Bristol Water plc: A reference under section 12(3)(a) of the Water Industry Act 1991

Appendices 5.1 – 11.1 and glossary

Appendix 5.1: Aqua Consultants Technical Support, Report of Findings – June 2015

Appendix 5.2: Supporting analysis for the review of base expenditure in Bristol Water's business plan

Appendix 6.1: Smaller enhancement schemes

Appendix 6.2: Cheddar Water Treatment Works – Notified Item

Appendix 8.1: Reconciliation of Bristol Water performance

Appendix 9.1: Outcome delivery incentives

Appendix 10.1: Cost of capital

Appendix 11.1: PAYG, financeability and total allowed Bristol Water revenue

Glossary

APPENDIX 5.1

Aqua Consultants Technical Support, Report of Findings – June 2015

Aqua Consultants

Bristol Water Price Determination – Technical Support

For

Competition and Markets Authority

Technical Support, Report of Findings – June 2015

Water | Gas | Electricity | Mining | Renewables | Power

Achilles Consultants of the Year 2011 Finalist RICS INVESTORS IN PEOPLE

Foreword

This document has been produced after considering written information provided to us, answers to questions, statements made in a meeting with Bristol Water and responses received as a result of questions posed at the meeting.

The data has been assessed by a team that has a large amount of experience in various aspects of the water industry whose skills include civil engineering, process engineering, asset management and quantity surveying. Together we believe we have the ability to understand all technical aspects of Bristol Water's Business Plan, Statement of Case and the large volume of supporting information provided.

Trevor Perry

Associate Director

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This Report has been amended following the receipt of two responses from Bristol Water; a letter from Greenberg Traurig Maher LLP (GTM) dated 18 June 2015 and a more comprehensive list of "*the major errors of fact and understanding*" dated 22 June 2015.

We do not believe that either of these documents provided any references to any substantial issues. Where this report has been challenged we have changed the text to ensure that our opinion is taken in the context it was intended to be, provided additional evidence in an appropriate footnote and made some additions to ensure the reader fully understands our opinion.

We have considered the challenges made to the Initial Findings Report and note that they have not changed our opinion or the conclusions we have reached.

We have corrected one error on page 25, paragraph 95. We apologise for this error.

Amendments to the report regarding the issues raised by BW have been highlighted in blue font for ease of location, generally other amendments have been annotated with a footnote. Paragraphs have been numbered for ease of reference.

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Document status				
Rev	**Reason for issue**	**Date**	**Originator**	**Approval**
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0	Draft	08 June 2015	T Perry	P Massey
1	Issue	12 June 2015	T Perry	P Massey
2	Issue (typing edits no content revision)	15 June 2015	T Perry	P Massey
3	Draft, revised to include BW's comments	26 June 2015		
4	Issued – including BW's comments.	29 June 2015	T Perry	P Massey

1 EXECUTIVE SUMMARY

1. Bristol Water (BW) have not been able to agree their Price Determination with The Water Services Regulation Authority (Ofwat), as a consequence the matter has been referred to Competition and Markets Authority (CMA). Aqua Consultants were commissioned by CMA to provide technical assistance, in particular regarding six aspects of BW's submission:-

- Cheddar Reservoir Nr 2
- Bedminster Service Reservoir
- Mains Replacement Programme
- Replacing 1990s TW Assets
- Raw WTW Enhancement (Cheddar)
- Southern Resilience

2. Additionally CMA also asked that we provide an overall view of BW's approach in their submission.

3. For each of the aspects that we have appraised we have taken a common approach to establish if BW have demonstrated:-

- The need for the investment.
- That a solution selection process has been followed and 'normal' engineering solutions were considered.
- That an appropriate approach to risk has been adopted.
- The cost efficiency of the selected scheme.

4. We have measured the information we have reviewed against a level of what we would reasonably expect; the tables below give a summary of our findings, as either achieved (✓) or did not achieve (×) the standard. We have not tried to provide any degree of 'partial' in this summary.

Cheddar Reservoir Nr 2			
Need	Selection	Risk	Cost
×	×	×	×

5. BW have sought to demonstrate that construction of Cheddar Reservoir Nr 2 (CR2) is required to commence during AMP6 on the basis of the imminent need to supply to a power station and due to future growth in their customer base. We are of the opinion that if BW implement means other than CR2, they have sufficient water available for use even if they supply the power station and would not need to commence construction for some 10 years. We have not been convinced by BW's selection procedure; some schemes have been disregarded and not all schemes have been compared on an equal basis. BW have taken a

very risk averse position. We have established that the price may be 10% higher than necessary and there has been a lack of sensitivity analysis especially regarding areas with significant quantities involved.

Bedminster Service Reservoir			
Need	Selection	Risk	Cost
✗	✗	✗	✓

6. BW have assumed that they need to replace Bedminster Service Reservoir (SR), they have not investigated their overall capacity, which is far in excess of what one other Water Company is known to have and we believe would be the normal standard. The potential to refurbish the structure was dismissed. In our opinion the selection process has not considered refurbishment, capacity or given due regard to constructing a replacement at Barrow where more benefit could be obtained. BW have taken a very risk averse position. The cost for the replacement is at a value we would have expected; however we believe that refurbishment or maintenance of service reservoirs would be part of BW's normal business.

Mains Replacement Programme			
Need	Selection	Risk	Cost
✓	✗	✗	✗

7. BW have used a model to determine the amount of work to be undertaken during AMP6, this uses the age of the mains as the only factor to influence the output, this is too simplistic and is fundamentally flawed in our opinion {The preceding sentence was challenged in GTM's letter dated 18 June 2015. We believe we have explained the rationale behind this statement in Section 5 Mains replacement} There is no rationale provided as to what mains will be replaced or relined or any break-down of the mix or diameters and lengths will be 'replaced'. BW have based their costs on the average of the cost per metre, assuming that the same diameters and methods will be repeated. This unquantified approach allows BW to reach the stated length but at a much lower cost than if they decided to replace smaller diameter mains. The trunks main programme does not demonstrate that the length proposed in their Business Plan will be met. The costing of the trunk main work is high due to the high level of 'contingency' that has been included in the cost build-up, this is very risk averse. {The Report has been amended to reflect information received after drafting of the Initial Report} From our comparison of 'like for like' rates we have found that BW are £6.2m higher than expected for their AMP 6 Expenditure on Mains and CPs.

Replacing 1990s TW Assets			
Need	Selection	Risk	Cost
✖	✖	✖	✖

8. BW have relied on a model output to establish the level of expenditure required for their water treatment works (WTW) maintenance programme, this is not based on a known level of work. BW have provided indicative schemes that do not justify the £7.5M increase in our opinion. Given the age of the assets, maintenance and replacement of elements of time served equipment would be expected. We do not believe BW have demonstrated the need, there is no selection process and the level of additional funding detailed in their Business Plan suggests BW are taking a very averse view on their risk and level of work. We cannot comment of the costs of actual schemes as no tangible information has been provided.

Raw WTW Enhancement (Cheddar)			
Need	Selection	Risk	Cost
✖	✖	✖	✖

9. The rationale that has been adopted for treating water from Cheddar Reservoir is that only a total replacement, (recently installed UV and chlorine dosing equipment would remain), of the existing works will enable a reliable output to be produced.{The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this and believe that our statement is correct from the evidence provided} Reservoir Management has been dismissed as a potential solution and as a result of this the potential link between algal blooms, the cause of the processing problems, and equipment installed immediately prior to the blooms occurring has been ignored. We do not believe that BW have demonstrated a link between the algae, the ability to treat the water and the necessity to replace the works has been established. The selection process has ignored some options and has not compared schemes equally. BW's approach is extremely risk averse. There are unexplained differences in the cost of the proposed scheme and we believe costs have been included for equipment that may not be required. Because a reservoir management solution has been ignored we are of the opinion that the cost to be able to produce water reliably from Cheddar WTW is greater than is required.

Southern Resilience			
Need	Selection	Risk	Cost
✓	✗	✗	✗

10. We do not consider that BW have demonstrated a proven necessity for the Southern Resilience Scheme, however the proposal does have significant merit and we believe that being able to link areas is of benefit. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We believe that there is merit for the scheme to proceed although we do not believe BW have demonstrated the need as such but we chose to show the scheme should be included with a tick in the 'Need'.} The full benefit of the scheme has not been realised in two areas:-

- The ability of this scheme to negate other issues, such as Raw WTW Enhancement at Cheddar.
- [1]There does not appear have been consideration given to combining facilities at Barrow to realise cost benefits.

11. We believe that some aspects of the scheme have not been considered and that the selection process has not considered all options. The model assumes that WTWs fail at a significantly higher frequency than we understand to be happening, this does not appear to have been questioned and is therefore extremely risk averse. We do not understand why additional service reservoir capacity is required given the amount BW have already in place. Because options have not been considered and expenditure justified by demonstrating a need for the SR we believe that the level of expenditure included in the Business Plan should be reassessed. We are satisfied with the costs elements proposed for the scheme detailed by BW but not with the level of total expenditure.

12. Overall, our view is that based upon the information reviewed BW does not appear to have a strategic plan and their Business Plan consists of individual elements that are proposed in isolation with no regard for any inter-relationships. It is unclear if the consultants employed by BW are given a narrow brief or if they have not considered the possibility the work they are undertaking is having an impact on other areas within BW. The end result is a lack of coherency and is potentially resulting in BW believing they need to invest more than they have to.

[1] Following changed due to receipt of information in BW's comments of 22 June 2015

2 INTRODUCTION

13. Aqua Consultants were commissioned by the Competition and Markets Authority (CMA) to provide technical assistance to them regarding Bristol Water's (BW's) referral of their Price Determination following them being unable to reach agreement with The Water Services Regulation Authority (Ofwat).

14. Aqua Consultants' commission relates to technical and costing elements of various aspects of BW's Business Plan, as such this report relates to providing commentary on whether BW have:-

- demonstrated the need for the proposed development and investment;
- demonstrated an effective methodology for selecting a solution;
- used a 'normal' approach to risk;
- demonstrated that the cost of the option(s) are appropriate and demonstrated an efficiency of solution.

15. We were requested to assess the following areas:-

1 Cheddar Reservoir No.2

2 Bedminster service reservoir

3 Mains replacement

4 Replacing 1990 Treatment Works assets

5 Raw WTW enhancement (Cheddar), and

6 Southern Resilience.

16. In addition to reporting on the above CMA also requested that Aqua Consultants provide commentary on BW's approach; the demonstration of their needs and methodology overall.

17. The findings in this report are based on the information supplied to us by CMA. At the meeting with BW, on 27 May 2015, we sought clarification regarding various aspects of the information where we believed we required more details. We have included information gathered from the meeting together with the documents supplied afterwards. On this basis we believe we have provided an assessment and findings, however we note that this is on the 'snap-shot' provided and that it may potentially be possible that we have not been provided with the full supporting information by BW.

18. As listed in Appendix A the latest information assessed was received on 05 June 2015. We have also reviewed information received on 10, 11 and GTM's letter of 18 June 2015 together with BW's comments on 22 June 2015.

3 CHEDDAR RESERVOIR NO.2

3.1 Cheddar Reservoir No.2 Summary

19. In the future BW will have to supply more water as their customer numbers increase and the quantity that they each require also potentially grows; this is at a period of time where there is increased uncertainty of their supply of raw water due to climate change. BW's customers expect to obtain their supply of water and this requires a resilient system to be in place.

20. A further significant aspect of BW's Water Resource Management Plan (WRMP) is the potential supply requirement to one of two proposed power stations that may be constructed within their area of operation at Avonmouth. SSE are proposing to construct Seabank 3 and Scottish Power Avonmouth. The schemes may require a bulk supply of raw water. At present neither of these schemes will definitely be constructed.

21. If BW supply raw water to either power station the amount of water available for their other customers will decrease. If the power stations are not constructed or do not take water from BW the amount that is available for their other customers is higher. The supply to Seabank 3 or Avonmouth has a significant effect on WAFU (water available for use), accounting for +/- 6% of the overall amount available to other customers.

22. Supplying either power station has a significant impact on BW's WRMP and directly affects their ability to supply customers, growth demand and resilience.

23. Following our review and investigation of information provided we conclude the following:-

- We initially believed that BW required Cheddar Reservoir 2 to allow them to supply raw water to one of the two proposed power stations at Avonmouth, although we now understand that BW's principal reason is to ensure adequate water and resilience is maintained in the system irrespective of the requirement to provide the bulk supply of raw water.
- Our opinion is that BW have failed to demonstrate the need to construct the new reservoir in AMP6 because:-
  - In BW's own analysis they have shown that target headroom can be met with the Power station and without Cheddar 2 reservoir as presented in Scenario 4 of the WRMP[2]. We also have reproduced BW's flow/demand profile graphs to demonstrate this using BW's information {This bullet point was challenged in BW's comments dated 22 June 2015. We have reviewed this and amended to clarify our comments.}
  - The supply to Seabank 3 power station is highly likely to be supplied by Wessex Water, even if the scheme goes ahead.
  - Scottish Power are considering air cooling.

---

[2] Water Resources Management Plan 2014 p.182-183 - SOC039 wrmp.pdf

- The new reservoir is not required to meet the demand in the south of their area.

- BW have not considered the impact of the proposed Southern Resilience on the proposed Cheddar Reservoir 2 scheme; water available in the north of their area could be transferred to the south.
- We believe that there are some anomalies in the costs for the project and that schemes are not being compared on an equal basis.
- We do not believe BW have demonstrated that there is a need for the investment to commence construction of Cheddar Reservoir 2 in AMP6.

3.2 Information

3.2.1 Information Considered

24. The following is a list of the information considered in this section:-

Filename	Document Title	Summary or Comment
150311 Bristol Water SoC.pdf	Bristol Water Statement of Case	
SOC039 wrmp.pdf.pdf	Water Resources Management Plan (WRMP) – Main report, Final June 2014	
http://www.bristolwater.co.uk/wp/wp-content/uploads/2013/05/WRMP-Non-Tech-Summary-submission-final-v2.0-140610.pdf	WRMP Non Tech Summary	
http://www.bristolwater.co.uk/environment/water-resource-plan/2014-water-resource-plan/	WRMP Appendices 8 & 10 – Option Appraisal	
SOC306	SDB - Approach and Methodology	
SOC361	Cheddar 2 Unconstrained Options for WRMP	

Filename	Document Title	Summary or Comment
SOC535	SDB Summary Scenario 1 to 13	Believed to be the source of the supply demand graphs in the WRMP and SOC but these do not show which planned activities deliver improvements in WAFU.
http://sse.com/media/197573/Seabank3_StageOne_Consultation_Report_FINAL.pdf Last accessed 07.06.2015	Seabank 3 Stage One Consultation Report October 2013	No reference to use of BW raw water supply to cool the power station.
http://sse.com/media/102498/Seabank-FAQ.pdf Last accessed 07.06.2015	Seabank 3: Frequently Asked Questions	P 10 has earliest estimated timings for Seabank 3 operations and further confirmation of Wessex Water supplying cooling water.
http://sse.com/media/227372/SSE-Seabank3-Newsletter-Issue-3-Apr14.pdf Last accessed 07.06.2015	SSE - Seabank 3 Consultation News Issue 3 April 2014	
SOC555	ARUP Report 009 Design Review Report - Phase 1 Issue Compressed.	Revised Arup information.
http://webarchive.nationalarchives.gov.uk/20130206062158/http:/a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/lit_6932_56bc01.pdf Last accessed 07.06.2015	Water resources planning guideline The technical methods and instructions October 2012	
	CCW submission to the CMA about BW's referral of its 2014 Ofwat FD	

Filename	Document Title	Summary or Comment
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291598/LIT_7764_ea1e43.pdf Last accessed 07.06.2015	EA Climate change approaches in water resources planning - overview of new methods Report SC090017/R3	
	CMA Price Determination for Bristol Water plc, Submission to the Inquiry Group from Wessex Water Services Ltd	
SOC136	ESD 9 - MM Assurance Report 20141002	
SOC170	Consultation report Final.docx	Noted.
SOC162	3 Stage-Two-Consultation-Report-low-res.pdf	Noted
https://www.ofwat.gov.uk/pricereview/pr14/res_stk201410pr14brlddrepccg.pdf	Bristol Water's - Local Engagement Forum - Report on the Ofwat Draft Determination on Bristol Water's 2015-2020 Business Plan October 2014	LEF raise question as to the evidence of BW supplying Seabank. BW response - We understand from SSE that they wish to have a combined water source and TTE supply to existing Seabank 1& 2 and the new Seabank 3.
http://www.avonpowerstation.com/pdf/Avon_Power_Station_Scoping_Report.pdf	Avon Power Station EIA Scoping Report	

Table 1

3.2.2 Shortfall of Information

25. We are not aware of any information shortfall for Cheddar Reservoir 2.

3.3 Demonstration of Need

26. BW must have sufficient water resources available to ensure that it can maintain supply to meet its customers' demands without the need for excessive water usage restrictions. This is effectively meeting the balance between supply and demand. In terms of water usage restrictions these are expressed in likelihood terms and in the case of BW are currently 1 in 15 years and a supply failure of 1 in 100 years.

27. In simple terms the water industry refers to the availability of untreated water resources as Water Available For Use (WAFU) and the supply to their customers of treated water in dry weather conditions (greatest demand) as Distribution Input (DI). DI includes leakage. The difference between WAFU and DI is due to the losses in the treatment process. Thus in order to meet its supply demand balance obligations, a water company must ensure that WAFU > DI. In addition there is the concept of headroom which is a contingency planning margin allowance of extra water between WAFU and DI; therefore WAFU > DI plus headroom. The difference between WAFU and DI plus headroom, will determine the likelihood of water restrictions, the greater this value the less likely that water restrictions will be required. This is in turn determined in part by customer preferences and willingness to pay.

28. Bristol Water is required to prepare a Water Resource Management Plan (WRMP) which sets out how it will meet its supply demand obligations and the investment requirements; the company forecasts its needs to meet these obligations in a sustainable way. In their Water Resource Management Plan (WRMP) BW have followed the guidance required for the preparation of their WRMP and subsequent preparation of PR14. We are satisfied that the process presented in the documentation is compliant. The followings sections deal with the question of the need for and timing of Cheddar 2 reservoir.

3.3.1 Demand

29. In BW's Final WRMP[3] June 2014 it sets out the base line supply demand balance as shown below in Figure 1:-

Baseline supply demand balance before any planned interventions

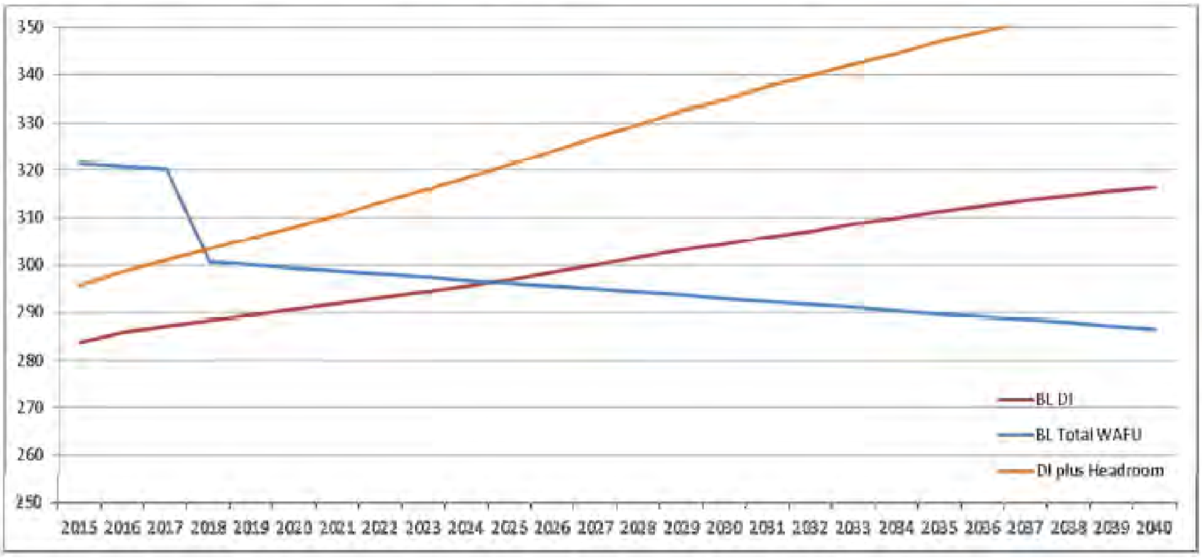

Figure 1

Distribution Input

30. The increase in DI is primarily due to an increase in population as forecast by the Office for National Statistics.

Headroom

31. BW has chosen to select a headroom target which will ensure a 90% confidence band.[4] The reasons given are that:-

- This provides an optimum balance between current and future headroom volumes.
- The margin of headroom required to mitigate both known and unknown impacts increases in future. The dominant driver for this future increase in uncertainty is the UKCP09 projected range of climate change outturns that need to be accounted for.[5]

Comments

- The impact of climate change is accounted for in WAFU and Headroom.

---

[3] SOC039 wrmp.pdf, page 174
[4] WRMP p. 105 para 6
[5] WRMP 7.1 Defining target headroom p. 104 para 3

- We note that other water companies tend to accept lower levels of headroom.
- The target headroom is risk averse and the evidence that customers are willing to pay extra for it is not compulsive[6].

3.3.2 Supply

32. The drop in WAFU of 20 ML/d in 2017/18 shown in the base line supply demand balance (Figure 1) is due to the demand for raw water from the new SSE - Seabank 3 power station. BW state in their final WRMP[7], that they are negotiating commercial terms for a non-potable water supply with SSE for the Seabank 3 power station.

33. With regard to the above we cannot find any reference to SSE planning to use raw water supplied by BW in the public domain or any details in the documents supplied by BW for this review. In the SSE Seabank 3 Stage One Consultation Report, October 2013, the plan was to use the effluent from Wessex Water's Waste Water treatment plant and this theme has continued through to the latest SSE documentation available. The Wessex Water site also provides cooling water for the existing Seabank 1 and 2 power stations.

34. During the meeting, on 27 May 2015, BW stated that they believed they would supply water to either Seabank or Avonmouth Power Station due to the limited availability of water from Wessex Water, however Scottish Power outline that they have several options for cooling and may not use any water[8].

35. The Consumer Council for Water had raised this issue with BW as part of the LEF[9] at the time BW responded to the LEF that they understood that SSE wished to have a combined raw water source and Tertiary Treated Effluent (from Wessex Water) supply to existing Seabank 1& 2 and the new Seabank 3. This suggests that BW were aware at this stage that the full 20 Ml/d may not be required; it is the only record of a combined supply in the PR14 documentation. However in the final WRMP, page 182, BW state *"In our preferred plan, we have made an assumption that we are likely to provide a large volume of non potable water supply to a power station (Seabank)"*.

36. The ongoing background reduction in WAFU of 0.5Ml/d/year as presented is due to the climate change impact on water resources. Climate change impacts are also accounted for in headroom. "*WAFU shows a steady decline until the reservoir is assumed to be operational, largely driven by the central estimate of climate change impacts."*[10] The supply to the power station has the equivalent to 40 years of climate change, emphasising the major impact this has on WAFU.

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[6] 150311 Bristol Water SoC, paragraph 623 - 624

[7] SOC039 wrmp.pdf , June 2014, Page 42

[8] Avon Power Station EIA Scoping Report, page 14, The Cooling System and Aqueous Discharges http://www.avonpowerstation.com/pdf/Avon_Power_Station_Scoping_Report.pdf

[9] Bristol Water's - Local Engagement Forum - Report on the Ofwat Draft Determination on Bristol Water's 2015-2020 Business Plan October 2014 Appendix 1 Query nr. C2R2 p.17

[10] BW's SoC para 1304 -

3.4 Solutions

3.4.1 Solutions Considered

37. In the final WRMP and PR14 Final Submission the preferred option was to start the construction of Cheddar 2 reservoir in AMP6. It should be noted that the WRMP preferred solution does not undertake a cost benefit of the Cheddar Reservoir in isolation. A series of schemes are assembled into a scenario that manages the future supply demand balance. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this challenge and believe that our statement is correct from the evidence provided} As presented in BW Final WRMP June 2014, pages 173-175. The preferred option (referred to as Scenario 1) was based on the following plan as shown in Table 2 below along with the associated supply demand balance graph shown in Figure 2.

Notional bill impact per customer over full planning period	NPV whole life cost £million	NPV capital cost £million	NPV operation cost £million
£24	183	219	46
OPTION DESCRIPTION	**START DATE**	**YIELD 2020 Ml/d**	**YIELD 2040 Ml/d**
Total leakage – ALC + pressure reduction	2015	6.0	13.0
Change of occupier metering	2015	3.4	9.4
Cheddar reservoir	2015	0	16
Supply-pipe replacement	2015	0.1	1.4
Bulk transfer reduction	2017	4.0	4.0
Honeyhurst transfer	2021	2.4	2.4
Demand management	2019	0.35	1.0
Hunstpill licence transfer	2025	0	3.0
Bridgwater bulk transfer	2031	0	10.0
Chew Stoke Stream reservoir	2031	0	8.0

Table 2

38. The preferred solution assumes that the 20ML/d of non-potable water will be supplied to the Seabank 3 power station.

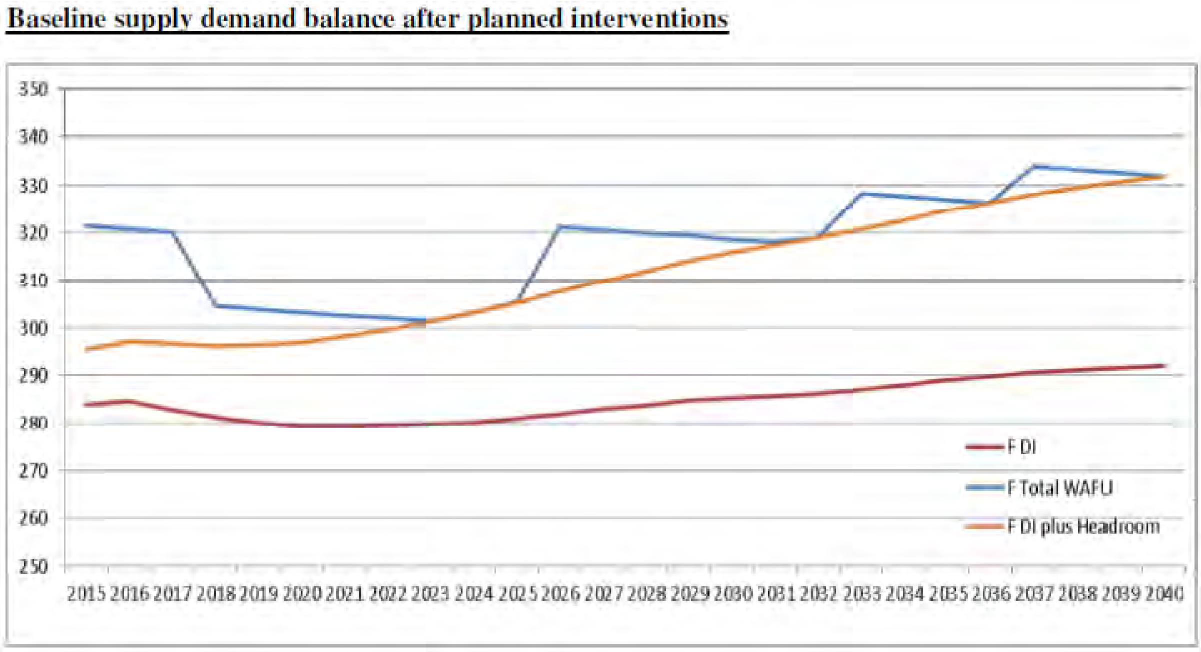

Figure 2

39. It was not possible to correlate the options in the table with the WAFU outputs in the graph. Also the spreadsheet of scenarios[11] does not show the options that deliver the changes in WAFU.

40. The WRMP presented 3 further scenarios in detail as part of the options available to BW customers. For the purpose of this report we have not reviewed in detail scenario options 2 - Level of Service improvement and 3 - Level of Service reduction since those scenarios do not meet customers preferred outcomes. Other options[12] listed as scenarios 5-12 are also noted. These (as do 1-4) include a mix of planning scenarios which should be covered in the headroom allowances (5, 6, 11 and 12) and some unusual variances of supply demand options (7, 8, 9 and 10). These are misleading as they cannot be compared like for like and add little value to the optioneering process.

41. Of the alternative options, Scenario 4 is of specific interest since this is a scenario with no allowance for non-potable supply to the Seabank 3 power station. We consider this the most likely scenario as discussed above and BW show the delivery of supply demand options giving a supply demand profile as shown in the WRMP, page 184, in Figure 3 below. We note this scenario is of lower cost and does not require Cheddar reservoir 2 within the planning horizon to 2040. We consider that this best meets the requirements of customers with respect to their stated preferences[13]. {The preceding sentences ware challenged in

[11] SOC535 SDB Summary Scenario 1 to 13.xlsx
[12] WRMP p. 187
[13] This statement was challenged by BW's comments dated 22 June 2015. From the documentation reviewed we did not see a sufficiently detailed investment appraisal of all the options, with consideration of the uncertainties, to enable us to do a direct comparison of the options and have sufficient confidence that the additional value of Cheddar 2 referred to by BW would provide clear justification for an investment of this size and scale

BW's comments dated 22 June 2015. We have reviewed this and believe that our statement is correct from the evidence provided please see footnote}

42. Within the WRMP scenario option 4 there is a variant which includes Cheddar 2 reservoir. This is presented as being better value for money to customers since it assumes lower overall cost to customers in the event that the supply to the power station is required and the cost of an improved service level is less than that of option 2 for almost the same outcomes. (This in itself shows option 2 is of little value).

Scenario supply demand balance after any planned interventions

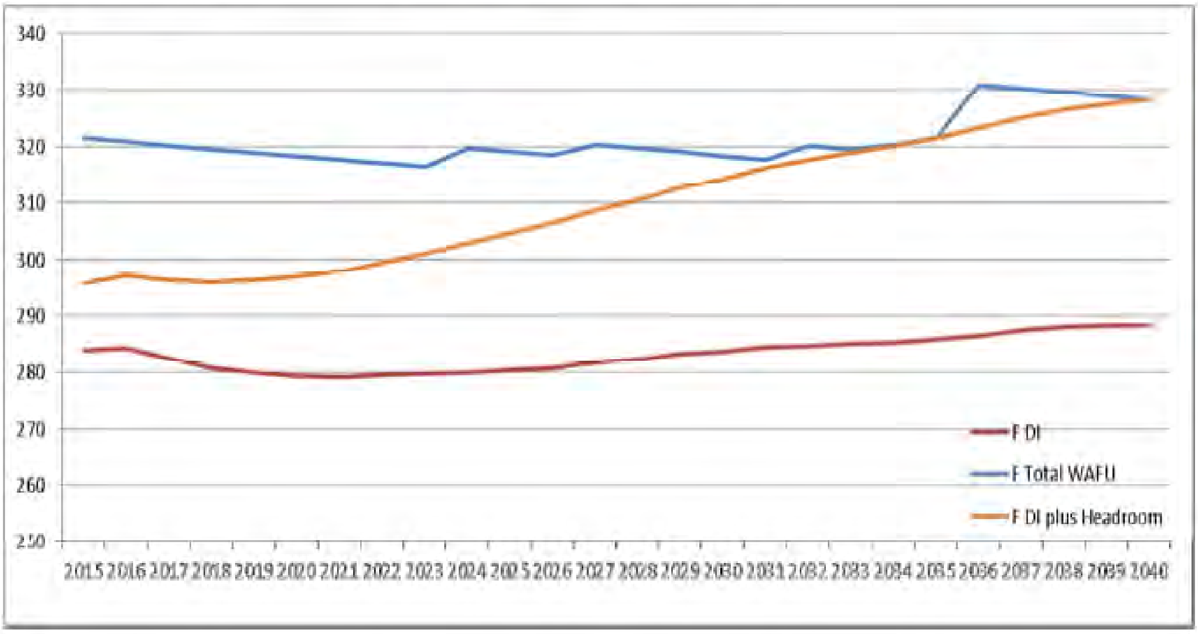

Figure 3

3.4.2 Options not Considered or not Reported

43. We consider it would be more appropriate to develop a range of smaller supply demand schemes that can be brought in and adjusted as a 'just in time' management, subject to their implementation time, as the impact of climate change becomes known. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this challenge and believe that our statement is correct from the evidence provided.} Such schemes should include smaller water resource augmentations, proactive demand management options and further options for leakage and pressure management. For example a priority programme based on the following series:-

Active Leakage Control → Demand Management → network optimisation and reconfiguration without or with pressure management → optimize existing source outputs → mains renewal (to reduce leakage) → develop new source (borehole/local river intake → storage reservoir → water reuse → desalination.

44. Other options for managing Supply Demand balance are not clearly developed. We would have expected to see a greater emphasis on demand management in the WRMP to counter the impact of climate change. In particular more proactive metering and water efficiency solutions, for example by a focused selective area by area metering programme.

45. The metering programme is based on an Optant and a change of occupier programme – which will take meter penetration to 80% by 2040. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this and added in the paragraph below for further explanation. 80% given in Section 6.1.2 Baseline Metering – SOC039} This is an inefficient programme since Optant installations are one-off in nature and therefore expensive. It lacks the opportunity to make real savings on installation costs, metering reading, customer demand and supply pipe leakage. The section on metering in the WRMP is brief and does not set out with clarity the metering programmes that have been considered. As an example Optant programmes are considered generally to provide a 5% reduction in customer demand but Southern Water have recently reported a 16% reduction from their Universal Metering Programme. AMR and fixed network metering programmes provide opportunities to identify customer side leakage and wastage from plumbing fittings far more effectively than with dumb metering; we do not believe that these benefits have been considered. Selective metering also provides a greater opportunity for a more proactive water efficiency initiative; again we do not believe that these have been considered fully. There is little evidence of considering these in the WRMP. Given the ability to tune such solutions to their required timing, we consider they provide an opportunity to better manage the risk exposure to customers and the impact on bills. Also implementation of smaller, flexible schemes, some with higher average incremental social costs (AISC) may provide a better risk profile and therefore impact on bills during an AMP period.

46. We recognise the BW area of water supply is not 'water stressed', however we consider there are available methods to accelerate meter penetration in a cost effective way and to achieve a greater penetration at the end of AMP6.

47. We note the current optimisation process may be too inflexible to realise these outcomes as we believe that the options were input as including Cheddar 2 reservoir and later assembled as the preferred scenarios. From the available documentation it is difficult to understand the relationship between the outputs of WiLCO and the S/D scenarios presented by BW.

3.4.3 Selection Process

48. Of most concern is the lack of presented viable alternative options which use the other supply demand options before Cheddar 2 Reservoir. We would expect the selection of the optimum scenario to be demonstrated in this way. For illustrative purposes we have annotated BW's preferred scenarios with the same scenarios as BW but with an alternative sequence as below.

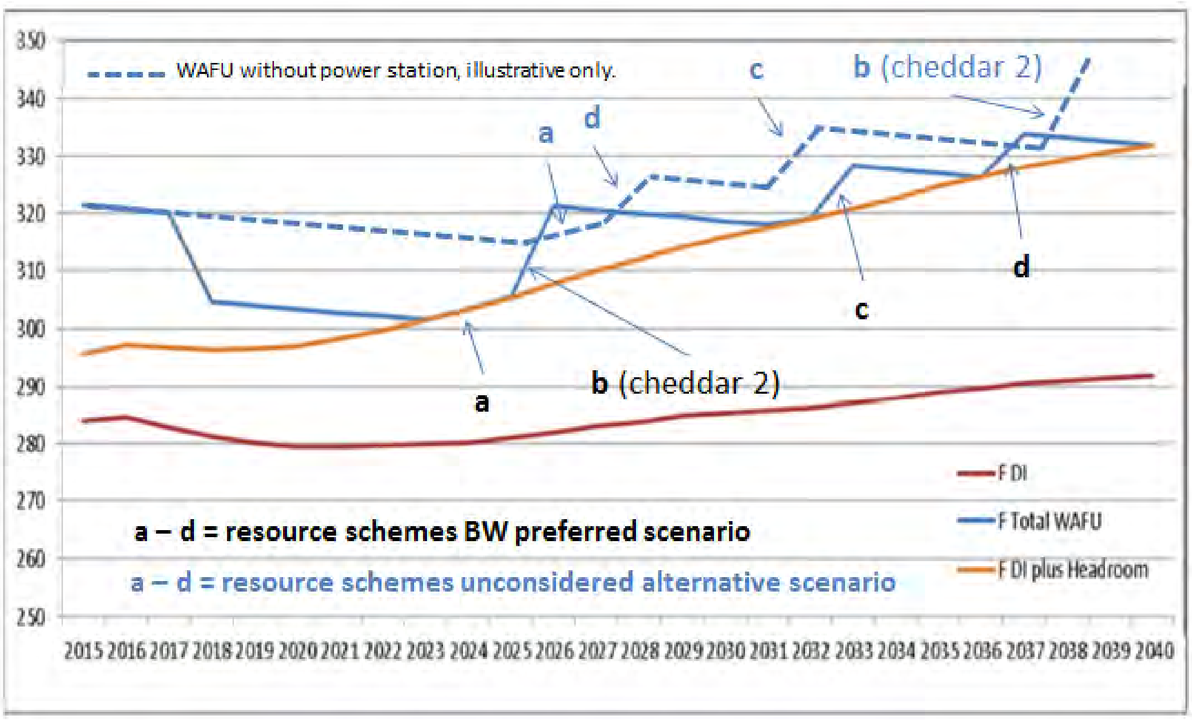

Figure 4 Possible alternative option without Power Station

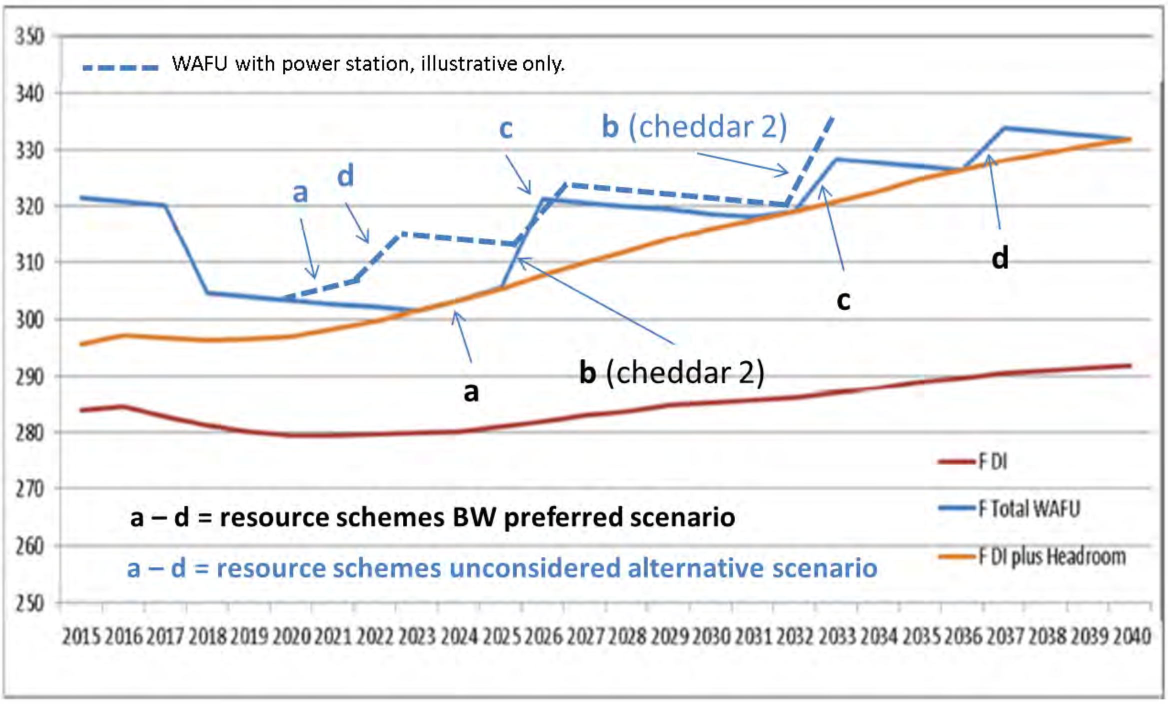

Figure 5 Possible alternative option with Power Station

49. Note these are similar to the Scenario 4 in the WRMP, page 182, 11.3.3 Scenario 4 – No allowance for non-potable supply. They suggest that Cheddar 2 construction is not required to start in AMP6 with or without the supply of non-potable water to Seabank 3 power station.

50. The schemes as illustrated by the dashed lines are as shown on a like for like basis from the original BW graphed solution. It has not been possible to directly ascertain whether the schemes shown above directly correlate to the schemes shown in Table 3[14], however we would expect them to include R018, R030, and R023 as these are more cost beneficial than Cheddar 2 in AISC (p/m^3) terms.

All options rank	Scheme id	Description	Scheme Yield (Ml/d)	AIC (p/m^3)	AISC (p/m^3)
2	R018	Bulk transfer reduction	4	21	-2
6	R030	Honeyhurst Transfer	2.4	29	43
8	R023	Huntspill Axbridge Transfer	3	57	69
13	R005	Cheddar Reservoir	16.3	82	83

Table 3

51. We note that BW's own assurance consultant raised this issue and advised BW to better demonstrate why their chosen solution was optimal[15].

"The plan describes what the benefits are of the chosen scheme, however, it does not demonstrate that other options were considered, what the costs and benefits of those schemes were and why building a new reservoir at cheddar was the best option.

Describe the options development process to address the need for meeting future supply requirements and why Cheddar was chosen as the optimal scheme. Provide a table of alternative options and detail the costs and benefits to strengthen the case for Cheddar."

52. In BW's SoC paragraph 1329, page 364, BW presents a table of alternative options. However these options are for the individual Supply Demand options, not the different scenarios (a mix of options to meet the overall supply demand balance).

53. Indeed the options do not appear to be presented on an equal basis in that paragraph 1331 states:

"The table shows that Cheddar Reservoir Two was selected by WiLCO and is the largest cost beneficial scheme."

54. It is, but only in the sense that it provides the greatest yield of WAFU of any individual selected scheme; it is not the most cost beneficial in terms of AISC (p/m^3) and does not include the cost of treating the water[16]. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this and believe that our statement is

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[14] from BW SoC paragraph 1329 page 364
[15] SOC136 ESD 9 - MM Assurance Report 20141002.pdf page. 254
[16] 27 May 2015 meeting.

correct from the evidence provided.} The cost of treating water at Cheddar WTW is given in Section 7.6.3 Treated Water Cost.

55. There is generally a lack of transparency in the SoC, for example the list of options are shown in BW's SoC page 365, paragraph 1331, table 97, in the two main scenarios essentially with/without Cheddar reservoir there is no indication of which schemes have been applied to which scenario. BW should provide this information in order to assist them in making a convincing case. More concerning is the lack of evidence on what the overall cost / benefit of either scenario is; these could each be presented as an AISC so that they could be compared like for like.

56. We note with reference to the scenario without Cheddar 2 reservoir:

- BW SOC p. 366 para 1334 - The scenario presented above (without Cheddar 2) showed a similar cost benefit over the 25 year period to the scenario presented in Section 10.6.3.2. (with Cheddar 2);
- BW SOC p. 367 para 1335 - This scenario is only more beneficial if customer preferences for improved resilience, "no regrets" planning and long-term costs are ignored;
- The spreadsheet SOC535 SDB Summary Scenario 1 to 13.xlsx, does not show the schemes that deliver the changes in WAFU;
- BW SOC p. 239 para 744, Claims that SDB model optimised all schemes on AISC and scenario outputs entered into WiLCO. No schemes or scenarios are presented

3.4.4 Synergies with the Southern Resilience Scheme

57. We note that BW are generally showing a demand of 19 Ml/d from the power station, however in the WRMP[17] the flow is 25% higher at 23.8 Ml/d. In comparison the proposed Cheddar Reservoir has a yield of 16.1 Ml/d, two-thirds of the proposed supply to the power station.

58. Essentially BW have 'surplus' water in the north of their region with less available in the south. The southern resilience scheme could make this available for use as treated water in the south. {This sentence was challenged in GTM's letter dated 18 June 2015. We believe the statement is correct in respect of the Southern Resilience Scheme that it is intended to allow water to be transferred from the North to the South of BW's region}

59. We are uncertain if some of the supply demand schemes that have been rejected have been appraised on an equal basis. The potential supply of potable water from Wessex Water[18] has an AISC of 103 p/m^3, this is compared to Cheddar Reservoir 2's raw water AISC of 83 p/m^3. The Wessex bulk supply is also to a location that would assist with Southern

[17] SOC039 page 182, maximum demand is 8,000 Ml pa of raw and 700 Ml pa of potable water, a daily average flow of 23.8 Ml/d

[18] BW's SoC Clause 265

Resilience[19]. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We believe the statement is correct, this does not imply that BW should implement a higher p/m^3 scheme. The comparison is between raw water and potable sources; we do not believe this is a correct process. A new sentence has been added.} The annualised cost of water from the proposed Cheddar WTW[20] is between £0.175 and £0.194/m^3 depending on flow.

3.5 Risk

3.5.1 Approach to Risk

60. BW's view is considered to be risk averse and we believe risk can be mitigated by means that do not involve the construction of Cheddar Reservoir 2 during this AMP.

3.5.2 Timing of Solution

61. There is much flexibility in terms of the timing of the reservoir since there are many available solutions to deliver the outcome required for the supply demand balance.

62. We understood that the key driver is the need to supply a Power Station and since there is uncertainty around the provision of this supply we consider there is not a sufficiently strong case to start the reservoir construction during AMP6. The revised Security of Supply Index (SoSI) graph shows the additional time that is available.

63. During the discussion on 27 May 2015 it became clear that BW's opinion is that the reservoir is still required and that the primary driver is due to a deficit in the WAFU in the south of their region. As discussed in the section on Southern Resilience we do not believe this to be the case.

64. We also note that proposed cost profile[21] does not align with the information given by Arup[22] where the site preparatory works were over a shorter duration, prior to embankment construction commencing, than the expenditure suggests. There is also two years allowed for landscaping at the end of the project. Considering both of these points we believe that BW could obtain a yield from a new reservoir in a period of six years from commencement rather than the 10 that is generally used. This also suggests that the scheme could be delayed.

[19] Confirmed in 27 May Meeting see notes in Appendices
[20] SOC206, page 49
[21] Table 98, 150311 Bristol Water SoC
[22] 27 May 2015, meeting

3.6 Cost

3.6.1 Basis and Appropriateness

65. We understand that Arup's estimate at the time the Business Plan was produced was a total scheme cost of £126m, however the CAPEX used in the NPV calculation is £114M. The estimate has subsequently been amended and the revised construction costs over AMP 6 and 7 are £116m[23] plus £4m which has already been spent on this scheme in AMP 5.

66. As an overall review of the estimate, we believe that it is susceptible to slight rate changes, which can vary the overall costs significantly due to the large quantities involved. We would have expected a sensitivity analysis to have been undertaken on some of the key rates. We have not seen any evidence of this but note that for each £0.05/m^3 change in rate for excavation alters the scheme cost by approximately £100k.

67. In our review of BW's cost estimate produced by Arup we have made the following observations:-

Borrow Pit

68. There appears to be some double handling of excavated material to the value of £808,320. From the information provided we can not be certain of the definite need for this, however there is potential to reduce this cost through programming effectively.

Dam Embankment

69. The construction of the reservoir will inevitably require a significant amount of double handling of excavated material. The contractor may be able to link the embankment building with the excavation and therefore be able to reduce movements and costs. This may not be significant.

Slope Protection

70. Topsoil from the on site stock pile is used in the works; however it appears that all topsoil is from site. There should be a reduction in the cost of removal from site by the quantity used in the works. This would be a value of £351,894 for 44,449m^3, if this has not been included elsewhere.

Access Road

71. The cost of the access road to the Dam is in excess of double what we would expect the road to cost. We estimate that some £334k has been included in this high rate.

Draw-off Culvert

72. Unable to check costs, as there is insufficient build up. This is not considered to be significant.

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[23] Business Plan includes £43M and £67M, total of £110M

Draw-off Pipework

73. Unable to check costs, as there is insufficient build up. This is not considered to be significant.

Draw-off Tower

74. The concrete rates and reinforcement quantity and rate are low. The reinforcing in particular could have a significant effect. We estimate that the costs should be £164k higher than is already included.

Mechanical & Electrical Works

75. Given the experiences of algal blooms on the existing reservoir and also Arup's concerns expressed about reservoir management we would have expected this to have been considered in more detail. This element could add to the OPEX cost of the project.

Utility Diversions

76. Wessex Water Rising Main and other services, not sufficient details, however this is not considered to be significant.

Landscaping

77. We do not have a comprehensive scope to validate the prices included however a number of priced furniture items included appear excessive such as £700/nr for bins and £900/nr for benches. There is an inclusion of a 4m footbridge at £25k, which depending on the scope could be excessive. In the scale of this project we would not consider it to be significant.

78. We have not had sight of a design to verify all the inclusions but significant inclusions without full substantiation such as: -

- Children's playground [✂];
- Duck Decoy Restoration [✂];
- Channel Modifications to River Cheddar Yeo [✂].

79. These are not considered to be significant. {This sentence was challenged in BW's comments dated 22 June 2015. BW have clarified that the item "Floating Island Mix" includes the island and not just seed as the description suggested. The paragraph has been amended and Table 4 of this report}

Other Items

80. There is an allowance of £2m for ground water included within this section. With an allowance of this value we would expect to see some justification or substantiation to support this estimate.

81. There is a section for Compensatory Storage for approximately £700k, which also includes excavation. It is unclear when reviewing the documentation provided whether this is a double counting of the previously included excavation.

82. It may be possible that these could be refined on a more detailed estimate.

Section 106/Section 278 Costs

83. We do not have enough detail to comment whether these inclusions are correct.

84. It may be possible that these could be refined on a more detailed estimate.

Land Costs

85. The Land Costs value used in the estimate is for Option F, which is [✂]. This should have been for Option C at [✂], therefore the Land Costs should be reduced by [✂].

86. However the Compensatory Storage Land Purchase should be [✂] rather than [✂].

Construction Preliminaries

87. Given the type of work being executed we would not expect to see a large site set up, throughout the works, compared to the value of the works. Essentially this is a 'muck-shifting' operation that requires large construction equipment but requiring a low level of supervision and management.

88. The 20% Construction Preliminaries included appears excessive in our opinion and would we expect to be in the region of less than 10%.

Archaeology

89. There is a £10M inclusion which we are unable to validate with the information provided. On face value this looks extremely excessive, we understood this is for investigation and reporting rather than excavation and removal, and would need further justification to be able to substantiate this sum.

Risk

90. The estimate includes 19% risk, £15M, has been added to the construction cost. This has been derived from the Optimism Bias calculation and we note that the price is sensitive to variation in this. A one percentage point change would add or deduct approximately £800k to the estimate.

Cost Summary Table[24]

Item Nr	Item	Addition / Risk £(000)	Deduction / Opportunity £(000)
1	Borrow Pit / Double Handling		800
2	Slope Protection / Topsoil		350
3	Access Road		330
4	Draw-off Tower	164	
5	Construction Prelims applied to items 1 to 5 (indirect % based on advised rate)	32.8	245
6	Construction Preliminaries		5,800
7	Land Cost		1,100
8	On-costs applied to items 1 to 7	62	2,716
	Total	**259**	**11,341**
9	Risk / Optimism Bias	_+/- 800 per 1% change	

Table 4

3.6.2 Efficiency of Solution

91. It may be possible to construct a new reservoir at a lower cost if the existing one is taken out of service for a period of time. {The preceding sentence was challenged in BW's comments dated 22 June 2015. However we believe this statement is correct, it is not addressing the practicalities of this particular scheme and we intended it to be read in conjunction with the next paragraph} This approach has been used elsewhere.

92. During the meeting on 27 May it was briefly discussed that this had not been considered due to the need to maintain the existing reservoir in use and to provide a wildlife corridor. However should the Southern Resilience scheme be implemented the potential to remove the Cheddar Spring source (reservoir and WTW) from supply for a period would be possible. {The preceding sentence was challenged in BW's comments dated 22 June 2015. The paragraph has been extended to explain our suggestion for potential efficiency of the solution} One of the reasons for of Southern Resilience is to enable Cheddar WTW to be removed from service.

93. Because Cheddar Reservoir has been designed in isolation from BW's other potential schemes, we believe that consideration should be given to a different approach that has not been investigated. Due regard will need to be given to all of the practical issues that may be raised. We would expect that this investigation would require input from the 'Panel' Engineer who would advise on what measure would be required, such as the degree of drain-down of the existing reservoir.

[24] Table amended to remove Floating Island Mix

3.7 Conclusions

94. Given the water demand projections based on the ONS population growth the decision is not whether Cheddar 2 reservoir should be built, but rather when it needs to be built. This question of timing is wholly dependent on the supply demand balance forecasts used by BW that incorporate a level of headroom (the safety margin between supply and demand) and the sequencing of alternative supply demand management options which would defer the construction of the reservoir. As described above we would expect that a new reservoir would only be justified once other supply demand options have been exhausted.

95. BW has not demonstrated the need to construct the reservoir during this AMP even if the Power Station goes ahead. If the power station does go ahead and is operational in 2019 and assuming the supply demand options presented by BW cannot be improved (we believe they can) it would need to start in AMP7 if 10 years is required for the construction period. We are of the opinion that the period is less than 10 years and construction does not need to commence until[25] AMP8. If there is no power station then on the basis of the above and assuming headroom is correct (it is likely to be overstated) then the reservoir will be needed by 2035-2040.

96. Finally there is the question of whether BW has made a convincing case for starting construction of the reservoir in AMP6. There are several issues in the documents presented by BW in making its case.

- No realistic alternative scenario has been developed or considered against which to judge the merits of the construction of the reservoir in AMP6.
- The optioneering has not sufficiently developed alternative scenarios and there is no strategic wholesale plan that identifies synergies between supply demand, Cheddar WTW enhancements and the Southern Resilience scheme.
- Of concern is the lack of consistency between the values used throughout the documents reviewed this does not provide confidence.
- Headroom due to climate change this is highly risk averse.
- There is little evidence that there is strong support from customers and that customers are willing to pay for the increased risk. Indeed the evidence suggests that customers have only been presented with the scenario which includes the supply to a power station.
- Seabank 3 Power station is likely to use effluent (most environmentally friendly) so there is little likelihood that there will be a need to supply 20Ml/d in the future.
- The potential to supply the proposed Avonmouth power station seems limited and given Scottish Power's statement[26].

[25] Typographical error corrected 25/06/15. "until" replacing "in"

[26] The Cooling System and Aqueous Discharges,

- No evidence of WAFU reduction due to climate change. Headroom includes climate change.
- Choosing not to supply either proposed power station and not constructing Cheddar Reservoir 2 gives BW a net improvement on WAFU of 4 Ml/d.

97. Therefore it is difficult to accept the case to start spending on Cheddar 2 in AMP6 based on the information BW have provided.

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http://www.avonpowerstation.com/pdf/Avon_Power_Station_Scoping_Report.pdf

4 BEDMINSTER SERVICE RESERVOIR

4.1 Bedminster Service Reservoir Summary

98. Following our review and investigation of information provided we conclude the following:-

- BW have based their proposed replacement of Bedminster Service Reservoir on the assumption that they require the storage volume it contains and that it increases the risk to customers if they do not replace it.
- BW have assumed that the service reservoir cannot be refurbished without investigation into the potential. The potential to refurbish the structure was dismissed.
- In our opinion the selection process has not considered refurbishment, capacity or given due regard to constructing a replacement at Barrow where more benefit could be obtained.
- BW have taken a very risk averse position.
- The cost for the replacement is at a value we would have expected however we believe that refurbishment or maintenance of service reservoirs would be part of BW's normal business.

4.2 Information

4.2.1 Information Considered

99. The following is a list of the information considered in this section:-

Filename	Document Title	Summary or Comment
150311 Bristol Water SoC.pdf	Bristol Water's Statement of Case to the CMA	
Bristol Water CMA response Q7.pdf	Question 7 from the CMA to BW 24th April 15	
Bristol Water CMA response Q9.pdf	Question 9 from the CMA to BW	Atypical relative to industry costs.
ENQ009 167N48 Bedminster Reservoir.xlsx		Wilco model - Business case need and driver build up for Bedminster Res scheme.
ENQ017 Preliminary Design Report (v3) (18.11.13) - PR14 NIM5 Bedminster Reservoir.pdf	Bedminster service reservoir preliminary design report - Black and Veatch Sept 13	
ENQ018 Bedminster_2007(1).pdf	Reservoir Inspection Report	Bedminster service reservoir inspection report March 2007.

Filename	Document Title	Summary or Comment
ENQ019 Bedminster 2013.doc	Reservoir Inspection Report	Bedminster service reservoir inspection report May 2013.
ENQ023 Table W5 - Asset Information - Asset data - EXTRACT.xlsx		Details of BW's Service Reservoirs and Water Towers.
SOC002 Wholesale Plan - June Submission.pdf.pdf	BW's Wholesale Plan Submission June 14.	
SOC213 Appendix H - Bedminster Reservoir Justification Report 20130926.pdf.pdf	Bedminster Reservoir Current and Future Requirement.	[✂] Network Planning, Nov 12. 2 page report background and justification. Rest of document appendices - figures and charts.
BedminsterSketches.pdf	Reservoir Drawing	Old drawing of Reservoir, list of repairs.
Bristol Water response to query CMA0185.pdf	Response to query CMA0185	Assurance of Bedminster costs, in ENQ066 BRL CMA - MM Bedminster assurance info 28 May 2015
Bristol Water response to query CMA0186.pdf	Response to query CMA0186	Bedminster SR decision to abandon taken in 2006 (seems premature when used for further 7 years).
Bristol Water response to query CMA0187.pdf	Response to query CMA0187	Bedminster £30k for ground improvement.
Bristol Water response to query CMA0188.pdf	Response to query CMA0188	Bedminster risk register supplied.
Bristol Water response to query CMA0189.pdf	Response to query CMA0189	10 days retention statement in 2007 Inspection Report is incorrect.
Bristol Water response to query CMA0190.pdf	Response to query CMA0190	Bedminster comments on storage across BW's area.
Bristol Water response to query CMA0191.pdf	Response to query CMA0191	Bedminster comments on storage across BW's area.
Bristol Water response to query CMA0192.pdf	Response to query CMA0192	Bedminster – to look in detail at building at Barrow.
BW_inspection_June13.docx		Bedminster report, similar to 2013 report issued previously.
ENQ053 Bedminster_2001.pdf	Reservoir Inspection Report	Bedminster report from 2001
ENQ054 Bedminster 17 05 13 003.jpg		Bedminster photo

Filename	Document Title	Summary or Comment
ENQ055 Bedminster 17.05.13 055.jpg		Bedminster photo
ENQ056 Excavation on roof 05.06.13 001.jpg		Bedminster photo
ENQ057 Excavation on roof 05.06.13 002.jpg		Bedminster photo

Table 5

4.2.2 Shortfall of Information

100. We consider the following information is required to enable a complete assessment to be undertaken:-

Information Required	Reason Considered Necessary
Photographic evidence of cracks	Substantiation of statements made in Reservoir Inspection Report

Table 6

4.3 Demonstration of Need

4.3.1 Overview

101. BW has a large number of Service Reservoirs with a significant quantity[27] of stored potable water to supply an average daily demand:-

- Number - 136
- Combined Capacity - 537 Ml
- Average Daily Demand - 300 Ml/d [28] (264Ml/d[29] in 2013/14)
- Capacity in store - 43 hours (48.8 hours in 2013/14)
- ADPW demand - 398.6 Ml/d (2040 horizon 508.7 Ml/d)
- ADPW Capacity in store - 32.3 hours (26.3[30] hours)

102. These figures demonstrate that BW has a significantly larger volume in storage than they have stated they require (12 hours capacity plus 12 hours strategic storage) and on a 'like for like' basis are approaching twice that of a comparable water company[31]. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this

[27] ENQ023 Table W5 - Asset Information - Asset data - EXTRACT.xlsx
[28] Executive Summary SOC039 wrmp
[29] BW's SoC Clause 313
[30] Includes proposed Rowberrow Service Reservoir
[31] South Staffs Water have 42 Service Reservoirs, combined capacity of 378 Ml, average daily demand of 320 Ml/d giving 28 hours storage

and believe that our statement is correct for further explanation the following paragraph has been added.}

103. The Water Companies have several different requirement that range from 15 hours Average Annual Demand in Wessex Water, we have enclosed in Appendix F – Service Reservoir Capacity. All of the required capacities are lower than BW's

104. Although Bedminster Service Reservoir (SR) has a significant capacity, 23.9 Ml, BW still maintain across their area significantly more treated water in storage than they have said they require. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have reviewed this and believe that our statement is correct and have added further explanation} Across BW's region they have over one days ADPW (average demand peak week) capacity until the 2040 design horizon[32].Within the Purton-Barrow-Littleton Zone, using what we would consider to be the usual Average Demand, a new SR would not be required until 2025[33].

105. We also note that should the trunk main currently supplying the zone fails "There are however 3 simple valve operations which would negate this within 2 hours"[34]

106. Bedminster SR is over 100 years old, beyond what would be considered to be its normal service life, and so it is not surprising that a Victorian structure would need replacement[35] or major refurbishment.

4.3.2 The need for Bedminster SR

107. It is now known that the decision to replace Bedminster SR was taken in 2013[36], the structure remained operational until 2013. {The date in the preceding sentence was challenged in BW's comments dated 22 June 2015. We have corrected this in line with their statement and added the following sentence.} The last time any substantial maintenance was carried out on Bedminster SR was in 1996-97. We note that there was a dramatic difference between the 2007 and 2013 Inspection Reports.

108. Bedminster SR has not been in service for almost two years at the time this report has been compiled, it has also been operating at a reduced volume due to a crack, at high level, for a significantly longer period of time. Neither of these changes have had an obvious impact on BW's ability to supply water to their customers. This can be accounted for by the potential to serve the area from several routes.

109. {This sentence was challenged in BW's comments dated 22 June 2015. The reference has been corrected and clarified with the inclusion of the text from the reference} BW also cite that the SR is used to 'break' the pressure from Barrow WTW. The concern being expressed

[32] Bristol Water response to query CMA0190.pdf. Point 3.

[33] SOC213 Appendix H - Bedminster Reservoir Justification Report 20130926.pdf, figure 3. NB we believe the Demand line has been increased by over 10 Ml/d when compared to the numeric values provided.

[34] SOC213 Appendix H - Bedminster Reservoir Justification Report 20130926.pdf, page 2.

[35] South Staffs Water are currently tendering for the replacement or major refurbishment of one of their Victorian SRs with a similar capacity.

[36] Bristol Water response to query CMA0186 and update 030615

as follows "…*the pressure gradient would increase without Bedminster Reservoir to break the pressure, resulting in an increased likelihood of failure with 22,200 connections being effected…*[37]" This use of the SR is negated due to BW installing pressure control zones.

4.3.3 Inspection Reports

110. [38]As noted above the 2013 Reservoir Inspection Report states that the condition of the SR is significantly worse than that in the previous one. Given that no maintenance work was carried out since 1997, some deterioration would be expected, however the impression is still that the SR is in a worse condition that it should be given the "*functionally sound*" report from 2007. There appears to have been no action taken following the conclusion recorded in the 2007 Inspection Report "*It is believed the crack at the top of the wall adjacent to the inlet and outlet chambers was caused when the reservoir was temporarily filled to top water level during the recent incident when there was a burst main in Hotwells Road*.[39]"

111. Allowing the structure to continue to leak[40] also has the potential to hasten its demise as viable.

112. The 2013 report notes that there is a 100mm[41] wide crack in the tank, the additional photographs supplied after the 27 May meeting have enabled the location and scale of this to be established. It is surprising that the report was not more comprehensive with regard to this. It is worth noting that the policy of maintaining the reservoir at a lower level was working as the crack appears to be dry, it would however be a likely source for bacteriological contamination.

113. We are surprised that the statement in the 2007 Reservoir Inspection Report stating that the SR has 10 days retention remained unchallenged.

114. B&V's report also noted the poor condition of the main supply to the reservoir; this would appear not to be the case[42].

4.4 Solutions

4.4.1 Solutions Considered

115. B&V report and BW's SoC[43] detail 5 options that were considered, all of these were variations of rebuilding the same capacity SR either at Bedminster or at another location.

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[37] SOC213 Appendix H - Bedminster Reservoir Justification Report 20130926.pdf, page 1
[38] Paragraph amended regarding 2006 decision to replace structure. Also extended for clarity.
[39] ENQ018, Conclusions page 6.
[40] Last recorded significant expenditure 1996 – SOC546 Forecast Capital Expenditure
[41] Measured diagonally. We note that the two side of the crack do not appear to match, a sliver of concrete appears to have been removed.
[42] Discussion at meeting on 27 May 2015
[43] Table 11 Scheme Options Considered

116. What appears to have been omitted in the selection process was the potential for a new SR to have greater use if constructed at Barrow WTW where the stored volume could supply any of four trunk mains. The size of the SR should also be considered, at any location so that the maximum benefit is provided.

4.4.2 Options not Considered

117. Whilst it may not have proved to be economically viable, or potentially would have had a short life expectancy, the obvious omission is the potential to refurbish the structure. A general period for refurbishment of a service reservoir would be 20 years the anticipated life of waterproofing. {Please see Appendix H – Bedminster SR, BW's Comments for specific responses to BW's comments in their Appendix One}

118. The structure, around the major crack reported in 2013, at the top of the wall, could have been rebuilt. The other reported defects could have been rectified, as is generally done by other water companies, in accordance with recognised guidelines[44]. The works to be considered at Bedminster would be along the lines of:-

- Pressure grouting and under floor voids;
- Structural repair;
- Internal coating wall and floor;
- Application of externally applied flexible water membrane and replacing gravel;
- Drop test;
- Roof leakage test (wetting for 6 hours).

4.4.3 Selection Process

119. Little evidence of a selection process has been provided; this to a large extent was not carried out, or cannot be shown to have been carried out, due to the decision taken in 2006, corrected to 2013, to replace the structure.

4.5 Risk

4.5.1 Approach to Risk

120. The approach taken by BW is extremely risk averse, there are several alternative options that enable customers to be supplied.

121. An increased risk option was to refurbish the structure, this could be possible, but due to the decision taken was not pursued. By not refurbishing the structure and preventing leaks at an earlier time the condition has significantly worsened.

