C5 A

Cost and Efficiency

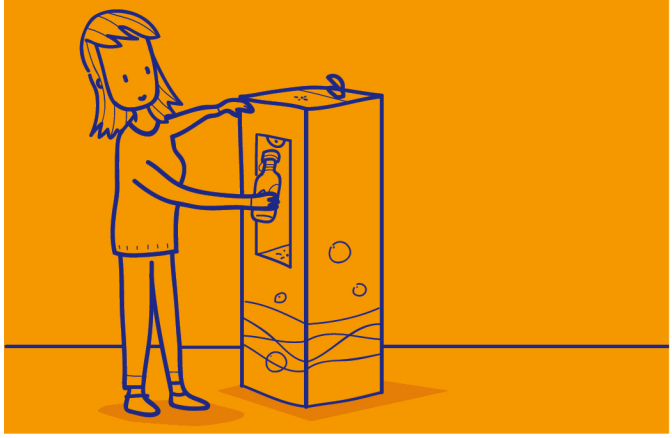
C5A Technical Annex
Cost Adjustment Claims

BRISTOL WATER

Structure of our Business Plan Submission

Appointee plan

A1
Bristol Water For All

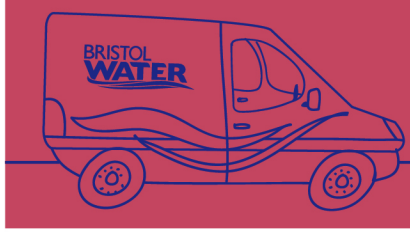


A2
Customer summary

Wholesale controls

B1
Water resources

B2
Water network plus



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B3
Residential retail

Supporting evidence

C1
Engagement, communication and research

Engagement Summary

C2
Addressing affordability and vulnerability

C3
Delivering outcomes for customers

C4
Bristol Water... Clearly Resilient

C5
Cost and efficiency

Investment cases

C6
Financeability, risk & return, and affordability

C7
Track record of delivery

C8
Securing Trust, Confidence and Assurance

Board Assurance Statement

1 Executive Summary

This Technical Annex to C5 of our business plan sets out the adjustments and exclusions that we believe will be required to the PR19 cost assessment process in order to adequately reflect particular cost drivers for Bristol Water that are unlikely to be captured within the models.

These adjustments have been identified through a detailed process, which reviewed the potential need for adjustments both from a top-down econometric perspective and a bottom-up assessment of our cost drivers.

We have considered the requirements for this submission as set out in Ofwat's PR19 Final Methodology[1]. We have updated the cost adjustment claim summary submission forms to reflect the revised template published in June[2].

We carried out a specific customer research event in order to explore customers' views on the specific challenges and opportunities provided by being served by a small local water company. These views helped to inform our decisions on the claims to include within this submission.

Our analysis has drawn on our experience of cost adjustment claims at PR14, and the views of Ofwat and the CMA on the relative merits of each case and the supporting evidence. We have engaged with Ofwat through the Cost Assessment Working Group (CAWG) and in company-specific meetings to provide our views on key cost drivers and the implications for cost adjustment claims. We were supported by NERA in the identification and shortlisting of potential claims, and NERA has provided a peer review of our cases at early submission. Formal assurance of the supporting evidence underpinning the claims has been provided by Atkins at early submission and this has been revised for our final submission; an assurance statement on the claims presented to Ofwat here within and the associated data tables is provided within this submission. The Bristol Water Board approved the cost adjustment claims presented herein for final submission and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency. This included consideration of the assurance evidence and the internal challenge process through the PR19 Board sub-committee. This follows the approach to Business Plan assurance outlined in section 7 of our 2018 Assurance Plan[3].

Throughout our process of identifying cost adjustment claims we have sought to identify any areas where a downward adjustment would be applicable to our costs due to favourable operating conditions. At early submission we did not identify any factors that met the relevant materiality thresholds and we retain this assessment for final submission.

A number of updates and improvements have been built into this submission. These reflect confirmation of year-end actuals and the coming together of our business plan as a whole. The most significant change has been the decision to drop the congestion cost adjustment claim due to materiality, which brings our total number of claims to four from the five presented in our early submission.

These are summarised in Table 1-1.

[1] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency
[2] Ofwat (2018) Revised pro-forma for cost adjustment claims
[3] Bristol Water (2018) Bristol Water Assurance Plan 2018/19 p.21-23

Table 1-1 - Summary of Cost Adjustment Claims

Cost Adjustment	Valuation 2020/21 to 2024/25 (£m, 2017/18 CPIH prices)	
	Lower estimate	Upper estimate
Purchase of Water from the Canal and River Trust	9.420	
Water Treatment Complexity	5.963	55.608
Prevailing Wages in the Bristol Water Supply Area	0	8.716
Network Age and Materials	12.282	
Total (Range)	**27.665**	**86.026**

Source: Bristol Water analysis

Our submission, as mirrored in the business plan data tables (WR8, WN6, R2 and R6) and summary pro-formas reflects the low end of the range shown in the table above. The total value of the cost adjustments in this submission therefore is £27.665m (£36.381m with the prevailing wage claim that depends on the modelling approach taken).

If we are assessed as more efficient than the upper quartile in Ofwat's cost assessment and our plan costs are accepted, these cost adjustment claims do not necessarily require consideration.

2 Summary Pro-formas

This section sets out a summary of each cost adjustment claim we are submitting for PR19, consistent with the revised pro-forma template published by Ofwat in June 2018[4].

[4] Ofwat (2018) Revised pro-forma for cost adjustment claims

BRL_001 – Cost adjustment claim summary form

Name of claim	**Purchase of Water from the Canal and River Trust**	
Name and identifier of related claim submitted in May 2018	BRL_001	
Business plan table lines where the totex value of this claim is reported.	£8.910m in WS1 Line 7 (for opex) and £0.510m in WS1 Line 10 (for opex); in the Water Resource business unit	
Total value of claim for AMP7	£9.420m (2017/18 CPIH prices)	
Total opex of claim for AMP7	£9.420m (2017/18 CPIH prices)	
Total capex of claim for AMP7	£0m	
Depreciation on capex in AMP7 (retail controls only)	n/a	
Remaining capex required after AMP7 to complete construction	n/a	
Whole life totex of claim	n/a	
Do you consider that part of the claim should be covered by our cost baselines? If yes, please provide an estimate	No. We are proposing that the cost of the claim, including historic costs reported, be excluded from the modelled cost baseline and accounted for on the basis of actuals outside the modelling framework, in the same way as *abstraction charges and discharge consents* are treated and in the same way as unique costs incurred by other companies, such as those associated with water softening or the traffic management act.	
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls.	12.0%	
Does the claim feature as a Direct Procurement for Customers (DPC) scheme? (please tick)	Yes	No
		✓

	Brief summary of evidence to support claim against relevant test	**List of accompanying evidence, including document references, page or section numbers.**
Need for expenditure	45.18% of our daily supply requirement is abstracted from the Sharpness Canal. Without this expenditure we would not be able to continue to supply our customers over AMP7 from a resilience and security of supply perspective. Alternative sources and trading options would not be able to support the 45.18% supply in the absence of this arrangement.	Section 5.5 sets out our need for the expenditure, as part of the narrative around management control.
Need for the adjustment	Contractual payments made to the Canal and River Trust for this abstraction are significant; no cost driver available to Ofwat may capture this third party water trading activity. These costs are unique and additional to the abstraction fees which we and other companies pay to the Environment Agency. We propose that the costs associated with this third party activity are removed from the modelling process and accounted for separately based on actual costs (cost exclusion not adjustment), comparable to the *abstraction charges and discharge consents* which are likely to be removed from the modelled costs.	Section 5.4 sets out the need for this cost exclusion case.
Outside management control	Whilst the original decision in 1962 to purchase water from the Gloucester and Sharpness Canal was within management control, any alternative to the current arrangement of supply would need to be able to provide 45.18% of our distribution input. We have not identified a more cost-efficient means of meeting this supply.	Section 5.5 sets out why this cost is outside of management control. In section 5.8 we demonstrate that alternative options could not provide the required supply needs at lower cost.
Robustness and efficiency of claim's costs	Cost estimates are based on current contractual arrangements, which set a fixed and volumetric fee for abstractions from the canal. High quality third party assurance of the cost estimates has been provided by Atkins.	Section 5.8 demonstrates that the costs are currently significantly cheaper than other options for increasing supply or purchasing water from neighbouring companies.
Affordability	The claim relates to base costs, present both in our historic and forecast costs and are therefore not explicitly associated with a given bill increase for AMP7 compared to AMP6 reflecting the ongoing incurrence of the activity.	Section 4.1.9 presents our affordability assessment of the claims.
Board assurance	None of our claims relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board has however approved our cost adjustment claims submitted and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency.	Section 4.1.10 provides confirmation of Board approval of the final claims.

BRL_002 – Cost adjustment claim summary form

Name of claim	**Water Treatment Complexity**	
Name and identifier of related claim submitted in May 2018	BRL_002	
Business plan table lines where the totex value of this claim is reported.	£1.469m in WS1 Line 1 (for opex), £1.894m in WS1 Line 7 (for opex), £0.484m in WS1 Line 10 (for opex); £2.116m in WS1 Line 13 (for base) in the water treatment business unit	
Total value of claim for AMP7	£5.963m (2017/18 CPIH prices)	
Total opex of claim for AMP7	£3.847m (2017/18 CPIH prices) total split based on water treatment expenditure.	
Total capex of claim for AMP7	£2.116m (2017/18 CPIH prices) total split based on water treatment expenditure.	
Depreciation on capex in AMP7 (retail controls only)	n/a	
Remaining capex required after AMP7 to complete construction	n/a	
Whole life totex of claim	n/a	
Do you consider that part of the claim should be covered by our cost baselines? If yes, please provide an estimate	We have assumed that the claim is in part within the modelled cost baselines, but this will depend on the explanatory variables and specification of the PR19 models for water treatment, network plus and wholesale water. Our claim estimate has been developed based on bottom-up benchmarking of the additional costs of our treatment works, Purton and Littleton compared to our other works, with external third party benchmarking of granular costs to other companies' works, on the assumption that Ofwat's models will make some allowance for the high complexity, high cost works that we operate.	
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls.	1.6%	
Doe the claim feature as a Direct Procurement for Customers (DPC) scheme? (please tick)	Yes	No
		✓

	Brief summary of evidence to support claim against relevant test	**List of accompanying evidence, including document references, page or section numbers.**
Need for the expenditure	We incur additional costs associated with water treatment compared to other companies which we need to expend in order to provide water that is high quality and safe to drink with a low tolerance of drinking water events, given the source type and raw water quality of our key sources from which we are heavily reliant.	Section 6.1 sets out our need for the expenditure and claim, as well as in Section 6.5 alongside narrative on management control.
Need for the adjustment	Whilst it is likely that Ofwat's PR19 cost assessment models will take some account of the level of treatment complexity as we have inferred from the models published by Ofwat in the cost model consultation, Ofwat's models may not capture the full costs associated with operating a number of SW5 treatment works and therefore special allowance is needed to accommodate these efficient additional costs.	Section 6.4 sets out our need for the claim, focusing on the volume of water we treat at a high complexity due to the quality of the raw water we rely on, including the Sharpness Canal. The claim pesents two scenarios dependent on the uncertainties of the final form of the PR19 models.
Outside management control	This cost is predominantly driven by the quality of raw water abstracted from the Sharpness Canal, and the resulting complexity of treatment required in order to meet Drinking Water Inspectorate standards.	Section 6.5 sets out why the claim is beyond management control. Section 6.8 demonstrates the steps we have taken to control the costs of operating a number of complex sites.
Robustness and efficiency of claim's costs	Econometric modelling developed by NERA, suggests that a value of up to £55.6m could be placed on the claim, however at around 50% of our treatment base expenditure this seems disproportionate to our actual treatment costs. Bottom-up benchmarking to inform our claim estimate suggests that unit costs of treating water at our Purton and Littleton works are £28.6 and £12.1 higher, respectively, per Ml, compared to our other works; which is further supported by third party (Aqua) benchmarking of our granular costs to other companies' sites. Based on forecast works output we calculate the claim to be £1.123m per annum, prior to adjustments. High quality third party assurance of the cost estimates has been provided by Atkins.	Our approach to developing our top-down econometric estimate and our bottom-up unit cost benchmarking estimate is set out in section 6.7. Section 6.8 demonstrates that our costs are efficient as demonstrated through efficient purchasing practices and process optimisation.
Affordability	The claim relates to base costs, present both in our historic and forecast costs and are therefore not explicitly associated with a given bill increase for AMP7 compared to AMP6 reflecting the ongoing incurrence of the activity.	Section 4.1.9 presents our affordability assessment of the claims.
Board assurance	None of our claims relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board has however approved our cost adjustment claims submitted and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency.	Section 4.1.10 provides confirmation of Board approval of the final claims.

BRL_003 – Cost adjustment claim summary form

Name of claim	**Prevailing Wages in the Bristol Water Supply Area**	
Name and identifier of related claim submitted in May 2018	BRL_003	
Business plan table lines where the totex value of this claim is reported.	£0.323m in WS1 Line 5 (for opex); £5.084m in WS1 line 7 (for opex); £1.480m in WS1 Line 12 (for base) and £1.829m in WS1 Line 13 (for base) across the Raw water distribution, treated water and treated water distribution business units	
Total value of claim for APM7	£8.716m (2017/18 CPIH prices)	
Total opex of claim for AMP7	£5.406m (2017/18 CPIH prices)	
Total capex of claim for AMP7	£3.309m (2017/18 CPIH prices)	
Depreciation on capex in AMP7 (retail controls only)	n/a	
Remaining capex required after AMP7 to complete construction	n/a	
Whole life totex of claim	n/a	
Do you consider that part of the claim should be covered by our cost baselines? If yes, please provide an estimate	We have assumed that the claim is in part within the modelled cost baselines, but this will depend on the explanatory variables and specification of the PR19 models for network plus and wholesale water. Insights from the cost model consultation suggest that a wage explanatory variable is unlikely to be included in the PR19 models and therefore no estimate of the value of the claim covered by Ofwat's modelled baseline costs is provided. We present analysis setting out the additional labour costs we incur compared to those prevailing more generally in the lower-wage South West region, independent of the approach Ofwat chooses to use to account for variations in regional wages as a driver of variations in costs across companies in the PR19 cost assessment framework (see section 7.7).	
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls.	2.3%	
Does the claim feature as a Direct Procurement for Customers (DPC) scheme? (please tick)	Yes	No
		✓

	Brief summary of evidence to support claim against relevant test	**List of accompanying evidence, including document references, page or section numbers.**
Need for the expenditure	Labour is an important factor input into the day-to-day operations of water companies.	Section 7.4 sets out the importance of labour as a factor input and wage variations as a driver of cost variations.
Need for the adjustment	This claim is required in the event that Ofwat adopts an approach to regional wages within the cost assessment framework that assumes labour costs in the Bristol Water supply area to be equivalent to the wider South West region, rather than the national average.	Section 7.4 presents findings of our analysis that median wages in the Bristol Water supply area are 6.75% higher than for the South West and 1.89% higher than for England and Wales.
Outside management control	Many roles carried out by Bristol Water require staff to be based local to the supply region, meaning that it is not practical to locate jobs in lower cost locations. Wage determination is the complex result of labour market interactions, which we only have a small influence over in the immediate labour market.	Section 7.5 sets out how we must match the prevailing wage requirements in our supply area, whilst also seeking to maintain an efficient level of salary costs.
Robustness and efficiency of claim's costs?	We have estimated the claim based on a methodology developed by NERA to calculate the wage differential between the median wage in the Bristol Water supply area and that in the lower-wage South West. This differential has then been applied to our forecast network plus labour botex costs, weighted by the mix of occupations we employ. High quality third party assurance of the cost estimates has been provided by Atkins.	Section 7.7 sets out our approach to quantifying the claim. Section 5.8 sets out how we seek to maintain efficient salary costs, particularly through use of the Towers Watson Salary Survey benchmarking service.
Affordability	The claim relates to base costs, present both in our historic and forecast costs and are therefore not explicitly associated with a given bill increase for AMP7 compared to AMP6 reflecting the ongoing incurrence of the activity.	Section 4.1.9 presents our affordability assessment of the claims.
Board assurance	None of our claims relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board has however approved our cost adjustment claims submitted and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency.	Section 4.1.10 provides confirmation of Board approval of the final claims.

BRL_005 – Cost adjustment claim summary form

Name of claim	**Network Age and Materials**	
Name and identifier of related claim submitted in May 2018	BRL_005	
Business plan table lines where the totex value of this claim is reported.	£5.437m WS1 Line 7 (for opex), £6.845m WS1 Line 12 (for base) in the Treated Water Distribution business unit.	
Total value of claim for AMP7	£12.282m	
Total opex of claim for AMP7	£5.437m split of £12.282m total based on claim elements)	
Total capex of claim for AMP7	£6.845m (split of £12.282m total based on claim elements)	
Depreciation on capex in AMP7 (retail controls only)	n/a	
Remaining capex required after AMP7to complete construction	n/a	
Whole life totex of claim	n/a	
Do you consider that part of the claim should be covered by our cost baselines? If yes, please provide an estimate	We have assumed that the claim is in part within the modelled cost baselines, but this will depend on the explanatory variables and specification of the PR19 models for network plus and wholesale water. The valuation estimate provided has been informed by econometric estimates of calculating the change in modelled costs when the variables proportion of mains laid prior to 1940 and the length of mains relined and renewed are added to our reference models (developed by Oxera) which otherwise only considered the portion of mains laid prior to 1980 as a driver of network maintenance costs. The estimate has been scaled back to reflect differences between our historic and forecast renewal activity, namely that we undertook an exceptional (atypical) level of mains replacement activity required during AMP5 (2011/12 to 2014/15) which we do not intend to take forward into AMP7 but which we expect will inform Ofwat's modelled cost baselines (2011/12 to 2017/18). However, having incurred this expenditure and additional activity, this expenditure does not represent inefficiency if included in assessing Bristol Water's current cost efficiency levels.	
Materiality of claim for AMP7 as percentage of business plan (5 year) totex for the relevant controls	3.2%	
Does the claim feature as a Direct Procurement for Customers (DPC) scheme? (please tick)	Yes	No
		✓

	Brief summary of evidence to support claim against relevant test	**List of accompanying evidence, including document references, page or section numbers.**
Need for the expenditure	We have one of the oldest water networks in England and Wales. Whilst the absolute age of pipes does not directly correlate to condition, the proportion laid in certain time periods indicates poorer quality materials which require higher levels of replacement or refurbishment. The age of our network compared to other companies therefore implies higher costs associated with capital maintenance.	Section 8.2 sets out the important of age and the material composition of mains laid in certain cohorts to treated water distribution maintenance costs.
Need for the adjustment	If Ofwat chooses not to include a mains age driver or chooses to include a young mains age driver, of network costs this will likely under-estimate the efficient additional costs we incur associated with operating a network older than the average. In addition, if Ofwat includes an activity driver of mains maintenance in their models this will likely under-estimate the efficient additional renewal costs we incur associated with operating a network of a particular age and material type, even with an adjustment for the fact that historic activity is higher than planned AMP7 activity.	Section 8.4 sets out the need for the claim given the uncertainties of the final form of Ofwat's PR19 models. Section 8.2 includes details of the relative age and materials of our network used in different time periods, and the correlation with burst rates.
Outside management control	The need for historic levels of mains replacement activity is to some extent within management control, it reflects managerial decisions over our history regarding the timing and type of network investment undertaken, in terms of materials used and the balance of maintenance vs. enhancement expenditure. Insights from the cost model consultation suggest Ofwat may be open to including such workload variables in the models despite them not being entirely beyond management control. The random failure of mains however is beyond management control.	Section 8.5 sets out why the claim is beyond management control.
Robustness and efficiency of claim's costs	The cost estimate is based on a top-down econometric approach developed by NERA. We have then scaled back this estimate through cross-referencing with a comparison of our actual activity and costs and forecasts. High quality third party assurance of the cost estimates has been provided by Atkins.	These calculations are set out in section 7.7. The NERA calculations are provided in a supporting document.
Affordability	The claim relates to base costs, present both in our historic and forecast costs and are therefore not explicitly associated with a given bill increase for AMP7 compared to AMP6 reflecting the ongoing incurrence of the activity.	Section 4.1.9 presents our affordability assessment of the claims.
Board assurance	None of our claims relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board has however approved our cost adjustment claims submitted and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency.	Section 4.1.10 provides confirmation of Board approval of the final claims.

3 Third Party Assurance Statement

Assurance Statement for Bristol Water's Cost Adjustment Claims 2018

This Assurance Statement is based upon our review of the documents 'BRL Final Submission of Cost Adjustment Claims', 'Cost Claim Summary Pro-Formas', the PR19 data tables WR6, WN8, R2 and R6 and related data table methodologies commentaries and supporting information received on 27th July 2018. This report builds on the findings of the Initial Review carried out in April 2018 and in particular provides assurance of the changes made between early and final submission of the claims. It is the outcome of the third and final external assurance activity which forms part of the Bristol Water's designated assurance plan for the Cost Adjustment Claims.

Our review focussed on the submission's consistency with the Ofwat requirements, the justification of cost claims against the Ofwat criteria, the methodology used to identify and quantify the extent of any claim, the basis of the costs presented and the company's response to the Ofwat evidence requirements. It is for Ofwat to accept or not the cost claims being presented. We also audited the relevant PR19 data tables (WR6, WN8, R2 and R6) and associated commentary for consistency with the Final Submission.

Our findings are summarised in the table below.

We found that, other than where indicated in the table below:

- the submission is consistent with the Ofwat requirements;
- the methodology is appropriate for deriving robust costs to support the claims;
- the Company has generally used its own data; this is supported by data from robust sources such as ONS, company comparative data in the public domain and other industry published sources. Cost modelling data is derived through OXERA models;
- the costs are derived from an appropriate analysis of this data;
- Tables, commentaries and CAC proformas are complete and consistent with the submission and Ofwat requirements.

No	Claim	Estimated Cost £M	Justification	Basis of cost	Ofwat evidence requirements
BRL 001	Purchase of water from the Canal and Rivers Trust	9.42	A good case has been made. Bristol Water is not the only company which purchases water from a third party however it is one of the largest in terms of volumes abstracted.	Clearly set out and robust	Persuasive evidence provided that the activity of purchasing water from a third party are unlikely to be included in the modelling, costs generally outside the management of the company.
BRL 002	Water treatment complexity	5.96 to 55.60	There is uncertainty as to whether the SW5 works will be specifically included in the Ofwat cost	The claim is based on a bottom-up analysis of the Purton and Littleton treatment works	The Company explains how it is deriving efficient costs by management actions through procurement of

			model. If SW5 is included in the modelling then the Company considers that the works with three WS5 processes is greater than the average SW5 site.	based on (i) the average of all other works costs and (ii) the average cost of other SW5 works. Both scenarios are based on the company's actual costs. The Company explains the reasons for the higher cost of the Purton works compared with Littleton.	power and chemicals, the two main cost components, and a programme of process optimisation at all its treatment works.
BRL_003	Prevailing wages in the Bristol Water supply area	8.72	A rational case has been made. An explanation why Bristol is different from other companies with offices in cities is provided but is open to counter-challenge.	Methodology satisfactory although some reworking was required. Cost data from robust sources.	There is persuasive evidence that costs in the Company's supply area is greater than the South West as a whole.
BRL_005a	Network age and materials - age of network	5.44	The proportion of mains laid before 1940 is greater than many other companies. Most of its repair costs are on pre-1980's mains There is a level trend of repair costs for earlier cohorts. We agree that costs are driven more by pipe material with a noticeable proportion of asbestos cement mains.	The derivation of additional costs through the econometric models is appropriate. This is supported by trends from an independent analysis of burst main repair costs by 20-year cohorts.	There is persuasive evidence for the claim for the additional maintenance costs of pre-1980's mains although, there are no clear differences with the 'pre-1940's mains' variable.
BRL_005b	Network age and materials - water mains renewal	6.85	The case for mains renewal is clearly presented in the submission and is dependent on the approach taken in excluding or including this variable in the econometric models.	The use of the econometric modelling with a scaling factor of 33.7% to take account of mains replacement above the long run average is appropriate. This percentage has been derived from actual activities and costs.	The analysis is based on historic mains renewal data and business plan forecasts. This work is within management control. The Company has made a clear statement to explain the impact of the mains replacement work in AMP5 on the econometric modelling of costs to avoid any ambiguity on efficiency assumptions.

Category	Description
RED	The case is not justified. Costs not valid because of assumptions made.
AMBER	Justification not sufficient and further work needed to provide a more robust case. Cost estimates not robust or need further checks and comparative benchmarking
GREEN	Justification provided; scope for improvements in presentation and clarity of costs

Jonathan Archer
Reporter providing Technical Assurance Services to Bristol Water

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4 Introduction

4.1 The Regulatory Framework

4.1.1 Types of claim

Ofwat confirmed in the PR19 methodology[5] that an adjustment process would apply to allow companies to make claims where models and baselines do not adequately capture expected costs, including through:

- Company specific statutory requirements;
- an atypically large investment by the company; or
- regional operating circumstances that result in higher costs.

Each claim in this submission falls into the latter category and seeks an adjustment to modelled Botex only. We have not identified any atypically large investment requirements within our PR19 plan that would require a cost adjustment claim.

All claims included in our submission relate to Wholesale Water. Although Retail cost adjustment claims were identified, none were included in our early submission and this remains true for our final submission. This reflects our view that the PR19 residential retail econometric models will likely capture all factors relevant to our retail operations in the cost drivers selected. We have not considered business retail cost adjustment claims as we have exited this market.

4.1.2 High evidential bar

The PR19 methodology states that a high evidential bar[6] will apply for allowing cost adjustment claims. We have taken account of the evidence requirements for cost adjustment claims as set out in the methodology and subsequently in the early submission Cost Adjustment Claim Information Notice IN18/02[7], which states that claims should be justified by:

- The need for the cost adjustment;
- Whether the cost is driven by factors beyond management control;
- The need for investment;
- That the claim is the best option for customers;
- The robustness and efficiency of costs;
- The customer protection provided for investments and through outcomes and incentives;
- The impact on affordability; and
- The assurance provided by the Board.

Each of our claims have been assessed both from a top-down perspective of identifying the need for an adjustment from the likely form of the PR19 models, and a bottom-up review of the evidence with respect to the value and reason for the additional costs stated. In each chapter we have set out how the claim fulfils the above evidence test, to the extent that each test is relevant to the claim submitted.

[5] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.11
[6] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.14-15
[7] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.14-15 and Ofwat (2018) Cost Adjustment Claim Information Notice IN18/02 p. 5-6

4.1.3 Symmetrical adjustments

The PR19 methodology[8] states that the adjustment process should by its very nature be symmetrical, as cost models are just as likely to overstate a company's efficient cost allowance as they are to understate it. We agree with this position in principle.

Ofwat intends to consider for each claim allowed whether an offsetting adjustment would be appropriate. This process will apply to 'persistent' claims such as regional factors rather than one-off costs related to large investments[9]. Ofwat expects companies to consider offsetting beneficial circumstances that could reduce the need to raise cost adjustment claims[10]. We have sought to present a balanced perspective in our submission of our Network Age and Materials cost adjustment claim; by scaling back the value of the claim to reflect a reduction in our planned mains renewal activities compared to historic levels likely to be included and allowed for in Ofwat's PR19 models[11].

Each of the claims we are submitting relates to regional operating circumstances, and as such if these claims are allowed then symmetric offsetting adjustments may be applicable to other companies. We have not sought to identify to whom such symmetrical adjustments might apply or their value. Our submission does however provide the supporting evidence and methodology on which to do so.

We have carefully considered within our approach to identifying cost adjustment claims whether any regional operating circumstances exist that may over-estimate our costs. We identified two areas in which this may apply:

- sludge disposal costs;
- permits to work on the roads; and
- regional wages.

Section 9.1 considers our sludge disposal activities and the preferential cost-savings that our location close to the Severn estuary provides. Our valuation of this candidate cost adjustment claim did not how pass Ofwat's materiality threshold for inclusion in our submission.

Section 9.3 presents our current arrangements in order to complete necessary renewal and emergency works which often involves road works and associated disruption to road users. At present, we do not incur any costs associated with permits to work or lane rental costs and therefore a downward cost adjustment claim may be appropriate. Since this candidate claim was first identified, changes in the regulatory environment have been announced in the roll out of lane rental schemes nationwide[12] suggesting that in the period 2020/21 to 2024/25 we may incur costs comparable to other companies operating in central London and Kent and therefore a symmetrical adjustment is no longer required[13].

[8] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.12
[9] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.13
[10] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.13
[11] Further information on this adjustment can be found in Section 8.7.2
[12] The Department for Transport announced in Autumn 2017 to roll out lane rental schemes nationwide. Department for Transport (2017) Consultation outcome: Future of lane rental schemes for roadworks [Accessed 21 August 2018]
[13] This assessment has been further confirmed by Ofwat's exclusion of costs associated with the Traffic Management Act from their published models in the consultation on econometric cost modelling; suggesting that a cost adjustment claim (and symmetrical adjustments) is not required as the costs will likely be treated

Regional wages is a candidate cost driver for symmetric adjustment. Chapter 7 presents our regional wages cost adjustment claim. On the assumption that variations in wages across the country is a valid driver explaining variations in companies' costs, the regulatory framework[14] sets out three main approaches (a pre, within or post) that could be adopted to account for this relationship. Insights from the cost model consultation suggest that a pre-model adjustment or a within model adjustment is unlikely[15] and therefore, by elimination, Ofwat may consider symmetric adjustments through the cost adjustment claim process to account for this driver of costs. We have prepared an upward cost adjustment claim in chapter 7, due to the uncertainties of how Ofwat may accommodate this driver in the cost assessment process, the underlying source of wage information used, it's granularity and the benchmarks that may be drawn (for example regional or national wage comparisons). If Ofwat choses to use regional level data, similar to that informing the PR19 wage index, we believe this will under-estimate our wage bill by assuming that in the immediate area of Bristol Water in close proximity to Bristol City we can recruit and retain staff on wages equivalent to those prevailing in the South West more generally.

4.1.4 Number of claims

We recognise and understand Ofwat's preference for the number of claims submitted to be kept to a minimum[16]. Our process for identification of claims was designed to ensure that claims are only included where the need for the claim is clearly justified, the claim is robustly evidenced and the relevant materiality threshold is achieved. A number of potential claims were therefore discounted through this process; we describe the process in more detail in Section 4.1.6 and some of the more significant claims dismissed in chapter 9. This process has resulted in us submitting significantly fewer adjustment claims compared to at PR14 and one less claim at final submission compared to early submission.

4.1.5 Finalisation of claims

We have undertaken a thorough review of our cost adjustment claims for final submission compared to those presented in our early submission which has resulted in a number of updates and improvements being made. These reflect confirmation of year-end actuals and the coming together of our business plan as a whole, including wider considerations of our business plan forecast assumptions. The most significant change has been the decision to drop the congestion cost adjustment claim due to materiality, as signalled in our early submission, which brings our total number of claims to four from five.

The key changes we have made in finalising the claims for business plan submission compared to those presented in our early submission are set out below. Further information on each change can be found in the relevant sections for each respective claim.

Insights from the cost model consultation

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as a cost exclusion with direct pass through within the PR19 cost assessment process. Ofwat (2018) A consultation on econometric cost modelling, p. 15

[14] See Table 7-2

[15] In the consultation, Ofwat identified that regional wages may be a driver of treated water distribution costs, however an explanatory wage variable was not included in any of Ofwat's published models. CEPA, Ofwat's support partners, tested both a pre-model adjustment and inclusion of a regional wage variable in their development of models to inform the consultation and found that neither approaches were robust. Ofwat (2018) A consultation on econometric cost modelling, p.17 and CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat, p.118.

[16] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.11

Where appropriate we have updated the cases to reflect latest insights from the cost model consultation[17]; these have been used to inform our view of what explanatory variables may be considered by Ofwat in the final PR19 cost assessment process.

However, where at early submission we used an econometric approach to estimate the value of the cost adjustment claim against our own reference models, we have taken the decision not to re-estimate these against the models published by Ofwat in the recent cost model consultation. We believe this is a proportionate approach and reflects the likely outcome that Ofwat's final PR19 models will differ to those presented in the cost model consultation.

Congestion in the City of Bristol

In our early submission we set out our concerns regarding the materiality of our congestion cost adjustment claim, reflecting the PR19 materiality thresholds[18] and the requirement for claims to be reported within a single price control. We have reviewed the claim and materiality assessment in light of updating the claim for 2017/18 actuals and have on this basis dropped inclusion of the claim in our final submission. A summary of this decision process is set out in section 9.1.

Payments to the Canal and River Trust

In our early submission we presented the Payments to the Canal and River Trust claim as a cost-adjustment claim. Ofwat's models published in the cost model consultation have excluded abstraction charges and discharge consents from the modelled costs[19]. In light of this we have revised the claim and presented it equivalently as either a cost adjustment or a cost exclusion case with direct pass through of costs, depending on the ultimate approach Ofwat adopts.

Forecast Assumptions

Our forecast assumptions compared to those presented in our early submission have been updated. Firstly, our business plan assumptions for inflation have been updated. The inflation assumptions in this submission are consistent with those reported in App23 of our business plan data tables.

Our inflation assumptions for the period 2020/21 to 2024/25 have also been adjusted to reflect that the price pressures affecting our cost base will likely differ to those prevailing in the general economy as captured by CPIH. This reflects the specialist inputs that we purchase to undertake our operations and how these differ to the general basket of goods used to inform the rate of change of prices as measured by CPIH. We commissioned NERA[20] to produce forecasts of these Real Price Effects (RPEs) for us to incorporate into our business plan forecasts. In this submission and consistent with our business planning assumptions, we have assumed that our opex costs will increase on average by 1.8% above CPIH per annum and our capex costs will increase on average by 0.9% above CPIH per annum[21].

[17] Ofwat (2018) A consultation on econometric cost modelling
[18] Ofwat (2017) PR19 Final Methodology, p.149
[19] Ofwat (2018) A consultation on econometric cost modelling, p. 15
[20] NERA (2017) *Forecast of Real Price Effects and Ongoing Productivity Improvement During PR19, p. iii*
[21] We have applied the opex real price effect forecasts to our water treatment complexity case and the capex real price effects forecasts to our network age and materials case. We have not applied any adjustments to the Canal and River Trust case for reasons set out in Section 5.7. Our forecasting approach for the regional

In building forecasts of the profile of our cost adjustment claims over the next planning period we have considered whether we need to apply adjustments to account for a catch-up efficiency[22] challenge and / or a frontier efficiency challenge[23] to our costs. In conclusion we consider it appropriate to not adjust our costs to reflect these efficiency challenges for the following reasons:

Within the cost assessment framework we expect that Ofwat will firstly compare our business plan costs to the allowance implied by their PR19 econometric models and in light of our implied relative efficiency position and efficiency gap, make adjustments to our costs to reflect their assessment of catch-up efficiency and frontier movements. Therefore in terms of the likely order of proceedings, we expect Ofwat's assessment of companies' cost adjustment claims will come later on and that to apply an explicit efficiency challenge to our cost adjustment claims would in effect be double counting, given that the costs captured by our claims are already in our historic baseline costs[24] (which feed into the models and inform the efficiency challenge) and our forecast baseline costs (to which the efficiency challenge will be applied[25]).

Furthermore, to apply an efficiency challenge to our cost adjustment claim costs, which by their very nature are to a large extent unavoidable and beyond management control, would be arbitrary.

Finally, we have considered specific risks to, and planned changes in, our operations which may affect the future profile of each cost adjustment claim. In particular, for the payments to the Canal and River Trust claim, we are mindful that through current contractual price negotiations the future cost profile of payments to secure water from the Sharpness Canal may look different to that based on an extrapolation of our baseline historic costs. We have considered this and made appropriate adjustments as set out in section 5.7 of the Canal and River Trust claim chapter. Separately, for forecasting costs associated with our water treatment complexity cost adjustment claim we have taken into account the operational cost-savings that our AMP7 capital enhancement programme is planned to deliver in terms of treatment costs.

Section 5 of each cost adjustment chapter presents step-by-step the adjustments set out above on a claim by claim basis.

Affordability

We have assessed the affordability implications of our cost adjustment claim with regard to Ofwat's tests and our wider business plan. This is presented in Section 4.1.9.

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wage case which draws upon our business plan forecasts used in Section 7.7 are already adjusted for real price effects.

[22] Catch-up efficiency, refers to the gap between our actual costs and our efficient costs as benchmarked to other companies in the industry. It refers to the percentage or value of cost-reductions to be delivered in order to achieve a particular efficiency benchmark or position, such as the upper quartile

[23] Frontier efficiency adjustments refer to ongoing productivity improvements (or frontier shift) that deliver cost-savings to us and equivalently to other companies. It reflects technological improvements and innovations that push the frontier of the industry out in terms of reducing the costs to deliver water services.

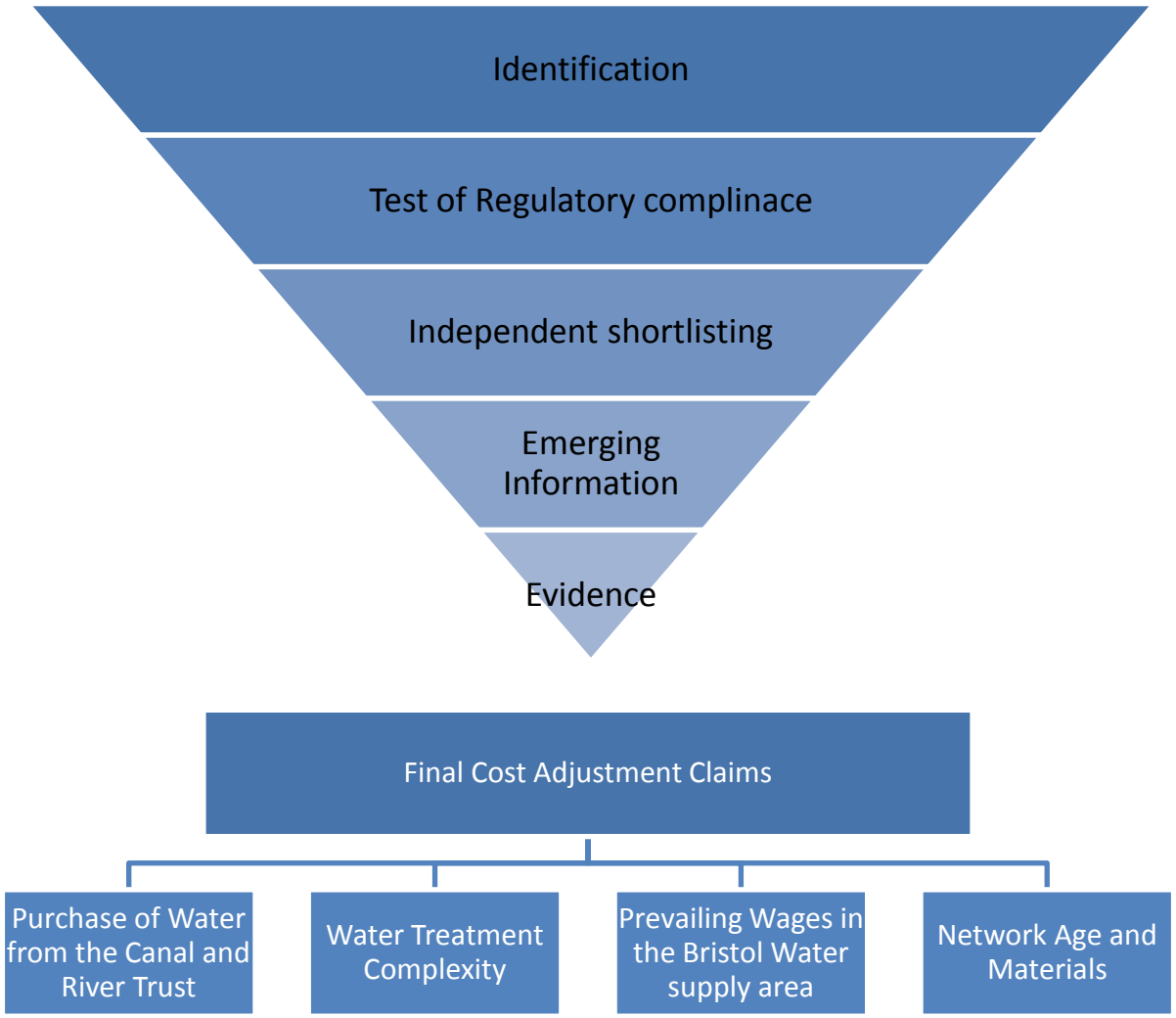
[24] Our cost adjustment claims are present both in our historic and forecast baselines and therefore the associated expenditure is explicitly included in our business plan botex costs. That is to say: securing 45% of our distribution input through the purchase of water from the Canal and River Trust; operating our treatment works to the required level of complexity given the nature of our raw water sources; paying staff salaries that at minimum encourage them to not look elsewhere in the South West; and maintaining our network in light of its age and material composition; are all costs built into our day to day operational and maintenance activities, both now and in the future.

[25] If any efficiency challenge at all needs to be applied

4.1.6 Identification and shortlisting of candidate claims

We have embraced a methodical approach to identifying, shortlisting and developing cost adjustment claims, such that only those most relevant and robustly evidenced have been included in our business plan. Our approach is summarised in the figure below and concludes what was a process of significant duration.

