2022/23 prices). This includes £39.05 for the meter itself, with £111.33 for installation, assuming no issues regarding installation processes or advance warning notices. We understand that there is no industry-wide dataset regarding the costs and outputs associated with meter renewal. However, we note that SEW undertakes meter renewal activity through competitive tendering with necessary negotiation,

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[6] Note that Ofwat's consultant, CEPA, has stated that it cannot estimate robust sewage treatment cost models that control for phosphorus removal due to the lack of historical variation in the data; see CEPA (2023), 'PR24 Wholesale Base Cost Modelling', April, p. 42. Nonetheless, Ofwat argues that phosphorus removal is a relevant driver of costs and, given the difficulty associated with modelling phosphorus removal, a post-modelling adjustment is required; see Ofwat (2023), 'Econometric base cost models for PR24', April, p. 41. A similar argument can be made with respect to meter renewal.

which in principle indicates that the costs are determined through market forces, and can be expected to be broadly efficient. We are exploring alternative evidence to determine the efficient unit cost of meter renewal in preparation for SEW's business plan submission.

The CAC estimation for meter renewal activity is shown in Table 2.2.[7]

Table 2.2 Meter renewals cost adjustment claim breakdown

	2025–26	2026–27	2027–28	2028–29	2029–30	AMP8
Properties forecast	996,940	1,004,204	1,011,180	1,017,895	1,024,297	-
Implicit renewals rate (%)	2.09	2.09	2.09	2.09	2.09	-
Implicit renewals activity	20,858	21,002	21,144	21,285	21,424	**105,713**
Implicit allowance (£m)	3.14	3.16	3.18	3.20	3.22	**15.90**
Expected renewals activity	54,889	54,889	54,889	54,889	54,889	**274,445**
Gross CAC value (£m)	8.25	8.25	8.25	8.25	8.25	**41.27**
Net CAC value (£m)	5.12	5.10	5.07	5.05	5.03	**25.37**

Note: Properties' forecasts are based on ONS household projections applied to the mapping of Local Authority Districts (LADs) for SEW. Implicit renewals rate is the triangulated rate for each year of AMP8, see appendix for breakdown per PR24 model.

The overall AMP8 net CAC value is estimated to be c. £25.4m, which is above the required materiality threshold of c. £17m (1% of network plus TOTEX).

2.4 Comment on symmetry

As demonstrated above, the PR24 cost models do not account for meter renewal activity, and this omission particularly underestimates SEW's efficient cost requirements in AMP8 given their planned renewal activity. In principle, other companies may be overfunded on the basis of this issue if they are planning to undertake less meter-renewal activity in AMP8 than is implicitly funded through the models. However, it is only possible to determine which companies will be affected by this CAC

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[7] Calculations for the implicitly funded meter renewal rate and the model-specific CAC values can be found in tables A1.5, A1.6 and A1.7 of the appendix.

(positively or negatively) when access to the industry's business plan information becomes available.

3 Network reinforcement

Box 3.1 Summary of claim

- SEW is anticipating to undertake significant network reinforcement activity in AMP8 (c. £34m p.a.) as a result of localised population growth and limited (existing) network capacity.
- Ofwat funds network reinforcement expenditure through its base cost models; however, the models do not account for explicit drivers of network reinforcement expenditure (such as excess capacity or reinforcement activity). As such, the models only fund companies for network reinforcement implicitly. SEW's implicit allowance for network reinforcement activity is c. £17.5m p.a., indicating that SEW is underfunded by c. £16.4m.
- SEW's underfunding of network reinforcement activity is driven by the omission of relevant cost drivers from the cost assessment models. That same omission could affect companies' efficient allowance positively or negatively depending on their planned network reinforcement activity relative to the implicit allowance from the models.

Source: Oxera

3.1 Introduction

Network reinforcement requirements are largely driven by factors outside management control. Ofwat includes network reinforcement expenditure in its modelled cost definition, and notes that network reinforcement is captured by exogenous measures of scale and population density that are already included in Ofwat's PR24 cost models. However, these models do not account for other relevant drivers of network reinforcement that are likely to be more relevant, such as excess capacity.[8] Moreover, network reinforcement activity is further complicated as it not only depends on company-wide population growth and excess capacity, but importantly the location of growth in

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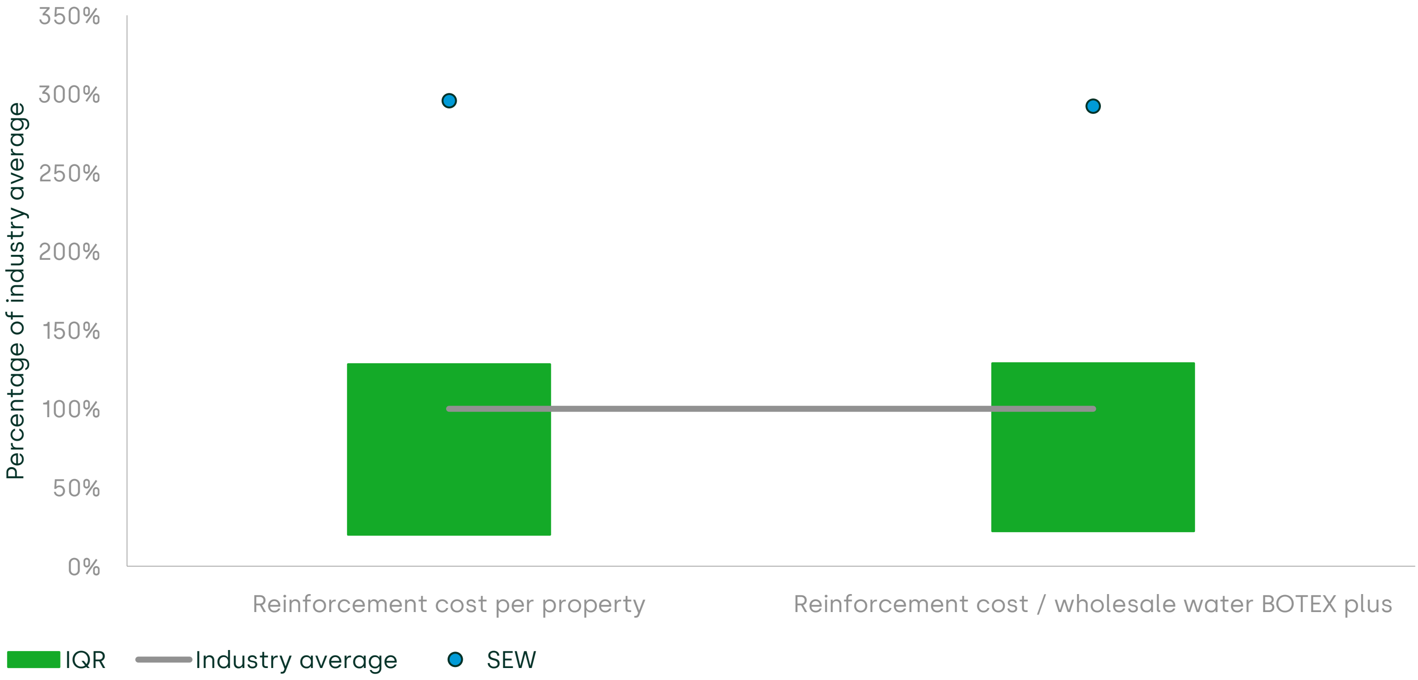
[8] For example, a company with significant excess capacity may be able to accommodate rapid population growth with minimal network reinforcement. Meanwhile, a company with minimal excess capacity may require significant network reinforcement to respond to comparatively slow population growth.

relation to the capacity of the existing network.[9] Therefore, Ofwat's omission of relevant drivers of network reinforcement expenditure may underestimate (or overestimate) the efficient network reinforcement requirements for some companies.

Figure 3.1 below shows how SEW compares to the rest of the industry with respect to its outturn network reinforcement expenditure in the last five years (2018–22).

Figure 3.1 Relative position of SEW in terms of network reinforcement expenditure (2018–2022)



Source: Oxera analysis.

SEW has undertaken significantly more network reinforcement in the last five years compared with the industry average (and the upper-quartile), both on a per property basis, and as a percentage of wholesale water BOTEX plus (c. three times more than the industry average). SEW's network reinforcement activity is expected to increase further in AMP8, from c. £32m in 2018–22 to c. £34m in AMP8 (in 2022/23 prices). Given

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[9] In other words, reinforcement requirements are 'localised'. In particular, we understand that SEW is expecting strong reinforcement requirements in commuter towns, given the post-COVID-19 economic environment.

SEW's network reinforcement requirements, the PR24 models may underestimate SEW's efficient cost allowance, given that the models do not account for relevant drivers of network reinforcement.

3.2 Why is an adjustment required?

As there are no explicit drivers of network reinforcement activity in the PR24 models, the extent to which the models implicitly fund network reinforcement expenditure will depend on companies' investment in network reinforcement over the modelled or benchmark period and the correlation between network reinforcement activity, and the drivers included in the PR24 models. Table 3.1 below shows the correlation[10] between two measures of network reinforcement activity and the PR24 cost drivers.

Table 3.1 Correlation of network reinforcement with PR24 cost drivers

	Reinforcement / Property (log)	**Reinforcement / WW BOTEX plus (%)**
Properties (log)	0.3034***	0.1082
Length of mains (log)	0.3027***	0.1597**
Water treated at complexity levels 3 to 6 (%)	-0.2210***	-0.0270
Weighted average treatment complexity (log)	-0.0807	0.0656
Booster pumping stations per length of mains (log)	-0.2881***	-0.0430
Average pumping head (log)	0.2592***	0.2558***
Weighted average density—LAD from MSOA (log)	0.0723	-0.2215***
Weighted average density—MSOA (log)	0.1463*	-0.1649**
Properties per length of mains (log)	0.0781	-0.1846**

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels, respectively.

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[10] While correlation analysis can provide indicative initial evidence on the strength of relationship, it can be misleading, as it does not capture the totality of the relationship between reinforcement activity and the PR24 cost drivers (e.g. because it only examines one cost driver at a time). Therefore such analyses must be augmented with additional evidence.

Network reinforcement costs per property are positively correlated with scale and average pumping head. It is also negatively correlated with treatment complexity and booster pumping stations per length of mains. Meanwhile, network reinforcement as a percentage of modelled BOTEX is negatively correlated with population density, and is positively correlated with average pumping head.

3.3 Empirical analysis

Given network reinforcement is included in modelled base costs for PR24, a viable estimation of the implicit allowance and subsequent cost adjustment claim would be to identify the change in SEW's predicted costs when network reinforcement is removed from the modelled cost definition. This can be compared to SEW's efficient network reinforcement expenditure for AMP8[11] to derive a net CAC value, as shown in Table 3.2 below.[12] This is aligned with one of Ofwat's approaches to estimating CACs as outlined in its final methodology.[13]

Table 3.2 Overview of implicit allowance and cost adjustment claims for network reinforcement across AMP8

	Bottom-up	Top-down	Triangulated
Modelled cost with reinforcement (£m)	726.78	765.54	746.16
Modelled cost without reinforcement (£m)	710.80	746.49	728.64
Implicit allowance for reinforcement (£m)	15.98	19.05	17.52
Gross CAC: SEW reinforcement expenditure (£m)	33.90	33.90	33.90
Net CAC value (£m)	**17.92**	**14.85**	**16.38**

Source: Oxera analysis

The net CAC value on the basis of this analysis is c. £16.4m for AMP8.

Note that this CAC value relates to the likely underfunding of network reinforcement for SEW in AMP8 **only**. That is, we understand that this

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[11] We understand that Ofwat has requested data on network reinforcement requirements (cost and outputs) for all water companies. Such a dataset could be used to verify the efficiency of SEW's proposed network reinforcement expenditure. However, we understand that it is not currently publicly available.

[12] Tables A2.4, A2.5 and A2.6 in the appendix provide the breakdown of implicit allowance and cost adjustment claims per PR24 model.

[13] See Ofwat (2022), 'Creating tomorrow, together: Our final methodology for PR24 Appendix 9 – Setting expenditure allowances', December, appendix A1.

network reinforcement expenditure is required to maintain the existing service on the network, given the expected (localised) population growth. If service is expected to improve, then additional expenditure may be required.

3.4 Comment on symmetry

The models may be biased against SEW on the basis that they omit relevant drivers of network reinforcement expenditure. In the same way, the models may overcompensate other companies on the basis of that omission. As such, the claim can involve positive and negative adjustments for companies on an outturn basis. However, the impact on companies' forward-looking allowances will depend on the level of network reinforcement activity that companies require in AMP8, which may be more or less than what they have delivered historically. The potential adjustment for each company on the basis of this network reinforcement CAC on a historical basis can be found in appendix table A2.9.

4 Economies of scale at water treatment works

Box 4.1 Summary of claim

- SEW operates the second-smallest water treatment works (WTWs) in the industry (defined as WTWs per property) on average. As such, it cannot benefit from the same WTW-level economies of scale as other companies in the industry, and faces higher costs as a result of this characteristic.
- The PR24 cost models do not account for explicit measures of WTW-level economies of scale. WTW size is correlated with some of the PR24 cost drivers such that WTW-level economies of scale are partially captured in the PR24 models. However, SEW's operating environment is such that the PR24 cost drivers significantly overestimate the size of SEW's WTWs (and, therefore, exaggerates SEW's ability to benefit from WTW-level economies of scale).
- Using WTW-level cost and output data provided by SEW, we have estimated a robust relationship between WTW size and water treatment unit costs (i.e. WTW-level economies of scale). This analysis shows that SEW is underfunded on the basis of WTW-level economies of scale by c. £19m when focusing solely on power and chemicals cost, and by c. £44m if the relationship with respect to power and chemicals cost is assumed to hold for the overall water treatment costs (which can also be an underestimation of the CAC value). We will refine the value of the claim as part of SEW's final business plan.