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[44] CIRIA Report R138 - Underground service reservoirs: waterproofing and repair manual

4.5.2 Timing of Solution

122. It is clear that, even given the predicted growth in demand, that a new SR is not required for a considerable number of years. {The preceding sentence was challenged in BW's comments dated 22 June 2015. Having reviewed the information we believe it is correct. Even with Bedminster SR, if the trunk main from the SR supplying customers burst, the situation would require the re-valving operation to take place.}

123. SRs have a relatively short design and construction period and could be built much closer to the period when BW's stored treated water is inline with their policy of 24 hours capacity held in SRs. From our experience of the Water Industry and knowledge of what other companies allow in their SR designs we would expect this to be based on average daily flow rather than ADPW flows. {The preceding sentence was challenged in BW's comments dated 22 June 2015. We have amended to clarify why we have expressed our opinion }

124. Consideration also needs to be given to other planned works by BW and the potential for them to be a deciding factor in when to refurbish or replace Bedminster SR. We note BW's Business Plan includes "*Construction of new mains and service reservoirs to meet increases in demand"*[45]*;* .please see 4.6.2 Efficiency of Solution. {The preceding sentence was challenged in BW's comments dated 22 June 2015. Having considered the point raised we have amended accordingly}

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[45] Last bullet point SOC002 top of page 29, in section on major elements of our wholesale investment programme

4.6 Cost

4.6.1 Basis and Appropriateness

125. We have undertaken an independent high level cost estimate to validate BW's Submission. This approach enables Aqua Consultants to pinpoint the issues should there be substantial differences. Our estimate is based on the scope information and dimensions provided in the document ENQ017 Preliminary Design Report completed by B&V. Our cost information is based on tendered prices for a similar service reservoir, which also includes demolition of an existing dilapidated reservoir.

126. In the table below we have compared our estimate against BW's estimate used in their PR14 submission.

[✂]

Table 7

127. We estimate the total scheme value of works within 5% of BW's estimate, and under 1% on the Direct Construction Costs. Given the level of detail we are working on, we are satisfied with BW's costing of this reservoir.

4.6.2 Efficiency of Solution

128. If a new reservoir was constructed where it can be used by other trunk mains it would provide additional benefit to BW.

129. BW are reviewing the location of the 'Bedminster' SR[46], we would also suggest that the impact of the Southern Resilience service reservoir should be included in this review {The preceding sentence was challenged in BW's comments dated 22 June 2015. We believe it to be correct but have extended the sentence to explain further}.as water at Barrow can be pumped to Rowberrow SR which is part of the proposed Southern Resilience Scheme.

4.7 Conclusions

130. BW have not demonstrated the need to replace Bedminster SR, they have significantly more storage than they require, the zonal demand can be supplied through various mains and when the demand requires it there may be a better location for the structure.

131. BW have not demonstrated that a refurbishment approach could not be carried out economically.

132. We consider that the replacement or major refurbishment of a structure over 100 years old should be expected to be part of BW's usual processes.

133. BW have not demonstrated that they require to invest in replacing Bedminster SR in this AMP.

[46] Bristol Water response to query CMA0192

134. Construction of any additional service reservoir capacity should be considered in the overall context of what facilities BW have and are planning.

5 MAINS REPLACEMENT

5.1 Mains Replacement Summary

135. Following our review and investigation of information provided we conclude the following:-

- BW have relied upon a model to demonstrate what lengths of distribution mains are to be replaced, this we believe has a fundamental flaw in that it relies on the age of the mains. The model is disconnected from the reality of the burst in BW's area.
- The length of Trunk Mains that BW have included in their Business Plan, derived from modelling, is not being met by the proposed trunk mains programme.
- We can not establish how BW have determined the sum they have included for distribution mains in their Business Plan.
- We believe that BW's cost estimate for trunk mains includes too high a level for risk and contingency.
- We conclude that the proposed costs for the mains programme should be clarified and should not be funded at the level proposed by BW.

5.2 Information

5.2.1 Information Considered

136. The following is a list of the information considered in this section:-

Filename	Document Title	Summary or Comment
150311BW SoC	Statement of Case	
SOC 011	CC report on BW 2010	
SOC 096	CH2MHILL Review	
SOC 136	MM Assurance Report	
SOC 137	Atkins Capital Maintenance Review	
SCO 292	Asset management	
SOC 347	WP1 - Distribution Mains	
SOC 349	WP1 – Trunk Mains	
SOC 367	BRL_PR14 MM Assurance	
SOC 476	Wholesale Plan	
ENQ 016	Trow Report – review of leakage	

ENQ 027	CP338 WRc Mains Intervention Report	
BW CMA Response Q7	Reports and references supporting Business Plan and Statement of Case	
BW CMA Response Q8	Evaluation of effectiveness of ALC	
CMA0195	Electronic copy of schedule 6 from Term Contract	
CMA0197	Leakage associated with trunk mains	
CMA0198	Fishponds 18” and 12” rates	
Example Quote Breakdown_sch6.xlxs	Contractor Framework rates	

Table 8

5.2.2 Shortfall of Information

137. We consider the following information is required to enable a complete assessment to be undertaken:-

Information Required	Reason Considered Necessary
CMA 0196 Distribution Mains Rehabilitation Tool	How 230km target gets prioritised
CMA 0196Trunk Main Rehabilitation Tool	Scheme selection for 30km target

Table 9

5.3 Demonstration of Need

138. The Business Plan sets the objective of maintaining stable serviceability across the mains network and promotes the need for 230km of distribution mains replacement and 30km of trunk mains relining during the AMP 6 period. The determination of these requirements comes from WiLCO (SEAMS) 4No. Distribution and 4No. Trunk Main scenarios which are input to the Cross Asset Optimiser (CAO) Tool to be optimised with all other schemes. The CAO output produces the target requirement for both the distribution mains replacement and the trunk mains relining, taking into account affordability. There is no sensitivity analysis of these target outputs.

139. These targets are then assessed in relation to company specific Distribution and Trunk Mains Rehabilitation Tools to prioritise the mains replacement programme and specify the trunk mains re-lining schemes. (Note: the Trunk Mains Rehabilitation tool is still under

development)[47]. The cost of the mains replacement programme is established on the basis of a single unit rate per metre derived from an historic average rate minus a defined efficiency saving. There is no evidence of sensitivity testing of the chosen rate which takes in diameter variation, ground condition, traffic loading, etc.

140. The Trunk Mains re-lining schemes are individually priced per scheme taking into account the specific diameters of the mains being re-lined with a defined efficiency saving built in (summarised in inquiry documents ENQ031 – 037).

141. In the WiLCO distribution mains model there is an age/burst relationship which defines the current state of the distribution network and its propensity to burst in order to establish the amount of replacement required to maintain stable serviceability over a fixed period (25 years). The CAO Tool then takes into account affordability and the 230km output is acknowledged by BW as sub-optimal and that "smarter network management" will be required in order to retain stable serviceability at the end of AMP 6. The current replacement rate maintains the rate established at CCFD10, at approximately 0.7% per annum, but no similar analysis is provided to establish the boundary between deteriorating and stable serviceability in light of the burst rate established by the AMP 5 programme. The Halcrow report[48] in 2010 stated that the boundary was somewhere between 42.5km/year and 45km/year. The current proposed rate of 46km/year needs to be tested to see at what point the boundary condition is met.

142. The interaction between distribution mains replacement, network maintenance and specific "smarter network management" targets is not evident. The relationship between mains replacement and leakage initiatives (more pressure management, the level of ALC (active leakage control), more meter penetration, supply pipe replacement policy etc.) is not clear in the narrative and is de-coupled in the distribution mains WiLCO model. The cost of smarter network management initiatives and the benefits in relation to leakage and burst rates is not established.

143. In the WiLCO trunk mains model there are burst ratings for the trunk mains to which is applied a linear deterioration rate in order to establish a future (25 year) burst rate. Initially 143km of trunk mains were assessed from which 43km were determined as being cost beneficial. After the model outputs were run through the CAO the outcome was a 30km re-lining programme – again acknowledged by BW as sub-optimal (the impact in terms of Fe water quality issues being compensated for in other schemes). The non-water quality benefits of the trunk main re-lining programme are not well evidenced.

144. The development of the need is therefore totally reliant on the WiLCO model scenarios and these being run through the Cross Asset Optimiser. The CAO can therefore be described as the decision "process" rather than just being a decision support tool. Under questioning[49] it was apparent that BW operational staff have expressed concern about over-reliance on CAO outputs but it is understood that all the outputs have been tested against many "hand

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[47] Bristol Water response to query CMA0196
[48] 100430 Final Report.pdf
[49] 27 May 2015, meeting

optimisation iterations"[50] as well as running numerous iterations of the CAO optimising tool. In the Atkins third review of the WiLCO models (SOC137) they commented on some lack of understanding of input probabilities and the risk of service/consequences; they also commented on high WTP values in the CAO. In the MM Assurance (SOC136) they questioned the proportion of the investment NOT being challenged in the CAO and being passed through as "must invest".

145. There are a number of concerns in establishing the need for the distribution mains replacement and the trunk mains re-lining programmes:

1 There is a disconnect between the modelling and narrative, with the narrative having an over-emphasis on mains age and deterioration rates whereas actual replacement takes account of historic and current burst rates. There is discussion in the Statement of Case (SoC) around soil corrosivity, ground conditions and traffic congestion but this is entirely disconnected from the modelling process[51].

2 The consequence of failure for individual mains has not been considered in sufficient detail. The availability of new datasets and advances in software and computing provide the ability to quantify the number and type of properties served by each main. This would allow the identification of the high consequence mains, which need to be managed in a particular way.

3 The models and optimisation process have not used a cost model that considers the pipe size or difference in the surface type (eg road, farm land, curtilage, etc.). This could have a signification impact in the cost of the programme of works based on the mains selected to be replaced

4 There is no detail establishing the total km replacement programme as the economic level of replacement. Indeed BW acknowledge that 230km is sub-optimal and there will be a need for "smarter network management" without this being detailed in terms of specific actions and costs. The proposed replacement rate is at the lower end of the bands analysed by Halcrow (CCFD10) but the rate of replacement which defines the boundary between deteriorating and stable serviceability utilising the AMP 5data has to be established (between 42.5km/yr and 45km/yr in 2010).

5 The WiLCO distribution models do not consider leakage but, under questioning, BW acknowledged that there would be increased pressure management (the percentage of properties under pressure management schemes increasing from 53 to 67% across AMP 6); increased Active Leakage Control (target not specified) and increased focus on innovation (dynamic DMAs mentioned). How this links to the overall "smarter network management" approach needs to be detailed.

[50] 27 May meeting

[51] Our understanding of the model is that should a very old main be replaced the network would have a low prediction of bursts. Old cast iron mains have proved to be resilient to burst, whereas PVC pipes from 1970s are prone to bursting. Self evidently the model is not able to utilise the necessary data.

6 There is little evidence of the decision process for selecting the number of Waste of Water Metering Districts (WWMD) in which all mains and service pipes will be replaced. Eight WWMD's were selected during AMP 5 with 43.7km of mains and supply pipes being replaced and these were selected on the ranking of the highest background leakage. There are 1200 WWMD's and it is assumed that a further eight WWMD's will be selected during AMP 6 and this will be part of the 230 km total. The total cost of the zonal interventions needs to be clear as does the unit rate cost differential with the main programme.

7 The trunk mains re-lining scheme costs in ENQ031-37 do not match the schemes in Table 59 of the business plan and the exact lengths and costs are not consistent between FD14 and the inquiry submissions. The narrative has a primary focus on reducing iron related water quality complaints but there is little focus on the non-water quality benefits even though trunk main leakage is accounted for at the model input stage. The narrative does however comment on reducing burst rates and improving unplanned interruptions.

8 We do not consider that 1,882m of abandoned mains should be included in the 30.5 km of relined mains detailed in the Business Plan[52].

5.4 Solutions

5.4.1 Solutions Considered

146. The Business Plan presents a programme with a target of 230km of distribution mains replacement and 30km of trunk mains re-lining over the AMP 6 period. These outputs result from four distribution main model scenarios and four trunk main model scenarios being input to the Cross Asset Optimisation tool which defines the outputs across the whole capital programme and which takes into account the LEF research, willingness to pay and affordability. The outputs are described as less than economic and the "difference" (in terms of maintaining stable serviceability) has to come from "smarter network management" (distribution) and "other schemes" (trunk) in relation to iron water quality failures.

147. There is some narrative around the impact of not meeting these target outputs but there is little narrative around alternative options and how more activity (such as ALC) may or may not impact the mains replacement programme. There is also a complete lack of specificity about the make-up of the 230km mains replacement programme although under questioning BW did discuss prioritising using a distribution mains rehabilitation tool.

148. BW response to CMA Q7 Para 39 states that "[BW have]…*not identified specific lengths of main to replace*…" - the focus is on meeting the overall objective (as defined by the CAO output).

[52] Bristol Water response to query CMA0200

5.4.2 Options not considered or not reported

149. We believe that the following should have been considered:-

- Replacement versus other rehabilitation options on distribution mains or a mixture thereof.
- Variability of the unit cost of replacement for different size water mains under different surfaces.
- Consequence of failure for individual pipes not representing the risk of failure correctly.
- Trunk main replacement versus re-lining or mixture thereof.
- What smarter network management will comprise and how this contributes to achieving stable serviceability.
- Leakage - what does more ALC look like and what is the impact?
- Pressure Management – definition of schemes and leakage and non-leakage benefits.
- Meter penetration – the AMP 5 targets were missed, how will this be recovered and what benefits accrue for the expenditure?
- Maintenance of non-infrastructure works – there is an acknowledged AMP 5 underspend on pump maintenance which has led to pump drives causing off peak network pressure increases. Other maintenance issues are outlined in ENQ016.
- We are not aware of any inclusion of surge suppression equipment (either installation or maintenance) although there are many references to high AZNP's across the DMA infrastructure.
- We are also not aware of any provision of maintenance to any Cathodic Protection (CP) systems that may be installed on any steel mains.

5.4.3 Selection Process

150. The selection process for the distribution mains replacement programme is entirely focused on Asset Level Model inputs to the SEAMS WiLCO Distribution mains model. The outputs from this model have been grouped into four scenarios and input to the Cross Asset Optimiser (CAO) which then determines the scale of the replacement programme taking into account affordability. This output figure then has to be assessed using a distribution mains rehabilitation tool in order to prioritise replacements. The details provided of the rehabilitation tool[53] are an overview Powerpoint™ that does not provide any details of the system.

151. The trunk main re-lining programme has been determined by initial assessment of 143km of trunk mains from which 43km were considered to deliver cost beneficial outcomes. Asset Level Model data were input to the SEAMS WiLCO Trunk Main model and the outputs were grouped into 4 scenarios and input to the Cross Asset Optimiser. The output, taking into account affordability, was 30km of re-lining and this figure was applied to a trunk mains

[53] ENQ062 Mains Rehabilitation Tool Details (1)

rehabilitation tool[54] in order to develop the seven schemes making up the programme (ENQ031 - 037). We note that BW in reality are only proposing to reline 28.59 km of trunk mains[55] not the 30.5 km stated in their Business Plan.

5.5 Risk

5.5.1 Timing of Solution

152. There is no significant risk to the timing of the proposed distribution mains replacement programme or the trunk mains re-lining programme assuming BW make a good start post determination and try to maintain a steady profile throughout the AMP 6 period.

153. The development and delivery of the smarter network management approaches need to be as early in the cycle as possible in order to demonstrate measurable effectiveness and to safeguard against the replacement or re-lining contracts taking longer to deliver than first programmed. This needs to be a fully costed programme which combines sustained network maintenance and a range of leakage related interventions (pressure management and ALC being just two such options).

154. Given the very heavy reliance on the SEAMS models and the use of the CAO Tool to generate outputs it is considered essential that these models are run at least annually to check the outputs and to refine the programmes as necessary. This could impact heavily on the need for more or less smart network management and the costs thereof. The WTP values in the CAO and the percentage of "must invest" schemes must be tested by BW as part of establishing confidence in the CAO outputs.

155. BW's actual means of determining which mains to replace is based on the historic trends and team discussions; this should enable solutions to be provided to the worst performing locations.

5.6 Cost

5.6.1 Basis and Appropriateness

Mains & Communication Pipes

156. The distribution mains replacement in BW's AMP6 Programme is captured under the Infrastructure Capital Maintenance Expenditure. In BW's submission this equated to £47.6M as stated in Table 59 of their Statement of Case[56]. The source of the table is SOC546[57], "Forecast of Capital Allocations", which provides the costs included in BW's submission.

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[54] Under development, Bristol Water response to query CMA0196

[55] Bristol Water response to query CMA0200

[56] 150311 Bristol Water SoC, page 286

[57] Capital Programme 9 February 2015 Extract (SOC546)

157. The sum of £47.6M includes for the 10% reduction in the value for efficiency savings. We have 'tracked' the values through the document to a breakdown of anticipated expenditure through AMP 6; however we are unable to validate the source of the figures in the information provided.

158. In discussions on 27 May 2015[58], BW advised that to build up the distribution mains costs a single unit rate was used of [✂] and this was later confirmed on 05 June 2015 that that this is pre-efficiency costs. In this response[59] it states that the rate is "*fully inclusive cost covering all aspects of the work*". We have understood this to mean that the rate includes all materials, plant, labour, connections, and all BW's costs such as compensation, management etc. We were also advised that this rate was based on work carried out between 2009/10 and 2012/13, so work in AMP 5 to date.

159. [60]The efficiency challenge for AMP6 is 10% reduction and therefore giving a post efficiency rate of [✂]. In using this rate and the proposed 230km of Main Replacement the total programme cost should be [✂], which we could not trace within Forecast of Capital Allocations[61]. This left a £10M discrepancy when compared to the Business Plan that we could not explain. BW have provided an explanation[62] for the £10M 'discrepancy' which we reviewed.

160. We have recently been working with a similar sized Water Company; their 'all-in' Mains Replacement unit rate is £166.07/m including all client on-costs, labour plant, materials and including adjustment for date.[63]

161. [64]When reviewing BW's all-in rate, in conjunction with the explanation of the £10M 'discrepancy' we found that a number of the items are included in the comparable all-in comparison rate. We have adjusted BW's all-in rate to enable a 'like-for-like' comparison which gave us [✂] compared to [✂]. From our comparison we have found that BW are £6.2M higher than expected and we would anticipate that the AMP6 Expenditure on Mains and CPs and should be £41.4M.

162. In addition we have carried out a further benchmarking exercise to evaluate BW's costing using the quotation provided[65]. This provided a build up to the rate for a 250mm diameter pipe at [✂] pre cost efficiency. This rate will form part of the basis of BW's 'all-in' rate of [✂], as that rate includes for various diameters and techniques experienced previously. We noted that the 250mm diameter rate excluded the free issue material, so for the benchmarking exercise we have allowed £20.66/m, giving a rate of £223.27/m. We also note that we would have expected other connections to be included in this rate, such as CPs and tees, therefore this would increase the rate further.

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[58] Meeting at Bristol Water's office
[59] Bristol Water response to qu1 of 5 June
[60] This paragraph revised following receipt of information
[61] SOC546
[62] Bristol Water CMA response qu 1 11 June.pdf
[63] This paragraph revised following receipt of information
[64] This paragraph revised following receipt of information
[65] Example Quotation Breakdown Sch6.xlsx

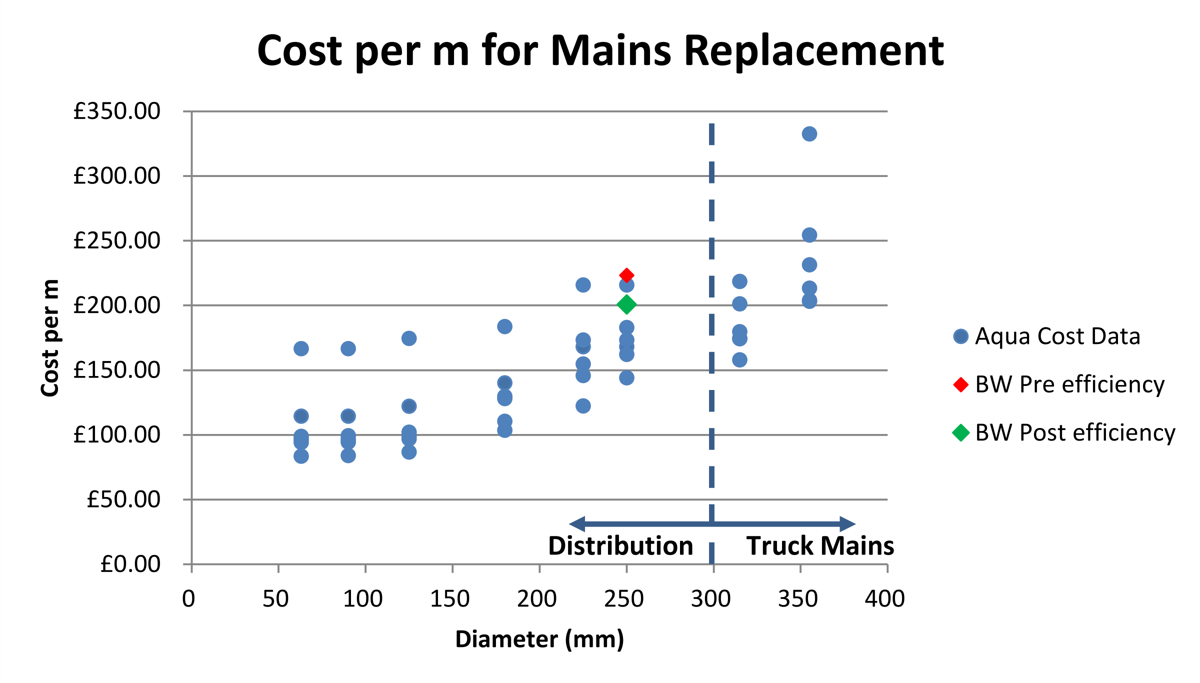

Figure 6[66]

163. The red data point is BW's pre efficiency rate for 250mm diameter mains replacement. This shows that that BW is above our dataset. The green data point is BW's post efficiency rate which, whilst within our data range, it is at the higher end of the scale, showing further potential for improvement.

Trunk Mains Lining

164. In Bristol Water's Draft Submission document 'SOC476 Wholesale Plan' their initial costs for Trunk Mains Lining at £12.7M, which is later revised to £12.2M in their revised submission[67] The Trunk Mains Lining is then adjusted in the Statement of Case to £10.2M.

165. We can trace the £10.2M value back to the document "Forecast of Capital Allocations"[68], however we are unable to find a sufficient substantiation to that value within the document. The £10.2M for the Trunk Main Lining is post efficiency which has had a reduction of 10%[69].

166. We have also been provided with a build up of estimates for the Trunk Mains Lining, however this equates to £10.8M. We have not been able to trace how the detailed estimates have been used and how they relate to the £10.2M submission value. We have reviewed the following estimates:-

- Fishponds Road – Durdham Down
- Durdham Fishponds

[66] Distribution/Trunk Main annotation added.
[67] SOC002 Wholesale Plan
[68] SOC546
[69] CProg Post Efficiency tab of SOC546

- Henleaze
- Summerlands Road
- Chelvey – Portishead
- Portway
- Durdham Down Reservoir.

167. We undertook a benchmarking exercise to compare the costing of the slipping lining and open cut pipe replacement costed in the above estimates, in order to validate the costings.

168. The cost data used to benchmark BW's comes from our experience working with other Water Companies including those of similar size to BW. We have had to cleanse the cost information to enable a like-for-like comparison of all the data sets. This has entailed spreading the costs for Valve and Pits, Bypass, Service Renewals, Free Issue Materials, Contractor On-costs and OHP, Enabling Works, Design Costs, BW Operational Costs and Overheads etc, included in BW's estimate, on a pro-rata basis based on the length of the runs. Our cost information for pipework is split on the location of the pipe runs, such as rural/suburban/urban. Looking at the areas where the work will be taking place we have assumed that BW's Trunk Main Works will be carried out in Urban Areas.

169. The graph below it shows the rate per metre for slip lining based on the diameter of pipes. The red data points from BW's Trunk Main estimates. Information used for BW's rates comes from BW and are stated to be Post Efficiency[70].

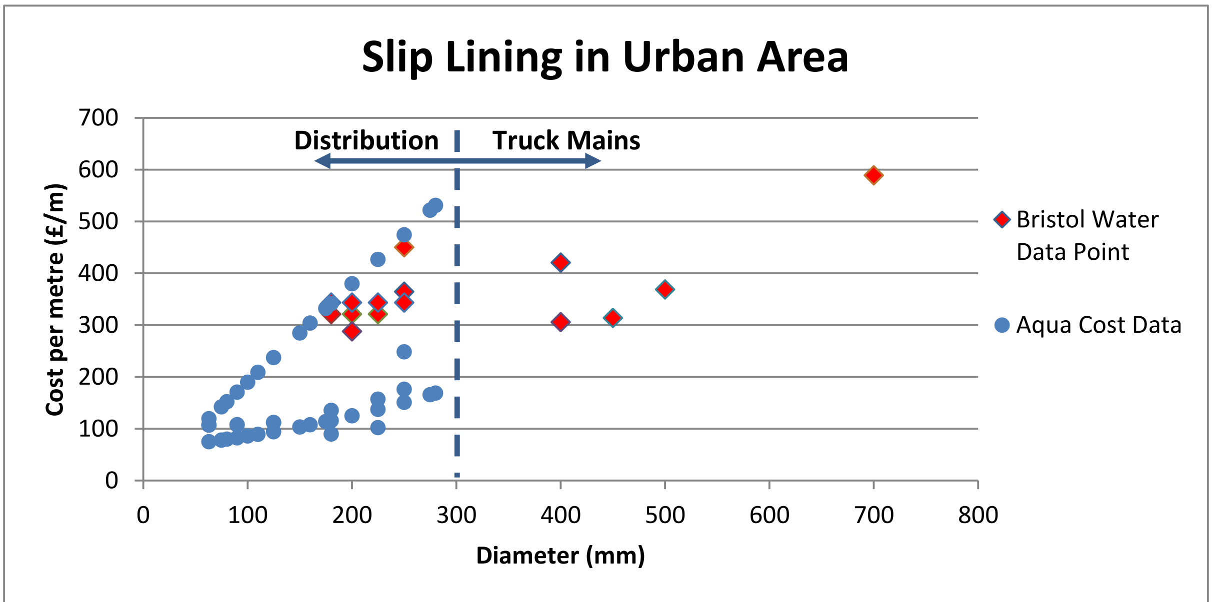

Figure 7[71]

[70] Sentence added for clarity.
[71] Distribution/Trunk Main annotation added

170. BW's large diameter slip lining rates, would fall between our data sets if these were extrapolated. However when we look at the lower diameter slip lining rates, commonly found in distribution networks, BW are at the higher end of the scale. Unfortunately this is where the higher frequency of work will be carried out. {This paragraph was challenged in BW's comments dated 22 June 2015. it has been replaced for clarity }

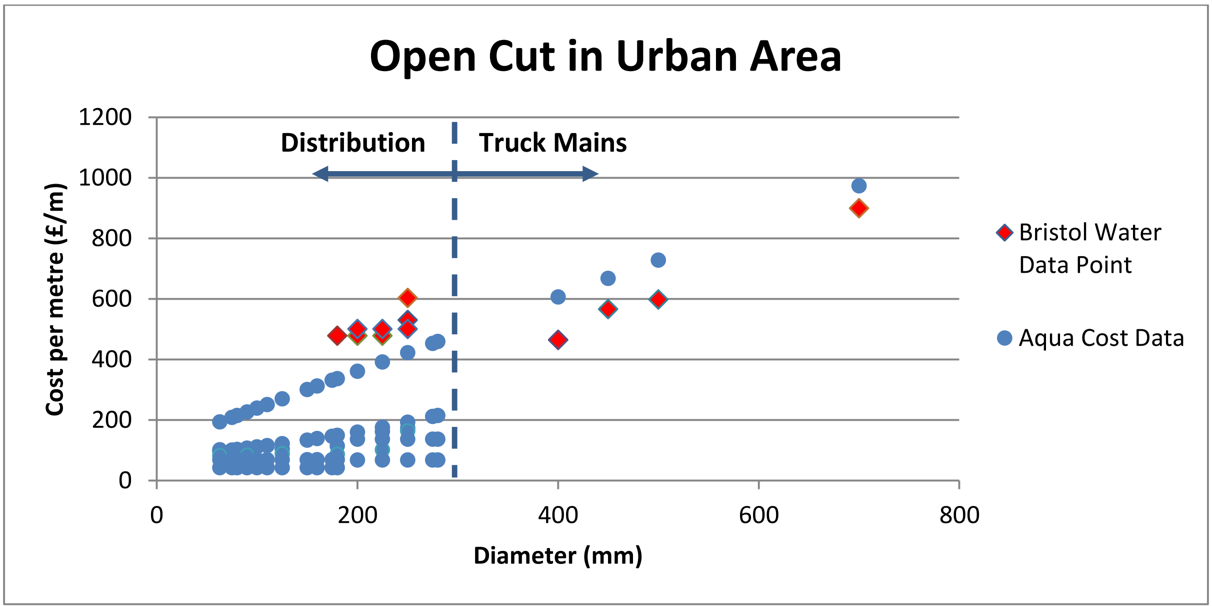

Figure 8[72]

171. The smaller diameter pipework is higher cost than we would expect, whilst the larger diameter pipework is within the range we would have expected.

172. As part of the cost review we have reviewed the 'add-ons' applied to the base costs.

173. There is 25% applied for sundry items, in BW's estimates, which BW have advised[73], to cover non-scheduled items that come to light during the detailed design for which there are no tendered rates. These non-scheduled items would then be included within the Target Costs. BW also identifies the document ENQ059 to demonstrate the percentage of non-scheduled items in AMP5. This therefore is a contingency amount applied to estimates to cover unforeseen items. Given the use of GIS and the level of detail in the estimates, the inclusion of 25% is far in excess of any contingency amount we have seen included elsewhere.

174. Another 15% of contractor risk is also applied, but this percentage is applied in a compound manner therefore value of contractor risk is 22% of the Construction Base Cost. BW has advised[74] that this is to reflect the level of detail at the time the AMP 6 estimate was calculated. They have further justified this as 5% to cover uncertainty over technique and 10% to cover client side risk following completion of a risk review.

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[72] Distribution/Trunk Main annotation added
[73] Bristol Water response to query CMA0199
[74] Bristol Water response to query CMA0199

175. A further 10% of BW's Risk Allowance is also added within the BW Costs section of the estimates. When taking the total value of Risk and Contingency allowances included, on average it equates to 22% of the Total Value of the schemes. We would not expect to see this level of risk being applied in this type of work, or even most construction projects.

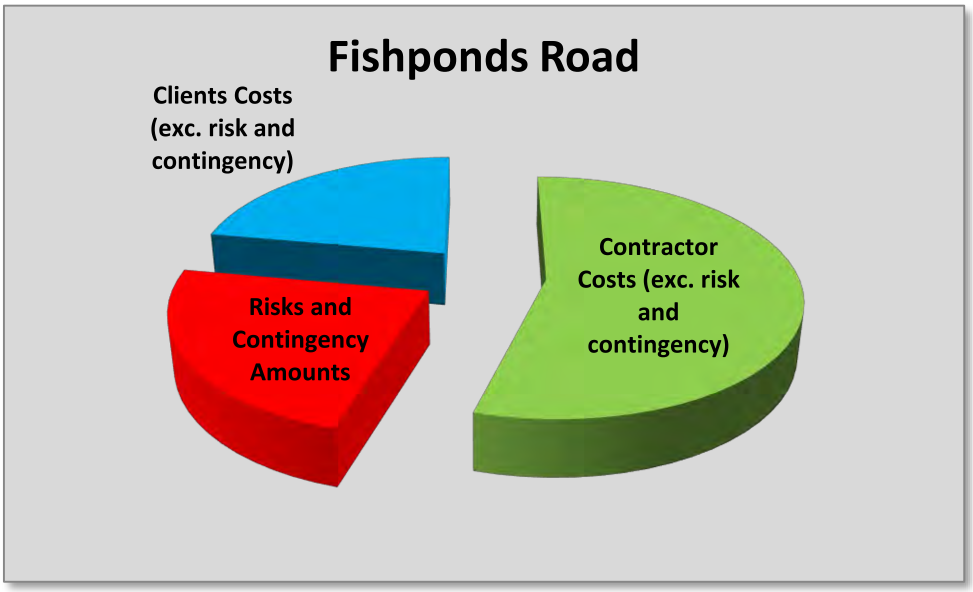

Figure 9

176. We would expect that BW would have sufficient internal capacity to estimate its programme of works to a better degree of accuracy than demonstrated and the business to have more confidence in this.

177. By taking the Contractor costs and Client costs without any Risk and Contingency included, the total Trunk Mains Lining would be £8.48M, by allowing a generous risk allowance of 12.5%, which would be on the upper end of the scale of what we would expect, the Total Scheme costs would be £9.54M. We believe that the 12.5% is more than sufficient given that the Traffic Management, sections of open cut etc. have been individually identified and priced.

5.6.2 Efficiency of Solution

178. We comment as follows on the efficiency of the proposed works:-

- There is not sufficient evidence that the distribution mains replacement programme proposed will deliver stable serviceability and the stated need to undertake smarter network management is not well defined and there is cost uncertainty.
- The proposed replacement rate of 0.7% is the same as CCFD10 but with some uncertainty around the unquantified "smarter network management" requirement.
- The proposed 30km trunk main re-lining programme is known to be sub-optimal and relies on benefits accrued from "other schemes".

- Both programmes use defined outputs from the Cross Asset Optimiser and are stated as meeting Affordability criteria. There is little evidence analysing how the programmes might be flexed or how changes to the mix of solutions might deliver efficiencies.
- There is independent discussion around Active Leakage Control, Pressure Management and Meter Penetration but this is not well linked to “smarter network management” commitment or the network maintenance issues highlighted in supporting documents (ENQ016 for example).

5.7 Conclusions

179. The 230 km of distribution main replacement will not, on its own, maintain stable serviceability and the need for smarter network management is acknowledged BUT the activity and costs thereof are not well evidenced (although there is some reference to more Active Leakage Control, more pressure management and more technology driven innovation). There is less said about routine network asset maintenance (pump drives, PRV settings and maintenance, DMA operability etc.) and how this will contribute to the smarter network management outputs which help maintain stable serviceability.

180. The replacement of all mains and supply pipes at the WWMD level is not explicit either in terms of being part of the 230km replacement target or the number of WWMD’s in which this work will be undertaken. It is assumed that eight WWMDs will be targeted with a contribution approaching 46km of mains replacement and this is part of the 230km total.

181. The mains replacement rate (at 46km/yr) has not been tested to establish the boundary condition between deteriorating and stable serviceability. In 2010 Halcrow suggested the boundary was at a rate between 42.5km/yr and 45km/yr. Given the current burst rate and the benefit derived from a significant lengths of mains replacement in AMP 5, it may be argued that a mains replacement rate of 46km/yr too high.

182. The mains re-lining programme at 30km is acknowledged as being sub-optimal (below the original estimate of 43km showing cost benefit and below the 60km in ENQ016). The iron water quality issues that will be overcome by “other schemes” but the non-iron water quality benefits of the proposed programme are not clear.

183. Changes to the trunk mains re-lining programme, in the various submissions, and to the pricing of schemes has created price uncertainty and this needs to be resolved.

184. The distribution mains replacement programme costs are built up from a single per metre rate with an efficiency “discount” of 10%. Again there is uncertainty over the total programme cost and this needs to be resolved. There is a significant sum in the Business Plan that cannot be evaluated and is not attributable to the ‘all-in’ unit rate used for distribution mains.

185. The activity and cost contribution of “smarter network management” and the cost and definition of proposed interventions in WWMD’s need to be explicitly stated and agreed. The three components of the mains replacement programme – replacement, zonal interventions and smarter network management need to be fully cost justified. The zonal interventions

based on WWMD's with the highest background leakage need to be justified in relation to the WiLCO modelling of distribution mains replacement in which leakage is NOT a component.

186. The narrative emphasis on the age of the network being the primary indicator of the degradation rate of the network is rejected as per the OFWAT Statement of Case, their comparison of BW in relation to Thames Water (on the issues of mains age and congestion) and the age of the network being but one of many factors used to determine investment options. The BW case does not have sufficient comparative analysis of the mix of replacement versus rehabilitation options – the simple delineation of re-lining trunk mains and replacing distribution mains is not necessarily wrong but the justification of the chosen processes is insufficient.

187. In 2005 – 2010 BW revealed in their SoC to CC an under-spend of £3.2M on pump stations (as funded under PR04). ENQ016 discusses pump drive maintenance (and a range of other maintenance interventions) which have created high pressures at off peak demand periods. It is suggested that a clearer focus on network asset maintenance needs to be integral to the proposed "smarter network management commitment" in AMP 6 to assure stable serviceability.

188. It is our opinion that BW have not demonstrated that their proposed trunk and distribution mains programme is the correct approach and that they have not shown the need to fund the works at the proposed level due to the anomalies in the costs included in their Business Plan.

6 REPLACING 1990 TREATMENT WORKS ASSETS

6.1 Replacement of 1990s Assets Summary

189. Following our review and investigation of information provided we conclude the following:-

- BW have used a model output to increase the value of maintenance works to WTW assets, in particular they have cited the early replacement of 1990s equipment.
- Several elements on WTWs have asset life or 20 years or less, these items would be expected to require replacement after this period of time.
- BW have not demonstrated that they have any additional maintenance that would be normally expected.
- We do not believe that BW have justified additional funding above AMP 5 levels for the work on these assets that they have included in their Business Plan.

6.2 Information

6.2.1 Information Considered

190. The following is a list of the information considered in this section:-

Filename	Document Title	Summary or Comment
150311 Bristol Water SoC.pdf	Bristol Water Statement of Case	Clause 957 refers to 1990s facilities and the need to replace life-expired chemical tanks
SOC002 Wholesale Plan - June Submission.pdf.pdf	PR14 Business Plan Wholesale Plan	There are only two references to chemical storage tanks
SOC546 Copy of Extract from CPROG 9 Feb 2015 based on DDR plus open market costs and TM lining to enhancement.xlsx	Forecast of Capital Allocations	Few schemes can be identified against the 1990s construction period that are appropriate to the proposed expenditure
Bristol Water CMA response qu 9 v1.pdf	Bristol Water's response to CMA Question 9 of 12 May 2015	Note v1 version used due to issues with graph in the original issue.
Bristol Water - Hearing Enquiry Response on Treatment Works MNI - Final ....pdf	Bristol Water's response to CMA Main Party Hearing Question 3 of 3 June 2015	Further explanation of BW WTW maintenance plans

Filename	Document Title	Summary or Comment
ENQ073 5114693.008.DG.001 Chemical Tank Report For Issue.pdf	Bristol Water PR14 Chemical Storage Tank Replacement Feasibility Report	Condition Report and cost estimate summary
ENQ074 Appendix 1 PR14 Cost estimate - Polypropylene tanks - AAC.XLSX		Cost estimate, used to build up costs used in Feasibility Report
ENQ075 Appendix 1 PR14 Cost estimate - Steel tanks - AAC.XLSX		Cost estimate, used to build up costs used in Feasibility Report

Table 10[75]

6.2.2 Shortfall of Information

191. We consider the following information is required to enable a complete assessments to be undertaken:-

Information Required	Reason Considered Necessary
Maintenance or replacement records of equipment that are from the installation BW have included in the element of their Business Plan.	The information provided by BW has been very high level, apparently produced from the SEAMS model and not from based on any actual records. If equipment is failing prematurely, especially equipment that has been installed recently, it should be demonstrable with actual records.

Table 11

192. We understood, at 12 June 2015, that BW have further information to demonstrate that they are experiencing a high level of failure of recently installed equipment and some of this is more recent that that of the 1990s. The sections below are written on the basis of the originally available information. 6.8 Additional Information Considered has been added to encompass this submission into this report.[76]

6.3 Demonstration of Need

6.3.1 Necessity of proposed work

193. During the 1990s all water companies invested in new processes to enable them to meet the demands of various legislation, as a result of this the scale of facilities increased. The equipment has to be operated and maintained with various parts of the equipment, now 20 or more years old, coming to the end of the expected life for the element. Whilst the civil

[75] Four additional documents issued by BW, after initial report, added
[76] Amended to encompass additional information.

engineering elements of the 1990s projects will be expected to have a life of 40 years or more, with appropriate maintenance, electrical and mechanical equipment will require replacement at much shorter intervals.

194. BW's Wholesale Plan – June Submission[77] gives details of schemes for Non-Infrastructure Maintenance works, other than "Replace chemical storage tanks"[78] no other works can be identified that correspond to those in Clause 957 of BW's SoC. The reply[79] given to the question regarding these works provides more information about what works are required.

195. The explanation provided of the £7.5M increase in maintenance expenditure from AMP 5 to AMP6 is £1.9M is earmarked for nine AMP 1 to AMP 5 projects with another named single project, Purton Densadeg, at [✂].

196. The need to expend £1.9M is derived from BW's model which produces an output based on "detailed analysis of asset deterioration"[80] and does not apply to specific locations. The basis of the model can be seen from the lengths of Depreciable Lives[81], for example:-

- 2 Years for Granular Activated Carbon (GAC) replacement
- 10 Years for instrumentation
- 20 Years for "Machinery and Installation", which includes chemical dosing systems
- 25 Years for pumping plant
- 60 Years for "Buildings and other construction", which includes tanks.

[77] SOC002 Table 11 Scheme Options Considered
[78] Page 55
[79] Bristol Water's response to CMA Question 9 of 12 May 2015
[80] Clause 954 SoC
[81] Forecast of Capital Allocations – SOC546

6.3.2 Justification of proposed work

197. During AMP6 it will be highly likely that some of the equipment installed during AMP 1 to AMP 5 would require some maintenance or replacement.

198. The following information, Table 3 from BW's response to CMA Question 9 of 12 May 2015, gives details of some 'potential' requirements. Of these the ones highlighted are worthy of comment.

Table 3 Expenditure by site for treatment processes installed in the 1990s, split by period of most recent investment

Site	Process	Period	£m
Banwell TW	Filtration - Slow Sand Filters (SSFs)	AMP1	0.135
Purton TW	Adsorption - Granular Activated Carbon (GAC)	AMP1	0.54
Rowberrow	Chlorination	AMP1	0.18
Purton TW	Effluent Treatment	AMP2	0.72
Littleton TW	Plumbosolvency - Phosphoric Acid	AMP4	0.0675
Banwell TW	ICA	AMP4	0.315
Cheddar TW	Plumbosolvency - Phosphoric Acid	AMP5	0.0675
Chelvey TW	Plumbosolvency - Phosphoric Acid	AMP5	0.0675
Purton TW	Adsorption - Powder Activated Carbon (PAC)	AMP5	0.45
	Total AMP1 and AMP2		*1.575*
	Total AMP3 and AMP4		*0.3825*
	Total pre-AMP5		***1.9575***
	AMP5		*0.585*

Source: Bristol Water

- Purton GAC – will have been an ongoing replacement requirement.
- Cheddar & Chelvey TWs – it would be unusual to require any major work on chemical dosing equipment within 5 to 10 years of installation.
- Purton PAC – PAC is regarded as a consumable item and would generally be seen as a chemical requirement. As with the two schemes highlighted above it would be unusual to require any major work on chemical dosing equipment within 5 to 10 years of installation.

199. The AMP 5 schemes highlighted above do not appear in BW's Forecast of Capital Allocations – SOC546; we would have expected to see these schemes included.

6.4 Solutions

6.4.1 Solutions Considered

200. It would be expected that the only appropriate solution for replacement of chemical tanks and dosing systems would be a like for like replacement; no alternatives have been recorded in Table 11 of BW's Business Plan[82].

201. Seven options have been recorded for the work to the Densadeg process[83], although it is not apparent which option is being considered. We have not considered this named element further.

6.4.2 Selection Process

202. No selection process has been demonstrated for the 1990s work elements other than the proposed monetary value derived from modelling., We understand that the work "which is converted into specific schemes at time of implementation within the capital programme, through our ongoing asset management processes reflecting the latest risk assessment."[84] means that the proposed investment will only be tied to real schemes at sometime in the future. {The preceding sentence was challenged in BW's comments dated 22 June 2015. After consideration we have expanded it to ensure clarity }

203. As a result of the approach it is not possible to comment upon the method that BW would adopt.

6.5 Risk

6.5.1 Approach to Risk

204. We have not been able to review BW's approach to risk in this instance; there is no explanation of what they have assumed. However we would comment that generally there would be duty/standby equipment installed for all process items and it is unlikely that the failure of a single unit would have a detrimental impact on the availability or quality of water produced.

6.5.2 Timing of Solution

205. Maintenance will be required during AMP6 as it has been in the past and will continue to be required. Whilst the equipment installed during the 1990s will in some instances be reaching the end of its expected life and depreciation period it does not immediately fail; which is why BW intend to have flexibility in which schemes are carried out.

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[82] Table 11, Page 55, SOC002
[83] Table 11, Page 54, SOC002
[84] Clause 20, Bristol Water's response to CMA Question 9 of 12 May 2015

6.6 Cost

6.6.1 Basis and Appropriateness

206. BW have proposed an increase in expenditure of £7.5M during AMP6, split as follows:-

- [✂] is for the named scheme at Purton WTW.
- [✂] relates to unnamed projects, derived from the model, installed during AMP 1 to AMP 4.
- c 10% for AMP 5 projects.
- 45% of the increase has not been allocated to any particular source; we assume that this is due to BW believing they will have a significant increase in maintenance expenditure on maintenance on pre-1990 works.

207. We are not able to confirm if the additional sum for AMP 1 to AMP 4 maintenance is appropriate due to the lack of information. At this time we are not aware of other Water Companies specifically highlighting the necessity to increase expenditure against 1990s equipment.

208. It is not obvious why such a level of works would be required to equipment installed during the last five years, AMP 5, potentially some of this is under warranty and if it is failing outside of the warranty period the possibility of a latent defect should be considered. During AMP 6 it may become necessary to maintain or replace equipment such as instrumentation however we consider that this is unlikely and would be of very limited value.

6.6.2 Efficiency of Solution

209. We are not able to comment on the efficiency of the solution as this will be dependent on what BW propose on a scheme by scheme basis.

210. There is insufficient information available to consider the named schemes included in the model output.

6.7 Conclusions

211. BW have proposed a substantial increase in maintenance of non-infrastructure facilities during AMP 6 due in a significant part to works installed during AMP 1 to AMP 4 but there is no clear substantiation of the need to do this.

212. There should be little need for any significant amount of replacement/maintenance to AMP 5 equipment.

213. We do not believe that BW have justified additional funding above AMP 5 levels based on the information provided regarding the 1990s assets.

6.8 Additional Information Considered

214. BW have sought to substantiate the increase of their maintenance budget between AMP 5 and AMP 6 in their 'Hearing Enquiry Response on Treatment Works' document; this has moved away from a direct correlation of 1990s assets and encompasses other elements. Unless noted all information has been obtained from this document.

215. The level of proposed expenditure has been derived from modelling work and then BW have sought justification with the use of examples of the type of work to be undertaken.

216. We have reviewed this additional submission and report in the following areas:-

- Named Schemes – Table 4 of the Response
- Treatment Works Structures
- Media Replacement
- Treatment Works ICA

6.8.1 Named Schemes – Table 4 of the Response

217. In addition to the modelled output BW have included several named schemes in their proposed maintenance expenditure. It is unclear why named schemes are required, if the model predicts accurate forecasts of expenditure we would have expected all works to be included.

[✂]

218. We draw attention to the yellow highlighted schemes, we do not understand why chlorine gas is being replaced when BW's policy is to replace gas with OSEC. We also note that there is no breakdown of the [✂] sum included for OSEC.

219. The schemes highlighted in blue and green appear to be a duplication; it is unclear if they are the same or are different work items.

220. Purton Densadeg is shown at [✂] in the above table. The values in this table are post efficiency and we note that the Forecast of Capital Allocations[85] that the scheme has a value of [✂], suggesting that the table is a mix of pre and post efficiency estimates.

221. We are not able to state if the costs are accurate or comment on their efficiency due to lack of information.

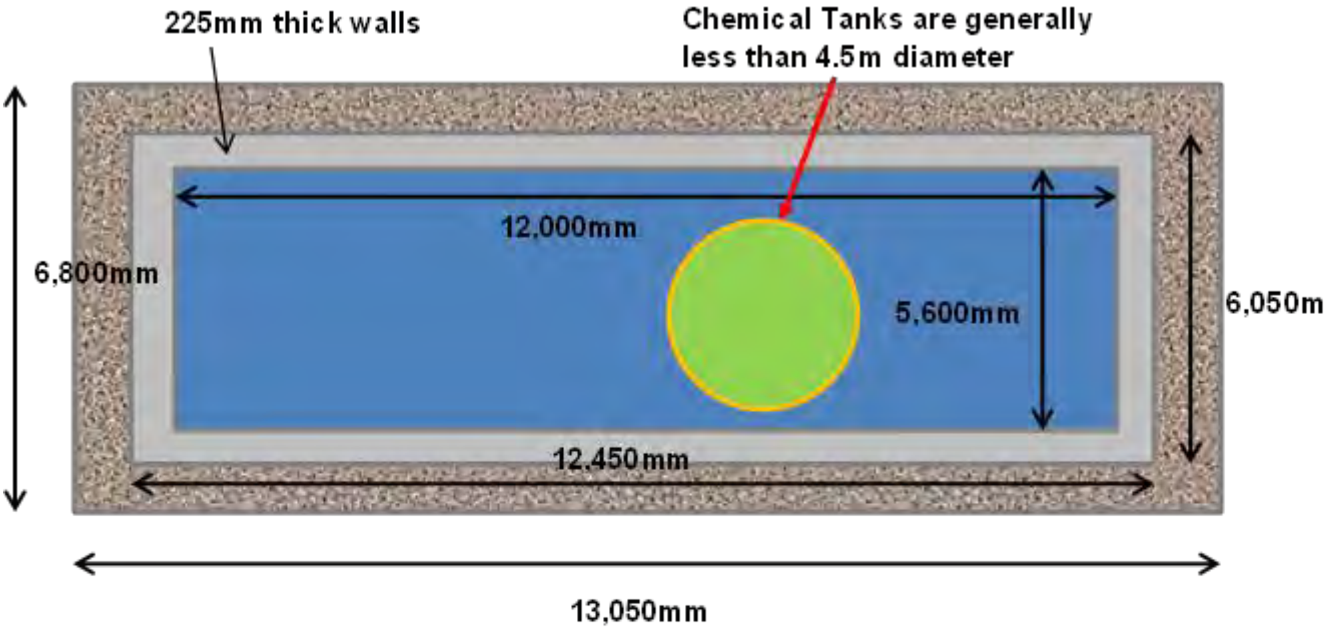
6.8.2 Treatment Works Structures

222. £4.2M has been included for Treatment Works Structures post efficiency, an increase from £1.2M (£3M increase). Of the AMP 6 figure £3.2M (£3.5M pre efficiency) has been stated to be for replacement or refurbishment of chemical tanks.

223. BW's estimate of £3.5m[86], produced by Atkins, for the replacement of bulk chemical storage tanks has some staggeringly large over estimates included. In total we have calculated that some 200 m^3 of bund capacity is required allowing the normal 10% over size, over 950 m^3 has been included.

224. The cost of this over sizing added some [✂] to the post efficiency total. The chemical tanks also have their own bund included in the price. Details of BW's proposed concrete bund below:-

[85] SOC546
[86] ENQ074 Appendix 1 PR14 Cost estimate - Polypropylene tanks - AAC.XLSX



225. In addition to the over size of bunds in the cost estimate we are also of the opinion that the following sums should not be included:-

- ICA equipment, there is no build-up of the [✂] sum and bulk chemical tanks do not have any ICA requirements other than level detection. As these are replacement tanks any telemetry systems would be included in the existing equipment.
- The estimate also includes substantial quantities of pipework, which would not be required in bulk tank replacement, over [✂] too much cost included
- The civil estimate includes [✂] of site cost that are also potentially included in the Main Contractor's Prelims.
- Risk register sum is included in addition to a further 10% contingency sum of [✂], there is no reason to add contingency when risk has already been added.

226. We have made the adjustments that we believe are necessary to reflect the required scope of works, making them to an appropriate size and increasing the number to suit the proposal. We believe the post efficiency cost should be £1.18M rather than £3.19M.

227. Additionally, having considered the survey information for the chemical tanks we would not have expected that all of the bunds would require replacement. Depending on the amount of bund replacement or refurbishment that is required the estimate could be lowered by up to £169k post efficiency.

6.8.3 Media Replacement

228. BW are proposing an increase in 'media' from £2.1M in Amp 5 to £3.6M in AMP 6.

229. Table 3 states "media replacement", this we believe is for GAC, membranes and UV lamps. In AMP 5 the expenditure, according to Table 8, was on GAC and Membranes only, at £1.5M and £0.6M respectively.

230. It is unclear what proportion of membranes has been replaced in AMP 5, no comparison is possible with AMP 6. A significant increase does not seem likely given membranes were replaced in AMP 5.

231. Replacement of GAC is not mentioned in AMP 6.

232. UV lamps require replacement possibly at 6 month intervals or so. BW's SoC notes UV lamps cost [✂] at Cheddar, one of the larger works. Using this sum for the six works with UV over the AMP the cost would be in the order of [✂].

233. On the information given we cannot recommend a sum that should be allowed for media replacement. BW will need an allowance for UV lamps over AMP 5 but at present the other works generally appears to be business as usual and it is not possible to understand the large rise.

6.8.4 Treatment Works ICA

234. £2.2M is included for replacement ICA work. It is not clear if there is duplication with the ICA in the chemical dosing section, we would have expected the ICA systems to cover the entire works.

235. The increase from £1.2M to £2.2M appears to be a large increase given that BW would have had ICA equipment that would have reached the end of its life in AMP 5. It is not possible to quantify any costs due to the level of detail available.

6.9 Conclusion on Additional Submission

236. BW have used a combination of named schemes and a modelled output to establish the level of maintenance for their WTWs, we would have anticipated the model to predict the required level of expenditure for all maintenance or for it to be clear that named schemes did not form part of the model.

237. There are several areas where we cannot establish what the cost of the proposed schemes should be due to the level of information provided. Where we can review the estimates we believe they are substantially in excess of what would be required to carry out the works.

238. The is a significant difference between the proposed level of expenditure on Treatment Works Structures and the sum we believe should have been estimated for the works BW have used to substantiate their proposed level of expenditure.

7 RAW WTW ENHANCEMENT (CHEDDAR)

7.1 Cheddar WTW Enhancement Summary

240. Following our review and investigation of information provided we conclude the following:-

- BW have assumed that to produce a reliable source of water from Cheddar WTW it will require a complete replacement as reservoir management will not be a solution.
- BW have not considered a phased approach or if further investigation of the raw water quality issue is merited.
- BW have not investigated the possible link between the replaced reservoir destratification equipment and the commencement of major algal blooms.
- We believe that a phase approach to reservoir management, investigation, implementation and incremental increases in treatment should be the systematic approach to be adopted.
- Consequently we do not believe that BW have justified the inclusion of the project within their Business Plan.
- We believe that BW should be funded to investigate the reservoir and to implement a staged increase in treatment facilities should they be required.

7.2 Information

7.2.1 Information Considered

241. The following is a list of the information considered in this section:-

Filename	Document Title	Summary or Comment
SOC205 5114693 Q2 56 DG024 Cheddar Algae Removal Outline Design Report Vers C.docx.pdf	Bristol Water Cheddar TW Water Quality Improvement Outline Design Report Rev C	
SOC206 5114693_Q2_56_DG_017_ Cheddar REVIEW Report 2013 11 05.docx.pdf	Bristol Water Cheddar TW Water Quality Improvement Feasibility Report Rev C	
SOC233 Cheddar FINAL Report_WQ Improvements_July 2013.pdf.pdf	Bristol Water Cheddar TW Water Quality Improvement Final Report Rev B	

Filename	Document Title	Summary or Comment
SOC234 14 06 03 BRL02 Cheddar WTW Raw Water Deterioration Further Support Letter FINAL as sent.pdf.pdf	DWI Commend for Support – Supplementary Letter	DWI Letter {GTM's letter dated 18 June challenged the omission of this letter please see 7.3.2 DWI Letter BRL02/37}
	Appendix H Water Quality File Note	Supplementary information
ENQ048 Cheddar Reservoir Algal Bloom – March 2014	Cheddar Reservoir Algal Bloom – March 2014	Supplementary information
Bristol Water Response to Query CMA0177	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0177 of 27 May 2015	Supplementary information
Bristol Water Response to Query CMA0178	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0178 of 27 May 2015	Supplementary information
Bristol Water Response to Query CMA0180	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0180 of 27 May 2015	Supplementary information
Bristol Water Response to Query CMA0181	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0181 of 27 May 2015	Supplementary information
Bristol Water Response to Query CMA0182	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0182 of 27 May 2015	Supplementary information
Bristol Water Response to Query CMA0183	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0183 of 27 May 2015	Supplementary information
Bristol Water Response to Query CMA0184	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0184 of 27 May 2015	Supplementary information - Confirmation of basis and amount for sludge costs for the membrane and the DAF options.

Table 12

7.2.2 Shortfall of Information

242. We consider the following information is required to enable a complete assessment to be undertaken:-

Information Required	Reason Considered Necessary
Scope and cost information for preferred solution	It is not clear exactly what the costs include. There is a substantial variation in cost (CAPEX and OPEX) between SOC205 and SOC 206. Scope is also poorly defined, for example in SOC205 PAC dosing which is included in the discussion of the preferred option in SOC206 is only mentioned once in the document and here it is referred to as still being required for the discounted Submerged Membrane option.
Further details of algae levels and how and when these have caused issues (increased OPEX / reduced throughput) at Cheddar TW	The link between increased levels of algae and reduced performance of the existing processes is not adequately demonstrated. The sole example is March 2014 {Please see footnote regarding the challenge to this statement[87]} which is post preparation of the feasibility and design reports (SOC205 & SCO206) and Business Plan submission.
Further details of zooplankton concentrations and demonstration that pre-ozonation is required to achieve sufficient removal levels.	In SOC233 Rev B of the Feasibility Study the requirement for ozone is considered to be debatable. In SCO206 Rev C of the same report ozone is included without reference to further data or why this is now a definite requirement. There is substantial OPEX & CAPEX tied to this element.
Details of draw off from Cheddar Reservoir. Is water drawn off from different depths? Is this possible with the current configuration?	Taking water from different depths within the reservoir may enable BW to avoid drawing algae into the treatment works.
Details of existing microstrainers – type, capacity, mesh size and design basis.	Are the existing microstrainers fit for purpose? Have there been operational problems that contribute to bypassing of the filters and carryover of algae to the SSF. Is it simply a mesh size issue?

Table 13

[87] This statement was challenged in BW's comments 22 June 2015, after consideration we believe it to be correct. Our opinion is that BW have not evidentially linked algal counts with production capacity in any event other than the one we have stated they have that occurred in 2014.

7.3 Demonstration of Need

7.3.1 Demand

243. Cheddar WTW essentially consists of microstrainers, slow sand filters (SSF) and chemical dosing.

244. Bristol Water's Report[88] summarises the deficiencies of the existing Cheddar WTW as follows:-

- *"Seasonal deterioration of raw water quality is leading to an increased risk of associated deterioration of the final water quality due to increased metal concentrations (Mn, Fe, Al, Pb, As) released by the filters and musty taste and odours*.
- *Deterioration in raw water quality leading to an increased risk of impacting on the works output due to algal blinding of the slow sand filters and consequential outage for skimming / re-sanding*.
- *Increased OPEX arising from increased maintenance requirements*.
- *Slow sand filters are unsuited to treating raw water from inferior alternative sources – such as Blagdon Reservoir*. "

245. On which we would comment:-

- No evidence of seasonal deterioration has been presented. At present treated water quality is being managed. Maintaining output may be more of an issue.
- A single instance an algal bloom has been cited, in March 2014; this instance was post submission of BW's Business Plan.
- No evidence of increasing OPEX has been provided and the scale has not been quantified. There is no comparison between the OPEX of slow sand filters and the proposed new works which will have a considerably higher power demand.
- We are unaware that Blagdon water requires to be treated at Cheddar WTW.

[88] Cheddar TW Water Quality Improvement Outline Design Report – SOC205, page 8

246. The trend in algal counts has been provided in several location and can be demonstrated by the following graph[89]:-

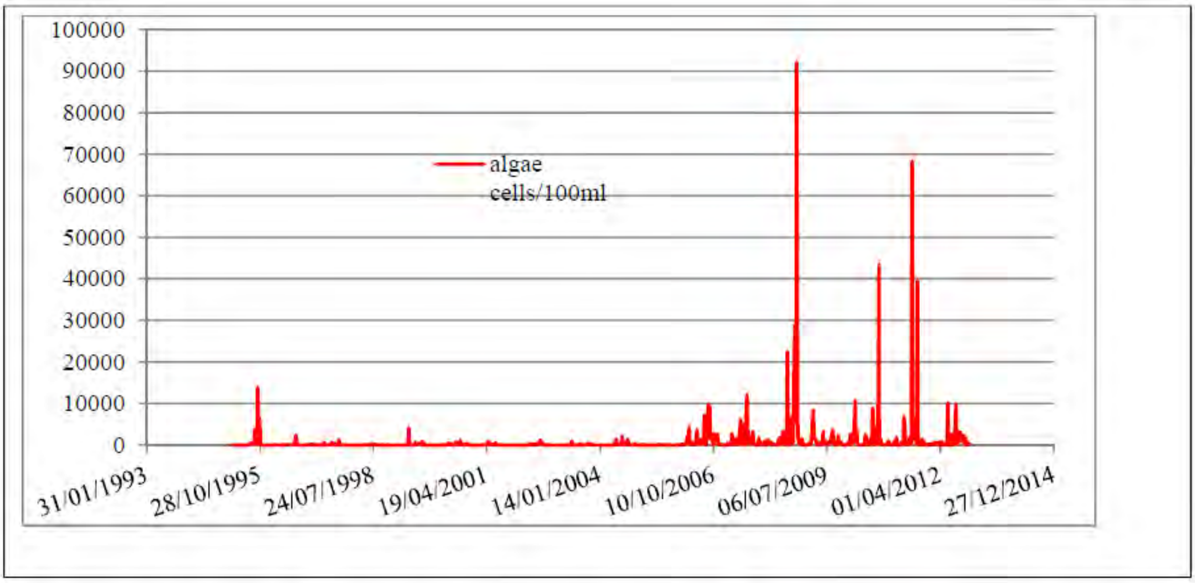


Figure 10

Algae

247. Algae levels are discussed[90] in various documents. The algae chart[91] shows deterioration in algae levels since 2006. The data is not summarised by year and a trend of decline is not clearly illustrated. The raw data in the Appendix only gives Max, Min, Ave and 95%ile across the whole period. Presenting the data year by year would better illustrate a declining pattern.

248. Supplementary information has been presented in BW's response[92] to CMA. The graph shows the number of occurrences per calendar year where algae exceeded 5,000 cells per ml. There were 23 occurrences in 2014 which is far higher than the previous maximum count of 9 in 2013. So whilst the highest spikes were observed in 2008 and 2011 the frequency of counts exceeding 5,000 increased in the last two years. (It should be noted that the "need" for the Cheddar TW scheme was identified prior to May 2013 and all of the 2013 and 2014 incidences occurred after this point in time.)

249. To demonstrate the need to change the WTW it would be beneficial to link the high algae levels with impact on the works such as reduced throughput, decline in treated water quality, filter headloss trends and increased skimming frequency. BW also need to demonstrate that all elements of the works were in operation and that other factor were not contributing to the reported issues; for instance were the microstrainers operational at the time of the reported

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[89] from Arup File Note, dated 20 Sept 2013

[90] Section 4 of the Design Report (SOC205 page 16), Section 2.1 and 3 of SOC206 and SOC233. Charts are missing from the versions of SOC205 and SOC206 (section 3) and SOC233 (Section 2.1)

[91] SOC206 (section 3)

[92] CMA Question 0177. Point 6

incidents. If this link to algae was demonstrated rather than just stated the case for replacement of the SSF would be much clearer.

250. One example of this has been presented retrospectively for a bloom in Spring 2014[93]. Again it should be noted that this event occurred after the submission of the business plan. In this example one SSF was out of service and as is normal practice one filter was in a "maturation" phase. The algae species that caused the problems was Dinobryon which at 20 μm by 10 μm can pass through the existing microstrainers as they have a 35 μm mesh size.

251. It is interesting to note that prior to submission of the business plan the Dinobryon species (which is described as being problematic as it is smaller than the microstrainer mesh size and has the ability to move within the sand bed) was over 5,000 only twice, in March 2010 and June 2012. Whether this caused any operational issues at these times is not known[94].

252. We draw attention to Appendix D – Observations on Cheddar Algal Bloom.

Geosmin and MIB (Methyl-Isoborneol)

253. The reports also indicate that peak levels of geosmin (max 66.5 ng/l) may lead to taste and odour problems. Current final water concentrations are well below detection thresholds. This impacts on the chosen solution identified, see Section 7.4 Solutions below.

[93] BW response to CMA0177 & CMA0183.

[94] Rev CMA0178

7.3.2 DWI Letter BRL02/37[95]

254. Greenberg Traurig Maher LLP draw attention to the lack of reference, in their letter dated 18 June 2015, to DWI's letter BRL02/37 in our report. We acknowledge that we had not explicitly mentioned this letter.

255. DWI's letter states:-

"We stated in our final decision letter that in this instance there are no grounds for enforcement, and…………………..

In conclusion, therefore, we would like to reiterate our support for Bristol Water's proposals to improve Cheddar Water Treatment Works because of deteriorating raw water quality and future risks to drinking water quality and sufficiency….."

256. Whilst we do not raise issue with DWI supporting BW's proposal for the need to take action at Cheddar WTW we believe that BW's proposal for a replacement WTW is based on an assumption and not evidence. It is clear in our opinion that BW have not investigated the deterioration in the quality of water in Cheddar Reservoir, algal blooms and the introduction of replacement destratification equipment.

257. BW's decision to construct a new WTW at Cheddar appear to be contrary to Article 7.3, of the Water Framework Directive, see Section 7.3.3 below.

7.3.3 EA Water Framework Directive Safeguard Zone Action Plan – Article 7.3[96]

258. Greenberg Traurig Maher LLP draw attention to the lack of reference, in their letter dated 18 June 2015, to Article 7.3 of the Water Framework Directive in our report.

259. We draw attention to the following:-

"3.6 Under Article 7.3 of the WFD, Member States are required to implement measures in DrWPAs with the aim of preventing further deterioration (from a 2007/8 baseline) in raw water quality due to anthropogenic sources of pollution, so that as a minimum, the need for additional water treatment to meet drinking water standards is avoided and ideally the level of treatment can over time be reduced.[97]"

260. We should have included this material as it underlies our opinion that the minimum amount of additional facilities should be added to Cheddar WTW.

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95 Additional Section 26 June 2015

96 Additional Section 26 June 2015

97 The Contribution of the Water Supply (Water Quality) Regulations to the implementation of the Water Framework Directive in England & Wales - 18 June 2012

7.4 Solutions

7.4.1 Solutions Considered

261. Solutions considered fall into 2 categories:

- Catchment management based solutions.
- Treatment based solutions.

