PR24 Cost Adjustment Claims

June 2023

WONDERFUL ON TAP

SEVERN TRENT

Content

1. Water network complexity (APH and Boosters/length as separately complementary explanatory variables)

We consider that APH and Boosters/length are both legitimate explanatory variables but describe separate network complexity cost drivers. If used alone, models will preferentially award efficiency to companies who are relatively advantaged by the driver that is included but not the one which isn't. We have identified cost pressures at control groups which show that the wider models do not sufficiently account for our network complexity costs (and APH more widely).

This CAC aims to redress is issue.

Table 3: Claim summary table

Claim component	Value	Description
Is the claim symmetrical?	Yes	Relates to costs historically incurred by all companies. Therefore the claim would be redistributing costs currently allocated by models
Can the cost be isolated from the botex+ dependent variable?	No	Costs incurred due to water Network complexity cannot be easily abstracted from Water Botex+ costs
Is there a suitable explanatory variable available to describe the costs?	Yes	Boosters/Length and APH included in models together
Central case: Gross claim	£266.1m	Net Claim + IA calculation
Central case: IA	£82.9m	Omitted variable approach [2 options] and/or Remove explanatory variable approach [2 options]
Central case: Net Claim	£183.2m	Difference between the allowances generated by the current models and the models with network complexity fully specified, i.e. including WRP APH in the WRP models, combing TWD APH and Boosters per Length in the TWD models, and combining WW APH (WRP & TWD APH separately) and Boosters per Length in the WW models.
Range: Gross claim	£197.6m-£266.1m	Dependent on which APH values are considered – the top of the range allows WRP APH to feature in WRP models and WW APH to feature in WW models. The bottom of the range only changes TWD and WW models to allow TWD APH and Boosters per Length to feature simultaneously.
Range: IA	£71.4m - £100.7m	These ranges are themselves averages of multiple IA approaches. The level of the implicit allowance is dependent on whether we are calculating the implicit allowance just for network complexity after the treatment works or allowing for all APH to be included.
Range: Net Claim	£96.9m-£191.1m	Dependent on which APH values are considered – the top of the range allows WRP APH to feature in WRP models and WW APH to feature in WW models. The bottom of the range only changes TWD and WW models to allow TWD APH and Boosters per Length to feature simultaneously.
Relevant Price Controls		Water Resources, Water Network+

1.1 Need for adjustment (necessary)

1.1.1 Unique circumstances

Criteria

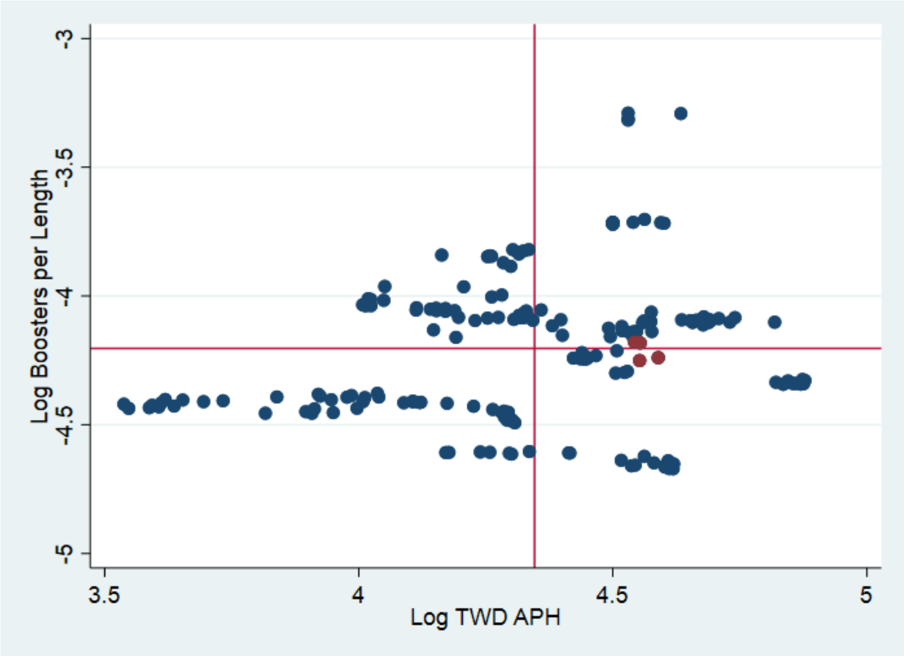
- a) Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?
- b) Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers (considering, where relevant, circumstances that drive higher costs for other companies that the company does not face)?
- c) Is there compelling evidence of alternative options being considered, where relevant?

This claim is less about that we face higher efficient costs relative to our peers but more that we face higher efficient costs relative the assumed efficient costs as predicted by Ofwat's draft PR24 consultation cost models. We consider that this due to the fact that legitimate cost drivers that are fundamentally outside of management control are not accounted for in the models. This claim focuses on drivers of water network complexity – Namely boosters/length and average pumping head. Both drive water network costs, but at differing rates, and at varying levels of importance depending on the landscape in which the assets are operating in. This is evidenced in observed control group examples which show how boosters/length and APH vary based on location (see section 2.1.3).

Whilst the drivers of network complexity that we face are not necessarily unique or exceptional (they are felt by all companies); models that are not adequately specified will systematically disadvantage companies that have more of the cost driver that is omitted from models, particularly where their other operating circumstances are such that they would be predicted to have lower levels of that cost driver, and vice versa. In this situation these companies will look less efficient than their peers who have less of the characteristic that is not accounted for in the models, particularly where the peer's operating circumstances are such that they are assumed to have a high level of the cost driver omitted from the model. For Severn Trent this is particularly pressing given the other variables included in the models are commonly associated with far lower levels of network complexity than Severn Trent has.

Figure 4 shows a scatter of log boosters per length and log TWD APH with their respective means displayed. However, the way in which this manifests into costs is a function of the way in which models are specified. We articulate this in more detail below with bottom-up evidence from control groups.

Figure 4: Scatter of Log Boosters per Length against Log TWD APH with the mean of each variable shown in red. The red scatter points highlight SVE.



We are also concerned about the omission of WRP APH. Currently this has been excluded from the models. Severn Trent has relatively high levels of WRP APH, and more than 40% of our total APH sits in Water Resources Plus. This is currently being treated as inefficiency. WRP APH is negatively associated with properties, and Severn Trent sits at around the density minima for WRP APH. The implications of this are discussed below.

1.1.2 Management control

Criteria
• d) Is the investment driven by factors outside of management control?   • e) Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

Water network complexity is fundamentally driven by the geography and geology of the companies supply area and the location and dispersion of its customers. In turn this determines where water resources can be developed, the treatment requirements and opportunities for economies of scale and how to best deliver the treated product to customers.

APH and boosters are dictated by the location of sources relative to the destination. In hilly areas with sparse populations and an absence of sources, boosters have to be used to supply those areas. Similarly, where downstream river, low lying reservoir or groundwater sources dominate there is little choice but to pump. Where these sources are large, this will contribute significantly to APH.

Whilst there may have been some opportunities for management choice at the point of planning configurations of assets. For example, trading off the location of treatment works to optimise between raw and treated networks or trading treatment requirements for proximity to demand centres. These are now fundamentally fixed due to the huge sunk costs associated with the existing network.

Overarching asset configuration must also be considered in the context of when the assets were constructed. This will have had very different input price pressures (e.g. the relative cost of pumping), demand requirements (population growth) and water resource characteristics (both raw water quality and availability). It is not appropriate for companies to be considered as efficient or inefficient given the relative outturn of these legacy configuration decisions.

We pay great attention to the performance of our assets to ensure that our network is operating as efficiently as the underlying geography/geology, location/dispersion of customers and legacy asset configuration will allow.

- [e.g. Pump efficiency team monitoring performance of pumps to determine the optimal time for them to be maintained and/or replaced;
- scheduling determining when to best use assets such that we optimise security of supply and cost – optimising when to pump and how quickly (pump slowly to reduce dynamic head and in low demand periods)].

However, these efficiency drives can only go so far. Whilst we can control the performance of our assets, we cannot control the hills and geology of our area or where our customers live.

1.1.3 Materiality

Criteria

- f) Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?
- g) Is there compelling quantitative evidence of how the factor impacts the company's expenditure?

The theoretical basis for network complexity explanatory variables.

Boosters per length is a measure of asset intensity within the network. This is the 'true' topography proxy – lots of small boosters are necessary to move water through hilly terrain to serve customers that live in these largely rural areas. This is seen in our control group analysis (below) in areas such as the northern Peak District and Rural Shropshire. Conceptionally, it is unlikely that high volumes of water will be moved through these areas because it would be particularly inefficient to do so. Where there are large population centres within such regions, water resources have traditionally been sought and developed such that gravity fed distribution networks that limit the impact on APH have developed. The need for boosters will to some extent depend on where sources and treatment works are located.

In contrast, **Average Pumping Head** (APH) is a direct measure of pumping and therefore energy usage. This can be considered as the intensity with which individual assets are working on average. APH is the weighted average 'height' that each Ml of water is pumped. This in turn is a function of the physical height lifted (static head) and the frictional effects acting on the pump (dynamic head, driven by the volume and speed of flow and the specific configuration of assets).

Most TWD pumping heads are located on water treatment sites (be it borehole pumps after treatment, or high lift pumps from surface water treatment works to strategic service reservoirs). For Severn Trent this is approximately 65% of TWD APH - with the remaining 35% largely being boosters located within the network. This means that, whilst the APH values are explicitly driving cost, they are less related to the 'hilliness' of the supply area.

On average, just 30% of pumps contribute 90% of APH but this varies between 17% and 58% of pumps for other companies[1]. Therefore, pumping energy (Opex) requirements will have a limited relationship with boosters per length. This is because these energy intensive pumps contribute just a single booster per water treatment works.

Ofwat has stated that boosters/length and APH variables are both measures of topography. This is uncontentious, but we think that they are fundamentally describing different aspects of that topography which can vary separately between companies. For example, companies can have a cost pressure from increased APH without necessarily having a corresponding increase in boosters/length and vice versa. However, where both manifest, the pressure is likely to be amplified. This is illustrated indicatively in ***Figure 5.***

Figure 5: Illustration of the interaction of boosters/length and APH explanatory variables on TWD costs. The cost gradient moves from bottom left to top right.

	Company cost pressures (where boosters/length and APH are both cost drivers)									
More boosters/length	6	7	8	9	10	11	12	13	14	15
	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5
	5	6	7	8	9	10	11	12	13	14
	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5
	4	5	6	7	8	9	10	11	12	13
	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5
	3	4	5	6	7	8	9	10	11	12
	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5
	2	3	4	5	6	7	8	9	10	11
Less boosters/length	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5
	Less TWD APH									More TWD APH

The two explanatory variables are acknowledged as legitimate explanatory variables by Ofwat due to their inclusion in the PR24 consultation models. However, they are only ever used separately in different models that are then triangulated. We consider that this causes two potential issues.

- The relative strength of the network complexity coefficients in the separate models will mean that companies that have a slight dominance of one variable over the other (e.g. relatively more APH than boosters / length) will be systematically advantaged or disadvantaged. The PR24 models suggest the Boosters / length has a slightly more stronger coefficient than APH, meaning that companies with slightly 'heavier' APH to boosters/length (including ourselves) will be slightly disadvantaged.
- There is an omitted variable bias in both of the separate models. This is the extent to which the remaining variables in the model (in this case scale, population density and the remaining network complexity driver) can accurately compensate for the omitted variable. Our analysis shows we are one of the most negatively impacted companies by this effect, This is a function of the characteristics of our supply networks meaning that we are more vulnerable to a negative omitted variable bias. Following on, the size of the remaining explanatory variables for us (most likely density) mean that this vulnerability is being realised. This can clearly be seen in our control group analysis set out below.

Demonstrating our engineering expectations at a control group level

To support our engineering expectations, we have identified a series of control groups from across our network that sit within distinct landscape and population situations. Control groups are an

[1] Average Pumping Head: data quality improvement, Turner & Townsend for Ofwat, 24 March 2022, available at: https://www.ofwat.gov.uk/wp-content/uploads/2022/05/Average-Pumping-Head-Data-Quality-Improvement-Final-Report-.pdf, p.38.

assemblage of water network assets from high lift pumps, through trunk mains, distribution service reservoirs (DSRs), booster pumping stations, into district metering areas (DMAs) to a customer's tap. They are essentially, the TWD asset assemblage for a given customer. To that end, we consider that they are valid units that can be modelled and still describe the relationships that are required in the industry wide cost models.

Companies will have a wide spectrum of control groups that in turn will have different cost signatures. Whilst these will to an extent balance out at a company level, company network expenditure requirements will be determined by the extent to which its control groups tend to more complex configurations at a company level. In order to make sure that our analysis covers the full range of control group configurations, we sampled to account for; differences in pumping head, differences in pumping assets and differences in population density. The 12 control groups that we have considered are shown in the 2 x 2 x 2 matrix below. In total, these control groups account for more than 200Ml/d of distribution input (around 12% of our company total).

Table 4: Matrix of control groups analysed to explore interaction of landscape and situation on inherent water network complexity as described by boosters/length and APH explanatory factors

		Lower levels of TWD APH		**Higher levels of TWD APH**	
		APH below 115APH below 100mhd		**APH above 100mhd above 115**	
Larger boosters per length **Boosters per Length above 0.019**	**Urban**	**Ramsdale control group**	North Nottinhgam supplied from multiple boreholes and surface water imports	**Old Park control group**	Telford / Wrekin supplied from three boreholes
	Rural	**Bakewell control group**	Rural Peak District supplied form Derwent Valley	**Bradwell Moor control group**	Rural Northern Peak District including Buxton supplied from Derwent Valley
	Rural			**Ludlow control group**	Rural undulating Shropshire supplied via remote pipeline from River Severn
Fewer Boosters per length **Boosters per Length** below 0.019	**Urban**	**Birmingham Low Level control group**	NE Birmingham supplied from Frankley (Elan) – Gravity fed	**Coventry High Level control group**	Central Coventry supplied from multiple remote surface water sources (Strensham, Whitacre, Melbourne, Frankley WTWs)
	Urban	**Warley control group**	W Birmingham supplied form Frankley (Elan Valley) via Warley Pumps		
	Rural	**Mitcheldean control group**	Rural Gloucestershire supplied from River Wye	**Higham control group**	Eastern Derbyshire Rother Valley supplied form Ogston Reservoir
	Rural	**Drum Hill control group**	Suburban fringe of N. Derby fed from River Derwent	**Ragdale Wolds control group**	Rural Leicestershire (Melton Mowbray) supplied via remote pipeline from Melbourne (River Dove)

Explanatory variable data has been gathered for each of the 12 control groups. This has large been undertaken though review of control group schematics and engineering inference rather that from empirical data sources. This will introduce uncertainty to this analysis. We plan to improve the robustness of the analysis and expand it to cover cost and performance metrics to help illustrate the direct impact of the control group configurations. Therefore we consider the analysis to be currently high level rather than precise at a local level.

Table 5: Identified attributes of the 12 control groups being analysed

Control group	Properties	Length of mains	Number of booster pumping stations (post control group input)	Number of sources (control group inputs)	Inferred Distribution Input of control group	Population Density (Properties/length)	Boosters per length	Inferred APH from boosters (after sources)	Inferred APH from sources (high lift at surface WTWs and borehole TWD fraction)	Inferred APH of control group
Bakewell	5,011	157	9	1	2.3	32.0	0.064	63	0	63
Birmingham Low	97,793	972	3	1	44.7	100.6	0.004	0	0	0
Bradwell Moor	22,270	451	10	1	10.2	49.4	0.024	96	94	189
Coventry High	92,815	737	3	5	42.4	126.0	0.011	3	147	150
Drum Hill	83,259	689	1	1	38.1	120.9	0.003	2	90	92
Higham	21,639	357	5	1	9.9	60.6	0.017	36	79	115
Ludlow	12,557	468	17	2	5.7	26.8	0.041	38	198	236
Mitcheldean	21,259	366	2	1	9.7	58.0	0.008	11	0	11
Old Park	40,658	525	6	4	18.6	77.5	0.019	22	92	114
Ragdale Wolds	11,994	220	2	2	5.5	54.5	0.018	15	134	149
Ramsdale	62,207	490	6	5	28.4	126.9	0.022	1	67	68
Warley	51,948	431	6	2	23.8	120.6	0.019	6	67	74

Notes: Given the speed of the analysis undertaken, the following assumptions have been made.
Control group distribution Input is determined at a company level and scale by connected properties.
Asset head values and pumping values are derived from a range of sources and high level understanding of the hydrology and operation of the control groups, or inferred where not available.
No Leakage assumed within the control group.

We have then placed this data into the PR24 consultation TWD models that include properties/length as a density driver. We note that these results are likely to be skewed by the size of control groups relative to companies, however this has allowed us to calculate indicative costs by control group using the following models:

- A model that includes TWD APH as the network complexity variable.
- A model that includes boosters/length as the network complexity variable.
- A triangulated values of the above two models (as per the PR24 consultation approach)
- A model that includes both the complexity drivers together.