Figure 4-1 - Our approach to submitting cost adjustment claims



Source: Bristol Water

Identification: We sought to cast a wide net to identify possible cost adjustment claims. This initial identification process involved firstly:

- Reviewing our own PR14 cost adjustment claims;
- Undertaking an industry review of the cost adjustment claims submitted by other companies at PR14;
- Econometric insights through work with both Oxera and NERA to understand cost areas that may not be captured by their own models developed in the PR19 framework; and
- Internal conversations.

This information gathering stage enabled greater appreciation of areas where our activities differ to those of other companies due to factors beyond our control from an operational perspective. This

process has provided a wealth of knowledge into the cost make-up of our operations and was formally concluded by a Bristol Water workshop, led by NERA, on the identification of cost adjustment claims.

We have actively sought to identify cost adjustment claims which may require a downward adjustment to our cost baseline.

Regional wages is one area in particular where a downward (or upward) adjustment may be appropriate, although the direction and magnitude ultimately remains dependent upon the final form of Ofwat's PR19 models and how Ofwat intends to account for variations in wages across companies. In chapter 7 we present a plausible uplift to the case of wages with the acknowledgement, as with all cases we have submitted, that the claim is 'model dependent'.

Two further downward cost adjustment claims are also worth acknowledgement; preferential sludge disposal arrangements and cost savings associated with operating in local authority areas where road permits to work are not required. These adjustments were however ultimately dismissed as they did not meet the second test of regulatory compliance in terms of materiality when it came to the evidence building stage. Further information on these claims can be found in chapter 9.

Test of Regulatory Compliance: Shortlisting commenced against two initial tests. The first was the likelihood of the claim to pass a materiality assessment of £1m[26] and dependent on this outcome an assessment was made against whether the claims truly fulfilled the regulatory requirements of what a cost adjustment claim constitutes, namely an atypically large investment, a regional operating circumstance, a new requirements or a disproportionate cost.

Independent Shortlisting: We commissioned NERA to undertake a shortlisting exercise to refine further the list of candidate claims and to provide an independent view on each of the claims with respect to economic rationale, uniqueness of the claim to Bristol Water, ability to quantify the claim, regulatory precedence and materiality. This exercise informed internal decision making and demonstrates our commitment to only take forward cost adjustment claims that are prudent and appropriate. The Bristol Water PR19 Board Sub-Committee was involved throughout this shortlisting process, providing recommendations on the claims to be included.

Emerging Information: Throughout the process continuous review took place against emerging information inclusive of the draft and final PR19 methodologies, business decisions and more recently the cost model consultation, to ensure that our candidate claims remained prudent and appropriate. This reassessment led to a number of claims ultimately being dismissed.

Evidence: With a handful of claims remaining, development of the evidence base commenced which involved continuous review of the quantity and quality of the evidence being collated, alongside a reassessment of each claim against the four stages of screening set out above to ensure that each case remained compliant with the regulatory tests and emerging information. A number of claims were dismissed at this stage in the process. These dismissed claims are set out further in chapter 9.

Final Cost Adjustment Claims: We have submitted four cost adjustment claims as part of our business plan, this is one less than at early submission and reflects our omission of the congestion

[26] This test took place prior to publication of materiality thresholds in the PR19 Final Methodology (December 2018). Materiality was subsequently re-assessed against the PR19 business unit thresholds as part of the independent shortlisting exercise.

cost adjustment claim on the grounds of materiality. Of our final cost adjustment claims, one relates to the Water resources price control and three relate to the Network plus control. We have not submitted any capital enhancement schemes as cost adjustment claims or any retail cost adjustment claims.

4.1.7 Quantification of claims

We have sought to develop robust valuation estimates for our cost adjustment claims based on both bottom-up and top-down methods. Our bottom-up methods have been based on actual costs, benchmarked to other companies where appropriate; and our top-down estimates have been informed by econometric methods consistent with the PR19 cost assessment framework.

Valuation estimates, both top-down and bottom-up, have been developed on a claim by claim basis, a high level discussion of which is provided in Table 4-4.

We discussed a number of plausible top-down and bottom-up estimation techniques with NERA including:

1) An **engineering assessment** of the additional costs identified in the claim compared to those incurred by other companies;
2) Performing an **off-model adjustment** by removing the costs entirely from the benchmarking exercise and accounting for them via a different method in the regulatory framework;
3) **Adding additional explanatory variables** to benchmarking models and calculating the change in modelled costs in order to attribute the cost change to the additional 'special factor' variable; and
4) **Using disaggregated models** that better capture the costs associated with the 'special factor'[27].

The latter two methods of which require reference econometric models against which to inform the estimation method.

To inform this reference suite of economic models we have used models developed by Oxera for a group of water companies, including ourselves in a workshop-style format. As such the model development process was informed by the respective views of the participating companies and therefore the resulting variables included in the models do not unfavourably represent the operations driving costs of one particular company more than the industry as a whole. Oxera's models were chosen as the reference suite because they represent a reasonable 'industry perspective' view of what the PR19 models could look like, removed from any individual company bias. Oxera developed four Water Resource Botex models, eleven Network plus models and eight Aggregate Botex models; the model specifications of which are set out in Table 4-1, Table 4-2 and Table 4-3.

[27] NERA (2017) Comparative Benchmarking and Special Cost Factor Assessment, p.65

Table 4-1 - Oxera's Water Resource Botex Models

		1	2	3	4
		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate
Cost Drivers	Connected properties (log)	✓		✓	✓
	Length of raw water mains and conveyors over DI (log)	✓	✓		
	Average pumping head, resources (log)	✓	✓	✓	✓
	Number of sources over distribution input (log)			✓	
	Proportion of distribution input from boreholes				✓
	2015 year dummy	✓	✓	✓	✓
	2016 year dummy	✓	✓	✓	✓
	Constant	✓	✓	✓	✓

Source: Oxera (2017) Industry Study Summary of Botex Modelling Results

Table 4-2 - Oxera's Network plus Botex Models

		1	2	3	4	5	6	7	8	9	10	11
		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate
Cost Drivers	Connected properties (log)	✓		✓	✓	✓	✓	✓	✓			
	Population (log)									✓		
	Distribution input (log)										✓	
	Water delivered (log)											✓
	Proportion of water treated at level 3 treatment plants	✓	✓	✓	✓				✓	✓	✓	✓
	Proportion of water treated at level 2 treatment plants					✓						
	Average pumping head, Network plus (log)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Proportion of mains laid before 1980	✓	✓	✓	✓	✓	✓	✓				
	Properties over mains (log)			✓					✓			
	Proportion of distribution input from boreholes						✓					
	Proportion of surface water treated							✓				
	Mains/connected properties (log)								✓			
	2015 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2016 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Constant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: Oxera (2017) Industry Study Summary of Botex Modelling Results

Table 4-3 – Oxera's Aggregate Botex Models

		1	2	3	4	5	6	7	8
		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate
Cost Drivers	Connected properties (log)	✓		✓	✓				✓
	Population (log)					✓			
	Distribution input (log)						✓		
	Water delivered (log)							✓	
	Proportion of water treated at level 3 treatment plants	✓	✓	✓	✓	✓	✓	✓	
	Proportion of water treated at level 2 treatment plants								✓
	Average pumping head (log)	✓	✓	✓	✓	✓	✓	✓	✓
	Proportion of mains laid before 1980	✓	✓	✓	✓	✓		✓	
	Raw water mains and conveyors/DI (log)	✓	✓			✓	✓	✓	✓
	Number of sources over distribution input (log)			✓					
	Proportion of distribution input from boreholes				✓				
	2015 year dummy	✓	✓	✓	✓	✓	✓	✓	✓
	2016 year dummy	✓	✓	✓	✓	✓	✓	✓	✓
	Constant	✓	✓	✓	✓	✓	✓	✓	✓

Source: Oxera (2017) Industry Study Summary of Botex Modelling Results

To inform our top-down view of our water treatment complexity and our network age and materials[28] cost adjustment claim, we have used method 3 discussed with NERA, adding additional variables to reference benchmarking models and calculating the change in modelled costs. Our treatment complexity case has been supplemented with bottom-up benchmarking our treatment opex costs compared to comparable sites and therefore most closely approximates the engineering assessment method (method 1). Our Canal and River Trust claim is based on a bottom-up valuation approach using our actual costs and is based on an off-model adjustment (method 2) given we understand this arrangement is unique to us. Finally, our regional labour case has been developed using an off-model adjustment which relates to the source information informing Ofwat's PR19 regional wage index.

The only method we haven't explicitly explored in our submission is the fourth proposed method of developing disaggregate models as a means of estimating the respective cost adjustment case.

Table 4-4 provides a summary of our approach to quantifying the claims, more detail of which is provided in Section 7 of each claim chapter.

[28] The econometric estimate implied for our network age and materials claim has been scaled back to reflect the fact that our future level of network mains renewal is lower than that which we have undertaken in the recent past, a period which we believe will inform Ofwat's PR19 cost assessment models.

Table 4-4 – Our approach to quantifying our cost adjustment claims

Cost Adjustment Claim		Estimation Method	Summary	Section reference
Purchase of Water from the Canal and River Trust		Bottom-up: Off-model adjustment	Estimated based on forward projections of the actual level of historic payments made to the Canal and River Trust	5.7
Water Treatment Complexity		Bottom-up: engineering assessment	Benchmarking of unit treatment costs to comparable sites	6.7.2
		Top-down: adding an additional explanatory variable	Estimation of the change in modelled costs attributable to adding the additional variable 'proportion of water treated at Level 5 and above' to the Oxera reference models	6.7.1
Prevailing Wages in the Bristol Water Supply Area		Bottom-up: Off-model adjustment	Estimation of the wage premium associated with wages in the City of Bristol compared to those prevailing in the South West region more generally	7.7
Network Age and Material	**Network Age**	Top-down: adding an additional explanatory variable	Estimation of the change in modelled costs attributable to adding the additional variable 'proportion of mains laid and structurally refurbished prior to 1940' to the Oxera reference models	8.7.1
	Mains Renewal	Top-down: adding an additional explanatory variable	Estimation of the change in modelled costs attributable to adding the additional variable 'proportion of mains relined and renewed' to the Oxera reference models	8.7.2
		Bottom-up: Off-model adjustment	Estimation of an appropriate scaling factor to reduce the top-down estimate for mains renewal given our future level of network renewal activity and costs will be lower than that we expect Ofwat to include in their modelling (2011/12 to 2017/18)	

Source - Bristol Water

4.1.8 Customer research

Our approach to PR19 is to put our customers at the heart of our planning decisions. In light of this holistic view to customer engagement in the business planning process, we have sought to evaluate customer priorities and views as part of our evidence base.

The cost adjustment claims submitted have been considered against our customers' priorities research[29].

Furthermore, we carried out a specific customer research event in order to explore customers' views on the specific challenges and opportunities that we think arise from operating in our supply area. These customer views helped to inform our decisions on the claims to include within this submission alongside Ofwat's evidence tests[30].

The event, held in January 2018 invited members of Bristol Water's Customer Forum to participate in a deliberative workshop to elicit their views on what makes Bristol Water different with respect to our local operations. A "top trumps" style game introduced a selection of our candidate cost adjustment claims[31] and invited customers to consider to what extent each claim was beyond

[29] C1 appendix: B5: Customer priorities focus groups
[30] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.14-15
[31] Congestion in the City of Bristol; (One of the) oldest networks compared to other companies; Complex Processes at Treatment Works; Sludge disposal (downward); Wages in the Labour Market; Payments to

management control and to what extent we should be allowed the claim, in acknowledgement of the associated bill impacts for each claim[32]. The event provided an opportunity to gather qualitative insights on our cost adjustment claims and speak to customers about some of our more localised and regional operations.

Insights from this research provided a supplementary source of evidence to consider alongside the other evidence required within the cost adjustment framework to assess the strength of each candidate claim for inclusion in our business plan.

Table 4-5 reproduces and updates the summary table set out in our findings report[33] to the customer forum event on cost adjustment claims to take account of subsequent information on the cost adjustment claims received since the research was undertaken. This includes for example, the consultation on econometric cost models, updates to the claims for receipt of 2017/18 actuals and strategic business decisions as we have moved towards final submission of the claims. Our final cost adjustment claims have not changed significantly as a result of the customer research but the insights have been used alongside other sources of evidence to inform our overall assessment of which cost adjustment claims to submit.

Further information on how our cost adjustment claims align with customer priorities and insights from the cost adjustment claim research are set out in section 6 of each claim chapter.

Canal and River Trust Charity; Permit to work on the roads (downward); Install a meter at every customer's property; Environmental initiatives; and High number of reasonably small water sources.

[32] We set out in our explanation of the game that for some of the claims, the costs are to some extent already effectively within customer's bills given the baseline nature of the respective costs

[33] C1 appendix: A3b: Customer Forum January 2018

Table 4-5 - Summary of Decision Making Framework informing our final submission of cost adjustment claims

Cost Adjustment Claim	Direction of claim	Economic Rationale	Likelihood of inclusion in Ofwat's models**	Regulatory Precedent	Strength of Case	Materiality	Customer Forum - outside management control	Customer Forum - should be included	Include in final submission?	Comments
Congestion in the City of Bristol	+		unlikely in full						No*	Claim did not meet Ofwat's materiality test
(One of the) oldest networks compared to other companies	+								Yes	Claim submitted to acknowledge to Ofwat future planned maintenance costs associated with the age and renewal work of the network likely to be lower than historic and therefore in the interests of customers
Complex Processes at Treatment Works	+								Yes	Many of the evaluation criteria suggest this claim should be submitted, including customer views
Sludge disposal	-		unlikely						No	Claim did not meet Ofwat's materiality test
Wages in the Labour Market	+								Yes	Significant uncertainty regarding how Ofwat will accommodate wages in cost assessment, claim is based on this uncertainty
Payments to CRT Charity	+		unlikely						Yes	Considered within management control by customers we engaged with; however without the canal source our supplies of water would be unsustainable. In interests of maintaining long term resilience this claim has been retained
Permit to work on the roads	-		unlikely						No	Despite customer support for the claim, it did not meet Ofwat's materiality test
Install a meter at every customer's property	+		unlikely						No	Not our agreed metering strategy for business plan so ultimately dropped and considered within management control by customers we engaged with
Environmental initiatives	+								No	No new environmental initiatives identified which we consider will fall outside of the modelling
High number of reasonably small water sources	+		unlikely						No	This claim was not identified as a business or customer priority, in the interest of limiting the number of claims this cost area was not pursued

*Included at early submission, materiality confirmed not to meet Ofwat's tests for final submission based upon latest available information

**Visibility of models will not be known until after business plan submission. The higher the likelihood of the cost being included in the models, the lower the likelihood to need the claim

4.1.9 Affordability Assessment

Ofwat's evidence requirements for demonstrating that our cost adjustment claims are affordable are:

- **Has the impact on affordability been considered?**
- **For large investment schemes in particular, is there persuasive evidence that the investment does not raise bills higher than what is affordable?[34]**

Firstly, we are not submitting any major one-off capital schemes as cost adjustment claims and therefore the second affordability test is not relevant.

Secondly, our costs associated with securing circa 45% of our daily distribution input[35], treating water, paying staff and maintaining our network[36] are all ongoing unavoidable costs which are present in our historic baseline costs. Therefore in terms of affordability we do not expect these specific costs to be attributable to any bill increase[37] in so far as these are baseline costs.

To summarise, our cost adjustment claims will not have a material impact on bills above what customers already pay – this reflects the fact that all our claims submitted represent long term activities and long term costs. We have demonstrated that there is customer support for the plan as a whole, including research on their support for current cost and service levels, which therefore encapsulates the activities and costs that make up our cost adjustment claims, with the efficiency challenges incorporated into our plan[38]. This therefore demonstrates customer acceptance from an affordability perspective.

4.1.10 Assurance and Governance

We have developed a dedicated plan for the assurance of cost adjustments claims supporting our business plan.

Ofwat's evidence requirements for demonstrating Board assurance with regard to cost adjustment claims are:

- **Does the company's Board provide assurance that investment proposals are robust and deliverable, that a proper appraisal of options has taken place and that the option proposed is the best one for customers?**

As none of our cost adjustment claims relate to investment proposals where options appraisal and cost-benefit analysis are integral to ensuring that the best option for customers is realised, specific Board assurance as per the Ofwat test has not been directly considered for final submission of our cost adjustment claims.

The Bristol Water Board has however approved our cost adjustment claims submitted and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency.

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[34] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15

[35] i.e. our Canal and River Trust claim
[36] i.e. our cost adjustment claims
[37] This is currently uncertain for our Canal and River Trust case, given current price negotiations with the Trust
[38] C1 appendix: B32: Pre-acceptability testing, B33: Future of the water sector, B34: Final business plan consultation – representative survey, B35: Final business plan consultation – focus groups with seldom heard customers, A3d: Customer Forum August 2018

In advance of both early submission and final submission, internal assurance has been provided by the Head of Economic Regulation and the Director of Strategy and Regulation, with critical review by our Executive Management Team and our PR19 Board Sub-Committee as part of our governance procedures.

Formal external assurance of the supporting evidence underpinning the claims has been provided by Atkins at early submission and this has been revised for our final submission. This has included assurance activities both with regard to this cost adjustment claim submission, the valuation estimates, source information, approach taken and fulfilment of Ofwat's evidence requirements; and also the associated cost adjustment claim data tables, R2, R6, WR8 and WN6, methodologies and commentaries supporting the reporting of these data tables. Atkin's assurance statement forms chapter 3 of this submission which demonstrates our compliance with **Ofwat's requirement to evidence "*high quality third party assurance for the robustness of the cost estimates*"[39].** Their final report is presented as a supporting document to this submission[40].

Our PR19 Board Sub-Committee has considered the shortlisting and development of cost adjustment claims on a number of occasions as part of our governance process. This has involved review of the claims and those most appropriate for submission and most recently, consideration of the internal and external assurance activities set out above. The PR19 Board Sub-Committee formally agreed to the decision to drop the congestion cost adjustment claim as presented at early submission due to immateriality.

4.2 Structure of this submission

Chapters 5 to 8 sets out the evidence underpinning the submitted cost adjustment claims:

BRL_001 – Chapter 5 – Purchase of Water from the Canal and Rivers Trust – p. 35
BRL_002 – Chapter 6 – Water Treatment Complexity – p. 52
BRL_004 – Chapter 7 – Prevailing Wages in the Bristol Water Supply Area – p. 83
BRL_005 – Chapter 8 – Network Age and Material – p. 98

Each claim chapter is structured as set out in Table 4-6:

[39] Robustness and efficiency of costs evidence requirement. Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.14-15
[40] Atkins (2018) Technical Assurance of Cost Adjustment Claims – August 2018

Table 4-6 – Chapter Structure

Section		Summary
1	**Introduction**	Presents a high level overview of the cost adjustment claim
2	**Background Context**	Presents background information and context
3	**Regulatory Background**	Assesses the experiences of Bristol Water and where appropriate other companies' submissions for comparable claims, provides context in light of Ofwat's consultation on cost models
4	**Need for the Cost Adjustment**	Fulfils Ofwat's evidence requirement for why the claim may not be captured in Ofwat's models, fully or in part
5	**Management Control**	Fulfils Ofwat's evidence requirements for why the claim is beyond management control
6	**What the Claim means for our Customers**	Evidences how the claim relates to key customer research findings
7	**Quantification of the Cost Adjustment**	Presents the methods and calculations used to support quantifying the magnitude and direction of the claim
8	**Demonstrating that Costs are efficient**	Fulfils Ofwat's evidence requirements that the costs and estimates of the claim are robust and efficient
9	**Materiality Assessment**	Presents the claim's value relative to Ofwat's materiality thresholds for the respective price control
10	**Evidence Assessment**	Presents a high level summary of the evidence presented in the Chapter
11	**Conclusion**	Presents a high level conclusion of the respective claim

All claims included in this submission seek an adjustment to modelled baseline Botex. In light of this, it is not considered appropriate to provide evidence against Ofwat's requirements for the Need for Investment, the Best Option for Customers or Customer Protection[41]. Details of our affordability assessment with regard to the cost adjustment claims is presented in Section 4.1.9 and our approach to assurance is provided in Section 4.1.9 as oppose to separately in each cost adjustment claim chapter.

[41] Ofwat (2017) Final Methodology - Appendix 11 Securing Cost Efficiency p. 15

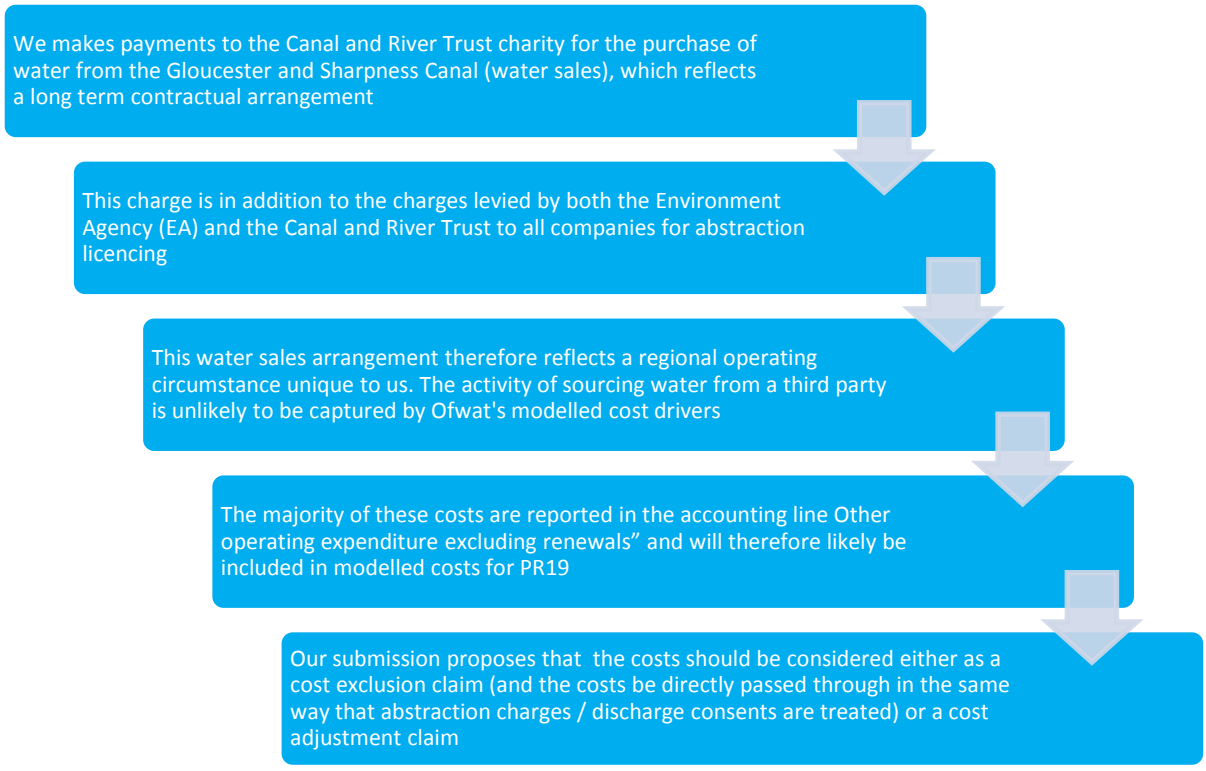
5 BRL _001 - Purchase of Water from the Canal and River Trust

5.1 Introduction

We make payments to the Canal and River Trust charity for the purchase of water from the Gloucester and Sharpness Canal (water sales). This charge is in addition to the charges levied by both the Environment Agency (EA) and the Canal and River Trust to companies for abstraction licencing. Models developed by Ofwat in the recent cost model consultation serve as the best indicator of the likely form of PR19 models and suggest that abstraction charges will be excluded from this modelling assessment[42]. The majority of payments to the Canal and River Trust for the purchase of water is reported in the account line "Other operating expenditure excluding renewals" and will therefore likely be included in modelled costs, although inclusion of any cost driver to capture this activity is unlikely. In light of insights from the cost model consultation and the absence of an appropriate cost driver, we propose that this cost adjustment claim could equivalently be considered either a cost exclusion case or a cost adjustment case for final submission[43]. We propose that the costs associated with this third party activity are removed from the modelling process and accounted for separately based on actual costs and in the scenario that this cannot be accommodated that the claim is retained as a cost adjustment.

The rationale for the claim is set out in Figure 5-1.

Figure 5-1 - Claim Summary



Source - Bristol Water

[42] Ofwat (2018) A consultation on econometric cost modelling, p. 15
[43] At early submission we presented this case as a cost adjustment case only

Our final submission estimate suggests that payments to the Canal and River Trust for the purchase of water will cost £9.420m (2017/18 CPIH prices) for the five year period 2020/21-2024/25.

Table 5-1 - Summary of the Purchase of Water from the Canal and River Trust Cost Adjustment Claim

Purchase of water from the Canal and River Trust	
Price control:	Water resources
Type of Claim:	Regional operating circumstances
AMP7 Estimate of claim:	£9.420m
Expected PR19 models relevant to claim:	Water resources Wholesale Water
PR19 Model dependency of claim:	Claim assumes that Ofwat's models will not include any cost driver to make allowance for the purchase of water from a third party provider

Source: Bristol Water

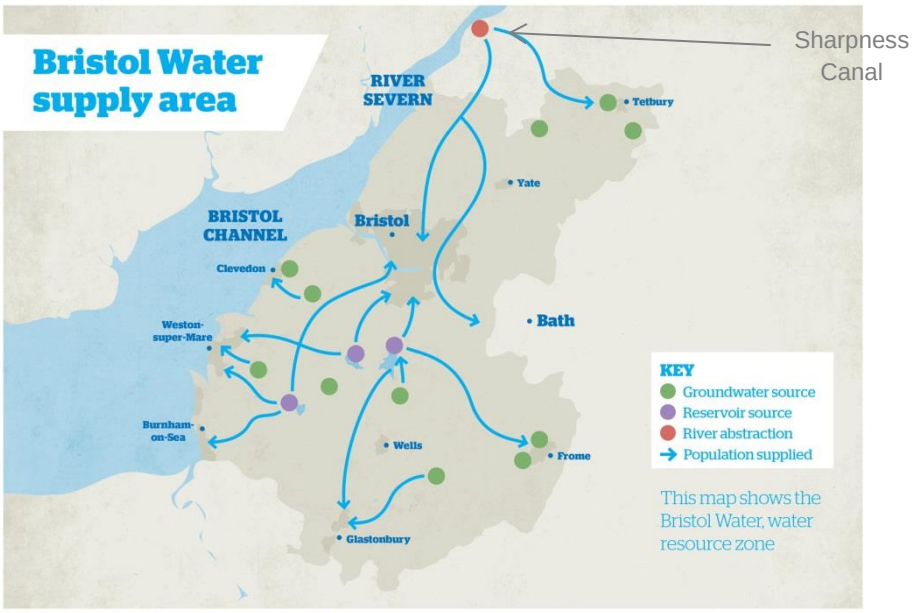
Table 5-1 provides a summary of the key details of the Canal and River Trust cost adjustment claim.

5.2 Background Context

The Gloucester & Sharpness Canal is owned and operated by the Canal and River Trust. Water levels in the canal are sustained by the River Severn. Since 1962 we have been engaged in a long term contractual agreement with the Canal and River Trust charity to allow the purchase of water from the Gloucester and Sharpness Canal, which is outside of our area of appointment. The agreement permits unrestricted abstraction for an annual average of 210Ml/d[44] with a maximum daily abstraction of 245 Ml/d, although in river regulation (dry) and high tide periods this can be limited to 195Ml/d. The water is abstracted close to Sharpness docks, outside of our supply area to the North as illustrated in Figure 5-2, to supply our water treatment works at Purton and Littleton.

[44] Equivalent to 76,650,000 Ml a year

Figure 5-2 - Our Supply Area[45]



Source: Bristol Water

In this agreement, we make an annual payment to the Canal and River Trust charity to cover the cost associated with the purchase of water which would otherwise be used in the canal network and the maintenance of the canal system to facilitate abstraction; and provisions to cover any emergency situations preventing abstraction. The Canal and River Trust explains that such "*Water sales are contracts we enter into with third parties to sell our surplus water (typically this is water that is surplus to the amount needed to meet the level of service)*."[46] In 2017/18 we abstracted 48,456.9 Ml/d from the Sharpness Canal, which represents 45.4% of total water abstracted and 45.18% of the Distribution Input which entered our treated water distribution network that year.

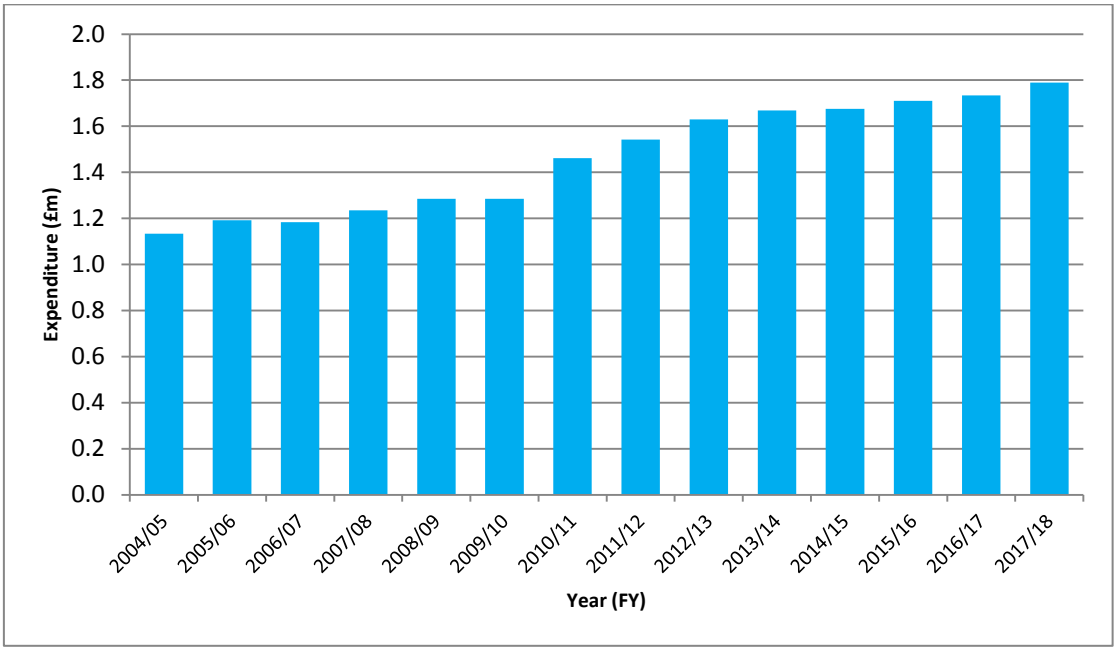
The size of the payment is contractual – it has a fixed and variable component, both of which are inflated by RPI from 1998[47]:

- **Fixed cost:** we can abstract up to 57,000Ml per annum at a cost of £1.000m inflated by RPI; and
- **Variable cost**: we can abstract between 57,000Ml and 76,650Ml per annum, at an additional cost of £20/Ml inflated by RPI.

In 2017/18, we paid £1.790m to the Canal and River Trust for the purchase of water. Figure 5-3 below presents our actual historic costs for the period 2004/05 to 2017/18.

[45] According to Ofwat's regulatory accounting definition of a source, the Sharpness Canal is not technically a river abstraction. A source by definition must capture the water resource asset that directly feeds a treatement works, for which the two pumped storage reservoirs (tanks) at Purton and the three pumped storage reservoirs (tanks) at Littleton, not the Sharpness Canal, are strictly speaking the source
[46] Canal and River Trust (2015) Water resources Strategy 2015-2020 p.17
[47] Reflecting the latest revision of terms

Figure 5-3 - Our Historic Payments to the Canal and River Trust (£m)



Source: Bristol Water, outturn prices

These water purchase costs are in addition to the costs all companies pay to the Environment Agency (EA) for abstraction licensing. In our reporting of the wholesale cost data, our payments to the Canal and River Trust are allocated to the line "Other Operating Expenditure excluding renewals" with a portion (approximately 5%) allocated to "Third Party Services" in the Water Resource price control. Payments to the Canal and River Trust for the purchase of water therefore represent an additional water resource cost that we incur compared to other companies[48].

5.3 Regulatory Background

At PR14, we submitted the same claim and sought £8.1m to cover the estimated payments to the Canal and River Trust over the five year period (2014/15 to 2019/20). Ofwat, in its Final Determination allowed £6.3m, reflecting a downward adjustment to the claim value to account for what was already included in the models and an upper quartile efficiency challenge. In our re-determination, the CMA assessed that there is "*no basis to use a figure for the adjustment that differed from Bristol Water's claim of £8.1 million*"[49] and therefore allowed the claim in full.

Reflecting our continued arrangement with the Canal and River Trust, this claim is still required for the business planning period 2020/21 to 2024/25.

Due to the long-term arrangement with the Canal and River Trust, payments for the purchase of water are included in our historic costs as reported to Ofwat and will therefore likely be included in the costs to be modelled in Ofwat's PR19 econometrics[50].

[48] This is separate and additional to the Canal River Trust maintenance charges as incurred by some companies (including Bristol Water) as reported in Table 18.2 WW Other, Section Service Charges of the Wholesale Cost return, line "Canal and River Trust service charges and discharges consent"
[49] CMA (2015) CMA Final Determination - Appendices 1.1 - 4.3 A4(3)-5
[50] That is that Ofwat includes "Other operating costs excluding renewals" in the cost model assessment, see Section 3.4. for further details

In comparison to the PR14 cost adjustment claim submission, for PR19 we are proposing that our payments to the Canal and River Trust for the purchase of water form a cost exclusion case because:

- Ofwat has sought to exclude of abstraction charges and discharge consents from their models published in the cost model consultation[51];
- Ofwat has sought to exclude third party costs from their models published in the cost model consultation[52] (which accounts for approximately 5% of the payments we make to the Canal and River Trust); and
- the lack of cost drivers collated at an industry level which capture the activity of buying and selling water from third parties (i.e. water trading).

On this basis we therefore propose that the costs associated with the purchase of water from the Canal and River Trust be excluded from the modelled costs and be accounted for separately as a direct pass through. This reflects our understanding that this arrangement is unique to us and therefore forms a similar rationale for exclusion as does costs associated with the Traffic Management Act and costs associated with statutory water softening as these costs are only relevant to small number of companies[53].

In the scenario that a 'pass-through' is not considered the appropriate mechanism to address this unique arrangement then the claim as a cost adjustment should be retained. The need for the claim, as either a cost exclusion or adjustment is set out in the next section.

5.4 Need for the Cost Exclusion or Adjustment

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is needed are:

- **Is there persuasive evidence that the cost claim is not included (or, if the models are not known, would be unlikely to be included) in our modelled baseline?**
- **Is it clear the allowances would, in the round, be insufficient to accommodate special factors without a claim? [54]**

Ofwat uses cost models to estimate the efficient level of costs a company of a given scale should incur, by taking account of cost drivers common to all companies. Ofwat compares the efficient costs implied by its models to the actual costs forecast by the company for the same period to inform the price review process[55].

Whilst the cost of our water purchases from the Canal and River Trust is reported to Ofwat, there is no activity or cost driver in the data Ofwat collects from companies that could capture the activity of obtaining water from a third party[56]. Therefore this activity is likely to be unaccounted for in Ofwat's models, suggesting that Bristol Water's efficient baseline is lower than is reflective of our actual operations. Within the cost assessment framework there are two options available to account for this. Firstly a cost adjustment claim, an option we have pursued in previous price reviews and secondly, a cost exclusion claim. The relevance of the latter option to this activity has only been

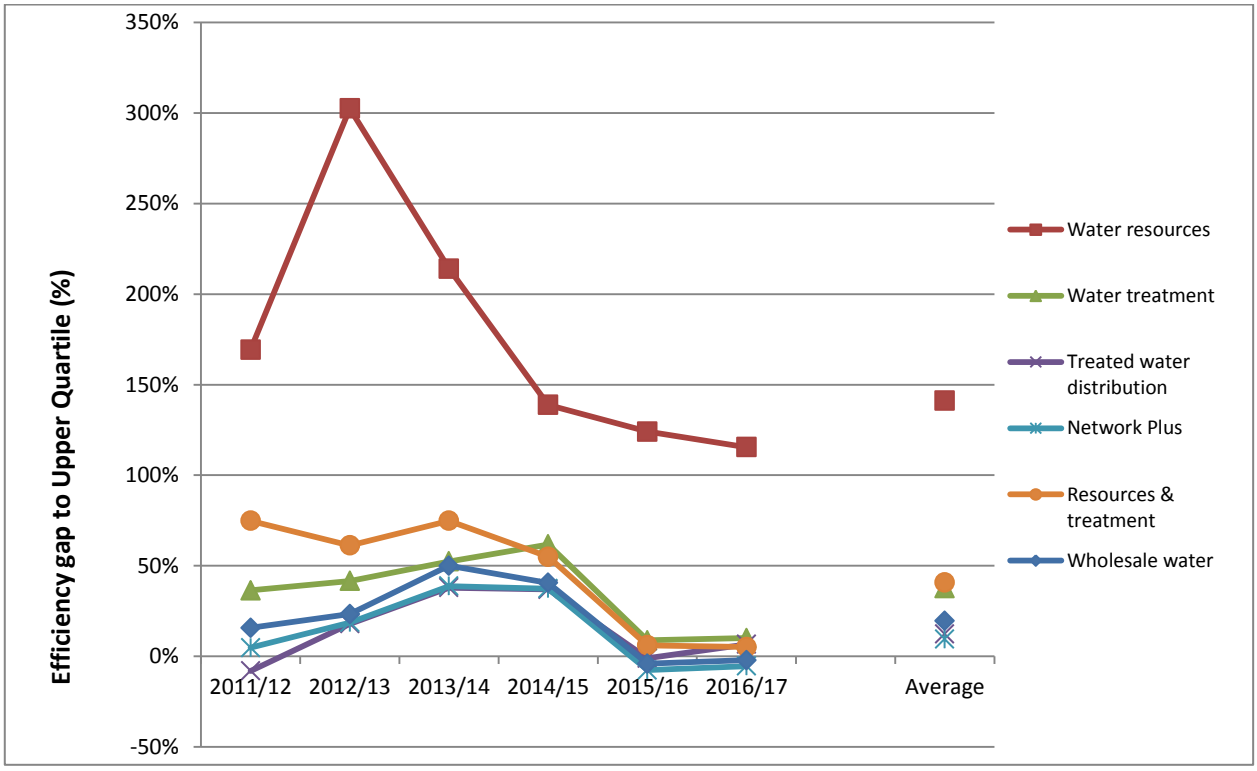
[51] Ofwat (2018) A consultation on econometric cost modelling, p. 15
[52] Ofwat (2018) A consultation on econometric cost modelling, p. 15
[53] Ofwat (2018) A consultation on econometric cost modelling, p. 15
[54] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[55] Ofwat (2017) PR19 Final Methodology p. 135
[56] In a similar observation, there is no cost driver in the data that Ofwat collects from companies to capture the activity of water trading

considered since publication of the cost model consultation which sets out Ofwat's likely exclusion of abstraction costs and discharge consents, a cost type very similar to our purchase of water from the Canal and River Trust. We consider that submitting a cost exclusion case for this activity may be more appropriate than a cost adjustment claim on the basis that, as the approach is more in line with Ofwat's thinking as set out in the cost model consultation, there is no relevant cost driver information collected at an industry level which could account for this activity and the fact that inclusion of this cost in models skews the efficiency results especially when modelled disaggregately as per the likely PR19 modelling approach (based on a re-production of Ofwat's PR19 models published in the consultation on cost models) as set out in Figure 5-4.

This reflects our view as set out in our response to the cost model consultation: "*For Water resources modelling, we think there is a case for further consideration of what costs are included and excluded from the cost modelling. There is logic in third party and abstraction charges to be excluded from the modelling, but with increasingly diverse cross-regional buying and selling of water there are other similar costs which are embedded in charges not excluded from the modelling that may be apparent. This may be a reason not to use disaggregated modelling as these factors are far less material at a wholesale total level*[57]."

In the scenario that Ofwat does not share our view that a cost exclusion approach is more appropriate for the Payments to the Canal and River Trust case, then a cost adjustment case should be retained to acknowledge this unique arrangement not captured by the econometric models.

Figure 5-4 - Ofwat models: BRL wholesale efficiency gap to Upper Quartile (% of modelled costs)



Source: Bristol Water, based on NERA (2018) Reproduction of Ofwat's models published in the cost model consultation March 2018

[57] Bristol Water (2018) Our response to the consultation on econometric cost modelling p. 4

Figure 5-4 suggests that we are an outlier in water resources and this further underpins the case for payments to the Canal and River Trust for the purchase of water to be removed from the costs to modelled using econometric techniques and instead considered separately[58].

Our preference for the case to be considered primarily as a cost exclusion case, and secondly as a cost adjustment case, also reflects our view of a likely disconnect between the risk-adjustment profile of future costs for the purchase of water from the Canal and River Trust compared to historic costs. This will be set out further in section 5.7.

For this submission we have not included an adjustment to the value of the claim for an implicit allowance. In part this reflects the cost assessment econometric models consultation, which demonstrates that Bristol Water is an outlier (see above), and that there is also a case to exclude the Canal and River Trust payments from the modelling in order to improve the water resources modelling (i.e. for the claim to be treated as cost exclusion as opposed to cost adjustment). This also reflects our view that the level of payments, both historic and forecast, are efficient as set out in Section 5.8. and regulatory precedence from the CMA's conclusions for the claim in the PR14 Bristol Water Appeal that there is "no basis to use a figure for the adjustment that differed from Bristol Water's claim"[59]. Dependent on Ofwat's judgement as to whether this claim should be a cost exclusion or cost adjustment and whether Ofwat concurs with the above rational for full pass through of costs, we have also presented a potential estimate for an implicit allowance for the claim based on analysis undertaken by NERA. Their analysis sets out a potential implicit allowance which would amount to a £1.509m reduction from our £9.420m claim to £7.911m in 2017/18 CPIH prices. However, we do not believe the water resources modelling is robust enough to value an implicit allowance in this way, based on the PR19 disaggregated consultation models.