Catchment management based solutions:

262. BW are planning for progressively deteriorating raw water quality. The chances of success of catchment and reservoir based options are considered to be low and solutions of this type are ruled out.

263. Improvements to the destratification system to reduce incidences of blooms are also considered to be unlikely to be successful[98]. The start of blooms occurring coincides with the replacement of the old destratification equipment in 2006/7. The operation of the new Helixor system coincides with an increase in the frequency of algal blooms. A response from BW[99] gave details of when the stratification equipment has been turned on and off. "*The decision to do this is based on algal counts, weather conditions and forecast weather conditions*."[100] Records from 2008 suggest that the window of mixing operation was increasing year on year to the point that on 28 February 2013 the system was started up and was then left running through to 07 January 2015. This coincides with the period where over 20 counts of algae above 5,000/ml occurred. This suggests that the mixing system may not be helping with regards to controlling algal blooms and may actually be having the opposite effect (see Appendix D – Observation on Cheddar algal bloom

264.

265. The draw off level from Cheddar reservoir is not discussed in any of the reports regarding the WTW. Arup's report[101] states:-

"We do not know as yet how the selection of draw off from the reservoir is made and if this varies seasonally or on water quality or just on reservoir level, this needs to be established as changes in water quality data may be explained by a change in draw off position".

266. To understand the issue various questions should have been raised, such as:-

- Are BW aware how much nutrient is entering the reservoir from Cheddar Spring?
- Are BW aware how much nutrient is entering the reservoir from treated River Ax water?
- Is the River Ax Actiflo process working to optimum levels?

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[98] SOC206 page 17
[99] Question Reference CMA0180
[100] Bristol Water response to query CMA0180
[101] Appendix H Water Quality Arup

267. Aqua Consultants believe that it should be possible for Bristol Water to do more to try and understand when and why algal blooms are occurring and to manage the reservoir mixing, draw off, River Ax pre treatment works and existing treatment works in a way to minimise problems caused by algae. This is essentially dismissed as not viable in the Feasibility Studies. There is limited evidence of any attempts to reduce either growth of algae or pass forward of algae to the treatment works.

268. Arup's report on Cheddar Reservoir 2 has much more appreciation of the water quality issues at Cheddar Reservoir that the reports that deal with the treatment works. Even here[102] there are limitations to what data has been captured; for example there is no Dissolved Oxygen (DO) data since 2000 and up to then a single monitoring point only.

269. We are aware of at least one other water company who developed and promoted to Ofwat, with success, an incremental investment programme in a previous AMP. In summary, it was to try the lowest cost interventions first (namely, reservoir management, including investigation costs). If these interventions failed to produce the required standards then a threshold would be crossed to trigger further investment – for example, ozone and GAC.

270. We have given some thought to this issue and would suggest that BW consider a similar strategy. The potential phased options are given below. Note space for an additional SSF is limited but the option is included for comparison.

[✂]

Table 14

271. However if a phased approach can not be accommodated in the determination the level of funding will require consideration to set an appropriate level.

Treatment based solutions

272. Atkins and BW have opted, due to the dismissal of a reservoir management option, to construct a new water treatment works. It was apparent in the discussions with Atkins[103] that they had not considered any other options other than a 'full' complex treatment works and had seriously considered two options for the treatment works; membranes or the proposed solution.

273. The only option considered for a 'lesser' option, which was rejected, was a RGF upstream of SSF, due to the risk of short run times/blinding of beds.

7.4.2 Options not Considered or not Reported

274. [104]The main option that has not been considered by BW is reservoir management, being dismissed as a "black art" by their consultants[105]. Whilst we believe that this should be the

[102] Arup report issued at meeting on 27 May, supplementary information App H
[103] Meeting 27 May 2015
[104] Added 26 June 2015 to provide clarity to the other options that we believe were not considered.
[105] Meeting 27 May 2015

primary option to be investigated we believe that other potential solutions were not considered. Options should be ruled out on evidence and cost basis.

275. Other options could have been considered:-

- Adding another SSF to counter the reduced throughput. There appears to be space for a further SSF. {Please see footnote regarding the BW's challenge to this point[106].}
- The design capacity of the existing microstrainers is not discussed. Adding to the capacity of the microstrainers would reduce loading rate, reduce incidences of bypass and generally improve the water quality passing forward to the SSF when raw water quality deteriorates.
- DAF as a pre-treatment to slow sand filters doesn't appear to have been considered. {Please see footnote regarding the BW's challenge to this point [107]}. This option would substantially reduce the load onto SSF.
- Addition of Pre ozonation but SSF retained {Please see footnote regarding the BW's challenge to this point[108].}
- RGF as considered for the 'lesser' option but with pre-ozonation and microstrainers.

7.4.3 Selection Process

276. Initial Options were brainstormed then three main options taken forward for costing purposes.

- Submerged membranes option – cost included. Issues with throughput and operational problems at Banwell WTW lead BW to favour the DAF / RGF process as installed at Barrow WTW. DAF/RGF is also lower CAPEX and OPEX in the feasibility report (although this contradicts the Design report).
- Offsite build option (DAF/RGF) – cost included but more expensive than development on site.
- Actiflo.

277. All catchment options were rejected due to lack of confidence in delivering required outcome. These were deemed too high risk and not costed.

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[106] This statement was challenged in BW's comments 22 June 2015, having considered the point we believe this should have been investigated and ruled out on evidence. We note that at the time of the 2014 incident that BW were using less SSFs that usual.

[107] This statement was challenged in BW's comments 22 June 2015, having considered the point we believe this should have been investigated and ruled out on evidence. We note that DAF plant may be used without coagulant

[108] This statement was challenged in BW's comments 22 June 2015, having considered the point we believe this should have been investigated and ruled out on evidence. We note that there is some evidence, AWWARF, 1991, that suggest a higher ozone dose might increase the filter run time.

7.5 Risk

7.5.1 Approach to Risk

278. The risk position adopted is very low. In summary the proposed design includes elements that essentially duplicate the process element and there is duty equipment proved in areas that would not normally have it provided.

279. We have enclosed a detailed opinion in Appendix E – Cheddar WTW – Attitude to risk.

7.5.2 Timing of Solution

280. The solution could be delayed and a detailed investigation into the performance of the reservoir mixing system and general nutrient balance carried out. A staged approach could be considered. {This paragraph was challenged in GTM's letter dated 18 June 2015. after consideration we believe the statement is correct and note the dismissal of reservoir management as a "black art". and the commencement of algal blooms with the installation of the new destratification equipment in 2006 prior to which there was low levels of algae}

281. Once the UV works are complete the SSF taken out of service to allow construction work should be returned to service, this will improve the situation compared to the March 2014 incident and reduce the potential impact of algal blooms.

282. Building to replace the existing capacity (60 MLD) in one phase will probably be required due to availability of land although we believe introducing a phased/staged solution should be possible.

7.6 Cost

7.6.1 Basis and Appropriateness

283. There is a substantial unexplained discrepancy of costs between reports SOC205 and SOC206.

	Feasibility Study Rev C SOC206	**Design Report Rev C SOC205**	**Business Plan**
Date Approved	05/11/2013	14/11/2013	
CAPEX	£16,805,398	£23,708,169	£20.8 million [109]
OPEX	£652,505	£488,854	?
Annualised	£1,919,070	£2,588,820	?

Table 15

109 150311 Bristol Water SoC page 23 Table 2

284. The RGF option was chosen based on the lower CAPEX, OPEX and Annualised costs of SOC206. The Membrane option was more expensive but is far cheaper than the SOC205 Design Report costs. A full explanation of both the costs and selection process is required.

285. It is not clear from the Design Report how costs have been arrived at. The costs given in the Design Report are very high level. The size of various unit stages are given in the Design Report but this is not comprehensive enough to enable comparison. It is not clear if costs are included for both ozonation and PAC dosing for example. In order to increase confidence a fuller breakdown of costs by area including sizing of the process units would be required.

286. The assumptions regarding sludge production that were made when selecting the DAF / RGF option over the membrane option are incorrect. BW response to Question CMA0184 states that "In terms of waste water treatment and sludge cake disposal to agricultural land (assumed), we have assumed for the purposes of the Outline Design that similar volumes of sludge cake will be produced as the loading is derived from the same source and waste water treatment process is also similar". This is not correct as the DAF / RGF option includes PACl dosing which will add considerably to the amount of sludge produced whereas the membrane option doesn't included coagulant dosing (ref SOC206 Section 4.2.3 "….*conclusions suggest that pre-coagulation prior to membrane filtration will not be required*."). The sludge stream for the membrane option will require smaller tanks, thickeners and dewatering equipment. This should be reflected in the costs. The cost breakdowns received are not detailed enough to determine if this is the case. {This paragraph was challenged in GTM's letter dated 18 June 2015. We believe it is correct and have added the relevant quotation to clarify the matter raised by GTM}

287. The information provided suggests that the raw water alkalinity and pH value varies seasonally. The change of process with addition of coagulant will reduce alkalinity / pH and we consider that lime dosing may be required periodically Lime dosing may be required for raw water pH correction there is no mention of this in either the design report or feasibility documents. {This paragraph challenged in GTM's letter dated 18 June 2015. We have added the first sentence to clarify our opinion}.

288. In terms of OPEX, generally details are limited and full assessment is not possible.

289. The assumptions regarding sludge production that were made when selecting the DAF / RGF option over the membrane option are incorrect. BW response[110] states that "*In terms of waste water treatment and sludge cake disposal to agricultural land (assumed), we have assumed for the purposes of the Outline Design that similar volumes of sludge cake will be produced as the loading is derived from the same source and waste water treatment process is also similar*". However the DAF / RGF option includes Poly Aluminium Chloride (PACl) dosing which will add considerably to the amount of sludge produced where as the membrane option doesn't included coagulant dosing[111]. Therefore the sludge disposal cost for the Membrane option should be substantially lower than the DAF/RGF option as with Al dosing 2.9 * the Al dose will be generated as sludge.

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[110] Question CMA0184

[111] SOC206 Section 4.2.3

290. Powdered Activated Carbon (PAC) costs may not be included, as discussed above details of PAC requirements are very limited. There is a risk that the OPEX costs are being underestimated as a result.

291. The cost of treated water from Cheddar will increase substantially over current levels. This cost increase is not reported.

7.6.2 Efficiency of Solution

292. The selected solution would address the requirement to produce 60 MLD treated water but there are risks around treatment efficiency and costing. The raw water has levels of ammonia and nitrite that require treatment, inlet pH correction with lime may also be needed periodically. PAC storage and dosing elements may be missing and lime storage and dosing may be required for inlet pH correction. The solution will not improve the situation regarding the frequency and size of algal blooms.

293. From the information presented BW could have made more attempt to optimise reservoir mixing, draw off and microstrainer operation to reduce the algal load onto the SSF beds.

7.6.3 Treated Water Cost[112]

294. BW have stated that the cost to treat water is [✂], in the meeting on 27 May 2015 and again in their comments dated 22 June 2015. We are not aware of the basis of this costing.

295. In SOC206, page 49, the annualised cost for the proposed Cheddar WTW is [✂]. The average output from the works is between 27 and 30 Ml/d, this provides the cost of potable water from Cheddar WTW at between [✂] and [✂].

7.7 Conclusions

296. The need for the project is not well demonstrated.

- There was a failure on the part of Bristol Water to link issues of algal blooms to operational problems at the works, reduced works throughput and water quality problems in the information that supported the Business Plan submission. To a certain degree this has now been done but using data from an event post Business Plan submission (March 2014 incident).
- The selection process as reported lacks detail and rules out some options too easily. A better understanding of reservoir performance could substantially reduce the required capital spend.

[112] Section added 26 June 2015

- Costs (CAPEX and OPEX) lack detail and there is inconsistency between SOC205, SOC206 and the Business Plan.

297. BW have not investigated the possible link between the replaced reservoir destratification equipment and the commencement of major algal blooms. This appears to be evident from the information provided but was ignored or dismissed by BW and Atkins.

298. We believe that a phase approach to reservoir management, investigation, implementation and incremental increases in treatment should be the systematic approach to be adopted as done by others.

299. We do not believe that BW have justified the inclusion constructing a new WTW at Cheddar within their Business Plan and should therefore not be funded for the project.

300. We believe that BW should be funded to investigate the reservoir and to implement a staged increase in reservoir management and treatment facilities should they be required.

8 SOUTHERN RESILIENCE

8.1 Southern Resilience Summary

301. Following our review and investigation of information provided we conclude the following:-

- BW have modelled the southern network to establish the need for the proposed Southern Resilience Scheme (SRS), however this model appears to be risk averse in that the modelled probabilities of failure seem high given the apparent infrequency of BW having difficulty in maintain supplies. {This paragraph was challenged in BW's comments dated 22 June 2015. After consideration of the point we have amended the paragraph for clarity} .
- However if viewed in the context of other proposed works, Cheddar WTW Enhancement, and BW's potential issues with algal blooms at a number of their works adding resilience into the network is seen as a positive.
- We consider that the option currently envisaged does not meet some of the fundamental needs, to have the ability to move water from the north to the south.
- We consider the costs proposed in B&V's report are acceptable, although we would question why an additional service reservoir is required. There may be some elements that have not been included.
- Prior to commencing on the proposed scheme BW should consider if additional benefits can be incorporated, CAPEX and OPEX reduced and include the ability to move water both south to north and north to south.

8.2 Information

8.2.1 Information Considered

302. The following is a list of the information considered in this section:-

Filename	Document Title	Summary or Comment
	Bristol Water Statement of Case	Restating the case set out in SOC002 June Wholesale Plan and SOC006 - June Cost Exclusion Cases.
SOC207	Banwell /Cheddar Zone Strategy Optioneering Report Sept 2013	Shows the method and options for meeting resilience requirements and new demand. Options selected on simple benefit assessment and capital cost at this stage. The selected option is E.
SOC208 (appendices missing)	Southern Support Scheme Preliminary Design Report November 2013	Pre design report. Advances the development of the selected option E from SOC207

Filename	Document Title	Summary or Comment
SOC037	Resilient Supply December Plan	General description of risk assessment approach and results. Two points to note. It is possible that the reliability models have modelled all the key assets in the Cheddar / Branwell supply systems to derive the overall availabilities. However the resilience project only addresses the loss of the treatment works (see SOC207/8). There is also a question over the calculated availability results which are low compared to expected real world scenarios. The result is that the benefits of the SRS are likely to be overstated.
SOC309	Southern Resilience Scheme CBA summary	All options considered are variations of Option E (see SOC207/8). No discounting (this is handled in CAO), no operational costs so not Totex. Only over 10 year horizon yet scheme designed for 2040. Very elementary CBA for this level of investment. The CBA benefits are overstated in that the individual probabilities of all 6 categories of resilience outage periods are included then summed. This therefore gives an annual probability {Please see footnote[113] regarding BW's challenge} of any resilience outage of ~ 23-25%/ year. It is not possible to reconcile the CBA risks in the spreadsheet options N66.1 – N66.5 etc. to the SEAMS CBA inputs.
SOC006	June Cost Exclusion Cases (p73 – p138)	Summary of all relevant documents supporting the case for SRS. Any comments are attributed to the source documents.
SOC002	June Wholesale Plan Outcome – Resilient supply (p. 178 onwards)	See note on SOC006 June Cost Exclusion Cases as this is essentially the same material summarised. A general observation is that the text contains some unsubstantiated claims (unsupported by evidence) about the need for this scheme. Whilst the need for the scheme may be genuine, these undermine confidence that the case is well made.
SOC136	Mott MacDonald PR14 Technical Assurance Report October 2014	Generally supportive of the SRS case. Raises the questions as to whether the modelling results have been compared to actual experience.

[113] This statement was challenges by BW in their comments on 22 June 2015. After consideration we believe our statement to be correct, to explain this issue we have provided further information in Appendix G – Southern Resilience Risk and CBA

Filename	Document Title	Summary or Comment
ENQ044	Part 1 Workstream 3 – Resilience p 21 - 3.11 Southern Resilience Scheme Parts 2 & 3	Criticised the original scheme for overstating the risks. Noted that the team that did this work later completed the UKWIR - Resilience: Making a Business Case for PR14 project and completed the risk assessment for PR14 SRS.
ENQ014 ???	Bristol Water's response to CMA's sole Question of 14 May 2015	Noted that Halcrow/ CH2M who originally rejected case for SRS in PR09CC case subsequently were engaged by BW to complete the SRS risk assessment in PR14.

Table 16

8.2.2 Shortfall of Information

303. We are not aware of any information that is missing, however there are some aspects of the scheme that are not explained.

8.3 Demonstration of Need

8.3.1 Risk

304. Industry standard[114] approaches were used to develop the risk component of the resilience case. This essentially supported previous work in PR04 and PR09 and can be seen as a refinement of previous work. This work is presented in SOC037 Resilient Supply December Plan.

305. Whilst the process followed is robust a high level 'sense check' of the calculated availability for Barnwell, Cheddar and Gloucester Sharpness Canal systems is in our opinion on the low side, thus potentially overstating the resilience risks.

[114] UKWIR - Resilience: Making a Business Case for PR14

306. The following table has been supplied.[115]

Table 66 Reliability modelling outputs for top critical assets

Measure (based on next 40 years)	Banwell	Cheddar	Oldford[92]	Glastonbury and Street	Gloucester Sharpness Canal
[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Total availability (%)	99.10	99.05	99.61	99.75	98.31
Number of outages any duration in 40 year time horizon	23	23	26	23	16
Number of outages >2days – 30 days (best case / worst case scenario)	4/21	4/22	4/12	3/6	3/16

Note: Explanation of measures:

Population currently impacted – Population at risk of service loss on asset failure and who would potentially benefit from resilience scheme

Total availability – This is the % of the time over 40 year time horizon of the analysis when service is available from the asset (this analysis takes into account the storage available in the system).

No. of outages any duration – This is the number of times asset failures are predicted to occur within the 40-year time horizon of the analysis and which would lead to a service interruption (any duration). This analysis takes into account the storage available in the system.

No. of outages of between 2 and 30 days duration - This is the number of predicted outages of between 2 and 30 days within the 40-year time frame of the analysis. Two figures are presented separated by /. The first is the best case scenario where repair times are estimated to be short, which in principle means that repair/recovery can largely be achieved during the period covered by storage in the system (in which case outages would be mainly of short duration of a few hours). The second figure is the worst case scenario modelled where extended repair times are assumed. In this case, repair cannot be fully effected during the period covered by the storage in the system. Extended repair/recovery times have been included to model situations where source contamination may have occurred Up to 30 days for a repair/recovery for source contamination is considered a reasonable estimate based on supply contamination events we have experienced elsewhere in Bristol Water. In some cases we have experienced contamination that has taken far longer to correct.

307. For Banwell WTW 99.1% availability = (1-0.991)*365 = 3.285 days per year when it is not operating on average as a result of resilience outages. Over 40 years this is 131.4 days or approximately 4 months.

308. For Banwell WTW >2-30 days outages, the best case is that 4 out of 23 (4/23) outages are >2 days therefore 17.4% of all outages result in service interruption of >2. This is a very high value for best case and the worst case 21/23 = 91.3% is inconceivably high. This simplifies to a >2 day outage in the Banwell system every 10 years in the best case. Including Cheddar (4) and Gloucester Sharpness Canal (3), then from the modelled results we could theoretically expect the resilience scheme to be required 1 in every 3.6 years.[116] {This

[115] SOC002 June Wholesale Plan Outcome – Resilient supply Table 66, page199 and SOC006 June Cost Exclusion Cases Table 31 page 95

[116] Values derived from SOC037 Resilient Supply December Plan

statement was challenged in BW's comments 22 June 2015. after consideration of the point raised the subsequent paragraph has been added}

309. The summation of probabilities that resulted in an estimate of 1 in 3.6 years was challenged by BW and we acknowledge that their models may have an allowance for interaction between systems which means that the risks cannot be summed, we consider this in more detail in Appendix G – Southern Resilience Risk and CBA

310. There are several questions that have not been answered:-

1 How often has BW been unable to supply due to resilience issues with the current system? From the evidence seen BW has a very good record of maintaining supply.

2 What is the actually availability/number of shutdowns of these WTWs? We are only aware of two instances at Cheddar WTW, in 2006 and 2014.

3 Is BW's WTWs availability similar to other Water Companies? Should BW have a higher level of outages it may suggest that maintenance is not being carried out effectively.

4 What proportion of WTW shutdowns result in service interruptions greater than two days? We understand that the output from Cheddar WTW was limited during the incidents.

311. A similar question was raised by Mott MacDonald[117],

Have you compared the results of the modelling with actual experience?	Not really – whereas some inputs are from data, the results are modelling major resilience events that have not happened. Therefore there is not data from which to test the models.	Resolved.

312. The statement above suggests that the model output values for service interruptions have not been 'sense' checked e.g. 'events have not happened' but accepting that models show them happening on average every 3.6 years?

313. We note that BW has only used the best case in their Cost Benefit Analysis (CBA). We question their assertion that the estimates of benefits are likely to be underestimated in this respect {Please see footnote regarding GTM's challenge[118].}

"Our cost benefit analysis has been undertaken on the 'best case' scenario, refer to footnote on Table 66 and No. of Outages of between 2 and 30 days duration. Consequently, it is likely that the estimates of benefits are underestimated. Even in the best case, these results demonstrate an unacceptably high probability that events will occur that will cause

[117] SOC136 Mott MacDonald PR14 Technical Assurance Report October 2014 page186.

[118] This statement was challenges by GTM in their letter dated 18 June 2015. After consideration we believe our statement to be correct, to explain this issue we have provided further information in Appendix G – Southern Resilience Risk and CBA.

customers to lose their water supply for greater than two days and potentially for much longer."[119]

8.3.2 Cheddar WTW Algae issues

314. As part of the CMA requirements we also reviewed the need for Cheddar WTW enhancements. These are primarily due to issues associated with algae blooms on the reservoir. We consider that this represents a risk of service interruption and given that a new treatment works at Cheddar was one of the options considered for the SRS we are surprised that the synergies between the Algae issues at Cheddar WTW and the SRS have not been presented by BW[120].

Resilience Option 3

Construct new treatment works at Cheddar with capacity 35.9Ml/d. Connect Cheddar TW to a new Rowberrow Hill service reservoir and then Rowberrow Hill to the Banwell zone, both mains of capacity 20.8Ml/d. Transfer 16Ml/d via the Winscombe Transfer.

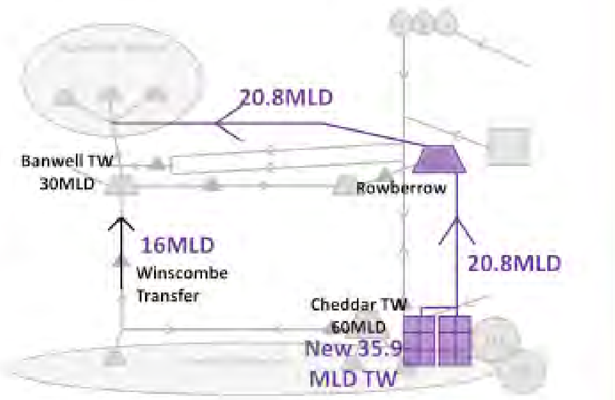

Figure 11

8.3.3 Demand

315. Demand is a secondary driver for this scheme and these have not been looked at in detail. However we note that BW state[121]:-

"Uncertainty Analysis

There are some uncertainties in the growth values since they arise from local plans and projections, as discussed in the section on Population Growth, page 210. However, if the actual population benefitting from the scheme is less, the solution is still cost beneficial."

316. The growth element of the SRS cost is £8-9M out of ~£31M, so depending on the uncertainties this could have a material impact on the Cost Benefit Analysis (CBA). We saw no evidence in the documents reviewed that these uncertainties have been included in the sensitivity analysis.

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[119] SOC002 Wholesale Plan - June Submission page 199 paragraph. 3
[120] SOC207 Banwell /Cheddar Zone Strategy Optioneering Report Sept 2013 page 7
[121] SOC002 Wholesale Plan - June Submission page 215

8.4 Solutions

8.4.1 Solutions Considered

317. Various options were developed which would provide full and partial mitigation of the risks for a planning horizon to 2040. During this process synergies were identified between resilience options and increased demand. The preferred option is a combined solution that meets both the needs of the resilience scheme and future demand. However, as discussed in 7 Raw WTW enhancement (Cheddar) Section above, the synergies between SRS and Cheddar WTW Algae problems do not seem to have been considered.

8.4.2 Options not Considered or not Reported

318. The proposed scheme has been based on the need to transfer a significant volume of water, 35 Ml/d. In practise outages of works will generally be for limited period of time the whole life cost of pumping plant/pipe size should be considered as the power demand would be higher it would be for short duration. The balance of CAPEX and OPEX requires consideration.

319. A detailed technical appraisal of other possible options was not within the scope of this work, however we have some observations that we consider should be highlighted. Essentially the proposal as we understand it is as follows:-

- Water can be pumped, 35 Ml/d, from low lying Cheddar WTW to Rowberrow SR at high level.
- Water can flow by gravity from Rowberrow SR to either Banwell or Barrow.
- Water can be pumped with existing pumps from Barrow to the south of the area. {This statement was challenged in BW's comments 22 June 2015, the stated assumption we had made was incorrect and has now been replaced with new information received from BW.}

320. There are some aspects of the scheme that give us concern and would make us question if the proposal is fulfilling the requirements, we believe, are placed upon it:-

- Water pumped to Rowberrow appears to be at a much greater elevation than is necessary to deliver the water to Banwell or Cheddar[122]. This will have a significant impact on OPEX.{Please see footnote for challenge response[123]}.
- To keep the water 'sweet' (maintaining turn-over, described as 'bleed water' by B&V), water will have to be transferred to Barrow and Banwell daily, this is moving some water to the north which has surplus capacity as described in Section 1 Cheddar Reservoir No.2 and will require high head pumping.
- Additional service reservoir capacity is being added to BW's existing capacity, which we consider to be larger than required, see Section 2 Bedminster service reservoir.

[122] Cheddar added to sentence

[123] A bullet point has been deleted following receipt of further information, in BW's 22 June comments on this report and the challenge made to the point.

- The proposed service reservoir has a capacity of c. 20Ml. At normal level of 'bleed' flows the retention time would be in excess of five days, significantly longer than normally considered desirable. At the bleed flow rate water is additionally retained in the Barrow to Rowberrow main for a period of over two days. Water of this 'age' is reaching a point where it would be flushed from the system to waste.
- It is not clear if there is an intention to transfer water from Banwell to Cheddar, if it is intended to do this the method of transfer, pumping or gravity flow, is not stated. It may be that a pumping station is required.

321. We have considered these issues and have concluded that fundamentally the problem may be able to be resolved by not 'breaking' the head at Rowberrow.

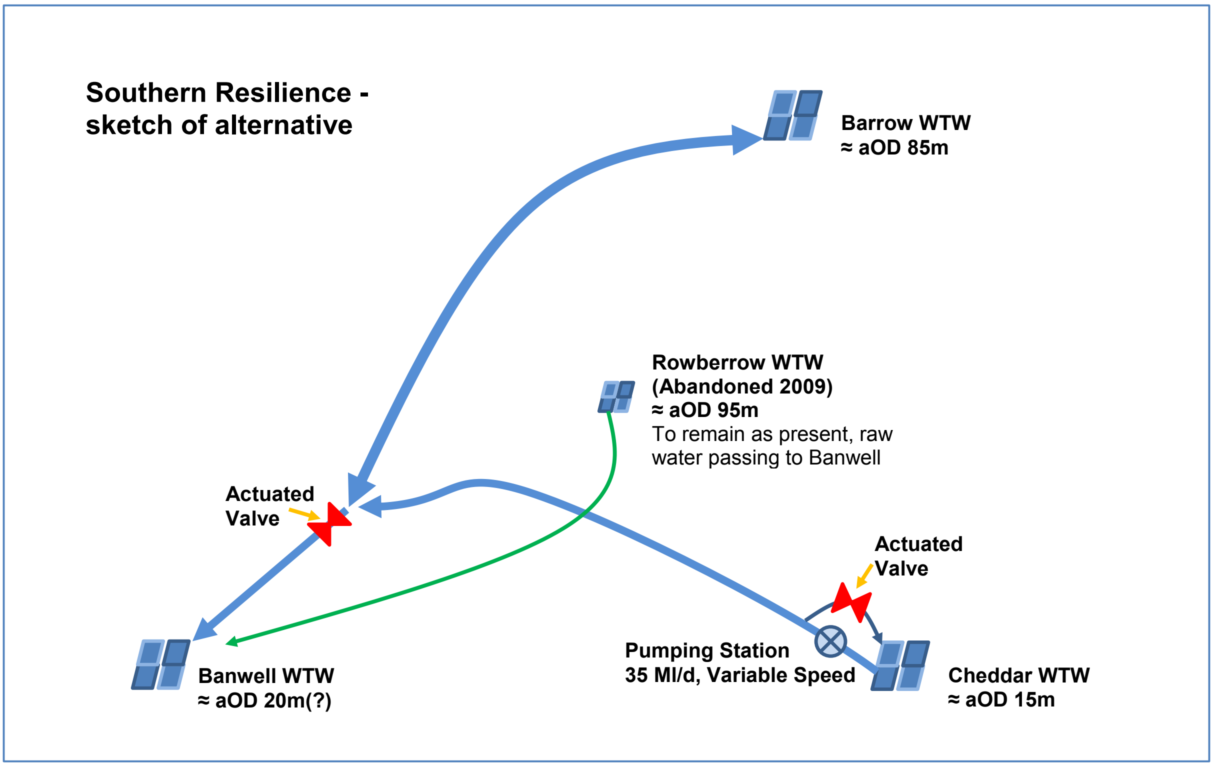

Figure 12

322. With little addition to the proposed solution, actuated valves, we believe that this may provide several benefits:-

- Considerable OPEX saving on water pumped to Banwell from Cheddar.
- Water can gravitate from Barrow to Banwell, this moves water north to south and would avoid the need to pump water to maintain the turn-over required.
- Water can potentially flow from Barrow to Cheddar, this would increase the resilience in the south.
- The proposal may not require the construction of a service reservoir at Rowberrow, it could be constructed at a more appropriate elevation to supply Banwell, saving OPEX, or could be supplied from a service reservoir at Barrow.

{This statement was challenged in BW's comments 22 June 2015, after consideration of the point raised we have extended it to explain our rationale}

8.4.3 Selection Process

323. The selection process was essentially in three stages.

324. Stage 1 - A preferred option was selected through a technical appraisal[124].

325. Stage 2 - Variants of the preferred option E (being essentially different sized pipes and service reservoirs) where assessed using a cost benefit criteria. Benefits were derived using the risks identified in SOC037 Resilient Supply December Plan. The cost benefit analysis is presented in SOC309 Southern Resilience Scheme CBA summary. This second stage essentially validates that the preferred solution and its variants meet the CBA criteria of greater than 1.

326. Stage 3 – Was the final selection of the preferred solution by the Seams CAO. We understand this was from a selection of 4 options; 3 of which were variants of option E[125]. The fourth 'new' option was a baseline option essentially 'do nothing' which incurred penalty costs for not achieving the output[126].

327. The selection process appears to have been limited.

8.5 Risk

8.5.1 Approach to Risk

328. The nature of resilience related service failures are that they are generally very low probability and high consequence events. Indeed it is preferably and likely that they will never occur. This makes normal risk based cost benefit analysis difficult. However water companies have a duty to prepare for eventualities and demonstrate that their proposals are in the interests of their customers. In making its case BW has relied heavily on modelled risk and these appear high. This does not mean that the scheme is not cost beneficial and in the best interests of customers, indeed customers have been shown willing to pay for the scheme.

329. Accepting this BW could have presented the scheme by demonstrating the combined benefits the scheme brings in terms of an overall strategic plan for its wholesale business including future demand and synergies with the enhancement of Cheddar WTW and Cheddar 2, rather than focusing on the risks.

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[124] SOC207 Banwell /Cheddar Zone Strategy Optioneering Report Sept 2013

[125] SOC207 Banwell /Cheddar Zone Strategy Optioneering Report Sept 2013

[126] CBA inputs to SEAMS' in SOC309 PostFD14 - Southern Resilience CBA data for MROS v3.1 GAH CBA calcs.xlsx

8.5.2 Timing of Solution

330. On the basis of the presented case the timing of the solution is time independent as the risks will not significantly change in the future other than through the increase in population thus the number of customers affected per event will be more. The risk analysis[127] shows a marginal increase in risk due to equipment aging but we expect this to be managed through base maintenance and this should therefore not affect timing.

331. However we note that the early implementation of SRS would provide an opportunity to reassess the need for Cheddar WTW enhancements should reservoir management prove to be unsuccessful in the long term.

8.6 Cost

8.6.1 Basis and Appropriateness

332. Bristol Water's submission for Southern Resilience is £28.1M in the Statement of Case[128]. We have not been supplied with a build up to this exact figure, however we have appraised the cost plan from Black & Veatch[129] of £32.14M for the scheme and by applying an efficiency saving of 12.5% for enhancements[130], the sum equates to £28.12M.

333. We have carried out an independent cost estimate of the Southern Resilience works to benchmark the costs. The estimate was high level and the dimensions and quantities based on those provided in Southern Support Scheme Preliminary Design Report[131].

[✂]

Table 17

334. We estimate the Total Scheme Cost of £29.6M which is with 5% variance of BW's figure used for their submission. Given the high level nature of the information we are satisfied with Bristol Water's costing of this Scheme.

8.6.2 Efficiency of Solution

335. We would question if it is necessary to include for future pumping provision at Cheddar WTW when the proposed capacity is in excess of the average production output.

336. We would also question if BW require another service reservoir and if it should be located at Rowberrow as this involves significant.

337. The capacity of the proposed scheme appears high when there have been few occurrences of supply issues.

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[127] SOC037 Resilient Supply December Plan
[128] 150311 Bristol Water SoC
[129] SOC208
[130] SOC546
[131] SOC208

8.7 Conclusions

338. The Southern Resilience Scheme will provide BW's customers with increased supply resilience in line with their expressed preferences. It will provide a fully integrated transmission system connecting the whole of the BW supply, providing BW customers with a similarly resilient supply system already afforded customers of other water companies such as Thames Water (Ring Main), Severn Trent and Wessex Water for example. As presented the proposed solution provides the best technical solution in terms of the estimated costs and investment drivers[132].

339. In SOC309 Southern Resilience Scheme CBA summary, the proposed solution is financially appraised and in simple cost benefit terms the scheme is justified. We have questioned the modelled risks that have been used and although we have not been able to test the sensitivity of this to the cost benefit assessment we note that Ofwat have also supported the scheme, albeit at a lower cost than that presented by BW.

340. We are surprised that BW has not presented the case for implementing the Southern Resilience scheme by including in its justification the benefit of deferring the need for treatment enhancements at Cheddar WTW. Once completed the SRS would ensure supply to the Cheddar system in the event of an algae problem affecting the treatment capability of Cheddar WTW. It would also provide BW with the opportunity to see if the catchment management actions being undertaken by BW (referred to in the DWI letter of support for the scheme) will succeed or provide the opportunity to develop better systems to control algae within the reservoir.

341. Overall it would have been better to have presented the need for the SRS scheme within the context of an overall strategic plan for the wholesale business including future demand, resources that identified synergies with the enhancement of Cheddar WTW and potentially Cheddar 2 reservoir. This lack of an overall strategic vision for the wholesale business is a gap in the plan.

342. The scheme should be re-assessed prior to making a commitment to construct the project to demonstrate that maximum efficiency has been derived from the project, that water can be transferred from the north to the south and vice versa with minimum pumping requirements[133], that the lowest whole life cost option has been included and that the location of any service reservoir is not producing unnecessary OPEX cost.

343. We are of the opinion that the scheme has been significantly substantiated and should be constructed, however BW need to demonstrate that there is need for a service reservoir and that all necessary requirements of the scheme can be met prior to the level being concluded. We believe it is possible to achieve this at a significantly lower level than proposed by BW in their Business Plan.

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[132] SOC207 Banwell /Cheddar Zone Strategy Optioneering Report Sept 2013 page 12 -Stage 2 Option Evaluation

[133] Amended for clarity

9 OVERALL VIEW OF BRISTOL WATER APPROACH

9.1 Summary of BW's Overall Approach

344. Following our review and investigation of information provided we conclude the following:-

- BW do not appear to have a Strategic Plan.
- The lack of a strategic plan does not allow BW to consider the interaction of schemes upon each other.
- BW appears to decide on the required solution and then provide justification of that position. Several proposals have failed to consider relevant information.
- BW and their consultants omit the value management (optioneering and comparison of different proposals to select a scheme) stage of projects and commence with value engineering (refining of the selected scheme).
- BW have used models to build-up their requirements without the models being tied to reality. There is a disconnect between the model output and how the work will be carried out.
- The impression given due to conflict and anomalies, albeit minor, is that there is a lack of care and deep understanding particularly at the strategic level.
- We also have the impression that BW's are 'fractured' into segments with reports not providing any or sufficient introduction to set it into context.
- Reports are 'wordy', lack diagrams that would explain engineering information in a simpler manner and are to a large extent confusing.

345. We are struck by the number of areas of overlap between comments made by the Reporter[134] and our own. During the meeting[135] with BW we gained an impression that the various consultants had been left to produce the various proposals without it being incorporated into the overall plan and that some elements of our questions were a surprise; potentially showing that proposals had not been rigorously challenged.

346. We would recommend that in future:-

- Reports give the context of the starting point – If it is commencing after value management and where the previous stage information may be located, what the 'end-product' has to deliver also needs to be included.
- Inter-relationships are detailed – Southern Resilience, Cheddar WTW, Cheddar 2 and service reservoirs are four elements that have potentially some major influences on each other.

[134] SOC136 ESD 9 - MM Assurance Report 20141002.pdf
[135] 27 May 2015

- Relevant issues are included – the Southern Resilience report does not explain how water moves between locations, this clearly is a fundamental requirement to enable the reader to understand the scheme.
- Schemes are selected in a clear and recorded process and not simply assumed to be correct or required – even when the answer is 'obvious' a selection procedure should be followed to ensure that the 'obvious' answer is correct.
- Projects are rigorously challenged to demonstrate the need and the solution is correct – Bedminster Service Reservoir shows in our opinion a project that is not required at present and, if it was, could potentially give more benefits if not replaced at Bedminster.
- Models used to predict required work need to correlate to reality.

9.2 Information

9.2.1 Information Considered

347. We have reviewed the information detailed in Appendix A - Information Supplied by CMA

9.2.2 Shortfall of Information

348. BW have not presented their strategic plan as part of their submission, without this our understanding of the integration of the proposed schemes in their Business Plan can not be seen.

9.3 Information Supplied

9.3.1 General Overview

349. Our largest concern with the information supplied is that there is no unified or strategic plan that is followed. There are several issues that have a significant impact on each other, yet the inter dependencies and relationships are omitted. By having work reported upon in 'silos' it would be possible to be of the opinion that Cheddar 2, Cheddar WTW Enhancement and Southern Resilience are all required – we do not believe that this is a true reflection.

350. The lack of a unified approach is particularly apparent where BW have used several consultants to produce and review aspects of their programme, there does not appear to be a strategic review where all aspects of inter-relationships have been considered.

351. We have also obtained the impression that decisions may be reached about what work is to be carried out or included in the Business Plan and then reports are produced to that are confirmations of the position already taken. This could be a false impression due to the lack of the development being detailed in reports but on balance we believe that a corporate

paradigm[136] was established at a detailed level rather than at a strategic plan that looks across areas.

352. Few of the documents that we have reviewed give an easily understandable initial view; it would be a significant improvement for the reader to have an introduction that outlines the project/reason for the document. The reader is expected to have some knowledge of what the background to the document is reporting on. We believe that documents should:-

- 'Set the scene' – for example detail what the existing treatment process is and what the issues are that require to be addressed.
- Consider what the reader may require to know – the further information issued regarding algal bloom[137] does not give any context that may be relevant; weather conditions, availability of equipment, what operators had done, etc.
- Be correct and consistent – we have identified several errors and inconsistencies, eg Cheddar 2 has a yield stated as 16.3 Ml/d[138] but in what we would consider is the source (Arup's report) it is 16.1 Ml/d[139].

353. BW have also failed to act on recommendations from Mott MacDonald[140] in what they should be providing to demonstrate their case. We concur with MM's view that BW provide "wordy" documents that are hard to follow.

354. The conflicting information between documents, although this may be minor, does not allow confidence and also shows that there is no unified position.

9.3.2 Externally Sourced Documents

355. The impression we have of externally prepared reports is that they have either been too tightly constrained in their scope or the consultants are choosing to adopt a narrow interpretation of what is required, in which case BW should ensure that their consultants deliver reports that encompass a full understanding of related schemes.

356. The Black & Veatch (B&V) report[141] on Bedminster Service Reservoir started from the premise that the reservoir required rebuilding, see section 2 Bedminster service reservoir, nothing was included about the potential to refurbish the existing reservoir. As a minimum we would have expected that a refurbishment option should have been mentioned even if that was only to record why it could not be refurbished. B&V also dismissed the alternative proposal to construct the new service reservoir at Barrow too easily; they did not see the potential for the same facility to enhance other parts of the trunk main network.

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[136] The company has assumed what is require, setting this as the criteria to judge against, in each instance and has not reviewed any strategic plan, leading to scheme inter relationships and potential overlaps being missed.
[137] ENQ048 Cheddar Reservoir Algal Bloom - March 2014.pdf
[138] 150311 Bristol Water SoC, paragraph 1311
[139] Report 013 Design Review Report - Phase Six - Issue 20.01.2014, page 10.
[140] SOC136 ESD 9 - MM Assurance Report 20141002.pdf
[141] ENQ017 Preliminary Design Report (v3) (18.11.13) - PR14 NIM5 Bedminster Reservoir

357. Atkins' report into Cheddar WTW Enhancement failed to ask what we would consider to be a fundamental question "*What changed in 2006 that would cause the reservoir water to have algal blooms?*" The report also failed to consider water quality data that was available within BW, obtaining water quality data is essential to be able to complete a process design. Atkins were also dismissive of looking at other potential solutions, generally their report is silent, and we felt, they were not open to questioning at the meeting on 27 May 2015. Effectively other solutions were not considered, which we believe is a failure in the work carried out. The 'brain-storming' of solutions, as described in the meeting, merely consisted of treatment options, the "black-art" of reservoir management or investigation into it were apparently ignored.

9.3.3 Bristol Water Produced Information

358. Documents produced by BW have a trait that we have observed within other small water companies; and that is because the staff are in position for a long time and they have a deep knowledge of the systems and facilities they fail to explain fully their understanding to others.

359. There is also the potential for a solution to be 'obvious' and other potential answers to be ignored. In some reports it appears that the solution is assumed and then justified.

9.4 Solutions

9.4.1 Solutions Considered

360. In the majority of aspects of the Business Plan that we have considered we find that other solutions could have been included:-

- Cheddar Reservoir 2 – the apparent urgency to commence the project has not been proved and other 'small' sources could be employed to meet the expected increase in demand.
- Bedminster Reservoir Replacement – this scheme could be delayed and potentially should be located at Barrow. As a minimum a refurbishment should have been considered.
- Cheddar WTW Enhancement – we believe reservoir management and a staged approach to enhancing the treatment works processes should be adopted.
- Southern Resilience – whilst the proposed scheme appears to have merit the ability to transfer water from the north to the south needs to be included to provide maximum resilience across the whole of BW's area.

361. In the other two areas we have considered, mains replacement and 1990s WTW maintenance the proposed solution has been derived from a model that is uses age as the only factor of influence, reality is self evidently more complex than this.

9.4.2 Selection Process

362. We do not consider that alternative solutions have been fully considered and where they have been it is not apparent that alternatives have been fully explored and compared on the same basis. We note two examples of each of these:-

- Reservoir Management was dismissed as a potential solution at Cheddar WTW.
- Bedminster refurbishment was dismissed without any apparent consideration.
- The OPEX comparison for Cheddar WTW sludge production included the same quantity even though the option would produce significantly different amounts.
- AISC of raw water from Cheddar Reservoir 2 to Wessex Water's potable supply was directly compared.

9.4.3 Integration of Projects

363. We have noted that there is a lack of a strategic plan and even below this level little consideration is given to how schemes do or should interact. For example:-

Bedminster Service Reservoir

364. One of the reasons cited to replace Bedminster SR is the need to 'break' the pressure prior to the supply zone, we understand that BW are installing pressure reduction measures as part of leakage control and therefore this aspect is not needed.

365. Relocating Bedminster SR to Barrow could, we believe, enable water to gravitate to Banwell and Cheddar, enabling the cost of the Southern Resilience Scheme to be lower.

Southern Resilience Scheme

366. A fundamental design requirement for SRS is to enable supplies to be met should Cheddar WTW be out of service. Once SRS is in place an algal bloom at Cheddar Reservoir would not impact customers. We believe this should raise questions about the necessity to replace the existing WTW that is known to have less frequent issues that has been used in the modelling for SRS.

9.5 Risk

9.5.1 Approach to Risk

367. BW appear to be highly risk averse, this is requiring them to include more expenditure than is considered necessary. The approach is requiring schemes such as Cheddar Reservoir 2, replacing Bedminster Reservoir and Cheddar WTW to be brought forward in time.

368. The risk averse attitude also is displayed in the estimates of some schemes. The trunk main relining work has a significantly higher cost risk that we would anticipate.

9.5.2 Timing of Solution

369. BW appear to want to provide solutions earlier than they are required, again we would make reference to Bedminster Service Reservoir, the construction of this could be delayed without the delay having a significant impact on BW's ability to supply customers with potable water. It may be beneficial to provide schemes earlier, before they become essential, but this needs to be recognised and the associated costs accepted.

370. We are also of the opinion that Cheddar Reservoir can be delayed with no construction being required within the next 10 years.

9.6 Cost

9.6.1 Basis and Appropriateness

371. We believe that costs are generally higher than would be expected, although the nature of the high cost is not the same in each case:-

- Cheddar Reservoir – high due to inclusion of items that are not required or correct. Potentially high risk.
- Mains Replacement – high due to inclusion of an un-accounted (NB subject to revision) for £10M on distribution mains and high risk on trunk mains.
- 1990s Assets – high as costs have not been justified.
- Raw WTW Enhancement – high due to the adoption of an 'expensive' solution.
- Southern Resilience – high due to inclusion of an asset that BW appear to have sufficiency of.

372. We do not consider that the expenditure on Bedminster Service Reservoir is appropriate; the service reservoir is not required in our opinion.

9.6.2 Efficiency of Solution

373. Because of the lack of a strategic plan and lack of reviewing all potential solutions the efficiency of BW's proposed works are not as high as it could be. Facilities could be 'made to work' harder if BW were in a position to inter-relate schemes.

374. We believe that BW could adopt lower cost solutions to solve their issues of WAFU, algal blooms and resilience.

9.7 Conclusions

375. As can be seen in the table below our opinion is that BW have generally not demonstrated that the need exists, that their selection process has not been sufficiently rigorous, have taken a highly risk averse position and have included higher costs in their business plan that than is necessary to achieve the outcomes that are required.

	Need	Selection	Risk	Cost
Cheddar Reservoir Nr 2	✗	✗	✗	✗
Bedminster Service Reservoir	✗	✗	✗	✓
Mains Replacement Programme	✓	✗	✗	✗
Replacing 1990s TW Assets	✗	✗	✗	✗
Raw WTW Enhancement (Cheddar)	✗	✗	✗	✗
Southern Resilience	✓	✗	✗	✗

Table 18

APPENDIX A - INFORMATION SUPPLIED BY CMA

Initial Information

Filename	Document Title / Contents
150311 Bristol Water SoC.pdf	Bristol Water's Statement of Case to the CMA.
Bristol Water CMA response Q7.pdf	Specific queries -question 7 from the CMA to BW 24 April 2015.
Bristol Water CMA response Q8 - TROW BW review of leakage target.pdf	Review of leakage management at BW and targets for AMP6 by Trow.
Bristol Water CMA response Q8.pdf	Please provide any evaluation of the effectiveness of your active leakage work over the AMP5 period" Deadline: 29 April 2015.
Bristol Water CMA response Q9.pdf	"Please provide any analysis of why the areas identified in question 7 might be atypical relative to industry costs." Deadline: 01 May 2015
ENQ006 Cheddar DWI submission.pdf	Proposal to DWI to carry out improvements to Cheddar WTW during PR14.
ENQ007 Aqualogy Report BARROW Cryptosporidium Risk Jun13.doc	The aim of this document is to validate the proposal included in the document "Outline Design Report Barrow WTW Cryptosporidium Risk Reduction" provided by Bristol Water.
ENQ008 85N60 Cheddar Algae Removal.xlsx	Business case need and driver build up for Cheddar TW scheme.
ENQ009 167N48 Bedminster Reservoir.xlsx	Business case need and driver build up for Bedminster Res scheme.
ENQ016 TROW Bristol Water review of leakage target Final.pdf	See row 13 - duplicate.
ENQ017 Preliminary Design Report (v3) (18.11.13) - PR14 NIM5 Bedminster Reservoir.pdf	Bedminster service reservoir preliminary design report - Black and Veatch Sept 2013.
ENQ018 Bedminster_2007(1).pdf	Bedminster service reservoir inspection report March 2007.
ENQ019 Bedminster 2013.doc	Bedminster service reservoir inspection report May 2013.
ENQ020 Banwell Cheddar Zone Strategy - Optioneering Report.doc	Banwell/Cheddar Zone Optioneering report - Black and Veatch Sept 2013. Growth and resilience options.

Filename	Document Title / Contents
ENQ022 LEF challenges on Cheddar TW and SRS.docx	LEF challenges (raised by CCW) on Cheddar TW and Southern Resilience Scheme.
ENQ023 Table W5 - Asset Information - Asset data - EXTRACT.xlsx	PR14 Table W5 - Asset Information - Service reservoirs and towers. Basic information of Bedminster reservoir.
ENQ027 CP338 WRc Mains Interventions.pdf	WRC Portfolio project final report P8129. WRc and Crosbie Consultants. Collaborators - BW, NW, Portsmouth, Scottish W, ST, South Staffs, TW, UU, Veolia.
ENQ031 12 Fishponds Rd to Durdham Down.xlsx	Budget build up/forecast for Fishponds Rd-Durdham Down - Lawrence Hill scheme. Shows build for two options 1) Slipline 2) Rolldown.
ENQ032 B - 7inch Greenbank to Lower Ashley Road.xlsx	Budget build up/forecast for Durdham Fishponds 7" Section. Shows build for two options 1) Slipline 2) Rolldown.
ENQ033 J - Henleaze Rd to Durdham Down.xlsx	Budget build up/forecast for Henleaze. Shows build for two options 1) Slipline 2) Rolldown.
ENQ034 K - Summerlands Rd, Weston.xlsx	Budget build up/forecast for Summerlands Road. Shows build for two options 1) Slipline 2) Rolldown.
ENQ035 P - Chelvey to Portishead.xlsx	Budget build up/forecast for Chelvey Portishead. Shows build for two options 1) Slipline 2) Rolldown.
ENQ036 R - Portway.xlsx	Budget build up/forecast for Portway. Shows build for two options 1) Slipline 2) Rolldown.
ENQ037 T - Durdham Down Res.xlsx	Budget build up/forecast for Durdham Down Res. Shows build for two options 1) Slipline 2) Rolldown.
ENQ039 85N60 Cheddar Algae Removal.xlsx	See row 18 - duplicate
Enquiry supporting documents - INDEX.pdf	Index of enquiry supporting documents. Refs ENQ001-ENQ039. References and full name.
SOC002 Wholesale Plan - June Submission.pdf.pdf	BW Wholesale Plan Submission June 2014. pp.3-4 details changes made since last subsmission.432 pages
SOC005 Company Wide Plan - June Submission.pdf.pdf	BW Company Wide Plan Submission June 2014. pp.3-4 details changes made since last submission. 212 pages.

Filename	Document Title / Contents
SOC006 Cost Exclusion Cases.pdf.pdf	Document detailing BW's Cost Exclusion Cases included in Table W11. Submission based on guidance from Ofwat July 2013, where compelling case must be submitted for all such exclusions.
SOC011 100804 CC report on Bristol Water.pdf.pdf	Report on previous BW dispute of Ofwat's Price determination for AMP5. Report details results and outcome of Competition Commission investigation and re-determination of K for 2010-15. Halcrow assisted CC. Main dispute was on CM. The CC and DWI agreed with some schemes (which Ofwat did not) but overall the CC agreed with Ofwat re. K.
SOC020 Bristol Water Representation on the PR14 Draft Determination Master Appendices reformat 20141010.pdf.pdf	BW Representation on PR14 Draft Determination. Consultants cited throughout see CH notes.
SOC022 LEF Report to Ofwat.pdf.pdf	BW's LEF Report to Ofwat on BW's 2015-20 Business Plan. Includes customer processes and findings used etc. Also, challenges and responses from other regulators and stakeholders. Date?
SOC023 LEF Report to Ofwat June 2014 including appendices and covering letter.pdf.pdf	LEF letter to BW Chairman 18 June 2014 (to submit to Ofwat) re changes to plan following Ofwat challenges ' BW LEF report to Ofwat on key changes to BW's BP 2015-20.
SOC039 wrmp.pdf.pdf	BW's WRMP 2014 Final. June 2014. 210 pp.
SOC046 AR_2014.pdf.pdf	BW Annual return Report 2014. July 2014.
SOC052 AR14 Regulatory Performance Report 20140715.pdf.pdf	BW's Regulatory Performance Report 2013/14
SOC053 Company Wide Overview 20131201.pdf.pdf	PR14 BP Company wide overview. Pp. 158. Less detail than previous documents.
SOC096 - CH2MHill Review 20141002.docx.pdf	CM Review prepared for BW by CH2M Hill, 29th August 2014. Summary - general approach considered sound many elements consisted of BP AM principles. Recommendations for model improvements.
SOC102 PWC PR14 Agreed Upon Procedures report.pdf.pdf	PWC report of factual findings in connection with certain financial tables of the PR14 BP supplementary regulatory submission.' 14 pages of detailed, specific analysis of BW's regulatory table data.

Filename	Document Title / Contents
SOC114 Bristol Water PR14 Business Plan 20131128.pdf	BW Business Plan 2015-20. Short version (36 pps) for Customers.
SOC130 in1313pr14board.pdf.pdf	Ofwat Information Notice (IN13/13) - Board Assurance for the 2014 Price Review - Board Leadership, Transparency and Governance. Formal document which alerts stakeholders to a change in Regulation.
SOC133 BW PR14 Governance KPMG report - for inclusion in FBP.pptx.pptx	KPMG Slide Pack - PR14 Working Group at BW. Suggested agenda and ownership for PR14 meetings and items, roles and responsibilities, timeline and associated meetings. Appendix 1 - Ofwat's business planning requirements. Appendix 2 - Requirements of the UK Corporate Governance code. Slide 30 - flags potential issues for BW PR14 WG.
SOC136 ESD 9 - MM Assurance Report 20141002.pdf.pdf	PR14 Technical Assurance Overview Report, Oct 2014 Motts. Produced under 'Reporter' contract with BW.
SOC137 70_DG04_Third_Model_Review_Report_V2.pdf.pdf	Technical Review of BW's PR14 Models. Third Model Review - SEAMS. 28 Aug 2013. 13 pp.
SOC142 PR14 BW Board Assurance Statement and Appendices 20131129.pdf.pdf	PR14 BW Business Plan Board Assurance Statement and appendices. Mentions PWC audit and pp. 27-32 detail Osbourne Clarke review of BW's compliance with the UK Corporate Governance Code.
SOC143 Water_in_the_future_full_web2.1 20130107.pdf.pdf	BW - Water in the Future - Our Vision to meet out Customers' Expectations by providing an Outstanding Water Service in a Sustainable and Affordable Way. December 2012. pp.36. Company background, aims (outcomes), outcome delivery, progress to 2020.
SOC162 3 Stage-Two-Consultation-Report-low-res.pdf.pdf	BW Cheddar Reservoir Two Stage Two Consultation Preferred Proposals June/July 2013. 24 pp. Public Consultation document on proposals, construction, amenity etc. How to Have your Say.
SOC170 29 Consultation20report2028Final29.docx.pdf	BW PPS Cheddar Reservoir Two Consultation Report. Exec Summary details process so far from the WRMP to Stage Two Consultation. Details key issues raised during the consultation so far and BW responses. 107 pp.

Filename	Document Title / Contents
SOC202 ESD 16 - Atkins Review of SEAMS fWRMP Report 20141002.docx.pdf	BW FWRMP14 and SEAMS Assurance Report, 2nd Oct 2014. Atkins Report. Summary of findings from QA audit of consistency between BW's final WRMP and SEAMS. Overall inputs and outputs from SEAMS are consistent with WRMP. Some non trivial inconsistencies identified but graded as 'green' in level of risk.
SOC203 ESD 1 - CKBS Benchmark Report 20141002.pdf.pdf	Chandler KBS Independent Assessment of PR14 Costs - Review of Proposed Benchmark Adjustment. Sept 2014. Chandler Benchmarked 7 Infra and Non Infra projects for BW costs were 19% lower than BW's. BW justified 14% of this back to Ofwat but asked Chandler to review this. Chandler agree with 5.6% max, leaving a difference of 13.4%. Disagree on Risk, Contingency and Congested Sites costings.
SOC205 5114693 Q2 56 DG 024 Cheddar Algae Removal Outline Design Report Vers C.docx.pdf	BW Cheddar TW Water Quality Improvement Outline Design Report. Approved: 14/11/13. This report considers DAF & RGF option (onsite and offsite). Membrane plant solution already reviewed in Feasibility report.
SOC206 5114693_Q2_56_DG_017_Cheddar REVIEW Report 2013 11 05.docx.pdf	BW Cheddar WTW Water Quality Improvement Feasibility Report. Approved 5/11/13. Identifies feasibility of preferred options. Concludes that DAF & RGFs are proffered option.
SOC207 Banwell Cheddar Zone Strategy - Optioneering Report 20131121.doc.pdf	Report 122157 BW PR14 B&V. Branwell/ Cheddar Zone Strategy Optioneering Report. Sept 2013. Lays out options for Growth and options for Resilience. Option evaluation and development. SEAMS Modelling Addendum.
SOC213 Appendix H - Bedminster Reservoir Justification Report 20130926.pdf.pdf	Bedminster Reservoir Current and Future Requirement. [✂] Network Planning, Nov 12. 2 page report background and justification. Rest of document appendices - figures and charts.
SOC233 Cheddar FINAL Report _ WQ Improvements_July 2013.pdf.pdf	BW Cheddar WTW Water Quality Improvement Final Report. 16/5/13. Background, options considered, WWT options. DAF & RGF is the preferred option to submerged membranes.

Filename	Document Title / Contents
SOC234 14 06 03 BRL02 Cheddar WTW Raw Water Deterioration Further Support Letter FINAL as sent.pdf.pdf	DWI letter to BW 3rd June 2014. DWI scheme ref BRL02 - Cheddar WTW Raw Water Deterioration and BRL37 Cheddar WTW Final pH correction. Commend for Support - Supplementary Letter. Sets out Regs which apply and why the DWI support BW's case and the chosen option.
SOC276 Section 106 Agreement dated 10 November 2014.pdf.pdf	10th Nov 2014. Sedgemoor DC and Somerset CC and BW Plc. Agreement relating to development of Cheddar Reservoir 2 on land South West of Cheddar, Somerset DS.10/1171. Signed by all 3 parties. 80 pp. doc.
SOC277 CR2 decision notice.pdf.pdf	Full Planning Permission granted by Sedgemoor DC to BW Plc. Includes what is included and the conditions. 16 pp.
SOC283 Atkins dWRMP14 Super Review.docx.pdf	Atkins BW WRMP14 Assurance Review. 6th, 7th, 10th, 11th June 13. Amber issues raised with Outage, efficiency schemes and Investment Optimisation of S&D schemes and the associated QA.
SOC292 Asset Management2 20131201.docx.pdf	Asset Management Overview document. BW's approach. 47 pp. Outcomes, AM systems and models, Common Framework.
SOC300 BW1557_CrossAssetOptimisationModel_Specification.docx.pdf	BW Cross Asset Optimisation Model. SEAMS Wilco Model Specification. 'This specification is for the BW Cross Asset Optimisation Model.' 18/9/13.
SOC301 WP2 CAO.docx.pdf	Asset Cross Optimisation Model - Work Package 2 Report. BW Phase 3 FBP. 29/07/13. 'This report details the extraction, assessment, and provision of data for analysis of asset and operational performance of Bristol Water’s TemplateCross Asset Optimiser.'
SOC302 AMP and CF compliance 20131201.docx	Asset Maintenance Planning and Common Framework Compliance. Outcomes, Common Framework, trends, models, overview of performance, annual returns. Appendix 1 - Analysis of historical Expenditure.
SOC303 Water Supply Resilience Risk Assessment Report.docx.pdf	Water Supply Resilience Risk Assessment Technical Report. BW. 'This report presents a technical account of the resilience risk assessment work undertaken by Bristol Water staff and independent expert / specialist support provided by Halcrow.'

Filename	Document Title / Contents
SOC304 Quality Schemes - Approach and Methodology.docx.pdf	Quality Schemes Approach and Methodology. Section (3 pps) of larger report? 'Our Water Safety Plan process identifies “unacceptable residual risks” as outlined in Section 2. We have examined the best way to address each of these risks through separate consultants' reports for each key risk identified. Our review process for developing these solutions involves formal assessment and review of the potential risk management options.'
SOC305 Named Schemes - Approach and Methodology.docx.pdf	Named Schemes Approach and Methodology. 6 pp document.
SOC306 SDB - Approach and Methodology.docx.pdf	Supply and Demand Balance Approach and Methodology. 'In this document we have set out a high level summary of the component sections of our dWRMP with reference to guidance and methodology outlined above. We have also summarised the optimisation modelling tool (WILCO) we have used to select the best long-term solution meet the needs of other stakeholders and deliver the Government's policy requirements.'
SOC307 Cross Asset Optimiser - Approach and Methodology.docx.pdf	Cross Asset Optimiser (CAO) Approach and Methodology.
SOC308 Costing and Estimating - Approach and Methodology.docx.pdf	Cost and Estimating Approach and Methodology. Overview of process. Sec 6. Process used to cost 59 major schemes = £1.5 bn. Not all included in the plan and some moved into AMP7.
SOC311 LEF Presentation PR14 25th July v7 revised following IPSC.pptx.pptx	LEF IPSE (?) Meeting PR14 Preferred Plan 25 July 2013. Revision Issued 13th Sept. PPt pack - 42 slides. Section 11:0 Specific Schemes - Cheddar TW, Cheddar 2 Reservoir (2 slides), Southern Resilience Scheme (2 slides), Growth - Service Reservoirs.
SOC312 BW Annual Data Return Master Version 2013-14 20141110.xlsx.xlsx	BW Annual Return 2013/14 tables. Master.

Filename	Document Title / Contents
SOC316 09.10.2013 BRL02 Cheddar FINAL Decision Letter as sent.pdf.pdf	Periodic Review 2014:BW plc. DWI Scheme reference: BRL002 - Cheddar WTW Raw Water Deterioration. Final Decision Letter - Commend for Support. DWI to BW Letter 9th Oct 2013. DWI agree with the inclusion of the project in the business plan because of evidence of deteriorating raw water quality but can't support the project as a drinking water quality enhancement.
SOC328 All table June data final.xlsm.xlsm	All June table data. June 2014.
SOC337 ICS 140626 Letter to Board of Bristol Water.pdf.pdf	Letter dates 26/06/14 from ICS to BW, Ref: Business Plan Advice and Challenge. ICS reviewed Dec 13 plan and gave feedback (detailed) to BW. Believe June 14 submission addresses all feedback from Ofwat.
SOC346 WP1 Line of Works.docx.pdf	BW SEAMS. Line of Works Model. Wilco model specification 11th Oct 2013. Describes the line of works model: context, process, input data, calculation & outputs.
SOC347 WP1_DistributionMains.pdf	BW SEAMS. Wilco model specification. Distribution Mains. Describes the distribution mains model: Context, process, input data, calculation and outputs.
SOC348 WP1 Raw Water Mains.pdf	BW SEAMS. Wilco model specification 24th Oct 2013. Raw Water Mains. Describes the raw water mains model: context, process, input data, calculation and outputs.
SOC349 WP1 Trunk Mains.docx.pdf	SEAMS 1472. Wilco Model Specification. Trunk Mains Distribution. 28th June 2012. Describes the Trunk Mains Model: Context, process, input data, calculation and outputs.
SOC350 WP1 Raw Water Reservoirs.docx.pdf	BW SEAMS. Wilco Model Specification 10th Oct 2013. Describes the Raw Water Reservoirs Model: Context, process, input, data, calculation and outputs,
SOC351 WP1 Zonal.docx.pdf	BW SEAMS. Zonal Model. 1469 Wilco Model Specification. Describes the Zonal Model: Context, Process, Input data, Calculation and Outputs. 24/10/2013.
SOC355 WP1 Operational Structures.docx.pdf	BW SEAMS. Operational Structures Model. Wilco Model Specification. Describes the Operational Structures Model: Context, Process, Input Data, Calculation and Outputs. 27/03/2013.

Filename	Document Title / Contents
SOC357 WP1 Service Reservoirs.pdf	BW SEAMS. Service Reservoir Model. Wilco Model Specification. Describes the Service Reservoir Model: Context, Process, Input Data, Calculation and Outputs. 10/10/2013.
SOC358 WP1 Treatment Works.pdf	BW SEAMS. Water Treatment Works Model. Wilco Model Specification. Describes the Water Treatment Works Model: Context, Process, Input Data, Calculation and Outputs. 10/10/2013.
SOC359 Bristol Water Gap Analysis 10th June 2014.pdf.pdf	BW PR14 Gap Analysis. Draft subject to board approval 10th June 2014. Tables addressing Ofwat feedback on draft BP. Proposed updates, additional evidence and assurance.
SOC361 Cheddar 2 Unconstrained Options for WRMP.pdf.pdf	BW AMEC. Unconstrained options list for WRMP. Unconstrained options before options screening workshop. Document presents methodology for short listing unconstrained list of options to a list of feasible options.
SOC367 BRL_PR14 Business Plan Assurance_Final Report_21112013 1.pdf.pdf	Price Review 2014. Business Plan Assurance Update to BW Board. [✂], Motts, 21st Nov 2013. Slide pack 16 slides. Explains scope of Motts role, what their review covers. Slide 4 details other reviewees - Prof Maurato LSE, PWC, Atkins. From slide 9 - details areas where Motts challenge and Ofwat are likely to.
SOC371 BRL FD Sup Rep final.pdf.pdf	Final Determination Price Limits for 2010-2015. Supplementary report for BW Plc. Ofwat - Protecting consumers, promoting value and safeguarding the future. 94 pp.s. Purpose of this report is to provide further explanation and detail underlying our FD of price limits for your company.
SOC387 DG3 - 12hr plus Unplanned Summary Oct-14 v2.xlsx.xlsx	Burst main data Oct 2014. DG3 Unplanned events >12 hrs. Data from 2002-2014. Further info on material, date laid, weather, no. customers affected, notes, Ops log etc.
SOC391 cost assessment cepa.pdf.pdf	Ofwat Cost Assessment 22nd Jan 2013, prepared by Cambridge Economic Policy Associates Ltd (CEPA). CEPA requested by Ofwat to provide support on the question of cost assessment for PR14 and beyond, building on previous work. Specifically to determine viability of total cost of Totex assessment for PR14 and beyond. Asked to advise on alternative approaches to Integrated Models which don't work.