The default expectations are the control groups which have high levels of boosters/length will have low population densities. Areas with high APH would be expected to be associated high density urban areas. Companies that legitimately deviate from this expectation (due to their external geographical circumstances) are more likely to not have their efficient costs accurately predicted.

Table 6: Cost model outputs for urban control groups with greater boosters/length

		Booster driver	APH driver	Triangulated	Combined model	Booster Driver	APH driver	Triangulated	Combined model
		Lower levels of APH				Higher levels of APH			
More boosters/length	Control group	Ramsdale				Old Park			
	Model output	8.2	6.1	7.1	7.5	2.3	2.6	2.5	2.7
	Variance to combined model	110%	81%	96%	100%	86%	94%	90%	100%
	Variance to triangulated model	115%	85%	100%	105%	96%	104%	100%	111%

Table 7: Cost model outputs for urban control groups with lesser boosters/length

		Booster driver	APH driver	Triangulated	Combined model	Booste r driver	APH driver	Triangulated	Combined model
		Lower levels of APH				Higher levels of APH			
Less boosters/length	Control Group	Birmingham low level				Coventry			
	Model output	3.7	1.0	2.4	0.7	8.7	12.0	10.4	11.1
	Variance to combined model	512%	144%	328%	100%	79%	108%	93%	100%
	Variance to triangulated model	156%	44%	100%	30%	84%	116%	100%	107%
	Control Group	Warley							
	Model output	5.5	4.6	5.1	5.3				
	Variance to combined model	104%	88%	96%	100%				
	Variance to triangulated model	109%	91%	100%	104%				

Table 8: Cost model outputs for rural control groups with greater boosters/length

		Booster driver	APH driver	Triangulated	Combined model	Booster Driver	APH driver	Triangulated	Combined model
		Lower levels of APH				Higher levels of APH			
More boosters/length	Control Group	Bakewell				Bradwell Moor			
	Model output	1.3	1.0	1.1	1.1	1.6	2.3	1.9	2.2
	Variance to combined model	118%	91%	105%	100%	73%	102%	88%	100%
	Variance to triangulated model	113%	87%	100%	96%	84%	116%	100%	114%
	Control Group					Ludlow			
	Model output					4.7	7.8	6.3	6.3
	Variance to combined model					74%	124%	99%	100%
	Variance to triangulated model					75%	125%	100%	101%

Table 9: Cost model outputs for rural control groups with lesser boosters/length

		Booster driver	APH driver	Triangulated	Combined model	Booster driver	APH driver	Triangulated	Combined model
		Lower levels of APH				Higher levels of APH			
Less boosters/length	Control Group	Mitcheldean				Higham			
	Model output	0.8	0.6	0.7	0.5	1.1	1.4	1.3	1.3
	Variance to combined model	172%	138%	155%	100%	83%	107%	95%	100%
	Variance to triangulated model	111%	89%	100%	65%	88%	112%	100%	105%
	Control Group	Drum Hill				Ragdale Wolds			
	Model output	3.7	8.2	6.0	4.6	0.7	0.9	0.8	0.9
	Variance to combined model	80%	179%	130%	100%	76%	110%	93%	100%
	Variance to triangulated model	62%	138%	100%	77%	82%	118%	100%	107%

Interpreting the control group modelling

If we consider the boosters model, the predicted level of APH increases with length, boosters and density past the minimum point at 62.4 props/length. Therefore, we would expect the boosters model to overpredict highly dense areas with long mains that have very small levels of APH (or indeed, just very low levels of APH). We would expect Birmingham Low, Ramsdale, Warley, and Mitcheldean to fit into this category and note that they all do. It could be argued that Coventry High would also be a contender for this category, but it has very high levels of APH so we would expect the result to be ambiguous and in this case, the boosters model underpredicts its estimated spend.

Considering the APH model, predicted boosters per length are decreasing with length and density. We would expect that companies with low levels of density and low length of mains with a low number of boosters per length (or just very low boosters per length) will have their expenditure requirements overpredicted by this model. We would expect Mitcheldean, Bradwell Moor, Ludlow, Drum Hill, and Birmingham Low to all have their expenditure requirements over-estimated by this model. Again, this is the case for all of these control groups.

We can therefore predict that control groups will have their expenditure requirements over-predicted if one of the following conditions is met:

- It has a very low level of both network complexity variables, particularly where it has conditions in which one is liable to be over-estimated in the model in which it does not feature.
- It has a very low level of the network complexity variable that is positively associated with its other features (e.g. it has relatively low boosters per length but is also low density).

If either of these conditions hold, then the triangulated models will also over-predict expenditure requirements, and vice-versa for control groups which are in opposition to both of the above conditions. Birmingham Low Level meets the first condition – it has very low boosters and APH, while being very dense and having a long network, so APH is liable to be vastly over-predicted and boosters are so low that the model can’t under-predict it. We see that it is overpredicted in both models but more so in the model with APH excluded. Mitcheldean meets the second criteria. We would expect it to have relatively high boosters per length given its relative sparsity, but it does not. As a result, its triangulated allowance is overpredicted. Note that the Mitcheldean control groups atypical circumstance is because the pumping that the model suggests it should have in TWD is actually located in the Water Resources+ costs due to the historical location of the treatment works. This creates a very large omitted variable – I.e. WRP APH).

Severn Trent has relatively high APH and middling boosters per length. Our density is at around the minimum level for APH, and this effect dominates length. Therefore, our APH levels will be under-estimated by the boosters models. While we only have around average boosters per length, we have a very long network, and middling density, so the APH models will be under-predicting our boosters per length too. As a result, the true picture of our network complexity is muted – our network is considerably more complex than the models allow for.

Quantifying omitted variable bias

We have then undertaken omitted variable analysis to reveal the impact on different control groups. This is shown graphically in ***Figure 10***. It shows the actual (start of arrow) and inferred network complexity values (arrow point) as described by the other variable when the driver in question is removed. The analysis reveals the following:

- Most control groups show significant movements between the actual and inferred network complexity values. This is strong evidence of omitted variable bias.
- The effect of this variable on forecast cost varies significantly. It is the function of:
  - The size of the movement
  - The direction of the move relative to the cost driver gradient (costs increase from the axis towards the top right hand corner.
- **Birmingham low** has a sizeable and clear movement. The control group is entirely gravity fed and requires very few boosters (it is a very 'efficient' control group due to its geographical circumstance. This means that the control group can only be positively impacted by omitted varible bias. The omitted variable movement suggests that the control group should have a 50mh and more than double its boosters / length. This is driven by the inferred relationship with density and the remaining complexity with the omitted variable which are clearly not correct in this case. The movement is directly against the cost driver gradient giving the greatest impact. (susceptible to a positive omitted variable impact which is realised)
- **Bradwell Moor** has the opposite effect to Birmingham. The control group has a large pumoing head a water is raised out of the Derwent valley up into the higher elevations to the Peak District. The undulating and rural landscape also means that water has to be boosted several times with some customers receiving water that has been pumped 4 times. This control group is at the top of the cost driver gradient. Therefore, it is highly vulnerable to a negative omitted variable bias. This transpires as the models infers that APH should be more that 100m less than is actually the case given that other variables.
- **Ramsdale** also has the biggest omitted variable movement. This is perhaps described by the fact that the control group configuration is unusual given that it is a complex borehole assemblage more typically seen in rural areas due to geological constraint but in a highly urban area. However, the impact of the omitted variable movement is relatively small, this is because the movement is across the cost driver gradient rather than transverse to it.

Figure 11 shows the same analysis but at a company level. This will be a function of the aggregate of each companies control groups. It shows that:

- Severn Trent has a very large negative impact, as one of only two companies that move directly up the cost driver gradient (i.e towards the origin).
- Thames has a large positive movement. Northumbrian and United Utilities also move directly up the gradient.

- Hafren shows a large movement that is highly negative for boosters per length, but mitigated to an extent as the movement is not directly down the gradient.

All these movements are a function of how the other independent variables interact with the omitted variable, and the initial levels of the network complexity drivers.

Figure 10: Movement of control group network complexity drivers to their predicted values, demonstrating impact of omitted variables bias.

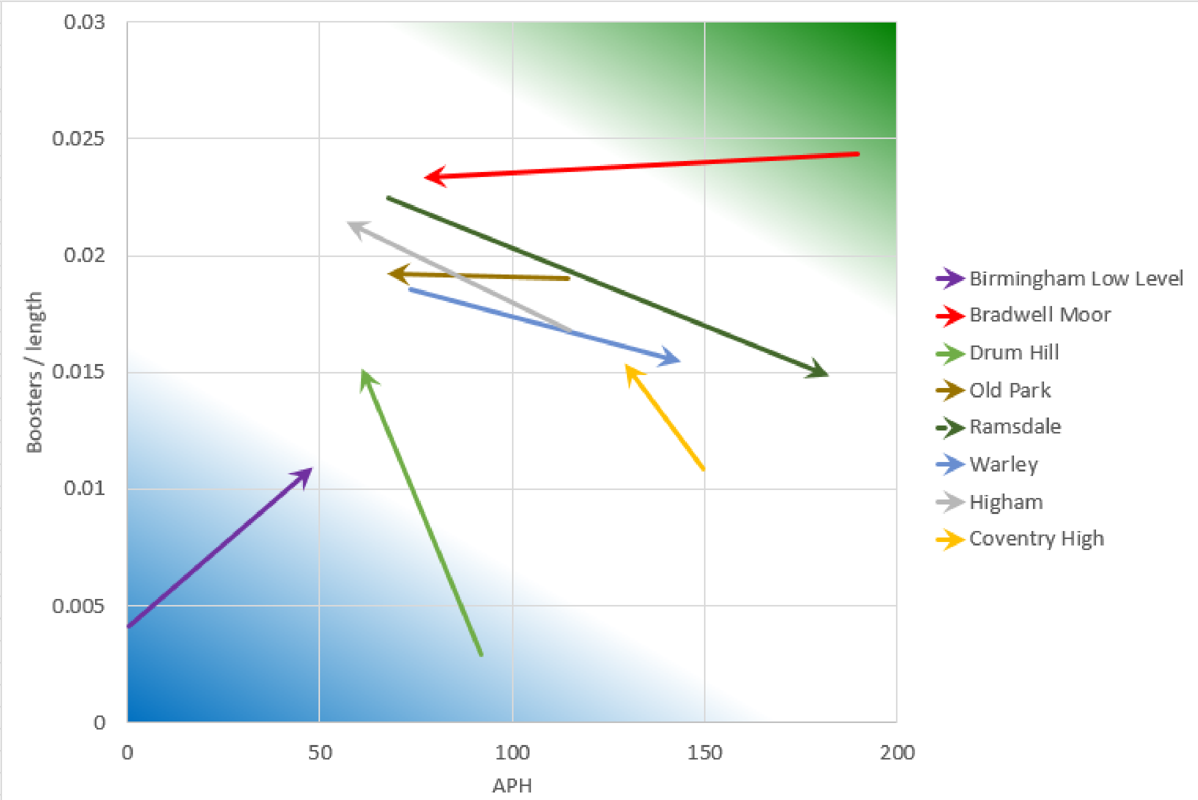
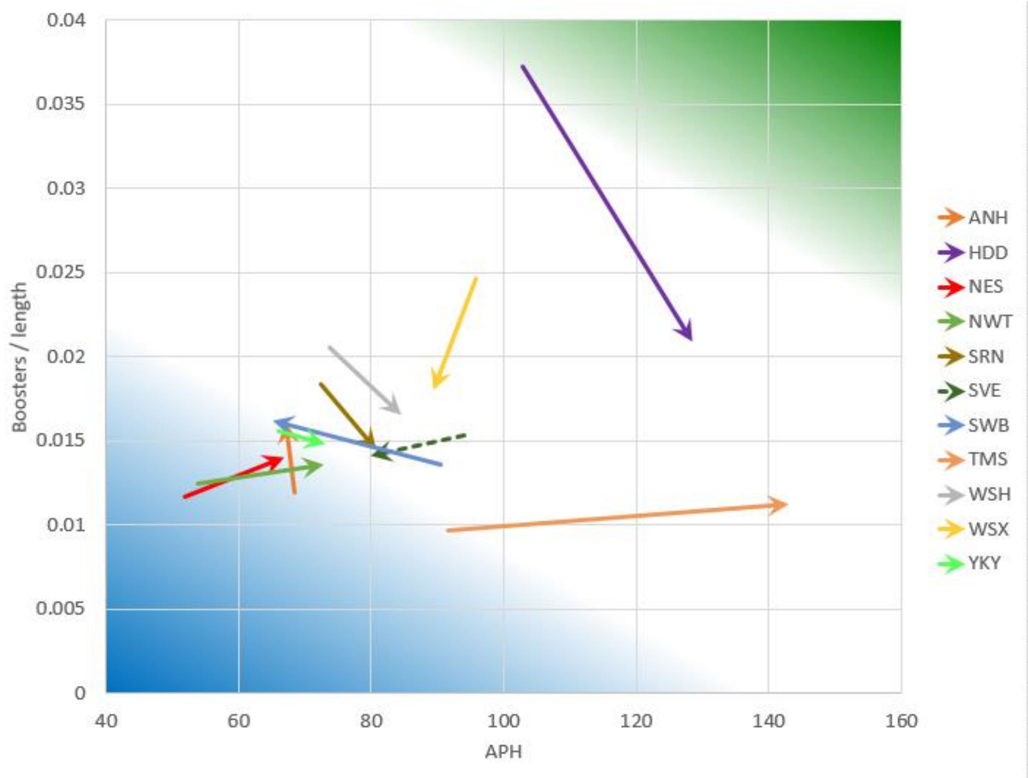


Figure 11: Movement of company network complexity drivers to their predicted values, demonstrating impact of omitted variables bias.



Water resources and treatment pumping are also omitted cost drivers

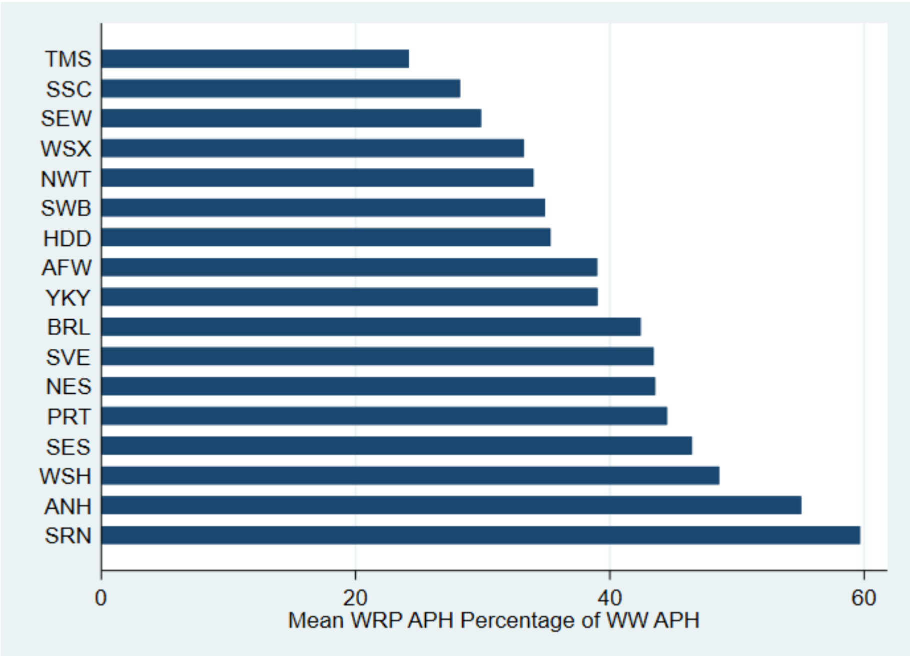
There is also a lack of accounting for pumping before the works in the current modelling suite. WRP APH can only be considered a legitimate driver of costs if TWD APH is also considered a legitimate driver of costs – total costs do not change whether pumping is performed before or after the works.

Currently, all pumping before the network is being treated as inefficiency, with companies that perform the majority of their pumping within the network being artificially considered more efficient than they should be, and vice versa for companies that perform a lower portion of their pumping within the network. ***Figure 13*** shows the proportion of pre-network pumping performed by each company. Those at the top of the figure are currently being artificially preferred by the models, while those towards the bottom are being artificially disadvantaged.

If we consider a model that treats WRP APH as the dependent variable, and regresses on properties, density, density squared and % of water treated in bands 1-3 (WRP5), we find that it is negatively associated with properties, positively associated with treatment complexity, and the density minima is at 63.36. Severn Trent is a large company, with a high number of properties, and sits just above the density minima. The independent variables in the model will therefore predict a low level of WRP APH for Severn Trent. This is shown in ***Figure 12***.

Figure 12: Actual WRP APH values and predicted WRP APH values for the independent variables in WRP5 from the PR24 consultation.

Figure 13: Historical average contribution of WRP APH to WW APH by company.



The missing APH is not a descriptor of inefficiency, but rather random error caused by model misspecification. Likewise, the failure to address APH and boosters per length simultaneously only serves to smooth out the random error currently being attributed to inefficiency.