Ofwat has many options available regarding the costs it chooses to include in the modelling. For example, Ofwat may choose to omit certain costs because they are beyond the control of companies or the costs perhaps only apply to one or a few companies[60]. As a recent example, industry discussions, led by Northumbrian Water, at the Cost Assessment Working Group (CAWG) have suggested it may be appropriate to exclude EA abstraction charges from the PR19 models and consider these costs by an alternative method, reflecting the fact that EA abstraction charges vary year on year, are not related to volumes abstracted and are beyond the control of companies. Indeed, in Ofwat's econometric cost modelling[61], they have excluded abstraction charges and discharge consents from costs. While this provides no guarantee that Ofwat will exclude these costs from its final econometric models, it does suggest that this approach is more likely.

Whilst Ofwat's exclusion of abstraction charges from their cost consultation models does not directly relate to the purchase of water from the Canal and River Trust (which is a water sale, not an abstraction license charge; and which is reported in the data line *Other operating expenditure excluding renewals,* not *Abstraction Charges / Discharge consent),* it does however exemplify the possibility that if the cost "*Other expenditure excluding renewals*" or more specifically the cost of water purchased from the Canal and River Trust is excluded from the cost assessment process and accounted for separately, then a cost *adjustment* claim may not be required. This reflects the

[58] This would therefore remove the need to make assumptions regarding the need or value of an implicit allowance and therefore such considerations have been removed from our final submission for this claim compared to that presented at early submission.
[59] CMA (2015) CMA Final Determination - Appendices 1.1 - 4.3 A4(3)-5
[60] Ofwat (2018) A consultation on econometric cost modelling, p. 15
[61] Ofwat (2018) A consultation on econometric cost modelling, p. 15

current uncertainties as to what may or may not be included in Ofwat's PR19 models and the fact that the purpose of the cost adjustment process is to mitigate the limitations of the models[62] through adjustments not exclusion. The evidence presented in the following sections sets out our case for the exclusion or adjustment of costs associated with the purchase of water from the Canal and River Trust as reported in the accounting line "*Other expenditure excluding renewals"* from Ofwat's cost efficiency models.

5.5 Management Control

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is beyond management control are:

- **Is the cost driven by factors beyond management control?**
- **Is there persuasive evidence that the company has taken all reasonable steps to control the cost?**[63]

Since 1962, we have made the managerial decision to enter into and maintain a contractual arrangement with the Canal and River Trust to purchase water from the Gloucester and Sharpness Canal. In this respect therefore, purchase of water from the Trust, like any other third party water trading arrangement, is a decision within management control.

Indeed, this observation was set out in the CMA's assessment of our case at PR14: "We *recognised that the costs arising from the use of resources from the Canal and River Trust were partly within Bristol Water's control*"[64].

However, in the absence of this arrangement, we would not be able to provide the 45.18% of Distribution Input (DI) that the Gloucester and Sharpness Canal can otherwise provide. Therefore from a resilience and security of supply perspective, the decision to purchase water from the Canal and River Trust is beyond the control of management now and in the short term more generally (2020/21-2024/25). Indeed, delivering 45.18% of DI from alternative sources would require a more long term solution, if indeed such alternatives were cost-beneficial and commercially viable. An examination of alternative options is presented in more depth in Section 5.8.

Furthermore, in the history of purchasing water from the Canal and River Trust, the Gloucester and Sharpness Canal has proved a reliable source of water providing uninterrupted supply, with the exception of one event. In June 1990, the canal burst it's banks and was the only occasion on which the canal has failed; since this event we have funded the Canal and River Trust for emergency standby cover that will enable them (even in the event of canal failure) to supply a minimum of 100 Ml/d to the Purton abstraction point.

Ensuring that the cost of water purchased from the Canal and River Trust is fair and cost-reflective is important to us and reflects our commitment to delivering value for money to our customers. In response to this need, in the terms of contract with the Canal and River Trust[65] it was set out to undertake a periodic review of prices. In January 2017, negotiations commenced with the Canal and River Trust to this effect. In latest correspondence, the Canal and River Trust have indicated

[62] if the cost item "*Other expenditure excluding renewals"* is accounted for outside of the models, the evidence presented herein is still relevant to Ofwat's assessment, for example to inform possible pass through of costs
[63] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[64]CMA (2015) CMA Final Determination - Appendices 1.1 - 4.3 A4(3)-6
[65] As drawn up in 1998

that they are seeking a significant increase in charges to reflect the "*market value of water*"[66]. The contract allows the issue to go to arbitration if no agreement is reached, which at the time of writing is an outcome that can now be confirmed.

As mentioned above and in more depth in Section 5.8, an examination of alternative options that could supply 45.18% of our raw water, further demonstrates our commitment to controlling costs by ensuring that the current option is the most cost-effective and efficient.

5.6 What the Claim means for our Customers

As discussed in Section 5.2, we source circa 45.18% of our Distribution Input from the Gloucester and Sharpness Canal. The purchase of this water from the Canal and River Trust therefore provides security of supply to a large proportion of our customer base. Indeed, we have not experienced a problem with long-term resource availability from the Sharpness Canal in the history of the arrangement.

Ensuring that we can deliver water that is safe to drink, without interruption is a key commitment we uphold to our customers. As Figure 5-5 summarises, having a reliable supply of water is key customer priority of which our long-standing arrangement with the Canal and River Trust enables to us to meet.

Figure 5-5 - Customer Priorities

Source - Bristol Water A5: Annual Customer Survey

As discussed in Section 4.1.8, we also undertook specific customer research regarding cost adjustment[67] claims in January 2018. The majority of customers we engaged with thought that whilst payments to the Canal and River Trust was within management control, the costs should be

[66] Bristol Water (2017) correspondence with the Canal and River Trust charity
[67] We have since identified a preference for payments to the Canal and River Trust to primarily form a cost exclusion case and secondly a cost adjustment claim

passed through to customers and therefore allowed by Ofwat as a cost exclusion or adjustment claim[68]. The following qualitative comments capture the prevailing views shared by customers:

> "*that as this is a long standing arrangement, relates to a large proportion of water and given the high costs of finding an alternative source of water, that this is beyond management control and is something that customers should pay for – i.e. for securing water supplies*".

> "*that this is inside management control but there may be alternatives that should be explored – participants linked this to the risk of having a single big source*".

In the context of this customer engagement we acknowledge in Section 5.5 that payments to the Canal and River Trust for the purchase of water can be considered both within and beyond management control. Having presented evidence on the costs of alternatives in Section 5.8, we consider on balance that the cost exclusion or adjustment claim is beyond management control and represents the most cost-beneficial option available in the short term.

5.7 Quantification of the Cost Exclusion or Adjustment

As discussed in Section 5.4, it is considered appropriate for the actual level of payments made to the Canal and River Trust to form the basis of our cost exclusion or adjustment claim.

Costs are made up of a fixed element (£1m inflated by RPI from 1998) and a variable element (£20/Ml if we abstract more than 57,000Ml per annum, which equates to an average abstraction of 156 Ml/d). Informing our estimate of future costs, it has been assumed that purchased volumes are similar to historic levels and that costs will increase by RPI, consistent with the measure of inflation used to set prices as per the contractual agreement.

The Canal & River Trust has triggered a 10-yearly review within the contract and has indicated that they intend to seek a significant increase to the value of the water supply contract, based on a higher "market value"[69] of water. The Canal and River Trust has provisionally indicated an increase to circa £10m per annum and at the time of writing a solution is being sought through arbitration. We are also reviewing the logic of the current price. We suggest notified item protection to reflect the uncertainty arising from the negotiation and arbitration, and the potential for the price to reduce as well as increase. A cost exclusion, or adjustment, is therefore justified based on this unique situation. The outcome of this process would be backdated to charges from 1 April 2018. As we will and are challenging this increase robustly, we have not included this in our future expenditure projections of this claim. We have considered this situation in the round in our business plan, and the below approach to quantifying the claim is in line with this view. Specifically, given that we are challenging the Canal and River Trust proposals robustly and the uncertainty regarding the future risk-adjusted cost profile of the charges, we have maintained a forecast based on a projection of actual costs adjusted for inflation. We do not consider it appropriate to present a range for this cost exclusion claim as we suggested at early submission and this reflects the continued uncertainties regarding the outcome of the price negotiation process.

Our approach to forecasting at early submission involved inflating 2016/17 actual costs by RPI, to reflect contract arrangements which provided outturn forecasts for the period 2017/18 to 2019/20, and then inflating by CPIH to provide forecasts for the period 2020/21 to 2024/25.

[68] C1 appendix: A3b: Customer Forum January 2018
[69] Bristol Water (2017) correspondence with the Canal and River Trust charity

Our final submission forecasts have been updated and are now based on 2017/18 actuals.

This is consistent with our reporting of forecasts for "Other operating expenditure – excluding renewals" data line in the WS1 of the PR19 data tables, for which payments to the Canal and River Trust is a component.

Table 5-2 presents the calculations used to estimate the value of the Canal and River Trust cost adjustment claim to be £9.420m for 2020/21-2024/25 (2017/18 CPIH prices).

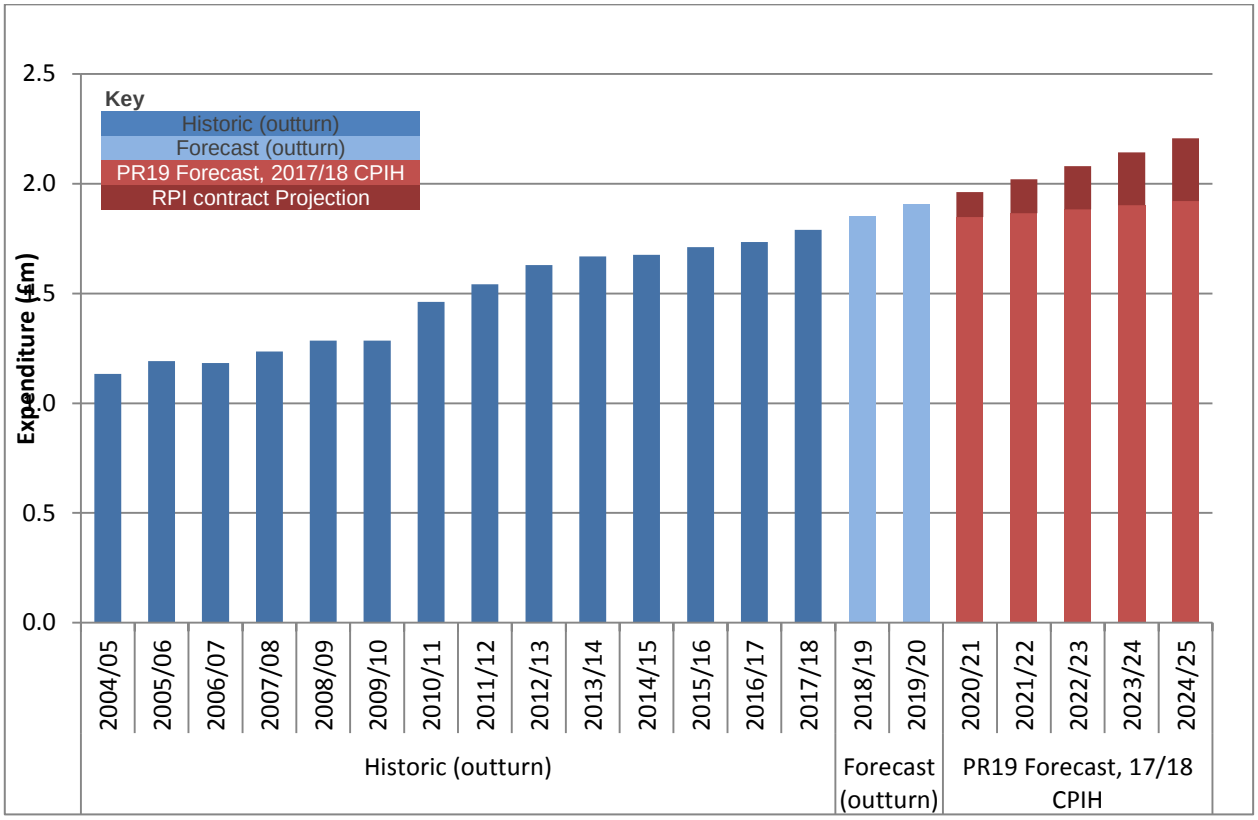
Table 5-2 – Valuation: Canal and River Trust cost adjustment claim

Financial Year	Historic Expenditure (£m)	Forecast Expenditure (£m)	
		Outturn prices (nominal)*	CPIH 2017/18 prices
2004/05	1.133		
2005/06	1.192		
2006/07	1.184		
2007/08	1.235		
2008/09	1.285		
2009/10	1.285		
2010/11	1.461		
2011/12	1.541		
2012/13	1.629		
2013/14	1.669		
2014/15	1.676		
2015/16	1.711		
2016/17	1.734		
2017/18	1.790		
2018/19		1.851	
2019/20		1.906	
2020/21		1.962	1.849
2021/22		2.019	1.865
2022/23		2.080	1.883
2023/24		2.142	1.902
2024/25		2.206	1.921
Estimate of Claim (£m)			**9.420**

Source: Bristol Water

Figure 5-6 graphically depicts the forecasts in order to illustrate the difference in price bases between the contractual arrangement with the Canal and River Trust (RPI) and Ofwat's reporting requirements (2017/18 CPIH prices).

Figure 5-6 – Valuation: Canal and River Trust Claim



Source: Bristol Water analysis of our costs

5.8 Demonstrating that costs are efficient

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is efficient are:

- **Is there persuasive evidence that the cost estimates are robust and efficient?**
- **Is there high quality third party assurance for the robustness of the cost estimates?**[70]

The costs we incur for this activity are efficient, as evidenced through our current engagement in a contractual price negotiation process with the Trust and a comparison of our costs incurred with the next best alternative source of supply.

The cost estimates provided in Section 5.7 are based upon actual historic expenditure incurred for the purchase of water from the Canal and River Trust. As also set out in Section 5.7, we are currently engaged in a contract review process as part of our commitment to customers to deliver the best possible price for the water we source. At the time of writing, it is unlikely that a contract settlement will be reached prior to final submission. Throughout the arbitration process, we will remain committed to demonstrating value for money to our customers through securing an efficient price.

In correspondence with the Canal and River Trust, the Trust commented "*that this* [Bristol Water arrangement] *is one of the largest raw water transfers in the country*"[71] adding elsewhere in the same correspondence that their "*most recent large raw water contracts to the Utilities sector have*

[70] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[71] Note the contractual arrangement we have with the Canal and River Trust is for Water Sales not water transfers.

attracted charges of £200/Ml"[72]. Comparison of the current charges charging arrangement we have to the £200/Ml quoted by the Canal and River Trust, suggests that the payments we make may be the lowest cost available to us. For example in 2017/18, we purchased 48,457Ml[73] from the Canal and River Trust which represented a unit cost of £36 per Ml.

The efficiency of the costs we incur for the purchase of water from the Canal and River Trust can also be evidenced through a comparison with the costs of the next best alternative source(s) of supply that could provide the water the Sharpness Canal otherwise provides.

Our Water resources Management Plan[74] models that the Sharpness Canal provides up to 210 Ml/d and 130 Ml/d on average. From our current water resource options it is not possible to provide the 210 Ml/d or 130Ml/d from alternative sources. For example even if the largest potential options were pursued (a second reservoir at Cheddar, no transfer to Wessex, 10Ml/d purchased water from 3rd party, and 6.5Ml/d of leakage reduction etc.) just over half (66 Ml/d) of the average water and one third of the maximum we currently source from the Sharpness Canal could be resourced from alternative options. The capital cost alone of delivering these options is estimated to be £122m (equivalent to the cost of 68 years continued water sales from the Canal and River Trust in 2017/18 prices). Furthermore, examination of wider water resource options in the West of England suggests that existing sources could not provide this volume of water[75].

However, other theoretically plausible options could include construction of a water main that takes water from the Severn at Gloucester, thereby bypassing the canal or a water trading option in relation to the River Severn or the sources that feed the Canal. Highly indicative estimates suggest that a water main bypassing the canal would cost in the region of £50m in Water Resource Capex[76]. We are currently seeking to engage with an independent third party provider to review and appraise alternative water resource supply options available to us. Our current Our Water resources Management Plan sets out the options which are likely to inform this independent review from a perspective of new resources[77].

Whilst it has been demonstrated that the above alternatives are more costly than the current arrangement with the Canal and River Trust, one further alternative option that could be pursued is to open up a water resource bidding platform for third parties to supply the volume required to displace the Gloucester and Sharpness Canal as one of our sources. We assess below that this currently appears implausible and would be at an increased cost compared to the current contract with the Canal and River Trust.

Finally, it is worth acknowledging that benchmarking of our water purchase costs from the Canal and River Trust with similar arrangements held between the Trust and other water companies is not possible as this information is not available in the public domain. Whilst the Canal and River Trust's annual statement reports that in 2016/17 the Trust received £27m in income from utilities and water development[78], we do not have access to the breakdown in order to greater assess the efficiency of

[72] Bristol Water (2017) correspondence with the Canal and River Trust charity
[73] In 2017/18 we purchased 48,456.90Ml/d of water from the Sharpness Canal, or equivalently 48,456.90 * 365 = 17,686,768.50 Ml
[74] Bristol Water (2018) Draft Water resources Management Plan 2019, p.35
[75] Bristol Water (2018)
[76] cost estimates are approximate and based on recent costs for the Southern Resilience Scheme, scales for the size of main and the need for abstraction infrastructure at Gloucester
[77] Given no new resources are currently required
[78] Canal and River Trust (2017) Annual Report 2016-17 p.76

these costs beyond the analysis presented above. However, this information may come to light on an anonymised basis if our price negotiation process with the Trust goes to arbitration. Indeed, this outcome may also present information on the expenditure incurred by the Trust in maintaining our contractual arrangement, to inform how costs relate to the pricing structure.

We do however have access to information on other companies supply / demand water resource options through the WRMP annual submission. Examination of this information has provided a useful tool to understand our neighbours' resource options from a perspective of water trading as an alternative to purchasing water from the Canal and River Trust which would therefore provide a comparison of costs on a unit basis. Indicative analysis of the preferred options of our neighbouring companies and their associated water resource zones, weighted by the average incremental cost (p/m3) of the respective options suggests that water purchases from the Canal and River Trust may be, as a water resource specifically part of our historic arrangements, the lowest cost available to us, as Table 5-3 summarises. 2016/17 water purchases from the Trust equated to a unit cost 3.6 pence per cubic meter (c£36/Ml/d)[79]; the next most cost effective option being our own preferred options at 15.5p per cubic meter, followed by those set out by Bournemouth Water (47.6p per cubic meter) and those of South West Water (57.0p per cubic meter). This is a crude calculation which will include treated water options as well as water resource options. Data from Dwr Cymru SEWCUS zone was not available in the published market information.

Table 5-3 - Water Resource Trading Options 2016/17

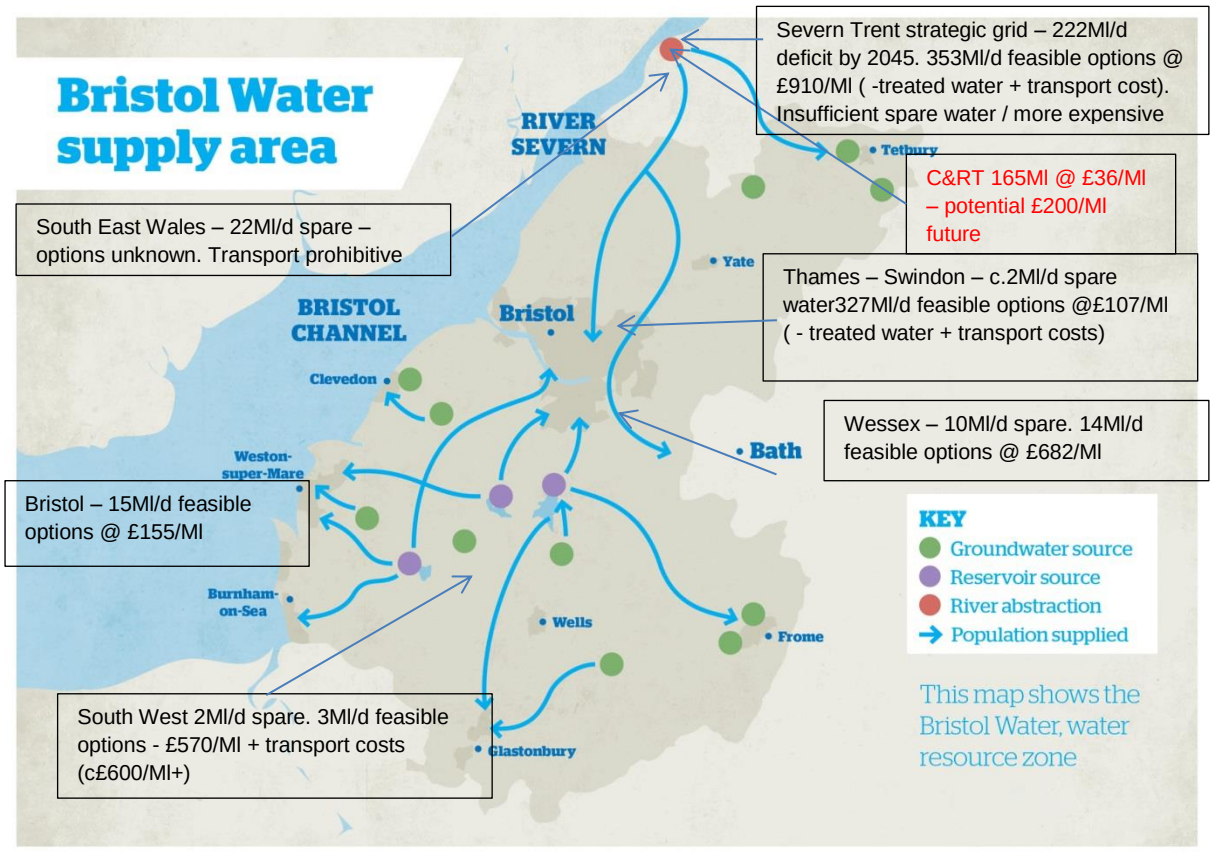
Neighbouring Company	Water Resource Zone	p/cubic meter
BWL	All	47.6
BRL	All	15.5
SVT	Forest & Stroud	319.6
SVT	Strategic grid	91.1
TMS	Swindon & Oxfordshire	107.1
WSX	All	68.3
SWT	Wimbleball	57.0
BRL	Sharpness Canal	2.8

Source: Bristol Water analysis of neighbouring Water Resource Management Plan 2016/17 Annual Submissions to Ofwat

This analysis is further illustrated diagrammatically on Figure 5-7. Table 5-3 and Figure 5-7 jointly demonstrate that there is insufficient surplus supply from a single neighbouring water company and of the options that could supply the operational capacity of our Purton treatment works this would be at a cost more expensive than the purchase of water from the Canal and River Trust and associated treatment costs, even before transportation costs are considered. We would also need additional alternative water to supply the operational capacity at our Littleton treatment works.

[79] 2017/18 water purchases from the Trust also equates to a unit cost of 3.6 pence per cubic meter; at the time of writing updated information on the water resource options and costs of other companies is not available.

Figure 5-7 - Neighbouring Water Resource Trading Options in proximity to Bristol Water's supply area



Source: Bristol Water analysis of neighbouring Water Resource Management Plan 2016/17 Annual Submissions to Ofwat

Overall, costs are demonstrated to be robust as they reflect actual payments historically made to the Canal and River Trust. As discussed in Section 4.1.10, assurance of the claims and associated costs has been provided for internal purposes.

The cost estimates set out in Section 5.7 are efficient in so far as they are based on actual costs, which we have demonstrated to be efficient as per the above comparison to alternative options and costs. We have therefore not included an efficiency challenge adjustment in the forecasting of this cost adjustment claim. We have not included adjustments for input price pressures above inflation for payments to the Canal and River Trust claim; this is because the main pressure influencing prices is the contractual agreement, not the input price pressures per se, although this does influence the prices set by the Canal and River Trust.

5.9 Materiality Assessment

Table 5-4 presents our assessment of the materiality of the Canal and River Trust cost adjustment or exclusion claim.

Table 5-4 - Materiality Assessment

AMP7 Gross value of claim (£m)	9.420
Business Plan 5yr Water Resource Totex (£m)	78.709
Net claim as percent of Water resources Totex (%)	12.0%
Ofwat materiality threshold for Water resources (%)	6%

Source - Bristol Water analysis

The claim represents 12% of Water Resource Totex, thereby passing Ofwat's materiality threshold for the Water Resource price control (6%)[80]. There has been no material change to the value of this claim since early submission.

5.10 Evidence assessment

This chapter has demonstrated the need for the Canal and River Trust claim, that the claim is beyond management control and that the costs are efficient. As discussed in Section 4.2, it is not considered appropriate to provide evidence of the need for investment or that the investment represents the best option for customers as the claim seeks an adjustment to baseline Botex costs only. The claim does not relate to a capital project involving strategic options appraisal where customer protection to ensure performance improvements are delivered, therefore this is not considered herein.

Table 5-5 presents an assessment of the evidence presented in this chapter to Ofwat's requirements.

[80] Ofwat (2017) PR19 Final Methodology p.149

Table 5-5 – Evidence Assessment

Evidence	Assessment	Comments
Need for cost adjustment	✓	Ofwat does not collect data that could capture our activity of taking water from the Sharpness Canal (i.e. water sales). We have proposed that payments to the Canal and River Trust should in the first instance be excluded from modelled costs and should be treated as a cost exclusion and in the second instance be treated as a cost adjustment.
Management control	✓	In the absence of this arrangement, we would not be able to source 45.18% of our Distribution Input (DI) on a long term basis, without developing an alternative source.
Need for investment	N/A	The claim does not relate to an investment and therefore no cost-benefit analysis of options is required; the claim seeks an adjustment to baseline Botex costs only. We have however engaged with customers on this claim, see Section 3.6.
Best option for customers	N/A	
Robustness and efficiency of costs	✓	The claim reflects the actual level of payments made to the Trust; comparison to alternative sources of supply suggests costs represent value for money. We are and will challenge robustly price negotiations throughout the arbitration process to ensure an efficient cost is reached.
Customer Protection	N/A	Customer protection in the instance the project is cancelled is not applicable as the case is not an investment project.
Affordability	N/A	The claim relates to base costs, present both in our historic and forecast costs and are therefore not explicitly associated with a given bill increase for AMP7 compared to AMP6 reflecting the ongoing incurrence of the activity and unavoidable cost compared to one-off capital enhancement schemes.
Board Assurance	N/A	This claim does not relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board provided assurance of the cost adjustment claims and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency with our business plan. Section 4.1.10 provides further information on the internal and external assurance undertaken to support our final submission as was presented to Board.

Source - Bristol Water

5.11 Conclusion

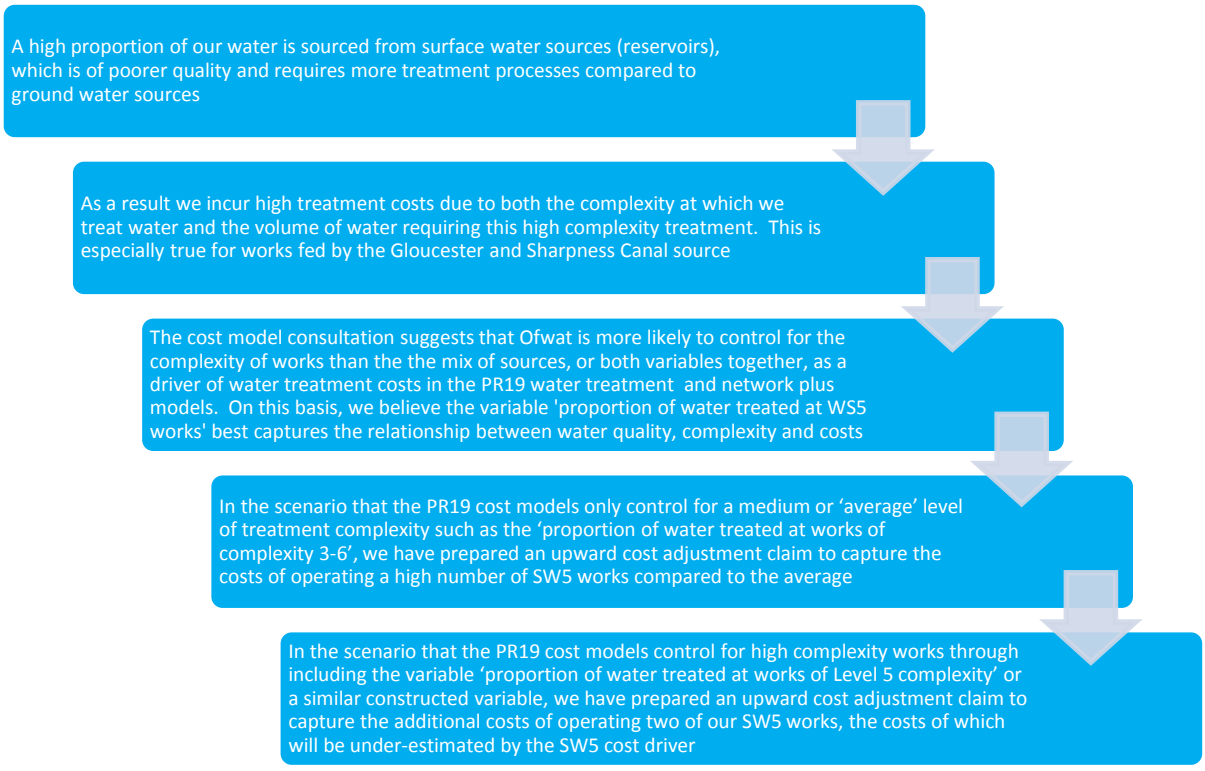
We make payments to the Canal and River Trust charity for the purchase of water from the Gloucester and Sharpness Canal (water sales); an activity in addition to EA abstraction licencing which is unlikely to be captured by the cost drivers included in Ofwat's PR19 cost models. We suggest this will cost £9.420m and that the preferred approach for accounting for this activity and associated costs is as an off-model adjustment through the cost-exclusion, not cost-adjustment, process.

6 BRL_002 - Water Treatment Complexity

6.1 Introduction

The rationale for our water treatment complexity case is set out in Figure 6-1.

Figure 6-1 - Claim Summary



Source - Bristol Water

The focus for our cost adjustment case for water treatment complexity is based on the possible outcome that Ofwat's PR19 cost assessment models may not fully account for the high number of SW5 works we operate and the high proportion of water that these works treat compared to the industry average. Ensuring that this aspect of our operations is fully captured in the cost assessment process is important to ensure that the assessment process is reflective of our efficient operations and costs.

We have developed two valuation estimates of the claim, dependent on different modelling scenarios we think Ofwat could adopt at PR19:

- ***Scenario 1:*** Ofwat controls for the complexity of works in the PR19 water treatment and network plus models through the inclusion of a medium or 'average' level of treatment complexity such as the 'proportion of water treated at works of complexity 3-6'. On the assumption that Ofwat adopts this modelling scenario, the full value of our treatment complexity case should be considered.

- ***Scenario 2:*** Ofwat controls for the complexity of works in the PR19 water treatment and network plus models through the inclusion of the variable 'proportion of water treated at works of Level 5 complexity' or a similar constructed variable. On the assumption that Ofwat

adopts this modelling scenario, a reduced value of our treatment complexity case should be considered to reflect a residual component of the claim.

In the scenario that Ofwat does control for the 'proportion of water treated at SW5 works' (scenario 2) we still consider there is a need for a claim and have prepared a valuation of this 'residual' component of our cost adjustment claim for this purpose. The rationale for this residual claim is that even if SW5 complexity works are explicitly controlled for in Ofwat's PR19 models, it will under-estimate the costs associated with two of our SW5 treatment works, Purton and Littleton. This is because they operate three complex processes which will not explicitly be acknowledged by the SW5 variable that controls loosely for works with "*more than one stage of complex, high cost treatment*"[81] and therefore the costs associated with the additional processes at Purton and Littleton will not be formally acknowledged in the cost assessment process.

We have developed estimates for the cost adjustment claim using both a top-down econometric method and a bottom-up benchmarking method. We have chosen to submit our claim based on the bottom-up estimate as we believe this is more robust. Nonetheless, the magnitude of the cost adjustment claim ultimately depends on the final form and specification of Ofwat's PR19 models, in particular with regard to whether an SW5 variable is included, which is unknown at the time of submission.

Based on inferences from the cost model consultation, we believe that Ofwat's PR19 water treatment and network plus models are more likely to approximate scenario 1 (that Ofwat's PR19 models only control for a medium or 'average' level of treatment complexity) and therefore we have submitted an estimate of the full value of our claim, consistent with this expectation.

Our final submission estimate suggests that the water treatment complexity cost adjustment claim is £5.963m (2017/18 CPIH prices).

Table 6-1 provides a summary of the key details for our water treatment complexity cost adjustment claim.

Table 6-1 - Summary of the Water Treatment Complexity Cost Adjustment Claim

Water Treatment Complexity	
Price control:	Network plus
Type of Claim:	Regional operating circumstances
AMP7 Estimate of claim:	£5.963m
Expected PR19 models relevant to claim:	Water Treatment Network plus Wholesale Water
PR19 Model dependency of claim:	Claim assumes that Ofwat's models will not explicitly include the variable 'proportion of water treated at works of Level 5 complexity' or a similar constructed variable

Source: Bristol Water

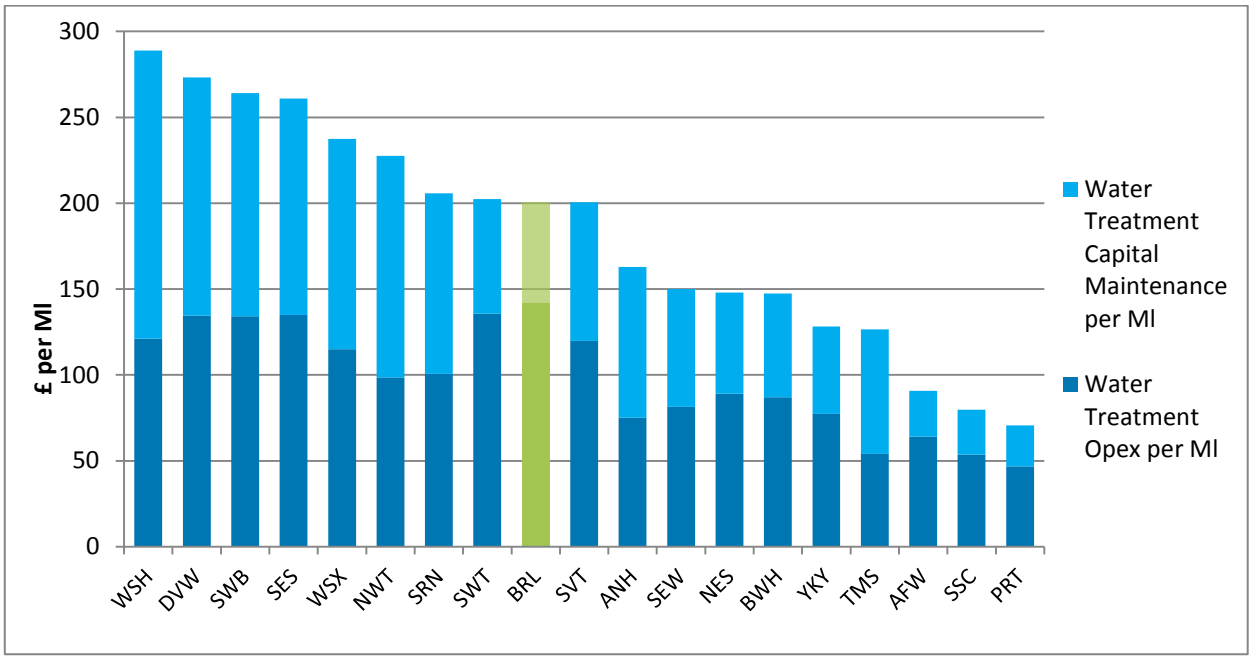
[81] Ofwat (2017) RAG 4.07 – Guideline for the table definitions in the annual performance report, p.71

6.2 Background Context

In 2017/18, we operated 16 treatment works. We treat a large proportion of our water at a high level of treatment complexity, reflecting the type of raw water sources we rely on, the quality of those sources and our risk appetite regarding drinking water safety and drinking water events.

As a result of these combined factors, we incur the highest level of water treatment opex per Ml in the industry as demonstrated by Figure 6-2.

Figure 6-2 - Average Water Treatment Botex per Ml (2011/12-2016/17), outturn prices



Source - Bristol Water analysis of the Wholesale Cost data (2011/12 to 2016/17)

Ofwat, with input from companies through the Cost Assessment Working Group (CAWG) has sought to develop a number of clearly defined and auditable variables for cost modelling that may help explain variations in companies water treatment costs. This has resulted in the collection of information by Ofwat on the following variables, which are likely candidates for inclusion in Ofwat's PR19 cost assessment models:

Number and Proportion of DI from Water resources by Type

Commencing in 2015/16 reporting of the wholesale cost information, Ofwat requested that companies report information on the number and proportion of DI from water resources by the following types:

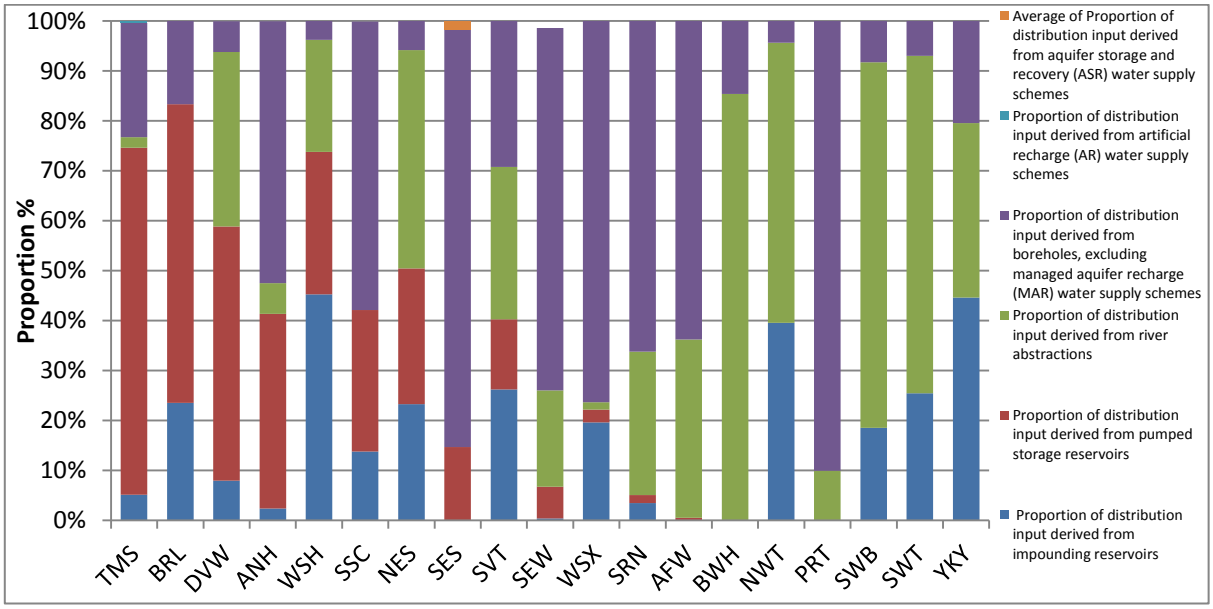
- Impounding Reservoirs;
- Pumped Storage Reservoirs;
- River Abstractions;
- Boreholes[82];
- Artificial Recharge (AR) water supply schemes; and
- Aquifer Storage and Recovery (ASR) water supply schemes.

[82] Excluding managed aquifer recharge (MAR) water supply schemes

Prior to 2015/16 reporting, Ofwat had only collected information on the proportion of water from impounding reservoirs and river abstractions.

According to these more granular source categories introduced by Ofwat, we have one of the highest shares of water sourced from reservoirs, compared to the industry, as Figure 6-3 demonstrates.

Figure 6-3 - Proportion of DI by source type - all companies (2016/17)



Source - Bristol Water analysis of the Wholesale Cost data (2011/12 to 2016/17)

Therefore if the proportion of water sourced from reservoirs (pumped and impounding) is not included in Ofwat's PR19 models this may under-estimate our modelled costs compared to our actual efficient costs.

Number and Total Water Treated at works of different complexity

Commencing in the 2015/16 reporting of the wholesale cost information, Ofwat requested that companies report information on the number of, and total water treated at, works as allocated to discrete categories based upon the complexity of treatment processes operational at each site. The categories capture six levels of complexity and reporting requirements distinguish between sites that treat surface water (SW) and sites that treat ground water (GW) for each level.

The reporting of information by site complexity represents a re-introduction and modification to information previously reported by companies up until 2007/08 which had fewer complexity categories and did not differentiate between ground water and surface water treating sites. Table 6-2 sets out a comparison of the reporting requirements, old and new.