Filename	Document Title / Contents
SOC392 SOC Graphs on model differences.xlsx.xlsx	Data table and charts made up of UK Water Co data from AMP5 and in Draft BPs. Tabs = Mains Age Data, Upstream Assets, W3W4 data, Enhancement Spend, Pumping, MEAV, Charts, Modelling, Cost Assessment.
SOC394 GrossAssetValuesJr11Company Comparisons140429.xlsx.xlsx	Data, tables, charts Water Company data. Tabs = CM1, CM2, CM3, W5Dec13, JR11 Table 25a, MEACharts1, MEACharts2, JR11 Table 21a, Power, Materials, Opex2, Inflation, Industry Aug13, IndustryAug13CpyCharts, INdAug2013 Company, EFFRepLives, MEA_Other, Bristol History, WatRes, RWDistn, Treatment,Distn, Infra, Non Infra, Mains, PopInfra, PopNonInfra
SOC395 JAR2011 Datashare - 20 June 2011.xls.xls	JAR2011 All Tables data for all Water Companies.
SOC396 Company Data for MJK11.6.14.xlsx.xlsx	Company data. Workbook has 3 tabs. 1 = Data for MJK 2011-13. Av pumping head, DG3 >3 hrs, Total connected properties, total length of mains, Total no. sources, Total pop served. Table 2= Pumping head, Tab 3 = burst data 1996-2013.
SOC474 ESD 2 - CKBS CR2 Costs 20141002.pdf.pdf	ChandlerKBS Independent Assessment of PR14 Project Cost for Cheddar Two Reservoir. Elemental Level Review for BW, Sept 2014. Summary - Estimated costs were prepared by BW and their Design Consultant ARUP. BW/ARUP = £126,091,200, CKBS = £116,653,769.
SOC476 Wholesale Plan 20131201.pdf.pdf	BW PR14 Business Plan. PR14 Business Plan, Wholesale Plan pp.205. Contents - Executive Summary, Wholesale Outcomes, Wholesale Costs, Base Operating Expenditure, Investment Planning and Delivery, Risk and Reward, Financeability, Affordability.
SOC507 Outcome - Sustainable Environmental Impact - N348 baseline surveys.docx.pdf	Outcome Sustainable Environmental Impact:N348 Baseline Surveys. Brief document which explains 'our' approach and how we plan to meet our targets. Our statutory duties on stream flow management and the investment programme we will carry out to meet these obligations. Estimates of actions required for waterbodies covered by the NEP. Lists waterbodies and EA notes.

Filename	Document Title / Contents
SOC508 Outcome - Sustainable Environmental Impact - N99 catchment management.docx.pdf	Outcome Sustainable Environment Impact: N99 Catchment Management. Document explains our statutory duties on catchment management as required by the EA under the NEP and the investment we will carry out to meet our obligations. Lists sites and watercourses, drivers, actions and investment plans.
SOC509 Outcome - Sustainable Environmental Impact -N113 SERA.docx.pdf	Outcome - Sustainable Environmental Impact: N113 Site Environmental Risk Assessments. This document explains our approach on site environmental risk assessment at Company sites and the investment programme we will carry this out to meet this target. Link to EA Statement of Obligations. Audits carried out by Suez Environment identified sites where additional management is required due to environmental risk. Link to Chelvey Report and Purton Report.
SOC510 SITE RISK ASSESSMENTS.xlsx.xlsx	Workbook with results of site risk assessments described in document/row above. Included - Index, Durdham Down SR, Axbridge PS, Victoria PS, Stowey WTW, Cheddar WTW, Banwell WTW, Barrow WTW, Littleton WTW, Cheddar Reservoir, Blagdon Lake, Oldford WTW BH, Chase SR, Chew Stoke PS, Purton WTW, Draycott SR, Sperrings Green SR & PS, Chew Valley Lake, Puckle Church SR, Gloucester Sharpness Canal, Brent Knoll SR, Clutton SR, Windmill Hill SR, Knowle PS, WT &SR, Hopewell PS, Cooks Corner PS, Tetbury WTW & BH, additional sheets - Top Sites 2013, Site rank WT, Risk ranking, Profiles, Schemes, Template, Weightings, Levels, Frequency, Columns, Mitigation.
SOC526 pap_pos140829pr14recrevbrl.pdf.pdf	August 2014 Water Today, Water Tomorrow. 2014 Price Review Draft Determination - recommendations to Ofwat's Board on Bristol Water's revised Business Plan. Includes - Background, Key Issues of Focus in Draft Determination, Revised Business Plan, Key Issues, Summary Interventions.

Filename	Document Title / Contents
SOC527 pap_pos140404pr14scorebrl.pdf.pdf	April 2014 Water Today, Water Tomorrow. Element Categorisation Scorecards: BW. Ofwat. Elements = Household Retail, Non Household Retail, Wholesale Water. Details company proposals, evidence and Ofwat recommendations. RAG scoring. Acceptable/ more evidence required/fail. Red slides 27-29 = Wholesale Cost Assessment specifically Cheddar Two reservoir and unmodelled costs of £70m. Ofwat deep dive into Raw Water Deterioration, Southern Resilience and NEP and allowed adjustment of £12m.
SOC529 Wholesale data tables.xlsx.xlsx	Wholesale Data Tables W1-W19.
SOC531 Independent Assessment of Bristol Water PR14 Project Costs Report -V1 AMP6 Elemental April 2014 .pdf.pdf	ChandlerKBS Independent Assessment of PR14 Project Costs Elemental Level Review, BW April 2014. Commissioned by BW to carry out independent benchmark estimates on a sample of project costs. Phase 2 Elemental Level - Barrow WTW UV, Cheddar WTW Algae Removal, Glastonbury and Street Growth, Paulton to Midsomer Norton, Southern Support, Stowey WTW pH Correction, Revised Mains Laying Schemes. CKBS costed all for less, biggest differences = Paulton to Midsomer Norton and Stowey WTW UV.
SOC532 Independent Assessment of Bristol Water PR14 Project Costs Report -V2 AMP6 Process level April 2014.pdf.pdf	ChandlerKBS Independent Assessment of PR14 Project Costs. Process Level Review, BW April 2014. 2nd Phase applies unit rates from CKBS water industry unit cost data base to the BW bill of quantities. Same projects as earlier phase (above). Still big variances in Paulton to Midsomer Norton and Stowey WTW UV projects.
SOC533 Independent Assessment of Bristol Water PR14 Project Costs Report -V1 AMP5 Process and elemental May 2014 AMP5.pdf	Independent Assessment of PR14 Project Costs Process and Elemental Level Review Bristol Water - May 2014
SOC535 SDB Summary Scenario 1 to 13.xlsx.xlsx	BW Performance Model - Supply and Demand Balance. Details resource, distribution input and headroom. Tables and charts. Scenario 0 - baseline. 13 Scenarios run.

Filename	Document Title / Contents
SOC536 Estimating Bristol Waterrsquos efficient cost level 100315.pdf.pdf	Estimating BW's Efficient Cost Level, prepared for BW in association with distinguished Professor Subal Kumbhakar, March 2015, Oxera. Following DD then FD BW asked Oxera to review Ofwat's models - the full Totex, 2 refined Totex, and the 2 base total expenditure or Botex models. Reports details BW specific Issues, approaches to mitigate these issues and alternative models.
SOC541 Oxera review of models 021014.pdf.pdf	Ofwat's Cost Assessment Framework: a review working draft prepared for BW, Oct 2014, Oxera. Bristol Water's DD menu threshold is £359m over the AMP6 period. This comprises a £315m basic cost threshold (estimated using CEPA/Ofwat's models), £29.5m policy additions, and £14m unmodelled costs. In this context, Bristol Water has asked Oxera to review CEPA/Ofwat's models and to assess whether these fully capture operating circumstances specific to Bristol Water.
SOC546 Copy of Extract from CPROG 9 Feb 2015 based on DDR plus open market costs and TM lining to enhancement.xlsx.xlsx	Forecast of Capital Allocations 1997/1998 - 2019/2020. 09/02/15 CPROG AMP5. Includes Transition Investment in 2014/15. Based on 7th November 2013 CAO Run. Sheets - C Prog Efficiency, Efficiency Summary, Maintenance Summary, Cashflow Pre-efficiency, W3, Transition Investment, W3A.
SOC547 2014Nov06 BRL assurance statement letter.pdf.pdf	Mott McDonalds letter to [✂], Director of Regulatory Affairs @ BW. 7th Nov 2014. 'OFWAT query about Cheddar WTW.' Re. Ofwat's challenge on your approach to disclosing assurance. Letter gives details on MM's and BW approach to assurance. At end of pp.2 specific reference to Ofwat's challenge on the Cheddar WTW upgrade and how BW responded to this by providing more data and evidence.
SOC550 150127 Project Channel Steering Group - Business case review - for Soc ref.pdf.pdf	BW Project Channel Business Case Review. Steering Group, 27th Jan 2015 (extract). 2 slides. Summary of Updated Business Case - Draft pending updates.

Filename	Document Title / Contents
SOC555 ARUP Report 009 Design Review Report - Phase 1 Issue Compressed.pdf.pdf	BW Cheddar Reservoir Two. Arup report. Report 009: Design Review Report , Phase 1. Issue 1, Nov 2012. 54 pp. report. Background - Arup commissioned by BW to assist in the preparation of the planning application for submission in Dec 2013. Aim of report - set out and define key engineering design parameters appropriate for the level of design development, which has been carried out during phase 1 - project definition.

15 May Information

Filename	Document Title / Contents
Bristol Water CMA Qu6 12 May.pdf	Bristol Water's response to CMA Question 6 of 12 May 2015
Bristol Water CMA Response Q10 pdf.pdf	Bristol Water's response to CMA Question 10 of 12 May 2015
Bristol Water CMA response Q5 12 May.pdf	Bristol Water's response to CMA Question 5 of 12 May 2015

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Filename	Document Title / Contents
Bristol Water CMA response qu 9 v1.pdf	Bristol Water's response to CMA Question 9 of 12 May 2015
Bristol Water CMA response qu 9.pdf.pdf	Bristol Water's response to CMA Question 9 of 12 May 2015

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Filename	Document Title / Contents
Bristol Water CMA Qu4 19 May.pdf	Bristol Water's response to CMA Question 4 of 19 May 2015
ENQ042 asset resilience to flood hazards.pdf	Asset Resilience to Flood Hazards: Development of an analytical framework
ENQ043 UKWIR Resilience Making a Business Case for PR14.pdf	RESILIENCE: MAKING A BUSINESS CASE FOR PR14

Filename	Document Title / Contents
ENQ044 combined Halcrow reports (Part 1 of 3).pdf	Competition Commission Inquiry CC 1064 - Bristol Water Price - Technical Report
ENQ044 combined Halcrow reports (Part 2 of 3).pdf	Competition Commission Inquiry CC 1064 - Bristol Water Price - Technical Report Appendix 5
ENQ044 combined Halcrow reports (Part 3 of 3).pdf	Competition Commission Inquiry CC 1064 - Bristol Water Price - Technical Report Appendix 6 - 10
ENQ046 PR09 FBP B6 Final.pdf	Bristol Water Plc - Periodic Review 2009 - Final Business Plan - Part B6 - Consumer Service Strategy and Changes in Service

21 May – Southern Resilience

Filename	Document Title / Contents
Bristol Water - Index of Enquiry supporting documents.pdf	Annex 1 - Index of Enquiry supporting documents
Bristol Water CMA response Q14 14 May final.pdf	Bristol Water's response to CMA's sole Question of 14 May 2015
ENQ042 asset resilience to flood hazards.pdf	Asset Resilience to Flood Hazards: Development of an analytical framework
ENQ043 UKWIR Resilience Making a Business Case for PR14.pdf	RESILIENCE: MAKING A BUSINESS CASE FOR PR14 Report Ref. No. 13/RG/06/3
ENQ045 PR04 FBP quality.pdf	Bristol Water Plc - Periodic Review 2004 Final Business Plan Part B4 Quality Enhancements
ENQ046 PR09 FBP B6 Final.pdf	Bristol Water Plc - Periodic Review 2009 Final Business Plan Part B6 Consumer Service Strategy and Changes in Service
ENQ047 Keeping the country running.pdf	Keeping the Country Running: Natural Hazards and Infrastructure
SOC048 Bristol Water Representation on the PR14 Draft Determination Master submitted PD version 20141006.pdf.pdf	Representation on the PR14 Draft Determination
SOC208 Preliminary Design Report v3 18.11.13 - PR14 R1 Southern Support Scheme.doc.pdf	R1 – Southern Support Scheme Preliminary Design Report

Filename	Document Title / Contents
SOC309 PostFD14 - Southern Resilience CBA data for MROS v3.1 GAH CBA calcs.xlsx.xlsx	PostFD14 - Southern Resilience CBA data for MROS

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Filename	Document Title / Contents
Bristol Water CMA Q2 19 May.pdf	Bristol Water's response to CMA Question 2 of 19 May 2015
ENQ048 Cheddar Reservoir Algal Bloom - March 2014.pdf	Cheddar Reservoir Algal Bloom – March 2014
ENQ049 Cheddar Algae table of documents_part1of3.docx	David Other DWI submissions Cheddar Algae Removal Part 1
ENQ049 Cheddar Algae table of documents_part2of3.docx	Other DWI submissions Cheddar Algae Removal Part 2
ENQ049 Cheddar Algae table of documents_part3of3.docx	Other DWI submissions Cheddar Algae Removal Part 3
ENQ052 NIRS 988782 08.docx	NIRS 988782 08
PR14 Drinking Water Quality Schemes - Caveats.msg	PR14 Drinking Water Quality Schemes - Caveats
Trunk Mains Lining Summary.xlsx.xlsx	Bristol Water Budget Forecast - Trunk Mains Lining Summary

27 May Information – Cheddar Reservoir from Arup on CD

Filename	Document Title / Contents
Appendix A - Submitted Planning Documents.pdf	Arup Cheddar Res 2 Information - Appendix A Submitted Planning Documents
Appendix B - Location Plan & Scheme Plans.pdf	Arup Cheddar Res 2 Information - Appendix B Location Plan & Scheme Plans
Appendix C - Intake.pdf	Arup Cheddar Res 2 Information - Appendix C Intake
Appendix D - Raw Water Transfer Mains.pdf	Arup Cheddar Res 2 Information - Appendix D Raw Water Transfer Mains
Appendix E - Transfer Pumping Station.pdf	Arup Cheddar Res 2 Information - Appendix E Transfer Pumping Station
Appendix F - Reservoir.pdf	Arup Cheddar Res 2 Information - Appendix F Reservoir
Appendix G - Reservoir Structures & Pipelines.pdf	Arup Cheddar Res 2 Information - Appendix G Reservoir Structures & Pipelines
Appendix H - Water Quality File Notes.pdf	Arup Cheddar Res 2 Information - Appendix H Water Quality File Notes
Appendix I - Other BW Projects in Cheddar.pdf	Arup Cheddar Res 2 Information - Appendix I Other Bristol Water Projects Proposed in Cheddar
Appendix J - Operational Schematic.pdf	Arup Cheddar Res 2 Information - Appendix J Operational Schematic
Appendix K - Hydrology & Drainage Drawings.pdf	Arup Cheddar Res 2 Information - Appendix K Hydrology & Drainage Drawings
Appendix L - Sustainability Proposals.pdf	Arup Cheddar Res 2 Information - Appendix L Sustainability Proposals
Appendix M - Scheme Programme.pdf	Arup Cheddar Res 2 Information - Appendix M Scheme Programme
Appendix N - Cost Plan.pdf	Arup Cheddar Res 2 Information - Appendix N Cost Plan
Appendix O - Risk Register.pdf	Arup Cheddar Res 2 Information - Appendix O Risk Register
Appendix P - Designer Risk Assessments.pdf	Arup Cheddar Res 2 Information - Appendix P Designer Risk Assessments

Filename	Document Title / Contents
Appendix Q - List of Relevant Meetings.pdf	Arup Cheddar Res 2 Information - Appendix Q List of Relevant Meetings
CX-001.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-001
CX-002.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-002
CX-003.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-003
CX-004.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-004
CX-005.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-005
CX-006.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-006
CX-007.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-007
CX-008.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-008
CX-009.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-009
CX-010.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-010
CX-011.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-011
CX-012.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-012
CX-013.pdf	Arup Cheddar Res 2 Information - Engineering Scheme Plan CX-013
CX-015 Construction Plan - Phase I.pdf	Arup Cheddar Res 2 Information - Indicative Construction Plan Phase I Enabling Works CX-015
CX-016 Construction Plan - Phase II.pdf	Arup Cheddar Res 2 Information - Indicative Construction Plan Phase II Main Reservoir Construction CX-016

Filename	Document Title / Contents
CX-017 Construction Plan - Phase III.pdf	Arup Cheddar Res 2 Information - Indicative Construction Plan Phase III Completion Phase CX-017
CX-024_rev02.pdf	Arup Cheddar Res 2 Information - Reservoir Embankment Sections Sheet 1 of 2 CX-024-02
CX-025_rev02.pdf	Arup Cheddar Res 2 Information - Reservoir Embankment Sections Sheet 1 of 2 CX-025-02
CX-026.pdf	Arup Cheddar Res 2 Information - Existing Drainage Plan CX-026
CX-027.pdf	Arup Cheddar Res 2 Information - Proposed Drainage Plan CX-027
CX-050.pdf	Arup Cheddar Res 2 Information - Operational Schematic CX-050
CX-051-02.pdf	Arup Cheddar Res 2 Information - Cheddar Springs Intake CX-051-02
CX-052-02.pdf	Arup Cheddar Res 2 Information - Transfer Pumping Station Plan layout CX-052-02
CX-053-02.pdf	Arup Cheddar Res 2 Information - Transfer Pumping Station Sections A-A & B-B CX-054-02
CX-054-02.pdf	Arup Cheddar Res 2 Information - Cheddar Pumping Station P&ID Diagram CX054-02
CX-055_rev01.pdf	Arup Cheddar Res 2 Information - Inlet Main and Inlet Structure Plan and Structures CX-055-01
CX-057_rev01.pdf	Arup Cheddar Res 2 Information - Embankment and Borrow Pit Layout Plan CX-057-01
CX-058_rev01.pdf	Arup Cheddar Res 2 Information - Typical Embankment Details CX-058-01
CX-059_rev01.pdf	Arup Cheddar Res 2 Information - Embankment Cross Section Ch 0.0 Ch 800.0 CX-059-01
CX-060_rev01.pdf	Arup Cheddar Res 2 Information - Embankment Cross Section Ch 1000.0 to Ch 1800.0 CX-060-01

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CX-061_rev01.pdf	Arup Cheddar Res 2 Information - Embankment Cross Section Ch 2000.0 to Ch 2800.0 CX-061-01
CX-062_rev01.pdf	Arup Cheddar Res 2 Information - Embankment Cross Section Ch 3000.0 to Ch 3600.0 CX-062-01
CX-063_rev01.pdf	Arup Cheddar Res 2 Information - Draw-off Structure and Sections CX-063-01
CX-064_rev01.pdf	Arup Cheddar Res 2 Information - Overflow and Emergency Draw down, Channel Plan and Longitudinal Section CX064-01
CX-065_rev01.pdf	Arup Cheddar Res 2 Information - Draw-off Main Route and Longitudinal Section CX-065-01
CX-066-02.pdf	Arup Cheddar Res 2 Information - Draw-off Pumping Station Plan & Section A-A CX-066-02
CX-067_rev01.pdf	Arup Cheddar Res 2 Information - Realignment of Helliers Stream CX-067-01
CX-071_rev01.pdf	Arup Cheddar Res 2 Information - Cheddar Springs - Lower Pond Level Schematic CX-071-01
GX-001 Location Plan.pdf	Arup Cheddar Res 2 Information - Location Plan GX-001
Report 013 Design Review Report - Phase Six - Issue 20.01.2014.pdf	Bristol Water Cheddar Reservoir Two Design Review Report – Phase Six

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SOC037 Supporting Resilience Information.docx.pdf	Resilient Supply Supporting Information
Water Supply Resilience Risk Assessment Report Pt1.docx	Water Supply Resilience Risk Assessment Technical report
Water Supply Resilience Risk Assessment Report Pt2.docx	Water Supply Resilience Risk Assessment Technical report Part 2

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Filename	Document Title / Contents
2014-10-27 Cheddar Reservoir Cost Plan_Rev10.xlsx	Cheddar Reservoir Two Cost Plan Rev 10
Bristol Water response to query CMA0172.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0172 of 27 May 2015
Bristol Water response to query CMA0175.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0175 of 27 May 2015
Bristol Water response to query CMA0179.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0179 of 27 May 2015
Bristol Water response to query CMA0189.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0189 of 27 May 2015
Bristol Water response to query CMA0195.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0195 of 27 May 2015
Bristol Water response to query CMA0197.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0197 of 27 May 2015
Bristol Water response to query CMA0198.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0198 of 27 May 2015
Example Quote Breakdown_Sch6.xlsx	Schedule 6 - Resource rates for main renewal work
Index of CMA and Technical Consultant Queries of 27 May 2015.pdf	Index of CMA and Technical Consultant Queries of 27 May 2015

01 June Information – Post 27 Meeting Responses

Filename	Document Title / Contents
BedminsterSketches.pdf	Scanned drawing with mark-ups
Bristol Water response to query CMA0171.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0171 of 27 May 2015
Bristol Water response to query CMA0174.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0174 of 27 May 2015
Bristol Water response to query CMA0176.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0176 of 27 May 2015
Bristol Water response to query CMA0177.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0177 of 27 May 2015
Bristol Water response to query CMA0178.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0178 of 27 May 2015
Bristol Water response to query CMA0180.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0180 of 27 May 2015
Bristol Water response to query CMA0181.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0181 of 27 May 2015
Bristol Water response to query CMA0182.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0182 of 27 May 2015
Bristol Water response to query CMA0183.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0183 of 27 May 2015
Bristol Water response to query CMA0184.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0184 of 27 May 2015
Bristol Water response to query CMA0185.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0185 of 27 May 2015
Bristol Water response to query CMA0186 - update 030615 .pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0186 of 27 May 2015

Filename	Document Title / Contents
Bristol Water response to query CMA0186.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0186 of 27 May 2015
Bristol Water response to query CMA0187.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0187 of 27 May 2015
Bristol Water response to query CMA0188.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0188 of 27 May 2015
Bristol Water response to query CMA0190.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0190 of 27 May 2015
Bristol Water response to query CMA0191.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0191 of 27 May 2015
Bristol Water response to query CMA0192.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0192 of 27 May 2015
Bristol Water response to query CMA0193.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0193 of 27 May 2015
Bristol Water response to query CMA0194.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0194 of 27 May 2015
Bristol Water response to query CMA0196.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0196 of 27 May 2015
Bristol Water response to query CMA0199.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0199 of 27 May 2015
Bristol Water response to query CMA0200.pdf	Bristol Water's response to CMA's Technical Consultant's Question Ref CMA0200 of 27 May 2015
BW_inspection_June13.docx	Structural Commentary on the Bedminster Reservoir.
ENQ049 Cheddar Algae table of documents.docx	Other DWI submissions Cheddar Algae Removal

Filename	**Document Title / Contents**
ENQ053 Bedminster_2001.pdf	ENGINEERING DIRECTORATE RESERVOIR INSPECTION REPORT
ENQ054 Bedminster 17 05 13 003.jpg	ENQ054 Bedminster 17 05 13 003
ENQ055 Bedminster 17.05.13 055.jpg	ENQ055 Bedminster 17.05.13 005
ENQ056 Excavation on roof 05.06.13 001.jpg	ENQ056 Excavation on roof 05.06.13 001
ENQ057 Excavation on roof 05.06.13 002.jpg	ENQ057 Excavation on roof 05.06.13 002
ENQ059 Timeline.xlsx	ENQ059 Timeline
ENQ060 Copy of PR14 potential mains lining schemes - Eng comment.xlsx	PR14 Potential Mains Lining Schemes
ENQ061 Copy of Appendix A - Risk Register.xlsx	Appendix A - Risk Register
ENQ062 Mains Rehabilitation Tool Details (1).pptx	Network Planning Mains Rehabilitation Tool
ENQ063 Mains renovations activity split.xlsx	Mains renovations activity split
ENQ064 Report 005 Reservoir Site Selection Study - Part 2- Issue 27-01-2012.pdf	Bristol Water - Cheddar Reservoir No. 2 Report 005 – Reservoir Site Selection Study - Part 2
ENQ065 Cheddar Reservoir No 2 - alternative site selection ISSUE (1).pdf	Bristol Water - Cheddar Reservoir No. 2 Report 003 - Reservoir Site Selection Study
ENQ065 Cheddar Reservoir No 2 - alternative site selection ISSUE.pdf	Bristol Water - Cheddar Reservoir No. 2 Report 003 - Reservoir Site Selection Study
ENQ066 BRL CMA - MM Bedminster assurance info 28 May 2015 (1).pdf	PR14 Business Plan Assurance - Competition and Markets Authority - Additional information for Competition and Markets Authority (Bedminster service reservoir costing)
ENQ066 BRL CMA - MM Bedminster assurance info 28 May 2015.pdf	PR14 Business Plan Assurance - Competition and Markets Authority - Additional information for Competition and Markets Authority (Bedminster service reservoir costing)
ENQ067 Part 1 Supplier Quotes.zip	ENQ067 Part 1 Supplier Quotes.zip
ENQ068 Email from Atkins - sludge costs.PNG	S114693 Q2 56 026 Cheddar Outline Design NPV & annualised costs

Filename	Document Title / Contents
Index of CMA and Technical Consultant Queries of 27 May 2015.pdf	Index of CMA and Technical Consultant Queries of 27 May 2015

04 June Information

Filename	Document Title / Contents
100430 Final Report.pdf	Competition Commission Inquiry CC 1064 - Bristol Water Price - Technical Report

05 June Information

Filename	Document Title / Contents
Bristol Water response to qu1 of 5 June.pdf	Bristol Water’s response to CMA Question 1 of 5 June 2015

APPENDIX B - PUBLIC DOMAIN INFORMATION

Filename	Document Title / Contents
Avon_Power_Station_Scoping_Report.pdf	Avon Power Station EIA Scoping Report Scottish Power Generation Limited
pap_pos140829pr14recrevbrl.pdf	2014 price review draft determination – recommendations to Ofwat's Board on Bristol Water's revised business plan
pap_tec20141212pr14fdboardbrl.pdf	2014 price review – recommendations to Ofwat's Board on Bristol Water's final determination
SSE-Seabank3-Newsletter-Issue-3-Apr14.pdf	Seabank 3 Consultation News – Issue 3, April 2014
Appendix 8 - WRMP	
BW Baseline Headroom Plot TOTAL PR14 V3.pdf	Headroom analysis
BW Baseline supply demand balance.pdf	Bristol Water Baseline Supply Demand Balance (Dry Year)
BW Headroom Components Table.pdf	Headroom Spreadsheet - PR14
BW Headroom Percentiles Table.pdf	Headoom Percentiles Table
BW Preferred plan supply demand balance.pdf	Bristol Water Preferred Strategy Supply Demand Balance (Dry Year)
Appendix 10 Option appraisal - WRMP	
Ranked schemes_AISC_ from WRMP.pdf	AISC costs
WiLCO model schematic.pdf	SEAMS diagram
WILCO scenario selected options 170114.pdf	WILCO scenarios

APPENDIX C – MINUTES ON MEETING HELD 27 MAY 2015

Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
1. Water Resources Management Plan (WRMP)	Atkins	WRMP Assurance	[✂]	1. SOC202 – Capex refers to R002 (Docks to Barrow) at £106M or £128M, which figure has been used in the NPV sum in BW's SoC page 364 Table 97? 2. SOC202 section 8 – has the cost benefit calculation been carried out? Noted as not being done. 3. SOC202 does not contain any assurance for R005, Cheddar Reservoir 2, why wasn't this included? 4. How can the statement "The Company indicated to us at audit that the realisation of this demand is a certainty due to the nature of the customer (cooling water for a power station)," in SOC283, page 7/12, be justified? What was done to ensure the statement was correct?	1. Costing done by B&V ([✂]). DB - Capex should be £128m, from SEAMS. No assurance done on the SOC by Atkins. Wessex Water not viable through AISC and SEAMS review. BW to confirm which figure is correct and which was used for the NPV. £128m went into SEAMS. 2. Willingness to pay and Cost Benefit calculations. [✂] could not review that as it was not available at the time. Professor Susan Mourato (spelling?) did an independent review of the willingness to pay. This has been provided within the SOC, says MK. To be provided – soc 138 3. Supporting data not available to [✂] to enable review. Capex £115-119m – TP asked which used for the AISC NPV calc? £119m used, sum still to expend. 4. At the time when [✂] queried – letters were provided indicating intent. Company indicated a high certainty, it's not his view. Letter "indicate intent"
	Arup	[✂]		1.	
10.30 to 11.30	BW	Project Director	[✂] Mike King [✂]	1. How was the Unconstrained list reduced, how was the process for reservoir selection progressed, 50+ sites reduced to 5? 2. What is BW's view regarding the supply to Avonmouth Power Station? SSE April 14 Newsletter. 3. 150311 Bristol Water SoC, page 364, Table 97, what has been included in the CAPEX for Cheddar Reservoir 2? 4. The AISC cost for the potential Wessex Water Transfer (103 p/m^3) is for treated water, is the Cheddar Reservoir Cost raw or potable? SOC039 page 174/210, R0191. 5. The Wessex Water bulk transfer is to Weston super Mare, is this beneficial to supplement the Southern Resilience?	1. There Is a report available (MK). Distance from source, geology, archaeology. All options come off the same source. 2 reports – long list to shortlist and shortlist to preferred. For shortlisted 5 they did GI for. All spring water goes to the reservoir but there is a facility to divert in emergency situations to WTW not used due to crypto risk (UV installed now). Abstraction for 60 Ml/d, annual license, but driving head doesn't allow this to flow by gravity, needs to be pumped – it's around 20-25 Ml/d treated,. Works theoretical is 60 Ml/d. Generally40 -45 Ml/d average over year captured. Springs deliver a lot in winter (250 (?)Ml/d) but very little in the summer !5 Ml/d. All new reservoirs based on using Cheddar Spring Water. 2. MK: at the moment, both projects are on hold. Still potential schemes. Unlikely to appear in the next AMP. Reservoir is required anyway. Believe one or both power stations will be there before 2025. If both happen the Wessex TTE wouldn't be sufficient. Power station say they spend more on chemicals on TTE rather than Vs clean water. Seabank 3 – SSE. Avonmouth CCG2. BW can only supply one not both. Improved resilience if power station doesn't come off. £7 per customer cost, £13 per customer benefit. SSE contract with Wessex for TTE but BW believe SSE are not tied to this and they could choose clean water. BW suspect they will want to mix and match between the two. 3. Cost of construction reservoir, connection back to the source through the PS and infra to connect back into BW system to enable treatment and distribution. River diversion, flood compensation and land acquisition. No treatment included, plan to use Cheddar WTW and Banwell. Key treatment is at Cheddar. 4. Marginal operating costs included only in the raw water in table 97. Cost for Wessex supply is for provision potable water. Comparison not like for like. Would add "4-5p" for cost to treat. BW accept its not a like for like comparison. BW believe Cheddar and Banwell have capacity to treat two reservoirs. (Barrow mentioned also). More pumping. Currently unable to capture all the water. Across winter pumping at high rates out of the area. Cost saving for holding water locally. In a dry year still be transferring water north to south even with the power station. South is the area that needs the water, north is self-sufficient generally. Southern resilience is independent of this, its not a supply and demand issue. 5. Yes Drop in WAFU, 2018, due to power station.

Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
	BW	WRMP	[✂] Mike King	1. SOC039 , WRMP, page 26 Ml/d raw water was supplied to non-domestic customers, where has this volume been detailed in the WRMP? Is it used as potable? 2. Page 140 of WRMP states that Severn Trent may have possible future supply. Has this been followed up since the compilation of the WRMP? 3. There is potential to supply Severn Trent in an emergency (19 May Q4 response) from Alderley, can the infrastructure be used for a supply? 4. SOC030, WRMP, page 96/210. What has 19 ml/d raw water been allocated to in 2018? (SoC clause 321 for power station and previous raw water supply) 5. Business Plan SOC476 page 69/205 - Security of Supply Index (SOSI) is shown dropping to 60%, 15 Ml/d below target headroom, is this still the position? Page 65/205 states 307Ml/d increased by Cheddar 2 to 322 ml/d in mid 2020s. Supply demand graoh shows only 297 Ml/d available. 6. SOC002, Business Plan June Submission,, page 266/432, has same table but has no supply to the Power Station. How can this be the same SOSI as the original Business Plan statement that had the power station supply included in the demand? 7. Has the potential for Wessex Water to supply raw water into Avonmouth via BW's existing infrastructure been investigated, ie the commercial supplied water, 26 Ml/d? If not way hasn't this been investigated?	1. MK: Timing of Cheddar demand would be 2021/2022 instead of 2018/19. Historic non potable (26mld) – ICI, which had a reservation agreement which ceased in 2006/7. Power station would be on the ICI site. Starting point of (supply/demand)graph takes account of no raw water supplies in Avonmouth. 2. STW don't have supply in AMP6 for sure, say BW. BW haven't pursued this as it would have resulted in one of the worst cost beneficial options. 3. BW no longer provide STW any water. 4. BW confirmed this was the power station. Peakflow 26mld 300l/s. Average. Based upon non contractual offer. Series of heads of terms. BW believe CR2 needed regardless of power station. 5. BW say this shows if they don't develop their resources there would be a reduction in the SS index. Other things in there like leakage but Cheddar is the main item. Climate change impact explained as greater risk as BW are almost entirely surface water with limited below ground source. HR Wallingford/Amec did an analysis. 6. Variance between 322 mld and 297 explained as dry weather demand net of any headroom margin at all. No supply to Seabank power station. [✂] to confirm whether they are the same graph and answer the question – 3 parts to it. 7. Not raw water capacity required. 8. MH additional question – risk averse approach to WRMP? Demand management and leakage. Could more be done on smart metering for example? Modest allowances made for the benefits associated? Answer: MK doesn't think BW are risk averse, medium risk appetite. Central estimates used for leakage reduction etc. By 2025, ambitious leakage targets. Wessex study used as basis of 15% for metering efficiency. Some info suggested more like 5% +/-7%. Proposals for smart meters etc not supported by CMA. Not sure what savings they will get. Headroom – operational headroom quite low, doesn't believe out of line in that. Climate change 90% was reasonable as no allowance for emissions. BW to provide sensitivity analysis on whether this would impact position up to 2025. 90-80% would amount to an extra volume available of 2-3mld which has an impact of around a year. Customer willingness to pay – 2 studies undertaken relevant to this. Enabled BW to optimize the plan. 98% willing to pay excluding inflation. Dropped to 93% post inflation. Unconstrained optimization suggested spending £412m, well above acceptability and financeability.
2. Projects **11.45 to 12.45**	Arup Project Director (inc. Planning, Outline design, Environmental, Project Management & Costing) [✂]			1. In Arup's report SOC555 Option C appears to be the selection option, however the quantities are for Option B, why? (Table 17 page 33/54) 2. What has been included in the proposal to transfer water around BW's area? 3. What cost estimates were provided for the scheme? 4. SOC555, section 7.3.1 states information is required regarding Cheddar WTW, what has been done to ensure that the proposed scheme for the reservoir can be utilized? What is included in the costs of the scheme?	1. Latest costing spreadsheet is based upon 9,000. Version January 2014 not provided previously. BW to provide – provided in the meeting – excel version of cost plan to be provided. 300l/s pumping station included at Cheddar WTW. Includes all interlinking pipelines etc. Treatment works costs excluded. Amount of water pumped on average will be less. Dry year is the issue. Don't believe that algae will be an additional issue. Allowance made for circulation – aerators. Not much allowance made for Opex. 2. See above, pipeline included 3. Estimates to be forwarded 4. See above, no WTW included, 5. Extra question What included for reservoir management? Lump sum for some equipment, needs to be modelled.

Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
	Mott Macs	Assurance	[✂]	1. What audit has been undertaken by MM on Cheddar Reservoir 2? SOC136 has little mention.	
	BW	Project Director	[✂] Mike King	1. What was the process from the long list to Cheddar, what was in second place? 2. In SOC039 page 174 what CAPEX and OPEX figures have been used, SOC has CAPEX of £114.5M, BW & CKBS, SOC474, vary from £116 to £126M. What has OPEX been based on? SoC Table 98 states costs are BW's based on Arup's report, what has been used Option B or C as the base for pricing. 3. Cheddar Res 2 is said to be used to supply other areas to 'free-up' water to supply Avonmouth, what has been included to enable this, both OPEX and CAPEX? 4. Why has 16.3 Ml/d been taken as the yield from Cheddar Reservoir 2? 5. What has been included for treating the water from the reservoir? 6. What is included in for pumping water 7. Can the spend profile be explained, SoC Table 98, what is being expended in the latter years? Where are the costs for associated works included? 8. What is included in OPEX costs, stated that there is negligible cost, has destratification been included? Has treatment or pumping cost been included?	1. Wookey – scheme discounted on cost, further from source, extra infra. Considered more risk. Different Planning Authority that might be more difficult to get permission from. 2. £119M used for NPV not the 116m. Was included before WRMP was finalized. [✂] to check the £119m. 3. Q "Why is CR2 being proposed?" To add capacity but in a better location. 4. 16.3 Ml/d yield in latest Arup report provided. 5. Mainly through Cheddar WTW, around 30 Ml/d on average and pumping around 15 to 20 elsewhere over the year. ¼ to a 1/3. Will be able to run at close to 60, not all year round. 6. Same High Lift PS required as for existing 7. Landscaping, planting, filling, pathways, visitor centre. £35M 8. [✂] to confirm what made up the Opex. Cost plan shows the build up of the optimism bias – 19% of the 31.5% included. £10m archaeology advised/agreed. Cost plan on the CD provided but the Excel version is to be provided. Arup suggested need to read Planning Pre-commencement decision.
Cheddar WTW **13.15 to 14.15**	Atkins	Scheme options, preliminary design and costs	[✂]	1. SOC 233 - How is water received at the WTW? What range of flows does the current WTW treat? From what Source? 2. SOC 205 / SOC 206 / SOC 233 - What is the proven link between algae count and the rate of blinding of the slow sand filters? 3. SOC 233 / SOC 206 Was an option of DAF prior to slow sand filters considered? 4. Why was the RGF option prior to slow sand filters rejected? 5. Were additional microstrainers considered? 6. What capacity has been allocated for Cheddar Reservoir 2 yield? 7. SOC 205 Why was duty standby facilities included for all elements of the sludge system?	1. As noted earlier, all flows go to Reservoir then back to WTW via pumping station 2. DWI events x2 related to Algae – lost supply to 20,000 people. Not able to provide required demand on first incident, second event demand low. Microstrainers will not provide 100% Algae removal. Residual risk of algae blooming after the microstrainers. Although not a high count, type can have a big impact on the blinding of the filters. Algae frequency is on an upward trend, deteriorating since 2006. [✂] to provide more detail behind the graph including type of species. Destratification in the reservoir is available and in use. [✂] noted in algal bloom microstrainers blind and then bypass to filters. 3. Brainstorming session with BW including catchment management, reservoir management. Not enough time to implement catchment and reservoir management. Roughing filters, followed by slow sands. Actiflow system. DAF followed by RGF. Membrane treatment. Ozone and PAC with DAF and RGFs. DAF selected based upon NPV. Preferred is pre-ozonation, PAC & PACL, DAF, RGFs, extg UV then marginal chlorination. Inlet pumps also. At Banwell its coag dosing, surge membranes, SSFs, UV, Chlorination. Sludge Opex has been included as the same on the comparison in the Atkins report? BW to confirm figures as more would be expected from the DAF. High frequency of replacement of membranes a key factor. 4. Covered above 5. Covered above 6. xx 7. Critical works – service interruptions. Band screen not really critical item. Atkins suggested its cost beneficial. Suggested a week out of service if sludge press needs maintenance. Recovery of wastewater was part of the consideration.
	BW	Project Director	[✂]	1. What has been used as the basis of the costs for this scheme?	1. Process equipment – out to supplier. Civils – cost data from standard costs, Balfours independent review. BW to provide quotes and build up of civils & meica. Opex data from BW operations. Power costs of pumping included but only on the works not for distribution. Raw water pumping cost to Banwell or Burrow – not included in this cost.

Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
	BW	Water quality	[✂]	1. Does Banwell or Barrow WTWs have an issue with the water from Cheddar, is any reservoir water passed to these works? page 81 SoC map of pipes 2. Was increasing Banwell or Barrow WTW capacity increases investigated to enable Cheddar slow sand filters to be lower loaded	1. Barrow does – enhancements made, to cope with algae loading. Banwell – SSFs blinded. Replaced RGFs with submerged membranes with coag dosing. Experienced similar issues. 2. Not asked.
	BW	Treatment process	[✂]	1. Should Atkins not answer the questions posed pass to [✂] 2. In BW's response Q2 19 May the algal bloom of March 2014 is stated as evidence of the need to replace the slow sand filters. Is an algae count of 10k considered high? Is it strange for this to occur in March? 3. Has the link between March 2010 'no water' incident and algae been established? 72 Hour Report - Brent Knoll document does not confirm the link 4. The other data regarding algal counts show figures of 50k for blooms – what is considered a bloom? 5. SOC546 Row 192, Destratification equipment was added to Cheddar in 2006/07, what effect has this had? Is it in use? 6. SOC546 Row 193, Replacement bandscreen included in AMP6, will this remove algae? 7. ENQ048 Cheddar Reservoir Algal Bloom - March 2014. Can you explain why the headloss dropped to zero? 8. ENQ048 Cheddar Reservoir Algal Bloom - March 2014. Can you explain why all the filters do not respond the same? Why did SSF2 blind before the bloom?	1. Questions mainly answered by BW 2. Bloom is type dependent, some types can pass microstrainer – microstrainer bypassed, 3. Believed report confirmed link to algae 4. Not asked – BW's view is that different algae cause different problems. After bloom can have taste and odour issues. 5. BW do not believe that there is a link. It is in use, BW believe it wasn't a new installation but will check. Not understood how effective this is. Some DO level monitoring done. Q "Would reservoir management be an option?" [✂] "It is a black art and not a solution" 6. At reservoir not on the treatment works.Protection to pumps not at WTW. Prior to the microscreening. 7. SSF2 headloss – 2 was always higher to begin with. Spike prior to others and prior to algae. [✂] to review reasons and explain. 3, 4, 5 & 6 – drop to zero when taken out of service for skimming. 8. As above. SSF2 perhaps had algal bloom due to extra sun light. Q "Can it be covered?" Covering will cause Schmutzdecke to die.
	BW	Investment Planning	[✂]	1.	
14.20 to 14.35 Teleconf	Mott Macs	Cost Assurance	[✂]	1. What audit has been undertaken by MM on Cheddar Reservoir 2? SOC136 has little mention. 2. Ditto but SOC555 Cheddar Reservoir 3. Comment regarding ENQ017 we are in close agreement with B&V's figure, are MM?	1. Excluded as MM didn't have Water Resources capability, which is why Atkins were appointed (WRMP). CKBS did the cost assurance / benchmarking. Different process to rest of the business plan. CKBS used their own costs to benchmark. 2. Ditto above. 3. see below

Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
Bedminster Reservoir **14.45 to 15.45**	B&V	Scheme options, preliminary design and costs	[✂]	1. ENQ017 - Why was a refurbishment option not considered? 2. Replacement with the same volume was apparently the only option considered why was this? 3. Was any investigation carried out regarding the bacterial contamination? Was either the water age or condition of the main considered as issues? 4. Was replacement of the SR with a pressure control valve considered?	[✂] – Need – clear that the tank had "had it". Reports, pictures of inside of the reservoir. General observations were that some costs were lower some were higher than Mott Mac benchmark. BW took lowest from BW, CKBS and Mott Mac as the challenged costs. [✂] to provide further info on cost assurance on Bedminster. Roots coming through the roof (MS). 1. Ruled out refurb due to condition, however not substantiate by photos in reports. Structural issues as well as leaks. Been patching for years. Voids under the floor. Report doesn't cover the structural failures, which were apparently seen by a B&V engineer. Internal report to be provided. Cost is based on same location so includes removing base to identify ground issues and rectify. Risk allowed. BW to check provision and provide risk register. 2. Like for like replacement. Marginal cost difference between 18-24 ML. Target storage will run out by 2020, this will make it OK upto 2035-2040. 25 year lookahead view. 3. New inlet and outlet mains but not from Barrow. Condition not considered to be a concern. B&V report says its vulnerable to bursts. BW to confirm. 2.5 days across patch, 10 days at Bedminster – why do BW need it? BW to provide background on zonal demand and explain comment in 2007 report. 4. Extg plans to put in a PRV downstream to protect the city. Strategic volume overall is the key requirement.
	BW	Project Director	[✂]	1. ENQ018 & ENQ019 - Was the replacement of the incoming main, A, that was highlighted as 'unreliable' included in the business plan? 2. Why was a reduced size not considered? 3. The 2013 report states that there is a 100mm wide crack has this been evidenced? 4. There is an apparent rapid deterioration in condition between 2007 and 2013, was this questioned? 5. What do BW consider as the minimum requirement for the volume of treated water to be held? 6. SOC213 Fig 2 - Would construction of a replacement reservoir at Barrow WTW not allow for greater flexibility? Could feed 4 mains.	1. No. 2. Not expressly. See above on cost differential. 3. 100mm crack not evidenced. BW to provide evidence – photos viewed in the meeting, t be provided. 4. Photo shown of spalling render at entry access, opposite corner to crack. 5. 10 days retention in report, BW were surprised by this. BW to review and respond to this. Turnover is a concern. BW design for 12 storage and 12 emergency and aim for less than 3 days. 6. Dismissed based upon planning / land. BW need to answer question on strategic flexibility, their current view is that its closer to the demand.
	BW	Network Modelling	[✂] Mike King	1. ENQ018 - The 2007 condition survey states that the SR has 10 days retention (page 9/11) at the reduced operating depth, this suggests that the population dependent on the SR (30,000) is over stated, what is the population served? 2. What would an optimum storage volume be at Bedminster? 3. Is storage required at Bedminster?	Answered above.

Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
Mains replacem't	SEAMS	Inv Modg	[✂]	1.	
	BW	P Dir	[✂]	1.	
	BW	PM	[✂]	1.	
	BW	Inv Stratgy	Mike King	1.	
16:00 to 17:00	BW	Pro Del	[✂]	1.	
	BW	Investment Modelling	[✂]	1. Why were other correlating factors not considered within the water mains burst model (E.g. material, diameter, soil type, etc)? 2. How was the service impact from a burst quantified within investment modelling to determine the mains replacement length? 3. How were the leakage benefits from the mains replacement programme derived from the burst model considered? 4. Confirm the list of interventions considered as part of the burst modelling? 5. Confirm the list of interventions considered as part of your leakage management strategy? 6. What other interventions could you have considered as part of your burst and leakage investment modelling? 7. How were the intervention cost and performance characteristics derived for both the burst and leakage model? 8. How were the bursts and leakage performance benefits associated with some interventions considered within both the burst and leakage models? 9. Why is the current mains replacement programme considered the economic level of replacement	1. BW – age isn't the driver its an explanatory factor. Target higher burst rates. Age is a key factor in degradation rate. Need to provide evidence of other factors being considered. 2. to 9 not specifically asked. Historic costs less 10% for mains. Trunk mains – more specific, based on dia but based on historic costs One unit rate for distribution mains – reflects historical mix. Need to see historical mix used. Cheaper rate for zonal Unit rates costs to be provided - [✂] before efficiency Trunk mains definition is based upon whats classed as trunk mains in GIS but legal definition is different. 79% no-dig and 21% open-cut. 4inch or 3 inch with a bit of 6 inch. 8 inch and above is classed as a trunk main. [✂] – to be provided. Mains rehab tool – details to be provided Cross asset optimizer – is this to give the solution or as a decision support tool? BW need to demonstrate the checks and balances process of verifying the optimizer selections. 4 mains 4 trunk 3 zonal and optimizer picked the least cost to deliver the outcome Infra spend less this AMP than last Leakage applied (4ml) evenly – is this correct? BW to confirm Background leakage negligible – OK Rationale for sub-level DMA – BW suggest this is a more targeted approach for background leakage.

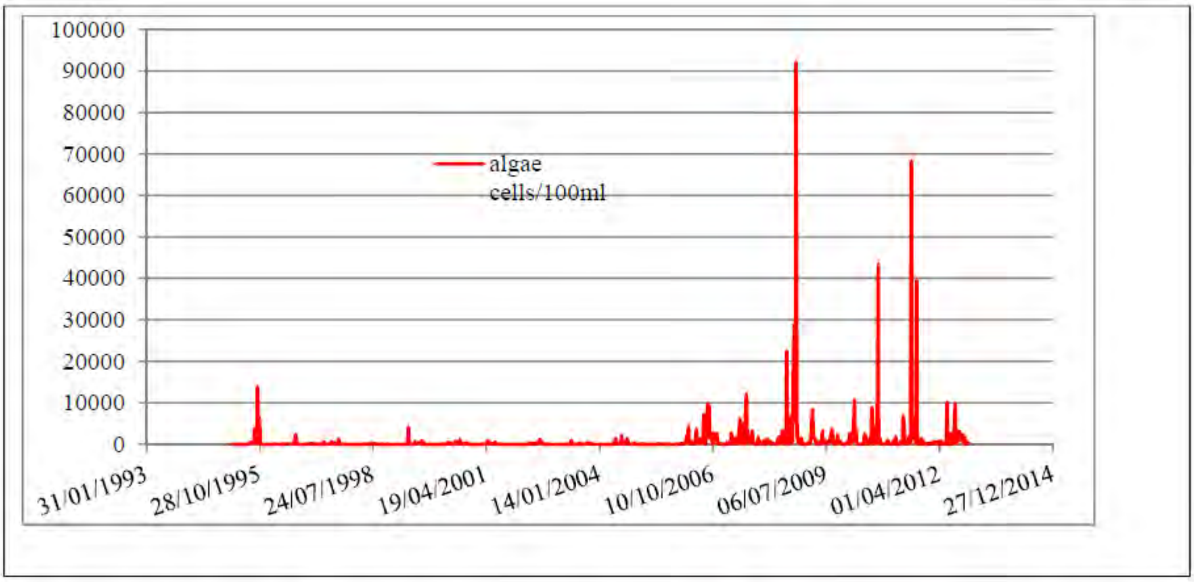
Scheme	Consul / BW	Area of work	Individual responsible	Questions	27TH May 2015
	BW	Costing	[✂]	1. Documents referenced - ENQ031 12 Fishponds Road, ENQ032 B 7 Inch Greenbank to Lower Ashley Road, ENQ033 J Henleaze Road , ENQ034 K Summerlands Road, ENQ035 P Chelvey to Portishead, ENQ036 R Portway, ENQ037 T Durdham Down Res 2. Why is the work not split into Rural/Suburban/Urban areas? 3. What is included in the 25% sundries? 4. On Fishponds Road – Durdham Down the rate for open cut 18" is less than 12", why? 5. How was the 25% Risk calculated? 6. What is the Core Team Management Fee under the Contractor Costs which is over and above the Contract Management & Staff? 7. What material is provided free issue? 8. What does the 9% business overheads include? 9. How is business compensation 10. Where have the changes post MM challenge been recorded? SOC136 page 34/385	1. Statement 2. Rural and Urban – MS says contractor has provided costs, but a single rate appears to have been used. Aqua to review the latest reconciliation provided this week. 3. "Non-scheduled items" – sundries – scope creep. BW to provide timeline on initial costs, 25% sundry application (how calculated) pre-target cost and then calculation and application of outturn cost. 4. BW to review reasons why 5. 15% contractor risk and 10% operational risk. 15% - outturn costs analysis contributed 6-8%. Cost based on slip lining, cheapest option, may need to use closefit techniques which is why the additional risk has been allowed. 10% Bristol risk is based upon experience of keeping 6. Compounded application of oncosts means that real impact is much higher than 25% risk. QS, Framework Manager and designer. 7. Everything – pipes, fittings 8. Not asked 9. Estimate made on experience after line walk. 10. Information in 24 May Information Trunk Mains Lining Summary.xlsx – need corrected for error 2 tab.

APPENDIX D – OBSERVATION ON CHEDDAR ALGAL BLOOM

Bristol Water Price Determination – Commentary on Cheddar Reservoir Algal Blooms
A review of the documents provided suggests a possible series of events that resulted in the algae blooms occurring from 2006 and onwards. The events are described here, along with some observations from a report by Arup.

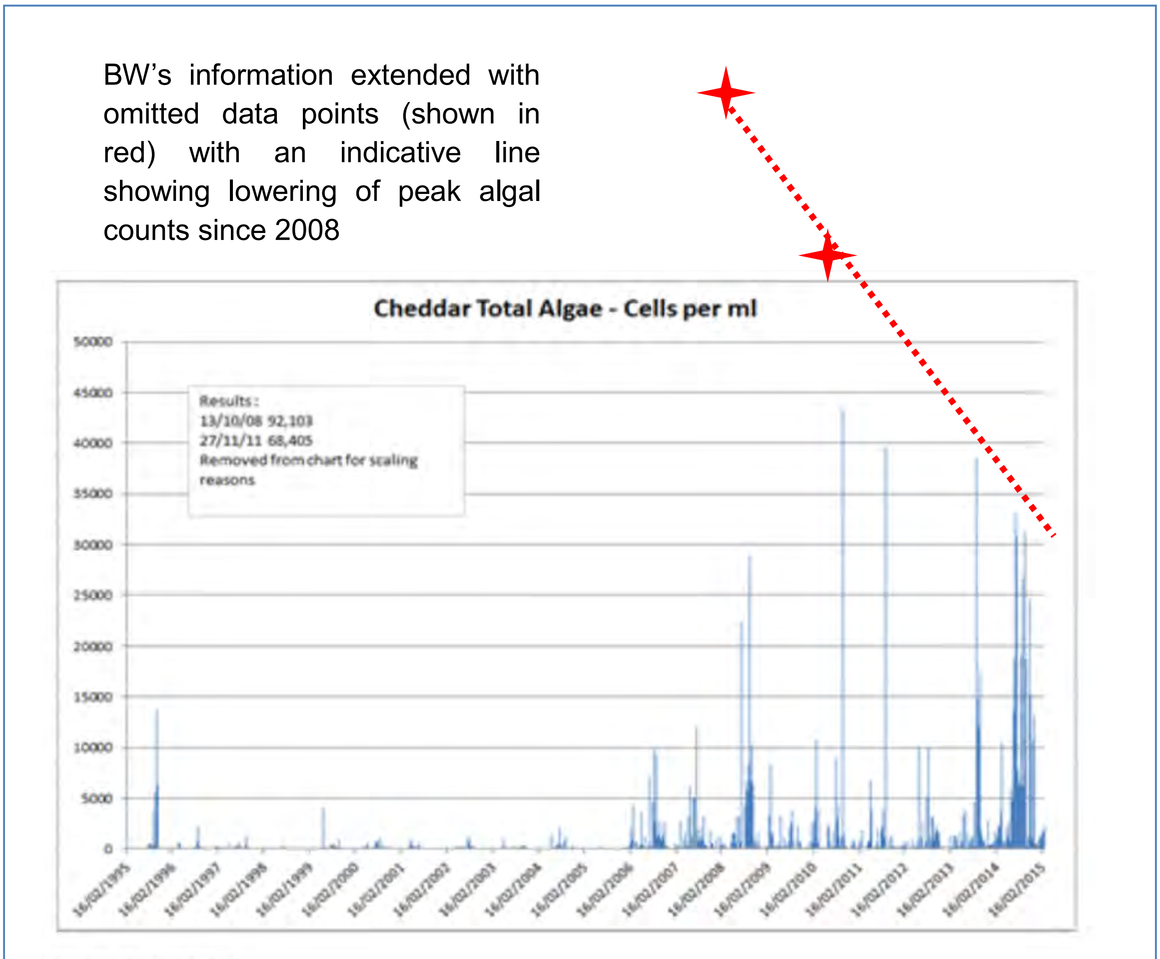
Reservoir Mixing
A new reservoir mixing system was installed in 2006-2007, according to investment records. From this data it is assumed that the first full year of operation was 2008 which also coincided with water from the new River Ax DAF plant being introduced to the reservoir.

Installation of a reservoir mixing system, such as Helixor mixers, required fixing or anchoring to the bottom of the reservoir. In anchoring the mixing system some localised disturbance of sediment will have occurred along with nutrients bound up in the reservoir sediment. The attached graph of algae cells/mls recorded in the reservoir outlet shows the occurrence of two small blooms in 2006 and 2007 respectively. It can also be seen that prior to 2006 there was little algal growth in comparison to after.



Algae Numbers in Reservoir Outlet (from Arup File Note, dated 20 Sept 2013)

The first major algae bloom occurs in 2008, which is when the reservoir mixing system is expected to have begun a full year of operation and to have River Ax water included. It is possible that this bloom occurred because of the nutrients released from the sediment when the reservoir mixing was used in a sustained manner. The Helixor units can impart a substantial amount of energy to the water. Their duty is to induce a flow of water into which air is introduced. The air bubbles are further reduced in size by the Helixor 'blades', which increases the surface area of the bubbles and hence the efficiency of gas/water exchange. In any event, the induced flow can be expected to have disturbed sediment in the vicinity of each Helixor unit. As a result, a large amount of nutrient is likely to have been released from the sediments and mixed into the body of the reservoir through the efficiency of the mixing system.



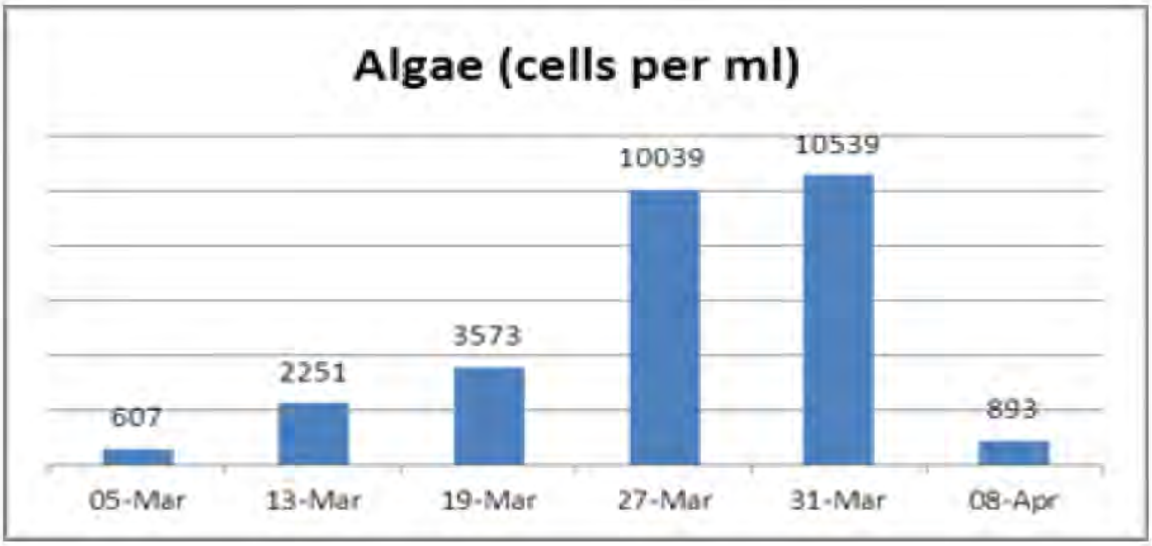
Source: Bristol Water

Figure 13

The repetition of blooms of algae is noted in the graph. There is considerable variation in algae numbers from year to year, but this is likely due to other seasonal factors, for example, light intensity and temperature. It is possible that the extent of the blooms is reducing, based on reduced algae numbers and it might be supposed that this is due to less nutrient being available following the initial scour of sediment. However, there will always be some accumulation of sediment between peak growing seasons, and therefore elimination of algae blooms is unlikely to occur.

With investigation to fully understand the cause and active reservoir management it may be possible to limit algal blooms; we do not have sufficient information available at present to determine the cause.

The subsequent data provided BW response to Question CMA0177 & CMA0178 shows that frequency of algal blooms increased markedly in 2014. There is evidence of high numbers of *algae occurring with increasing frequency. Some of these species have the potential to blind filters (Dinobryon, Microcystis, Melosira and Cyclotella) and that will cause taste and odour problems (Dinobryon, Microcystis and Cyclotella). It is also true that some of the algae will not be removed by the microstrainers.*



Source: Bristol Water

Above from BW response to CMA0177 & below CMA0178

CMA0180 gives details of the operating window for the Helixor mixing system. However, the question that is not being answered is the possible catastrophic impact of the reservoir mixing system. We have been provided with data that shows the problems started at the time installation of the mixing system was completed. The situation deteriorated massively when the mixing system was turned on, and that the intensity and frequency of the blooms increased when the reservoir mixing system was left on (28 Feb 2013 to 7 Jan 2015).

Year	Destratification On	Destratification Off
2008	1 April	6 October
2009	12 March	1 October
2010	1 March	31 October
2011	25 March	1 November
2012	23 February	27 November
2013	28 February	N/A
2014	N/A	7 January 2015
2015	25 March	-

Source: Bristol Water

From BW response to CMA0180

It is quite possible that the reservoir mixing system is providing the ideal conditions for growth of algae - ensuring a well aerated medium, with rapid access to light (courtesy of the lift provided by the mixers) and a good supply of nutrients lifted from the sediments. Perfect conditions for the culture and growth of the very thing one is trying to eliminate.

Observations from the Arup Report on Cheddar 2

It is interesting to note that Arup describe the greatest possible challenge to the new reservoir is algae. The report continues that it is important to understand the operation of the existing reservoir with respect to operation of the scour, mixing, and selection of the draw off (level). An understanding of the behaviour of the existing reservoir will greatly assist in the design of the new.

Arup suggests it is recommended that some sampling is carried out to look at the effectiveness of the reservoir mixing, sediment levels and the release of nutrients from these sediments. Further, to construct a mass balance to see whether the reservoir is accumulating nutrients (and hence pose a constant risk if these sediments are disturbed. Monitoring of oxygen levels should be carried out. It is also pertinent to point out that Arup report states the need to consider nitrite and ammonia concentrations in the raw water, if the slow sand filters are abandoned. We are not aware of any process to remove these with the proposed new WTW.

Conclusions

It is concluded that the existing reservoir mixing system is implicated in the cause of recent algae blooms at Cheddar Reservoir.

The existing reservoir management system is not effective in reducing algal blooms.

Investigation is required to determine if the mixing system is providing benefit.

Further, reservoir monitoring, as suggested by Arup, should be carried out, along with speciation of algae, in order to ascertain the nature of the algae blooms, and the impact of reservoir management.

Reservoir mixing is likely to be required. However, any mixing should ensure that sediments are not disturbed, and is only operated when necessary - based on actual monitoring data and not a 'blind' on/off strategy.

APPENDIX E – CHEDDAR WTW – ATTITUDE TO RISK

The solution includes for both PAC and ozone. In Feasibility Study Rev B the need for ozone was questioned. By Rev C ozone is part of the main solution but it is not made clear why this is the case. PAC dosing will remove the Geosmin peaks. Ozone will assist with removal of zooplankton which are reported as a potential problem (again dealt with adequately by the SSF). The inclusion of a high CAPEX and OPEX process stage is currently not well justified.

The whole sludge stream has duty / standby redundancy. This will add substantially to the costs. There are 3 square hopper bottomed tanks, 2 sludge buffer tanks, 2 WRc type thickeners, 2 thickened sludge tanks and 2 belt presses. A stream consisting of a single sludge buffer tank, thickener, thickened sludge tank and belt press would be substantially cheaper (1 large tank cheaper than 2 small tanks, reduced instrumentation, cabling, pipework and valves). Storage volumes can be retained through larger tanks and footprint would be reduced. Including for duty / standby elements across the whole sludge stream is out of line with industry practice. Overall average thickened sludge volume is $11m^3$/d in the event of for example belt press failure storage allows for 12 days (buffer and thickened sludge tanks) beyond this 1 tanker load every 2 days would not be cost prohibitive.

There are duty / standby ozone dosing chambers again this is very risk averse as there is no M&E equipment within the ozone contact tank (side stream dosing).

Ammonia in raw water – currently will be dealt with on SSF. The new process won't address this and it may cause issues with chlorination. Pg 10 App H.

App H recommends "*Good management of the new reservoir is important and understanding the behaviour of existing reservoir will greatly assist the design of the new. It is recommended that some sampling be carried out to look at the effectiveness of the reservoir mixing (thermal stratification), sediment levels and the release of nutrients from these sediments and mass balance model to investigate whether the reservoir is accumulating nutrients"* There is no evidence of BW carrying out this work to date.

If the existing treatment process is changed (micro strainer, slow sand filters) then it is important to ensure that the biological action of the slow sand filters is either retained or replaced so as to handle ammonia and nitrite which is generated within the reservoir and also treatment considered for effective manganese removal.

The new process selection will not be effective in removal of ammonia or nitrite as there is no biological stage.

The issues raised in the Arup Cheddar 2 water quality report (App H) do not appear to be addressed in the BW/Atkins work on Cheddar TW. Were Atkins aware of these issues? Ammonia and Nitrite are not mentioned in the feasibility study or design report for Cheddar

TW (outside of the water quality data). With the complete change of process there should be some commentary as to how ammonia and nitrite will be dealt with.