We will generate a symmetrical claim by combining APH and boosters per length in the models. We have a number of ways to generate the implicit allowance currently accounted for by the models which will be discussed below.

1.1.4 Adjustment to allowances (including implicit allowance)

Criteria

- h) Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?
- i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?
- j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?
- k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?
- l) Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?
- m) If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

We have developed a methodology to quantify the incremental amount of expenditure currently allowed for in the models to account our level of network complexity relative to the sector average. This means that fundamentally:

- The **gross claim** relates to the additional costs required to operate our network given the geographical circumstances faced relative to other companies.
- The **implicit allowance** relates to the allowance for network complexity assumed by botex+ models for AMP8.
- The **net claim** relates to the marginal network complexity cost (relative to the data panel average) assumed across AMP8 that are not allowed for in botex+ models.

We describe the premise we have followed below. However, we have identified a wide range of scenarios for how it can be applied which can materially change the size of the claim. These are subsequently described. Finally, we set out in detail the central scenario of the quantified claim.

Premise for quantifying the claim

The specific calculation choices, and the selection of our central case, are set out in ***Figure 14***.

For this claim, we will generate an Implicit Allowance using two different ways of calculating the omitted variable impact as outline in 'Omitted variable approach: Quantifying the effect that existing variables account for some of the identified costs', and two different ways of generating an implicit allowance via a difference approach, as outlined in 'Remove an explanatory variable approach: Running models with and without specific explanatory variables'. This is illustrated in ***Figure 15***.

On the omitted variables approach, it should be noted that to generate the implicit allowance for WW APH where TWD APH already features in the model, the following relationship is used:

$$\beta = \beta \ln(APH_{TWD} + APH_{WRP}) = \beta \ln\left(APH_{TWD}\left(1 + \frac{APH_{WRP}}{APH_{TWD}}\right)\right)$$
$$= \beta \ln(APH_{TWD}) + \beta \ln(1 + \frac{APH_{WRP}}{APH_{TWD}})$$

We then treat as the $\ln(1 + \frac{APH_{WRP}}{APH_{TWD}})$ omitted variable.

Figure 14: Option tree showing how the various options for quantifying the claim interact. Central case selections highlighted in bold

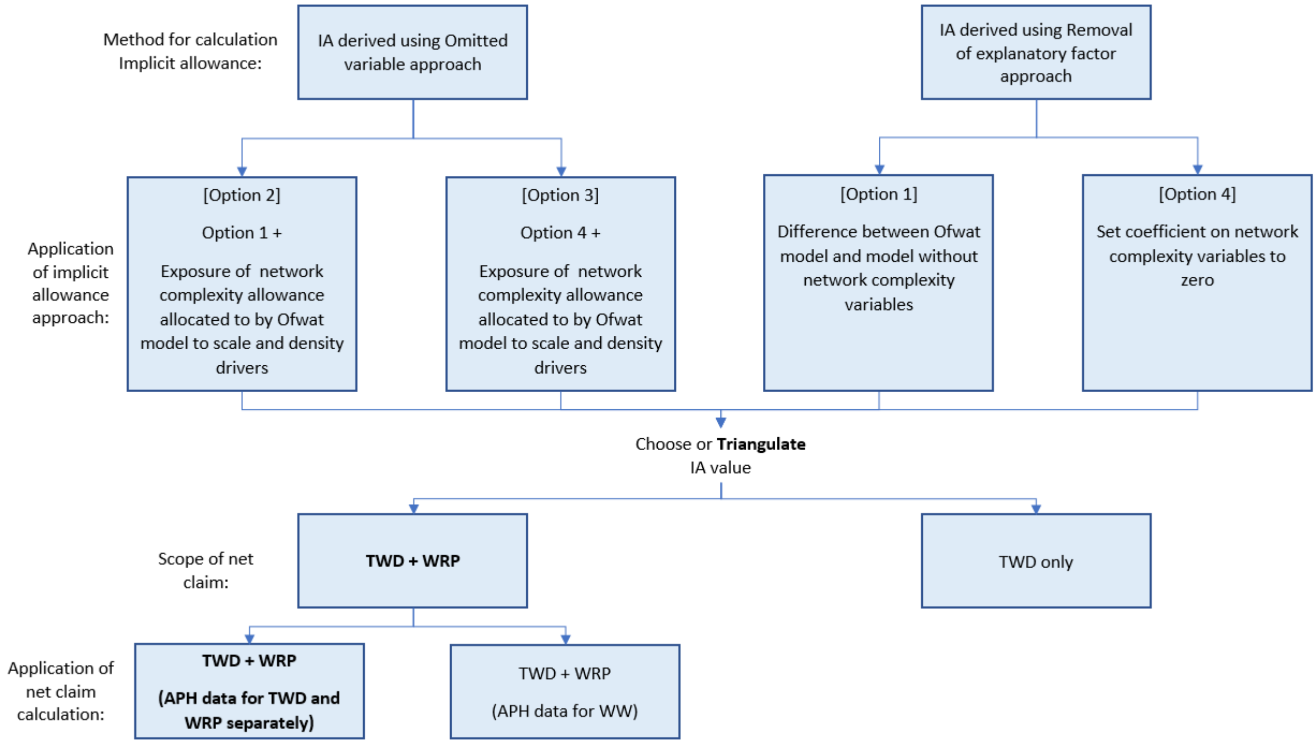
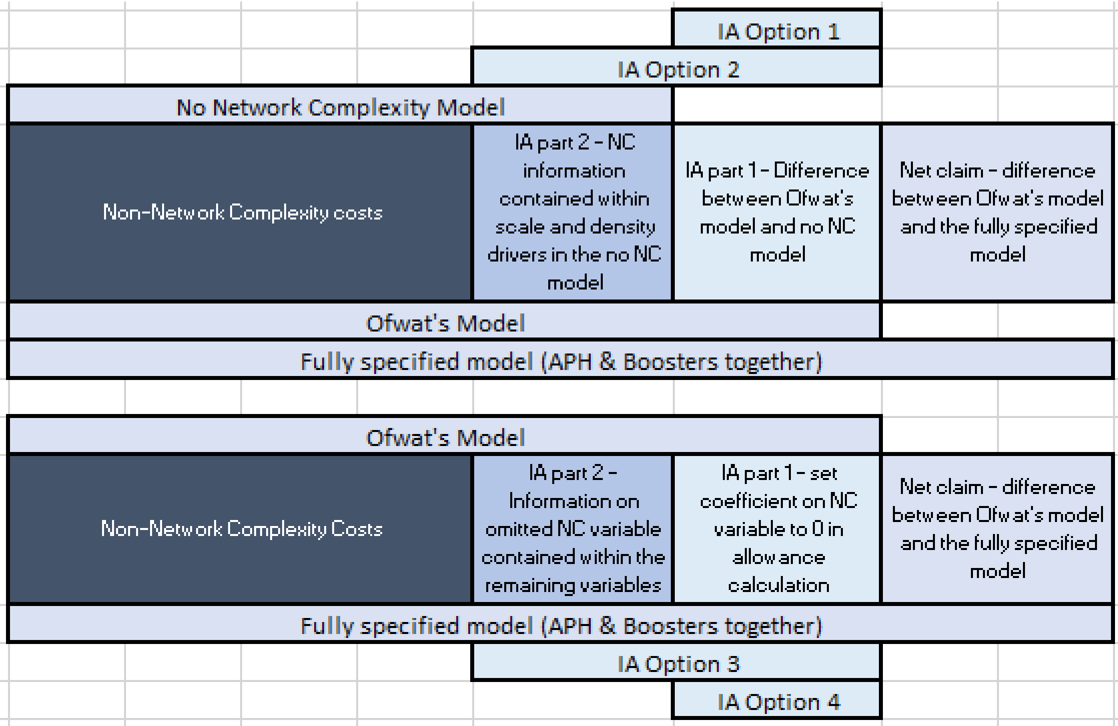


Figure 15: Schematic representation of the various options for quantifying the claim



Determining if the claim is symmetrical and exposing the potential impact on other companies.

We consider that the claim would require a symmetrical adjustment. This is because as our network complexity variables are under-estimated by the other independent variables in the model, for other companies they are overpredicted. This gives some companies a comparative, artificial, advantage in the current modelling suite.

Application of efficiency

As set out in the methodology section, we have sought to challenge ourselves when quantifying the claims. As this claim is quantified from information derived from cost models, we have set the efficiency challenge as the more most stringent of:

- The PR19 efficiency challenge for the relevant set of models,
- The 4th company efficiency from the PR24 consultation modelling suite, or
- The 4th company efficiency from the PR24 modelling suite, amended with our modelling changes used to derive a claim value.

For this claim the PR19 efficiency challenge has been applied.

We also do not apply an efficiency challenge to implicit allowance values where doing so would increase the value of our net claim. For this claim, as it does not impact on the net claim size, the PR19 efficiency challenge has also been applied.

Quantifying the claim

Table 5: Detailed quantification of the central view of the claim, all values in 22/23 prices

Claim Component	Description	Value
AMP8 Consultation Model Allowance	Allowance generated through the PR24 consultation models. **Efficiency**	£2796.9m
AMP8 Fully Specified Allowance	Allowance generated through the PR24 consultation models where WRP APH is included in the WRP models, TWD APH and Boosters per Length are combined in the TWD models, and Boosters per Length, TWD APH and WRP APH are all combined in the WW models.	£2980.0m
Net Claim	**Difference between the fully specified allowance and the consultation model allowance**	**£183.2m**
Implicit Allowance, Average Omitted	Average implicit allowance generated through the two alternative methods of calculation through the omitted variables approach	£51.5m
Implicit Allowance, Average Difference	Average implicit allowance generated through the two alternative methods of calculation through the omitted variables approach	£114.3m
Implicit Allowance, Triangulated	**Average of the average of the two different implicit allowance approaches**	**£82.9m**
Gross Claim	**Implicit Allowance + Net Claim**	**£266.1m**

Table 6: Calculating an implicit allowance

Company	Gross Claim	IA	Net Claim (Symmetrical)
ANH	-£112.6	-£96.0m	-£18.7m
HDD	£31.8m	£25.5m	£6.4m
NES	-£225.8m	-£91.2m	-£102.5m
NWT	-£345.9m	-£171.6m	-£192.9m
SRN	£107.7m	£28.7m	£79.0m
SVE	£266.1m	£82.9m	£183.2m
SWB	-£33.6m	-£6.1m	-£30.9m
TMS	£250.2m	£203.5m	£46.7m
WSH	£51.7m	£40.7m	£11.0m
WSX	£68.8m	£52.2m	£16.6m
YKY	-£77.9	-£42.9m	-£39.4m
AFW	£71.6m	£35.6m	£36.0m
BRL	£39.1m	£25.5m	£22.4m
PRT	-£51.5m	-£25.2m	-£28.0m
SES	-£7.2m	-£6.8m	-£0.4m
SEW	£27.8m	£34.4m	-£7.4m
SSC	£45.8m	£26.8	£19.0m
Total	**£106.5m**	**£60.1m**	**£0**

1.2 Cost efficiency (necessary)

Criteria

- a) Is there compelling evidence that the cost estimates are efficient (for example similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?
- b) Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?
- c) Does the company provide third party assurance for the robustness of the cost estimates?

The costs of this claim have not been calculated form a ring-fenced set of interventions. They are inherent across all out TWD base costs. We consider that our maintenance costs are efficient as demonstrated by the efficiency performance in the PR24 consultation models.

The TWD models show us to have an efficiency score of 103% placing us as the 5th company in the industry. This is despite the fact that some of these legitimately incurred costs are being considered as inefficiency (as per the substance of this claim).

If the PR24 consultation models are amended to better specify network complexity, our TWD efficiency performance improves to 96% and the 2nd ranked company suggesting that we are one of the best performing companies in the sector.

As described above, we have also applied the PR19 efficiency challenge to the claim, or that which is inferred from the PR24 consultation models, whichever is more stringent.

1.3 Need for investment (where appropriate)

Criteria

- a) Is there compelling evidence that investment is required?
- b) Is the scale and timing of the investment fully justified?
- c) Does the need and/or proposed investment overlap with activities already funded at previous price reviews?
- d) Is there compelling evidence that customers support the need for investment (both scale and timing)?

Network complexity drives base expenditure. We contest that we require more than the base models currently allow for given our operating conditions. This claim does not relate to the isolation of specific interventions.

1.4 Best option for customers (where appropriate)

Criteria

- a) Did the company consider an appropriate range of options to meet the need?
- b) Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?

- c) Has the impact of the investment on performance commitments been quantified?
- d) Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?
- e) Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?
- f) Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?
- g) Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?

Efficient network expenditure needs to account for the geographical challenges faced. Robust, well maintained networks are required to deliver appropriate service to customers.

1.5 Customer protection (where appropriate)

Criteria

- a) Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?
- b) Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?
- c) Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?

Performance measures incur penalties and determine the effectiveness of base expenditure.

2. Sewage treatment works growth costs

In the Botex+ cost modelling data panel, the industry has incurred cost to maintain sewage treatment works (STWs) capacity in the face of growth (this equates about £80m for Severn Trent for a 5-year period. This is the level of expenditure that what will be distributed between companies by Botex+ or standalone STW growth cost models depending on the approach eventually followed. However, this is not sufficient for the perfect storm we are facing as and when growth triggers the need to intervene due to resultant changes in FFT:DWF ratios and ratcheting discharge consents.

Table 18: Claim summary table

Claim component	Value	Description
Is the claim symmetrical?	No	Sewage Treatment Works growth costs do not currently sit in Botex+ costs being modelled by econometric models. If the costs were to be included in Botex+ they would be additional to historic expenditure meaning that symmetrical adjustments would still not be required.
Can the cost be isolated from the botex+ dependent variable?	Yes	Sewage treatment works growth costs are available as their own lines in the dataset, however there are currently excluded from the base cost models.
Is there a suitable explanatory variable available to describe the costs?	No	The true driver of costs is the additive effect of DWF, FFT and other permit limits. This interaction is location specific and therefore cannot easily be shown by an explanatory variable.
Gross claim	£341.3m	Bottom-up assessment of costs
IA (assuming consultation models)	£0	Costs currently excluded from base cost models
Net claim (assuming consultation models)	£341.3m	Gross claim – implicit allowance
IA (assuming Botex+ approach)	£100.3m	Difference approach (with and without STW growth being included in the dependent variable PR24 consultation models
Net Claim (assuming Botex+ approach)	£241.0m	Gross claim – Implicit allowance
IA (assuming separate 'ARUP' model)	£61.0m	Separate simple STW growth model as per ARUP CAWG presentation
Net Claim (assuming separate 'ARUP' model)	£280.3m	Gross claim – Implicit allowance

From 2026, i.e. coinciding with the start of the PR24 regulatory period, the Environment Agency (EA) is changing the way it assesses DWF compliance at STWs. Simultaneously, when updating consent values, we are anticipating more stretching increases to both FFT and other discharge consents than has been required historically. Specifically, we are expecting the following three changes:

- <u>Changes to assessment of compliance with dry weather flow (DWF) consents</u>.[2] This essentially determines when an STW requires investment to accommodate population growth in the

[2] Dry Weather Flow (DWF) is the average daily flow to an STW during a period without rain, so reflects the minimum flow rate that a sewage treatment plant needs to handle during periods of dry weather. STWs must be designed with sufficient capacity to treat the waste from the sewage collection system it is connected to. The EA regulate the quality and quantity of treated effluent from an STW. Monitoring and regulating DWF enables the EA to set permit limits which avoid unacceptable impact on the environment and enables wastewater companies to design the infrastructure and processes to meet such permit limits when handling maximum flows as well as at these minimum flow rates. The permit level and therefore capacity will have to be updated at STWs when the minimum flow grows to the point where it exceeds the permitted level (on a permanent basis, not just the result of an unusually wet year). At this juncture, the STW will have to increase its DWF capacity in order to qualify for a higher consent value.

relevant catchment area. In addition to this, a regulatory decision in 2010 to update DWF consents at a number of sites simultaneously means that headroom is now running out at a number of these sites simultaneously.

- Related changes to limits in flow to full treatment (FFT) consents[3]. FFT consents are recalibrated at the same time as any required changes to DWF. FFT determines the volume that must be treated at any given time – therefore it accounts for both foul and surface water flows. Depending on the existing ratios between DWF and FFT, this can be a very material driver of cost resulting from growth pressures.
- Related changes to limits in other discharge consents. These will tighten as DWF volumes increase to ensure that the polluting load in treated effluents remains constant. Again, this will be a very material driver of cost resulting from growth pressures as it will likely affect both the volume of treatment capacity and the treatment processes used.

These are introduced in more detail below. Together, these growth driven pressures show that we are facing two key challenges in AMP8:

- there is a need to increase capacity at STWs in order keep pace with forecast population growth and maintain stringent environmental standards; and
- increasing this capacity is likely to be more costly than reflected in historic costs due to the tightening of environmental standards and historical regulatory decisions.