Source: Oxera

4.1 Introduction

It is well-established that there are economies of scale in the water and wastewater treatment processes. Ofwat's relevant wholesale wastewater models (sewage treatment, bioresources and network plus) all control for some measure of economies of scale at the sewage treatment works (STW) level.[14] Similarly, in wholesale water, CEPA

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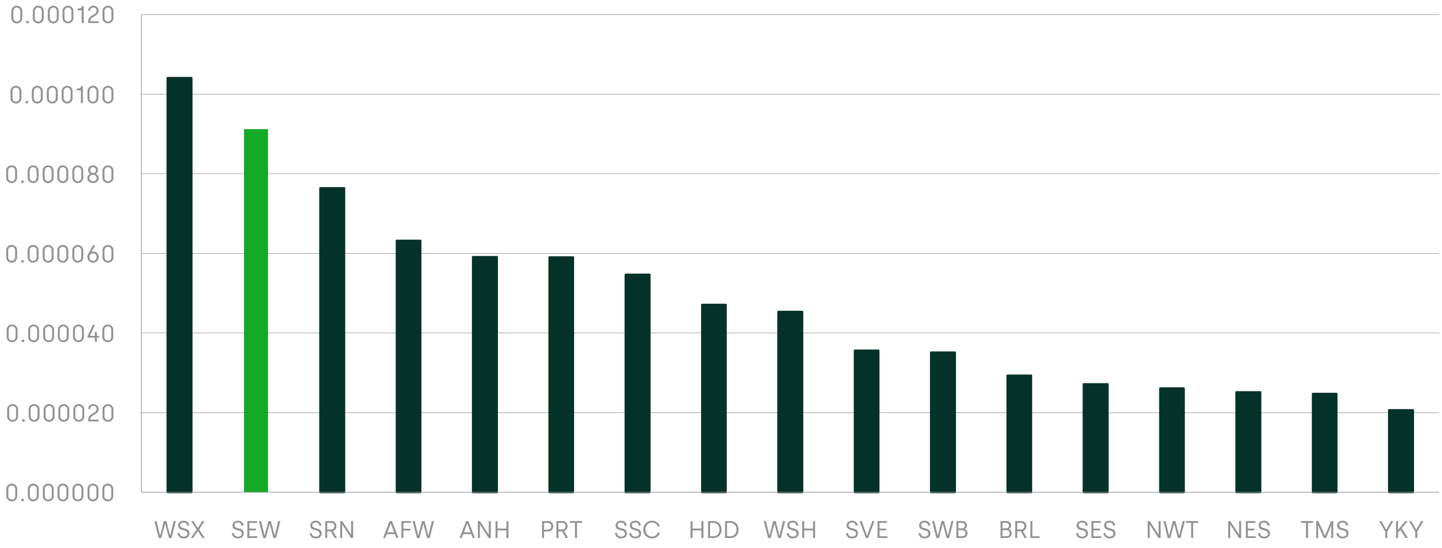
[14] See Ofwat (2019), 'PR19 final determinations: Securing cost efficiency technical appendix', December, Table A2.2; and Ofwat (2023), 'Econometric base cost models for PR24', April, section A4.

(Ofwat's consultants) stated that 'large treatment works are expected to have a lower unit cost of treatment than small treatment works'.[15] Ofwat also explored accounting for water treatment plant (WTW) level economies of scale in its wholesale water models, as part of the PR24 modelling consultation. Therefore, WTW-level economies of scale are clearly an operationally relevant driver of expenditure.

Figure 4.1 below illustrates the position of SEW in comparison to the rest of the sector when focusing on a possible WTW size measure.[16] It is clear that, overall, SEW predominantly operates with smaller WTWs (based on the number of WTWs per property).[17]

Figure 4.1 Industry distribution of WTWs per property (2018–2022)



Source: Oxera analysis.

Figure 4.2 below shows how SEW compares to the rest of the industry on a relative level across the range of measures that could capture WTW-level economies of scale.

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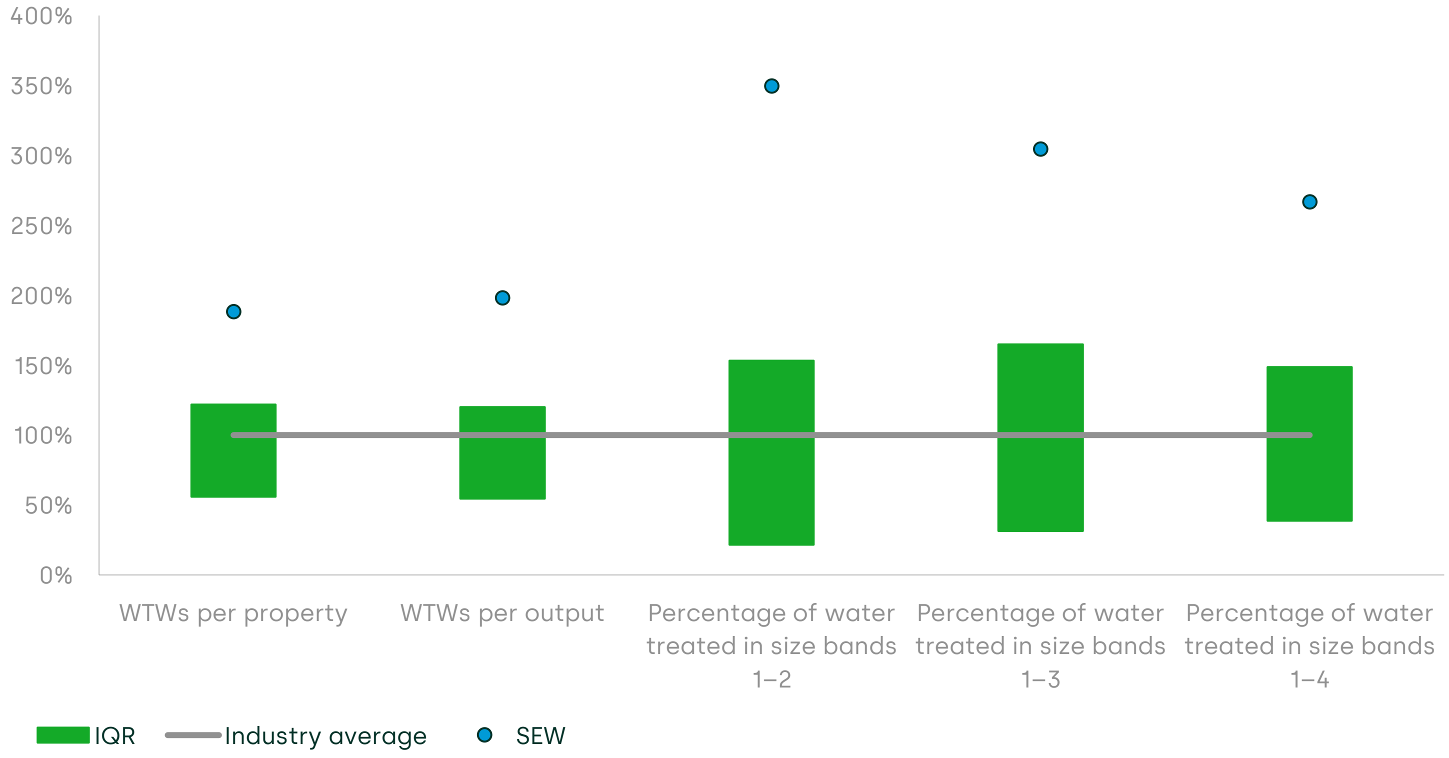
[15] See CEPA (2023), 'PR24 Wholesale Base Cost Modelling', April, table 4.2.
[16] Comparisons and distributions of the industry in terms of WTW sizes based on alternative measures are depicted appendix tables A3.1, A3.2, A3.3 and A3.4.
[17] Note that Wessex Water (WSX) operates smaller WTWs according to this metric, and submitted a claim to this effect at PR19.Ofwat rejected this claim on the basis that its models already implicitly captured WTW-level economies of scale. See Ofwat (2019), 'Cost adjustment claim feeder model Wessex Water', December. As shown in section 4.2, the PR24 models do not sufficiently capture WTW-level economies of scale in the case of SEW.

Figure 4.2 SEW economies of scale relative to the industry average



Source: Oxera analysis.

SEW has significantly more WTWs per property than the industry average (it is above the horizontal line) as well as the upper-quartile (it is above the interquartile range, IQR). Similarly, SEW treats significantly more water at small WTWs than the rest of the industry. This indicates that SEW has substantially smaller WTWs than the rest of the industry, and is therefore less able to benefit from WTW-level economies of scale than the rest of the industry.

WTW-level economies of scale are regarded as 'largely exogenous' given companies cannot influence: (i) where clusters of populations reside; (ii) the geology of their operating environment (i.e. where water sources are located); or (iii) the historical formation of the infrastructure.

4.2 Requirement of cost adjustment claim

Ofwat has previously argued that the impact of economies of scale on companies' WRP expenditure is already captured through the density variable in its PR19 models.[18] In the PR24 cost modelling consultation, Ofwat made additional arguments.[19]

CEPA did not include any variables to directly capture economies of scale at water treatment works in its recommended models. This may be because the population density variables already capture economies of scale in water treatment works.

Ofwat did not provide empirical evidence regarding the extent to which the PR24 cost drivers capture WTW-level economies of scale. Table 4.1 below shows the correlation between the PR24 cost drivers and variables that could capture economies of scale, which can provide initial evidence regarding the extent to which the PR24 cost drivers capture WTW-level economies of scale. However, such analysis is 'univariate' (i.e. it does not account for multiple drivers simultaneously) and is therefore only a partial analysis. 'Multivariate' analysis is presented later in this section.

Table 4.1 Correlations of economies of scale variables with PR24 cost drivers

	WTWs per property	**WTWs per volume of output**	**Water treated in size bands 1–2 (%)**	**Water treated in size bands 1–3 (%)**	**Water treated in size bands 1–4 (%)**
Properties	-0.2926***	-0.3422***	-0.1376*	-0.1385*	-0.1347*
Water treated in complexity levels 3–6 (%)	-0.6012***	-0.6185***	-0.2858***	-0.4531***	-0.5561***
WAC	-0.4956***	-0.5425***	-0.2104***	-0.3488***	-0.4681***
WAD_MSOA to LAD	-0.4416***	-0.4665***	-0.4708***	-0.4000***	-0.3537***
WAD_MSOA	-0.3576***	-0.3901***	-0.3938***	-0.3209***	-0.2582***
Properties/length of mains	-0.3589***	-0.3803***	-0.3403***	-0.2613***	-0.2676***

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[18] For example, see Ofwat (2019), 'Cost adjustment claim feeder model SEW', December.
[19] Ofwat (2023), 'Econometric base cost models for PR24', April 2023, section 3.3.3.

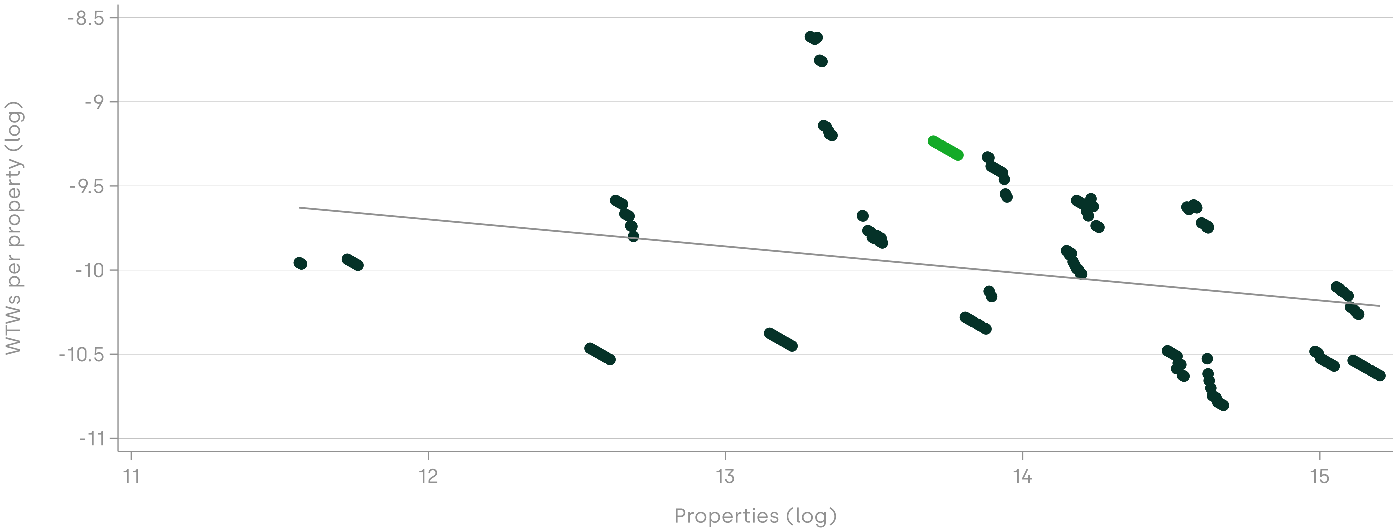
Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. All variables are in logs, with the exception of those denoted as percentage terms.