APPENDIX F – SERVICE RESERVOIR CAPACITY

Company	Ref Doc	Notes
United Utilities	Water Network: Service Reservoirs Jan 2013	Hrs storage not specified
Welsh Water	Water Distribution Manual 2005	3.5.2 Capacity
		3.5.2.1 Service reservoirs have two main functions: (a) to balance the fluctuating demand from the distribution system against the output from the WTW. (b) to act as a safeguard for continuance of the supply should there be any breakdown at the WTW or on the trunk main pipelines supplying the service reservoir. 3.5.2.2 The minimum storage to balance flows shall be not less 6 hours supply. 3.5.2.3 Contingency storage shall be not less than 24 hours supply to cope with variations in demand, trunk main bursts and source works plant breakdowns. This 24 hour storage can be achieve though the control of storage within a number of service reservoirs serving that supply area. 3.5.2.4 Where daily fluctuations are large, trunk mains are not duplicated or the source works rely on pumping, consideration should be given to providing up to 48 hours storage
South West Water	TS 399 Design and Maintenance of Service Reservoirs 2008	2.1 Capacity & Layout
		The gross capacity of the reservoir shall be a minimum of 30 hours* based on the annual daily average demand at the current design planning horizon, unless: a. The reservoir has 2 or more independent feeds, then the capacity can be reduced by a factor equivalent to the loss of the larger feed, subject to a minimum storage of 24 hours, calculated in the same manner as above. b. The reservoir supply zone can be served wholly or in part from an alternative source then this factor should be taken into account in the sizing of all reservoirs feeding the zone. c. An existing upstream reservoir has a capacity greater than 30 hours. In this case the size of the new reservoir can be reduced pro rata, subject to adequate capacity to deal with diurnal demands. this capacity should ensure that there is 21 hours supply if an incident occurs affecting the reservoir supply when the reservoir is at 75% capacity and assuming that the last 5% in the reservoir cannot be used.

Company	Ref Doc	Notes
Wessex Water	DS660 Service Reservoirs	The following guidelines shall be applied: (a) Normal design capacity: – 15 hours Average Annual Demand at Design Horizon. – If the reservoir provides transit storage for bulk supplies to other reservoirs, then only 6 hours storage is required for this component of the average annual demand at the design horizon. – Where there is a normal diurnal variation in demand, this will give a minimum of six hours storage in the event of failure of the bulk supply, which is adequate to effect most repairs. (b) If the following qualifications apply, consider further:– A risk analysis shall be carried out to determine the risk of loss of supplies more frequently than once in every 5 years. (If this risk is significant, it may be economical to reduce it by relaying mains, bringing in supplies from an alternative source, etc, rather than increasing the reservoir capacity). – If the reservoir or its zone is fed from two or more sources, each of which are able to meet the majority of the demand, the capacity may be reduced. – If the bulk supply to the reservoir is insecure, due to a long or vulnerable supply main, or unreliable source or pumps, the capacity shall be increased. - If the distribution zone has a poor record of bursts, a larger capacity can be allowed in the short term. – If the demand on the reservoir is exceptionally "peaky", there shall be a minimum of six hours storage at all times. • In an area with exceptional seasonal demand from tourism or industry for example, it may be appropriate to use the Peak Week, or Peak Day demand, rather than the Annual Average.

APPENDIX G – SOUTHERN RESILIENCE RISK AND CBA

BW's comments 22 June 2015.Ref 28

We acknowledge the use of industry best practice processes. With regards to further comments on the risk associated with the CBA we refer to our responses to refs 29 and 30.

BW's comments 22 June 2015 Ref 29

We accept BW's point that the failures are independent in their CBA and therefore can be summed. We note that BW has chosen to quote only part of the relevant sentence in their feedback:

"The CBA benefits are overstated in that the individual probabilities of all 6 categories of resilience outage periods are included then summed. This therefore gives an annual probability"

The full sentence in the report is:

"The CBA benefits are overstated in that the individual probabilities of all 6 categories of resilience outage periods are included then summed. This therefore gives an annual probability of any resilience outage of ~ 23-25%/ year."

Given that BW did not present any evidence of any resilience events having occurred previously we therefore consider that a 23-25% probability (1 in 4 years) is a high value to use in the CBA.

BW's comments 22 June 2015.Ref 30.

From our understanding of the data presented and the explanation of measures in the table below, we summed the individual system probabilities. This meant that we understood the modelled best case probability of any > 2 day event was 1 in 3.6 years and that was then applied to the CBA. We acknowledge BW's point that their model accounts for the interactions between systems and therefore our estimates derived from the table are not correct.

Our assumptions were made based on our understanding of the modelling approach as described in Water Supply Resilience Risk Assessment Report Pt1.docx

> Section 5.2 Hydraulic modelling revealed the following outcomes in the event of Banwell being unavailable, but with supply continuing from Cheddar WTWs
>
> Section 5.3 Hydraulic modelling revealed the following outcomes in the event of Cheddar being unavailable with supply continuing from Banwell, Charterhouse and Stowey WTWs
>
> Section 5.3 Hydraulic modelling revealed the following outcomes in the event of GSC being unavailable with supply continuing from Barrow and Stowey

We therefore considered that the modelled events for each system were independent and therefore could be summed as they are in the CBA described in Ref 29.

We request BW to demonstrate how the individual probabilities were summed and therefore applied as presented in SOC309 PostFD14 - Southern Resilience CBA data for MROS v3.1 GAH CBA calcs.xlsx, Sheet N66.1.

Following this we propose to use the failure probability data presented in SOC309 PostFD14 - Southern Resilience CBA data for MROS v3.1 GAH CBA calcs.xlsx, Sheet N66.1.

Our understanding of the data as presented in year 4 when the scheme is implemented is that the overall probability of any resilience event is 0.2412 (1 in 4 years) without the SRS and that the overall probability of a > 2day event is 0.091 (1 in 11 years) without the SRS and that these are the best case scenarios. These probabilities are presented in the CBA as 6 independent event probabilities such that:

Independent Events	Probability / year	Frequency (years)
6-12hr Resilience Event probability	0.0476	1 in 21
12-24hr Resilience Event probability	0.0551	1 in 18
>24hrs Resilience Event probability	0.0476	1 in 21
>48hrs Resilience Event probability	0.0650	1 in 15
>1week Resilience Event probability	0.0250	1 in 40
>1month Resilience Event probability	0.0010	1 in 100
Summed probabilities (Probability of any event)	0.2412 (for >48 hrs. 0.091)	1 in 4 (for >48 hrs. 1 in 11)

With the SRS in place these probabilities reduce to 0.067 (1 in 15 years) and 0.0303 (1 in 33 years) respectively. The differences in probabilities are then multiplied by the number of properties benefitting and willingness to pay which is set at £337 per property over 7 years (undiscounted) and on this basis the CBA is made.

Measure (based on next 40 years)	Banwell	Cheddar	Oldford[92]	Glastonbury and Street	Gloucester Sharpness Canal
[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Total availability (%)	99.10	99.05	99.61	99.75	98.31
Number of outages any duration in 40 year time horizon	23	23	26	23	16
Number of outages >2days – 30 days (best case / worst case scenario)	4/21	4/22	4/12	3/6	3/16

Note: Explanation of measures:

Population currently impacted – Population at risk of service loss on asset failure and who would potentially benefit from resilience scheme

Total availability – This is the % of the time over 40 year time horizon of the analysis when service is available from the asset (this analysis takes into account the storage available in the system).

No. of outages any duration – This is the number of times asset failures are predicted to occur within the 40-year time horizon of the analysis and which would lead to a service interruption (any duration). This analysis takes into account the storage available in the system.

No. of outages of between 2 and 30 days duration - This is the number of predicted outages of between 2 and 30 days within the 40-year time frame of the analysis. Two figures are presented separated by /. The first is the best case scenario where repair times are estimated to be short, which in principle means that repair/recovery can largely be achieved during the period covered by storage in the system (in which case outages would be mainly of short duration of a few hours). The second figure is the worst case scenario modelled where extended repair times are assumed. In this case, repair cannot be fully effected during the period covered by the storage in the system. Extended repair/recovery times have been included to model situations where source contamination may have occurred Up to 30 days for a repair/recovery for source contamination is considered a reasonable estimate based on supply contamination events we have experienced elsewhere in Bristol Water. In some cases we have experienced contamination that has taken far longer to correct.

Source – BW

APPENDIX H – BEDMINSTER SR, BW'S COMMENTS

In their response to our Initial Report BW had included Appendix One as an example of "…*an issue which we have not addressed but where we do have concerns about the assumptions and implications*."

In relation to Bedminster service reservoir, Aqua states that no consideration was given to refurbishment options for the reservoir.	
Bristol Water response	**Aqua Consultants' Reply**
This is not the case.	No evidence has been seen of any work carried out by BW in regard to a refurbishment. In section 4.4.1 we state "…all of these were variations of rebuilding the same capacity SR…" and note that BW have not said where they have considered a refurbishment. We note in the last row of this table, BW's opinion is that "…*refurbishment is not appropriate as it is no longer considered a viable alternative to replacement*…". This in our opinion is an assumption and not factual.
The existing reservoir is constructed from mass concrete (i.e. there is no steel reinforcement) and would not meet modern standards.	The material in contact with water is concrete in both mass concrete and reinforced concrete structures. The use of mass concrete is not used in the construction of new service reservoirs due to cost. Concrete is used throughout the water industry and is permitted to be used by DWI. Service reservoirs across the UK are constructed from various materials, mass concrete, brick, stone and reinforced concrete. Due to the longevity of these structures many still in use are constructed from Victorian materials and technology

<table>
<tr><th colspan="2">In relation to Bedminster service reservoir, Aqua states that no consideration was given to refurbishment options for the reservoir.</th></tr>
<tr><th>Bristol Water response</th><th>Aqua Consultants’ Reply</th></tr>
<tr><td>All the major elements of the structure are known to leak, and therefore refurbishment would require significant work to the floor in addition to much of the walls and the roof to make the structure watertight.</td><td rowspan="2">We have not denied that considerable work would be required, in section 4.4.2, paragraph 118, we have indicated what works may be required.

The information provided by BW does not provide any information that would mean that the existing structure cannot be repaired. In our opinion the question that has not be asked is if the structure can be repaired economically.

With regard to the structural failure we draw attention to the following “It is believed the crack at the top of the wall adjacent to the inlet and outlet chambers was caused when the reservoir was temporarily filled to top water level during the recent incident when there was a burst main in Hotwells Road.”[142]</td></tr>
<tr><td>The columns are leaning and the latest inspection has revealed significant displacement of the structure in the forms of large cracks indicating structural failure.</td></tr>
<tr><td>Record drawings indicate that repairs were first undertaken before 1912 and further repair and refurbishment have continued throughout the subsequent decades.</td><td>We do not consider repairing a service reservoir to be an unusual practise, as we have commented in section 4.4.2, paragraph 117, 20 years would be a normal interval for refurbishment as this is considered to be the life of roofing membranes.</td></tr>
</table>

[142] ENQ018, from Conclusions page 6.

In relation to Bedminster service reservoir, Aqua states that no consideration was given to refurbishment options for the reservoir.	
Bristol Water response	**Aqua Consultants' Reply**
Black & Veatch's structural engineering report commented that "*Due to its age, the extent of crack defects present and the inherent and residual structural damage it is considered, from an initial engineering appraisal for PR14 assessment, that the reservoir structure has exceeded its expected life span*". Clearly, it can be inferred from the comment that refurbishment is not appropriate as it is no longer considered a viable alternative to replacement, but there is no specific reference in that report to refurbishment having been considered as an option.	Age is not an appropriate measure in our opinion, just because the structure is 'old' does not make it unsuitable to be used. BW have 12 service reservoirs that are older than Bedminster, the oldest of which dates from 1844[143]. Given that refurbishment is a normal activity for service reservoirs we believe that the measure that should be applied to judge if the structure requires replacement is to establish if refurbishment can be undertaken economically. We do not believe that BW or their consultants have investigated the option to refurbish Bedminster SR.

[143] ENQ023

Supporting analysis for the review of base expenditure in Bristol Water's business plan

1. This appendix includes additional analysis and considerations that we made in arriving at our assessment of Bristol Water's planned base expenditure, and further commentary on Bristol Water's response to our provisional findings.

2. In particular, we provide additional analysis on detailed aspects of our reviews of opex (paragraphs 3 to 37) and MNI (paragraphs 38 to 56).

Operating expenditure

3. In this section we set out further evidence and analysis on the following aspects of opex:

   (a) CC10 determination and AMP5 outturn.

   (b) Bristol Water's approach to planning opex.

   (c) Ofwat's views on Bristol Water's approach.

   (d) Further details of our analysis of opex including:

      (i) selecting a base period for comparison;

      (ii) labour costs; and

      (iii) forecast trends in operating costs in AMP6.

CC10 determination and AMP5 outturn

4. In CC10, Bristol Water's appeal focused on seven different areas of opex allowance, and the CC agreed to make adjustments where it considered costs to be beyond management control.

5. The CC10 decision allowed an additional £6.9 million base opex for Bristol Water (2007/08 prices) compared to the Ofwat allowance. The changes related to bad debts (£3.3 million), abstraction charges (£1.9 million); and pensions (£1.7 million).

6. CC10 included an additional allowance for opex associated with enhancement capex that Bristol Water was allowed within AMP5, including £0.5 million for

supply demand balance and £1.8 million for water quality compared to the Ofwat allowance.

7. In the first three years of AMP5, Bristol Water spent some £7.8 million less than its allowance (noting that year one contained £1.5 million of CC referral costs) as shown in Table 1. Consistent with the regulatory framework for AMP5, both allowed and outturn opex include retail costs.

Table 1: Bristol Water AMP5 opex allowances and outturn

£m (2012/13 prices)

	2010/11	*2011/12*	*2012/13*	*2013/14*	*2014/15*
Allowance	55.2	54.9	55.3	55.5	55.8
Outturn	54.5	51.1	52.1	55.6	n/a
Difference	0.7	3.9	3.2	0.0	n/a

Source: CMA analysis of Bristol Water SoC, Figure 21.
Note: Includes wholesale and retail.

Bristol Water's approach to planning opex

8. Bristol Water's business plan included a small overall increase in total wholesale opex from AMP5 to AMP6 of £3 million (1%). AMP5 expenditure (some £225 million) included a number of one-off items including costs related to the CC10 appeal and reorganisation that complicate a like-for-like comparison.

9. Bristol Water's planned level of opex for AMP6 was estimated using a baseline for 2013/14 adjusted for anticipated future changes in expenditure.

10. With respect to its planned level of AMP6 opex, Bristol Water said that:

> 2014-15 operating costs are forecast to be above the CC10 allowance and include the increased impact of additional operating expenditure related to capital investments allowed at PR09 in addition to some one-off costs that we would expect to reverse (eg increased rechargeable work, external input into our business efficiency project, an enforced change of banking supplier due to the RBS downgrade, set-up costs to prepare for the opening of the retail market).[1]

11. Bristol Water applied an efficiency challenge to its planned opex, totalling some £14.0 million,[2] offset by price inflation above RPI of £5.6 million (see Table 2).

[1] Bristol Water SoC, paragraph 350.
[2] Comprising two effects based on analysis by First Economics and Oxera respectively.

Table 2: Bristol Water wholesale opex efficiency in final business plan

£m (2012/13 prices)

	Annual (%)	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*	*AMP6 impact*
Wholesale input price inflation (relative to RPI)	0.6	0.6	0.8	1.1	1.4	1.7	5.6
Frontier productivity growth	–1.0	–1.0	–1.4	–1.9	–2.3	–2.8	–9.4
Relative efficiency	–0.5	–0.5	–0.7	–0.9	–1.2	–1.4	–4.7
Total efficiency	**–1.5**	**–1.4**	**–2.1**	**–2.8**	**–3.5**	**–4.2**	**–14.0**
Overall effect (price inflation less total efficiency)	–0.9	–0.9	–1.3	–1.7	–2.1	–2.5	–8.5

Source: Bristol Water analysis (Bristol Water SoC, Table 56). 2015/16 data represents the cumulative change relative to Bristol Water's choice of base year (2013/14).

Ofwat's view of Bristol Water's planned opex

12. In its response to the Bristol Water SoC, Ofwat did not specifically address the level of opex, since its econometric modelling was based on totex. However, Ofwat did state that it had increased Bristol Water's base cost allowance in respect of certain categories of opex. Ofwat said that where special cost factor claims and modelling adjustments were concerned, it had given Bristol Water the benefit of the doubt in a number of areas (for instance in relation to the Cheddar WTW and traffic congestion costs). Ofwat said it had also made significant adjustments to its modelled allowances.[3]

13. Ofwat also said that the significant adjustments it had made to its modelling results suggested that the remaining differences indicated Bristol Water had a relatively high cost plan and the scope to make very significant efficiency savings.[4]

CMA analysis

Selecting a comparative base period for future opex

14. Bristol Water's AMP5 opex is set out in Table 3 below.

Table 3: Bristol Water AMP5 opex outturn

	Units	2010/11	2011/12	2012/13	2013/14	2014/15
Opex	*£m (2012/13 prices)*	44.0	42.8	43.3	45.5	49.8
Change year on year	%		–2.7	1.1	5.5	9.2
Cumulative change	%		–2.7	–1.7	3.7	13.2

Source: CMA analysis.

[3] For both base (in relation to water treatment costs) and enhancement expenditure (by increasing the allowance in the refined totex modelling stream). Ofwat response, paragraph 23.
[4] Ofwat response, paragraph 51.

Note this table refers to wholesale opex – Table 1 refers to total opex.

15. The opex in 2011 included £1.5 million relating to the CC referral (wholesale element 2012/13 prices). Excluding this item, 2013/14 was 7.3% above the 2010/11 cost and 6.3% above the average for the first three years.

16. Bristol Water incurs a range of opex costs. Our analysis of data provided by Bristol Water has indicated the following:

(a) 2013/14 year costs were £2.4 million (5.5%) higher than 2012/13 (in real terms). This was driven mainly by:

(i) staff costs attributed to opex (ie not recharged to capex) increased by £0.3 million. There was a 2.5% pay rise to all staff. This followed a 3.75% rise for staff in 2012/13;[5]

(ii) energy costs increased by £0.4 million and rates by £0.1 million;

(iii) a £1.6 million increase in 'other' costs. Bristol Water identified additional regulatory costs (PR14 work) (£0.6 million);[6] additional contracting services due to large bursts (£0.8 million); and additional costs due to new DWI sampling requirements (£0.2 million);

(iv) a £0.3 million increase in rechargeable costs (which is ultimately recovered from third parties);

(v) a £0.3 million increase in regular cash pension contributions; and

(vi) an offsetting £0.6 million reduction due to the application of PR14 specific cost allocation guidance.

(b) Bristol Water said that, in calculating the base year, it has removed significant one-off events. This was not apparent from the information it supplied, which showed actual costs for 2013/14 (deflated to 2012/13 prices) agreeing to the base starting position shown in the statement of case.[7]

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[5] Bristol Water regulatory accounts 2014.
[6] Bristol Water said it had not chosen to make an adjustment for this costs and suggested that this would be offset by other costs returning to a more average level.
[7] Bristol Water told us that from the 2013/14 base year it removed the one-off costs for responding to an Ofwat investigation into charges for self-lay developers. These costs were allocated to retail non-household, and so did not result in any reductions to wholesale opex.

(c) Bristol Water also said that 2013/14 benefited from favourable operating conditions compared to historic averages (although less favourable when compared to 2012/13).

(d) The average level of opex in the three years preceding 2013/14 was some £2.7 million lower[8] (see Table 3). Relative to this level, the Bristol Water AMP6 plan (£228 million) represented on average a 5.5% increase (compared with the 0.3% that Bristol Water calculated as the average increase relative to a base year of 2013/14).[9]

(e) Within the allowance for opex, both Ofwat and the CC at PR09 allowed some additional costs associated with enhancement capital spend (for example the opex associated with optional metering).The AMP5 enhancement opex costs included in the Bristol Water business plan were based on what the CC determined rather than an actual forecast.[10] This resulted in an uplift of £1.1 million to reflect the additional costs that were not reflected in the 2013/14 base year. We would have expected that a forecast taking into account actual AMP5 experience would have been used, rather than using the CC10 allowance that does not take into account developments in the intervening three years. In its draft 2014/15 variance explanation, Bristol Water said that this expenditure is included in the total of 'other' expenditure of £0.2 million, and so might be assumed to be less than £0.1 million.

17. In response to further questions on this forecast, Bristol Water provided an analysis of the schemes where the opex impact had not fully impacted on AMP5. This analysis estimated the element of allowed costs that had not been reflected in AMP5 actual costs. We found that the reliance on forecast costs from some five to six years ago to evidence expected increases to be likely to be flawed. We would not expect the actual design and construction of engineering solutions to perfectly follow the original outline (which some five years before would be less certain). Engineering techniques and approaches change and the final solution could be different and more fit for purpose.

Labour costs

18. From information in Bristol Water's regulatory accounts, the number of staff employed by Bristol Water has risen consistently over the past five years (2009 to 2014). Excluding staff employed on non-appointed activity, the full-

[8] Ignoring CC costs in 2010/11 of £1.7 million.
[9] Bristol Water SoC, paragraph 897.
[10] Bristol Water SoC, paragraph 904.

time equivalent figure was 452 in 2014, a 15% increase since 2009. We considered the drivers of this increase in staff numbers: support services staff increased by 15% and administration staff by 95% (while this may be down to classification, the consequence is that more than a third of the staff now appear to be of an administration/support nature).[11] This is illustrated in Table 4 below.

Table 4: Bristol Water reported full-time equivalents excluding non- appointed activity

Full-time equivalent excl. non-appointed	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Water treatment and distribution	262	269	272	271	262	273
Support services	91	82	78	85	93	105
Administration	38	46	47	58	72	74
Total	391	397	397	414	427	452

Source: CMA analysis.

19. Bristol Water told us that:

> Our headcount has been slowly increasing, which reflects the growing size and complexity of the business. In particular, it reflects the impact on the business of the size of the capital programme for AMP5. The case for recruitment for each new position requires the approval of the Executive Team.[12]

20. The increase in the size of Bristol Water's workforce and in rates of pay means the gross payroll cost has risen by 25% in five years with the average cost per employee increasing by 11%.

21. Bristol Water told us that these figures, which are drawn from the regulatory accounts, include both capital and operating staff. It has provided a breakdown of headcount, which is shown in Table 5.

[11] Over the same period, Bournemouth Water staff rose from 191 to 196. The split between Administration and Other cannot be readily tested against other companies.
[12] Bristol Water SoC, paragraph 184.

Table 5: Bristol Water reported headcount excluding non-appointed activity

	March 2012	*March 2014*	*FTE variance (March 2012 to March 2014)*
Engineering	[✂]	[✂]	[✂]
Production	[✂]	[✂]	[✂]
Customer Services	[✂]	[✂]	[✂]
Legal services, HR and central admin	[✂]	[✂]	[✂]
Asset planning	[✂]	[✂]	[✂]
Business improvement	[✂]	[✂]	[✂]
Environment	[✂]	[✂]	[✂]
Network	[✂]	[✂]	[✂]
Procurement	[✂]	[✂]	[✂]
Finance	[✂]	[✂]	[✂]
Quality	[✂]	[✂]	[✂]
Regulatory affairs	[✂]	[✂]	[✂]
Directors	[✂]	[✂]	[✂]
Risk management	[✂]	[✂]	[✂]
Total	420.4	461.4	41.0

Source: Bristol Water.

22. Table 5 illustrates that much of the growth was [✂], which would accord with a greater capex programme, but there has been an overall increase in activities that will be classed as opex.

23. From this information, it can be seen that staff numbers have risen by almost 10% in two years. Bristol Water has said that it is undertaking a business review programme that will entail a reduction in staff of 10%. [✂]. We have taken this into account in considering an efficient recurring opex within AMP6.

24. Bristol Water has also provided details of pay increases awarded by other companies across AMP5 as a comparison to those awarded by Bristol Water, to seek to demonstrate that its labour costs included efficiently incurred pay increases. It has not been possible to compare all companies fully, but from the data available it suggests that Bristol Water is not an outlier compared to the industry. We note that Bristol Water is higher than the Wessex Water average, but this may be as a result of timing.

Forecast operating cost trends in AMP6

25. There are special factors relating to the Bristol Water area that add to costs, such as the payments made to the Canal and River Trust for abstraction. These have been considered as part of our econometric analysis.

26. Bristol Water described its forecast as a realistic, evidence-based and challenging assessment of its requirements.[13] The forecast did not directly associate any savings with the additional capital maintenance expenditure

[13] Bristol Water SoC, paragraph 926.

requested, however, on the basis that these are implicitly captured in the overall efficiency assumption.

27. This efficiency challenge discussed in paragraph 11, based on analysis by Oxera, was intended to move Bristol Water towards upper quartile performance. The challenge to the level of expenditure was equivalent to an increase in efficiency of 1.5% per year (0.9% per year net of RPE factors). This improvement in efficiency was however based on total opex, of which around 20% related to aspect of expenditure that were more difficult to reduce.[14] Should such expenditure not be subject to an efficiency challenge, then the overall efficiency rate would be in the order of 1.125% per year (net of RPEs), relative to RPI inflation.[15]

28. Table 6 sets out recent regulatory precedent with respect to productivity challenges. Each example shown in Table 6 was in the order of 1% per year, which is comparable to that proposed by Bristol Water. Bristol Water's overall efficiency challenge was 1.5% when its additional upper quartile adjustment was included. Bristol Water assumed a 1.2% efficiency challenge per year for its retail business.

Table 6: Recent opex productivity targets

Opex productivity	*% yearly*	*Date*
Ofgem – GB DNOs	0.8-1.1	November 2014
Ofgem – Transmission & Gas Distribution	1.0	November 2012
CC decision for Northern Ireland Electricity	1.0	March 2014
UR – Water and sewerage	0.9	December 2014
PPP Arbiter – underground infracos, opex	0.9	2010

Source: CMA analysis.

29. We also considered supporting evidence provided by Bristol Water as part of its overall planning process. We noted that the current work to refurbish the Bristol Water headquarters is designed to generate efficiency. We have seen no estimates of where these cost savings might be (Bristol Water has suggested that impacts of MNI spend are a part of the overall challenge). It is reasonable to assume that this, and the impact of other capital schemes (for example IT projects) would reduce opex. We note that Bristol Water's company-wide plan[16] stated that the nearly £5 million investment in systems, processes and people, (made between October 2011 and October 2013) remained on track to deliver ongoing annual benefits.

30. We also note that Mott MacDonald was asked to provide assurance on the reforecasting of opex data. Mott MacDonald's review appears to have

[14] For example business rates of £4.7 million and payments to the Canal & River Trust of £3.5 million
[15] That is 1.725% efficiency on 80% of opex and 0% on the remainder, offset by 0.6% RPE on the whole.
[16] Written as part of the business planning process.

concentrated on changes from the opening position as identified by Bristol Water. Mott MacDonald drew attention to the significant enhancement cost forecast for 2014/15, but did not challenge the underlying scheme that this forecast was predicated on. We also noted that, in response to challenge from the LEF, Mott MacDonald confirmed that: 'We did not review opex build-up in detail'. Several parties have looked at aspects of opex,[17] but it is not clear that any one party reviewed all the assumptions and linkages.

31. The other items that Bristol Water has included as adjustments to the opex forecasts within its business plan are: (i) base opex adjustments; (ii) the impact of new connections; and (iii) AMP6 enhancement adjustments to base opex. These are forecast by Bristol Water to be £1.3 million, £1.8 million and £1.5 million respectively.[18]

32. The base opex adjustments are shown in Table 7, and comprise costs related to new obligations. In respect of the carbon reduction commitment in particular, although relatively small, it has been understood for some time that power costs are increasing in real terms due to sustainability measures. Therefore the carbon reduction commitment might be expected to have been covered by the RPEs calculated by Oxera and factored into the offset to the overall efficiency challenge (0.6% yearly). Bristol Water told us that the carbon reduction commitment was an adjustment for the above-inflation element of the increase that is not reflected in the base year (2013/14) opex and has subsequently confirmed that this is included in the Oxera estimate of RPEs.[19,20]

Table 7: Bristol Water base additions to opex (2012/13 prices)

						£m
	2015-16	*2016-17*	*2017-18*	*2018-19*	*2019-20*	*AMP6*
Carbon reduction commitment	0.2	0.2	0.2	0.2	0.2	0.8
Leakstop SP replacement	0.1	0.1	0.1	0.1	0.1	0.3
Open Water programme	0.1	0.0	0.0	0.0	0.0	0.2
Base opex adjustments	0.3	0.2	0.2	0.2	0.2	1.3

Source: Bristol Water SoC, Table 53 (note these figures do not add up which we have assumed is due to roundings).

33. The additions for new connections (shown as supply/demand balance (SDB)) and PR14 enhancement scheme impacts are shown in Table 8.

[17] Bristol Water SoC, paragraphs 982–986.
[18] Bristol Water SoC, Tables 53 and 55.
[19] Bristol Water SoC, paragraph 900.
[20] Bristol Water response to our provisional findings, paragraph 246.

Table 8: Bristol Water enhancement additions to opex (2012/13 prices)

£m

	2015-16	*2016-17*	*2017-18*	*2018-19*	*2019-20*	*AMP6*
SDB expenditure	0.2	0.3	0.4	0.5	0.5	1.8
PR14 enhancement schemes	0.0	0.1	0.2	0.4	0.9	1.5
AMP6 enhancements total	0.2	0.3	0.6	0.8	1.4	3.3

Source: Bristol Water SoC, Table 55.

34. The enhancement costs shown in Table 8 are driven by:

(a) the impact of new connections, based on assumed growth and the average cost per connected property in 2012/13; and

(b) new opex relating to AMP6 enhancement schemes.

35. In its response to provisional findings, Bristol Water said that since the unit cost models that we used were based on customer numbers, AMP6 operating costs should increase in line with the predicted change in customer numbers.[21] Our approach to opex was to review the items within the Bristol Water plan, which includes an allowance for increased costs as a result in growth in demand (and therefore growth in customer numbers), which is the SDB expenditure above. We have allowed this amount in full, and we have following Bristol Water's own projections. Therefore, we consider we have sufficiently reflected the change in customers over the period.

36. The remaining items were pensions and recharge for retail use of wholesale assets.

37. We performed a number of sensitivities to our various assumptions and a summary of that work is shown in Table 9. These sensitivities were based on:

(a) our various potential approaches to establishing an appropriate base starting point; and

(b) our view on potential disallowance of additions to the base.

[21] Bristol Water response to our provisional findings, paragraphs 244 & 257–260.

Table 9: Sensitivity of total opex allowed to CMA judgements

			£m
Starting point	*Disallowance from base*	*Base additions*	*Opex total*
2013/14	Regulation £0.4m; capitalisation £0.2m; EA refund £0.1m	PR09 enhancement £2.3m; PR14 enhancement £1m; base additions £0.5m	224
2013/14	Regulation £0.4m; capitalisation £0.2m; EA refund £0.1m	PR09 enhancement £2.3m; PR14 enhancement £1.5m; base additions £1.5m	226
2014/15	Regulation £0.4m; capitalisation £0.2m; Restructure £2m; CMA determination £1.4m; EA refund add back £0.4m	PR09 enhancement £2.3m; PR14 enhancement £1m; base additions £0.5m	226
3 year average (2010/11 - 2012/13)	CC10 £1.5m; EA costs £0.1m pa	PR09 enhancement £2.3m; PR14 enhancement £1m; base additions £0.5m	212
AMP5 average	CMA determination £1.4m; CC10 review £1.5m	PR09 enhancement £2.3m; PR14 enhancement £1m; base additions £0.5m	217

Source: CMA analysis.
Note: We have followed the Bristol Water approach on efficiency in these scenarios.

Maintenance non-infrastructure

38. As part of our review of MNI, we asked Bristol Water to provide further information on how it had identified a suitable level of investment in MNI. We reviewed evidence provided in respect of the models which Bristol Water used in developing its approach to investment, and also of certain ‘named schemes’. In this section we provide additional background on:

(a) Named schemes (paragraphs 39 to 42);

(b) 1990s water treatment assets (paragraphs 43 to 49); and

(c) Management and general (paragraphs 50 to 56), consisting of:

(i) buildings;

(ii) health and safety; and

(iii) information technology.

Named schemes

39. As part of our review of Bristol Water’s plan, we asked Aqua to consider Bristol Water’s approach to the scope of its MNI programme. In response to the Aqua review, Bristol Water commented on particular named schemes. We understand that the named scheme approach identifies certain priority projects as ‘must invest’. This occurs in parallel to the ALM process) used generally to identify a level of investment across Bristol Water’s assets. However, when schemes are identified as named schemes we would expect

the outputs from the ALMs to be reduced accordingly to prevent duplication. For example, we noted that for On Site Electrolytic Chlorination (OSEC) a duplication of £350,000 had been identified. In response, Bristol Water said that this was not considered significant.[22]

40. We noted that OSEC is being installed as a company strategy to address health and safety and resilience risks, in line with the company's risk appetite statement.[23] Bristol Water has also advised us that although OSEC has been installed at Purton, the need for drum chlorine will continue at this specific site for the raw water feed to Littleton to reduce the risk of bromate failures. Bristol Water said that these assets are being replaced over AMP5, AMP6 and AMP7. This indicated that assets replaced could have potentially been replaced as their condition warranted, in line with ALMs. Our review suggested that in practice, there may be opportunities to either defer certain replacement investments highlighted in either the ALMs, or that the combination of the ALM and named schemes could result in efficiencies within the programme.

41. From the detailed list of named schemes provided we noted that £3.2 million (pre-efficiency) is to be spent replacing electrical installations no longer compliant with existing standards. We agree that such health and safety expenditure is a priority, but question whether, since by definition these will be older assets, any of these assets would have been forecast for replacement by the ALMs. We have not seen any reduction relating to these items.

42. The named environmental schemes (total £4 million pre efficiency) were described as 'must invest' for the original plan but were reclassified in January 2015. This suggests that there is some element of discretion around Bristol Water's approach to this work.

1990s water treatment assets

43. For water treatment assets (the category formerly described as 1990s assets) Bristol Water have explained further about the process of asset led models (ALMs) and named schemes. They have also provided a list of the named schemes considered and noted why each scheme was not generated from ALMs.

44. Bristol Water have supplied us with a chart of the processes that the ALMs have identified for replacement in AMP6. We note that at Purton some £4.5 million is forecast to be spent. When this is added to the additional

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[22] Bristol Water response to our provisional findings, paragraph 419.
[23] There is no specific formal direction requiring the installation.

named schemes identified for water treatment assets this suggest an overall spend of around £8 million at this works. This is in addition to a further £5 million (of which we are aware) spent in AMP5. This suggests more than 20% of the AMP6 spend on water treatment works is at a single location which has already benefited from a significant replacement programme.

45. Shortly before we published our provisional findings Bristol Water provided evidence in support of its claim that structures in particular needed replacement. This was accompanied by a report provided by Atkins in April 2013. Atkins' report showed that a detailed assessment of chemical storage tank replacement needs had taken place. The report detailed the condition of 62 tanks and 50 bunds[24] stating that 77% of the tanks and 84% of the bunds were in good condition. It recommended action to maintain each, including replacement where thought necessary.

46. The analysis provided appears to demonstrate that some tanks that have been assessed to be currently in sound condition have been identified for replacement based purely on age. While we accept that over five years some tanks now in sound condition may deteriorate sufficiently to require replacement, we expect in practice that Bristol Water will not need to replace all of these tanks.

47. Aqua's review queried the estimated costs quoted for some of the tank replacements. Bristol Water has responded to this by noting that only some of the bunds are being replaced and that polypropylene tanks have internal bunds.[25] They also give detail of what alarms (and therefore ICA) are included in such tanks.

48. We noted Bristol Water's points and that the tanks are linked directly to SAP reorder systems. These systems appear to have been introduced in AMP5 and should not require replacement (the existing cabling will also not be required to be replaced). It was also unclear how the £10.5 million (pre-efficiency) IT budget interacts with these costs.

49. A similar point was made by Aqua concerning the need to replace pipework when replacing the tanks. Bristol Water has explained why the standard design requires pipework. However, Aqua's analysis suggested that the

[24] A secondary enclosure or wall to retain liquids in the event of spillage.
[25] Bristol Water response to our provisional findings, Appendix 3.2 paragraph 83.

replacement programme appeared to be broader in nature than was required to address the issues which were driving the need for intervention.[26]

Management and general

50. There are four areas of management and general (M&G) expenditure, and the change in expenditure from AMP4 is illustrated in Table 10.

Table 10: Bristol Water M&G proposed spend (2012/13 prices)

£m (2012/13 prices)

	AMP4	*AMP5*	*AMP6*	*Change AMP4 to AMP6*
Buildings	0.3	10.3	2.5	2.2
H&S	0.1	0.4	4.3	4.2
IT	7.1	13.8	9.6	2.5
Other	7.9	6.1	5.3	(2.6)
Total	15.4	30.5	21.8	6.4

Source: Bristol Water response to PFs, Table 19.

Buildings

51. Bristol Water spent more during AMP5 on buildings than it had requested or was allowed in the final determination. This overspend was partly possible due to underspend in other areas, notably pumping stations.

52. Bristol Water has surveyed a sample of sites and identified a number of properties that require maintenance in AMP6.

Health and safety

53. Proposed expenditure includes £3 million for replacement of switchgear that is non-compliant with latest legislation. While we understand the importance of this expenditure we would have expected that many of these assets will be at or near the end of their useful life and therefore potentially identified by the ALMs for replacement.

54. The remaining expenditure in this area relates to various minor areas, all in themselves apparently reasonable. We note, however, that in total the expenditure is significantly higher than previous AMP periods.

[26] Bristol Water response to our provisional findings, Appendix 3.2 paragraph 88. Bristol Water noted that the move to a standard design requires standard pipework which is different to that found on site, hence its replacement.

Information technology

55. Although increased from AMP4, Bristol Water said the spend was in line with AMP3 and reflects the cyclical nature of such expenditure.[27]

56. Bristol Water said that the increase over AMP4 reflected a greater reliance on IT systems, and, consequently, an increased cost of maintenance. It additionally gave examples of system improvements to aid the business.

[27] Bristol Water response to our provisional findings, Appendix 3.2 paragraph 72.

Smaller enhancement schemes

1. This appendix includes our assessment of smaller enhancement schemes that support our findings as set out in Section 6. The basis of our review of these schemes has primarily been an assessment of evidence presented by Bristol Water.

Raw water deterioration schemes

2. We reviewed relevant evidence on the three individual schemes that, with Cheddar WTW, comprised Bristol Water's approach to addressing raw water deterioration.

3. We considered that DWI undertakings and orders that imposed a legal duty to deliver the schemes demonstrated need. Where a letter to commend had been issued by DWI, we considered this with additional supporting evidence.

4. We placed weight on Mott MacDonald's review with respect to whether the schemes were the most appropriate, and Mott MacDonald and Chandler KBS' (CKBS) respective work on whether the cost of the schemes was appropriate.

5. We set out the key pieces of evidence for each project in turn.

Barrow WTW UV

6. This scheme relates to the installation at Barrow WTW of ultraviolet light treatment equipment to inactivate cryptosporidium, a parasite that causes cryptosporidiosis, a gastrointestinal illness, in humans.

7. The scheme was included in Bristol Water's SoC at £6.8 million.[1]

Need

8. The scheme is subject to a DWI instrument to address cryptosporidium.[2]

9. Mott MacDonald reported to Bristol Water that it recognised the need for the scheme, and commended Bristol Water for its thorough assessment of the options.

[1] Bristol Water SoC, Table 82.
[2] DWI Barrow TW Regulation 28 Notice 2014.

10. We found that need had been demonstrated through the DWI's requirement for Bristol Water to undertake the scheme.

Most suitable option

11. We understand that slow sand filters are generally effective at removing cryptosporidium oocysts as part of water treatment,[3] and that slow sand filters are installed at Barrow. We further understand that exposing treated water to ultraviolet light is a standard additional treatment process for inactivating cryptosporidium and provides a safeguard to circumstances where other treatment processes fail to remove oocysts.[4]

12. Bristol Water has installed UV equipment at five water treatment works in AMP5.

13. We found that the proposed option was appropriate and further noted installation is a requirement of the DWI.[5]

Cost estimation

14. The scheme was included in a review by Mott MacDonald of large capital schemes, which concluded that the project costs appeared to be in the right order of magnitude. We noted Bristol Water's statement that it had received a tender for the Barrow scheme that would give rise to a total cost of £6.9 million (2015-16 prices; equivalent to £6.5 million 2012-13 prices), compared to the £6.8 million included in its submission.

15. In response to our provisional findings Ofwat stated that we had not given sufficient consideration of the CKBS benchmarks (for Barrow or Stowey, which together were £6.4 million).[6] In reaching our provisional findings we had noted that the adjusted CKBS benchmark was £5.8 million (though did not specifically comment on it in our provisional findings).

16. We had reached our provisional findings by considering the evidence on cost from CKBS, Mott MacDonald and Bristol Water's own tender. We raised the

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[3] DWI, Cryptosporidiosis: A report on the surveillance and epidemiology of Cryptosporidium infection in England and Wales, paragraph 8.9; Cryptosporidium in Water Supplies, Third report of the Group of Experts (The Bouchier Report), paragraph 5.3.1.
[4] UKWIR, UV Inactivation of Cryptosporidium (08/DW/06/20); Foundation for Water Research, Cryptosporidium in water supplies, 2011, p10.
[5] DWI Barrow TW Regulation 28 Notice 2014.
[6] Ofwat response to the provisional findings, paragraph 79. The CKBS benchmark for Barrow was £5.5 million. In response to our enhancement working paper, Bristol Water stated that making an appropriate adjustment for historic experience the comparable figure was £5.8 million.

role of tenders in providing evidence in our hearings with Bristol Water and Ofwat.

17. Ofwat said that cost efficiencies achieved through tendering were dependent on how effectively the supply chain was managed, whether the contracting out involved challenges to scope or just unit costs, and a company's attitude to risk. It said evidence of efficiency required scrutiny of the nature of the tender process. Ofwat told us that where companies had market tested elements of their business plan, Ofwat had still reviewed and challenged the tender process, with a proportionality test so that the level of scrutiny would depend on the size of the scheme.

Stowey WTW pH correction

18. The scheme relates to the installation of sodium hydroxide storage and dosing equipment to maintain the alkalinity of treated water at Stowey WTW.

19. It was included in Bristol Water's SoC at £0.8 million.[7] It is the subject of a 'commend for support' letter from DWI.

Need

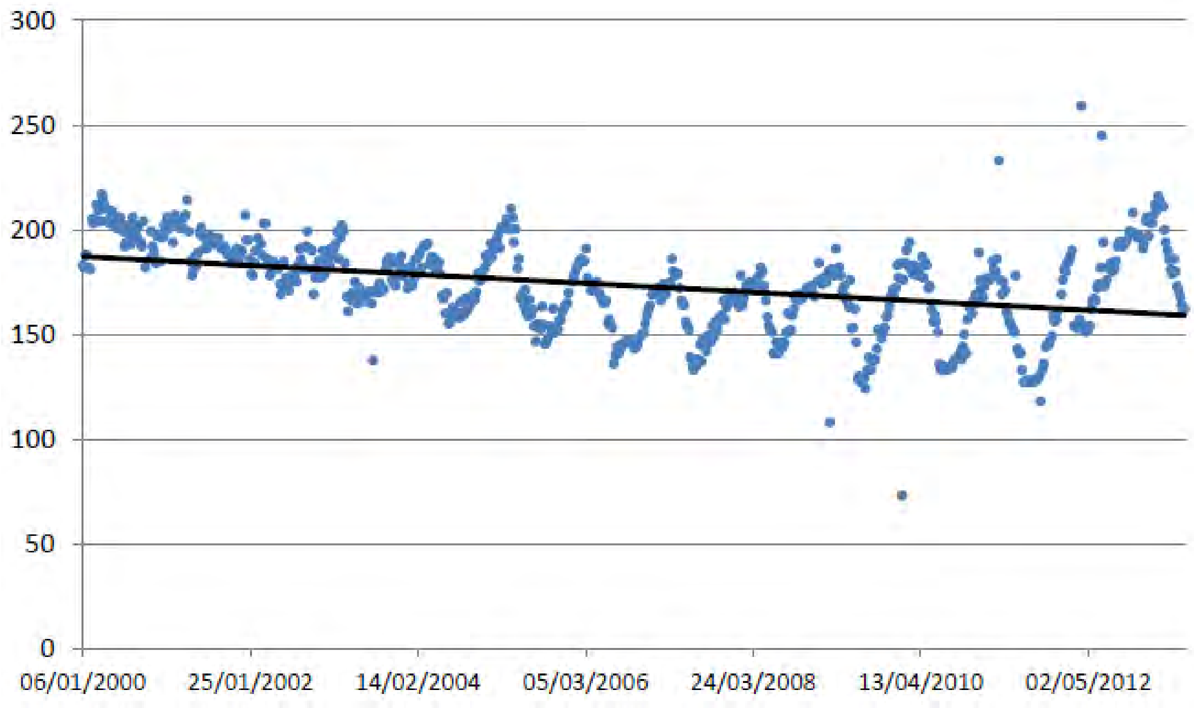
20. Bristol Water stated that the final water quality leaving Stowey WTW demonstrates seasonal variation, including pH and alkalinity due to increased frequency and intensity of algal blooms in Chew Valley Lake as a result of raw water deterioration.

21. The scheme is subject of a 'commend for support' letter from DWI as it will improve the quality of the drinking water supplied to consumers at times when high levels of algae are present in the raw water. We noted that DWI stated that there was no clear link between the performance of the existing treatment processes and any non-compliance with the drinking water standards in the final water. We did not, however, discount the need for the scheme given Bristol Water's arguments on the possible impact of reduced alkalinity on corrosion of pipes.

22. Bristol Water presented evidence of a decrease in alkalinity (Figure 1). We noted the increase in 2012 but considered Bristol Water's argument that this was due to weather in 2012.

[7] Bristol Water SoC, Table 82.

Figure 1 Alkalinity levels in Chew Valley Lake (mg/l as $CaCO_3$)



Source: Bristol Water's PR14 Business Plan – Wholesale Plan, Figure 74.

23. We considered that the evidence on alkalinity appeared to demonstrate the need for the equipment. We reviewed Bristol Water's argument on increased levels of algae in the reservoir,[8] but did not consider whether algae was the specific cause of reduced alkalinity.[9]

Most suitable option

24. We noted that Bristol Water had introduced a catchment management plan to reduce the level of nutrients entering the raw water and affecting the level of algae, but that this wouldn't address algae levels in the short term.

25. We reviewed Bristol Water's assessment of possible options for this scheme and found that Bristol Water had presented a rational case for its chosen implementation of pH correction. We did not see evidence of Bristol Water's decision not to address the presence of algae (in response to specific blooms and in addition to its long-term catchment management).

26. We considered that the proposal was a relatively low cost capital project and would address the impact of algae in the short term, subject to the longer term catchment management plan.

[8] Bristol Water's PR14 Business Plan – Wholesale Plan, Figure 25.
[9] We noted Mott MacDonald's comments in 2013 that Bristol Water's analysis of apparent changing algal populations was not conclusive.

Cost estimation

27. CKBS estimated that an appropriate benchmark for the project was £0.6 million against Bristol Water's initial estimate of £0.9 million (subsequently reduced post-efficiency to £0.8 million). Bristol Water stated that with an adjustment for risk, CKBS' benchmark would be £0.63 million.

28. Mott MacDonald reviewed the direct costs elements of the scheme (£0.4 million out of £0.8 million post-efficiency) and found they were in the right order of magnitude. We noted that Mott MacDonald found that benchmarked indirect costs were 79% of Bristol Water's across a number of projects. We adjusted the indirect cost element (£0.5 million of the original £0.9 million cost) by 21% (100 to 79%), which, when added to £0.4 million of direct costs, gave a figure of £0.8 million.

29. We found that the amount included in Bristol Water's statement of case was broadly appropriate.

Metaldehyde catchment management

30. This scheme related to a catchment management scheme for metaldehyde, a pesticide, and was included in the statement of case at £0.4 million.[10]

Need

31. This scheme is subject to a DWI undertaking requiring the existing catchment management scheme to be continued.[11]

32. Mott MacDonald reported that:

> The raw water supply to both the Purton and Littleton Treatment Works […] is known to contain metaldehyde, a molluscicide. Both of the treatment works are unable to remove metaldehyde to levels below the individual pesticide standard and there is a continual risk of drinking water failure with respect to individual pesticide or total pesticides at these works. There is no cost effective solution available for metaldehyde removal at these works […].[12]

[10] Bristol Water SoC, Table 82.
[11] There appear to be two versions of the undertaking dated 21 May and 29 May (DWI website).
[12] Mott MacDonald further stated that analytical records show that significant peaks in raw water metaldehyde content are not consistently reduced at either works to a level below the drinking water standard of 0.1 µg/l.

33. We found that the DWI undertaking demonstrated the legal requirement for Bristol Water to undertake the scheme.

Most suitable option

34. We found that DWI's undertaking prevented any significant optioneering.

Cost estimation

35. Mott MacDonald stated that:

> [C]atchment management is the only viable option identified since treatment options are either not cost effective, or currently represent unproven technology requiring further development that cannot guarantee quality standards are met.

36. On the issue of cost, Mott MacDonald responded to an LEF query that catchment management is likely to be the lowest totex solution until such time as an effective treatment process is available.

37. We have not reviewed evidence on the specific costing of the scheme given its relatively low size compared to other enhancement projects.

Growth expenditure

Overview of the proposed enhancement

38. Bristol Water's proposed programme was to build four trunk mains and three reservoirs to accommodate population growth. It was included in Bristol Water's SoC at £12.5 million. The individual elements are set out in Table 1.

Table 1: Summary of BW Growth enhancement schemes

	£m
	Cost
Forum to Shepton Mallet Mains Reinforcement	1.4
Marksbury to Timsbury Mains Reinforcement	1.1
Paulton to Midsomer Norton Mains Reinforcement	0.5
Tetbury Main	0.3
Croscombe New Service Reservoir	2.1
Draycott New Service Reservoir	3.4
Windmill Hill New Service Reservoir	3.7
Total	12.5

Source: Bristol Water SoC, Table 82 (excludes growth element in Southern Resilience scheme).

39. Bristol Water told us that growth schemes could be categorised as one of the following:

(a) **Balancing supply and demand** – ensuring there is sufficient water to meet customer demand.

(b) **New development** – new mains to new properties.

(c) **Growth** – expenditure to reinforce the network in relation to overall growth.

40. Bristol Water told us that these growth schemes were in the final category.

Need

41. Ofwat, in its review of special cost factors, found that the company demonstrated that the projects planned to deal with growth were likely to be required.

42. We reviewed evidence on the need for the schemes based on Bristol Water's analysis of population projections. We noted Aqua's comments on the current level of capacity in service reservoirs across the network, but placed weight on Bristol Water's modelling of the localised effects of future growth, with particular reference to 2020 and 2040 and the additional resilience that the schemes would provide to the respective local communities.

43. We considered that Bristol Water's evidence demonstrated evidence of need.

Most suitable option

44. We reviewed Mott MacDonald's conclusions on Bristol Water's growth schemes (set out in paragraph 53) and considered that this indicated that an appropriate consideration of options had been undertaken.

45. In its initial review of special cost factors Ofwat found that Bristol Water had set out the detailed 'optioneering' that had been carried out but it had not presented how these options fit with the overall least cost plan to maintain the supply/demand balance. Without visibility of these strategic options, Ofwat concluded that it was not possible to say if the detailed options selected were the most cost beneficial way of ensuring the supply demand balance was maintained.[13]

[13] Ofwat, Bristol Water - Special Cost Claims, s5.

46. In its subsequent review of these growth schemes prior to final determination, Ofwat reviewed Bristol Water's evidence on its investment modelling (Wilco and Cross Asset Optimiser). Ofwat stated that Mott MacDonald's review showed Bristol Water's process was reasonable, using robust source data and specialist strategic network modelling to determine the potential effects on customers. Furthermore, Ofwat found that Mott MacDonald's assurance identified a strong 'line of sight' from the company's plans to accommodate population growth to outcomes for customers.[14]

47. We considered the above and found that the evidence that Bristol Water had presented demonstrated Bristol Water's optioneering was appropriate.

Cost estimation

48. Ofwat did not formally assess the robustness of the cost estimate but noted MM's review, which we discuss below.[15]

49. As part of its assurance programme Mott MacDonald sampled the Paulton to Midsomer Norton Mains project in September 2013. Mott MacDonald estimated its cost at some £0.36 million (49.0%) less than Bristol Water's pre-efficiency estimate of £0.74 million. As a result of the scale of this variance, Bristol Water reviewed all of its growth mains laying projects. This was completed in September 2014.

50. Mott MacDonald also reviewed the Windmill Hill service reservoir in September 2014, and its benchmark was £0.11 million (2.6%) lower than Bristol Water's estimate of £4.2 million. Bristol Water's post-efficiency cost of £3.7 million is around 10% lower than Mott MacDonald.

51. The mains relining scheme (Paulton to Midsomer) reviewed by Mott MacDonald was also reviewed by CKBS as part of its benchmarking. CKBS estimated the cost at an almost identical level to Mott MacDonald (Mott MacDonald £0.377 million; CKBS £0.379 million). Bristol Water amended the costs in response to Mott MacDonald's review (to £0.528 million pre-efficiency, £0.462 million post-efficiency)) to which Mott MacDonald (referring to pre-efficiency costs) concluded:

> Mott MacDonald consider the direct costs are reasonable and offer a high level of confidence. In addition the recent cost

[14] PL14W011, Feeder template, Sheet DD06, cell G78.
[15] In Ofwat's view, Bristol Water had failed in its special cost claim to prove the need and cost benefit for the programme as an un-modelled cost because the total growth expenditure included in BW's business plan was below the bottom-up implicit allowance.

reduction with regards to the in-directs also offer more confidence.

52. Mott MacDonald concluded on a review of five growth schemes (including both Paulton to Midsomer and the Glastonbury Street scheme) that:

> We found that overall your costs were about 18% lower than the competitor average although corporate overhead costs had not been included. We considered the direct costs were robust and aligned well with your previous out-turn costs. We made suggestions to better align the estimating techniques of different suppliers.

53. Mott MacDonald further concluded that:

> We reviewed your approach to modelling growth and the cost assumptions you have made. Your process was reasonable, using a robust source data and specialist strategic network modelling to determine the potential effects on customers. There is a strong 'line of sight' from your plans to accommodate population growth to outcomes for customers.

54. Mott MacDonald identified in its initial review that there were some differences in the approach to costing of growth schemes between the two firms (Atkins and Black & Veatch) which had designed and costed the schemes,[16] and that only Black & Veatch's estimates were sufficiently detailed to allow its projects to be benchmarked. Similarly, Mott MacDonald found that in a review of the opex costs for large capital schemes, the reports provided for review did not provide detailed calculations to support each cost area.

55. We considered that the scheme costs included in Bristol Water's SoC appear to be appropriate, but noted that Bristol Water's initial cost estimation appeared to be significantly above an industry benchmark.[17]

[16] Each firm was responsible for a number of schemes.
[17] In this regard, we also noted that the Glastonbury and Street scheme, which was not included in Bristol Water's SoC was subject to CKBS benchmarking which found a benchmark to be 29% lower than Bristol Water's estimated costs.

National Environment Programme

Overview of the proposed enhancement

56. Water companies are required by Defra to include schemes in Business Plans to address adverse environmental impacts. The schemes required are compiled as the NEP by the EA every five years.

57. AMP6 is the first time that Bristol Water has been subject to a requirement under the NEP.[18] Broadly, the schemes that Bristol Water is required to complete are:

(a) catchment management;

(b) baseline surveys;

(c) invasive species investigations; and

(d) eel protection.

58. The schemes are included in Bristol Water's SoC at £11 million. The individual schemes that Bristol Water intend to pursue to comply with the NEP are set out in Table 2.

Table 2: Sustainable environmental impact schemes

Scheme	*Performance commitment*	*Regulatory requirement*	*Expenditure*
Catchment management	Raw water quality of sources	NEP	4.0
Baseline surveys	Raw water quality of sources	NEP	0.9
Invasive species investigations	Biodiversity index	NEP	0.1
Eel protection	Biodiversity index	EA exemption notice	6.0
		Total	11.0

Source: Bristol Water SoC, Table 85.

Need

59. Bristol Water said that the requirements under the NEP are mandatory, and that failure to comply is subject to financial penalties and/or enforcement orders, and the validity of Bristol Water's permits to abstract water were linked to compliance with the NEP.

60. Ofwat made no comments on the need of the projects.

[18] Such obligations arise from UK and European legislation including the Water Framework Directive (WFD), The Countryside and Rights of Way Act 2000, The Environmental Permitting Regulations 2010 and the Eels (England and Wales) Regulation (2009) (Eels Regulation). Bristol Water SoC, s2.4.3.2.

61. We noted Mott MacDonald's comment that that it was unclear whether eels were present in the canal and whether they were being affected by the current abstraction, and hence whether changes at Purton would have any beneficial effect. Bristol Water told us that eel protection works were required in watercourses that historically would be expected to have an eel population.

62. We found that Bristol Water had provided evidence that there is a statutory obligation to achieve the requisite standards that these schemes seek to deliver.

Most suitable option

63. Ofwat made no comments on the suitability of the projects.

64. We reviewed Bristol Water's evidence and focused on catchment management (£4 million) and eel protection (£6 million), which comprise 91% of the NEP schemes by expenditure.

Cost estimation

65. The project passed Ofwat's robustness of estimate assessment gateway during the risk-based review.

66. We reviewed Mott MacDonald's assurance work and noted that Mott MacDonald considered that because of the uncertainty of the effectiveness of the approach adopted by Bristol Water in protecting eels in the Sharpness that its cost may be understated.

67. Ofwat did not raise specific concerns with the cost estimation of this project.

68. We did not find evidence to indicate that Bristol Water's cost estimation was inappropriate.

Asset reliability – discoloured water contacts

Overview of the proposed enhancement

69. This scheme seeks to reduce negative contacts (complaints) relating to discoloured water by relining 30.5km of iron pipes to prevent leaching. Bristol Water included a cost estimate of £10.2 million for this scheme in Bristol Water's SoC.

70. Bristol Water included a performance target to reduce negative water quality contacts by 14% in its business plan. In its stage 2 acceptability research,

customers ranked reducing the number of complaints about discoloured water as ninth in importance for investment.

Need

71. No disagreement around need appeared to exist.

72. We reviewed Bristol Water's submitted evidence on its targeted reduction in discoloured water contacts and relevant customer preference and found that it demonstrated need, and noted the amendment to the scheme to reflect customer priorities.

Most suitable option

73. Bristol Water stated that discoloured water was one of the most volatile elements of its commitment to reduce 'negative water contacts'. Bristol Water undertook an investigation as to the cause of discolouration found that 'leaching' from iron trunk mains was the cause. Bristol Water initially identified 143km of mains as being potential contributors to the discolouration experienced by customers. Following further investigation and cost benefit studies, Bristol Water found that relining some 30.5km (set out in Table 3), together with some operational activities would provide a reduction of discoloured water contacts, which would be supported by its customers.[19]

Table 3: Summary of proposed relining

	km
Scheme	*Length*
12inch Fishponds Rd to Durdham Down	9.1
12inch/16inch Summerlands Rd, Weston	3.8
18inch Chelvey to Portishead	8.4
27inch Portway	3.7
8inch WWM2252 to Durdham Down	1.0
Henleaze Rd to Durdham Down	4.5
Total	30.5

Source: Bristol Water.

74. We found that given the nature of customer complaints on discoloured water and Bristol Water's approach to investigating the cause of discolouration, the proposed project appeared appropriate. The length of mains subject to relining has been adjusted to reflect relative customer priorities.

[19] Bristol Water SoC. Bristol Water originally identified 143km of cost beneficial trunk mains relining work. As part of customer engagement it asked customers to consider a plan involving 47km of relining with an improvement of 19% in the number of negative water quality contacts (ie a reduction from 2,572 down to 2,081). Customers however did not consider this to be a key area for investment, and Bristol Water reduced the level of improvement to 14% (ie a reduction from 2,572 down to 2,221).

Cost estimation

75. The relining costs were reviewed by Mott MacDonald as part of its review of capital costs of large schemes. Mott MacDonald raised a number of concerns with its trunk mains schemes, which Bristol Water responded to. It was not clear from our review of the Mott MacDonald document what the final outcome of some of the cost challenges was. However, we noted that the claimed cost of the scheme had reduced significantly by £2 million from the Ofwat draft determination.[20]

76. Relining schemes were included by Aqua in its review of mains replacements schemes. It found that Bristol Water had included a significant level of risk and contingency in its cost estimates that it did not expect, given the nature of the scheme. Aqua considered that £9.54 million would be an appropriate level of expenditure on the scheme.

77. In our provisional findings we made an allowance of £9.54 million, which was some £0.7 million less than included by Bristol Water in its SoC. This cost challenge was based on evidence from Aqua on the level of risk and contingency.

78. In response to our provisional findings Bristol Water said that Aqua's findings were based on misunderstandings on the nature of data that Aqua had reviewed. Bristol Water in particular noted that the allowance for 'contingency' (25%) was supported by its experience in AMP5 where it incurred additional costs of 27%.[21] Additionally Bristol Water stated that the amount considered by Aqua as 'contingency' was in fact an allowance to cover unspecified items that experience showed would occur.[22]

79. Bristol Water told us that the rehabilitation technique to be used was unknown at this stage of its design, as it was subject to the diameter of the existing pipe. Bristol Water's experience was that where sliplining[23] was not possible, costs increased by 69%. Bristol Water had, however, allowed only 5% across its programme.[24]

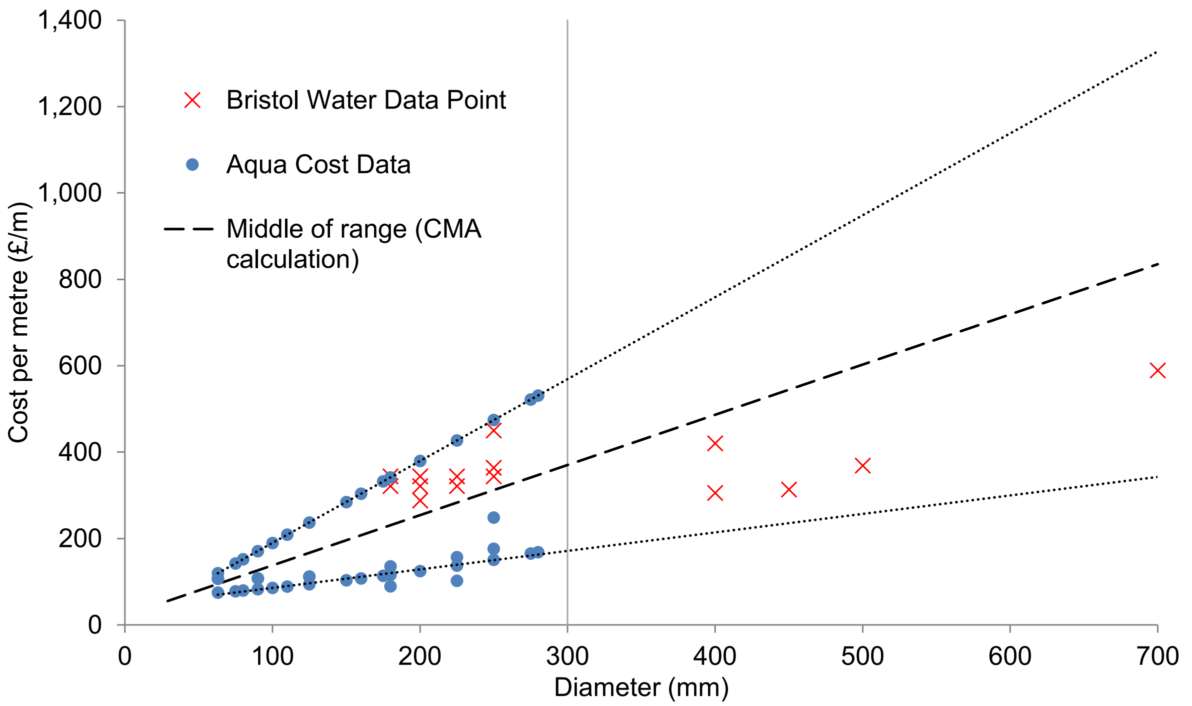
80. We recognised that where sliplining was not possible, costs could be significantly higher. It was not evident what the basis for determining the extent to which this would be the case but we recognised that an amount to allow for such eventualities could be appropriate.

[20] In the draft determination, Bristol Water had sought £12.3 million.
[21] Bristol Water response to the provisional findings, paragraph 585 and section 4.9.1.
[22] Bristol Water response to the provisional findings, paragraph 589.
[23] That is, the insertion of a polyethylene pipe into the existing piper
[24] Bristol Water response to the provisional findings, paragraph 592.

81. Bristol Water challenged Aqua's evidence that Bristol Water's sliplining was more expensive than other companies. Bristol Water noted that the basis for Aqua's finding was benchmarking of cost rates (expressed as £/m) for pipes with diameters of around 200-250mm. Bristol Water said that Aqua's data showed that cost rates for pipes with diameters of 400-500mm were closer to the lower end of an extrapolated range.[25]

82. We considered Bristol Water's concerns and reviewed the basis for Aqua's findings. Figure 2 below reproduces Aqua's analysis but is amended, with an indicative upper and lower boundary of the range of sliplining costs (based on four water companies' costs) extrapolated from data on pipes with diameters under 300mm This range was then bisected (shown as the heavy dashed line) to better illustrate where Bristol Water's data points sat in the range of benchmarked data.

Figure 2 Aqua benchmarking of sliplining in urban areas



Source: CMA Analysis based on Figure 7, Aqua Consultants Technical Support, Report of Findings – June 2015, published as Appendix 5.1.
Note: Extrapolation of upper and lower bounds of Aqua benchmark data using linear trend and estimation of the middle of that range calculated by CMA.

83. We observed that on the basis of this analysis that for pipes over 300mm[26] (which we understand is broadly the minimum diameter of a trunk main), Bristol Water's cost rates have not been demonstrated to be comparatively high. We noted that there was evidence that cost rates for pipes with a

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[25] Bristol Water response to the provisional findings, section 4.9.
[26] 80% of Bristol Water's planned relining was for pipes with diameters greater than 300mm.

diameter less that 300mm were clustered in the upper half of the range but also noted that Bristol Water's rates did not exceed the benchmark range.

84. In undertaking this analysis, we recognised that it was contingent on assuming a linear relationship between the cost per metre of sliplining pipe and the diameter of that pipe. This assumption was necessary as Aqua's benchmark data did not include any pipes with a diameter greater than 300mm.[27] We further recognised that such cost information was also heavily contingent on the particular circumstances of the pipe being relined.[28]

New developments

85. In reaching our provisional findings we did not review the £25.7 million of (gross) new connection expenditure in detail. We adopted this approach as when connection charges are considered, the net amount requiring an allowance was £0.4 million which we considered to be immaterial in the assessment of £152 million of enhancement expenditure.

86. In our initial review of Bristol Water's SoC and Ofwat's final determination we did not identify any evidence that suggested that Ofwat or any other party had concerns with this expenditure or that the basis of its inclusion in the business plan was inappropriate.

87. Given Ofwat's concerns with our approach we reviewed the evidence presented by Bristol Water and Ofwat's own assessment in its final determination. We reviewed Ofwat's unit cost model,[29] which we understand is based on historic actual industrywide costs,[30] and considered that it could provide a suitable benchmark. We found that the unit cost model provides a net cost estimate of £3.9 million[31] for new connections against Bristol Water's estimate of £0.4 million.