Table 6-2 Allocation of treatment works by the complexity of treatment processes at each site

Treatment complexity categories discontinued 2007/08		Treatment Complexity Categories introduced 2015/16	
Categories of treatment types:	**Examples**	**Categories of treatment types:**	**Examples**
SD: Works providing simple disinfection only;	• Marginal chlorination	SD: Works providing simple disinfection only;	· Marginal chlorination · Pre-aeration
W1: Simple disinfection plus simple physical treatment only;	• Rapid gravity filtration • Slow sand filtration • Pressure filtration	W1: Simple disinfection plus simple physical treatment only;	· Rapid gravity filtration · Slow sand filtration · Pressure filtration
W2: Single stage complex physical or chemical treatment;	Super chlorination • Coagulation • Flocculation • Bio-filtration • pH correction • Orthophosphate dosing • Softening • Membrane filtration	W2: Single stage complex physical or chemical treatment; W3: More than one stage of complex treatment; but excluding processes in W4, W5 or W6.	· Super chlorination · Coagulation · Flocculation · Biofiltration · pH correction · Softening
W3: More than one stage of complex treatment; but excluding processes in W4.		W4: Single stage complex physical or chemical treatment with significantly higher operating costs than in W2/W3; W5: More than one stage of complex, high cost treatment;	· Membrane filtration (excluding desalination) · Ozone addition · Activated carbon / pesticide removal · UV treatment · Arsenic removal · Nitrate removal

Source – Ofwat, Wholesale Cost Data

Analysis with respect to these candidate cost drivers (the mix of raw water source types and the categories of treatment work complexity) will form the backbone of this cost adjustment case.

6.3 Regulatory Background

At PR14, we submitted two cost adjustment claims relating to treatment complexity. The first related to Ofwat's categorisation of treatment works, in particular the omission of any driver to control for the complexity of treatment processes at works (such as the W3/W4 variable[83]);and the second related to additional water treatment costs at our Purton and Littleton treatment works. Each case is briefly considered in turn below.

Treatment Complexity: W3/W4 treatment processes

At PR14, we sought a cost adjustment claim to the value of £12.6m[84] (over 5 years, 2012/13 prices) relating to the omission of any cost driver that would account for the complexity of processes at treatment works in Ofwat's PR14 models[85]. Whilst Ofwat's models did control for the proportion of water from rivers and reservoirs (the mix of sources), no account was made for the complexity of treatment work processes as a driver of costs. In the PR14 Final Determination, Ofwat made an adjustment of £18.2m following what it considered to be a "*more holistic assessment*"[86] of our base expenditure[87]. However, in our PR14 re-determination, the CMA did not find clear evidence that an

[83] As per the discontinued categories of treatment complexity
[84] Ofwat (2014) Final Determination p.83
[85] In what was called a modelling issue (Bristol Water, 2014) Cost Exclusion Cases Report p.246
[86] CMA (2015) CMA Final Determination - Appendices 1.1 - 4.3 A4(3)-7
[87] This adjustment was calculated by using the estimation technique that involves adding additional explanatory variables to models – in this case the W3/W4 variable – and calculating the change in modelled costs implied by the models; with further adjustments made to reflect the relative weightings Ofwat had

adjustment was required on the basis of modelling uncertainties[88] and the fact that comparative industry-level information on the W3/W4 variable was out-of-date.

However, as set out in Table 6-2, data on the complexity of works on a more granular classification system is now available to support the PR19 cost assessment process.

Insights from the recent cost model consultation[89] suggests that a complexity variable may feature in Ofwat's PR19 water treatment and network plus models, but that a variable capturing the mix of water resources is less likely. In the water treatment models, both Ofwat and their consultants CEPA, have sought to capture differences in water treatment complexity either through the inclusion of variables such as the 'proportion of water treated at Levels 3-6' (Ofwat) or the 'proportion of water treated at Levels 4-6' (CEPA), or separately through the inclusion of the variable the proportion of DI sourced from boreholes, AR schemes and aquifer storage, but not both.

Some of the Network+ models developed by both CEPA and Ofwat control for the complexity of works as per the variables above, but do not seek to account for the mix of sources as a driver of Network+ botex costs[90].

The likely inclusion of water treatment complexity variable(s) in the PR19 models represents a step change from PR14 and no doubt reflects an improvement in the data collected on the complexity of works at an industry level compared to PR14.

As set out in our response to the cost model consultation[91], we consider that the models published by Ofwat in the consultation may be improved through increased granularity of the complexity variables used, for example level 4 and / or level 5, as opposed to levels 3-6. Figure 6-4 seeks to reinforce this point.

Figure 6-4 presents information on the proportion of water treated at works by complexity for our works compared to the industry average. The left-hand figure groups the works of different complexity according to the variable proposed by Ofwat in the cost model consultation, 'the proportion of water treated at works of Level 3-6'; the right-hand figure does not combine any of the complexity categories.

applied to its models in a triangulation process and a 6.53% adjustment to reflect upper-quartile efficiency. CMA (2015) CMA Final Determination - Appendices 1.1 - 4.3 A4(3)-13

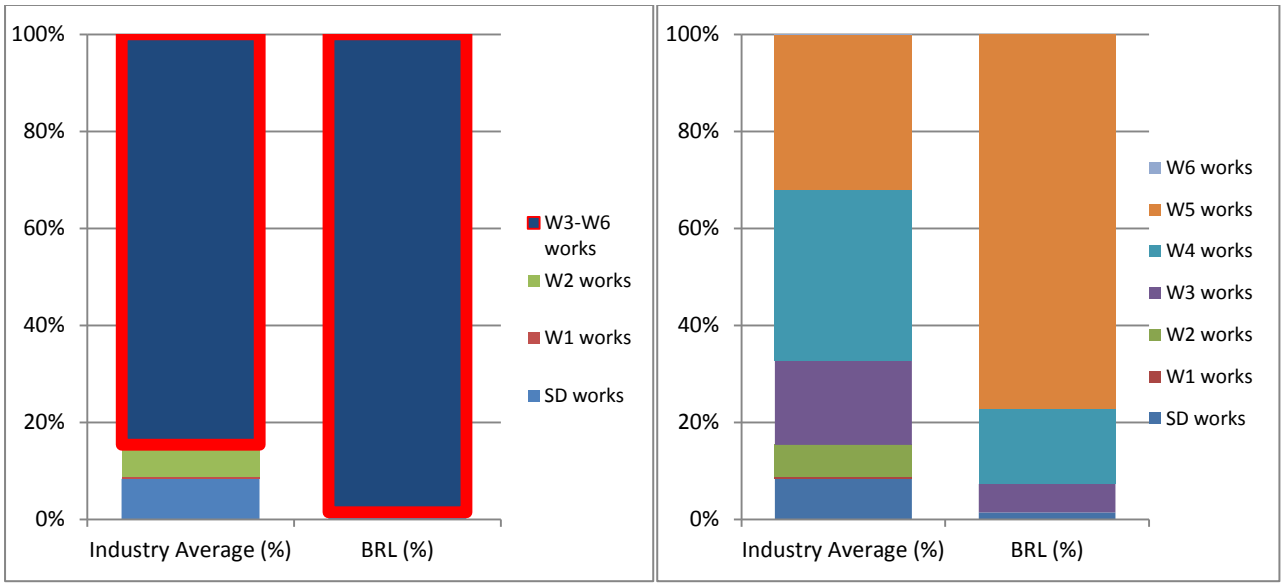
[88] small sample size, difficult to fully capture / account for varying effects of treatment complexity and source type on company costs (especially given correlation between W3/W4 variable and source type from a perspective of disentangling the two effects), plus W3/W4 not up-to-date – last collected 2007/08

[89] Ofwat (2018) A consultation on econometric cost modelling

[90] Ofwat (2018) A consultation on econometric cost modelling and CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat

[91] Bristol Water (2018) Our response to the consultation on econometric cost modelling ,p.5

Figure 6-4 - Proportion of water treated at works of different complexity, BRL compared to the industry average (proportions averaged over 2011/12 to 2016/17)



Source - Bristol Water analysis of the Wholesale Cost data (2011/12 to 2016/17)

Figure 6-4 demonstrates that:

- we are an outlier compared to the average or medium, with a high proportion of water treated at works of high complexity[92]; and
- by grouping categories together, it is not possible to differentiate the effects of individual complexity categories on costs, for example the impact of operating a Level 5 works on costs could be inferred to be the same as operating a level 3 works, which is unlikely to be the case. As complexity increases through the categories it is expected that so will costs[93], but by grouping the categories together effectively homogenises the expected relationships as complexity increases (effectively creating an average relationship that takes no account of a companies' works that are at either extremes of the complexity categories).

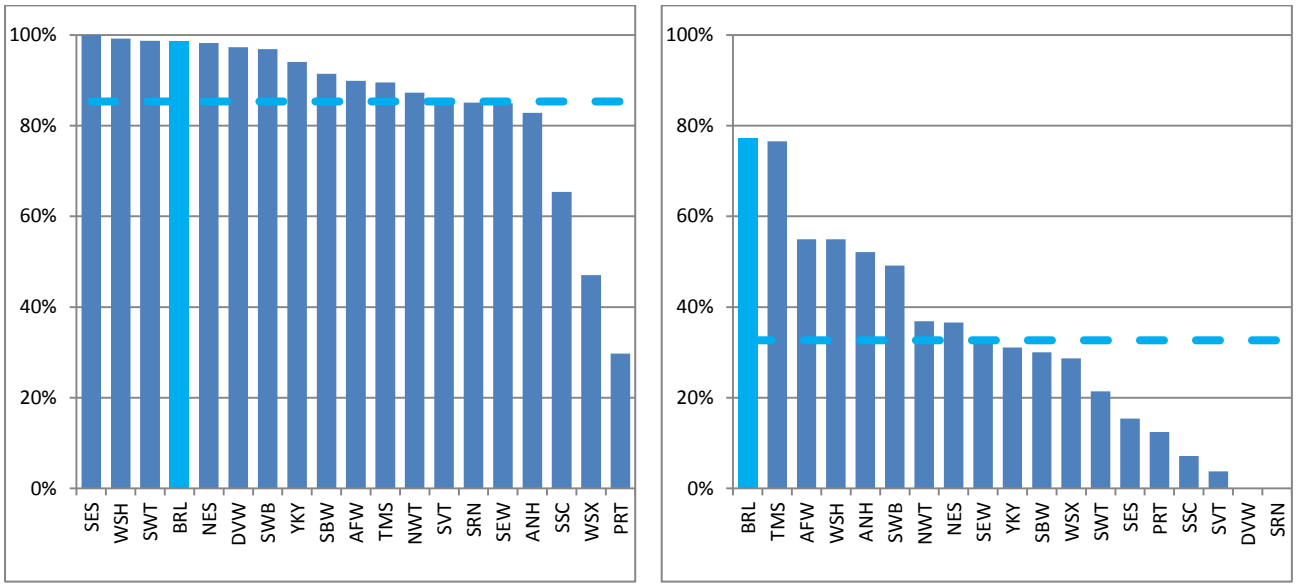
Furthermore, by grouping categories together it reduces the variation in complexity across companies as a driver of variation in companies' costs (which draws upon the point above), as is set out in Figure 6-5.

[92] For example, we treat 77.2% of our water at works of level 5 complexity, the industry average is 32.7%. Based on analysis of Ofwat (2017) Wholesale Cost Data, all companies 2011/12 to 2016/17

[93] As confirmed by Ofwat that "More complex water treatment works will typically have a higher cost of water treatment." Ofwat (2018) A consultation on econometric cost modelling p.17. And CEPA "one could expect that treatment costs will increase with the complexity of these treatments" CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat p.21

Figure 6-5 - The Proportion of Water Treated at Level 3-6 (left) and The Proportion of Water Treated at Level 5 and above (right), average 2011/12 to 2016/17

Proportion of water treated at Level 3-6 (variance 0.03); proportion of water treated at Level 5 or above (variance 0.05)



Source - Bristol Water analysis of the Wholesale Cost data (2011/12 to 2016/17)

From a modelling perspective, selecting drivers which exhibit greater variation between companies will better explain differences in treatment costs between companies[94]. This provides a rationale for not grouping complexity categories, such as levels 3-6 in the econometric models, but instead choosing an individual category with wide variance[95]. For example, the level 5 variable exhibits greater variation across companies than levels 3-6 as Figure 6-5 illustrates and would therefore be a better variable to include in the modelling in terms of driving robustness of estimates.

The above arguments present a case for using complexity categories that are not grouped or if grouped, demonstrate sufficient variation between companies to explain variations in costs.

Additional water treatment costs at Purton and Littleton

At PR14, we also sought a cost adjustment claim of £8.1m[96] (over 5 years, 2012/13 prices) to capture the additional costs of treatment incurred at our Purton and Littleton treatment works. Both Ofwat in its Final Determination and the CMA, in our re-determination, did not consider it justified to make an adjustment to reflect additional water treatment costs at Purton and Littleton. The rationale underpinning this assessment is summarised in Table 6-3.

We consider that additional treatment complexity costs at Purton and Littleton as a cost adjustment claim is still required for the modelling period 2020/21 to 2024/25 and reflects the residual cost adjustment valuation we have prepared in our submission. Table 6-3 sets out the key improvements in the evidence base we have made in response to the PR14 challenges.

[94] As per NERA's recommendation (NERA, 2017) NERA (2017) Comparative Benchmarking and Special Cost Factor Assessment, p.76
[95] We have however considered it appropriate to group W5 and W6 given only a very small proportion of water in the industry is treated at W6, this approach has been confirmed by Aqua (2018) External Support for Cost Benchmarking of Treatment Works, p. 8
[96] Ofwat (2014) Final Determination p.83

Table 6-3 – Assessment of the PR14 cost adjustment claim evidence base and PR19 improvements

PR14 assessment	PR19 update
Insufficient justification that the water treated at Purton and Littleton is of unusually poor quality compared to sites of comparable complexity (in Bristol Water and those of other companies) and therefore that additional / more complex treatment is required at these sites.	Section 6.4, factor 2) provides evidence on the raw water quality of the source waters feeding Purton and Littleton and the complex treatment processes this therefore requires.
That the additional costs were incurred efficiently compared to sites of comparable complexity.	Section 6.7.2 provides a comparison of unit treatment costs at Purton and Littleton compared to our other works and this informs our bottom-up approach to estimating the residual component of our claim. Further benchmarking to other companies' works of comparable complexity has been undertaken by an independent third party provider, AQUA and is set out in Section 6.4, factor 4). Section 6.8 demonstrates our best practice in delivering efficient costs.
Insufficient consideration of mitigation activities and alternative (potentially more optimal) water treatment solutions.	We have taken reasonable steps to control the costs as set out in Section 6.8, which includes discussion of our continuous commitment to driver process optimisation and review processes.

Source - Bristol Water

Regulatory Reporting Qualifications

Finally, it is important to acknowledge that since PR14 the Gloucester and Sharpness Canal is no longer considered a river source. In 2017 it was confirmed by Ofwat[97] that water from the Sharpness Canal is strictly speaking not a river abstraction. Instead the two pumped storage reservoirs[98] at Purton and the three pumped storage reservoirs[99] at Littleton are considered the water resource assets that directly feed the treatment works and hence are the actual sources reported to Ofwat and therefore included in the cost modelling assessment[100]. The allocation could be discussed with Ofwat further, but we assume that this is not considered a river abstraction for this case.

6.4 Need for the Cost Adjustment

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is needed are:

- **Is there persuasive evidence that the cost claim is not included (or, if the models are not known, would be unlikely to be included) in our modelled baseline?**
- **Is it clear the allowances would, in the round, be insufficient to accommodate special factors without a claim?** [101]

[97] Bristol Water (2017) Minutes of Call with Ofwat: Sources Allocation 13 October 2017
[98] Identified as tanks
[99] Identified as tanks
[100] In practice, Purton treatment works can also be fed direct via abstraction from the canal rather than from the two pumped storage reservoirs; this operational set-up exists partly to avoid quality variability in the canal.
[101] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15

The need for the treatment complexity claim is dependent upon the cost drivers Ofwat chooses to include in the PR19 models:

- ***Scenario 1:*** If Ofwat controls for the complexity of works in the PR19 water treatment and network plus models through the inclusion of a medium or 'average' level of treatment complexity such as the 'proportion of water treated at works of complexity 3-6', then the treatment complexity case in full, as presented herein, is required

- ***Scenario 2:*** If Ofwat controls for the complexity of works in the PR19 water treatment and network plus models through the inclusion of the variable 'proportion of water treated at works of Level 5 complexity' or a similar constructed variable, the magnitude of the treatment complexity cost adjustment case, as presented herein, should be reduced to reflect our valuation of a residual component of the claim. The rationale for this residual claim is that even if SW5 complexity works are explicitly controlled for in Ofwat's PR19 models, it will under-estimate the costs associated with two of our SW5 treatment works, Purton and Littleton. This is because they operate three complex processes which will not explicitly be acknowledged by the SW5 variable that controls loosely for works with "*more than one stage of complex, high cost treatment*"[102] and therefore the costs associated with the additional processes at Purton and Littleton will not be formally acknowledged in the cost assessment process.

The need for the claim is therefore model dependent and reflects uncertainties at the time of submission as to the variables and likely form of Ofwat's PR19 models.

As set out in Section 6.3 we believe that a variable made up of treatment complexity categories that exhibits a large variance, such as the 'proportion of water treated at level 5 or above' will generate the most robust econometric estimates[103] as appose to a variable which captures a more average or 'medium' level of complexity. This provides background context for the model dependency of this claim.

If Ofwat includes the variable the 'proportion of water treated at level 5 or above' in their PR19 models (scenario 2) then there is only a need for the residual component of the claim. If Ofwat does not however include this variable, the full cost claim presented under Scenario 1 is needed in order to pick up the additional costs we incur by operating a number of high complexity, high cost works compared to a more average perspective of treatment complexity and costs implied by the grouped variable level 3-6.

As we consider Scenario 1 more likely than Scenario 2, the costs provided in this submission are based on Scenario 1.

These modelling scenarios are updated versions of those presented at early submission. The updates reflect insights from the cost model consultation, namely an inference that Ofwat is more likely to include a treatment complexity variable as opposed to either a mix of sources, or both variables, in their PR19 water treatment and network plus models (see Section 6.3). Whilst we do

[102] Ofwat (2017) RAG 4.07 – Guideline for the table definitions in the annual performance report, p.71
[103] Which is therefore beneficial to all companies

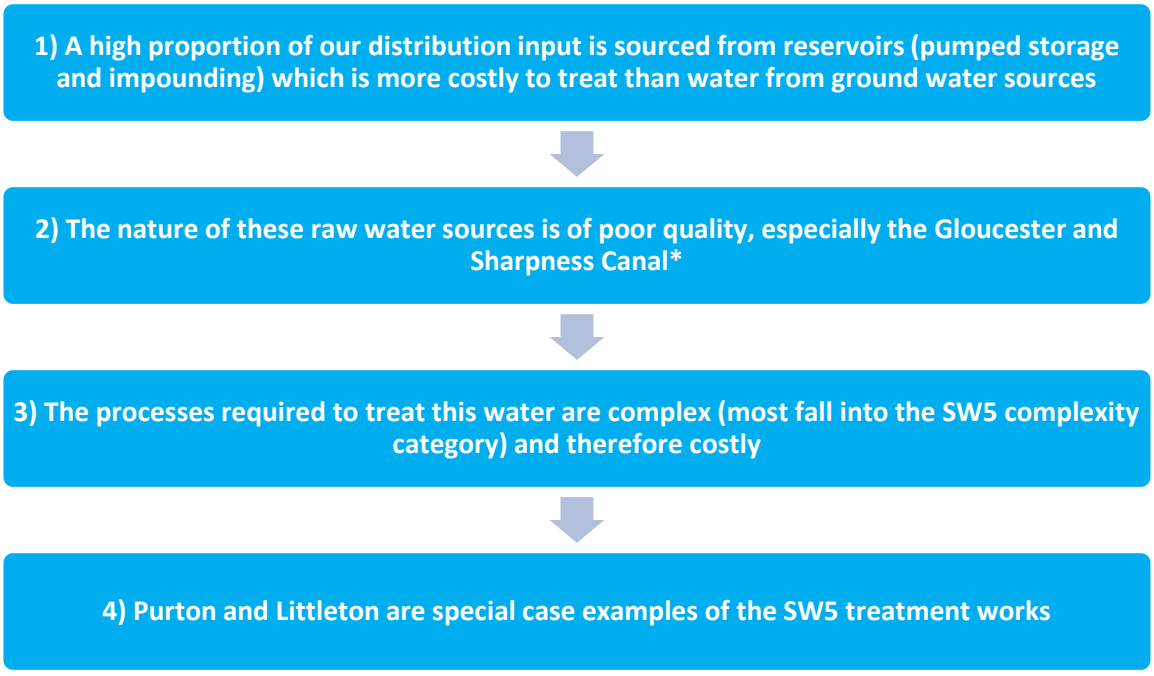
not believe that the mix of sources is a direct substitute for the complexity of works as a driver of costs[104] (Section 6.4 factor 2), we have acknowledged:

- insights from the cost model consultation that the complexity of works seems the more likely driver of costs to be included in the PR19 models; and
- the likely correlation between a variable capturing the mix of sources and treatment complexity in econometric models, meaning inclusion of a single driver will likely produce better econometric estimates;

and therefore we have dropped the reference to the mix of sources (in particular the proportion of water sourced from reservoirs) from the modelling scenarios set out above.

Overall we consider there is a likely need for a treatment complexity claim and this reflects the fact that we incur an above industry-average level of water treatment opex as demonstrated in Figure 6-2 which will not be captured by the PR19 models. It is important to understand the driver of these above industry average costs from a perspective of our actual operations and from a perspective of candidate explanatory variables that could be included in Ofwat's PR19 models. Our analysis underpinning the need for the claim suggests the high opex costs reflect the complex interaction of a number of factors as set out in Figure 6-6.

Figure 6-6 - Factors underpinning our need for the treatment complexity claim



**whilst technically a river abstraction, water from the canal is classified as two pumped storage reservoirs reflecting the definition of a source as the water resource asset that directly feeds a treatment works*

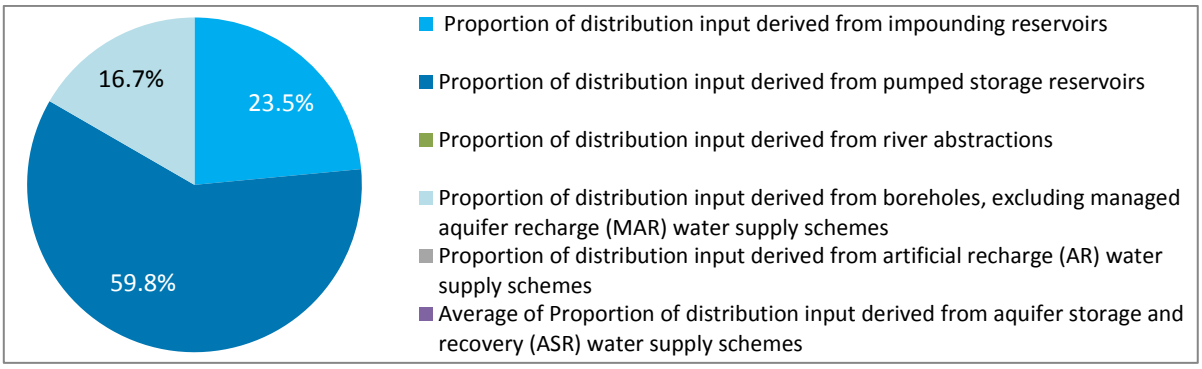
Each factor is now discussed in turn.

[104] For example two sources of the same type (e.g. reservoirs) can require different levels of treatment complexity given the raw water hazards present in the respect sources

1) A high proportion of our distribution input is sourced from reservoirs (pumped storage and impounding) which is more costly to treat than water from ground water sources

As Figure 6-7 illustrates, we source over 80% of our water from either impounding or pumped storage reservoirs, with the remainder being sourced from boreholes.

Figure 6-7 - Proportion of DI by source type - BRL (2016/17)



Source - Bristol Water analysis of the Wholesale Cost data

Compared to the industry, we have one of the highest shares of water sourced from pumped storage reservoirs as Figure 6-3 demonstrates, which is one of the component factors driving our higher water treatment opex costs compared to the industry (Figure 6-2).

Whilst it is less likely that Ofwat will control for the mix of sources in their models (see Section 6.3), it is still important to consider the mix of sources as a driver of the complexity of works required. We source a high proportion of our water from reservoirs which is more costly to treat than water sourced from ground water sources. Furthermore 45% of our distribution input, whilst strictly speaking[105] comes from a pumped storage reservoir, by origin is a canal, the water quality of which is more akin to a river source and therefore more costly to treat than a reservoir[106]. This provides context for our treatment complexity claim in totality, given the high proportion of water we source from more costly source types; and also the residual component of the claim, providing further justification[107] for why we incur additional costs at our Purton and Littleton water treatment works (which are fed by the canal) compared to our other SW5 works.

CEPA also acknowledge that water from rivers to be of variable quality and therefore the need to treat over a wide range of water quality has the potential to increase complexity and cost[108], with associated risks. This again is contextually relevant to the residual component of this case and in particular the short storage times at Purton and Littleton.

[105] as per its current classification against Ofwat's regulatory guidelines. In practice, storage at Purton equates to approximately 1.1 days and at Littleton eight hours, insufficient for particulates to come out of solution and therefore for any gains of storage in terms of water quality to be realised.
[106] As confirmed by CEPA that water abstracted from reservoirs is cheaper than rivers on the basis that particulates can come out of solution during storage. CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat ,p.20
[107] In addition to our view that Purton and Littleton operate three complex processes compared to the SW5 variable which loosely considered "more than one" and therefore may under-estimate our costs of operating these particular works
[108] CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat ,p.20

2) The nature of these raw water sources is of poor quality, especially the Gloucester and Sharpness Canal

Our surface water treatment works not only have to treat a high proportion of water from surface water sources, but those surface water sources have a high number of unacceptable and medium level water quality risks, compared to our ground water sources, which have to be mitigated by the respective works. In response to this, our surface water treatment works have a number of highly complex, high cost treatment processes. Table 6-4 maps our sources to our works and their respective complexity against Ofwat's categories based on the number of unique unacceptable and medium risks present in the source waters feeding the works.

A more detailed mapping of our sources to our treatment works and water quality risks they have to mitigate is provided in Appendix One, Table 10-1.

Table 6-4 - Mapping of our Source to Treatment Works, Risks to Processes

Source type feeding treatment works	Treatment works site	Water Quality risks requiring treatment		Complexity of Treatment
		No. Unique Unacceptable Risks	No. Unique Medium Risks	
pumped storage reservoir (3)	Littleton	15	22[109]	SW5
pumped storage reservoir (2)	Purton	15	22	SW5
impounding reservoir (3) boreholes (2)	Banwell	15	13	SW5
impounding reservoir (3) pumped storage reservoir (3)	Barrow	14	12	SW5
impounding reservoir (2)	Stowey	12	7	SW5
impounding reservoir (3)	Cheddar	14	11	SW4
borehole (1)	Sherborne	6	3	GW4
borehole (1)	Charterhouse	5	4	GW4
borehole (2)	Forum	5	3	GW4
borehole (1)	Alderley	4	2	GW4
borehole (1)	Chelvey	3	6	GW4
borehole (1)	Frome	3	4	GW4
borehole (1)	Oldford	3	0	GW4
borehole (1)	Shipton Moyne	2	7	GW4
borehole (1)	Clevedon	3	3	GW Simple Disinfection
borehole (1)	Tetbury	0	2	GW Simple Disinfection

Source - Bristol Water

In review of this mapping from source type to risks to the complexity of processes, Aqua summarised "it is clear that this complexity is driven by raw water quality and risk"[110]. Aqua's review of the "processes shows they are credible and treatments to the water quality challenges cited…and

[109] The number of unique risks treated at the Purton and Littleton works has been reduced from 23 at early submission to 22 and the number of medium risks from 16 to 15, reflecting a duplication of hazards across different sources feeding the Gloucester and Sharpness Canal.
[110] Aqua (2018) External Support for Cost Benchmarking of Treatment Works, p. 5

consequently that SW5 complexity categorisation is appropriately driven by raw water quality risks"[111].

Table 6-4 demonstrates that there is not a straight-forward relationship between source mix and complexity and that therefore, the complexity of processes at works is a better variable to capture water treatment costs than the mix of sources in water treatment (and network plus) econometric models[112].

The water source mix, by itself, does not capture the potential for water from similar sources to be more or less complex to treat, for example water from two pumped storage reservoirs could require different levels of treatment complexity reflecting different water quality risks in the two sources. If the proportion of water sourced from reservoirs alone was included as a cost driver, this would not control for the nature of the raw water differing between reservoirs, for example due to different raw water quality risks; and therefore we believe that the complexity of processes at works is a better variable to capture water treatment costs in water treatment (and network plus) econometric models[113] as it also acknowledges water quality hazards and risk as a driver of costs.

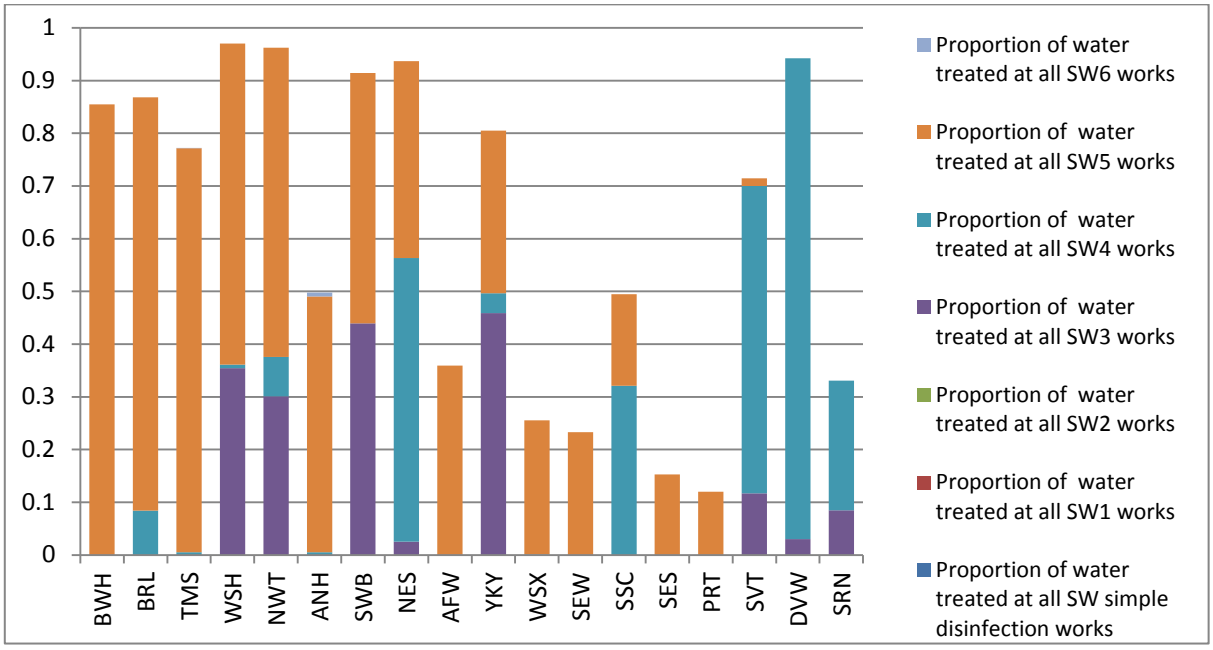
3) The processes required to treat this water are complex (most fall into the SW5 complexity category) and therefore costly

Not only are our surface treatment works highly complex as illustrated in Table 6-4, but they also treat a high volume of our water, thereby further increasing costs. This is confirmed by Aqua in their review of our treatment works that "in the national context…we conclude that there is a strong factual case that Bristol Water has an unusually high proportion of water produced by highly complex treatment works"[114].

Figure 6-8 demonstrates that in 2016/17 the proportion of water that we treated at SW5 works was the second highest in the industry.

[111] Aqua (2018) External Support for Cost Benchmarking of Treatment Works, p. 11
[112] On the assumption that including both will lead to multicollinearity issues
[113] On the assumption that including both will lead to multicollinearity issues
[114] Aqua (2018) External Support for Cost Benchmarking of Treatment Works p. 5

Figure 6-8 - Proportion of Water Treated at Surface Water Treatment Works by Complexity (2016/17)



Source - Bristol Water analysis of the Wholesale Cost data

We operate a high number of high complexity works and this reflects the fact that:

- Our water treatment works must be able to mitigate against the worst of hazards from the source waters it faces given variable and poor raw water quality; and
- We operate a resilient raw water distribution network. Our raw water distribution network allows water from sources to be treated at more than one site which provides resilience in that few of our customers are dependent on a single supply of water. Our treatment works must therefore be equipped to deal with the hazards present in all the sources that feed it.

This justifies the need for the case on grounds that not only do we operate a number of high complexity works but that those works treat a high proportion of our water, reflecting the nature of our raw water sources, thereby incurring additional water treatment opex costs.

It must be acknowledged that from an industry perspective, complexity is not the only driver of costs, the size of works relative to the overall network size and associated economies of scale can also be relevant factors. Whilst such scale factors are less relevant to us, these other factors mean that the correlation between the proportion of water treated at level 5 works and above and opex is not a perfect positive relationship as identified by Aqua[115]. Whilst Aqua further acknowledge that other companies also sit in the extremes of the cost-complexity relationship (some companies have high complexity and low costs, others have high costs and low complexity), it is also suggested that "Bristol Water might be considered to be outperforming other small companies with similarly high opex despite much lower treatment complexity"[116] although they acknowledge that further insights into the differences and similarities across companies with regard to this complexity-cost relationship cannot be drawn without further information on the raw water quality, process selection and configuration of other companies' works.

[115] Aqua (2018) External Support for Cost Benchmarking of Treatment Works, p. 14
[116] Such as Sutton and East Surrey and Dee Valley, Aqua (2018) External Support for Cost Benchmarking of Treatment Works, p. 15

4) Purton and Littleton are special case examples of the SW5 treatment works

As evidenced by Table 6-4 our Purton and Littleton treatment works treat a disproportionately high number of water quality risks[117] in order to meet drinking water quality standards. This relates to the variable quality of water abstracted from the Gloucester and Sharpness Canal[118].

Purton and Littleton each have three SW5 complexity, high cost processes accordingly to Ofwat's categories (Table 6-2). These are ozone, GAC and UV[119]. When these particular treatment works are compared to other SW5 treatment works in Ofwat's models (depended on model Scenario Two being adopted by Ofwat), this may underestimate our costs of operating Purton and Littleton if the other works only have two high cost processes[120].

This aspect of our treatment complexity cost adjustment case therefore relates to the 'residual' component. That is, even if Ofwat includes the proportion of water treated at level SW5 or above, given the definition that SW5 works have "*more than one stage of complex, high cost treatment*", this implicitly assumes that sites with more than two complex processes can be run at the same cost as sites with two processes if this variable is included in Ofwat's models. That is, the SW5 variable makes no distinction between the cost implications of running sites that operate two complex processes compared to three (or more), even if the SW5 variable is included in the models.

Therefore, some of the costs of operating these special case examples of our SW5 works will be overlooked even if Ofwat adopts modelling scenario 2 in the PR19 models.

To substantiate the need for this residual component of the claim we have sought to benchmark the additional costs we incur at our Purton and Littleton treatment works. Comparisons have been made between Purton and Littleton and our other works and this forms the basis for our bottom-up quantification of the residual component of the claim; and between Purton and Littleton and other companies' sites through external third-party support provided by Aqua.

As set out in Section 6.3 this further benchmarking to other companies' works has been undertaken since our early submission of the cost adjustment claims. In June 2018, we commissioned Aqua to provide benchmarking analysis of our costs of treatment by site (£ per Ml) in direct response to an evidence gap identified at PR14 – namely insufficient evidence that the quality of water, complexity and resulting costs differed significantly to those of other companies[121]. This has focused on a comparison of our treatment works, in particular Purton and Littleton, to peer sites at other companies at a granular level of costs focusing on chemicals, power, labour and maintenance opex costs. Aqua selected the peer sites of other companies, subject to data availability, on the criteria that they sourced water from surface water sources (predominately river abstractions), they had

[117] Compared to our other works
[118] The canal is fed by the lowland rivers Severn, Frome and Cam which presents a number of water quality risks and variability. The river Cam can provide additional water quality risks with regard to nitrate and metaldehyde and unlike the Severn and Frome, this water source cannot be prevented from entering the Canal
[119] At a process level, whilst both sites have rapid gravity filters, at Littleton the GAC absorbers are incorporated within the rapid gravity filters compared to at Purton where this forms a separate process within the works
[120] The definition of W5 works is "More than one stage of complex, high cost treatment" thereby implying works with at least two complex, high cost treatment processes
[121] Aqua have also considered the implications of Ofwat's revised treatment complexity categories for PR19 compared to PR14 for Bristol Water, the links between raw water quality, risk and treatment complexity and benchmarked operational costs at an aggregate (company level) and disaggregate (treatment work level) between Bristol Water and peer companies / sites. Their report is included alongside this submission.

comparable treatment capacity and they were comparable in terms of treatment complexity (predominately SW4 works).

For chemical unit opex, Purton was identified to have the highest unit rate for chemical usage, whilst Littleton was comparable with the highest peer sites. In terms of power consumption, both Purton and Littleton unit opex costs are comparable to the highest peer sites in the Winter, but less comparable in the Summer and so overall our two sites are slightly more costly overall on a unit basis. Labour costs at the two sites are within the range set by the peer sites, a conclusion also reached when Aqua examined unit maintenance costs.

Overall therefore, the driver of higher SW5 costs on a unit cost basis at Purton and Littleton is largely chemical and power usage. Demonstration that these costs are efficiently incurred is covered in Section 6.8.

Overall, in terms of the need for our treatment work complexity case, Aqua have expressed their support "that there are genuine factors driving process complexity and that this is a factor in relatively high opex costs at its treatment works, in particular Purton WTW. In large part these factors are beyond management control"[122] which brings us on to the next section.

6.5 Management Control

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is beyond management control are:

- **Is the cost driven by factors beyond management control?**
- **Is there persuasive evidence that the company has taken all reasonable steps to control the cost?**[123]

The operation of treatment processes at our treatment works and associated costs are to an extent beyond management control. As set out in Section 6.4, the processes in place are specifically designed to mitigate against raw water quality risks identified in the sources that we utilise (which is beyond the control of management in the period 2020/21 to 2024/25 in terms of developing alternative sources). This ultimately reflects our compliance to the drinking water quality framework and associated standards set in the interests of the health and safety of our customers. The processes in place have all received DWI consent as an appropriate mitigation to the raw water quality risks identified in our drinking water safety plans and therefore the arising costs can to some extent be considered beyond management control.

However, to an extent the costs can be considered partly within management control and this reflects our adverse risk appetite to drinking water incidents, consistent with the above. Whilst it is within management control to turn-off processes and reduce costs, the trade-off is increased risk of drinking water events – a risk we do not take lightly on behalf of our customers. This is reflected in our upper quartile DWI Compliance Risk Index (CRI) performance in 2017[124].

We have taken reasonable steps to control for our water treatment costs as set out in Section 6.8.

[122] Aqua (2018) External Support for Cost Benchmarking of Treatment Works, p. 5
[123] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[124] We were third out of 21 companies

6.6 What the claim means for our Customers

Customer priorities research has confirmed that drinking water quality is their number one priority, as evidenced by Figure 6.7. Ensuring that treatment is sufficient to meet this number one customer priority provides an important justification to our risk adverse, high complex and high cost approach to treating water and hence this complexity claim.

Figure 6-9 - Customer Priorities

Source - Bristol Water A5: Annual Customer Survey

As discussed in Section 4.1.8, we undertook specific customer research regarding cost adjustment claims in January 2018. Of the customers we engaged with, a majority thought that treatment complexity was outside of management control and that the claim should be allowed by Ofwat with the implication that costs may be passed through to customers.

A few participants were surprised by the fact that our raw water sources from the canal is of worse quality than other companies or from our Mendip reservoirs, which led to a discussion about the challenge associated with developing an alternative source and the precedence for developing reservoirs in England and Wales. Others commented that in order to meet government standards on water quality we have no choice but to operate complex treatment processes and this underpinned their decision making in the research exercise[125].

6.7 Quantification of the Cost Adjustment

Section 6.4 sets out that the need for the claim is dependent on two modelling scenarios. The need for these different modelling scenarios reflects uncertainty at the time of preparing this submission as to what the final PR19 models will look like. The need and valuation estimate of the claim is ultimately dependent on the PR19 models.

Scenario 1: assumes that Ofwat will include the variable the 'proportion of water treated at works of complexity 3-6' in the PR19 water treatment / network plus models to capture the average level of treatment complexity driving company costs.

[125] Consistent with customer's number one priority for drinking water quality

Scenario 2: assumes that Ofwat will include the variable 'proportion of water treated at works of Level 5 complexity' in the PR19 water treatment / network plus models to capture the proportion of high complexity, high cost treatment works that some companies operate.

We have worked with NERA to develop an econometric estimate that aligns best with modelling Scenario 1. This estimate has been developed by calculating the change in modelled costs implied when the variable 'proportion of water treated at level 5 or above' is included in models that otherwise do not capture this high complexity, high cost relationship. This informs our top-down estimate as set out in Section 6.7.1.