There is correlation of varying strengths between several economies of scale variables, and the variables currently included in the WRP models. In particular, economies of scale drivers are negatively correlated with treatment complexity (on average, companies that treat more complex water have larger WTWs) and population density (on average, companies that operate in denser regions have larger WTWs). Therefore, the PR24 cost drivers capture **some** of the cost impact of WTW-level economies of scale for **the average company**.

However, given that the PR24 models only capture WTW-level economies of scale imperfectly, the models can be biased in favour of (or against) individual companies, depending on their operating environments. For example, although the data shows that there is a negative relationship between density and WTW size at the industry level, it is feasible that an individual company that operates in a densely populated environment may have small WTWs (counter to the industry-wide correlation).

The figures below illustrate the relationship between WTW size and the PR24 cost drivers, such that companies that do not follow the industry-wide correlations can be readily identified.

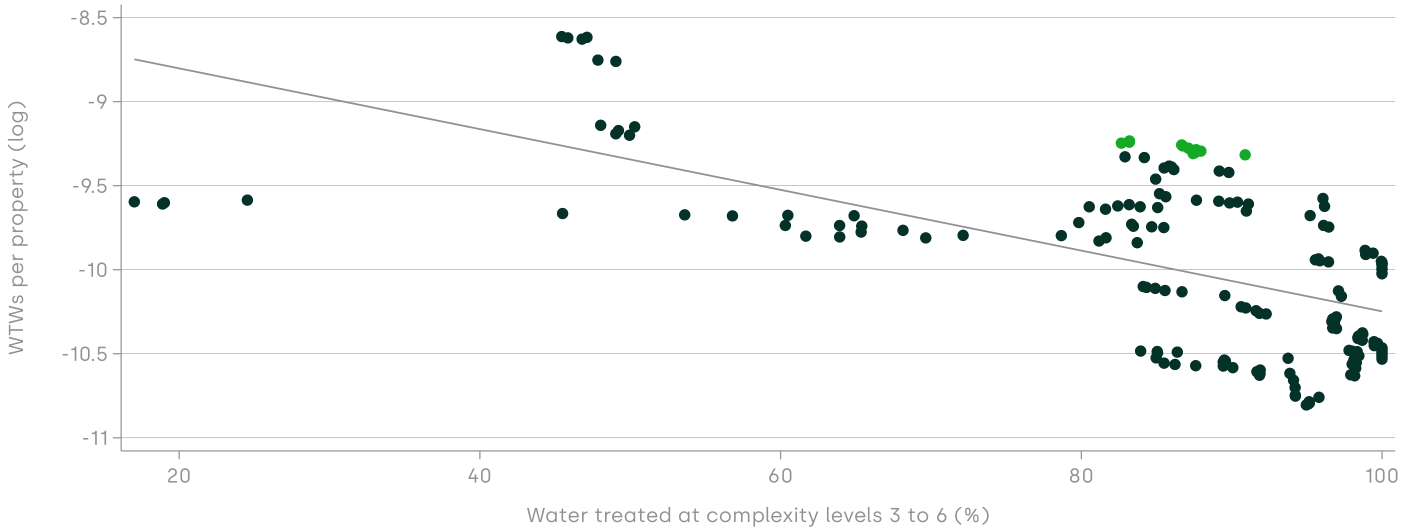
Figure 4.3 Economies of scale against properties



Note: SEW's position is indicated by the bright green dots.

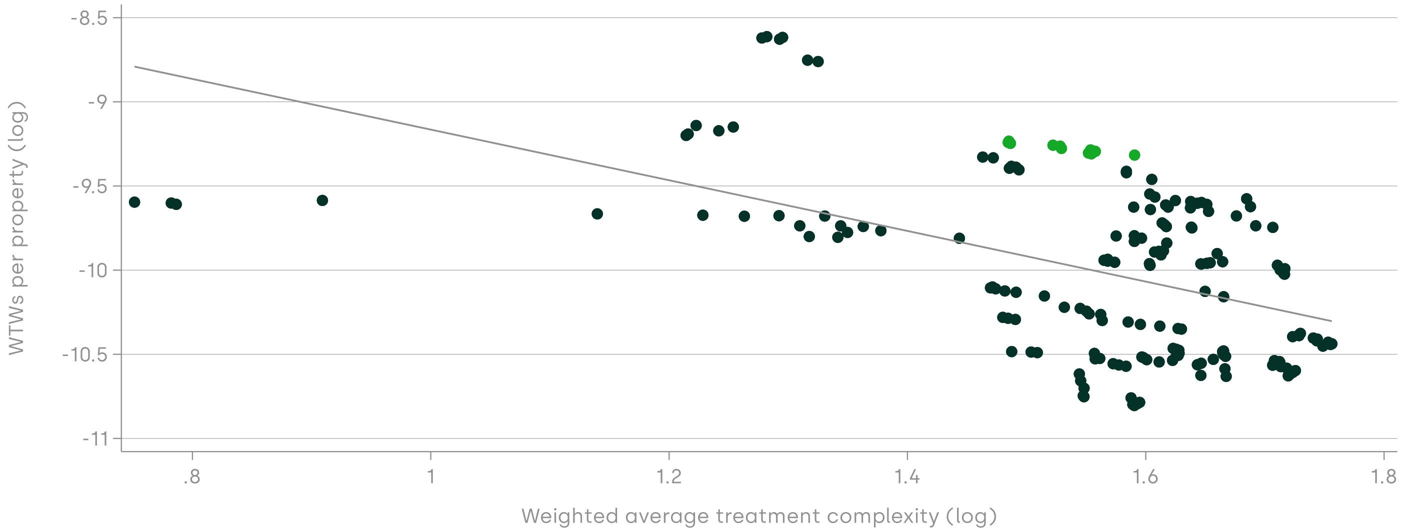
Source: Oxera analysis.

Figure 4.4 Economies of scale against proportion of water treated at complexity levels 3 to 6



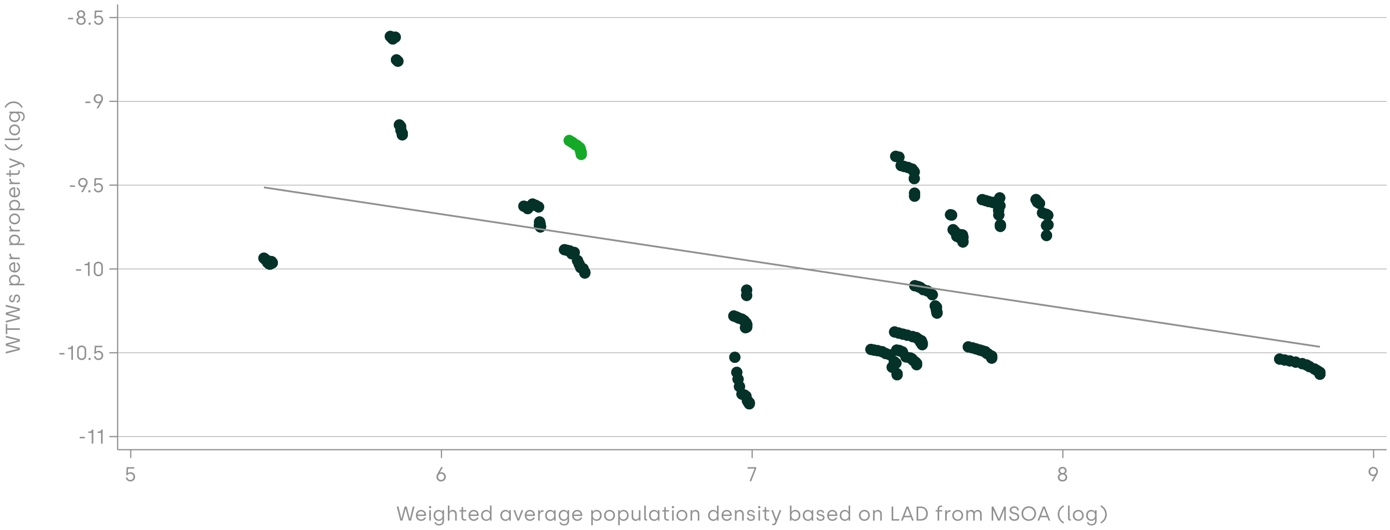
Note: SEW's position is indicated by the bright green dots.
Source: Oxera analysis.

Figure 4.5 Economies of scale against weighted average treatment complexity



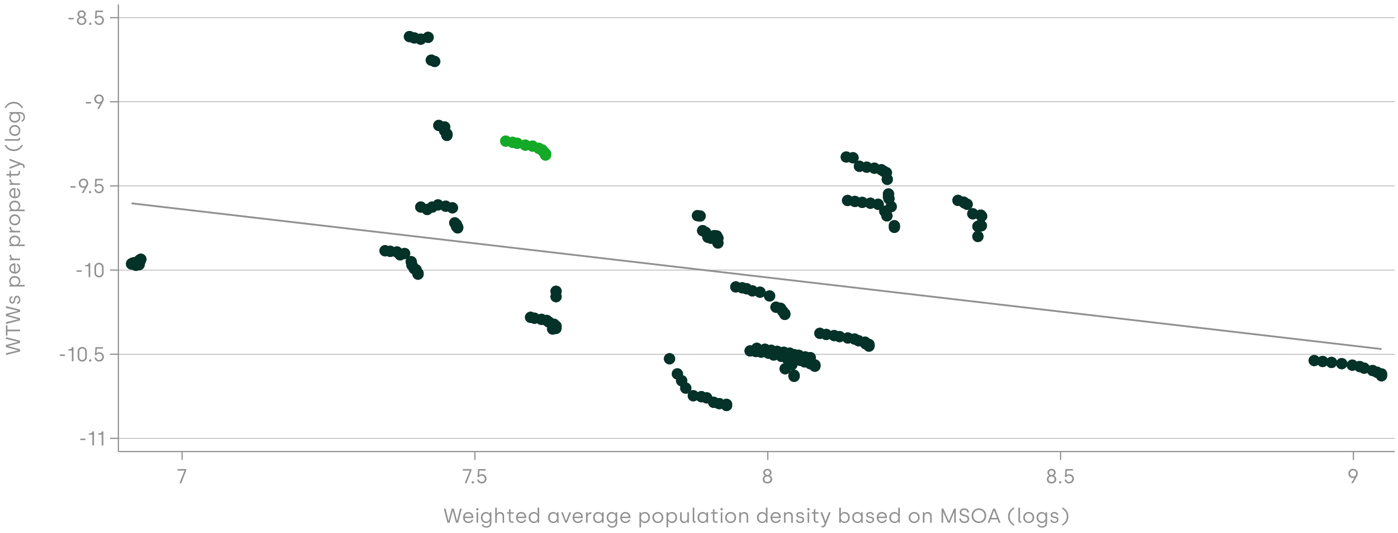
Note: SEW's position is indicated by the bright green dots.
Source: Oxera analysis.

Figure 4.6 Economies of scale against weighted average population density–LAD from MSOA



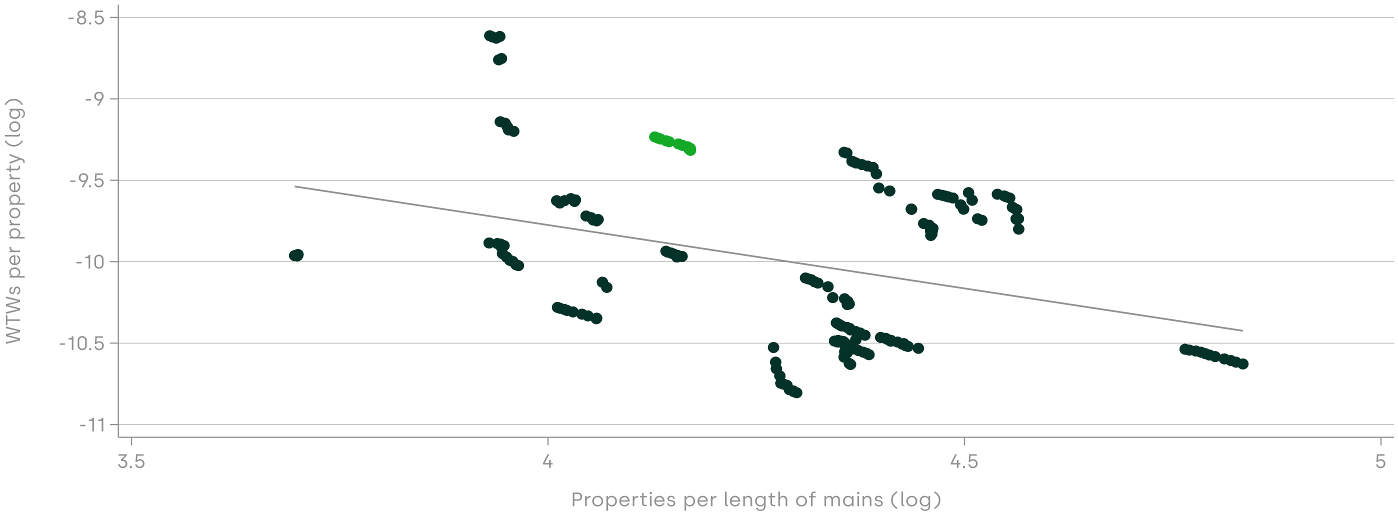
Note: SEW's position is indicated by the bright green dots.
Source: Oxera analysis.

Figure 4.7 Economies of scale against weighted average population density–MSOA



Note: SEW's position is indicated by the bright green dots.
Source: Oxera analysis.