[27] We considered that Aqua's cost data for pipes between 50 and 300mm showed a strong linear relationship between diameter and £/m at the upper and lower boundaries and justified our approach.
[28] For example, the location and ground conditions of the pipe.
[29] The populated Ofwat model for Bristol Water is published online.
[30] Ofwat, Basic Cost Threshold Model, Appendix C Enhancement Modelling.
[31] Basic cost threshold populated feeder model, Sheet 'Unit cost calc', cell K37. We note that Bristol Water's gross costs are greater than indicated by the unit cost model but these are subject to connection charges and Bristol Water recovers a greater proportion of charges than companies on average.

Smaller supply/demand balance schemes

88. Bristol Water included schemes at a cost of some £79.2 million in its SoC to address the supply/demand balance. We reached our provisional findings having reviewed 80.4% of relevant expenditure comprising:

(a) Cheddar 2 (£42.8 million);

(b) Southern Resilience (£8.4 million); and

(c) Growth Expenditure (£12.5 million).[32]

89. We noted however that of these large schemes, only Cheddar 2 directly addressed the supply/demand balance.[33] A number of smaller schemes that directly addressed supply/demand balance were included in Bristol Water's SoC at £15.5 million. These schemes would in aggregate improve the supply/demand balance by 9.4Ml/d by the end of AMP6.[34] Details of the individual schemes are shown in Table 4 below.

Table 4: 'Other' supply/demand balancing schemes

		£m		*Ml/d*
	Cost per SoC		*Impact on supply/demand*	
Additional active leakage control (ALC)	1.6		3	
Pressure reduction and monitoring	0.5		2	
Supply pipe replacement	0.1		0.15	
Intelligent district metering areas (DMAs)	0.1		0.75	
Efficient use of resources		2.3		5.9
Selective metering household	7.5		3.15	
Optant metering	5.8		0.35	
Metering		13.3		3.5
Total		15.5		9.4

Source: Bristol Water SoC, table 87.
Note: Improvement in supply/demand balance is in dry year annual average conditions. Additionally a further 4Ml/d will be obtained by reducing supplies to Wessex Water.

90. In reaching our provisional findings, we did not review the £15.5 million of smaller supply/demand balancing schemes as individually we considered they were relatively small and that detailed review was not a proportionate approach.

91. As with new developments (see above), in response to Ofwat's comments that we had not challenged a large proportion of expenditure, we decided to

[32] We reviewed growth expenditure in greater detail above as it was considered as a cost exclusion case.
[33] This was noted by Ofwat in its assessment, which led to a number of schemes being grouped together across enhancement expenditure categories.
[34] The 'growth' schemes discussed in this appendix and the growth element of Southern Resilience do not address the supply/demand balance, rather increase operational capacity of the water supply network through new mains or service reservoirs.

undertake a high-level review of the cost estimate using Ofwat's unit cost models as with new developments/connections. For supply/demand balancing schemes, the driver of the model is either the dry year critical or, if that was zero, the average annual supply/demand deficit over the period 2015 to 2020 measured in Ml/d.[35]

92. In Ofwat's final determination, its unit cost model calculated an allowance for supply/demand balancing schemes of £27.9 million, some £12.4 million greater than included by Bristol Water in its SoC.[36]

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[35] We submitted a query to Ofwat on the basis of its calculation and were told that the driver was the supply/demand deficit in the AMP. The calculation takes its data from a value described as 'enhancement to the supply/demand balance' which did not reconcile to the value provided by Bristol Water.
[36] In its final determination, Ofwat used data from the draft WRMP in its unit cost models, which gave an allowance of £40.4 million before applying an adjustment to the total output of the bottom-up modelling stream of £16 million reflecting changes in the final WRMP which was triangulated to £5.3 million. The published basic cost threshold calculation spreadsheet was not updated to reflect this change. Ofwat, Final Determination, Bristol Water company specific appendix, table AA1.2.

Cheddar Water Treatment Works – Notified Item

1. The CMA gives notice that, with the exception of the Allowed Amount specified in paragraph 2, the following item has not been allowed for in making the Determination and is therefore a Notified Item to that extent.

Notified Item: Cheddar WTW

2. We have included £1 million (the Allowed Amount) for Bristol Water plc (Bristol Water) to carry out:

   (a) additional investigations into the cause of the increased levels of algae at Cheddar WTW (the Investigations); and

   (b) associated reservoir management and minor capital works to address those levels.

3. We consider that it is in consumers' best interests for Bristol Water to manage its compliance with drinking water quality standards in a sustainable way, to control risks to public health and to ensure its water supply resilience.

4. If, having been completed, the Investigations identify that the Allowed Amount is not sufficient to ensure compliance with section 68 (no deterioration of water quality) of the Water Industry Act 1991 and regulation 4 (wholesomeness) of the Water Supply (Water Quality) Regulations 2000 (the Legal Obligations), and that additional works are required to ensure compliance with the Legal Obligations (the Additional Remedial Works), then, subject to the following condition, the reasonable forecast costs for, and directly attributable to, carrying out the Additional Remedial Works shall be a Notified Item.

Condition

5. That it is demonstrated to the satisfaction of the Water Services Regulation Authority (Ofwat), having taken due account of the views of the Drinking Water Inspectorate, that:

   (a) Deterioration in the raw water taken by Cheddar WTW is continuing to occur and is such that, in the absence of the Additional Remedial Works, the operational capacity of Cheddar WTW is likely to be insufficient to meet consumer demand and compliance with the Legal Obligations; and

(b) the Additional Remedial Works are a demonstrably cost-effective, efficient and proportionate solution to ensure that a sufficient volume of drinking water, which meets the Legal Obligations, is available.

Reconciliation of Bristol Water performance

1. The following appendix provides additional details and calculations made when considering the reconciliation of Bristol Water's performance in Section 8.

2. The rest of this appendix follows the structure below:

   (a) Ofwat assessment of Bristol Water's serviceability.

   (b) Summary of Bristol Water major DG3 UI>12 events.

   (c) DG3 UI>12 Comparison between 2010 workshop exercise and Bristol Water's current situation.

   (d) Ofwat statements around updated guidance on assessing serviceability.

   (e) COPI figures.

   (f) Views on accuracy of COPI series.

   (g) Interaction of RCV capping and shortfalling.[1]

   (h) Party views on CIS indexation methods.

Ofwat assessment of Bristol Water's serviceability

3. Table 1 below shows the serviceability indicators, and Ofwat's assessment of Bristol Water's performance in 2010-15.

Table 1: Table of serviceability measure and Ofwat assessment

	Description of metric	*Ofwat assessment of Bristol Water*
Infrastructure metrics	Total bursts (#)	Stable
	DG3 interruptions >12hr (# properties)	Deteriorating
	Iron non-compliance (% mean zonal compliance)	Stable
	DG2 low pressure (# properties)	Stable
	Customer contacts - discolouration (#/1000 properties)	Stable
	Distribution index TIM (% mean zonal compliance)	Stable
Non-infrastructure metrics	Water treatment works coliforms non-compliance (%)	Stable
	Service reservoir coliforms non-compliance (%)	Stable
	Turbidity performance at treatment works (#)	Stable
	Enforcement orders from DWI (# incidents)	Stable
	Unplanned maintenance (#)	Stable

Source: Bristol Water SoC, Tables 120 & 121; Bristol Water company-specific appendix, Tables AA3.8 & AA3.10.

[1] Shortfalling is used by Ofwat to refer to a reduction in the RCV of a water company where serviceability targets have not been met.

4. Ofwat’s assessment of serviceability was primarily based around whether performance in this set of indicators ‘oscillated’ around the reference level and within the control limits that were specified at FD09 (or subsequently amended in 2012). Where performance did this, it was considered to be stable. Where it did not, performance was assessed as not being stable (either marginal or deteriorating).

5. Ofwat stated that it then considered, on a case-by-case basis, any evidence companies provided to explain the impact of exceptional events that were outside the control of the company on performance. This review by Ofwat included commissioning external assurance on its judgements on company claims around exceptional events.

6. Bristol Water was assessed as being ‘deteriorating’ in a single metric, DG3UI>12,[2] (and hence ‘deteriorating’ on its infrastructure serviceability as a whole), and as a result of this had a downward adjustment (‘shortfall’) of £4.1 million applied to its RCV.

Summary of Bristol Water major DG3 UI>12 events

7. There were a number of specific major events (that is, those which affected more than 100 properties) which contributed to Bristol Water exceeding its DG3 UI>12 allowances over the past ten years.

8. Based on Bristol Water’s interpretation of Ofwat’s guidance, successive increases in 2014 and 2015 above the control limit alone would result in a ‘marginal’ assessment[3] and hence a shortfall being applied. Therefore, consideration of the events in these two years is key.

9. A summary of these major events which resulted in Bristol Water exceeding its control limits for DG3 UI>12 in these two years is included in Table 2 below. This included CH2M’s assessment of degree of management control.

[2] This metric is referred to as DG3 UI>12, and represents the number of properties which experienced an unplanned interruption for more than 12 hours.
[3] Bristol Water SoC, paragraphs 1811–1812 and 1831.

Table 2: Summary of major events impacting DG3 UI>12 (>100 properties), 2014 and 2015

Event name	*Year*	*Number of properties*	*Time*	*Details of activity*	*Ofwat's view*	*Bristol Water's view*	*CH2M assessment of management control*		
							Fully within control	*Partially within control*	*Outside control*
Luckington Bridge	2014	801	17 hrs	During a planned shutdown of a mains pipe, crew accidently left a valve partially closed.	• Not outside management control, as due to one of the company's valves being partially closed	• Planned works that ran into difficulties therefore does not represent an infrastructure investment issue • Due to human error (of a contractor) despite planning, preparation, and risk assessments • CH2M determined event was entirely unpredictable	10 hrs	7 hrs	-
Wedmore Vale	2015	450	15 hrs 4 mins	A burst pipe which required a deep excavation in unstable ground, close to a park gate as well as gas and electricity mains, and requiring additional shoring (after the trench collapsed). Complications with re-zoning prevented its use.	• Not outside management control, as delays were due to staff not having appropriate training or competence for installation of shoring	• Complex repair, including proximity to gas and electrics • Delays from need for bigger shoring to complete the repair • H&S concerns identified during event requiring deep excavation training were exceptional • CH2M concluded that elements beyond/partially within control extended the interruption beyond 12 hours	-	12 hrs 3 mins	3 hrs
Burnham-on-Sea	2015	12,270	14 hrs 15 mins	Large burst at extremity of area-time for crew to reach, which required a particularly large and deep excavation.	• The material of the main (asbestos cement) is known to fail at a much higher frequency, yet no mention of a separate risk assessment • Particularly lacking given the large number of properties the mains served • No contingency plans in place	• Complex repair • Service reservoir ran dry and needed refilling • Both the material used and the mains in question, were not considered higher risk than others due to historical burst rate comparisons • An alternative pipe was in process of being replaced due to high burst rates, which overran due to complexity of the repair • CH2M concluded that significant elements of the event which were only partially in management's control extended the interruption beyond 12 hours	-	14 hrs 15 mins	-

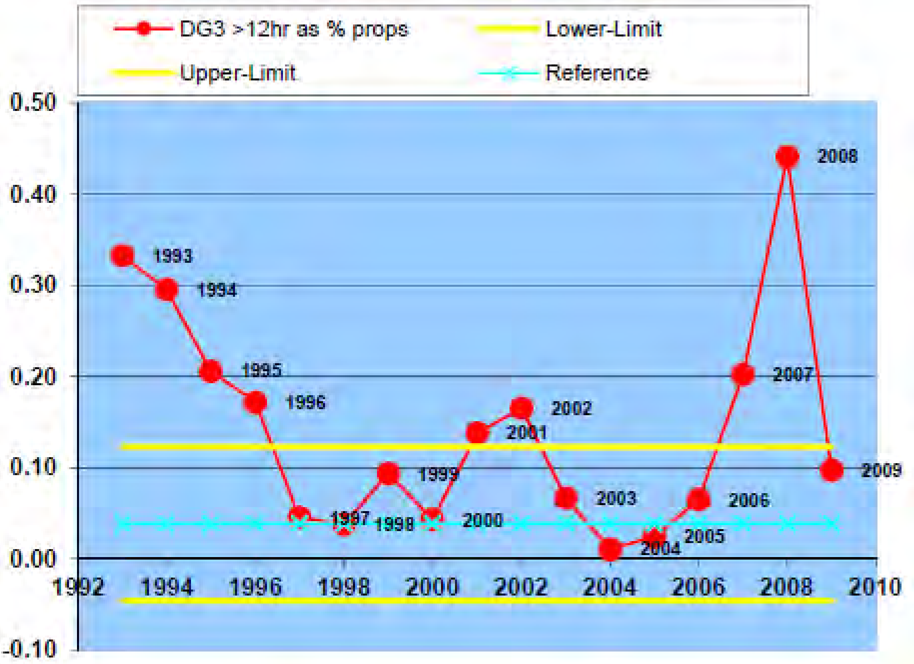
Event name	*Year*	*Number of properties*	*Time*	*Details of activity*	*Ofwat's view*	*Bristol Water's view*	*CH2M assessment of management control*		
							Fully within control	*Partially within control*	*Outside control*
Fisher Road/ Kingswood	2015	28,391	43 hrs	Large burst main. Crew were denied access for 21 hours by Fire Service due to potentially ruptured gas main. 8 hours of repair. Wessex Water also onsite in case of failure in nearby sewage network which could contaminate water. 11 hours delay due to gas provider monitoring an adjacent mains. Re-zone was considered (to protect 9,000 houses) but rejected due to high risk of discolouration.	• Wider network was less resilient at time of outage due to planned outages of numerous principal trunk mains • Management had made the choice to manage their network and associated risks this way	• 21 hour delay as Fire Service prevented access • Led to service reservoir and parts of the network running dry which needed to be refilled and flushed • Only a single additional main was out of service, and had it been operating, 8k households would still have been affected • CH2M concluded that elements beyond/partially within control extended the interruption beyond 12 hours	3 hrs	8 hrs	32 hrs

Source: Bristol Water SoC, paragraphs 1866–1876; Bristol Water reply, paragraphs 510–519; Ofwat response, paragraphs 508–510.
Note: CH2M assessment taken from SOC334, in answer to: ‘Identify how much, if any, of the duration of the interruption was caused by aspects outside management control’.

Comparison between 2010 workshop exercise and Bristol Water's current situation

10. In its SoC, Bristol Water presented charts on bursts (as it was considered to be the headline indicator) and DG3 UI>12. Regarding DG3 UI>12, Bristol Water highlighted the relevant example chart in the workshop, as shown in Figure 1 below.

Figure 1: Ofwat Serviceability 2010 Workshop Exercise 2, Question 1: DG3 interruptions >12 hours (% of properties experiencing an interruption of over 12 hours)

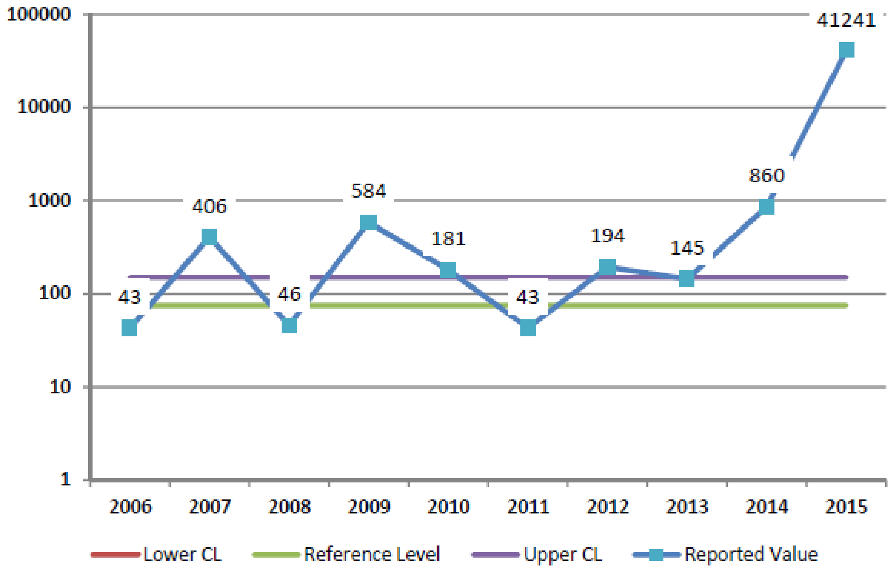


Source: Bristol Water SoC, Figure 87.

11. It compared this with its own performance in DG3 UI>12, as is shown in Figure 2 below, commenting that they appear analogous.[4]

[4] Bristol Water SoC, paragraph 1823.

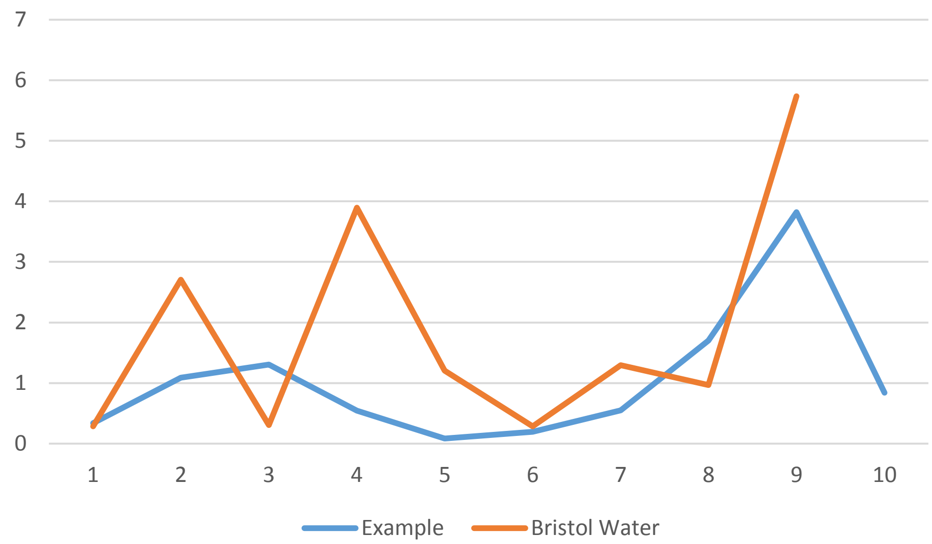
Figure 2: Bristol Water Serviceability DG3 UI>12 performance (number of properties experiencing an interruption of over 12 hours)



Source: Bristol Water SoC, Figure 89.

12. We noted that the relative scales of these charts (including the use of a logarithmic scale in Figure 1) are potentially misleading, and converting figures to a ratio of the control limit (such that any figures greater than 1 represent exceeding the limit) and putting on the same axis may provide a better comparator. This is provided both with and without Bristol Water's performance in the final year due to issues with scale (see Figure 3).

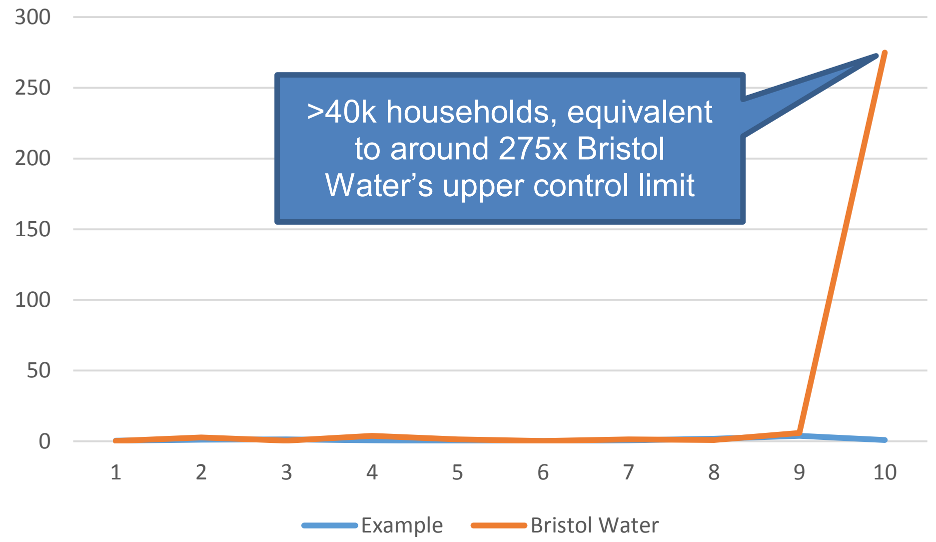
Figure 3: Example vs Bristol Water scaled to control limit



Source: CMA analysis, Bristol Water SoC Figure 89.
Note: Last 10 years data, excluding final year for Bristol Water (performance as a ratio of the control limit).

13. Figure 4 shows that the scale of the performance breach by Bristol Water was substantially in excess of scales in the workshop example, while the workshop example also reduced to being below the upper control limit prior to the end of the period.

Figure 4: Example vs Bristol Water scaled to control limit, last 10 years data, including final year for Bristol Water (performance as a ratio of the control limit)



Source: CMA analysis, Bristol Water SoC Figure 89.

14. Bristol Water also provided the following table from the workshop exercises in support of its overall assessment.

Table 3: Ofwat Serviceability 2010 Workshop Exercise 2, Question 1

Sub-service	*Indicator*	*Notes*
Bursts	Stable	Headline indicator
DG3	Marginal	
Fe	Stable	
DG2	Stable	
Discoloured	Stable	
TIM	Stable	
Assessment	Stable	

Source: Bristol Water SoC, Table 122.

Ofwat statements around updated guidance on assessing serviceability

15. Ofwat stated that Bristol Water referred to RD15/06 which was published in 2006, but that this was superseded by final determinations at PR09, where Ofwat set out its methodology both in the confidential supplementary reports that were sent to companies alongside the 2009 final determination, and the public letter PR09/38.[5]

[5] Ofwat response, paragraph 103.

16. Ofwat stated that its expectation, as set out in its FD09 supplementary report, was for each company to monitor its performance against the indicators and to manage and maintain assets such that all indicator values remained well within the control limits and that they exhibited a stable or improving trend year on year. In particular, it highlighted text stating:[6]

> Should you fail to demonstrate a stable or improving trend in **any indicator** in 2014 our starting point will be a shortfall in output [emphasis added by Ofwat subsequently].[7]

17. Ofwat also referenced a statement from its technical summary document from PR09 (PR09/38) on individual indicators:

> We expect the companies to monitor **each indicator** and to manage and maintain assets so that **all indicator values** remain well within the control limits [emphasis added by Ofwat subsequently].[8]

18. Ofwat said on short-falling consequences:

> Stable serviceability required for **all indicators** from 2012, if less than stable company should assume it is at risk of shortfall. Shortfall will be applied at the next periodic review if marginal or deteriorating in 2014' [emphasis added by Ofwat subsequently].[9]

COPI figures[10]

19. The figures quoted by BIS/ONS for COPI are as follows (note the series used different base years).

Table 4: Construction output price indices

	2007-08	*2008-09*	*2009-10*
CC10 1995 COPI	162.5	159	149.6
Finalised 1995 COPI	162.5	159	149.3
2005 COPI	111.3	114	110.5

Source: Ofwat, Bristol Water, ONS.

20. Indexing these to 100 in 2007/08 (set as the base year) results in the following indices.

[6] Ofwat response, paragraph 488.
[7] Ofwat response, paragraph 104.
[8] Ofwat response, paragraph 489.
[9] Ofwat response, paragraphs 104 and 490.
[10] Annual figures based on mean averages of quarterly data (where 2007-08 = 2007Q2 to 2008Q1 inclusive). 'COPI' refers to the 'All new construction output price index', which reflects the output price for all tracked types of new construction projects in the period.

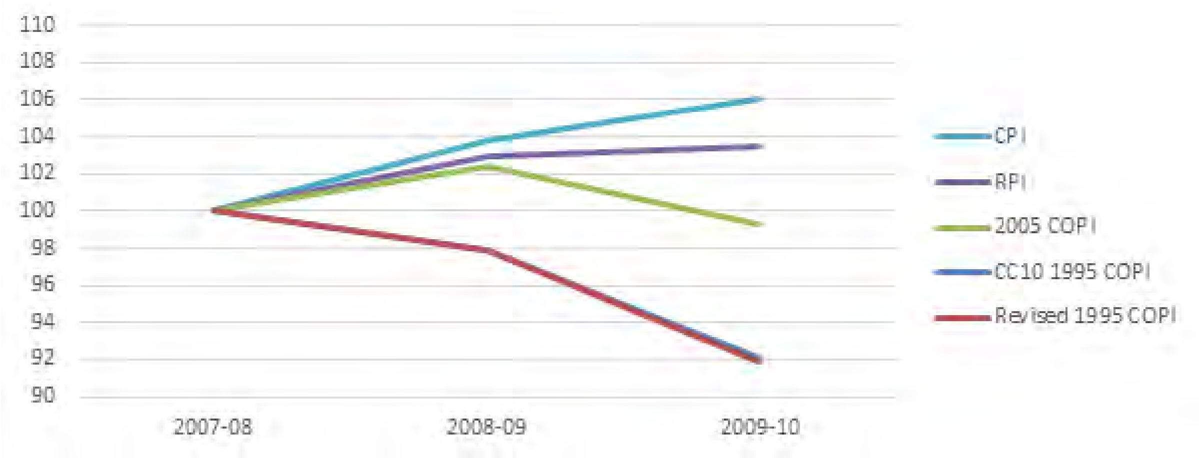
Table 5: Construction output price indices, indexed to 100 in 2007-08

	2007-08	*2008-09*	*2009-10*
CC10 1995 COPI	100	97.8	92.1
Finalised 1995 COPI	100	97.8	91.8
2005 COPI	100	102.4	99.3

Source: CMA analysis.

21. These indexed figures, along with RPI and CPI, can be displayed graphically as shown in Figure 5 below.

Figure 5: COPI series, RPI and CPI over time period in question



Source: CMA analysis.

Views on accuracy of COPI series

22. We considered how well the series reflected underlying cost inflation rates, and in particular the expected accuracy of each series in doing so.

23. In principle, series are revised in order to more accurately reflect the underlying conditions they are trying to reflect. This would imply that the updated 2005 series should more accurately reflect underlying inflation.

24. However, we note that there are significant ongoing concerns around the accuracy of the 2005 COPI series, and COPI in general. COPI was revised twice in 2010,[11] and is currently suspended from being issued due to concerns regarding its methodology.[12]

[11] Annual construction statistics. See figures in Table 4.9 that show different values for COPI. Also referenced in subsequent guidance such as COPI notes and definitions (methodology and revision policy), p2, which refers to an ‘old 2010 series’.
[12] Suspended by BIS in December 2014, with subsequent transfer of responsibility to ONS on 1 April 2015; Suspension of construction OPIs, BIS; Update on Construction Output Statistics, ONS, 8 May 2015.

25. This would imply that any improvements in accuracy as a result of changing series are likely to be small, if they exist at all.

26. We also put weight on guidance issued by BIS at the time of the first revision which stated that for existing arrangements, the original series should be used up to 2Q 2010:

> In any existing arrangement for the OPIs (2010) for New Construction […], where the old superseded 1995=100 series [1995 COPI] […] are being used, and subject to the wording of any contract, they should continue to be used up until 2Q2010.[13]

27. If followed in this case, the BIS guidance would imply that it is not appropriate to change methodology to use the 2005 COPI series based on arguments around increased accuracy.

Party views on CIS indexation methods

28. The actual capex for the period is compared with the allowed amount to determine the value to add to the RCV.

29. Both of these values need to be converted to 2007/08 prices (the base year used for PR09), for which Ofwat used the following approach:

(a) Adjust actual capex using outturn RPI.

(b) Adjust allowed capex to outturn prices using COPI, then deflate using RPI.

30. For the second of these steps, Ofwat now states that it was inconsistent in its use of RPI. It used **outturn RPI** for this calculation, but **forecast RPI** for its financing cost adjustments.[14] It therefore proposes using **forecast RPI** in this calculation as well.[15]

31. Bristol Water also highlighted that the FD09 methodology which used **outturn RPI** but **forecast COPI** resulted in companies bearing RPI risk (which the regulatory regime is designed to avoid). It elaborated around the risks the company bears through different methods, as shown in Table 6 below.

[13] COPI notes and definitions (methodology and revision policy), p2, bullet 2.
[14] The discount factor (for which RPI is a component) used to account for timing differences used to reconcile between the final determination and actual performance; PWC PR14 Reconciliation Rulebook March.
[15] Ofwat response, paragraph 515.

Table 6: Possible methods and implied impact on Bristol Water

	RPI used	*COPI used*	*Impact on Bristol Water*
Method 1 (Final Determination)	Outturn	Forecast	N/A
Method 2 (Current proposition)	Forecast	Forecast	–£9.3m
Method 3 (Bristol Water possible alternative)	Outturn	Outturn	+1.1m

Source: Bristol Water.

32. On 26 March 2015, Ofwat published a consultation on its proposed approach (Method 2) which applies to all the licensees.

33. Bristol Water said that either Method 2 or Method 3 should be used depending on Ofwat's intentions at the time around whether companies were expected to bear RPE (real price effects) risk.[16]

34. Bristol Water stated that it has had insufficient time to review the PR09 methodology to determine which approach was intended, but highlighted that PR04 and earlier specifically protected the companies from RPE risks whilst PR14 specifically did not (ie companies bear the risk).

[16] Real price effects is the difference between RPI and COPI and represents the differential inflation of capital costs.

Outcome delivery incentives

1. The following appendix provides additional details and calculations made when considering Bristol Water's outcome delivery incentives (ODIs) as set out in Section 9.

2. The rest of this appendix follows the structure below:

   (a) Bristol Water vs Ofwat target levels for three metrics in contention.

   (b) Theoretical basis for ODIs.

   (c) Use of rewards in ODIs.

   (d) Unplanned customer minutes lost calculations.

   (e) Mean zonal compliance (MZC) industry performance data.

   (f) Bristol Water's views on reducing taste complaints.

   (g) Bristol Water Negative Water Quality Contacts.

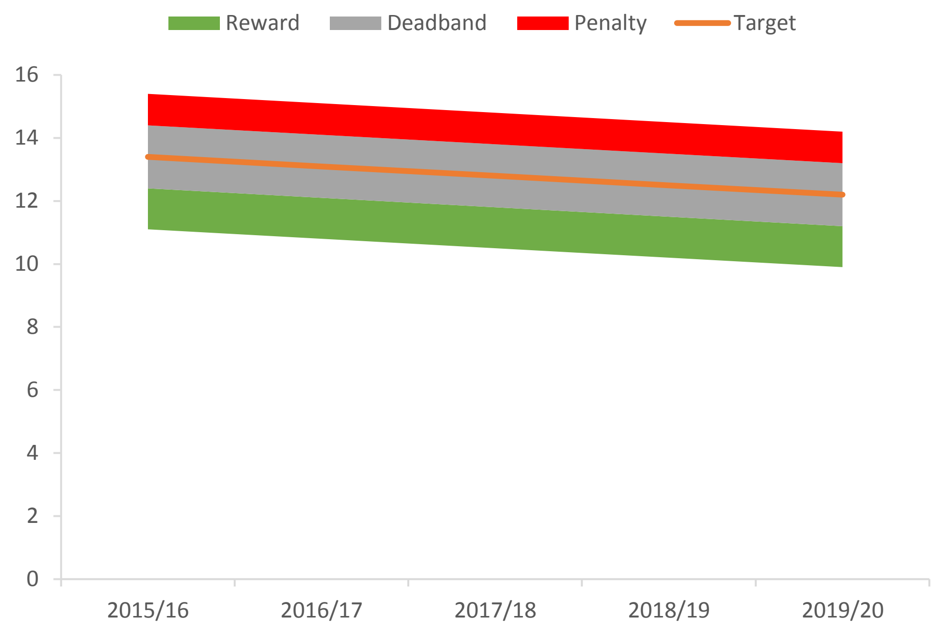
   (h) Bristol Water cross-industry service performance data provided to customers during research phase.

Bristol Water vs Ofwat target levels for three metrics in contention

Unplanned customer minutes lost

3. Figure 1 and Table 1 show Bristol Water's ODI figures for unplanned customer minutes lost.

Figure 1: Unplanned customer minutes lost ODIs – Bristol Water



Source: Bristol Water.

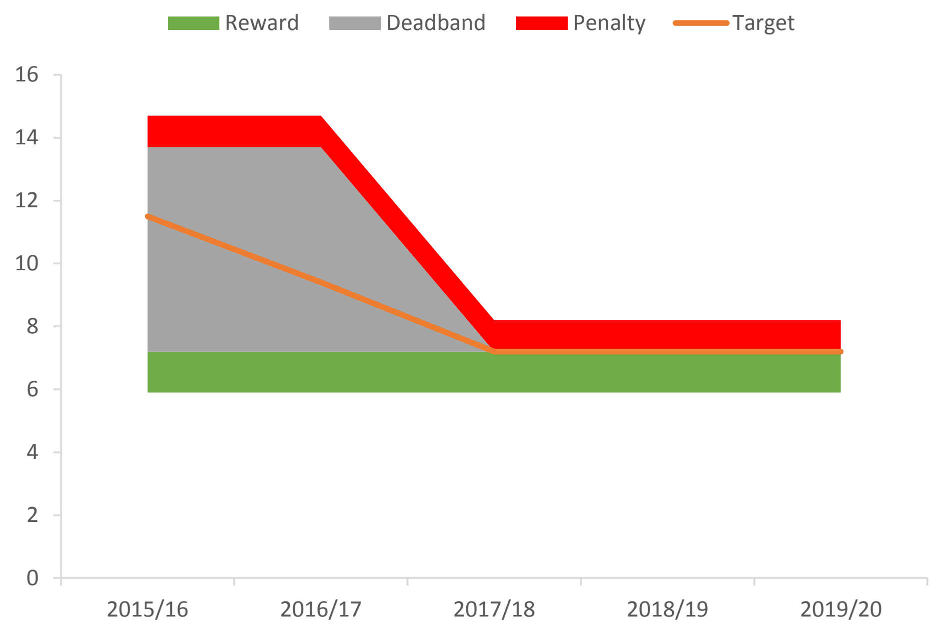
Table 1: Unplanned customer minutes lost ODIs – Bristol Water

	Current	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
Reward cap		11.1	10.8	10.5	10.2	9.9
Reward deadband		12.4	12.1	11.8	11.5	11.2
Target	13.7	13.4	13.1	12.8	12.5	12.2
Penalty deadband		14.4	14.1	13.8	13.5	13.2
Penalty collar		15.4	15.1	14.8	14.5	14.2

Source: Bristol Water.

4. Figure 2 and Table 2 show the results of Ofwat's intervention on the ODI for unplanned customer minutes lost.

Figure 2: Unplanned customer minutes lost ODIs – Ofwat



Source: Ofwat.

Table 2: Unplanned customer minutes lost ODIs – Ofwat

	Current	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
Reward cap		5.9	5.9	5.9	5.9	5.9
Reward deadband		7.2	7.2	7.2	7.2	7.2
Target	13.7	11.5	9.4	7.2	7.2	7.2
Penalty deadband		13.7	13.7	7.2	7.2	7.2
Penalty collar		14.7	14.7	8.2	8.2	8.2

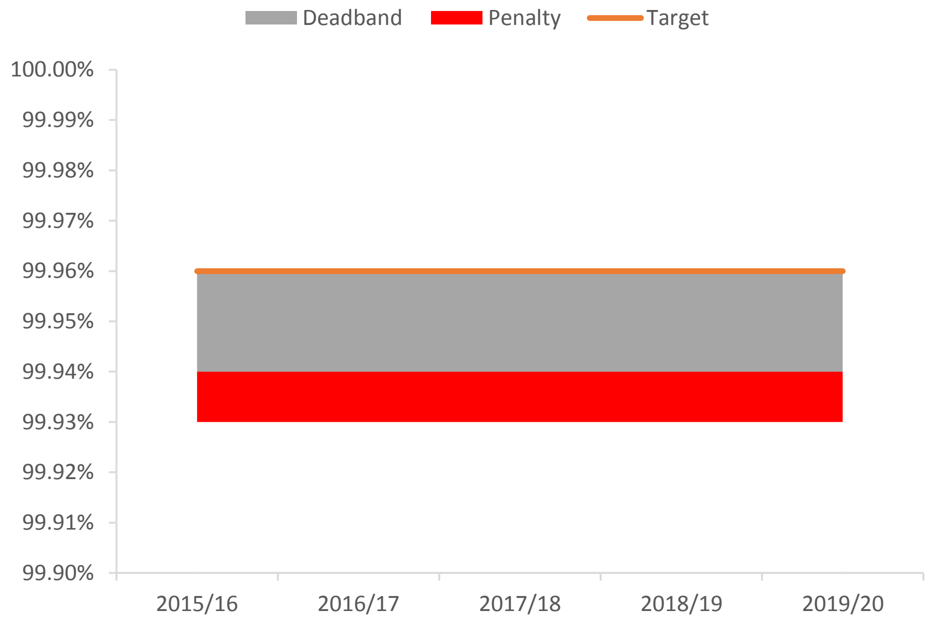
Source: Ofwat.

Mean zonal compliance

5. Mean zonal compliance (MZC) has a financial incentive (penalty only), with the standard level being uncontentious and Bristol Water only contesting Ofwat's intervention on the penalty deadband and collar.

6. Figure 3 and Table 3 show Bristol Water's ODI figures for MZC (note that the scale on this chart is broken to allow the data to be seen).

Figure 3: Mean zonal compliance ODIs – Bristol Water



Source: Bristol Water.

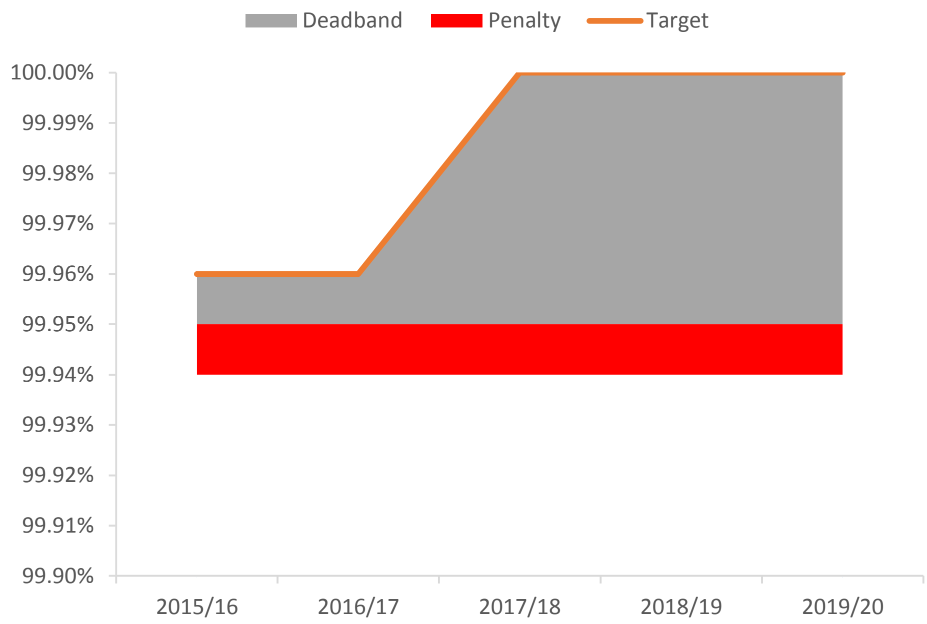
Table 3: Mean zonal compliance ODIs – Bristol Water

						%
	Current	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
Standard	99.96	99.96	99.96	99.96	99.96	99.96
Penalty deadband		99.94	99.94	99.94	99.94	99.94
Penalty collar		99.93	99.93	99.93	99.93	99.93

Source: Bristol Water.

7. Figure 4 and Table 4 show the results of Ofwat's intervention on the MZC ODI (the axis remains broken at the same point as the Bristol Water chart for comparison purposes).

Figure 4: Mean zonal compliance ODIs – Ofwat



Source: Ofwat.

Table 4: Mean zonal compliance ODIs – Ofwat

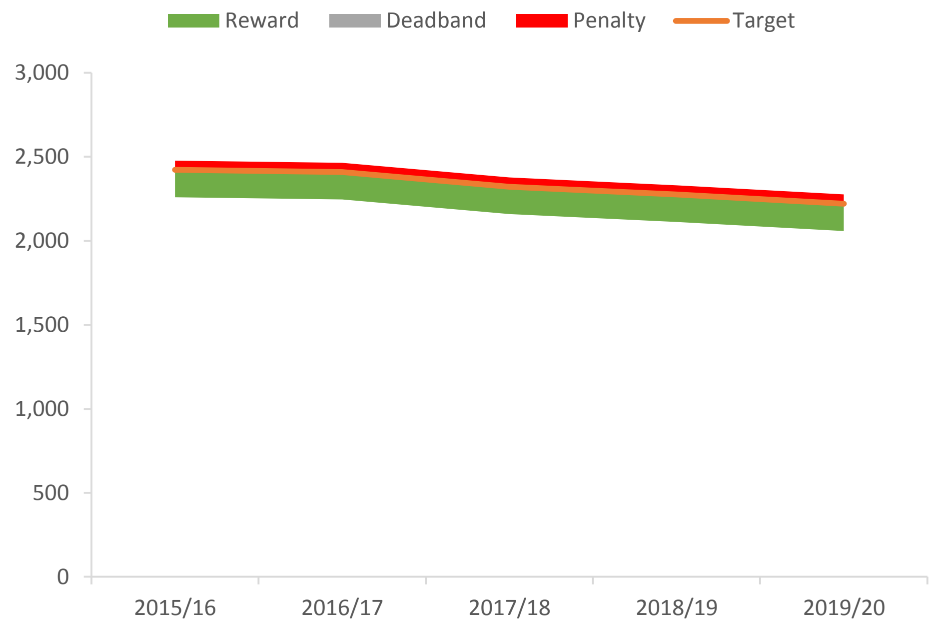
						%
	Current	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
Standard	99.96	99.96	99.96	100.00	100.00	100.00
Penalty deadband		99.95	99.95	99.95	99.95	99.95
Penalty collar		99.94	99.94	99.94	99.94	99.94

Source: Ofwat.

Negative water contacts

8. Figure 5 and Table 5 show Bristol Water's ODI figures for negative water quality contacts.

Figure 5: Negative water quality contacts ODIs – Bristol Water



Source: Bristol Water.

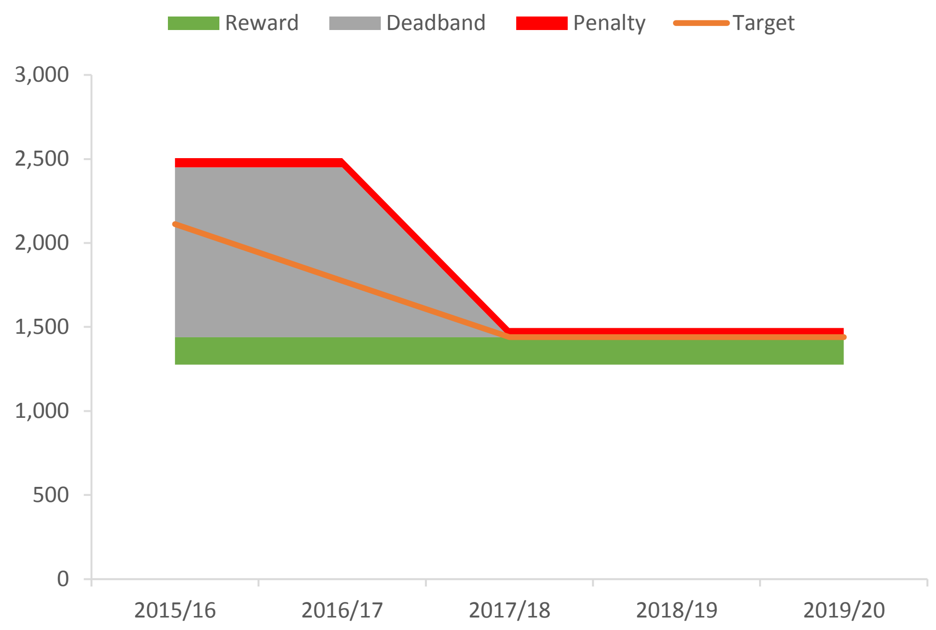
Table 5: Negative water quality contacts ODIs – Bristol Water

	Current	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
Reward cap		2,259	2,246	2,159	2,112	2,058
Reward deadband		2,422	2,409	2,322	2,275	2,221
Target	2,450	2,422	2,409	2,322	2,275	2,221
Penalty deadband		2,422	2,409	2,322	2,275	2,221
Penalty collar		2,477	2,464	2,377	2,330	2,276

Source: Bristol Water.

9. Figure 6 and Table 6 show the results of Ofwat's intervention on the ODI for negative water quality contacts.

Figure 6: Negative water quality contacts ODIs – Ofwat



Source: Ofwat.

Table 6: Negative water quality contacts ODIs – Ofwat

	Current	*2015/16*	*2016/17*	*2017/18*	*2018/19*	*2019/20*
Reward cap		1,276	1,276	1,276	1,276	1,276
Reward deadband		1,439	1,439	1,439	1,439	1,439
Target	2,450	2,113	1,776	1,439	1,439	1,439
Penalty deadband		2,450	2,450	1,439	1,439	1,439
Penalty collar		2,505	2,505	1,494	1,494	1,494

Source: Ofwat.

Theoretical basis for setting performance commitment targets

10. The development of a reasonable target which companies should target includes three components, which are:

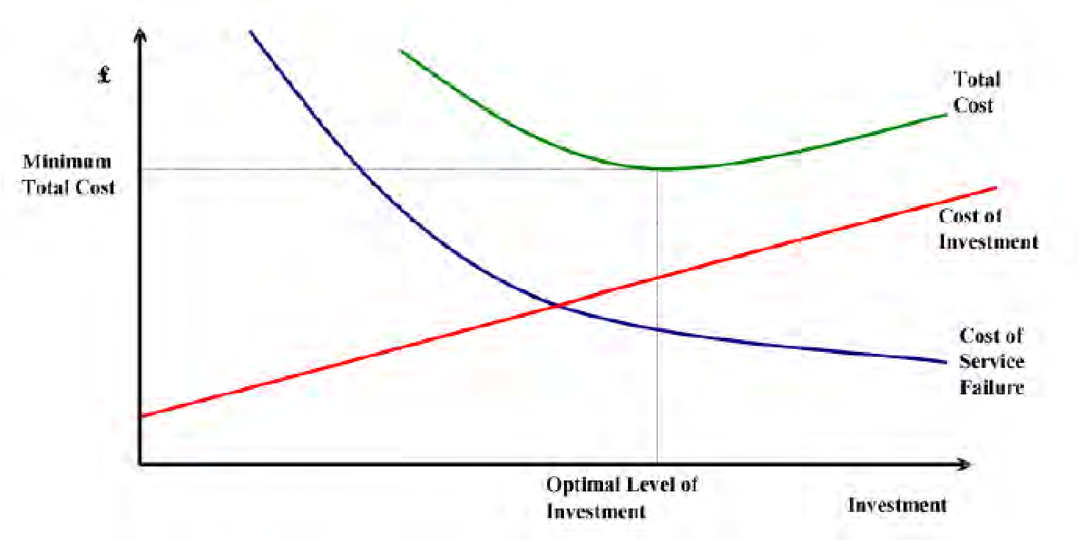
(a) the investment cost required to improve the metric to a particular level;

(b) the cost when a problem occurs; and

(c) the impact this has on consumers.

11. Figure 7 sets out Bristol Water's illustration of this concept (it has chosen to combine the second and third components (*(b)* and *(c)* above), and referred to this as the 'cost of service failure'):

Figure 7: Level of investment and cost



Source: Bristol Water.

12. For example, if considering leakage, the three components could be considered as:

    (a) the cost of replacing pipes to reduce leakage;

    (b) the ongoing cost of water lost to leakage; and

    (c) customers' views on the wastefulness of lost water.

13. It is therefore possible to use the economic level as an initial target (which includes the optimum balance of investment cost and required cost to fix), and then adjust this based on customer willingness to pay (an estimation of the impact on consumers).

14. Ofwat stated that it considered that (particularly for inefficient/poorly performing companies), the economic level was likely to be closer to the upper quartile performance level than the level proposed in business plans.[1]

15. We considered this to be an overly simplistic representation of the circumstances. As was recognised in the assessment of leakage, local issues can significantly influence the true economic level of performance. Although the extent to which this is true will differ between metrics, we were not convinced that a blanket use of the industry upper quartile target was a superior method.

[1] Ofwat response to our provisional findings, paragraphs 136–140.

16. For example, Ofwat's stated logic could equally apply to the leakage measure, but Ofwat itself considered this to differ widely between companies, and so did not target an industry upper quartile level.

Use of rewards in ODIs

17. Ofwat's approach encouraged companies to propose ODIs that included financial rewards for out-performance, in addition to penalties for poor performance.

18. Both CCWater[2] and the LEF[3] suggested that it was not appropriate to fund financial rewards for out-performance through higher customer bills. Bristol Water's customers also rejected the concept of rewards being funded through an increase in bills.[4]

19. Bristol Water agreed with this penalty-only approach. As a result, Bristol Water's initial business plan (in December 2013) had excluded financial rewards from its ODIs.[5] Bristol revised this following more specific guidance from Ofwat which strongly recommended the inclusion of rewards.[6]

20. Ofwat stated that customer support for rewards showed mixed results (either supporting it or opposing it) across the companies, often depending on the context of the question.[7] Ofwat considered that approaching the use of rewards in a totally consistent manner across all companies was an impossible task.[8]

21. It was clear that there are pros and cons to the use of rewards. For example, the Gray review highlighted the potential for introducing more financial rewards as well as penalties into Ofwat's overall price review framework. However, we considered that some aspects of performance are more likely to be suitable for penalties and rewards than others and the setting of risks and rewards should also take account of customer views.[9] Both the LEF and CCWater criticised Ofwat's approach of recommending financial rewards.

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[2] Summary of hearing with CCWater, paragraph 17.
[3] Bristol Water SoC, paragraph 1898; LEF report to Ofwat on Bristol Water's 2015-2020 Business Plan, December 2013, pp18–19.
[4] Summary of hearing with CCWater, paragraph 17.
[5] Bristol Water SoC, paragraph 1898.
[6] Bristol Water SoC, paragraph 1904.
[7] Ofwat response to our provisional findings, paragraphs 150–151.
[8] Ofwat response to our provisional findings, paragraph 152.
[9] We note that the Gray review stated that 'Incentives [should aim to provide] the right balance between rewards and penalties in the context of the challenges facing the companies, with increased emphasis on incentives for behavioural change'; Defra (2011) Review of Ofwat and consumer representation in the water sector, p30.

22. We considered whether some of the outcome delivery incentives would be better specified as penalty-only schemes rather than schemes that also provide financial rewards.

ODIs with financial rewards

23. Bristol Water has six ODIs that incorporate a financial reward for outperformance. These are:[10,11]

(a) unplanned customer minutes lost;

(b) negative water quality contacts;

(c) Service Incentive Mechanism (SIM);[12]

(d) leakage;

(e) meter penetration; and

(f) population in centres >25,000 at risk from asset failure.[13]

24. Bristol Water's number of ODIs with financial rewards was close to average for the water companies (mean of 7.2, median and mode of 6), although this does not consider the size of any associated rewards, only the number of them included. The number of ODIs for each company can be seen in Figure 8 below.

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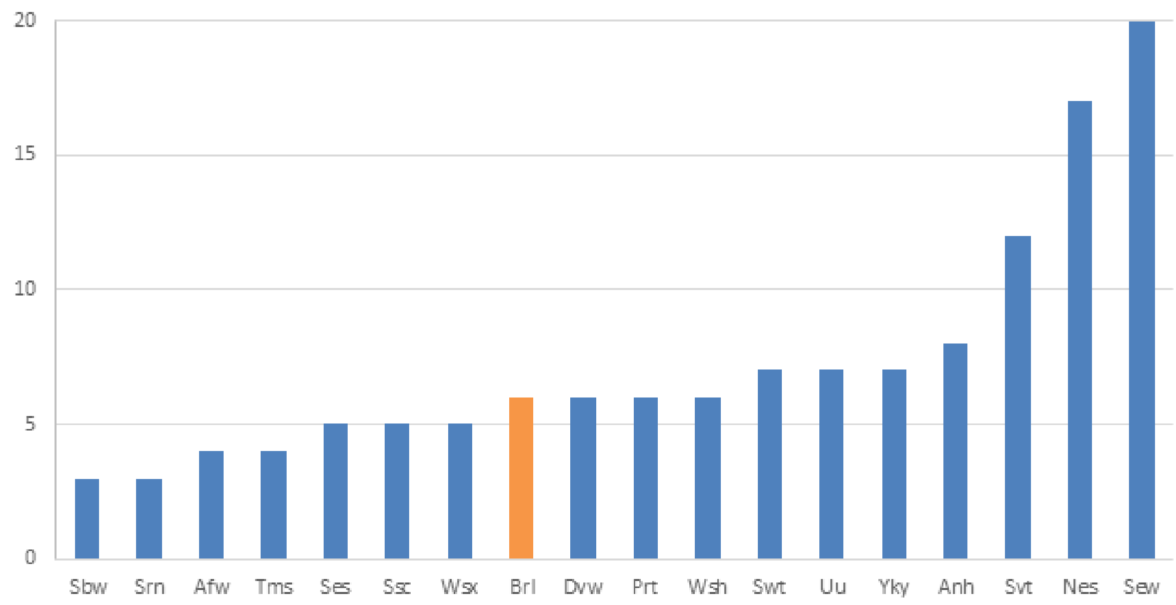
[10] Bristol Water company-specific appendix, pp123–171.
[11] MZC did not have a reward.
[12] An Ofwat metric which measures customer service levels based on a mix of data sources.
[13] Defined as populations in centres of greater than 25,000 who are at risk of failure of the single supply source serving them.

Figure 8: Number of wholesale water and retail ODIs with financial rewards, by company



Source: Company-specific appendices.

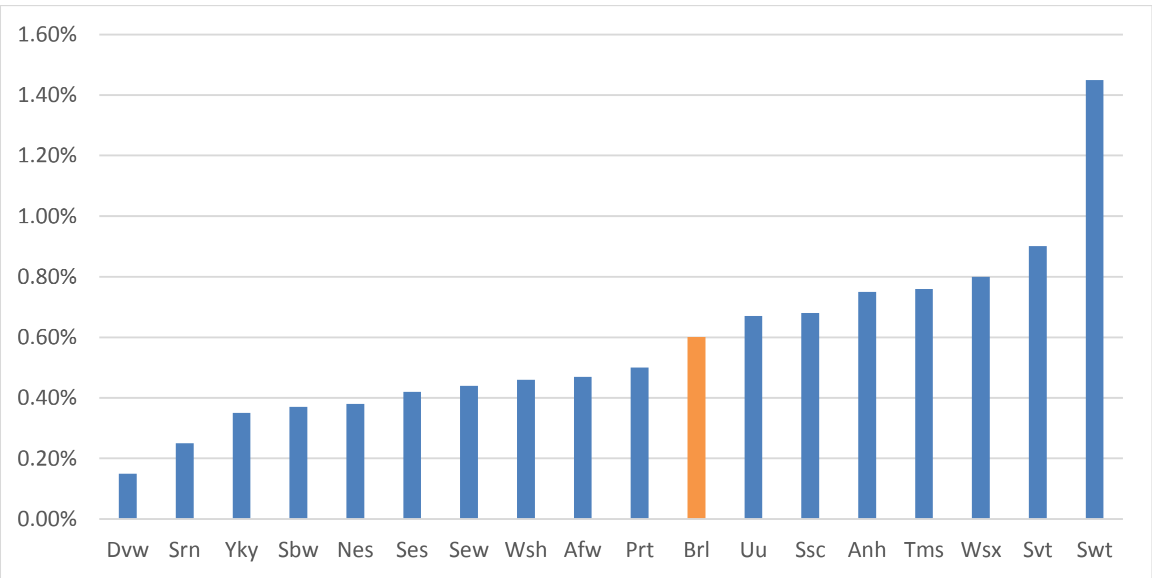
25. In particular, all 18 water companies have included a financial reward for two particular metrics, which are:

(a) SIM; and

(b) leakage.

26. As well as having an average number of ODIs with financial rewards, the size of the rewards available appears to be close to the industry average (as a percentage of RoRE), as shown in Figure 9 below.

Figure 9: Rewards from ODIs as a proportion of the return on regulated equity, by company



Source: Ofwat response to our provisional findings, Table 6.

27. Bristol Water could receive a maximum of £12.3 million in rewards from its ODIs, which is less than the maximum potential penalties in the same ODIs of £18.8 million.[14]

CMA observations

28. Ofwat stated that it was concerned that removing rewards for ODIs would introduce asymmetric risk on the company, and would theoretically result in a higher cost of capital. However, Ofwat separately highlighted that there have been many changes to the PR14 framework and Ofwat did not seek to establish a direct link between assessment of each company's business risks and the cost of capital allowance. We consider that the scale of this effect would be small in the context of the overall cost of capital.

29. If an increase in risk did represent a material concern, there are other possible ways to address the issue than through the introduction of rewards. For example, it may be appropriate to address this by a small adjustment to the weight given to a more conservative cost of capital estimate.

30. The impact on the cost of capital did not appear to represent a material concern for the original company business plans which included penalty-only incentives. We noted that the maximum penalties are relatively high, at around 2% RoRE (approximately 0.75% on the cost of capital). However, this level requires the companies to be at or breach the penalty collar on every incentive. Given that the incentives relate to very different areas of network performance, this is unlikely to occur, so the expected impact is likely to be much lower.

31. The £12.3 million reward could represent an increase in bills of around £5 over the period.[15] However, to be rewarded in this way, Bristol Water would need to:

(a) reduce its time of all interruptions to about 35% of its current level;

(b) halve its negative water quality contacts;

(c) achieve leakage levels beyond 2019/20 targets in the first year (and every subsequent one);

(d) advance expected levels of meter penetration by a year; and

[14] Bristol Water SoC, Table 124.
[15] Estimated based on 12.3/5 = £2.5 million per year. Based on 493,000 properties, this would imply an increase of £4.99 per household per year.

(e) deliver the Southern Resilience Scheme two years early, and ensure all major population centres have backup water supplies by 2017/18.

32. Since the original calculations on the ODIs were based on customer willingness to pay (which the LEF supported), the benefits to customers from such improvements exceed this bill increase.

33. There were also possible alternatives to the outright removal of financial rewards that could have been considered. For instance, it may be possible to disallow a net total reward, but to allow potential rewards to be used to offset penalties incurred in other ODIs. This would allow the company to benefit from over-performance (if it incurs penalties elsewhere), while ensuring customers do not pay more (which is aligned with their views).

34. We considered that it may be necessary to nuance such an approach to include/exclude particular ODIs (eg SIM rewards may be excluded, and scheme-specific penalties may also be excluded).

Unplanned customer minutes lost calculations proposed by Ofwat and Bristol Water

35. Ofwat and Bristol Water provided a number of calculations for estimating the industry upper quartile level for unplanned customer minutes lost. These were based on three core methodologies (using a range of time periods):

(a) **Comparison with Ofwat KPI** – based on using Bristol Water's performance at the Ofwat KPI (all types of interruption over 3 hours) to infer a target level for its own metric (unplanned interruptions of any duration).

(b) **2-step estimation** – converted from the Ofwat KPI to Bristol Water's own metric through two separate steps. The first changed the type of interruption (all vs unplanned only), whilst the second changed the duration (>3 hours to any duration).

(c) **Using industry datashare** – using a partial set of industry datashare for one year to directly estimate the level for unplanned interruptions of >3 hours, and then converting this to unplanned interruptions of any duration.

Method 1 – Comparison with Ofwat KPI

36. Ofwat estimated a target by comparing Bristol Water's performance at the Ofwat KPI to the industry upper quartile at the same measure. It then applied

this ratio to Bristol Water's current performance at its own metric to derive an implied upper quartile figure.

37. We note that the actual methodology Ofwat stated it used was to use the ratio of Bristol Water's performance in the Ofwat KPI to its own metric, and then apply this ratio to the industry upper quartile for the Ofwat KPI. This has the equivalent effect to that above.[16]

38. This method was originally applied to Bristol Water's 2013/14 performance to estimate its original target of 7.2 minutes/property/year for final determination. However, in response to a comment from Bristol Water, Ofwat noted that if it had used a longer time period (2011/12 to 2013/14), then the implied target would be lower, at 6.1 minutes/property/year.[17]

39. These calculations can be seen in Table 7 below:

Table 7: Calculation of implied upper quartile level (Method 1)

	1 year	*3 years*
Bristol Metric performance (BW)	14.0	11.7
	÷	÷
Ofwat KPI performance (BW)	23.5	22.7
Ratio performance levels	**0.60**	**0.51**
	x	x
UQ Ofwat KPI (industry)	12	12
Implied UQ Bristol Metric (industry)	**7.2**	**6.1**

Source: Ofwat response, Table A4.2.

Method 2 – 2-step estimation

40. Bristol Water suggested an alternative calculation based on a two-step process (using its internal data). This involved taking the industry upper quartile level for the Ofwat KPI (all types of interruption over 3 hours), and then converting as follows:[18]

   (a) Step 1: convert to **unplanned** interruptions >3 hours.

   (b) Step 2: convert to unplanned interruptions of **any duration**.

41. In doing so, Bristol Water used ten-year averages for its internal data. It stated that this long time period was appropriate to use because more recent years included major mains rehabilitation programmes which resulted in an increase in the level of planned interruptions, and hence was not representative of the expected future levels.[19]

[16] Ofwat response to Bristol Water SoC, paragraph 448.
[17] Ofwat response to Bristol Water SoC, paragraph 451 and Table A4.2.
[18] Bristol Water SoC, paragraphs 1996–1999.
[19] Bristol Water reply, paragraph 557.

42. Ofwat stated that the ten-year average Bristol Water relied on was inappropriate given how performance changes over time. It instead proposed using the last three years instead.[20]

43. These calculations can be seen in Table 8 below:

Table 8: Calculation of implied upper quartile level (Method 2)

	3 years	*10 years*
UQ Ofwat KPI (industry)	12	12
	x	x
% unplanned vs planned (BW)	37%	62%
Implied UQ unplanned > 3 hours (industry)	**4.44**	**7.44**
	÷	÷
% of unplanned events >3 hours (BW)	72%	55%
Implied UQ Bristol Metric (industry)	**6.2**	**13.4**

Source: Bristol Water SoC, Ofwat response.

Method 3 – Using industry datashare

44. Bristol Water had access to some partial[21] industry-share data for 2012-13, which effectively allowed for a direct estimate of the industry upper quartile for unplanned events >3 hours. This effectively removes the first step required in Method 2.

45. Bristol Water then used this single year of data to estimate an implied ‘duration of interruptions >3 hours’ average for the industry. It assumed that this had remained constant from year to year, and combined with Ofwat data on number of interruptions >3 hours to estimate the number of customer minutes lost three years.

46. Meanwhile, Ofwat relied on the single year of actual data available to estimate an industry upper quartile level for unplanned events >3 hours.

47. Both parties then once again converted this to an estimate for all duration of events using Bristol Water’s internal data for the percentage of unplanned minutes lost from events greater than 3 hours (as there is still no industry data available for this).

48. Bristol Water highlighted that Ofwat had made an error in its calculations, specifically relating to this conversion using the percentage of unplanned minutes lost from events greater than 3 hours. Previous estimates for this figure included both planned and unplanned events, and so were inflated.[22]

[20] Based on a calculation of 12 x 0.37 / 0.72 (UQ Ofwat KPI x % of interruptions over 3 hours that are planned / % of unplanned interruptions that are over 3 hours); Ofwat response, paragraphs 452–453.
[21] Includes 16 out of the 18 water companies.
[22] Unplanned events are usually shorter than planned events. Bristol Water submitted that ‘for an unplanned interruption the company will try to restore supplies as quickly as possible, whilst for a planned interruption, whilst

49. We noted that it appeared that Bristol Water were the first to make this mistake in proposing its estimates through Method 2. Ofwat simply adopted Bristol Water's methodology and adjusted the time periods used. Ofwat did not have a chance to respond to this comment (due to its late timing), or adjust its calculations, so we have restated its calculation with the new estimate of the conversion factor.

50. We would also consider that these changes would affect the estimates made through Method 2, but have not updated these ourselves. Also, neither Ofwat nor Bristol Water proposed updated figures for this methodology.

51. These calculations can be seen in Table 9 below:

Table 9: Calculation of implied upper quartile level (Method 3)

	Ofwat (actual, 1 year)	*Bristol Water (extrapolated, 3 years)*	*Ofwat restated with new % unplanned figure*	*Bristol Water updated*
Implied UQ unplanned > 3 hours (industry)	**4.4**	**7.7**	**4.4**	**7.7**
	÷	÷	÷	÷
% of unplanned events >3 hours (BW)	72%	67%	47%	47%
Implied UQ Bristol Metric (industry)	**6.1**	**11.4**	**9.4**	**16.4**

Source: Bristol Water and Ofwat.

Unplanned customer minutes lost, CMA calculation

52. We considered that of the proposed methodologies, Method 3 is the most robust, as it used the smallest number of assumptions, and incorporated the most direct industry data.

Estimation of upper quartile for unplanned events >3 hours

53. We have used direct industry evidence on unplanned events >3 hours when estimating the upper quartile performance level. This is based on partial industry datashare figures for 2012/13. Figures are available for 16 out of the 18 major water companies, as shown below in Table 10.

not wishing to unduly delay the restoration of supplies to customers, work is generally scheduled to take a longer period of time.'

Table 10: Unplanned customer minutes lost for events over 3 hours, 2012/13 (16 companies, minutes/property/year)

	Company performance
PRT	1.3
SSC*	2.3
SBW	2.7
BRL	4.3
WSX	4.4
DVW	7.5
YKY	8.6
SES	8.8
NWT	9.6
TMS	11.2
SEW	11.2
ANH	12.7
SWT	13.2
SRN	14.3
SVT	19.7
WSH	31.0
Upper quartile	4.37

Source: CMA analysis.
*SSC figure is based only on South Staffordshire Water performance, excluding Cambridge Water.

54. As discussed in paragraph 45, Bristol Water used this partial data to make a number of additions to the evidence base, which we have not relied on. This was largely based on back-calculating an estimated 'average duration' for events from this 2012/13 data, and applying it to Ofwat data from previous years to generate an implied performance.[23]

55. The reasons we have not made the same adjustments are discussed below:

(a) **Use of industry duration average** – Bristol Water used an industry duration average and applied it to all companies, rather than using the known actuals for each individual. This has no obvious advantages, and gives an incorrect upper quartile even in the year data is available.