Our STWs currently have a high level of performance

Historically, Severn Trent has been one of the top performing wastewater companies in the industry in relation to the environment. It has achieved the highest average Environmental Performance Assessment (EPA) star rating over the last 10 years, with an average of 3.6. It has also achieved the highest number of 4-star ratings (6 in the last 10 years). For discharge permits specifically, SVH has performed joint best amongst the industry with 9 green ratings and 1 amber rating in the last 10 years.[4] It has delivered this alongside maintaining capacity at STWs in an efficient manner to deliver cost-effective outcomes for its customers.

It is neither economic nor desirable to maintain large capacity headroom at all STWs. Over-sized STWs result in unnecessary consumption of power and chemicals and create issues with septicity. Also, capital interventions have high fixed costs meaning that constantly adding small incremental amounts of capacity is very expensive.

Consequently, is it accepted that spare STW capacity should be used up to the point that there is none left and then an intervention is made that will then accommodate the growth requirements for a number of years. When the threshold to increase capacity is crossed, we typically then size assets for a 1.5 to 2 AMP design horizon. This means that, the extent to which growth in the region triggers the need for DWF capacity interventions depends on the size of the growth anticipated in a particular location relative to the existing headroom.

[3] Flow to Full Treatment (FFT) is a measure of the maximum amount of wastewater a treatment works must be able to treat at any time. STWs are regulated with an FFT permit to ensure that they have sufficient capacity to effectively treat the maximal amount of wastewater that is expected to be received without overloading the system. Having a sufficiently high FFT capacity means that an STW is less likely to have to use storm tanks or discharge using a combined sewer overflow (CSO).

[4] Jointly with Wessex Water.

However, the scale of the changes at PR24 mean that the current capacity at several of our STWs are anticipated to run out during AMP8. This will lead to higher costs over AMP8 as a result of the larger number of sites requiring intervention, as well as the factors set out above which will lead to higher costs of expanding capacity at each site. This issue is unlikely to be unique to us. Other companies will also be subject to the new tighter method of assessing DWF compliance and will also be exposed to a tightening of discharge consents and step change in investment in FFT capacity. However, different companies may face varying levels of individual exposure to this issue over AMP8. This will depend on the extent to which their DWF consents were updated in 2010, how much the FFT:DWF ratios were eroded at that time, the rate of population growth since, as well as how other discharge consents have been managed by the EA in the intervening period.

Limitations of econometric cost modelling and bottom up assessment of AMP8 requirements.

In its PR24 base costs assessment consultation, Ofwat has indicated that it will consider a separate econometric model for costs relating to growth at STWs, but "*may revert to including growth at sewage treatment works costs in the base cost models*" if constructing a robust model is not feasible.[5] It commissioned Arup to investigate the feasibility of a separate assessment of costs for growth at STWs, who concluded that "*a standalone econometric model is a viable option for assessing growth at WwTW cost at PR24*".

We have considered both possible approaches. However, given the scale and discontinuity of the pressures anticipated in AMP8, these dynamics will not be well captured by an explanatory variable capturing population growth in an econometric model. As a result, both approaches will not be able to sufficiently identify the efficient costs we will face in AMP8. We have calculated implicit allowances for both approaches. These both identify the need for a material net adjustment (after IA).

As a result of the issues described above, the limitations of using econometric benchmarking methods mean that these costs will likely need to be supported by a thorough deep-dive assessment based on an understanding of the unique situation at each relevant STW. To identify the sites that require investment, we have:

- assessed and projected DWF headroom requirements into the future up to the design horizon using our wastewater treatment works growth tool;
- assigned a compliance assessment and certainty score relating to the time frame over which the STW is anticipated to breach its DWF consent; and
- used this to identify and prioritise STWs that are likely to fail compliance over AMP8. On this basis, we consider that we will need to invest to increase capacity at 22 of our STWs over the course of AMP8.

We estimate the efficient costs of increasing this capacity at these 22 STWs are £341 million. The process we have followed to arrive at these robust cost estimates is set out in the following sections.

[5] Please see pg. 14 here: https://www.ofwat.gov.uk/wp-content/uploads/2023/04/Econometric_base_cost_models_for_PR24_final.pdf

2.1 Need for adjustment (necessary)

2.1.1 Unique circumstances

Criteria

- a) Is there compelling evidence that the company has unique circumstances that warrant a separate cost adjustment?
- b) Is there compelling evidence that the company faces higher efficient costs in the round compared to its peers (considering, where relevant, circumstances that drive higher costs for other companies that the company does not face)?
- c) Is there compelling evidence of alternative options being considered, where relevant?

Drivers of the need for additional investment

The additional costs we are anticipating incurring over AMP8 are related to a regulatory change that will impact all companies. As set out above, the change in how regulatory compliance is measured and the EA's decision to update DWF consents at a number of sites simultaneously in 2010 will lead to more sites requiring increases in capacity over AMP8 compared with historical levels. Additionally, more stretching increases to FFT and the tightening of discharge consents to maintain environmental standards will also increase the cost of increasing capacity on a per-site basis compared with historical levels. Beyond the regulatory choices that are leading to increased costs, this issue is fundamentally being driven by growth, leading to larger flows having to be processed at STWs.

Uniqueness of these issues to Severn Trent

It should be noted that these circumstances are not unique to Severn Trent, they will be felt by all companies. However, there will likely be some variation in the extent to which companies are exposed to these costs. The extent of this exposure will depend on:

- The extent to which their DWF consents were updated in 2010 and the rate of population growth since. This will determine the number of sites that will have headroom running out over the course of AMP8.
- How much the FFT:DWF ratios were eroded at that time. In 2010, DWF consents were raised without corresponding increases in FFT capacity. We anticipate that when DWF consents are next updated, FFT:DWF ratios will be restored to historical norms.
- How other discharge consents have been managed in the intervening period. If a permit for other discharge consents has been introduced through WINEP which is relatively close to technically achievable levels, then further tightening is likely to take the consent value very close to technically achievable levels which will be more capex intensive.

As a result, this claim relates to the fact that we face higher efficient costs relative to the observations that exist in the historical data rather than us forecasting higher costs relative to other companies. This means that similar claims are likely to be applicable to all companies. This also means that it will be inappropriate for this claim to be symmetrical, as we set out in more detail in section 2.1.4.

Limitations of econometric modelling in this instance

Currently, Ofwat is looking into the potential for estimating the costs relating to growth at STWs using a standalone model, assessing these costs separately from base expenditure. Towards this end, Ofwat commissioned Arup to consider the viability of conducting a separate assessment of costs for growth at STWs. Arup concluded that "*a standalone econometric model is a viable option for assessing growth at WwTW cost at PR24*", however it also noted that Ofwat "*may want to consider supplementing the econometric models with a cost adjustment claim process similar to that used at PR19*".[6] In its PR24 base costs assessment consultation, Ofwat has indicated that it will continue to consider a separate econometric model for these costs, however it notes that if a robust model is not feasible it "*may revert to including growth at sewage treatment works costs in the base cost models*".[7]

The factors driving the predicted increase in costs will not be captured by either Ofwat's base modelling or a standalone econometric model of growth at treatment works. This means that, for the upcoming expenditure at AMP8, historical costs will likely not be a good predictor of future costs.

As set out above, costs are likely to be higher for AMP8 for the following reasons:

- (i) There is a requirement to increase DWF consents at more sites over AMP8 than historically due to (a) a change in the way compliance is measured; and (b) because of a historical regulatory decision that led to a many sites having their consents updated in 2010.
- (ii) FFT consents will simultaneously need to be updated. The extent of the update to FFT consents is anticipated to be disproportionately larger than has historically been necessary due to a new methodology being imposed by the EA and the historical decline in the FFT:DWF ratio due to the EA decision to update DWF consents in 2010. In addition, the costs of increasing FFT capacity are higher than those for increasing DWF capacity.
- (iii) Discharge consent limits are expected to be tightened substantially which will increase the capital and operating costs required to treat water to the required level relative to historical costs.

We set out the evidence for these changes in more detail in section **Error! Reference source not found.**.

None of these costs will be sufficiently captured by the historical costs of growth at STWs. The only way to capture these effects is if the model contains appropriate drivers to be able to capture and scale up the costs from historical levels to reflect the differences set out above. These factors will not be well captured by a scale variable such as population or load treated. In principle:

- (i) could be captured by including a variable that reflects the number of sites at which expansion has been undertaken. Then the predictions for PR24 could reflect the fact that SVH is due to have to update a greater number of sites.
- (ii) could be captured by including a variable that could separately capture the costs of expanding FFT and DWF capacity separately. The FFT variable could then be scaled up to predict the additional costs of the larger increase in FFT capacity required over AMP8 compared with historical precedent.
- (iii) may be challenging to capture in the context of cost benchmarking models as the relationship between costs and tighter consent levels may not be linear, especially as we approach the frontier of what is technically feasible in terms of wastewater treatment. The incremental capital costs of treating wastewater to a lower discharge consent level might increase the closer to the technical frontier the discharge consent level gets. This would require careful thought to adequately

[6] Please see slide 16 here: https://www.ofwat.gov.uk/wp-content/uploads/2022/05/2022-04-07-Growth-CAWG-slides-Arup-and-data-collection.pdf.

[7] Please see pg. 14 here: https://www.ofwat.gov.uk/wp-content/uploads/2023/04/Econometric_base_cost_models_for_PR24_final.pdf

capture this effect within a linear model and, if there is not sufficient historical precedent for treating water to these levels in the dataset, it may not be possible to capture at all.

Arup has only tested models including the following variables: population equivalent served by WwTWs (scale); (ii) % load receiving tertiary treatment (treatment complexity); (iii) change in volume of WW treated (scale); and (iv) % load treated in size bands 1-3 (economies of scale). However, its preferred model only contains two explanatory variables to explain the variation in costs between companies: (i) and (ii). None of these variables would be sufficient to capture the factors driving increased costs for SVH over AMP8 set out above.

Similarly, the base cost models for sewage treatment that Ofwat has presented in its 2023 consultation use load as a scale variable.[8] The increases in load with population will be insufficient to capture the discontinuity in the number of sites that are requiring updating over the course of AMP8 as a result of regulatory decisions that have been taken. Treatment complexity is also captured in these models using the load treated with an ammonia permit ≤3mg/l. However, the technically achievable limit for ammonia is recognised as 1mg/l, and discharge consents in some cases are being moved right to the edge of this frontier, as can be seen in Table 19. This variable is likely to be insufficiently sensitive to capture the increased capital costs required at works that are approaching the technically achievable limit.

Therefore, the models proposed by Arup and Ofwat will underestimate the cost of growth at our STWs over AMP8, as they will assume that growth costs in the future will be similar to the growth costs that have been experienced in the past and would be unable to account for the unprecedented factors that will drive higher costs in AMP8 than have been observed historically. The limitations of a top-down econometric benchmarking approach means that means that efficient costs would be better identified using deep dives / bottom-up modelling which can capture the unique challenges being faced at each STW individually. This indicates that a cost adjustment claim is required in this case to ensure that companies are given adequate cost allowances to fund investment to deal with growth and its impact on STWs.

Further issues with Arup's modelling

There are further issues with the models proposed by Arup. Arup identifies that the data for growth at STWs is lumpy with companies incurring highly fluctuating amounts of costs across different years. It proposes to deal with this issue by aggregating costs and drivers over a long time period, which it claims makes the data more amenable to modelling.9 However, this has the effect of reducing the number of observations substantially. Arup's preferred model specification contains only 10 observations, one for each wastewater company. This is a major shortcoming of this approach as it severely limits the statistical power and reliability of the results.

Arup also note that there are issues with data availability. It was unable to find data for one of the key variables identified as a driver of growth at STWs. Namely, capacity headroom. We have also identified other important factors to account for in the model above that are not noted by Arup. Omitting important variables from the model due to data availability issues could lead to biased estimates of the efficient costs required for growth at STWs.

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8 Ofwat: Econometric base cost models for PR24 (April 2023) – page 85

9 See pg. 52 - https://www.ofwat.gov.uk/wp-content/uploads/2022/11/Arup_Growth_related_Costs_Final.pdf

Consideration of other options

We have taken a holistic approach towards solving this issue and have considered both upstream and downstream solutions to this problem. Where appropriate, we have sought to alleviate pressure on STWs by investing in the upstream sewerage network by preventing flows from entering the sewerage system. This is being done through a business case entitled UME07. This project will generate headroom capacity at the STWs by removing upstream flows from the system, thereby creating headroom to accommodate other flows at the downstream treatment works.

We have identified four catchments for this project: Finham (Coventry), Kidderminster, Netheridge (Gloucester), and Stoke Bardolph (Nottingham). Each of these have been chosen based on their suitability for this type of intervention. We note that funds are not being sought for the sites that fall under UME07 in this cost adjustment claim.

Where we have decided that expanding capacity at STWs the optimal approach for dealing with these headroom issues, we have constructed a range of process options that reflect different possible types of asset configurations for each site. Then we choose from these options balancing what is likely to be deliverable, with ensuring a reasonable level of compliance risk and ensuring that the project can be delivered at an efficient cost.

Therefore, as outlined, we have considered a range of different methods to relieve capacity at our STWs to ensure they are able to meet the demands of the new environmental requirements set out by the EA. We have considered both upstream as well as downstream approaches to alleviate pressure on headroom, as well as different configurations of options to increase capacity at existing treatment works where increasing headroom has been determined to be required.

2.1.2 Management control

Criteria

- d) Is the investment driven by factors outside of management control?
- e) Have steps been taken to control costs and have potential cost savings (eg spend to save) been accounted for?

We are facing more stringent requirements to maintain environmental standards that will create cost pressures that are outside of our management control

Dry weather flow is the average daily flow to a STWs during a period without rain.[10] The flow in a combined sewerage system will increase when it rains. This flow may vary seasonally due to changing levels of sewer infiltration and population numbers.

The Environment Agency sets limits on the quality and quantity of treated effluent from STW so that STW do not cause an unacceptable impact on the environment. The flow that may be discharged in dry weather is one of these limits. When an application is made for an increase to the DWF, the Environment Agency will usually tighten the numeric discharge quality limits. At treatment works with storm overflows limiting the maximum flow that is fully treated, an increase in permitted DWF will

[10] Dry weather flow is calculated as: DWF = PG + IDWF + E
Where: DWF = total dry weather flow (l/d); P = catchment population (number); G = per capita domestic flow (l/hd/d); IDWF = dry weather infiltration (l/d); and E = trade effluent flow (l/d)

usually lead to an increase in the overflow pass forward flow settings and storm tank capacity requirements.

From 2026, i.e. coinciding with the start of the PR24 regulatory period, the Environment Agency is changing the way it assesses DWF compliance at STWs. Simultaneously, when updating consent values, we are anticipating more challenging changes to other discharge consents and permits than has been required historically to maintain environmental standards. Specifically, we are expecting the following four changes:

Updates to DWF consents in 2010 leading to headroom running out at multiple sites

In 2010, the EA revised the permitted DWF values at a number of STWs due to anomalies that were found in the existing figures when measured data started to become available. The increasing use of measured DWF data showed that the previous results, which had been calculated by applying a formula, were not accurate. As a result, the EA intervened and recalibrated DWF permits to account for the improved measurement information as well as future growth. Because of this intervention in 2010, we are now seeing this headroom running out at many sites simultaneously rather than being more evenly spread over time.

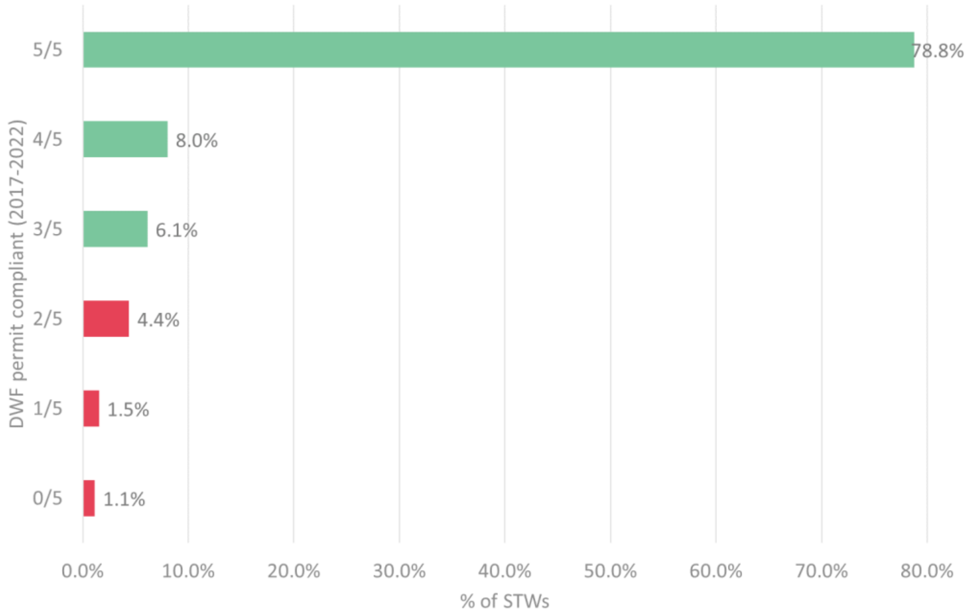
As a result, we are forecasting that we will need to update the DWF consents at a larger than normal number of our sites over the course of AMP8 which will lead to us incurring significantly higher costs compared with previous asset management periods. We note that this is outside of management control as it is driven by a historical regulatory decision. Growth is exogenously determined, and it does not make sense to pre-emptively expand capacity at treatment works as this would be inefficient as the capacity would remain idle until it was required. We set how we have managed our STWs capacity in an efficient and environmentally conscious way in more detail later in this section.