Figure 4.8 Economies of scale against properties per length of mains



Note: SEW's position is indicated by the bright green dots.
Source: Oxera analysis.

The figures show that SEW is always materially above the 'regression line'. For example, for SEW's given level of population density, it has more WTWs per property than a simple correlation would suggest, because it is materially above the regression line. As such, while these cost drivers may adequately capture the cost-impact of economies of scale for some companies and the industry on average, it is unlikely that they adequately capture the costs associated with SEW's unique operating environment.

As noted above, this correlation analysis is 'univariate', i.e. it only examines the relationship between one economies-of-scale cost driver and one other cost driver included in the model. This analysis can be extended to examine the relationship between economies of scale, and all of the cost drivers included in the WRP models simultaneously. Table 4.2 below shows the cost driver coefficients and model fit when WTWs per property (log) is regressed against the PR24 cost drivers in the Water Resources Plus (WRP) models.

Table 4.2 Results from regressions of WTW per property (log) on PR24 WRP models

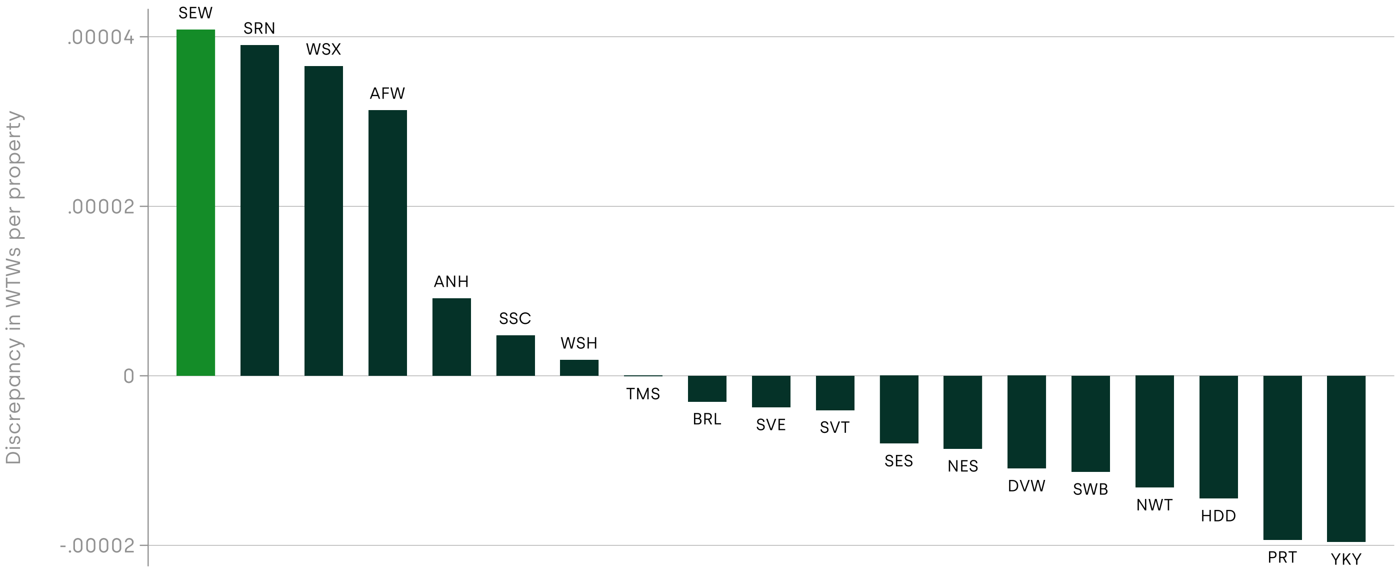
	WRP1	**WRP2**	**WRP3**	**WRP4**	**WRP5**	**WRP6**
Properties	-0.019	-0.001	-0.009	-0.010	-0.048	-0.043
Percentage of water treated in complexity levels 3–6 (%)	-0.018***	—	-0.019***	—	-0.018***	—
WAC	—	-1.395***	—	-1.452***	—	-1.416***
WAD_MSOA to LAD	0.056	-0.679	—	—	—	—
WAD_MSOA to LAD Squared	-0.023	0.030	—	—	—	—
WAD_MSOA	—	—	-0.346	-1.228	—	—
WAD_MSOA Squared	—	—	-0.006	0.054	—	—
Properties/length of mains	—	—	—	—	0.887	-4.058
Properties/length of mains Squared	—	—	—	—	-0.196	0.392
Constant	-7.445***	-4.527**	-5.177	-1.305	-7.941	2.968
Adjusted R-squared	0.533	0.393	0.505	0.343	0.509	0.359

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. Variables are in logs unless otherwise stated. The dependent variable is the natural logarithm of WTW per property.
Source: Oxera analysis.

WTW size is most strongly associated with treatment complexity, as the coefficient on treatment complexity is statistically significant across WRP model specifications. However, the model fit is relatively low, indicating that the cost drivers included in the PR24 cost models capture some of the variance in the economies of scale variables, but that there remains a significant unexplained component. This pattern of relatively low model fits continue across the PR24 Wholesale Water (WW) model specifications as seen in tables A3.1 and A3.2 in the appendix.

The models in Table 4.2 can be used to predict the average WTW size that is 'assumed' in the PR24 cost models for each company. The difference between this assumed average WTW size and a companies' actual average WTW size is then a measure of the extent to which the models are biased against companies on the basis of WTW size. Figure 4.9 below shows this 'average discrepancy' for each company.

Figure 4.9 Average discrepancy between actual WTW size and that predicted by the PR24 WRP models



Source: Oxera analysis

Figure 4.9 shows that SEW has significantly more WTWs per property than the PR24 cost drivers would suggest, and is the most affected company in the industry (it has the largest positive discrepancy).

Overall, our analysis indicate that the PR24 cost models do not capture important economies-of-scale variables in the case of SEW.

4.3 Empirical analysis

As noted by Ofwat, WTW-level economies of scale cannot be robustly captured in the PR24 cost assessment models through relevant variables.[20] However, the analysis in the preceding section can be used to estimate the difference between: (i) SEW's average WTW size 'assumed' by the PR24 cost drivers; and (ii) SEW's actual average WTW size. Therefore, it is possible to estimate a CAC on the basis of this

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[20] Ofwat (2023), 'Econometric base cost models for PR24', April 2023, section 3.3.3.

information, if one can estimate the relationship between costs and treatment plant size.

To our knowledge, there is no industry-wide dataset that includes costs and outputs at the WTW level. However, SEW has provided Oxera with data on power, chemicals and maintenance costs for its treatment plants, as well as some relevant outputs (volume of water treated and the treatment complexity level). We understand that there are concerns regarding the quality of the maintenance expenditure dataset, particularly in relation to the allocation of maintenance expenditure across WTWs. Therefore, we currently focus our analysis on power and chemicals costs.

From this dataset, we estimate that there are statistically significant economies of scale at the WTW level with respect to power and chemicals cost, as shown in appendix figure A3.5 and appendix table A3.3. The unit cost models listed in appendix table A3.3 demonstrate that the estimate of economies of scale is similar across the specifications. In order to translate this into a claim relating to modelled BOTEX, we consider two alternatives as follows.

1. Assume that only power and chemical costs are affected by economies of scale. This is an extremely conservative assumption and could form the lower bound for a CAC.
2. Assume that the relationship between power and chemical costs, and WTW size is the same as the relationship between all modelled BOTEX and WTW size. This estimation is built on an assumption that cannot be robustly tested on the available dataset, given the limitations with the maintenance expenditure data. While the CAC estimate under this assumption is more realistic than the previous one, it can also be downwardly biased and we will look to refine its value as part of SEW's business plan.

Table 4.3 below show the magnitude of the claim in Ofwat's PR24 models.

Table 4.3 Cost claims for economies of scale (triangulated)

	2025/26	2026/27	2027/28	2028/29	2029/30	AMP8
Forecasted total volume of output (Ml)	186111	186412	186714	187015	187317	-

	2025/26	2026/27	2027/28	2028/29	2029/30	AMP8
Implicit average WTW size as predicted by PR24 models (Ml)	3863	3871	3879	3886	3894	-
Modelled unit cost (£/output)	93.02	92.96	92.90	92.84	92.78	-
Implicit allowance (£m)	17.31	17.33	17.35	17.36	17.38	-
Forecast average WTW size (Ml)	2139	2143	2146	2150	2153	-
Modelled unit cost (£/output)	113.31	113.25	113.19	113.13	113.07	-
Gross Claim (£m)	21.09	21.11	21.13	21.16	21.18	-
Net CAC (£m)—assumption one	**3.78**	**3.78**	**3.79**	**3.79**	**3.80**	**18.94**
Net CAC (£m)—assumption two	**8.66**	**8.72**	**8.77**	**8.83**	**8.88**	**43.85**

Note: Average WTW size is defined as the average volume of water treated per WTW. The implicit average WTW size is a triangulated estimate (assuming equal weights as per Ofwat guidelines). More details regarding the breakdown of this CAC across the PR24 model specifications are provided in appendix tables A3.7, A3.8 and A3.9.
Source: Oxera analysis.

Table 4.3 shows that the net CAC value is between £18.9m and £43.9m per AMP, depending on the assumption used. Note that assumption one (which leads to the lowest CAC value) only represents economies of scale in relation to power and chemicals costs—this will certainly underestimate the value of the claim if economies of scale also affect other aspects of modelled BOTEX (such as maintenance and renewal expenditure). Indeed, if economies of scale are more prevalent in other expenditure categories, then assumption two will also underestimate the value of the CAC.

At this stage, we consider that assumption two is more appropriate for determining SEW's CAC in this area. However, we are exploring more detailed WTW-level data that may include a more robust allocation of expenditure that cannot currently be modelled (e.g. maintenance and renewal expenditure). If this data could be compiled, assumptions regarding which costs are more susceptible to economies of scale could be tested.

4.4 Comment on symmetry

The models are biased against SEW on the basis that they inadequately account for WTW-level economies of scale. In the same way, the models may overcompensate other companies if they can benefit from greater WTW-level economies of scale. As such, the claim can involve positive and negative adjustments for companies on an outturn basis. The potential adjustment for each company on the basis of this network reinforcement CAC can be found in appendix table A3.12.

A1 Meter renewals

A1.1 Requirement of adjustment

This section provides supplementary evidence regarding the need for a cost adjustment claim in meter renewals.

Table A1.1 below lists the correlation between the PR24 cost drivers meter renewal rates.

Table A1.1 Correlations between meter renewal rate and PR24 cost drivers

	Meter renewal rate (%)
Properties (log)	-0.0046
Length of mains (log)	0.0867
Water treated at complexity levels 3 to 6 (%)	-0.0528
Weighted average treatment complexity (log)	-0.0215
Boosters per length of mains (log)	-0.0314
Average pumping head (log)	0.0797
Weighted average density—LAD from MSOA (log)	-0.3298***
Weighted average density—MSOA (log)	-0.3095***
Properties per length of mains (log)	-0.3509***

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively.

As discussed in section 2, the meter renewal rate is generally uncorrelated with the PR24 cost drivers, with the exception of population density.

A1.2 Implicit allowance

This section provides supplementary evidence on the estimation of the implicit allowance

Table A1.2, A1.3 and A1.4 below list the model results when regressing the PR24 models to meter renewal rates. Note that all models are estimated using pooled OLS.

Table A1.2 PR24 model results when regressed to meter renewal rates (TWD1–TWD6)

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Length of mains (log)	0.263	0.299	0.048	0.275	0.292	0.156
	(0.309)	(0.329)	(0.783)	(0.458)	(0.454)	(0.608)
Boosters per length of mains (log)	-2.708*	-2.077	-3.022*	–	–	–
	(0.096)	(0.174)	(0.053)	–	–	–
Average pumping head (log)	–	–	–	0.273	0.19	0.081
	–	–	–	(0.628)	(0.757)	(0.883)
Weighted average density—LAD from MSOA (log)	-2.793	–	–	-2.044	–	–
	(0.325)	–	–	(0.265)	–	–
Weighted average density—LAD from MSOA (log) squared	0.103	–	–	0.095	–	–
	(0.567)	–	–	(0.412)	–	–
Weighted average density—MSOA (log)	–	-9.594	–	–	-6.56	–
	–	(0.305)	–	–	(0.342)	–
Weighted average density—MSOA (log) squared	–	0.477	–	–	0.336	–
	–	(0.379)	–	–	(0.401)	–
Properties per length of mains (log)	–	–	-28.002*	–	–	-12.544
	–	–	(0.057)	–	–	(0.333)
Properties per length of mains (log) squared	–	–	2.703*	–	–	1.18
	–	–	(0.081)	–	–	(0.406)
Constant	2.414	35.936	58.714*	7.535	28.776	31.815
	(0.828)	(0.329)	(0.058)	(0.281)	(0.318)	(0.279)
Adjusted R-squared	0.227	0.181	0.251	0.112	0.102	0.114

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses. The dependent variable is meter renewal rate (%).
Source: Oxera analysis.