(b) **Use of multiple years** – Bristol Water have applied the 2012/13 average durations it calculated to 2010/11 and 2011/12 data from Ofwat to give estimates for these years too. While we would support using a longer time series of robust data, we have concerns with this methodology. In particular, both the very limited data on duration available from 2010/11 (nine companies) and Bristol Water's longer term internal performance show that durations can change by over 25% in just a single year.[24] This volatility makes applying a single year duration estimate to previous years not very robust.

[23] (# properties affected) x (duration) / (total # properties) = customer minutes lost per property. The average duration figure is the only one that Ofwat does not collect as standard from all companies.
[24] For example, Bristol Water average duration increased by 75% from 2007/08 to 2008/09, then dropped 57% to 2009/10. Similarly, Wessex Water average duration increased by nearly 30% from 2011/12 to 2012/13.

(c) **Data gaps in industry data** – Bristol Water estimated the implied performance for Affinity Water and Northumbrian Water (the companies which did not provide industry datashare figures) using an industry duration average. We would consider that using the actual performance for the known 16 companies as being more reflective of industry performance since duration figures can be highly variable (eg Dee Valley had nearly twice the average duration of Portsmouth Water in 2012/13).

56. Therefore, we considered that the most appropriate upper quartile figure for unplanned customer minutes lost is 4.37 minutes/property/year, as shown in Table 10. We note that this was also very similar to the estimate of 4.44 minutes/property/year we used in provisional findings.

Conversion from unplanned events >3 hours to unplanned events of all duration

57. The conversion ratio used in the estimation is based on internal Bristol Water data, since wider industry data is not available.

58. As highlighted in paragraph 48, Bristol Water raised concerns that previous estimates had relied on an inaccurate conversion ratio. This was because the ratios used previously relied on an estimate of the number of customer minutes lost due to events over 3 hours compared to the total number of customer minutes lost. However, this includes the impact of planned events as well as unplanned events, which is erroneous.

59. Therefore, to be more accurate, we have adopted the figures from Bristol Water’s data based only on unplanned events. To be consistent with our market estimates above, we would consider it most appropriate to use the estimate from 2012/13 for this figure.

60. Table 11 below shows the Bristol Water internal data for both planned an unplanned customer minutes lost, as well as events >3 hours and all duration events:

Table 11: Customer minutes lost per property by type of event, 2012/13

	Planned	Unplanned	Total
All events	21.65	9.91	31.55
Events >3 hours	19.35	4.25	23.60
% conversion ratio	89%	43%	75%

Source: CMA analysis.

61. We have therefore used a conversion ratio of 43% in our upper quartile calculation.

Resulting estimate for industry upper quartile performance level

62. The implied upper quartile for Bristol Water's ODI is calculated by taking the upper quartile estimate for unplanned events >3 hours and applying the conversion ratio to account for events of all durations. This results in an estimate of 4.37 / 43% = 10.18.

MZC industry performance data

63. The DWI provided Ofwat with 2014 MZC data under the new lead standard, as shown in Table 12 below.

64. Companies are ranked based on current views of performance in 2014.

Table 12: MZC performance by company, including 2014 data for performance under new lead standard

%

	2012	*2013*	*2014*	*2013/14 Delta*
Sembcorp Bournemouth.	>99.99	99.96	>99.99	0.03
Sutton and E. Surrey	100.00	99.96	99.98	0.02
South Staffordshire	99.91	99.95	99.98	0.03
Affinity Water	99.95	99.99	99.97	–0.02
Wessex Water	99.99	99.97	99.97	0.00
Portsmouth Water	99.96	99.97	99.97	0.00
Southern Water	99.93	99.94	99.97	0.03
Thames Water	99.97	99.99	99.96	–0.03
South West Water	99.97	99.98	99.96	–0.02
South East Water	99.96	99.97	99.96	–0.01
Yorkshire Water	99.93	99.98	99.95	–0.03
United Utilities	99.95	99.97	99.95	–0.02
Anglian Water	99.96	99.96	99.95	–0.01
Northumbrian Water	99.92	99.93	99.95	0.01*
Severn Trent Water	99.96	99.97	99.94	–0.03
Dŵr Cymru	99.96	99.97	99.94	–0.03
Bristol Water	**99.99**	**99.97**	**99.92**	**–0.05**
Dee Valley Water	99.93	99.93	99.88	–0.05
Upper Quartile	99.97	99.97	99.97	
Mean	99.957	99.965	99.955	

Source: DWI 2014 water company statistics.
*Only +0.01 due to rounding of the 2013 and 2014 figures calculated from weighting the sub-regions of Northumbrian Water and Essex and Suffolk Water

Proportion of communication pipes made from lead versus 2014 MZC

65. Bristol Water highlighted that it had the fourth highest proportion of lead communication pipes in 2008, and it stated that it was unlikely this relative position had changed since then.

66. Table 13 below compares the proportion of lead communication pipes with 2014 MZC performance.

Table 13: Comparison of water company share of lead communication pipes and 2014 MZC performance

%

	2014 MZC performance	*Share of communication pipes made of lead (2008)*
Sembcorp Bournemouth.	>99.99	0
Sutton and E. Surrey	99.98	56
South Staffordshire	99.98	68
Affinity Water	99.97	29
Wessex Water	99.97	10
Portsmouth Water	99.97	51
Southern Water	99.97	19
Thames Water	99.96	57
South West Water	99.96	31
South East Water	99.96	10
Yorkshire Water	99.95	33
United Utilities	99.95	36
Anglian Water	99.95	20
Northumbrian Water	99.95	35
Severn Trent Water	99.94	22
Dŵr Cymru	99.94	35
Bristol Water	**99.92**	**51**
Dee Valley Water	99.88	42

Source: Bristol Water and DWI 2014 water company statistics.

67. We noted that that the four companies with a greater proportion of communication pipes made of lead[25] than Bristol Water (in 2008) are able to achieve higher levels of mean zonal compliance than Bristol Water did in 2014. All of these companies would be above the deadband set by Ofwat for Bristol Water in FD14 (99.95%).

68. We also noted that Bristol Water received £165,000 in PR09 to replace lead communication pipes, which we would expect to reduce its proportion (and absolute length) of lead communication pipes.

Bristol Water's views on reducing taste complaints

69. Bristol Water provided the following evidence to support its views that reducing taste contacts is beyond customer willingness to pay due to high implementation costs. These are quoted directly from Bristol Water's submission in Figure 10.

[25] Sutton and East Surrey, South Staffordshire, Portsmouth Water and Thames Water all have equal to or higher shares of lead communications pipes than Bristol Water.

Figure 10: Bristol Water submission on taste complaints

The majority of taste and odour complaints are chlorine or chlorine-related contacts. Customers tend to complain more about changes in the level of chlorine as opposed to the actual level. Due to variations in the supply arrangements customers see variations in the chlorine residual and as a result we get increased numbers of calls.

[…]

Changing our free chlorine policy to chloramination would very significantly reduce chlorine complaints but due to our 'open' supply system with Purton water finding its way to virtually all parts of our system we would need to use chloramination at virtually all of our sites. This is a not a policy change we wish to adopt for the following reasons:

A. Additional costs due to further equipment need and increased ongoing costs due to need to dose ammonium.

B. Greatly increased risk of ammonium and nitrite failures in the network with consequential deleterious impact on our MZC.

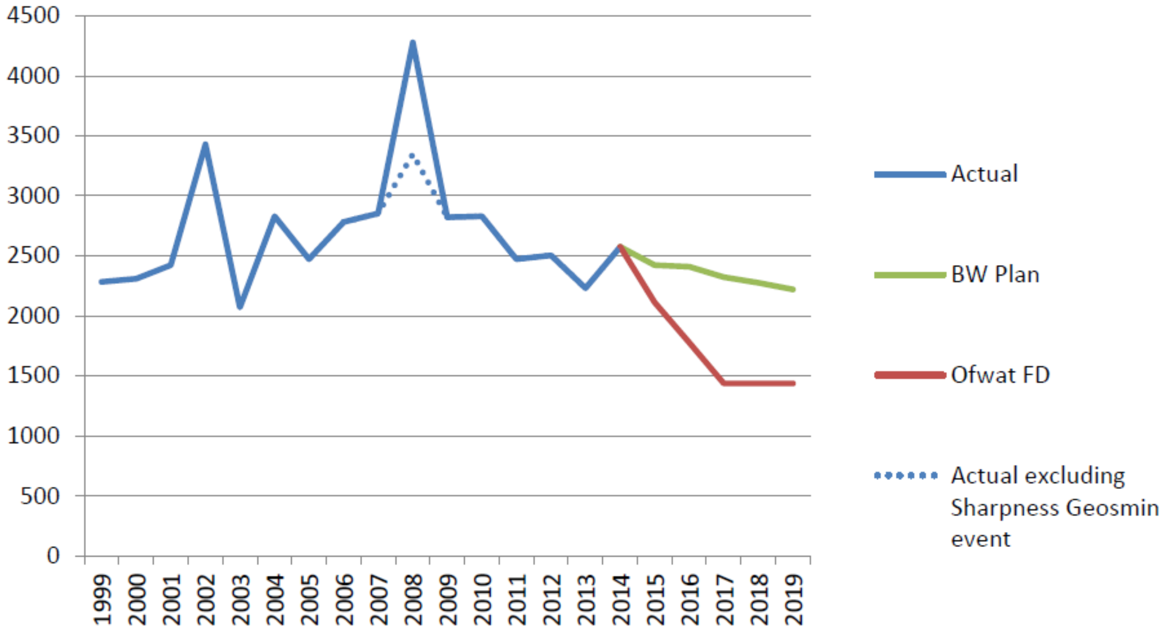
C. Reduced bacteriological quality in the network (combined chlorine residual is not as effective as free chlorine residual) again with possible impact on our MZC.

Source: Bristol Water SoC, paragraphs 2022–2025.

Bristol Water negative water quality contacts

70. Figure 11 presents evidence from Bristol Water showing how its negative water quality contacts had evolved over time, along with its targets (both its own and Ofwat's intervention).

Figure 11: Bristol Water negative water quality contacts performance time series



Source: Bristol Water.

71. Table 14 presents a breakdown of these contacts for the period 2009 to 2013, by type (ie the reason the contact was made).

Table 14: Bristol Water negative water quality contacts, by type

		2009	*2010*	*2011*	*2012*	*2013*	*Average*
Appearance	Discoloured Water – brown/orange	1,300	1,301	1,289	1,141	995	1,205
	Discoloured Water – blue/green	8	16	1	9	3	7
	Particles	79	65	56	62	48	62
	White – air	599	715	380	413	448	511
	White – Chalk	0	0	0	0	0	0
	Animalcules	7	10	2	3	5	5
	General conditions	81	87	84	74	89	83
Taste/Odour	Chlorine	300	281	351	314	431	335
	Earthy/musty	124	51	55	85	71	77
	Petrol/Diesel	11	9	2	19	14	11
	Other taste or odour	314	294	253	384	127	274
	Appearance Total	2,074	2,194	1,812	1,702	1,588	1,874
	Taste/Odour Total	749	635	661	802	643	698
	DWI Taste/odour/appearance	2,823	2,829	2,473	2,504	2,231	2,572

Source: Bristol Water SoC, Table 136.

Bristol Water cross-industry service performance data provided to customers during research phase

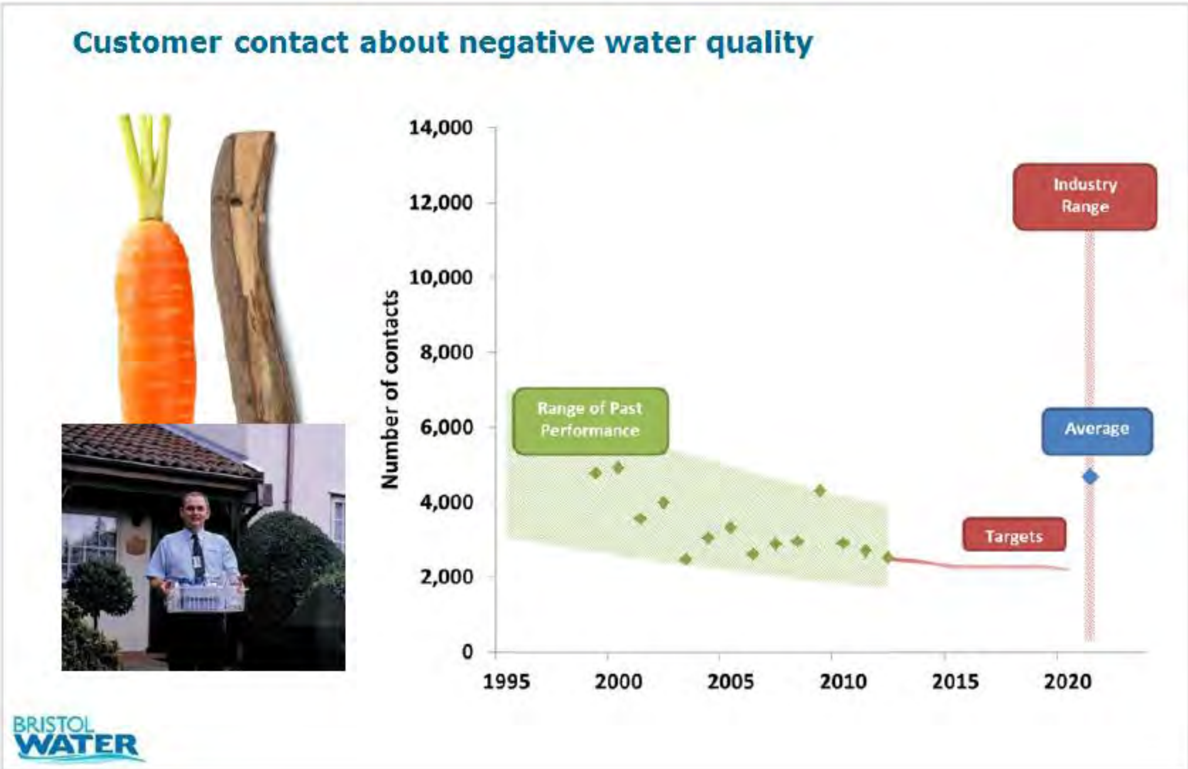
72. Bristol Water provided the following relevant material to its customers when it was conducting its ODI research.

Figure 12: ODIs information provided to customers

Measure	Current Bristol Water Performance	Industry Position	Industry Average
 *Interruptions to supply*	21 minutes per property per year	10th out of 21	20 minutes per property per year
 *Complaints about discoloured water*	1,577 per year	13th out of 21	2,201 per year
 *Leakage*	18% (43.1Ml/d)	10th out of 21	20%
 *Carbon Dioxide emissions (from electricity used to pump water)*	435 Kg/Ml *(N.B. Hilly terrain)*	18th out of 21	346 Kg/Ml

Source: Bristol Water response, Figure 12.

Figure 13: Negative water quality contacts information provided to customers

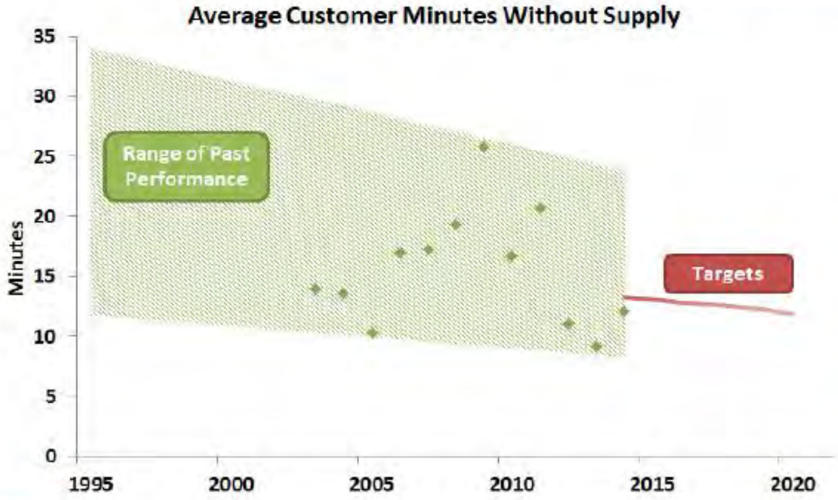


Source: Bristol Water response, Figure 13.

Figure 14: Interruptions to supply information provided to customers

Average customer minutes without supply due to an unplanned interruption to the supply (minutes per customer per year)

Current Performance	2020 Target	Industry Position	Industry Average
13.9	12.2	10th out of 21	21



BRISTOL WATER

Source: Bristol Water response, Figure 16.

Cost of capital

1. The following appendix provides additional details and calculations made when estimating a reasonable level for Bristol Water's cost of capital and supports the reasoning set out in Section 10.

2. The rest of this appendix follows the following structure:

   (a) Inflation estimates.

   (b) Bristol Water actual debt costs and adjustments.

   (c) Issuance costs and cash holding.

   (d) Ofwat's customer benefits test.

   (e) New debt costs.

   (f) Market-based asset beta analysis.

   (g) Bristol Water beta uplift.

   (h) Implied asset beta range.

   (i) Risk-free rate market data analysis.

   (j) Wholesale-Appointee adjustment.

Inflation estimates

3. Bristol Water calculated the rate of inflation by using the difference between nominal and index-linked government bonds, based on five-year bonds, as this was the length of the price control period. Over the first two weeks of January 2015, Bristol Water states that this was 2.46%.[1] Subsequently, Bristol Water has stated that the best estimate for the five-year period is the updated OBR forecast of 2.4%.[2]

4. Ofwat stated that its RPI assumption, which was 2.80%, was based on a number of factors, including historical implications of ten-year government bonds, OBR forecasts, and yield differences between ten-year nominal and

[1] Bristol Water SoC, paragraph 1722.
[2] Bristol Water response to our provisional findings, paragraph 810.

index-linked government bonds (accounting for inflation risk).[3] It considered that using a longer period is more reliable, consistent with minimising regulatory uncertainty, and more accurately reflects prices of fixed rate bonds as they include inflation expectations. Ofwat subsequently stated that 2.8% was a conservative estimate from the market evidence available.[4]

5. We noted that the large difference in RPI estimates stated by Ofwat and Bristol Water was primarily due to the different time periods which these applied to (Bristol Water supporting a five-year estimate, and Ofwat a longer term estimate), rather than a difference in figures for a particular time period.

6. For our provisional findings, we considered that an RPI assumption of 2.6% was appropriate drawing on five- to ten-year market data.[5] Following additional representation, we refined this by considering the specific calculation for which RPI is being used, and the associated estimates for that time period. These figures are discussed in the relevant sections.

7. In converting nominal figures to real, we applied the Fisher formula (real = (nominal + 1) / (inflation + 1) – 1).[6]

Bristol Water actual debt costs and adjustments

8. Based on the evidence Bristol Water presented in its SoC, its statutory accounts, supporting KPMG documents, and responses to our provisional findings, we built a more granular table of Bristol Water embedded debt and its associated characteristics. The basic figures (before any adjustments) are presented in Table 1 below.

9. The table includes a reconciliation back to the figures presented in Bristol Water's SoC. In presenting this, we noted that the nominal (and corresponding real) rate on debt classified as 'variable' appeared slightly higher than that stated by Bristol Water (1.34% vs 1.22%). This was likely due to Bristol Water having access to more up-to-date data on these types of debt; however, the effects on the overall cost of embedded debt were very small.

[3] December 2014, Final price control determination – risk and reward, p36.
[4] Ofwat response to our provisional findings, paragraph 192.
[5] Provisional Findings, Appendix 10.1, paragraph 13.
[6] This differed from Bristol Water's approach in its SoC, where it subtracted the inflation figure, and hence resulted in slightly different estimates for real yields.

Table 1: Analysis of Bristol Water embedded debt costs

	Bristol Water class	*Issuance*	*Maturity*	*Value at December 2014 (£m)*	*% Nominal cash interest rate*	*% Real interest rate (Bristol Water assumptions)**	*% Real interest rate (CMA assumptions)†*
Artesian bond index-linked	IL	2003-05	2032	91.1	3.64	3.64	3.64
Indexation of Artesian	IL	N/A	2032	34.6	3.64	3.64	3.64
Bond index-linked	IL	2011	2041	44.8	2.70	2.70	2.70
Artesian bond fixed rate	Fixed	2003-04	2033	57.5	6.01	3.55	3.51
Bank loan fixed rate	Fixed	2008	2017	10.0	5.73	3.27	3.23
Preference shares	Fixed	1992	N/A	12.5	8.75	6.29	6.18
Debentures	Fixed	Various	Various	1.6	4.00	1.54	1.54
Bank loan fixed rate (FFL)	FFL	2014	2019	50.0	2.40	-0.06	–0.02
Bank debt floating rate	Variable	2008	2017	10.0	0.70	-0.40	–0.28
Finance leases fixed rate	Variable	Various	Various	2.6	3.80	2.70	2.79
	IL total	N/A	N/A	170.5	3.39	3.39	3.39
	Fixed total	N/A	N/A	81.6	6.36	3.90	3.85
	FFL total	N/A	N/A	50	2.40	-0.06	–0.02
	Variable total	N/A	N/A	12.6	1.34	0.24	0.35
	Total blended	N/A	N/A	314.7	3.92	2.85	2.85

*Assumes RPI of 2.46%, Libor is –1.1% compared to this, and applies a straight subtraction of inflation when converting from nominal to real.
†Assumes RPI of 2.42%, Libor is –0.9% compared to this (based on 5 year swap data since January 1 2015), and applies the Fisher formula for converting from nominal to real.
Note: IL refers to index-linked debt, and FFL refers to the Funding For Lending bank debt.
Source: Bristol Water SoC Table 114; KPMG assessment of embedded debt; Bristol Water 2014 annual accounts, pp85–97; CMA analysis.

10. We considered a number of potential adjustments in determining a suitable level of embedded debt costs for use in AMP6. Below, we discuss in more detail:

(a) differentials between coupon and yield;

(b) preference shares; and

(c) non-operational financing (eg financing of shareholder distributions).

Differentials between coupon and yield

11. Over the period when the Artesian bonds were issued by Bristol Water (2003-05), there was a decline in market interest rates. Under the approach taken to bond issuance, the coupon level (as a percentage of face value) was fixed, at 3.64% for index-linked bond issues, and 6.01% for nominal bond issues. Given that market yields had fallen below the coupon rates, the bonds were therefore sold at a premium of up to 14% (the size of premium depending on exact timing of each tranche). This resulted in a coupon rate which differed to the underlying yields on the bonds.

12. Bristol Water argued that in estimating the cost of embedded debt, it is more accurate to use the coupon rate rather than the yield at issuance.[7] It also stated that this is more consistent with regulatory precedent in both CC10 and NIE.[8]

13. Bristol Water also stated that if a yield at issuance estimate was to be used, it should include the associated costs of the Artesian bonds, as well as the premium received.[9]

14. Instead of a yield analysis, Bristol Water suggested that the use of amortisation of the premium over the life of the loan would be a superior approach.[10]

15. Bristol Water also stated that using the yield at issuance is incorrect for index-linked debt, since the associated cost of the indexation component would be the coupon rate rather than the yield at issuance of the original bond.[11]

16. Ofwat stated that the coupon for Artesian debt did not reflect the actual costs of this debt to Bristol Water. It also considered that amortising any premium

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[7] Bristol Water response to our provisional findings, paragraph 859.
[8] Bristol Water response to our provisional findings, paragraph 869.
[9] Bristol Water response to our provisional findings, paragraph 875.
[10] Bristol Water response to our provisional findings, paragraph 886.
[11] Bristol Water response to our provisional findings, paragraph 857.

was not the correct approach as the fact that the company received more debt than it had to repay reduced the effective interest rate rather than constituting a cash payment to be amortised over time. Ofwat stated that the reason that this may have been used previously is due to information asymmetry on Bristol Water's actual cost of debt, and a lack of understanding at the time.

17. We have estimated the difference between the coupon and average yield at issuance for each tranche of Artesian debt, as shown in Table 2 below; for index-linked Artesian bonds the yield was 3.13% (rather than the coupon of 3.64%) and for fixed rate Artesian bonds, it was 5.94% (rather than 6.01%).

Table 2: Yield at issuance calculations on Bristol Water's Artesian bonds (excluding cost of issuance)

	Term at issuance	*Coupon (%)*	*Par value (£m)*	*Price (index to 100)*	*Yield at issuance (%)*
1st tranche fixed rate	30.4	6.01	30.0	100	6.03
1st tranche index-linked	29.4	3.64	15.0	102	3.54
2nd tranche fixed rate	29.7	6.01	27.5	102	5.85
2nd tranche index-linked	28.7	3.64	26.0	105	3.33
3rd tranche index-linked	27.4	3.64	50.1	114	2.90
Index-linked total		3.64		109	3.13
Fixed total		6.01		101	5.94

Source: Bristol Water; CMA analysis.

18. We consider the yield approach remains the most appropriate method to use, and would accurately reflect the actual cost of the debt to Bristol Water, once the impact of premia have been included.

19. For example, consider a company which has a choice of issuing one of two 30-year bonds which have equivalent yields and equivalent face value of £100. Bond A has a coupon of 5% and a price of 100% of principal (face value). Bond B has a higher coupon of 11.5% and therefore a higher price of 200% of principal (face value). If the company needs to raise £200, it has a choice of issuing two Bond As or one Bond B. The financing costs should be the same as they are seen as equivalent yields by the market, yet the coupons (as a percentage of principal) will be very different. This illustrates that the coupon rate does not reflect the true costs of the debt when bonds are sold at a premium/discount.[12]

20. Amortising a premium on bonds is a potentially valid approach to estimating the impact of the premia on the Artesian bonds; however, we would consider this to be a simplified method to obtain a comparable result. This is because the act of accurately amortising the premium across the period of the loan

[12] This is because in the case of the higher premium, more investment is repaid during the period. In practice, the accounting approach to amortisation will normally be 'straight line' and therefore underestimate the effect.

(assuming the amortization principles match the market views) would reduce the coupon to the level of the yield.

21. This is supported by Bristol Water's own estimates for amortising the Artesian premia having a 0.1% impact on cost of debt.[13] This is comparable to the 0.17% impact we have calculated based on using yields at issuance (see Table 10.2 in Section 10).

22. Regarding the costs associated with the Artesian bonds, we have dealt with these separately, when assessing the issuance costs of debt. To include them in the yield analysis as well would have the effect of double-counting these elements, and result in an artificially inflated cost of debt.

23. We agreed with Bristol Water that the indexation component of the Artesian index-linked loans would incur costs equal to its coupon, rather than the yield at issuance. This is because there was no premium achieved on the indexation component, and hence the equivalent yield on this debt is equal to the stated coupon rate.

24. We have therefore continued to use the yields to represent the cost of Bristol Water's embedded debt for the fixed rate Artesian Debt, and £91.1 million of the Artesian index-linked debt (the principal amount as can be seen in Table 1), but are using the coupon rate on the £34.6 million indexation element of the Artesian index-linked debt.

Preference shares

25. Bristol Water's liabilities include £12.5 million worth of preference shares which were issued in 1992.

26. In response to our provisional findings, Bristol Water stated that the preference shares are closer to debt than equity. This was supported by KPMG analysis of the characteristics of preference shares and how they compared to both debt and equity. KPMG illustrated that preference shares have characteristics comparable to both, but concluded that they were more like debt than equity (as shown in Figure 1 below). Bristol Water stated that preference shares should be included in the calculation of embedded debt costs.[14]

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[13] Bristol Water response to our provisional findings, Table 27.
[14] Bristol Water response to our provisional findings, paragraph 915.

Figure 1: Characteristics of Bristol Water's preference shares compared with debt and equity

Feature	BW preference shares	Debt	Hybrid Securities	Equity
Claim	Conditional claim on cash flows and / or assets but not residual	Conditional claim on cash flows and / or assets of the firm	Usually limited, similar to equity	Owns residual cash flows after all other obligations are met
Maturity	BW shares are irredeemable	Typically fixed but examples of perpetual debt	Usually fixed but could convert into equity	Indefinite
Payments	Contracted, paid out of profits and cumulative—i.e., can be delayed but must be paid later	Contractual	Usually contractual but can be subject to special provisions	Residual
Conditions	Set ex ante by contract	Typically none or set by contract	Typically none or set by contract with conversion	Typically none due to control
Control	Conditional on non-payment; automatically acquire control rights only if in arrears	Conditional on non-payment; subject to bankruptcy process	Depends on security, can gain control rights in certain cases	Typically full control rights
Tax	Not tax deductible	Tax deductible	Depends on security	Not tax deductible
Risk	Shows limited systematic risk	Largely default risk plus recovery	Depends on security	Equity risk premium
Default	Priority claim over equity, seniority determined by contract	Priority claim over equity, seniority determined by contract	Depends on security, can bear the risk similar to equity	Residual value only
Coupon	Fixed	Defined fixed or floating	Fixed or floating, might not be defined	Variable dividend
Convertible into ordinary shares?	No	No	Depends on security	n/a

Similar to BW preference shares
Closest to BW preference shares

Source: Bristol Water.

27. As a 'hybrid instrument', preference shares are neither debt nor equity, as they exhibit a mixture of equity-like and debt-like characteristics. This is apparent from their inconsistent treatment within Bristol Water's financial reporting. For example, when stating headline net debt figures in its 2014 annual report, Bristol Water excluded preference shares from its

calculations.[15] However, they are included within the 'debt' category within regulatory accounts.[16]

28. It is for Bristol Water to determine its actual financial structure, and whether to include additional types of finance such as preference shares, which are neither debt nor equity. However, our WACC is based on a simple capital structure, with 62.5% of debt, and 37.5% of equity. As discussed in paragraphs 10.93 to 10.98 (Section 10), when assessing the cost of the investment-grade senior debt issued by Bristol Water, preference shares would be excluded.

29. This approach is consistent with the treatment of preference shares in CC10 in which they were excluded from consideration of the cost of embedded debt,[17] as well as when considering financeability.[18]

Non-operational financing

30. Bristol Water stated that it had previously made a £68.5 million loan to its holding company.[19] In its assessment of embedded debt, KPMG highlighted that the source of this was £57.5 million of fixed rate Artesian loans which had been combined with £11 million of other funds.

31. Bristol Water stated that making an adjustment for shareholder returns is inappropriate as it has been made as a result of an unduly narrow perspective on the issue. It also argued that the proceeds of the Artesian debt were used for operational purposes.

32. Based on the evidence provided by Bristol Water and KPMG, Bristol Water paid out higher than average dividends in 2002-03 and 2003-04, which was largely funded from the Artesian issuances.

33. Table 3 shows KPMG's evidence of Bristol Water's dividend yield (treating the deduction for the parent loan we made at provisional findings as a distribution). We note that this deduction was only around 40% of the loan made to the parent company.

[15] Bristol Water 2014 annual accounts, p31.
[16] Bristol Water response to our provisional findings, paragraph 912.
[17] CC10, Appendix N, Table 1 on pN56.
[18] CC10, Appendix O, footnote 11 on pO5.
[19] Bristol Water reply, Appendix 1, Table 3.

Table 3: Dividend yield during AMP3 and AMP4, treating the CMA's deduction for the parent loan as a distribution

%

	2000-01	*2001-02*	***2002-03***	***2003-04***	*2004-05*	*2005-06*	*2006-07*	*2007-08*	*2008-09*	*2009-10*	*Average*
Bristol Water	3.8	4.0	**9.6**	**15.1**	3.6	4.4	2.4	4.3	3.1	3.7	5.4
WoCs average*	4.4	4.4	**5.7**	**4.0**	5.7	4.4	5.7	4.1	3.2	9.8	5.1

Source: Bristol Water, emphasis added by the CMA.
*Excluding Bristol Water.

34. We note that KPMG's analysis understates the scale of the distributions to Bristol Water's parent during 2003-05 as it excludes the remainder of the quantum of the loan. However, at the levels within Table 3, KPMG's analysis demonstrates that Bristol Water's shareholder distributions were greater than average during this period, when interest rates were relatively high.

35. Ofwat considered that Bristol Water used the Artesian debt to make a loan to its parent company, and was used to fund higher dividends, which is not an operational use of funds. It also argues that the CMA should consider excluding all of the parent loan.

36. Bristol Water's funding is generally fungible, ie there is no obligation on Bristol Water to use particular funds for specified purposes. In that context, whether the specific cash used from the Artesian debt was used for operational purposes is not the only relevant consideration. The Artesian loans resulted in a substantial increase in gearing to above even the current notional level of 62.5% in 2004, as can be seen in Bristol Water's own evidence.[20] At the same time, Bristol Water made a loan to its parent company to facilitate a payment to shareholders. These funds were therefore unavailable for operational costs, and we considered that it may be appropriate to remove them from Bristol Water's cost of debt.

37. While we considered it appropriate for Bristol Water to pay a reasonable dividend to its investors, the choice of timing and quantum paid were a decision for management to balance. We would not however expect customers to be expected to manage any increase in risk as a result of a particular policy for shareholder distributions. Bristol Water's financing policy has resulted in it incurring relatively high cost on these debt issues.

38. However, Bristol Water's current gearing level is not substantially above the notional level of 62.5%. We also noted Bristol Water's evidence that prior to the introduction of Artesian debt, WoCs found it hard to secure long term debt.

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[20] Bristol Water response to our provisional findings, Figure 19.

39. This could imply that Bristol Water's level of debt is appropriate, much of which was taken out as a 'catch-up' through the Artesian issuances. Therefore, excluding this could be penalising Bristol Water for reasonable behaviour.

40. In considering the effect of Bristol Water's approach to financing, we considered the correct counterfactual position to be one in which a lower quantum of Artesian debt was incurred. We therefore considered a range of actual embedded debt costs to include two options:

(a) Do not exclude any debt which was used to finance intercompany loans.

(b) Exclude £23 million of the fixed rate Artesian loans (total of £57.5 million) assumed to fund intercompany loans. This has the effect of degearing Bristol Water to the 62.5% notional level set by Ofwat.[21]

41. Ofwat said that the regulatory accounts implied that index-linked Artesian debt was used to finance the parent company loans rather than the fixed rate issuances. Although this would expose the regulated entity to a greater risk of interest movements since the loan was not made on a 'back-to-back' basis,[22] it would not have a major impact on our assessment of embedded cost (as can be seen in Table 4 below).

Impact of changes on Bristol Water's actual embedded debt costs

42. Table 4 shows Bristol Water's embedded debt costs recalculated based on our considerations as outlined in paragraphs 11 to 41. This approach indicated a blended real cash interest rate of 2.47 to 2.54%.

[21] 68% gearing currently on an RCV of £411 million implies a reduction to 62.5% gearing: 5.5% x 411 = about £23 million; Bristol Water's 2014 annual accounts, p1. This excludes the latest FFL bank loan and Bristol Water's preference shares.

[22] Artesian fixed rate loan interest payable of 6.01%, whilst the parent company loans have an average of 5.888%. Using index-linked debt would result in the possibility of larger differences; Ofwat response, paragraph 311.

Table 4: Updated Bristol Water actual embedded debt costs

	Bristol Water Class	*Issuance*	*Maturity*	*Value (£m)*	*Nominal cash interest rate (%)*	*Real cash interest rate (including adjustments) (%)*
Artesian bond index-linked	IL	2003-05	2032	91.1	3.13	3.13
Indexation of Artesian	IL	N/A	2032	34.6	3.64	3.64
Bond index-linked	IL	2011	2041	44.8	2.70	2.70
Artesian bond fixed rate	Fixed	2003-04	2033	34.8–57.5	5.94	3.44
Bank loan fixed rate	Fixed	2008	2017	10.0	5.73	3.23
Preference shares	Fixed	1992	N/A	N/A	N/A	N/A
Debentures	Fixed	Various	Various	1.6	4.00	1.54
Bank loan fixed rate (FFL)	FFL	2014	2019	50.0	2.40	–0.02
Bank debt floating rate	Variable	2008	2017	10.0	0.70	–0.28
Finance leases fixed rate	Variable	Various	Various	2.6	3.80	2.79
	IL total	N/A	N/A	170.5	3.12	3.12
	Fixed total	N/A	N/A	46.1–69.1	5.83–5.87	3.33–3.37
	FFL total	N/A	N/A	50	2.40	–0.02
	Variable total	N/A	N/A	12.6	1.34	0.36
	Total blended	N/A	N/A	279.5–302.2	3.36–3.55	2.47–2.54

Source: CMA analysis.

Issuance costs and cash holding

43. Companies incur additional costs from issuing debt, beyond the base interest payments.

44. The largest of these costs are associated with issuing the debt (eg fees of the investments banks which organised the issuance), and the ongoing costs from not breaching any covenants of the debt (eg holding cash, or retaining sufficient undrawn lending facilities).

45. Bristol Water stated that 0.3% is a reasonable estimate for issuance and cash holding costs.[23] This is largely based on regulatory precedent, including the CAA (Gatwick and Heathrow) and CC (NIE).

46. CC10[24] and Ofwat in PR14[25] both allowed an addition of 0.1% for the issuance costs associated with debt. In response to our provisional findings, Ofwat highlighted that PwC had found that the Artesian debt had issuance costs of 0.06%.

47. This figure was supported by Bristol Water's evidence on issuance costs following provisional findings, which estimated a cost (based on amortisation of the fees) of 0.12% for its debt instruments which includes shorter term bank

[23] Bristol Water response to our provisional findings, paragraph 959.
[24] CC10 Appendix N, paragraph 48.
[25] Ofwat FD14 Final price control: policy chapter A7 – risk and reward, p42, Table A7.10.

loans.[26] Bristol Water also stated it had been able to achieve 0.1% issuance costs through use of longer tenor debt (more than ten years).[27]

48. Therefore, we considered that an uplift of 0.1% for issuance costs remains appropriate for both actual and notional embedded debt costs, as well as for new debt, which we assume to have an expected tenor of ten years and over.

49. The implied cost of holding cash was estimated in CC10 to be 0.2%.[28] In PR14, Ofwat acknowledged that these costs could exist, but argued that an efficient treasury function can mitigate these, particularly at a time of low interest rates. Ofwat did not include the impact of lower cost short term floating rate debt in its estimation of the cost of debt.[29,30]

50. We considered that when assessing the actual embedded debt costs, it is necessary to include any implied costs from cash holding. However, a notional company has a number of ways to mitigate these costs, such as through use of short-term debt to act as a liquidity buffer. We therefore included a cash-holding cost in the actual company embedded debt cost estimate, but not for the notional company (either embedded or new debt).

51. For the actual company, we considered the available evidence on cash holding costs and liquidity facilities and set this out in turn:[31]

(a) Bristol Water stated that under its covenants it needs to hold approximately £12 million of cash with a nominal debt cost of 5.7%, resulting in 0.2% costs.[32]

(b) This marginal debt cost is very high compared to the actual costs associated with raising short-term cash. The most recent FFL bank loan was at 2.7% (nominal), which would result in costs of 0.1%.

(c) S&P stated that the cash holding requirements for the Artesian bonds (which Bristol Water highlighted as having particularly stringent cash holding requirements) was £5.7 million. Given this, and using Bristol Water's marginal rate of 5.7%, indicates a cash holding cost of 0.1%.

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[26] Amortisation of IL bond costs, bank loan arrangement costs, and artesian costs; Bristol Water response to our provisional findings, Table 27.
[27] Bristol Water response to our provisional findings, paragraph 956.
[28] CC10, Appendix N, paragraph 48 and footnote 20.
[29] PwC company specific uplift analysis, p22.
[30] Jan 2014, Setting price controls for 2015-20 – risk and reward guidance, p21, footnote 23.
[31] This was because Bristol Water had the option of either holding cash against these bonds, or utilising a liquidity facility to effectively provide the additional cash required.
[32] Bristol Water SoC, paragraph 1678.

(d) Bristol Water stated that the cost for its liquidity facility (up to £70 million of undrawn debt) is 0.08%.[33]

52. We considered the evidence outlined above was consistent with an estimated cost of 0.1 to 0.2% for actual embedded cash holding costs of debt for Bristol Water, which we considered appropriate.

53. This resulted in an overall uplift in 0.2 to 0.3% for issuance and cash holding costs on Bristol Water's actual embedded debt, which is similar to the level suggested by Bristol Water (0.3%).

Ofwat's customer benefits test

54. In PR14, Ofwat determined that smaller companies have a higher cost of debt than larger companies, but introduced a new customer benefits test before allowing the company in question to recover these higher costs from customers. This had the effect of disallowing the higher financing costs of some small companies.

55. Specifically, Ofwat considered how, if no uplift in WACC was awarded, this would impact:[34]

(a) the likelihood of a merger occurring;

(b) whether mergers which removed a comparator would result in weaker efficiency challenges;

(c) whether mergers which removed a comparator would result in weaker service level challenges; and

(d) implied reduction in financing costs from not requiring an SCP.

56. Ofwat allowed two companies (Portsmouth Water and Sembcorp Bournemouth) a 0.15% increase in WACC (equivalent to a 0.25% increase in the cost of debt), but did not allow this for any other company, including Bristol Water.[35]

57. The most substantive quantitative factor in Ofwat's assessment was an estimate of the implied costs associated with losing a specific company as a wholesale benchmark. This was based on the likelihood of the company being in the top efficiency quartile (and hence included in the efficiency

[33] Bristol Water response to our provisional findings, Table 27.
[34] December 2014, Final price control determination – risk and reward, p49.
[35] December 2014, Final price control determination – risk and reward, p49.

benchmarks) and the associated impact of removing them. On top of this, the implications of the loss of comparators for SIM (quantitatively assessed) and ODI (qualitatively assessed) were also included in the assessment.[36]

58. Ofwat's approach will result in some companies, in particular very small companies, being in a position where their notional cost of efficient finance, is higher than Ofwat's assumption. If the notional company is based on a total industry average, the resulting cost of debt could be perceived as too low for these very small companies, which could be perceived as being potentially inconsistent with its financing duty.

59. Table 5 presents the outcome of Ofwat's customer benefits test, which resulted in four of the six companies in question being disallowed an SCP.

Table 5: Ofwat final customer benefits test for company-specific uplift

Impact (£m, 20-yr NPV)

		BRL	*DVW*	*PRT*	*SBW*	*SES*	*SSC*
Wholesale costs benchmark		–19 to –10	–11 to –6	7 to 15	4 to 8	–7 to –4	–4 to –2
SIM		1 to 3	–2 to –1	–0 to –0	2 to 4	1 to 1	2 to 4
ODIs	WQC*	×	×	✓	✓	✓	×
	MZC†	✓	×	×	✓	✓	×
	WSI‡	×	✓	✓	✓	×	×
Comparator benefits		–18 to –7	–13 to –7	7 to 15	6 to 12	–6 to –3	0 to 0
Increased financing cost		–13	–2	–4	-4	–6	–9
Net benefits		–29 to –21	–16 to –9	4 to 11	2 to 8	–12 to –9	–9 to –9

Source: December 2014, Final determination annex 3 – benefits assessment of an uplift on the cost of capital, Table A7A.19 (p49).
*Negative water quality contacts.
†Mean zonal compliance.
‡Water supply interruptions.
Notes:
1. Figures may not add due to rounding.
2. The six companies in order are Bristol Water; Dee Valley Water, Portsmouth Water, Sembcorp Bournemouth Water, Sutton & East Surrey Water and South Staffordshire Water.

60. In response to our provisional findings, Ofwat stated that it considered the customer benefits test to be consistent with its Finance Duty. This is because it assessed all the small companies (including those which were disallowed an uplift in debt costs) as being financeable.[37] We have some concerns with the principle of assuming a WACC level which is beyond the reasonable efficient level which management could expect to be able to directly achieve.

[36] December 2014, Final determination annex 3 – benefits assessment of an uplift on the cost of capital, pp22–47.
[37] Ofwat response to our provisional findings, paragraph 183.

New debt costs

Appropriate time period

61. In estimating the cost of new debt, we make an estimate of the likely future rates, based on their historical levels. Bristol Water raised concerns that the use of shorter term (six-month) historical gilt rate averages is inconsistent with using longer periods in other aspects of the cost of capital estimation.[38,39]

62. We did not consider it necessary to use a single time period in the different components of cost of capital estimation, since the different components are by their nature dependent on different time periods. For example, it may be appropriate to consider the last ten years for embedded debt (since much of it was incurred over that period), but much more recent data for new debt as this would best reflect the latest market conditions which the company is operating under.

63. When estimating the cost of new debt, using more recent data is the preferred approach, since this will reflect the most recent market conditions and expectations. However, we agreed that using a very short period of data may capture temporary distortions which would unduly influence the estimated forecasts.

64. Figures 2 and 3 below show how the rates have changed for the iBoxx and forward gilts since January 2005.

Figure 2: iBoxx A and BBB yield since January 2005

Source: CMA analysis.

[38] Bristol Water response to our provisional findings, section 8.3.2.2.1.
[39] Although not specifically mentioned by Bristol Water, we note that a similar question around reasonable time period could be raise for the iBoxx index.

Figure 3: Forward 20-year gilt rates since January 2005

Source: CMA analysis.

65. Bristol Water specifically supported using two years of historical data in estimating these figures. We have considered the mean values over periods up to the last two years, as below shown in Table 6 below.

Table 6: Historical mean iBoxx A/BBB and forward gilt rates over different periods

		%
	iBoxx A/BBB (nominal)	*Forward gilts (real)*
Current (31/08/2015)	4.18	–0.79
6 months	3.90	–0.71
1 year	3.93	–0.59
2 years	4.29	–0.16

Source: Markit, Bank of England yield curves.

66. Both sets of data indicate decreases over the past two years, which is consistent with the longer-term trends seen in Figures 2 and 3. However, there does appear to have been a certain degree of volatility recently which could represent short-term distortions (eg recent stock market losses in China).

67. We therefore consider it appropriate to use a short historical average (rather than simply the current rate), and judged that a one-year average should have been sufficient to remove the effects of short-term distortions, whilst still reflecting the up to date market views.

Analysis of relevant period

68. As discussed in paragraph 67, we consider that the one year average iBoxx is an appropriate time period to use, which results in a nominal range of 3.81% to 4.05% based on A and BBB-rated debt, consistent with the credit rating assumption generally used for a notional regulated company.

69. We consider that the use of both A and BBB-rated debt is consistent with setting a cost of debt for a notional company, particularly given our subsequent consideration of any need for a small company premium. Otherwise there is a risk of double-counting the benefits of this uplift.

70. RPI was used to convert the nominal 10+ years iBoxx A/BBB yields to their real equivalents in estimating the real cost of new debt. We have converted these using a ten-year RPI estimate. This represents the estimate of the RPI which is 'priced in' to ten-year yields by the market. Applying the ten-year RPI estimate of 2.7%[40] results in an equivalent real range of 1.1% to 1.3%.

71. Ofwat allowed a 0.60% increase on these yields to reflect market expectations of base rate rises. However, these expectations appear to have dropped substantially since the FD14 analysis was completed. Table 7 below shows an updated analysis of the future trends work completed by PwC which supported Ofwat's approach.

Table 7: Market expectations of base rate rises

%

	2015			*2016*				*2017*				*2018*		
	Q2	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*	*Q4*	*Q1*	*Q2*	*Q3*
November 2013 report*	0.7	0.8	1.0	1.1	1.3	1.5	1.7	n/a	n/a	n/a	n/a	n/a	n/a	n/a
November 2014 report†	0.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.6	1.7	1.7	n/a	n/a	n/a
August 2015 report‡	0.5	0.5	0.5	0.6	0.7	0.9	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.7

Source: Bank of England inflation reports, PwC.
*Time of Ofwat guidance.
†Time of Ofwat FD14.
‡Most recent.

72. In response to our provisional findings, Ofwat stated that the increase in corporate bonds is unlikely to completely follow the increase in government bonds, and there is a risk of an allowance being overstated. It also highlighted the CC's decision in NIE not to include a forward-looking adjustment as it considered that the company could take advantage of the prevailing low debt costs.

73. Ofwat also stated that a reduction of the uplift to 0.25% would be consistent with the increase in forward real gilt yields to the end of 2017.

74. Bristol Water stated that the latest revisions could represent a delay rather than a fundamental change in future levels.[41] It also referenced KPMG

[40] Difference in nominal and real spot curves over past two years (2.99%) based on BoE yield curves, and applying a 0.3% reduction due to inflation risk premium on ten-year gilts; BoE quarterly bulletin 2012, Q3, Volume 52, number 3.
[41] Bristol Water response to our provisional findings, paragraphs 932 & 933.

analysis that compared the change from Q2 2015 to the latest projection available, stating that this has not significantly changed.[42] KPMG also stated that the difference between spot yields and forward rates (to the middle of AMP6) on ten-year gilts (0.52%) would imply a higher size of uplift.

75. We consider that the evidence shows that the projections of base rates remain lower for substantially longer than expected at the time of Ofwat's determination, with projected rates at just over half the level for 2016 (the latest dates available to Ofwat at the time it originally assessed this impact). As highlighted by KPMG, 2018 data is now available and does suggest that rates will increase at some point within AMP6 towards the levels projected during PR14. However, the increase is expected to occur over a longer period. This would result in a projected lower average interest rate environment for AMP6, and hence a reduction in the forward-looking allowance is appropriate.

76. Taken together, relative to our provisional findings which assumed a 0.3% uplift to our estimate of current yields, the market evidence could indicate either an increase or decrease in the scale of this uplift. On balance, we consider that providing an allowed uplift for expected base rate rises to 0.3% appears appropriate and prudent. This resulted in an implied range of 1.4 to 1.6%.

77. Consistent with our approach to embedded debt, we considered the need for a small company premium. As noted in paragraph 10.66, WoCs have previously issued at rates equivalent to 0.11% above the iBoxx, and a comparable uplift would be appropriate here. We would also include issuance costs of 0.1% to give an implied rate of new debt of 1.6 to 1.8%.

78. We compared this iBoxx data to evidence on WoC premia to real gilt rates. Our analysis of the estimated gilt rate costs (based on 20-year real gilts) implied a rate of –0.59% as an average over the past year.[43]

79. As noted above, Bristol Water provided evidence that the expected spread of a WoC was 1.62 to 2.1% above the gilt rate (excluding issuance costs). From this it picked a point estimate of 1.75%, which appears reasonable.[44]

80. Following provisional findings, Bristol Water stated that its estimated spread was based on the cost of fixed rate debt, and that index-linked debt was

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[42] At provisional findings, the latest projection was 1.4% in Q2 2018.
[43] Forward rates calculated based on average yield difference between 2.5-5 and 22.5-25 year real gilt rates (to give 20-year estimates); Bank of England, Daily GLC Real, average from 31 July 2014 to 31 July 2015.
[44] Bristol Water SoC, paragraphs 1672–1673.

usually 0.2% higher, indicating a total spread of 1.95% (for example, the spread on Bristol Water's own index-linked bond in 2011 was 2%).[45]

81. Ofwat stated that it was not clear why an uplift should be provided for index-linked debt relative to fixed rate debt, or why a single index-linked bond issuance would be considered robust evidence. It also noted that Bristol Water's estimated spread included comparator bonds which were two grades lower in credit rating, resulting in an overestimate of the spread required.[46]

82. We would consider that both of these arguments have a degree of merit, and the effects would act to offset one another. We have therefore retained Bristol Water's original estimates for the spread. Including issuance costs of 0.1% in addition to this resulted in a cost of new debt in the range of 1.15 to 1.6%.

Market-based asset beta analysis

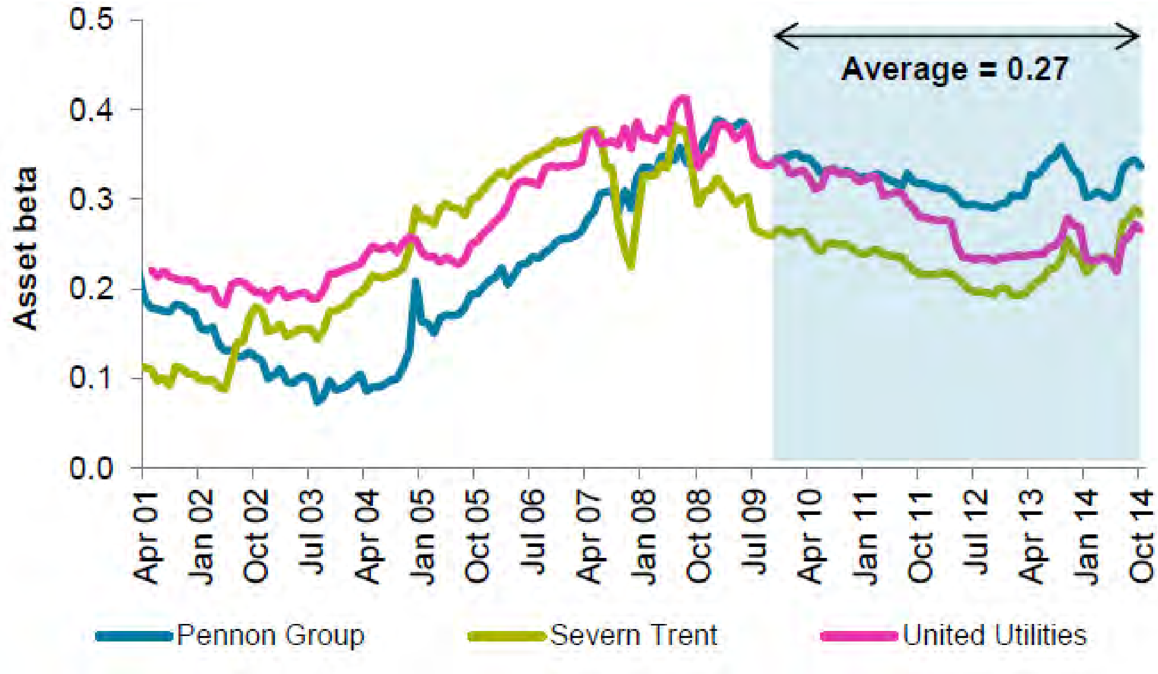
83. Bristol Water's beta is not observable (as its shares are not publically traded), and therefore we followed regulatory precedent in taking the starting point for estimation as the quoted water companies. We then considered the need to adjust this observed evidence to reflect any differences in systematic risk between Bristol Water and these comparators. Both Ofwat and Bristol Water agree that FD14 fairly estimated the beta of the comparators.[47]

84. Ofwat noted that the recent evidence is consistent with a range of 0.2 to 0.3. It also compared to other regulated industry betas, which indicated a range of 0.27 to 0.46.[48] On this basis, it concluded that the top end of this range (0.3) represented a reasonable asset beta.

85. Ofwat conducted market analysis based on monthly sampling over five years and weekly sampling over two years which are shown in Figures 4 and 5 below.

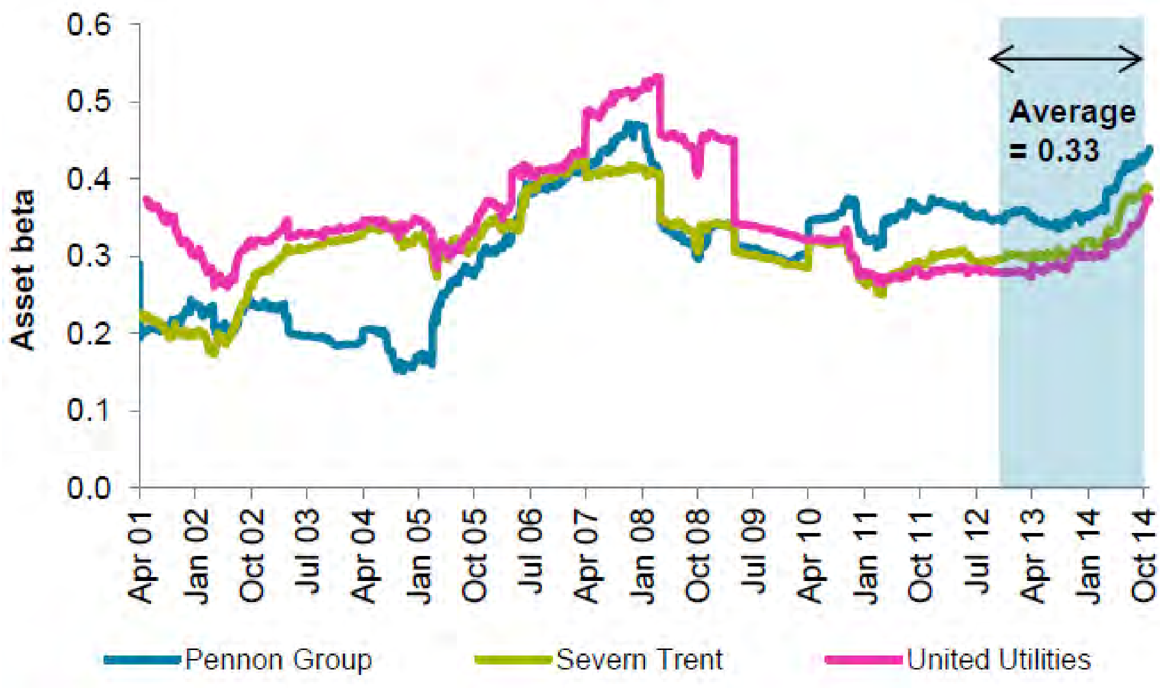
[45] Bristol Water response to our provisional findings, paragraphs 952–953.
[46] Ofwat response to our provisional findings, paragraph 205.
[47] We have not included Dee Valley in the analysis of water companies' beta as due to its small size and associated illiquidity, we are concerned with the level of potential error in estimating its asset beta.
[48] Ofwat Risk and Reward Guidance, January 2014, pp17–18.

Figure 4: Ofwat beta estimates using monthly sampling over five years



Source: Ofwat risk and reward final determination notice (December 2014), Figure A7.2.

Figure 5: Ofwat beta estimates using daily sampling over two years

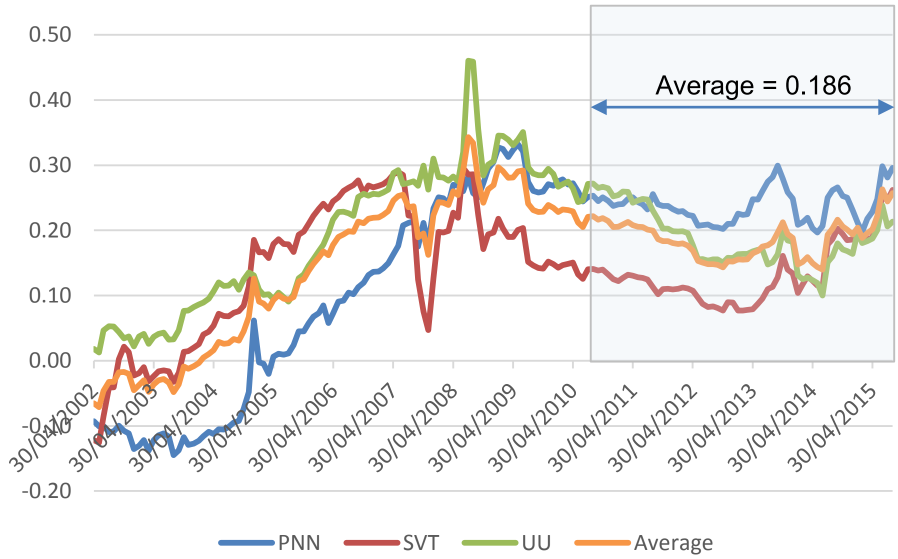


Source: Ofwat risk and reward final determination notice (December 2014), Figure A7.3.

86. We have used the latest data to calculate the mean average beta values for the three public comparators (Pennon Group, Severn Trent, and United Utilities), using a range of sampling frequencies and periods, examples of which are presented in Figures 6 and 7 below. In doing so, we have not

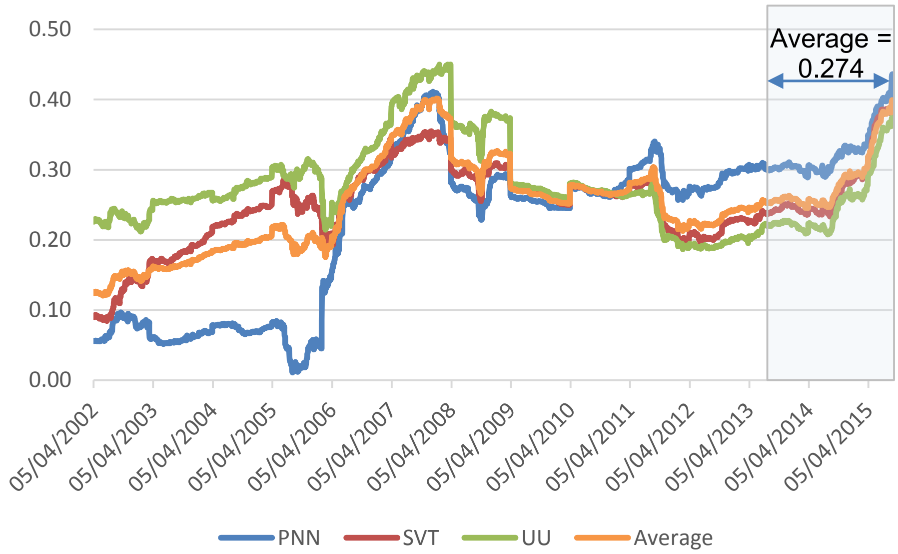
applied a Blume adjustment[49] (unlike Ofwat) since, as in CC10, we do not consider that the evidence suggests that water companies' equity betas will converge to one from their current levels (nor would one necessarily expect this for regulated companies).

Figure 6: CMA beta estimates using monthly sampling over five years



Source: CMA analysis, Bloomberg.

Figure 7: CMA beta estimates using daily sampling over two years



Source: CMA analysis, Bloomberg.

[49] A Blume adjustment is an attempt to adjust for forecast future betas based on historical observations. Blume observed that over time, betas tended to converge towards '1'. Therefore he made the empirical estimate of weighting up future betas based on the following equation: $\beta_{future} = 0.6667 \times \beta_{past} + 0.3333$.

87. In estimating the asset beta for public water companies, we placed weight on a range of sampling frequencies (including daily, weekly, and monthly) and time periods (from latest day, to five-year average).

88. Regarding sampling frequency, Bristol Water supported the use of higher frequency (daily and weekly) based on arguments that the monthly data has lower r-squared, as well as following precedent from CC10 and NIE.[50]

89. On the other hand, Ofwat stated that the lower frequency sampling (such as monthly and quarterly) was more in line with the most recent CMA precedent in the energy market investigation, and referencing academic literature.[51]

90. We were aware that the choice of sampling frequency when estimating an observable asset beta remains a matter of some debate amongst regulators as well as academic literature.[52]

91. We also noted that some of the academic literature supporting the use of lower sampling frequencies stated that high frequency beta estimates may be biased downwards compared to low frequency betas,[53] which does not appear to be the case here. Meanwhile, the lower r-squared values of these long sampling frequencies which Bristol Water highlighted are a result of having fewer observations, rather than these observations being less accurate themselves.

92. In the context of estimating a cost of capital for Bristol Water, we considered that the most appropriate method was to consider the range of evidence available from the different sampling frequencies. We subsequently refined this through the removal of outlying data points. We did not use quarterly betas in this review as a result of the evidence that betas have not been stable over the period, which casts doubt on the reliability of this data for the WaSC comparators.

93. Regarding time periods, Ofwat highlighted that CC10 considered asset beta averages up to ten years previously,[54] while Bristol Water stated that it would

[50] Bristol Water response to our provisional findings, paragraphs 993–995.
[51] Ofwat response to our provisional findings, paragraph 212.
[52] For example, Ofwat based its PR14 decision on a combination of daily and monthly sampling; CEPA (on behalf of the ORR) relied exclusively on daily data; and CEPA (on behalf of the CAA) for Q6 primarily relied on daily data to make its decision, but also compared with weekly and monthly data; Gilbert et al support the use of monthly or quarterly sampling, as does Gregory et al.
[53] 'In general, low frequency betas should always be preferred to high frequency betas. If users still wish to use high frequency betas in their analysis, then it is important to check whether those high frequency beta estimates are being biased downwards by size and illiquidity factors'; In search of beta, Gregory, Hua and Tharyan, p18.
[54] Ofwat response to our provisional findings, paragraph 210.

be better to only reflect more the recent market betas (it suggested using data for the last two years).

94. Looking at the observed asset beta estimates over time in Figures 6 and 7, it appeared to have displayed a certain variability over time. Since CAPM is a single-period model, using an unsuitably long time period would risk introducing inconsistencies into the analysis. For example, this analysis would have spanned multiple AMPs with different regulatory frameworks.

95. On the other hand, over-reliance on short-term beta may be distorted by specific events, for example, any uncertainty associated with the price review process itself.

96. Therefore, we considered that an analysis which includes different timings up to five years remains the most appropriate periods of time to include in this analysis.

97. Bristol Water also commented that averaging of coefficients where the time series on which these coefficients are based overlap results in standard errors being biased downwards. It could also introduce an auto-correlation term which may lead to biased coefficients.[55] Ofwat highlighted that the source Bristol Water referenced in its own analysis stated 'it can be reasonable to use overlapping data when the goal is to predict a multi-period change'. Ofwat considered a five-year price control to be multiple periods, and using overlapping periods is reasonable.

98. We consider that the arguments presented above by Bristol Water and Ofwat demonstrate that different approaches have merit, and therefore support our views that the most robust method is to consider a number of sampling frequencies and periods when estimating the asset beta. This resulted in a series of asset beta estimates for the public comparators as shown in Table 8 below:

Table 8: Mean average beta of public WaSCs, to end August 2015

	Single day (28/08/2015)	*Last year*	*Last 2 years*	*Last 5 years*
2-year daily	0.397	0.299	0.274	0.270
2-year weekly	0.372	0.396	0.361	0.285
5-year weekly	0.297	0.279	0.269	0.304
5-year monthly	0.257	0.216	0.195	0.186

Source: CMA analysis, Bloomberg.

[55] Bristol Water response to our provisional findings, paragraph 1005.

99. The different frequency/sampling for large public water companies' betas gave a wide range of beta estimates of around 0.186 to 0.397. We noted that half the observations are within a narrow range of 0.27 to 0.3, which formed the basis for our estimated range for the asset beta.[56]

100. We noted that despite not applying a Blume adjustment (which would increase beta estimates), the asset beta range is similar to Ofwat. This is because:

(a) Ofwat's choice of sampling frequencies and periods as shown in its charts above appeared to have resulted in particularly low beta estimates (equivalent to 0.19 to 0.27 using our analysis);

(b) asset betas appeared to have increased since Ofwat's final determination; and

(c) Ofwat included the CC10 range (0.21 to 0.31) in its considerations.

Bristol Water beta uplift

101. The case for an uplift for Bristol Water was considered by the CC in 2010. The CC observed the following:

(a) Size alone did not support the need for an uplift. While there was theoretical evidence that small companies required a higher return on capital (such as the Fama-French model), there was insufficient evidence to show that small water companies had higher systematic risk.

(b) By contrast, operational gearing was relevant to the level of beta (at least in principle), and the evidence was that the smaller water companies, including Bristol Water, tended to have higher operational gearing.

(c) One measure for this, the proportion of operating cash flow to revenue, would support an uplift of 18% in the asset beta.