Changes to assessment of compliance with dry weather flow (DWF) consents.

The EA currently assesses compliance with DWF consents at each STW on a case-by-case basis through consultation with the relevant wastewater company. From 2026, the EA will make its assessment of compliance more formalised, such that a STW will be considered non-compliant or failing if it has breached its DWF permit level in 3 or more years over the preceding 5 year period. The implication of this change is that we will need to adopt a more cautious approach and, therefore, increase DWF capacity more pro-actively at our STWs than had previously been the case to avoid sites being listed as failing. This also means that a larger number of sites will require updating over AMP8 than would otherwise have been the case.

We have assessed the implications of this change in the regulatory regime by assessing each of our STWs using this new 3-in-5 criteria based on the last 5-years of outturn data (2018-2022). The figure below shows the proportion of STWs that have achieved compliance using this new metric.

Figure 48: Current DWF permit compliance under upcoming EA compliance changes



Source: Economic Insight Analysis of SVH data

Note: Red bars denotes scenarios that would be deemed to be failing under the new regulations, while green bars show scenarios that would still be compliant.

This figure yields the result that approximately **7% of our STWs would be categorised as 'failing' under this new regulatory framework**. This shows that these changes reflect a step change in regulation that will require investment to avoid being listed as failing under the new regulations. As these changes have been imposed by the EA, this is not under management control. This is not to say that our STWs are already failing. This simply highlights that a change in the way compliance is assessed implies a step change in regulation that will need to be responded to with additional investment.

We note that we are already in the process of addressing the sites that would already be considered to be failing under the upcoming compliance regime, as well as those that are anticipated to run out of headroom by the end of AMP7, also taking into account the impact of Covid influenced working patterns that resulted in elevated flows at some sites serving 'dormitory' towns/villages, where a return to flows nearer to those experience pre Covid is expected. We are taking a pro-active approach and are not waiting for the changes in compliance in 2026 to resolve these potential compliance issues. Therefore, the failing sites should be addressed before the new compliance regime begins. We also note that the sites for which we are expanding capacity prior to AMP8 have not been included in this cost adjustment claim. This claim only relates to sites that are anticipated to run out of headroom during AMP8. The details of the claim are set out in more detail in section 2.2.

Related changes to limits in flow to full treatment (FFT) consents.

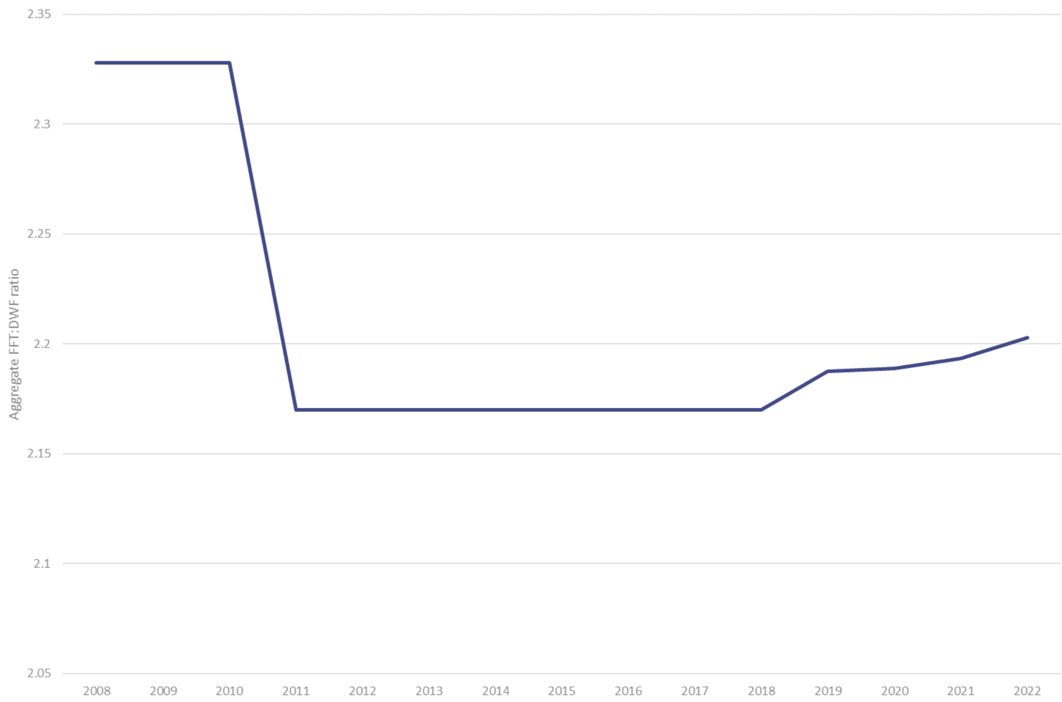
The EA's holistic approach to reviewing discharge permits means that when an application is made for an increase in permitted DWF, a simultaneous review and updating of the corresponding FFT value should be expected. The way in which FFT requirements are recalibrated when applying for changes in DWF consents has changed over time. Historically the EA have accepted DWF changes with a proportional increase (or no increase) in FFT. However, increases in DWF are now accompanied by a restoration of the historical FFT:DWF ratio. Again, as this is a regulatory decision being imposed by the EA, it is beyond management control.

As set out above, in 2010 the EA revised the permitted DWF values in 2010. However, when DWF permits were updated in 2010, the EA decided not to impose corresponding increases in FFT consents. This has meant that for those works receiving an increase in permitted DWF, FFT has remained constant lagging behind DWF changes, leading to a reduction in the FFT:DWF ratio.

DWF Headroom at these sites is now running out due to growth in the intervening period. This means that when DWF consents are updated, we will have to expand FFT capacity at these sites disproportionately more than has historically been the case.

The EA have now begun calculating FFT using an I_{MAX} methodology, where I_{MAX} reflects the maximum infiltration rate over the whole year, instead of using a dry weather or average infiltration rate. Using this methodology typically restores the historical FFT:DWF ratio. Given that FFT growth has lagged behind DWF growth since 2010, this restoration of the historical ratio implies a disproportionate increase in FFT compared to what has been required of Severn Trent historically.

Figure 49: Aggregate FFT:DWF ratio for 18 of the 22 sites included in the claim, by year[11]

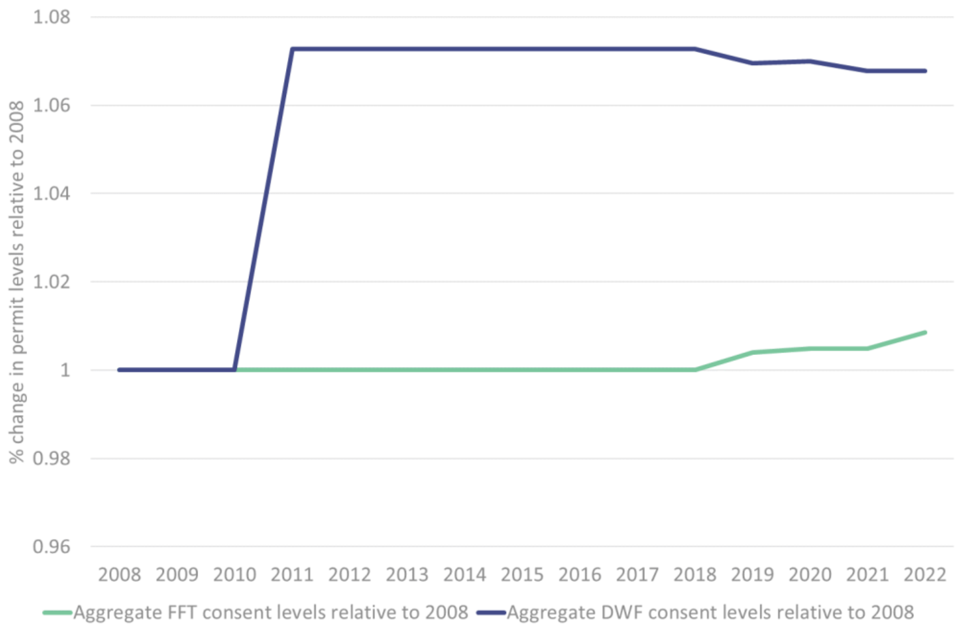


The figure shows that there was a substantial drop in the FFT:DWF ratios in 2010 at the sites requiring investment. The ratio can also be seen to remain at a lower level in the years since this event.

The figure below shows the evolution of the aggregate DWF and FFT consent values at these sites. Both series are normalised to 1 in 2008 and presented in relative terms to this figure. This enables us to see the underlying reason for the change in the FFT:DWF ratio.

11 In this figure we assess the aggregate FFT:DWF ratio (i.e. $\sum FFT \;/ \sum DWF$) instead of the average of the individual ratios as each site. We consider this to be the most appropriate measure as it better demonstrates the overall extent to which FFT capacity has lagged behind DWF capacity, and therefore the extent to which SVH will have to invest to catch up when it updates its DWF consents over AMP8.

Figure 50: Relative changes in aggregate FFT and DWF consents across 18 of the 22 sites in the claim



Source: Economic Insight Analysis of SVH data

As can be seen, the drop in the ratio in 2010 is driven by a rise in the DWF consents, without a commensurate rise in the FFT consents. We can see that FFT consents have not risen substantially since this point, preserving this lower ratio in the years since 2010.

This shows that FFT:DWF ratio fell precipitously in 2010 and has remained low since. This suggests that FFT capacity will have to be increased proportionately more than DWF to restore historical ratio levels. If this is the case, Severn Trent will incur larger costs to increase FFT capacity than it has done historically when increasing its DWF consents. These costs will not be captured in historical data.

Related changes to limits in other discharge consents (e.g. BOD, NH3 and P).

We also expect that the above changes in relation to DWF will also come with tighter treated effluent permit limits (for example biochemical oxygen demand (BOD), ammonia (NH_3), phosphorus (P), etc.). This is to prevent the deterioration of water bodies in the country, as measured against WFD Environmental Quality Standards. As flows increase, the effluent must be treated to a higher standard to ensure against deterioration of the water quality of the receiving watercourse.

Where such tightened consents cannot be delivered through installed treatment processes, and especially as permit limits approach technically achievable limits, wastewater companies will need to install new infrastructure and more intensive processes to comply with these tighter standards (e.g. replacing biofilters with a more advanced treatment process such as an Activated Sludge Plant). This will increase the costs associated with updating DWF consents over AMP8 compared with those that have been incurred historically.

SVH engages in a ‘pre-application process’ with the EA to better understand how their consent values are likely to change ahead of time. The table below shows the results of two of the pre-application outputs relating to sites which SVH predicts will require investment during AMP8: Lutterworth and Prees Higher-Heath. These have been chosen at random and are representative of a wider trend of tightening consents.

Table 19: Pre-application results for Lutterworth and Prees Higher-Heath

Site		DWF (m^3/d)	BOD (mg/l)	Solids (mg/l)	Ammonia (mg/l)	P (mg/l)	FFT (l/s)
Lutterworth	Before	2,400	20	40	5/10	1	75
	After	4,338	10	15	3	0.55	165
	% change	81%	-50%	-63%	-40%/-70%	-45%	120%
Prees Higher-Heath	Before	443	40	45	15	0.9	15.4
	After	720	10	15	1	0.5	27
	% change	63%	-75%	-67%	-93%	-44%	75%

Source: Economic Insight Analysis of SVH pre-application data

Note: Cells highlighted in red reflect consents that are set to be made more challenging by the EA.

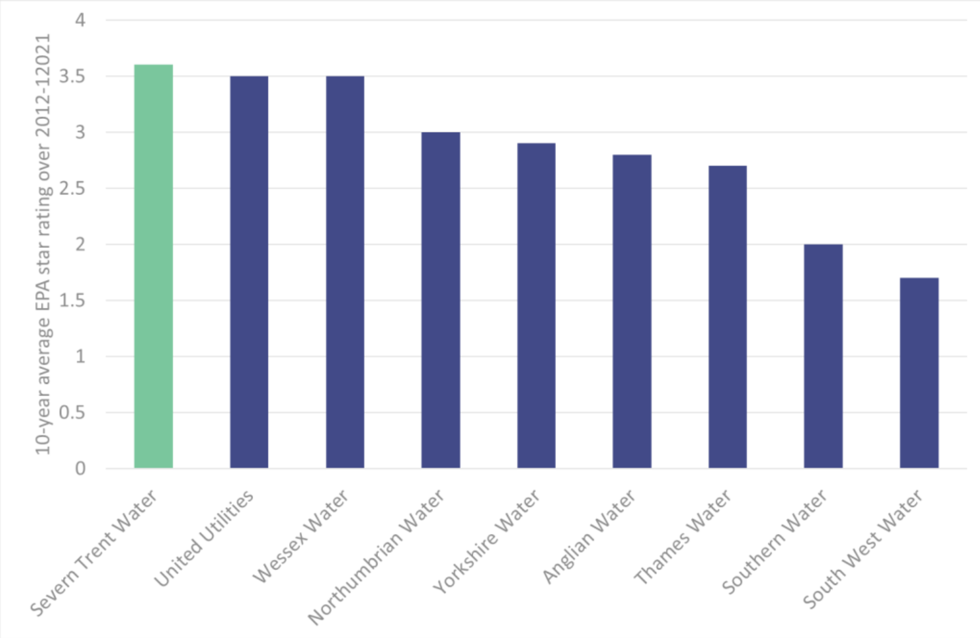
This shows that for these two sites that are anticipated to require investment during AMP8, the discharge consents for BOD, Solids, Ammonia, and Phosphate are all predicted to be substantially tightened when the DWF consent is updated, with the changes ranging between -44% and -93%. Again, these changes to discharge consents are imposed by the EA, so this is not under management control.

SVH has historically managed its STWs in an environmentally friendly and cost-efficient manner

We are one of the top performing wastewater companies in terms of its environmental performance. The EA produce an annual Environmental Performance Assessment for wastewater companies. As a part of this, it produces an overall star rating which reflects company performance across a range of metrics, including pollution incidents, discharge consent compliance, satisfactory sludge disposal, WINEP programme delivery and security of supply. Each company is rated with 1-4 stars, where 4-stars reflects an industry leading company, 3-stars a good company, 2-stars a company that requires improvement, and 1-star a poorly performing company.

The figure below shows the average EA star rating over the last 10 years. As can be seen, we have the highest average star rating with an average of 3.6. We also had the joint highest number of 4-star ratings (6 out of the last 10 years) alongside Wessex Water. This is high compared to the industry median number of 4-star results of 2.

Figure 51: Average EPA star rating over preceding 10-year period (2012-2021)[12]



Source: Economic Insight analysis of EA EPA data

Looking at discharge permit compliance, this is assessed by the EA using a RAG rating. The annual discharge permit compliance thresholds for these RAG ratings are set out in the figure below.

Table 20: Annual discharge permit compliance % thresholds for RAG ratings

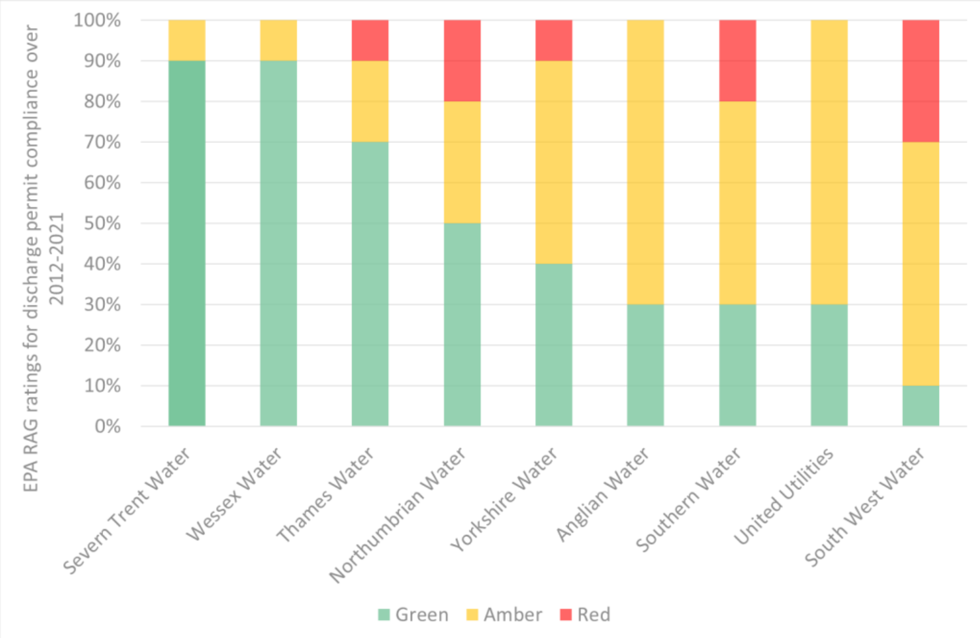
RAG Rating	2011-2015	2016-2020	2021
Green	99% ≤ x	99% ≤ x	99% ≤ x
Amber	96% < x < 99%	97% < x < 99%	99% < x < 99%
Red	x ≤ 96%	x ≤ 97%	x ≤ 98%

Source: EPA metric guide for 2021

The figure below shows the composition of the RAG ratings achieved over the last 10 years, by company. It clearly shows that Severn Trent is also one of the industry leading companies in discharge permit compliance, an issue closely related to DWF, having achieved 9 green ratings in the last 10 years, alongside Wessex Water.