Table A1.3 PR24 model results when regressed to meter renewal rates (WW1–WW6)

	WW1	**WW2**	**WW3**	**WW4**	**WW5**	**WW6**
Properties (log)	0.26	0.254	0.338	0.32	0.089	0.081
	(0.350)	(0.345)	(0.316)	(0.322)	(0.620)	(0.629)
Boosters per length of mains (log)	-2.718*	-2.697	-2.164	-2.082	-3.090**	-3.051*
	(0.094)	(0.101)	(0.151)	(0.173)	(0.045)	(0.052)
Water treated at complexity levels 3 to 6 (%)	-0.008	–	-0.015	–	-0.011	–
	(0.338)	–	(0.198)	–	(0.177)	–
Weighted average treatment complexity (log)	–	-0.398	–	-0.875	–	-0.635
	–	(0.546)	–	(0.283)	–	(0.308)
Weighted average density—LAD from MSOA (log)	-2.367	-2.638	–	–	–	–
	(0.415)	(0.360)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.067	0.088	–	–	–	–
	(0.721)	(0.636)	–	–	–	–
Weighted average density—MSOA (log)	–	–	-10.805	-10.87	–	–
	–	–	(0.273)	(0.279)	–	–
Weighted average density—MSOA (log) squared	–	–	0.538	0.549	–	–
	–	–	(0.346)	(0.346)	–	–
Properties per length of mains (log)	–	–	–	–	-26.432*	-28.994*
	–	–	–	–	(0.078)	(0.050)
Properties per length of mains (log) squared	–	–	–	–	2.498	2.808*
	–	–	–	–	(0.117)	(0.071)
Constant	0.76	1.746	40.761	41.319	55.657*	61.216**
	(0.950)	(0.882)	(0.289)	(0.293)	(0.079)	(0.047)

	WW1	WW2	WW3	WW4	WW5	WW6
Adjusted R-squared	0.225	0.219	0.191	0.176	0.26	0.251

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses. The dependent variable is meter renewal rate (%).
Source: Oxera analysis.

Table A1.4 PR24 model results when regressed to meter renewal rates (WW7–WW12)

	WW7	WW8	WW9	WW10	WW11	WW12
Properties (log)	0.292	0.293	0.346	0.335	0.192	0.184
	(0.464)	(0.428)	(0.430)	(0.399)	(0.552)	(0.522)
Average pumping head (log)	0.383	0.375	0.348	0.344	0.186	0.16
	(0.490)	(0.546)	(0.577)	(0.617)	(0.743)	(0.801)
Water treated at complexity levels 3 to 6 (%)	-0.008	–	-0.013	–	-0.009	–
	(0.424)	–	(0.272)	–	(0.365)	–
Weighted average treatment complexity (log)	–	-0.525	–	-0.844	–	-0.498
	–	(0.564)	–	(0.322)	–	(0.552)
Weighted average density—LAD from MSOA (log)	-1.726	-2.032	–	–	–	–
	(0.330)	(0.281)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.067	0.089	–	–	–	–
	(0.549)	(0.466)	–	–	–	–
Weighted average density—MSOA (log)	–	–	-7.876	-8.21	–	–
	–	–	(0.291)	(0.241)	–	–
Weighted average density—MSOA (log) squared	–	–	0.407	0.431	–	–
	–	–	(0.338)	(0.286)	–	–
Properties per length of mains (log)	–	–	–	–	-11.037	-13.27

	WW7	WW8	WW9	WW10	WW11	WW12
	–	–	–	–	(0.404)	(0.297)
Properties per length of mains (log) squared	–	–	–	–	0.981	1.247
	–	–	–	–	(0.498)	(0.368)
Constant	5.506	6.68	33.154	34.644	28.188	33.071
	(0.394)	(0.330)	(0.269)	(0.222)	(0.339)	(0.244)
Adjusted R-squared	0.111	0.107	0.109	0.099	0.117	0.111

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses. The dependent variable is meter renewal rate (%).
Source: Oxera analysis.

A1.3 Cost adjustment claims breakdown

This section details the breakdown of each PR24 model and their implicitly funded renewal rates, subsequent allowances and cost adjustment claim values.

Table A1.5, A1.6 and A1.7 below list the implicit meters renewal activity predicted by the PR24 models for SEW, and their subsequent implicit allowances and cost adjustment claim values.

Table A1.5 Meter renewals implicit allowances and cost adjustment claims (TWD1–TWD6)

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Implicit renewals rate (%)						
2025/26	2.42	2.01	1.94	2.22	2.00	1.92
2026/27	2.43	2.01	1.94	2.21	2.00	1.92
2027/28	2.43	2.01	1.94	2.21	1.99	1.91
2028/29	2.44	2.00	1.95	2.21	1.98	1.91
2029/30	2.45	2.00	1.96	2.21	1.98	1.91
Implicit renewal activity						
2025/26	24126	20066	19334	22090	19960	19158
2026/27	24375	20186	19488	22241	20046	19255

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
2027/28	24618	20300	19656	22386	20126	19354
2028/29	24856	20408	19836	22525	20199	19457
2029/30	25087	20511	20030	22657	20267	19563
Implicit allowance (£m)						
2025/26	3.63	3.02	2.91	3.32	3.00	2.88
2026/27	3.67	3.04	2.93	3.34	3.01	2.90
2027/28	3.70	3.05	2.96	3.37	3.03	2.91
2028/29	3.74	3.07	2.98	3.39	3.04	2.93
2029/30	3.77	3.08	3.01	3.41	3.05	2.94
Expected renewal activity						
2025/26	54889	54889	54889	54889	54889	54889
2026/27	54889	54889	54889	54889	54889	54889
2027/28	54889	54889	54889	54889	54889	54889
2028/29	54889	54889	54889	54889	54889	54889
2029/30	54889	54889	54889	54889	54889	54889
Gross value of CAC (£m)						
2025/26	8.25	8.25	8.25	8.25	8.25	8.25
2026/27	8.25	8.25	8.25	8.25	8.25	8.25
2027/28	8.25	8.25	8.25	8.25	8.25	8.25
2028/29	8.25	8.25	8.25	8.25	8.25	8.25
2029/30	8.25	8.25	8.25	8.25	8.25	8.25
Net value of CAC (£m)						
2025/26	4.63	5.24	5.35	4.93	5.25	5.37
2026/27	4.59	5.22	5.32	4.91	5.24	5.36
2027/28	4.55	5.20	5.30	4.89	5.23	5.34
2028/29	4.52	5.19	5.27	4.87	5.22	5.33
2029/30	4.48	5.17	5.24	4.85	5.21	5.31
AMP8	**22.76**	**26.01**	**26.48**	**24.44**	**26.14**	**26.72**

Source: Oxera analysis

Table A1.6 Meter renewals implicit allowances and cost adjustment claims (WW1–WW6)

	WW1	WW2	WW3	WW4	WW5	WW6
Implicit renewals rate (%)						
2025/26	2.43	2.44	1.99	2.01	1.93	1.94
2026/27	2.43	2.44	1.98	2.00	1.93	1.94
2027/28	2.44	2.45	1.98	2.00	1.93	1.94
2028/29	2.45	2.46	1.98	2.00	1.94	1.95
2029/30	2.46	2.47	1.97	1.99	1.95	1.95
Implicit renewal activity						
2025/26	24186	24279	19798	19998	19225	19311
2026/27	24440	24532	19913	20115	19383	19467
2027/28	24687	24778	20021	20225	19554	19637
2028/29	24928	25018	20123	20329	19738	19820
2029/30	25161	25250	20217	20424	19936	20017
Implicit allowance (£m)						
2025/26	3.64	3.65	2.98	3.01	2.89	2.90
2026/27	3.68	3.69	2.99	3.02	2.91	2.93
2027/28	3.71	3.73	3.01	3.04	2.94	2.95
2028/29	3.75	3.76	3.03	3.06	2.97	2.98
2029/30	3.78	3.80	3.04	3.07	3.00	3.01
Expected renewal activity						
2025/26	54889	54889	54889	54889	54889	54889
2026/27	54889	54889	54889	54889	54889	54889
2027/28	54889	54889	54889	54889	54889	54889
2028/29	54889	54889	54889	54889	54889	54889
2029/30	54889	54889	54889	54889	54889	54889
Gross value of CAC (£m)						
2025/26	8.25	8.25	8.25	8.25	8.25	8.25
2026/27	8.25	8.25	8.25	8.25	8.25	8.25
2027/28	8.25	8.25	8.25	8.25	8.25	8.25
2028/29	8.25	8.25	8.25	8.25	8.25	8.25

	WW1	WW2	WW3	WW4	WW5	WW6
2029/30	8.25	8.25	8.25	8.25	8.25	8.25
Net Value of CAC (£m)						
2025/26	4.62	4.60	5.28	5.25	5.36	5.35
2026/27	4.58	4.57	5.26	5.23	5.34	5.33
2027/28	4.54	4.53	5.24	5.21	5.31	5.30
2028/29	4.51	4.49	5.23	5.20	5.29	5.27
2029/30	4.47	4.46	5.21	5.18	5.26	5.24
AMP8	**22.71**	**22.65**	**26.22**	**26.07**	**26.56**	**26.50**

Source: Oxera analysis

Table A1.7 Meter renewals implicit allowances and cost adjustment claims (WW7–WW12)

	WW7	WW8	WW9	WW10	WW11	WW12
Implicit renewals rate (%)						
2025/26	2.26	2.26	2.02	2.04	1.94	1.94
2026/27	2.26	2.26	2.02	2.03	1.94	1.94
2027/28	2.26	2.26	2.01	2.03	1.94	1.94
2028/29	2.25	2.26	2.00	2.02	1.93	1.93
2029/30	2.25	2.26	2.00	2.02	1.93	1.93
Implicit renewal activity						
2025/26	22491	22576	20171	20345	19367	19368
2026/27	22650	22736	20255	20432	19468	19468
2027/28	22802	22888	20332	20512	19572	19571
2028/29	22947	23033	20402	20584	19678	19677
2029/30	23084	23170	20464	20648	19788	19786
Implicit allowance (£m)						
2025/26	3.38	3.40	3.03	3.06	2.91	2.91
2026/27	3.41	3.42	3.05	3.07	2.93	2.93
2027/28	3.43	3.44	3.06	3.08	2.94	2.94
2028/29	3.45	3.46	3.07	3.10	2.96	2.96

	WW7	WW8	WW9	WW10	WW11	WW12
2029/30	3.47	3.48	3.08	3.11	2.98	2.98
Expected renewal activity						
2025/26	54889	54889	54889	54889	54889	54889
2026/27	54889	54889	54889	54889	54889	54889
2027/28	54889	54889	54889	54889	54889	54889
2028/29	54889	54889	54889	54889	54889	54889
2029/30	54889	54889	54889	54889	54889	54889
Gross value of CAC (£m)						
2025/26	8.25	8.25	8.25	8.25	8.25	8.25
2026/27	8.25	8.25	8.25	8.25	8.25	8.25
2027/28	8.25	8.25	8.25	8.25	8.25	8.25
2028/29	8.25	8.25	8.25	8.25	8.25	8.25
2029/30	8.25	8.25	8.25	8.25	8.25	8.25
Net value of CAC (£m)						
2025/26	4.87	4.86	5.22	5.19	5.34	5.34
2026/27	4.85	4.84	5.21	5.18	5.33	5.33
2027/28	4.83	4.81	5.20	5.17	5.31	5.31
2028/29	4.80	4.79	5.19	5.16	5.29	5.30
2029/30	4.78	4.77	5.18	5.15	5.28	5.28
AMP8	**24.13**	**24.07**	**25.99**	**25.85**	**26.55**	**26.55**

Source: Oxera analysis

Table A1.8 below lists the expected total historical expenditure for meter renewals.

Table A1.8 Meter renewals total historical expenditure

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Total renewal activity	5656	6048	13312	18616	28748	29128	7597	8490	9047	8571	8575

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Total historical expenditure (£m)	0.851	0.909	2.002	2.799	4.323	4.380	1.142	1.277	1.360	1.289	1.290

Note: Total historical expenditure has been assumed to be the total cost of renewal activity for the year, at the efficient unit cost assumed for the CAC. Total renewal activity is the sum of the number of household and non-household meters renewed (BN1765 + BN1767)

Table A1.9 below lists the forecast CACs and implicit allowances for the meter renewals claim.

Table A1.9 Meter renewals forecast CACs and implicit allowances

	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Gross CAC (£m)	2.070	2.086	2.101	8.254	8.254	8.254	8.254	8.254
Implicit allowance (£m)	3.038	3.060	3.115	3.137	3.158	3.180	3.201	3.222
Net CAC (£m)	-0.968	-0.974	-1.014	5.118	5.096	5.075	5.053	5.032

Note: The expected meter renewal activity for 2022/23 to 2024/25 has been assumed to be the average of the historical dataset. We note that this is unrealistic, given internal information that there will be a surge in activity during these years.

A2 Network reinforcement

A2.1 Model results

This section provides details on the PR24 models results when network reinforcement expenditure is excluded from modelled base cost.

Table A2.1 PR24 cost model results excluding network reinforcement expenditure (TWD1–TWD6)

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Length of mains (log)	1.057***	1.013***	1.063***	1.051***	1.006***	1.036***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Weighted average density—LAD from MSOA (log)	-2.683***	–	–	-3.016***	–	–
	(0.000)	–	–	(0.000)	–	–
Weighted average density—LAD from MSOA (log) squared	0.218***	–	–	0.233***	–	–
	(0.000)	–	–	(0.000)	–	–
Weighted average density—MSOA (log)	–	-5.372***	–	–	-6.617***	–
	–	(0.000)	–	–	(0.000)	–
Weighted average density—MSOA (log) squared	–	0.383***	–	–	0.451***	–
	–	(0.000)	–	–	(0.000)	–
Properties per length of mains (log)	–	–	-14.622***	–	–	-17.076***
	–	–	(0.000)	–	–	(0.000)
Properties per length of mains (log) squared	–	–	1.871***	–	–	2.111***
	–	–	(0.000)	–	–	(0.000)
Boosters per length of mains (log)	0.522***	0.483***	0.546***	–	–	–
	(0.000)	(0.000)	(0.000)	–	–	–
Average pumping head (log)	–	–	–	0.328***	0.382***	0.329***
	–	–	–	(0.000)	(0.000)	(0.000)

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Constant	4.256***	15.067***	24.573***	2.295	17.022***	27.211***
	(0.001)	(0.002)	(0.000)	(0.130)	(0.000)	(0.000)
Adjusted R-Squared	0.96	0.955	0.962	0.961	0.964	0.966

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses.
Source: Oxera analysis.