Table 6-5 - Estimation Methods to Support the Quantification of the Treatment Complexity Cost Adjustment Claim

Scenario	Top-down approximation	Bottom-up approximation
Scenario 1	Econometric estimate through calculating the change in modelled costs when the variable 'proportion of water treated at Level 5 or above' is added to models which otherwise only control for the proportion of water treat at Level 2-3	Benchmarking of the unit cost of operating our most complex and costly SW5 treatment works compared to all our other works
Scenario 2		Benchmarking of the unit cost of operating our most complex and costly SW5 treatment works compared to all our other SW5 works

Source: Bristol Water

We have also developed estimates on a bottom-up basis using our actual costs. In the absence of Ofwat controlling for the 'proportion of water treated at level 5 or above' (Scenario 1) we have estimated the additional costs of operating our most complex and costly SW5 works compared to the average of all our other works on a unit cost (£ per Ml) basis. In the scenario that Ofwat does control for the 'proportion of water treated at level 5 or above' (Scenario 2) we have estimated the additional costs of operating our most complex and costly SW5 works compared to the average of all our other SW5 works on a unit cost (£ per Ml) basis.

Each approach to estimation is now considered in turn.

6.7.1 Top-down econometric approach to estimation

As discussed in Section 4.1.7, we have worked with NERA to provide an econometric valuation of the treatment complexity case. Our chosen method has been to add additional explanatory variables to the Oxera reference models to control for the complexity of our water treatment processes above that already captured in the models and then calculate the change in modelled costs attributable to operating high complexity, high cost treatment works (as proxied by the SW5 variable).

Table 4-2 and Table 4-3 set out the Oxera model specifications. Some but not all of the Oxera models control for high complexity of treatment and to varying extents. The Oxera reference models take some account of the mix of sources (through inclusion of the variable 'proportion of water sourced from boreholes) and the proportion of water treated at Level 2-3. This top-down econometric approach therefore, provides a cost adjustment claim estimate that most closely approximates Scenario 1 being adopted by Ofwat at PR19.

To estimate the value of the cost adjustment claim under Scenario 1 NERA added the variables:

- 'the proportion of water sourced from reservoirs' to Oxera's Water Resource, Network plus and Aggregate models; and
- The 'proportion of water treated at Level 5 and above' to Oxera's Network plus botex and Aggregate botex models.

A summary of the additional variables added to the respective business units is presented in Table 6-6, Table 6-7 and Table 6-8 alongside the Oxera model specifications.

Table 6-6 - Additional Variables included in Oxera's Water Resource models

		1	2	3	4
		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate
Cost Drivers	Connected properties (log)	✓		✓	✓
	Length of raw water mains and conveyors over DI (log)	✓	✓		
	Average pumping head, resources (log)	✓	✓	✓	✓
	Number of sources over distribution input (log)			✓	
	Proportion of distribution input from boreholes				✓
	2015 year dummy	✓	✓	✓	✓
	2016 year dummy	✓	✓	✓	✓
	Constant	✓	✓	✓	✓
Additional Drivers for Treatment Complexity Quantification	Proportion of distribution input from reservoirs	✓	✓	✓	✓

Source: Bristol Water summary of NERA's analysis

Table 6-7 - Additional Variables included in Oxera's Network plus models

		1	2	3	4	5	6	7	8	9	10	11
		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate
Cost Drivers	Connected properties (log)	✓		✓	✓	✓	✓	✓	✓			
	Population (log)									✓		
	Distribution input (log)										✓	
	Water delivered (log)											✓
	Proportion of water treated at level 3 treatment plants	✓	✓	✓	✓				✓	✓	✓	✓
	Proportion of water treated at level 2 treatment plants					✓						
	Average pumping head, Network plus (log)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Proportion of mains laid before 1980	✓	✓	✓	✓	✓	✓	✓				
	Properties over mains (log)			✓					✓			
	Proportion of distribution input from boreholes						✓					
	Proportion of surface water treated							✓				
	Mains/connected properties (log)								✓			
	2015 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2016 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Constant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Additional Drivers for Treatment Complexity Quantification	Proportion of distribution input from reservoirs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Proportion of water treated at level 5 treatment plants or above	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: Bristol Water summary of NERA's analysis

Table 6-8 - Additional Variables included in Oxera's Aggregate models

		1	2	3	4	5	6	7	8
		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate
Cost Drivers	Connected properties (log)	✓		✓	✓				✓
	Population (log)					✓			
	Distribution input (log)						✓		
	Water delivered (log)							✓	
	Proportion of water treated at level 3 treatment plants	✓	✓	✓	✓	✓	✓	✓	
	Proportion of water treated at level 2 treatment plants								✓
	Average pumping head (log)	✓	✓	✓	✓	✓	✓	✓	✓
	Proportion of mains laid before 1980	✓	✓	✓	✓	✓		✓	
	Raw water mains and conveyors/DI (log)	✓	✓			✓	✓	✓	✓
	Number of sources over distribution input (log)			✓					
	Proportion of distribution input from boreholes				✓				
	2015 year dummy	✓	✓	✓	✓	✓	✓	✓	✓
	2016 year dummy	✓	✓	✓	✓	✓	✓	✓	✓
	Constant	✓	✓	✓	✓	✓	✓	✓	✓
Additional Drivers for Treatment Complexity Quantification	Proportion of distribution input from reservoirs	✓	✓	✓	✓	✓	✓	✓	✓
	Proportion of water treated at level 5 treatment plants or above	✓	✓	✓	✓	✓	✓	✓	✓

Source: Bristol Water summary of NERA's analysis

NERA calculated the change in modelled costs for each model (Water resources, Network plus and Wholesale Water) for each year of the six year wholesale cost data set available when the additional variables set out in Table 6-6, Table 6-7 and Table 6-8 were added.

As we have set out in Section 6.2 we think it is more likely that Ofwat will seek to account for differences in water treatment costs through a treatment complexity variable than a mix of sources variable or both[126]. On this basis we have revised our top-down econometric method of estimation to only focus on the change in modelling costs attributable to adding the variable the 'proportion of water treated at level 5 or above' to the reference models, as opposed to also adding the variable the 'proportion of distribution input from reservoirs'.

This implies that we have dropped the estimates from the water resource models, an action we have also justified by the need to present a cost adjustment claim within a single price control[127] (which would not strictly be compliant if we used the model estimates from the water resource models).

We have also decided to drop the aggregate model estimates informing the cost adjustment claim given that by adding the variable the 'proportion of water treated at level 5 or above' to aggregate models, it will inevitably be picking up a relationship between complexity (through correlation with the mix of sources) and water resource costs as opposed to our cost adjustment claim which is

[126] Due to likely multicollinearity issues
[127] Ofwat (2017) PR19 Final Methodology p. 150

focused purely on the relationship between complexity and water treatment (network plus) costs. We have therefore dropped the cost adjustment claim estimate from the aggregate models given we expect it will likely over-estimate the value of the claim on this basis.

The average cost adjustment claim implied by the econometric models for the Network plus Botex models when both the variable 'proportion of distribution input from reservoirs' and the 'proportion of water treated at level 5 and above' are added is £10.341m[128] in 2016/17 outturn prices[129].

The average implied cost adjustment claim for the Network plus Botex models when only the variable the 'proportion of water treated at level 5 and above' is added is £9.421m, as set out in Table 6-9 in 2016/17 outturn prices.

Table 6-9 - Estimate of our water treatment complexity cost adjustment claim (when the variable 'proportion of water treated at level 5 or above' as the only additional variable added)

Claim (in 2016/17 £ million)	2012	2013	2014	2015	2016	2017	Average
Network plus 1	10.520	10.040	10.385	9.041	8.111	9.488	**9.598**
Network plus 2 (per prop.)	9.277	8.731	9.163	7.838	7.004	8.288	**8.384**
Network plus 3	9.557	9.130	9.423	8.222	7.385	8.636	**8.725**
Network plus 4	10.387	9.928	10.240	8.914	8.006	9.361	**9.473**
Network plus 5	10.898	10.435	10.699	9.363	8.400	9.714	**9.918**
Network plus 6	11.433	10.957	11.253	9.897	8.811	9.358	**10.285**
Network plus 7	6.844	6.408	7.048	5.771	4.867	5.506	**6.074**
Network plus 8	14.405	13.590	13.522	11.775	10.705	12.471	**12.745**
Network plus 9	13.306	12.164	12.041	10.522	9.605	11.255	**11.482**
Network plus 10	9.102	8.598	8.620	7.661	6.925	8.184	**8.182**
Network plus 11	9.817	9.221	9.226	8.198	7.391	8.752	**8.768**
Average	**10.504**	**9.928**	**10.147**	**8.837**	**7.928**	**9.183**	**9.421**

Source: NERA (2017)

In projecting the £9.421m (2016/17 outturn prices) top-down estimate of the cost adjustment claim for our business planning period 2020/21 to 2024/25 we also need to consider:

- Operational cost-savings that our AMP7 capital enhancement programme is planned to deliver in terms of treatment work costs; and
- inflation, and in particular the potential for movements in the price of inputs we use to have a rate of change different to that measured by CPIH; called real price effects (RPEs).

Table 6-10 below sets out these adjustments to derive our estimate for the upper range of the treatment complexity cost adjustment claim based on an econometric approach and assuming a model dependency of the claim based on Ofwat adopting the modelling Scenario 1 as set out in Section 6.4.

[128] NERA (2017) Comparative Benchmarking and Special Cost Factor Report, p. 78
[129] £10.616m in CPIH 2017/18 prices

Table 6-10 - Top-down estimate for water treatment complexity cos adjustment claim, forecast assumptions 2020/21 to 2024/25

Financial year	Historic Outturn	AMP6 forecast, outturn	2020/21 to 2024/25 Forecast		
			Inflation adjustment, re-priced to reporting requirements[130]	Adjustment for AMP7 capital programmed and planned change in treatment opex profile	Adjustment for RPEs above CPIH
	£m, nominal	£m, nominal	£m, 2017/18 CPIH prices	£m, 2017/18 CPIH prices	£m, 2017/18 CPIH prices
2016/17	9.421[131]				
2017/18	9.672				
2018/19		9.885			
2019/20		10.071			
2020/21			10.689	10.689	10.882
2021/22			10.902	10.745	10.842
2022/23			11.124	10.976	11.119
2023/24			11.347	11.198	11.344
2024/25			11.569	11.421	11.421
Claim value £m					**55.607**

Source: Bristol Water analysis

This therefore leads to an implied cost adjustment claim for the period of 2020/21 to 2024/25 of £55.607m (2017/18 CPIH prices) as an upper end estimate[132]. We have assumed that other than the capital investments which will alter future spend profiles, water treatment opex costs will otherwise stay the same over the period.

6.7.2 Bottom-up benchmarking approach to estimation

We have also sought to undertake bottom-up estimates, reflecting our actual operations and costs. Whilst a modelling approach estimates a £55.607m adjustment, this analysis does not appear robust when actual costs are considered (as the above 50% of planned water treatment base expenditure suggests). Informing this bottom-up approach we have estimated the additional average costs of operating our treatment works, when Purton and Littleton are considered compared to our other works. The analysis for both scenarios seeks to estimate the additional cost of our most complex and costly treatment works (Purton and Littleton) compared to the unit cost of treating water across our other sites, with costs adjusted for the Canal and River Trust claim to avoid double counting.

This unit cost benchmarking exercise has been undertaken to reflect the two modelling scenarios we expect Ofwat could take in their development of PR19 models:

Scenario 1: assumes that Ofwat will control for a medium or average level of treatment complexity in their PR19 models through inclusion of a variable such as 'the proportion of water treated at Level 3-6' to capture the average level of treatment complexity driving company costs. We have therefore

[130] 2017/18 CPIH prices for 2020/21 to 2024/25 forecasts
[131] Source: Table 6-9
[132] This is in comparison to a claim of £53.08m over the period 2020/21 to 2024/25 if both the mix of sources (proportion of water from reservoirs) and treatment complexity (proportion of water treated at Level 5 and above) were added to the econometric models; and assuming no planned changes in treatment costs other than for inflation.

calculated a bottom-up estimate by comparing the costs (£ per Ml) of our most complex and costly treatment works to the average cost (£ per Ml) of all our other works. The basis for this valuation is to estimate the size of the claim on the rationale that including a 'medium or average complexity' variable in the models will under-estimate our costs given the high proportion of water we treat at works more complex than WS2-3.

Scenario 2: assumes that Ofwat will control for high complexity works as a driver of costs, through inclusion of the variable 'proportion of water treated at works of complexity Level 5' in the PR19 water treatment / network plus models. We have therefore calculated a bottom-up estimate by comparing the unit costs (£ per Ml) of our most complex and costly treatment works (Purton and Littleton) to the average cost (£ per Ml) of all our other SW5 works. The basis for the valuation is to estimate the size of the residual component – that is even if Ofwat were to include an SW5 variable in the water treatment (and network plus) models, this is likely to understate our efficient costs because both Purton and Littleton treatment works operate three SW5 processes which will not be distinguished in the modelling from other SW5 works which only operate two processes categorised as SW5.

We have updated the analysis presented at early submission to reflect the latest available information for 2017/18 on our costs at a treatment work level and audit recommendations.

The analysis for each modelling scenario is presented in turn below.

Scenario 1: Comparison of our most complex and costly works to all our other works

Table 6-11 - Treatment work site comparison of costs per Ml to all other works at Bristol Water, 2016/17 and 2017/18

2016/17	Purton	Littleton	Other Works
Treatment Work costs (£/Ml)	181.31	178.50	155.39
Cost difference to all other works (£/Ml)	25.92	23.11	-
Treatment Work output (Ml)	34,582	10,943	
Total cost difference to SW5 works (£m)[133]	0.896	0.252	**1.149**

2017/18	Purton	Littleton	Other Works
Treatment Work costs (£/Ml)	177.52	161.02	149.88
Cost difference to all other works (£/Ml)	28.64	12.14	
Treatment Work output (Ml)	34,036	12,199	
Total cost difference to SW5 works (£m)	0.975	0.148	**1.123**

Source: Bristol Water analysis, 2016/17 and 2017/18 outturn prices, respectively

Based on 2017/18 data, this analysis suggests the additional costs at Purton and Littleton compared to all our other sites on a unit cost basis equates to £1.123m per annum in 2017/18 CPIH prices, on the basis that Ofwat adopts modelling Scenario 1.

[133] The efficient unit cost of treatment per megalitre of water at Purton is higher than at Littleton. This is due to a combination of the following operational reasons: the configuration of the works at Purton, as a large scale site that has been developed with many process additions over time and which subsequently has high requirements for inter-stage pumping compared to our Littleton works; whilst both sites have rapid gravity filters, at Littleton the GAC absorbers are incorporated within the rapid gravity filters compared to at Purton where this forms a separate process within the works; which makes Purton on a unit cost basis more expensive than Littleton; and from a resilience perspective we are dependent on always running Purton. Some customers, such as those located in the North of Bristol can only be supplied by Purton, in comparison to the customers supplied by Littleton can largely be supplied by other treatment works depending on our supply strategy. This means in times when the raw water quality is bad, we are more prone to use Purton as it is better at treating pesticides (such as metaldehyde) than Littleton, as Purton has a dedicated GAC absorber process (compared to Littleton where it is incorporated into the rapid gravity filters), which means the unit costs at Purton can be higher due to higher process costs associated with GAC and the need to always be supplying customers who are dependent on this works, what ever the raw water quality and cost.

Scenario 2: Comparison of our most complex and costly works to all our other WS5 works

Table 6-12 - Treatment work site comparison of costs per Ml to other WS5 works at Bristol Water, 2016/17 and 2017/18

2016/17	Purton	Littleton	Other SW5 works
Treatment Work costs (£/Ml)	181.31	178.50	159.51
Cost difference to SW5 works (£/Ml)	21.80	18.99	-
Treatment Work output (Ml)	34,582	10,943	
Total cost difference to SW5 works (£m)	0.754	0.208	**0.962**

2017/18	Purton	Littleton	Other SW5 works
Treatment Work costs (£/Ml)	177.52	161.02	155.30
Cost difference to SW5 works (£/Ml)	£22.22	£5.72	-
Treatment Work output (Ml)	34,036	12,199	
Total cost difference to SW5 works (£m)	0.756	0.070	**0.826**

Source: Bristol Water analysis, 2016/17 and 2017/18 outturn prices, respectively

Based on 2017/18 data, this analysis suggests the additional costs at Purton and Littleton compared to our other SW5 sites on a unit cost basis equates to £0.826m per annum in 2017/18 CPIH prices. This bottom-up cost exercise provides a suitable value for the residual component of the cost adjustment claim consistent with modelling Scenario 2 and the view that Purton and Littleton are special case examples of the SW5 treatment works as set out in Section 4.4.

6.7.3 Combining the Top-Down and Bottom-Up Valuations

We have decided to drop the top-down econometric estimate of the treatment complexity cost adjustment claim contingent on Ofwat adopting modelling Scenario 1 on the basis that:

- the implied claim seems disproportionate to our actual treatment costs for AMP7 set out in our business plan;
- it seems prudent to base our estimates on actual costs as these are more substantially rooted in our actual operations and cost observations; and
- we expect Ofwat is more likely to adopt a modelling specification that approximates the 'medium or average complexity' across treatment works[134] and hence Scenario 1.

We considered taking an average of the 2016/17 and 2017/18 additional costs at Purton and Littleton compared to our other sites but considered it more appropriate to take forward the 2017/18 cost differential because it:

- Captures the most up-to-date information available;
- Produces a lower cost estimate than taking the average which is in the interests of customers and our commitment to present 'balance' in every aspect of the cases we submit; and
- Reflects the step-change in costs we have achieved over the last few years as set out in C5 of our business plan.

[134] We consider that Ofwat's inclusion of the variable 'proportion of water treated at Levels 3-6' can be considered to land on the average, given how broad this variable is in terms of the complexity categories included

Our water treatment complexity cost adjustment claim valuation is therefore £1.123m (2017/18 CPIH prices).

In developing our estimate of the treatment complexity cost adjustment claim profile for the period 2020/21 to 2024/25 we need to take account of inflation and input price pressures above inflation specific to our cost base across the business planning period (2020/21 to 2024/25).

At early submission, we assumed that the future profile of our additional treatment costs would stay the same for AMP7, adjusted for inflation only. The profile of treatment opex will, however, be changing over AMP7, reflecting planned activities. For example, many of the interventions making up the treatment work investment case commence with up-front capital enhancement spend, which then reduces opex costs going forward. To align the cost adjustment claim with the investment proposals in our business plan, these savings over the cost profile of AMP7 need to be built into the cost adjustment claim forecasts. Such savings are estimated to be £0.6m[135] over the period 2020/21 to 2024/25 and these are built into our forecasts as set out in Table 6-13. Further information can be found in our investment cases.

Table 6-13 sets out these adjustments to derive our estimate for the treatment complexity cost adjustment claim.

Table 6-13 - Valuation estimate of the Treatment Complexity Cost Adjustment Claim

Financial year	Historic Outturn	AMP6 forecast, outturn	2020/21 to 2024/25 Forecast		
			Inflation adjustment, re-priced to reporting requirements[136]	Adjustment for change in opex profile from investment cases	Adjustment for RPEs above CPIH
	£m, nominal		£m, 2017/18 CPIH prices		
2011/12	1.016				
2012/13	1.041				
2013/14	1.063				
2014/15	1.074				
2015/16	1.080				
2016/17	1.094				
2017/18	1.123				
2018/19		1.148			
2019/20		1.169			
2020/21			1.241	1.241	1.264
2021/22			1.266	1.109	1.129
2022/23			1.292	1.143	1.164
2023/24			1.317	1.169	1.190
2024/25			1.343	1.195	1.216
Claim value £m					**5.963**

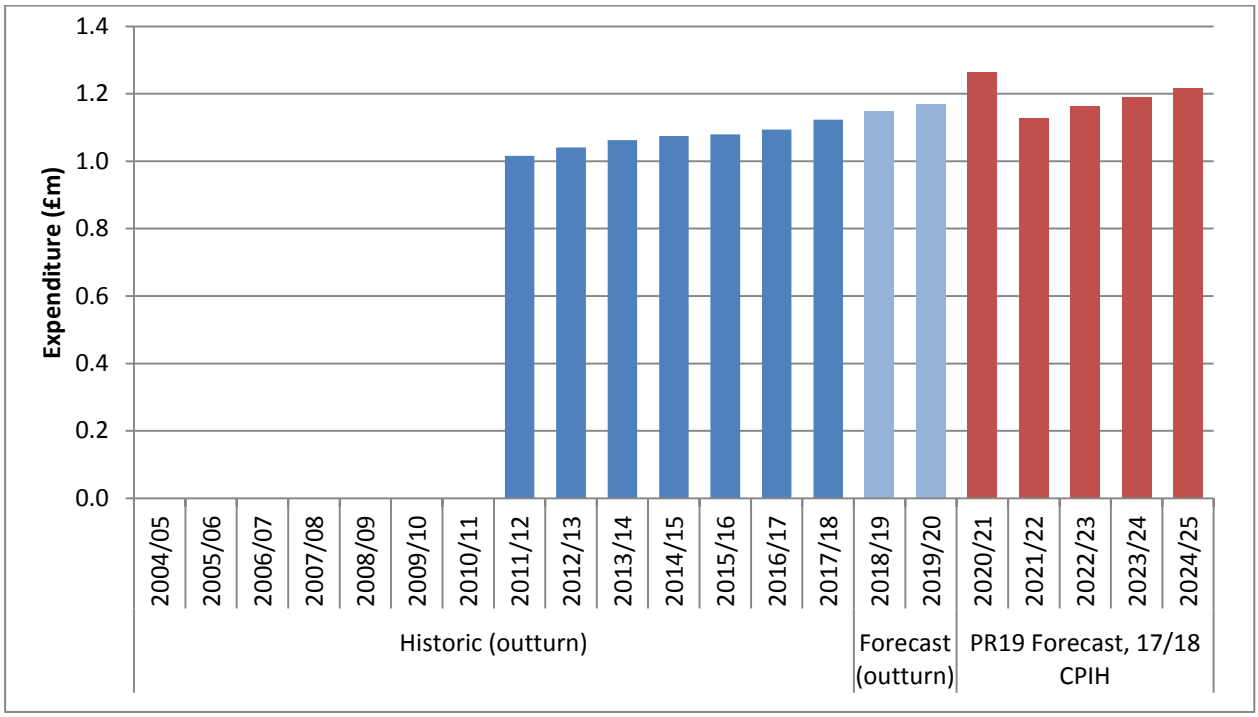
Source: Bristol Water analysis

[135] C5B Technical Annex: Treatment Works Strategic Maintenance Investment Case: Technical Approach and Business Case, NTPBP-INV-STR-0542. Section 5.2, p.29 Table 8 sets out a £170,700 per annum (£740,838 per AMP) opex saving as a result of the treatment works investment case. Application of an 8% efficiency challenge, p32. Table 9 brings this to £0.6m opex saving.
[136] 2017/18 CPIH prices for 2020/21 to 2024/25 forecasts

Table 6-13 sets out that the implied bottom-up estimate for the treatment complexity cost adjustment claim is £5.963m (2017/18 CPIH prices), once accounting for anticipating savings in treatment opex due to our intended investment programme.

Figure 6-10 graphically illustrates the estimated value for our treatment complexity cost adjustment claim as set out in this chapter, based on modelling scenario 1 being adopted by Ofwat and our bottom-up approach to estimation.

Figure 6-10 - Valuation estimate of the Treatment Complexity Cost Adjustment Claim[137]



Source - Bristol Water

To some extent, high treatment Opex costs underpinning this cost adjustment claim may be compensated for by lower water treatment capital maintenance costs in Ofwat's Botex models.

6.8 Demonstrating that costs are Efficient

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is efficient are:

- **Is there persuasive evidence that the cost estimates are robust and efficient?**
- **Is there high quality third party assurance for the robustness of the cost estimates?**[138]

In C5 of our business plan we demonstrate the improvement in our costs and efficiency we have achieved across our cost base over the last years. A reproduction of our step-change in efficiency over time, according to models published by Ofwat in the cost model consultation is presented in Figure 5-4[139]. This illustrates, inclusive of our water treatment costs, that our costs in relative terms compared to other companies in the industry are in the upper quartile.

[137] The step change in costs from 2020/21 to 2021/22 reflects the realisation of treatment opex savings after year 1 of AMP7 capital programme
[138] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency, p.14-15
[139] And also Figure 1-1 of C5

We are committed to securing low-cost efficient input prices for energy and chemicals, two of the largest inputs to our treatment work operations and subsequent cost base. Despite our relatively small size we are able to secure efficient costs for our chemical purchases through our participation in a supplier consortium, the Western Procurement Hub, and therefore we are able to reap the cost benefits of purchasing power through joint buying with other members of the consortium in the region. Similarly we have secured stable and efficient prices for energy through hedging market prices until 2020. This demonstrates efficiency of the costs underpinning the claim.

We are also committed to driving process optimisation. As part of our continuous improvements we are currently engaged in reviewing the performance of our water supply assets and assessing their efficacy in delivering safe and sufficient treated water to our customers. This exercise is in particular focusing on our water treatment works at Purton, Littleton, Stowey, Barrow, Cheddar and Banwell, all of which, with the exception of Cheddar, are WS5 works. This demonstrates our commitment not only to secure efficient costs now, but drive these forward in the future and continually reassess what is strategically optimal.

6.9 Materiality Assessment

Table 6-14 presents our assessment of the materiality of the claim.

Table 6-14 - Materiality Assessment

	Bottom-up Estimate	Top-Down Estimate
AMP7 Gross value of claim £m	5.963	55.608
Business Plan 5yr Network plus Totex £m	378.137	
Net claim as % of Network plus Totex	1.6%	14.7%
Ofwat materiality threshold for Network plus	1%	

Source - Bristol Water analysis

On claim represents between 1.6% and 15% of Network plus Totex, thereby passing Ofwat's materiality threshold for the Network plus price control (1%)[140].

6.10 Evidence assessment

This chapter has demonstrated the need for the treatment complexity cost adjustment claim, that the claim is beyond management control and that the costs are efficient. As discussed in Section 4.2, it is not considered appropriate to provide evidence of the need for investment or that the investment represents the best option for customers as the claim seeks an adjustment to baseline Botex costs only. The claim does not relate to a capital project involving strategic options appraisal where customer protection to ensure performance improvements are delivered, therefore this is not considered herein.

Table 6-15 presents our assessment of the evidence presented in this chapter against Ofwat's requirements.

[140] Ofwat (2017) PR19 Final Methodology, p.149
Our claim is based on the bottom up estimate of £5.963m, although this may depend on the final approach to econometric modelling and the level of treatment complexity considered.

Table 6-15 – Evidence Assessment

Evidence	Assessment	Comments
Need for cost adjustment	✓	Water treatment complexity for level 5 works is unlikely to be included in Ofwat's PR19 water treatment and network plus models; although our analysis has demonstrated that the variable is significant for the industry as a whole.
Management control	✓	Our water treatment costs are partly beyond management control, reflecting a required response to the risks and hazards present in the raw water sources we use (which pursuing alternatives is beyond the control of management for AMP7) and also our risk-appetite to drinking water events within the regulatory framework set by the DWI.
Need for investment	N/A	The claim does not relate to an investment and therefore no cost-benefit analysis of options is required; the claim seeks an adjustment to baseline Botex costs only. We have however engaged with customers on this cost adjustment claim, see Section 2.4.3.
Best option for customers	N/A	
Robustness and efficiency of costs	✓	Our estimate for this claim has been rooted in actual costs, which we can demonstrate to be efficient through our best practices in securing low costs for our key inputs, including power and chemicals though our participation in the Western Procurement hub. We are also committed to driving process optimisation at our works as part of our continuous improvement. Furthermore reproduction of Ofwat's PR19 models suggest that in recent years we have embraced a step-change in our network plus costs of which these baseline costs form a part, see C5 of our business plan.
Customer Protection	N/A	Customer protection in the instance the project is cancelled is not applicable as the case is not a new investment project.
Affordability	N/A	Water treatment costs are present both in our historic accounts and in our cost forecasts. As the claim relates to base costs it is not associated with an explicit bill increase in so far as these are baseline costs.
Board Assurance	N/A	This claim does not relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board provided assurance of the cost adjustment claims and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency with this business plan submission. Section 4.1.10 provides further information on the internal and external assurance undertaken to support our final submission as was presented to Board.

Source - Bristol Water

We are reviewing the evidence for the cost of our works compared to works operated by other companies that use similar water sources and volumes. This evidence is not generally available and is not critical to our case, but if it is available will further validate our actual works cost calculation.

6.11 Conclusion

Water treatment complexity at level 5 is not directly captured in most of the potential econometric models. We have limited the case from the potential £55.607m to £5.963m by relating the factor specifically to the operating conditions at Purton and Littleton treatment works, which are affected by the quality of the water from the Gloucester & Sharpness Canal, c45% of our water source, making this combination of factors a specific operating circumstance that does not represent inefficiency.

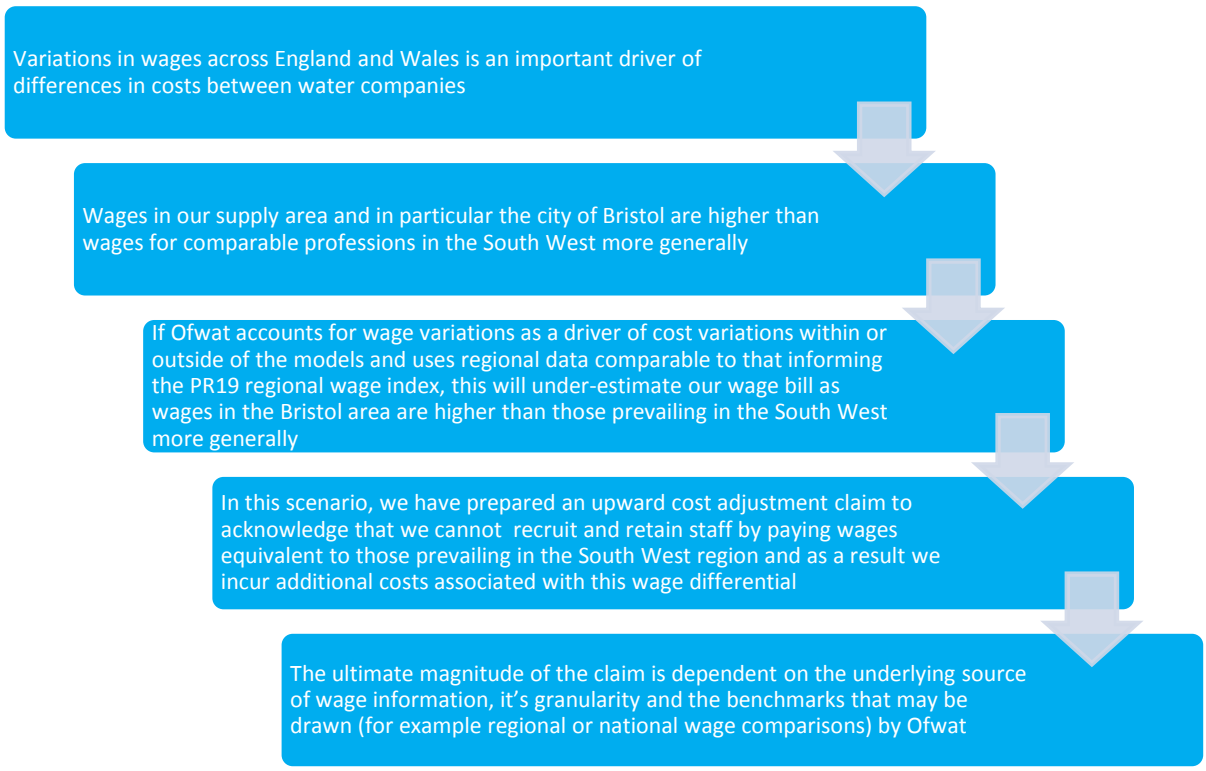
7 BRL_003- Prevailing Wages in the Bristol Water Supply Area

7.1 Introduction

Variations in wages across England and Wales are an important driver of differences in costs between water companies. Companies have no choice but to base most of their staff in the areas they serve, particularly for operation of physical networks and treatment works which have to be based close to the customer population they serve. Our early submission was presented on the likelihood that Ofwat may adopt a regional wage explanatory variable. Our final submission sets out the likelihood that Ofwat may not include a regional wage explanatory variable in its PR19 models, but may still seek to accommodate this driver of costs in the cost assessment basis. The ultimate magnitude of the claim is dependent on the underlying source of wage information, its granularity and the benchmarks that may be drawn (for example regional or national wage comparisons) by Ofwat in this assessment. If this assessment is based on data comparable to that informing the PR19 regional wage index developed by Ofwat, it will likely lead Ofwat to implicitly assume that we can recruit and retain staff by paying wages equivalent to those prevailing in the South West region in general. However, prevailing wages in our supply area and indeed in the immediate labour market of Bristol City are higher than in the South West and as a result we face additional costs associated with this wage differential.

The rationale for our prevailing wages in the Bristol Water supply area case is set out in Figure 7-1.

Figure 7-1 - Claim Summary



Source: Bristol Water

Our final submission estimate suggests that prevailing wages in the Bristol supply area therefore represents a case for an £8.716m upward adjustment to be made to our cost baseline in the

Network plus price control unit[141] for PR19. Table 7-1 provides a summary of the key details for the cost adjustment claim.

Table 7-1 - Summary of the Prevailing wages in the Bristol Water Supply area Cost Adjustment Claim

Prevailing Wages in the Bristol Water Supply Area	
Price control:	Network plus
Type of Claim:	Regional operating circumstances
AMP7 Estimate of claim:	£8.716m
Expected PR19 models relevant to claim:	Network plus Wholesale Water
PR19 Model dependency of claim:	Claim assumes that Ofwat's models will not include any regional wage cost driver, but that variations in wages may still be considered by Ofwat in the PR19 cost assessment process

Source: Bristol Water

In the event that Ofwat does not make an adjustment for regional wage variation within the cost assessment process then this claim will not be required, as our analysis shows that our wage costs are in line with the national average[142].

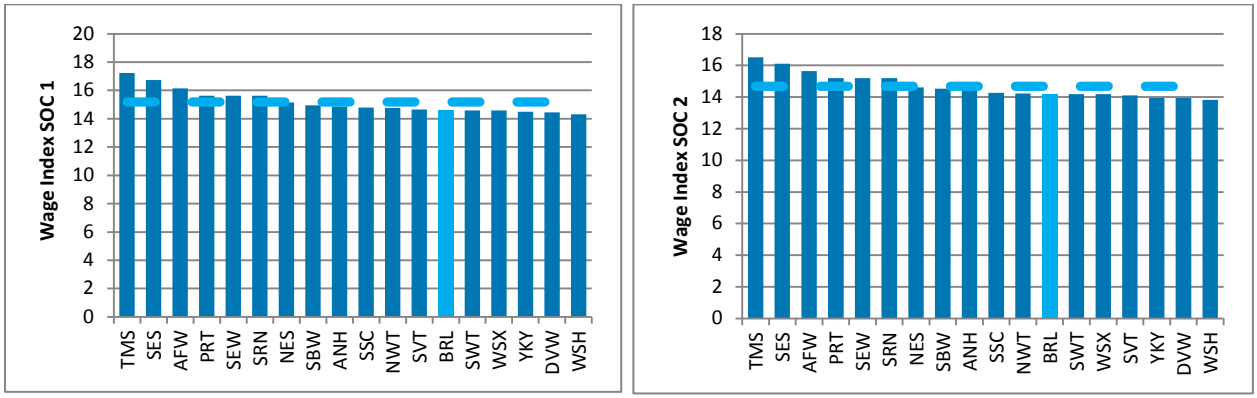
7.2 Background Context

Variations in wages across the country are an important driver of differences in costs between companies. The persistent existence of wage variations reflects the fact that labour is sufficiently immobile to arbitrage wage differentials. Accounting for regional wage differences in efficiency benchmarking is important and is a key consideration for Ofwat and the industry for PR19[143].

In testament to this, Ofwat has constructed a regional wage index to support PR19 cost modelling efforts. The index seeks to control for different wage pressures in different regions, which draws upon ONS wage data and company information on the mix of occupations a typical water company employs. By mapping regional level wage data by detailed occupational codes to company supply areas, Ofwat has constructed a wage index more tailored to the labour markets water companies actually face compared to the PR14 approach used to account for variations in wages. Figure 7-2 presents companies' relative position according to Ofwat's constructed wage index for both the Major Group (SOC1) and Sub-Major Group (SOC 2) standard occupational groupings. On both occupational groupings, we reside below the average.

[141] Reflecting the PR19 final methodology that a claim must be considered within a single price control unit only. Ofwat (2017) PR19 Final Methodology p. 150
142 See Table 7-3
143 Cost Assessment Working Group (2016)

Figure 7-2 - Ofwat's Constructed Regional Wage Index, Company (average 2011/12-2017/18)



Source: Bristol Water analysis of Ofwat's Index, Data ONS and Water Companies

Through industry discussions over the last two years, Ofwat has communicated a preference to include the constructed regional wage index in its PR19 models[144]. Ofwat had also set out that they will consider alternative methods if necessary; a summary of all likely method communicated by Ofwat are summarised in Table 7-2.

Table 7-2 - Adjustment Methods for Accounting for Variations in Wages and therefore labour costs between companies

Adjustment	Example
Pre-model	• Adjust Thames / Affinity costs down (e.g. regional wages* proportion of work that needs to be done locally) • Adjust company costs to a level where wages in the respective companies' area equalled the national average, as Ofgem conducted at RIIO-ED1
In-model	• Include the constructed regional wage index as an explanatory variable, or a similar cost driver
Post-model	• Treat variations in wages as a symmetric cost adjustment claim

Source - Cost Assessment Working Group

The cost model consultation provides the most recent insights into the likely approach that Ofwat might take to account for variations in regional wages as a driver of variations in company costs, although Ofwat's final approach remains uncertain.

In the consultation[145], Ofwat identified that regional wages may be a driver of treated water distribution costs, however no wage adjustments (for example inclusion of an explanation variable[146]) were made to any of Ofwat's published models[147].

CEPA, Ofwat's support partners, developed a two-phase approach to model selection, the latter phase of which included two tests on the sensitivity of modelled outcomes to variations in regional wages as a driver of cost differences between companies[148]. For all models, both aggregate and

144 Cost Assessment Working Group (November 2016)
145 Ofwat (2018) A consultation on econometric cost modelling ,p.17
146 Or other adjustment as per the possible approaches in Table 7-2
147 Ofwat (2018) A consultation on econometric cost modelling, Appendix 1 Modelling results
148 The first test involved making ex-ante adjustments to the costs to be modelled through the exclusion of company labour costs; the R2 of models with and without labour costs were then compared to assess whether the exclusion of labour costs improved how well the models fitted the data. The second test involved the inclusion of a modelling variable, where both average wage and wage indices variables (consistent with those developed by Ofwat for PR19) were trialled. CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat, p.118-121

disaggregate, neither approach to making regional wage adjustments improved modelled outcomes for the models tested; the ex-ante[149] adjustments did not make a significant improvement to the predictive power of the models and the inclusion of a regional wage variable was not statistically significant.

From the cost model consultation, it can likely be deduced that a regional wage variable will not be included in Ofwat's PR19 models. The constructed regional wage indices do not appear to be particularly robust for this purpose, despite its inclusion as an explanatory variable in the models being Ofwat's initial preference. This inference regarding the likely modelling approach for wages is reflected in our response to the consultation where we set out our view that regional wage factors should be excluded from the models[150] based upon the evidence presented and that therefore cost adjustment claims present the most appropriate avenue through which to make allowance for variations in regional wages as a driver of variations in company costs.

On this basis we have developed a cost adjustment claim which reflects the wage premium we have to pay to staff above that prevailing in the South West generally due to the impact of market forces nationally, namely the impact of London and the South East in skewing national averages and setting wages which we in the South West ultimately have to compete with.

7.3 Regulatory Background

At PR14, both Ofwat and the CMA (in our re-determination) used a within-model adjustment to control for variations in wages across companies using a regional wage variable. In this approach our costs were modelled using wage information for the South West. During our re-determination, the CMA raised specific concerns that the regional wage variable might underestimate our costs, suggesting that a cost adjustment may be appropriate. The CMA commented that "*it is possible that the wages faced by Bristol Water were significantly higher than those across the South West region as whole*" (p. 34) and that therefore the models were likely to disadvantage us. We subsequently demonstrated that wages in our supply area were 7.4% higher than comparable data for the South West. In light of this, the CMA made an adjustment of £5.93m to account for variations in wages prevailing in our supply area compared to the South West more generally.

7.4 Need for the Cost Adjustment

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is needed are:

- **Is there persuasive evidence that the cost claim is not included (or, if the models are not known, would be unlikely to be included) in our modelled baseline?**
- **Is it clear the allowances would, in the round, be insufficient to accommodate special factors without a claim?** [151]

Labour is a key input into the operations of a water company. A variation in wages across the country and the causes and consequences of this economic phenomenon of the labour market has been a topic which has attracted long-standing research and debate.

As set out in Section 7.2 variations in wages is an important driver of differences in costs between companies. Identifying appropriate methods and measures to robustly account for these

[149] i.e. a pre-model adjustment
150 Bristol Water (2018) Our response to the consultation on econometric cost modelling , p.4
[151] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15

differences between companies and the areas in which they operate is important and something the industry and regulator has devoted significant thought to.

As also set out in Section 7.2 recent insights from the cost model consultation and in particular the publication of models and associated methods by both Ofwat and Ofwat's consultants, CEPA suggest that inclusion of an explanatory wage variable is not likely to be the observed approach used in the PR19 cost assessment framework to account for variations in wages. This therefore suggests that variations in wages as a driver of variations in companies' costs will not be included in the modelled baselines but this ultimately depends on Ofwat's chosen approach to account for this input cost driver in the cost assessment framework more broadly.