12 2021 is the latest observation available at the time of writing.

Figure 52: EPA RAG rating performance for discharge permit compliance, 2012-2021



Source: Economic Insight Analysis of EA EPA data

We are confident that we are running our STWs in a way that is both cost-efficient for our consumers and environmentally conscious. We make sure to exhaust headroom before expanding capacity, but doing so in a timely manner once capacity is exhausted to minimise the potential for any negative environmental outcomes. In general, when DWF capacity is required, we build sufficient headroom to last for 1.5-2 AMPs to ensure that it can accommodate projected growth in the area into the future negating the need for further investment in that time period.

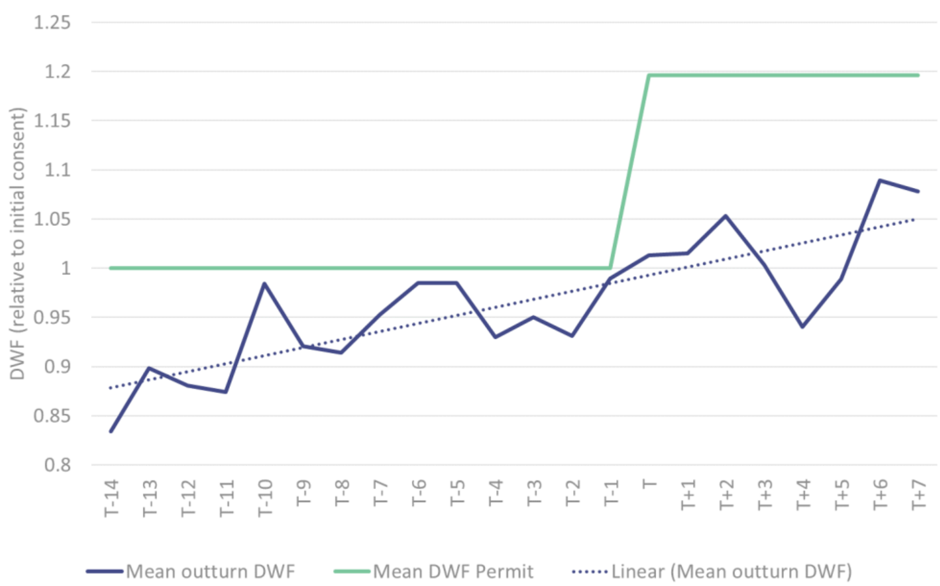
The reason for doing this is that there are substantial fixed costs incurred when undertaking a project to expand capacity (such as planning costs, land acquisition, etc) which make it un-economic to increase capacity incrementally at more regular intervals. It is much more cost efficient for customers if such expansion in capacity is done relatively infrequently in larger increments. Updating capacity every AMP would lead to incurring twice as many fixed costs compared to if capacity were upgraded every two AMPs, aligning with the upper end of the design horizon. There will also be savings relating to operational resource to carry out other projects. If the project is undertaken less frequently, less operational resource will be tied up overall, leading to more spare capacity to undertake other initiatives.

On the other hand, it is inefficient to increase capacity in increments that are too large. Firstly, predictions over where growth is likely to materialise become less accurate the further into the future. This means that there is a risk of building capacity but the growth materialising in a different area. Secondly, when too much headroom is built in, assets may have to sit idle, use unnecessary amounts of power or chemicals, or may be approaching the end of their serviceable life by the time the additional capacity is required. Similarly, too much capacity may mean that technological innovations in the intervening period cannot be taken advantage of. Regulatory risk also leads to the potential that more stringent new environmental legislation will make certain assets redundant before they have the chance to be fully utilised.

On balance, we have determined that 1.5-2 AMPs is the appropriate time horizon over which to build in headroom when undertaking capital investment at STWs. This can be thought of as 'spend to save', as a larger upfront investment means that fixed costs of increasing capacity do not need to be incurred as frequently.

The figure below shows how we have historically managed DWF headroom at STWs. It shows how the average outturn DWF has evolved relative to the consent value, both before and after a consent increase.[13] This chart summarises data across all treatment works and normalises it relative to the initial consent level and the time at which the consent is raised in order to be able to compare observations occurring at different time periods and across treatment works with different consent values.

Figure 53: Summary of how SVH manages headroom capacity on average



The blue line shows the average DWF value across STWs prior to and after the DWF consent being raised. We note that there are fluctuations in this, but that they generally follow an upward trend, represented by the dotted line. The green line shows the original permit level which then increases in time T to a new level which reflects the average proportional increase in DWF permits.

The figure shows that, on average, we wait until headroom capacity has almost been fully eroded before raising our DWF consent. This is cost efficient for consumers as it ensures that headroom capacity is only raised when necessary, rather than being raised more frequently than required. For example, in T-10 we can see that the series almost reaches the consent value. However, this is interpreted as a deviation from the trend rather than a reason to immediately increase DWF capacity. We subsequently see that this deviation from trend was transitory. The figure also shows that on average Severn Trent raises headroom before DWF breaches its consent value, which is important for ensuring that wastewater is treated effectively.

2.1.3 Materiality

Criteria

[13] We have normalised time 'T' to be the time period in which the STW raises its DWF permit capacity and have also normalised the initial permit value to equal 1. This frames the analysis in relative terms and ensures comparability between observations occurring at different time periods and across STWs with different permit values.

- f) Is there compelling evidence that the factor is a material driver of expenditure with a clear engineering / economic rationale?
- g) Is there compelling quantitative evidence of how the factor impacts the company's expenditure?

In this section, we set out that there is a clear engineering rationale for increases in DWF and FFT headroom, as well as tighter discharge consents, being a driver of capital costs for growth at STWs.

An STW that has to process a larger amount of base flow will have to have bigger assets than one that has a lower DWF consent value. Larger assets are a clear intuitive driver of higher costs. As such, there is a clear engineering rationale linking higher DWF consents to increased capital costs at STWs.

As set out in section **Error! Reference source not found.**, we expect that the increasing of permitted DWF will lead to a simultaneous requirement to increase permitted FFT . It should also be noted that the costs of increasing FFT are significantly higher than those of increasing DWF capacity. Again, there is a clear engineering rationale for why an increase in FFT capacity would drive higher expenditure. Dry weather flow tends to represent expected base flow within the overall hydraulic capacity of the treatment works and upon which other permit limits are set to ensure the protection of the downstream watercourse. An increase in DWF implies that there is more load to be treated at the works, but not necessarily substantially more overall wastewater volume. Therefore an increase in dry weather flow alone can sometimes be handled without major modifications to existing assets, but by increasing the intensity of the existing processes (for example, increasing the density of mixed liquors within an activated sludge process and optimising control to maximise aeration efficiency and subsequent settleability). However, FFT reflects peak flow conditions and the maximal amount of wastewater that needs to be processed at a given site. Many treatment processes rely on retention of flow to achieve adequate settlement of solids and to provide the correct conditions for certain biological and biochemical processes to take place. For an increase in FFT, achieving the same treatment performance requires larger assets such as primary sedimentation tanks, secondary treatment units, final settlement tanks, etc. As a result, increasing FFT capacity requires more extensive modifications to assets to increase their capacity. Again, there is a clear intuitive and engineering link between larger assets and higher costs.

In addition, as demonstrated by recent pre-application submissions with the EA, we anticipate that other permit limits (sanitary, nutrient, metals, etc.) will be tightened when DWF permits are increased. These changes will move many more STWs to the frontier of what is technically achievable for wastewater treatment and will require us to install new infrastructure and implement new processes at our treatment works to comply with these tighter standards (e.g. replacing biofilters with a more advanced treatment process such as an Activated Sludge Plant).[14] In addition, these more complex assets will require more energy to run and higher chemical dosing. There is a well-established link between tighter discharge consent standards and the capital investment costs at STWs. Significant tightening of discharge permit limits will therefore lead to higher costs than have been incurred historically, as we are legally compelled to comply with these tighter standards.

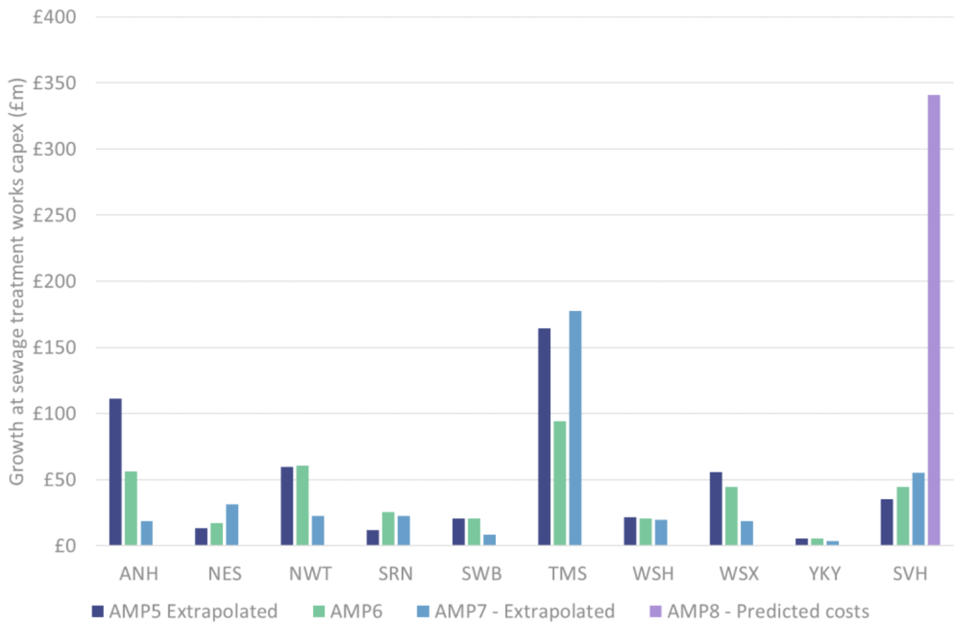
[14] Activated Sludge Plants (ASPs) are a secondary sewage treatment process whereby a microbial culture called biological activated sludge and oxygen are added to the wastewater. This leads to biological reactions which break down the organic matter present in the wastewater. Tight discharge limits require more complex ASP, with more chemical dosing or additional subsequent tertiary processes.

We have been unable to devise a top-down econometric model that can clearly capture these relationships, linking the factors that have been identified as cost drivers to historical expenditure of companies in the industry. This is largely because the data does not exist to control for these factors, as set out in section 2.1.1. As a result, we have instead pursued bottom-up modelling as a means to capture these individual cost drivers at a site level.

Our bottom-up assessment of costs (described in greater detail in section 2.2) shows that the expenditure that will be required for AMP8 is significantly higher than historical expenditure levels to manage costs of growth at STWs.

The figure below sets out the historical expenditure in previous AMPs, pro-rated to account for account for all of AMP5 through to AMP7. This is compared to the expenditure projected to be required by Severn Trent over AMP8 (this relates to the £341m being sought in the cost adjustment claim).[15] This shows that the extent of the predicted expenditure for Severn Trent's orders of magnitude higher than it has been over the preceding three AMPs and is substantially higher than the expenditure of all other companies in the industry. We do not have projected expenditure for other companies over AMP8.

Figure 54: Growth at STWs capex across AMPs (£m real)



Source: Economic Insight analysis of Ofwat and SVH data

This demonstrates that growth at STWs is likely to require substantially larger capital expenditure than it has at previous AMPs.

2.1.4 Adjustment to allowances (including implicit allowance)

Criteria

[15] Four out of five years of data are available for AMP5 as the earliest available data in Ofwat's dataset relates to 2011/12. Similarly, we have only two out of five years of data for AMP7 as we are only part way through this AMP. To adjust ensure comparability, we multiply the AMP5 and AMP7 totals by 5/4 and 5/2 respectively. This approach may be imperfect as the expenditure on growth at STWs is lumpy and can vary relatively substantially by year.

- h) Is there compelling evidence that the cost claim is not included in our modelled baseline (or, if the models are not known, would be unlikely to be included)? Is there compelling evidence that the factor is not covered by one or more cost drivers included in the cost models?
- i) Is the claim material after deduction of an implicit allowance? Has the company considered a range of estimates for the implicit allowance?
- j) Has the company accounted for cost savings and/or benefits from offsetting circumstances, where relevant?
- k) Is it clear the cost allowances would, in the round, be insufficient to accommodate the factor without a claim?
- l) Has the company taken a long-term view of the allowance and balanced expenditure requirements between multiple regulatory periods? Has the company considered whether our long-term allowance provides sufficient funding?
- m) If an alternative explanatory variable is used to calculate the cost adjustment, why is it superior to the explanatory variables in our cost models?

Current status of the models

Sewage treatment works growth has currently been excluded from the models. As a result, there is currently no implicit allowance within the models presented for the PR24 cost modelling consultation. Therefore, the gross claim and the net claim will be the same value. However, we have sought to present potential net claims in the event that these costs are either included in the base models, or Arup's standalone sewage treatment works growth models are considered.

Econometric benchmarking models based on historical costs would not allow sufficient costs

Ofwat states that the strategic growth required "*to address supply (network or treatment) issues where existing headroom is limited*" was discussed at the Cost Assessment Working Group (CAWG) meeting on 12 October 2021.[16] Following the CAWG meeting, Ofwat commissioned Arup to consider a separate assessment of costs for growth at STWs. Arup concluded that "*a standalone econometric model is a viable option for assessing growth at WwTW cost at PR24*", however it also noted that Ofwat "*may want to consider supplementing the econometric models with a cost adjustment claim process similar to that used at PR19*".[17] In its PR24 base costs assessment consultation, Ofwat has indicated that it will continue to consider a separate econometric model for these costs, however it notes that if a robust model is not feasible it "*may revert to including growth at sewage treatment works costs in the base cost models*".[18]

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16 Please see the discussion on strategic growth on slide 28 here: https://www.ofwat.gov.uk/wp-content/uploads/2021/12/Growth-CAWG.pdf.

17 Please see slide 16 here: https://www.ofwat.gov.uk/wp-content/uploads/2022/05/2022-04-07-Growth-CAWG-slides-Arup-and-data-collection.pdf.

18 Please see pg. 14 here: https://www.ofwat.gov.uk/wp-content/uploads/2023/04/Econometric_base_cost_models_for_PR24_final.pdf

Inclusion in Botex+ models or use of a separate backwards looking model will not adequately forecast the increased costs that we are facing in AMP8

We have estimated the amount of expenditure relating to STW growth that is included within base costs. Given the uncertainty around how Ofwat will assess costs relating to growth at STWs, we have taken two different approaches.

The first approach is based on a standalone model assessing growth at STWs. This is the approach that Ofwat has indicated that it will take in its consultation. This method uses the results from Arup's preferred capex specification to produce an estimate of the allowance that would likely be granted to Severn Trent if Ofwat were to take such an approach. This yields a pre-catch-up efficiency estimate of the AMP8 allowance of £136.6m, which is reduced to **£100.3m** when a 3rd company catch-up efficiency challenge is applied.

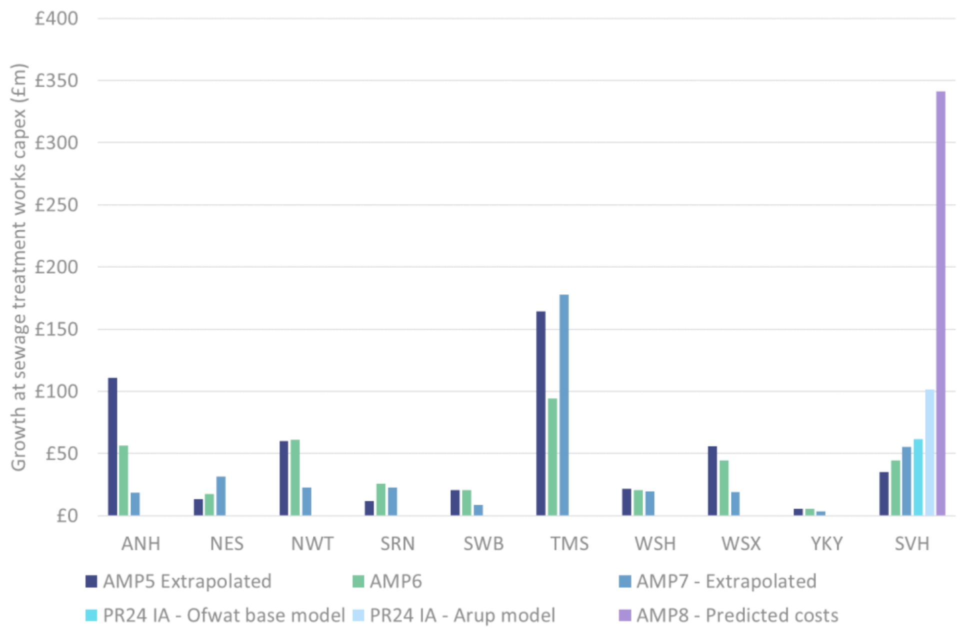
The second approach assumes that Ofwat reverts to including STW growth costs within its base models. This is the approach Ofwat state that it may take if it is unable to devise a sufficiently robust standalone model. To calculate the portion of the implicit allowance that is attributable to growth at STWs, we have assessed the difference between two sets of models, one including STW growth costs in the dependent variable and another excluding these costs when using Ofwat's April 2023 consultation models. This method yields an allowance of **£61.0m** pre-frontier shift.