Table A2.2 PR24 cost model results excluding network reinforcement expenditure (WW1–WW6)

	WW1	WW2	WW3	WW4	WW5	WW6
Properties (log)	1.065***	1.055***	1.045***	1.040***	1.039***	1.032***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Weighted average treatment complexity (log)	–	0.346**	–	0.315**	–	0.357***
	–	(0.020)	–	(0.037)	–	(0.009)
Water treated at complexity levels 3 to 6 (%)	0.003***	–	0.003**	–	0.003***	–
	(0.003)	–	(0.015)	–	(0.001)	–
Weighted average density—LAD from MSOA (log)	-1.850***	-1.667***	–	–	–	–
	(0.000)	(0.000)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.133***	0.119***	–	–	–	–
	(0.000)	(0.000)	–	–	–	–
Weighted average density—MSOA (log)	–	–	-4.614***	-4.294***	–	–
	–	–	(0.001)	(0.001)	–	–
Weighted average density—MSOA (log) squared	–	–	0.299***	0.277***	–	–
	–	–	(0.000)	(0.001)	–	–
Properties per length of mains (log)	–	–	–	–	-11.096***	-10.272***

	WW1	WW2	WW3	WW4	WW5	WW6
	–	–	–	–	(0.000)	(0.000)
Properties per length of mains (log) squared	–	–	–	–	1.305***	1.202***
	–	–	–	–	(0.000)	(0.000)
Boosters per length of mains (log)	0.495***	0.481***	0.537***	0.514***	0.415**	0.390**
	(0.003)	(0.002)	(0.001)	(0.002)	(0.019)	(0.024)
Constant	-1.79	-2.566*	10.125**	8.716*	15.395***	13.499***
	(0.211)	(0.070)	(0.049)	(0.094)	(0.002)	(0.005)
Adjusted R-squared	0.965	0.967	0.963	0.965	0.966	0.967

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses.
Source: Oxera analysis.

Table A2.3 PR24 cost model results excluding network reinforcement expenditure (WW7–WW12)

	WW7	WW8	WW9	WW10	WW11	WW12
Properties (log)	1.061***	1.054***	1.035***	1.031***	1.020***	1.015***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Weighted average treatment complexity (log)	–	0.274	–	0.246	–	0.304*
	–	(0.103)	–	(0.139)	–	(0.052)
Water treated at complexity levels 3 to 6 (%)	0.003**	–	0.002*	–	0.003**	–
	(0.041)	–	(0.092)	–	(0.020)	–
Weighted average density—LAD from MSOA (log)	-2.222***	-2.091***	–	–	–	–
	(0.000)	(0.000)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.152***	0.142***	–	–	–	–
	(0.000)	(0.000)	–	–	–	–

	WW7	WW8	WW9	WW10	WW11	WW12
Weighted average density—MSOA (log)	–	–	-6.174***	-5.947***	–	–
	–	–	(0.000)	(0.000)	–	–
Weighted average density—MSOA (log) squared	–	–	0.387***	0.372***	–	–
	–	–	(0.000)	(0.000)	–	–
Properties per length of mains (log)	–	–	–	–	-12.959***	-12.270***
	–	–	–	–	(0.000)	(0.000)
Properties per length of mains (log) squared	–	–	–	–	1.492***	1.408***
	–	–	–	–	(0.000)	(0.000)
Average pumping head (log)	0.327***	0.320***	0.340***	0.333***	0.259**	0.249*
	(0.003)	(0.004)	(0.004)	(0.005)	(0.037)	(0.052)
Constant	-3.488**	-3.990**	13.386***	12.441**	17.388***	15.881***
	(0.047)	(0.024)	(0.010)	(0.021)	(0.000)	(0.000)
Adjusted R-squared	0.962	0.963	0.959	0.96	0.964	0.965

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses.
Source: Oxera analysis.

A2.2 Cost adjustment claim breakdown

Tables A2.4, A2.5 and A2.6 breakdown the network reinforcement implicit allowances and cost adjustment claims by PR24 model.

Table A2.4 Network reinforcement implicit allowances and cost adjustment claims (TWD1–TWD6)

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Predicted cost with reinforcement (£m)	350.65	392.14	383.95	412.81	451.02	435.13
Predicted cost without reinforcement (£m)	336.07	379.16	371.48	393.99	432.37	416.74
Implicit allowance for reinforcement (£m)	14.58	12.98	12.47	18.82	18.66	18.39
SEW's reinforcement expenditure (£m)	33.90	33.90	33.90	33.90	33.90	33.90

	TWD1	TWD2	TWD3	TWD4	TWD5	TWD6
Net claim value (£m)	15.42	17.02	17.53	11.18	11.34	11.61

Source: Oxera analysis.

Table A2.5 Network reinforcement implicit allowances and cost adjustment claims (WW1–WW6)

	WW1	WW2	WW3	WW4	WW5	WW6
Predicted cost with reinforcement (£m)	724.05	726.57	717.49	719.61	715.01	717.69
Predicted cost without reinforcement (£m)	704.34	706.30	703.18	704.74	700.71	702.58
Implicit allowance for reinforcement (£m)	19.72	20.27	14.31	14.87	14.29	15.10
SEW's reinforcement expenditure (£m)	33.90	33.90	33.90	33.90	33.90	33.90
Net claim value (£m)	14.18	13.63	19.59	19.03	19.61	18.80

Source: Oxera analysis.

Table A2.6 Network reinforcement implicit allowances and cost adjustment claims (WW7–WW12)

	WW7	WW8	WW9	WW10	WW11	WW12
Predicted cost with reinforcement (£m)	843.51	841.36	807.58	805.67	785.12	782.84
Predicted cost without reinforcement (£m)	818.97	817.14	786.95	785.21	764.88	762.83
Implicit allowance for reinforcement (£m)	24.53	24.21	20.62	20.46	20.24	20.01
SEW's reinforcement expenditure (£m)	33.90	33.90	33.90	33.90	33.90	33.90
Net claim value (£m)	9.37	9.69	13.28	13.44	13.66	13.89

Source: Oxera analysis

Table A2.7 below lists the total historical expenditure for network reinforcement.

Table A2.7 Network reinforcement total historical expenditure

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Total historical expenditure (£m)	17.722	16.879	13.298	11.322	23.503	8.119	6.457	4.722	4.007	5.158	11.621

Note: Total historical expenditure calculated as the sum of infrastructure network reinforcement—CAPEX and OPEX—treated water distribution (B0201DSITDWNC + B0201DSITDWNO)

Table A2.8 below lists the forecast CACs and implicit allowances for the network reinforcement claim.

Table A2.8 Network reinforcement forecast CACs and implicit allowances

	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Gross CAC (£m)	11.164	11.164	11.164	6.780	6.780	6.780	6.780	6.780
Implicit allowance (£m)	3.311	3.368	3.427	3.452	3.478	3.504	3.530	3.555
Net CAC (£m)	7.853	7.796	7.738	3.328	3.302	3.276	3.250	3.225

Note: The gross CAC for 2022/23 through to 2024/25 is assumed to be the average network reinforcement expenditure across the historical dataset.

A2.3 Symmetrical adjustment

The table below shows how the network reinforcement CAC affects other companies' cost allowances on an outturn basis (2018–22).

Table A2.9 Symmetrical adjustment

Company	Gross CAC (£m)	Implicit Allowance (£m)	Net CAC (£m)
AFW	25.10	11.04	14.06
ANH	97.39	50.44	46.95
BRL	11.65	3.72	7.93

Company	Gross CAC (£m)	Implicit Allowance (£m)	Net CAC (£m)
HDD	0.05	1.12	-1.07
NES	6.87	24.27	-17.40
NWT	23.35	42.64	-19.29
PRT	1.72	-0.65	2.37
SES	0.42	2.42	-2.00
SEW	31.97	16.03	15.94
SRN	2.10	6.12	-4.02
SSC	7.97	8.47	-0.50
SVE	53.37	60.32	-6.96
SWB	2.40	19.24	-16.83
TMS	42.52	37.90	4.63
WSH	2.77	27.55	-24.78
WSX	4.78	9.20	-4.42
YKY	23.51	31.45	-7.94
Industry total			-13.34

Source: Oxera analysis.

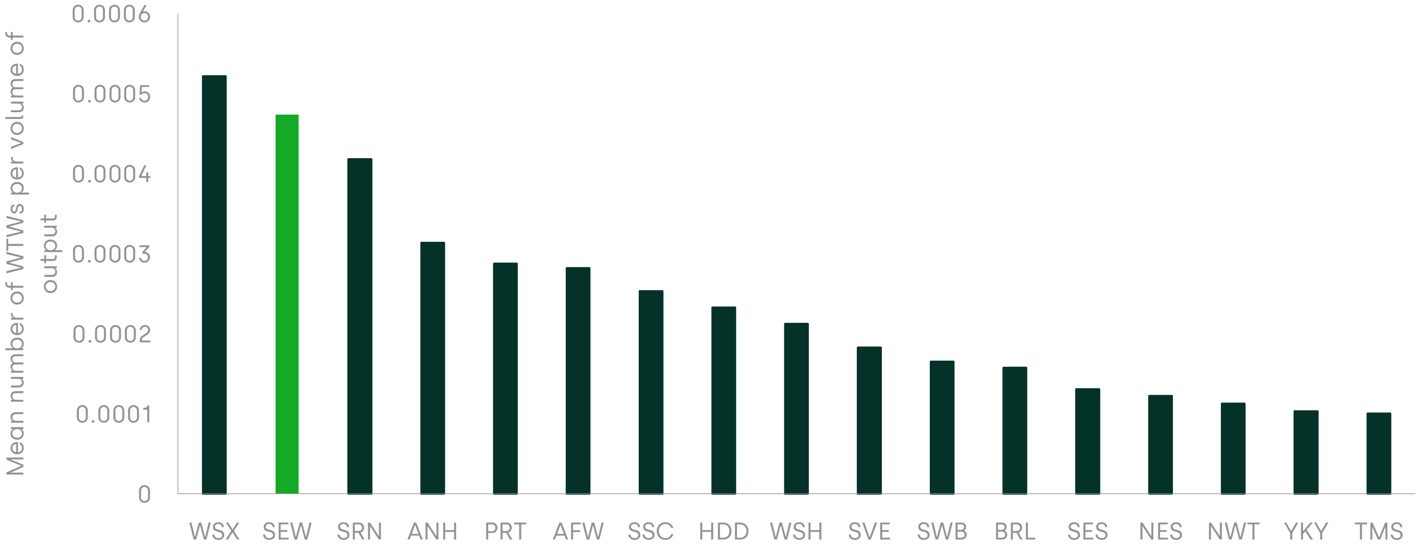
A3 Economies of scale at water treatment works

A3.1 Requirement of adjustment

This section provides further evidence regarding the unique position of SEW relative to the industry in terms of WTW sizes, and thus, the ability to exploit economies of scale.

Figure A3.1 below illustrates the distribution of WTWs per output across the industry.

Figure A3.1 Distribution of WTWs per volume of output

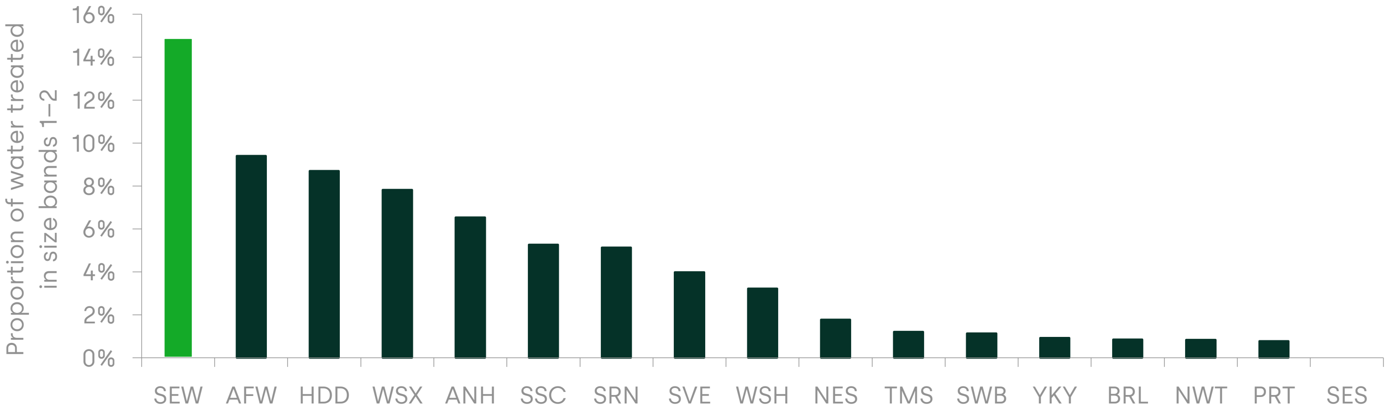


Source: Oxera analysis

The figure shows that SEW has more WTWs per volume of water treated than the rest of the industry, with the exception of WSX.