Allowances in the round will be insufficient to accommodate labour as an input cost driver, given it is unlikely that Ofwat will seek to include a regional wage variable in the models and given the likelihood that any allowance for wages will be based upon regional level wage information, comparable to the PR19 wage index which makes the assumption that we can recruit and retain staff at a cost equivalent to the prevailing level of wages in the South West more generally.

This assessment reflects the fact that Ofwat's PR19 wage index is constructed from wage data reported at a regional (not more granular) level[152]. As our supply area is entirely within the South West, Ofwat's constructed wage index therefore makes an implicit assumption that we can source labour at a cost equivalent to the average prevailing wages in the South West. Indeed, as Figure 7-2 illustrates according to Ofwat's constructed wage index, we face below industry average wages when both the Major Group (SOC 1) and Sub-Major Group (SOC 2) standard occupational groupings are examined.

However, prevailing wages in our supply area and in the immediate labour market of Bristol City are higher than in the South West as Table 7-3 demonstrates.

Assessment of wages in Ofwat's cost assessment framework using this underlying data source will therefore likely underestimate our labour costs and hence an upward a cost adjustment claim is required.

[152] The limiting factor here is that whilst the ONS reports wage data by SOC code at a regional level; and wage data (e.g. by gender) at a local authority level; it does not report wage data by SOC code at a local authority level; which would assist in the mapping of wage data to company areas

ONS data on median wages[153] in our supply area are 6.75% higher than for the South West and 1.89% higher than for England and Wales. As a result we face additional costs associated with this wage differential that are not accounted for if Ofwat uses this the same wage information as in the PR19 wage index to assess wages in the cost assessment framework.

Table 7-3 - Median and Mean Hourly Wage Comparison (2017)

	Hourly wage (£, median)	% Difference	Hourly wage (£, mean)	% Difference
Bristol, City of	12.91	-	15.49	-
North Somerset	12.92	-	16.50	-
South Gloucestershire	12.78	-	15.97	-
Sedgemoor	10.50	-	14.58	-
Mendip	11.25	-	15.02	-
Bristol Water supply area (Local authority weighted average, rows 1-5)	12.76	-	15.59	-
South West	**11.90**	**6.75%**	**15.10**	**3.15%**
England and Wales	**12.52**	**1.89%**	**16.34**	**-4.80%**

Source: Bristol Water analysis of ONS data on wages and population density

At early submission, we presented the wage case based on median hourly wages excluding overtime. Whilst CEPA's approach in the PR19 cost consultation methodology used a mean (average) based approach[154] to assessing wage differentials for an in-modelling adjustment, for the development of this cost adjustment claim we have used a median approach. This is because, the median approach provides a better measure of spread and avoids the skewing effect that inclusion of London and South East wages will have on the mean.

Our employee data[155] shows that we draw workers from a labour market much smaller than our own supply area, as circa 80%[156] of our staff live in an area with a Bristol postcode[157], 53.2% of whom live within the City of Bristol local authority area. Whilst it may not be unusual for a water company to draw the majority of its staff from within its supply area, the regional wage differential may be particularly acute for water only companies as the smaller supply areas therefore represent proportionally smaller coverage of the wider regions, compared to water and sewerage companies with larger supply areas that map more closely to regions. The differential between Bristol as a large metropolitan city and the wider region with an economy more dominated by agriculture and tourism is also likely to be greater than that which would be observable in other areas of the country.

Whilst the ONS data above provides a useful comparison of median wages for all employees generally, wage data by occupation is only available at a regional level; which inhibits more granular comparison of occupational wages in the South West with that of our supply area.

[153] Comparison of median wages is preferred to mean wages, as the middle 'median' statistic is less influenced by the extreme tails of the distribution and therefore is a better summary statistic. Indeed, the ONS choose to report earnings on a median basis for this same reason: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/methodologies/guidetointerpretingannualsurveyofhoursandearningsasheestimates#why-is-the-median-used-as-the-main-measure-of-earnings

154 CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat

155 Analysis based on employee data at July 2018

156 79.7% based on employee data at July 2018

157 Postcode where the first two letters are BS

Analysis of internal salary data paid to our staff suggests that the 6.75% wage differential with prevailing wages in the South West is largely borne true. Table 7-4 below presents a comparison of our wages paid to staff to the ONS wage data for the South West for median hourly wages for comparable occupational codes[158].

We are reliant on some occupations more than others in terms of the mix of skills. Therefore the extent to which the wage differential for each occupation affects the total wage bill depends on the number of staff actually employed. To capture this effect, a weighted average has been taken which suggests that the median wage variation between us and the South West, weighted by occupation (SOC1) is 5.92%; not too dissimilar to the 6.75% differential in the ONS wage data above.

Table 7-4 Comparison of Bristol Water and South West median ONS wage data

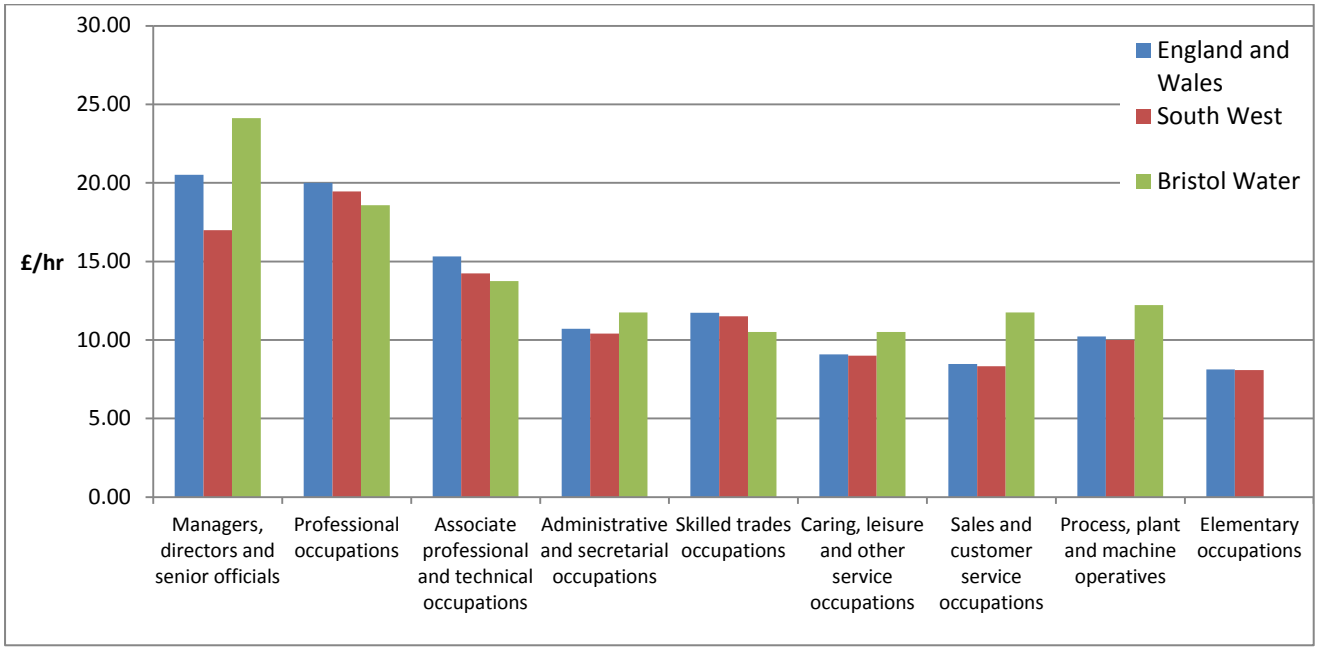
		Count of BW employees by SOC1 (not WR*)	Median Hourly Wage (£m year, 2017)			Wage differential (%), Bristol Water compared to the South West	Wage differential (%) weighted by mix of occupations at Bristol Water
			England and Wales	South West	Bristol Water		
Major SOC group	**Calculation**	**a**	**b**	**c**	**d**	**e=(d-c)/d**	**f = e *a**
1	**Managers, directors and senior officials**	80	20.51	16.99	24.12	30%	23.7
2	**Professional occupations**	80	20.00	19.45	18.59	-5%	-3.7
3	**Associate professional and technical occupations**	195	15.33	14.24	13.76	-4%	-6.9
4	**Administrative and secretarial occupations**	49	10.71	10.40	11.76	12%	5.7
5	**Skilled trades occupations**	9	11.74	11.50	10.52	-9%	-0.8
6	**Caring, leisure and other service occupations**	1	9.09	9.00	10.52	14%	0.1
7	**Sales and customer service occupations**	22	8.47	8.33	11.76	29%	6.4
8	**Process, plant and machine operatives**	11	10.23	10.00	12.22	18%	2.0
9	**Elementary occupations**	-	8.13	8.08	-		-
Weighted average wage variation (%)							**5.92%**

Source: Bristol Water analysis of Ofwat's Constructed Wage Index, ONS and Bristol Water wage data (as at 11 July 2018)

For illustrative purposes the comparison of median wages by the major group Standard Occupation Code (SOC) is also presented in Figure 7-3, drawing upon the information presented in Table 7-4.

[158] SOC1 – Major Group

Figure 7-3 - Comparison of Median Wages by Major SOC Group (2017)



Source: Bristol Water analysis of Ofwat's Constructed Wage Index, ONS and Bristol Water wage data

Therefore, if Ofwat accounts for variations in wages using regional level salary information comparable to the source data used in the PR19 wage index, this will not reflect the true costs of employing labour we incur to the value of the estimated 5.92% weighted average wage differential. The implied allowances would, in the round, be insufficient to accommodate this factor without a cost adjustment claim.

7.5 Management Control

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is beyond management control are:

- **Is the cost driven by factors beyond management control?**
- **Is there persuasive evidence that the company has taken all reasonable steps to control the cost?**[159]

Prevailing wages in our supply area are the result of the interaction of labour market supply and demand characteristics in local, regional and national markets simultaneously. In Ofwat's constructed wage index, we believe Ofwat has made the assumption that the proportion of labour costs subject to regional cost pressures is 70% for all occupations at a SOC1 and SOC2 level[160]. In making this assumption it can be understood that Ofwat considers that 30% of jobs can be sourced from lower cost locations elsewhere in the country and therefore are arguably more within management control. Our experience however suggests that this is not necessarily borne out in reality due to the significant travel time in commuting that this would involve. It remains to be seen however, whether Ofwat will use the index, or at least the underlying source data informing the index, to support their assessment of wage variations in the PR19 cost assessment framework.

[159] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[160] Ofwat (2017) Company specific labour cost indices

The local nature of water company operations means that there is a limited degree to which management can control for localised wage pressures, as staff and contractors are predominantly drawn from locations in and around Bristol. Bristol is becoming an increasingly desirable place to live and work as indicated by rising house prices[161]. Within this competitive local market for labour, we must either match competitors wage offerings or accept high staff and skills turnover, detrimental to long term productivity improvements and efficiency gains.

7.6 What the claim means for our Customers

As discussed in Section 4.1.8, we undertook specific customer research regarding cost adjustment claims in January 2018. Of the customers we engaged with, they were mixed views as to whether or not local wage pressures are beyond management control. More than half of the customers however thought that the claim should be allowed by Ofwat and passed through to customers. Qualitative insights from the event refer to the local knowledge that our staff have, one particular customer making the comparison to “a taxi driver” whilst others praised the friendliness of our staff as a benefit of being served by us. Indeed, the benefits of having locally sourced staff sets precedence for this claim.

7.7 Quantification of the Cost Adjustment

Based on the 5.92% wage variation between median wages at Bristol Water with that of the South West ONS wage data, the additional costs associated with this wage differential can be calculated, as presented in Table 7-5 below. This estimation of the additional costs relies upon business plan assumptions of Network plus Botex for AMP7 and the share of labour in Botex for AMP7[162]. This approach to estimation assumes that the mix of labour at Bristol Water by occupation code (SOC1) stays the same for AMP7 which is a reasonable assumption to make.

[161] Bristol City Council (2017) Bristol Housing Market in 2017 - A Summary p. 4
[162] From which an assumption can be made about the share of labour in opex

This estimation technique replicates a method presented by NERA in a report to us on benchmarking and cost adjustment claims. NERA set out an approach for estimating a cost adjustment claim that would be required if Ofwat developed a model controlling for wage variation across regions. They replicate analysis developed in the CMA re-determination to estimate the wage differential between the average wage in our supply area (weighted by population) and that in the South West, and then apply this wage differential to the labour share of modelled costs[163]. This approach has been adopted and adapted to inform this submission; the main methodological difference being the use of a wage differential which links to actual wages and the mix of occupations we employ. This therefore takes on board one of the methodological recommendations made by the CMA – the need to account for differences in the mix of occupations as a driver of variations in labour costs as well as variations in wages for comparable occupations[164].

Table 7-5 - Quantification of the Additional Costs Bristol Water incurs beyond the prevailing South West wages

Year	Status	Price base	Network+ Botex estimate (£m)	Labour proportion of Network+ Botex (%)[165]	Weighted average wage variation Bristol Water to South West (%)	Cost impact of wage differential (£m)
2017-18	Actual	Outturn (nominal)	61.121	46.3%	5.92%	1.676
2018-19	Forecast		71.751			1.968
2019-20	Forecast		66.921			1.835
2020-21	Forecast	2017-18 FYA (CPIH deflated)	63.261			1.735
2021-22	Forecast		63.645			1.746
2022-23	Forecast		60.589			1.662
2023-24	Forecast		64.680			1.774
2024-25	Forecast		65.596			1.799
Implied AMP7 Cost Adjustment Claim (£m)						**8.716**

Source: Bristol Water analysis of internal and Bristol Water business plan forecasts

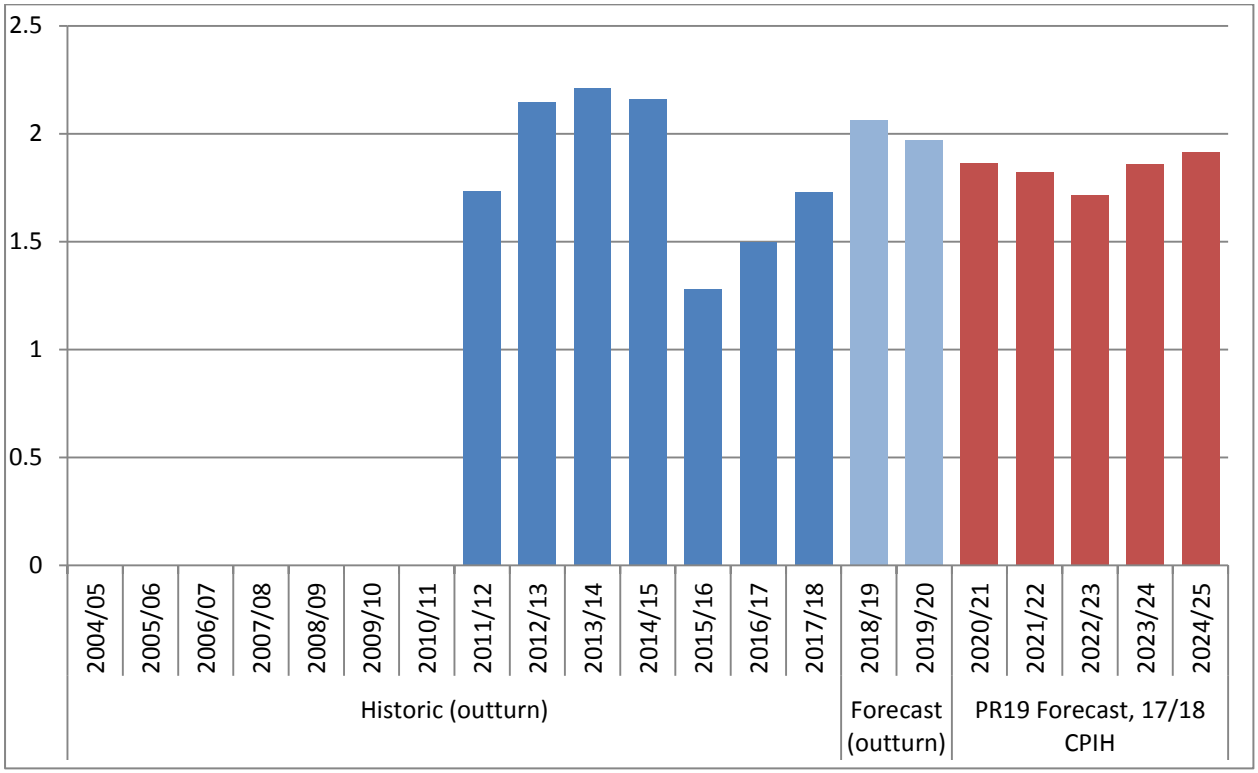
The estimated additional cost of prevailing wages in our supply area being higher than those in the South West more generally is £8.716m (2017/18 CPIH deflated) over the period 2020/21-2024/25.

The Botex forecasts presented in Table 7-5 are consistent with those reported in the WS1 PR19 data table. The forecasts presented in table WS1 have been based on a projection of actuals, given planned changes in activity for the period 2020/21 to 2024/25 adjusted for CPIH inflation and forecast input price pressures on our cost base above CPIH. Therefore, for the Prevailing Wages in the Bristol Water supply area cost claim it is not necessary to consider each of these forecast adjustments discussed in Section 4.1.5 again in turn.

The breakdown of our claim per annum in PR19 is graphically depicted in Figure 7-4 below.

[163] NERA (2017) Comparative Benchmarking and Special Cost Factor Assessment, p.90-91
[164] CMA (2015) CMA Final Determination - Appendices 1.1 - 4.3 A4(3)-41
[165] The share of labour in botex is based on a weighted average of the share of labour in opex and the share of labour in capex weighted by how much opex and capex make up our overall costs. Based on a six year average (2011/12 to 2016/17), labour costs make up 49.8% of opex and 43.7% of capex (source: Bristol Water cost analysis). Taking a weighted average provides an overall labour share of costs of 46.3%. This presents a methodological improvement compared to that set out at early submission and reflects the outcome of assurance discussions.

Figure 7-4 - Prevailing Wages in the Bristol Water Supply Area - Summary of Claim



Source: Bristol Water analysis

We believe that the profile of the PR19 cost forecasts will need to be shifted upwards (i.e. making the positive claim more positive) given future expected labour cost pressures from the construction of the new Hinkley Point C power station adjacent to our supply region, thereby increasing demand for labour in the immediate area including our supply area, which would not be reflected in our historical cost baselines.

7.8 Demonstrating that costs are Efficient

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is efficient are:

- **Is there persuasive evidence that the cost estimates are robust and efficient?**
- **Is there high quality third party assurance for the robustness of the cost estimates?**[166]

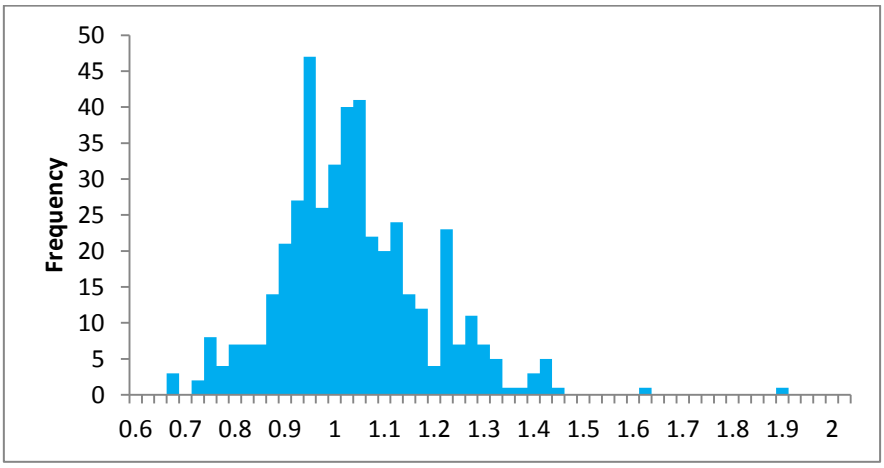
Given the method for quantifying the claim set out above, the botex forecasts used, consistent with reporting of data table WS1, already includes an adjustment for inflation, input price pressures above inflation, frontier shift and efficiency. Therefore our wage claim, in similarity to the treatment complexity and network age and materials claim, embrace efficiency assumptions consistent with our wider business plan submission.

To facilitate in the setting of salaries, we participate in the Tower's Watson Salary Survey which provides a benchmarking service of occupations by job title and job family to other companies in a similar sector. Comparison of our salary data with the Tower's Watson Salary Survey data suggests that the wages we pay are broadly speaking on par with those of other companies surveyed in the Manufacturing Distribution and Services nationally (excluding Central and Outer London). Figure

[166] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15

7-5 illustrates the distribution of wages relative to the Tower's Watson median for all of our employees.

Figure 7-5 - Histogram of Bristol Water Wages compared to the Tower's Watson median for all employees (2018)



Source: Bristol Water analysis of internal and Tower's Watson data

A study undertaken by EU skills in 2014[167], demonstrates that whilst salary levels in the utility and energy sector have exhibited a greater increase than salary levels in the general economy, increases in the water sector have comparably been the most "modest". The study conducts comparative benchmarking analysis of salaries across the gas, power, waste management, water supply services and sewage disposal services in the UK, drawing primarily on the Annual Survey of Hours and Earnings (ONS) data source supplemented by information provided by Hay Group on salary and reward information. The main conclusion reached is that the increase in mean salaries for each industry in the utility and energy sector between 2012 and 2013 was higher than that experienced across the industry as a whole (1.4%). The increase in mean salaries for the Water collection and treatment sector was 3.7% which is relatively low compared to sectors which employ a similar mix of occupations and skilled professions – for example the increase in mean salaries for waste management, gas transmission and distribution and power was 5.3%, 5.6%, 5.9% respectively and for sewage it was even higher at 9.5%.

In the body of the report, median annual wages by utility sector are benchmarked, an extract of which is provided in Table 7-6 and updated to reflect 2017/18 CPIH prices.

[167] EU skills (2014) A statistical analysis of salary levels within the energy and utility sector p. 4-5.

Table 7-6 - Mean Wage Comparison by Utility Sector, EU Skills Benchmarking and Bristol Water Salary data

Sector	Median wage 2013, EU Skills Study (£)	Median wage inflated by CPIH, 2016/17 (£)
Manufacture of gas; distribution of gaseous fuels through mains	37,576.00	39,710.13
Electric power generation, transmission and distribution	38,128.00	40,293.48
Waste collection, treatment and disposal activities; materials recovery	26,889.00	28,416.16
Water collection, treatment and supply	31,162.00	32,931.85
Sewage	30,610.00	32,348.50
All sectors in the general economy	27,017.00	28,551.43
Bristol Water FTE median	-	**30,395.23**

Source: Bristol Water analysis of EU Skills Salary Benchmarking and Bristol Water's own Salary information

Whilst median wages in the water collection, treatment and supply sector are above that for median wages in the general economy, full time equivalent (FTE) wages at Bristol Water (£30,395.23) are below that for the UK Water industry (£32,931.85). This comparison therefore provides supportive evidence that wages at Bristol Water are efficient, through an outward comparison to other sectors employing a broadly comparable mix of occupations and skills.

This therefore illustrates a wider demonstration of efficient labour costs in the water sector, inclusive of Bristol Water, compared to UK based sectors that employ a similar mix of skilled professions.

In Table 7-7 we present, using the EU Skills data (above) a comparison of our wages to the Bristol supply area median with the national position shown in the tables in section 5.4 above.

Table 7-7 - Annual and Hourly Wage Comparison, 2017/18 CPIH prices

Median Wage in UK Water Sector (£)	32,931.85	Median Hourly wage in England & Wales (£)	15.39
Bristol Water FTE median wage (£)	30,395.23	**Median Hourly wage rate in Bristol Water Supply area (£)**	12.76
Ratio	**0.92**	**Ratio**	**0.83**

Source: Bristol Water analysis of Bristol Water, EU Skills and ONS data

Our FTE median wage is below the UK water sector (0.92) and the hourly wage is below the national corresponding figure for England and Wales (0.83), which suggests efficient wage costs in the use of the ONS wage data for the potential cost adjustment claim.

7.9 Materiality Assessment

Our claim sets out the additional costs associated with paying staff higher wages, to the differential of 5.92% above those in the South West. As it is assumed Ofwat will capture the costs of wages equal to those in the South West in their cost assessment framework, the costs presented in this

claim are the additional costs associated with the wage differential, the cost estimate therefore represents a *net claim*.

Table 7-8 presents our assessment of the materiality of this claim in accordance with Ofwat's regulatory requirements for cost adjustment claims.

Table 7-8- Materiality Assessment

AMP7 Net value of claim (£m)	8.716
Business Plan 5yr Network plus Totex (£m)	378.137
Net claim as % of Network plus Totex	2.3%
Ofwat materiality threshold for Network plus	1%

Source: Bristol Water analysis

The cost adjustment claim therefore passes the materiality assessment.

7.10 Evidence assessment

This chapter has demonstrated the need for the prevailing wages in the Bristol Water supply area claim, that the claim is beyond management control and that the costs are efficient. As discussed in Section 4.2, it is not considered appropriate to provide evidence of the need for investment or that the investment represents the best option for customers as the claim seeks an adjustment to baseline Botex costs only. The claim does not relate to a capital project involving strategic options appraisal where customer protection to ensure performance improvements are delivered, therefore this is not considered herein.

Table 7-9 presents our assessment of the evidence presented in this chapter against Ofwat's requirements.

Table 7-9 - Evidence Assessment

Evidence	Assessment	Comments
Need for cost adjustment	✓	We are uncertain of Ofwat's preferred approach to accounting for wage variations in the PR19 cost assessment framework. In the likelihood that this assessment is based on a regional comparison of wages across companies, we believe this will over-look the wage premium we pay for staff in the immediate area of Bristol City compared to that of the South West more generally and therefore our claim is required to mitigate against this uncertainty.
Management control	✓	Wage determination is the complex result of labour market interactions, which we only have a small influence over in the immediate labour market.
Need for investment	N/A	The claim does not relate to an investment and therefore no cost-benefit analysis of options is required; the claim seeks an adjustment to baseline Botex costs only. We have however engaged with customers on this cost adjustment claim, see Section 2.4.3.
Best option for customers	N/A	
Robustness and efficiency of costs	✓	Benchmarking our salary data to comparable companies suggests that our offering is in line with the median. The ratio of our wages to water sector wages is below the equivalent ratio for the economy as a whole, demonstrating efficiency of employment costs. Furthermore reproduction of Ofwat's PR19 models suggest that in recent years we have embraced a step-change in our network plus costs of which these baseline costs form a part, see C5 of our business plan.
Customer Protection	N/A	Customer protection in the instance the project is cancelled is not applicable as the case is not an investment project.
Affordability	N/A	Wage costs are ongoing unavoidable costs which are present both in our historic accounts and in our cost forecasts. As the claim relates to base costs it is not associated with an explicit bill increase in so far as these are baseline costs.
Board Assurance	N/A	This claim does not relate to capital enhancement schemes for which Board assurance around the optioneering was required. The Bristol Water Board provided assurance of the cost adjustment claims and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency with this business plan submission. Section 4.1.10 provides further information on the internal and external assurance undertaken to support our final submission as was presented to our Board.

Source - Bristol Water

7.11 Conclusion

The direction and magnitude of our cost adjustment claim for Prevailing Wages in the Bristol Water supply area is dependent on the method Ofwat choses to use to account for variations in wages across the country as a driver of variations in companies costs and the geographic granularity of the information that Ofwat uses to inform this assessment. If Ofwat adopts an assessment based on a regional benchmark between Bristol Water and prevailing wages in the South West this will likely under-estimate the efficient labour costs we incur and an £8.716m upward adjustment to the Network plus price control will be required.

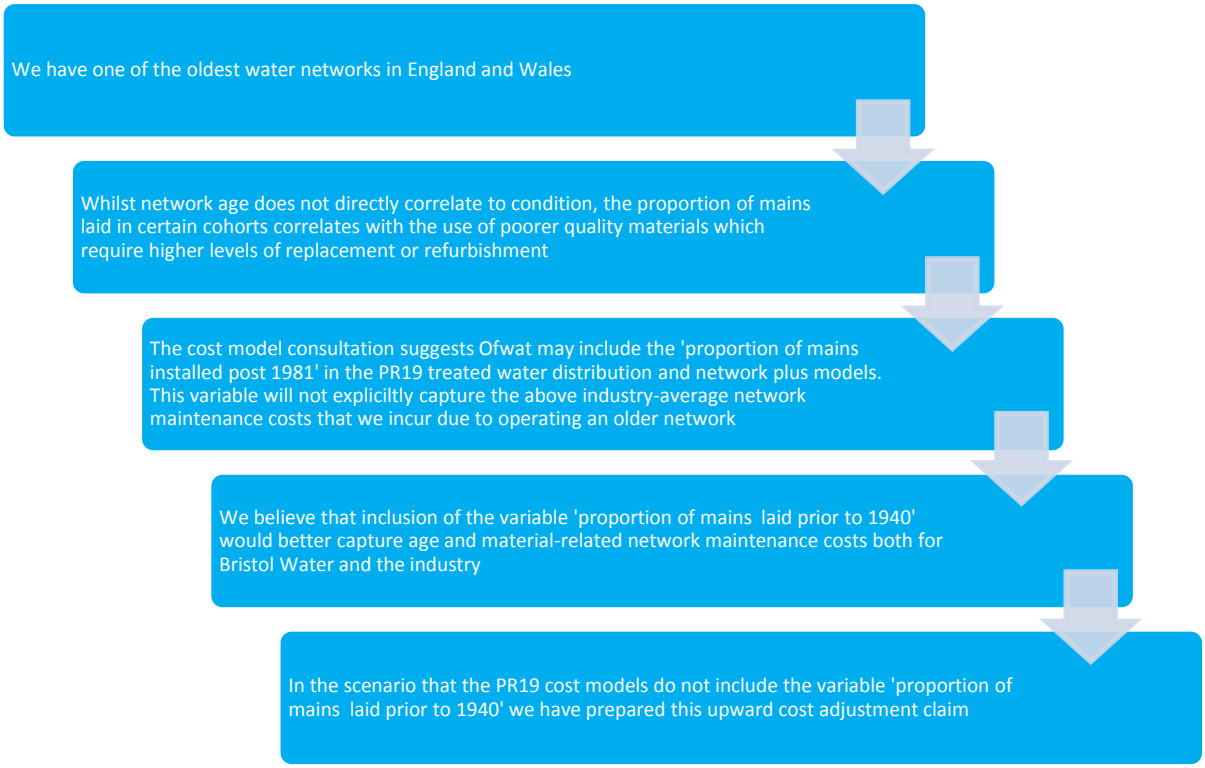
8 BRL_005- Network Age and Materials

8.1 Introduction

Our Network Age and Materials cost adjustment claim comprises of two components.

The first component relates to the age of our network. The rationale for the claim is set out in Figure 8-1.

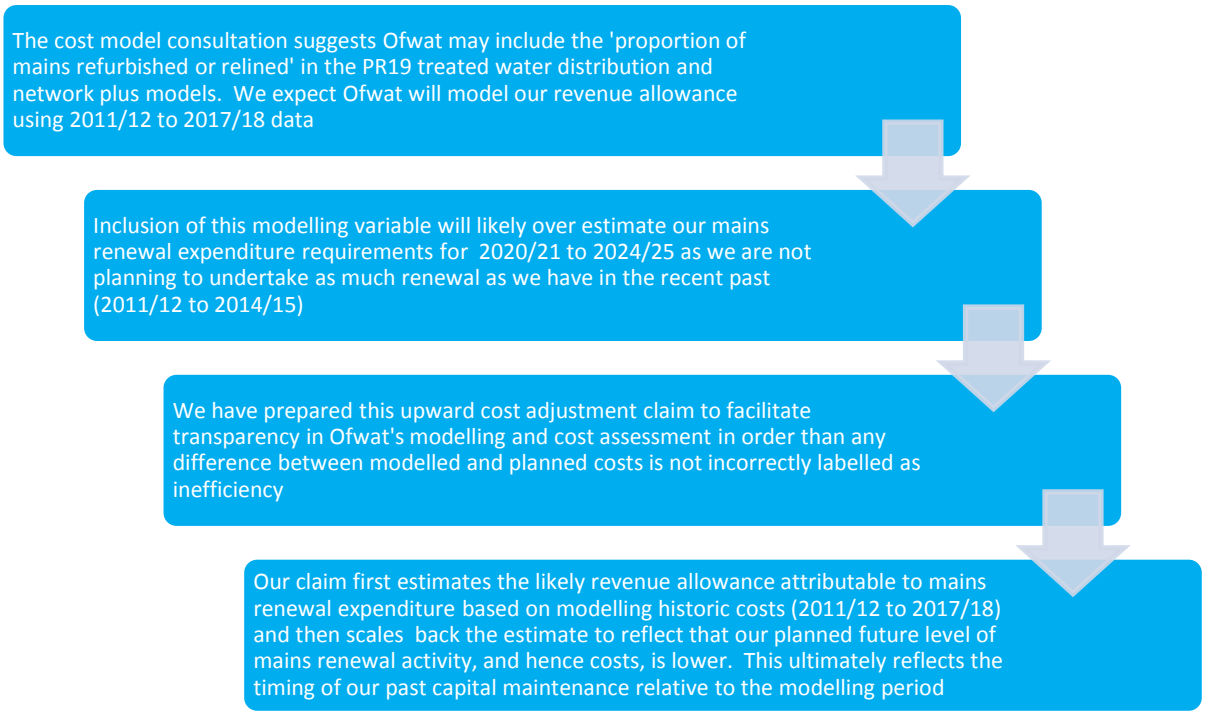
Figure 8-1 - Summary of the Network Age Component of the Claim



Source: Bristol Water

The second component relates to our historic level of mains replacement and renewal activities compared to those planned for the future, reflecting the above relationship between age and materials as a driver of activity and therefore capital maintenance costs. The rationale for the claim is set out in Figure 8-2.

Figure 8-2 - Network Renewal Component of the Claim



Source: Bristol Water

Our final submission estimate suggests that the Network Age and Materials cost adjustment claim is £12.282m (2017/18 CPIH prices). This reflects the summation of the two components of the claim. Table 8-1 provides a summary of the key details of the Network Age and Materials cost adjustment claim.

Table 8-1 - Summary of the Network Age and Materials Cost Adjustment Claim

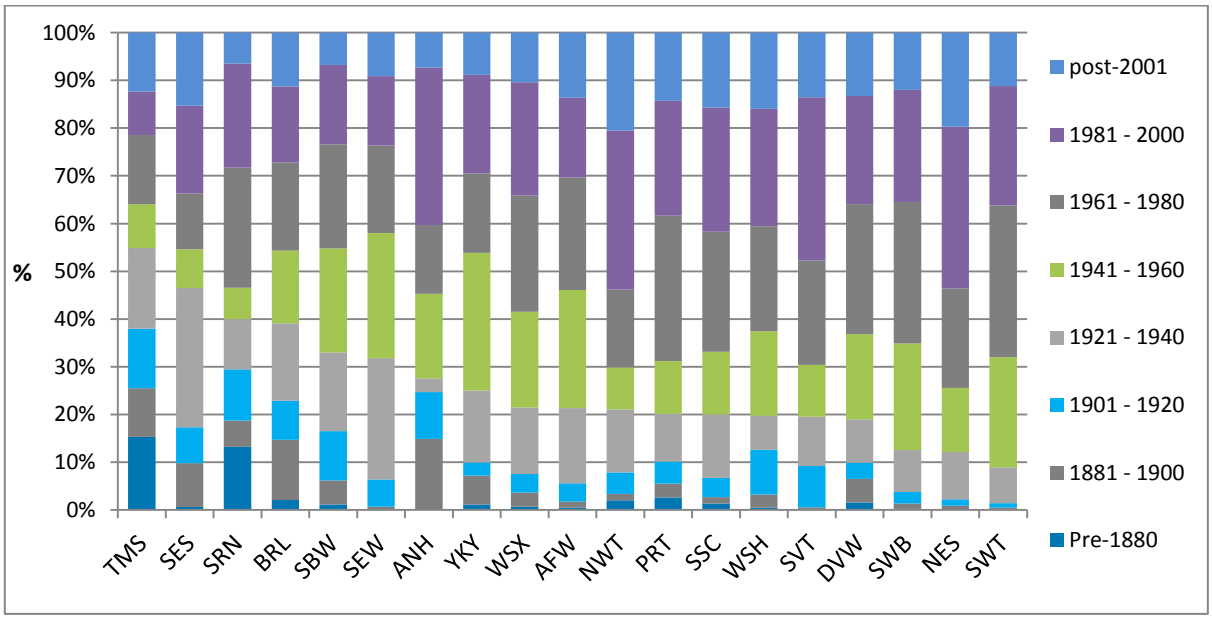
Network Age and Materials		
Claim Component	**Network Age**	**Network Materials (renewals and relining)**
Price control:	Network plus	
Type of Claim:	Regional operating circumstances	Other (atypical catch-up expenditure)
AMP7 Estimate of claim:	£5.437m	£6.845m
Expected PR19 models relevant to claim:	Treated Water Distribution Network plus Wholesale Water	
PR19 Model dependency of claim:	Claim assumes that Ofwat's models will not include the variable 'proportion of mains laid prior to 1940'	Claim assumes that Ofwat's models will not include the variable 'proportion of mains refurbished or relined'

8.2 Background Context

Developing comparative company information on mains age has been a focus for Ofwat as part of an exercise with the Cost Assessment Working Group. Further to this exercise, in 2015/16 Ofwat requested that companies' report information on the total length of mains laid or structurally refurbished by 20 year cohorts. According to this new variable and as evidenced by Figure 8-3, we have an above industry average share of mains that were either laid or structurally refurbished up to and including 1940.

Figure 8-3 - Mains age by 20year interval as a proportion of total mains laid and structurally refurbished (average 2011/12 to 2016/17)

Figure 8-3 compares companies' age of mains data. We have the fourth highest share of mains laid prior to 1940. (add numbers to qualify)



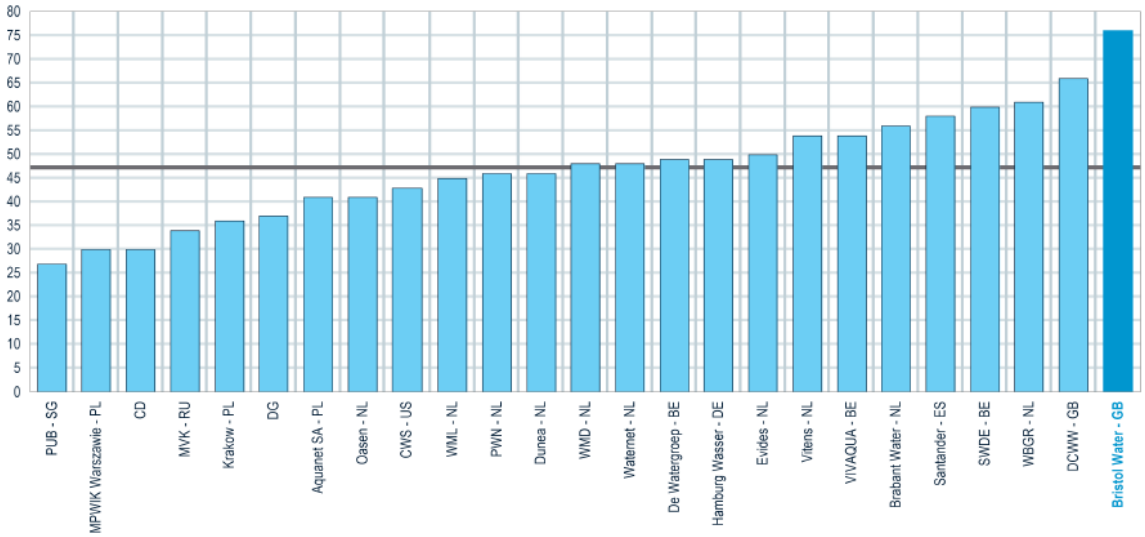
Source - Bristol Water analysis of Wholesale Cost data

Bristol Waterworks was founded in 1846 making us one of the oldest water companies with one of the oldest networks in England and Wales[168]. This conclusion was also confirmed in a European setting through a recent study[169] with the European Benchmarking Co-operation as Figure 8-4 illustrates.