The figure below sets out the scale of the costs estimated to be required over AMP8. It shows:

- historical expenditure in previous AMPs,
- the calculated implicit allowances,
- as well as the expenditure projected to be required over AMP8.

This shows that the extent of the predicted expenditure for Severn Trent is orders of magnitude higher than it has been over the preceding three AMPs and is substantially higher than the expenditure of all other companies in the industry. We do not have projected expenditure for other companies over AMP8.

Figure 55: Growth at STWs capex across AMPs (£m real)



This demonstrates that growth at STWs is anticipated to be a substantially larger issue than it has been at previous AMPs. While there will clearly be a portion of this expenditure which will be captured by the implicit allowances, the chart indicates that any implicit allowance is only likely to cover a small proportion of the costs that will be required over AMP8.

Symmetrical adjustments

Ofwat state that it will be making the cost adjustment claim process at PR24 more symmetrical, to protect customers from the risks of a one-sided process that only increases costs rather than increases and decreases them. It sets out that cost adjustment claims should be symmetrical where the claim relates to costs that have been incurred historically, and subsequently included in the modelled cost baseline. However, Ofwat states that claims do not need to be symmetrical if costs have not been incurred in the past.[19]

As the underlying cause of this cost adjustment claim is down to regulatory changes to be implemented at PR24, as well as the impact of historical regulatory decisions, it is anticipated that all companies will require additional costs in order to invest in growth at STWs over PR24. While we do not have access to other company data, we note that the extent to which other companies will require investment over AMP8 may differ.

While growth costs relating to STWs have been incurred in the past, the extent the costs expected to be incurred over AMP8 are substantially greater than those that have been incurred in the past and will relate to expanding flow capacity and tightening discharge consents to levels that go beyond historical levels. For this reason, we consider that a symmetrical adjustment should not be required as the costs for which funding is being sought have not been incurred in the past.

Interaction with base expenditure

We have applied standard proportional allocation rules. Where existing capacity is replaced with a new process, we calculate the value of what it would have cost to replace the existing capacity and level of treatment performance. This is then deducted from the value of the new asset to determine the value that is required to address growth. Investment at treatment works to address growth and accommodate an increase in DWF may comprise expansion of existing process, addition of processes (intermediate processes or final effluent polishing processes), or replacement of existing processes with ones that can both treat greater volumes and treat to higher standards. This third type of investment may reduce future capital maintenance in existing capacity, hence the application of proportional allocation of expenditure.

Estimation of the implicit allowance

We have developed a methodology to quantify the amount of expenditure currently allowed for in the models to account our level of sewage treatment works growth. This means that fundamentally:

- The **gross claim** relates to a bottom-up assessment of expenditure requirements required to ensure compliant treatment as the population grows.
- The **implicit allowance** relates to either:
  - The costs implicit in Ofwat's consultation suite of models.
  - The costs that will be assumed by botex+ models for AMP8.

[19] Ofwat – PR24 final methodology - Appendix 9: Setting expenditure allowances; page 32.

- o The costs that will be allowed for through a separate STW growth model.
- The **net claim** relates to the additional costs that we have identified to manage STW growth pressures but will not be appropriately accounted for by the cost assessment approach eventually selected by Ofwat.

We describe the premise we have followed below. However, we have identified a wide range of scenarios for how it can be applied which can materially change the size of the claim. These are subsequently described. Finally, we set out in detail the central scenario of the quantified claim.

Premise for determining the implicit allowance

In the consultation model suite, sewage treatment works growth costs have been excluded, and as such the implicit allowance is 0. We have identified two different approaches to quantify the implicit allowance subject to how Ofwat accounts for Sewage Treatment Works Growth as its thinking progresses is this space.

Including Sewage Treatment Works Growth in the consultation models

The first approach is to put sewage treatment works growth back into the current suite of PR24 models. This is a difference approach, which considers the difference in forecast allowances when models with and without the inclusion of sewage treatment works growth are used. To quantify this claim, we consider efficiency to be set at the 3rd company level, which for the models with the inclusion of Sewage Treatment Works growth is 1.00. While this is too high for an efficiency challenge, we have set the efficiency challenge at this level to illustrate the impact the inclusion of sewage treatment works growth has on the models.

We have quantified the implicit allowance for Severn Trent to be £61.0m if Sewage Treatment Works growth is added to the current suite of consultation models.

Arup Capex Model

We have also sought to quantify the implicit allowance generated when the capex model presented by Arup is considered. While we have concerns with this model, we recognise it as valid approach that Ofwat may choose to take. We attempted to replicate the Totex model too, but could not do so. We were able to perfectly replicate the Capex model, however, so shifted the 10-year window from 2011-12 to 2012-13 and from 2020-21 to 2021-22 and re-ran the model. We note that the model is highly sensitive to the 10 year window selected.

We divide by 2 to account for this model predicting a 10-year window, and apply a 3rd company efficiency of 0.74 to this model to generate the final implicit allowance, although we note that if the efficiency challenge is to be based on model quality then this model should not be given such a tight challenge. For Severn Trent, this generates an implicit allowance of £100.3m.

The implicit allowance for all companies for all three potential IAs are shown in ***Table 21***.

Table 21: IAs for all companies for different modelling options

Company	Consultation Suite IA	Consultation Suite + Sewage Treatment Works Growth IA	Arup Model IA
ANH	£0m	£70.7m	£41.5m
NES	£0m	£22.8m	£25.1m
NWT	£0m	£45.8m	£70.5m
SRN	£0m	£34.4m	£27.5m
SWB	£0m	£61.6m	£31.1m

TMS	£0m	-£134.7m	£141.6m
WSH	£0m	£41.4m	£10.2m
WSX	£0m	£36.9m	£35.2m
YKY	£0m	-£11.0m	£4.3m
SVE	£0m	£61.0m	£100.3m
HDD	£0m	£0.56m	£0.92m

Quantifying the claim

In figure 10 we outline our view of our gross claim, the potential implicit allowances, and the potential net claims resulting from these implicit allowances.

Table 22: Table setting out details of how claim has been quantified

Component	£m Central case	Basis for central case
Gross claim	£341.3m	Bottom-up assessment of costs
IA (assuming consultation models)	£0	• Costs currently excluded from base cost models
Net claim (assuming consultation models)	£341.3m	Gross claim – implicit allowance
IA (assuming Botex+ approach)	£100.3m	Difference approach (with and without STW growth being included in the dependent variable PR24 consultation models
Net Claim (assuming Botex+ approach)	£240.05m	Gross claim – Implicit allowance
IA (assuming separate 'ARUP' model)	£61.0m	Separate simple STW growth model as per ARUP CAWG presentation
Net Claim (assuming separate 'ARUP' model)	£280.3m	Gross claim – Implicit allowance

2.2 Cost efficiency (necessary)

Criteria

- a) Is there compelling evidence that the cost estimates are efficient (for example similar scheme outturn data, industry and/or external cost benchmarking, testing a range of cost models)?
- b) Does the company clearly explain how it arrived at the cost estimate? Can the analysis be replicated? Is there supporting evidence for any key statements or assumptions?
- c) Does the company provide third party assurance for the robustness of the cost estimates?

Bottom up estimation of the costs included in the claim

We have calculated the CAC in the following way:

- First, we have estimated the impact of the changes to DWF, FFT and discharge consents on the required capacity at each of our STWs. We have estimated that we will need to increase capacity at 22 of our STWs over the course of AMP8. This is a direct result of the change in consents we are forecasting due to population growth eroding the current DWF headroom.
- Second, we have identified the efficient costs related to this increase in capacity at each of these STWs. In totality, the efficient costs of increasing this capacity at these STWs are £341m.

The table below sets out the estimates of costs relating to growth at STWs that are predicted to require investment over AMP8.

Table 23: Breakdown of costs relating to growth at STWs over AMP8, by STW

Site	Assumed intervention	Options currently considered	Justification for Intervention	AMP8 Investment (£m)	Estimation method
Armitage	Inlet Works; Hydraulic upgrades; new FST & TAR	2	Available space; minimal disruption to treatment process; reduced abandonment	£5.74m	Bottom-up
Wirksworth	Inlet Works; Hydraulic upgrades; new FST & TAR	3	Available space; minimal disruption to treatment process; reduced abandonment	£6.85m	Bottom-up
Higher Heath-Prees	Transfer and then Replacement asp works	3	Minimise the abandonment, less risk of compliance issues with transfer relocation;	£9.00m	Comparative
Lichfield	Retain works with sidestream ASP	3	Maximises utilisation of existing assets and minimises abandonment	£28.00m	Comparative
Derby	Additional ASP	2	Scope driven by forecast load (COD) of planned trade effluent increase	£22.40m	Comparative
Harworth	Expansion of biofilter works	3	Available space; minimal disruption to treatment process; reduced abandonment.	£13.76m	Bottom-up
Kegworth	Replace secondary treatment with ASP	2	Available space; minimal disruption to treatment process; reduced abandonment.	£11.21m	Bottom-up
Napton	NSAF + FE transfer	1	Minimise the abandonment, less risk of compliance issues with transfer relocation;	£3.25m	Comparative
Shenstone	Inlet Works; Hydraulic upgrades; New PST; New Biofilters; New HST	2	Available space; minimal disruption to treatment process; reduced abandonment.	£4.31m	Bottom-up
Worksop – Manton	New ASP and ancillaries	2	Process selection based on future sanitary permit limits as a consequence of increased DWF	£18.00m	Comparative
Ludlow	Side stream ASP	2	Available space; minimal disruption to treatment process; reduced abandonment.	£3.60m	Bottom-up
Lutterworth	Pocket ASP	3	Opportunity to convert site to BNR and compliments existing treatment process	£16.00m	Bottom-up
Boughton	Retain works, extend TAR, new ballasted TSR	1	Maximises utilisation of AMP6 existing assets and minimises abandonment	£12.34m	Bottom-up
Norton-In-Hales	TBC – Estimate based on similar sized works by PE and Flow with similar capacity increase			£3.00m	Comparative
Swinford	Retain works with additional treatment – biofilter, HST and reed bed	2	Available space; minimal disruption to treatment process; reduced abandonment.	£2.09m	Bottom-up
Warwick – Longbridge	Retain Existing Works, Supplementary Primary Tanks with a Conventional Settled Activated Sludge Sidestream and new Full Flow TSR	7	Available space; minimal disruption to treatment process; reduced abandonment.	£28.87m	Bottom-up
Edingale	Retain works plus additional RBC	1	Available space; minimal disruption to treatment process; reduced abandonment.	£2.61m	Bottom-up

Kimcote	Additional treatment with TAR	2	Maximises utilisation of existing assets and minimises abandonment	£3.75m	Comparative
Woolstone	New inlet pumping station and new iRBC, incorporating AMP6 TSR	3	Maximises utilisation of existing assets and minimises abandonment	£4.00m	Bottom-up
South Kilworth	TBC – Retain works and possible additional treatment in form of RBC extension and either Aerated Reed Bed/NSAF plant plus Chemical Dosing	1		£5.00m	Comparative
Newent	PST retained, secondary treatment replaced with ASP, two point dosing, expanded TSR	2	Available space; minimal disruption to treatment process; reduced abandonment.	£18.82m	Bottom-up
Rugby Newbold	Additional ASP	4	Available space; minimal disruption to treatment process; reduced abandonment.	£118.7m	Bottom-up
Total				£341.3m	-

Below, we set out in more detail the methodology that we have followed to derive these costs.

Identifying impact of the changes to DWF, FFT and discharge consents

To identify the impact of changes to the EA consents, we have taken the following steps:[20]

- **Step 1: Assessed and projected DWF headroom into the future** – Firstly, we performed an assessment of how DWF is likely to evolve going forward in the context of the new rules on compliance due to be implemented in 2026. This takes account of the recent DWF performance, projections of future growth from the ONS, as well as any information available on acute local growth pressures such as major new development site (e.g. Bassetlaw Garden Village – Worksop Catchment, Lutterworth East SDA – Lutterworth Catchment, Rugby Radio Station Site SUE – Rugby Catchment .
- **Step 2: Assign a compliance assessment and certainty score** relating to when the STW is anticipated to breach DWF levels assuming the future '3 in 5' method. We assign a compliance assessment identifying the AMP in which the STW is anticipated to require investment. Similarly, we assign a certainty assessment which relates to the likelihood that the compliance assessment is correct with consideration of the year by year variability of measured DWF as a consequence of weather, known development completions and the highly variable impact of covid from site to site. This enables the identification and prioritisation of STWs that are likely to fail over each AMP going forward.

This process has identified **27 sites** where we are forecasting that the requirement for growth enhancement will occur in AMP8 (i.e. through the new '3 in 5' method, the 3rd year will occur during AMP8). However, 1 site can be managed entirely through other investment planned. There are a further 4 sites where we have identified the potential for catchment rather than treatment solutions (Netheridge, Stoke Bardolph, Finham and Kidderminster), as set out in section 2.1.1. These will be considered separately through an enhancement business case. Consequently, they have been removed from this cost adjustment claim to avoid double counting. This leaves this claim covering **22 sites**.

20 PR24 Base Plan Build Up It3 v0.1 extract

However, it does not include sites where DWF interventions may be required in AMP7. Using the '3 in 5 method, we have identified an additional **25 sites** where the criteria is already met. In most cases we are already in dialogue with the EA as part of the existing consent change process. Consequently, we are assuming here that they will be live issues in AMP8 meaning that the costs should not be relevant to this cost adjustment claim.

We have also identified a further **14 sites** where the '3 in 5' method identifies a potential meeting of the criteria between now and the end of AMP7. Therefore, these sites may be subject to engagement with the EA during AMP7 through the existing consent change process. Where this does become the case, we have assumed that the requirement would land in AMP7 and therefore have not added the sites and costs to this AMP8 cost adjustment claim. However, if the satisfying of the '3 in 5' criteria does not happen at these sites until AMP8, or the current consent process does not lead to requirements for intervention in AMP7, it is highly likely that they would then become an AMP8 requirement under the '3 in 5' process. Whilst we have cautiously not included these 14 sites in this cost adjustment claim, our current estimate for interventions at these 14 sites totals to £85.4m (by virtue of the smaller sizes of these sites relative to the larger sites included in those forecast to exceed permitted DWF requirements in AMP8 - e.g. Rugby, Longbridge, Lichfield, Derby, Worksop). This highlights some of the uncertainty that we currently absorbing in scoping the claim at the 22 sites.

Identifying efficient costs of increasing capacity

For the sites that were identified as likely to fail over AMP8, we have engaged in a process of planning the required capacity changes and identifying the efficient costs of increasing capacity. To do this, we have taken the following steps.

Step 1: Planning headroom requirements

The first step we have taken is to plan out the headroom requirements while accounting for future growth pressure. This analysis is referred to as 'Design Envelope Confirmation'. This process plans using a design horizon, which is the date until which the new headroom is intended to last. This is generally 1.5-2 AMPs, although longer for "small works" (<2,000 PE), where the investment solutions available are typically the smallest units available for modular expansion in any case. This process predicts growth in DWF, FFT, and other permit limit values out to the design horizon to establish the new permit limit values that will be required for the site's new permit to give sufficient headroom.[21]

Step 2: Identification of options

After planning the headroom requirements, options are generated for how to deliver the increase in capacity required.

Options can be fundamentally considered as:

- Providing more capacity / treatment processes at the STW – E.g. more primary, secondary (and potentially tertiary) treatment.
- Managing the existing capacity on site – E.g. Sludge liquor treatment releasing secondary treatment capacity
- Reducing flows arriving at STWs – E.g. Managing sewer infiltration, diverting flows to other sewage works, package treatment for large industrial users.

[21] Keyworth STW DEC.xlsm / Keyworth STW FFT.xlsx

This optioneering process for traditional STWs interventions requires process designers to assess the existing processes and determine options for how the site might be able to be upgraded to increase capacity. These options are generated internally by our process design team. In designing the process options, they consider:

- How much of the current infrastructure can be utilised in meeting future permit requirements.
- To what extent other processes can be added in parallel to achieve the desired outcomes. This will depend on the configuration of the existing infrastructure and the availability of space.
- Whether new infrastructure should be built to replace outdated infrastructure. This will depend on whether certain infrastructure is reaching the end of its life, as well as the extent to which consents have been tightened requiring more advanced treatment methods. Where new infrastructure is built to replace old, there will be an overlap between base costs for maintenance and enhancement costs for growth. A certain portion of such expenditure will be implicitly funded by base, while the portion that expands capacity will be funded by enhancement.