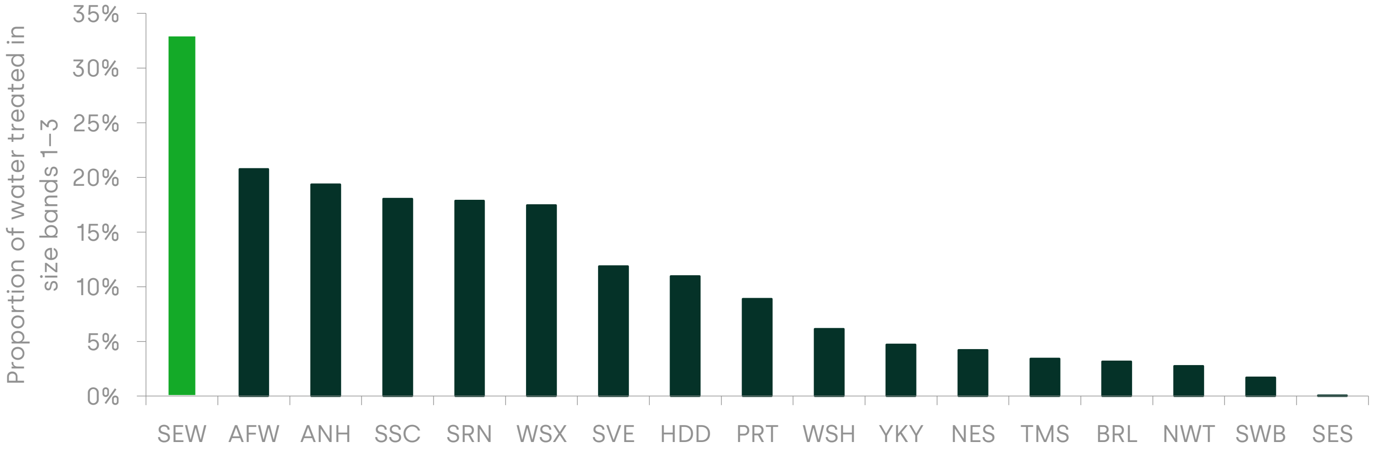
The figures below show how SEW compares to the rest of the industry with respect to the proportion of water treated in 'small' size bands. These are equivalent to the economies of scale variables that Ofwat considers in its sewage treatment models.

Figure A3.2 Proportion of water volume treated in size bands 1–2 by company



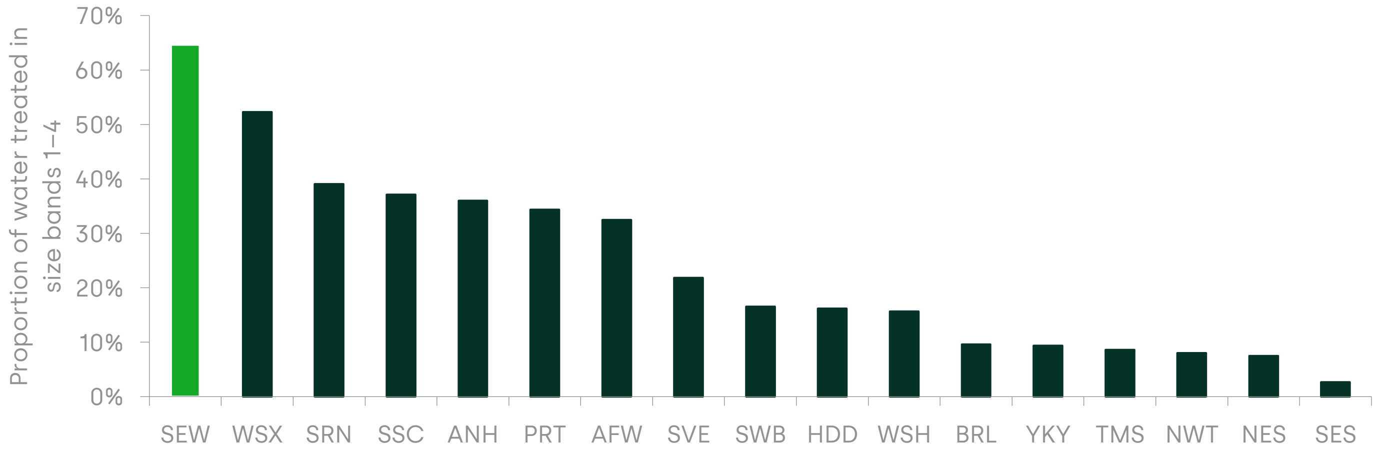
Source: Oxera analysis.

Figure A3.3 Proportion of water volume treated at size bands 1–3



Source: Oxera analysis.

Figure A3.4 Proportion of water volume treated size bands 1–4



Source: Oxera analysis.

The figures show that SEW treats more water at smaller WTWs than the rest of the industry, indicating that it cannot benefit from the same WTW-level economies of scale as other companies.

The tables below show the extent to which the PR24 wholesale water cost drivers capture economies of scale (i.e. a regression of the WTWs per property against the PR24 cost drivers).

Table A3.1 Results from regressions of WTW per property (log) on PR24 models (WW1–WW6)

	WW1	**WW2**	**WW3**	**WW4**	**WW5**	**WW6**
Properties (log)	-0.015	0.003	-0.009	-0.01	-0.029	-0.022
	(0.814)	(0.972)	(0.893)	(0.915)	(0.635)	(0.777)
Water treated at complexity level 3 to 6 (%)	-0.017***		-0.018***		-0.018***	
	(0.000)		(0.000)		(0.000)	
Weighted average treatment complexity (log)		-1.377***		-1.374***		-1.368***
		(0.001)		(0.002)		(0.002)
Weighted average density – LAD from MSOA (log)	0.201	-0.512				

	WW1	WW2	WW3	WW4	WW5	WW6
	(0.792)	(0.601)				
Weighted average density – LAD from MSOA (log) squared	-0.025	0.027				
	(0.638)	(0.679)				
Weighted average density – MSOA (log)			0.629	-0.086		
			(0.793)	(0.977)		
Weighted average density – MSOA (log) squared			-0.053	-0.002		
			(0.708)	(0.990)		
Properties per length of mains (log)					3.868	-0.701
					(0.581)	(0.935)
Properties per length of mains (log) squared					-0.49	0.058
					(0.536)	(0.953)
Boosters per length of mains (log)	0.511	0.545	0.587	0.665	0.608	0.651
	(0.166)	(0.231)	(0.102)	(0.132)	(0.160)	(0.218)
Constant	-6.316**	-3.361	-7.515	-4.119	-13.071	-2.89
	(0.034)	(0.387)	(0.422)	(0.720)	(0.384)	(0.877)
Adjusted R-Squared	0.575	0.44	0.569	0.425	0.565	0.423

Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are in parentheses. The dependent variable is the log of WTW per property.
Source: Oxera analysis.

Table A3.2 Results from regressions of WTW per property (log) on PR24 models (WW7–WW12)

	WW7	WW8	WW9	WW10	WW11	WW12
Properties (log)	-0.01	0.015	-0.002	0.006	-0.043	-0.032
	(0.853)	(0.851)	(0.974)	(0.951)	(0.446)	(0.677)

	WW7	WW8	WW9	WW10	WW11	WW12
Water treated at complexity level 3 to 6 (%)	-0.019***		-0.020***		-0.019***	
	(0.000)		(0.000)		(0.000)	
Weighted average treatment complexity (log)		-1.605***		-1.677***		-1.588***
		(0.000)		(0.003)		(0.001)
Weighted average density – LAD from MSOA (log)	-0.057	-0.891				
	(0.939)	(0.371)				
Weighted average density – LAD from MSOA (log) squared	-0.014	0.046				
	(0.792)	(0.500)				
Weighted average density – MSOA (log)			-0.935	-2.198		
			(0.683)	(0.470)		
Weighted average density – MSOA (log) squared			0.033	0.117		
			(0.814)	(0.526)		
Properties per length of mains (log)					1.259	-4.064
					(0.809)	(0.559)
Properties per length of mains (log) squared					-0.233	0.401
					(0.700)	(0.615)
Average pumping head (log)	0.321*	0.367*	0.308	0.365	0.284	0.318
	(0.066)	(0.075)	(0.130)	(0.113)	(0.133)	(0.115)
Constant	-8.499***	-5.337	-4.282	0.956	-10.077	1.574
	(0.003)	(0.140)	(0.634)	(0.937)	(0.380)	(0.918)
Adjusted R-Squared	0.565	0.433	0.533	0.38	0.533	0.387

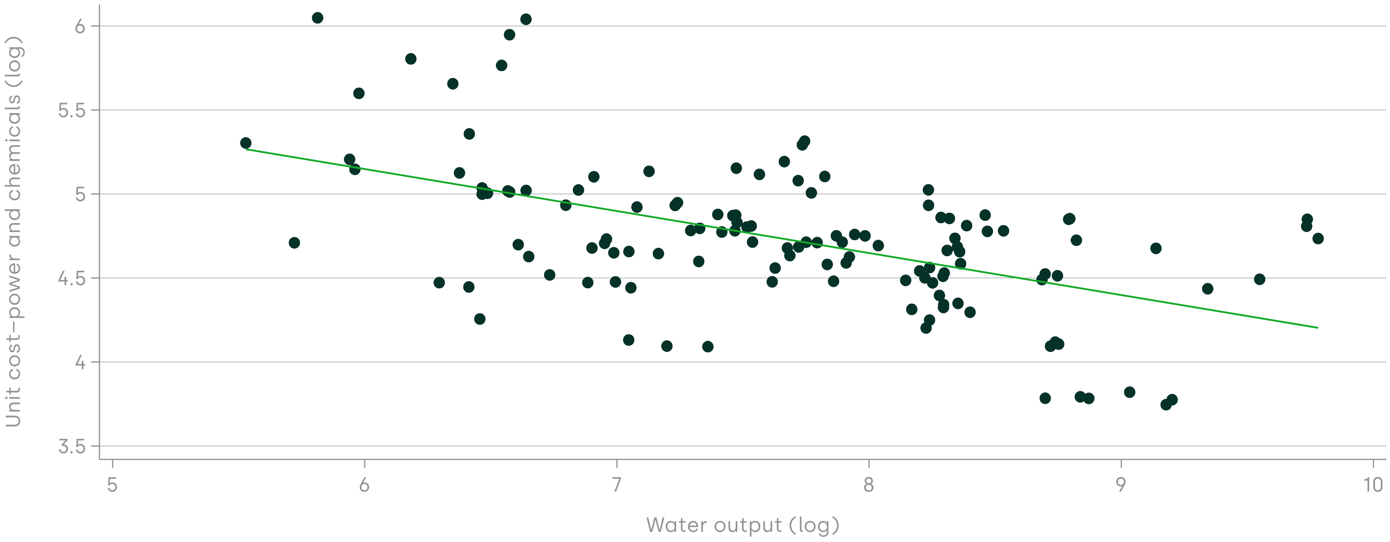
Note: ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are in parentheses. The dependent variable is the log of WTW per property.
Source: Oxera analysis.

A3.2 Evidence for cost adjustment claim

This section provides evidence regarding the presence and magnitude of economies of scale at the WTW-level. This is based on internal data provided by SEW regarding expenditure, volume of water treated and treatment complexity levels.

Figure A3.5 below shows the relationship between unit costs (defined as power and chemicals expenditure divided by the volume of water treated) and WTW size (defined as the volume of water treated).

Figure A3.5 Relationship between volume of water treated and unit cost of power and chemicals



Note: Correlation between water output (log) and unit cost–power and chemicals (log) is -0.5395, and is statistically significant at the 1% level.

The figure shows that unit costs are negatively correlated with WTW-size i.e. unit costs fall as the size of the WTW increases. Therefore, there is evidence that WTW-level economies of scale is present in the data.

Table A3.3 below shows the regression results when estimating the relationship between water output, and power and chemicals unit costs.

Table A3.3 Power and chemicals unit cost at the WTW level regression results

	Power and chemicals unit cost (log)	Power and chemicals unit cost (log)	Power and chemicals unit cost (log)
Water output (log)	-0.334***	-0.331***	-0.336***
	(0.000)	(0.000)	(0.000)
Treatment complexity 3 to 6		0.079	
		(0.329)	
Treatment complexity			0.032
			(0.378)
Constant	7.290***	7.191***	7.181***
	(0.000)	(0.000)	(0.000)
Adjusted R-squared	0.291	0.276	0.275
Observations	129	125	125

Note: Treatment complexity 3 to 6 is a dummy variable = 1 if the WTW operates at complexity bands 3 to 6. ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are in parentheses.
Source: Oxera analysis using SEW data.

The coefficient on water output is negative and statistically significant across specifications, supporting the presence of economies of scale.

A3.3 Implicit allowance

This section provides supplementary evidence on the estimation of the implicit allowance.

Tables A3.4, A3.5 and A3.6 list the model results when the PR24 models are regressed to average WTW size, based on volume of water treated per WTW.