[168] Thames water has origins as far back as 1600s

[169] In 2016/17 we participated in a European Benchmarking exercise led by the European Benchmarking Co-operation. Bristol Water had the oldest network when compared with 24 other Western European companies in the Standardised Average Network age index. European Benchmarking Co-operation (2017) International Benchmark 2016 Water Supply, p.33

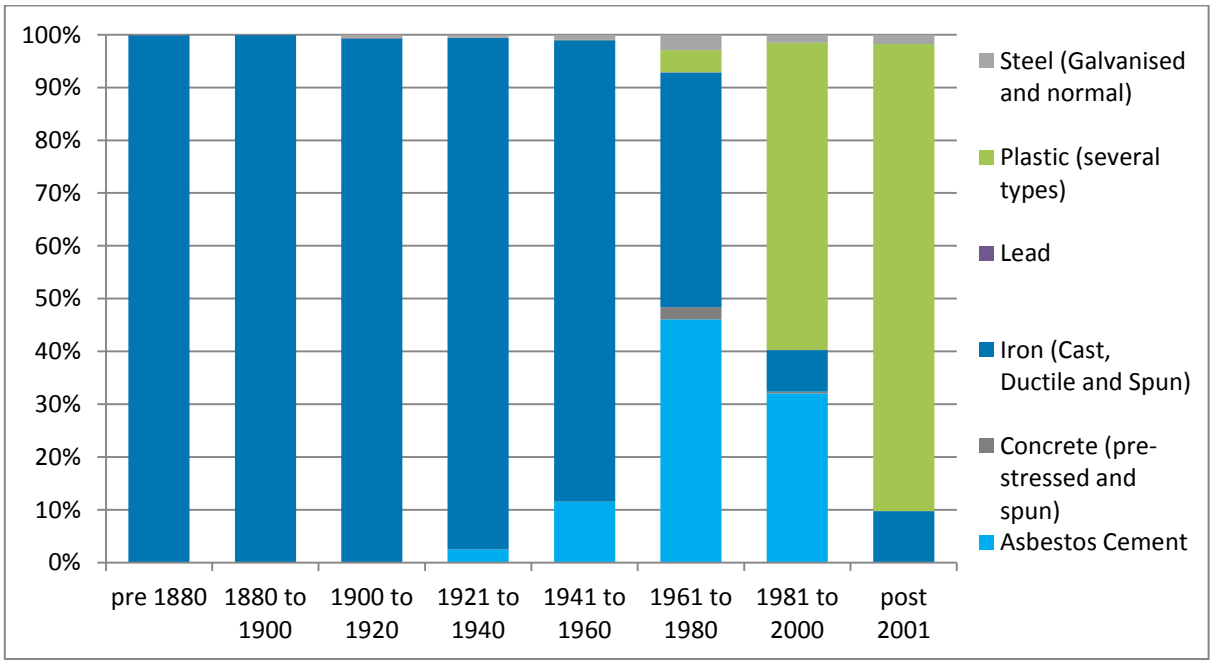
Figure 8-4 - Standardised Average Network Age Index (SNAX) for participant companies in a European Benchmarking Exercise of the Water Sector



Source: European Benchmarking Co-operation (2017)

Whilst we acknowledge that the absolute age of mains does not directly correlate with condition, the proportion of mains laid in certain time periods indicates poorer quality materials which require higher levels of replacement and refurbishment.

Figure 8-5 - Proportion of mains laid by material, by 20 year cohort - BRL



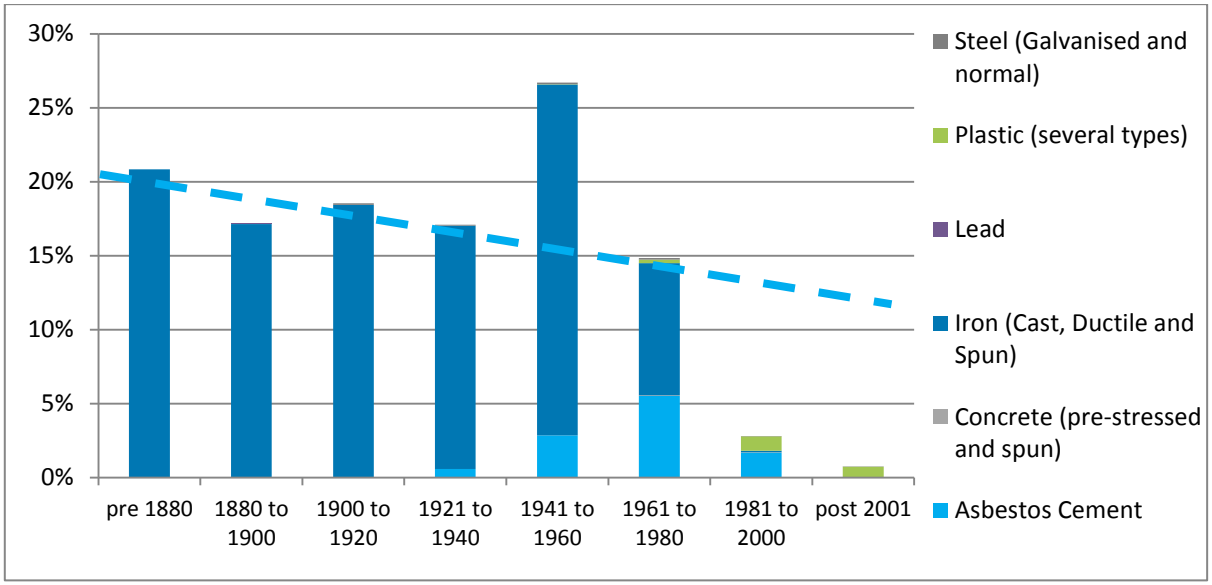
Source - Bristol Water analysis of Bristol Water data (for data where both the age laid and material type is known)

This is evidenced by Figure 8-5 which demonstrates a distinct pattern in the proportion of mains laid by material type over our history. For much of our early history iron mains, especially cast iron mains, were laid as the network developed. From the 1920s, asbestos cement was introduced and gradually reached peak use in the 1960s to 1980s. This was then followed by the introduction of

plastics in the 1960s which increasingly replacing both asbestos cement and iron as the material of choice.

Mapping of our mains materials by age of installation confirms a degree of correlation between age and materials and subsequently also performance as proxied by bursts. As Figure 8-6 demonstrates there is a clear, although by no means perfect, positive relationship between age and deterioration, with the period including the Second World War and immediate post-war period being an anomaly. This is consistent with the hypotheses that poorer quality materials were available at that time as a result of diversion of resources and need for rapid reconstruction of infrastructure.

Figure 8-6 - The proportion of pipes laid by 20 year cohort and material that have subsequently burst



Source - Bristol Water analysis of Bristol Water data (for data where both the age laid and material type is known)

Whilst this graph does not exhibit a major structural break evidencing that our mains older than the 1940s are especially more prone to deterioration, the fact that there is a clear relationship between age and deterioration, and that we have an above industry average share of mains laid and structurally refurbished prior to 1940 (Figure 8-10) suggests that a cost adjustment claim may be warranted in the absence of a mains age variable controlling for the share of mains laid prior to 1940s from Ofwat's cost assessment models. More specifically, a pre-1940s modelling variable is most appropriate given that if the war-time period is included this may over-estimate network related capital maintenance for all companies.

We note that our data presented in Figure 8-6 shows that mains laid post 1981 are significantly less liable to burst than those from older age cohorts. However, cost benchmarking work undertaken by NERA using industry data suggests that the proportion of mains laid prior to 1940 is a statically better driver of costs than the proportion of mains laid prior to 1980.

Based on an eight year sample of internal cost data we have further sought to evidence the relationship between age, performance and costs. Figure 8-7 presents total costs expended on our mains that have burst in the period 2010 to date. Figure 8-8 presents the average cost per main burst by age cohort. Both confirm a relationship that older mains drive costs, with especially the pre-1980 period reflecting the turning point.

Figure 8-7 - Total Cost of Mains Bursts by 20 year cohort (based on mains which have burst since 2010)

This shows the total cost of all works related to mains that have burst

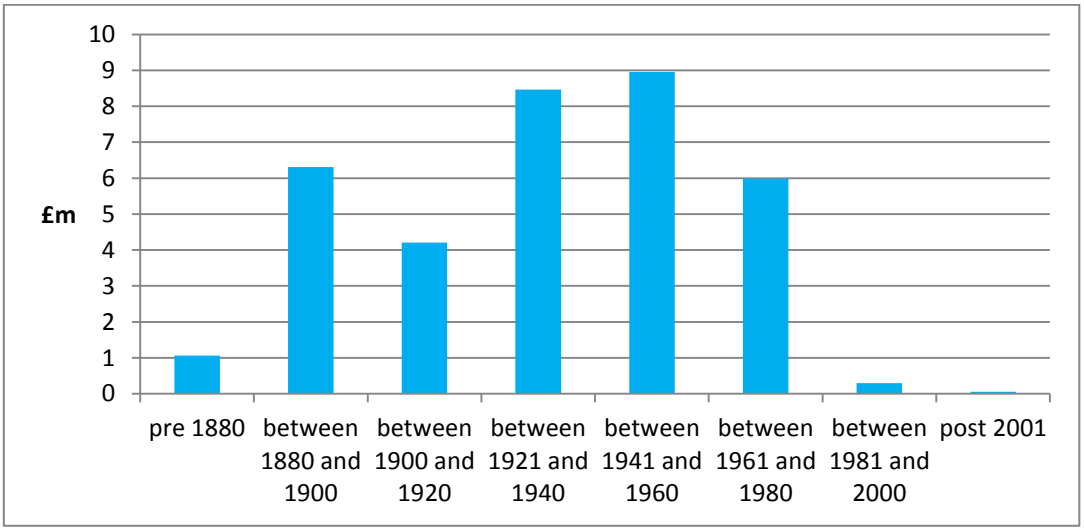
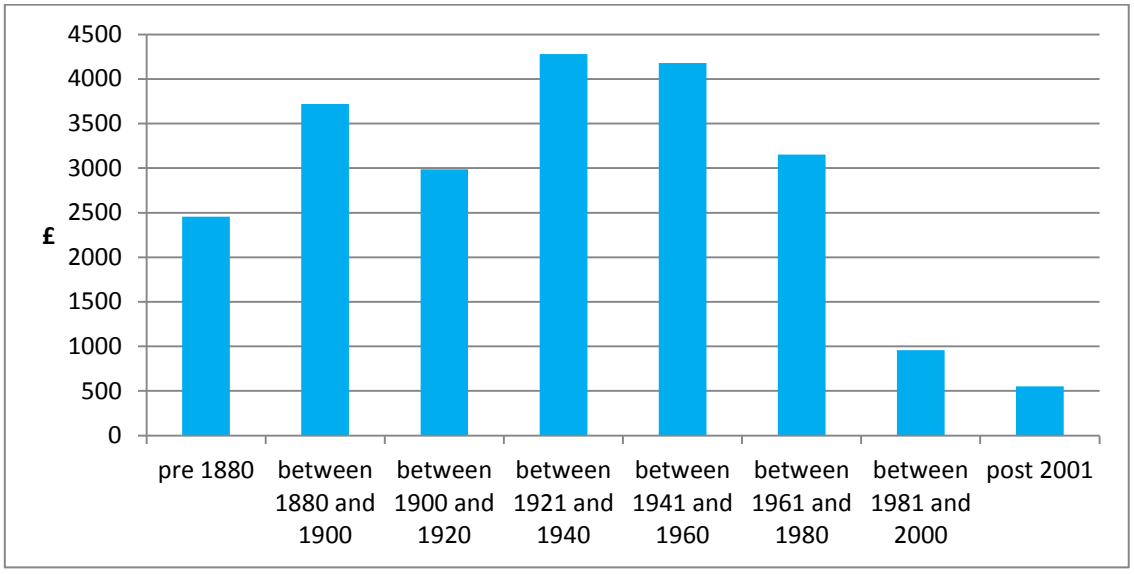


Figure 8-8 - Average cost associated with a maintenance of burst mains by 20 year cohort (based on mains which have burst since 2010)

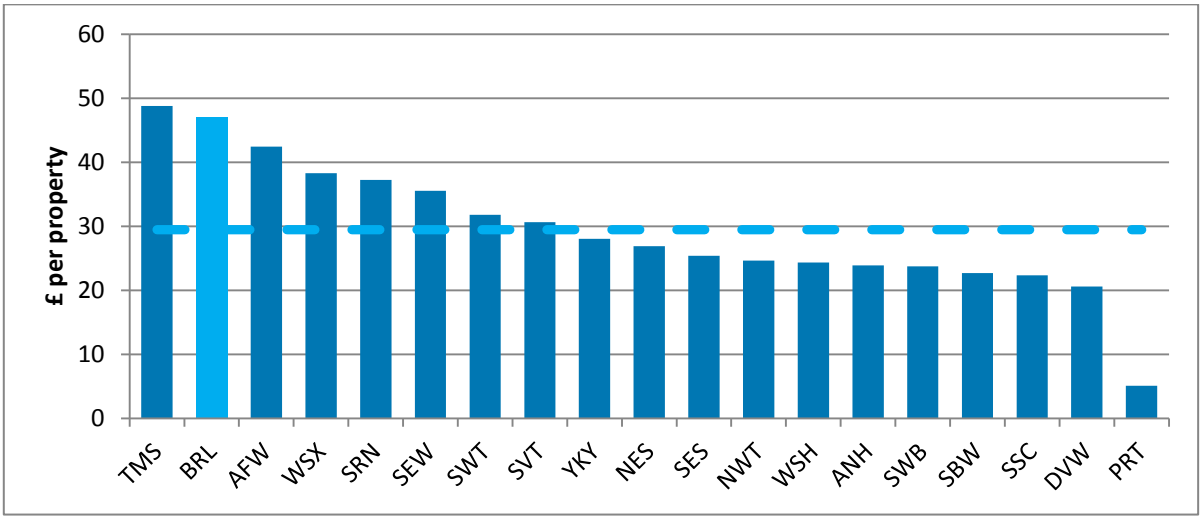


Source: Bristol Water

Overall, it is the age and to an extent the particular types of materials laid in certain periods that leads us to incur higher maintenance costs associated with mains relining, renewal and refurbishment due to natural deterioration of materials, a relationship which has been historically demonstrated in this section. Ensuring that age is appropriately modelled for in Ofwat's treated water distribution, network plus and wholesale water models is therefore important in order to fully capture this relationship between network age (the mains materials this associated with) and costs.

Such higher costs are evidenced in Figure 8-9 which illustrates that we have incurred the second highest level of Treated Water Distribution Capital Maintenance per property over the period 2011/12 to 2016/17 as evidenced in Figure 8-9.

Figure 8-9 - Treated Water Distribution Capital Maintenance per Property (average 2011/12-2016/17)



Source - Bristol Water analysis of Ofwat Cost Assessment Data, £ per property

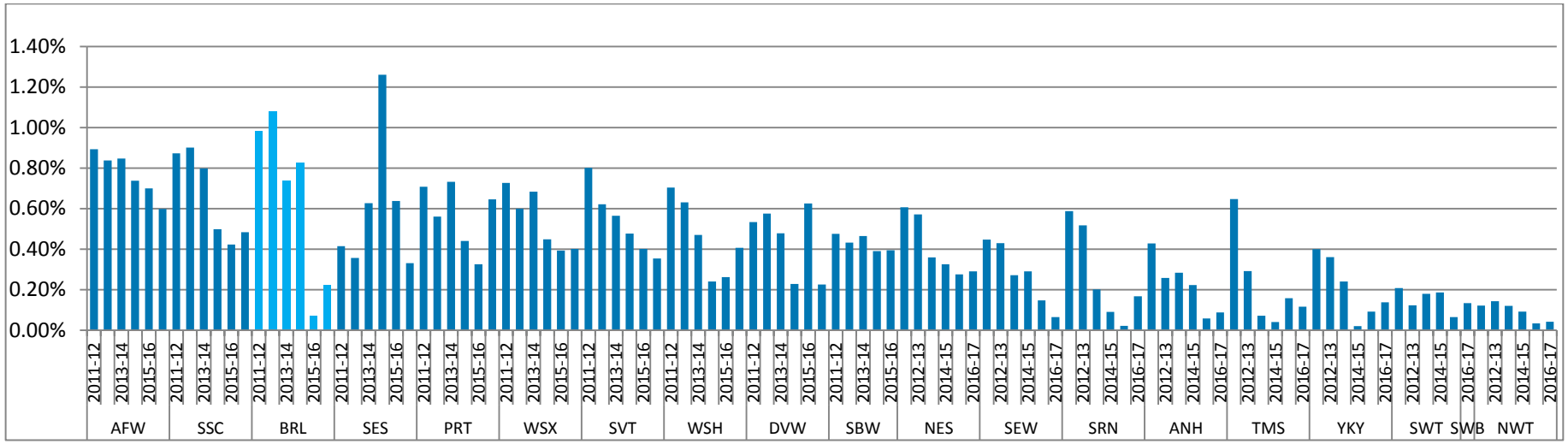
The costs presented in Figure 6-5 are based on the historic period 2011/12 to 2016/17, a period when we undertook a higher level of mains renewal and replacement compared to other companies due to age related deterioration. As a workload cost driver, mains renewal activities are not entirely beyond the control of management (as acknowledged in Section 8.5), the timings of which will therefore inevitably vary across companies[170]. During the period 2011/12 to 2014/15 we undertook an atypical, above-average, level of renewal activity in order to maintain the condition of our network. This above-average level of activity and associated costs will likely be included in Ofwat's PR19 cost models, which we expect will focus on the period 2011/12 to 2017/18.

Figure 6-6 sets out our above industry average renewal rates for the period 2011/12 to 2016/17, having undertaken the third highest level of mains renewal rates. Whilst it could be argued that comparison of renewal rates across companies, given the different timings that companies chose to invest, should be based on a longer time series, what is important here are the costs and activities that Ofwat may choose to include in their PR19 cost models. We expect Ofwat to base their modelling on the period 2011/12 to 2017/18 which will include this atypical peak in our mains renewal activities and costs that we are not planning to replicate in AMP7.

It is this particular observation of our above industry-average mains renewal rate in the period 2011/12 to 2014/15, as evidenced in Figure 8-10, compared to that required for AMP7, that informs the need to scale back any implied modelling allowance for mains renewal and relining activities.

[170] This reflects business priorities and the timings of investments over and across AMPs since privatisation

Figure 8-10 - Mains renewal rate as percentage of total mains (2011/12-2016/17)



Source - Bristol Water analysis of Ofwat Wholesale Cost data

Bristol Water has averaged an annual rate of mains replacement of 0.65%, compared to the industry average of 0.42% per annum, just behind South Staffordshire and Cambridge (0.66%) and further ahead, also Affinity (0.77%).

In summary therefore, whilst the absolute age of mains is an important driver of mains renewal and relining activities and therefore costs, so too is the material of the pipes and as Figure 8-5 suggests the two drivers are correlated. Analysis with respect to the age of mains and mains relining and renewal variables will form the backbone of this cost adjustment case presented in the following sections.

8.3 Regulatory Background

We proposed a special cost factor related to the age of mains assets in our re-submitted PR14 business plan in June 2014. This proposal was not allowed by Ofwat, due to issues with the availability and quality of data. Analysis undertaken suggested that *"network age is not a reliable indicator of asset condition, in that burst rates appear largely uncorrelated with network age."*[171]

During our PR14 re-determination, the CMA developed its own econometric models to inform it's assessment of our cost adjustment claims. For models that included a mains age variable, the CMA observed that this increased our modelled Botex by between £10-£20m dependent on the precise model specification[172]. However, both the CMA and Ofwat had concerns regarding data quality of the mains age variable, in particular because there appeared to be no industry level data on the age of mains that was up to date and reliable, and of the measures that were available, for example the *average age of mains variable,* they had a number of questionable assumptions which cautioned against their use. In light of this, the CMA therefore considered it appropriate to make a cost adjustment claim of £8.64m to us to reflect mains renewal activities, in the absence of robustly being able to account for mains age in their models.

It is important to acknowledge data quality improvements since the assessments made by Ofwat and the CMA at PR14: up-to-date and comparable data on mains age is now available and reported by 20 year cohort which provides a more granular assessment than the *average age of mains* variable considered, although ultimately overlooked, at PR14. Collation of this data allows for greater analysis of the relationship between age and cost, which could be captured in the PR19 cost assessment models.

Many of Ofwat's and CEPA's Treated water distribution, Network plus and Wholesale Water models published in the recent cost model consultation include the proportion of mains installed post 1981 in order to capture the relationship that these *new mains* should require less maintenance. The modelling coefficients for this variable are typically negative in Ofwat's models, confirming the hypothesised direction of this relationship to be correct in those specific model specifications. It is important to note that inclusion of this variable will likely reduce the modelled costs for companies operating on younger networks and will therefore inversely make some account for increased costs associated with companies, including Bristol Water, that operate older networks. However, a more direct way to account for age-related deterioration and maintenance costs is to consider age variables of older cohorts more explicitly in the cost models. CEPA explicitly set out in their report of the relationship between age and maintenance costs, that "as the network ages the costs of the company are expected to increase"[173].

Many of Ofwat's and CEPA's Treated water distribution, Network plus and Wholesale Water models also feature the length of mains refurbished[174] or relined, although few models include both network related explanatory variables. In CEPA's report it is acknowledged that there is a degree of endogeneity associated with the inclusion of such activity based cost-drivers. We refer to this further in Section 8.5 on management control. CEPA also set out that where Ofwat does choose to include variables such as the length of mains relined and renewed that assurance is also provided that the estimated volume of activity for these variables is efficient[175]. We had already considered

[171] Ofwat (2014) Final Determination p.79
[172] 2013.14 outturn prices
[173] CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat, p. 23
[174] We have interpreted this to mean 'renewed' as per RAG 4.07
[175] CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat, p. 23

this at early submission and our analysis has been updated for final submission in Section 8.7.2, with a specific adjustment to reflect that our AMP5 renewal activity was atypically but not inefficiently high compared to the volume of mains renewal we are proposing for AMP7. If this variable is included in the final PR19 models, it will be directly relevant to this claim.

Statistical significance for both variables is strongest in the treated water distribution models, and this no doubt reflects a crowding out-effect when the same variables are included in the more aggregate network+ and wholesale water botex models.

8.4 Need for the Cost Adjustment

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is needed are:

- **Is there persuasive evidence that the cost claim is not included (or, if the models are not known, would be unlikely to be included) in our modelled baseline?**
- **Is it clear the allowances would, in the round, be insufficient to accommodate special factors without a claim?** [176]

If Ofwat chooses to include the variable 'proportion of mains laid or refurbished post 1981' in their models this will likely reduce the modelled costs for companies operating younger networks. If this is the only age related variable included in the PR19 models, this approach however will take no account of older mains as a driver of companies' network maintenance costs and therefore appears to present an unbalanced view of age-driven network maintenance costs. In practice, every company will have a proportion of mains considered old and young and therefore it is important that both ages (old and young) of mains are included in the models in order to determine the net position of network age on costs given the assumptions that the:

- Proportion of young mains drives maintenance costs down and therefore should carry a negative coefficient; and
- Proportion of older mains drives maintenance costs up and therefore should carry a positive coefficient.

Therefore, whilst inclusion of the variable 'proportion of mains laid or refurbished post 1981' will account for lower costs incurred by companies for the proportion of 'young' mains that they operate, it will not make any allowance for the costs that companies incur for the proportion of old mains they operate. This will be particularly disproportionate in terms of the modelled revenues for companies, including ourselves, with a particularly high proportion of older mains. Indeed this assessment is supported by CEPA who commented with regard to the relationship between age and maintenance costs, that "*as the network ages the costs of the company are expected to increase*"[177].

As set out in Section 8.2 the impact of older mains on costs is in part driven by the association of mains age with materials laid in certain periods, hence burst rates and therefore maintenance costs.

Whilst Figure 8-6, Figure 8-7 and Figure 8-8 could imply from our perspective that the 'proportion of mains laid prior to 1980' is the most appropriate driver of costs (based on our actual costs), from an industry perspective we believe that inclusion of the variable 'proportion of mains laid prior to 1940' is most appropriate for inclusion in Ofwat's PR19 models. Therefore we have prepared this case in

[176] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[177] CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat,, p. 23

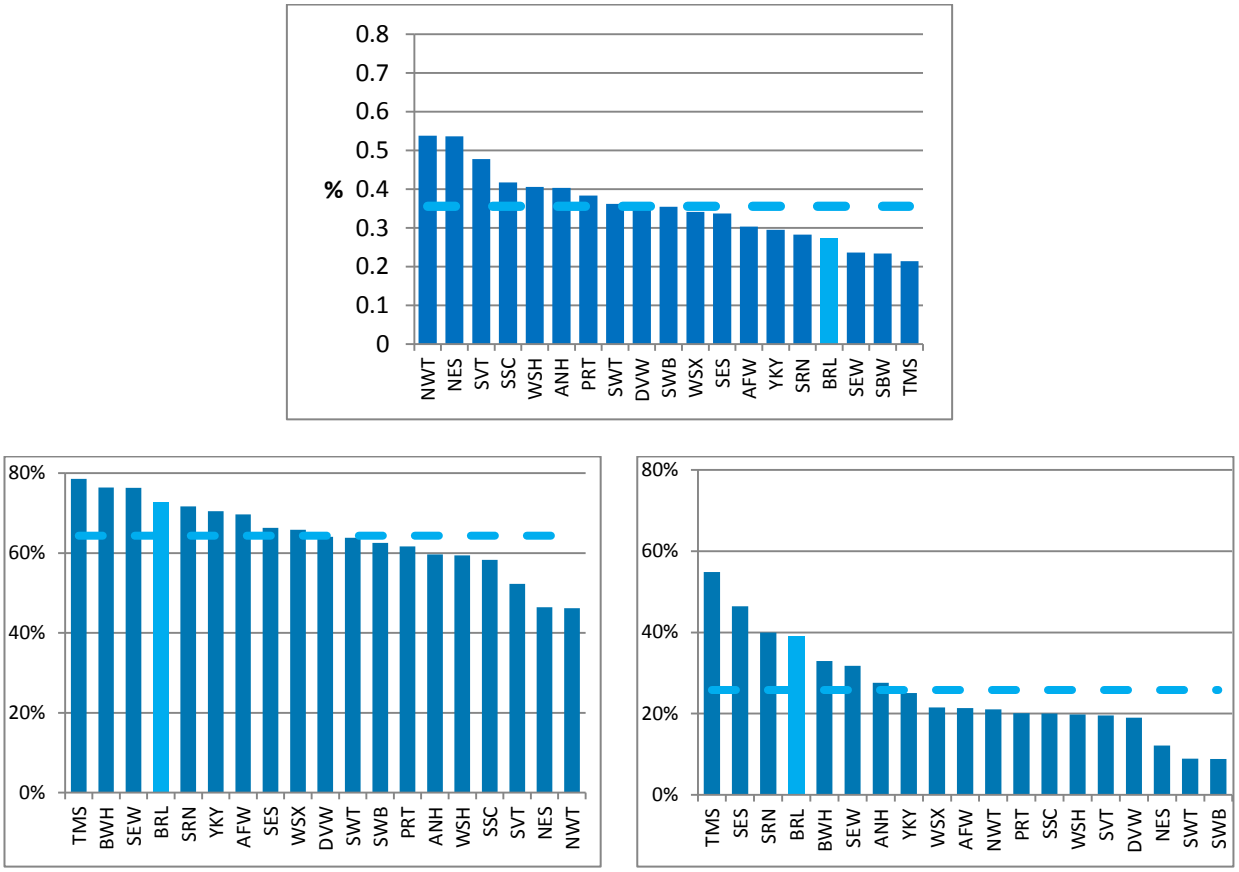
the modelling scenario that the variable 'proportion of mains laid prior to 1940' is not included in Ofwat's PR19 models.

We believe this cost adjustment claim will be required in order to explain age-driven maintenance costs that will not be explicitly picked up by the variable 'proportion of mains laid and structurally refurbished post 1981' and that the variable 'proportion of mains laid and structurally refurbished prior to 1940' is most appropriate for this purpose because of the large variance present in the reporting of this data across companies.

To justify this point Figure 8-11 provides a comparison of the proportion of mains laid and structurally refurbished post 1981, prior to 1980 and prior to 1940 across companies. Whilst Figure 8-6, Figure 8-7 and Figure 8-8 sets out that the 'proportion of mains laid prior to 1980' is on an actual cost and operational basis, the most appropriate driver of our costs, from an industry perspective inclusion of the variable 'proportion of mains laid prior to 1940' is most appropriate as this driver exhibits a high variation across companies as an explanatory variable of variations in costs across companies.

Figure 8-11 - Proportion of Mains laid post 1980 (top), prior to 1980 (bottom left) and prior to 1940 (bottom right)

Variable variance: 'proportion of mains laid post 1980' (0.008); 'proportion of mains laid prior 1980' (0.008); and 'proportion of mains laid prior 1940' (0.01)



Source - Bristol Water analysis of Ofwat's Wholesale Cost data

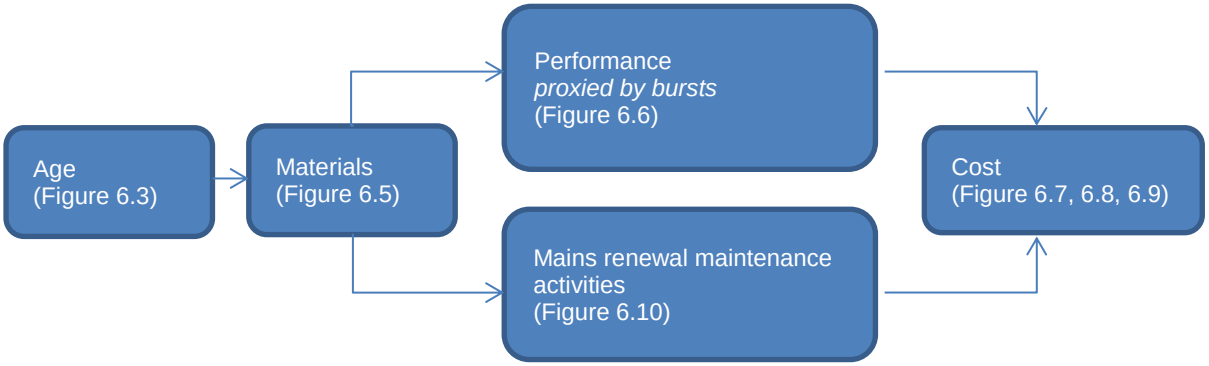
It is clear that there is greater variation in the data for the 'older' mains age variable indicating that the variable will better explain differences in companies costs compared to the 'younger' variable and this justification is supported by our econometric support partners, NERA[178].

On this basis we have opted to develop a mains age component of the case on the basis of the 'proportion of mains laid prior to 1940' variable. This presents a further advantage in that it removes the impact of the post second world war period in activity and costs that may skew the age-maintenance relationship in the modelling for all companies. In the instance that the variable 'proportion of mains laid prior to 1940' is not included in Ofwat's models, we have prepared this cost adjustment claim to account for the above-average industry costs that we incur in operating a network of above industry-average age.

The second component of the Network Age and Materials case relates to mains renewal. The need for the two components of the claim are linked as per the simple flow diagram set out in Figure 8-12.

[178] This view is supported by NERA. Furthermore, NERA also identified that "*the share of mains laid pre-1940 is the age-of-mains driver that leads to the best model outcomes*" for the industry as a whole in separate benchmarking work undertaken for Bristol Water. NERA (2017) Comparative Benchmarking and Special Cost Factor Assessment, p.36 and 84

Figure 8-12- Summary of Need for the Network Age and Materials cost adjustment case



Source: Bristol Water

The cost model consultation suggests Ofwat may include the 'proportion of mains refurbished or relined' in the PR19 treated water distribution and network plus models.

If this variable is included in the models we believe the allowance in the round will over-estimate our mains renewal expenditure requirements for 2020/21 to 2024/25. This is because we are not planning to undertake as much renewal as we have in the recent past (2011/12 to 2017/18) which can be considered a period of atypical activity and expenditure for which customers should not be expected to pay for.

The need for this component of the claim therefore stems from the need to justify that the likely difference between Ofwat's PR19 modelled costs and our business plan costs is not due to inefficiency but rather a change in the level of efficient activity and costs. The overall value of the claim that we have prepared remains positive (to reflect that we are still intending to undertake mains renewal in AMP7), it is just lower than it otherwise might be based on a straight forward modelling allowance. Our claim first estimates the likely revenue allowance attributable to mains renewal expenditure based on modelling historic costs (2011/12 to 2017/18) and then scales back the estimate to reflect that our planned future level of mains renewal activity and hence costs are lower. The need for the claim ultimately reflects the timing of capital maintenance relative to the modelling period.

To fully account for the relationship between network age and network-related capital maintenance it is important to understand the intermediate driver of such costs, namely mains renewal and relining activities. As Figure 8-10 above illustrates, we undertook an atypical level of mains renewal and relining activities in the period 2011/12 to 2014/15. As expenditure in the these years is expected to be used in the cost assessment models, the implied modelled allowance may assume a level of inefficiency due to future mains renewal requirements being lower than that undertaken in the historical modelling period. We therefore consider there to be a need for a second component to the Network claim which captures this planned level of age-related base activity being lower than previous years.

Again, the relevance of this component of the claim is dependent on the final specification of Ofwat's models.

We have set out in Section 8.2 that the relationship between network age and network-related capital maintenance is a valid one, through examination of the inter-related effect of mains age and material on observed bursts and hence our costs.

8.5 Management Control

Ofwat's evidence requirements for demonstrating that our cost adjustment claim is beyond management control are:

- **Is the cost driven by factors beyond management control?**
- **Is there persuasive evidence that the company has taken all reasonable steps to control the cost?**[179]

The age and material composition of our network is to some extent within management control - it reflects managerial decisions over the company's history regarding the timing and type of network investment undertaken, in terms of materials used and the balance of maintenance vs. enhancement expenditure. However it can be argued that the installation of mains and the materials chosen were the results of decisions taken upon the best available information at the time, the legacy effects of which are to an extent beyond the control of current management.

Furthermore whilst it would be theoretically possible for us to carry out an increased level of mains renewal in order to improve the condition of the network, to do so would require a significant increase in expenditure beyond that which customers have expressed a willingness to pay for, therefore it is not only the extent to which management have control over the costs that drives this claim but also customers preferences on investments compared to maintenance and the associated bill impacts. We explore in this claim the atypical extra cost during AMP5 that does not form part of our future plans, but will be reflected in expenditure included in the 2011/12 to 2017/18 cost modelling. The atypical value of this "catch-up" has been used to reduce the modelling claim to a level which is beyond management control.

This approach fully embraces best practice as recommended to Ofwat by their consultants, CEPA, in the recent cost model consultation[180]. CEPA have set out in their report that activities such as the length of mains refurbished and renewed as a driver of costs are to some extent beyond management control. We agree with this logic as explained above and believe that this does not invalidate the need for a cost adjustment claim in the same respect that this does not invalidate the inclusion of an activity based cost driver in the models where companies can reasonably and robustly demonstrate that the estimated volume of activity and associated costs are efficient.

Whilst the above sets out that mains age and materials is neither strictly within or beyond management control, what is beyond management control is the random failure of mains. We have sought to control for the costs associated with age and materials driven network maintenance costs through adopting mains information technology developed by Minerva. This monitoring technology provides information that enables the identification of critical lengths of mains which has facilitated increased proactive as opposed to reactive mains replacement as a means of driving efficient costs both now and in the future.

We set out in Section 8.8 our demonstration of efficiency and in Section 8.7.2 our approach to reducing our estimated claim for mains renewal to reflect that our AMP5 renewal activity was atypically but not inefficiently high compared to the volume of mains renewal we are proposing for AMP7.

[179] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15
[180] CEPA (2018) PR19 Econometric Benchmarking Models for Ofwat, p. 23

8.6 What the claim means for our Customers

The age and condition of the network affects the reliability and quality of our service and more directly our leakage performance, all key customer priorities which set precedence for this claim from a customer perspective.

Figure 8-13 - Customer Priorities

Source - Bristol Water A5: Annual Customer Survey

As discussed in Section 4.1.8, we undertook specific customer research regarding cost adjustment claims in January 2018. Of the customers we engaged with in the deliberative research, a majority of customers considered that the age of the network is within management control. Mixed views were received on whether or not this claim should be allowed by Ofwat in their evaluation of cost adjustment claims, with the balance slightly favouring that it should be allowed.

8.7 Quantification of the Cost Adjustment

We have chosen to develop our econometric estimates for this cost adjustment claim against a suite of PR19-style models developed by Oxera for a group of water companies. The models developed represent an independent and un-biased view of what Ofwat's PR19 models could look like and were developed taking on board the collective input from companies. This has led to the development of models that present a balanced view of industry, not just company specific, cost drivers and therefore provides a good basis on which to calculate cost adjustment claims (representing company specific cost drivers). As a result of this study, Oxera developed 11 Network plus botex models and 8 Aggregate botex models. The specification of the models developed by Oxera which are relevant to this case (Network plus and Aggregate botex models) are presented in Table 8-2 and Table 8-3. The models have been developed on the six year wholesale cost data set covering the years 2011/12 to 2016/17.

Table 8-2 Additional Variables included in Oxera's Network plus botex models

Oxera Network plus Botex Models Dependent variable		1 Log Aggregate	2 Log cost / properties	3 Log Aggregate	4 Log Aggregate	5 Log Aggregate	6 Log Aggregate	7 Log Aggregate	8 Log Aggregate	9 Log Aggregate	10 Log Aggregate	11 Log Aggregate	
Cost Drivers	Connected properties (log)	✓		✓	✓	✓	✓	✓	✓				
	Population (log)									✓			
	Distribution input (log)										✓		
	Water delivered (log)											✓	
	Proportion of water treated at level 3 treatment plants	✓	✓	✓	✓				✓	✓	✓	✓	
	Proportion of water treated at level 2 treatment plants					✓							
	Average pumping head, Network plus (log)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Proportion of mains laid before 1980	✓	✓	✓	✓	✓	✓	✓					
	Properties over mains (log)			✓					✓				
	Proportion of distribution input from boreholes						✓						
	Proportion of surface water treated							✓					
	Mains/connected properties (log)								✓				
	2015 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	2016 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
	Constant	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Additional Drivers for Network Age Quantification	Proportion of mains laid before 1940	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	**Average £m**
	NERA Econometric valuation estimate £m 2016/17 prices	0.26	0.28	0.65	0.58	0.10	0.79	1.57	2.60	0.96	1.07	1.26	**0.92**
Additional Drivers for Mains Renewal Quantification	Proportion of mains relined and renewed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	**Average £m**
	NERA Econometric valuation estimate £m 2016/17 prices	3.13	4.39	3.58	3.73	3.72	2.59	3.82	2.34	1.73	1.70	1.52	**2.93**

Source: Bristol Water summary of NERA's analysis

Oxera developed 11 Network plus models for the study collectively commissioned by a group of water companies. To provide an estimate of the Network Age component of the claim for Bristol Water, NERA have added the variable 'proportion of mains laid prior to 1940' to the Oxera Network plus models. The average implied Network age cost adjustment claim against the Network plus models is £0.92m (2016/17 prices). To provide an estimate of the Network Renewal component of the claim for Bristol Water, NERA have added the variable 'proportion of mains relined and renewed' to the Oxera Network plus models. The average implied Network Renewal cost adjustment claim against the Network plus models is £2.93m (2016/17 prices).

Table 8-3 Additional Variables included in Oxera's Aggregate botex models

Oxera Aggregate Botex Models		1	2	3	4	5	6	7	8	
Dependent variable		Log Aggregate	Log cost / properties	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	Log Aggregate	
Cost Drivers	Connected properties (log)	✓	·	✓	✓				✓	
	Population (log)					✓				
	Distribution input (log)						✓			
	Water delivered (log)							✓		
	Proportion of water treated at level 3 treatment plants	✓	✓	✓	✓	✓	✓	✓		
	Proportion of water treated at level 2 treatment plants								✓	
	Average pumping head (log)	✓	✓	✓	✓	✓	✓	✓	✓	
	Proportion of mains laid before 1980	✓	✓	✓	✓	✓		✓		
	Raw water mains and conveyors/DI (log)	✓	✓			✓	✓	✓	✓	
	Number of sources over distribution input (log)			✓						
	Proportion of distribution input from boreholes				✓					
	2015 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	
	2016 year dummy	✓	✓	✓	✓	✓	✓	✓	✓	
	Constant	✓	✓	✓	✓	✓	✓	✓	✓	
Additional Drivers for Network Age Quantification	Proportion of mains laid before 1940	✓	✓	✓	✓	✓	✓	✓	✓	**Average £m**
	NERA Econometric valuation estimate £m 2016/17 prices	**0.74**	**0.98**	**0.14**	**0.27**	**0.60**	**2.18**	**0.99**	**1.34**	**0.91**
Additional Drivers for Mains Renewal Quantification	Proportion of mains relined and renewed	✓	✓	✓	✓	✓	✓	✓	✓	**Average £m**
	NERA Econometric valuation estimate £m 2016/17 prices	**4.61**	**6.06**	**3.24**	**3.37**	**3.94**	**2.55**	**3.43**	**3.86**	**3.88**

Source: Bristol Water summary of NERA's analysis

Oxera developed 8 Aggregate botex models for the study collectively commissioned by a group of water companies. To provide an estimate of the Network Age component of the claim for Bristol Water, NERA have added the variable 'proportion of mains laid prior to 1940' to the Oxera Aggregate botex models. The average implied Network age cost adjustment claim against the Aggregate botex models is £0.91m (2016/17 prices). To provide an estimate of the Network Renewal component of the claim for Bristol Water, NERA have added the variable 'proportion of mains relined and renewed' to the Oxera Aggregate botex models. The average implied Network Renewal cost adjustment claim against the Aggregate botex models is £3.88m (2016/17 prices)

As set out in Section 4.1.7, in order to develop the cost adjustment claim estimates we have worked with NERA. NERA used the model specifications developed by Oxera for a group of water companies and then sought to calculate the change in modelled costs when specific additional cost drivers are added to the models. These additional cost drivers sought to capture each component of the Network Age and Materials case:

- **Network Age** – the change in modelled costs was calculated when the variable 'proportion of mains laid prior to 1940' was added to Oxera's Network plus and Aggregate botex models[181]; and
- **Network Renewal** – the change in modelled costs was calculated when the variable 'proportion of mains renewed and relined' was added to Oxera's Network plus and Aggregate botex models.

Table 8-2 and Table 8-3 present the additional variables added by NERA to the Oxera models in order to develop an estimate of each respective component of the Network claim. An estimate has been provided for each model developed by Oxera for each year of six years of data modelled (2011/12 to 2016/17). The values presented in Table 8-2 and Table 8-3 represent the average implied cost adjustment claim for each model specification, with an overall average then calculated to summarise the 11 Network plus models and the 8 Aggregate botex models respectively.