An operational risk rating is assigned to each of these options, and it must be determined whether operational risk should be stretched or maintained.

Cost estimates may also be calculated for a few of the different options. The selection of which options are costed is determined by technical experts from our asset strategy and planning team, process design team, and capital delivery (engineering) teams. The number of options which are costed will depend on time and resource required, as well as their viability. This is a judgement call made by experts based on which options present tolerable compliance risk. This generally means that not all of the options that are devised end up being costed.

These projects are still a relatively long way off given they will be spread across AMP8. As a result, there are still further rounds of optioneering and feasibility studies to be undertaken to ensure that the option we have selected is viable and efficient.

Step 3: Constructing bottom-up cost estimates

When the process option being taken forward has been decided on, Severn Trent estimate the efficient costs of implementing these changes.

Cost estimates are built up of the following elements:

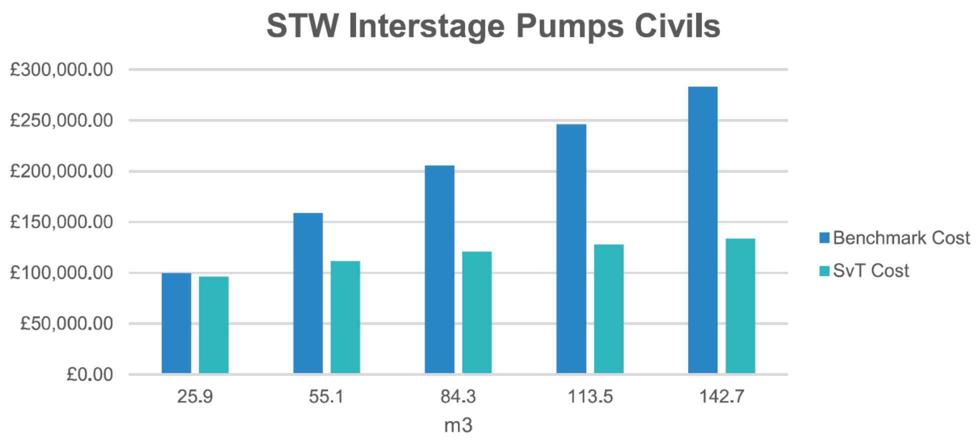
- Standard cost components (e.g. tanks and pumps)
- Non-standard components (i.e. scope items for which Severn Trent doesn’t have a reliable cost curve)
- Project On-costs (e.g. design and project management)
- Optimism bias (based on a review of scope increase as a result of unknown unknowns in the delivery of similar investment schemes over AMP6/AMP7)

Standard cost components

Standard cost components are for these projects are estimated using Severn Trent Unit Cost Application (STUCA) cost curves. These curves are calculated by independent consultants, and include Severn Trent specific cost curves, as well as being benchmarked relative to an industry-wide curve. They are calculated using cost information from historical projects broken down into the different types of assets and processes used in sewage treatment. Costs attributed to a certain asset or process are aggregated together to produce an estimate of the total cost of that asset or process for each historical observation. These costs are plotted against a yardstick measure for each cost item that best reflects how the cost varies depending on the scale of the asset or process. This enables the estimation of a curve showing how the cost varies depending on the scale of the asset of process being implemented. This curve is then used to predict the cost of building similar assets.

An extract from a report by Mott Macdonald shows that our cost curves compare favourably relative to the industry, with most of SVH's costs falling below the industry benchmark for most areas of significant expenditure.[22] This indicates that these costs are likely to be efficient. An example from this extract is presented in the figure below.

Figure 56: Screenshot from Mott Macdonald report setting out benchmarked cost curves



Source: Mott Macdonald report for Severn Trent

It should be noted that in the production of these cost curves there is a risk of not comparing like for like between different companies in terms of the scope of the costs are captured in each cost curve category. This increases the uncertainty of these estimates. This could lead to us looking more or less efficient than we should depending on the nature of the inconsistency of cost reporting between companies.

The costs for each project are calculated by applying the cost curves for each area of expenditure to the yardstick value that is estimated to be required for the project. These components are summed together yielding the bulk of the estimate.

We note that an 'on-cost' percentage is captured within these STUCA curves to reflect the cost of feasibility, design, project management etc. required in the delivery of the assets covered by the specific curve.

Non-standard costs

There are also separate estimates produced for 'non-standard' items that do not fit within the cost curve categories but are required to complete the project. These cost items, by their nature as non-standard, are not able to be benchmarked, but they generally tend to only reflect a small proportion of the total costs of a project.

An 'on-cost allowance' is applied to non-standard items to reflect the cost of feasibility, design, project management etc. required in the delivery of these items – i.e. to provide a total project outturn value for this element.

22 Growth related curves benchmarks.pdf

Optimism bias

Internal analysis we have conducted has demonstrated that forecast outturn costs increase from promotion to outline design stage by as much as 60% as a consequence of certain aspects of the scope of the project not being identified at an earlier stage. Our approach at PR24 has been to apply an 'optimism bias' uplift to counter this systematic underestimation of costs. This aligns with green book recommendations, which suggests making an explicit adjustment for optimism bias. The figure used to adjust for optimism bias has been informed by our historical evidence of such a bias, as well as green book guidance. We have applied an uplift of 5% to Growth schemes, which aligns with our approach to pricing WINEP schemes, as the type of investment and maturity of the solutions identified are not dissimilar to those identified for WINEP.

Similarly, an adjustment is made to account for head office overheads, amounting to 6.25%. This is to account for the fixed costs that are incurred by head office whenever a capital investment project is undertaken.

Comparative cost estimates

We note that not all of the cost estimates are computed using bottom-up analysis. ***Table 23*** sets out which have been estimated using bottom-up and which have been estimated on a comparative basis. The decision not to estimate all of these using a bottom-up methodology was motivated by the resource and cost required for such an exercise. However, as the bottom-up estimates have been estimated efficiently, as long as comparative estimates are calculated appropriately, they should be efficient as well.

Example

In this example, we set out how the bottom-up cost estimates were produced for Boughton treatment works.

First, the standard costs are estimated. These are split between infrastructure and non-infrastructure. For Boughton, there are only non-infrastructure costs estimated, however infrastructure costs for other projects include items such as rising mains and gravity sewers for significant lengths of inter-process pipework. Non infrastructure items include categories such as interstage pumping, sludge holding tanks, nutrient removal etc. These categories are further subdivided into 'civil' and 'mechanical and electrical' ('M&E') components. For each item, a 'size' of the asset is specified. The size is then compared to a STUCA cost curve to produce an estimate of the cost relating to each component. For Boughton, the sum of these STUCA components totals £8,108,617.

Second, the non-standard costs are estimated. These cost items are also subdivided into 'civil' and 'M&E'. The basis for the calculation of each cost item is briefly set out. In the case of Boughton, the total for non-standard work items is £3,842,957 including a Programme Level Non-Standard Allowance of £435,403, which represents a risk contingency based on analysis of historical outturn costs for costs estimated outside of standard cost curves. Project on-costs are added based on standard percentages, variable by value, for the type of investment scheme, in this case Sewage Treatment. The project on-costs (feasibility, design, project management, etc.) for Boughton amount to £2,329,842, bringing the total scheme estimate to £14,281,398.

A driver allocation exercise is then undertaken to determine how much of the forecast scheme outturn relates to growth and how much is replacing existing assets, which would otherwise be the subject of capital maintenance. For Boughton this results in the nett investment for Growth of £11,063,213.

Following this stage, an adjustment is made for optimism bias. This adjustment factor is 5% based on a review of scope increase as a result of unknown unknowns in the delivery of similar investment schemes over AMP6/AMP7.. Overhead is also apportioned to this project at 6.25%. This yields an estimate of the total costs of this project of £12,342,000.[23]

2.3 Need for investment (where appropriate)

Criteria

- a) Is there compelling evidence that investment is required?
- b) Is the scale and timing of the investment fully justified?
- c) Does the need and/or proposed investment overlap with activities already funded at previous price reviews?
- d) Is there compelling evidence that customers support the need for investment (both scale and timing)?

The costs outlined in this claim are driven by the onset of new regulatory changes as well as the EA's decision to update DWF consents in 2010. Our modelling, which estimates the timing of this investment, is robust and is likely to be an accurate reflection of when investment is likely to be required at each site. Our approach to this modelling is set out in more detail in section 2.2. We present evidence in section **Error! Reference source not found.** that under the new compliance regime, 15% of STWs would already be considered to be failing. We are already pro-actively planning and undertaking investment to avert this over the course of AMP7, before the changes are implemented in 2026. The costs relating to investment that falls into AMP7 are not currently being requested through this claim. The modelling indicates that a substantial number of sites will also require investment over the course of AMP8.

In addition to the compliance modelling, we present evidence that FFT:DWF ratios at some of the sites requiring investment over AMP8 declined in 2010 and did not recover in the years since. Our recent experience with the EA indicates that FFT:DWF ratios are likely to be restored to their historical levels when DWF consents are raised. We also show that discharge consents are going to be substantially tightened using data from SVH's pre-application processes with the EA. These results are all set out in more detail in section **Error! Reference source not found.**, and the engineering rationale for these factors driving increased costs is set out in section 2.1.3. This indicates that costs per site are likely to be more substantial than those incurred historically, indicating that more investment will be required.

Our bottom-up modelling illustrates the extent to which the costs required for AMP8 will depart from historical norms. The costs that are estimated to be required over AMP8 will be substantially larger than those that have been incurred historically, and higher than the implicit allowances we have estimated using the methods that we consider Ofwat is most likely to take at PR24. Again, this is compelling evidence that costs will deviate from historical norms and additional investment will be required at AMP8.

The timing of the investment is also justified. As we set out in section **Error! Reference source not found.**, it is efficient to exhaust headroom entirely before increasing the capacity of treatment works. This is because upgrading capacity too early leads to incurring investment costs more frequently than is required which is not cost effective for customers. Additionally, due to the nature of these changes

[23] Overall cost estimate = £11,063,213 × 1.05 × 1.0625 = £12,342,000 after rounding

being statutory, we are compelled to invest as these changes come in to ensure that we remain compliant with the new permitting conditions. To delay investment would lead to treatment works beginning to be listed as failing which would be in breach of our obligations and would lead us to incur penalties. Therefore, because these sites are anticipated to run out of headroom during AMP8, this is the appropriate time to make this investment.

The proposed investment does overlap with base costs. Historically, growth at STWs has been contained within base costs. The premise of this cost adjustment claim however is that the costs required for growth at STWs have begun to depart from historical trends due to the factors we have outlined in section 2.1.1. Therefore, the required investment will be part funded by base, but base will be insufficient to cover the entirety of these costs. We have produced estimates of our expectations of base allowances for growth at STWs, as set out in section 2.1.4. This demonstrates that the expected allowances for growth at STWs at PR24 will be substantially lower than our estimates of the investment required.

However, this investment does not overlap with activities funded at previous price controls. This additional expenditure is being driven by a combination of factors described above on top of population growth, so will not have been funded at previous price controls.

As these costs are being driven by regulatory decision making, we are required to comply with these changes regardless of the preferences of customers. However, environmental issues are an area that is strongly supported by SVH's customer base. This is set out in greater detail in section 2.4 below. This indicates that customers are likely to be supportive of our pro-active approach to dealing with these regulatory changes.

2.4 Best option for customers (where appropriate)

Criteria

- a) Did the company consider an appropriate range of options to meet the need?
- b) Has a cost–benefit analysis been undertaken to select proposed option? There should be compelling evidence that the proposed solution represents best value for customers, communities and the environment in the long term? Is third-party technical assurance of the analysis provided?
- c) Has the impact of the investment on performance commitments been quantified?
- d) Have the uncertainties relating to costs and benefit delivery been explored and mitigated? Have flexible, lower risk and modular solutions been assessed – including where utilisation will be low?
- e) Has the company secured appropriate third-party funding (proportionate to the third party benefits) to deliver the project?
- f) Has the company appropriately presented the scheme to be delivered as Direct Procurement for Customers (DPC) where applicable?
- g) Where appropriate, have customer views informed the selection of the proposed solution, and have customers been provided sufficient information (including alternatives and its contribution to addressing the need) to have informed views?

As set out in section 2.3, in this instance the EA is effectively the primary customer. As these costs are being driven by regulatory decision making, we are required to comply with these changes regardless of the preferences of customers. If we were not to make these investments, sites that breach the new compliance criteria over AMP8 would be listed as failing. This would have ramifications in terms of fines, enforcement notices, and eventually, if these issues are not rectified, license breaches. However, despite this investment being required from a regulatory perspective, we have tried to ensure that we have dealt with this in a way that yields the best outcome for customers.

As set out in section 2.1.1, we have engaged in optioneering to ensure that we deal with this issue in the most appropriate way. This involved consideration of the best way to deal with the issue, considering both upstream approaches to dealing with these flows, as well as the more conventional boosting of capacity at STWs. For the sites at which increased headroom capacity was decided to be the most appropriate solution, we engaged in the identification and appraisal of a range of process options that reflect different approaches and configurations of assets to deliver the required increases in capacity at each site. This ensured that we selected the most appropriate option, balancing cost with compliance risk. This process is set out in more detail in section 2.2.

While a cost-benefit analysis has not been carried out, we are confident that our careful consideration of the options available to us means that we have selected the most appropriate option to deal with these issues at each STW. We have gone to lengths to ensure that the bottom-up costs we estimate are efficient which should therefore provide a cost-effective solution for customers. We believe that we are striking a sensible balance between environmental compliance and providing lumpy, but lowest whole life cost, interventions.

We consider it too early to have considered funding options. These projects are due to be delivered over the course of AMP8 as the need arises. We are currently in the process of developing the case for the investment that is required at each site over the course of AMP8. There are still further rounds of optioneering and feasibility studies to carry out to ensure that the choices we have made for investment at these sites are the correct ones. We will be sure to consider these options further at a later stage.

Although we understand that this issue will not interact with the Discharge Permit Compliance PR24 Common Performance Commitment[24], the EA has strongly indicated that DWF compliance will be a metric for its Environmental Performance Assessment (EPA) and reporting arrangements in AMP8[25]. Therefore, a failure to adequately invest to improve the headroom at the identified sites will result in loss of our EPA status during AMP8 as these sites start to fail compliance.

We note that customer views also align well with the course of action we are pursuing. Our willingness to pay research highlights that customers care strongly about the environment, and that this is an issue that was raised spontaneously as an area of core service and key concern. Similarly, sewage being released into rivers is another area of priority for customers. It is a top 3 environmental concern for customers, behind only climate change and plastic pollution.

"*Preventing the sewage network from causing environmental pollution*" and "*doing more to ensure sewers and sewage treatment works do not cause environmental harm to rivers*" are high investment priorities, ranked by 71% and 67% of customers respectively.[26] The willingness to pay research even indicates that there is customer support for going further than statutory requirements. Given that the

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24 PR24 Common performance commitments – Discharge permit compliance v0.2

25 Strategic Water Quality and Waste Planning Group meeting of 8th March 2023

26 Severn Trent willingness to pay research

motivation behind the EA's change in approach relates to ensuring that the sewage treatment system does not cause harm to the environment, it seems highly likely that investing in increased capacity at STWs, at which such increased capacity is required, would be supported by our customers.

2.5 Customer protection (where appropriate)

Criteria

- a) Are customers protected (via a price control deliverable or performance commitment) if the investment is cancelled, delayed or reduced in scope?
- b) Does the protection cover all the benefits proposed to be delivered and funded (e.g. primary and wider benefits)?
- c) Does the company provide an explanation for how third-party funding or delivery arrangements will work for relevant investments, including the mechanism for securing sufficient third-party funding?

Specific customer protection measures are not necessary for this claim. The EA has strongly indicated through the Strategic Water Quality and Waste Planning Group meeting of 8th March 2023 that the Environmental Performance Assessment (EPA) and reporting arrangements for AMP8 will include Dry Weather Flow (DWF) compliance as a metric. We are proud of our strong environmental performance credentials and are positively incentivised to continue to uphold these standards, which are demonstrated by our EA Environmental Performance Assessment (EPA) status.

There is already a rigorous process in place by the EA to manage and enforce failures. Ultimately, Severn Trent is required by law to be compliant with the Environmental Permits under which it operates and failure to do so will lead to enforcement, prosecution and fines as well as seriously impact on our reputation. The new 3 in 5 year permit conditions being introduced in 2026 formalise a process, removing ambiguity over whether a works is compliant or not, with clarity on the status of a works.

The is a minor risk that growth will not materialise as predicted and/or per capita consumption, and therefore per capita wastewater flows, will reduce sufficiently to negate the need to invest in additional wastewater treatment works capacity in AMP8. We believe this scenario to be highly unlikely, based on current trends of net migration to England and Wales combined with expected growth of the existing population. Indeed, a minor change in average weather during drier months, or a small deviation in working patterns could exacerbate our permitted DWF compliance position resulting in more works exceeding DWF than we are currently forecasting. In this event we will engage with the EA and Ofwat Ofwat to manage this uncertainty.