Table A3.4 PR24 model results when regressed to average WTW size (WRP1–WRP6)

	WRP1	WRP2	WRP3	WRP4	WRP5	WRP6
Properties (log)	0.057	0.035	0.042	0.039	0.08	0.07
	(0.379)	(0.694)	(0.562)	(0.702)	(0.212)	(0.406)

	WRP1	WRP2	WRP3	WRP4	WRP5	WRP6
Water treated at complexity level 3 to 6 (%)	0.019***	–	0.020***	–	0.020***	–
	(0.000)	–	(0.000)	–	(0.000)	–
Weighted average treatment complexity (log)	–	1.599***	–	1.642***	–	1.626***
	–	(0.000)	–	(0.002)	–	(0.001)
Weighted average density—LAD from MSOA (log)	-0.772	0.054	–	–	–	–
	(0.315)	(0.958)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.075	0.016	–	–	–	–
	(0.171)	(0.827)	–	–	–	–
Weighted average density—MSOA (log)	–	–	-1.252	-0.174	–	–
	–	–	(0.568)	(0.953)	–	–
Weighted average density—MSOA (log) squared	–	–	0.11	0.037	–	–
	–	–	(0.414)	(0.837)	–	–
Properties per length of mains (log)	–	–	–	–	-5.938	-0.384
	–	–	–	–	(0.280)	(0.957)
Properties per length of mains (log) squared	–	–	–	–	0.797	0.137
	–	–	–	–	(0.214)	(0.867)
Constant	7.560**	4.24	9.122	4.387	16.323	4.026
	(0.016)	(0.301)	(0.313)	(0.719)	(0.181)	(0.799)
Adjusted R-squared	0.591	0.46	0.561	0.415	0.569	0.426

Note: Average WTW size is based on output per WTW (log). ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses.
Source: Oxera analysis.

Table A3.5 PR24 model results when regressed to average WTW size (WW1–WW6)

	WW1	WW2	WW3	WW4	WW5	WW6
Properties (log)	0.053	0.03	0.042	0.038	0.06	0.049
	(0.423)	(0.721)	(0.567)	(0.692)	(0.350)	(0.547)
Water treated at complexity level 3 to 6 (%)	0.019***	–	0.019***	–	0.020***	–
	(0.000)	–	(0.000)	–	(0.000)	–
Weighted average treatment complexity (log)	–	1.582***	–	1.564***	–	1.577***
	–	(0.000)	–	(0.000)	–	(0.000)
Weighted average density—LAD from MSOA (log)	-0.914	-0.109	–	–	–	–
	(0.252)	(0.911)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.077	0.019	–	–	–	–
	(0.159)	(0.778)	–	–	–	–
Weighted average density—MSOA (log)	–	–	-2.23	-1.325	–	–
	–	–	(0.368)	(0.645)	–	–
Weighted average density—MSOA (log) squared	–	–	0.157	0.094	–	–
	–	–	(0.283)	(0.581)	–	–
Properties per length of mains (log)	–	–	–	–	-9.011	-3.849
	–	–	–	–	(0.208)	(0.657)
Properties per length of mains (log) squared	–	–	–	–	1.1	0.482
	–	–	–	–	(0.173)	(0.620)
Boosters per length of mains (log)	-0.496	-0.533	-0.589	-0.67	-0.627	-0.672
	(0.210)	(0.282)	(0.134)	(0.162)	(0.175)	(0.243)
Constant	6.465**	3.1	11.467	7.223	21.61	10.072
	(0.036)	(0.419)	(0.234)	(0.521)	(0.156)	(0.588)

	WW1	WW2	WW3	WW4	WW5	WW6
Adjusted R-squared	0.624	0.499	0.616	0.487	0.62	0.485

Note: Average WTW size is based on output per WTW (log). ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses.
Source: Oxera analysis.

Table A3.6 PR24 model results when regressed to average WTW size (WW7–WW12)

	WW7	WW8	WW9	WW10	WW11	WW12
Properties (log)	0.049	0.017	0.035	0.023	0.075	0.06
	(0.411)	(0.839)	(0.604)	(0.818)	(0.229)	(0.474)
Water treated at complexity level 3 to 6 (%)	0.021***	–	0.021***	–	0.021***	–
	(0.000)	–	(0.000)	–	(0.000)	–
Weighted average treatment complexity (log)	–	1.814***	–	1.867***	–	1.808***
	–	(0.000)	–	(0.000)	–	(0.000)
Weighted average density—LAD from MSOA (log)	-0.662	0.271	–	–	–	–
	(0.408)	(0.786)	–	–	–	–
Weighted average density—LAD from MSOA (log) squared	0.067	-0.001	–	–	–	–
	(0.240)	(0.993)	–	–	–	–
Weighted average density—MSOA (log)	–	–	-0.692	0.796	–	–
	–	–	(0.777)	(0.796)	–	–
Weighted average density—MSOA (log) squared	–	–	0.073	-0.026	–	–
	–	–	(0.628)	(0.889)	–	–
Properties per length of mains (log)	–	–	–	–	-6.317	-0.378
	–	–	–	–	(0.235)	(0.956)

	WW7	WW8	WW9	WW10	WW11	WW12
Properties per length of mains (log) squared	–	–	–	–	0.834	0.127
	–	–	–	–	(0.178)	(0.870)
Average pumping head (log)	-0.315	-0.375*	-0.293	-0.364	-0.289	-0.335
	(0.101)	(0.077)	(0.196)	(0.131)	(0.160)	(0.118)
Constant	8.597***	5.068	8.271	2.128	18.495	5.495
	(0.003)	(0.149)	(0.387)	(0.860)	(0.112)	(0.712)
Adjusted R-squared	0.617	0.496	0.583	0.447	0.59	0.454

Note: Average WTW size is based on output per WTW (log). ***, **, * indicate statistical significance at the 0.01, 0.05 and 0.1 levels respectively. P-values are denoted in parentheses.
Source: Oxera analysis.

A3.4 Cost adjustment claim breakdown

This section details the breakdown of each PR24 model and their implicitly funded renewal rate, subsequent allowances and cost adjustment claim values for economies of scale at the WTW level.

The following tables A3.7, A3.8 and A3.9 breakdown the implicit WTW size and subsequent cost adjustment claims by PR24 model.

Table A3.7 Possible cost claims for economies of scale (WRP1–WRP6)

Model	WRP1	WRP2	WRP3	WRP4	WRP5	WRP6
Average WTW size predicted by PR24 model (Ml)						
2025/26	3736	3647	4092	3980	4072	4014
2026/27	3740	3650	4102	3989	4079	4022
2027/28	3744	3654	4112	3998	4086	4028
2028/29	3747	3658	4122	4007	4092	4034
2029/30	3751	3661	4133	4017	4097	4039
Forecasted average WTW size (Ml)						
2025/26	2139	2139	2139	2139	2139	2139
2026/27	2143	2143	2143	2143	2143	2143
2027/28	2146	2146	2146	2146	2146	2146

Model	WRP1	WRP2	WRP3	WRP4	WRP5	WRP6
2028/29	2150	2150	2150	2150	2150	2150
2029/30	2153	2153	2153	2153	2153	2153
AMP8 CAC claim: assumption one, £m	17.9	17.2	20.6	19.8	20.4	20.0
AMP8 CAC claim: assumption two, £m	41.8	40.1	48.1	46.2	47.7	46.7

Note: 'Average WTW size' is defined as the average volume of water treated per WTW.
Source: Oxera analysis.

Table A3.8 Possible cost claims for economies of scale (WW1–WW6)

Model	WW1	WW2	WW3	WW4	WW5	WW6
Average WTW size predicted by PR24 model (Ml)						
2025/26	3929	3851	4155	4057	4104	4050
2026/27	3939	3861	4169	4070	4117	4063
2027/28	3949	3871	4184	4084	4129	4076
2028/29	3958	3881	4198	4098	4141	4088
2029/30	3968	3891	4212	4111	4153	4101
Forecasted average WTW size (Ml)						
2025/26	2139	2139	2139	2139	2139	2139
2026/27	2143	2143	2143	2143	2143	2143
2027/28	2146	2146	2146	2146	2146	2146
2028/29	2150	2150	2150	2150	2150	2150
2029/30	2153	2153	2153	2153	2153	2153
AMP8 CAC claim: assumption one, £m	19.5	18.9	21.1	20.4	20.7	20.4
AMP8 CAC claim: assumption two, £m	45.0	43.7	48.9	47.3	48.0	47.1

Note: 'Average WTW size' is defined as the average volume of water treated per WTW.
Source: Oxera analysis.

Table A3.9 Possible cost claims for economies of scale (WW7–WW12)

Model	**WW7**	**WW8**	**WW9**	**WW10**	**WW11**	**WW12**
Average WTW size predicted by PR24 model (Ml)						
2025/26	3425	3284	3780	3602	3748	3645
2026/27	3428	3287	3790	3610	3754	3651
2027/28	3432	3290	3799	3618	3760	3656
2028/29	3435	3293	3808	3626	3765	3661
2029/30	3438	3296	3817	3634	3769	3664
Forecasted average WTW size (Ml)						
2025/26	2139	2139	2139	2139	2139	2139
2026/27	2143	2143	2143	2143	2143	2143
2027/28	2146	2146	2146	2146	2146	2146
2028/29	2150	2150	2150	2150	2150	2150
2029/30	2153	2153	2153	2153	2153	2153
AMP8 CAC claim: assumption one, £m	15.3	14.0	18.3	16.9	18.0	17.2
AMP8 CAC claim: assumption two, £m	35.5	32.5	42.4	39.1	41.7	39.8

Note: 'Average WTW size' is defined as the average volume of water treated per WTW.
Source: Oxera analysis.

Table A3.10 below lists the expected total historical expenditure for power and chemicals cost at WTW.

Table A3.10 Economies of scale at WTWs total historical expenditure

	2011/12	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**	**2021/22**
Total volume of water treated (Ml)	189078	176780	178699	185671	187634	181057	179704	180893	179597	190753	187493

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
Total historical expenditure (£m)	21.312	20.378	20.525	21.055	21.203	20.705	20.602	20.692	20.594	21.437	21.192

Note: Historical total expenditure is calculated as the modelled unit cost at the average WTW size for that year, multiplied by the total volume of water treated.

Table A3.11 below lists the forecast CACs and implicit allowances for the economies of scale at WTWs claim.

Table A3.11 Economies of scale at WTWs forecast CACs and implicit allowances

	2022/23	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30
Gross CAC (£m)	21.020	21.043	21.065	21.088	21.111	21.134	21.156	21.179
Implicit allowance (£m)	17.426	17.254	17.297	17.313	17.329	17.345	17.362	17.379
Net CAC (£m)—assumption one	3.594	3.788	3.769	3.775	3.782	3.789	3.795	3.800
Net CAC (£m)—assumption two	8.053	8.601	8.600	8.657	8.716	8.773	8.826	8.876

Note: Assumption one: solely power and chemicals expenditure. Assumption two: relationship between economies of scale with power and chemicals expenditure is consistent with that of other expenditures involved at the WTW level (e.g. capital maintenance).

A3.5 Symmetrical adjustment

Table A3.12 below shows the adjustment for each company on the basis of the WTW-level economics of scale CAC, as estimated over the last five years of outturn data (2018–22).

Table A3.12 Symmetrical adjustment

Company	Expected actual cost (Gross CAC)—£m	Implicit allowance—£m	Net CAC—£m assumption one	Net CAC—£m assumption two
AFW	163.552	134.561	28.991	35.905
ANH	208.263	189.910	18.353	27.776
BRL	40.037	40.736	-0.699	-1.762
HDD	10.028	10.973	-0.945	-2.808
NES	152.201	166.552	-14.352	-39.004
NWT	275.501	318.545	-43.044	-123.949
PRT	31.854	31.380	0.474	0.451
SES	22.691	24.825	-2.134	-8.628
SEW	104.517	85.681	18.836	35.866
SRN	112.630	88.244	24.385	97.521
SSC	74.264	71.199	3.065	2.035
SVE	297.044	303.041	-5.997	-12.816
SWB	90.574	98.279	-7.706	-22.149
TMS	328.391	326.797	1.594	4.190
WSH	134.971	135.054	-0.083	0.181
WSX	73.248	76.322	-3.074	-8.771
YKY	160.129	199.247	-39.118	-112.595
Sector	–	–	-21.452	-128.556

Source: Oxera analysis.

As shown in table A3.12, the CAC relating to WTW-level economies of scale is symmetrical on an outturn basis. Given that WTW size is largely exogenous, and does not vary materially over time, it is likely that the CAC will remain symmetrical in AMP8.

Company	Expected actual cost (Gross CAC)—£m	Implicit allowance—£m	Net CAC—£m assumption one	Net CAC—£m assumption two
AFW	163.552	134.561	28.991	35.905
ANH	208.263	189.910	18.353	27.776
BRL	40.037	40.736	-0.699	-1.762

Company	Expected actual cost (Gross CAC)—£m	Implicit allowance—£m	Net CAC—£m assumption one	Net CAC—£m assumption two
HDD	10.028	10.973	-0.945	-2.808
NES	152.201	166.552	-14.352	-39.004
NWT	275.501	318.545	-43.044	-123.949
PRT	31.854	31.380	0.474	0.451
SES	22.691	24.825	-2.134	-8.628
SEW	104.517	85.681	18.836	35.866
SRN	112.630	88.244	24.385	97.521
SSC	74.264	71.199	3.065	2.035
SVE	297.044	303.041	-5.997	-12.816
SWB	90.574	98.279	-7.706	-22.149
TMS	328.391	326.797	1.594	4.190
WSH	134.971	135.054	-0.083	0.181
WSX	73.248	76.322	-3.074	-8.771
YKY	160.129	199.247	-39.118	-112.595
Sector	–	–	-21.452	-128.556

Source: Oxera analysis.

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