We have not revised these estimates against Ofwat's models published in the cost model consultation as we do not believe this is a proportionate approach given that the PR19 final models will inevitably differ to those published in the consultation and the Oxera models we have used to inform our cost adjustment claim estimates.

The estimates for each component of the claim are discussed in turn in more detail below.

[181] This particular network age variable was selected because NERA's Monte Carlo modelling to inform cost model selection in another part of their work for Bristol Water was identified as contributing to good modelling outcomes for the industry as a whole. NERA (2017) Comparative Benchmarking and Special Cost Factor Assessment, p.84

8.7.1 The general age of Bristol Water's distribution network

Oxera developed 11 Network plus models and 8 Aggregate botex models. Of the 11 network plus models, 8 control for the share of mains laid prior to 1980 as do 6 of the 8 Aggregate Botex models.

As we set out in Section 8.4 we believe it appropriate to calculate our mains age cost adjustment claim based on the modelling variable 'proportion of mains laid prior to 1940'. As the Oxera models already control for the 'proportion of mains laid prior to 1980' and there is inevitably a degree of correlation between the two drivers of costs[182], we believe that the estimate presented for this component of the claim is conservative (an under-estimate). This is because the overall purpose of econometric modelling seeks to identify the direction and magnitude of relationships between variables and costs so that statements such as "a one percent increase in variable X leads to a Y percentage increase in total costs"[183]. The inclusion of variables that therefore have some overlap means the strength of the relationship (in terms of magnitude) between each respective variable and total cost is less due to the presence of the other. This means the increase in cost solely attributable to the age variable X is less due to the inclusion of an age variable Z in the models also, as an example. Therefore our approach to including the variable 'proportion of mains laid prior to 1940', in a model which already controls for 'proportion of mains laid prior to 1980' suggests that the value of this component of the cost adjustment claim is an under-estimate. We consider this approach valid, as we are only using it as a means for calculating a cost adjustment claim and not recommending it as an actual model specification[184]. Table 8-4 summarises the average implied cost adjustment estimate for the Network Age component of the claim, drawing from the Network plus botex model estimates set out in Table 8-2 and the Aggregate botex model estimates set out in Table 8-3.

The average implied cost adjustment claim is £0.913m in 2016/17 prices.

Table 8-4 - NERA econometric estimate of the Network Age cost adjustment claim

Network Age Component of the Cost Adjustment Claim	Average £m per annum
Valuation estimate from Network+ models, 2016/17 prices	0.920
Valuation estimate from Aggregate models, 2016/17 prices	0.905
Average valuation estimate, 2016/17 prices	**0.913**

Source: Summary of NERA analysis

The claim as set out above, however needs to take account of inflation and input price pressures above inflation specific to our cost base across the business planning period (2020/21 to 2024/25). The table below sets out these adjustments to derive our estimate for the Network Age component of the cost adjustment claim.

[182] The variable 'proportion of mains laid prior to 1940' is part of 'proportion of mains laid prior to 1980' in terms of a literal assessment of the respective time-series
[183] Example based on a log-log model specification being used
[184] In any case, calculating the cost adjustment claim through including the variable 'proportion of mains laid prior to 1940' in a model with no age variable would likely result in a higher implied cost adjustment claim than the method we have adopted.

Table 8-5 - Network age cost adjustment claim, forecast assumptions 2020/21 to 2024/25

Financial Year	Historic Outturn	AMP6 forecast, outturn	2020/21 to 2024/25 Forecast	
			Inflation adjustment, re-priced to reporting requirements[185]	Adjustment for RPEs above CPIH
	£m, nominal		£m, 17/18 CPIH prices	
2011/12	0.848			
2012/13	0.868			
2013/14	0.886			
2014/15	0.896			
2015/16	0.901			
2016/17	0.913			
2017/18	0.937			
2018/19		0.957		
2019/20		0.975		
2020/21			1.035	1.045
2021/22			1.056	1.065
2022/23			1.077	1.087
2023/24			1.099	1.109
2024/25			1.121	1.131
Claim value £m				**5.437**

Source: Bristol Water analysis

Capital maintenance costs related to the age (and materials) of the network are expected to stay the same over the period 2020/21 to 2024/25. As set out in Table 8-5 this therefore leads to a cost adjustment claim for the AMP of £5.437m (2017/18 CPIH prices).

8.7.2 Mains renewal and relining

Oxera developed 11 Network plus models and 8 Aggregate botex models. As the Oxera model specifications in Table 6-7 and Table 6-8 set out, none of them account for the proportion of mains renewed and relined as a driver of Network plus Botex or Aggregate Botex costs. To capture and quantify the costs associated with mains renewal and relining, NERA has calculated the change in modelled costs implied by each of Oxera's Network plus and Aggregate Botex models for each year of the six year wholesale cost data set available when the proportion of mains relined and renewed is added as an additional explanatory variable.

Table 8-6 summarises the average implied cost adjustment estimate for the Network Renewal component of the claim, drawing from the Network plus botex model estimates set out in Table 8-2 and the Aggregate botex model estimates set out in Table 8-3.

The average implied cost adjustment claim is £3.406m in 2016/17 prices.

[185] 2017/18 CPIH prices for 2020/21 to 2024/25 forecasts

Table 8-6 - NERA econometric estimate of the Network Mains Renewal and Relining cost adjustment claim

Network Renewal Component of the Cost Adjustment Claim	Average £m per annum
Valuation estimate from Network+ models, 2016/17 prices	2.931
Valuation estimate from Aggregate models, 2016/17 prices	3.881
Average Valuation estimate, 2016/17 prices	**3.406**

Source: Summary of NERA analysis

However, we believe that this claim will over-estimate the efficient level of activity and costs for mains renewal over the period 2020/21 to 2024/25 as we expect the modelling estimates developed by Ofwat will be based on an historic period when we undertook an atypical level of mains renewal.

We intent to undertake an average of 20km mains renewal per annum in the period 2020/21 to 2024/25 as set out in Table 8-7 and this reflects commitments for AMP7 activities as set out in our Investment Cases (within C5B Technical Annex)[186]. This compares to an average renewal length of 39.7km per annum which we undertook over the period 2011/12 to 2017/18; a period of data we expect Ofwat will use to inform their modelling and hence our revenue allowance.

This step change in activity reflects the fact that we have been implementing innovations in network monitoring and leakage reduction in order to reduce renewal and relining requirements through being more targeted and adopting a more risk-based approach to deterioration-based mains renewal.

In order to reflect this difference between historic and future costs we have sought to scale back the valuation of the mains renewal cost adjustment claim. We have developed two approaches to develop an appropriate scaling factor which are:

Approach A – scales the case downwards by 66.3%. This reflects a downward adjustment, calculated on the basis that our historic mains activity in the period 2011/12 to 2017/18 was 66.3% higher on average that the level we require for AMP7 (2020/21 to 2024/25).

Approach B – scales the case downwards by 37.9%. This reflects a downward adjustment, calculated on the basis that our historic mains activity in the period 2011/12 to 2017/18 was 66.3% higher on average that the level we require for AMP7 (2020/21 to 2024/25), weighted by 4/7ths to reflect that only 4 out of the 7 years we expect to be modelled we undertook an above average rate of mains renewal.

Approach B is therefore an extension of Approach A.

We have opted to use Approach A to inform our estimates because:

- Approach A generates the lowest overall value of the cost adjustment claim; and
- Approach A demonstrates a greater commitment to considering the full extent of upward and downward pressures on costs, in-keeping with Ofwat's expectations to present a 'balanced' view within and across the submitted cost adjustment claims.

Both approaches are presented below.

[186] For 100km between 2020/21 to 2024/25, implies an average of 20km per annum. Source: PR19 Data table WN2, line 3: Total length of potable mains renewed

It is important to note however, that the extent to which it is appropriate to reduce the value of the claim does depend partly on the form of efficiency modelling, and whether higher activity within the 2011/12 to 2014/15 period (as set out in Table 8-7) compared to the long-run trend is taken into account, as it does not reflect the current or proposed future level of expenditure we expect to undertake on mains renewal and relining activities for maintenance.

Approach A:

Table 8-7 presents a comparison of our historic mains renewal lengths (which we expect will inform Ofwat's modelling in terms of costs and activities) to the average renewal lengths we require in AMP7. The proportion of our historic mains laid is 66.3% higher than the average mains length per annum we intend to undertake in AMP7.

Table 8-7 - Comparison of Historic Mains Renewal Activities to Average (2011/12 to 2017/18)

	Total length of mains renewed km	Historic renewal (km) > average future renewal (km)?	Length of mains above average (km)	Proportion of mains laid above average
	a	b	c	d
Calculation			a - average renewal length for AMP7	c/a
2011/12	65.2	Yes	45.2	69.3%
2012/13	72.1	Yes	52.1	72.3%
2013/14	49.3	Yes	29.3	59.5%
2014-15	55.5	Yes	35.5	64.0%
2015/16	4.85	No		-
2016/17	14.9	No		-
2017/18	16.23	No		-
2018/19	25	-		-
2019/20	35	-		-
2020/21	17	-		-
2021/22	23	-		-
2022/23	21	-		-
2023/24	22	-		-
2024/25	17	-		-
Bristol Water's average renewal length for AMP7, km per annum	**20.0**			**66.3%**

Source: Bristol Water analysis

Table 8-7 therefore suggests we should scale back the econometric estimate by 66.3%, which implies retaining 33.7% of the econometric estimate developed by NERA for this component of the claim.

Under Approach A the implied cost adjustment claim over the five year period 2020/21 to 2024/25 in 2017/18 CPIH prices is £6.845m, after adjustments have been made for inflation and input price pressures above CPIH which affect out cost base. The calculation to derive the cost estimate under Approach A is set out in full in Table 8-8.

Table 8-8 – Approach A: Adjustment to the Network Mains Renewal Component of the Cost Adjustment Claim

Financial Year	Historic Outturn	AMP6 forecast, outturn	2020/21 to 2024/25 Forecast		
			Inflation adjustment, re-priced to reporting requirements[187]	Scaling for historic atypical mains renewal activity (*33.7%)	Adjustment for RPEs above CPIH
	£m, nominal		£m, 2017/18 CPIH prices		
2011/12	12.465				
2012/13	20.076				
2013/14	16.032				
2014/15	15.416				
2015/16	5.979				
2016/17	3.406[188]				
2017/18	3.497				
2018/19		3.574			
2019/20		3.641			
2020/21			3.865	1.304	1.315
2021/22			3.942	1.330	1.341
2022/23			4.022	1.357	1.369
2023/24			4.102	1.384	1.396
2024/25			4.183	1.411	1.424
Claim value £m					**6.845**

Source: Bristol Water analysis

Approach B:

Approach B provides an extension to Approach A. Approach B seeks to acknowledge that, as set out in Table 8-7, only four out of the seven years we expect to be modelled by Ofwat are above the average length of mains we are proposing to undertake for AMP7.

On this basis, Approach B seeks to weight the 66.3% scaling factor by 4/7ths. Table 8-10 sets out the calculations which suggests we should scale back the econometric estimate by 37.9%, which implies retaining 62.1% of the econometric estimate developed by NERA for this component of the claim.

[187] 2017/18 CPIH prices for 2020/21 to 2024/25 forecasts
[188] Source: NERA's Econometric Estimate, see Table 8-6

Table 8-9 - Approach B Method for Calculating the Renewal Adjustment Scaling Factor

Value	Calculation	Note
66.3%	a	Approach A downward adjustment
57.1%	b	Weighting for four out of the seven historic years when mains renewal lengths are above the forecast average
37.9%	c = a*b	Approach B scaling factor
62.1%	d = 1-c	Approach B - proportion of cost adjustment claim retained (i.e. multiply claim by 62.1%)

Source: Bristol Water

The scaling factor calculated using Approach B is lower than Approach A (37.9% compared to 66.3%) and therefore the value of the claim to be retained will be larger under Approach B compared to A.

The implied cost adjustment claim associated with Approach B over the five year period 2020/21 to 2024/25 in 2017/18 CPIH prices is £12.609m, after adjustments have been made for inflation and input price pressures above CPIH which affect out cost base. The calculations to derive the cost estimate under Approach A is set out in full in Table 8-10.

Table 8-10 - Approach B: Adjustment to the Network Mains Renewal Component of the Cost Adjustment Claim

Financial Year	Historic Outturn	AMP6 forecast, outturn	2020/21 to 2024/25 Forecast		
			Inflation adjustment, re-priced to reporting requirements	Adjustment for historic atypical mains renewal activity (*62.1%)	Adjustment for RPEs above CPIH
	£m, nominal		£m, 2017/18 CPIH prices		
2011/12	12.465				
2012/13	20.076				
2013/14	16.032				
2014/15	15.416				
2015/16	5.979				
2016/17	3.406[189]				
2017/18	3.497				
2018/19		3.574			
2019/20		3.641			
2020/21			3.865	2.401	2.423
2021/22			3.942	2.449	2.471
2022/23			4.022	2.499	2.521
2023/24			4.102	2.549	2.572
2024/25			4.183	2.599	2.622
Claim value £m					**12.609**

Source: Bristol Water

As set out earlier in this section, we have considered it appropriate to present the valuation for the network renewal component of the claim based on Approach A. The value for the cost adjustment claim is therefore £6.845m.

[189] Source: NERA's Econometric Estimate, see Table 8-6

Overall, we present an estimate of £6.845m for the network renewal component of the cost adjustment claim. This is significantly less than what would otherwise be implied by a straight-forward econometric estimate approach (circa £17.5m[190]). This is due to the adjustment made to reflect the fact that in the period we expect Ofwat to use to inform their modelling (2011/12 to 2017/18), our activities and costs associated with mains renewal were higher than the average level of activity we are planning to undertake for the business planning period (2020/21 to 2024/25).

8.7.3 Combining the Network adjustments

Table 8-11 summarises the valuation estimates for the network age and materials cost adjustment claim as set out in this chapter, by combining the two estimates for age and relining and renewal activities together. This suggests a £12.282m cost adjustment claim over the five year period 2020/21 to 2024/25 (2017/18 CPIH prices) is appropriate.

Table 8-11 - Valuation Summary for the Network Age and Materials Cost Adjustment Claim

Financial Year	Price base	Mains age component (£m)	Mains renewal component £m)	Network Age and Materials claim (£m)
2020/21	2017/18 CPIH prices	1.045	1.315	2.360
2021/22		1.065	1.341	2.406
2022/23		1.087	1.369	2.456
2023/24		1.109	1.396	2.505
2024/25		1.131	1.424	2.554
Total		**5.437**	**6.845**	**12.282**

Source: *Bristol Water analysis informed by NERA*

Figure 8-14, Figure 8-15 and Table 8-11 graphically illustrate the valuation estimates for the network age and materials cost adjustment claim components as set out in this chapter. The peak in expenditure in Figure 8-15 shown in AMP5 reflects the additional mains renewal and relining length which is not typical of our future plans, and therefore has been removed from the respective component of the cost adjustment claim.

[190] Based on the £3.406m per annum (2016/17 prices) econometric estimate set out in Table 6.8, inflated to 2017/18 prices and multiplied by five to give an AMP7 estimate

Figure 8-14 - Valuation estimate of the Network Age Component of the Cost Adjustment Claim

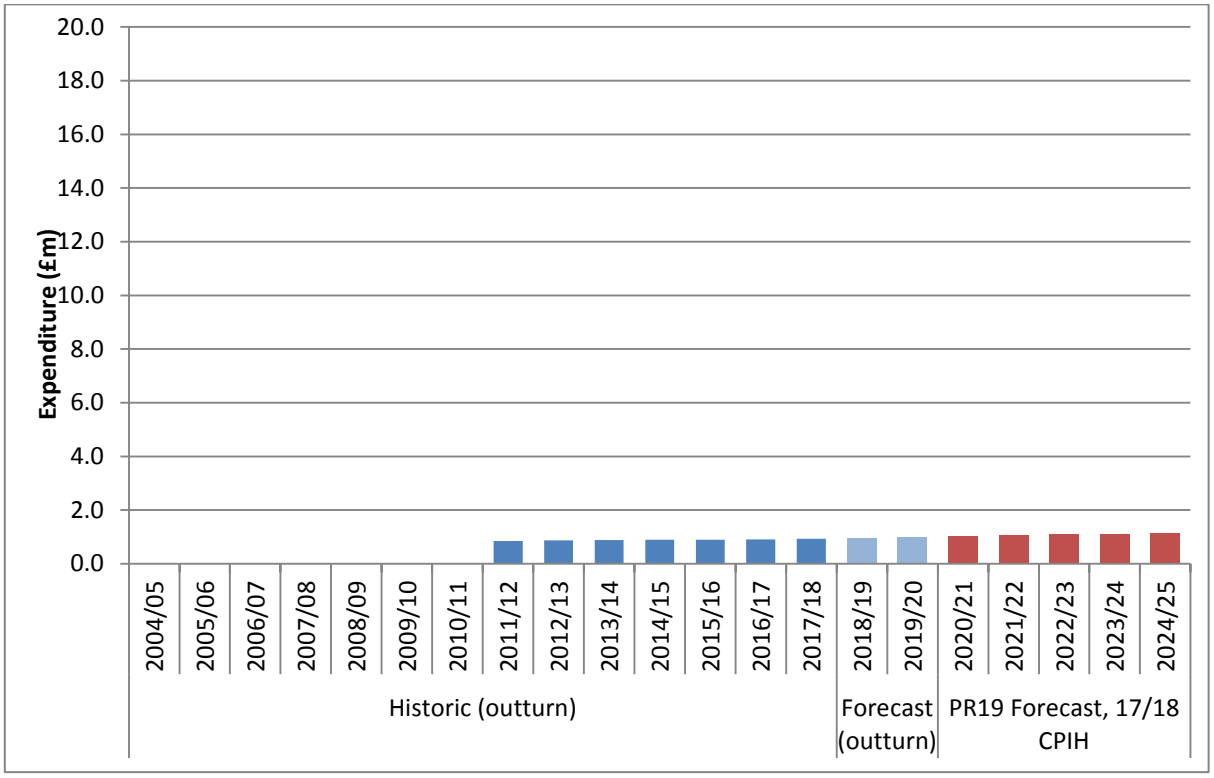
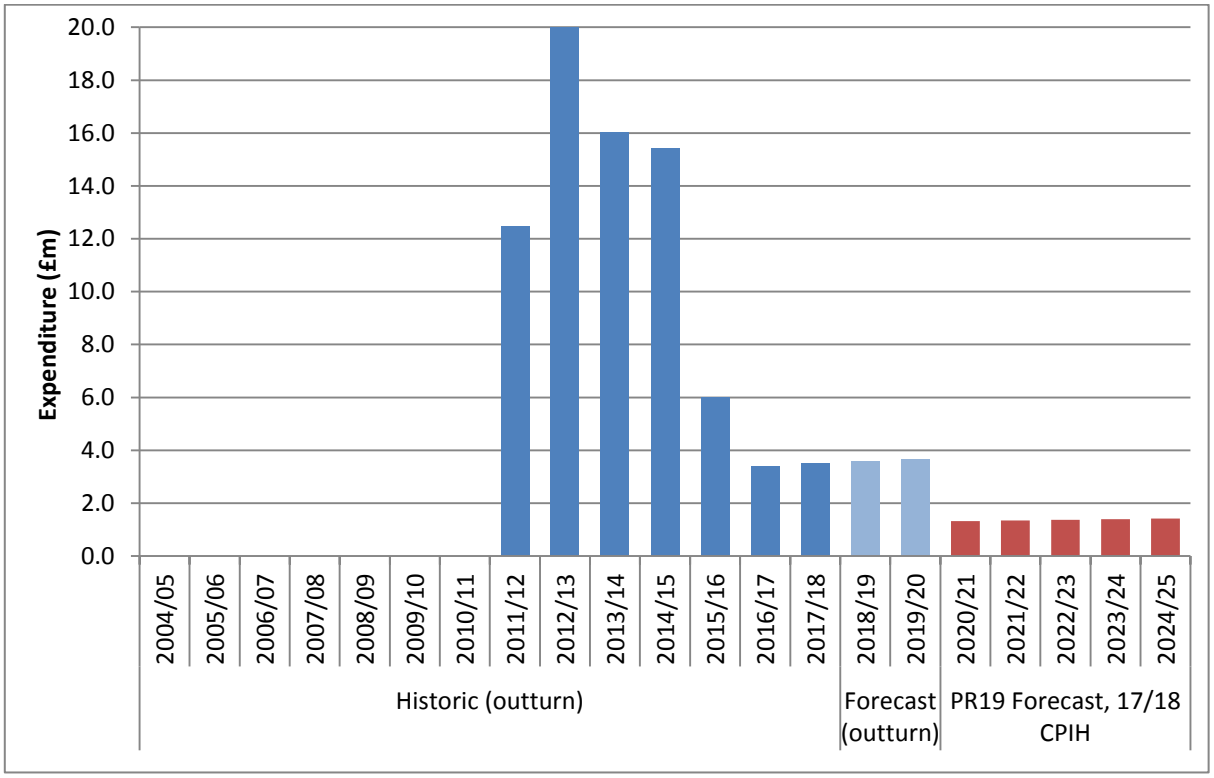


Figure 8-15 - Valuation estimate of the Network Age Component of the Cost Adjustment Claim



Source - Bristol Water

8.8 Demonstrating that costs are Efficient

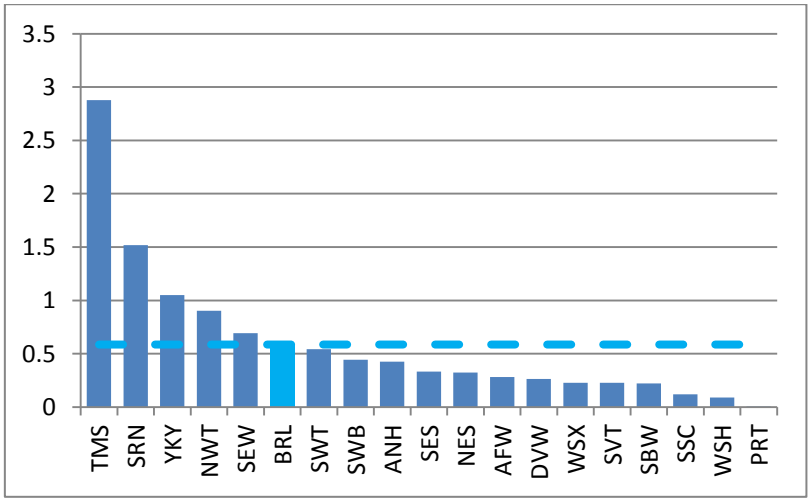
Ofwat's evidence requirements for demonstrating that our cost adjustment claim is efficient are:

- **Is there persuasive evidence that the cost estimates are robust and efficient?**
- **Is there high quality third party assurance for the robustness of the cost estimates?**[191]

Volumes of all age and materials-related mains renewal activities proposed in the business plan are the result of a cost-beneficial optimisation process and are supported by mains deterioration models. The benefits appraised can be directly mapped to our outcome delivery incentives and the performance commitments which drive them and beyond that quantitative and qualitative customer research which have informed our key performance priorities for the period 2020/21 to 2024/25. The nature of the optimisation process, by only selecting those interventions or suite of interventions which deliver the highest cost-beneficial ratios, provides the basis for demonstrating that the volumes of renewal activity set out in this case and more generally in our business plan are efficient. Further information on the optimisation process and mains renewal can be found in Investment Cases 1 and 2 on Trunk Mains and Distribution Mains respectively.

By means of further demonstrating that our current costs are efficient (as these in part drive our forecast costs), Figure 8-16 presents unit cost benchmarking of mains renewal costs across companies for the modelling period 2011/12 to 2016/17. This sets out that despite the above average level of renewal activity we have undertaken in this period our costs are not inefficient.

Figure 8-16 - Benchmarking Unit Maintenance Costs per km Main Renewed (average 2011/12 to 2016/17)



Source: Bristol Water analysis of Ofwat's wholesale cost assessment data (2011/12 to 2016/17)

Finally, the approach to this assessment has been based on modelling of the efficient industry cost. This has been supplemented by Bristol Water's assessment of the improvement in the efficiency and effectiveness of our management of network mains replacement and relining, indicated by the peak in workload over 2011/12 to 2014/15 which represented a "catch up" in past infrastructure activity. Together with the forecast efficiency position based on 2015/16 and 2016/17 data from PR19 cost assessment consultation models, this provides evidence that the costs included in the claim are efficient (post mains renewal and relining length adjustment).

Given that mains renewal activities are not entirely beyond management control it is important to demonstrate that the proposed levels of mains renewal and associated costs are efficient and this is true whether the costs are allowed for explicitly in the models or through the cost adjustment claim process or both. This is as per the recommendation made by CEPA to Ofwat to control for any

[191] Ofwat (2017) PR19 Final Methodology - Appendix 11: Securing Cost efficiency,p.14-15

inefficiencies that might otherwise be introduced into the modelling through the inclusion of variables which aren't entirely beyond management control.

8.9 Materiality Assessment

Table 8-12 presents our assessment of the materiality of the network age and materials cost adjustment claim.

Table 8-12 - Materiality Assessment

	Mains age component	Mains renewal component	Network Age and Materials claim
AMP7 Net value of claim (£m)	5.437	6.846	12.282
Business Plan 5yr Network plus Totex (£m)	378.137	378.137	378.137
Net claim as % of Network plus Totex	1.4%	1.8%	3.2%
Ofwat materiality threshold for Network plus (%)	1%	1%	1%

Source - Bristol Water analysis

It is estimated the claim represents 3.2% of Network plus Totex, thereby passing Ofwat's materiality threshold for the Network plus price control (1%).

8.10 Evidence assessment

This chapter has demonstrated the need for the network age and condition cost adjustment claim, that the claim is beyond management control and that the costs and cost estimates are efficient. As discussed in Section 4.2, it is not considered appropriate to provide evidence of the need for investment or that the investment represents the best option for customers as the claim seeks an adjustment to baseline Botex costs only. The claim does not explicitly relate to a capital enhancement project involving strategic options appraisal where customer protection to ensure performance improvements are delivered, therefore this is not considered herein. As set out in Section 8.8 however, for the renewal component of the network claim, evidencing the efficiency of the planned volumes of activity relates back to a cost-beneficial optimisation process which inevitably provides some contribution to delivering and improving performance, albeit if primarily to ensure performance levels do not deteriorate[192].

Table 8-13 presents an assessment of the evidence presented in this chapter to Ofwat's requirements.

[192] Which is the definition of capital maintenance – the level of capital spend requirement to maintain performance and operations without deterioration

Table 8-13 - Evidence Assessment

Evidence	Assessment	Comments
Need for cost adjustment	✓	We demonstrate the age and materials mix of our network is substantially different to other companies as a driver of our costs. Furthermore our future level of planned mains renewal is lower than historic, we have raised this claim to aid transparency in the cost assessment process. It is uncertain whether an age and mains renewal will be captured by Ofwat's water treatment and network plus models.
Management control	✓	Historic decisions on pipe materials and age are substantially outside of management control. We adjust the value of the case for the mains relining and renewal decisions over the modelling period which are within management control.
Need for investment	N/A	The claim does not relate to an investment and therefore no cost-benefit analysis of options is required; the claim seeks an adjustment to baseline Botex costs only. We have however engaged with customers on this cost adjustment claim, see Section 2.4.3
Best option for customers	N/A	
Robustness and efficiency of costs	✓	The econometric estimate for the claim has been reduced through a robust procedure (based on actual costs and renewal activity) to an efficient level. Benchmarking of unit maintenance costs per km main renewed in the industry demonstrates our historic costs have been incurred efficiently. Furthermore reproduction of Ofwat's PR19 models suggest that in recent years we have embraced a step-change in our network plus costs of which these baseline costs form a part, see C5 of our business plan.
Customer Protection	N/A	Customer protection in the instance the project is cancelled is not applicable as the case is not an investment project
Affordability	✓	The claim relates to base costs, present both in our historic and forecast costs and are therefore not explicitly associated with a given bill increase for AMP7 compared to AMP6 reflecting the ongoing incurrence of the activity and unavoidable cost compared to one-off capital enhancement schemes.
Board Assurance	N/A	This claim does not relate to capital enhancement schemes for which Board assurance around the optioneering is required. The Bristol Water Board provided assurance of the cost adjustment claims and the approach taken to them in the context of our wider business plan submission and our overall assessment of efficiency with this business plan submission. Section 4.1.10 provides further information on the internal and external assurance undertaken to support our final submission as was presented to Board

Source - Bristol Water

This case will be updated for further assessment of the efficient level of relining and mains replacement and mains age and material cohort information. The level of allowance within cost models will also be considered based on the PR19 cost modelling consultation.

8.11 Conclusion

The network age and materials cost adjustment claim depends in part on what age and mains replacement/relining variables are included in the efficiency modelling. Our claim has two components, one which takes into account pre-1940 atypical age of pipes (£5.437m) and another which takes into account an atypical level of activity on the 1941-1960 cohort of pipe materials (£6.482m). The £12.282m claim in total includes exclusion of an atypical level of expenditure by Bristol Water based on historic "catch up" mains relining over the period 2011/12 to 2014/15 which will improve efficiency challenges across the industry if this historic cost is removed through a cost adjustment.

9 Other Claims

As set out in chapter 2 we have engaged ourselves in an extensive process to identify and shortlist cost adjustment claims that are worthy of submission to Ofwat. Reflecting our assessment criteria, a number of claims did not meet the internal and external requirements for submission. The following sections set out the more significant of these claims and the reasons for dismissal.

9.1 BRL_004- Congestion in the City of Bristol

As part of our early submission, we presented a case on congestion.

This case set out that traffic speeds in the city of Bristol are amongst the lowest in the country, compared to local authorities of similar density. This means that we incur additional costs to deliver service and performance levels for our customers, as more resources are required than would be the case if jobs could be carried out more quickly. We further set out that such additional costs associated with longer travel times are unlikely to be fully captured by the density variables which Ofwat is likely to include in its models for PR19, an assessment which we still consider valid at final submission.

We believe there is a strong case for an upward adjustment to be made to our cost baseline in the Network plus price control unit to reflect this aspect of our operations which generates additional costs that are beyond management control. However, our assessment at final submission has confirmed that the claim is not material with respect to Ofwat's PR19 materiality thresholds for the Network+ price control and therefore we have, with Board approval, decided to drop this claim for our final submission.

Although from a regulatory perspective this claim is not material, inevitably we will continue to face the additional costs that operating in a heavily congested area brings. We will have to respond to this challenge going forwards and respond to the costs through efficiency.

9.2 Sludge Disposal

Circa 45% of our sludge is produced at our Purton and Littleton treatment works. At these sites we have received Environmental Agency (EA) consent to dispose of the sludge into the Severn estuary (via pipes)[193]. This arrangement for effluent disposal has been in place since 2001.

As a result of this arrangement we have lower sludge disposal costs (wholesale water), compared to other companies, as we do not incur costs associated with transportation and land fill which reflects the alternative and more commonly practiced method of sludge disposal in the industry. Sludge disposal costs therefore represent a case for a downward adjustment to be made to our cost baseline in the Network plus price control unit.

Table 9-1 presents our current sludge disposal costs associated with the disposal consent for Purton and Littleton.

[193] Environment Agency (1979) Waste Waters Discharge from a Water Treatment Works

Table 9-1 - Sludge Disposal Costs[194]

	Environment Agency Cost of Consent		
	(£ per annum, 2016/17 prices)	(£m per annum, 2016/17 prices)	£m over 2020/21 to 2024/25, CPIH 2017/18 prices
Purton	10,260.00	0.0103	0.053
Littleton	10,260.00	0.0103	0.053
Total	**20,520.00**	**0.0205**	**0.105**

Source: Bristol Water

On the basis of these estimates the claim is not material and was therefore not included at early submission or in this final submission.

9.3 Costs Associated with Permits to Work

Completion of necessary mains renewal and emergency works often involves road works and associated disruption to road users. At present, we do not incur any costs associated with permits to work or lane rental costs and therefore a downward cost adjustment claim may be appropriate. Since this candidate claim was first identified, changes in the regulatory environment have been announced in the roll out of lane rental schemes nationwide[195] suggesting that in the period 2020/21 to 2024/25 we may incur costs comparable to other companies operating in central London and Kent and therefore a symmetrical adjustment is no longer required[196].

9.4 Average Pumping Head

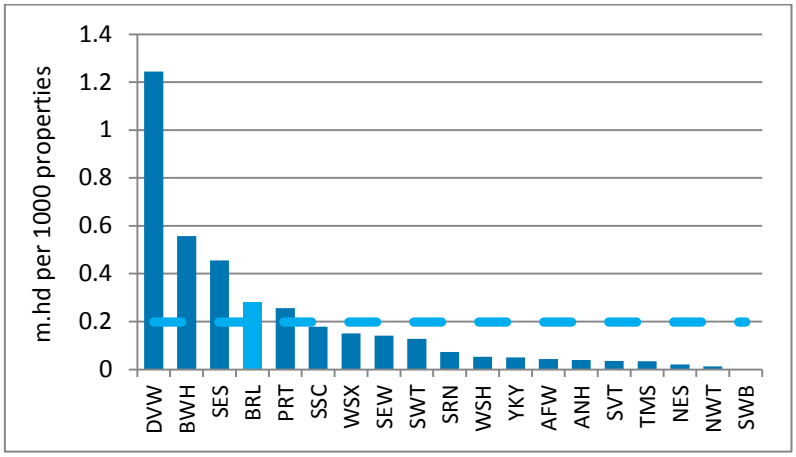
In December 2017, Ofwat requested companies to report average pumping head data against a new definition and formula. Previously, average pumping head had often exhibited an unintuitive sign and was not statically significant when incorporated as a cost driver in econometric models. As a result, we considered that an average pumping head cost adjustment claim in the Network plus price control might be appropriate in order to account for our average pumping head in the treated water distribution business unit being slightly higher than the industry average, as Figure 9-1 illustrates:

[194] We have not considered it proportionate to update these costs for 2017/18 actuals as the claim will remain immaterial

[195] The Department for Transport announced in Autumn 2017 to roll out lane rental schemes nationwide. Department for Transport (2017) Consultation outcome: Future of lane rental schemes for roadworks [Accessed 21 August 2018]

[196] This assessment has been further confirmed by Ofwat's exclusion of costs associated with the Traffic Management Act from their published models in the consultation on econometric cost modelling; suggesting that a cost adjustment claim (and symmetrical adjustments) is not required as the costs will likely be treated as a cost exclusion with direct pass through within the PR19 cost assessment process. Ofwat (2018) A consultation on econometric cost modelling, p. 15

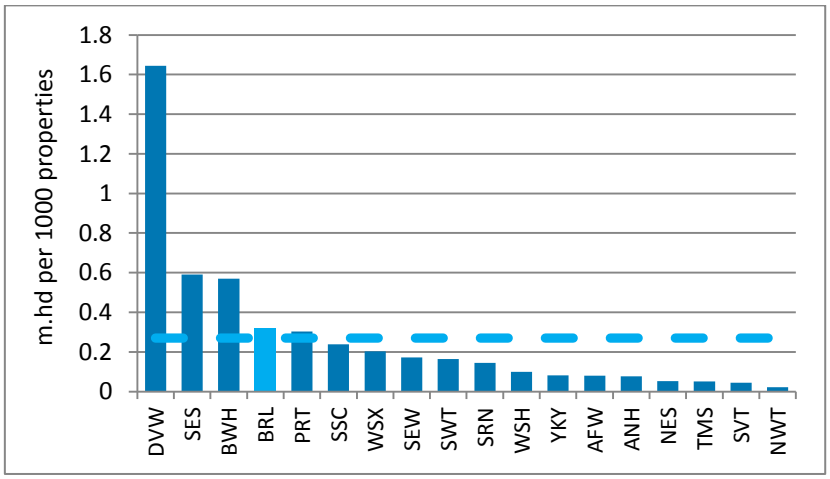
Figure 9-1 – Average pumping head, network plus per connected property (2016/17)



Source: Bristol Water analysis of Ofwat's wholesale cost information

However, upon analysis of the revised industry level data on average pumping head, inclusion of the average pumping head variable in models developed by NERA for us suggests the cost driver now has a positive and statistically significant impact on costs. In light of this, it is highly likely that Ofwat's PR19 models will include average pumping head variables (as indicated also by the cost model consultation[197]) and if the variables exhibit the correct positive relationship with costs and are statistically significant, an average pumping head cost adjustment claim will be difficult to argue given our pumping head data lies almost exactly on the industry average at the Aggregate level, as Figure 9-2 depicts:

Figure 9-2 - Average Pumping Head, Aggregate per connected property (2016/17)

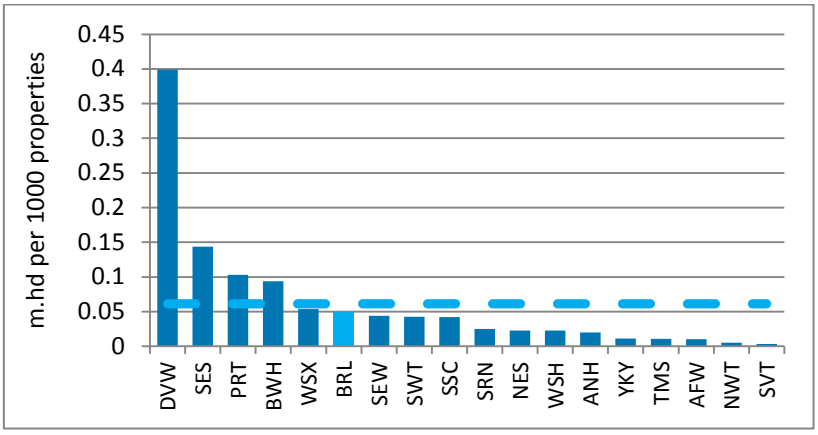


Source: Bristol Water analysis of Ofwat's wholesale cost information

This reflects the fact that our average pumping head in Water resources is slightly below the industry average as Figure 9-3 illustrates. This provides a further reason to drop the claim as, whilst average pumping head is above average in the Network plus price control, this is offset in the Water Resource control.

[197] Ofwat (2018) A consultation on econometric cost modelling, Appendix 1 Modelling results

Figure 9-3 - Average Pumping Head - resources per connected property (2016/17)



Source: Bristol Water analysis of Ofwat's wholesale cost information

In terms of the implied offsetting costs and the strong likelihood of average pumping head variables being included in Ofwat's PR19 models, we decided not to submit average pumping head as a cost adjustment claim in our early or final submission.

10 Appendix One

Table 10-1 - Bristol Water's Raw Water Sources and Hazards, Treatment Processes and Complexity Categorisation (2016/17)

Treatment Works	Sources feeding Works		Source type						Unique Raw Water Quality Risks (No.)		Complexity of Treatment - Processes types and number					Complexity
	No.	Source	impounding	pumped storage	river	boreholes	AR	ASR	Unacceptable Risks	Medium Risks	SD	W1	W2 / W3	W4 / W5	W6	
Littleton	1	Littleton pumped storage x3		3					15	22[198]	Pre-chlorination, raw water aeration (2)		ph lowering and increasing, coagulant dosing (2)	ozone, UV, GAC (3)		SW5
Purton	1	Purton pumped storage x2		2					15	22	Raw water aeration, Pre Chlorination (2)	RGF (1)	coagulant dosing, ph Lowering and increasing	ozone, UV, GAC (3)		SW5
Banwell	5	Blagdon, Banwell springs, Cheddar, Chew, Winscombe	3			2			15	13		slow sand filtration (1)	ph lowering and increasing, coagulant (2)	membrane, UV (2)		SW5
Cheddar	3	Blagdon lake, Chew valley lake, Cheddar reservoir	3						14	11		slow sand filtration (1)		UV (1)		SW4
Barrow	6	Barrow 1, Barrow 2, Barrow 3, Blagdon lake, Cheddar reservoir, Chew valley lake	3	3					14	12		RGF (1)	ph lowering and increasing, coagulant dosing, flocculation (3)	ozone, UV (2)		SW5

[198] The number of unique risks treated at the Purton and Littleton works has been reduced from 23 at early submission to 22 and the number of medium risks from 16 to 15, reflecting a duplication of hazards across different sources feeding the Gloucester and Sharpness Canal.

Treatment Works	Sources feeding Works		Source type						Unique Raw Water Quality Risks (No.)		Complexity of Treatment - Processes types and number					Complexity
	No.	Source	impounding	pumped storage	river	boreholes	AR	ASR	Unacceptable Risks	Medium Risks	SD	W1	W2 / W3	W4 / W5	W6	
Stowey	2	Blagdon, Chew	2						12	7		RGF, slow sand filtration (2)		ozone, UV (2)		SW5
Sherborne	1	Sherbourne springs				1			6	3			ph lowering and increasing, coagulant dosing (2)	membrane (1)		GW4
Charterhouse	1	Charterhouse spring				1			5	4				membrane (1)		GW4
Forum	1	Yelling mill (spring) and Windsor hill (spring)				2			5	3				membrane (1)		GW4
Alderley	1	Alderley spring				1			4	2				membrane (1)		GW4
Clevedon	1	Clevedon well				1			3	3	marginal chlorination (1)					GW SD
Chelvey	1	Chelvey well				1			3	6				membrane (1)		GW4
Frome	2	Egford main well, Egford sub well				2			3	4				membrane (1)		GW4
Oldford	1	Oldford boreholes				1			3	0				membrane (1)		GW4
Shipton Moyne	1	Long Newton boreholes				1			2	7		RGF (1)		UV (1)		GW4
Tetbury	1	Tetbury boreholes				1			0	2	marginal chlorination (1)					GW SD

Source: Bristol Water, aligned with 2016/17 wholesale cost submission