102. This uplift was considered as sufficient to cover any higher costs originating from illiquidity (from investing in smaller companies) as well as higher levels of systematic risk.[57] CC10 concluded that, on balance, there was sufficient evidence to allow an uplift to Bristol Water's beta. However, this decision was taken in the context of a determination where the CC's estimated cost of

[56] We also conducted this analysis based on an unweighted portfolio of the three public comparators and the results are very similar, with the same tightened range (0.27-0.3) of the middle observations.
[57] CC10, Appendix N, paragraph 137.

capital was significantly below that calculated by either Ofwat or Bristol Water.[58]

103. In PR14, Ofwat considered that WoCs faced similar levels of systematic risk to WaSCs, so no uplift in the asset beta was necessary.

104. Bristol Water stated that a high evidence hurdle is required to move away from the approach used in CC10.

Illiquidity

105. CC10 highlighted that treating Bristol Water as a stand-alone company meant it would be appropriate to take into account the relative cost of investing in small companies. It considered that there may be higher costs associated with investing in unquoted smaller companies than in larger ones, but that these were likely to be relatively small.[59]

106. No evidence has been presented that indicates that circumstances have changed and we did not separately identify any additional evidence that they had. In the context of the likely impact being small, we found the approach of considering any illiquidity uplift in the round with other potential uplifts to be appropriate (as in CC10).[60]

Levels of operational gearing

107. We analysed a number of projected figures for operational gearing metrics based on Ofwat's FD14, which are presented in Table 9. We noted that all of these comparisons show that Bristol Water has higher operational gearing than the public comparators used in estimating beta.[61]

[58] CC10 stated that the CC considered that the arguments for a higher cost of equity due to small size in itself were weak. However, the CC saw merit in the argument that WoCs, including Bristol Water, had higher systematic risk than the WaSCs and therefore increased Bristol Water's asset beta by 18%. The CC noted that this was likely to overestimate the relevant effect, and it considered that the overestimate of this aspect should offset it not allowing explicitly for the transaction costs involved in buying and selling smaller companies. CC10, Appendix N, paragraphs 129 & 137.
[59] CC10, Appendix N, paragraphs 125–126.
[60] CC10 stated that the uplift calculated on operational gearing was likely to overestimate the relevant effect, and it considered that the overestimate of this aspect should offset the CC's decision not to allow explicitly for the transaction costs involved in buying and selling smaller companies. CC10, Appendix N, paragraph 137.
[61] Figures are taken from Ofwat's published company-specific appendices for each company.

Table 9: Operational gearing comparisons for Bristol Water and comparators (AMP6)

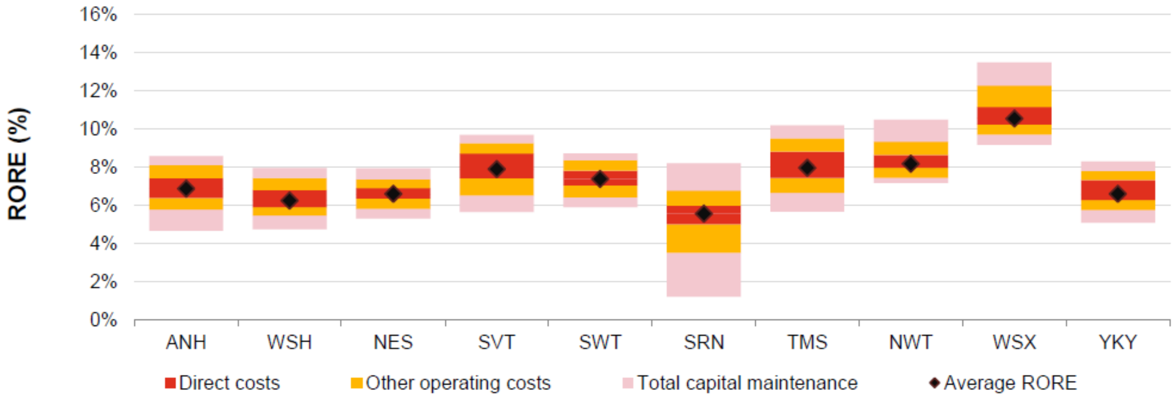
%

	Bristol Water	*Water company comparators**	*WoCs*	*WaSCs*
Totex to average RCV	100	62	94	63
Revenue to average RCV	103	79	108	78
Wholesale totex to wholesale average RCV	100	71	94	71
Wholesale revenue to wholesale average RCV	103	88	108	86
Operating cashflow as % of revenue	45	51	38	51

Source: CMA analysis of data from Ofwat Final Determination, company-specific appendices, Tables A2.9/2.10/2.11, A3.9/3.10, A5.1/5.2/6.2/7.3.
* Water company comparators are the three publically listed companies used in the asset market-based asset beta analysis.
Notes: Totex and Revenue (top two rows of table) figures used in these ratios include both wholesale water and wastewater figures, but excludes any retail controls. Operating cashflow (bottom row of table) represents the proportion of wholesale and wastewater revenue (excluding adjustments) which is made up of return on capital and RCV run-off.

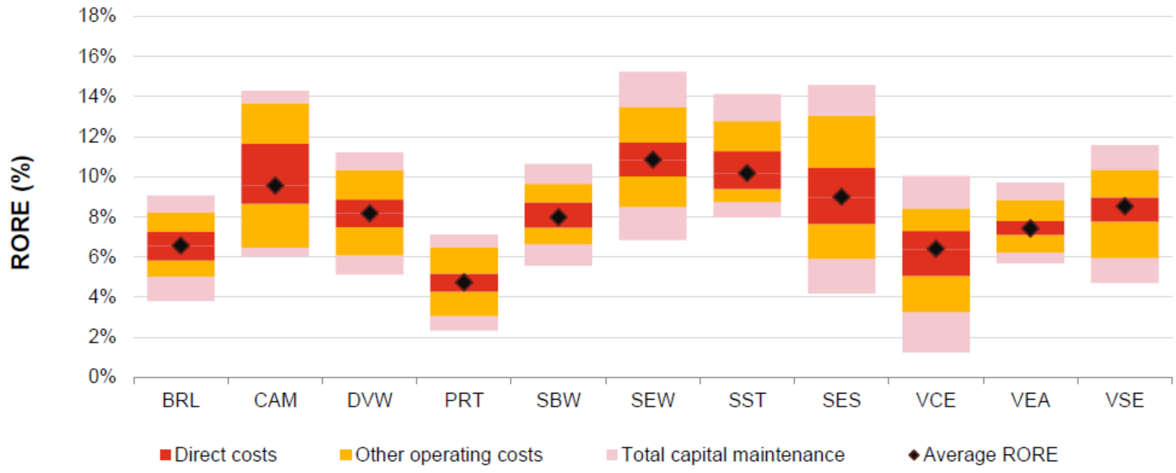
108. If WoCs have a higher operational gearing, it would be expected that this would result in wider fluctuations in observed returns over time. Figures 8 and 9 below show PwC's analysis of the historical returns made on regulated equity for WaSCs and WoCs respectively for 2001/02 to 2012/13.

Figure 8: WaSC historical RoRE



Source: PwC company specific adjustments to the WACC, Figure 9.

Figure 9: WoC historical RoRE



Source: PwC company specific adjustments to the WACC, Figure 10.

109. This analysis was consistent with the case made by Bristol Water and the approach assumed within CC10, which is that, on balance, the risks faced by WoCs tend to be higher than WaSCs.

110. The PwC analysis cannot be extrapolated directly to a single value for the differential within the asset beta. In practice, the asset beta will be influenced by a range of factors, of which operational gearing is only one.

111. The case against an uplift was made by PwC in its report for Ofwat.[62] PwC argued that there is no basis for an uplift, in part because the circumstances have changed since CC10. Additionally, Ofwat and PwC highlighted the following evidence:

(a) A comparison of RoRE based on estimates from forward-looking business plans. This analysis indicated that the pattern observed above was unlikely to continue into the future.

(b) Dee Valley's asset beta is not demonstrably higher than that of the public WaSCs.

(c) There is no theoretical link between higher operational gearing and a higher asset beta.

(d) WoCs have a level of financial gearing similar to (or even slightly higher than) the WaSCs. This was not true at the time of CC10 where WoCs had a 10% lower average financial gearing.[63]

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[62] PwC company specific adjustments to the WACC, August 2014.
[63] Ofwat response to our provisional findings, paragraph 225 & Table 10.

(e) MARs for WoCs tended to be higher than the corresponding figure for WaSCs, potentially indicating that investors do not perceive higher risk for WoC assets compared to WaSC assets.

112. We provide further analysis below on Ofwat's arguments: first that there should be no uplift; and second, that if there is an uplift, our approach does not correctly measure that uplift.

Theoretical arguments against an uplift

113. We noted Ofwat's points regarding the use of PwC's historical RoRE analysis as presented, including concerns around whether it is fit for the purpose of considering systematic risk as it was not originally designed for this. We accept that there are limitations on the use of this evidence. Nevertheless, it has some weight as an example of actual observed evidence.

114. By contrast, we considered that PwC's conclusion that Ofwat's forward-looking analysis indicated a different pattern into AMP6 was speculative. It appeared to us that the forward-looking estimates used by PwC had been heavily influenced by specific guidance from Ofwat regarding target values, and provide limited evidence in this respect.[64] We recognised the limitations associated with using the historical RoRE to assess systematic risk, and considered it insufficient for calculating an uplift figure from directly. However, we considered that it is still a valid piece of evidence supporting an asset beta uplift for Bristol Water and noted that PwC used it as such previously.[65]

115. Regarding Dee Valley's beta, due to intrinsic difficulties of estimating a beta for an illiquid share, and this representing a single data point, we were concerned with how much weight could be placed on this evidence. Also, as a single comparator, questions would remain about how well it would represent the wider group of WoCs and Bristol Water specifically.

116. We have also considered Ofwat's statements regarding the level of financial gearing for WoCs and WaSCs. The evidence which Ofwat provided on this is shown in Table 10 below.

[64] 'We expect a RoRE variance from base returns of +/- 3.5% to +/-4.5% or given an allowed cost of equity of 5.7%, a RoRE range between 2% to 10%'; Ofwat Risk and Reward Guidance, January 2014, p49.
[65] PwC company specific adjustments to the WACC, August 2014, pp32–33.

Table 10: Changes in financial gearing for WaSCs and WoCs, as stated by Ofwat

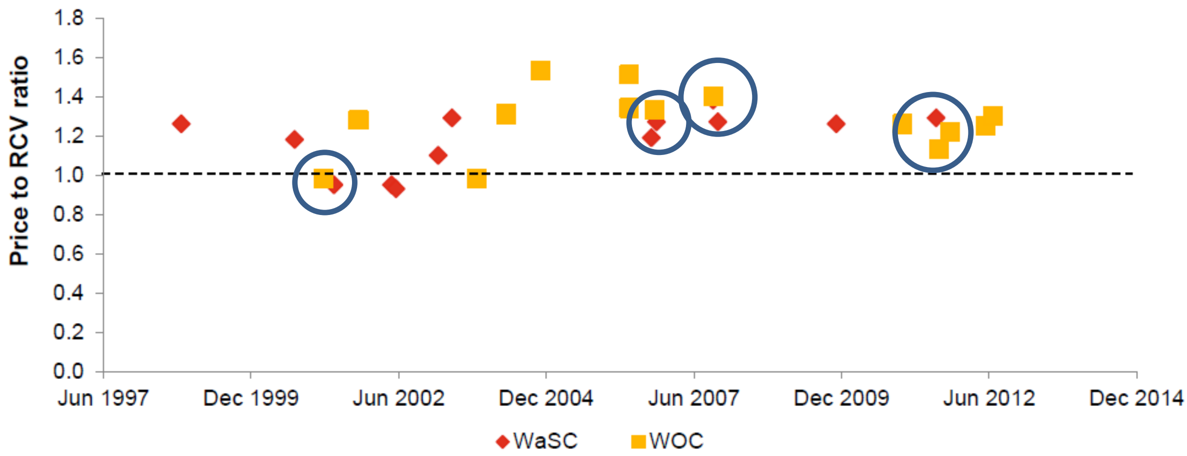
		%
	2009	*2014*
ANH	90	79
WSH	73	63
SRN	95	88
TMS	74	77
YKY	66	78
NES	60	61
SVT	61	64
SWT	64	56
UU	68	65
WSX	71	64
WaSC average	72	70
SEW	84	81
BRL	81	71
DVW	65	77
PRT	76	81
SBW	55	58
SES	77	76
SST	86	-
CAM	52	-
SSC	-	64
VWC*	40	-
VWE*	23	-
VWSE*	46	-
AFW	-	80
WoC average	62	74

Source: Ofwat response to our provisional findings, Table 10.
*These three companies merged to form AFW (Affinity Water) during this time.

117. However, we note that the increase in WoC financial gearing levels is almost entirely driven by the merging of three water companies (VWC, VWE, VWSE; marked with asterisks in Table 10) to form Affinity Water (AFW), while substantially increasing their financial gearing levels (from an average of 36% to 80%). If this effect is excluded, the WoC financial gearing levels have increased by less than 1% since 2009.

118. Ofwat's evidence regarding WoC vs WaSC MARs was provided by PwC, as shown in Figure 10 below, where we have highlighted certain time periods.

Figure 10: PwC's price to RCV ratios implied by equity transactions for water companies



Source: PwC company specific adjustment to the WACC, p38.
Note: Circles added by CMA.

119. Based on this evidence, we would consider that WoCs and WaSCs have experienced similar equity transaction premia, particularly looking at transactions which took place at a similar time (as shown by blue circles). It is reasonable to assume that investors would have expected that WoCs would continue to be allowed a small company uplift in their cost of capital. If so, then a comparable premium between WoCs and WaSCs would imply a higher actual cost of capital for WoCs than WaSCs, of a similar scale to the investors' expectations of a future uplift. While it may not be sufficient evidence to demonstrate a particular level for the differential in the actual cost of capital, we do not consider that this evidence supports the case for a zero uplift.

120. Following our provisional findings, Ofwat continued to emphasise its view that that there is no theoretical basis that the higher operational gearing of Bristol Water should lead to an uplift in the CAPM asset beta. It also provided further analysis illustrating that applying the same methodology to the other WoCs would result in very different asset beta estimates for each, resulting in a potentially unstable framework.

121. PwC illustrated that in theory higher risk for the WoCs could actually reduce the WoC beta, as the risks which are greater for WoCs appear to be negatively correlated to the overall economy. However, as noted by Bristol Water, if this was a major contributor to systematic risk, it would appear to suggest a relationship which could result in water companies (and, in practice, all infrastructure companies) having a negative beta. We noted that the quoted WaSCs all have observable positive betas. Therefore the evidence from actual market behaviour was not consistent with this theoretical argument.

122. PwC considered other conceptual scenarios, and concluded that these were inconclusive for making any adjustment to the cost of equity. Instead, PwC and Ofwat relied on the empirical evidence discussed above.[66]

123. Ofwat also makes the case that any uplift must be capable of being linked to the underlying drivers of the equity beta. Ofwat states that 'for operational gearing to impact on the asset beta and cost of equity it must impact on the way the company's share price would move relative to the rest of the stock market'.[67]

124. One argument is that there is a straightforward theoretical case that operational gearing should have this effect – as it is comparable in its effect to financial gearing, which is accepted to increase equity betas wherever there is a positive asset beta. We recognise however that it is difficult to identify a particular relationship between the actual form of operational gearing for water companies and the level of beta, in part for the reasons identified by PwC. For example, operational gearing is different from financial gearing in that there is no measurable balance sheet obligation.

125. Our analysis of asset betas above, adjusted for gearing, demonstrates equity betas consistently between 0.5 and 1 in recent years. Against this background, we do not consider it is reasonable to assume that there is no link (or a negative link) between the operational risks of water companies and the market. An equity beta of between 0.5 and 1 implies that equity risks of investments in water companies are comparable in direction to the market, ie the market considers that the residual risks (after adjusting for the proportion of low risk returns funded by investment-grade debt) will tend to be correlated with the equity market. If, as proposed by Ofwat, there is no case for an uplift related to operational gearing, this would imply that all of this equity risk in practice relates to issues unrelated to the operational risks which increase in proportion to operational gearing.

126. In coming to a view on the level of any uplift, we do however recognise that not all of the operational gearing will necessarily reflect systematic risk, and also that not all beta risk will result from operational factors. We consider this as part of our review of the evidence on the size of the uplift.

127. Although there is uncertainty over the scale of any uplift, and we agree that calculating a single value is difficult, we were not persuaded that zero is a suitable point estimate for the uplift.

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66 Ofwat response to our provisional findings, paragraph 220.
67 Ofwat response to our provisional findings, paragraph 221.

Scale of asset beta uplift

128. In response to our provisional findings, Ofwat stated that not only did it consider that an uplift to the asset beta was unnecessary in principle, but also highlighted that some of the changes to the regulatory framework in PR14 could reduce the risks that the CMA had identified (for example the move to a consistent incentive framework across all totex).

129. In its own response, Bristol Water highlighted a number of academic papers which examine the impact of operational gearing on systematic risk, showing that there was a positive relationship in the industries it studied.[68]

130. Bristol Water also provided examples of alternative measures (as a proxy for operational gearing) which it stated as suggesting WoCs have a nearly two times higher operational gearing level than WaSCs, as shown in Table 11:

Table 11: Bristol Water example operational gearing metrics for WaSCs and WoCs

	Average WoCs	*Average WaSCs*	*Ratio of WoCs to WaSCs*
Opex to RCV	14.0%	6.4%	2.20x
Revenue to RCV	23.7%	15.2%	1.55x
Opex to (return + depreciation)	165.8%	78.1%	2.12x
Opex to revenue	59.1%	41.8%	1.41x
Average			1.82x

Source: Bristol Water.

131. These ratios do not directly translate into a comparable asset beta uplift, but demonstrate in Bristol Water's view that an uplift at least as high (and potentially higher) than the 18% allowed in CC10 could be justified. We noted that although we agree that some aspects of the new regulatory framework could act to reduce systematic risk, others could increase it. For example, the increased emphasis on benchmarking may increase the exposure of individual firms to industry-wide risks.

132. As stated in our provisional findings, we acknowledged that estimating an appropriate asset beta change/uplift for Bristol Water is a difficult exercise. Ofwat and Bristol Water presented arguments that the overall uplift could vary between 0% (Ofwat) and 27% (Bristol Water).[69]

133. This is complicated by the introduction of PAYG rates that differ from the 'natural accounting rate', as it has resulted in the operational gearing levels of the water companies differing to their underlying characteristics. This could result in differing estimates of the level of operational gearing, and hence the

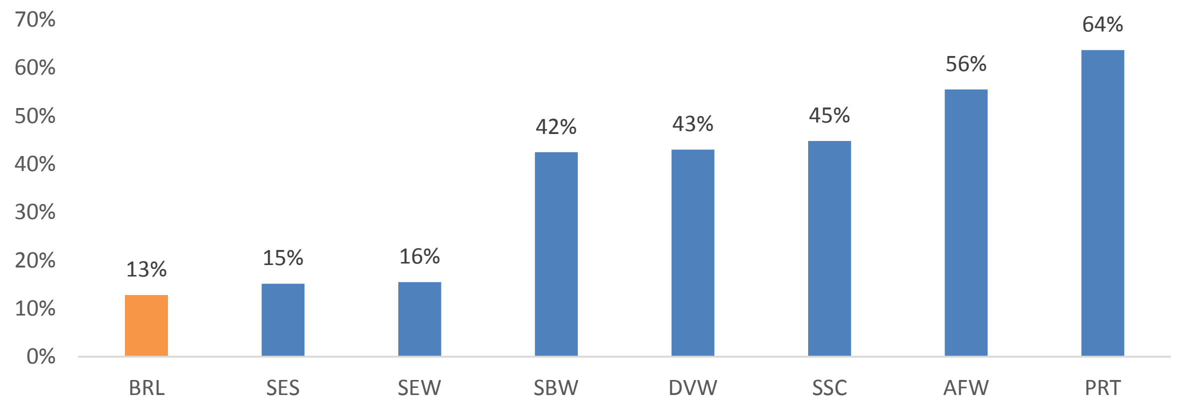
[68] Particularly a report by Lord (1996) on US electricity utilities, car manufacturers, and airlines.
[69] An approximation based on using coefficients identified by Lord's study.

implied systematic risk of the business. We also note that although in theory Bristol Water could use extra flexibility associated with PAYG to offset some of its operational gearing, this was neither the main purpose of the PAYG rate, nor the main impact of changing it. Therefore we do not consider that Bristol Water could justify increases to its PAYG on this basis, so is unable to benefit from them.

134. As can be seen in Table 9 above, Bristol Water's operating cash flow was 45% of revenue, whilst the public comparators had a 51% ratio. This implied that an uplift of around 13% [(51 / 45) – 1] was appropriate.[70] This figure was of a comparable scale to the figure used in CC10 (18%), and was consistent with the evidence provided by Bristol Water (up to 27%). Using this value continued to reflect an 'in the round' judgement for higher systematic risk faced by Bristol Water than the comparators used to estimate beta.

135. Ofwat provided us with analysis which illustrates that this particular measure is not stable across the WoCs, shown in Figure 11 below. We agree that there are limitations on using a particular measure, in part because of the difficulty in demonstrating the scale of the relationship between any measure of operational gearing and asset beta.

Figure 11: Ofwat analysis of asset beta implied by CMA methodology



Source: Ofwat response to our provisional findings, Figure 9.

136. We applied the measure of operating cash flow to revenue as a starting point in part to have regard to consistency with CC10. In coming to our final view, we have considered whether this approach remains valid through comparison of the results under this measure with other approaches.

[70] These figures are based on Ofwat's Final Determination for the full next period, so are on a like-for-like basis.

Implied asset beta range

137. Bristol Water expressed concern that the CMA's estimated asset beta for provisional findings (0.32) was considerably lower than the CC10's point estimate of 0.37.[71]

138. It also referenced KPMG's analysis, stating that the systematic risk profile of regulated utilities' asset betas tends to be relatively stable, and that this reduction of 0.05 is large in comparison with regulatory precedent.[72]

139. Finally, Bristol Water stated that the estimate of 0.32 is also inconsistent with the NIE asset beta estimate of 0.37 (adjusting to a debt beta of 0), considering a 2014 investor survey showed that water companies were considered to have higher risk than electricity distribution companies.[73]

140. The public comparator (WaSC) asset beta range from CC10 was estimated as being 0.21 to 0.31, assuming a debt beta of 0,[74] which was consistent with our estimate of 0.27 to 0.3.

141. Similarly, CC10 estimated asset beta for Bristol Water itself was 0.26 to 0.37,[75] which was again consistent with our estimate of 0.3 to 0.34.

142. Therefore, we considered our estimates to be consistent with CC10, and it is only the choice within the range which could be considered to have changed. The choice of point estimate within a range is discussed further in paragraphs 10.190 to 10.196.

143. Regarding the change in underlying risk facing Bristol Water, it stated that a survey of investors from 2014 had indicated that there was a significant increase in perception of political and regulatory risk since the previous year.[76]

144. However, Ofwat also commented that the fact that the survey was completed in the year of its determination meant it was no surprise that investors considered regulatory risk had increased. Following the final determinations, credit rating agencies continue to rate the UK water regulatory regime as

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[71] Bristol Water response to our provisional findings, section 8.4.1.3.3.
[72] Bristol Water response to our provisional findings, paragraph 1032.
[73] Bristol Water response to our provisional findings, paragraph 1033.
[74] CC10, Appendix N, paragraph 112.
[75] Adjusted for a debt beta of 0 (from 0.1 in CC10) using the Miller formula: asset beta = (equity beta x (1- gearing)) + (debt beta x gearing); This is equivalent to the 0.21 to 0.31 WaSC beta estimate with the 18% uplift allowed at the time; CC10, Appendix N, Table 11.
[76] Bristol Water response to our provisional findings, paragraph 999.

strong for regulatory certainty and transparency (for example, Moody's rates it as Aaa).

145. We also noted that a change in asset beta of 0.05 for a regulated company is both reasonable and has supporting precedent. For example, Ofwat itself reduced its market asset beta estimate from 0.4 in PR09[77] to 0.3 in PR14,[78] a reduction of 0.1. Table 12 below shows how the public company asset betas varied over the same time period, with the betas changing by substantially more than 0.05. This shows that regulated utility betas can and do change over time.

Table 12: Asset beta changes over past 5 years (based on 2-year weekly data)

	Pennon	*Severn Trent*	*United Utilities*
Min	0.23	0.17	0.16
Max	0.44	0.48	0.45
Min-max delta	0.20	0.32	0.28

Source: CMA analysis.

146. In NIE, the CC estimated an asset beta range of 0.29 to 0.37 from the market data, assuming a debt beta of 0. It then chose to restrict this to 0.32 to 0.37 based on the fact that the comparator set was not an exact match, both since it was based on GB business, and it included a number of water companies.[79] This may be partially due to the fact that, the water company asset betas were consistently below the others (including an electricity distribution firm) considered in the portfolio.[80]

147. It was therefore reasonable to expect Bristol Water to have an asset beta range below that set for NIE, as we estimated. Once again, the CMA chose a spot estimate at the top of the range, which we discuss further in paragraphs 10.190 to 10.196.

148. We also noted CCWater's response to provisional findings in which it states that its advisor ECA considers an asset beta of 0.19 to 0.23 is more reflective of the market evidence.[81] However, we considered that our proposed range for the asset beta better reflects the latest market evidence for the following reasons:

(a) **Treatment of gearing** – ECA estimated an equity beta for the public comparators directly, which it then proposes is applicable for the industry.

[77] Ofwat PR09 future water and sewerage charges 2010-15 final determinations, p128.
[78] Ofwat PR14 final price control determination notice, policy chapter A7 – risk and reward, p36.
[79] Stated as 0.35-0.4 based on a debt beta of 0.05. NIE (2014), paragraph 13.183.
[80] NIE (2014), Table 13.9.
[81] Based on an equity beta recommendation of 0.5–0.6 which is equivalent to 0.19–0.23 based on a notional gearing of 62.5%; CCWater response to our provisional findings, paragraph 3.2.

However, this does not control for any differences in financial gearing between companies or over time which may prevent direct comparison between the equity betas.

(b) **Sampling frequency and time periods** – ECA only considered two-year daily data when estimating the equity beta. As discussed above, we considered it appropriate to use a wider dataset.

(c) **Adjustment from comparators** – ECA calculated an equity beta based on the listed water companies, but did not suggest any adjustments from these companies to Bristol Water. We have discussed this further in paragraphs 101 to 136.

Risk-free rate market data analysis

149. In both CC10[82] and NIE,[83] (and since 2000) the CC has taken the view that long-dated index-linked gilt yields are in principle the most suitable basis for estimating the RFR applicable to the cost of equity.

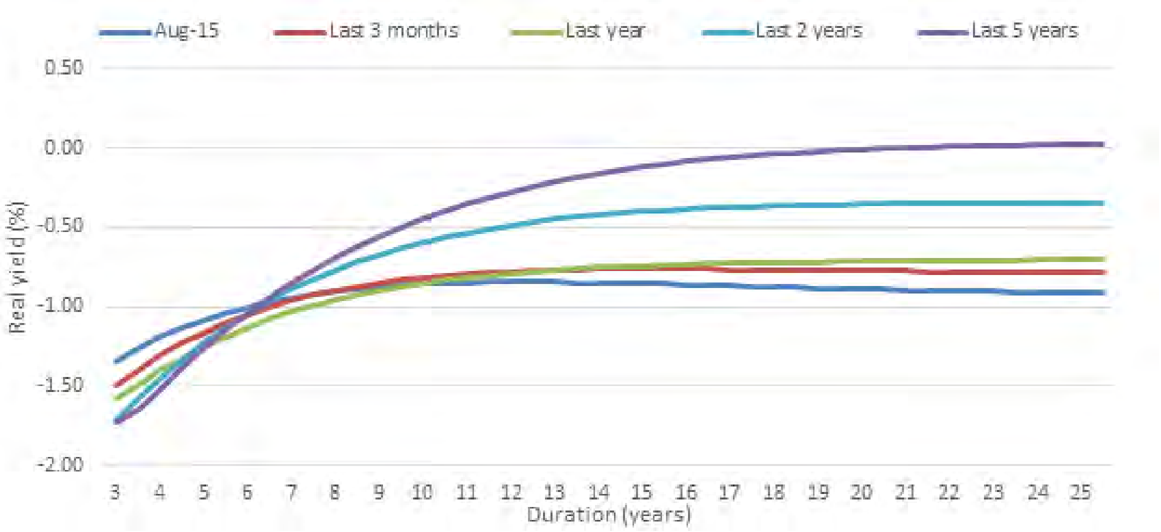
150. However, the CC has also previously discussed factors which could distort the yields of long versus shorter term gilts. For example, NIE noted that longer-dated index-linked gilt yields have been affected by factors such as pension fund asset allocations and central bank policies, and that shorter-dated index-linked gilts were affected by action by the authorities to address the recession which followed the global financial crisis. It is unclear to what extent such distortions may still be observable in current market yields.

151. We therefore found that it is appropriate to consider both longer-term and shorter-dated index-linked gilt yields when considering the RFR.

152. Although it is possible to consider other measures to estimate a risk free rate, we continue to regard index-linked gilt yields as in principle the most suitable source for estimating the RFR, since index-linked gilts have negligible default and inflation risk. Index-linked gilt yields (up to a 25-year duration) are shown in Figure 12 below.

[82] CC10, Appendix N, paragraphs 63–73.
[83] NIE (2014), paragraphs 13.117–13.129.

Figure 12: Index-linked gilt rates



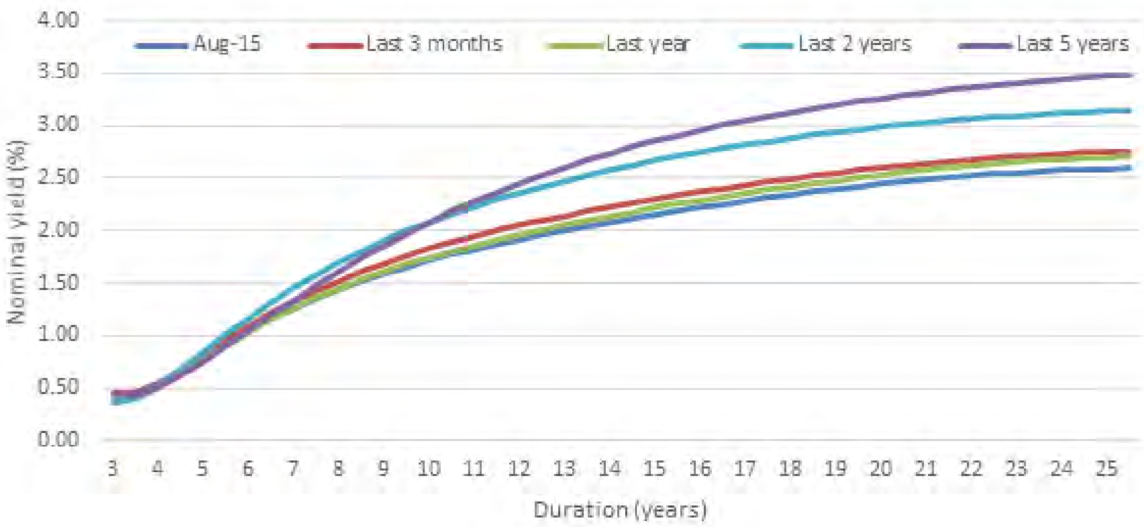
Source: Bank of England. Rates measured over different periods are averages of daily yields over the relevant period.

153. As noted by the CC in NIE,[84] long-dated index-linked yields have remained below 1% for at least the last five years. The prolonged period of low yields may suggest that long-run rather than temporary factors are at work. Shorter term yields have consistently been below 0%.

154. Nominal gilts also have negligible default risk, but are subject to inflation risk. Nominal gilt yields can be used to estimate a real RFR if assumptions are made about expected inflation and any inflation risk premium. Nominal gilt rates can be seen below in Figure 13.

[84] NIE (2014), paragraph 13.127.

Figure 13: Nominal gilt rates



Source: Bank of England. Rates measured over different periods are averages of daily yields over the relevant period.

155. Adjusting nominal gilt yields for an RPI estimate of about 2.5 to 3.5% over this period[85] would indicate real yields of just over 0% for the periods in question.

Wholesale-Appointee adjustment

156. Financial theory would indicate that dividing an existing company into parts (retained under the same ownership) should not affect either its profitability or the returns it generates. Therefore, we are not convinced that the implementation of separate controls should in itself require any increased returns.

157. Bristol Water highlighted three areas which it stated as being in error within Ofwat's approach to the calculation of an adjustment:[86]

(a) Incorrect application of a nominal return to a real wholesale cost of capital.

(b) Treatment of tax.

(c) Analysis of risk.

158. In response to our provisional findings, Bristol Water also proposed an alternate approach calculating the appointee-wholesale adjustment to ensure

[85] Depending on time period used, about 2.5% for past year, 3.5% for five-year data; ONS data selector.
[86] Bristol Water response to our provisional findings, section 8.6.

that returns on the RCV/assets are not double-counted in both wholesale and retail.[87]

159. The alternative approach was based on estimating the value share of the retail assets in the wholesale RCV, and hence the implied return (based on the appointee WACC) these would generate. Bristol Water estimated this value as 0.03%, and stated that this is the maximum adjustment that should be made to remove double-counting.

Incorrect application of a nominal return to a real wholesale cost of capital

160. Bristol Water stated that the nominal post-tax retail return is 0.14% of RCV, based on industry figures.[88] Bristol Water stated that the nominal post-tax retail return needed to be converted to a real return using an inflation scaling factor.[89] This had the effect of splitting the 0.14% retail return into a cash component of 0.09%, and an inflation indexation component of 0.05%.

161. Bristol Water's argument was effectively that only the cash component should be used as an adjustment to the wholesale WACC, since the WACC is a real figure. However, the inflation element of the return to the wholesale business will be unchanged. The wholesale RCV (which the inflation is applied to) is unchanged, and this part of the wholesale return is not affected by the separation of the retail business.

162. We therefore do not consider it appropriate to amend the wholesale-appointee adjustment on this basis.

Treatment of tax

163. Bristol Water stated that the retail post-tax return will be lower than the post-tax return assumed using the overall appointee tax rate (10%). This is based on the assumption that the retail business will in fact have a tax rate of 20%, resulting in an uplift of 0.01% on the WACC.[90]

164. A tax rate of 20% implicitly assumes that the company has no debt shield, which would indicate a business entirely financed using equity. Although there are lower levels of fixed assets in a retail business, it still requires a certain amount of overheads and working capital. General practice would be to fund a proportion of this with debt (particularly given the relative cost of debt and

[87] Bristol Water response to our provisional findings, section 8.6.4.
[88] Bristol Water response to our provisional findings, Table 31.
[89] Calculated as WACC / nominal WACC, where the retail nominal WACC is (1 + WACC)*(1 + RPI) – 1; Bristol Water response to our provisional findings, paragraph 1055 & footnote 514.
[90] Bristol Water response to our provisional findings, paragraph 1060 & Table 32.

equity in the current environment), which would provide a debt shield, and lower the resulting tax rate.

165. We also note both that the recently announced changes in corporation tax would slightly affect this figure, and the very small scale of the potential impact which Bristol Water is proposing.

166. Therefore, in light of the evidence available, we would not propose any amendment to the wholesale-appointee adjustment on this basis.

Analysis of risk

167. With regard to the analysis of the risk, this related to the removal of indexation from the retail business. This resulted in Bristol Water bearing the risk of future cost inflation.

168. We still considered that this change is relatively small in the context of the changes being made to the overall risk/reward framework as part of PR14 (eg introduction of ODIs, menu, totex etc), particularly given the relatively small size of the retail business. To adjust for this element specifically but not consider other areas could be inconsistent.

169. Therefore, we did not consider it appropriate to make an explicit adjustment for any changes in risk associated with the removal of indexation from the retail business.

Bristol Water's proposed alternative approach

170. We considered Bristol Water's alternative approach to calculating the adjustment based on the calculation of the level of retail returns which could otherwise be double-counted through inclusion in the wholesale RCV.

171. Bristol Water's analysis estimated that 0.75% of assets in its wholesale RCV could be allocated to retail.[91] Combining this with data on the industry total RCV indicates an estimated industry retail asset base of £473 million.[92] Applying Bristol Water's appointee WACC estimate of 4.3%[93] to this would generate £20 million of retail returns per annum. Given the retail revenue of around £10 billion yearly,[94] this would indicate that the commensurate retail

[91] Bristol Water response to our provisional findings, Table 31.
[92] Industry RCV of £63,072 as average over AMP6, Ofwat final price control determination notice: policy chapter A7 – risk and reward, Table A7.9.
[93] Bristol Water response to our provisional findings, paragraph 1074.
[94] Ofwat final price control determination notice: policy chapter A7 – risk and reward, Table A7.9.

margin would be 0.2% rather than the 0.9% (after tax) which has been allowed.

172. As stated in paragraph 156, we consider that the splitting of wholesale and retail price controls would not imply that the appointee as a whole should receive a different return (other than where the underlying characteristics of the company have changed, such as risk exposure). Bristol Water's proposed alternative approach to determining the wholesale WACC would require a change in the approach to determining the retail margin to compensate.

173. We did not consider that it was appropriate, given that Bristol Water had accepted the retail margin, to consider amendments to the wholesale WACC which would imply re-opening the retail control. We therefore consider that the most appropriate action here is to retain both the retail margin and the wholesale-appointee adjustment at their current levels.

PAYG, financeability and total allowed Bristol Water revenue

1. The following appendix provides additional details and calculations made when setting a PAYG rate for Bristol Water, and subsequently assessing its financeability as set out in Section 11.

'Natural' PAYG rates

2. As discussed in paragraph 11.17, there are a number of ways to try and estimate the 'natural' PAYG rate. In particular:

   (a) the economic natural rate;

   (b) the RCV natural rate; and

   (c) the accounting natural rate.

3. The objective of the first of these would be to align the economic balance of totex remuneration across present and future customers. In other words, the allocation of cash flows between periods for all asset classes would be linked to the economic value created by those assets across their life. To do so requires the phasing of benefits associated with every element of the determination, and as such would be highly complex.

4. As a result, regulators tend to set cash rates using either a regulatory assumption (based on a top-down approach to asset lives) or a rate based on accounting principles. We discuss the concept and estimates of the regulatory and accounting natural rates in this appendix.

RCV natural rate

5. This is the rate such that the RCV at the end of the period would, excluding the effect of enhancement expenditure, be equal to its value at the beginning, after allowing for inflation. The amount of totex Bristol Water paid into its RCV (excluding enhancement) would balance the amount it is taking out across the period.

6. This is based on the principle that any ongoing non-enhancement work will maintain the value of Bristol Water's system, without adding to it. Therefore the RCV should only increase if enhancement work is completed. On the other hand, the RCV should not be 'run-down' over the period. Unless the scope or quality of services provided by Bristol Water is declining, this could

represent current customers overpaying due to higher levels of cash in period than is justified by the work completed.

7. Bristol Water described this approach as similar to Ofwat's 'broad equivalence' approach used in PR04 and earlier, as well as conceptually similar to a method it proposed in response to our provisional findings.

8. Assuming an annual depreciation rate of new assets of 3.7%, an RCV runoff of 6%, and inflation of the RCV in line with the RPI, the PAYG rate which corresponds with a flat RCV (excluding enhancements) is 49.5%.[1]

9. There are a number of reasons that this figure may be below a fair allocation of costs between current and future customers:

   (a) **Inflation measure used in calculation** – the RPI is not necessarily an accurate measure of the rate of inflation for a water company's costs. Over AMP6, our assumption is real costs will decline as a result of balancing cost inflation and productive efficiency. In our assessment of Bristol Water's wholesale base expenditure requirements in Section 4, we assumed a cost trend of RPI – 1%. In addition, the RPI lost its status in National Statistics because of the deficiencies in the formulae used to calculate it. The estimated effect of this deficiency in the formulae is that RPI overstates inflation by around 0.9%.[2] If translated to asset values, the amount of spend required to replace these items would be below the level implied by the RCV + RPI. As such, a PAYG rate which results in a decrease in the RCV (excluding enhancements) relative to the RPI of this scale may be reasonable.

   (b) **Replacement value of assets** – the value of the RCV for Bristol Water is likely to under-represent the MEAV of the system. As such, current customers are benefitting from lower costs, which the future customers will receive to a lesser degree as enhancements are added to the system at their economic cost. Shifting a small amount of cost into this period may offset this effect.

   (c) **Reducing scope/services** – if there were reasons for decreases in the value of the system (eg closing aspects, or allowing sections to degrade due to decreased requirements), this could result in a lower closing RCV than currently assumed, as well as lower maintenance cost levels. Bristol Water did not specifically highlight any areas where this was occurring.

[1] This results in a real increase of £89 million in the RCV over AMP6.
[2] Bank of England inflation report, February 2014, p34; UK consumer price statistics: A review, UK statistics authority, p51.

10. Bristol Water stated that it could be appropriate to include an allowance for depreciation of enhancements from previous periods as well as in-period depreciation. Based on the expectation that any enhancement spend is subsequently maintained sufficiently, we do not consider the level of accounting depreciation as relevant to the underlying value of the system, and so have excluded its effects from our calculation of the RCV natural rate.

11. The arguments in paragraph 9 could justify an increase in the PAYG rate above the 49.5% RCV natural rate. However, given the concerns we raised with Bristol Water's comment in paragraph 10, we do not consider that its proposed figure of 'above 59%' is particularly robust. For example, a sensitivity to reflect a cost trend of RPI – 1% would be consistent with a PAYG rate of 54.7%.

12. A PAYG rate of 55.3% appears consistent with the range of evidence for a suitable RCV natural rate.

Accounting natural rate

13. An accounting rate would calculate the PAYG based on the split of expenditure between those costs taken to the profit and loss account (comparable to PAYG) and those added to assets in the balance sheet from an accounting perspective (RCV additions). This figure would vary based on the choice of depreciation rate and the level of IRE which is expensed vs that which is capitalised within the relevant accounts.

14. This approach is based on the idea that accounting principles already attempt to reflect a reasonable estimate for when the associated benefits will occur and for an appropriate allocation of costs over time (in-year represented by the P&L, or in the future represented by the balance sheet).

15. A complication occurs because of the recent change for water company reporting from GAAP to IFRS. This has resulted in a change in the accounting treatment for IRE. Previously, companies recovered an in-period amount of IRE in line with average expenditure over 15 years[3] (therefore, if IRE is roughly flat over time, this will be close to 100% of annual IRE spend). Under the new policy, companies expense a proportion of actual in-period spend. The proportion expensed can vary between companies.

[3] Ofwat consultation on setting price controls for 2015-20, p70.

16. This results in a wide range for the accounting natural rate from 49.9% (if no IRE is expensed) to 66% (if 100% of IRE is expensed).[4]

17. Bristol Water stated that using 100% of IRE is based on an assessment of cash flows (rather than accounting policy), which minimises differences between companies and periods (where accounting policy may differ), and is consistent with previous price determinations, including CC10.

18. The use of a pure cash flow basis for calculating the PAYG rate is not necessarily consistent with the general accounting principle that returns on asset investments should be measured over the lives of the assets. More importantly, our analysis suggests that this would require a downwards adjustment to the RCV run-off rate of 6% assumed by Bristol Water.

19. Instead, we have followed the accounting principles of allocating spend to the appropriate period. Following the financeability assessment, we determined whether the implied cash flow was sufficient for Bristol Water, and whether any changes are needed to compensate for this. Based on Bristol Water's own ex ante expensing policy of 25% of IRE, the implied PAYG rate is 53.9%.[5]

20. Therefore, a PAYG rate of 55.3% (while retaining a 6% RCV run-off rate) appears consistent with the range of evidence for a suitable accounting natural rate.

Comparative assessment of credit ratios

21. Table 1 and Table 2 below show our adjusted calculations of the water companies' credit ratios for the S&P metrics, and their industry ranking respectively (ordered by average FFO/net debt).[6]

22. We have applied the same restriction on notional gearing (constraining it at 62.5%) when calculating these ratios as we applied to Bristol Water, but have not made other changes regarding inflation assumptions or menu choice. Therefore, we have calculated Bristol Water's credit ratios under a similar set of assumptions (including the RPI within Ofwat's decision on PR14) to ensure a like-for-like comparison with other companies in the industry.[7] As a result,

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[4] Based on £214 million of opex, £69 million of IRE, and £429 million of totex. This is comparable to the breakdown of totex assumed within Section 11.
[5] Based on £214 million of opex, £69 million of IRE, and £429 million of totex. Therefore 214 + (25% * 69) = £231 million. 231/429 = 53.9%.
[6] Based on Ofwat's published final financial models.
[7] We have used Ofwat's original RPI estimates as well as those for corporation tax and costs of debt.

the ratios for Bristol Water in Table 1 include small differences to the credit ratio estimates in Section 11.

Table 1: Calculations of water company credit ratio values (notional gearing level)

	Average FFO/net debt	*Average net debt/EBITDA*	*Minimum FFO/net debt*	*Maximum net debt/EBITDA*
SSC	11.8%	5.4	10.9%	5.8
AFW	11.1%	5.9	10.2%	6.2
SES	10.4%	6.0	10.0%	6.2
DVW	10.3%	6.0	9.0%	6.5
BRL	10.3%	6.0	9.3%	6.4
NES	10.2%	5.7	8.2%	5.8
SRN	9.8%	6.4	9.6%	6.5
SBW	9.7%	5.9	8.8%	6.1
WSX	9.4%	6.3	8.6%	6.7
SVT	9.2%	6.3	9.1%	6.4
NWT	8.9%	6.6	8.2%	6.9
SWT	8.5%	6.5	8.3%	6.6
SEW	8.1%	7.1	7.9%	7.2
YKY	7.8%	7.4	7.4%	7.5
TMS	7.5%	7.5	6.8%	7.8
ANH	7.4%	7.1	5.9%	7.2
PRT	6.9%	7.9	6.2%	8.3
WSH	5.8%	8.9	5.6%	9.2
Average	9.1%	6.6	8.3%	6.8

Source: Ofwat company financial models, CMA analysis.

Table 2: Ranking of water company credit ratio rankings (notional gearing level)

	Average FFO/net debt	*Average net debt/EBITDA*	*Minimum FFO/net debt*	*Maximum net debt/EBITDA*
SSC	1	1	1	1
AFW	2	4	2	5
SES	3	6	3	4
DVW	4	7	7	9
BRL	5	5	5	7
NES	6	2	11	2
SRN	7	10	4	8
SBW	8	3	8	3
WSX	9	9	9	11
SVT	10	8	6	6
NWT	11	12	12	12
SWT	12	11	10	10
SEW	13	13	13	13
YKY	14	15	14	15
TMS	15	16	15	16
ANH	16	14	17	14
PRT	17	17	16	17
WSH	18	18	18	18

Source: Ofwat company financial models, CMA analysis.

Revenue sense check

23. As discussed in paragraph 11.80, we considered it prudent to conduct a final check on these revenue calculations, in the light of Bristol Water's arguments that we had set the PAYG rate too low and that it should be allowed to recover more revenue from customers during the price control period from 1 April 2015 to 31 March 2020.

24. Our assessment in Section 7 found that the regulatory allowance for Bristol Water's base expenditure requirements should be £340 million over this period. This works out at around an average of £68 million per year for Bristol Water to continue to supply its existing levels of services to customers and to maintain its system. This figure was based on industry-wide benchmarking analysis and, on the information available, we identified no reason why it would be substantially higher or lower over the longer term (excluding the effects of inflation). We considered that it provided a guide to an appropriate revenue to recover during the period covered by our determination in respect of base expenditure.

25. In addition, we determined that Bristol Water needed to carry out enhancements to improve the capabilities of its system (eg to reduce supply risks to some customers and to meet environmental requirements). In Section 7 we stated the total value of these enhancements to be £88.6 million. We did not have a specific depreciation rate for these enhancements, but Bristol Water had told us that, on the basis of our provisional findings, an appropriate average annual depreciation rate across all new assets would be 3.7% per year (based on an average asset life of 27 years). If we were to apply this rate to our assessment of the value of enhancement expenditure required, this would produce an annual charge of £3.3 million for these enhancements (by the end of the period). Adding this to the £68 million above results in £71.3 million per year.

26. We compared this with the sum of the revenue allowances for PAYG and RCV run-off in Section 11 Table 11.7, which works out to £72.5 million per year.[8] This high-level comparison provide a further confirmation that our revenue calculation was reasonable and, in particular, that we had not unduly limited Bristol Water's PAYG rate or revenues for the price control period.

[8] AMP6 PAYG + RCV run-off = £238.1 million + £124.6 million = £362.7 million over AMP6. This is equivalent to £72.5 million per year.

Glossary

ACTS	Average cost to serve. The average cost per customer for the household retail activities. The ACTS was used as part of the calculation of **Ofwat**'s household retail price controls.
Adjustment factor	See **K factor**.
AFW	A term occasionally used by **Ofwat** to refer to Affinity Water.
AIC	Average incremental cost. AIC is based upon the financial net present value of a scheme. **AISC** also includes environmental and social costs of the project.
AISC	Average incremental social cost. See **AIC**.
AMP	Asset Management Plan: a plan submitted by a **water company** to **Ofwat** for a five-year period.
AMP period	A five-year period in relation to which an **AMP** is submitted by **water companies** to **Ofwat**. Also known as a price control period. AMP2 – the AMP period April 1995 to March 2000 (the PR94 price control period); AMP3 – the AMP period April 2000 to March 2005 (the PR99 price control period); AMP4 – the AMP period April 2005 to March 2010 (the PR04 price control period); AMP5 – the AMP period April 2010 to March 2015 (the **PR09** price control period); AMP6 – the AMP period April 2015 to March 2020 (the **PR14** price control period); and AMP7 – the AMP period April 2020 to March 2025 (the **PR19** price control period).
ANH	A term occasionally used by **Ofwat** to refer to Anglian Water.
AOD	Above Ordnance Datum. AOD is the elevation of a location relative to the Ordnance Survey's measure of mean sea level measured at Newlyn, Cornwall.
Appointment	The instrument by which the Secretary of State or **Ofwat** (with a general authorization given by the Secretary of State) appoints a body under the **WIA 91** to be the **water**

	undertaker for the area described in that instrument. The word '**Licence**' is used interchangeably with 'Appointment'.
Aqua	Aqua Consultants. Engineering consultants used by the **CMA**.
Basic cost threshold	For its **PR14** cost assessment, Ofwat produced a basic cost threshold for each water company. This represented an estimate of the company's efficient total expenditure requirements for the period 1 April 2015 to 31 March 2020 (in 2012/13 prices and before RPI indexation) that was based on the output of Ofwat's benchmarking modelling and analysis. The basic cost threshold did not include allowances for **policy items** or adjustments for **special cost factors**.
BCT	See **Basic Cost Threshold**
Benchmarking analysis	Comparisons and comparative analysis across companies (or other entities) on aspects of their performance (eg costs or quality of service) so as to assess the relative performance of different companies and/or to estimate what a good or efficient level of performance would be. **Econometric analysis** is one possible method to use for benchmarking analysis.
Botex	Base totex. **Opex** + capital maintenance expenditure (capital expenditure required to maintain existing assets) but excluding **capex** attributed to enhancement projects.
Business Plan	**Ofwat** requires each appointed **water company** to submit a business plan at each **price review**.
Bristol Water	Bristol Water plc.
Bristol Water reply	**Bristol Water**'s reply to **Ofwat's response**, submitted to the **CMA** on 13 April 2015.
Bristol Water SoC	**Bristol Water**'s statement of case, submitted to the **CMA** on 11 March 2015.
BRL	A term occasionally used by **Ofwat** to refer to Bristol Water.

Capex	Capital expenditure. Expenditure and costs for new, replacement or refurbished capital assets, such as construction and buying machinery.
Capex bias	The tendency for companies to prefer **capex** solutions to **opex** solutions.
Capital maintenance	**Appointed water companies'** planned activity to replace and renovate water and sewerage assets to provide continuing services to consumers.
CC	Competition Commission. (As from April 2014, the functions of the CC have been taken over by the **CMA**.)
CC10	Bristol Water plc price determination (2010). On 8 February 2010, **Ofwat** referred an appeal from **Bristol Water** to the **CC** following the company's decision to reject the regulator's **FD** on price limits for the period 2010–2015, broadly on the grounds that they were too low.
CCG	Customer Challenge Group.
CCWater	The Consumer Council for Water. A statutory consumer body representing water and sewerage consumers in England and Wales.
CEPA	Cambridge Economic Policy Associates. Consultants used by **Ofwat**.
CH2M	An engineering company.
Cheddar 2	A proposed second reservoir at Cheddar, Somerset.
Cheddar WTW	Cheddar water treatment works.
CIS	Capital Expenditure Incentive Scheme. A system of incentives used at **PR09** that explicitly recognises that **appointed water companies** have access to better information about their future **capex** needs than **Ofwat** does. It was used with the aim of providing incentives to encourage regulated water companies to produce realistic and credible capex forecasts before price limits were set. After price limits have been set each company retained incentives to outperform **Ofwat**'s determinations, with the

	reward being higher for those companies that have made more challenging expenditure assumptions.
CMA	Competition and Markets Authority.
Cobb-Douglas	A specific type of model or equation that was used by **Ofwat** in the **econometric models** used its **benchmarking analysis** for **PR14**.
COPI	Construction output price index. The index measures the change in the costs of construction over time.
Cost of capital	The cost of financing a company. See **WACC**.
Cost sharing incentive	**For PR14**, **Ofwat** developed and applied a system of incentives in relation to companies' **totex**. The cost sharing incentive (scheme) meant that there was sharing, between a company and consumers, of the financial risk that the company's outturn expenditure is higher or lower than the wholesale expenditure allowance which was used to set its wholesale revenue control. The cost sharing incentive applied equally to **capex** and **opex**.
Cost sharing incentive rate	Under **Ofwat**'s **cost sharing incentive** for **PR14**, the cost sharing incentive rate is the proportion of any over- or under-spend against the wholesale expenditure allowance that is retained by the company and not subsequently passed through to consumers. A higher rates means that companies face a greater financial exposure to variations in their outturn expenditure and also to the cost assessment used to set the wholesale price control.
Draft Determination	Produced by **Ofwat** during each periodic review, serving as the basis for consultation on the price controls for each company for the relevant price review period. The **PR14** Draft Determinations were published on 30 April 2014 for the enhanced companies, 30 May 2014 for the early Draft Determination companies and 29 August 2014 for all other companies.
Deep dive	A deep dive is an **Ofwat** term for a focused review of a specific element of a **business plan**.

Determination	In the context of the **Periodic Review**, the setting by **Ofwat** or the **CMA** of the price control conditions under Condition B of the **Licence** of a **water undertaker**.
DI	Distribution input. The average amount of potable water (ie suitable for drinking) entering the distribution system to be supplied to customers in a water company's area of supply.
Dinobryon	Dinobryon is a unicellular flagellate algae (that is, one with a flagella or whip-like structure, or organelle, extending from the cell).
DVW	A term occasionally used by **Ofwat** to refer to Dee Valley Water.
DWI	Drinking Water Inspectorate.
EA	Environment Agency.
Econometric(s)	Econometrics is concerned with the analysis of economic data using, for example, statistical methods.
Econometric model	A model or equation used for econometric analysis.
Enhanced company	A company selected for enhanced status, due to the high quality of its **business plan**. The benefits of being awarded enhanced status include a higher **totex** allowance and an increased cost of capital, acceptance of the **business plan** 'in the round' and an earlier publication date for the **draft determination**. Also known as a fast-tracked company.
Enhancement	Enhancement is a level of service delivered better than previously defined. Examples of enhancements include: fewer supply interruptions for customers; fewer disruptions for the public in general; and less pollution.
Enhancement expenditure	Expenditure needed to deliver or achieve **enhancements**.
ERP	Equity risk premium. The return that an equity provides over the **risk free rate** which reflects the relative risk of holding equity.
FD	Final determination: produced by **Ofwat** at the end of each **periodic review**, setting out the **K factor**s for each **water company**. To indicate which one is being referred to, a

	year indication is added, for example the most recent final determination for the period 1 April 2010 to 31 March 2015 is referred to as ‘FD14’. The **PR14** FDs were published on 12 December 2014.
FFO	Funds from operations. An accounting measure of operating cashflow. It is used by Ofwat in credit ratio analysis when expressed as a proportion of a company’s net debt.
GLS	Generalised Least Squares. GLS is a technique for estimating the unknown parameters in a linear regression model. It is applied, for example, when some of the assumptions of the classical regression model break down – such as when the variance of the disturbances is assumed to be non-constant across observations (heteroscedasticity) or when there may be correlation between the disturbances (autocorrelation).
GMEAV	Gross Modern Equivalent Asset Value. The gross capital cost of replacing an existing asset with a technically up-to-date new asset with the same service capability.
Halcrow	Halcrow Management Sciences Limited, the consultant engineers engaged by the **CC** to advise it about **Bristol Water**’s **capex** proposals for the **CC10** determination.
IDoK	Interim Determination of K: a new determination of the **K factor** by **Ofwat** between **periodic price review**s in response to changes in circumstance as set out in Condition B of the **Licence**.
Implicit allowance	The amount of any **special cost factor** claim that Ofwat considered to be included in the **basic cost threshold**.
Instrument of Appointment	See **Licence**.
IRE	Infrastructure renewals expenditure. Infrastructure is mainly below-ground or underground assets, such as water mains and sewers, and also dams and reservoirs that last for a long time. A distinction is drawn between infrastructure and non-infrastructure assets because of the way the appointed water companies manage, operate and maintain them.

K or K factor — The wholesale price control for **Bristol Water** operates as a restriction on a measure of its revenue from wholesale activities. The restriction specifies that the wholesale revenue restriction changes from one year to the next by a percentage given by the formula **RPI** + **K**. The factor **K** can be positive or negative and is determined by **Ofwat** (or the **CMA**) at a price control review every five years. **RPI** is expressed as the percentage increase in the retail price index in the year to the November before the charging year.

KPI — Key Performance Indicator.

Leakage — Water lost between the treatment works and supply to customers' premises.

LEF — Local Engagement Forum. The LEF is **Bristol Water**'s **CCG**.

Licence — An instrument appointing a **water undertaker** (or water and sewerage undertaker) under Part II of the **WIA 91**.

See **Appointment**. The word 'Licence' is used interchangeably with the word '**Appointment**'.

Logging up — A process by which **Ofwat** takes into account at the next **periodic price review** any variations in costs which have not been taken into account in the current periodic review or in an **interim determination of K**.

M&G — Management and General.

MAR — Market asset ratio.

MEAV — Modern Equivalent Asset Valuation.

Menu scheme — The menu scheme was part of **Ofwat**'s price control framework for PR14. It is a complex regulatory incentive scheme, the main purpose of which was to give extra incentives for companies to submit accurate expenditure forecasts and provide further flexibility to companies in terms of the level of the **cost sharing rate** that each company faces. The menu scheme was a development of the CIS that **Ofwat** introduced at **PR09** which was, in turn, based on the information quality incentive (IQI) that Ofgem

	has used as part of its regulation of electricity distribution companies and gas distribution companies in Great Britain.
mg/l	Milligrams per litre.
Ml	Megalitre (1 million litres, 1,000 cubic metres or 220,000 gallons).
Ml/d	Megalitres per day.
MNI	Non-infrastructure maintenance. Non-infrastructure is mainly above-ground assets, such as water and sewage treatment works, pumping stations, company laboratories, depots and workshops.
MZC	Mean Zonal Compliance.
NEP	National Environment Programme.
NES	A term occasionally used by **Ofwat** to refer to Northumbrian Water.
NIE	Northern Ireland Electricity price determination. On 30 April 2013, the Northern Ireland Authority for Utility Regulation referred a price control determination for Northern Ireland Electricity Ltd to the **CC** following the company's decision to reject the Utility Regulator's price control determination for the period January 2013 to September 2017.
Notified item	An item identified by **Ofwat** in an **FD** which, if its cost changed, could be used by **water companies** as a reason for a request for an **IDoK**. A 'one way' notified item allows the **water company** to request that **Ofwat** make an allowance before the next **periodic price review** if certain conditions are met. A 'two way' notified item also allows **Ofwat** to intervene to reduce an allowance.
ODI	Outcome Delivery Incentive. These were introduced during **PR14** as part of **Ofwat**'s outcomes based approach to focus companies on delivering a result or action that customers and society value.
Ofwat	The Water Services Regulation Authority. The economic regulator of water and sewerage companies in England and Wales.

Ofwat response	**Ofwat**'s response to **Bristol Water**'s **SoC**, submitted to the **CMA** on 25 March 2015.
Ofwat submission	**Ofwat**'s initial submission, submitted to the **CMA** on 4 March 2015.
OLS	Ordinary Least Squares. Statistical method used in **regression analysis** that finds the relationship of best fit between a dependent variable and one or more explanatory variables by minimizing the sum of squared differences between that relationship and each combination of the dependent and explanatory variables.
ONS	Office for National Statistics.
Opex	Operating expenditure. Expenditure that is not treated as **capex**.
Oxera	Consultants used by **Bristol Water**.
PAYG rate	Pay-as-you-go rate. The proportion of 2015-20 **totex** that is recovered during the 2015-20 price control period. The remainder is added to the **RCV** and recovered in future periods. This rate is set by the company as part of its **business plan**.
Periodic review	See **price review**. The term 'periodic review' is used interchangeably with the term '**price review**'.
Policy items	Policy items are areas of a water company's costs that Ofwat excluded from its cost benchmarking analysis and its basic cost threshold. The policy items for **Bristol Water** included business rates and **Ofwat's** allowance for pension deficit repair contributions.
Policy additions	Allowances in the cost assessment for **policy items**
PR09	**Ofwat** 2009 **price review**.
PR14	**Ofwat** 2014 **price review**.
PR19	**Ofwat** 2019 **price review**.

Price control A form of economic regulation that acts to constrain the prices or tariffs that a regulated company may charge (the price control may also regulate other aspects of the company's activities, such as service quality and performance). The price control may take the form of a restriction on the company's revenues, rather than limiting specific tariffs directly.

Price control review The process undertaken every five years by **Ofwat** to determine water company **price controls** for the next five years. PR94 covered the period from 1995 until 2000; PR99 covered the period from 2000 until 2005; PR04 covered the period from 2005 until 2010; **PR09** covered the period from 1 April 2010 until 31 March 2015; **PR14** covers the period from 1 April 2015 to 31 March 2020; and **PR19** will cover the period from 1 April 2020 to 31 March 2025.

PRT A term occasionally used by **Ofwat** to refer to Portsmouth Water.

RCV Regulatory Capital Value. The capital base used in setting **price controls**. The value of the regulated business which earns a return on investment. It represents the initial market value (200-day average), including debt, plus subsequent net new **capex** as assumed at the time of initial price setting. It includes new obligations imposed since 1989. The capital value is calculated using **Ofwat**'s methodology. Also known as 'regulatory asset base' (RAB) and 'regulatory asset value' (RAV).

RCV run-off rate The proportion of the regulatory capital value that is recovered in period, equivalent to depreciation. This rate is set by the company as part of its **business plan**.

RFR Risk-free rate.

RoRE Return on Regulated Equity. A concept introduced in **PR14** as a key metric of returns to shareholders. Calculated as:

- Return due to shareholders/equity component of **RCV** assumed in notional capital structure.

- Return due to shareholders calculated as EBIT − tax − (cost of debt x average net debt).

RPE	Real price effects. RPEs reflect the extent to which the input prices (including wages) that a company faces may grow faster, or slower, than the **RPI** which is used for the wholesale price control indexation.
RPI	Retail price index: a general purpose domestic measure of inflation in the UK.
SBW	A term occasionally used by **Ofwat** to refer to SembCorp Bournemouth Water.
Scheme	Schemes can be an individual capital project or a group of discrete or interconnected projects with the same strategic purpose.
SCP	Small company premium.
Serviceability	**Ofwat** makes an assessment of the capability of a system of assets to deliver an expected level of service to consumers and to the environment. This is done to ensure companies are not underinvesting in their assets, and is completed by considering the trend in performance of a number of different indicators such as bursts and long duration interruptions to supply.
SES	A term occasionally used by **Ofwat** to refer to Sutton & East Surrey Water.
SEW	A term occasionally used by **Ofwat** to refer to South East Water.
SFA	Stochastic Frontier Analysis, which is a type of **econometric** technique for **benchmarking analysis**.
SIM	Service Incentive Mechanism. An **Ofwat** metric which measures customer service levels based on a mix of data sources.
SoC	**Bristol Water**'s statement of case, submitted to the **CMA** on 11 March 2015.
Special cost factor	The purpose of special cost factors is to take account of specific characteristics or circumstances of a company (in this case **Bristol Water**) that affect its costs and which may not be adequately captured by **benchmarking analysis**.

	Ofwat and Ofwat considered potential adjustments for special cost factors as part of its cost assessment for **Bristol Water**. We use the term special cost factor to refer to all types of adjustment considered by **Ofwat**, including what Ofwat referred to as modelling adjustments and cost exclusions.
SRN	A term occasionally used by **Ofwat** to refer to Southern Water.
SSC	A term occasionally used by **Ofwat** to refer to South Staffordshire Water.
SVT	A term occasionally used by **Ofwat** to refer to Severn Trent Water.
SWT	A term occasionally used by **Ofwat** to refer to South West Water.
TMS	A term occasionally used by **Ofwat** to refer to Thames Water.
Totex	Total expenditure. **Capex** + **opex**.
Translog	A specific type of model or equation that was used by **Ofwat** in the **econometric models** used its **benchmarking analysis** for **PR14**.
UU	A term occasionally used by **Ofwat** to refer to United Utilities.
UV	Ultra violet. Ultra violet light can be used in the treatment of water by inactivating microorganisms such as bacteria and protozoa.
WACC	Weighted average cost of capital. For an **appointed water company**, the average cost of its debt and the cost of its equity capital, weighted according to the balance of debt and equity which finances the company's assets. It is expressed as a percentage of the value of a company's capital.
WAFU	Water available for use. A concept used in the planning of water resources.

WaSC	An appointed water and sewerage company. WaSCs provide water and sewerage services.
Water company	See **water undertaker**. The term ‘water company’ is used interchangeably with the term ‘**water undertaker**’.
Water undertaker	A water company appointed under the Water Act 1989 or **WIA 91** to provide water services in a specified part of England and/or Wales. ‘**Water company**’ is used interchangeably with water undertaker.
WIA 91	Water Industry Act 1991 (as amended).
WoC	An appointed water-only company. WoCs provide water but not sewerage services.
WRMP	Water Resource Management Plan.
WSH	A term occasionally used by **Ofwat** to refer to Dŵr Cymru.
WSX	A term occasionally used by **Ofwat** to refer to Wessex Water.
WTW	Water treatment works. A treatment plant which processes raw water.
YKY	A term occasionally used by **Ofwat** to refer to Yorkshire Water.